(No Model.) 3 Sheets—Sheet 1.

# E. W. HARDEN.

## VALVE CONTROLLING MECHANISM.

No. 505,764. Patented Sept. 26, 1893.

Fig. 1.

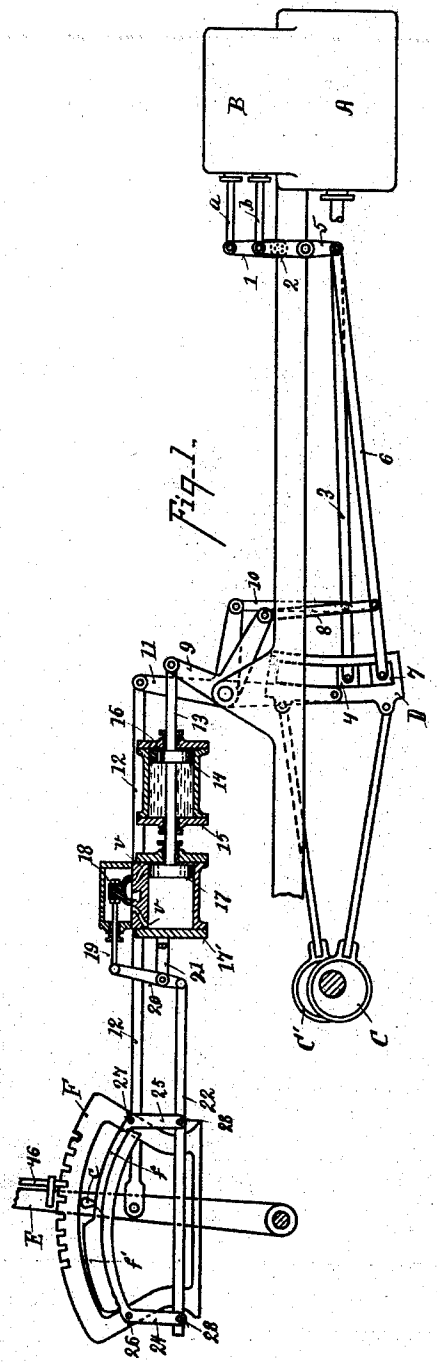
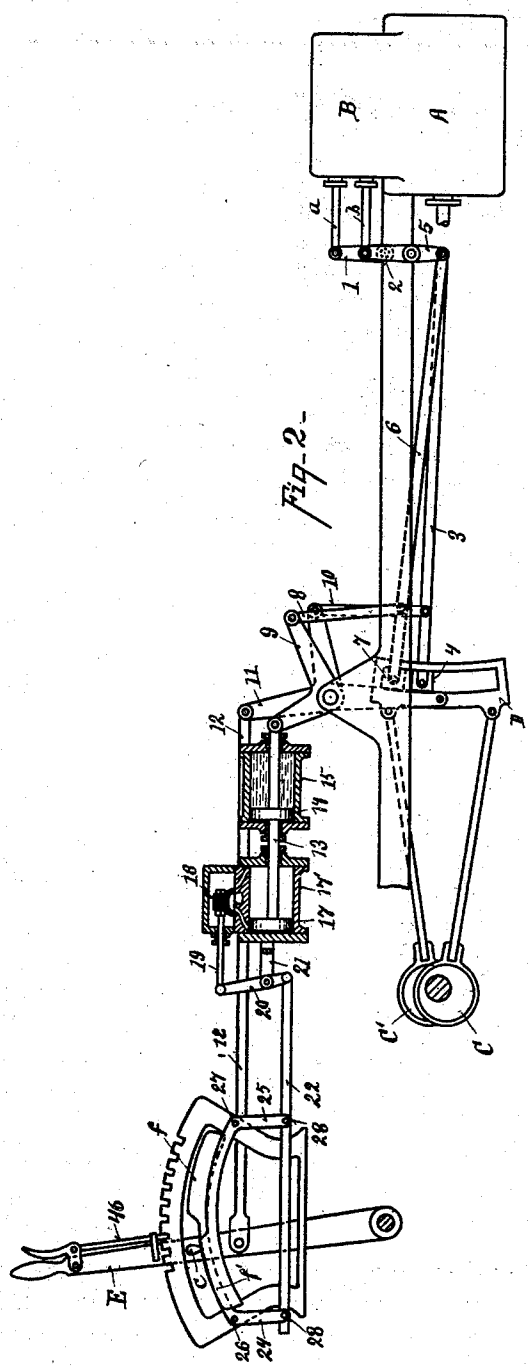



Fig. 2.

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(No Model.) 3 Sheets—Sheet 2.

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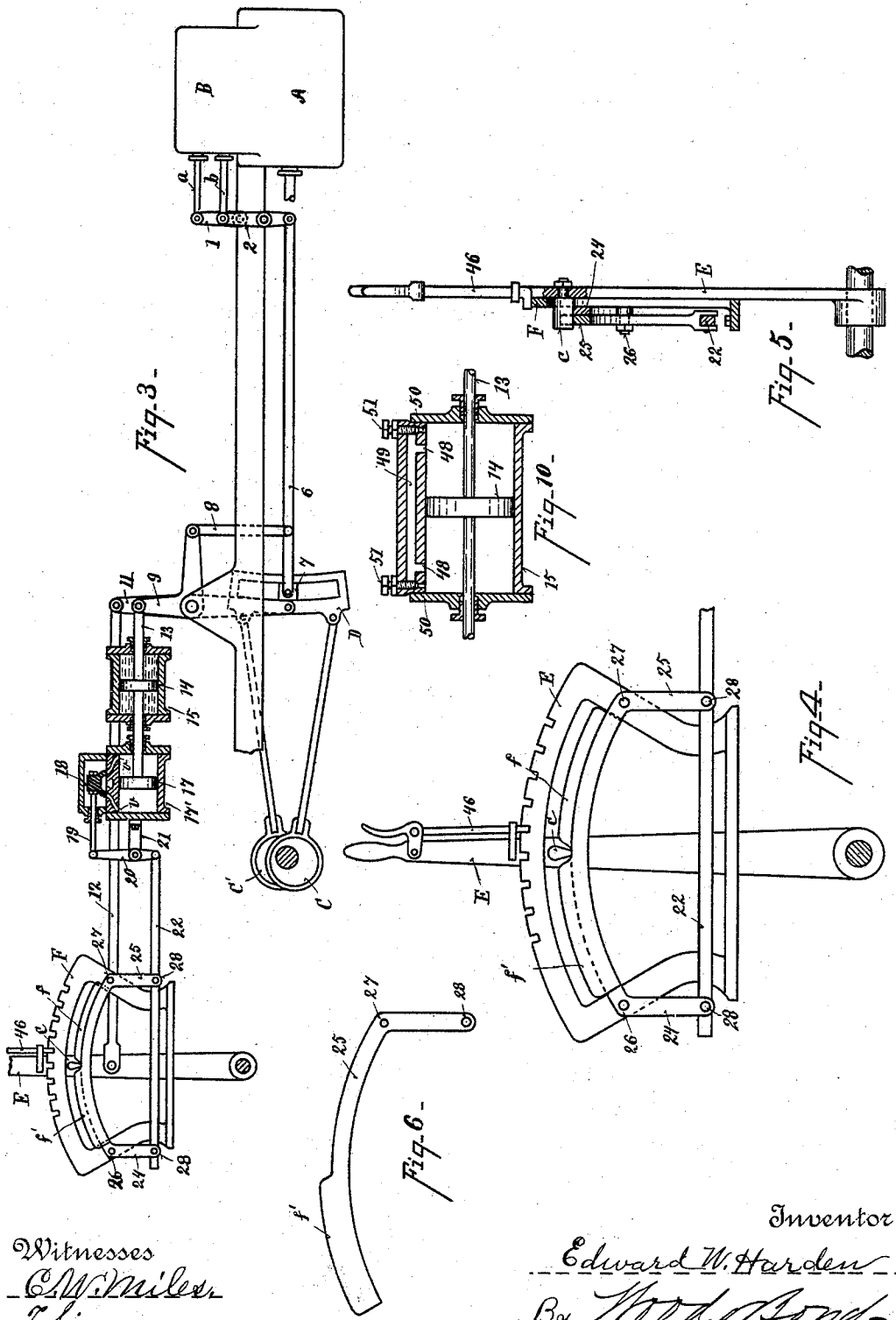


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(No Model.) 3 Sheets—Sheet 3.

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## VALVE CONTROLLING MECHANISM.

No. 505,764. Patented Sept. 26, 1893.

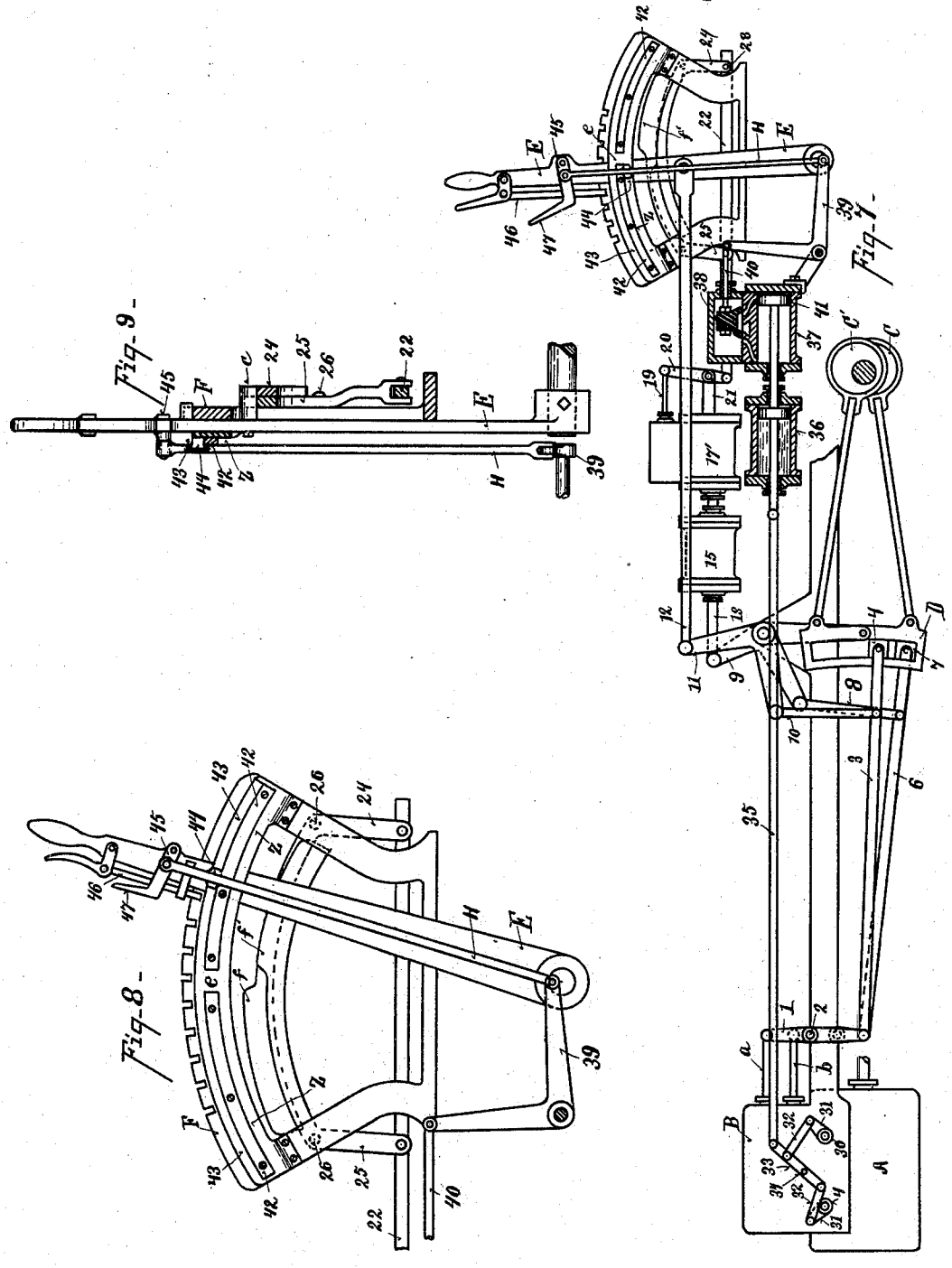

Fig. 7.



Fig. 9.



Fig. 8.

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# UNITED STATES PATENT OFFICE.

EDWARD W. HARDEN, OF CINCINNATI, OHIO, ASSIGNOR TO FREDERIC C. WEIR, OF SAME PLACE.

## VALVE-CONTROLLING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 505,764, dated September 26, 1893.

Application filed April 20, 1893. Serial No. 471,122. (No model.)

*To all whom it may concern:*

Be it known that I, EDWARD W. HARDEN, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Valve-Controlling Mechanism, of which the following is a specification.

The object of my invention is, first, to provide mechanism for controlling simultaneously both the main and cut off valves of a steam engine through the medium of a single lever; second, to provide valve mechanism for controlling the main and cut off valves of a steam engine by the operation of a single cut off lever, and also, to change a compound to a simple, and vice versa, by the same lever mechanism; the various features of which are fully set forth in the description of the accompanying drawings making a part of this specification, in which—

Figure 1 is a side elevation partly in section showing my improvements attached to a simple engine. Fig. 2 is a similar view showing the position of the parts when the engine is reversed. Fig. 3 is a similar view to Fig. 1 showing the position of the parts when the valves are cut off. Fig. 4 is an enlarged side elevation of the cut off lever and quadrant. Fig. 5 is a central vertical section of the same partly in elevation. Fig. 6 is a detail view of one of the connecting levers. Fig. 7 is a longitudinal side elevation partly in section of my improvement attached to a compound engine. Fig. 8 is an enlarged side elevation of the cut off lever and quadrant. Fig. 9 is a central vertical section of Fig. 8. Fig. 10 represents a modification of the cataract of Fig. 1.

A represents a steam cylinder; B the steam chest; *a* a cut off valve stem; *b* a main valve stem; C C′ eccentrics; D a link; E a cut off lever; F a quadrant provided with notches for locking the lever in any desired position.

1 represents a lever pivoted to the valve stem *a*.

2 represents a pivot on which the stem oscillates.

3 represents a radii valve rod hinged to the lower end of lever 1 at one end and to the block 4 of link D.

5 represents a lever hinged at the upper end to the valve stem *b*, and at the lower end is hinged to radii valve rod 6. The rear end of said valve rod is hinged to the block 7, the link D being a double or compound link.

8 represents a connecting rod hinged to the valve rod 6 at one end and to the bellcrank lever 9 at the upper end.

10 represents a link hinged at the lower end to valve rod 3 and at the upper end to the bellcrank lever 11; the upper end of this bellcrank lever is pivoted to the rod 12, the rear end of which is pivoted to the cut off lever E. These parts are constructed in the manner shown in Letters Patent No. 490,331, granted F. C. Weir and E. W. Harden, January 24, 1893. In that application two separate levers were shown one for operating the main valves of the engine, and the other for operating the cut off valve; by my improvements herein shown I operate both valves simultaneously with one lever by means of the following mechanism:

13 represents a piston rod hinged to the upper end of bellcrank lever 9. This piston rod carries two pistons which operate in respective cylinders. One piston and cylinder is an auxiliary engine for shifting the rod in the link for reversing the engine, and the other piston and cylinder form a cataract.

14 represents the cataract piston located in cylinder 15; it is pierced with an orifice 16 for letting the liquid pass slowly through the piston head from one side of the cylinder to the other. Upon the rear end of the piston 13 is mounted a piston 17 operated in the steam cylinder 17′.

18 represents a valve which alternately opens and covers the ports *v*, *v*′.

19 represents a valve stem pivoted to lever 20 which is pivoted to the stud 21; to the lower end of lever 20 is pivoted a connecting rod 22, the rear end of which is pivoted to the bellcrank lever 24 which is pivoted to the quadrant F by the center 26.

25 represents a bellcrank the counterpart of bellcrank lever 24, but pivoted to the front end of the quadrant by center 27; these levers are pivoted side by side but act independently. Levers 24 and 25 are pivoted to

connecting rod 22 by the centers 28, by means of which said connecting rod 22 is oscillated back and forth to throw the valve 18. This oscillation is accomplished as follows:

*c* represents a lug on the lever E; the rear end of bellcrank lever 24 is cut away so that the lug *c* will slide over it without acting on said lever when it is moved backward; but the forward end of said bellcrank lever 24 is provided with the flange *f* projecting up in the path of lug *c*, so that when the said cut off lever E is moved forward it depresses the forward end of bellcrank lever 24 which being pivoted to the connecting rod 22 throws it backward, oscillating the lever 20 and throwing the valve 18 forward into the position shown in Fig. 1. This movement takes place while the lever has been moved from the central notch *d* forward to the first notch, in which position it is shown in Fig. 1. The rear end of the bellcrank lever 25 is likewise provided with a flange *f'* which is raised to be in the path of the lug *c* so that when the lever E is moved back the rear end of bellcrank lever 25 will be depressed and the connecting rod 22 moved forward oscillating the lever 20, and moving the valve 18 into the reverse position, as shown in Fig. 2. By the throw of valve 18 the bellcrank lever 9 is either raised or lowered in whichever position it is thrown, and this is done by the movement of the lever E one notch either forward or backward of the central notch. By this means when the cut off lever E is in the central position the valves are in the normal position ready for starting in either direction. When the lever is moved forward say, the valves are set to move the engine forward when the lever is moved, say, backward, from the central position the engine is reversed, the valve being set so that the engine or locomotive will travel backward in reverse position to the opposite setting. Both the main and auxiliary valves are reversed by either operation by a single lever movement. The throw of the piston 16 reverses the main valve and the cut off valve being hinged directly to the cut off lever is reversed and controlled by the movement of said lever. It is desirable not only to operate the main and auxiliary valves for simple and compound engines, but also to convert a compound into a simple acting engine, and vice versa, by the same lever movement.

In Fig. 7, 30, 31, 32, 33, 34, represent the crank and link mechanism for operating the two-way valve of the construction shown in Letters Patent, No. 490,349, granted me January 24, 1893, which is one of the methods employed for converting a compound into a simple engine; sometimes this is accomplished by adjustment of the valve on its seat which would be an equivalent of the means herein shown.

35 represents a connecting rod pivoted at the forward end to the valve adjusting mechanism.

36 represents a cataract cylinder and piston; 37 another auxiliary engine operated by valve 38.

39 represents a bellcrank lever pivoted to the lower end of the setting lever H.

40 represents a valve rod pivoted at one end to bellcrank lever 39 and the other attached to the valve 38, so that steam is admitted alternately on to the steam piston 41, by the throw of the valve 38, thereby adjusting the valves in the steam chest, so as to convert the engine from a simple to a compound, and vice versa; and this is done simultaneously with the moving of the cut off lever E.

It is desirable to convert the engine from a single to a compound when the valves are cut off; I have consequently provided mechanism which will only operate when the lever is moved to the central position.

42 represents segmental guides on the side of the quadrant; these guides are cut away at the center leaving an opening *e* between them.

43 represents the upper and Z the lower side of segmental guide.

44 represents a guide block rigidly attached to the setting lever H.

45 represents a bellcrank lever hinged to the cut off lever E at one end and pivoted to the setting lever H, as shown in Figs. 7 and 8. In Fig. 7 this setting lever and its guide block 44 are shown riding on the under side of guide 42. Consequently the lever E may be moved backward and forward without disturbing the position of the setting lever H simply by releasing the lock rod 46, the end of which engages in the notches of the quadrant. In Fig. 8 the guide block 44 is moving the other side of guide 42. If now it is desired to convert the engine say from a compound to a simple the setting lever 47 is raised when the cut off lever H is in the central position, the guide block 44 passing up through the recess *e* on top of the guides. This raising of the setting lever H shifts the bellcrank lever 39, throws the valves 38 which operate the steam piston 39 reciprocating the connecting rod 35 and adjusting the valves in the steam chest. It is obvious that these valves might be operated by a direct connection to the bellcrank lever 39, but I prefer to employ the cataract so as to secure a positive and quick movement of the converting valves.

Mode of operation: The cut off lever E is normally in the central position, as shown in Figs. 3 and 4; the radii valve rods 3 and 6 will be opposite each other, and the guide blocks 4 and 7 in the center of the compound or double link D, and the valves of the engine are cut off; the parts all being in the position shown in Fig. 3. If it is desired to go ahead the lever E is moved forward say one notch as shown in Fig. 1; the radial valve rod 6, which controls the main valve is thrown in the lowered position by the operation of the steam chest 14, the piston being operated by

the lug *c* depressing the bell crank lever 24, oscillating the valve lever 20, and moving the valve 18 forward, and the main valve is making a full stroke at all times. The auxiliary or cut off valve controlled by the connecting rod 16 has but a little movement as the valve block 4 occupies a position slightly one side of the center of the compound link D. Now if the lever be moved forward another notch the guide block 4 and valve rod 3 will be lowered a little more; if the lever is moved to the extreme forward position the guide block 4 will be at the lowest point opposite the guide block 7, and both valves will be making a full throw, or admitting the largest amount of steam. If, now, the engineer desires to stop the engine he brings the lever back to the center; if he desires to reverse it he moves the lever backward say one notch; lug *c* then depresses the bellcrank lever 25 which oscillates the connecting rod 22 and reverses the valve 18, the steam moving it into the position shown in Fig. 2; reversing the position of the valve rod 6, throwing it to the upper side of its guide in link D, and the connecting rod 16 likewise reverses the auxiliary or cut off valve. By this means I am enabled to reverse both valves by moving one lever as well as to regulate the amount of steam admitted to the main cylinder. It will be observed that the mechanism for converting the engine from a compound to a simple can only be operated when the cut off lever is in the central position, as the guide block 44 on the setting lever H cannot be raised or lowered except when the lever is in that position. In Fig. 8 I have shown the guide block 44 and the position of the lever 8 and bellcrank lever 39 when the engine is working simple, the block 44 being over the guide 42; the setting lever 47 being moved to accomplish this purpose. In Fig. 7 the guide block 44 is shown under the guide 42, and the engine is worked compound. Thus, to work the engine compound the lever 47 is not touched by the operator, and it is working compound. But if the operator desires to work the engine as a simple engine he must before he moves the cut off lever E raise the setting lever H by means of the lever 47 and bring the guide block 44 up and then he may move the lever either forward or backward in accordance to the direction which he wishes to run. It is highly advantageous to compel the operator to bring his lever to the central position before he changes his engine from a compound to a simple, and when the lever is brought back to the central position the setting lever H and the guide block 44 will gravitate into the position for working the engine compound, which is the normal position desired. Thus, it will be seen that I can control both the main and auxiliary valves and the converting mechanism by the operation of the cut off lever to which all the valve adjusting mechanisms are attached.

In Fig. 10 I have shown a modified form of cataract, piston and cylinder; the object of the modification is to have a quick motion of the cylinder to throw the valve, and to provide means for slowing up the movement of the piston at the last end of the stroke to prevent shocks. The instrumentalities provided are as follows: 48 represents orifices pierced in the cylinder 15 communicating with each other through the passage 49; these orifices 48 are some little distance from the end of the cylinder, and are large enough to allow the liquid to be rapidly forced out of the cylinder by the piston; but when the piston passes these orifices they are cut off and graduated orifices 50 are provided for the last end of the stroke; these orifices are shown as regulated by screws 51; the valve is thrown by the piston at or before the time it passes the orifices 48; the contracted orifices slow up the motion and prevent shock by sudden stopping.

Having described my invention, what I claim is—

1. In an engine employing a main and cut-off valve, each having an independent valve rod, the auxiliary valve mechanism connected directly to the cut-off lever E, and the main valve mechanism connected to the piston of the auxiliary engine, provided with a cataract cylinder and piston, whereby the auxiliary valve of the main engine is reversed by the reversal of the auxiliary engine, substantially as described.

2. In a steam engine, the combination of the main and auxiliary valves, radii valve rods 3 and 6, link D, eccentrics C C′, the main valve setting mechanism connected to the piston of the auxiliary engine, the valve 18 of which is operated by the cut-off lever E, and the link 11 of the auxiliary valve connected to the cut-off lever E, whereby both the main and auxiliary valves are operated and reversed simultaneously by the cut-off lever E, substantially as described.

3. In combination with the steam engine employing a main and cut-off valve, the main valve with its radii rod 6 supported in link D, and connected directly to piston 13 of an auxiliary engine, with its valve 18 operated by the cut-off lever E, whereby the main valve is always set for a full throw, whenever said lever is moved forward or backward of the central point, substantially as described.

4. In a compound engine having a main and a cut-off valve, and valve controlling mechanism, the cut-off lever E, and setting lever H mounted thereon and connected to the valve 38 of the auxiliary steam engine 37, and the valve reversing mechanism connecting lever H to the valve 18 of the auxiliary engine 17, and the auxiliary valve setting mechanism directly controlled by cut-off lever E, substantially as described.

5. In a valve setting mechanism of a steam engine, in combination with a quadrant F, cut-off lever E provided with a lug *c*, the bell crank levers 24, 25, connected to and operat-

ing the steam valve 18, the connecting rod 16 connected directly to the cut-off lever E, and to the crank and link mechanism of the auxiliary valve, and the crank and link mechanism of the main valve connected to and operated by the piston 13 of the auxiliary engine 17, substantially as described.

6. In combination with the cut off lever E, the setting lever mounted thereon, the quadrant F, the segmental guides 42, with upper and lower surface 43, having the central recess *e*, and the guide block 44, mounted upon said setting lever, substantially as specified.

7. In combination with the quadrant F, and the cut off lever E, bellcrank levers 24, 25, each having oppositely recessed faces *f*, *f'* the lug *c*, and the connecting rod 22, pivoted to said bellcrank levers 24, 25, whereby said rod is reciprocated forward, or backward, according to the movement of the cut off lever E, substantially as specified.

8. In combination with a compound engine having valve controlling mechanism operated by the cut-off lever E, and secondary lever H mounted thereon connected to and operating the valve 38 of the auxiliary steam engine, which is connected to the valve controlling mechanism of the steam chest B, whereby the valves are moved to convert the engine from a simple to a compound by the operation of lever H and intermediate steam engine, substantially as described.

9. In a compound engine having valve mechanism in the steam chest for converting the engine from a simple to a compound, operated by the connecting rod 35, steam engine 36, valve 38, and the lever H adapted to reverse the auxiliary engine 37, in combination with the setting lever E, and the valve setting mechanism connected thereto, whereby the lever E will operate to stop, start, and reverse the engine whether it be acting as direct or compound, substantially as specified.

10. In combination with the steam piston connected up to and operating valve controlled mechanism, the cataract piston and cylinder provided with the orifices 48, passage 49, and contracted orifices 50, substantially as specified.

In testimony whereof I have hereunto set my hand.

EDWARD W. HARDEN.

Witnesses:
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C. W. MILES.