H. F. SHAW.

VALVE GEAR.

APPLICATION FILED OCT. 7, 1910.

979,212.

Patented Dec. 20, 1910.

4 SHEETS—SHEET 1.

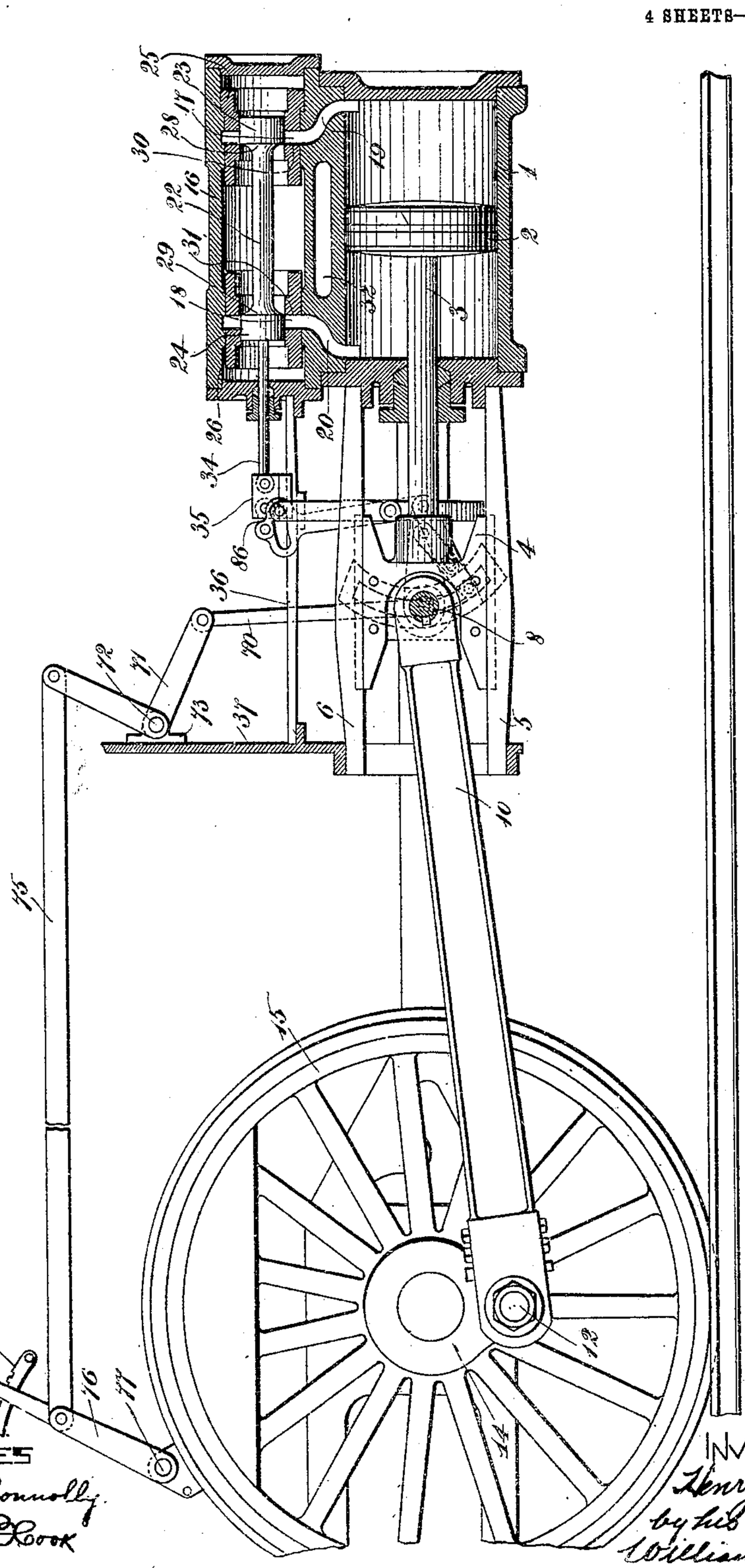

FIG. 1

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Henry F. Shaw
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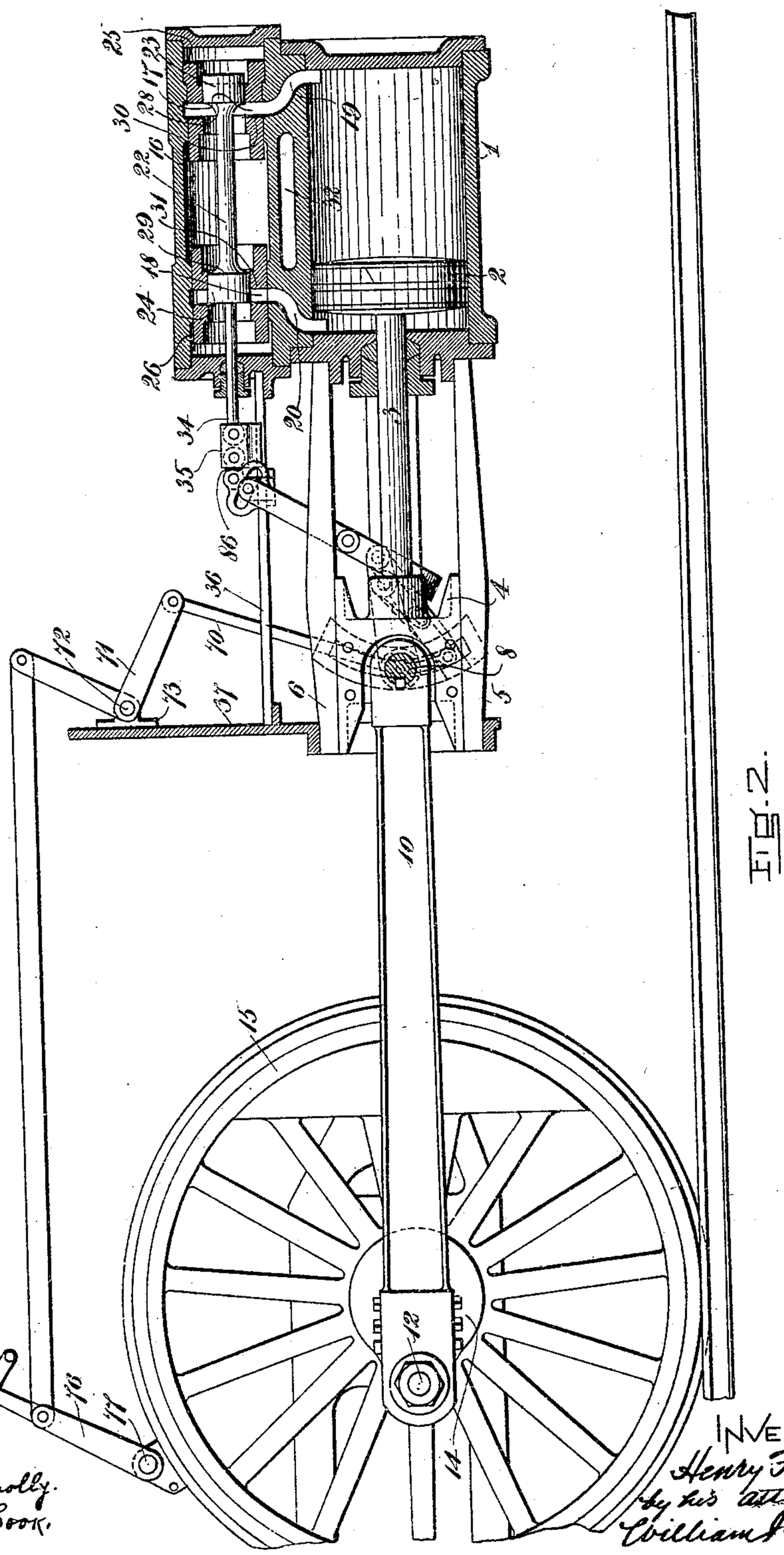

Fig. 2.

WITNESSES

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4 SHEETS—SHEET 3.

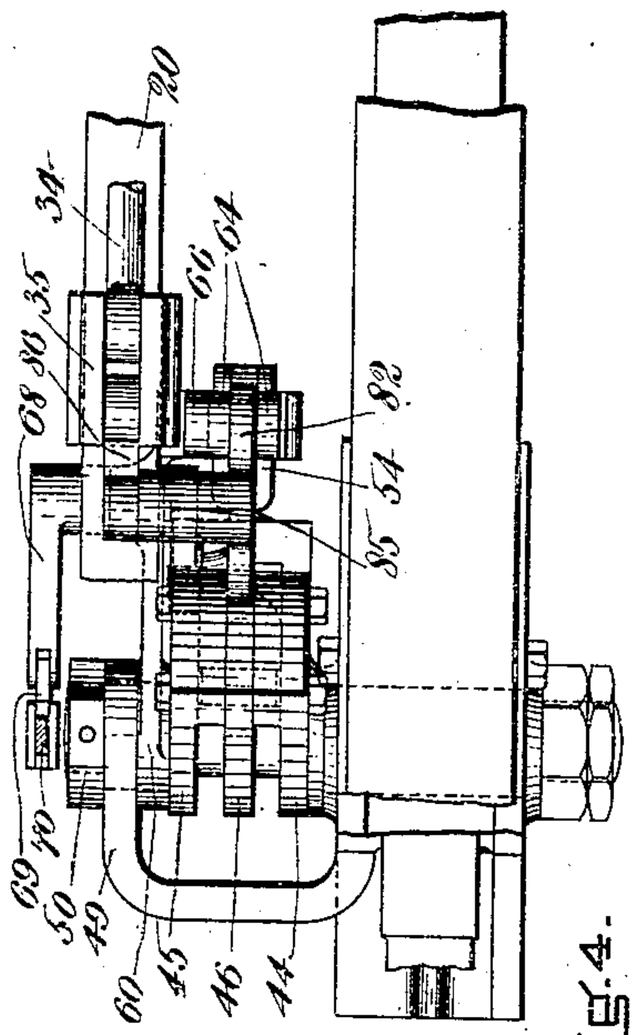

FIG. 4.

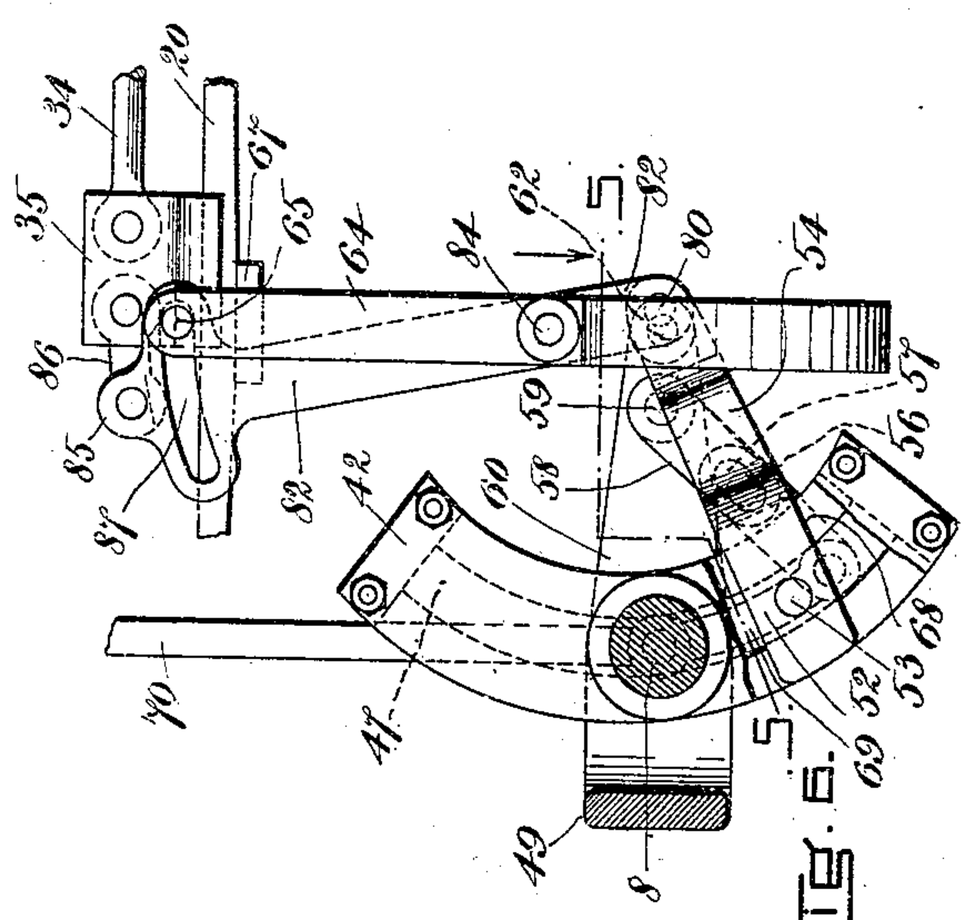

FIG. 6.

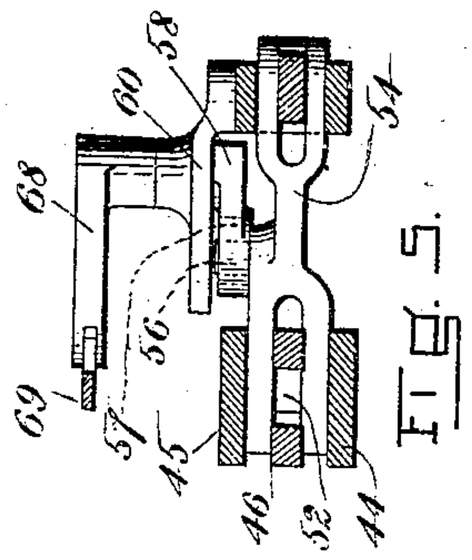

FIG. 5.

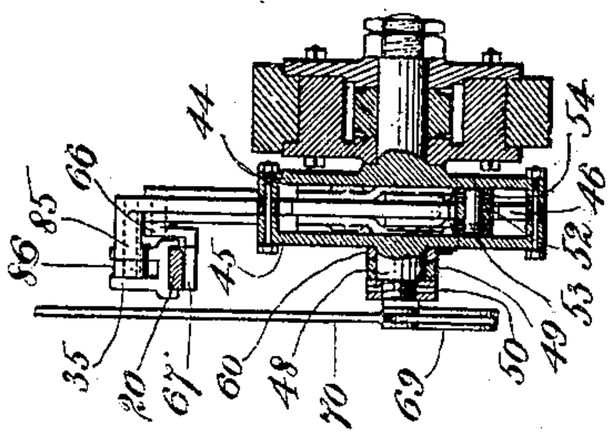

FIG. 3.

WITNESSES

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4 SHEETS—SHEET 4.

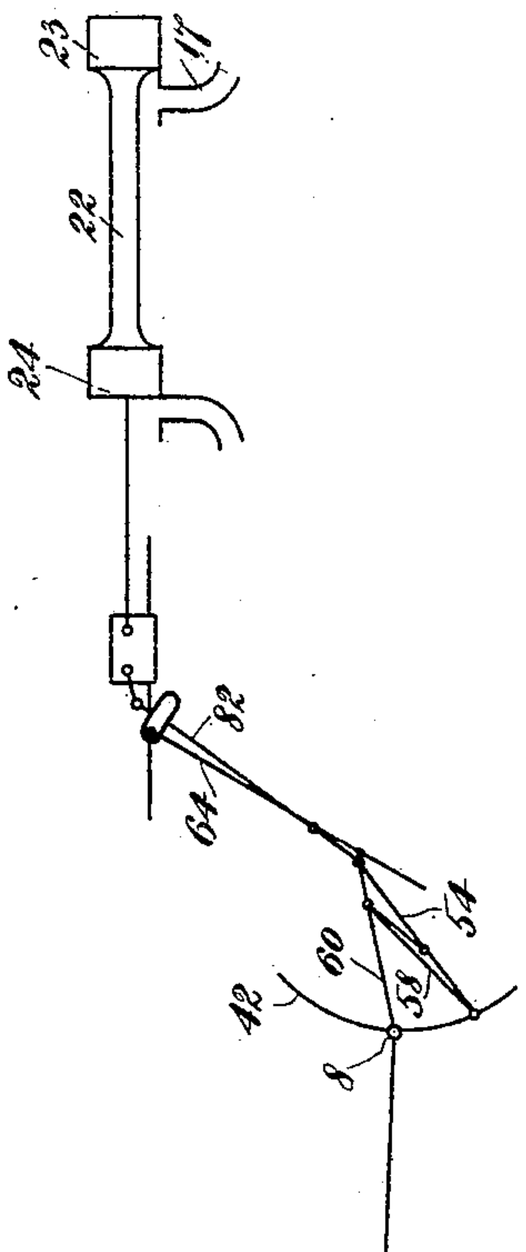


Fig. 7.

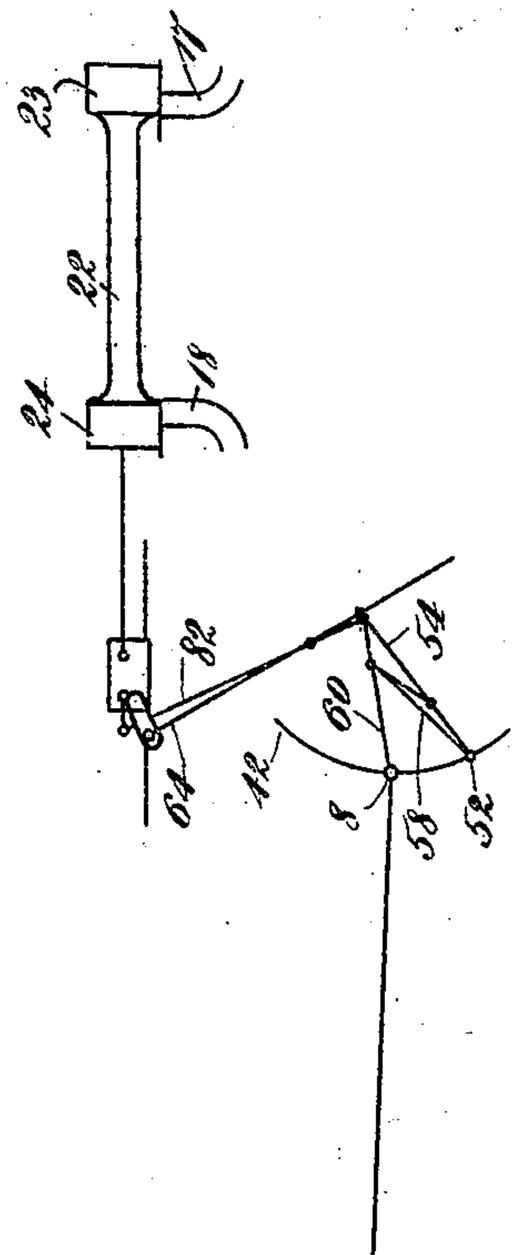
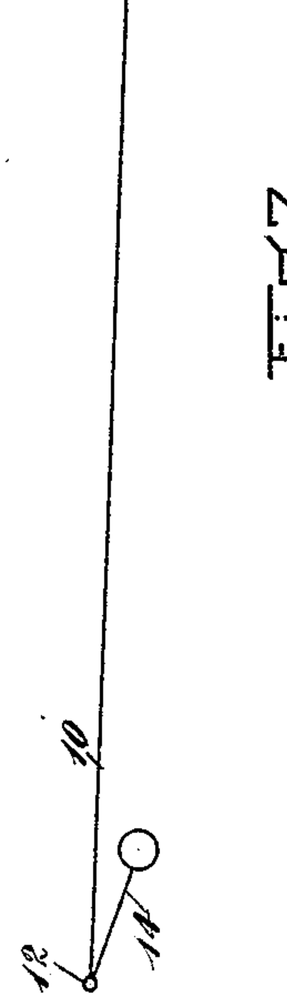


Fig. 8.



WITNESSES

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UNITED STATES PATENT OFFICE.

HENRY F. SHAW, OF BOSTON, MASSACHUSETTS.

VALVE-GEAR.

979,212. Specification of Letters Patent. **Patented Dec. 20, 1910.**

Application filed October 7, 1910. Serial No. 585,740.

To all whom it may concern:

Be it known that I, HENRY F. SHAW, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Valve-Gears, of which the following is a specification.

This invention relates to a variable cut-off and reversing valve gear for engines.

One object of the invention is to provide a valve gear that is simple; that is adapted to operate quickly to allow free admission at the beginning and produce a dwell toward the end of each stroke to allow a free release; and that is adapted to produce equal cut-off from each end of the cylinder at any desired adjustment of the reversing lever.

A further object of the invention is to provide a valve gear that is easily manipulated by the operator when the engine is running; that is so constructed that only a comparatively small pressure is thrown on the link-block when the engine is running; and that when applied to a locomotive or traction engine is unaffected by vibration produced by running over tracks or uneven surfaces.

A further object is to provide a valve gear that is of light and durable construction, unaffected by the wear of connecting rod bearings, and adapted to be attached to the engine frame in position where all the parts are readily accessible.

With the above objects in view, the invention consists in the valve gear hereinafter described and claimed, the advantages of which will be obvious to those skilled in the art from the following description.

In the accompanying drawings Figure 1 is a sectional side elevation of a portion of a locomotive with the valve gear in full gear forward and the crank pin on the lower quarter; Fig. 2 is a similar view with the crank pin on the rear dead center; Fig. 3 is a transverse, sectional elevation taken through the center of the cross-head pin and the link; Fig. 4 is a fragmentary plan view on an enlarged scale of the cross-head, link and connecting parts; Fig. 5 is a sectional plan view taken on the line 5—5 in Fig. 6; Fig. 6 is a fragmentary sectional elevation of the parts shown in Fig. 4; Fig. 7 is a diagrammatic view showing the positions of the parts when the steam-admitting port is wide open; and Fig. 8 is a diagrammatic view showing the positions of the parts when the crank is at the corresponding distance above the center at the other end of the stroke.

As illustrated in the drawings, the valve gear is applied to a locomotive comprising a cylinder 1 having a piston 2 secured to a piston rod 3 which is attached to a cross-head 4. The cross-head 4 is mounted to slide on guides 5 and 6, and is provided with a wrist pin 8 which is journaled to rotate therein and is keyed to one end of a main rod 10, or otherwise secured thereto, so that it may be oscillated thereby. The other end of the main rod 10 is connected to the crank pin 12 on the crank 14 of the driving wheel 15.

A steam chest 16 is mounted upon the cylinder 1, and is provided with ports 17 and 18, which register with the front and rear ports 19 and 20, respectively, of the cylinder. A piston valve 22 is mounted to reciprocate within the steam chest, and its enlarged ends 23 and 24 fit the bushings 25 and 26, respectively, in which the ports 17 and 18 are formed, and they control the passage of the steam through said ports. The valve is arranged for outside steam admission, and as shown in Fig. 1, when the crank pin 12 is in its quarter position the inner edges 28 and 29 of the enlarged heads or ends 23 and 24 are line and line with the inner or exhaust edges 30 and 31, respectively, of the ports 17 and 18. An exhaust passage 32, of usual construction, is provided. Although the valve is shown as arranged for outside admission of steam, it is to be understood that the valve gear is equally applicable for use with the valves arranged for inside steam admission. Furthermore, the valve is not limited to the positions shown, but may be arranged for pre-admission.

The valve 22 is provided with a valve stem 34, which is pivotally connected to a block 35 mounted to slide upon a bar or support 36 carried by the end of the steam chest and the frame 37 of the locomotive. The movements of the valve are governed by a link 42, which is composed of two outer sector-shaped plates 44 and 45, and an intermediate sector-shaped plate 46 having an arcuate slot 47. These plates are bolted together. The plate 44 is formed integrally with, or is secured to, the wrist pin 8, so that it will be oscillated by the main rod and will reciprocate with the cross-head. The plate 45 is formed with a stud 48 having its outer end journaled in a yoke 49 ex-

tending laterally from the cross-head. A nut 50 is threaded upon the outer end of the stud 48 and bears against the outside of the yoke 49 to hold the parts in proper position.

Mounted to slide in the arcuate slot 47 is a link-block 52. The link-block is pivoted upon a pin 53 having its ends mounted in a forked link or lifting bar 54, which straddles the plate 46. A stud 56 projects laterally from the lifting bar 54, and is received in an elongated slot 57 formed in a crank arm 58, which is on one end of a rocker shaft 59 journaled in a link or bar 60. The link 60 is pivoted at one end upon the stud 48, and at its other end it is pivotally connected at 62 to a U-shaped lever 64, which may be termed the lap lever. The parallel arms of the lap lever 64 are fulcrumed on a pin 65, carried by an arm 66 of a bracket 67 secured to the underside of the support 20. The lap lever is so proportioned that it just works off the lap between the two extreme positions of the cross-head. A rocker arm 68 is secured to the other end of the rocker shaft 59 and is pivotally connected to one end of a short link 69, the other end of which is pivotally connected to the lower end of a lifting link 70. The upper end of the lifting link or rod 70 is pivotally connected to the horizontal arm of a bell-crank lever 71 fulcrumed at 72 in a block 73 mounted on the engine frame 37. The vertical arm of the bell-crank lever is pivotally connected to one end of a reach rod 75, the other end of which is pivotally connected to the reversing lever 76, fulcrumed at 77, and co-operating with the toothed sector 78. By moving the reversing lever forward and backward the link-block 52 can be lowered or raised to vary the position of the latter with respect to the center of oscillation of the link 42, and thus vary the extent of movement of the link-block. The lifting bar 54 is also forked at its other end and pivotally connected at 80 to a lever 82, which may be termed the port lever, as this lever determines the extent to which the ports are uncovered. The port lever is fulcrumed at 84 on the lap lever 64, and is provided with an elongated boss 85 at its upper end, which is pivotally connected to one end of a link 86, the other end of which is pivotally connected to the block 35. The port lever is widened at its upper end and provided with an arcuate slot 87 through which the pin 65 passes.

When the reversing lever is in middle position, the link-block 52 is in its middle position, so that when the link 42 is oscillated the block has no effect upon the valve, and although the valve is reciprocated the extent of its movement is not sufficient to open either of the ports. The pivotal points 62 and 80 of the lap and port levers, respectively, are brought into registry, and these two levers will oscillate in unison when the cross-head is reciprocated. The parts are so proportioned and the pivotal point 65 of the lap lever 64 is so located that when the cross-head moves from one extreme position to the other the valve is moved double the outside lap, that is, double the distance which the outer ends of the heads 23 and 24 project beyond the outside steam line of the ports 17 and 18, respectively, when the valve is in middle position, as shown in Fig. 1. When the crank pin 12 is on the quarter, as shown in Fig. 1, the inside edges 28 and 29 of the valve 22 are line and line with the inside or exhaust edges 30 and 31 of the ports 17 and 18, respectively, both ports being closed. In the present instance it will be considered that the ports 17 and 18 are one and a half inches wide, and the outside lap of the valve at each end is an inch and a quarter. As the engine moves forward the crank moves toward the rear dead center, as shown in Fig. 2, the lap at the rear end of the cylinder has been removed thus bringing the valve ready for admission and the port 17 is uncovered an inch and a quarter. Thus the engine is ready to take steam at the rear port 18 and is exhausting through the front port 17. When the crank pin is moved up to the position shown in Fig. 7, that is, about twenty degrees, the rear port 18 is wide open and the exhaust port is also wide open. Thus it will be seen that a comparatively slight movement of the crank from the dead center throws the steam admitting port wide open and gives a free admission at the beginning of the stroke and also allows a free exhaust. In this connection it will be observed that when the crank pin moves across the dead center line the main rod has considerable angular movement, while the cross-head has only a slight motion of translation. The angular movement of the main rod determines the oscillation of the link, and this in turn determines the throw of the link-block, the extent of the motion of the link-block being also determined by its distance from the center of oscillation of the link. The effect upon the valve of wear of the crank pin bearings is practically negligible since the first effect of the lost motion is to vary the extent of oscillation of the wrist pin, and this slight variation is applied to the long arm of the levers which move the valve, so that the effect on the short arm is practically nothing. After the crank pin leaves the position shown in Fig. 7 and until it nearly reaches the upper quarter the valve is caused to dwell, that is, there is practically no movement of the valve during this time and the steam admission continues freely, the exhaust being also open to allow free release. When the crank pin arrives at the upper quarter the steam is cut off and the

valve is line and line with the exhaust as shown in Fig. 1. The difference in the speed of the cross-head during the rear half of the stroke as compared with that during the front half may be compensated for by proportioning the lengths of the levers so as to cause the valve to be set slightly back on the front half of the stroke and thus retard it sufficiently to have the ports opened for steam admission uniformly at each end. When the crank pin is moved over to the position shown in Fig. 8, the port 18 is open slightly to exhaust, and the port 17 is closed against admission of steam.

One purpose of placing the link upon the cross-head is to increase the leverage by having the link-block attached to the long arm of the lever which moves the valve, so that when the engine is running and the reversing lever is moved up toward the middle position there is only a small amount of pressure upon the link-block, and the reversing lever can be easily manipulated. The ratio of the lengths of the arms of the respective levers can be varied as desired in accordance with the length of stroke, length of main rod and width of ports. By the present arrangement of one and one quarter inch lap and the quick removal of the lap just previous to the beginning of the stroke, the exhaust port is opened an inch and a quarter thus giving a free release.

While I have illustrated and described a preferred embodiment of the invention, I am aware that many modifications can be made therein by any person skilled in the art without departing from the scope of the invention as expressed in the claims. Therefore I do not wish to be limited to all the details of construction shown and described, but

What I claim is:—

1. In a variable cut-off valve gear for engines, the combination with a valve, a cross-head and a main rod connected to the cross-head; of a link carried by the cross-head and oscillated by the main rod, a link-block slidably mounted on the link, connections between the link-block and the valve, and a reversing lever operatively connected to the link-block.

2. In a variable cut-off valve gear for engines, a valve, a cross-head and a main rod, in combination with a link carried by the cross-head and oscillated by the main rod, a link-block slidably mounted on the link, a lap lever operatively connected to the cross-head, a port lever pivotally mounted on the lap lever and operatively connected to the valve and to the link-block, and a reversing lever operatively connected to the link-block.

3. In a variable cut-off valve gear for engines, the combination with a valve, a cross-head and a main rod, of a link carried by the cross-head and oscillated by the main rod, a link-block slidably mounted on the link, a bar pivotally connected at one end to the cross-head, a lap lever pivotally connected to the bar and fulcrumed at a fixed point, a lifting bar pivotally connected to the link-block, a port lever pivotally connected to said lifting bar and fulcrumed on said lap lever, connections between the valve and the port lever, and a reversing lever operatively connected with the link-block.

4. In a variable cut-off valve gear for engines, the combination with a valve, a cross-head and a main rod, of a link carried by the cross-head and oscillated by the main rod, a link-block slidably mounted on the link, a bar pivotally connected at one end to the cross-head, a lap lever pivotally connected to the bar and fulcrumed at a fixed point, a lifting bar pivotally connected to the link-block, a port lever pivotally connected to said lifting bar and fulcrumed on said lap lever, connections between the valve and the port lever, and a reversing lever operatively connected to the lifting bar.

5. In a variable cut-off valve gear for engines, the combination with a valve, a cross-head and a main rod, of a link carried by the cross-head and oscillated by the main rod, a link-block slidably mounted on the link, a bar pivotally mounted on one end and moving with the cross-head, a lifting bar connected to the link-block, a rocker shaft journaled in said first mentioned bar, a reversing lever operatively connected to said rocker shaft, operative connections between said rocker shaft and said lifting bar, a lap lever pivotally connected to said first mentioned bar, a port lever fulcrumed on the lap lever and pivotally connected to said lifting bar, and connections between the port lever and the valve.

6. In a variable cut-off valve gear for engines, the combination with a valve, a cross-head and a main rod, of a link carried by the cross-head and oscillated by the main rod, a link-block slidably mounted on the link, a lap lever connected to the cross-head, a port lever operatively connected to the link-block and to the valve, and a reversing lever operatively connected to the link-block.

In testimony whereof I have affixed my signature, in presence of two witnesses.

HENRY F. SHAW.

Witnesses:
WILLIAM J. SPERL,
JOHN J. REILLY.