C. J. PILLIOD & A. D. BAKER.

VALVE GEAR.

APPLICATION FILED NOV. 20, 1907.

902,603.

Patented Nov. 3, 1908.

2 SHEETS—SHEET 1.

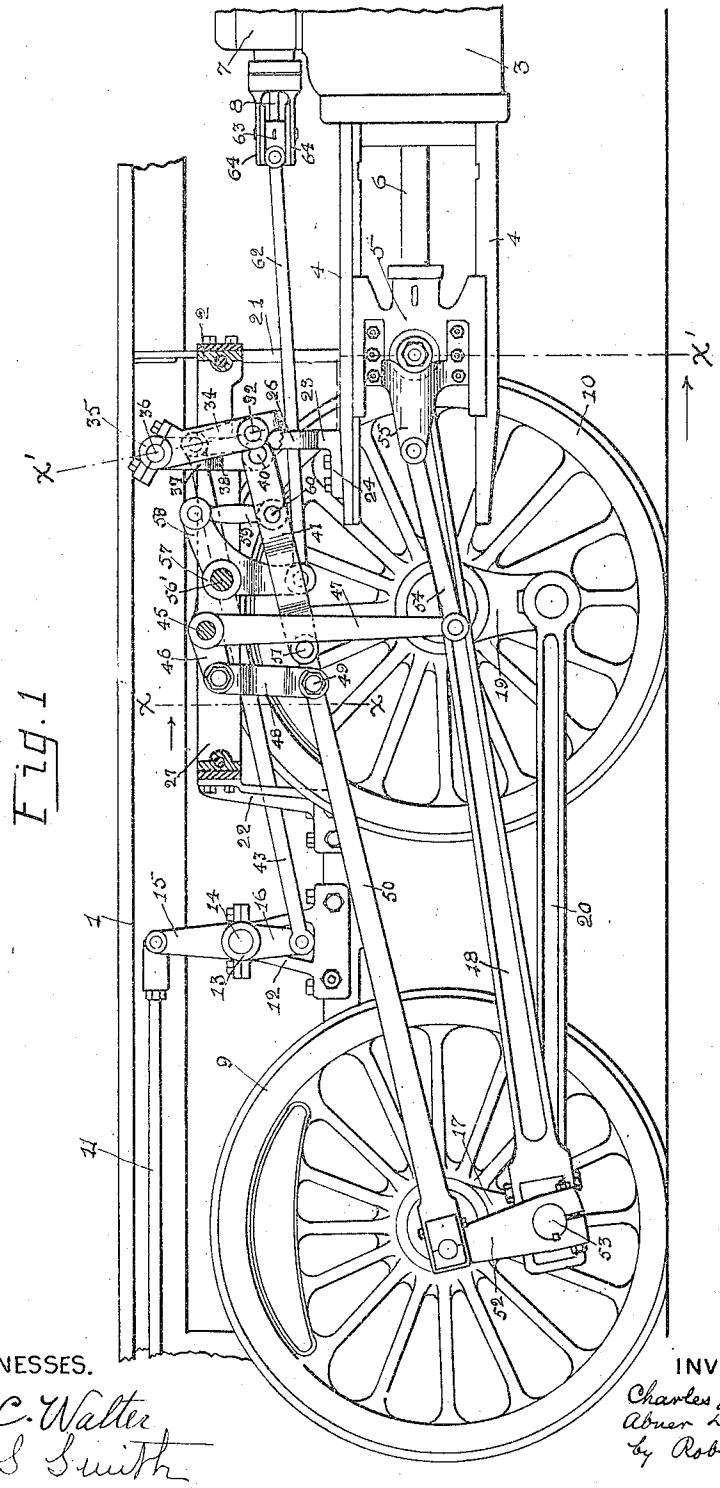

Fig. 1

WITNESSES.

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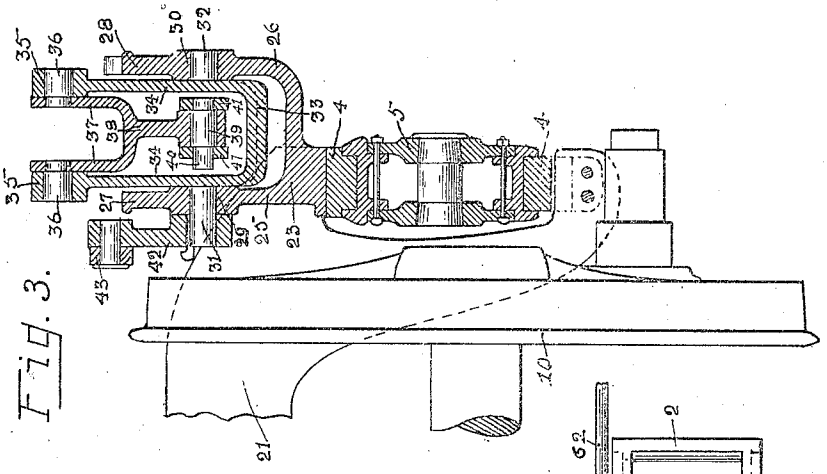

Fig. 3.

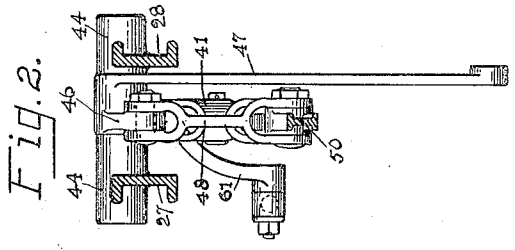

Fig. 2.

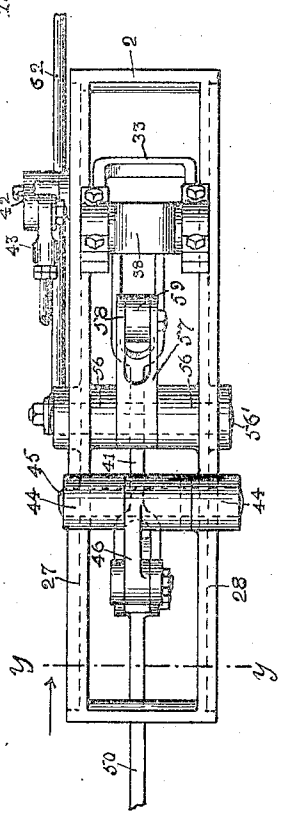

Fig. 4.

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# UNITED STATES PATENT OFFICE.

CHARLES J. PILLIOD, OF ANGOLA, INDIANA, AND ABNER D. BAKER, OF SWANTON, OHIO, ASSIGNORS TO FREDERICK E. PILLIOD, TRUSTEE, OF SWANTON, OHIO.

## VALVE-GEAR.

No. 902,603. Specification of Letters Patent. Patented Nov. 3, 1908.

Application filed November 20, 1907. Serial No. 402,955.

*To all whom it may concern:*

Be it known that we, CHARLES J. PILLIOD, a citizen of the United States, residing at Angola, in the county of Steuben and State of Indiana, and ABNER D. BAKER, a citizen of the United States, residing at Swanton, in the county of Fulton and State of Ohio, have invented a new and useful Improvement in Variable-Cut-Off Valve-Gear for Engines, of which the following is a specification.

Our invention relates to a variable cut-off and reversing valve gear for locomotives and all classes of steam, air or other gas driven engines, and has for its object to provide an efficient valve gear of the kind, that is adapted to produce free admission at the beginning and free release at the end of each stroke, that is adapted to operate the valve to produce equal cut-off from each end of the cylinder at any desired distance of piston travel to which the gear is adjusted by the reach rod, and that when applied to locomotives or traction engines is unaffected by the lateral vibration produced by running over tracks or uneven surfaces.

A further object is to provide a gear of the kind that is of light and durable construction and adapted to be attached to a locomotive frame in position where all the parts are readily accessible.

We accomplish these objects by the construction, arrangement and combination of parts as hereinafter described and illustrated in the drawings, in which—

Figure 1 is a side elevation of a valve gear constructed in accordance with our invention and attached to a locomotive. Fig. 2 is a cross section of the same on line $x$—$x$ of Fig. 1, and $y$—$y$ of Fig. 4. Fig. 3 is a cross section of the same on line $x'$—$x'$, and Fig. 4 is a top view of the same.

In the drawings 1 designates the frame of a locomotive partly broken away, and 2 the valve gear frame attached to the frame 1, and in which the valve gear is mounted and supported in position.

3 designates the cylinder, 4—4 the guide bars, 5 the cross head, 6 the piston rod, 7 the steam chest, 8 the valve stem, 9 the main driving wheel, 10 the secondary driving wheel, 11 the reach rod of the reversing lever, 12 a pedestal support mounted on the main frame, 13 a rock shaft bearing at the top of the pedestal, 14 a rock shaft mounted in the bearing, 15 a rock arm mounted on the rock shaft 14, to which is connected the reach rod 11, 16 a rock arm extending opposite to the lever 15, 17 the crank of the main driving wheel 9, 18 the main connecting rod connecting the cross head 5 of the crank 17 of the main driving wheel, 19 the crank of the driving wheel 10, and 20 the parallel connecting rod connecting the crank 19 with the crank 17 of the main driving wheel.

To operate the valve stem 8 there is provided a valve gear which is connected to the crank 17 of the main driving wheel, the cross head 5, and the rock arm 16 of the rock shaft 14.

The gear is supported on the main frame 1 by the gear frame 2, which is attached at the front end to the guide yoke 21, and at the rear end to the standard 22, mounted on the main frame 1. The gear frame 2 is also supported on the upper guide bar 4 by the standard 23, which is bifurcated above the base 24, and is provided with the arms 25 and 26 which are integral with the parallel sides 27 and 28 respectively of the gear frame 2.

The arms 25 and 26 are provided with the alined bearings 29 and 30 respectively, in which are journaled the rock trunnions 31 and 32 of a U shaped rock yoke 33, having the arms 34 extending above the sides 27 and 28 of the frame 2, these arms 34 having their upper end portions provided with the alined bearings 35 in which are journaled the trunnions 36 of the arms 37 of the bifurcated link 38, the lower end of which is provided with a link bearing 39, to which there is pivotally connected by the pin 40 the bifurcated oscillating bar 41. The trunnion 31 of the rock yoke 33 is extended beyond its bearing 29 and has mounted thereon the rock arm 42 to which is pivotally connected one end of the connecting rod 43, the opposite end of which is pivotally connected to the rock arm 16 of the rock shaft 14.

Centrally of the frame 2 the sides 27 and 28 are provided with the alined bearings 44 in which is journaled the rock shaft 45, upon which is mounted between the sides 27 and 28 of the frame 2, a bell crank having the short

arm 46 and the long arm 47. To the outer end of the bell crank arm 46 there is pivotally connected one end of a link 48, which at the opposite end is pivotally connected by a pin 49 to the connecting rod 50, one end of which is connected by the pin 51 to the oscillating bar 41, and the opposite end to a crank 52 mounted on the crank pin 53 of the crank 17 of the main driving wheel 9. To the lower end of the rock arm 47 there is pivotally connected one end of a connecting rod 54 which at the opposite end is connected to a yoke 55 secured to the cross head 5.

Adjacent to the rock shaft 45 the sides 27 and 28 of the gear frame 2 are provided with the alined bearings 56, in which is journaled the rock shaft 56′ upon which is fixedly mounted the bell crank 57, to the outer end of the upper arm 58 of which there is pivoted the upper end of a link rod 59. The lower end of the link rod 59 is pivotally mounted on a pin 60, attached to the oscillating bar 41. The lower end of the lower arm 61 of the bell crank lever 57 has pivotally connected thereto one end of a connecting rod 62, the opposite end of which is pivotally connected to a cross head 63 to which is attached the valve stem 8, provided with the guide bars 64.

The crank 52 is fixedly mounted on the pin 53 of the crank 17 at a suitable angle relative to the center line of the crank, and is of suitable radius less than the radius of the crank 17 and extends inward.

The rod 50 and the bar 41 pivotally connected thereto by the pin 51, together form a pivot jointed eccentric rod connecting the eccentric crank 52 with the link 38.

The valve gear thus constructed and connected, with the parts properly proportioned operates as follows: The reciprocation of the cross head 5 revolves the crank 52 and thereby oscillates the pivot jointed eccentric rod comprising the rod 50 and the bar 41. The cross head 5, being also connected to the rod 50, through the connecting rod 54, the bell crank arms 47 and 46, and the link 48, in its reciprocation causes the pivot pin 51, forming the pivot joint of the rod 50 and the bar 41, to move through an ellipse that modifies the oscillation of the bar 41, and changes the path of motion of the pivot pin 60 which connects the bar 41 to the mechanism which transmits reciprocating movement therefrom to the valve. This modified path of motion of the pin 60 gives to the valve a movement that produces equal admission and release at each end of the cylinder, and cut off during each stroke at equal distances from each end of the cylinder, however the cut off may be varied by the reversing lever.

The irregularity of cut-off incident to variable cut-off valve gears that our invention is mainly designed to correct, is due to the angularity of the eccentric rod which operates the valve,—whether directly or indirectly,—and of the connecting rod of the piston, whereby the valve moves with greater speed, and the piston travels a greater distance before cut-off occurs, from one end of the cylinder than from the other.

When motion is transmitted to a valve, either directly or indirectly, by an eccentric rod that receives its motion direct from an axle or shaft that is revolved by the main connecting rod of the piston, the travel of the valve is a reproduction on a smaller scale of the travel of the piston, excepting only that the travel of the valve has a lead over the travel of the piston. The necessary result of this variation of the travel of both the valve and the piston in the two strokes, is a variation of the point of cut-off in the two strokes. It is manifest therefore, that to remedy this defect and produce equal cut-off in the two strokes, the valve must be given a different motion from that of the piston, in order to equalize the cut-off, and that this different travel of the valve can only be effected by producing a different oscillation of the eccentric rod from that of the main connecting rod. To obtain this different oscillation of the eccentric rod, we have substituted for the ordinary eccentric rod a pivotally jointed eccentric rod comprising the connecting rod 50 and the oscillating bar 41, and by connecting the rod 50 to the cross head of the piston by mechanism comprising the connecting rod 54, the bell crank arms 47 and 46, and the link 48, properly proportioned to each other, we produce an elliptical instead of a circular movement of the pivot pin 51 connecting the oscillating bar 41 to the connecting rod 50, the path of motion of the pin 51 being such as to change the path of motion of the pivot pin 60 of the oscillating bar 41, from that which it would have if the bar 41 and the connecting rod 50 formed a rigid eccentric rod actuated by the axle of the driving wheel or whereby the defective movement of the valve incident to the angularity of an ordinary eccentric rod is corrected to equalize the motion of the valve during both strokes and produce uniform admission and release at each end of the cylinder, and cut-off at equi-distant points from each end thereof. The motion of the valve obtained by our gear also produces a quick opening and closing of the inlet ports, while the movement of the valve is such that between the times of opening and closing, the ports remain open to the full extent to which they are set to open by the reversing lever.

By the construction shown and described the action of the valve is undisturbed and unaffected by lateral vibration, such as oc-

curs in locomotive gears, by reason of the yielding of the springs in running over inequalities of the track, whereby the relation of the eccentric rod to the valve seat is suddenly changed and causes a shifting of the valve thereon. This action is avoided by our pivotally jointed eccentric rod 50 and 41, it being manifest that such vibration can only produce a slight acceleration of speed of the pin 51 at a point in its elliptical path of travel, without diverting it from such path, or perceptibly affecting the travel of the valve. It will be seen therefore that by our construction, we both equalize the forward and backward strokes of the valve, and avoid the effects of lateral vibration. As located on a locomotive, it will be seen also that all parts of our gear are conveniently accessible.

What we claim to be new is—

1. A valve gear for engines of the class described, comprising a support, a member reciprocably mounted on the support, a pivot mounted on the crank shaft eccentric thereto, a pivot-jointed eccentric rod connecting the eccentric pivot and the reciprocable member, means connecting one member of the eccentric rod to the valve and adapted to transmit the lateral motion of the eccentric rod to reciprocate the valve, and means indirectly connecting the other member of the eccentric rod with the piston of the engine, adapted to modify the oscillation of the eccentric rod produced by the eccentric pivot of the shaft, for the purpose set forth.

2. In a valve gear for engines, the combination with the valve, cross head, crank shaft and main connecting rod of an engine, of means to equally reciprocate the valve on the forward and backward strokes, comprising a support, a pivot mounted on the crank shaft eccentric thereto, a pivot-jointed eccentric rod connected at one end to the eccentric pivot, and connected by a link at the opposite end to the support, means connecting the eccentric rod to the valve, and adapted to transmit the lateral motion of the eccentric rod to reciprocate the valve, and means connecting the cross head with a member of the eccentric rod, adapted to modify the oscillation of the eccentric rod produced by the eccentric pivot of the crank shaft, for the purpose set forth.

3. In a variable cut off valve gear for engines, the combination with the valve, cross head, crank shaft and main connecting rod of an engine, of means to equally reciprocate the valve on the forward and backward strokes, comprising an adjustable support, a member reciprocably mounted on the support, a pivot mounted on the crank shaft eccentric thereto, a pivot-jointed eccentric rod connecting the eccentric and the reciprocable member, means connecting one member of the eccentric rod to the valve, adapted to transmit the lateral motion of the eccentric rod to reciprocate the valve, and means connecting the other member of the eccentric rod with the cross head, adapted to modify the oscillation of the eccentric rod produced by the eccentric, for the purpose set forth.

4. In a variable cut off valve gear for engines, the combination with the valve, cross head, crank shaft, and main connecting rod of an engine, of means to equally reciprocate the valve on the forward and backward strokes, comprising an adjustable support, a member reciprocably mounted on the support, a pivot mounted on the crank shaft eccentric thereto, a pivot-jointed eccentric rod connecting the eccentric and the reciprocable member, means connecting one member of the eccentric rod to the valve adapted to transmit the lateral motion of the eccentric rod to reciprocate the valve, and means connecting the other member of the eccentric rod with the cross head, comprising a bell crank, and links connecting the arms of the bell crank respectively with the eccentric rod, and with the cross head, adapted to modify the oscillation of the eccentric rod produced by the eccentric, for the purpose set forth.

5. In a variable cut off valve gear for engines, the combination with the valve, cross head, crank shaft, and main connecting rod of an engine, of means to equally reciprocate the valve on the forward and backward strokes, comprising an adjustable support, a member reciprocably mounted on the support, a pivot mounted on the crank shaft eccentric thereto, a pivot-jointed eccentric rod connecting the eccentric and the reciprocable member, means for trasmitting the lateral motion of the eccentric rod to the valve, comprising a bell crank, and link rods connecting the arms of the bell crank respectively with the member and the valve, and means adapted to modify the oscillation of the eccentric rod produced by the eccentric pivot of the crank shaft, comprising a bell crank, and links connecting the arms of the bell crank respectively with the other member of the eccentric rod and with the cross head.

6. In a variable cut off valve gear for engines, the combination with the valve, cross head, crank shaft, and main connecting rod of an engine, of a support, a rock shaft journaled on the support and provided with a radial arm, means to rock the shaft and the arm through an arc, a pivot mounted on the crank shaft eccentric thereto, a pivot-jointed eccentric rod connected to the eccentric and to a link connected to the arm of the rock shaft, means connecting the eccentric rod to

the valve, adapted to transmit the lateral motion of the eccentric rod to reciprocate the valve, and means adapted to modify the oscillation of the eccentric rod produced by the eccentric, for the purpose set forth, comprising a bell crank, and links connecting the arms of the bell crank respectively with the eccentric rod and the cross head.

In witness whereof, we have hereunto signed our names in the presence of two subscribing witnesses, this twenty-third day of October, 1907.

CHARLES J. PILLIOD.
ABNER D. BAKER.

In presence of—
FRED H. KRUSE,
A. M. SHOWALTER.