A. McDONALD.

ROTARY ENGINE.

APPLICATION FILED OCT. 16, 1918.

1,341,332.

Patented May 25, 1920.

4 SHEETS—SHEET 1.

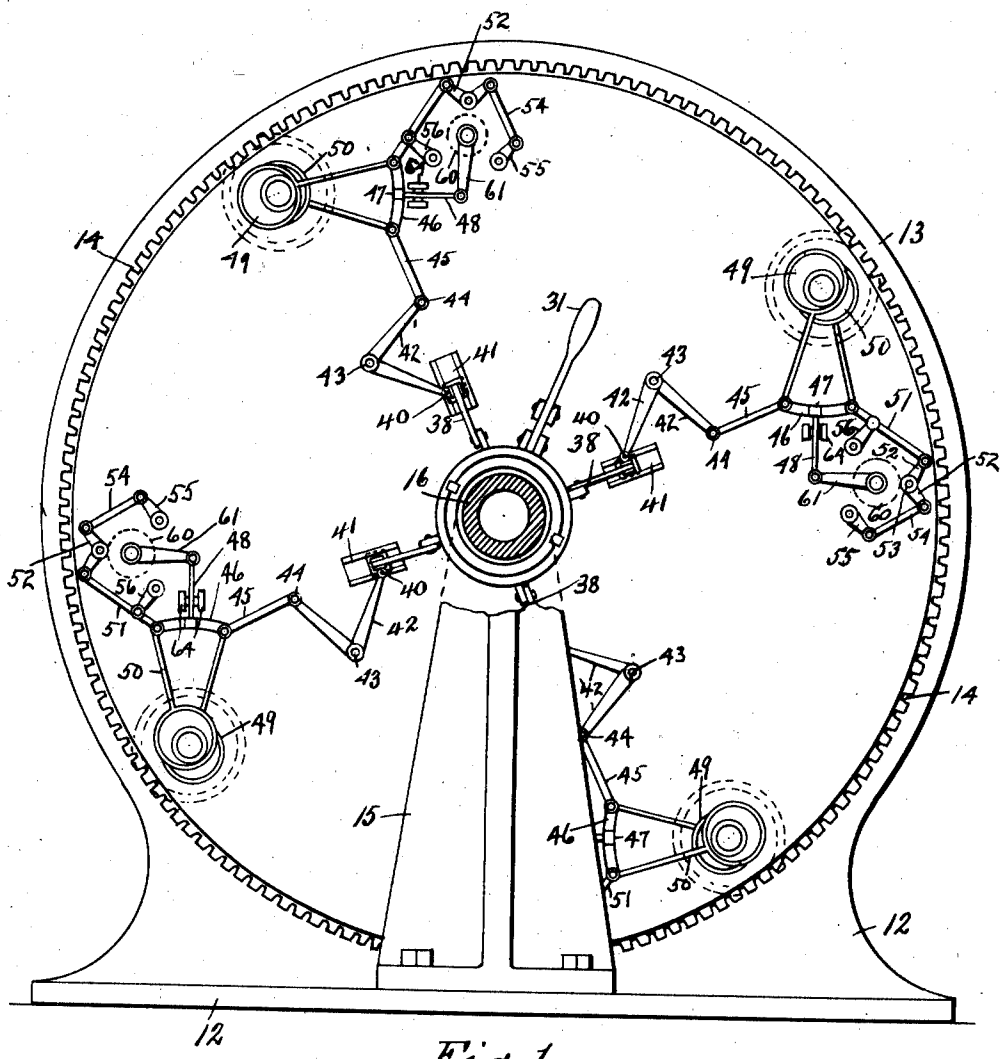


Fig. 1.

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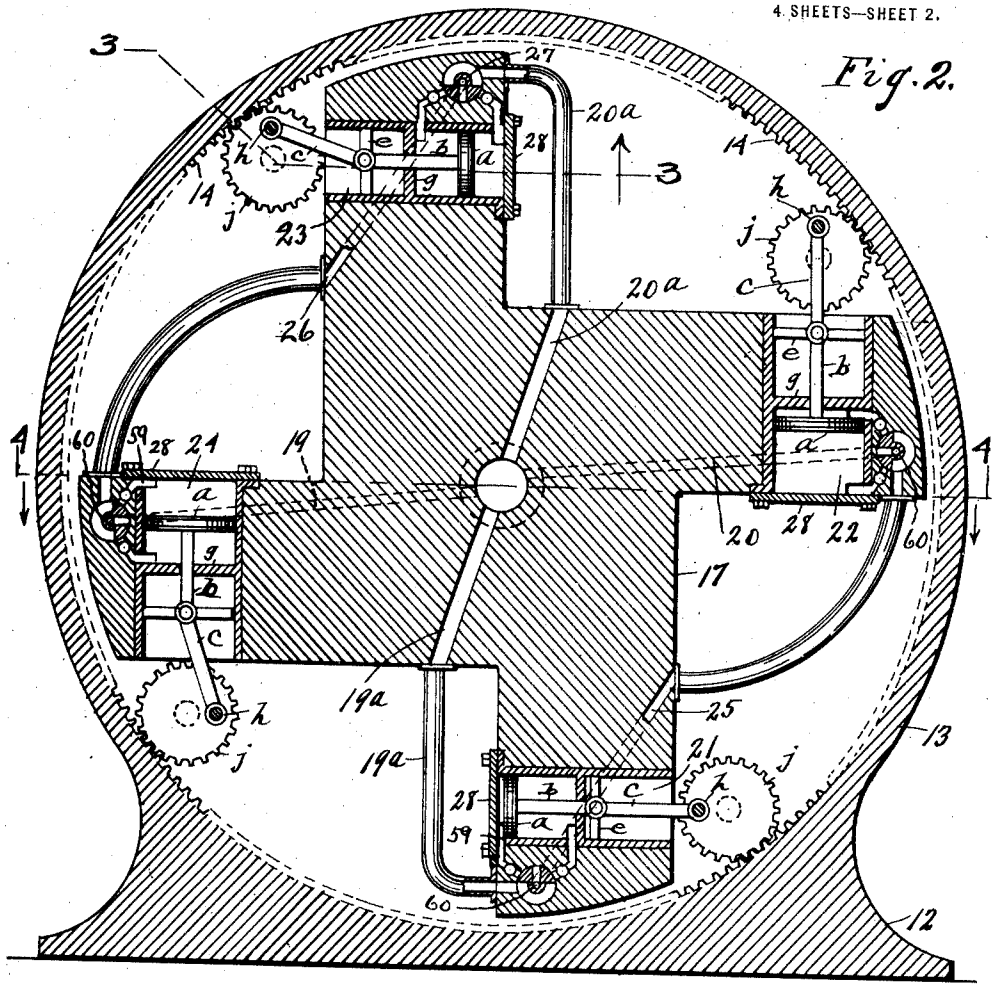
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Fig. 2.



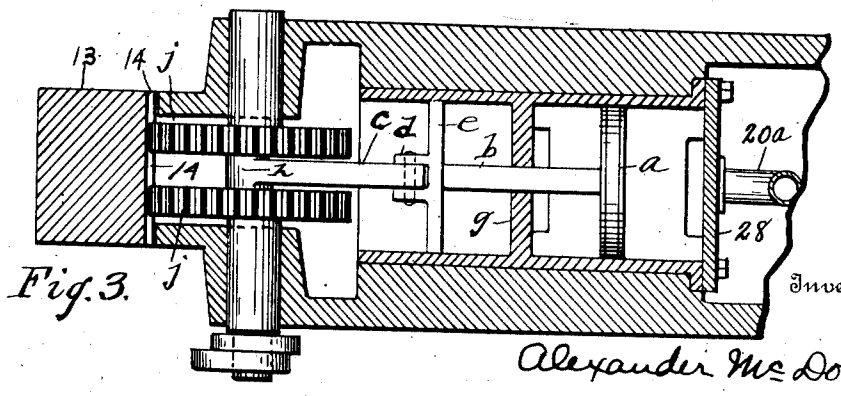


Fig. 3.

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4 SHEETS—SHEET 3.

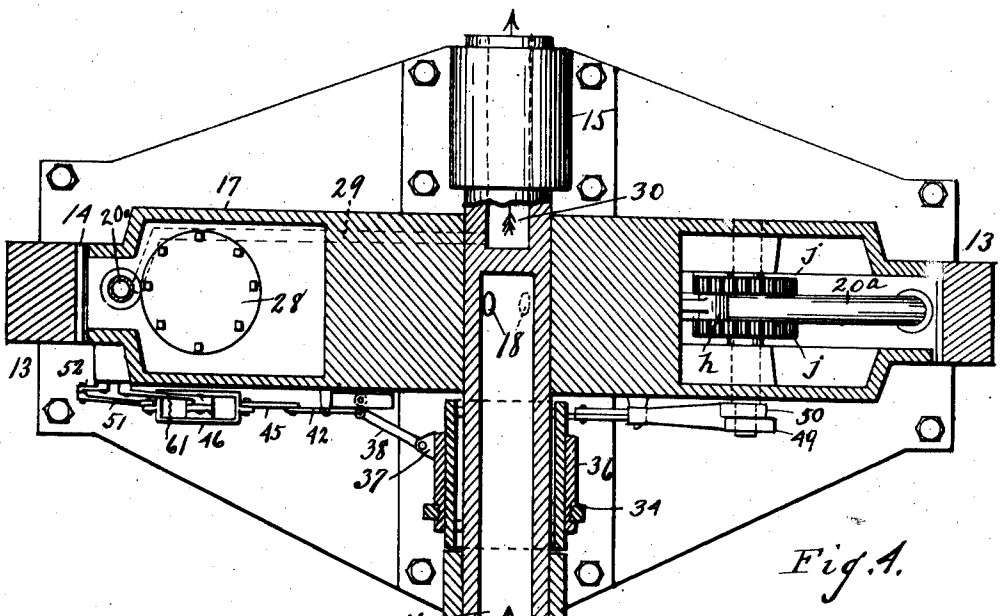


Fig. 4.

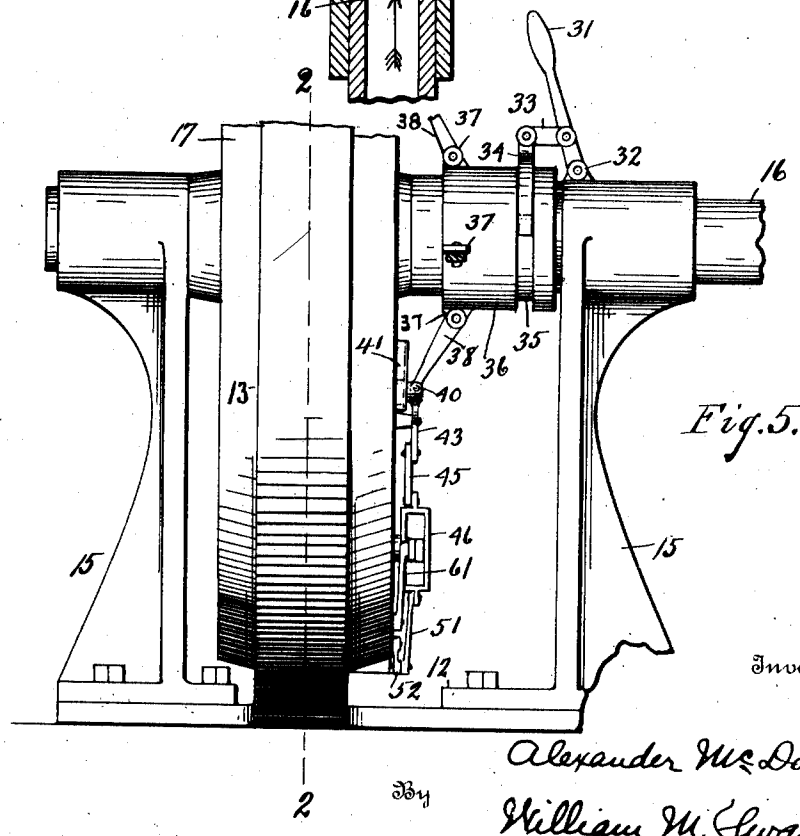


Fig. 5.

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4 SHEETS—SHEET 4.

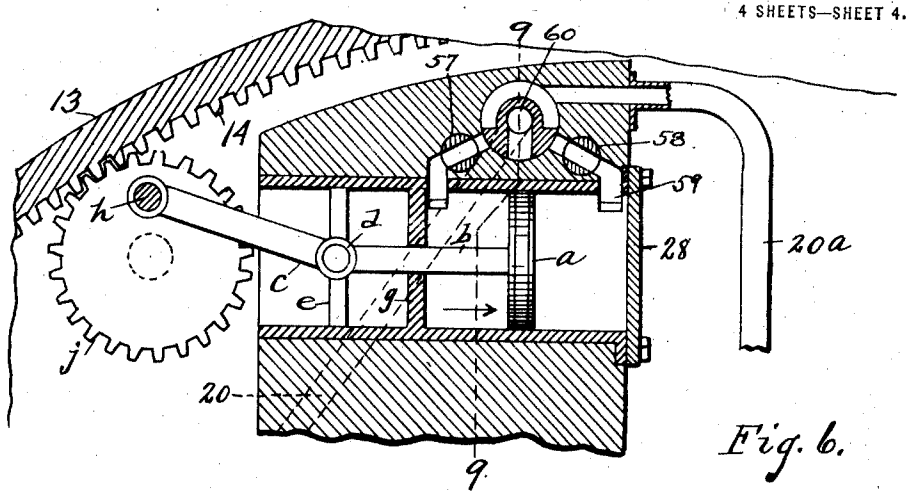


Fig. 6.

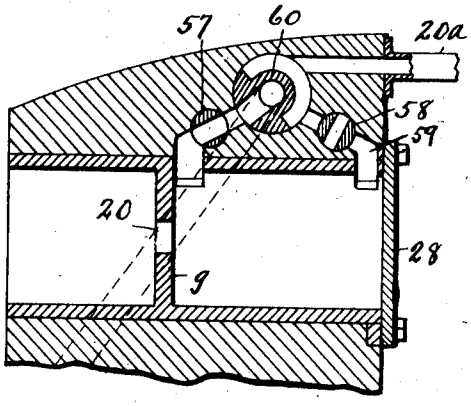


Fig. 8.

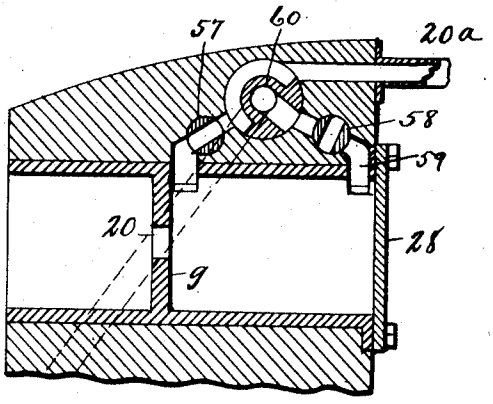


Fig. 7.

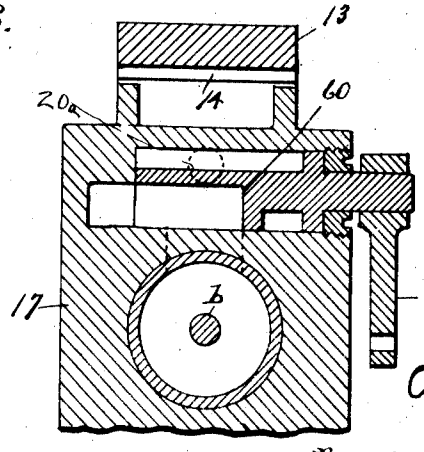


Fig. 9.

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UNITED STATES PATENT OFFICE.

ALEXANDER McDONALD, OF DETROIT, MICHIGAN.

ROTARY ENGINE.

1,341,332. Specification of Letters Patent. Patented May 25, 1920.

Application filed October 16, 1918. Serial No. 258,360.

To all whom it may concern:

Be it known that I, ALEXANDER McDONALD, a citizen of the United States, residing at Detroit, county of Wayne, State of Michigan, have invented a certain new and useful Improvement in Rotary Engines, and declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

This invention relates to single-acting rotary engines, and has for its object an improved organization of cylinders rotating about a central axis, and so disposed relatively to one another, and to the direction in which it is desired that their power be delivered, as to give the greatest possible efficiency stroke proportionately to the actuating power employed.

In the drawings:

Figure 1 is a side elevation of the engine viewed from the side on which the valve gear is located.

Fig. 2 is a central vertical section along the line 2—2 of Fig. 5.

Fig. 3 is a sectional plan view on an enlarged scale of one of the cylinders and its related parts, being taken along the line 3—3 of Fig. 2.

Fig. 4 is a sectional plan along the line 4—4 of Fig. 2.

Fig. 5 is a front elevation of my improved machine, the engine's parts proper being hidden between the outer casing.

Fig. 6 is a detail of one of the cylinders emphasizing its valve and gear connections.

Figs. 7 and 8 are detailed views bringing out the variant position of the rotary valves at various points in a cycle of operations.

Fig. 9 is a sectional elevation along the line 9—9 of Fig. 6.

Suitably supported upon a base 12 is the shell or inclosing member 13, whose inner surface is toothed as at 14. On each side of the shell 12 rise struts 15, in whose top portion is journaled the hollow shaft 16, axially in alinement with the cylinder block 17, which is within the shell 13. As is brought out particularly in Fig. 4, that end of the hollow portion of the shaft 16 which lies within the lines of the cylinder block 17 is provided with a pair of diametrically located vent holes 18, which are adapted to register with the steam passages 19 and 20 through the block 17. These passages continue, through the pipes 19^a and 20^a respectively, to the rotary valves controlling the inlets to the cylinders 21 and 23. These valves and the passages which they control, as will be hereinafter explained, so function that at certain points in each cycle of operations, steam will be admitted directly to the end of the cylinders 21 and 23, whereas, at certain other points in the cycle of operations, the steam will be directed through the passages 25 and 26 so as to proceed into the cylinders 22 and 24.

Each one of the cylinders 21, 22, 23 and 24 is provided with a piston member *a*, piston rod *b* and connecting rod *c*, one end of which is pivoted at *d* to the knuckle *f* in the outer face of the guide member *e*, which is located on the other side of the partition *g* in the cylinder from that on which the piston *a* is located. At its outer end this connecting rod is eccentrically pivoted at *h* between the faces of the small gear wheels *j*, whose teeth mesh with the teeth of the internal gear 14 of the shell 13.

The actuating steam approaches the engine through the hollow shaft 16, as shown by the arrow in the bottom portion of Fig. 4, and passes thence through the vent holes 18 to the pipes 19^a and 20^a to cylinders 21 and 23, its entry thereinto being regulated by the rotatable valve 60. In Figs. 6, 7 and 8 I have shown on enlarged scale how the steam may be directed into the cylinder on one side of the piston or on the other, as for reversing the direction of rotation of the engine, or wholly shut off from further approach to the cylinder. In Fig. 7 I have shown the valve so positioned as to discharge steam between the piston and the outer end of the cylinder, while in Fig. 8 I have shown the valve 60 so positioned as to direct steam through that one of the inlet passages 59 which opens in the cylinder between the piston and the cylinder head 28. These will be referred to in further detail later on. If the position of the valve 60 is such as to prevent the passage of the steam in the cylinders through either entrance, the flow of the steam is thereby diverted past the valve and into the passages 25 and 26, which lead past similarly located and similarly functioning valves appurtenant to the cylinders 22 and 24, whence it proceeds through the

vent passages 29 to the hollowed portion 30 of the shaft, escaping therefrom to the outer air.

The controlling mechanism for these several cylinders consists in a corresponding series of toggle members positioned on the outer face of the shell 13. When the engine is at rest and no steam is entering through the shaft 16, the control lever 31 is in the position shown in Fig. 5. This lever, which is pivoted to a conveniently located projection 32 on the frame 15, is connected by link 23 with the partial ring 34, which loosely engages in the annular depression 35 of the sleeve 36. On this sleeve 36, at points ninety degrees removed from one another (in the case of the four cylinder engine here described), are located projecting knobs 37, to each of which is pivoted the inner end of its toggle link 38. Thus when the sleeve 36 is forced lengthwise of the shaft 16 by movement of the lever 31, each of these links is pushed radially outward, tending to assume a position nearly parallel with the planes of the faces of the cylinder block 17. The outer end of each toggle link 38 is pivoted to the head portion of a guide shoe 40, which slidably engages in a track or guide groove 41, which is so located that the path of possible travel there along is substantially radial. The outer end of each toggle link 38 is also pivoted to the end of one branch of the bell crank lever 42, which is pivotally supported upon the cylinder block 17 by means of the pin 43. The end of the other branch of the bell crank lever 42 is pivoted as at 44 to one end of a link 45, the outer end of which is connected with a yoke 46, whose center portion 47 lies opposite the end of the pivoted lever 48. To each end of this yoke piece 46 is pivotally connected the end of the straight or "handle" portion of one of the valve eccentrics 49 and 50, one for starting the engine ahead, the other for reversing. In Fig. 1 this regulating mechanism is shown in neutral position, that is, with the center of the yoke 46 opposite the end of the lever 48, which lies between guide studs 59. The opposite end of the yoke 46, from that which the link 45 is connected, is also pivoted to the end of a link 51, which is connected with one end of the bell crank lever 52 which, like the bell crank lever 42, is pivoted at 53 to the face of the cylinder block 17. Leading from the far end of the bell crank lever 52 from that with which the link 51 is connected, is another link 54. The end of this link 54 is pivotally connected with one of two companion levers 55 and 56, the other lever being connected with the link 51 intermediate its ends, in such a way that when the yoke 46 is swung, both of the lever members 55 and 56 will be actuated in the same direction and to the same degree, when the rotary distributing valve 60 is actuated by the swing of its lever 61. The stems whereon these lever members 55 and 56 are mounted lead to the rotary valve members 57 and 58, shown on an enlarged scale in Figs. 6, 7 and 8, whereas the dotted circle 60 shown in Fig. 1 represents the position relative thereto of the rotary distributing valve 60, which is adapted to be actuated about its axis by the movement of the lever 61, whose outer end is pivoted to that end of the pivoted lever 48, farthest removed from the yoke 46. Fig. 6 shows this valve 60 in neutral or cutting-off position as to both rotary valves 57 and 58; Fig. 7 shows the valve 60 turned so that its cut-away top portion is in registry with the passage of the valve 57, which is in fully open position relatively thereto, while its exhaust passage is moving into registry with the passage of the still closed valve 58; and Fig. 8 shows the valve 60 swung in the opposite position to that just described, so that its exhaust passage is in registry with the passage controlled by the valve 57, which being open, allows the steam to pass it into the steam passage 20 leading to the lower pressure cylinder. In this position of these valves the action of the steam is against that face of the piston from which the piston rod projects. If the movement of the engine in the reverse direction is desired, the valve 57 is closed and the valve 58 is opened and the valve member 60 swung into registry therewith so that the steam can act on the other face of the piston from that just described, the right-hand face as viewed in Figs. 6, 7 and 8. In order for steam to be admitted against either face of the piston *a*, not only must the valve 57 or 58 be open, but the exhaust passage of the distributing valve 60 must be in registry with it.

The above-described mechanism operates as follows: movement of the pivoted lever 31 toward the engine casing or shell 13 (from right to left in the position shown in Fig. 5) serves to actuate the toggle and valve links in the manner just described, resulting in turn in turning the rotary valves 58 and 60 of each of the cylinders 21 and 23 so that steam can flow past them behind the pistons *a*, thus rotatively actuating the small gear wheels *j*, whose teeth mesh with the teeth 14 of the shell 13. The turning of the rotary valves controlling the inflow of steam has of course kept on as the reciprocatory movement of the pistons progressed, and they soon reach a point where they shut off the further flow of steam into the cylinders 21 and 23. It is now exhausted through the passages 25 and 26 into the cylinders 22 and 24, which are similarly guarded by rotary valves 57 and 58 and 60. When these open, steam passes into these cylinders to actuate their pistons in like manner as in the case of the first pair 21 and 23. The movement of

the pistons in the cylinders 22 and 24 being similarly communicated to their small gear wheels *j*, the continued rotative movement of the cylinder block 17 within the shell 13 is brought about, since the members of each pair of cylinders, as 21 and 23, function while the other pair 22, and 24, is shut off from the access of steam, or vice versa. Of course when it is desired to stop the engine, the actuation of the lever 31 in the opposite direction from the starting movement (to the right in Fig. 5) serves to so neutrally position the rotary valves 58 and 60, that no steam can proceed to any of the cylinders. The positioning of the cylinders so that the lines of reciprocation of their respective pistons are practically perpendicular to the radii gives the maximum leverage for operating the small gear teeth *j* against the toothed shell 14 and avoids the necessity of making the parts so heavy as to give a flywheel effect to carry the cylinder block past "dead centers."

What I claim is:

1. In a rotary engine, the combination of a rotatable engine block, a series of cylinder members disposed about the periphery thereof in position for the reciprocation of their pistons transversely of the radii passing therethrough, regulatable means for selectively admitting steam into diametrically oppositely located cylinders, means for exhausting steam to other pairs of cylinders during the periods of inactivity of the first named pair, and a casing member with which connected parts of said cylinder mechanisms operatively engage.

2. A rotary engine, having in combination an interiorly toothed shell, a hollow shaft centrally disposed with respect to said shell, an engine block rotatably disposed on said shaft within said shell, a plurality of cylinder and piston members peripherally disposed about said engine block in position for operative action on said shell in directions generally transverse to the several radii at those points, means for regulatably admitting a supply of steam through said hollow shaft into diametrically opposed pairs of said cylinders, and means for exhausting steam from the first pair of cylinders to the other pair of cylinders after the actuative period of the first has been completed.

In testimony whereof, I sign this specification in the presence of two witnesses.

ALEXANDER McDONALD.

Witnesses:

HARRY L. WAGNER,

WILLIAM M. SWAN.