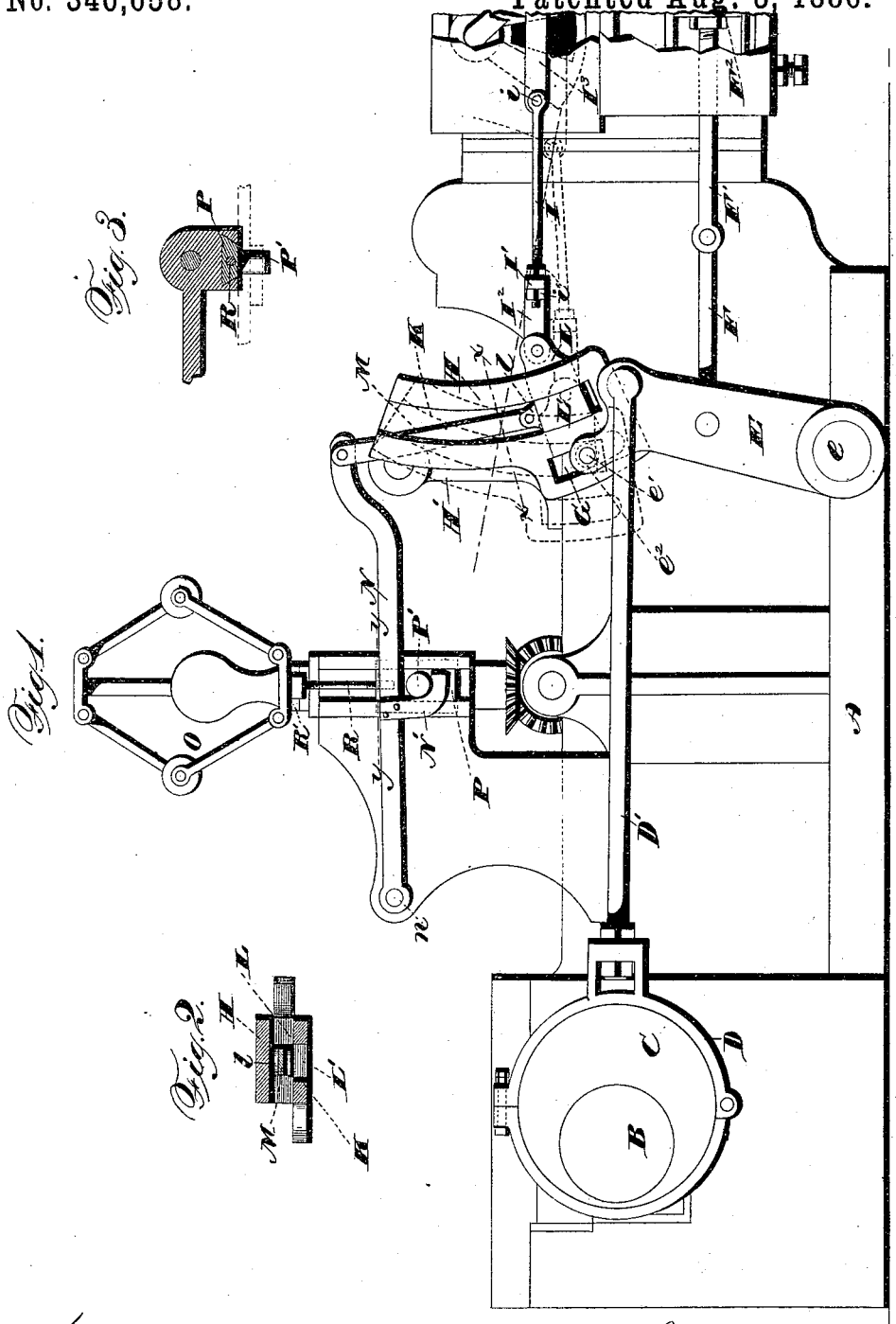
(No Model.)

B. B. HOUGH.

VALVE GEAR.

No. 346,658. Patented Aug. 3, 1886.



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UNITED STATES PATENT OFFICE.

BENJAMIN B. HOUGH, OF WILMINGTON, DELAWARE, ASSIGNOR OF ONE-HALF TO SAMUEL G. WARNER, OF SAME PLACE.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 346,658, dated August 3, 1886.

Application filed November 14, 1885. Serial No. 182,860. (No model.)

To all whom it may concern:

Be it known that I, BENJAMIN B. HOUGH, of Wilmington, in the county of New Castle, and in the State of Delaware, have invented certain new and useful Improvements in Valve-Gears; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, in which—

Figure 1 shows a view in elevation of my improved valve-gear; Fig. 2, a sectional view of a portion of the same on line *x x* of Fig. 1, and Fig. 3 a detail sectional view on line *y y* of Fig. 1.

Letters of like name and kind refer to like parts in each of the figures.

The object of my invention is to provide an improved valve-gear; and to this end my invention consists in the construction, arrangement, and combination of parts, as hereinafter specified.

In the drawings, A designates the bed of the engine; B, the fly-wheel shaft; C, the ordinary eccentric thereon, and D the eccentric-strap, connected with the eccentric-rod D′ by means of an adjustable connection. This rod is pivotally connected with the swinging lever or arm E, pivoted to the frame at *e*. Such arm has pivoted to it the link F, which in turn is jointed to the valve-rod F′, connected with and operating the exhaust-valves, as shown and described in my application No. 182,859, filed by me of even date with this one. In Fig. 1, at F^2, is shown a portion of one of these valves.

On the inner or rear side of the upper end of arm F is a pin, *e′*, carrying an anti-friction roller, e^2, which engages the slot G in the swinging arm H, pivoted at or near its upper end to the standard H′. The inlet-valve operating-rod I, pivoted to the valve-operating bar at *i*, has its outer end threaded and passed through a lug, I′, on the link I^2, and fastened thereto by means of nuts *i′ i′* on the rod on each side of the lug. The pivoted swinging arm H is slotted or forked vertically in a plane parallel to that in which the arm swings—that is, at right angles to the axis of motion of the arm on its pivot—and is also provided in one of the legs of the slot thus made with a slot, K, curved from the pivotal connection of the valve-rod I, with the valve-operating bar I^3 as a center when the arm H is at the middle point of its swing.

Between the forks of the arm H fits and slides the block L, having on its side the arm or projecting portion L′, fitting and sliding in slot K, and curved with the same curvature as said slot.

To block L is pivotally connected the outer end of link I^2, and to the lug *l*, on the upper side or end of the block, is pivoted the lower end of link M, which is pivoted at its upper end to lever N. This lever extends along close to and past the frame-standard upon which the governor O is supported, and is pivoted at *n* to the frame, preferably so as to swing in substantially the same plane with block L.

In a vertical dovetail groove on the governor-standard, close beside lever N, fits and slides the block P, having pin P′ projecting under and engaging the lower side of the lever. On the lever is a hook, N′, extending under and adapted to engage the lower side of pin P′. Instead of such hook-lug, obviously a lug with a slot or opening to receive the pin could be used.

Into the upper end of slide-block P is tapped the lower end of rod R, connected at its upper end with and operated by the rising and falling sleeve R′ of the governor, which can be of any of the well-known forms desired. I prefer, however, the form shown in the drawings—that is, the fly-ball kind connected with and driven from the main shaft by any desired gearing.

I have only shown a portion of the valves to be operated by connection with rods I and F′, as no particular form of valve is to be claimed in this application. So far, however, as the valve-gear or operating mechanism shown and described in this application is concerned, any desired forms of valve can be used without departure from my invention; but I prefer the forms of valves shown and covered in my other application referred to, and have, therefore, shown in the drawings of the present case portions of such valves.

With the construction as shown and de-

scribed in this application, as the arm E is always swung the same distance by the eccentric-rod and eccentric, the exhaust-valves will obviously be always opened to the same extent, independent of any change of throw or in the amount of opening of the inlet-valves. By such an arrangement the exhaust will always be most free and unimpeded, and will not interfere with the work of the engine. The inlet-valve operating-bar is actuated through rod I, link I^2, and block L by the swinging of the arm H, which is swung back and forth on its pivot by engagement of the friction-roller e^2 on pin e' on swinging arm E with the slot G in arm H. As the latter arm swings, the amount of throw of the valve-bar and the valves will obviously depend upon the position of block L with reference to the pivot of the arm, and will vary directly with the distance of the block from such pivot. As the load of the engine is diminished from any cause, the governor-sleeve R′ will be drawn up by the governor in the well-known way, and through rod R, slide-block P, and pin P′ will raise lever N. As the lever rises, it will, through link M, raise block L, so as to bring it nearer the pivotal point of arm H, and so diminish the throw of the inlet-valves and cause them to open the inlet-ports less widely, as and in the manner indicated hereinbefore. If the load is increased so that more power and more strain are needed, the governor lowers the governor-sleeve in the well-known way, and the lever N is lowered, carrying the block L downward and farther from the pivotal center of arm H, so that it and consequently the valves have greater throw, and the latter open the inlet-ports wider. This automatic adjustment of the block up and down on arm H is always proportional to the load of the engine to the amount of steam needed and the work to be done, so that the engine has been found to run most regularly and without any perceptible variation even when the most careful observations or tests have been continued for a long time. On account of the curve of slot K from the point of pivotal connection of rod I, with the valve-bar I^3 as a center, the block L′ is rendered most freely and easily adjustable up and down on arm H by the lever N and link M. The adjustment has been found to take place not only easily, freely, and accurately, but without jar or noise; and in whatever position the block is with reference to the arm H the forward and rear curved sides of the part L′ of the block have such bearing against the forward and rear sides of the slot K that there is no tendency of the block at any point of the swing of arm H to be slid up or down by the action or resistance of link I^2 and rod I upon it. In other words, the line of bearing of the part L′ of the block against the sides of the slot is always substantially at the most advantageous angle to the line of draft upon or application of power to the valve-operating rod.

Having thus described my invention, what I claim is—

1. In combination with means for operating the exhaust and inlet valves of a steam-engine positively in both directions, adjustable connections whereby the throw of the inlet-valves can be adjusted independently of the exhaust-valves, and automatic means for adjusting such connections, substantially as and for the purpose shown.

2. In a valve-gear, in combination with a moving piece actuated by suitable connections from a moving portion of the engine, means for connecting and operating the exhaust-valves therefrom, and adjustable connections between said moving piece and the inlet-valves, whereby such valves are positively operated in both directions, and their throw can be adjusted without affecting the exhaust-valves, substantially as and for the purpose set forth.

3. In combination with a lever actuated from a moving part of the engine, means for connecting the same with the exhaust valve or valves, a movable piece actuated by connection with the lever, and means for connecting the inlet valve or valves positively with such movable piece, made adjustable to regulate the throw of the inlet valve or valves, substantially as and for the purpose described.

4. In combination with the lever E and connecting means whereby the exhaust valve or valves are operated therefrom, a swinging arm operated by lever E, an adjustable block carried by the arm, and positive connections adapted to connect the block with the inlet valve or valves, substantially as and for the purpose specified.

5. In combination with lever E, suitably actuated from a moving part of the engine, an exhaust valve or valves and connections between the same and the lever, the swinging arm actuated by the lever, the adjustable block on the arm, the inlet valve or valves and connections between the same and the block, and automatic means, substantially as described, to adjust the block on the arm, so that it will have greater or less throw, substantially as and for the purpose shown.

6. In combination with the lever E and the eccentric-rod connected with and operating the same, suitable connections between the lever and the exhaust valve or valves for operating the latter, the swinging arm provided with a slot engaged by roller on a pin on the lever E, the sliding block on the arm adapted to be moved toward or from the center of motion of the arm, and connections between the block and the inlet-valves, substantially as and for the purpose set forth.

7. In combination with the valve-operating lever and connections between the same and the exhaust valve or valves, the swinging arm actuated by the lever, a movable block carried by the arm and adapted to be moved thereon toward or from the pivotal center thereof, connections between the block and

the inlet valve or valves independent of the swinging arm, the lever connected with the block to move the same on the arm, and a governor adapted to actuate the lever, substantially as and for the purpose described.

8. In combination with the swinging arm and the block carried thereby, adjustable thereon to have greater or less throw as the arm swings, connections independent of the arm between the block and the inlet valve or valves, a lever, a link connecting the block and lever, a governor and connecting means between the same and the lever, substantially as and for the purpose specified.

9. In combination with arm H, having the curved slot K, the block L, having a portion fitting in and guided by the slot, the valve-operating bar I^3, and a connecting-rod connecting the bar and block, substantially as and for the purpose shown.

10. In combination with the valve-operating bar, the adjustable block, and a link-connection between the block and bar, the swinging arm carrying the block and having a slot curved from the pivotal connection of the link with the bar when the arm is at the middle of its swing, said slot engaging a portion of or projection on the block, so as to guide the latter, substantially as and for the purpose set forth.

11. In combination with the forked swinging arm H, provided with curved slot K, the block fitting the fork of the arm and provided with a portion or projection guided by the curved slot, connections between the block and the valve or valves, the lever N, the link M, connecting the lever and link, the governor, and connecting means whereby the lever is moved by the governor, substantially as and for the purpose described.

12. In combination with the governor and the rising and falling sleeve thereof, the slide provided with a pin, the rod connecting the slide with the sleeve, the lever adapted to be moved by the pin, the link, the swinging arm, the block adjustable on the same toward or from the pivotal center thereof, connected with the link so as to be moved thereby, and means for connecting the block with the valve or valves, so that the latter will be actuated as the block swings with the arm, substantially as and for the purpose described.

In testimony that I claim the foregoing I have hereunto set my hand this 29th day of October, A. D. 1885.

BENJAMIN B. HOUGH.

Witnesses:
EDWIN J. PRINDLE,
HENRY C. HAZARD.