

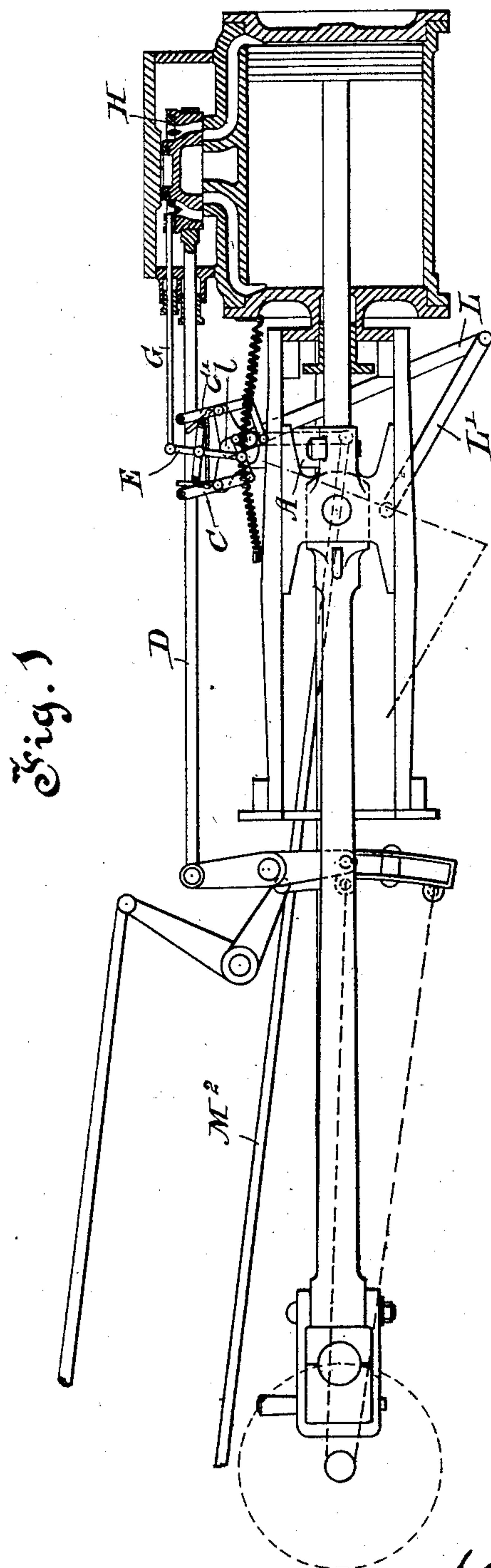
(No Model.)

3 Sheets—Sheet 1.

J. HEPWORTH.
VARIABLE EXPANSION GEAR.

No. 367,713.

Patented Aug. 2, 1887.



Witnesses:-
Wm. L. L. L.
J. P. L. L.

Inventor
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Per Atty:-
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(No Model.)

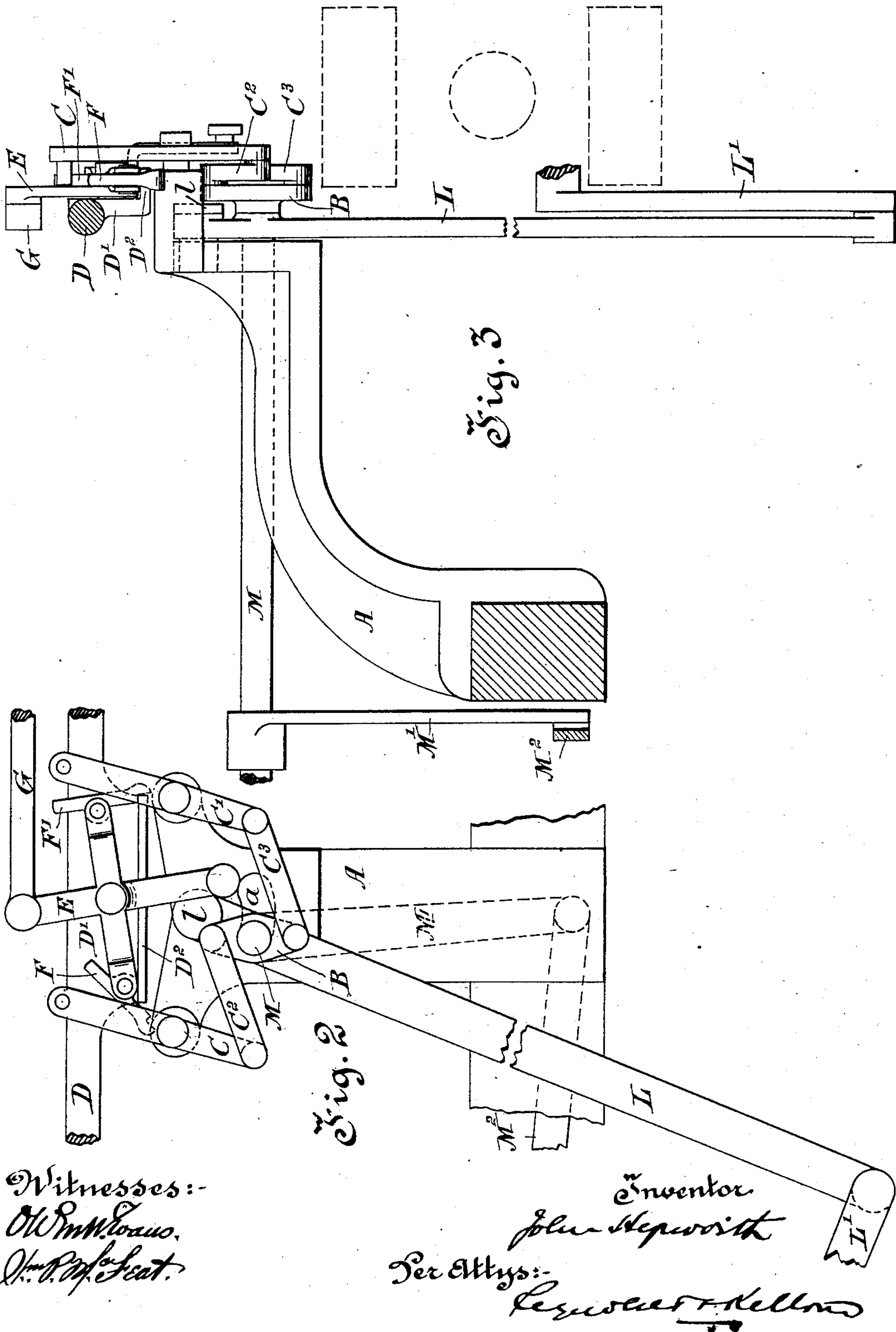
3 Sheets—Sheet 2.

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3 Sheets—Sheet 3.

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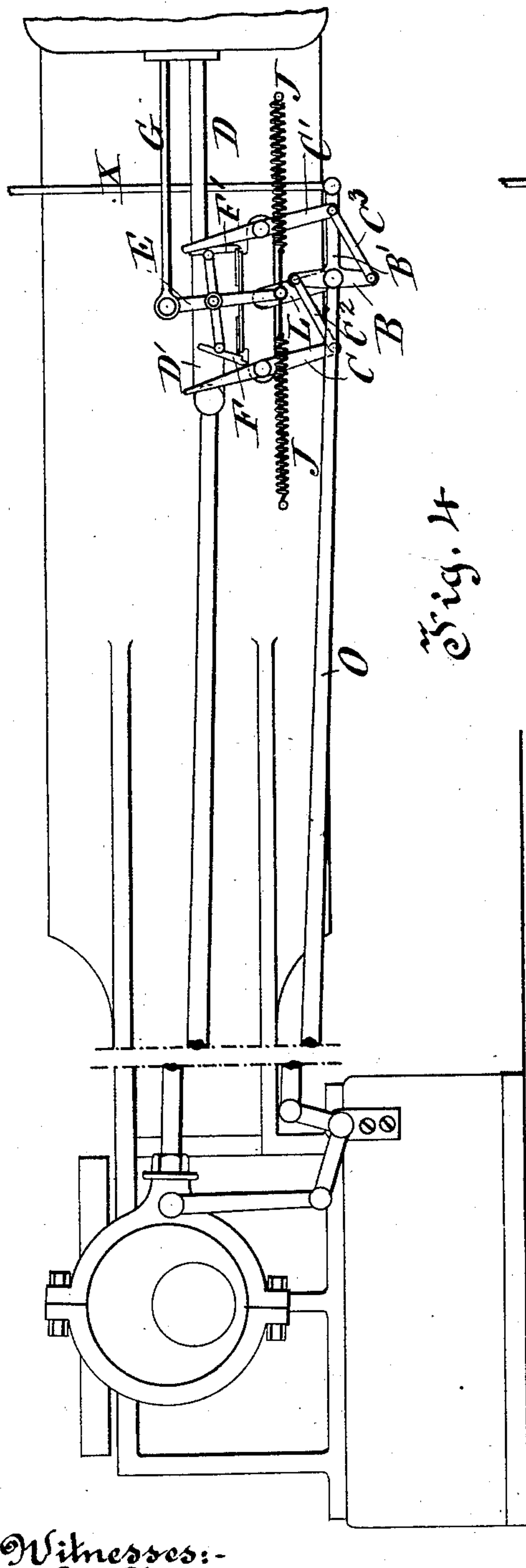


Fig. 4

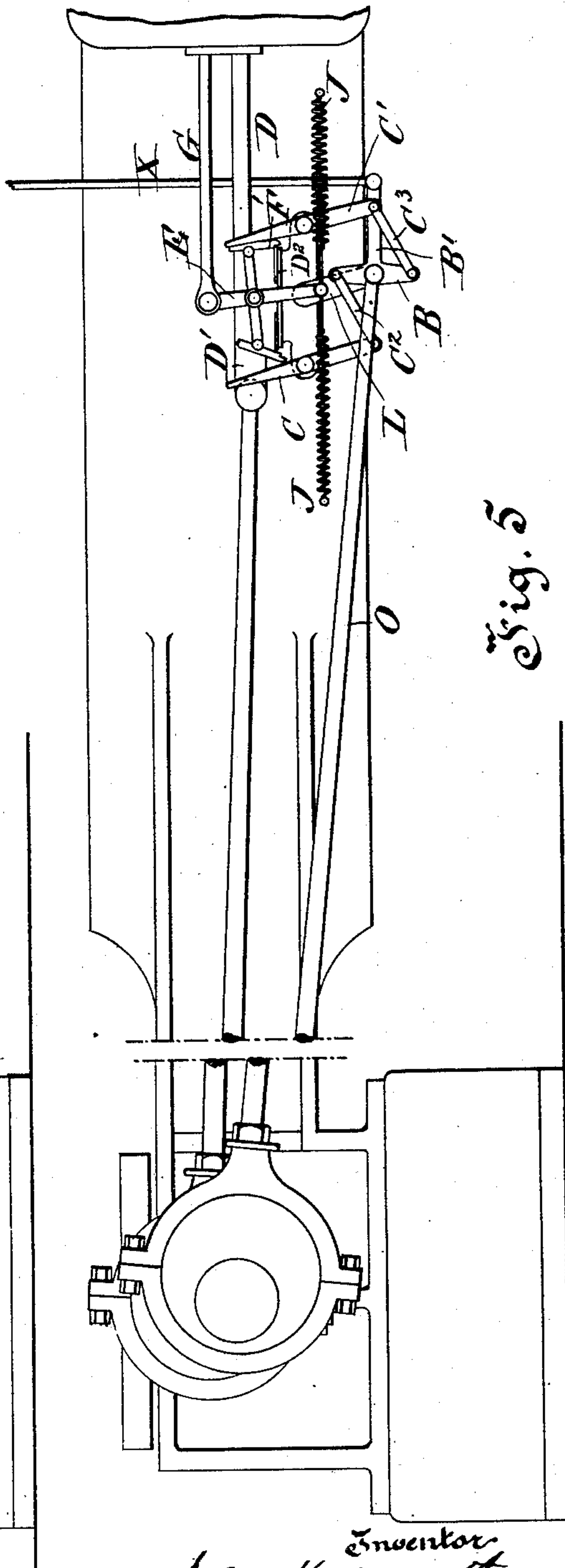


Fig. 5

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UNITED STATES PATENT OFFICE.

JOHN HEPWORTH, OF MONTREAL, QUEBEC, CANADA.

VARIABLE-EXPANSION GEAR.

SPECIFICATION forming part of Letters Patent No. 367,713, dated August 2, 1887.

Application filed April 5, 1887. Serial No. 233,790. (No model.) Patented in Canada February 14, 1887, No. 25,998.

To all whom it may concern:

Be it known that I, JOHN HEPWORTH, of the city of Montreal, in the district of Montreal and Province of Quebec, Canada, have invented certain new and useful Improvements in Variable-Expansion Gears; and I do hereby declare that the following is a full, clear, and exact description of the same.

This invention covers certain improvements on the variable-expansion gear for which I have already filed application for Letters Patent of the United States, under the Serial No. 227,148; and it consists in certain modifications of the construction therein shown and described, which will render the invention applicable to locomotives and other engines which require to have steam admitted at from zero to three-fourths of the stroke.

The construction of the several parts—viz., the plate formed on the main-valve stem with foot on lower side, four-armed piece pivoted to plate in its center, connected at its upper end with stem of riding-valve and at its lower end by springs to fixed points on the engine, and the stops pivoted to the cross-arms of four-armed piece—is as described in the application above referred to, and needs no modification.

The main modification of the invention is that the double crank, to which the ends of the tripping-levers are pivoted, is not simply pivoted to a fixed point on a standard and operated solely by the governor and for the regulation of the distance apart of the tripping-levers, but has a positive motion imparted to it by means of a swinging link, to which it is secured and which is pivoted to some fixed point, and connected in a locomotive by another link to the cross-head; but in a horizontal stationary engine this link is made to move by means of a separate eccentric, or it may be made to do so by connecting with the main-valve eccentric through a bell-crank. The means by which the link is made to travel differ according to the type of engine to which this cut-off is applied, and the swinging link may be connected to any moving part of the engine that gives a lateral travel to the double crank, which coincides with that of the cross-head of the engine. This positive motion of the double crank will also impart to the tripping-levers a positive motion, and as the double crank is thrown in either direction by the movement of the cross-

head or through the eccentrics, as the case may be, the tripping-levers are brought to meet the stops and act upon them to disengage them in turn from the foot, as described in the pending application.

The regulation of the point at which the cut-off shall take place is in the stationary engine effected, as before, through suitable connections, automatically by the governor, and is in the locomotive under the control of the driver, who operates by means of a rod connected with the expansion-lever secured to the expansion-bar on which the double cranks are attached.

For full comprehension of the invention, reference must be had to the annexed drawings, forming part of this specification, in which—

Figure 1 is a side view of the invention as applied to a locomotive; Fig. 2, a similar view, enlarged, of operating parts; Fig. 3, an end view of same; Fig. 4, a view showing parts connected to a single eccentric, and Fig. 5 a view of same when operated from a double eccentric.

Similar letters of reference indicate like parts.

As the construction and arrangement of the cylinder, piston, steam-chest, main valve, and riding-valve differ in no points from types of those now in use, no further allusion will be made to them.

A is the standard or bracket, secured to any fixed point on the engine, B being, as before, the double crank, and C C' the tripping-levers, pivoted to A, both these to be hereinafter more particularly alluded to, and C² C³ links.

D is the main-valve stem, D' the extension on same, D² the step, E the cross or four-armed piece, F F' stops pivoted to side arms of same, G riding-valve stem, H the riding-valve, and J J springs, all constructed and arranged as set forth in pending application.

In a locomotive, and when the double crank receives its motion from the cross-head, the double crank B is secured to a swinging lever, L, pivoted at l to the standard, extended downward, and connected by a link, L', with the cross-head. In this case, and in others with double cylinders, the regulation of cut-off is effected through the expansion-bar M, passing through slot a in standard, this being operated by a rod, M², through expansion-lever M'.

In a stationary engine, where the motion to

the double crank is imparted by means of an eccentric, then the swinging lever L will be made much shorter and the stud that carries the double crank will also connect with one 5 eccentric or bell-crank.

In a double eccentric the rod O will be connected directly with that one which does not impart motion to the main-valve stem.

In Figs. 4 and 5 an extension, B', is shown 10 formed on the double crank at right angles to it, and connected by rod X with the governor.

The operation of the parts will, as regards the action of the four-armed piece E through the springs J J on the riding-valve H, be similar to that described in the pending case; but 15 the movement (simultaneously with that of the cross-head) of the double crank B, actuated by the swinging link L, which is operated from the cross-head, either directly or by compound 20 motion, through the eccentrics, gives to the tripping-levers positive motion in either direction, so that each of these is brought alternately in contact with one of the stops F or F', knocking it off the step D' and releasing the valve, 25 as before described. The motion of the tripping-levers is at first slow, but gradually increases in speed as the piston advances toward the middle of the stroke, at which time the main-valve stem has ceased to advance, so that 30 all degrees of expansion from one-twelfth to one-third of the stroke are made while the valve is traveling, and from one-third to two-thirds of the stroke while the valve is almost stationary. The difference in the means for 35 imparting to the swinging link L motion corresponding to that of the cross-head are simply due to the varying types of the engines before mentioned, and devised to accommodate them; but if absolutely desired the swinging link 40 could be connected on a stationary engine with the cross-head, and in some types of locomotives could be worked from the eccentrics.

I am aware of the Patent No. 324,964, granted to And. J. Stevens, August 26, 1885; but the invention therein described has reference to 45 double main valves and corresponding valve-stems.

Having thus described my invention, I beg to state that what I claim is as follows:

1. In a steam-engine, the combination, with 50 a four-armed lever pivoted to and moving with the main-valve stem, connected at one end with the stem of the riding-valve and at the other by springs with fixed points on the engine, and carrying on its cross-arms stops locking 55 the lever in place, of tripping-levers pivoted centrally to fixed points, a double crank to which the ends of such tripping-levers are pivoted, a swinging link carrying such double crank, and means for imparting thereto the 60 motion derived from the cross-head, all substantially as herein set forth, and for the purposes described.

2. In a steam-engine having double cylinders, the combination, with the double cranks 65 B, to which ends of tripping-levers C C' are pivoted, of swinging levers connected by links with the cross-heads, and expansion-bar actuated by lever and rod passing through such swinging levers and carrying on its ends the 70 cranks B, all substantially as and for the purposes described.

3. The combination, with the double crank B, connected by links with tripping-levers C C', and means for releasing at regulated inter- 75 vals the riding-valve, of the swinging lever L, pivoted to frame, carrying crank B, and connected by rod O with eccentric on crank-shaft, all as and for the purposes herein described.

JOHN HEPWORTH.

Witnesses:

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WM. P. McFEAT.