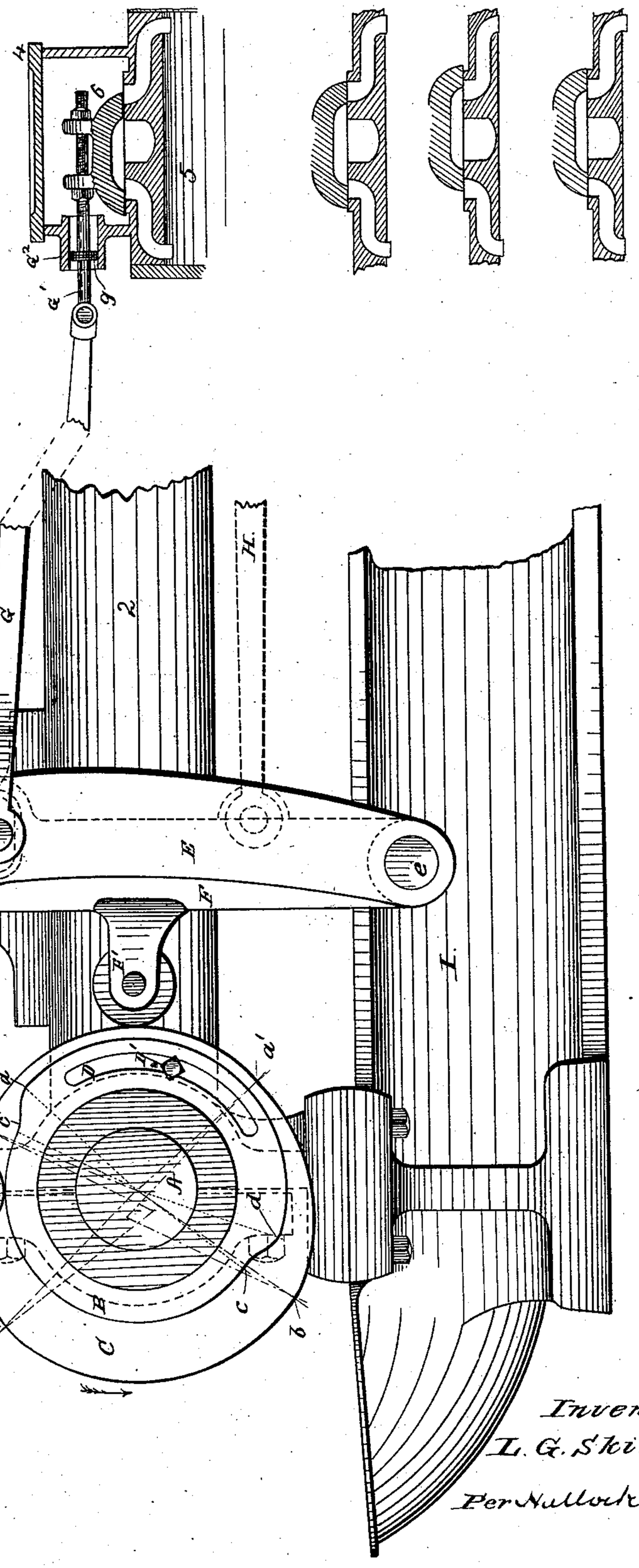
(No Model.)

4 Sheets—Sheet 1.

LE GRAND SKINNER.

VALVE GEAR.

No. 287,877. Patented Nov. 6, 1883.



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(No Model.) 4 Sheets—Sheet 2.

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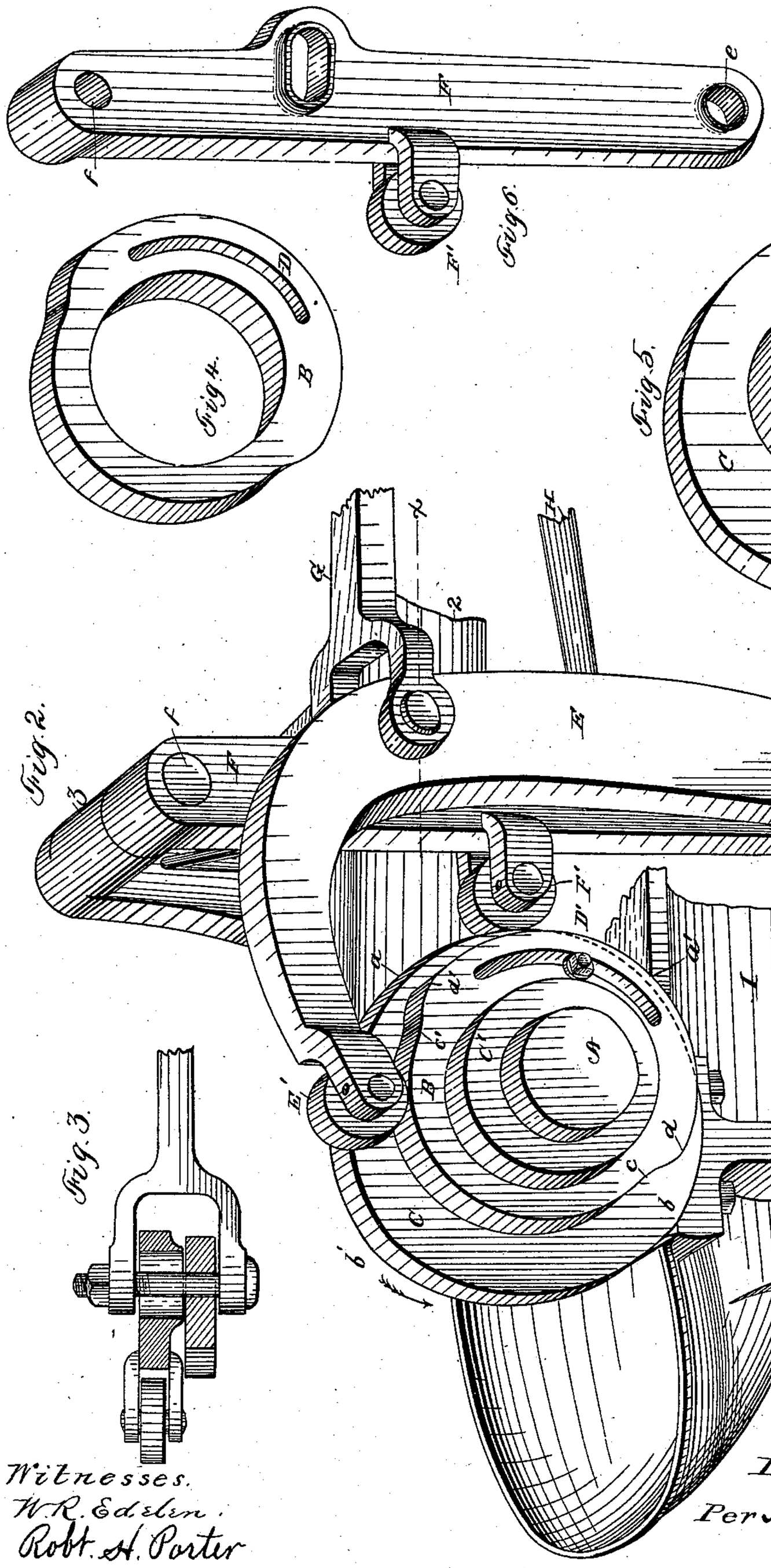

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LE GRAND SKINNER.

VALVE GEAR.

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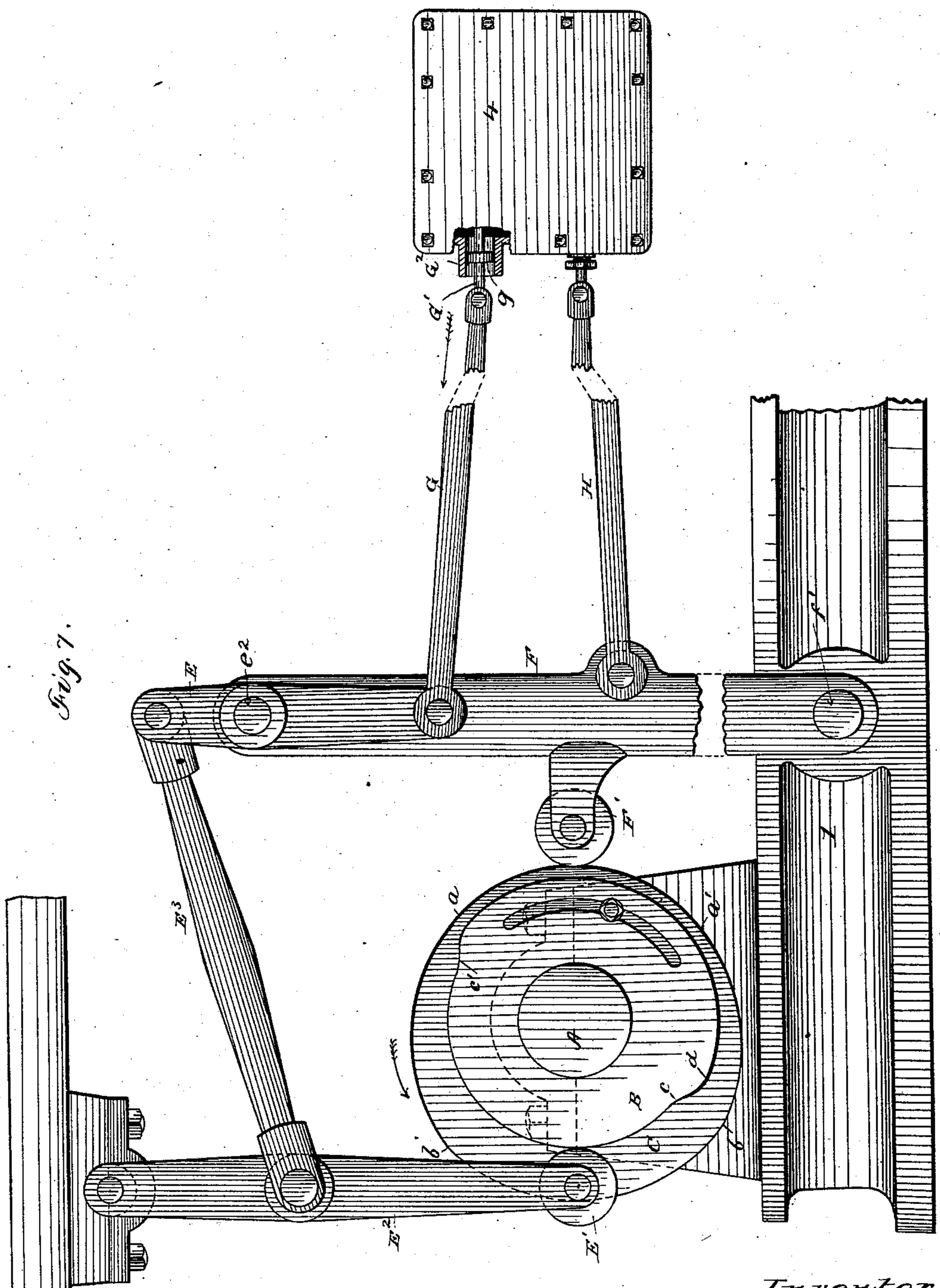

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(No Model.) 4 Sheets—Sheet 4.

LE GRAND SKINNER.

VALVE GEAR.

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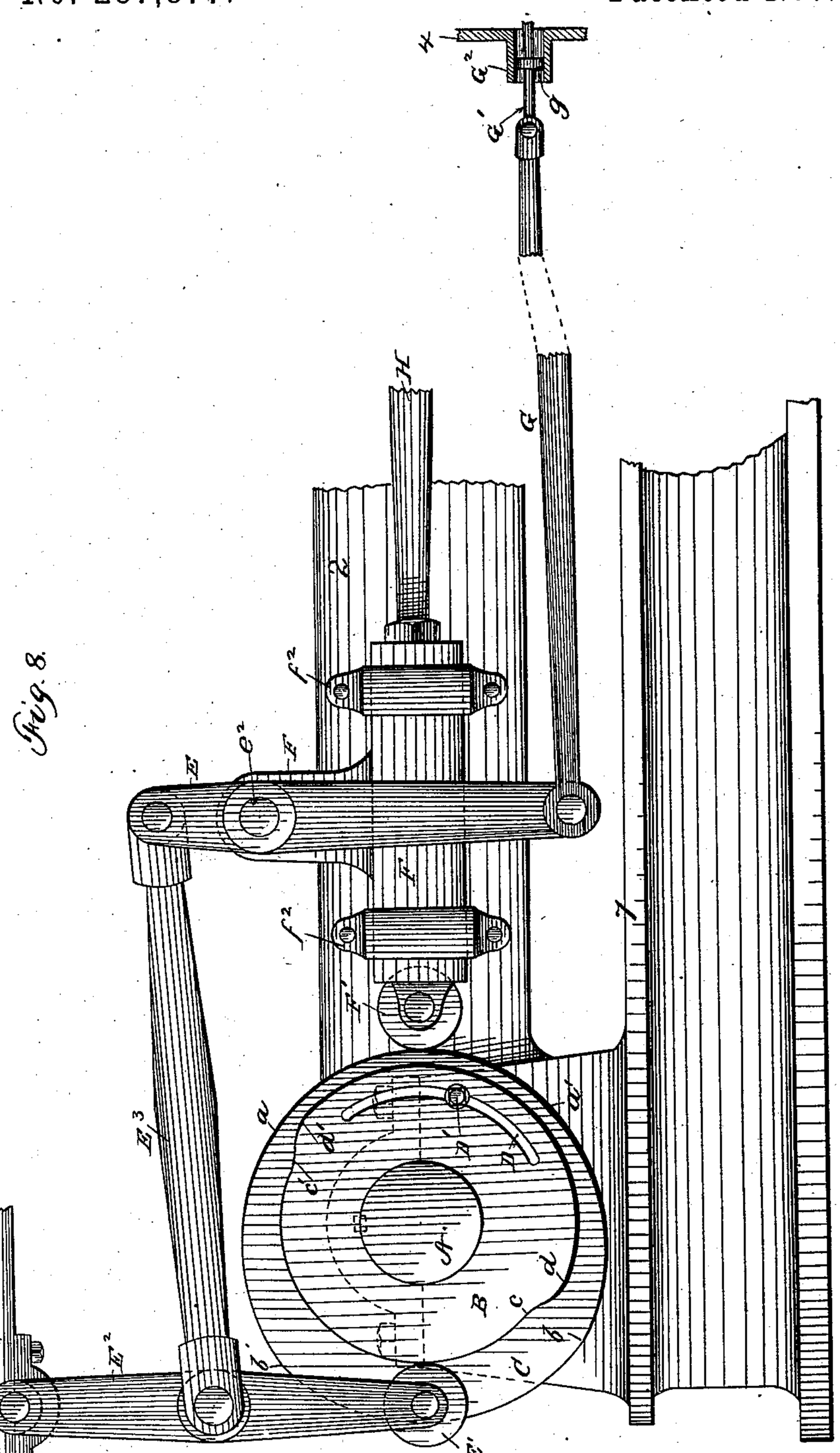

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UNITED STATES PATENT OFFICE.

LE GRAND SKINNER, OF ERIE, PENNSYLVANIA.

VALVE-GEAR.

SPECIFICATION forming part of Letters Patent No. 287,877, dated November 6, 1883.

Application filed April 26, 1883. (No model.)

To all whom it may concern:

Be it known that I, LE GRAND SKINNER, a citizen of the United States, residing at Erie, in the county of Erie and State of Pennsylvania, have invented certain new and useful Improvements in Valve-Gears for Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention consists in providing a new and improved valve-gear for steam-engines.

The object of the invention is to provide a valve-gear for a single valve which may be adjusted to cut off the steam at any desired point in the piston-stroke without affecting the length of traverse of the valve or changing its lead.

In all valve-gears for operating a single valve with a variable cut-off with which I am acquainted, the length of traverse of the valve is changed as the time of cut-off is changed, so that the ports at a one-fourth cut-off are opened less than when the cut-off is at one-half the piston-stroke, thus choking both the supply of steam to and the exhausting of it from the cylinder, and also giving an uneven wear to the valve-seat. These have been some of the chief objections to the use of a single valve with a variable cut-off.

By this device the above objections are overcome and the ports are opened just as wide for one point of cut-off as another. I accomplish this result by providing a valve-gear which gives the valve an intermitting or varying movement in each part of its vibration and still moves it through an unvarying length of traverse. The movement of my valve is as follows, beginning with the valve set so as to take steam at the outer end of the cylinder and ready to cut off: a sharp, quick movement just far enough to close the port, but not far enough to close the exhaust of the valve communicating with the opposite port, thus leaving the exhaust-passage open; then a dwell until the piston reaches the end of its stroke; then a further movement in the same direction as before, far enough to carry the valve over and open the opposite port; then a dwell until the elected line of cut-off occurs; then a sharp, quick return movement just far enough to cut off, as on the other side; then a dwell to the end of the piston-stroke, and then a further return movement, opening the valve as in the beginning; then the dwell in which we found the ports in the beginning. Thus it will be seen that a complete movement of the valve consists of two separate movements each way and a dwell between each of the several movements—four in all.

My device is illustrated in the accompanying drawings as follows:

Figure 1 is a side elevation of the gear on the shaft, and a section through the steam-chest, valve, and cylinder-ports, and a series of diagrams showing the positions of the valve at each dwell. Fig. 2 is a perspective view of the gear. Fig. 3 is a section on the line *x* in Fig. 2. Figs. 4, 5, and 6 are details of construction. Figs. 7 and 8 are views similar to Fig. 1, and show alternative constructions, which will be explained in proper place hereinafter.

The parts are indicated by letters and numbers as follows:

1 2 3 are the frame of the engine, 4 the steam-chest, 5 the cylinder, and 6 the valve. A is the shaft. B and C are cams on the shaft. E and F are levers moved by the cams. G is the valve-rod; G′, the valve-stem; G^2, the stuffing-box or gland in which the stem works, and g^2 is a small piston on the stem, forming a packing in the gland.

Motion is communicated from the cams to the valve-rod G through the levers E and F. The form, arrangement, and position of these levers may be varied very greatly. Two modifications are shown in Figs. 7 and 8. Generically they may be defined as follows: a vibrating part, F, having a regular movement from a fixed cam or eccentric, C, on the shaft; a second vibrating part, E, mounted on the first-named part, F, and moved by it, and also moved independently by a second cam, B, on the shaft.

The valve-rod receives its motion by being connected only with the last-named vibrating part, E, and therefore its movements will be, first, such as the part E receives from the cam C through the part F, and, second, such as the part E receives directly from the cam B. As shown, these parts E and F are constructed and arranged as follows: In Fig. 1 the part F

is a lever, pivoted at *f* on standard 3, and treads upon the cam C by a roller, F′. The part E is a lever also, pivoted at *e* to the lever F, and treads upon the cam B by a roller, E′. In Fig. 7 the part F is a lever pivoted below the shaft-line on the bed I at *f*, and treading on the cam C by a roller, and the part E is a lever pivoted to the upper end of F at e^2, and receiving its motion from a second lever, E^2, through a connecting-rod, E^3. In Fig. 8 the part F is a sliding bar held in guides f^2 f^3, and the part E is the same as in Fig. 7. It requires no explanation to show that these modifications are all the same in effect, being only such changes as any mechanic might adopt as an expedient, and it is also obvious that many other modifications might as easily be suggested.

We come now to consider the means by which these parts are moved—viz., the cams.

It may be stated at this point that a simple eccentric may be substituted for the cam C and an eccentric-strap be substituted for the roller F′. If this were done, the part F would be vibrated without intermissions or dwells of any perceptible duration, which might be desirable, as a continuous movement of the valve, if slow at points where if operated as above stated there are actual dwells, would prevent dead-points.

The cam C is divided into four spaces, two of which, *a a′* and *b b′*, are concentric, and the other two, *b′ a* and *a′ b*, are eccentric. So we have a lift, *a′ b*, and a drop, *b′ a*, and two dwells, *a a′* and *b b′*, and hence this cam will move the lever F forward during one-fourth of the time and backward during one-fourth of the time, and will make two intermediate dwells, consuming the other two-fourths of the time; and if the valve were moved only by this lever it would have an even reciprocating movement, with pauses or dwells at each end of its traverse; but the valve is only moved by this lever F as it moves the other lever, E, and whatever movement the other lever, E, may have *per se* will also be communicated to the valve. This brings us to consider the second cam, B, which acts directly upon and gives to the lever E an individual or separate movement. This cam is mounted by the side of the other, and if it were not desired to vary their relative positions in order to vary the cut-off, they would be made of one piece of metal. This cam has four spaces, of which two are dwells, and the other two respectively a lift and a drop. Thus *c′ d′* is a lift, *d′ d* a dwell, *d c* a drop, and *c c′* a dwell. I have found it desirable to make the lift and drop on this cam precipitous and the dwells long; but such a construction is not essential. It will be observed that these two cams have their throws in opposition one to the other. The movement of the valve from these two cams, acting upon the two levers, will be seen to be as follows, beginning with the parts in the position shown, and the shaft revolving in the direction indicated by the arrow: The first thing that will occur will be the passage of the lift *c′ d′* under the roller E′. This will lift the lever E and move the valve to the right so as to close the port, but not enough to close the exhaust. This position is shown in the first diagram. The lift *a′ b* on the cam C will next pass under the roller F′. This will throw the valve clear over to the right and open the left port. (See the next lower diagram.) Then there will be a dwell until the drop *d c* runs under roller E′. This will draw back the valve and close the left-hand port. (See the third diagram.) After this there will be a dwell until the drop *b′ a* on cam C runs under the roller F. This will bring the valve back into the position first shown, and there will then be a dwell until the lift *c′ d′* again acts.

To vary the cut-off, the duration of the dwell after the valve is moved off the port must be varied. We have seen that the valve was moved off the port into the position shown by the drop *b′ a* on cam C, and that the valve will be moved back over the port by the lift *c′ d′* on cam B. It must therefore follow that any adjustment of the cam B on C which will change the relative positions of these parts of the cams will vary the time between the two movements one way or the other, as the case may be. To effect this variation the cam B is made adjustable upon the cam C by having a slot, D, in it and a set-screw, D′, in the cam C.

It will now be seen that the essential features of this device are as follows:

Two cams, C and B, or equivalents, with their throws in opposition, mounted on the engine-shaft, and two vibrating parts, F and E, moved, respectively, by said cams, one of which, E, is connected with the valve-rod and is carried by the other part, so as to be moved by it as well as by its own cam B. Where the cams and levers are constructed as shown and the engine is horizontally adjusted, there must be some means for keeping the parts in contact—as, for example, a spring arranged at some point. It will also be observed that whatever force may be employed it need only act upon the lever E to keep both the rollers E and F in contact with the cams. In place of a spring, I have provided for the use of the pressure of the steam in the steam-chest to hold the parts in contact, thus: In place of an ordinary stuffing-box for the valve-stem, I construct a small cylinder, G^2, and on the stem place a small piston, *g*, which is perfectly packed. The pressure of steam from within the chest acts against this piston *g* with sufficient force to hold the vibrating parts in contact with the cams.

I am aware that cams with levers, sliding blocks, and like devices having rollers or plane friction-surfaces or yokes have been used to move the valve of a steam-engine, and that two cams with their throw in opposition have been used to move two separate valves—as, for instance, an exhaust and a cut-off valve; but I am not aware that heretofore two cams have been employed to give a single valve an intermittent vibrating movement such as

above described, whereby the same effect is obtained from one valve as may be had from two valves.

I have shown in the drawings a rod, H, which may be used, as shown, where it is desired to move a second valve. This rod H will have a simple reciprocating movement.

What I claim as new is—

1. In the valve-gear of a steam-engine, the combination, substantially as shown, of two cams having their throw in opposition, and two vibrating parts moved, respectively, by said cams, one of which is connected with the valve-rod and is carried by the other part, in a manner substantially as shown, whereby it may vibrate when moved by the cam with which it is in contact, and will be vibrated when the part supporting it is vibrated by the other cam.

2. In the valve-gear of a steam-engine, the combination, substantially as shown, of two cams having their throw in opposition, and made adjustable relatively one with the other, and two vibrating parts moved, respectively, by said cams, one of which is connected with the valve-rod and is carried by the other part, in a manner substantially as shown, whereby it may vibrate when moved by the cam with which it is in contact, and will be vibrated when the part supporting it is vibrated by the other cam.

3. In the valve-gear of a steam-engine wherein two cams are used to move two vibrating parts which act upon the valve-rod, the adjustment of said vibrating parts one upon the other, in a manner substantially as shown, whereby a force acting upon one of said parts to hold it upon its cam will also hold the other part upon its cam.

In testimony whereof I affix my signature in presence of two witnesses.

LE GRAND SKINNER.

Witnesses:

JNO. K. HALLOCK,

ROBT. H. PORTER.