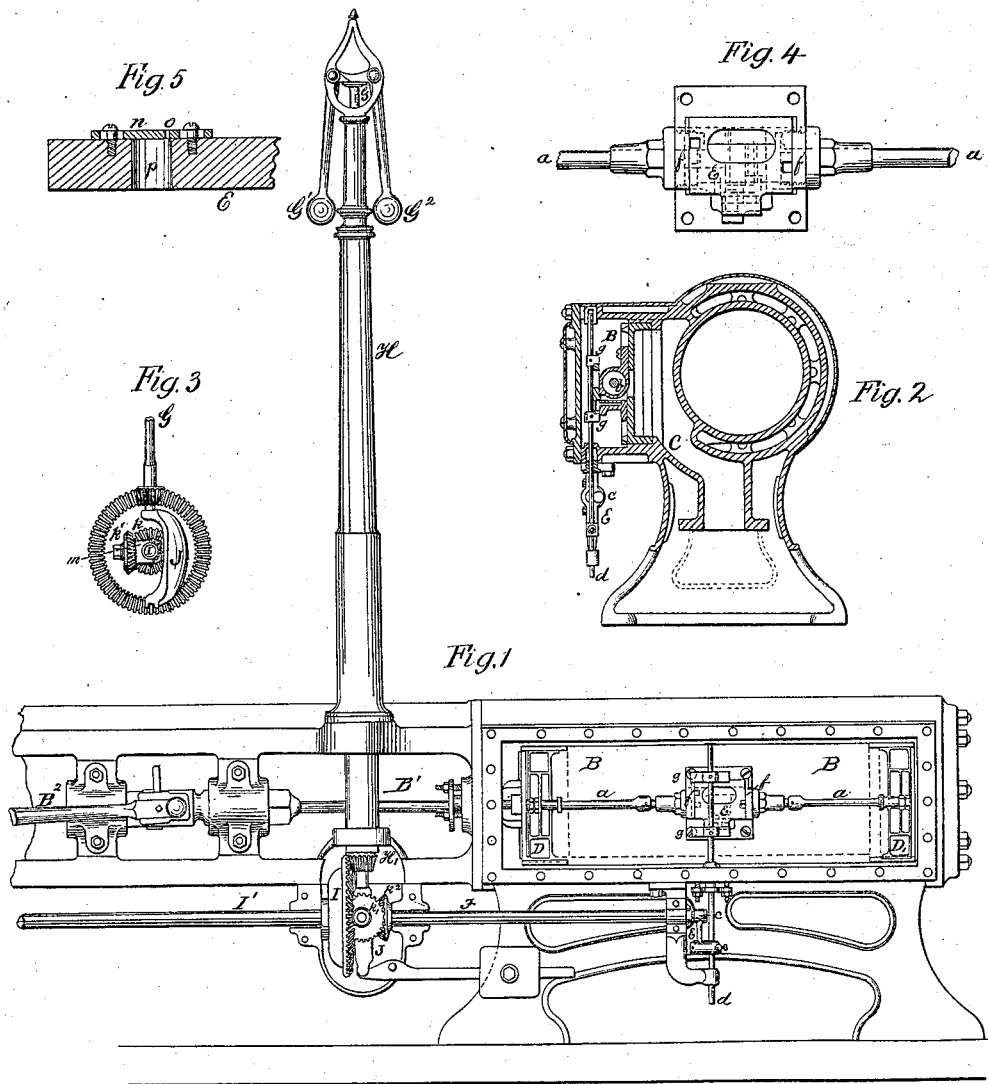


G. H. Babcock & S. Wilcox, Jr.,

Steam-Cut Off.

Patented Apr. 24, 1866.

N<sup>o</sup> 54,090.



Witnesses

Benj. F. Thurston

H. J. Spencer

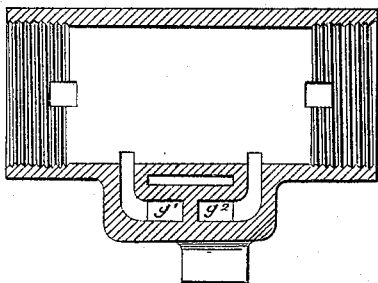
Inventor.

G. H. Babcock

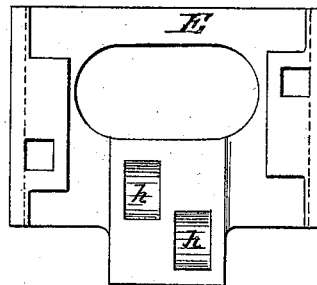
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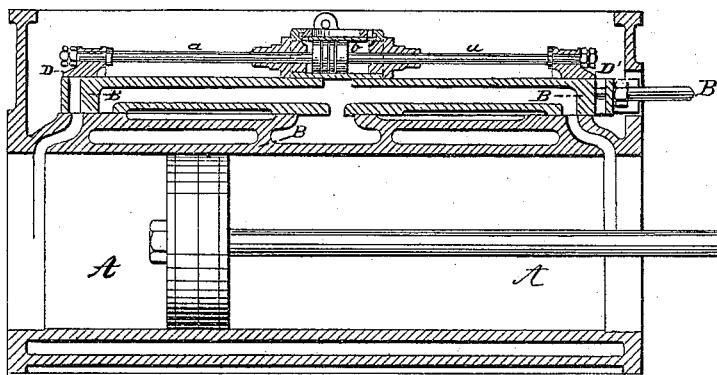
*Fig 7*



*Fig 8*



*Fig 9*



*Witnesses*

*Ben. T. Thurston*  
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*G. H. Babcock*  
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# UNITED STATES PATENT OFFICE.

GEORGE H. BABCOCK AND STEPHEN WILCOX, JR., OF PROVIDENCE, R. I.

## IMPROVEMENT IN CUT-OFF VALVES.

Specification forming part of Letters Patent No. 54,090, dated April 24, 1866.

### *To all whom it may concern:*

Be it known that we, GEORGE H. BABCOCK and STEPHEN WILCOX, Jr., both of the city and county of Providence, in the State of Rhode Island, have invented certain new and useful Improvements in Steam-Engines; and we do hereby declare that the following specification, taken in connection with the drawings making a part of the same, is a full, clear, and exact description thereof.

Sheet 1: Figure 1 is a side elevation with the bonnets of the steam-chest removed. Fig. 2 is a transverse section through the cylinder and steam-chest. Fig. 3 shows, in detail, the connection between the regulator and the cut-off-valve mechanism. Fig. 4 is an enlarged view of the valve arrangement of the auxiliary cylinder which works the cut-off. Fig. 5 shows an arrangement for preventing the too rapid admission of steam to the auxiliary cylinder.

Sheet 2: Fig. 6 is a longitudinal and horizontal section through the cylinder and steam-chest. Fig. 7 shows, in section, the arrangement of steam and exhaust ports. Fig. 8 is a view of the underside of the valve of the auxiliary cylinder, showing the exhaust-pockets.

The engine herein described does not belong to that class of steam-engines which employ a liberating valve-gear, or, in other words, a valve-gear which, to permit a cut off of the steam to be effected during the stroke of the piston, must be disconnected from the valve, in order that the latter may be free to close in less time than it was opening by an impulse derived from a force independent of the engine, but it belongs to that class in which the cut-off valves are operated through an auxiliary steam-cylinder and piston by the steam itself independently of the main-valve mechanism; and our invention consists in certain devices, combinations, and arrangements by which we make the point of cut-off variable for any desired point in the stroke of the piston in the main cylinder, and in the combination of the regulator therewith for determining automatically the point of such cut-off.

In the accompanying drawings, A represents the cylinder of a horizontal engine, the piston and its connection with the crank-shaft being the same as in ordinary engines of this class, and which, being familiar to those acquainted with the art, needs no explanation.

B is the main valve, in this instance independent of the cut-off valves, which are supplemental thereto and ride upon its back. The main valve is made with mortises through it near its ends, corresponding with the steam-ports, in the same manner as the well-known lap slide-valve of this class; and as, in this particular instance, the steam-ports are used also as exhaust-ports, apertures are cut in the under side of the valve, connecting with a hollow space between the two faces of the valve, as shown in Fig. 6, through which the steam is conducted to the main exhaust-pipe, C, Fig. 2, and the said valve has in consequence sufficient motion given to it to bring these apertures alternately in connection with the ports in the cylinder. In other words, this valve performs the same functions as the common D-valve, which admits steam through mortises cut in it instead of at the ends.

The main valve B is operated by the properly-guided valve-rod B', as shown, through the connecting-rod B<sup>2</sup>, attached to an eccentric on the main shaft in the usual way.

The cut-off valves D D' have, as here arranged, their seats upon the back of the main valve, and move simultaneously, for the reason that the rods *a a* connecting them are attached to the piston of a small auxiliary cylinder, *b*, (shown in section in Figs. 2 and 6,) which is also mounted upon the back of the main valve B.

Steam to operate the piston of the cylinder *b*, and thereby work the cut-off valves, is admitted to each side alternately through steam-ports at opposite ends of the cylinder, which are controlled by the sliding valve E, to which a reciprocating motion is given in a direction at right angles to the axis of the cylinder by means of the valve-rod *d*, which passes through a stuffing-box in the wall of the steam-chest, and is worked by an eccentric or crank, *c*, on the shaft F, with which it is connected by the link *e*.

Inasmuch as the main valve B has a motion in a line at right angles with the line of motion of the valve E, and as the latter, with the cylinder to which it belongs, rides upon the back of the former, it becomes not only necessary to provide guides *ff* upon the top of the cylinder *b*, between which the valve E can work to control the parts, but also to connect the valve-rod with the valve by means of two check-strips, *g g*, in contact with the valve at each end, be-

tween which the valve is permitted to have its endwise movement, due to the movement of the main valve, and by which it can at the same time be worked in a direction at right angles therewith.

The exhaust-steam is worked out from the small cylinder *b* through the ports *g' g''*, Fig. 7, both located upon the lower side of the cylinder, so as to freely drain the same of condensed steam, and each port has its appropriate pocket *h h'* in the valve *E*, which connects the port to which it belongs at the proper times with the exhaust-pocket of the main valve, as shown in Fig. 2.

For the purpose of preventing the piston of the auxiliary cylinder from slamming against the cylinder-heads in working the cut-off, we cover each port in the valve *E* with a plate, *n*, through which is a small orifice, *o*. (See Fig. 5.) Now, while the said valve-port is not connected with the cylinder-port, the steam will be working through the orifice and fill the space occupied by the valve-port *p*, acting as a pocket to collect the same; but so soon as the valve-port comes into connection with the cylinder-port the steam so pocketed will rush into the cylinder *b* and start the piston rapidly, but will continue to exert a diminishing force as it expands in volume until the stroke is completed, the steam which is being admitted during the stroke through the contracted orifice *o* not being sufficiently powerful, from the fact that it is so wire-drawn, to cause the piston to slam, and the size of this orifice can be adjusted to accomplish the work required.

It is obvious from the foregoing description that if the eccentric on the shaft *F*, which works the valve *E* of the auxiliary cylinder *b*, and which revolves coincidently in point of time with the eccentric on the main shaft, which works the main valve, is set relatively to the latter at any point in advance of it, it will cause the valve *E* to admit steam to the auxiliary cylinder at a corresponding point in advance of the completion of the stroke of the main piston, whereupon the cut-off valve which appertains to the port that is admitting steam to the main cylinder will be instantaneously closed, and at the same time the cut-off valve at the other end of the cylinder will uncover the aperture in the main valve to which it belongs, preparatory to the admission of steam through the port at that end for the return stroke so soon as such port shall be opened by the proper movement of the main valve, and consequently a cut off of the steam can be effected at any desired point in the stroke of the piston by adjusting the position of the eccentric on its shaft *F* correspondingly.

We determine automatically the point of cut off according to the rate of speed of the engine by the following means for combining the regulator with the cut-off-valve mechanism and for controlling the same:

The form of the regulator which we prefer is shown in Fig. 1. In this instance it is of the fly-

ball variety. The rod *G*, Figs. 1 and 3, whose range of upward or downward movement is determined by the plane in which the balls *G'* and *G''* revolve, extends through the upright hollow shaft *H*, which supports the frame of the regulator, and which is made to revolve upon its axis by means of the bevel-gear *H'*, keyed to its foot and driven by the larger bevel-gear *I* on the shaft *I'*, connected by appropriate gearing with the main shaft. The rod *G* terminates with a rack, *J*, Fig. 3, of sufficient length to comprehend the whole range of motion of the rod *G*.

The shaft *I'* and the shaft *F*, before referred to, revolve in opposite directions with each other, but in the same times as the main shaft of the engine; and the connection between the two is maintained through the bevel driving gear-wheel *k* on the shaft *I'*, the intermediate pinion, *k'*, and the driven gear-wheel *k''* on the shaft *F*. Now, although these two shafts *I'* and *F* revolve in the same times, yet a given point upon the surface of *F*, which for a given plane of revolution for the balls of the regulator will coincide at each revolution with a given point upon the surface of *I'*, will not so coincide with such point when the regulator-balls revolve in any other plane, for the reason that the intermediate pinion, *k'*, turns upon a vibrating radial axle, *m*, Fig. 3, the opposite end of which is flattened, and has for its pivot the end of the shaft *I'*, and as the end of such axle opposite the end on which the pinion is mounted is provided with a segmental gear, with the teeth of which the teeth of the rack *J* engage, (see Fig. 3,) it follows that for every change in the position of the regulator-rod *G* there will be a corresponding change in the position of the pinion *k'*—that is to say, it will be made to take a different position upon the face of the driving-gear *k*, and will thereby necessarily cause the shaft *F*, which is the only one of the two that is free to be shifted in its bearings, to be turned in the one direction or the other, and thus change the relative relation of the eccentric which controls the operation of the cut-off-valve mechanism to the eccentric which works the main-valve mechanism, the result of which will be that the point of cut off will be determined automatically by the speed of the engine.

We are aware that an auxiliary cylinder and piston to work the cut-off valves of a steam-engine has been heretofore used; but its range of operation has been heretofore limited to cutting off the steam at a fixed point within the half-stroke without the capacity of being adjusted at will variably with respect to the position of the stroke of the main piston, while our invention gives to this variety of cut-off a capacity for cutting off steam at any point in the entire stroke, and adapts the same to the control of the regulator.

We do not wish to limit ourselves to the precise construction or arrangement of the several parts as described, but mean to include all

mere formal variations of structure and arrangement involving substantially the same mode of operation.

What we do claim as our invention, and desire to secure by Letters Patent, is—

1. An auxiliary piston and cylinder to operate the cut-off of a steam-engine, to which auxiliary cylinder the admission of steam can be regulated in point of time to correspond with any desired point in the stroke of the piston in the main cylinder, substantially as described.

2. Combining with the main valve or valves an auxiliary piston and cylinder to operate the cut-off when arranged to travel with the valve, but to work independently of it, substantially as described.

3. The intermediate toothed pinion,  $k'$ , or its equivalent, connecting the valve-gear which controls the cut-off with the moving member of the engine which actuates such valve-gear,

when the same is arranged to alter the relation of such valve-gear to its moving force without breaking the connection between the two, substantially as herein described.

4. The combination, substantially as described, of a regulator with a cut-off valve-gear of the character and possessing the qualities herein specified.

5. The combination of the contracted orifice  $o$ , Fig. 5, with a pocket,  $h$ , formed by the port of the auxiliary valve E, substantially as described, and for the purposes specified.

In testimony whereof we have hereunto subscribed our names this 8th day of February, A. D. 1866.

G. H. BABCOCK.  
STEPHEN WILCOX, JR.

Witnesses:

BENJ. F. THURSTON,  
JOHN D. THURSTON.