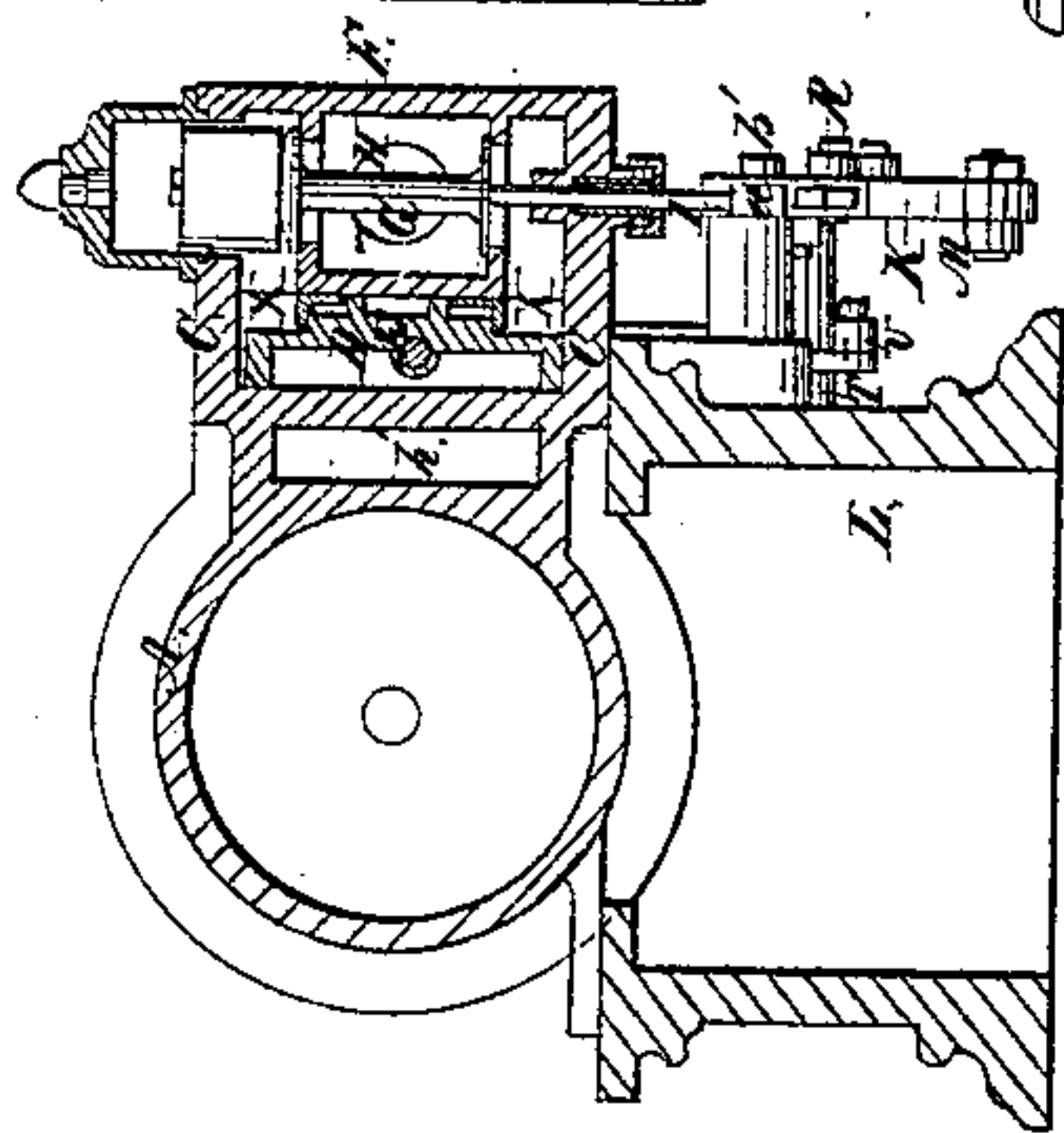
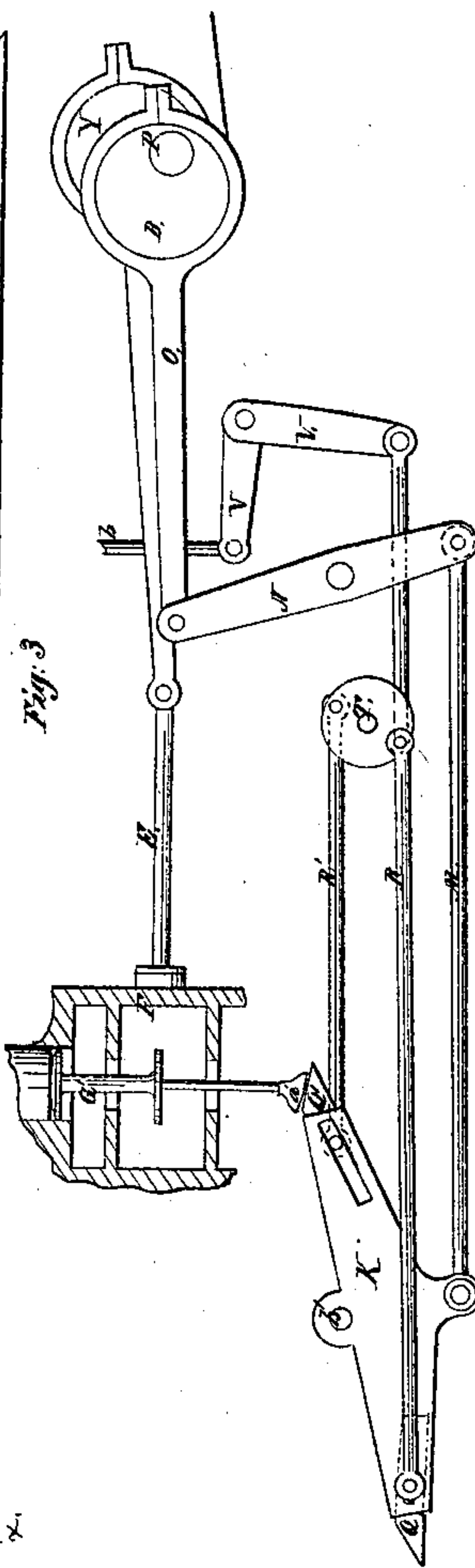
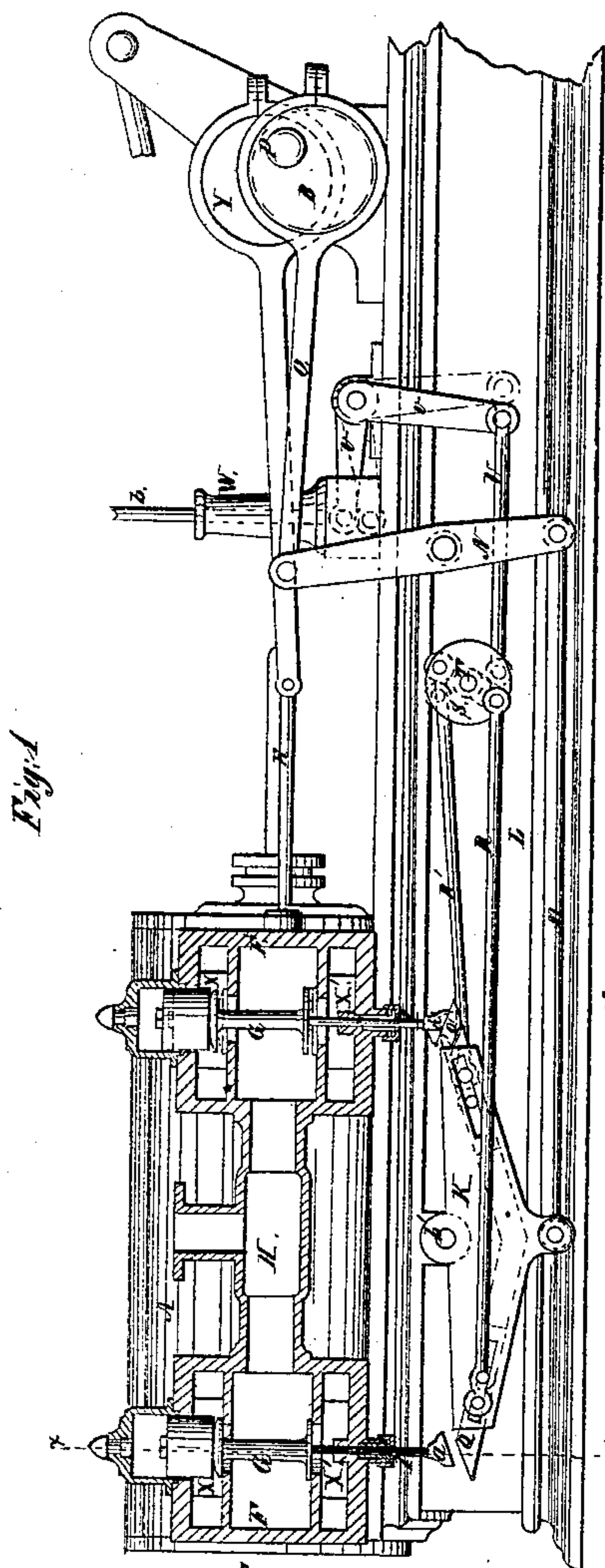


*J. Broughton,
Steam-Engine Valve-Gear.*

N^o 33,821.

Patented Dec. 3, 1861.



*Witnesses:
L. W. Bendre
John J. Smith*

*Inventor
John Broughton*

UNITED STATES PATENT OFFICE.

JOHN BROUGHTON, OF NEW YORK, N. Y.

IMPROVED CUT-OFF VALVE FOR STEAM-ENGINES.

Specification forming part of Letters Patent No. 33,821, dated December 3, 1861.

To all whom it may concern:

Be it known that I, JOHN BROUGHTON, of the city, county, and State of New York, have invented certain new and useful Improvements in the Cut-Offs of Steam-Engines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a side view of a horizontal steam-engine with my improvement applied, showing the cut-off-valve chests and the induction-pipe in section. Fig. 2 is a transverse vertical section of the same, taken in the plane indicated by the line $x x$ in Fig. 1. Fig. 3 is a side view of the valve-gear and one cut-off valve of the engine in a different position to Fig. 1.

Similar letters of reference indicate corresponding parts in the several figures.

My invention consists, principally, in the operation of the cut-off valve or valves of a steam-engine with a positive movement which is so controlled by a governor or other means independent of the eccentric or its equivalent from which such movement is derived as to be capable of producing a variable lead of the valve, and as to make the amount of lead determine the point in the stroke of the piston at which the steam is cut off.

To enable others to make and use my invention, I will proceed to describe its construction and operation.

A is the cylinder of the engine, having on one side near each end two short steam-chests C, (only one of which is shown,) provided with suitable ports and passages for the steam and containing the two main valves D, (only one of which is shown,) said valves being worked by a rod E, passing through stuffing-boxes in the chests C C. These valves are the ordinary D slide-valves, with their backs or outer faces packed and working steam-tight against the steam-chest cover to relieve them from the pressure of steam, and may be operated in the same manner as the valves of non-expansive steam-engines by an eccentric Y on the main shaft P, or by other means.

F F' are two valve chests or casings containing the cut-off valves G G', which are the ordinary double or balanced puppet-valves.

These valve chests or casings are attached in front of and serve to form the covers of the main-valve chests C.

X X' are the ports or openings in the back of the cut-off-valve chests through which the steam passes into the main-valve chests.

H is the steam-pipe connecting with and opening into the two cut-off-valve chests F F'.

h' is the exhaust-passage.

I I' are the vertical stems of the cut-off valves working through stuffing-boxes in the under sides of the valve-chests F F', and provided at their lower ends with the tappets $a a'$, the lower faces of which are beveled or inclined, as shown in Fig. 1.

K is a double-acting lifter vibrating at the point b' on a stationary pin-bearing attached to the main frame or engine-bed L. This vibrating lifter derives its motion from the connecting-rod M, which, through the lever N and rod O, is operated by an eccentric B or its equivalent upon the main shaft P.

Q Q' are movable slides working in grooves or guides in the lifter K parallel with its inclined lower edges, and having their ends beveled or inclined to correspond with the bevel or inclination of the lower faces of the tappets $a a'$, said slides forming elongating and contracting toes to the lifter K.

R R' are two light rods connected by small wrist-pins at one end to the slides Q Q' and at the other end to the disk S, which is arranged to vibrate or partly rotate on an axis T. This disk S is connected by a rod U and right-angled lever V with the vertical and central rod b of the governor W, or may be connected with any hand-gear for adjusting the sliding toes Q Q' by hand.

The operation is as follows: Assuming the position of the piston to be at one end of the cylinder, as shown in Fig. 3, and the main slide-valve without lap or lead, the position of the eccentric Y, that operates the main valve, will be at right angles to the crank; and assuming, further, the operation of the cut-off valves to be such that the induction of steam to the cylinder shall be limited to one-half the stroke of the piston, while at the same time, by automatic or other adjustment, they shall be able to cut off the steam at an infinitesimal portion of the stroke or even prevent the induction of steam altogether, the position of the eccentric B, that

operates the cut-off-valve gear, must be precisely the reverse of that of the crank and at right angles to the main eccentric Y, and the crank being now on its center the position of the cut-off eccentric is such that it will have given to the lifter K the full amount of vibration of which it is capable, and the valve G' at that end of the cylinder to which steam is to be inducted will have been raised to its highest position, or, in other words, have had its full lift produced. Assuming the engine to be in motion, the steam passes through the pipe H and through the ports of the open cut-off valve G' and is admitted to the cylinder by the opening motion of the corresponding main valve, which then commences. Simultaneously with the opening motion of the main valve D and the return motion of the piston the cut-off valve G', by the vibration of the lifter K, commences its downward or closing motion, coming to its seats and closing its ports and cutting off the further induction of steam to the cylinder when the piston arrives at half-stroke, leaving the remaining portion of the stroke to be accomplished by the expansion of the steam in the cylinder. The lifter K, by the continuation of its motion, now comes in contact with and raises the cut-off valve G at the opposite end of the cylinder, but no steam is as yet inducted into the cylinder, owing to the ports at that end being closed by the main valve. As the last-mentioned cut-off valve arrives at the extremity of its lift, the main valve comes back to its central position and the piston to the end of its stroke, after which the steam commences to be exhausted in the usual manner by the continued movement of the main valve, and the piston commences its movement in the contrary direction, steam being inducted and cut off precisely in the same manner as during the previous stroke. When steam is following the piston up to half-stroke under the above conditions and the engine working up to its full capacity, the movable slides Q Q', forming the points or toes of the lifter K, are elongated to their full extent, and at the movement of half-stroke of the piston their upper faces are in contact with the under side of both tappets *a'* on the valve-stems, the toe at one end having descended to that position and allowed the valve to drop to its seat, while the lifter at the other end has ascended to that position ready to raise the opposite valve from its seat. The slides Q Q' being connected with the governor-rod *b*, the said rod will now be at its extreme height and correspond with the lowest position of the governor. Assuming now a diminution of the work or resistance to the engine or an increase in the pressure or tension of steam in the boiler to take place, the speed of the engine will become accelerated, and the governor-balls, expanding, will carry down the rod *b*, and will, through the connection of the said rod with the slides or toes Q Q', contract or withdraw

the latter within the body of the lifter K. The withdrawal or contraction of the slides or toes, owing to the combined effect of the inclination of the said slides or toes in the body of the lifter, the inclination of their upper faces or extremities, and the inclination of the under faces of the tappets *a a'*, will cause the upper faces of the said slides or toes to recede from the tappets, leaving an open space in a vertical direction between the toes and tappets, and thus a portion of the vibrating motion of the lifter is lost to the tappets and the lead of the valve and the point at which the steam is cut off is varied. This variation of the lead and point of cut off is as follows: The eccentric B, which operates the lifter K, being secured to the main shaft in the same plane as the crank, the toes of the lifter in its vibration will invariably rise to the full extent of its lift or throw as the piston arrives at the corresponding end of its stroke. Assuming the toes of the lifter K to be elongated to their full extent, they are brought in contact with the tappets *a a'* and commence to raise the cut-off valves from their seats when the piston is at half-stroke and give their full lift as the piston comes to the end of its stroke. Consequently the downward or closing movements of the valves will be performed as the piston is making its first half-stroke and steam will be cut off at half-stroke. Now as the whole throw of the valve up or down coincides with one-half the stroke of the piston, so will any given portion of the throw of the valve coincide with a proportionate part of the stroke of the piston. Suppose, now, the sliding toes Q Q' to be partially withdrawn by the action of the governor, a portion of the vibratory movement of the lifter K will be lost to the tappets and the valves will be raised through the last portion of the lifters only, arriving at the highest point of their lift or throw, but at a less distance from their seats, as the piston comes to the end of its stroke. Consequently on the return movement of the piston, the motion of the lifter being positive and invariable, they (the valves) will arrive at their seats and cut off the steam in a proportionately shorter space of time and at an earlier point in the stroke of the piston, as is illustrated in Fig. 1 of the drawings, where the toes are represented in black outline as expanded or forced out to their full extent, and in red outline as partly drawn into the body of the lifter, the positions of the body of the lifter, the crank, and all other working parts of the engine but the toes and valves being the same in both cases, the crank rotating in the direction of the arrow shown near it, and the piston having nearly arrived at half-stroke. The end of the toe Q', in the position represented in black, has not yet descended low enough to let the valve down to its seat, but in the position shown in red outline is shown to have already let the valve close some time and to have moved some distance clear

of the face of its tappet *a*. The toes may be drawn so far into the body of the lifter by the action of the governor that the vibratory movement of the lifter K will fail to bring them into contact with the tappets *a a'* at all, and in that case the valves will not be raised from their seats and no steam will be inducted to the cylinder. Thus it will be seen that while the motion of the lifter K is positive and invariable the position of the governor or regulator will determine the position of the toes, which in their turn will determine the lead of valve-point in the stroke of the piston at which the steam is cut off.

Owing to the cut-off valves G G' being wide open when the induction of steam to the cylinder commences, they present no obstruction whatever to the free passage of the steam, and, as the main valve D, open their ports with the swiftest possible motion; or, in other words, at the direct throw of the eccentric Y the induction of the steam into the cylinder is effected freely and with the least possible obstruction. The cut-off valves may have so large an area of port and lift so proportioned as to be capable of admitting steam to the full capacity of the steam-pipe when at a distance from their seats or ports of about one-fifth part of their whole lift, and hence though they commence their closing motion as the main valves commence their opening motion they need have no actual effect to cut off the steam or diminish the area of their ports below the capacity of the steam-pipe until they have nearly completed their closing motion, and as the last portion of their

closing motion takes place as the eccentric arrives at or approaches its direct throw the closing motion is very rapid and their operation approximates in its effects to that of an instantaneous or tripping cut-off. Thus the steam is cut off with the least possible amount of strangulation or wire-drawing, and consequently to the best possible advantage.

In addition to the advantage above specified, this mode of operating the cut-off valves has the advantages of a positive action, requiring but a very slight expenditure of power, and of being performed by very simple mechanism, which is very little liable to wear or get out of order.

Having thus described my invention, I will proceed to state what I claim and desire to secure by Letters Patent.

1. Regulating the velocity of a steam-engine by combining the regulator with a positively-operating valve-gear when such regulator determines the lead of the valve, and the lead of the valve is made to determine the point in the stroke of the piston at which the steam is cut off.

2. In combination with a lifter K, having a certain movement in relation to the main valve, the sliding bevel-faced toes Q Q', inclined tappets *a a'*, and rods I I', or their equivalents, operating substantially in the manner explained to impart a positive movement to the cut-off valves G G'.

JOHN BROUGHTON.

Witnesses:

L. W. BENDRÉ,
JNO. H. SCOTTE.