S. HAUDENSHIELD.

ROTARY ENGINE.

APPLICATION FILED JULY 24, 1908.

978,743. Patented Dec. 13, 1910.

4 SHEETS—SHEET 1.

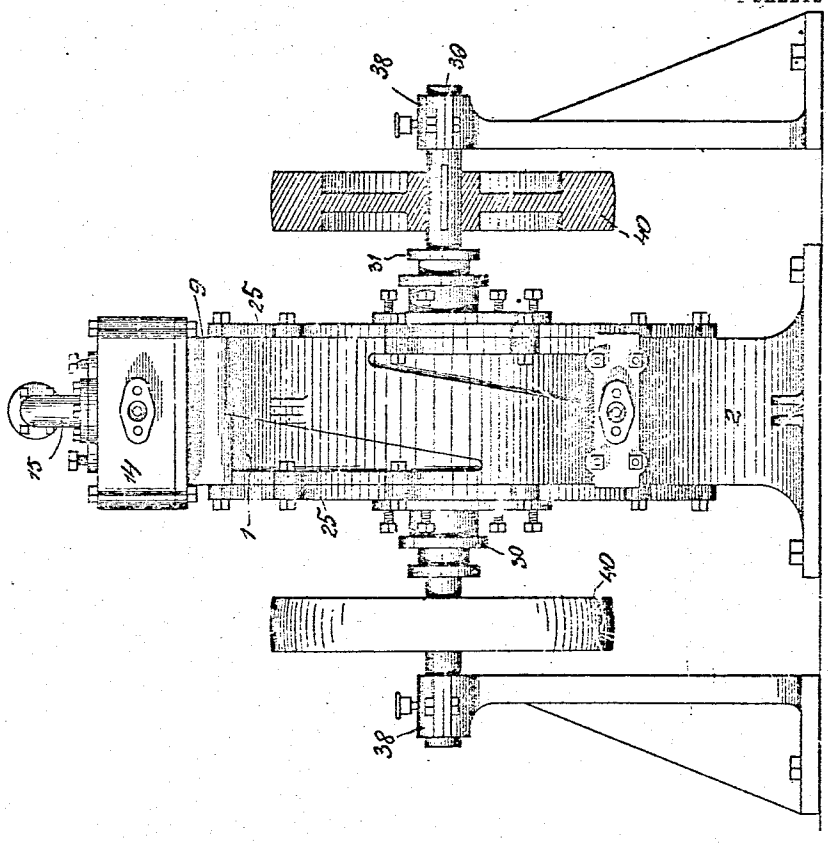

Fig. 2.

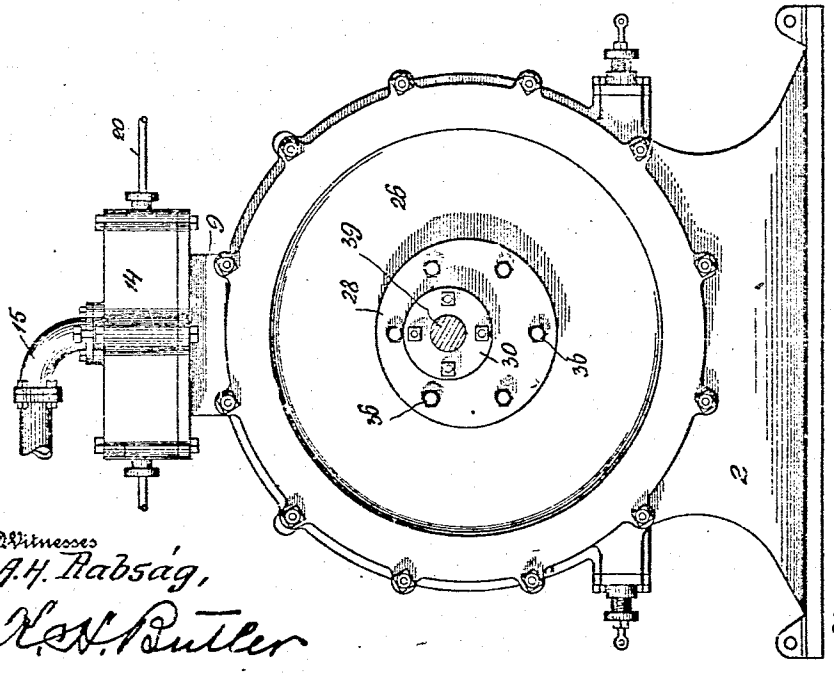

Fig. 1.

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4 SHEETS—SHEET 2.

Fig. 6.

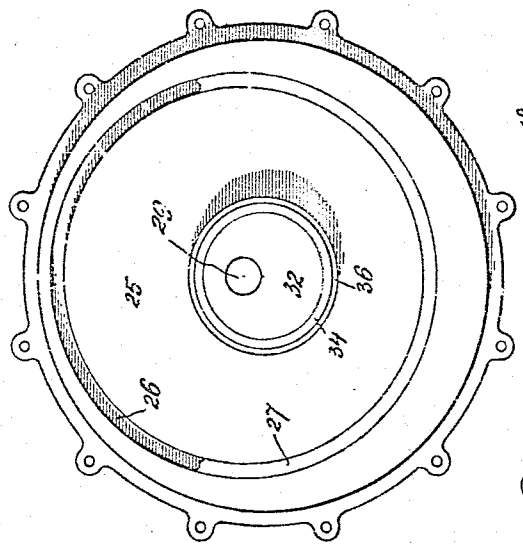


Fig. 8.

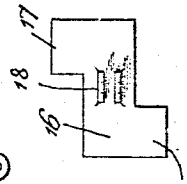


Fig. 5.

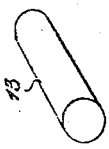
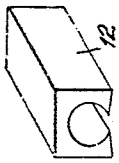


Fig. 4.



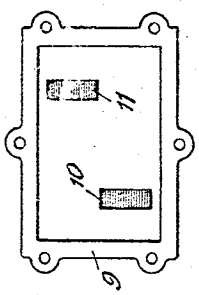


Fig. 7.

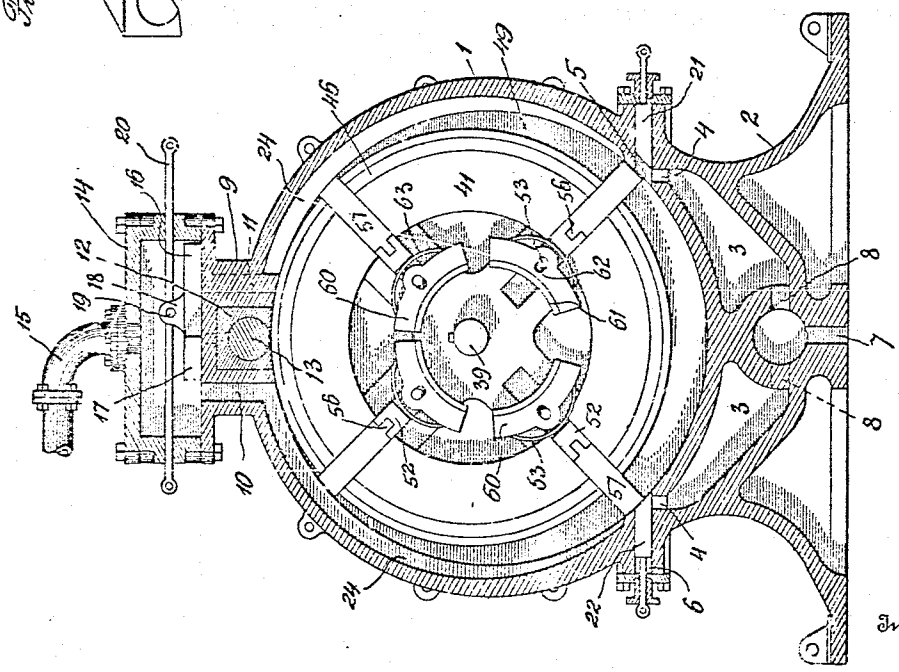


Fig. 3.

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4 SHEETS-SHEET 3.

Fig. 13.

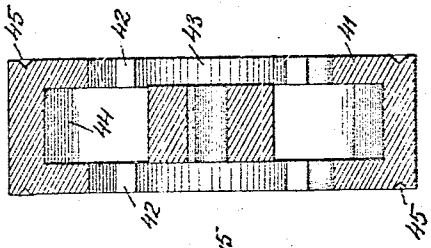

Fig. 18.

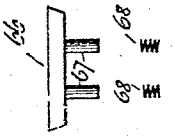

Fig. 12.

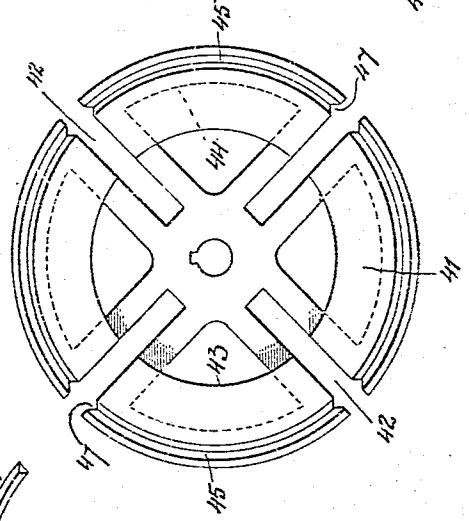

Fig. 17.

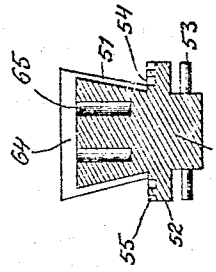

Fig. 16.

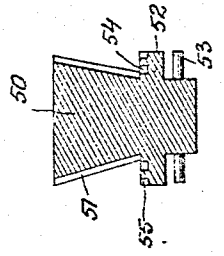

Fig. 14.

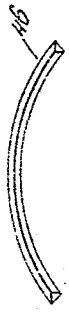

Fig. 10.

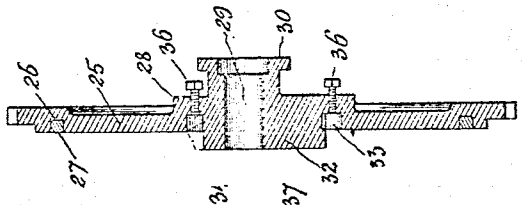

Fig. 11.

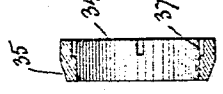

Fig. 15.

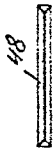

Fig. 9.

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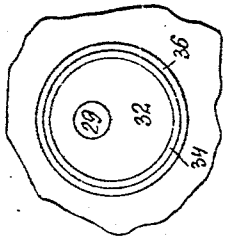
4 SHEETS—SHEET 4.

Fig. 26.



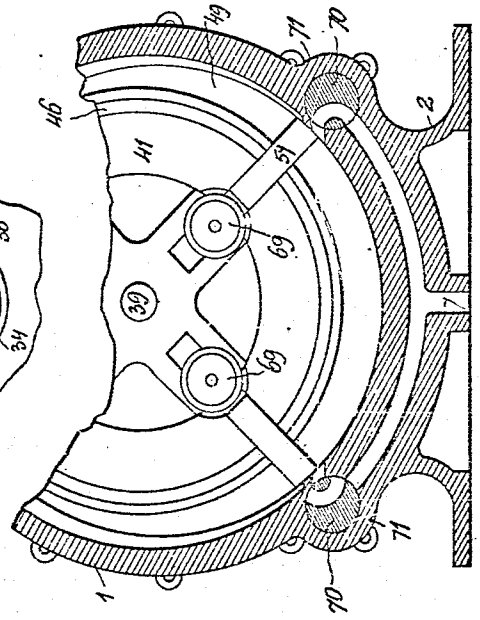


Fig. 25.

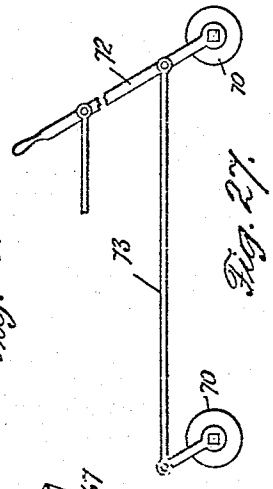


Fig. 27.

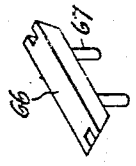


Fig. 24.

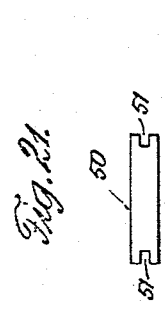


Fig. 21.

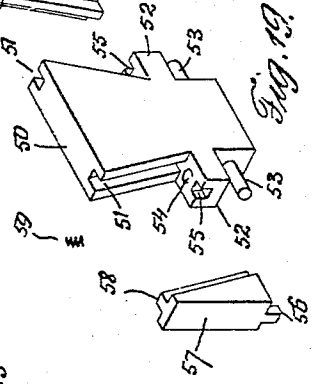


Fig. 19.

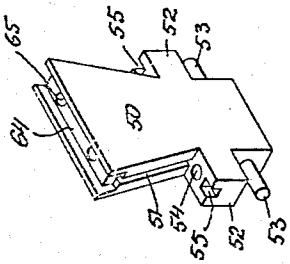


Fig. 22.

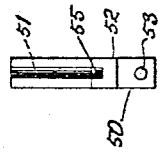


Fig. 20.

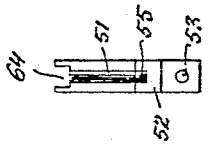


Fig. 23.

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UNITED STATES PATENT OFFICE.

SAMUEL HAUDENSHIELD, OF CARNEGIE, PENNSYLVANIA.

ROTARY ENGINE.

978,743. Specification of Letters Patent. Patented Dec. 13, 1910.

Application filed July 24, 1908. Serial No. 445,221.

To all whom it may concern:

Be it known that I, SAMUEL HAUDENSHIELD, a citizen of the United States of America, residing at Carnegie, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Engines, of which the following is a specification, reference being had therein to the accompanying drawing.

This invention relates to rotary engines of that type wherein steam or air can be used for propulsion.

The primary object of my invention is to provide a novel reversible engine in which a high degree of efficiency can be obtained with a minimum expenditure of fuel.

Another object of this invention is to provide an equally balanced rotary engine having an eccentrically mounted revoluble head, provided with a plurality of radially disposed pistons easily and quickly adjusted to compensate for the wear and tear of the pistons, without removing the same from the engine.

A further object of this invention is to provide a novel packing for the pistons of my engine, whereby the engine can be economically and safely operated.

A still further object of this invention is to provide a rotary engine that can be advantageously used as a water pump, water motor or can be utilized as a gasolene explosive engine by the addition of explosive chambers at the upper end of the engine.

The present invention is an improvement upon the construction of rotary engine which forms the subject matter of the Letters Patent granted to me September 29, 1908, #900,013, the present improvement consisting principally in the provision of positive and reliable means for effecting an even and steady movement of the radially disposed pistons within the engine, also, steam channels for increasing the driving power of the pistons.

Further, my improvement consists in certain structural details that will be hereinafter fully considered, and reference will now be had to the drawings, wherein,

Figure 1 is a side elevation of an engine constructed in accordance with my invention, with one of the bearings thereof removed. Fig. 2 is a front elevation of the engine with one of the belt wheels or balance wheels in section. Fig. 3 is a vertical longitudinal sectional view of the engine, illustrating the revoluble head of the engine in elevation, Figs. 4 and 5 are perspective views of packing used in the engine cylinder, Fig. 6 is an elevation of one side of one of the detachable side plates of the engine, Fig. 7 is a plan of an enlargement of the engine cylinder, Fig. 8 is a plan of a slide valve used in the steam chest of the engine, Fig. 9 is a vertical cross sectional view of the engine cylinder, Fig. 10 is a vertical cross sectional view of one of the detachable side plates of the engine, Fig. 11 is a similar view of a detached bearing block, Fig. 12 is a side elevation of the revoluble head of the engine, Fig. 13 is a vertical cross sectional view of the same, Figs. 14 and 15 are views of packing used in connection with the revoluble head, Fig. 16 is a vertical sectional view of one of the pistons of the engine, Fig. 17 is a similar view of a modified form of piston, Fig. 18 is an elevation of a packing and compression springs forming part of a modified form of piston, Fig. 19 is a perspective view of the preferred form of piston illustrated in Fig. 16 of the drawings, with the side packing strips separated from the pistons, Fig. 20 is a side elevation of the preferred form of piston, Fig. 21 is a plan of the same, Fig. 22 is a perspective view of the modified form of piston illustrated in Figs. 17 and 18, Fig. 23 is a side elevation of a modified form of piston, Fig. 24 is a perspective view of the packing illustrated in Fig. 18 of the drawings, used in connection with the modified form of piston, Fig. 25 is a vertical longitudinal sectional view of a portion of a modified form of engine, illustrating the rotary reversing valves and roller bearing pistons, Fig. 26 is an elevation of a portion of one of the side plates of the modified form of engine, and Fig. 27 is a side elevation of an operating lever for simultaneously moving the rotary valves of the modified form of engine.

In the accompanying drawings, 1 designates a cylinder having an integral base or foundation 2 in which is cast exhaust chambers 3 communicating with the bore of the cylinder 1 through the medium of vertical ports 4 and horizontal oppositely disposed ports 5 and 6. The chambers 3 communicate with an exhaust port 7 through the medium of ports 8, said exhaust port 7 being common to both of the exhaust chambers 3.

The top of the cylinder 1 is formed with an enlargement 9 having vertical ports 10 and 11, these ports being diagonally disposed, as best shown in Fig. 7, whereby the port 10 will feed at one side of the cylinder 1 and the port 11 at the opposite side thereof. The enlargement 9 between the ports 10 and 11 is recessed for a packing block 12 containing a revoluble packing roller 13, which is placed in the packing block 12 prior to placing said block in the recessed enlargement. The object of the packing block 13 will hereinafter appear.

Secured to the enlargement 9 is a steam chest 14 and connected to the top of this chest is a steam inlet pipe 15. In the steam chest 14 is arranged a slide valve 16 having side extensions 17 for controlling the ports 10 and 11. The slide valve 16 is provided with apertured lugs 18, and connected to these lugs by a pin 19 is a slide rod 20, said rod extending through the steam chest to be coupled to a suitable operating lever (not shown), but illustrated in connection with Fig. 18 of the above mentioned Letters Patent.

In the horizontal oppositely disposed ports 5 and 6 are slidably mounted valves 21 and 22, said valves being alternately operated through the medium of suitable operating levers mounted upon the base and foundation of the engine. These levers are not shown in the present application but are illustrated in connection with Fig. 18 of the above mentioned Letters Patent.

The sides of the cylinder 1 are provided with annular-seats 23, and the cylinder within the bore is chamfered to provide two channels 24, these channels extending from the inlet ports 10 and 11 to the horizontal oppositely disposed ports 5 and 6. By reference to Fig. 9, it will be observed that the ports 5 and 6 are of a width approximately equal to the cylinder and in order to compensate for the wear of pistons within the cylinder, I arrange the channels 24 inclined relatively to the plane of the sides of the cylinder, the direction of inclination of one channel being opposite to the other. The channel 24 extending from the port 10 at one side of the cylinder traverses the bore of the cylinder to the opposite side thereof, while the channel from the port 11 is similarly formed, whereby steam entering either of the ports 10 or 11 will equally impinge pistons within the cylinder.

The angularity of the channels 24 interiorly and exteriorly is clearly indicated in Figs. 2 and 5 of the drawings, and by reference to the first mentioned figure, it will be observed that I save material in the construction of the cylinder by reducing the thickness of the wall thereof at the sides of the channels. Mounted in the annular seats 23 of the cylinder are side plates 25, and since these plates are identical in construction, I deem it only necessary to describe one of said plates, reference being had to Figs. 6 and 10. The side plate is securely bolted to the cylinder and snugly fits in the seat 23. The plate 25 contiguous to the periphery thereof and upon the inner side is provided with an annular groove 26 having located therein a packing ring 27, this packing ring being broken away in Fig. 6 of the drawings, to clearly show the groove 26. Centrally of the plate 25 is an annular enlargement 28 having a bore 29 formed therein. The enlargement 28 upon the outer side of the plate 25 is formed with a stuffing box 30 for a gland 31, and upon the inner side of said plate is formed an extension 32, eccentric with relation to the bore 29, said eccentric extension being surrounded by a groove 33 formed in the enlargement 28, the periphery of said extension and said groove 33 being substantially concentric with relation to the inner circumference of the cylinder. Adapted to fit upon the eccentric extension 32 is an annular bearing block 34 having a beveled bearing surface 35. This block is adjustably mounted upon the eccentric extension 32 and is adjusted thereon by a plurality of set screws 36 arranged in the enlargement 28. Said bearing block is prevented from rotating upon said eccentric extension by suitable keys (not shown) arranged in the grooves 37 of the bearing block 34. The bearing block forms a salient feature of my invention, together with the set screws 36; whereby I am enabled to obtain certain adjustments from the exterior of the engine, without detaching the side plates 25.

Arranged at the sides of the engine are bearings 38, these bearings alining longitudinally with the bores 29 of the side plates 25. Journaled in the bearings 38 and extending through the cylinder 1 and the side plates 25 is a shaft 39, said shaft being eccentric to the bore of the cylinder 1. Mounted upon the shaft 39 between the bearings 38 and the cylinder 1 are balance or belt wheels 40.

Keyed upon the shaft 39 within the bore of the cylinder 1 is a head 41, said head having radially disposed slots 42 formed therein, preferably four in number, with two opposing slots arranged at right angles to the other two opposing slots. Both sides of the head are cut away, as at 43, to provide clearance for the bearing blocks 34, and to reduce the weight of the head 41, said head is recessed, as at 44. The sides of the head adjacent to the periphery thereof are provided with annular V-shaped grooves 45, these grooves being provided with segment shaped strips of packing 46 adapted to engage the packing rings 27 of the side plates 25. These packing strips and rings form

an air tight connection, and can be easily renewed when worn. The confronting faces of the slots 42 adjacent to the outer ends thereof are provided with transverse V-shaped grooves 47, adapted to hold V-shaped packing strips 48, the object of which will presently appear. With the head 41 mounted upon the shaft 30 within the cylinder, a crescent-shaped compartment 49 is formed, irrespective of the channels 24, between the inner walls of the cylinder and the periphery of the head, this compartment having its greatest depth at the bottom of the cylinder.

Slidably mounted in the slots 42 of the head 1 are pistons, each piston comprising a V-shaped dove-tailed block 50 having side grooves 51, side lugs 52 and side pins 53. The side lugs 52 are provided with sockets 54 and notches 55, said notches receiving the depending tongues 56 of wedge-shaped wearing shoes 57, these shoes having tongues 58 fitting in the grooves 51 of the dove-tailed block 50. Coil springs 59 are mounted in the sockets 54, these springs normally forcing the shoes 57 upwardly, whereby as the head 41 rotates, said shoes will be frictionally held in engagement with the inner sides of the plates 25.

Loosely mounted upon the side pins 53 of the pistons are segment-shaped arms 60, these arms being beveled, as at 61, to engage the beveled bearing surface 35 of the bearing blocks 34. The segment-shaped arms 61 are provided with slots 62, whereby said arms can shift upon the pins 53, but to normally hold the arms 60 in engagement with the bearing blocks 34, I arrange curved springs 63 between said blocks and the side lugs 52 of the pistons, these springs bearing upon the outer ends of the arms and against the under side of the lugs 52.

Before referring to the modifications of my invention, I will first describe the operation of the engine, in order that the modifications can be fully understood with a brief description of the same.

Operation: With the slide valve 16 in the position shown in Fig. 3 of the drawings, steam entering the chest 14 passes through the vertical port 10, enters the crescent-shaped compartment 49 of the bore 5, where it impinges against the first piston, which lies within that portion of the compartment extending between the steam inlet and the exhaust ports, thereby causing the piston and the head to rotate until the piston passes exhaust ports 5 and 4, at which time the steam behind the piston exhausts, but in the meantime another piston has taken steam from the port 10, and the head 41 continues to revolve imparting a rotary movement to the shaft 39 and the wheels 40 carried thereby. It will thus be observed that the steam traverses practically one-half of the cylinder before exhausting, thus obtaining beneficial use of the same before its final escape. The channels 24, being open to the crescent-shaped compartment, form steam passages which permit of the communication between the steam chambers on the opposite sides of the piston, and being also in communication with the inlet port, provide means whereby the inlet ports can not be closed or cut off by the pistons, so that there is no possibility of the head 41 stopping in such a position as would prevent its being started again as soon as steam is introduced through one of the inlet ports. The annular bearing blocks 34 are arranged with their peripheries concentric with respect to the inner surface of the cylinder bore, but eccentrically to the shaft 39, therefore, during the propelling of the head 41 by the steam-impelled pistons, the pistons will remain in contact with both the inner face or walls of the cylinder and the periphery or beveled wearing surfaces 35 of the wearing blocks 34, the eccentric mounting of the head causing the pistons to have a relative in and out movement within the slots 42 of said head. To reverse the engine, the reversing valves 21 and 22 are moved to open the port 6 and close the port 5, and the slide valve 16 is shifted whereby the port 11 becomes an inlet port with the port 10 closed. The packing block 12 and the packing roller 13 prevent the escape of steam across the top of the head 41, while the packing rings 27 and packing strips 46 and 48 confine the steam within the crescent-shaped compartment.

Considering the modifications of my invention, reference will first be had to the pistons. In Figs. 17, 18, 22, 23 and 24, I have illustrated a modified form of piston, wherein the outer end of the dove-tailed block 50 is provided with a groove 64 and with sockets 65, said groove accommodating a shoe 66 having depending pins 67 adapted to extend into the sockets 65. Mounted in the sockets 65 are coil springs 68, these springs cushioning the shoes 66 and at the same time maintaining said shoes in engagement with the inner walls of the cylinder; otherwise the modified form of piston is similar to the preferred form.

In Figs. 25, 26 and 27, I have illustrated a further modification of my invention, wherein the segment-shaped arms 60 are dispensed with, and beveled rollers 69 are revolubly mounted upon the side pins 53 of the pistons. The slide reversing valves 21 and 22 are dispensed with, and rotary reversing valves 70 used, these valves being revolubly mounted in enlargements 71 provided therefor upon the lower side of the cylinder. The base and foundation of the cylinder are simplified, as clearly shown in Fig. 25. The rotary valves 70 are operated in unison by an operating lever 72 and a

link connection 73. The eccentric bearing block used in connection with the beveled rollers 69 is constructed with major and minor axes, shown in Fig. 26, whereby the pistons will evenly travel within the cylinder without the use of springs 63.

An important feature of my invention resides in the novel packing which is automatically expansible under wear, said packing comprising independent members for the face and ends of each piston, thereby insuring a steam tight connection between the revoluble head, the pistons thereof and the cylinder.

I desire to call attention to the fact that the principal wearing elements of my engine can be readily renewed, and that each and every part of the engine is easily assembled. Suitable provision can be made for a thorough lubrication of the movable parts of the engine.

While in the drawings forming a part of this application there is illustrated the preferred embodiments of my invention, I would have it understood that the same can be varied or changed as to shape, proportion and exact manner of assemblage without departing from the spirit of the invention.

Having now described my invention what I claim as new, is:—

1. In a rotary engine, a cylinder having inlet and exhaust ports and a steam space, and a head mounted eccentrically of said cylinder, said head having pistons having a path of movement to retain the outer end of the pistons in contact with the inner circumference of the cylinder, said cylinder having a channel extending from the steam inlet port and terminating at a point intermediate said port and exhaust port and being of less width than the width of the pistons, said channel being in open communication with the interior of the cylinder, and having a gradually increasing depth toward the steam inlet port.

2. In a rotary engine, a cylinder having inlet and exhaust ports and a steam space, and head mounted eccentrically of said cylinder, said head having pistons having a path of movement to retain the outer end of the pistons in contact with the inner circumference of the cylinder, said cylinder having a steam channel extending from the steam inlet port and terminating at a point intermediate said port and exhaust port and being of less width than the width of the pistons, said channel being in open communication with the interior of the cylinder, and having a gradually increasing depth toward the steam inlet port, said channel being inclined relatively to the plane of the sides of the cylinder.

3. In a rotary engine, a cylinder having inlet and exhaust ports and a steam space, and a head mounted eccentrically of said cylinder, said head having pistons having a path of movement to retain the outer end of the pistons in contact with the inner circumference of the cylinder, said cylinder having a steam channel extending from the steam inlet port and terminating at a point intermediate said port and the exhaust port and being of less width than the width of the pistons, said channel being in open communication with the interior of the cylinder, and having a gradually increasing depth toward the steam inlet port, said channel being inclined relatively to the plane of the sides of the cylinder, said channel being of a length greater than the distance between successive pistons.

4. In a rotary engine, a cylinder having inlet and exhaust ports and a steam space, said inlet ports being spaced from each other and located at direct right angles to the axis of the cylinder, and a head mounted eccentrically of said cylinder, said head carrying pistons having a path of movement to retain the outer ends of the pistons in contact with the inner circumference of the cylinder, said cylinder having steam channels extending from the steam inlet ports and terminating at a point intermediate said port and the exhaust port and being of less width than the width of the pistons, said channels being each in open communication with the interior of the cylinder and having a gradually increasing depth toward a steam inlet port, each channel being inclined relatively to the plane of the side of the cylinder, the inclination running in the plane of its inlet port to a point adjacent the opposite side of the cylinder.

5. In a rotary engine, a cylinder having inlet and exhaust ports and a steam space, said inlet ports being spaced from each other and located at direct right angles to the axis of the cylinder, and a head mounted eccentrically of said cylinder, said head carrying pistons having a path of movement to retain the outer ends of the pistons in contact with the inner circumference of the cylinder, said cylinder having steam channels extending from the steam inlet ports and terminating at a point intermediate said port and the exhaust port and being of less width than the width of the pistons, said channels each being in open communication with the interior of the cylinder and having a gradually increasing depth toward a steam inlet port, each channel being inclined relatively to the plane of the side of the cylinder, the inclination running in the plane of its inlet port to a point adjacent the opposite side of the cylinder, each channel being of a length greater than the distance between successive pistons, said channels having a combined length less than the inner circumferential length of the cylinder.

6. In a rotary engine, the combination

with a cylinder having inlet and exhaust ports and a steam space, of a head mounted eccentrically on said cylinder, said head having pistons movable relatively to the head, and adjustable means carried by the sides of the cylinder for controlling the relative movements of the head and pistons, said pistons each having an element movable with respect to the pistons and in contact with said means.

7. In a rotary engine, the combination with a cylinder having inlet and exhaust ports and a steam space, of a head mounted eccentrically of said cylinder, said head having pistons movable relatively to said head, and means carried by the sides of the cylinder for controlling the relative movements of the head and pistons, said means being adjustable in a manner to take up wear, said pistons having an element movable with respect to the pistons and in contact with said means.

8. In a rotary engine, the combination with a cylinder having inlet and exhaust ports and a steam space, of a head mounted eccentrically of said cylinder, said head having pistons movable relatively to the head in a radial direction, and wear-adjusting beveled blocks carried by the sides of and arranged concentrically with the bore of the cylinder, said blocks being adjustable axially of the cylinder, each of said pistons having an element in contact with and movable on the beveled face of the blocks.

9. In a rotary engine, the combination with a cylinder having inlet and exhaust ports and a steam space, of a head mounted eccentrically of said cylinder, said head having pistons movable relatively to the head, and means for controlling the relative movements of the head and pistons, said means comprising a bearing block extending axially of the cylinder, said block having its periphery concentric with the inner circumference of the cylinder, said block being adjustable axially to compensate for relative wear of block and pistons.

10. In a rotary engine, the combination with a cylinder having inlet and exhaust ports and a steam space, of a head mounted eccentrically of said cylinder, said head having pistons movable relatively to the head, and means for controlling the relative movements of the head and pistons, said means comprising a bearing block extending axially of the cylinder, said block having its periphery concentric with the inner circumference of the cylinder, said block being adjustable axially to compensate for relative wear of block and pistons, said block and the pistons having complemental faces movable relative to each other.

11. In a rotary engine, the combination of a cylinder having inlet and exhaust ports and a steam space, said cylinder having its side plates formed with axially extending bearings, a head mounted eccentrically of said cylinder, said head having pistons movable relatively to the head and in directions radially thereof, and means for controlling the relative movements of the head and pistons, said means comprising a bearing block carried by each of said bearings, said block being adjustable to compensate for wear, each block and the pistons having surface contact at spaced intervals of the periphery of the blocks and having complemental faces movable relative to one another, the contacting portions of the pistons consisting of a member movable with respect to the pistons.

12. In a rotary engine, the combination of a cylinder having inlet and exhaust ports and a steam space, said cylinder having its side plates formed with axially extending bearings, a head mounted eccentrically of said cylinder, said head having pistons movable relatively to the head and in directions radially thereof, and means for controlling the relative movements of the head and pistons, said means comprising a bearing block carried by each of said bearings, said block being adjustable to compensate for wear, each block and the pistons having surface contact at spaced intervals of the periphery of the blocks, the contacting portions of the pistons consisting of a member movable with respect to the pistons, each of said blocks having an outer beveled space against which said members ride, the blocks being adjustable axially.

13. In a rotary engine, the combination of a cylinder having inlet and exhaust ports and a steam space, said cylinder having its side plates formed with axially extending bearings, a head mounted eccentrically of said cylinder, said head having pistons movable relatively to the head and in directions radially thereof, and means for controlling the relative movements of the head and pistons, said means comprising a bearing block carried by each of said bearings, said block being adjustable to compensate for wear, each block and the pistons having surface contact at spaced intervals of the periphery of the blocks, the contacting portions of the pistons consisting of a member movable with respect to the pistons, each of said blocks having an outer beveled space against which said members ride, the blocks being adjustable axially, each side plate being recessed to receive its blocks.

14. In a rotary engine, a section head having an inwardly extending annular flange on its opposite sides and a plurality of radially-extending slots leading to the periphery of the head and extending through said flanges, to provide segments having bearing faces on their sides and ends, each of said faces having grooves for the reception of a packing.

15. In a rotary engine, a section head having an inwardly extending annular flange on its opposite sides and a plurality of radially-extending slots leading to the periphery of the head and extending through said flanges, to provide segments having bearing faces on their sides and ends, each of said faces having grooves for the reception of a packing, said grooves being V-shaped in cross-section.

16. In a rotary engine, a piston having its side walls inclined inwardly from the face of the piston, and having outwardly-extending lugs at the inner ends of the inclined faces, and angular packing members adapted to be mounted within the recesses formed by the inclined faces and lugs, said members being automatically adjustable along said inclined faces.

17. In a rotary engine, a piston having its side walls inclined inwardly from the face of the piston, and having outwardly-extending lugs at the inner ends of the inclined faces, said inclined faces being grooved in the direction of their length, and angular packing members adapted to be mounted within the recesses formed by the inclined faces and lugs, said members being automatically adjustable along said inclined faces, said members having ribs extending within the grooves.

18. In a rotary engine, a piston having its side walls inclined inwardly from the face of the piston, and having outwardly-extending lugs at the inner ends of the inclined faces, and angular packing members adapted to be mounted within the recesses formed by the inclined faces and lugs, said members being automatically adjustable along said inclined faces, the face of said piston having a recess, and a packing member mounted within said recess.

In testimony whereof I affix my signature in the presence of two witnesses.

SAMUEL HAUDENSHIELD.

Witnesses:

MAX H. SROLOVITZ,

K. H. BUTLER.