(No Model.)

5 Sheets—Sheet 1.

J. BARRETT.

VALVE GEAR.

No. 260,522.

Patented July 4, 1882.

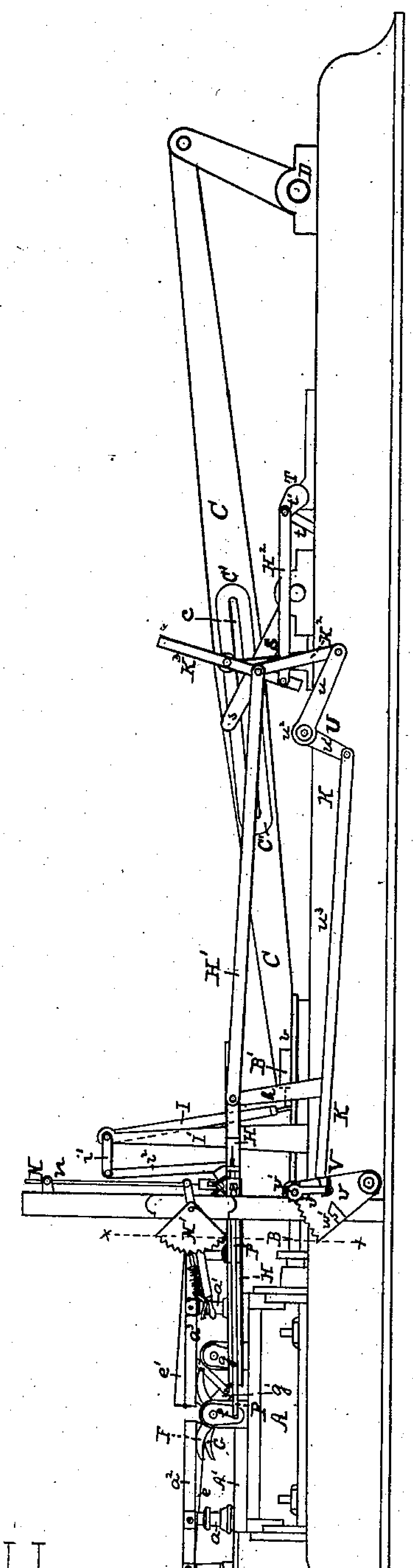

Fig. 1

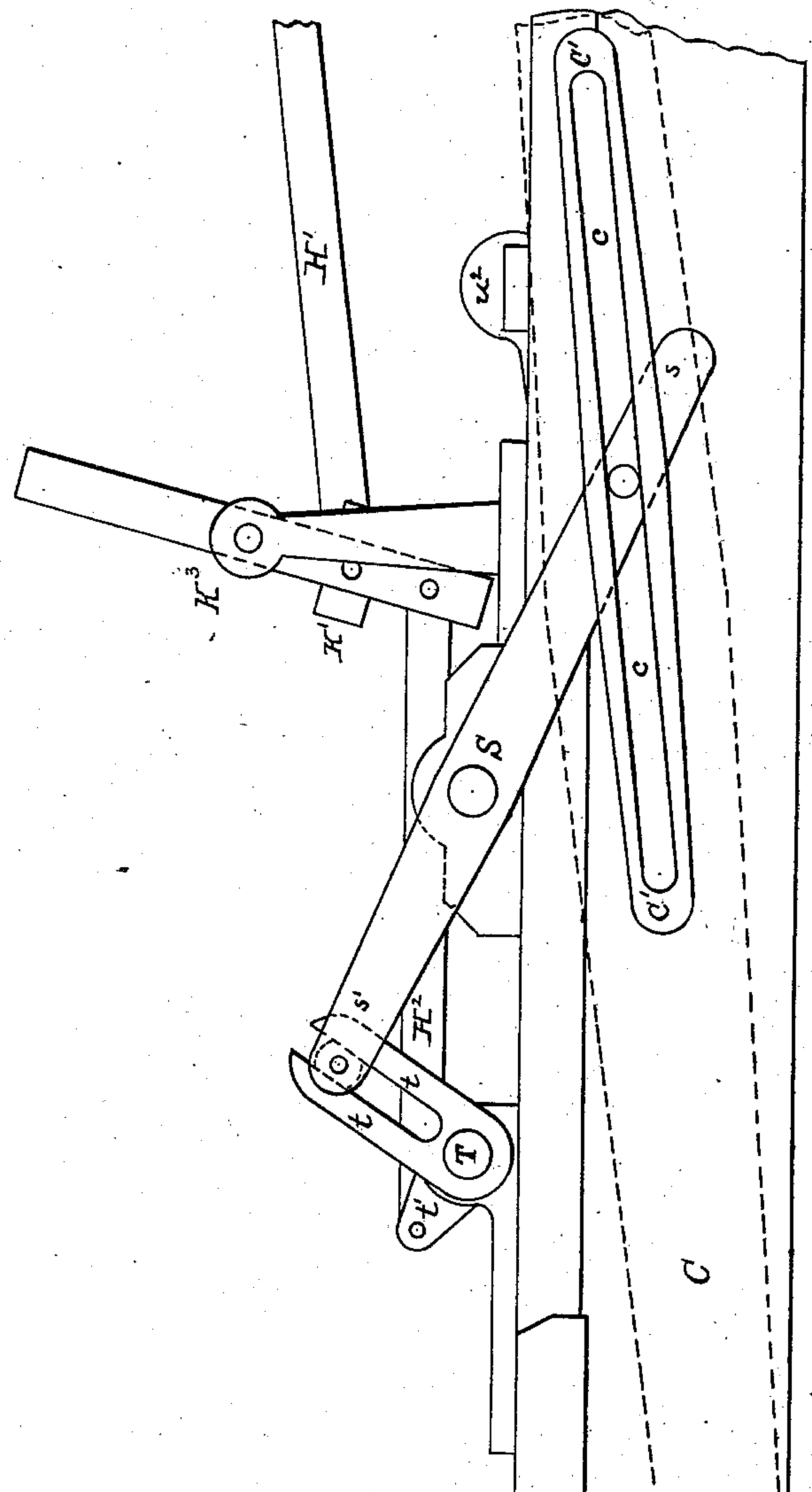

Fig. 2

WITNESSES_

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R. C. Winshall

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Josiah Barrett
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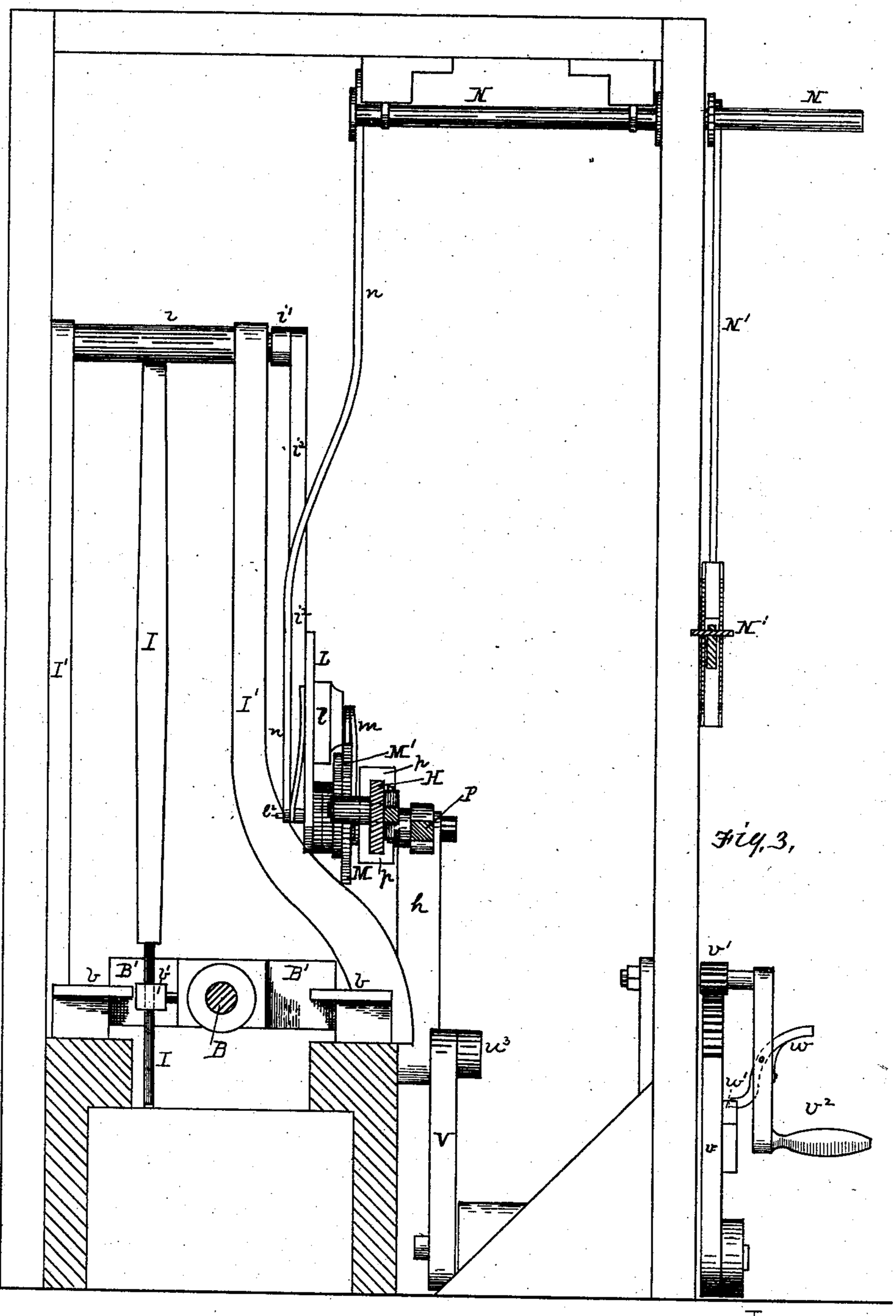
(No Model.)

5 Sheets—Sheet 2.

J. BARRETT.

VALVE GEAR.

No. 260,522. Patented July 4, 1882.



WITNESSES.

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(No Model.) 5 Sheets—Sheet 3.

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VALVE GEAR.

No. 260,522. Patented July 4, 1882.

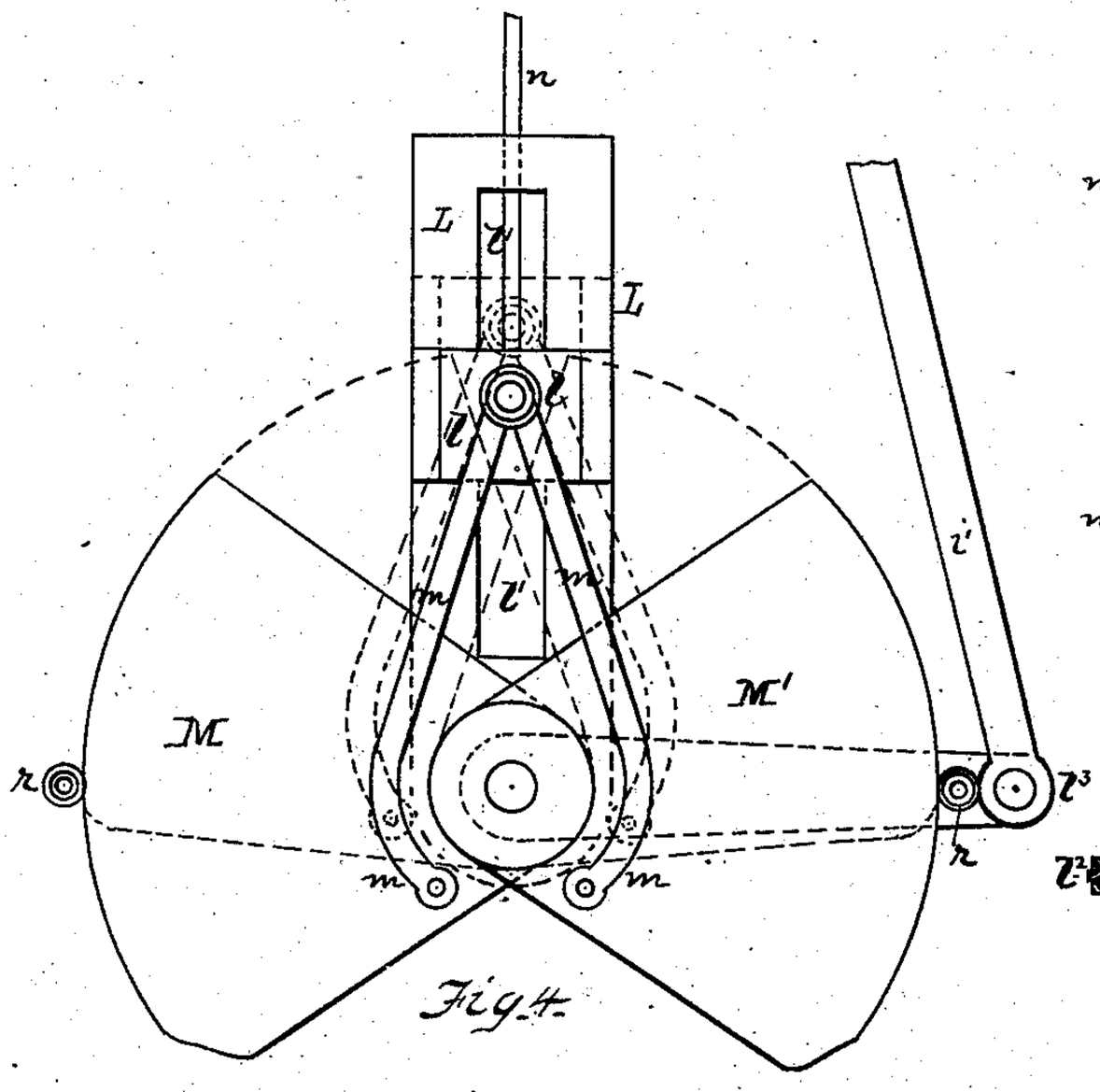

Fig. 4.

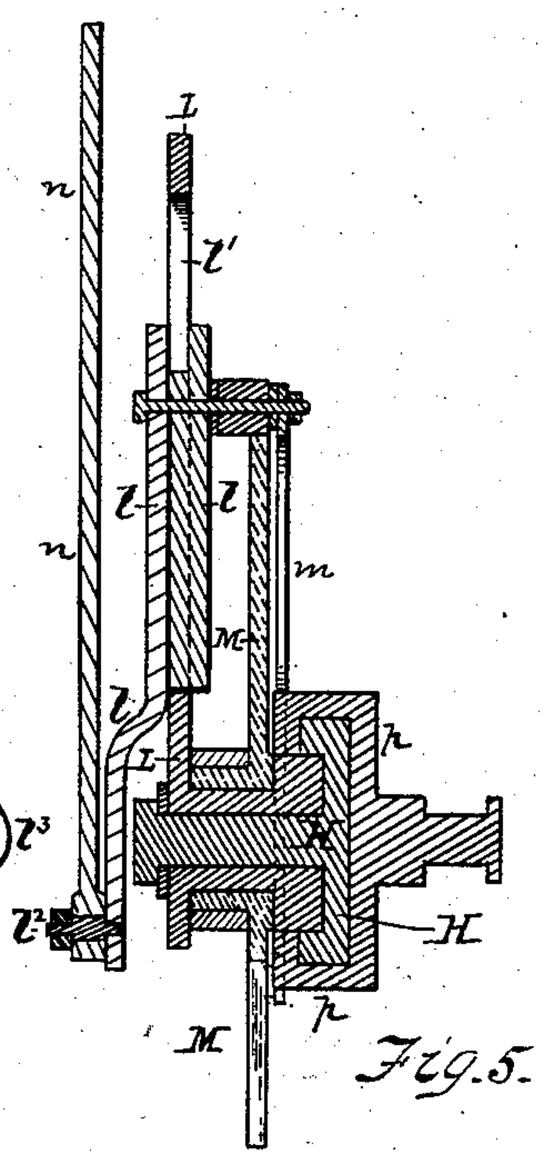

Fig. 5.

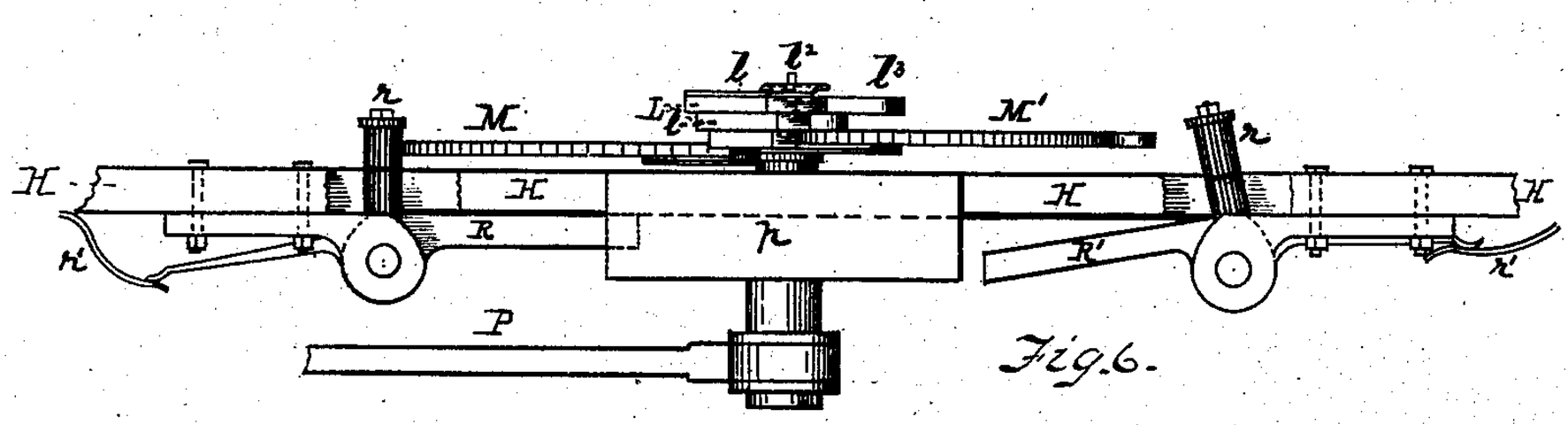

Fig. 6.

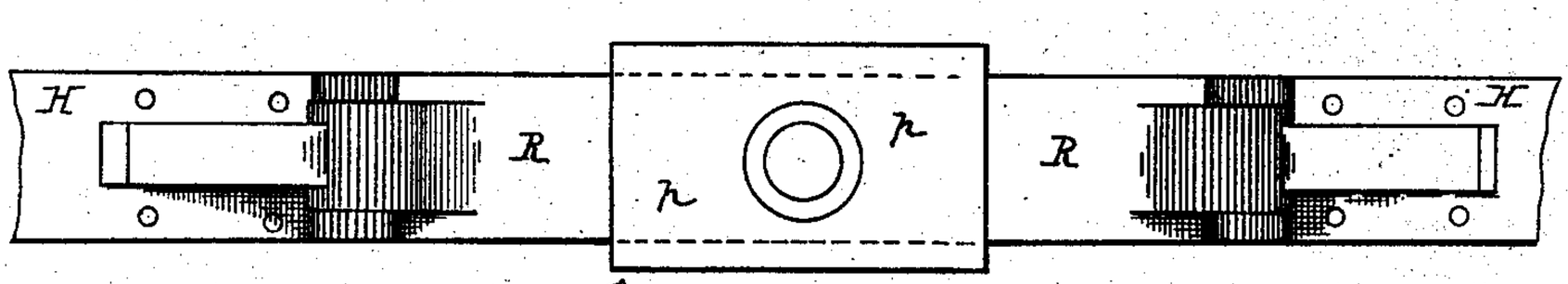

Fig. 7.

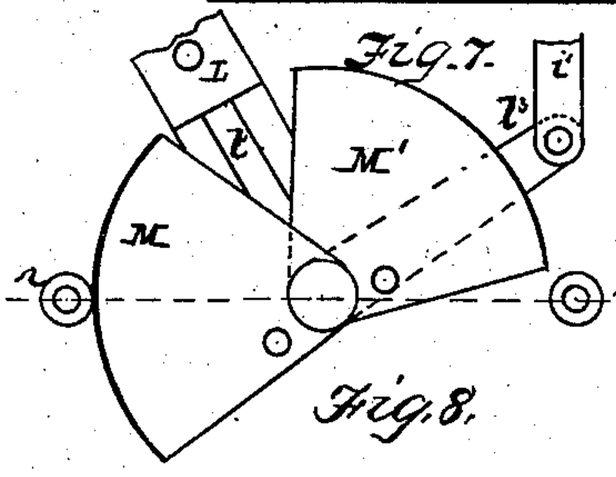

Fig. 8.

Witnesses.
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(No Model.) 5 Sheets—Sheet 4.

J. BARRETT.

VALVE GEAR.

No. 260,522. Patented July 4, 1882.

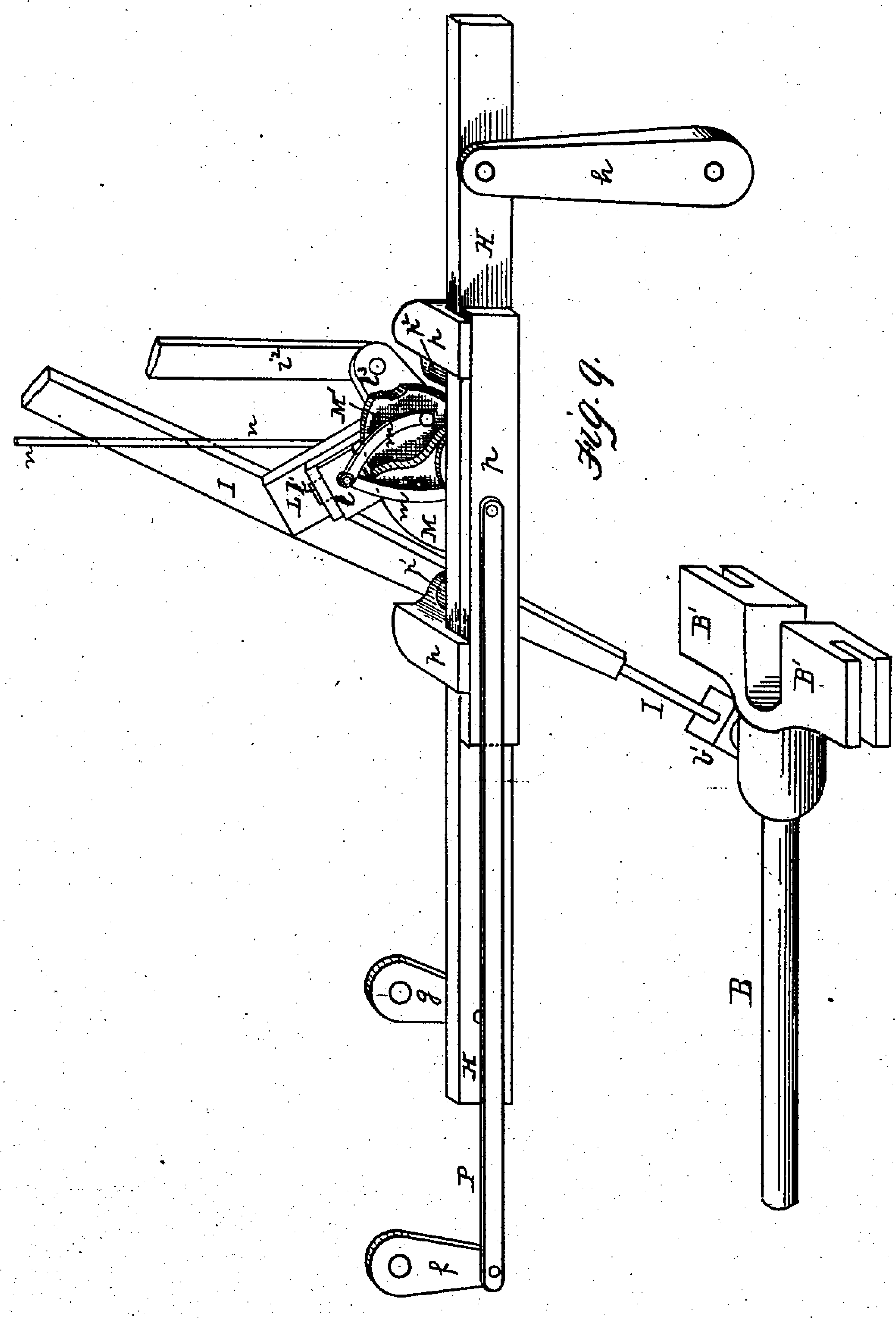

Fig. 9.

Witnesses.

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5 Sheets—Sheet 5.

J. BARRETT.

VALVE GEAR.

No. 260,522.

Patented July 4, 1882.

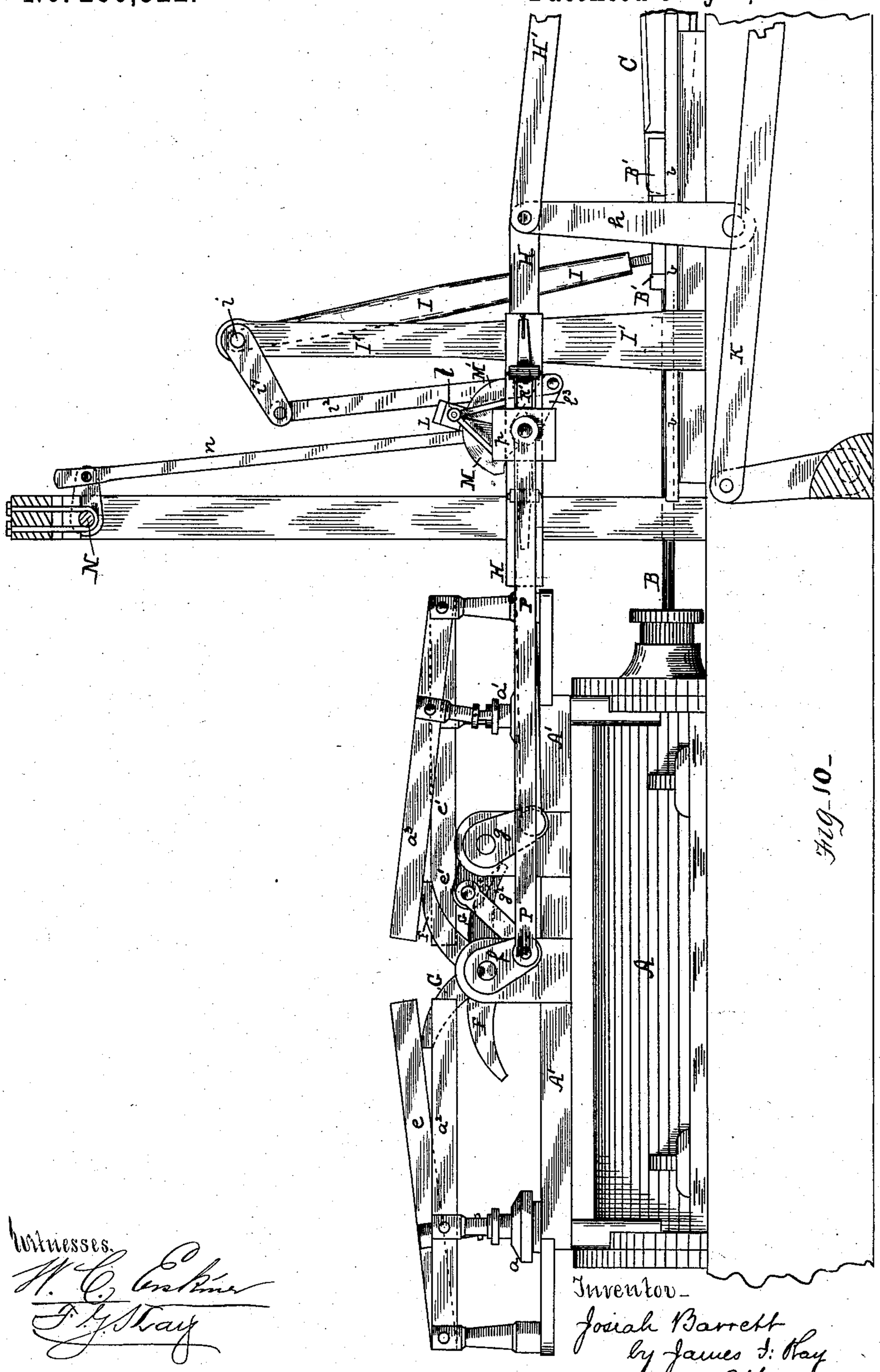

FIG. 10.

Witnesses.
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UNITED STATES PATENT OFFICE.

JOSIAH BARRETT, OF PITTSBURG, PENNSYLVANIA.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 260,522, dated July 4, 1882.

Application filed November 16, 1881. (No model.)

To all whom it may concern:

Be it known that I, JOSIAH BARRETT, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Valve-Gear for Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof, reference being had to the accompanying drawings, forming a part of this specification, in which—

Figure 1 is a front elevation of a steam-engine illustrating my invention. Fig. 2 is a detached rear view, illustrating the movement of the apparatus for operating the cam-rods. Fig. 3 is a cross-section of the apparatus on the line *x x*, Fig. 1. Fig. 4 is a face view of the variable cams, the cam-rod being removed and only the idle-wheels of the spring-pawls being shown. Fig. 5 is a vertical cross-section of the variable cams and connecting-rods; Fig. 6, a detached top view of the variable cams and connecting-rods. Fig. 7 is a side view of the cam-rod and its pawls. Fig. 8 is a detail view, showing the vibratory movement of the cut-off. Fig. 9 is a detached perspective view of a modification of the cut-off apparatus. Fig. 10 is an enlarged front view of the cylinder end of the steam-engine shown in Fig. 1.

Like letters of reference indicate like parts in each.

My invention relates to apparatus for operating the valves of steam-engines, and has special reference to heavy mill-engines and the engines used on steamboats and vessels, known as "river-engines."

It consists, first, in improved apparatus whereby the supply of steam to the engine can be regulated to cut off at a full stroke or any required part thereof, being varied at the will of the operator during the movement of the engine, if so desired; second, in apparatus for imparting from the pitman of the engine the desired movement to the rod which operates the valve apparatus; and, third, in certain improvements in the construction of the apparatus employed.

To enable others skilled in the art to make and use my invention, I will describe its construction and operation.

In the drawings, A represents the steam-cylinder, B the piston-rod, C the pitman, and D the paddle-wheel or fly-wheel shaft, of an ordinary steamboat-engine, neither paddle-wheel nor fly-wheel being shown.

The cylinder A has the ordinary steam-supply pipe, A′, and steam-exhaust pipe back of it, (not shown,) and the supply-valves *a a′* and exhaust-valves (not shown) on the opposite side above the cylinder, the supply-valves being opened by the supply-valve rods a^2 a^3 and the exhaust-valves by the exhaust-valve rods *e e′*. The supply-valve rods a^2 a^3 are lifted by the supply-lifter F, which is rigidly secured to a shaft mounted in suitable bearings above the center of the cylinder A and turned by means of an arm, *f*, secured thereto. The exhaust-valve rods *e e′* are lifted by the exhaust-lifter G, which works loosely on the supply-lifter shaft, and is provided with an arm, *g′*, connected by a rod with an arm secured to a shaft mounted above the cylinder at the side of the supply-lifter, said shaft having an arm, *g*, connected to the cam-rod H. These parts, except the cam-rod, are of the usual construction on river-engines and are operated in the usual manner.

Secured to either side of the slide *b*, on which the T-head B′ of the piston-rod works, are the uprights I′, at the top of which is mounted the shaft *i*, to which the pendulum I is secured, the lower end of this pendulum sliding in a socket, *b′*, pivoted on the T-head B′, so that as the T-head moves back and forth on the slide *b* a vibratory motion is imparted to the pendulum and through its shaft to the crank-arm *i′*.

The cam-rod is divided into several parts, H, H′, and H^2, the part H being pivoted to the crank-arm *g* and to an upright pivoted bar, *h*, by which it is held in proper position, and the part H′ extending back to the reversing apparatus K, referred to hereinafter, while the part H^2 connects with the cam on the paddle-wheel shaft or to other operating apparatus, as hereinafter described.

Mounted on a shaft extending from the back of the cam-rod H is the cut-off frame L, having an arm, l^3, extending at right angles therefrom, which arm is connected to the crank-arm *i′* of the pendulum-shaft *i* by a rod, i^2, so that the motion obtained from the pendulum is imparted to the frame L. A long slot, *l′*, is formed in this frame L, in which slot a slide, *l*, is mounted, part of the slide working on the back of the frame, and having an extension carry-

ing a pin or spindle, l^2. The pin l^2 is supported on the extension in such position that on the longitudinal movement of the slide l in the slot l' the pin is held approximately in line with the shaft on which the frame is pivoted, so that on the vibration of the frame the pin, being at or near the pivotal point of the frame, has little motion, except a partial rotary motion, it being arranged in this manner for the reason hereinafter shown.

Mounted on the same shaft with the frame L are the cut-off cams M M′, each cam being substantially a quarter arc or segment of a circle, the lower edge of which is slightly curved off. The cams are connected to the slide l by means of arms m, pivoted to both cams and slides, being so arranged that the cams are spread out or folded past each other upon the movement of the slide in the slot l', and the cut-off being by means of these variable cams changed at the will of the operator. This variation of the cut-off cams is obtained by means of a rod, n, connected at the bottom to the pin l^2 of the slide l and connected at the top to an arm on a shaft, N, extending across the top of the engine-room, or otherwise supported above the engine, this shaft N being turned to vary the cut-off by any suitable apparatus, N′, within the reach of the engineer.

Mounted on the front of the cam-rod H is a slide, p, which is generally formed in the shape of a block adapted to slide back and forth along the cam-rod, and a rod, P, extends from this sliding block p to the arm f, which operates the receiving-lifter F, so that on the movement of the block p the receiving-valves a a' are opened or closed, as desired.

Pivoted to the cam-rod H on either side of the shaft carrying the cut-off cams M M′ are the spring-pawls R R′, which operate in the front of the cam-rod in the course of the sliding block p, so as to hold the block and cause the cam-rod H to draw the rod P back and forth with it during all of its movement when a full stroke is desired, and during part when the cut-off cams are arranged to withdraw the pawls.

The pawls are held out, as above described, by the springs r', except when drawn back by the cut-off cams M M′, which is accomplished when either cut-off cam M or M′, on its vibration, comes against a pin or idle wheel, r, on one of the pawls and withdraws either pawl out of the course of the sliding block. As soon as the sliding block p is thus freed from the pawl there is no force to sustain the supply-lifter F, and the weight of the supply-valve rods a^2 or a^3 presses down the supply-lifter and closes or cuts off the steam-supply before the stroke is finished, the expansion of the steam carrying the piston the balance of the stroke.

On the side or face of the pitman C, at about the center of the pitman, is secured a plate, C′, having a long straight slot, c, formed therein.

Mounted in a suitable journal on the bed-frame of the engine is the rock-shaft S, which has at each end a pivoted block, one block of which fits into the long slot c on the pitman and the other block fits into the slotted or forked arm t of the double crank T, the other crank, t', of which is connected with the part H^2 of the cam-rod.

A slide-rod may be secured to the pitman instead of the slot formed therein, and a slide connected with the rock-shaft be mounted thereon; and this I consider equally within my invention.

Upon the movement of the pitman back and forth at each stroke of the engine, as it rises and falls in converting the longitudinal into rotary motion, the end of the rock-shaft S pivoted in the slot c is raised and lowered thereby, and at its opposite end imparts the reverse movement to the slotted arm t of the double crank T, which causes a rocking movement of the double crank, and through the crank-arm t' draws the cam-rods back and forth, imparting to them the same movement as is usually obtained from the cam and cam-yoke on the paddle-wheel shaft. As the pivoted block at one end of the rock-shaft slides in the slotted arm t of the double crank T, it is evident that it imparts the quickest movement to the crank T when near the base of the slot. By this means the quick movement necessary to open and close the engine-valves is imparted through the crank to the cam-rod when the pivoted block is near the base of the slotted arm t, and comparatively little movement is imparted to the crank when the pivoted block is at the end of the slotted arm, the quick movement therefrom being only obtained when desired.

The reversing apparatus K shown is that ordinarily known as the "Stephenson Reverse," there being a slide-rod, K^3, pivoted on a standard secured to the engine bed-frame, and a block, K′, sliding thereon, this block K′ having a pin on which the back end of the cam-rod H′ works, a rod, K^2, being also pivoted thereon, and connecting with one arm, u, of an elbow, U, pivoted at u^2 to the bed-frame. The other arm, u', of the elbow connects with a rod, u^3, extending forward to the throttle in proper position for operation by the engineer, and is connected to one arm of a double crank, V. This crank has usually been operated by a hand-lever; but it often happens that on attempting to reverse the steam-pressure acts against the reversing of the apparatus, and the strength of the engineer is not sufficient to accomplish it. I have therefore formed the one arm v of the double crank V in the shape of a segment of a circle having its periphery cogged, and have mounted on a standard above the cogged segment a pinion, v', meshing into the cogs of the segment and turned by a handle, v^2.

To reverse the engine the pinion is rotated, and thus throws the crank V forward, and through the rod u^3, elbow U, and rod K^2 raises the block K′ on the slide K^3 until it is raised past the pivotal point of the slide, thus causing the reversing of the apparatus.

The apparatus is locked by means of a spring-catch, w, on the handle v^2, which catches in a

seat, w', on the cogged segment v, in whichever position the apparatus is arranged. The force necessary to reverse is thus greatly reduced and the apparatus arranged to be wholly within the control of the engineer. The apparatus shown is arranged as one of two engines to be used on a steamboat or vessel, the paddle-wheel operating as the ordinary fly-wheel and overcoming the dead-point, and the shaft N has connected to it the cut-off-regulating apparatus of the opposite engine, so that the cut-off apparatus of both engines can be changed or varied by the engineer from one place and at the same time.

My improved valve-operating apparatus works in the following manner: The supply-valve a at the front of the cylinder is opened by means of the supply-lifter F, which raises the valve-rod a^2, the lifter F being held in position through the arm f, rod P, and slide p, which presses against the spring-pawl R'. At the same time the rear exhaust-valve is opened through the exhaust-lift G and exhaust-valve rod e'. Steam having been admitted, it forces back the piston, and through the piston-rod B the pitman C, the pitman raising the paddle-wheel crank, and of course being raised at an angle to the piston-rod. During the backward movement of the pitman the forward end, s, of the shaft S, by its block fitting in the slot or groove c, is first slightly raised; but as soon as the back end of the pitman passes its highest point and begins to descend the end s of the rock-shaft S is lowered, consequently lifting the back end, s', of the rock-shaft, which, by its block sliding in the slotted arm t of the double crank T, at the proper time, by the quick motion obtained as above described, raises this arm, and by the arm t' draws back the cam-rods H^2, H', and H, the cam-rod H being connected with the exhaust-valve apparatus, and through the arms g and g' operates the exhaust-lifter G, opening the forward exhaust-valve ready for the next stroke. During the backward movement of the piston the pendulum is swung backward by the pivoted socket b', and through the arm i', rod i^2, and arm l^3 vibrates or tilts the frame L and cut-off cams M M' over toward the rear, causing the cam M' to press against the idle-wheel r on the spring-pawl R', withdrawing the pawl and freeing the block p, so that it can slide in a backward direction over the pawl, when, as the rod P no longer supports the supply-lifter F, the lever a^2 presses down the lifter and closes the valve, the block p sliding along the cam-rod over the pawl R'. As the cam-rods are drawn back, as above described, they open the forward exhaust-valve by means of the valve-rod e, and when the pawl K comes against the slide p draw with them this slide p, and through it and the rod P, arm f, and lifter F open the rear supply-valve, a', so that the steam entering through this supply-valve forces the piston forward, when the motions above described are reversed, the pitman C, on its forward motion through the slot c, raising the forward arm, s, of the rock-shaft S, and by its rear arm, s', lowering the slotted or forked arm t of the double crank T, which by its arm t', at the proper time, draws forward the cam-rods, so as to open the rear exhaust-valve by means of the valve-rod e', and also the forward supply-valve, a, at the end of the stroke. In the meantime the pendulum, swinging forward, by means of the connections, vibrates or tilts the frame L and cut-off cams M M' over toward the front, causing the cam M to press against the idle-wheel r on the spring-pawl R, withdrawing the pawl and freeing the sliding block p, so that the weight of the rear supply-valve rod, a^3, will press down the supply-lifter F, thus closing the supply-valve and causing the slide p to slide forward over the pawl R along the cam-rod, where it rests till caught by the pawl R' on the forward movement of the cam-rod, the pawl R' having been thrown out by the spring as soon as freed by the tilting of the cut-off cams. The stroke is then repeated, the apparatus operating in the manner above set forth. If the usual cam on the paddle or fly wheel shaft is employed, the movement of the cam-rods is obtained therefrom in the usual manner.

In order to vary the cut-off so that steam is supplied to the piston during the full stroke, or is cut off at any desired part of the stroke, the cut-off cams M M' are closed together or spread open, so as to operate on the spring-pawls R R' at any desired time of the stroke. This is accomplished by means of the rod n and its connections, as above described. To spread the cams so as to cut off earlier in the stroke, the rod n is forced down, and, drawing on the slide l by the pin l^2, causes the arms m to press out and spread the cams, and as the frame L is vibrated the cams come in contact with the pawls, free the sliding bar, and cut off the supply-valve earlier in the stroke; and to give more steam to the piston the rod n is raised, so as to fold the cams past each other and cause them to trip the pawls and cut off later. By folding the cams past each other, so that they do not trip the pawls, the pawls hold the slide p and cause it to move with the cam-rod H, thus giving a full stroke.

The slide l is arranged to support the pin l^2 approximately at the pivotal point of the frame, so that little or no motion is imparted to the rod by the vibration of the cam-frame, and as its force is exerted at the dead-point of the frame, it can operate to vary the cut-off cams during the motion of the apparatus. As the cut-off apparatus of both engines is secured to the same operating-shaft, they can both be varied at the same time by one operation.

It is evident that the exact form of the cut-off cams may be varied, and that they may be supplied with arms or supplemental devices for tripping the pawls.

In Fig. 9 is shown a modification of my improved cut-off apparatus, by which the valves are prevented from dropping when cut off, this dropping of the valves wearing away the pack-

ing and causing a jar to the machinery. In it the slide *p* is made in the form of a yoke, which slides on the cam-rod H, and is provided with an idle-wheel, p' p^2, on either side of the cut-off cams M M′. The cams are of substantially the same shape, the lower edges being curved in slightly more, and they are vibrated by the same apparatus, the relative time of their vibration being slightly altered. The supply-lifter F is connected to the slide *p* by the same rod P. On the operation of the engine with this form of cut-off the cams are vibrated by the pendulum I, so as to hold the supply-valve open by the edge of one cam pressing against the idle-wheel p' or p^2 until the time to cut off, when the cam is raised so that the idle-wheel runs down the lower curved edge of the cam and causes the valve to fall without shock. To arrange the cut-off for full stroke, it is spread so as to hold the slide *p* and cam-rod together, the idle-wheels playing up and down the cams as they are vibrated.

No claim is made herein to the special apparatus shown in this modification, as it will be made the subject of another application.

Where it is desired to regulate the cut-off by means of a governor, as is sometimes done in stationary mill-engines, this can be accomplished by connecting the rod *n* with the governor, the motion of which will thus operate to spread out or fold together the cams M M′ and vary the cut-off as desired.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In combination with a cam-rod operating the exhaust-valves of a steam-engine, a cut-off located on the cam-rod and a slide mounted on the cam-rod and connected with the supply-valves of the engine, substantially as and for the purposes set forth.

2. In combination with a cam-rod operating the exhaust-valves of a steam-engine, a vibrating cut-off pivoted on the cam-rod and a slide mounted on the cam-rod and connected with the supply-valves, substantially as and for the purposes set forth.

3. A cut-off for steam-engines formed of two segmental cams adapted to be spread out or folded together to vary the cut-off, substantially as and for the purposes set forth.

4. The variable cut-off cams M M′, mounted in the frame L, in combination with the slide *l* and rods *m* *m*, substantially as and for the purposes set forth.

5. The variable cut-off cams M M′, mounted in the pivoted frame L, in combination with the rods *m* *m*, slide *l*, having spindle l^2 approximately at the pivotal point of the frame, and apparatus secured to the spindle for operating the slide, substantially as and for the purposes set forth.

6. In combination with the variable cut-off cams M M′, mounted on the pivoted frame L, the rods *m* *m*, slide *l*, carrying a spindle, l^2, approximately at the pivotal point of the frame, shaft N, and rod *u*, connecting the spindle of the slide with the shaft, substantially as and for the purposes set forth.

7. In combination with a pendulum operated by the stroke of the engine, a cut-off pivoted on the cam-shaft, and connecting mechanism, whereby a vibrating motion is imparted to the cut-off, substantially as and for the purposes set forth.

8. The combination of the cut-off frame L, pivoted on the cam-rod H, and having an arm, l^3, the pendulum-shaft *i*, having an arm, i', rod i^2, and pendulum I, substantially as and for the purposes set forth.

9. The cam-rod H, having the spring-pawls R R′, in combination with the slide *p* and cut-off apparatus for operating the pawls, substantially as and for the purposes set forth.

10. The combination of the cam-rod H, connected with the exhaust-valve apparatus, slide *p*, sliding thereon, and connected with the supply-valve apparatus, and a cut-off mounted on the cam-rod to operate the slide, substantially as and for the purposes set forth.

11. The combination of the cam-rod H, slide *p*, mounted thereon, spring-pawls R R′, and vibrating cut-off cams M M′, pivoted on the cam-rod, substantially as and for the purposes set forth.

12. The combination of the pivoted cut-off cams M M′ and spring-pawls R R′, having tripping devices *r* in the line of movement of the cams, substantially as and for the purposes set forth.

13. In combination with the pitman C, having the slot *c*, the rock-shaft S, working in the slot *c*, whereby, on the rising and lowering of the pitman, a rocking motion is imparted to the rock-shaft to operate the cam-rod of the engine, substantially as set forth.

14. The combination of the pitman C, having the slot *c*, crank T, having the slotted arm *t*, and rock-shaft S, working in the slot *c* and slotted arm *t*, substantially as and for the purposes set forth.

15. The combination of the engine-pitman C, having slot *c*, the double crank T, having arm t', connecting with the cam-rod and slotted arm *t*, and the rock-shaft S, working in the slot *c*, and slotted arm *t*, substantially as and for the purposes set forth.

16. In combination with the reversing apparatus K, the double crank V, having the cogged segmental arm *v*, the pinion v', and the handle v^2, substantially as and for the purposes set forth.

17. In combination with the reversing apparatus K and double crank V, the cogged segmental arm *v*, having the locking-seats w', pinion v', and handle v^2, having the spring-catch *w*, substantially as and for the purposes set forth.

In testimony whereof I, the said JOSIAH BARRETT, have hereunto set my hand.

Witnesses: JOSIAH BARRETT.

JAMES I. KAY,

F. G. KAY.