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ENGINE VALVE GEAR.

APPLICATION FILED JULY 16, 1907.

909,665.

Patented Jan. 12, 1909.

3 SHEETS—SHEET 1.

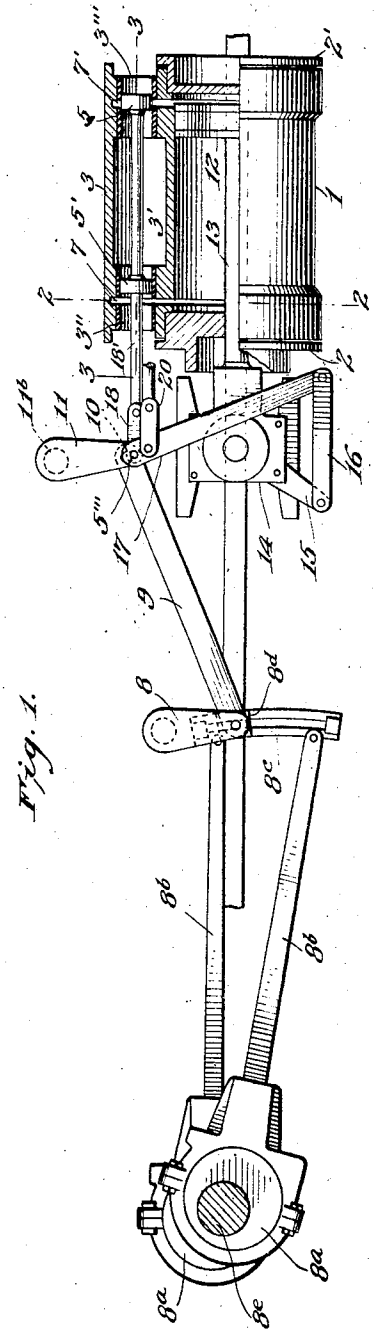


Fig. 1.

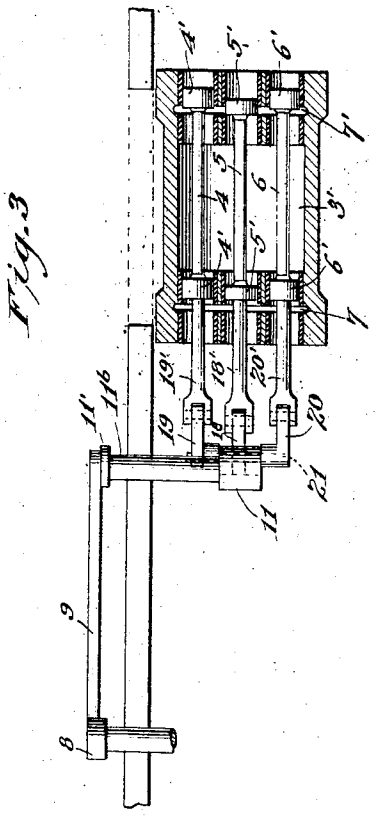


Fig. 3.

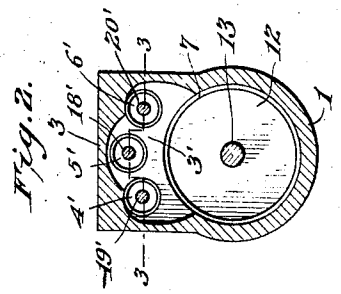


Fig. 2.

Witnesses

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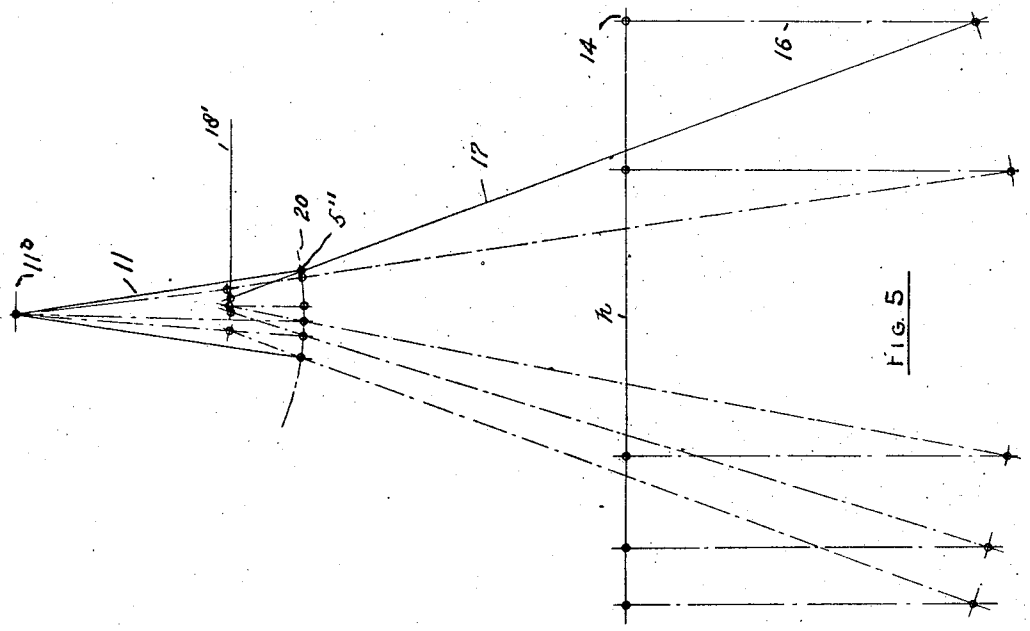


FIG. 5

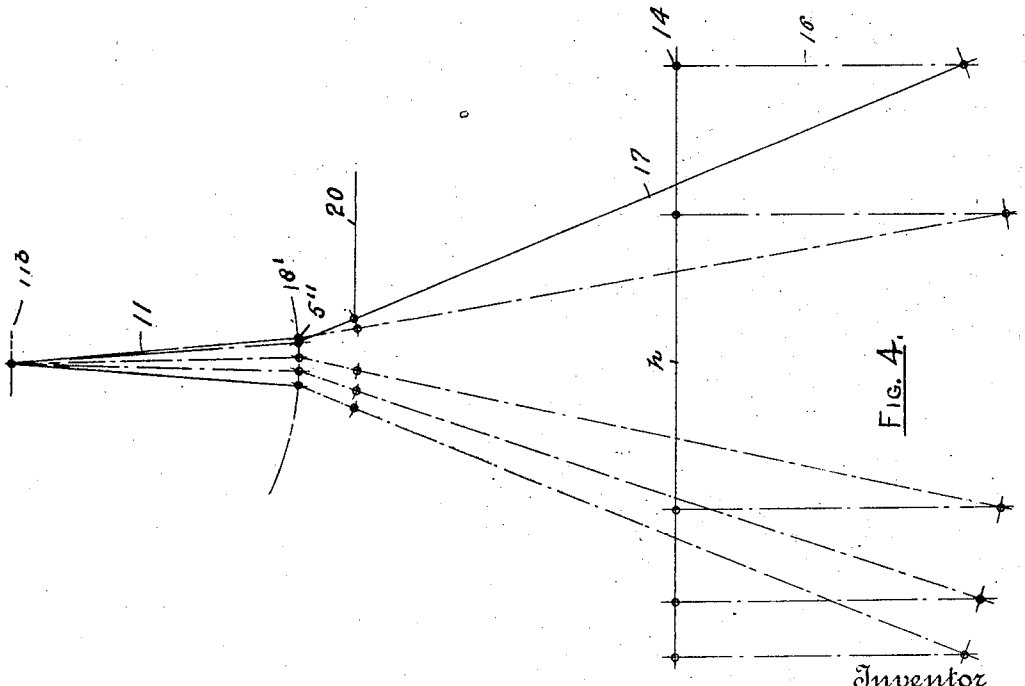


FIG. 4.

Witnesses

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ENGINE VALVE GEAR.

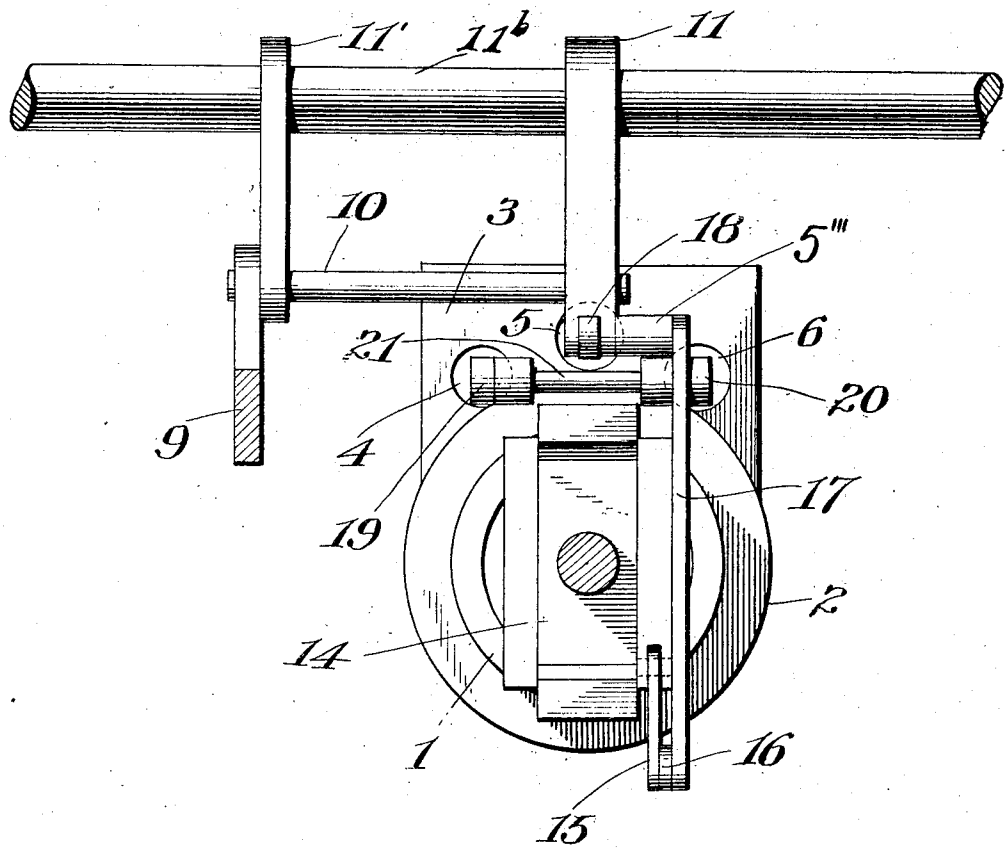
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3 SHEETS—SHEET 3.

Fig. 6.



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ENGINE VALVE-GEAR.

No. 909,665. Specification of Letters Patent. Patented Jan. 12, 1909.

Application filed July 16, 1907. Serial No. 384,054.

To all whom it may concern:

Be it known that I, CHARLES F. PRESCOTT, a citizen of the United States, residing at Philadelphia, in the county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Engine Valve-Gears, of which the following is a specification.

My invention relates to steam engines, and particularly to means for delaying the "events" of opening and closing of the exhaust port.

The object of the invention is to provide a mechanism of simple character which shall act positively to decrease the linear advance of an auxiliary exhaust or compression controlling valve relative to the linear advance of the valve which admits and cuts off the steam, or in other words, to accelerate the linear advance of the valve that cuts off the steam, relative to the linear advance of the exhaust valve, thus so timing the operation of the valves as to delay the points of exhaust opening and exhaust closure. This holds the steam within the cylinder during the greater portion of each stroke, thereby increasing the ratio of expansion, decreasing the terminal pressure and getting more work from a given quantity of steam. By delaying the closing of the exhaust port at all points of cut off, the volume of steam in compression is decreased, and this decreases back pressure. It is therefore to be understood that hereafter in the specification that the phrases "to delay the exhaust closing relative to the main valve" or "to accelerate the main valve relative to the exhaust" are used indiscriminately, and are to be understood as practically synonymous for the results obtained are precisely the same.

Another object of my invention is to provide a compression controlling valve which will open for exhaust simultaneously with or later than the main valve, but so arranged as to close for compression much later than the main valve.

My invention consists broadly in the provision of an auxiliary exhaust or compression controlling valve and positively actuated mechanism for operating it, so arranged and connected to the auxiliary valve and to the steam inlet valve that the auxiliary valve is always moving behind the steam admission and cut off valves, and with a decrease in its linear advance relative thereto. It also consists in a motion for operating these valves compounded of a primary motion derived from a reciprocating rocking arm of an ordinary type, and a secondary motion derived from the cross head of the engine, this secondary motion acting to delay and modify the movement of the valves due to the rocking arm.

In the drawings, Figure 1 is a side view partly broken away of a simple form of engine cylinder and connected mechanism. Fig. 2, is a vertical section thereof on line 1—1 of Fig. 1. Fig. 3, is a plan view thereof in section on lines 3—3 of Figs. 1 and 2. Fig. 4, is a diagram showing the movements of the auxiliary valve and steam valves relative to the movement of the piston at various points of the piston movement with the construction shown in Fig. 1. Fig. 5, is a similar diagram showing the effect of a modified form of valve motion. Fig. 6, is a view in end elevation of Fig. 1.

Throughout the several views like parts are indicated by like reference characters.

In the drawings 1 designates the cylinder of an engine, 2 and 2′ the heads thereof, and 3 a valve chest thereon having a steam space 3′ in the center thereof, and the exhaust spaces 3″, 3‴ at both ends.

4, 5 and 6 designate ordinary piston valves for admitting and cutting off steam and opening the exhaust ports, 4 and 6 being the steam admission and cut off valves, and 5 the auxiliary exhaust valve. This last valve has a shorter lap than the valves 4 and 6, and might indeed be made solid from one end to the other as far as its operation as a compression regulating valve is concerned. It is not shown solid however, and would of course not be solid in practical use. All the valves as I have shown them have the valve heads connected by reduced intermediate portions. While I have shown piston valves for the purpose of illustration and because of their simplicity, it will be understood that I do not wish to confine myself to this form inasmuch as the ordinary slide valves would operate in precisely the same way.

The valve chest is provided with the ports 7, 7′ having passages leading directly into the cylinder at the extremities thereof. These ports are adapted to be covered or uncovered in the usual manner by the heads of the valves as the valves are reciprocated. The valve heads on valves 4 and 6 act to connect the ports alternately with the steam

space and exhaust, but the valve heads of valve 5 only open the ports to the exhaust.

It is necessary in carrying out my invention that the auxiliary exhaust valve 5 shall be delayed in its movement relative to the valves 4 and 6 and hence the need of the differential valve movements now to be described. This valve movement is compounded of a primary movement derived from a rocking shaft in the usual manner and a secondary movement derived from the cross head of the engine.

In detail 8 and 11′ designate two parallel rocking arms actuated by a Stevenson link motion as shown in Fig. 1, and said arms 8 and 11 are connected by a link 9. In line with arm 11′ and laterally disposed with relation thereto is a corresponding rocking arm 11 both of said arms 11 and 11′ being mounted on a rod 11^b forming the axis of the movement of said arms. Rotatably supported or otherwise mounted on the extremities of these arms 11 and 11′ is a transverse shaft or pintle 10.

The Stevenson link motion shown in Fig. 1 comprises the usual eccentrics 8^a turned by the drive shaft of the engine 8^e, operating to reciprocate links 8^b, the latter being connected to the opposite ends of a slotted link 8^c. The block 8^d to which the lower ends of arms 8 and link 9 are connected is mounted in the slot in said link 8^c. By raising and lowering this link 8^c, the engine can be reversed, as is well known in the art.

As shown in Fig. 8 the arm 11 extends somewhat beyond the shaft 10 and at its extremity is pivotally connected by a link 18 with the rod 18′ of the auxiliary valve 5. Pivoted to the extremity of the arm 11 on the axial line 5‴ of the valve connection 18 is a link 17, which extends downward and is in turn pivoted to a link 16 which at its forward end is pivotally attached to a fixed arm 15 projecting from the cross head 14 of the engine. Connected to link 17 below its pivotal connection with the link 18 is the valve rod of the usual steam valve 4. Preferably I use two of these steam inlet and cut off valves 4 and 6, their rods 19′ and 20′ being connected by links 19 and 20 to a pintle or shaft 21 which is mounted on link 17 below the upper pivotal point of the link as shown clearly in Fig. 8.

As shown in Figs. 1 and 3, the valve 5 including its heads is not as long as the valves 4 and 6, and hence when the ports of valves 4 and 6 at the right hand end of the cylinder are open to steam pressure as seen in Fig. 1, the like port of valve 5 is closed, the valve being edge to edge with the port, while at the opposite end of the cylinder at this time when the spent steam is exhausting, the valve 5 does not close the port, but is in line with the valves 4 and 6. It will also be obvious that the compound motion derived from the rocking arm 11 and the cross head 14 will act to accelerate the movement of valves 4 and 6 relative to the valve 5, or in other words act to delay the linear advance of the valve 5 relative to the valves 4 and 6 in every position of the valves, and that this will thus secure a delay in the events of the exhaust opening and closure.

From the position shown in Fig. 1 the action of the valves is as follows: In this position the induction valves 4 and 6 are open to the extent of the steam lead, the exhaust valve 5 however having less length of movement by reason of being pivoted to the axis of the link 17 is not moved past the port 7′ and therefore closes the same. In this position the cross head is about to move toward the crank, and the rocking arms have not yet quite completed their movement toward the cylinder. As a consequence the valves 4 and 6 will open to the full extent, (the valve 5 opening slightly to steam if desired). As the cross head moves forward it swings the link 17 forward also upon its pivotal axis 5″, thus modifying the rearward movement of the rocker arms 11 and 11′, as otherwise communicated to the valves 4 and 6, and tending to carry these valves towards the crank end of the cylinder. Now upon this movement, the valves 4 and 6 act at the proper time to close the port 7′ and cut off the steam to the cylinder. By reason of their relative swiftness and movement due to the point of connection to the link 17, valves 4 and 6 pass the valve 5 and move through the remainder of the stroke in advance of it, and in due course open the exhaust ports behind them. The heads 4′, 6′ then cut off the exhaust ports 7 and if there were no auxiliary valve the steam in the crank end of the cylinder would be under compression for the remainder of the stroke; compression would occur as usual and the terminal pressure be relatively great with a consequent loss of power. As it is the auxiliary compression valve being delayed, the middle exhaust port remains open until nearly the end of the stroke and the valve 5 only closes the auxiliary exhaust port just before the piston reaches the end of the cylinder.

The office of the auxiliary valve is first to delay the final closure of the exhaust port until the piston has completed about 90% of its stroke, thus preventing undue compression, and second to provide additional area of exhaust port opening so as to reduce back pressure.

The final closure of the exhaust port is fixed by the auxiliary compression controlling valve and is delayed until the piston has completed about 90% of its stroke, thereby decreasing the volume of steam in compression.

The relative motion of the several valves,

connected as shown in Figs. 1 and 3 and before described, is shown in the diagram Fig. 4. There 11^b designates the axis of the rocking arm 11, 18′ the point of connection of the valve rod 18′, 20′ the point of connection of the valve rods 19′, 20′, and h the line of movement of the cross head.

At the time of admitting steam, the valves 4 and 6 are behind the valve 5; at the point of cut off the valves 4 and 6 have moved more nearly in the line with the valve 5; at the middle position the valves are practically in line; at the point of release the valves 4 and 6 are in advance of the valve 5, and this advance is maintained from the point of release to the closing of the exhaust and the admission of steam.

While I have described one method of securing the result which I desire, it will be seen from Fig. 5 that the same result will be attained if the link 17 is carried upward beyond its pivotal point 5″ and the valve 5 be connected to the extended upper end of the link 17. Such a combination of parts is shown in the diagram Fig. 5, wherein the letters are the same as in the diagram Fig. 4. Thus from the motion of the rocker 11 towards the cylinder and the crankward movement of the cross head, the valve 5 will be moved towards the right the steam valves will be moved towards the crank end of the cylinder and will pass the auxiliary valve, continuously traveling in advance of said valves and that thus the same effects will be attained as with the arrangement shown in Fig. 6.

As before stated in the beginning of the specification, my sole object is to provide a positive means for operating an auxiliary exhaust or compression controlling valve. I am aware that auxiliary compression controlling valves have heretofore been devised, but such valves have heretofore not had positive operation and act therefore differently at different speeds of the engine. Such valves also have been incapable of regulation to suit changes in the speed.

My invention provides a very simple and effective construction composed of elements which are well known in engine designing, and with which locomotive engineers are fully acquainted. It can be regulated to suit the exigencies of any particular case, and it is entirely positive in its action.

In addition it may be pointed out that my valve gear avoids the use of a multiplicity of parts or the use of springs, counterweights, toothed gears, dash-pots or other devices of like character which have been employed in the attempt to obtain like results.

While I have shown piston valves, I do not wish to be limited to this form, nor do I wish to be limited to the use of three valves, as the principle of my invention can be applied to any number.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. In valve gears for steam engines, a cylinder, a steam chest, admission and exhaust ports connecting the steam chest with the cylinder, auxiliary exhaust ports, a main valve controlling the admission and exhaust through said steam ports, a compression regulating valve controlling the auxiliary exhaust ports, and mechanism operated by the engine for moving the main valve at an accelerated speed and linear advance relative to the speed and linear advance of the auxiliary valve.

2. In valve gears for steam engines, a cylinder, a steam chest, admission and exhaust ports connecting the steam chest with the cylinder, auxiliary exhaust ports, a main valve controlling the admission and exhaust through the said steam ports, a compression regulating valve controlling the auxiliary ports, a primary valve motion, a secondary valve motion having a lead over said primary valve motion, a link connecting said primary with said secondary motion, and means for connecting said auxiliary valve and said main valve to said link in such manner that the linear advance of said main valve shall be accelerated relative to the linear advance of said auxiliary valve at all points of cut off.

3. In valve gears for steam engines, a cylinder, a steam chest, admission and exhaust ports connecting the steam chest with the cylinder, auxiliary exhaust ports, a main valve controlling the admission and exhaust through the steam ports, a compression regulating valve controlling the auxiliary exhaust ports, a primary rocker arm, means for operating the arm from a moving part of the engine, a secondary reciprocating element, a link connecting the two and modified in its movement by the relative motions of said primary and secondary motions, and auxiliary valves connected at such points on said rocker arm that the linear advance of the main valve shall be accelerated relative to the linear advance of said auxiliary valve.

4. In valve gears for steam engines, a cylinder, a cross head connected to the piston, a steam chest, admission and exhaust ports connecting the steam chest to the cylinder, auxiliary exhaust ports, a main valve controlling the admission and exhaust through the steam ports, an auxiliary compression regulating valve controlling the auxiliary exhaust ports, a rocker arm, means for operating the arm from a moving part of the engine, a link pivoted to the extremity of said rocker arm at one end and connected with said cross head at the other end, and a valve rod connecting said auxiliary valve to said link at its point of connection with the rocker arm.

5. In an engine valve gear, the combination with a cylinder, a steam chest, admission and exhaust ports connecting the steam chest with the cylinder, auxiliary exhaust ports and main valves controlling the admission and exhaust through the steam ports, a compression regulating valve controlling the auxiliary exhaust ports, a piston in said cylinder, a cross-head connected to said piston, a rocking arm, means for operating said arm from a movable part of the engine, a rocking arm parallel to said first named arm, a rod connecting said link arms, an oscillating auxiliary link pivoted to the extremity of said last named rocking arm and pivotally connected to the cross-head of the engine, a rod connected to the auxiliary valve and to the said rocker arm, and a valve rod pivoted to said link below its pivotal connection with said rocker arm and below the pivotal connection of the auxiliary valve rod.

6. In valve gears for engines, a cylinder, a steam chest, a plurality of valve chambers communicating with the steam chest, admission and exhaust ports connecting each valve chamber with the cylinder, an auxiliary valve chamber having exhaust ports leading from the cylinder, main valves controlling the admission and exhaust of steam located in the said valve chambers, a compression regulating valve controlling the auxiliary exhaust ports therein, a piston in said cylinder, a rocking arm means for operating the arm from a movable part of the engine, a cross-head attached to said piston, means for operating said cross-head in lead of said rocking arm, a rocking arm parallel to said first named rocking arm but longer than the same, a link connecting said rocking arms the distance between the pivotal point of said link and the axis of said rocking arm being the same at both arms, an oscillating auxiliary link pivoted to the extremity of said longer rocking arm, an arm projecting rearward from the cross-head of the engine to which the auxiliary link is pivoted, and a valve rod connected to the extremity of said rocking arm at the same pivotal point as said auxiliary link and attached at its other end to the auxiliary valve, the valve rods of the main valves being pivoted to said auxiliary link at a point below its pivotal connection with said rocking arm.

7. In valve gears for engines, a cylinder, a steam chest, admission and exhaust ports connecting the steam chest with the cylinder, auxiliary exhaust ports, a main valve controlling the admission and exhaust through the steam ports, a compression regulating valve controlling the auxiliary exhaust ports and mechanism for moving the main valve at an accelerated speed and linear advance relative to the speed and linear advance of the auxiliary valve, said auxiliary valve having a valve face shorter than the valve face of said main valve.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

CHAS. F. PRESCOTT.

Witnesses:
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