(No Model.) 4 Sheets—Sheet 1.

J. P. DORAU.

ENGINE.

No. 587,361. Patented Aug. 3, 1897.

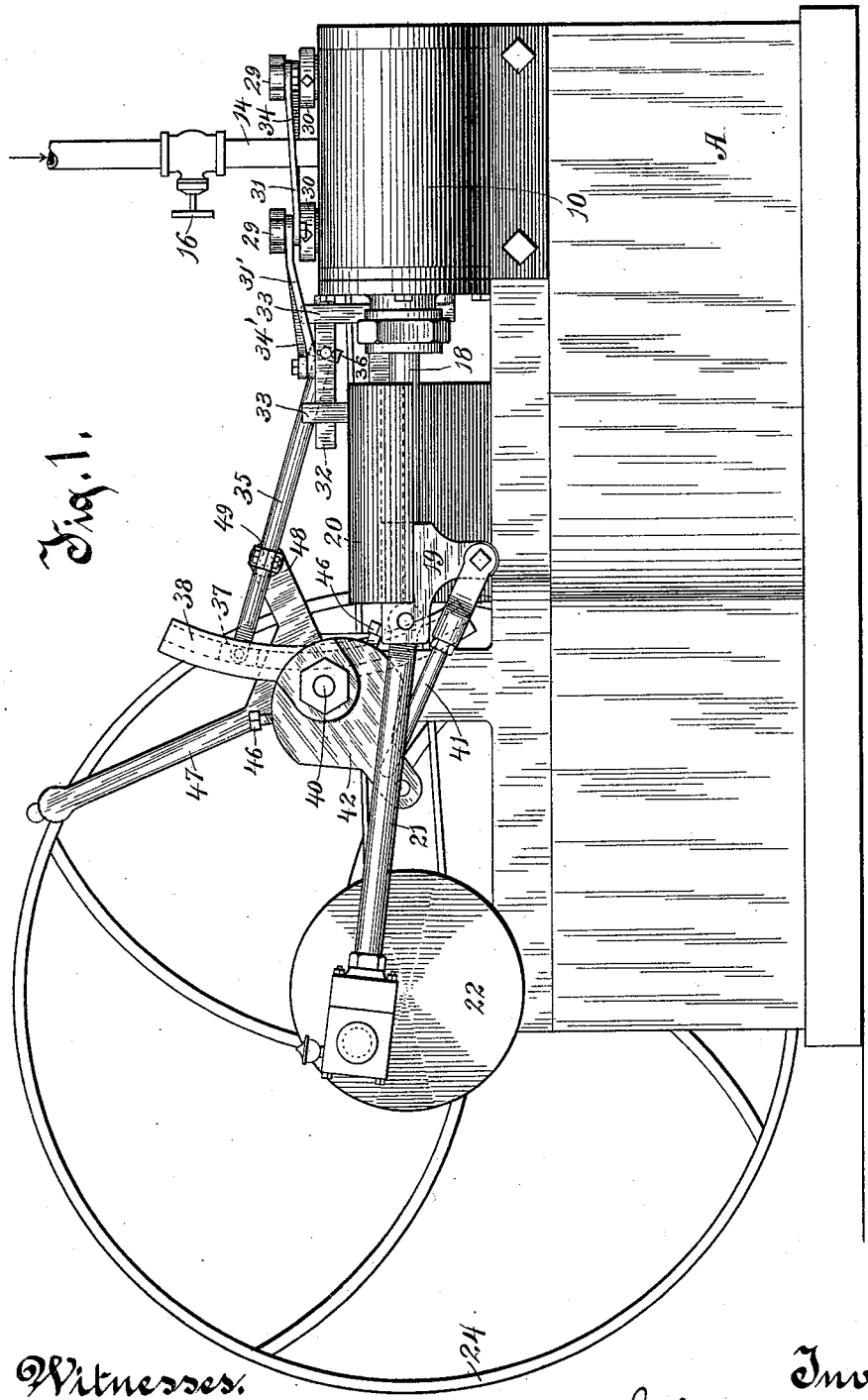

Fig. 1.

Witnesses.
A. H. Keeney.
Anna V. Faust.

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(No Model.)

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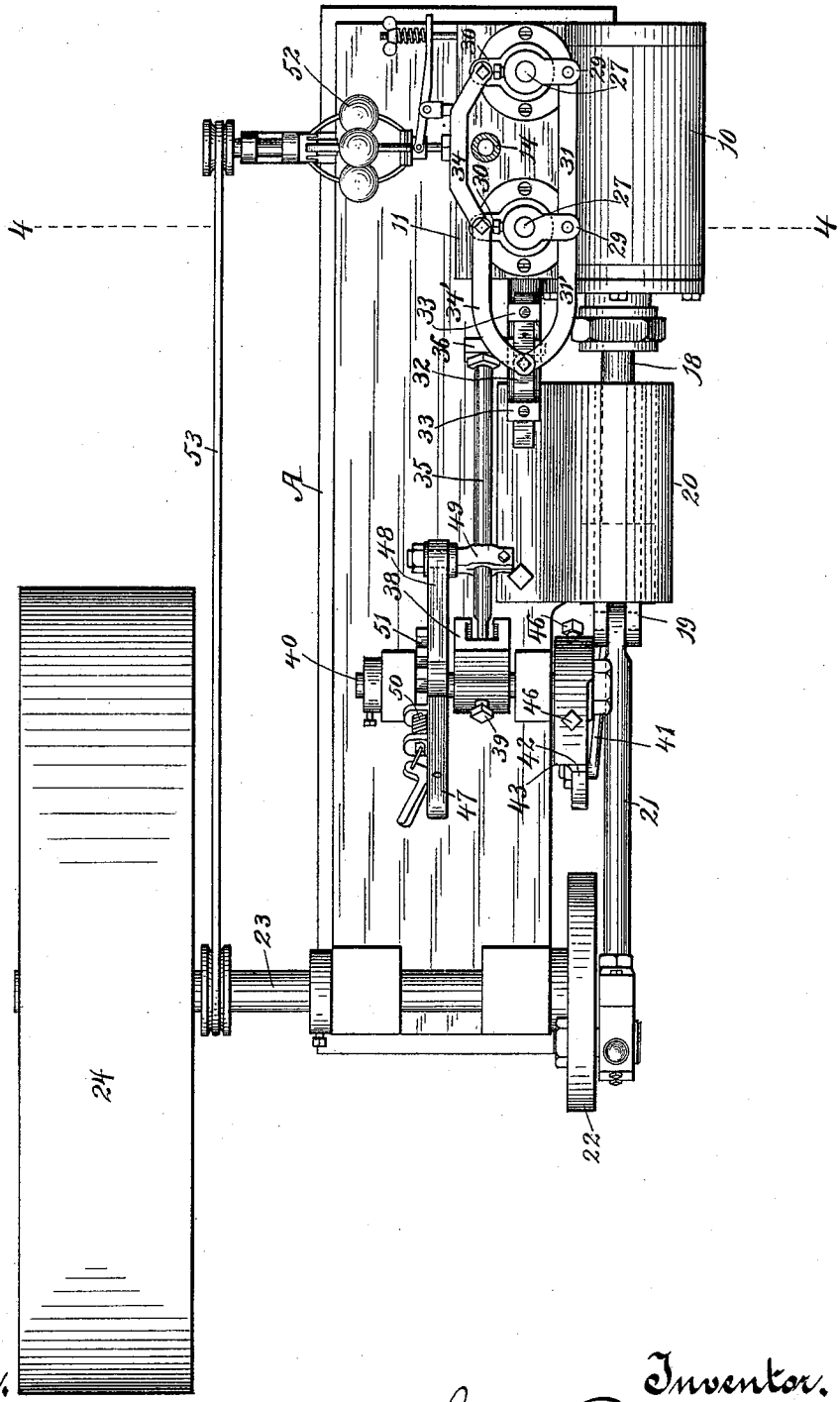

Fig. 2.

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

J. P. DORAU.

ENGINE.

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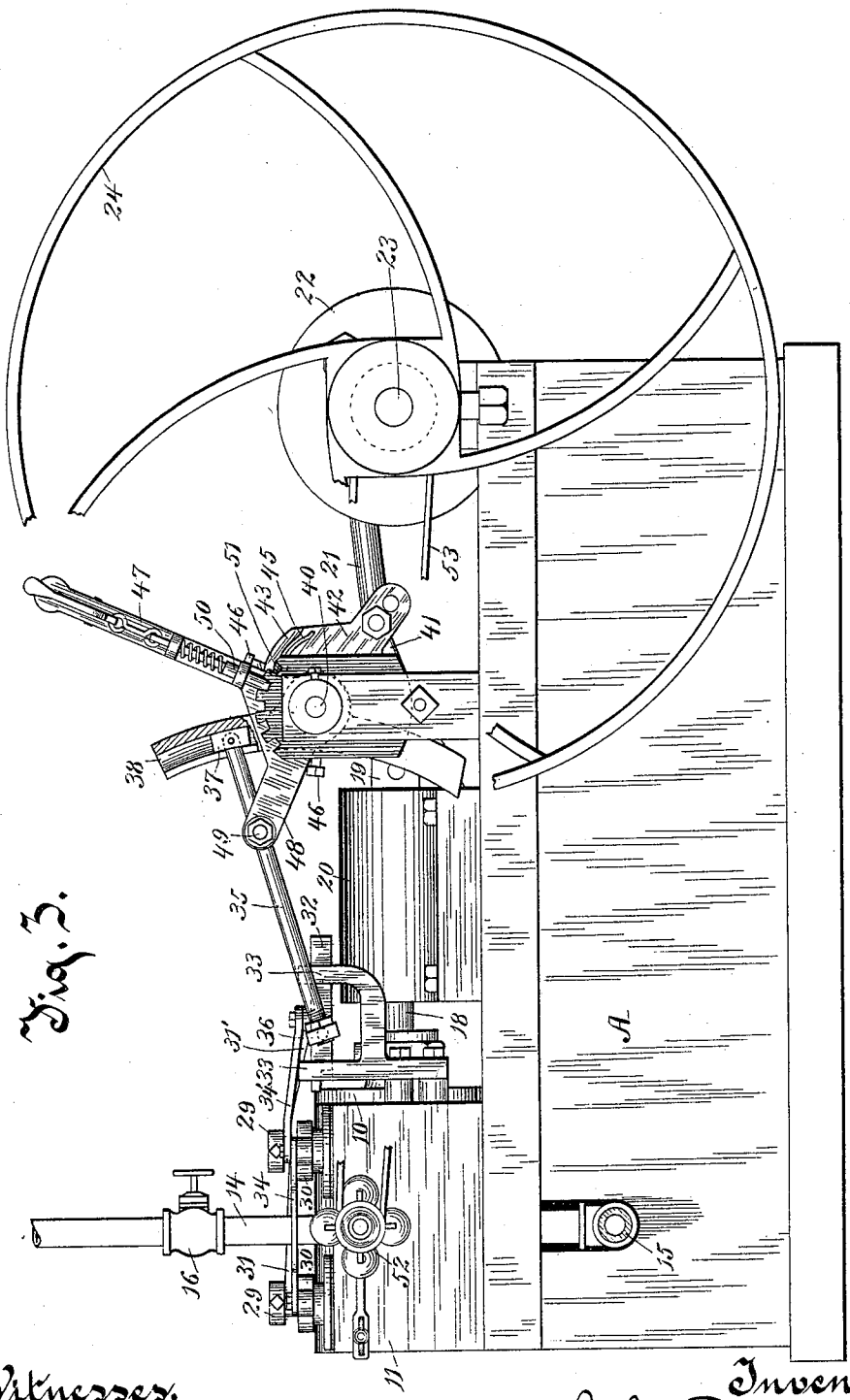

Fig. 3.

Witnesses.
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4 Sheets—Sheet 4.

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ENGINE.

No. 587,361. Patented Aug. 3, 1897.

Fig. 4.

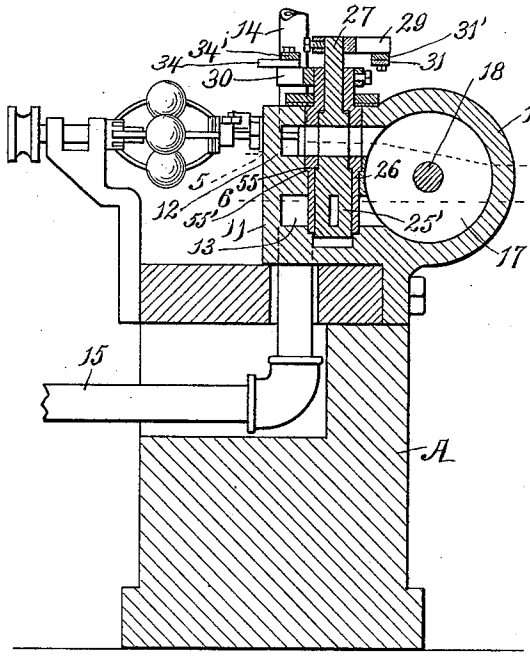


Fig. 7.

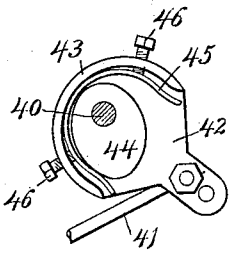


Fig. 5.

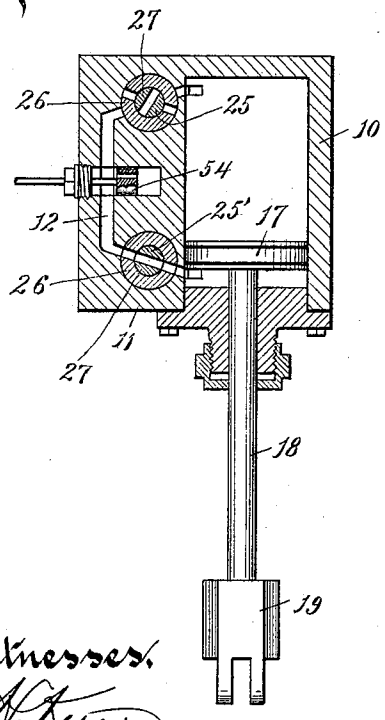
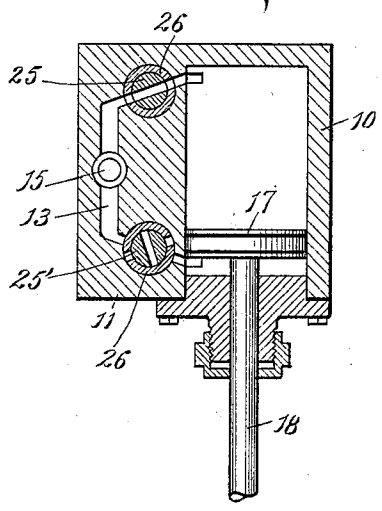


Fig. 6.



Witnesses.

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Anna V. Faust.

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UNITED STATES PATENT OFFICE.

JOHN P. DORAU, OF BONDUEL, WISCONSIN.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 587,361, dated August 3, 1897.

Application filed November 12, 1896. Serial No. 611,801. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. DORAU, of Bonduel, in the county of Shawano and State of Wisconsin, have invented a new and useful Improvement in Engines, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

The object of my invention is to provide a simple and inexpensive engine, strong and enduring in character, compact and reliable in form, and in which unnecessary parts, cross-strain, and resistance are obviated to a great extent, and which is easily and surely operated. The construction includes a cut-off of steam, both supply and exhaust, at two points by two valves, a double closure of the steam-ports, steam-port valves very close to the cylinder, cut-off valves actuated by a movement that opens and closes them quickly at or near the end of the stroke of the piston and directly from the cross-head, means for limiting the admission of the steam-supply, and means by which with one lever the engine is reversed or stopped without reversal of the lever.

The invention consists of the mechanism and its parts and combination of parts, as hereinafter described and claimed, or their equivalents.

In the drawings, Figure 1 is a side elevation of a complete engine embodying my improvements. Fig. 2 is a top plan view of the same engine embodying my improvements. Fig. 3 is an elevation of the same engine, showing the opposite side to that shown in Fig. 1, parts being broken away and other parts being shown in section for convenience of illustration. Fig. 4 is a transverse vertical section on line 4 4 of Fig. 2. Fig. 5 is a substantially horizontal section on line 5 5 of Fig. 4, being a section through the cylinder and through the live-steam or supply ducts and valves. Fig. 6 is a horizontal section on line 6 6 of Fig. 4, being a section through the cylinder and through the eduction or exhaust passages and air-valves. Fig. 7 is a detail of a tappet for operating the cut-off valves.

In the drawings, A is the frame or bed on which the engine is mounted. The steam-cylinder 10 is fixed on the bed A and is preferably so constructed as to provide an integral member 11, in which the live-steam ducts 12 and the exhaust-steam ducts 13 are located, which ducts, respectively, have ports opening into and from the steam-cylinder. The live-steam ducts connect with and open from a supply-pipe 14, and the exhaust-ducts connect with and lead into an exhaust-pipe 15. The supply-pipe is provided with a shut-off cock 16. The live-steam or supply ducts 12 and the exhaust-steam ducts 13 each open by two ports into the cylinder, which ports are respectively located near the ends of the cylinder.

The piston 17, reciprocating in the cylinder 10, is provided with a stem 18, reciprocable endwise through the head of the cylinder in suitable steam-tight packing therefor and is provided with a head 19, fitted to and traveling reciprocably in guides 20 therefor fixed on the bed A. The pitman or connecting rod 21, pivoted to the head 19, is at its other extremity wristed on the disk 22, fixed on the driving-shaft 23. The driving-shaft 23 is mounted on the bed and is provided with a band-wheel 24.

The induction-ducts 12 and the eduction-ducts 13 are substantially alike in form and are located at a little distance apart in parallel planes in the enlarged member or boss 11, preferably integral with the cylinder 10. In and across these ducts two sets of valves 25 25′ are used. Each set of valves consists of an outer or tubular shell 26 and a therein-fitted cylindrical plug 27, and each valve 25 and 25′ is fitted revolubly in a suitable socket therefor across one of the induction and one of the eduction ducts. The shell and the plug of each valve are provided with registering transverse ports opposite the induction-duct and the eduction-duct and are so disposed and operated that the ports through the shell and plug of the valve 25′ will be open for one of the induction-ducts 12, as shown at the bottom in Fig. 5, at a time when the ports in the other valve 25 will be closed to the induction-duct 12, as shown at the top in Fig. 5, when at the same time the exact reverse conditions will be present in the disposition and arrangement of these valves in the eduction-ports, as shown at 25 and 25′ in Fig. 6. The action of each valve is such that the shell rotates or oscillates in one direction while the plug therein oscillates in the other direction, thus putting the ports through the plug and

through the shell out of registration with each other and out of registration with the ducts when shifted in the manner shown at 25 in Fig. 5 and at 25′ in Fig. 6, thus accomplishing a double and absolutely sure closure of the ducts. It will be understood that this simple arrangement of the cut-off valves, by which two valves 25 25′ only are used, is such that when the induction-duct 12 is open to one end of the cylinder, as shown at 25′, Fig. 5, the other valve 25 in Fig. 6, at the other end of the cylinder, is open to the exhaust-duct.

For operating the cut-off valves 25 25′ each cylindrical plug 27 is provided with a crank-arm 29, and each of the tubular shells 26 is provided with a crank-arm 30, and the free extremities of the crank-arms 29 are pivoted to a connecting-rod 31, which in turn is attached by a rod 31′ to a slide 32, reciprocable endwise in fixed guides therefor. The free extremities of the crank-arms 30 are pivoted to a rod 34, which rod is also connected by a rod 34′ to the slide 32. An actuating-rod 35 is pivoted to the slide 32 conveniently by means of a stud-pin 36, pivoted in the slide 32, and to which the rod 35 is attached by screw-thread and lock-nut, so as to be adjustable therein. At its other extremity the rod 35 is provided with a sliding block 37, to which it is pivoted, which block is fitted and adapted to slide in ways therefor in the segmental guide-arms 38, secured medially (and adjustable revolubly by set-screws 39) on the rock-shaft 40. A connecting-rod 41, pivoted at one extremity to the cross-head 19, is pivoted at its other extremity to an oscillating arm 42, which oscillating arm is revolubly loose on the rock-shaft 40. This connecting-rod 41 is preferably made in two sections, joined together by screw-thread, so as to be adjustable lengthwise, and a plurality of apertures in the oscillating arm 42, disposed at unequal distances radially in the arm, are preferably provided for connecting the rod 41 thereto, so that the throw of the oscillating arm can be changed and regulated. The arm 42 is provided with a curved flange 43 on each side of and extending around the rock-shaft 40. A tappet 44, fixed on the rock-shaft 40, is so disposed as to be contacted with alternately by the respective sides of the flange 43 and to be thereby shifted, oscillating the rock-shaft 40. A spring 45 is advisably interposed between the tappet 44 and the flange 43 to serve as a cushion, obviating undue shock that might otherwise occur by the direct contact of the flange 43 with the tappet. The tension and the cushion effects of the spring 45 are adjusted and controlled by set-screws 46.

It will be observed that the flange 43 is intended and adapted to contact near its respective ends with the tappet 44, and thereafter to correspondingly shift the tappet and rock-shaft; but it will be understood that the play between the tappet and the flange provides a sufficient amount of lost motion, so that the throw of the oscillating arm 42 is considerably more than the movement given to the tappet 44, thus providing that the valves 25 25′, which are actuated by the tappet 44, are only moved near the close of each oscillation of the arm 42, thus reversing admission of steam to the cylinder only when the piston 17 is near the end of its movement in the cylinder.

For stopping or reversing the engine a lever-handle 47 is provided, which is pivoted on the rock-shaft 40. A bell-crank arm 48, integral with the lever-handle 47, is provided with a pivoted stud-pin 49, through which the actuating-rod 35 passes and on which the stud-pin slides. The lever-handle is provided with a spring-actuated latch 50, which takes into a fixed segmental rack 51 and locks the lever-handle in position. By means of the lever-handle 47 the engine-driver can shift the sliding block 37 into such position in the segmental guide-arms 38 as desired. To stop the engine, the block 37 is shifted to a point close to the rock-shaft 40 and in a line from it to the connection between the rod 35 and the slide 32, and for starting or reversing the engine the block 37 is shifted on the arms 38 upwardly or downwardly away from the rock-shaft 40, the distance to which the block 37 is shifted from the rock-shaft 40 determining the extent to which the cut-off valves will be opened for the admission of steam to the cylinder.

For automatically reducing the speed of the engine a governor 52 may be provided, connected by a belt 53 to the driving-shaft 23, adapted by its slower or more rapid revolution to open or close the valve 54, which is provided in the member 11 and is adapted to be pulled across or pushed out of the live-air ducts 12 as the governor rotates more rapidly or slowly. This valve 54 is provided with a longitudinal bore or passage to allow steam to pass through it from the duct 12 to its rear, to thus balance the pressure against the opposite end of the valve. The regulating-valve, in connection with my novel induction-ducts, forms a part of my invention; but the form of governor employed I do not claim, as any form of governor in common use may be employed.

To provide closer fittings and thereby more secure steam-tight joints between the cylindrical plugs 27 and the shells 26, the plugs 27 are enlarged in diameter between the ducts 12 and 13, forming at the point of such enlargement annular shoulders 55, which shoulders fit against corresponding shoulders formed in the interiors of the shells 26 by their corresponding enlargement diametrically. This construction is especially desirable as providing a very secure joint to prevent the escape of live steam from the ducts 12 to the exhaust-ducts 13. This enlargement of the lower portion of the cylindrical plugs 27 also adapts the valves for larger ports therethrough reg-

istering with the larger exhaust-ducts 13. Similar shoulders 55′ are arranged on the shells 26 and fit against corresponding shoulders on the part 11.

One important object gained by my improved valves 25 25′ is that as the cylindrical plug rotates in one direction and the shell rotates in the reverse direction they open and close the induction and eduction ports very quickly—in fact, in half the time that a single plug-valve revolving in one direction would close the port.

It will be noted that the means for operating the cut-off valves is devised with reference to maximum economy and desirability, in that the rock-shaft 40 is connected through the crank 42 and rod 41 directly with the cross-head 19, so as to give a direct motion without the intervention of unnecessary mechanism, and also the arrangement is such that the cut-off valves are actuated by the cylinder-piston through the cross-head at the moment when the connection between the pitman 21 and its wrist on the disk 22 are at or near their dead-centers and when the cylinder-piston is not exerting much energy on the driving-shaft, so that the cut-off valves are shifted when power is not operating with much force on the driving-shaft, and thereafter leaving all the power of the piston to be exerted on the driving-shaft at the times when its energy is most required there.

While in the foregoing description I have only referred to steam as the medium of power-supply, it must be understood that this engine is also adapted for the use of gas, compressed air, or other analogous expansive fluid medium for producing power.

What I claim as my invention is—

1. In an engine for use with steam or analogous power medium, the combination with a member having induction and eduction ducts, of valves passing through and controlling one or more of the ducts each of which valves consists of a revoluble tubular shell and a revoluble cylindrical plug having ports registering with each other and with a duct aforesaid, a crank-arm on said tubular shell and on said plug respectively, and means adapted to oscillate the shell and the plug in opposite directions.

2. In an engine, the combination of a piston-containing cylinder, a member adjacent having induction-ducts leading to the cylinder, and a reciprocable plug-valve adapted to be pulled across or pushed out of the duct, and means, as a governor, for automatically actuating the valve.

3. In an engine for using an expansive power medium, the combination with a cylinder, a piston reciprocable therein, a cross-head connected to the piston, permanent ways on which the cross-head is supported and travels, a rock-shaft, an oscillating arm loose on the rock-shaft and connected to the cross-head by a thereto-pivoted connecting-rod, a tappet fixed on the rock-shaft disposed after lost motion to be contracted and actuated by the oscillating arm, and means actuated by the rock-shaft for opening and closing medium-supplying cut-off valves.

4. In an engine for using an expansive power medium, the combination with a cylinder, a piston reciprocable therein, a cross-head connected to the piston, a rock-shaft, an oscillating arm loose on the rock-shaft and connected to the cross-head, a tappet fixed on the rock-shaft disposed after lost motion to be contacted and actuated by the oscillating arm, curved arms fixed medially on the rock-shaft and provided with ways, a block sliding in the ways and connected to medium-supplying cut-off valves, and means for shifting said sliding block in the ways.

5. In an engine for using an expansive power medium, a means for controlling the power-supply, comprising a rock-shaft provided with a tappet, an oscillating arm on the rock-shaft connected to the engine cross-head and adapted to contact with the tappet and oscillating the rock-shaft, segmental arms on the rock-shaft having ways therein, a block sliding in the ways, means connecting the sliding block with cut-off valves and means for shifting the sliding block in the ways.

6. In an engine using a fluid-power medium, the combination with a rock-shaft and means for oscillating it intermittently, of segmental arms secured medially to the rock-shaft and having ways therein, an actuating-rod provided with a block sliding in the ways and pivoted at its other extremity to a reciprocating slide, the slide, ways in which the slide travels, rods connected to the slide and attached to the crank-arms of medium-cut-off valves, and means for shifting at will the actuating-rod in the ways in the segmental arms.

7. In an engine, a reciprocable cross-head, permanent ways on which the cross-head is supported and travels, a rock-shaft, a crank-arm fixed on the rock-shaft and connected with the cross-head, and a tappet on the rock-shaft adapted intermittently to be contacted by the crank-arm and oscillate the shaft.

8. In an engine, a rock-shaft, segmental arms fixed medially on the rock-shaft and provided with ways extending in both directions past the axis of the shaft, a block sliding in the ways, a rod connected to the block and to a valve-shifting rod or rods, a pivoted lever-arm connected medially movably to the block-rod and means for swinging the lever-arm whereby the position of the block in the segmental arms may be shifted at will.

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

JOHN P. DORAU.

Witnesses:
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C. H. KEENEY.