(No Model.) 3 Sheets—Sheet 1.

J. D. CITÉ.

CUT-OFF VALVE GEAR.

No. 332,381. Patented Dec. 15, 1885.

Fig. 1.

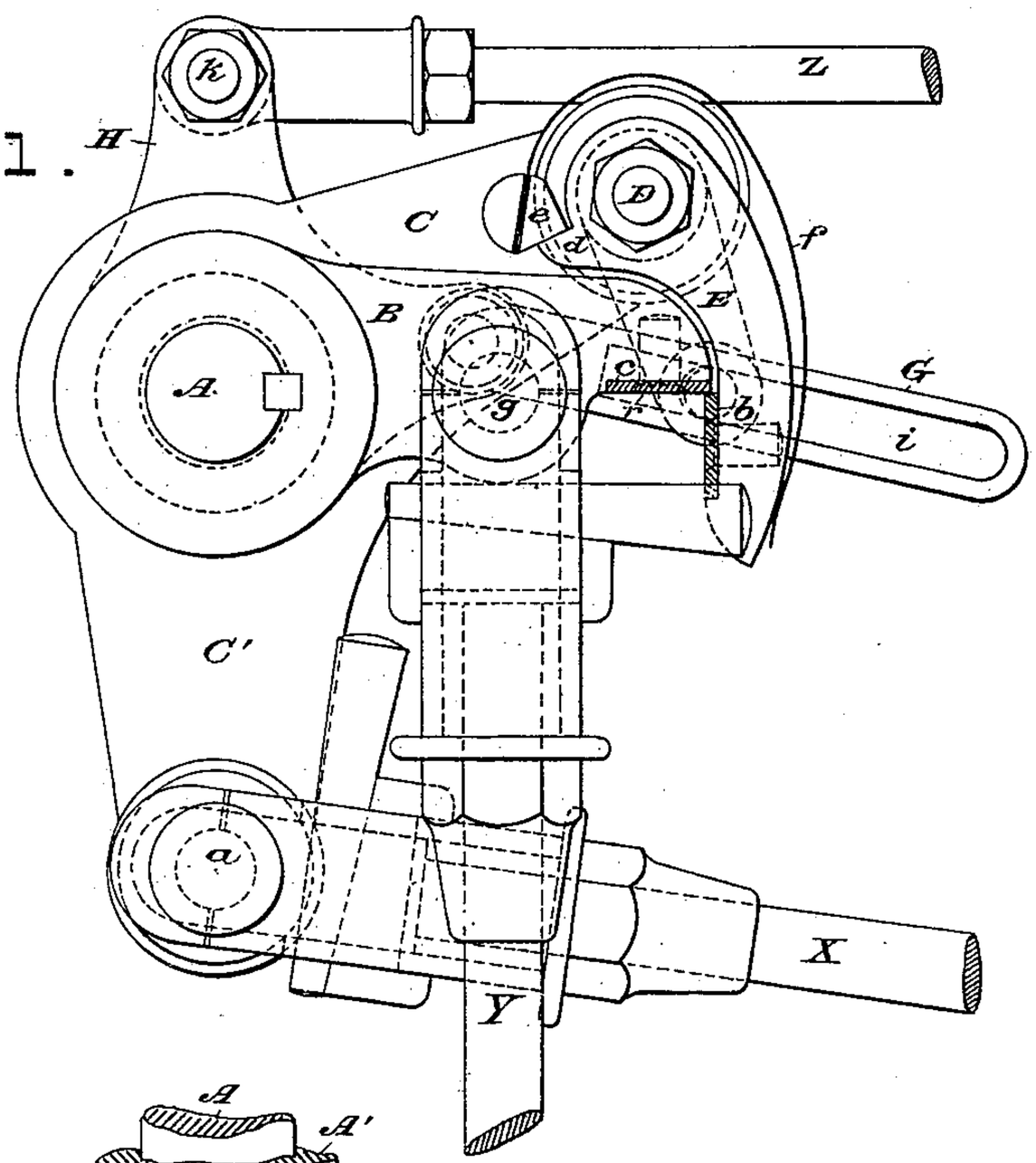
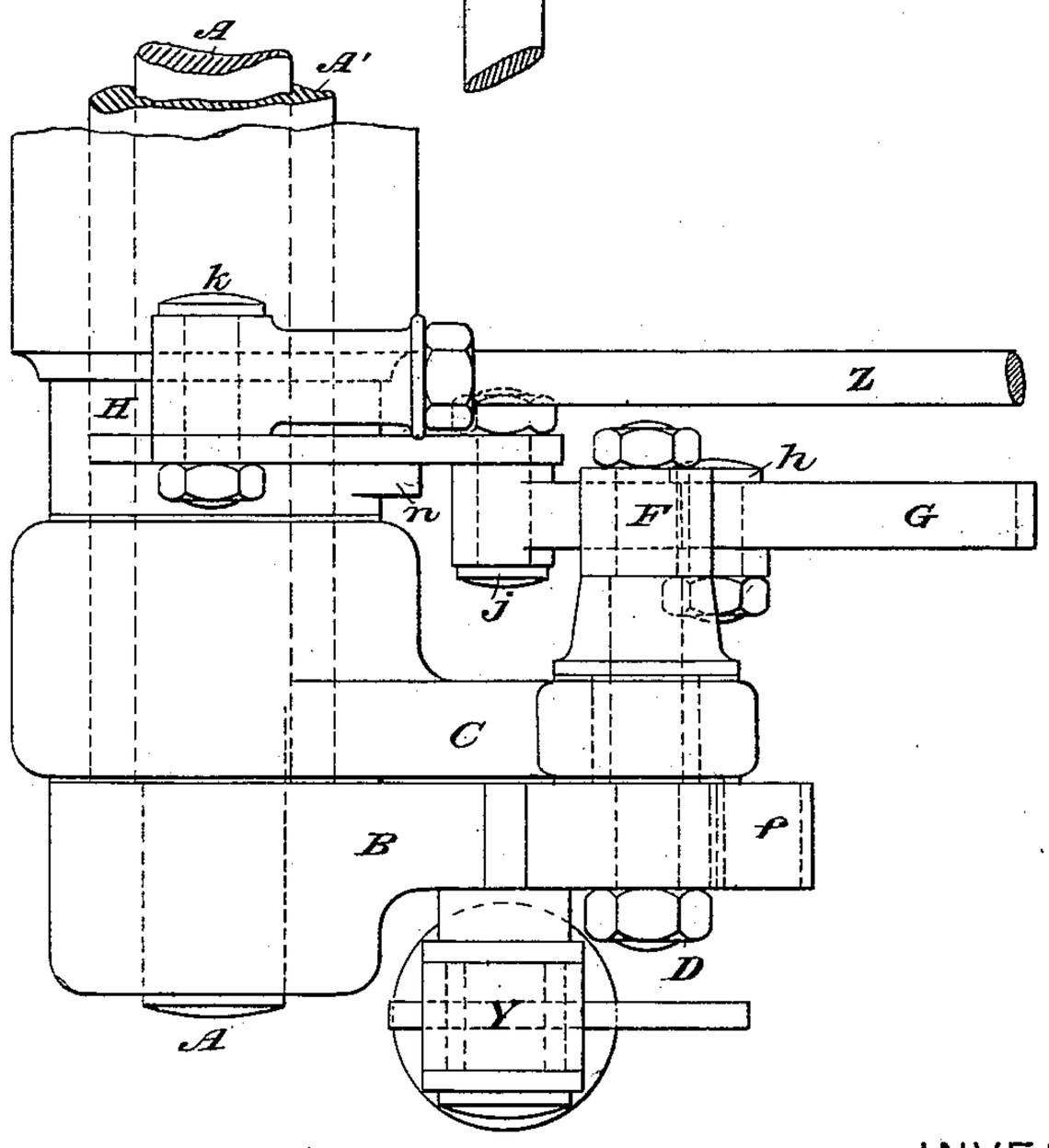


Fig. 2.



WITNESSES:
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Sam'l. F. Fuller

INVENTOR:
Joseph D. Cité
By his Attorneys,
Burke, Fraser & Connett

(No Model.) 3 Sheets—Sheet 2.

J. D. CITÉ.

CUT-OFF VALVE GEAR.

No. 332,381. Patented Dec. 15, 1885.

Fig. 3.

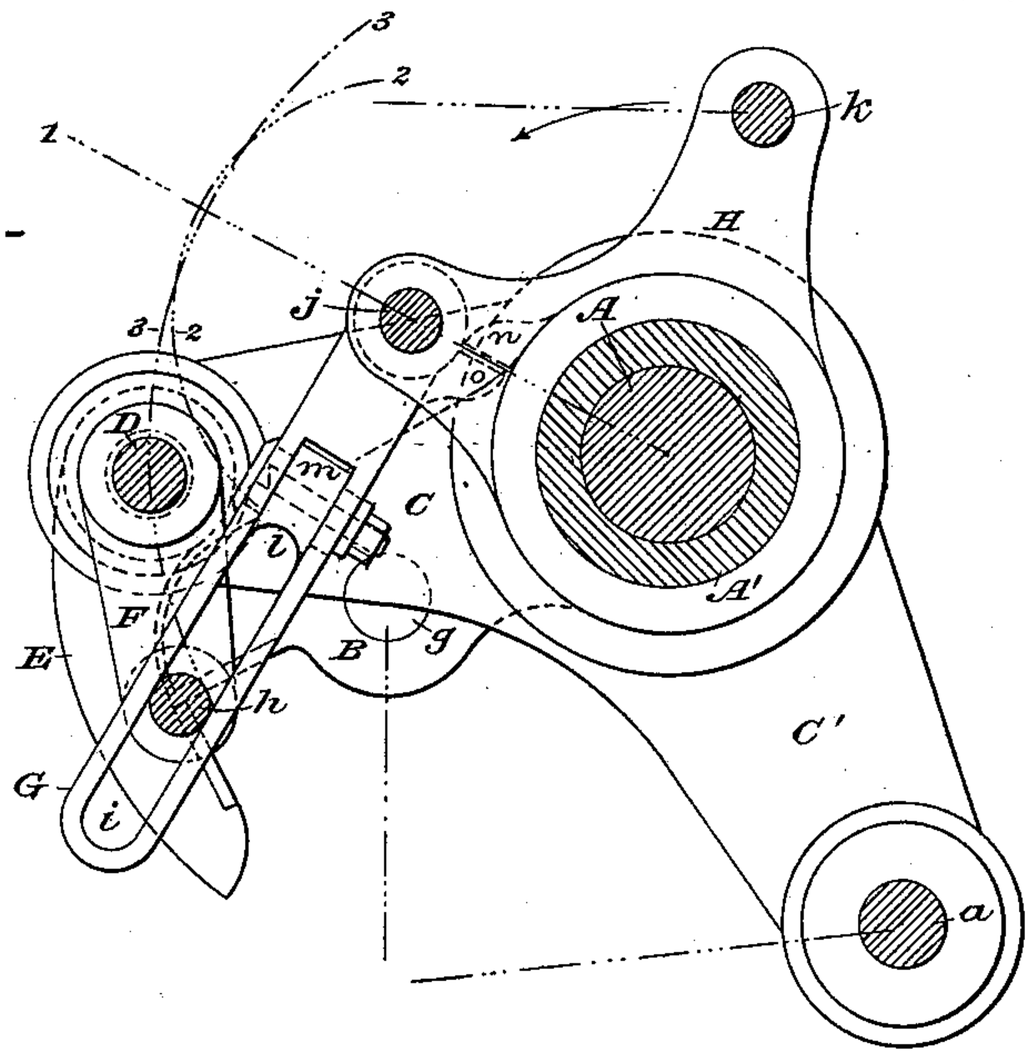
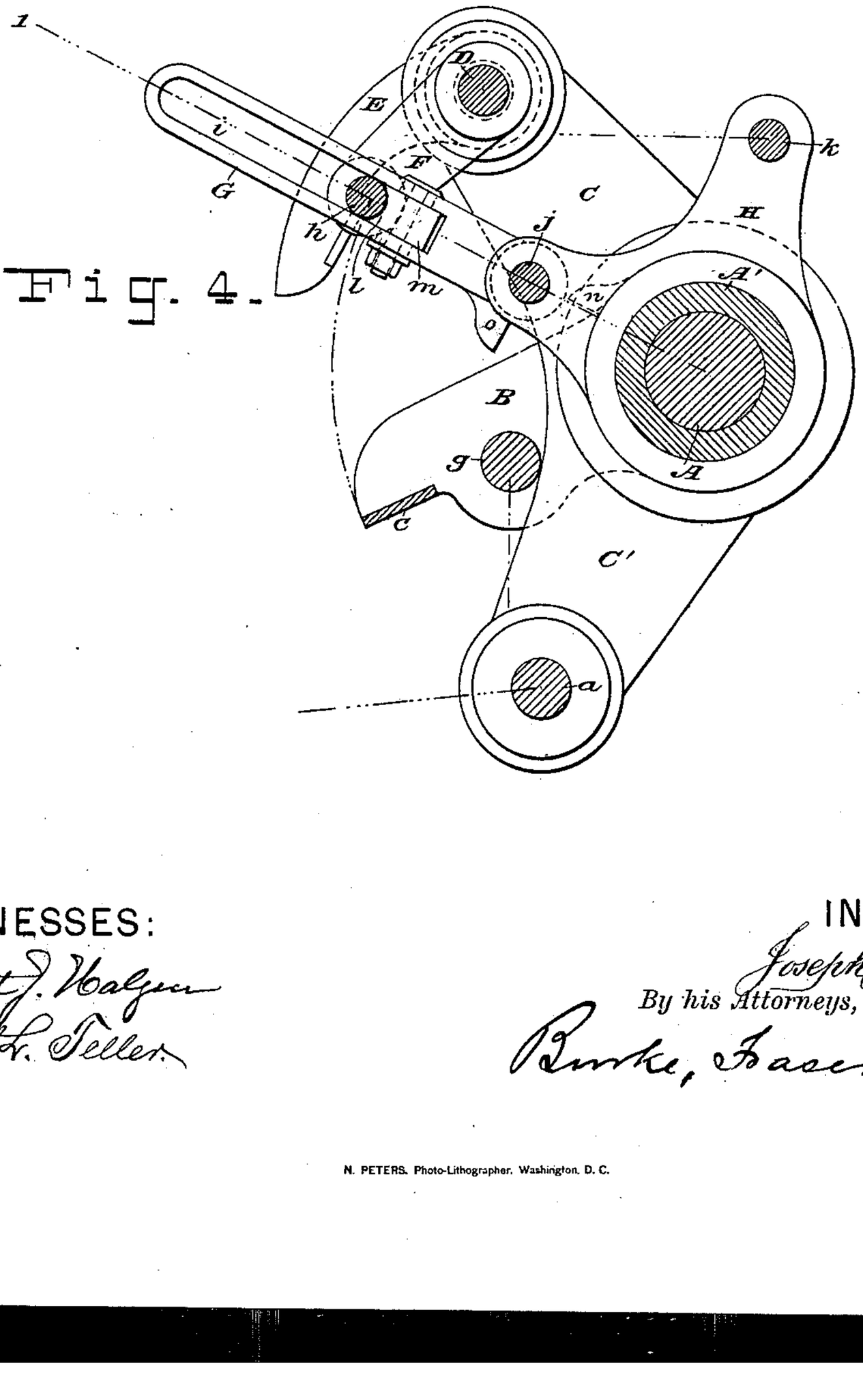


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

J. D. CITÉ.

CUT-OFF VALVE GEAR.

No. 332,381. Patented Dec. 15, 1885.

Fig. 5.

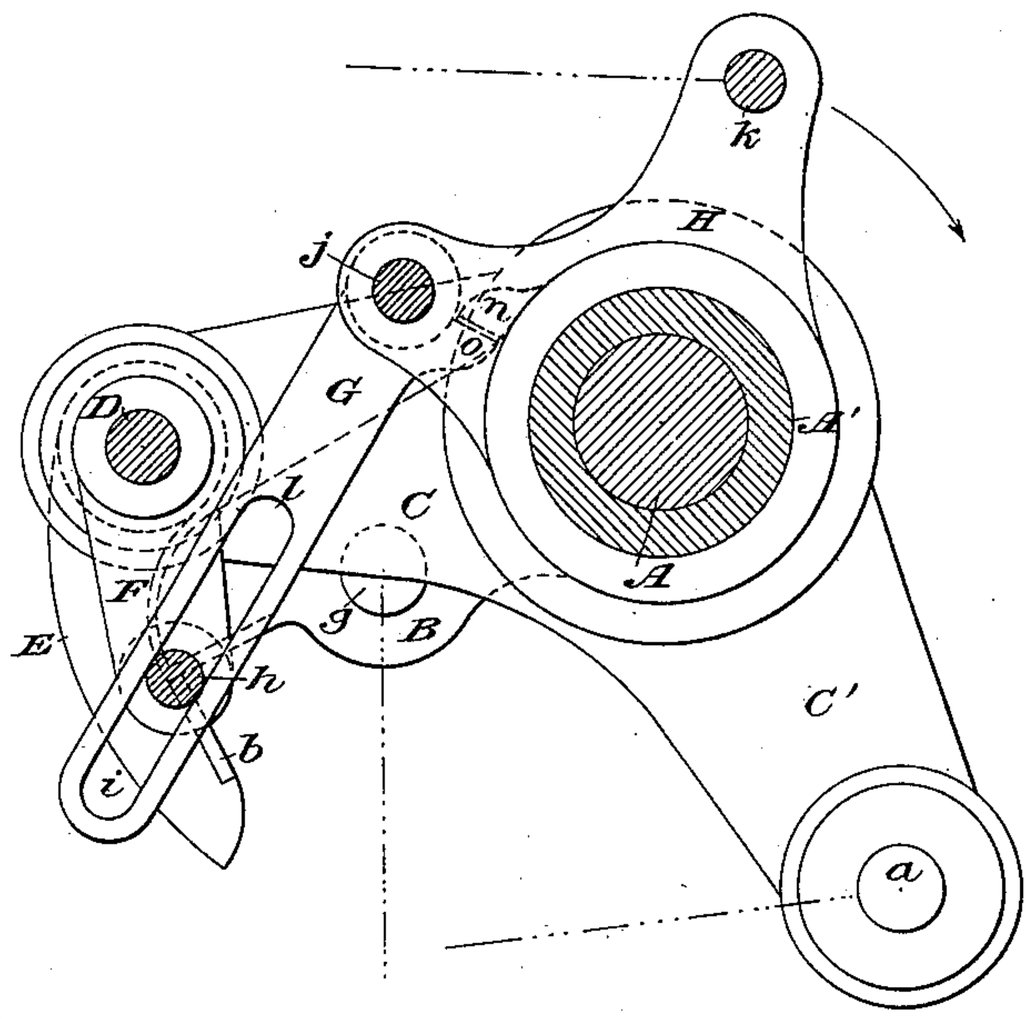

Fig. 7.

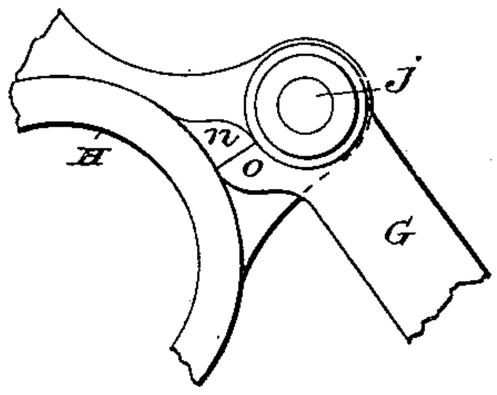

Fig. 8.

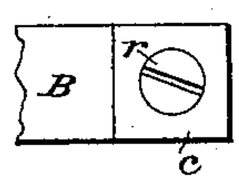

Fig. 6.

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INVENTOR:

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UNITED STATES PATENT OFFICE.

JOSEPH D. CITÉ, OF FISHKILL-ON-THE-HUDSON, NEW YORK, ASSIGNOR TO THE FISHKILL LANDING MACHINE COMPANY, OF SAME PLACE.

CUT-OFF-VALVE GEAR.

SPECIFICATION forming part of Letters Patent No. 332,381, dated December 15, 1885.

Application filed August 29, 1885. Serial No. 175,676. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH D. CITÉ, who have declared my intention to become a citizen of the United States, and who am a resident of Fishkill-on-the-Hudson, Dutchess county, New York, have invented certain new and useful Improvements in Cut-Off-Valve Gear, of which the following is a specification.

My invention relates to valve-gear for steam and other engines which employ elastic fluids operated expansively, wherein the point of cut-off is determined by a governor. In engines of the class to which my invention applies the valve-lever is liberated automatically at the proper point by the movement of the parts under the control of the governor, and the valve is caused to instantly close the steam-port through the medium of a dash-pot or other equivalent means. In valve-gear of this class the valve is opened by a positive mechanism and liberated at such time as may be indicated by the governor, by means of a mechanism which frees the valve from the opening power and permits it to be closed by an extraneous force. In all existing forms of liberating valve-gear of this character more or less strain is thrown upon the connections of the governor at the moment of disengagement in resisting the power required to release the valve from the mechanism which opens it and to permit it to close. This strain upon the governor tends to disturb its equilibrium, and when the governor is sensitive its normal action is destroyed, and it will oscillate more or less according as it may be affected by this disturbance. These oscillations being transmitted back to the liberating-gear, render the latter irregular in its action, and thus cause fluctuations in the normal speed of the engine.

The object of my invention is, in part, to provide a mechanism that will effect the liberation of the valve at the cut-off point indicated by the governor without throwing any strain upon the governor, and without exerting any disturbing influence on it that would affect its normal action.

The object of my invention is, also, in part, to provide an automatically-operating mechanism connected with the valve-gear, whereby, when the governor-belt breaks, as will sometimes occur, and the governor ceases to rotate, the governor will still maintain control of the engine and stop it.

In my valve-gear the valve is opened and closed by the alternate vibrations of a lever on some center of vibration—as on a rock-shaft, for example. This lever may be connected to the valve in any convenient way. The valve-lever is vibrated by an operating-arm, which vibrates on the same center as the valve-lever and receives its vibratory motion from the engine through any of the usual mechanism—as an eccentric, for example. Near the free end of the operating-arm, and in the same, is mounted a small rock-shaft, which has its axis arranged parallel to the axes of vibration of the valve-lever and operating-arm. Fixed on one end of this rock-shaft is a hook-like catch, which is arranged to engage the valve-lever, and when so engaged to impart the movement of the operating-arm to said lever in one direction, so as to open the valve. In order to move back the catch at the proper time, so as to free the valve-lever and permit the dash-pot or other extraneous force to instantly act on said lever and close the valve, I secure to the small rock-shaft a short crank-like arm provided with a wrist-pin or stud. This pin engages a slot in a link, the end of which is coupled to a short arm of a bell-crank mounted to vibrate on a solid axis, preferably the same axis on which vibrate the operating-arm and the valve-lever. To the other arm of this bell crank is connected the operating-rod of the governor. The radius in which the wrist-pin of the small crank swings is greater than that in which the link which engages this wrist-pin swings, measuring from the coupling-point of said link to the nearest end of the slot in the link in which the wrist-pin plays. Consequently, when the operating-arm raises the valve-lever by the catch, in order to open the valve, the wrist-pin also raises the link, and when the wrist-pin shall have reached a point in the right line which passes through the coupling-point of the link to the bell-crank and the axis of vibration of said bell-crank, then the wrist-pin will have engaged the end of the slot in

the link, and been pushed out by the toggle-like action of the parts far enough to free the catch from the valve-lever and allow the valve to close suddenly. As the position of the coupling-point of the link is controlled by the governor, and as this is one of the three points that must be brought into a straight line to effect the disengagement of the catch, it will readily be seen how the governor will control the point of cut-off; and as the three points are in a straight line when the disengagement is effected, it will also be seen that the strain exerted in effecting the disengagement will be transmitted in a right line radially to the axis of vibration of the bell-crank and will not be felt by the governor. In order to enable the stoppage of the governor to effect the stoppage of the engine, I provide a shoulder on the boss of the bell-crank and a corresponding shoulder on the link where it is coupled to the bell-crank. Normally these cannot engage, and the link swings freely; but if the governor ceases to rotate from any cause the balls drop below their lowest normal level, the bell-crank turns on its axis, the shoulder on the bell-crank engages that on the link, thus rendering the link rigid, and the further movement of the bell-crank acts through the link, wrist-pin, and crank to move out the catch beyond the path in which the valve-lever plays. Consequently the valve will remain closed.

In order that my invention may be the better understood, I will now describe it with reference to the accompanying drawings, wherein I have shown it as applied to an oscillating valve.

Figure 1 is a front elevation of my automatic cut-off-valve gear, and Fig. 2 is a plan of the same. Figs. 3 and 4 are rear elevations of my valve-gear—that is to say, views taken from the side opposite to that seen in Fig. 1. These views are mainly illustrative, and I have not shown all of the parts, as I will hereinafter explain. Fig. 3 shows the parts in engagement at the moment the valve starts to open, and Fig. 4 shows the position of the parts at the moment after disengagement. Figs. 5 and 6 are views similar to Figs. 3 and 4, and are designed to illustrate the operation of the mechanism for stopping the engine through the stopping of the governor. Fig. 8 is a detached detail view that will be hereinafter described.

A represents the valve-stem of an oscillating valve, which latter may be of the usual kind.

B is the valve-lever, keyed or otherwise fixed to the valve-stem A.

C is an operating-arm, which is mounted to vibrate loosely on the valve-stem as an axis of vibration. This arm C has a branch arm, C′, to which is coupled at *a* the connecting-rod X, whereby the proper vibration is imparted to arm C from the engine, usually through the medium of an eccentric on the engine-shaft. Mounted in a suitable bearing in the end of the arm C is a small rock-shaft, D, on one end of which, in the plane of the valve-lever B, is fixed a hook-like catch, E, which is usually provided with a hardened-steel catch-plate, *b*, that engages at the proper time a similar plate, *c*, on the end of the valve-lever B. The catch E is prevented from swinging too far inward by means of a shoulder, *d*, thereon, which engages or strikes a corresponding shoulder, *e*, on the arm C. I usually provide a spring, *f*, to keep the catch E pressed elastically up to stop *e*, the fixed end of said spring being secured in a slit in the stop *e*, and the free end arranged to press on the back of the catch.

Y is the rod which connects the valve-lever B at *g* to the dash-pot or other equivalent device for suddenly closing the valve at the point of cut-off. This is a common device, and will require no description or illustration herein.

On the end of rock-shaft D, opposite to the catch E, is fixed a short crank, F, which has a wrist-pin, *h*, that engages a slot, *i*, in a link, G, which is coupled at the point *j* to one arm of a bell-crank, H, which is in this instance mounted to vibrate loosely on the valve-stem A as an axis of vibration. To the other arm of bell-crank H is coupled at *k* a rod, Z, that connects said crank to the governor. Any ordinary governor may be employed and be connected to the bell-crank by rod Z in such a manner that the movements of the governor, due to fluctuations of the speed of the engine, will move the bell-crank on its axis of vibration and vary the angle which a radial line drawn through the axis of A and the coupling-point *j* makes with a radial line drawn through the axis of A and the engaging end of the plate *c* on valve-lever B. The operation of such governors is too well known to require any description herein.

By reference to Figs. 3 and 4, which are designed to explain the operation, the dotted radial line 1 is drawn from the axis of valve-stem A through the axis of *j*, where the link G is coupled to H. The dotted curved line 2 is drawn from *j* as a center, and with a radius equal to the distance from *j* to the inner end, *l*, of the slot *i* in link G. The dotted curved line 3 is drawn from the axis of the valve-stem A as a center, and with a radius equal to the distance from the center of A to the near side of the wrist-pin *h*, when the catch *e* is in engagement with the valve-lever B. It will be seen that the curved line 2 crosses the curved line 3 near the radial line 1, and on each side of it, and extends a little beyond the curved line 3 at the point where they cross line 1. When the parts stand as seen in Fig. 3, the catch E has just engaged the valve-lever B, and arm G is ready to rise with said lever. The crank H, connected to the governor, we will suppose to be stationary during the movement. The wrist-pin *h*, by engaging slot *i*, raises the link G to the position seen in Fig. 4—that is, until the radial line 1 passes through the axis of the wrist-pin *h*, as well as

through the centers of A and *j;* but this movement will cause the pin *h* to abut against the end *l* of the slot *i* in link G, and the pin will be pushed out to a sufficient extent to release the catch E from the valve-lever B and liberate the latter. The dash-pot will then act and close the valve instantly. It will be seen by inspection that pin *h* will come in contact with the end *l* of the slot when the point is reached where the dotted circles 2 and 3 cross, and that the liberation will be effected when the three centers of A, *j*, and *h* are in the line 1. It will be obvious, then, that at the moment of disengagement, owing to the toggle-like action of the parts, the pressure on the bell-crank H, in effecting the liberation of the valve-lever, will be exerted radially from the end *l* of the slot through *j* to the axis of A, and that during the entire movement of the catch E in liberating the valve-lever there will be no appreciable strain or pressure tending to turn the bell-crank H on its axis A. Consequently no part of this strain will act to disturb the normal operation of the governor.

If we suppose that the engine is running under a load and cutting off at half-stroke, for example, then the dotted radial line 1 may be considered as the cut-off line for half-stroke. Now, if the load be thrown off, the governor will instantly move the bell-crank H to the left in Fig. 3, as indicated by the arrow, the coupling-point *j* will be lowered, and a new (and shorter) cut-off point will be established; but in every case the liberation will always be effected when the axes of A, *j*, and *h* are in the same radial line, and the entire movement required to effect the liberation of the valve-lever may be brought within the compass of a few degrees, so that no appreciable strain or force tending to rotate bell-crank H will be thrown on the latter. The amount of movement of the catch E will not usually exceed one-sixteenth of an inch at the plate *b*, and by making crank F shorter than catch E, and by lessening the distance between the coupling-point *j* and the end *l* of the slot in the link, the angular distance through which the link will move during the disengagement of the catch will be reduced to a minimum.

In order to regulate the distance from *j* to *l*, I usually mount an adjustable block, *m*, in the slot *i;* but this I do not deem absolutely essential, and I have omitted it in Figs. 5 and 6.

It is not absolutely essential that the bell-crank H, which is connected with the governor, shall be mounted on the same axis as the lever B and arm C; but this arrangement is convenient and economical. The link G might be coupled to the wrist-pin *h* and the slot *i* be made to engage a pin at *j*, with precisely the same results as above described; but, owing to the length of the link, this change of position would require a change in the sizes of the parts. The spring *f* is only a precautionary device, and designed to insure the catch against sticking from friction of rock-shaft D on its bearings. The weight of link G will usually suffice to guarantee the proper action of the catch.

In Figs. 3, 4, 5, and 6 I have omitted the spring *f* and the rods X, Y, and Z, in order to avoid obscuring the figures. The levers C and H are not mounted directly on the valve-stem A, but on a sleeve, A′, on said stem. The rock-shaft D rotates in an elongated brass bearing in the lever C.

When the gear is applied to a reciprocating valve—as a slide-valve, for example—the valve-lever B would be mounted on a stud similar to stem A, and would have a branch coupled to the valve-stem.

I will now describe the device for stopping the engine through the medium of the governor, referring especially to Figs. 5, 6, and 7. On the boss of the bell-crank H is fixed or formed a stop, shoulder, or abutment, *n*, and on the link G, at the coupling-point *j*, is formed a similar shoulder, *o*, which may, under certain conditions to be described, engage shoulder *n*. In Figs. 5 and 6 these shoulders are only seen in dotted lines, being behind the arm on the bell-crank; but in Fig. 7, which is a view from the opposite side, these stops or shoulders are shown in full lines.

Fig. 5 shows the position of the parts when the engine is at its lowest speed and the catch E is at the point of engaging the valve-lever B. The shoulders *n o* stand just clear of each other under these conditions; but should the governor-belt break, for example, or the governor be stopped from revolving from any cause, then the centrifugal force will no longer act on the balls, and they will fall or be drawn down below or beyond the extreme point occupied when the governor is in motion. The bell-crank H will be moved over in the direction of the arrow, (to the right in Figs. 5 and 6,) the shoulder *o* on link G will be brought against the shoulder *n*, and the continued movement of the bell-crank will cause the lower side of the slot *i* in the link to act as a cam or wedge under the pin *h*, to move it outward, or from the axis A. This will cause the catch E to move outward far enough to free the valve-lever B, and the valve will remain closed. This position of the parts is shown in Fig. 6, wherein the dotted radial lines 5 and 6 show, respectively, the relative positions of the bell-crank arm in Figs. 5 and 6 and the movement of said arm effected by the stopping of the governor. The vibration of the arm C, caused by the last few revolutions of the engine, cannot affect the valve, as the catch E will be thrown out far enough to miss the end of the valve-lever at the moment when under ordinary conditions it would engage it.

Where the engine is provided with the above-described attachment, it will of course be necessary for the engineer at starting to move by some means the bell-crank H over a little, (to the left, as seen in Figs. 5 and 6,) in order to leave the catch free to engage the valve-lever and open the valve. After the

governor is in motion the device may be left to itself. I have not considered it necessary to show any device for enabling the engineer to do this, as it may be effected in many ways. I have referred to the balls of the governor as moving up and down, and this will be the case with the ordinary ball-governor, where the balls swing around a vertical axis; but any governor may be used with my valve-gear.

Where the link G is coupled to the crank and the slot engages the stud *j*, the shoulders *n o* will be respectively on the crank F and that end of the link coupled thereto.

I have said that the catch E is provided with a steel catch-plate, *b*, and the valve-lever with a similar catch-plate, *c*. I will say, further, that I make these plates square, as seen in Fig. 8, and secure them in place, each with a single centrally-arranged screw, *r*. The tendency to wear on these plates is considerable, and this construction enables me to readily turn the plate around by merely loosening the screw, whereby each of the four edges may in succession be brought into position to take the wear.

I do not limit myself to the precise construction and arrangement of parts herein shown, as these may be varied to some extent without materially departing from my invention—as, for example, the shoulders *n* and *o* on the bell-crank and link need not be arranged precisely as shown, so long as the movement of the link on its coupling-pin *j* is limited properly. Other slight changes have been hereinbefore described.

Having thus described my invention, I claim—

1. The combination, with mechanism, substantially as described, for opening the valve, of the toggle-like mechanism, substantially as described, for liberating the valve-lever, whereby the point of cut-off may be controlled by the governor without any appreciable strain being thrown on the governor at the moment of liberation of the valve, as set forth.

2. The combination of the valve-lever, the operating-arm mounted on the same axis of vibration as the valve-lever, the rock-shaft mounted in the operating-arm, the swinging catch, to engage the valve-lever, fixed to said rock-shaft, the crank fixed to the rock-shaft and provided with a wrist-pin, the link provided with a slot, which engages said wrist-pin, and the bell-crank to which said link is coupled, all arranged to operate substantially as set forth, whereby the governor may control or indicate the point of cut-off without being disturbed by the strain necessary to effect the liberation of the valve-lever, as set forth.

3. The combination of the valve-stem A, the valve-lever B, fixed to said stem, the operating-arm C, mounted to vibrate on the same axis with lever B, the rock-shaft D, mounted in arm C, the catch E, fixed on the rock-shaft D in the same plane with the lever B, the crank F, fixed to the rock-shaft D and provided with the wrist-pin *h*, the bell-crank H, mounted to vibrate on the same axis with the operating-arm C, and the slotted link G, coupled at *j* to the bell-crank H and its slot engaging the wrist-pin *h*, substantially as and for the purposes set forth.

4. In a valve-gear wherein the valve-lever is actuated by a catch, substantially as described, the catch-plate which takes the wear made square and secured in place by a centrally-arranged screw, substantially as and for the purposes set forth.

5. The combination, with the valve-lever, operating-arm, rock-shaft, catch, crank, and bell-crank, all arranged to operate substantially as described, of the slotted link G, connecting the bell-crank with the crank F, and a stop device, as described, for limiting the movement of the link in one direction, whereby, when the governor ceases to revolve, it will still continue to act on and stop the engine, as set forth.

In witness whereof I have hereunto signed my name in the presence of two subscribing witnesses.

JOSEPH D. CITÉ.

Witnesses:
HENRY CONNETT,
GEO. BAINTON.