

Nov. 14, 1944.

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2,362,744

VALVE MECHANISM FOR HIGH SPEED STEAM ENGINES

Filed Aug. 22, 1942

4 Sheets-Sheet 1

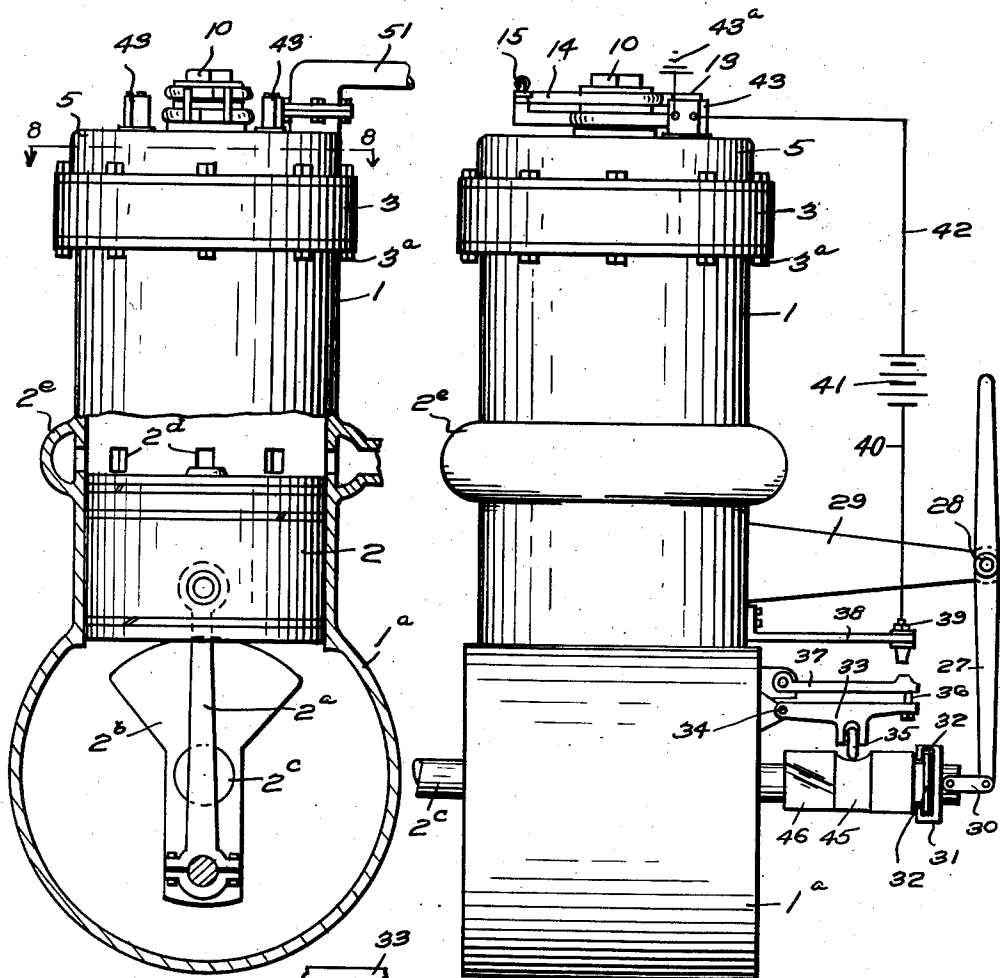


Fig. 1.

Fig. 2.

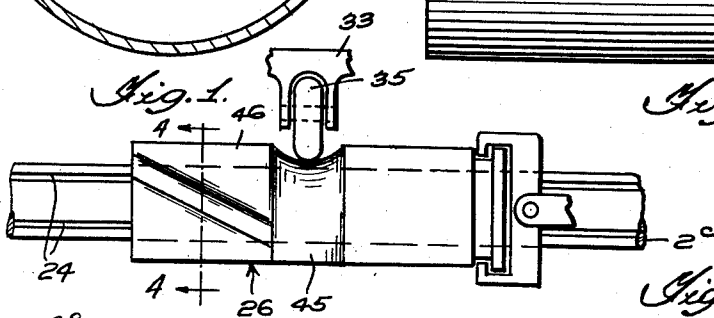


Fig. 3.

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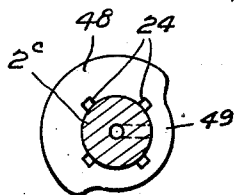


Fig. 4.

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4 Sheets-Sheet 2

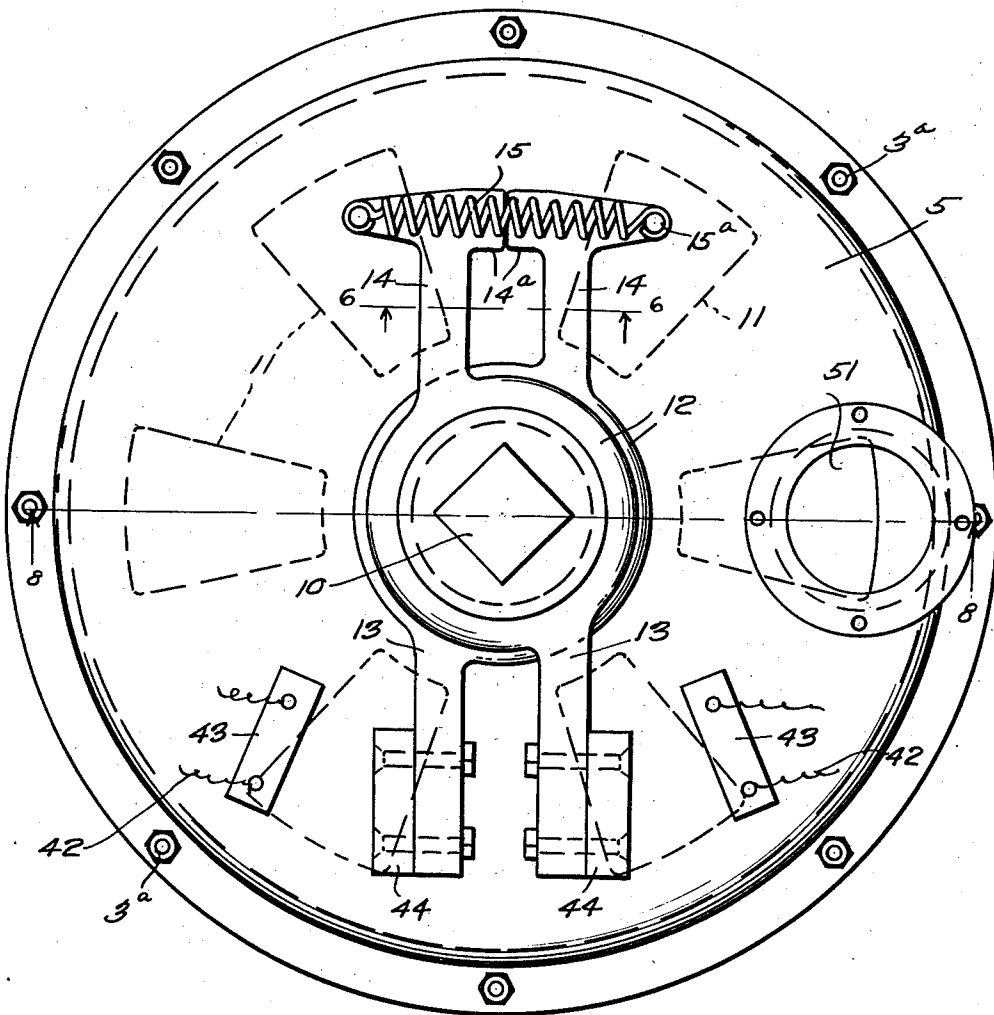


Fig. 5.

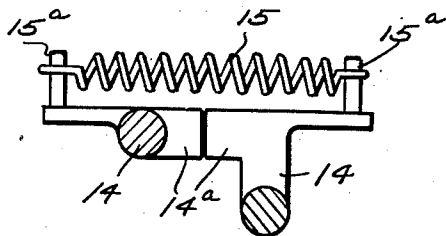


Fig. 6.

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4 Sheets-Sheet 3

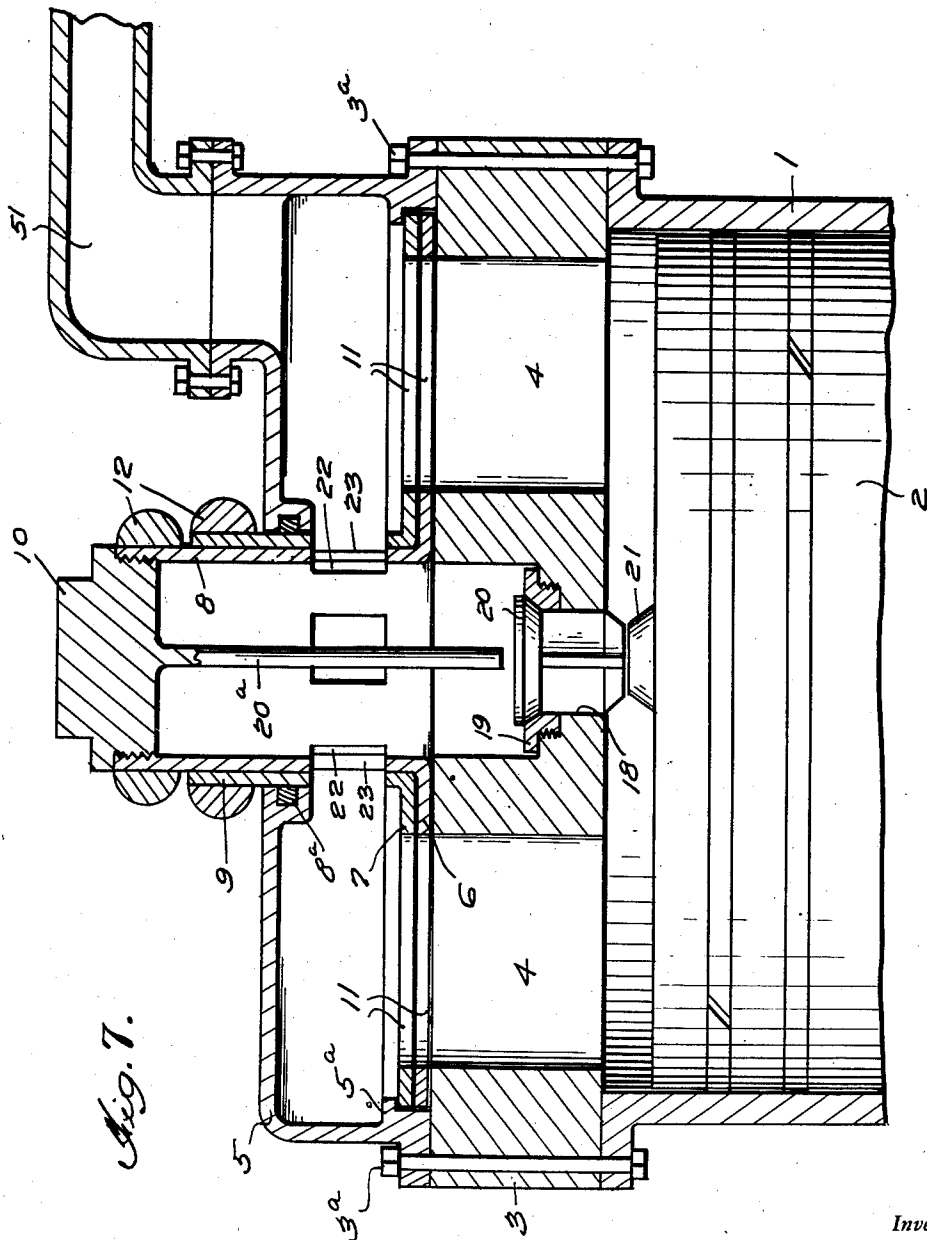


Fig. 7.

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4 Sheets-Sheet 4

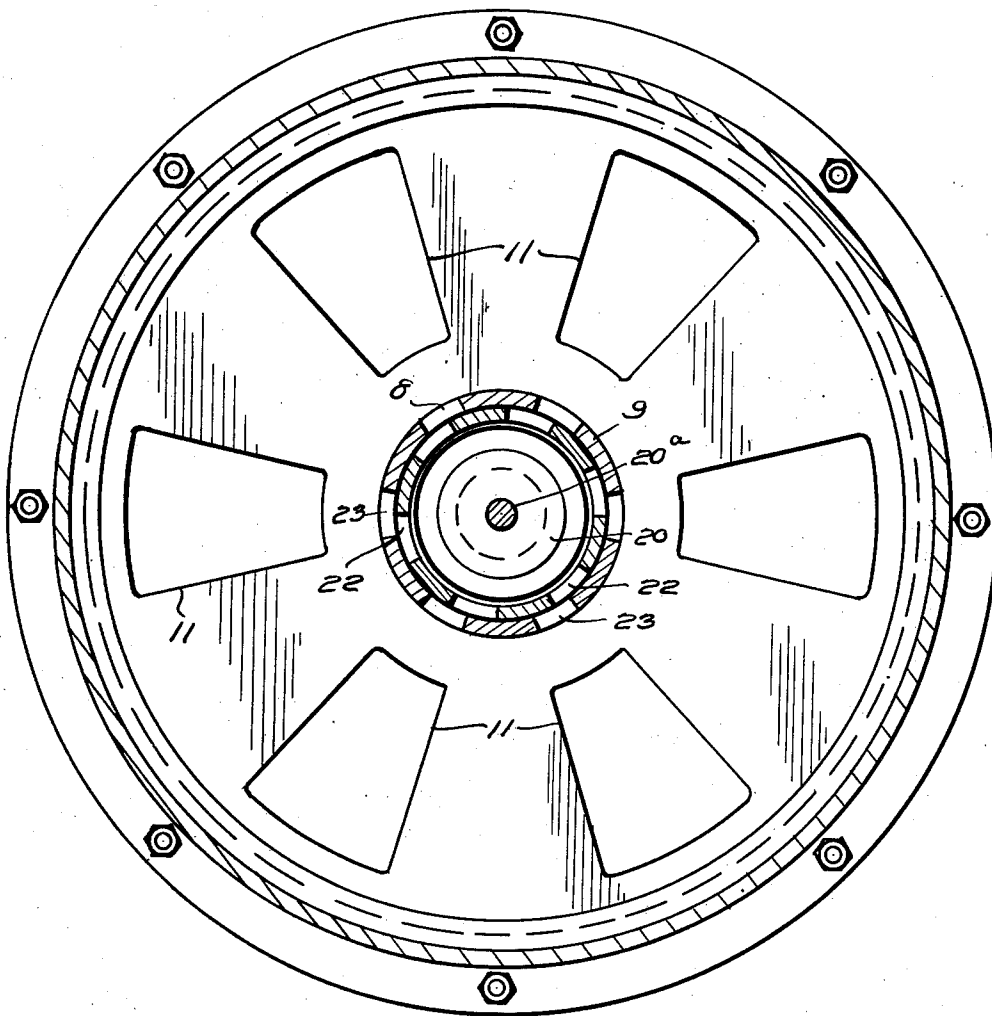


Fig. 8.

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UNITED STATES PATENT OFFICE

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VALVE MECHANISM FOR HIGH-SPEED
STEAM ENGINES

Henry E. Culbertson, McCook, Nebr.

Application August 22, 1942, Serial No. 455,809

4 Claims. (Cl. 121-148)

My invention relates to improvements in valve mechanism for high speed steam engines and of the type forming the subject matter of my co-pending application Serial No. 405,101, filed August 1, 1941, now abandoned and of which the instant application is a continuation in part.

Among the important objects of my invention is to provide in such engines valve gear of simplified construction and few parts which is adapted for quick operation and requires a minimum amount of power to operate.

Another object is to provide for unrestricted steam admission openings into a cylinder with greatly reduced movement of the steam admission valves.

Still another object is to provide for delivery to the cylinders of an absolutely uninterrupted, or unimpeded flow of steam at full boiler pressure from the instant that the power stroke begins, to the instant of cut-off of steam supply to the cylinders, and to effect a quick opening of the admission valves and a quick cut-off.

Still another object is to provide for equalizing and converting into effective piston driving power a vast amount of power now lost in steam engines attempting high speed operations, because of strangulation due to attempting to pass the steam through tortuous poorly constructed admission channels and ports.

Other and subordinate objects are also comprehended by my invention, all of which, together with the precise nature of my improvements will be readily understood when the succeeding description and claims are read with reference to the drawings accompanying and forming part of this specification.

In said drawings—

Figure 1 is a view partly in side elevation and partly in section of a single cylinder steam engine embodying my improvements.

Figure 2 is a view in side elevation taken at a right angle to the showing of Figure 1.

Figure 3 is a fragmentary view in side elevation of the crankshaft, control cam, and parts associated therewith drawn to an enlarged scale.

Figure 4 is a view in transverse section taken on the line 4-4 of Figure 3.

Figure 5 is a view in top plan of the engine drawn to an enlarged scale.

Figure 6 is a detail view in transverse section taken on the line 6-6 of Figure 5.

Figure 7 is a fragmentary view taken on the line 7-7 of Figure 5.

Figure 8 is a view in horizontal section taken

on the line 8-8 of Figure 1 and drawn to an enlarged scale.

Referring now to the drawings by numerals, my improvements have been shown therein, by way of exemplifying a preferred practice of the invention, as embodied in an engine including a single cylinder 1, vertically disposed in this instant, and having therein a suitable reciprocating piston 2, connected by a piston rod 2a to a counterbalanced crank 2b housed in a crank casing 1a and fast on a crank, or power shaft 2c. The cylinder 1 is provided therein, immediately above the level of the top of the piston, in its lowermost limit of movement, with a circumferentially spaced series of exhaust ports 2d communicating with an exhaust manifold 2e surrounding the cylinder 1.

The upper end of the cylinder 1 is capped by a circular plate, or valve seal 3 provided therein with a circumferentially spaced series of radial steam inlet ports 4. A flat, open bottom, steam chest 5 surmounts the plate 3 and together with the same is bolted, as at 3a, to the cylinder 1. A circular grid-type valve 6 is rotatably imposed on the plate 3 in the bottom of the chest 5. A second similar valve 7 is rotatably imposed on the valve 6 in said chest. An internal annular flange 5a, in the steam chest 5, overlies the outer edge of the valve 7 to prevent vertical displacement of said valves. The valve 6 is provided with an axial upstanding, tubular sleeve part 8 which extends through the top of the steam chest 5. A similar, shorter, tubular sleeve part 9 on valve 7 extends through the top of the steam chest 5 and fits around the part 8. A packing ring 8a in the steam chest 5 surrounds the part 9 to prevent leakage around the same. A cap 10 threaded into the upper end of the sleeve part 8 closes the same. The valves 6, 7 are each provided with a series of radial, circumferentially spaced steam inlet ports 11 therein of the same size as the ports 4 and which are normally in registration with the ports 4 and each series with the other. The ports 11 and 4 are of a combined area such as to permit a full head of steam in the steam chest 5 to pass into the cylinder 1.

The valves 6, 7 are rotated in relatively opposite directions to open and close the same and by means of a pair of superposed valve rockers each comprising a hub 12 fast on the sleeve parts 8, or 9, as the case may be, and a pair of arms 13, 14 extending from opposite sides of the hub and staggered relatively circumferentially of said hub, so that the arms 13 are opposed on one side

of the parts 8, 9 for relative separation to close the valves 6, 7 and the arm 14 are opposed on the other side of said parts 8, 9 for movement toward each other to open said valves 6, 7. The arms 14 are formed to provide confronting stops 14a coacting by engagement each with the other to establish the fully opened position of the valves 6, 7. A coil spring 15 suitably connected to the arms 14, as at 15a, tensions said arms against relative separation and hence tensions the valves 6, 7 against closing movement.

An axial port 18 is formed in the plate 3 in which is threaded a valve seat 19 for a steam preadmission valve 20. As shown in Figure 8, the port 18 opens into the sleeve part 8 of the valve 6. The valve 20 is designed to be elevated off the seat 19 into opening position by a frustro-conical, axial, projection 21 on the top of the piston 2 arranged to engage and open said valve slightly in advance of movement of the piston 2 into its upward limit of movement, or, in other words, in its return idle stroke. A stop rod 20a depends from the cap 10 and limits opening movement of the valve 20.

Registering series of circumferentially spaced ports 22, 23 are provided in the parts 8, 9 opening into the steam chest 5, the ports in each series being staggered relative to those in the other series so that they constantly register in all positions of the valves 6, 7 to provide for the constant passage of steam from the steam chest 5 into the port 18.

As will be apparent, by virtue of the described mounting arrangement of the valves 6, 7 and the ports 11 and 4, the valves 6, 7 may be fully closed by a slight rotary movement thereof and a minimum amount of power is required to separate the arms 13 to cause said valves to close. Hence, a low power mechanism may be advantageously utilized to separate said arms 13 and close the valves 6, 7, such as the electro-magnetic means now to be described.

Suitably splined, as at 24, on the crankshaft 2e outside the crank casing 1a is a sleeve type control cam 26 endwise shiftable in opposite directions into and from a neutral position respectively. The hand lever 27 pivoted, as at 28, on a fixed bracket arm 29 is operatively connected to one end of the cam 26 to shift the same and by means of links, as at 30, forming an articulated connection between the lever and a yoke 31 fitting in a groove 32 in said cam.

Above the cam 26 is a vertically movable lever 33 pivoted, as at 34, on the crank case 1a and carrying a roller 35 riding on the cam 26. A set screw 36 in the lever 33 bears upwardly against an upwardly flexible circuit making and breaking arm 37 fixed to and extending horizontally from the crank casing 1a. Above the arm 37 is a contact carrying arm 38, of insulation, extending horizontally from the cylinder 1 and provided with an end contact 39 connected by a lead 40 to one side of a suitable source of electrical energy such as a battery 41. The other side of the battery is connected, as by the common lead 42, to a pair of electro-magnets 43 fixed on top of the steam chest 5 upon opposite sides of the pair of arms 13 in a position such that when energized by an electric current passing there-through, said electro-magnets will attract a pair of armature blocks 44 suitably fixed to the arms 13, respectively, to thereby cause separation of the arms 13 and closing of the valves 6, 7. The electro-magnets 43 are designed to be grounded

to the cylinder 1 through the arm 37 as represented at 45a.

The control cam 26 has formed therein a central circumferential groove 45 in which, in the neutral position of said cam, the roller 35 rides to permit the arm 33 to assume a position permitting the contact arm 37 to flex away from the contact 39 and thereby break the circuit to the electro-magnets 43 permanently, as when the engine is not in use. Further, the control cam 26 comprises a cam section 46, which may be moved under the roller 35 by the previously described shifting of said cam 26 in one direction. The cam section 46 includes a spiral portion 48 arranged so that in one direction of rotation of the crankshaft 2c the arm 33 is maintained elevated to flex the arm 37 against the contact 39 and thereby maintain the electro-magnets 43 energized during the upstroke of the piston 2. Thus, as will be clear, the valves 6, 7 are maintained closed during the upstroke of said piston. During the down stroke of the piston 2, the roller 35 rides on the low portion 49 of said cam section 46 to open the circuit and permit the valves 6, 7 to remain open until the piston 2 passes the exhaust ports 2d.

The steam may be admitted to the steam chest 5 from a high pressure boiler, not shown, under control of a throttle valve, not shown, and by way of a steam inlet conduit 51.

In stopping the engine, the steam may be cut off by closing the throttle valve previously mentioned, after which the cam 26 may be moved to neutral position to permanently break the electric circuit to the electric magnets 43, in the manner already described. The crank 2b is counterbalanced, thereby tending to prevent the piston 2 from stopping below the exhaust ports 2d, but, if such a situation should occur, the piston may be moved to close those ports by means of a suitably provided flywheel on the crank shaft, conventional in such engines, and therefore not illustrated in the drawings. Thus, when the engine is again started, the exhaust ports 2d will be closed.

As will now be clear, when the piston 2 nears the end of its return or upstroke, the pre-admission valve 20 will first be opened so as to permit steam to enter the cylinder 1, and then the valves 6, 7 will be opened by the action of the spring 15 on the arms 14 quickly and fully so that a full head of steam may pass through the ports 11 and 4 to act on said piston.

The foregoing will, it is believed, suffice to impart a clear understanding of my invention without further explanation.

Manifestly, the invention, as described, is susceptible of modification without departing from the inventive concept, and right is herein reserved to such modifications as fall within the scope of the subjoined claims.

Having described the invention, what is claimed as new is:

1. In a steam engine, a cylinder having a head, a piston in the cylinder, a steam chest connected at one end of the cylinder and the cylinder head having ports therein, rotary valves in the chest placed one upon the other and having ports therein for registering with the ports of the head when the valves are in open position, and means for quickly opening the valves when the piston reaches the end of its return stroke to permit a full head of steam to freely pass from the chest into the cylinder, a pre-admission port in the head, a valve controlling the same and a pro-

jection on the piston for opening the last-named valve as the piston nears the end of its return stroke.

2. In a steam engine, a cylinder having a head provided with ports, a piston in the cylinder, a steam chest connected with the head, inner and outer rotary valves having ports therein for registering with the ports of the head, tubular members connected with the central portions of the valves passing through the chest, a pair of arms connected with the outer end of the tubular member respectively, said arms being opposed on one and the same side of said tubular members, and movable toward each other in limited degree to rotate said tubular members and said valves and thereby register said ports in the valves with the ports in said head, and spring means urging said arms toward each other.

3. In a steam engine, a cylinder having a head provided with ports, a piston in the cylinder, a steam chest connected with the head, inner and outer rotary valves having ports therein for registering with the ports of the head, tubular members connected with the central portions of the valves passing through the chest, a pair of arms connected with the outer end of the tubular member respectively, said arms being opposed on one and the same side of said tubular members, and movable toward each other in limited degree

to rotate said tubular members and said valves and thereby register said ports in the valves with the ports in said head, and spring means urging said arms toward each other, and electro-magnetic means for moving said arms in the opposite direction to rotate said tubular members and valves and thereby move the ports in the valves out of registration with the ports in said head.

4. In a steam engine, a cylinder having a head provided with ports, a piston in the cylinder, a steam chest connected with the head, inner and outer rotary valves having ports therein for registering with the ports of the head, tubular members connected with the central portions of the valves passing through the chest, a pair of arms connected with the outer end of the tubular member respectively, said arms being opposed on one and the same side of said tubular members, and movable toward each other in limited degree to rotate said tubular members and said valves and thereby register said ports in the valves with the ports in said head, and spring means urging said arms toward each other, and electro-magnetic means for moving said arms in the opposite direction to rotate said tubular members and valves and thereby move the ports in the valves out of registration with the ports in said head of the engine during the return stroke of the piston.

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