A. D. BAKER.

REVERSIBLE VARIABLE CUT-OFF VALVE GEAR FOR LOCOMOTIVES.

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**1,036,058.** **Patented Aug. 20, 1912.**

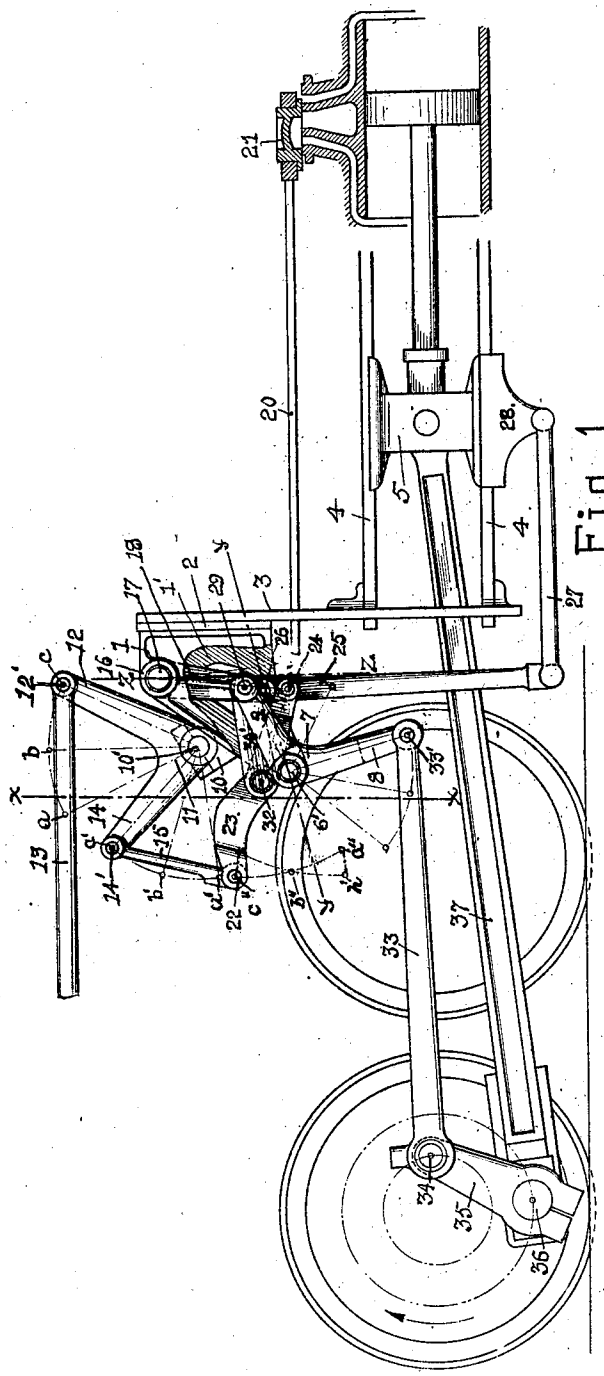

Fig. 1.

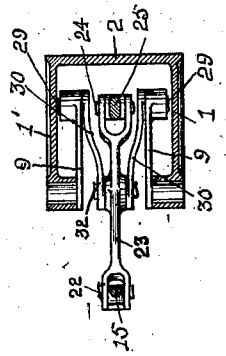

Fig. 4.

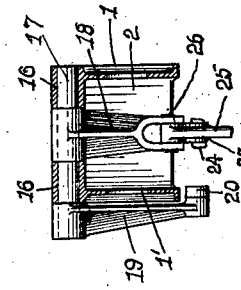

Fig. 3.

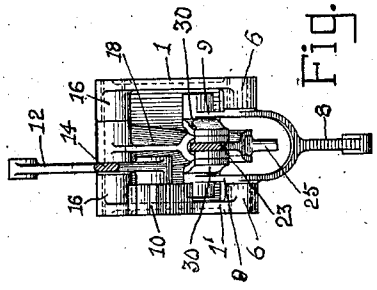

Fig. 2

WITNESSES.

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# UNITED STATES PATENT OFFICE.

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## REVERSIBLE VARIABLE-CUT-OFF VALVE-GEAR FOR LOCOMOTIVES.

1,036,058. Specification of Letters Patent. Patented Aug. 20, 1912.

Application filed August 10, 1911. Serial No. 643,328.

*To all whom it may concern:*

Be it known that I, ABNER D. BAKER, a citizen of the United States, residing at Swanton, in the county of Fulton and State of Ohio, have invented certain new and useful Improvements in Reversible Variable-Cut-Off Valve-Gear for Locomotives, of which the following is a specification.

My invention relates to a reversible and variable cut-off valve gear for locomotives.

In application Serial No. 484,788 I have shown and described a valve gear of the kind wherein lateral motion of the eccentric rod, as produced and controlled by a radius rocker that is adjustable by the reach rod through an arc is transmitted to the valve by a bell crank through a lever that is fulcrumed near one end to an arm of the bell crank and connected by the short arm to the valve stem and by its long arm to the cross head, and whereby the resultant motion produced and transmitted to the valve, produces admission at the beginning of each piston stroke to the full extent the valve is adjusted to open the port, quick cut-off at equal distances of piston travel on the forward and backward stroke proportionate to the extent of port opening, and prompt and full release at the end of each stroke, and continuing through the succeeding stroke and whereby equal valve action is attained on the forward and backward strokes of the piston, and on reverse movement as well as on forward movement, and whereby also, vibration produces no disturbing effect on the action of the valve.

The object of my present invention is to produce the same results by the direct instead of lateral motion of the eccentric rod. I accomplish these objects by the construction, combination and arrangement of parts, as hereinafter described and illustrated in the drawings, in which—

Figure 1 is a side view of a valve gear constructed in accordance with my invention, and showing the relative position of the parts at beginning of cut-off during the backward stroke of the piston in forward movement of the engine, a part of the gear frame being broken away to more clearly show the construction and connection of the parts. Fig. 2 is a cross section of the same on line *x*—*x* of Fig. 1. Fig. 3 is a vertical section of the gear frame on line *z*—*z* of Fig. 1 and showing a side elevation of the rock shaft and its arms. Fig. 4 is a section of the gear frame on line *y*—*y*, showing a top view of the radius rocker and radius bar.

In the drawings 1 and 1′ designate the parallel sides and 2 the end of a bracket frame being secured to the supports 3 of the guide bars 4 of the cross head 5 with the sides 1 projecting rearward. In the rear ends of the sides 1 are provided the alined bearings 6 in which are journaled the trunnions 6′ of a bell crank 7 having a bifurcated arm 8 extending downward and the arms 9 extending the bifurcations of the arm 8 forward at an angle thereto.

Above and forward of the bearing 6 of the side 1′ is provided a bearing 10 in which is journaled the trunnions 10′ of a bell crank 11 having an arm 12 extending upward, to the free end of which is pivotally connected one end of the reach rod 13 by a pivot pin 12′. The other arm 14 of the bell crank 11 extends rearward and to its free end is pivotally connected a link rod 15 by a pin 14′.

Forward of the bearing 10 the sides 1 and 1′ are provided at their upper edges with the alined bearings 16 in which is journaled the rock shaft 17 having the rock arm 18 extending downward central between the sides 1 and 1′ and on an extension of the rock shaft beyond the bearing 16 of the side 1′ is fixedly mounted the rock arm 19 of greater length than the rock arm 18 and extending downward parallel therewith. To the free end of the arm 19 is pivoted the rear end of the valve rod 20 the forward end of which is connected to the valve 21.

To the lower end of the link rod 15 is pivoted by a pin 22 the rearward end of a radius bar 23 the forward end of which is pivoted by a pin 24 to a lever 25 near its upper end, which is fulcrumed by a pin 26 to the lower end of the rock arm 18. To the lower end of the lever 25 at a distance from its fulcrum proportionately greater than the distance of the pin 24 which connects the radius bar 23 to the lever, is pivotally connected one end of a link rod 27, the forward end of which is pivotally connected to a downward arm extension 28 of the cross head 5.

To the free ends of the arms 9 of the bell crank journaled in the bearings 6 are pivotally connected by the pins 29 the forward ends of a pair of arms 30 comprising a radius rocker 30′, which are curved inward

and rearward and have their rear ends pivotally connected centrally to the radius bar 23 by a pin 32 at a distance from the pins 29 equal to the radial distance of the pins 29 from the trunnions 6′ of the bell crank journaled in the bearings 6.

To the lower end of the bifurcated arm 8 of the bell crank is pivotally connected the forward end of the eccentric rod 33 by a pin 33′. The rearward end of the eccentric rod is connected to the pin 34 of a return crank 35 fixedly mounted on an extension of the crank pin 36 of the rearward end of the connecting rod 37, the forward end of which is connected to the cross head 5. The crank pin 34 is at a radial distance from the axis of the driving wheel, adapted to produce the desired maximum length of valve stroke, and is set to follow the pin 36 at 90°, on the forward movement of the engine, and to lead it on the rearward movement.

Thus constructed the relative movements of the parts are as follows:—The pin 12′ of the arm 12 of the bell crank 11 is movable by the reach rod 13 through an arc *a*, *b*, *c*, which moves the pin 14′ of the arm 14 through an arc *a′*, *b′*, *c′*, which in turn moves the pin 22 of the rearward end of the radius bar through an arc *a″*, *b″*, *c″*. The reciprocation of the eccentric rod reciprocates the pins 29 through an arc and causes the variable reciprocation of the radius bar 23 by the radius rocker 30′, according to the distance the pin 12′ is adjusted by the reach rod in either direction from the point *b*, it being manifest that if the pin 12′ is at the point *b*, the pin 22 of the radius bar will be at the point *b″*, and the pin 32 will be in line with the trunnions 6′ of the transmitting bell crank, in which position there will be no reciprocation of the radius bar, but at points equi-distant above or below the point *b″* in the arc *a″*, *b″*, *c″*, the reciprocation of the pin 22 of the radius bar will be through equal distances proportionate to the distance of the pin 22 from the point *b″*. It will be noted also that when the pin 12′ is between the points *b* and *c*, the reciprocation of the radius bar 23 will be in exact reverse of the reciprocation of the eccentric rod, and that when it is between the points *b* and *a*, the bar 23 will reciprocate in unison with the eccentric rod. It is manifest also that in the reciprocation of the radius bar there will be proportionately reproduced the variable speed movement of the eccentric rod that it receives from its crank 35, whereby is reproduced in the valve increasing speed movement from a state of rest (which occurs while the eccentric is passing its dead centers) to its highest speed (which occurs while the eccentric is passing its 90° centers) and diminishing speed movement to a state of rest after passing a 90° center, as it approaches the other dead center.

The connecting rod produces in the piston and in the lever 25 the same increasing and diminishing speed movement from and to a state of rest, but as it passes its dead centers while the eccentric is passing its 90° centers, it will be seen that the speed of the eccentric rod is increasing while the speed of the connecting rod is decreasing and vice versa, and that the highest speed of each is reached while the other is at rest. Therefore the piston being at rest at the end of its stroke, the eccentric rod produces quick opening of the port by the valve during the ending of the stroke of the piston and the beginning of a new stroke. At the same time, the radius bar is shifting the fulcrum of the lever 25 in the direction of its movement whereby the effect of the lever on the valve is neutralized without creating any resistance from the lever. After moving the valve to open the port the eccentric rod slows up to a state of rest, while the piston and the lever 25 increasing in speed operate, at the time the eccentric rod is passing a dead center, to quickly reverse the direction of the valve and quickly close the admission port opened at the beginning of the stroke, and thereby cut off the steam, and thereafter during the remainder of the stroke the piston is operated by the expansion of the steam admitted during the first half of the stroke, and while the piston and the lever are nearing the end of the stroke and coming to a state of rest, the eccentric rod and the radius bar, approaching their highest speed, move the valve to open the opposite port and connect the admission port of the stroke with the exhaust, which movement is completed while the piston is beginning a new stroke.

It will be seen from the foregoing that the movements of the valve produced by my present gear are substantially identical with the movements thereof produced by the gear shown and described in my said application Serial No. 484,788, and that like my said former described gear, it produces the same equality of action of the valve on the reverse movement as on the forward movement. In my former gear, however, the forward end of the eccentric rod is oscillated through an arc as directed by a radius rocker, which varies the direction of the arc according as the pivotal center of the rocker is established by the reach rod in an arc of equal radius, and the lateral movement of the eccentric rod thus produced is transmitted by one arm of a bell crank to the valve by a lever that is fulcrumed on the other arm of the bell crank. In my present gear the direct movement of the eccentric rod is transmitted through a bell crank and a radius rocker to a swinging radius bar pivotally suspended by its ends by parallel rocker arms, one of which is adjustable through an arc by the reach rod and the other is connected to the

valve, whereby the distance of the reciprocation of the radius bar is varied, thereby varying the length of the valve stroke.

By my present gear I utilize the direct movement of the eccentric rod as is done in gears of the Walschaart type, but without using the link lever and slide block used in that type of gears for varying the length of valve stroke, and I thereby avoid the unequal wear, friction and strain which are incident to the use of the slide block and link, and also the unequal leverage and inequality of movement of the valve due to change of radius in varying the valve stroke, whereas in my gear the leverage is constant, and the motion of the eccentric rod is transmitted by the radius rocker moving in a constant arc and operating always to move the valve in either direction by a pull of the radius bar on one or the other of its supporting rocker arms. It is also apparent that the effect on the valve of any abnormal movement of the eccentric rod produced by vibration, is neutralized by counteracting effect produced on the lever 25 by the connecting rod.

What I claim to be new is—

1. In a reversible, variable cut-off valve gear for locomotives, the combination with an eccentric rod, valve stem, cross head and reach rod, of a support, a rocker journaled on the support, and having a pair of arms, one connected to the valve stem, a lever fulcrumed by one end on the other arm of the rocker and having the other end connected to the cross head, an adjusting bell crank journaled on the support and having one arm pivotally connected to the reach rod and adjustable thereby through an arc, a rocker link pendently pivoted to the other arm of the adjusting bell crank, a radius bar pivotally connected by one end to the rocker link, and by its opposite end to the lever near its fulcrum, a transmitting bell crank journaled on the support and having one arm pivotally connected to the forward end of the eccentric rod, and a radius rocker pivotally connected by one end to the other arm of the transmitting bell crank and by the opposite end centrally to the radius bar at a radius equal to the radius of the bell crank arm.

2. In a reversible, variable cut-off valve gear for locomotives, the combination with an eccentric rod, valve stem and reach rod, of a support, an adjusting bell crank journaled on the support and having one arm connected to the reach rod, a radius bar, a link pivotally and pendently connecting one end of the radius bar to the other arm of the adjusting bell crank, a rocker journaled on the support and having an arm pendently supporting the other end of the radius bar and adapted to reciprocate the valve stem, a transmitting bell crank journaled on the support and having one arm connected to the forward end of the eccentric rod, and a radius rocker having one end pivoted to the other arm of the bell crank and its opposite end pivoted centrally to the radius bar, substantially as set forth.

In witness whereof I have hereunto set my hand this 20th day of July, 1911.

ABNER D. BAKER.

In presence of—

FRED H. KRUSE,

FRANK W. MACPHIE.