No. 647,718. Patented Apr. 17, 1900.

D. M. DEARING.

ROTARY ENGINE.

(Application filed July 11, 1898.)

(No Model.) 3 Sheets—Sheet 1.

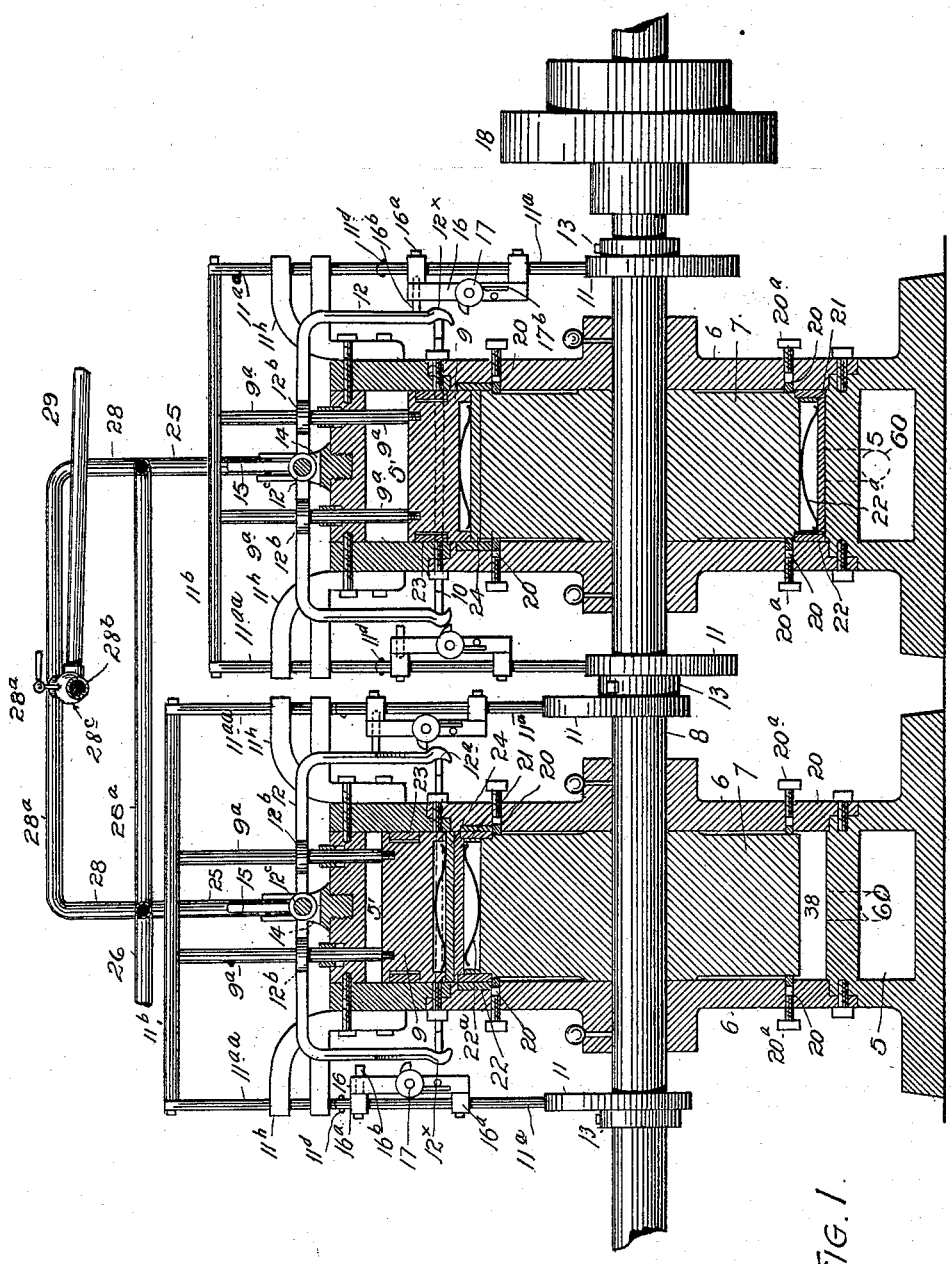

FIG. 1.

Witnesses
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(No Model.) 3 Sheets—Sheet 2.

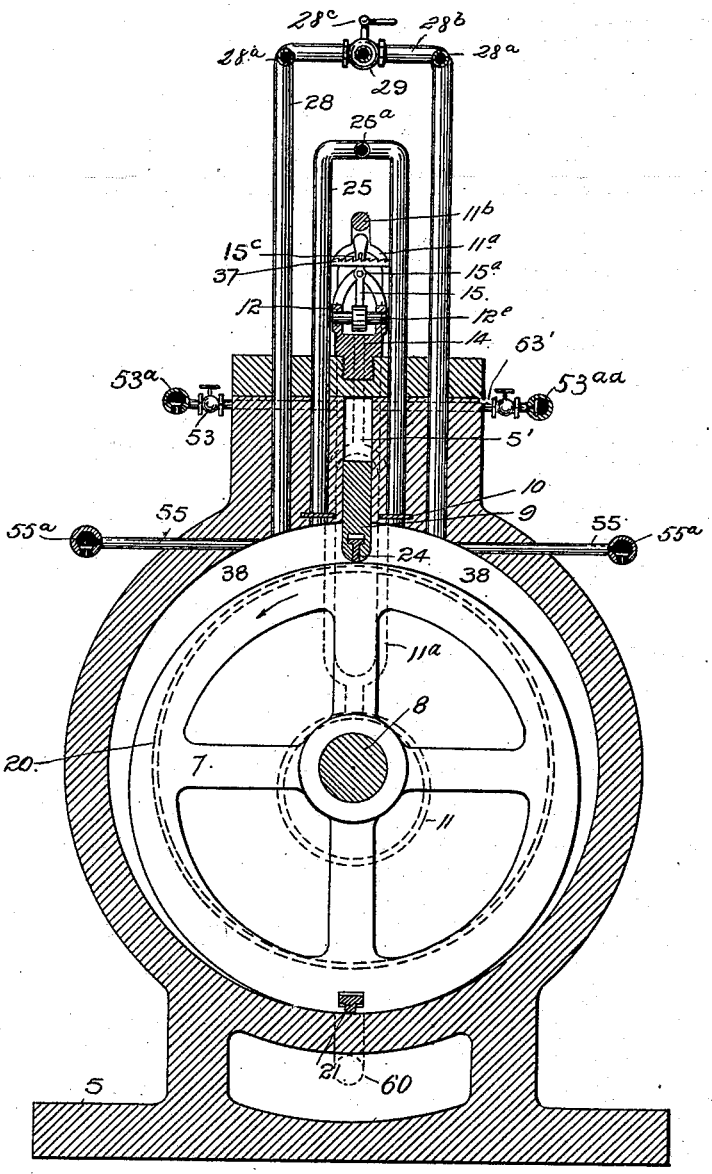

FIG. 2

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No. 647,718. Patented Apr. 17, 1900.

D. M. DEARING.

ROTARY ENGINE.

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(No Model.) 3 Sheets—Sheet 3.

FIG. 7.

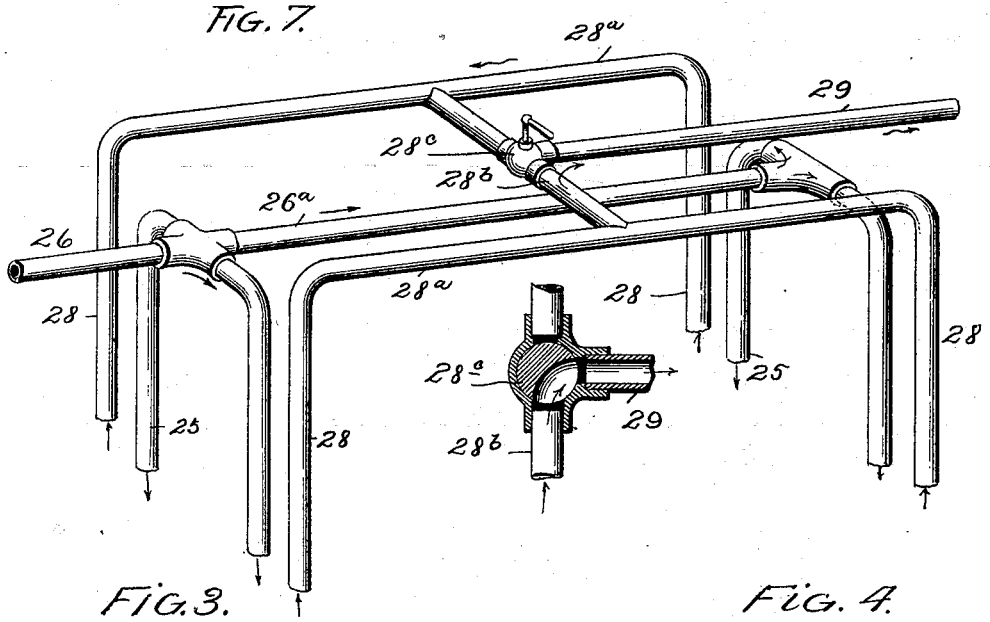


FIG. 3.

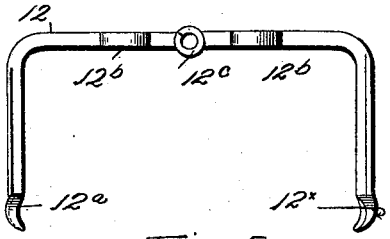


FIG. 4.

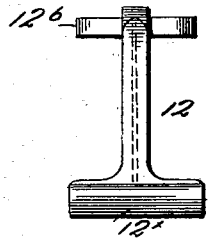


FIG. 10.

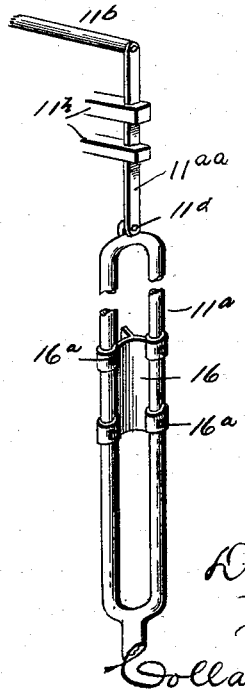


FIG. 5.

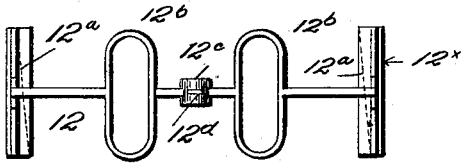


FIG. 6.

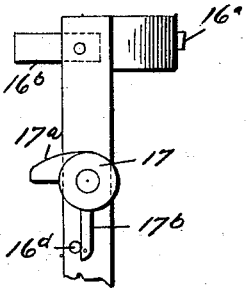


FIG 9

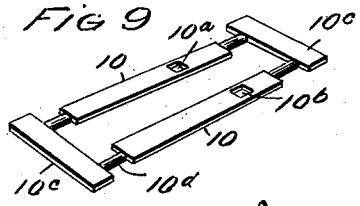
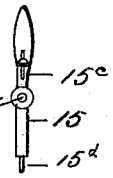


FIG. 8.



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Inventor:
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by
Collamer & Co., Attorneys

UNITED STATES PATENT OFFICE.

DAVID M. DEARING, OF DENVER, COLORADO, ASSIGNOR TO GUILFORD S. WOOD, OF SAME PLACE, AND HENRY P. DEARING, OF SANDSTONE, MICHIGAN.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 647,718, dated April 17, 1900.

Application filed July 11, 1898. Serial No. 685,697. (No model.)

To all whom it may concern:

Be it known that I, DAVID M. DEARING, a citizen of the United States, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Rotary Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to steam-engines, and more especially to that class thereof known as "rotary;" and the object of the same is to produce an improved pneurotary engine of this character, as will appear below.

To this end the invention consists in a rotary engine constructed substantially as hereinafter described with provision for admitting air at a certain point in the stroke to admix with the steam and afterward for cutting off said steam to allow the mixed air and steam to expand; and the invention further consists in the details of mechanism and arrangement of parts by which this idea is carried out, more especially as illustrated in the accompanying drawings, wherein—

Figure 1 is a central vertical longitudinal section of the two connected members constituting this improved pneurotary engine. Fig. 2 is a vertical transverse section through the center of one of the members illustrated in Fig. 1. Fig. 3 is a side elevation, Fig. 4 an end elevation, and Fig. 5 a plan view, of the yoke forming part of the valve-throwing mechanism. Fig. 6 is an enlarged elevation of the support and its dog for moving said yoke. Fig. 7 is a diagram, partly in section, showing one arrangement of the valve for throwing either pair of outlets into connection with the main exhaust and simultaneously closing the other pair of outlets. Fig. 8 is a detail of the hand-lever for setting the yoke above mentioned. Fig. 9 is a perspective view of the cut-off valves for one member and their heads which coöperate with said yoke. Fig. 10 is an enlarged perspective detail of a portion of the eccentric-frame, showing the adjustability of the dog-support thereon.

Referring to the drawings by numerals, 5 designates the bed, by which is supported the (preferably circular) end pieces or heads 6 6, having hubs through which is journaled a main shaft 8. In the present instance I have shown my improved engine in two members arranged within a plurality of such casings end to end, and the main shaft continues through both of them and carries a main driving or balance wheel 18, from which power may be belted or geared to the machinery to be driven. However, it will be understood that a greater number might be mounted on this shaft without departing from the spirit of my invention, but any number more than one might be employed on this shaft, if desired. However, I consider two "members" the best arrangement, and they are duplicates of each other with the exception that the cores hereinafter described are set in the two members at points directly opposite each other. Hence a description of one will suffice for both, except where reference is made to their joint action.

Within the casing and on the shaft 8 is rigidly mounted the core 7, shown in Fig. 2 as truly cylindrical and set eccentric to said shaft so as to leave a steam-space 38, of crescent shape and the full width of the core, and at the point of its greatest radius is inserted packing 21 to coact with the interior face of the rim, and thus form the terminal point of the piston-head. In the heads 6 are set annular packing-rings 20, pressed inward by set-screws 20^a or equivalents, so as to coact with the ends of the core and prevent escape of steam. The extremities of the piston-head may also have packing 22 for a like purpose, and a spring 22^a is here shown throwing each head outward, as is used in some cases. However, these details form no essential part of the present invention.

9 designates the cylinder-head, here shown as mounted in an upright chamber 5′ at the top of the rim. The inner end of the head is preferably provided with packing 24 to coact with the periphery of the core—that is, making complete connection between the cylinder-head and core, while the former travels always close to the latter but never touches it.

Adjacent suitable collars 13 on the shaft

8 are set eccentrics 11, one at each end of the engine, and the working faces of these eccentrics stand absolutely parallel with the periphery or "active face" of the core. Connected with these eccentrics are suitable devices for causing the vertical reciprocation of the cylinder-head in such manner that its packing 24 will always coact with the active face of the core, and I will now describe one form of mechanism by which this is accomplished. Mounted on the bands surrounding these eccentrics is a frame comprising rods 11^a, which are preferably double, as seen in Fig. 10, up to the pivot 11^d, which connects their lower with their upper portions 11^{aa}, and the latter are preferably single rods passing through guides 11^h, rigidly supported from the end plates 6 or from any other suitable source. The upper ends of these single rods are in turn connected by cross-rods 11^b, and from the latter extend rods 9^a, leading downward through suitable packing in the top of the rim-chamber 5′ and connected with the cylinder-head 9, and hence the rotation of shaft 8 and eccentrics 11 results in the reciprocation of the head within its chamber at just such times as shall cause its packing 24 to always coact with the active face of the core. The fact that the eccentrics and their bands (the wearing parts of this engine) are on the exterior of the casings I consider important, as it renders their replacement or adjustment extremely easy, and they can be always watched and lubricated by the engineer without difficulty. However any other suitable mechanism may be used in this connection and for this purpose.

In connection with the devices for causing the vertical reciprocation of the cylinder-head any suitable mechanism may be employed for effecting the horizontal reciprocation of the cut-off valves 10, and I will now proceed to describe one such construction, although it will be understood that any other form of devices may be used for this purpose without departing from the spirit of my invention.

16 in Figs. 6 and 10 is a support adjustably mounted by screws or bolts 16^a on each upright 11^a and having a stop 16^b projecting inward. 17 is a dog pivoted to this support with its nose 17^a projecting inward and its tail 17^b pendent and standing behind a stud 16^d in the support, whereby the nose is rigid on its downward movement but turns pivotally on its upward movement, all for a purpose to appear below.

14 is a bracket supported in the top of the rim-chamber and sustaining a rod 12^e, as in Fig. 2. On this rod is mounted the eye 12^c of a yoke 12, whose horizontal portion has loops 12^b passing around the rods 9^a, as seen, and whose pendent extremities carry cross-arms provided with horizontal cam-shaped inner faces 12^a, standing truly parallel with each other and slightly oblique and with truly transverse horizontal and vertically-rounded outer faces 12^x. In the top of the eye 12^c is a slot 12^d, engaged by the tip 15^d of a hand-lever 15, having its pivotal support at 15^a in the bracket 14, and the upper part or handle proper of this lever carries a dog or catch 15^c of any suitable type adapted to engage a toothed or ratchet plate 37, supported by the bracket. The purpose of these details will be described below, although they form no part of the present invention.

Fig. 9 illustrates the cut-off valve preferably employed in connection with the devices above described and which in the present instance comprises twin parallel plates 10 10, connected, as at 10^d, to heads 10^c, which latter contact with the cam-faces 12^a, above described, while the plates 10 move horizontally and longitudinally through suitable ways in the rim-chamber astride the cylinder-head, as in Fig. 2. At proper points in the plates 10 are cut inlet-ports 10^a and 10^b, each twice the width of the inlet-duct hereinafter described and the outer edge of one port standing in a transverse line with the inner edge of the other.

The numeral 26 designates the fluid-inlet, which branches, as at 25, and leads downward on opposite sides of the cylinder-head 9, the cut-off valve standing across the ducts formed by said branches 25, as seen in Fig. 2. 28 28 are the two outlet-ducts, preferably standing outside the inlets, as also shown in this view, and the two pipes therefrom lead upward and are respectively connected at the sides of the entire machine, as at 28^a, with the corresponding outlets of the other member. (See Fig. 7.) These side connections 28^a are in turn connected by a cross-pipe 28^b, within which is located a valve 28^c, of such shape as to connect either side pipe 28^a with the main exhaust 29 and simultaneously close the other cross-pipe 28^b therefrom, the exhaust thus being always open on one side of the cylinder in each member of this engine.

Coming now more particularly to the present invention, I have shown at 53 53′ in Fig. 2 a pair of air-pipes leading into the chamber 5′, within which the cylinder-head 9 reciprocates, and these air-pipes have check-valves 53^a and 53^{aa} in their bodies, opening, respectively, inward and outward. Hence as the cylinder-head is projected outward the left valve 53^a opens and permits the intake of air to the chamber, so that no vacuum is produced therein, while when the cylinder-head recedes with a tendency to compress the air in the chamber the left valve 53^a closes to prevent the exit of the air through the pipe 53, and the right valve 53^{aa} opens to permit the air behind the head to pass through the air-pipe 53′ to the free air, resulting in the nature of a pumping action and avoiding vacuum and air-cushion. This view also shows

two pipes 55, leading into the steam-space 38 near its top and adjacent the points from which the outlets 28 lead, and these pipes are both provided with check-valves 55^a, which, like the valve 53^a, permit the passage of air inward but prevent its passage outward. The dotted lines 60 at the bottom of this view designate my preferred form of exhaust, which may be used in addition to the two exhausts 28 or not, but which when employed stands always open at a point directly opposite the cylinder-head 9.

The operation of this pneurotary engine is as follows: Assuming that steam is to be admitted to the left of the cylinder-head in Fig. 2 and that the right exhaust 28 in this view is open, and also that the same admission and exhaust take place in the complementary member as in Fig. 1, the piston-head 21 being at the top and the cylinder-head 9 having receded within the chamber 5', the former moves to the left, as indicated by the arrow, for about one-eighth of a revolution, during which time the narrow end of the crescent-shaped space 38 between the active face of the core and the interior face of the cylinder takes in air through the pipe 55 at the left automatically and in order to avoid a vacuum. The eccentrics 11 at the left of Fig. 1 then move their frame downward, and the dogs 17 being properly set the nose 17^a of one of them acts on the outer rounded face $12^\times$ of the yoke 12 and causes its inner cam-face 12^a to engage the head 10^c of the cut-off valve, Fig. 9. The parts being properly timed and set, one of the plates 10 then moves so as to open the left inlet 25, and steam is admitted into the steam-space 38 in Fig. 2. This continues until the core is revolved for about a second one-eighth of a revolution, the pressure of the steam obviously passing out through the pipe 55 and closing the left check-valve 55^a. At this time the eccentrics 11 move their frame so as to bring the opposite dog 17 of Fig. 1 into play, and the cut-off valve is so moved that the plate 10 cuts off the inlet of the steam, and it so remains cut off until the core makes two-eighths of a complete revolution, (one-half revolution in all so far,) when the piston-head will stand at the bottom, as seen in Fig. 2. During all this time the right exhaust 28, which has been in communication with the right side of the space 38, prevents the formation of an air-cushion therein. If my preferred single exhaust 60 is not employed, this member of the engine makes its second half-revolution and carries the mixed and expanded steam and air around to the right side of the cylinder, where it exhausts through the duct 28; but if my single exhaust 60 is employed, as indicated in dotted lines, the mixed and expanded steam and air will pass out at the bottom of the cylinder, as is clear, the right exhaust 28 still serving the purpose of preventing the formation of an air-cushion. However, in either event it will be understood that while the core is making this second half of its revolution and is not taking steam through the inlet 25 precisely the same action as above described is taking place in the other or right-hand member in Fig. 1, and as the two members are fast on the main shaft 8 there is consequently a constant application of power thereto.

If the above details are employed in connection with the main parts of the invention herein, the adjustability of the supports 16 and their dogs is for the purpose of effecting earlier or later cutting on or off of the steam, as will be clear, for the lower each is set the quicker its action. Thus this adjustment produces a longer or shorter use of steam under its full force, of steam under expansion, or both, as may be desired. When two or more engines are used on a single shaft, greater power and perfect balance may thus be assured, and by proper adjustment the combined engine may be caused to work slowly and powerfully or with greater speed and no expansion, as the exigencies of the case may demand.

In order to reverse the direction of rotation, it will obviously be necessary to move the valve 28^c so as to close the outlets that were formerly open, and vice versa, and also to reset the dog-supports 16, so as to produce a movement of each check-valve in such direction as to bring the other port therein across the right-hand inlet 25 at proper times. Opposite action then takes place or, rather, the same action in the opposite direction, and it will be obvious that intake of air will be through the other pipe 55.

I have said that the ports 10^a and 10^b are twice as wide as the inlet-ducts with which they act and that the inner edge of one is in a transverse line with the outer edge of the other. Obviously this arrangement is for the purpose of allowing the cut-off valves as a whole to still do their work even after the engine has been reversed. Supposing live steam to be passing inward through duct 25, which registers with port 10^a, the movement of the plates 10 will be such that the duct will stand over the left half of the port, as seen in Fig. 9, when open, and, the plate moving here to the right, the closed portion of the plate at the left end of the port will stand across the duct when closed. Thus it will be seen that the cut-off valve can move so as to open and close one inlet as necessary while keeping the other inlet always closed, and the various movements and degrees of movement of this plate are obviously controlled by setting the dogs 17 higher or lower on the frames 11^a and by moving the yoke 12 longitudinally on the rod 12^e, so as to bring other portions of its cam-faces 12^a into contact with the heads 10^c of the cut-off plate. This longitudinal movement of the yoke is obviously effected by disengaging the catch 15^c, Fig. 8, from the plate 37 and swinging the lever 15 on its pivot, and hence causing its tip 15^d, which engages the slot 12^d of the eye 12^c, to move the eye and

the yoke along on the rod 12ᵉ, after which it is held in adjusted position by reëngaging the catch 15ᶜ with the plate 37.

From the above description it will be seen that my improved pneurotary engine uses two fluid agents, one of which may be under considerable head, and then the expansive force of the combined agent. In the preferred construction, as described above, one agent, such as air, is admitted into the smallest end of the crescent-shaped space during about one-eighth of a revolution, which, as stated, is useful for preventing a vacuum and causing the core to have a retroactive tendency. Then the second agent, such as steam, is admitted into the larger end of the space just opened, and its admission is continued until the core has made another one-eighth revolution, during which time the space naturally enlarges in size and the two agents admix, and, finally, the second agent is cut off and the combined or mixed agent is permitted to expand as the core makes the third and fourth eighths of its revolution, and the space consequently increases in size. It will be obvious that a first fluid agent other than air might be employed, if desired, and under pressure, if preferred; also that a second fluid agent other than steam might be employed and that it might be admitted with such velocity as to give some initial impact force; also that the precise distances hereinbefore mentioned are not essential, and, finally, that two agents might be used (either under pressure or not) which by their nature would expand when admixed. I therefore desire it to be understood that where I have described the admission of air herein through the pipes 55 and of steam through the pipes 25 other fluid agents might be used without departing from the spirit of my invention. It will further be clear that the forward end of the crescent-shaped steam-space which first takes air is its smallest end, the portion or eighth which next takes steam is somewhat larger, and the consequently-increasing size of this space throughout that portion which follows permits ready expansion of the mixed agents without a too great consumption of either, and hence this engine requires a minimum amount of steam. The preferred construction of parts herein illustrated shows that the front half of the steam-space 38, which serves as a cylinder in this case, has a substantially-flat rear end formed by the cylinder-head 9, whence it tapers forward to practically a vanishing-point at the piston-head 21, and hence the inflowing and expanding agents exert their pressure not only forward around the axis, but radially against the active face of the core and the inner face of the casing. The mechanism herein described for admitting and cutting off the steam, for moving the cut-off valves, for adjusting the range of movement and the time thereof, and for moving the piston-head all form no essential part of this application.

It will be obvious that in this machine I have embodied in one cylinder all the essential features found desirable in existing engines of the type wherein three separate cylinders are employed. The engine begins its stroke as a high-pressure cylinder in point of steam-space, increases in cubic inches of area midway to a cylinder-chamber of intermediate capacity, at which time the low pressure commences and the expansion begins and terminates in a cylinder of increased area, the equivalent of a low-pressure engine. Hence the single machine produces the result of three cylinders in one of the above types.

What is claimed as new is—

1. In a rotary engine, the combination with a substantially-circular casing, a reciprocating cylinder-head at one point therein, a steam-inlet on one side of said head, and an exhaust; of a core rotating within the casing and whose active face coacts with the cylinder-head, a piston-head in the core at its point of greatest radius, an air-pipe entering the casing near the steam-inlet pipe and provided with an outwardly-closing check-valve, and means for admitting and cutting off the flow of steam at predetermined moments, as and for the purpose set forth.

2. In a rotary engine, the combination with a substantially-circular casing, a reciprocating cylinder-head at the top thereof, a branched steam-inlet entering the casing at opposite sides of said head, and an exhaust; of a core rotating within the casing and whose active face coacts with the cylinder-head, a piston-head in the core at its point of greatest radius, air-pipes entering the casing at points near said inlets and having outwardly-closing check-valves in their bodies, a cut-off valve across said inlets and provided with suitable ports, means for setting this valve to close either inlet, and mechanism for simultaneously reciprocating said valve to open and close the other inlet at predetermined moments, as and for the purpose set forth.

3. In a rotary engine, the combination with a substantially-circular casing having an open exhaust at the bottom, a reciprocating cylinder-head at its top, a branched inlet communicating with the interior of the casing at opposite sides of said head, a truly-circular core mounted within the casing eccentrically to the main shaft, and a piston-head terminating at its point of greatest radius; of air-pipes communicating with the steam-space at points adjacent the inlets and having outwardly-closing check-valves in their bodies, and means substantially as described for closing one inlet according to the direction of rotation desired and for opening and closing the other meanwhile at predetermined moments, as and for the purpose set forth.

4. In a rotary engine consisting of a pair of substantially-duplicate members, the combination in each of a circular casing having an upright chamber at its top and a constantly-

open exhaust at its bottom, a reciprocating cylinder-head in said chamber, an eccentric core within the casing, and a piston-head at its point of greatest radius, the cores in the two members being set diametrically opposite and mounted on a common shaft; of an inlet branched to each side of each cylinder-head, cut-off valves across the inlets, means for closing the valves on corresponding sides of the two heads at will, and mechanism substantially as described for opening and closing the other valves so as to drive each core alternately with the other for part of a half-revolution on live steam and for the balance of the half-revolution on the expansion thereof, as and for the purpose set forth.

5. In a rotary engine, the combination with a casing having a radial chamber, a cylinder-head reciprocating in said chamber, a rotary core within the casing having a piston-head, and an inlet and exhaust; of two air-pipes leading from the cylinder-head chamber, and inwardly-closing and outwardly-closing check-valves in said pipes respectively, as and for the purpose set forth.

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

DAVID M. DEARING.

Witnesses:
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M. H. LLOYD.