No. 647,717. Patented Apr. 17, 1900.

D. M. DEARING.

ROTARY ENGINE.

(Application filed Dec. 17, 1897.)

(No Model.) 4 Sheets—Sheet 1.

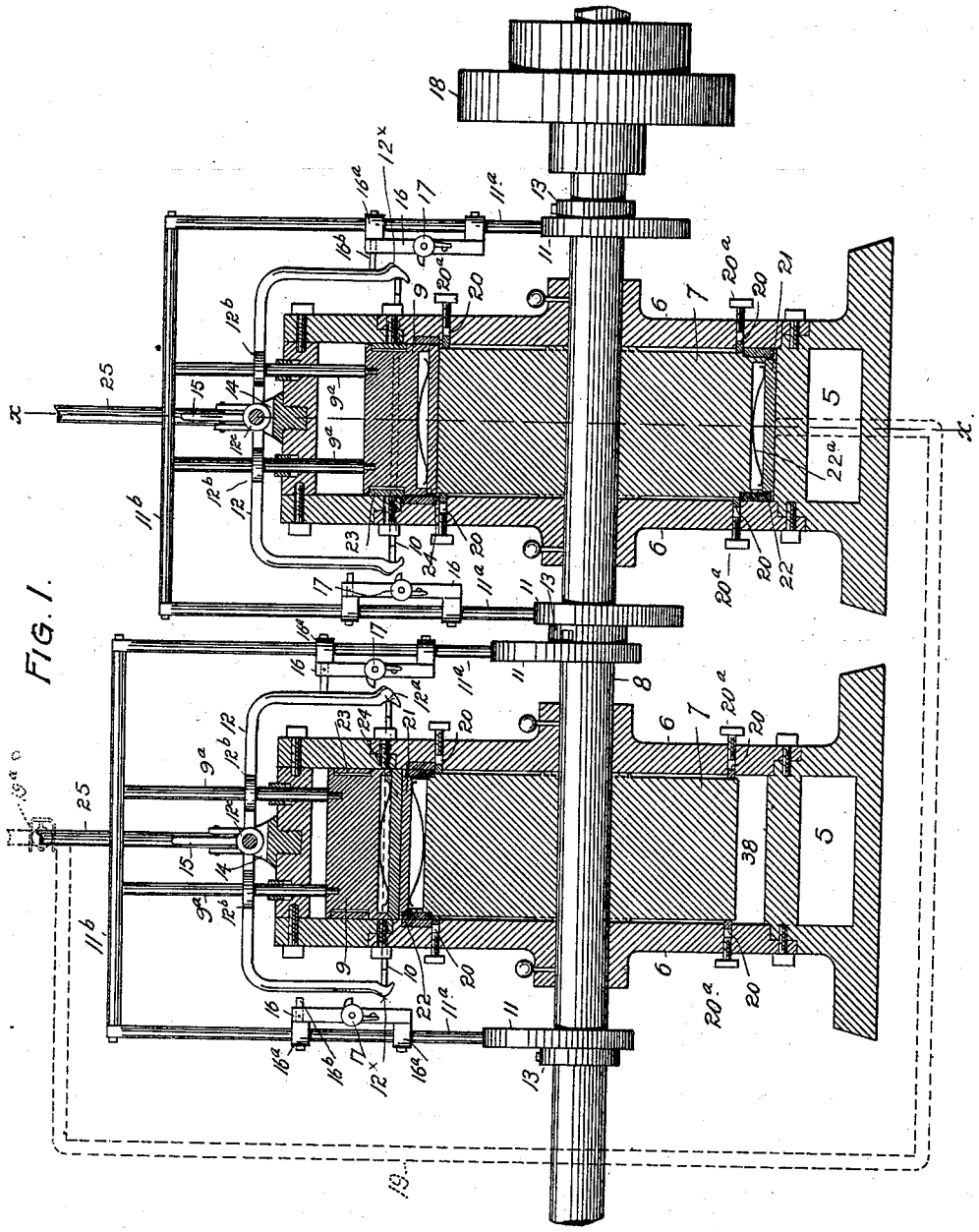

FIG. 1.

Witnesses
John S. Gibbons.

D. M. Dearing
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James A. Killon

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(No Model.) 4 Sheets—Sheet 2.

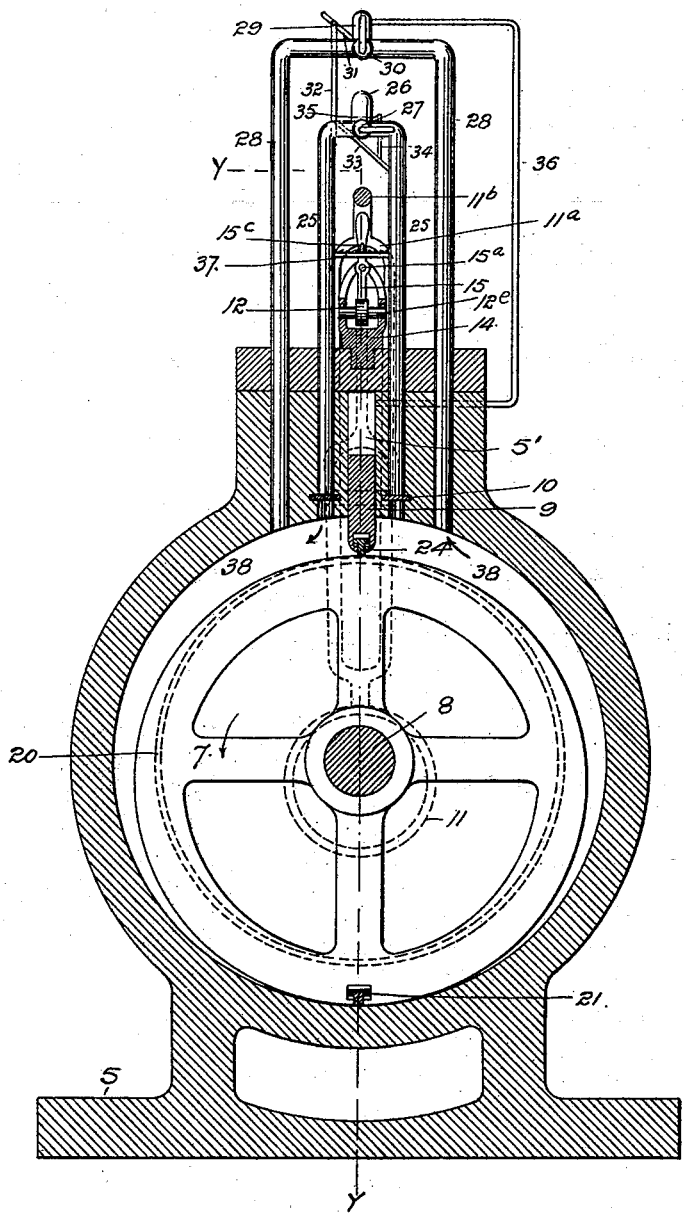

FIG. 2

Witnesses
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(No Model.) 4 Sheets—Sheet 3.

FIG. 4.

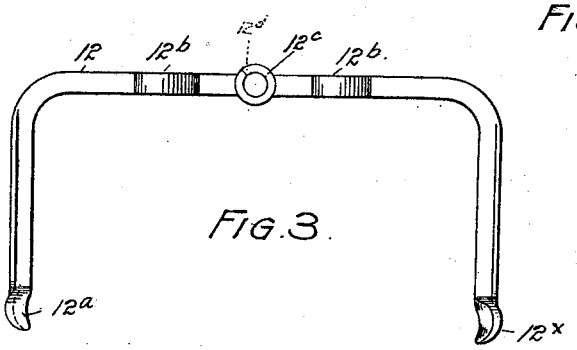
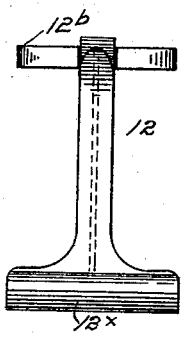


FIG. 3.



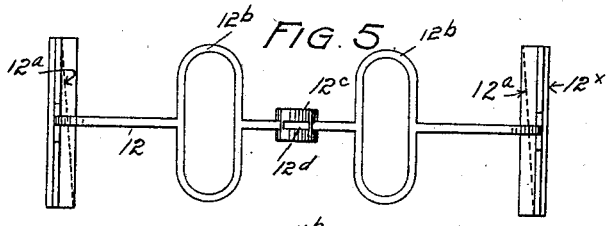


FIG. 5.

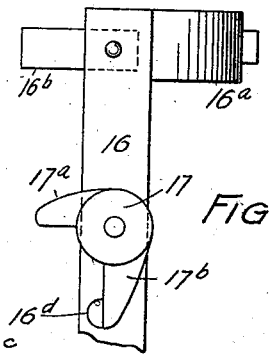


FIG. 6.

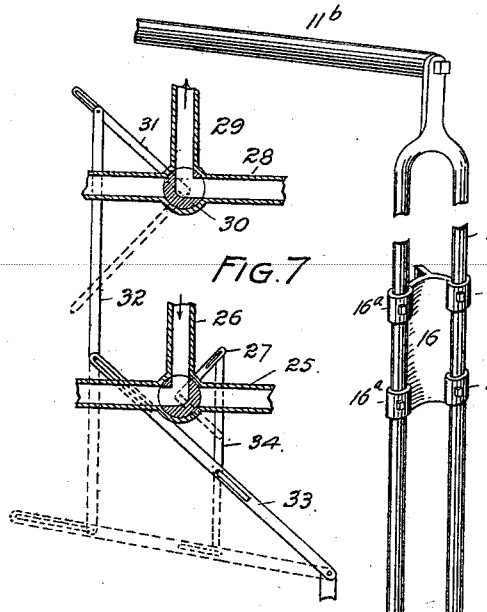


FIG. 7.

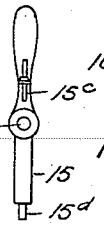


FIG. 8.

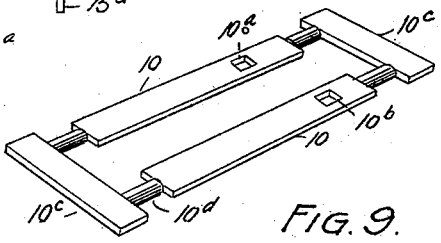


FIG. 9.

FIG. 10.

Witnesses
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ROTARY ENGINE.

(Application filed Dec. 17, 1897.)

(No Model.) 4 Sheets—Sheet 4.

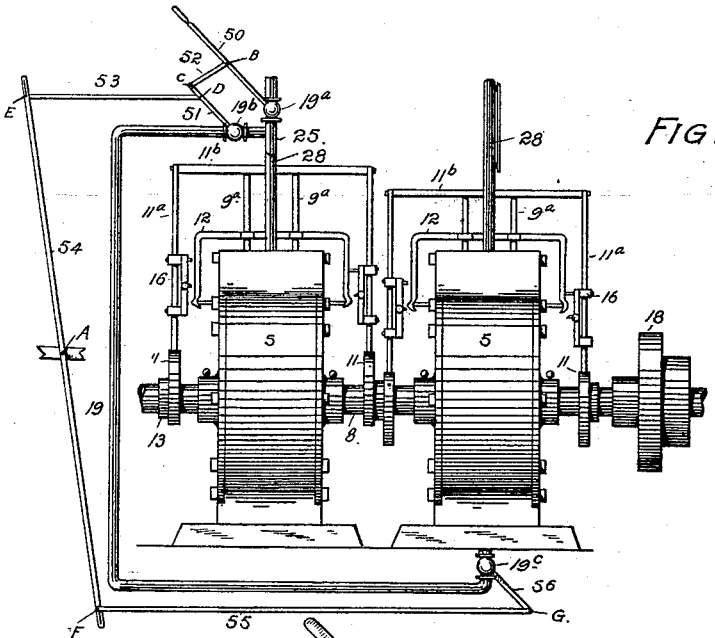


FIG. 11

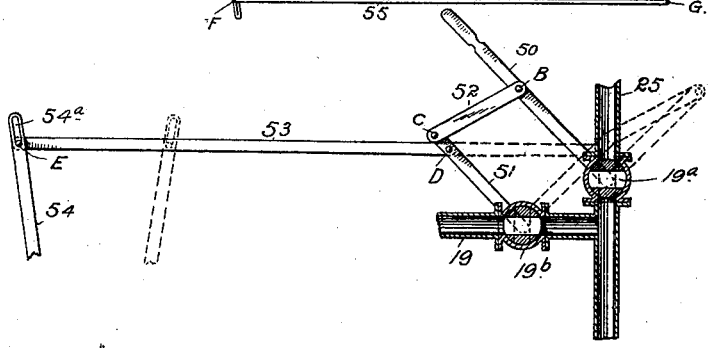
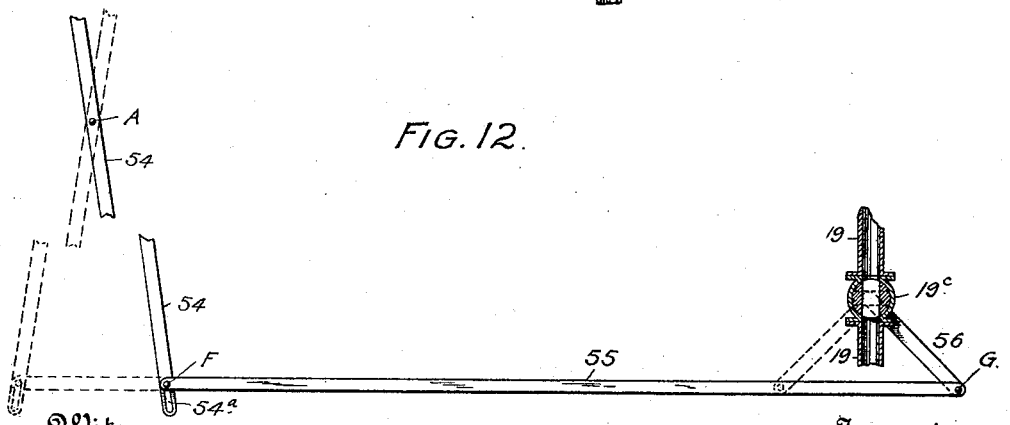


FIG. 12.



Witnesses
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Inventor
David M. Dearing

By his Attorney
James A. Wilson

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. 647,717, dated April 17, 1900.

Application filed December 17, 1897. Serial No. 662,343. (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 engine of this character, as will appear below.

To this end the invention consists in an engine constructed substantially as hereinafter more fully described and claimed and as illustrated in the accompanying drawings, in which—

Figure 1 is a central vertical section on line Y Y of Fig. 2, taken through two engines of the type herein described and showing them in directly-opposite positions. Fig. 2 is a vertical section on line *x x* of Fig. 1 at right angles to the section-line of that view. 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 the connection of the inlet and outlet valve plugs with their operating mechanism. 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 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. Fig. 11 is an elevation of the two engines shown in Fig. 1, to which is added one form of mechanism for causing them to work together by automatically admitting and cutting off the steam at proper points. Fig. 12 is an enlarged detail, partly in section, showing the same mechanism and some of the valves controlled thereby.

Referring to the drawings by reference letters and 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 two of my improved engines arranged within a plurality of such castings 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 or lesser number might be mounted on this shaft without departing from the spirit of my invention; but when a plurality of engines are so used they are set either quartering or otherwise out of parallelism with each other, so as to prevent dead-centers, as usual in compound engines. Hence a description of but one of my engines will suffice herein, 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 circular and set eccentric to said shaft, so as to leave a steam-space 38 of crescent shape and of 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 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, which chamber has a fine outlet-pipe 36 leading to the exhaust, so as to prevent the formation of an air-cushion behind the head. The inner end of the latter is preferably provided with packing 24 to coact with the periphery of the core—that is, making complete connection between cylinder-head and core, while the cylinder-head travels always close to the core, but never touches it.

Adjacent suitable collars 13 on the shaft 8 are set eccentrics 11, one at each end of the

engine, and these eccentrics stand absolutely parallel with the periphery or "active face" of the core. Mounted on the bands surrounding these eccentrics is a frame comprising uprights 11^a, (preferably double, as seen in Fig. 10,) a cross or connecting rod 11^b, and a pair of rods 9^a, leading downward from the latter 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 causes the reciprocation of the head within its chamber at just such times as shall cause its active face to always coact with the periphery of the core. The fact that the eccentrics and their bands (the wearing parts of this engine) are on the exterior of the casing 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.

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 horizontal cams 12^a, whose oblique or cam-shaped inner faces stand truly parallel with each other and slightly oblique to the rod 12^e. 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.

Fig. 9 illustrates the cut-off valve, which comprises twin parallel plates 10 10, connected, as at 10^d, to heads 10^c, which latter contact with the cam-faces 12^a, just above described, while the plates 10 move horizontally 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, 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 unite in a single exhaust 29, being always open on one side of the cylinder-head, except as described below.

In the engine as thus far described the operation is as follows, assuming that the steam is admitted to the left of the cylinder-head shown in Fig. 2. Entering the steam-space 38 between the two heads 9 and 21 the full force of the fluid agent acts against the piston-head 21 to turn the core 7 (in this illustration) to the left. When this head has reached a point one-fourth or one-half a revolution or other desired distance from the cylinder-head, the cut-off of the live steam takes place, and for the balance of the stroke the engine works on the expansion of such steam as remains within the space 38. Meanwhile the exhaust has been through the right-hand duct 28 to prevent cushion behind the head 21 and the eccentrics 11 have been moving their frame to cause the cylinder-head 9 to descend as the shorter radii of the core 7 come under its active face. If two engines of this type are used, as shown in Fig. 1, one performs the above-described actions until its piston-head reaches a point at the bottom (see position illustrated in Fig. 2) when the other commences its stroke, and hence while the first is running on momentum the second is running under power. It will be obvious that a still greater number could be employed on the same shaft and possibly to even better advantage. Said cut-off is effected by the descent of the two supports 16, which are properly set on the frame-bars 11^a. In descending as the eccentrics turn the nose 17^a at one side first engages the rounded back 12^x of the yoke and bears it inward, and then the nose at the other side engages the rounded portion on the opposite side and presses the yoke back to its initial position, and these movements of the yoke are imparted through heads 10^c to the cut-off plates 10, thus throwing the proper port in one of them first across the inlet-duct 25 and then out of alinement therewith. Further rotation of the eccentrics 11 causes the rise of the two supports, when the noses 17^a trip under the rounded backs of cams 12^a and have no effect thereon. Thus the engine continues its rotation, as will be clear.

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. If 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 open the inlet and outlet that were formerly closed, and vice versa. The opposite action then takes place, or rather the same action in the opposite direction. The inlet of steam is then at the right of the cylinder-head in Fig. 2 and the outlet at the left. To accomplish this, it will be seen that it is necessary that the inflowing steam be shifted from one pipe 25 to the other and the exhaust be also switched from one pipe 28 to the other, and unless such changes are made practically simultaneously an explosion may result if the steam-pressure is high. In order, therefore, to make the shifting or switching automatic and positive, the inlet and outlet valves are coupled together in any suitable manner, one of which I have shown herein and will explain in detail.

Fig. 7 shows the inlet 26 branched into two pipes 25, and at their junction is located a valve having here a quarter-way port through its plug and operated by an arm 27, while the outlet 29 and its branches 28 have a similar valve 30 with its arm 31. These arms are connected, respectively, by links 34 and 32 with a lever 33 in such manner that when this lever stands as seen in full lines in this view the inlet leads to one branch 25 and the outlet communicates with the branch 28 on the other side of the cylinder-head. When, however, the lever 33 is moved to the dotted position, the links and arms cause the simultaneous movements of the plugs, so that the inlet is led to its other branch and the outlet is also caused to communicate with its other branch. Hence one movement of the lever 33 causes the simultaneous turning off and on of the live and exhaust steam in proper manner and without requiring attention of the engineer.

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 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 remain set and 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 right half of the port, as seen in Fig. 9, when open, and the plate moving here to the left the closed portion of the plate at the right end of the port will stand across the duct when closed. The latter movement obviously brings the left end of the other port 10^b in register with the other duct 25; but as the latter is closed at its valve 27 no steam will be admitted. It often occurs, as when such an engine is used on a locomotive or in other cases, that the engine is suddenly called on to do very heavy work, as in ascending steep grades, and it is then no longer desirable to have the expansive force of the steam utilized at all, the direct and full force of the steam against the cylinder-head being alone desired. This improved construction permits such shifting, temporarily or permanently, and with the engine working in either direction, and I will explain how.

With the operation above described taking place and the emergency just mentioned present the engineer grasps lever 15, disengages its catch 15^c from plate 37, and swings it on its pivot 15^a. This causes the tip 15^d, which engages slot 12^d in the eye 12^c, to move said eye along the rod 12^c. Such motion is imparted to the yoke 12, and the result is that its cams 12^a, which are oblique, but parallel, are moved along and still in engagement with the heads 10^c of the cut-off. This causes the entire cut-off to be moved within its slide-chamber in one direction or the other, according to the direction in which lever 15 is moved and to a corresponding extent, so that thereafter the cut-on and cut-off effected by the dogs will not be interrupted in any way nor the rotation of the core in either direction desired prevented at all; but yet the ports 10^a and 10^b (or rather whichever one of them is in use) will then in their movements travel through different distances, as will be clear. The result will be that the inlet of the live steam will be from full head to cut-off entire, from full to partial head, or full head at all times, the latter resulting when each port (of double width) simply moves back and forth across its duct, (of single width.)

With a plurality of my improved engines it sometimes becomes desirable to work them together or so that the exhaust-steam from one engine may be piped to another and again used therein, as set forth above. One means for accomplishing this change automatically and positively is shown in dotted lines in Fig. 1 and more fully in Figs. 11 and 12. In these views, 19^a is a valve in one inlet 25, and 19 is a switch-pipe leading into this inlet 25 below such valve from a supplemental exhaust, herein shown at the bottom of the other engine, while the main exhaust 28 (if used) will be closed by a valve. (Not shown.) In this switch-pipe 19 is located a valve. In the illustration two are shown, as at 19^b and 19^c, and their function is to cut off the exhaust from one engine or to permit it to pass on to the next. The main valve 19^a is operated by a lever 50, the valve 19^b by a lever 51 and the valve 19^c by a lever 56. Levers 50 and 51, are connected by a link 52, pivoted to them, as at B and C, whereby these valves are caused to open or close in unison.

54 is a rocking link pivoted centrally at A and having slotted ends 54^a. In one of the latter stands a pin E at the extremity of a link 53, which is pivoted at D to one or the other lever 50 or 51, while in the other slot stands a pin F at the extremity of a link 55, which is pivoted at G to the exhaust-valve lever 56. By this arrangement the manipulation of hand-lever 50 moves all the links

and levers with the following result, although I desire it understood that any other system of moving the valves simultaneously and positively will answer, the one shown being merely for sake of illustration.

When it is desired to work the two engines together, as above mentioned, the main lever 50 is thrown from the dotted position to that in full lines. The result is that valve 19^a cuts off the inlet of live steam to the left engine and the valves 19^b and 19^c simultaneously open into the left inlet 25 the exhaust-steam from the right engine, the one movement of main lever 50 from dotted to full line position operating to change the two engines from two "direct" to one "direct" and one "secondary" engine, the left one using the exhaust-steam from the right.

What is claimed as new is—

1. In a rotary engine, the combination with a casing, a cylinder-head therein, an inlet at one side and an exhaust at the other side of said head, a truly cylindrical core having a smooth exterior face and journaled within the casing off the center of the core, and a piston-head terminating at its point of greatest radius, of a cut-off valve across the inlet, a yoke engaging the extremities of the valve-plate, means for causing the reciprocation of the yoke, and mechanism for adjustably timing said reciprocation, as and for the purpose set forth.

2. In a rotary engine, the combination with a casing, a cylinder-head, a core, a piston-head, a main shaft, and a frame connected with the cylinder-head and reciprocated by said shaft; of inlet and exhaust ducts on opposite sides of the cylinder-head, a cut-off plate sliding across the inlet and having a port, a yoke engaging the extremities of said plate and having rounded portions opposite thereto, and on each bar of the frame an adjustable support carrying a pivoted dog engaging said rounded portion on its movement in one direction and sliding thereover in the other direction, as and for the purpose set forth.

3. In a rotary engine, the combination with a casing, a core therein off center and having a piston-head at its point of greatest radius, a cylinder-head coacting with the active face of the core, and a frame for reciprocating said cylinder-head; of inlet and exhaust ducts at opposite sides of the cylinder-head, a cut-off plate sliding across the inlet and having a port double the width of such duct, connections between the frame and plate for reciprocating the latter, and means for setting the plate with respect to the position its port occupies with reference to the duct, as and for the purpose set forth.

4. In a rotary engine, the combination with a casing, a cylinder-head, a core, a piston-head, and inlet and exhaust ducts; of a cut-off plate sliding across the inlet and having a port, a yoke engaging the plate and having rounded portions, reciprocating supports each having a pivot-pin and stud, and a dog pivoted on each pin with its tail engaging said stud and its nose projecting into position to engage said rounded portion, as and for the purpose set forth.

5. In a rotary engine, the combination with a casing, a cylinder-head, a core, a piston-head, and inlet and exhaust ducts; of a cut-off plate across the inlet-duct and having a port twice the width thereof, a yoke for reciprocating said plate through predetermined distances, cams on the arms of the yoke engaging the extremities of the plate, such cams standing oblique to the length of the plate but parallel with each other, and means for moving the yoke laterally, as and for the purpose set forth.

6. In a rotary engine, the combination with the casing, a cylinder-head, a core, a piston-head, and inlet and exhaust ducts; of a cut-off plate across the inlet-duct and having a port twice the width thereof, a bracket having a rod, a yoke having a slotted eye engaging said rod and provided with arms with cam-shaped inner faces engaging the extremities of the cut-off plate, a lever on the bracket with its tip engaging the slot in the yoke-eye for the purpose set forth, and means for reciprocating the yoke longitudinally of the plate, substantially as described.

7. In a rotary engine, the combination with a casing, a cylinder-head, a core, a piston-head, and inlet and exhaust ducts; of a cut-off plate across the inlet-duct and having a port twice the width thereof, a bracket having a fixed rod at right angles to the length of the plate, a yoke having an eye journaled on said rod and depending arms with parallel oblique inner faces engaging the extremities of the plate and rounded outer faces opposite, reciprocating dogs engaging said rounded portions as set forth, and an adjusting-lever on the bracket for sliding the yoke-eye longitudinally on said rod therein, substantially as described.

8. In a rotary engine, the combination with a casing, a cylinder-head, a core, a piston-head, and inlet and exhaust ducts; of a cut-off plate sliding across the inlet and having a port larger than the size of the duct, a pivoted yoke having parallel oblique inner faces at the ends of its arms engaging the extremities of said plate and rounded portions opposite thereto, means for moving the yoke laterally as set forth, loops in its body, an eccentric connected with the core-shaft, a frame operated thereby and having a double bar and rods extending through the yoke-loops to the cylinder-head, a support adjustably bolted to said double bar, and a pivoted dog carried by the support and engaging the rounded back of the yoke-arm in one direction only, substantially as described.

9. In a rotary engine, the combination with a casing, a cylinder-head therein, a core having a piston-head, connections between the core-shaft and cylinder-head, and an inlet and

an exhaust duct leading into the casing at each side of the cylinder-head; of a pair of cut-off plates sliding across the inlet-ducts and having ports extending from opposite sides of a transverse line across both plates and hence out of alinement with each other so that when one is open the other is closed, a valve for each outlet, and means for reciprocating said plates through predetermined distances at either side of said transverse line, as and for the purpose set forth.

10. In a rotary engine, the combination with a casing, a cylinder-head therein, a core having a piston-head, means for reciprocating the cylinder-head, and a single inlet and single outlet each branched to opposite sides of said cylinder-head; of valves at their branches, a pair of cut-off plates sliding across the inlet branches and having ports out of alinement with each other, a yoke for moving said cut-off a predetermined distance, and connections between the yoke and core-shaft, as and for the purpose set forth.

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

DAVID M. DEARING.

Witnesses:
OSCAR LACHMUND,
G. J. STUNNER.