(No Model.)

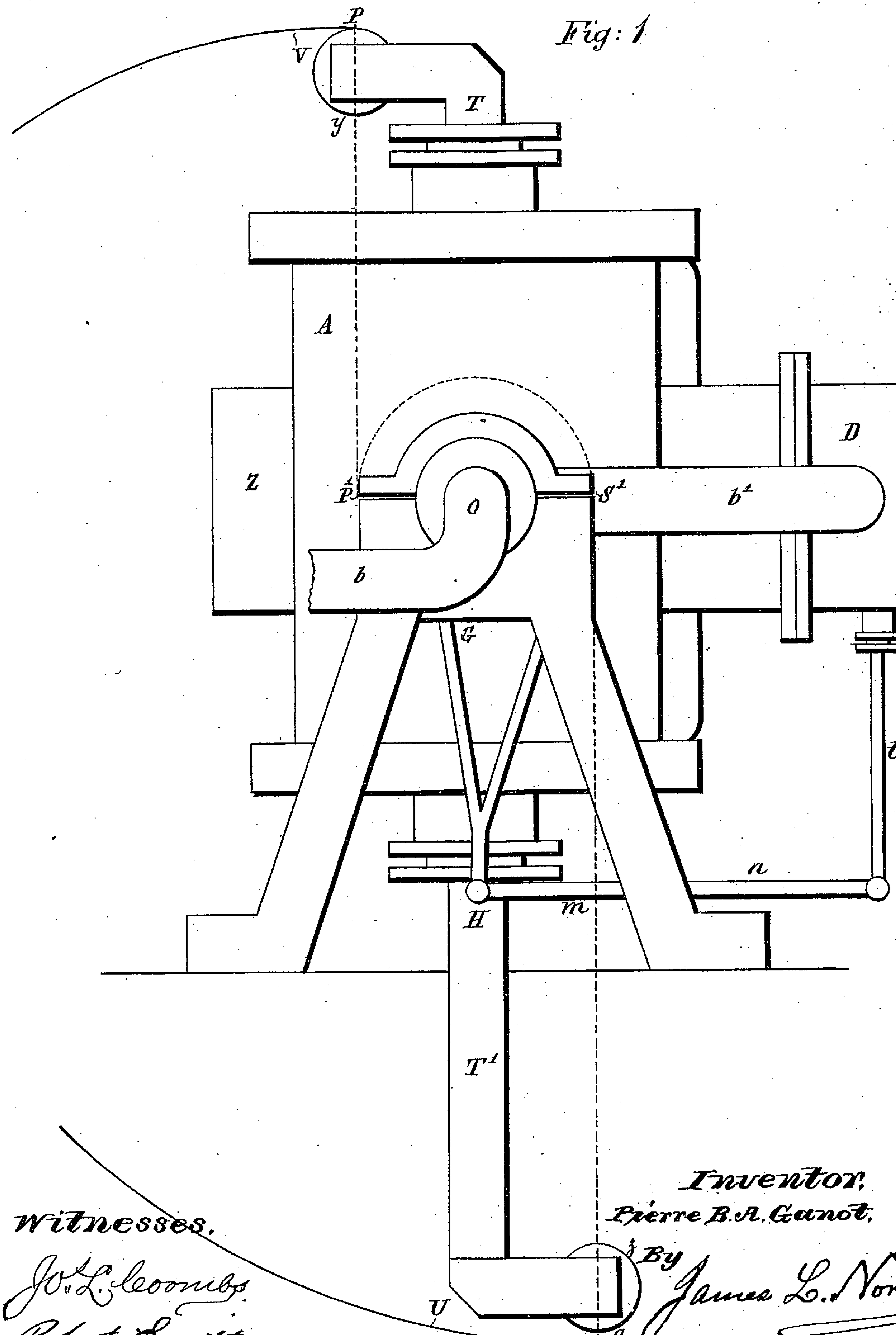
4 Sheets—Sheet 1.

P. B. A. GANOT.

ROTARY ENGINE.

No. 308,249. Patented Nov. 18, 1884.

Fig: 1



Witnesses,

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Robert Everett,

Inventor,

Pierre B. A. Ganot,

By James L. Norris

Atty.

(No Model.)

4 Sheets—Sheet 2.

P. B. A. GANOT.

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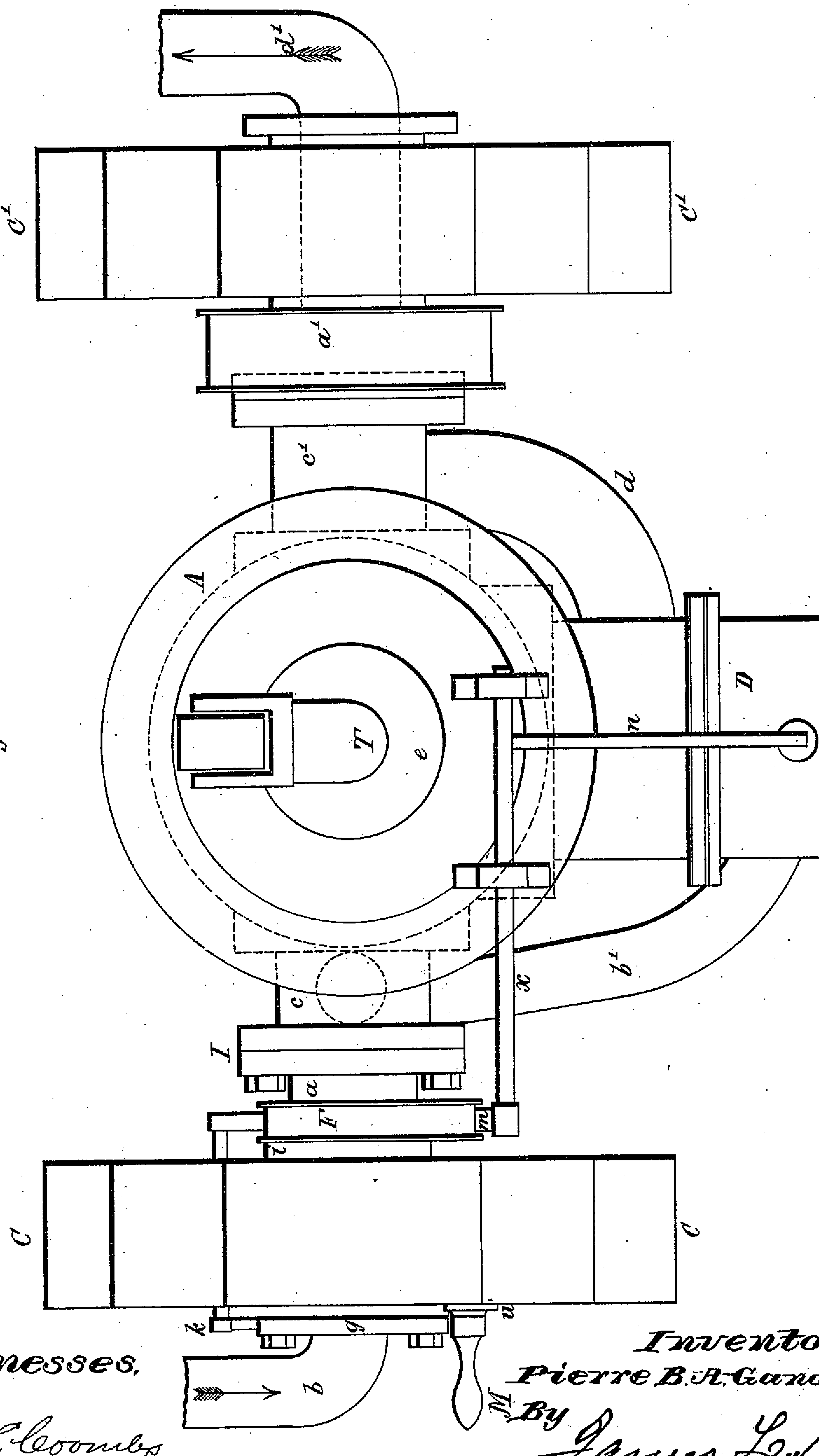

Fig: 2

Witnesses,

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N. PETERS. Photo-Lithographer, Washington, D. C.

(No Model.)

4 Sheets—Sheet 3.

P. B. A. GANOT.

ROTARY ENGINE.

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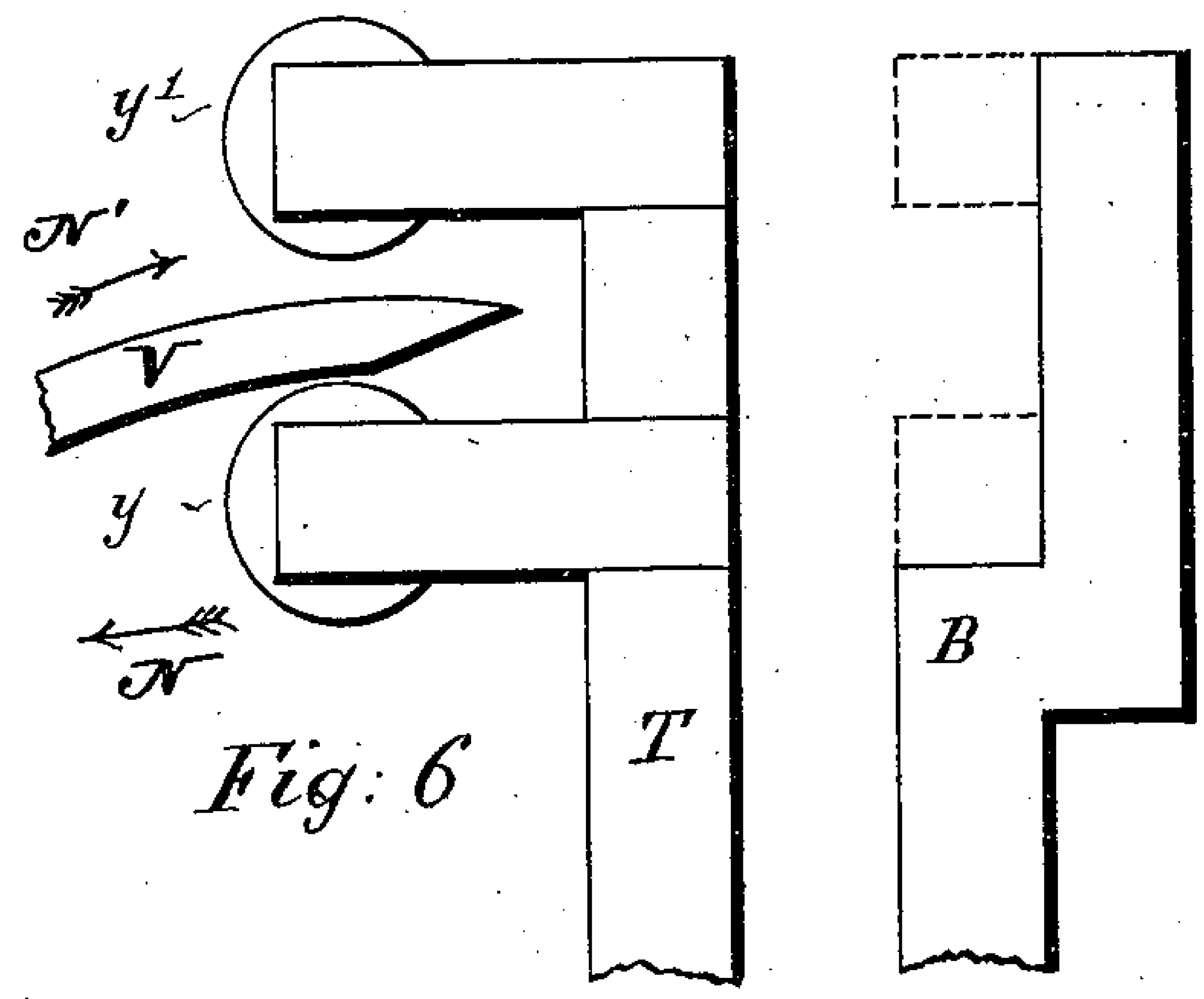


Fig: 6

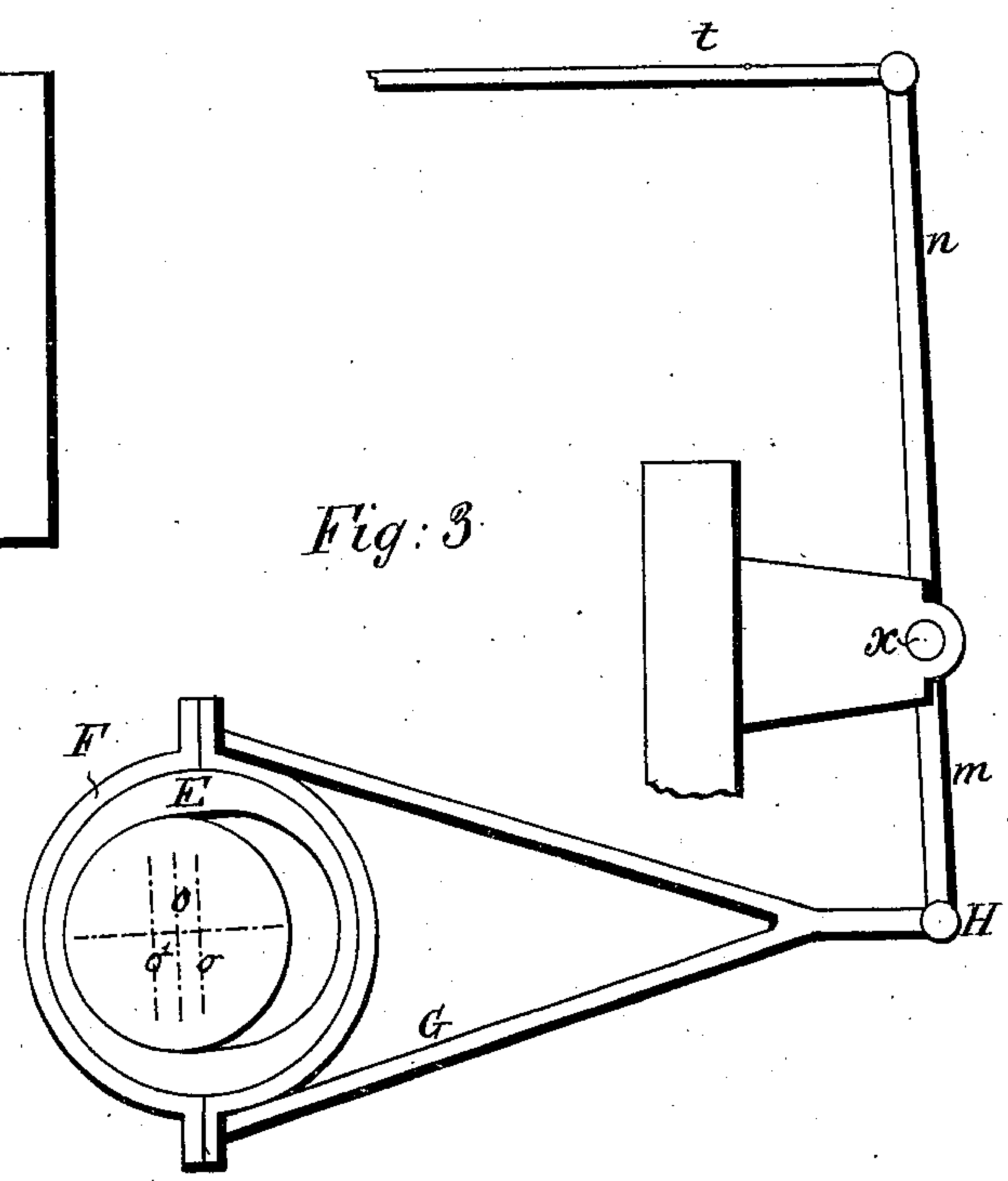


Fig: 3

Fig: 5

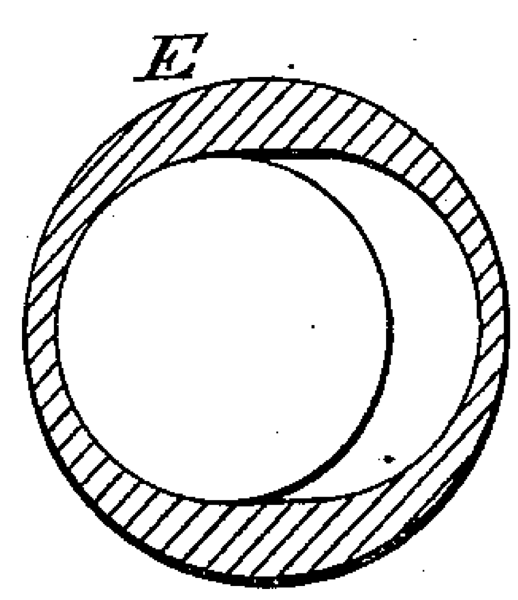
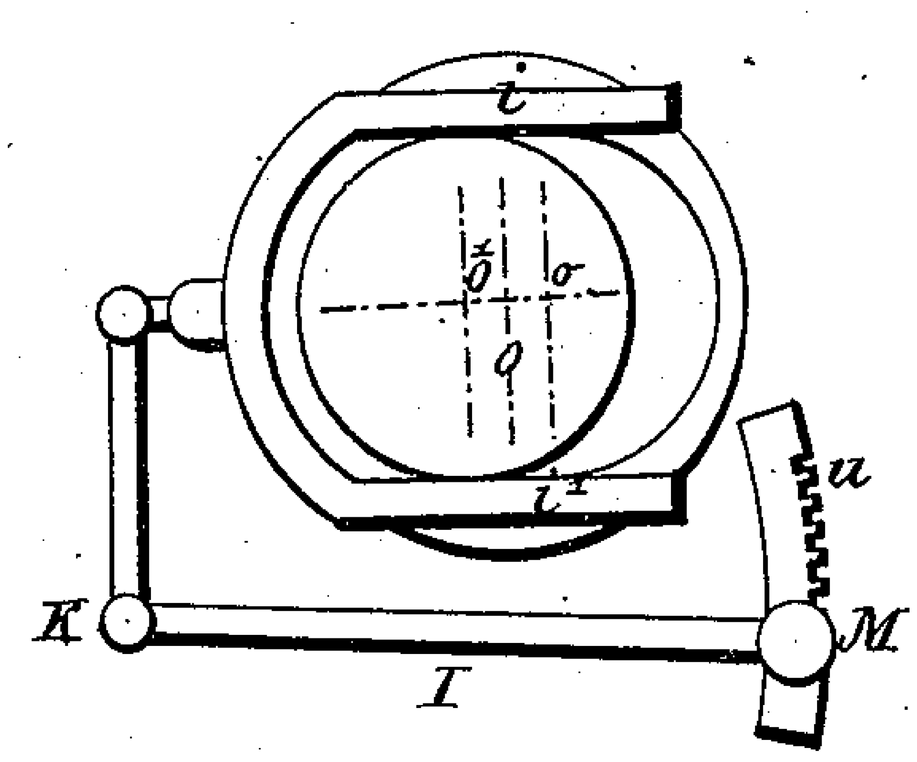


Fig: 4



Witnesses.

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(No Model.)

4 Sheets—Sheet 4.

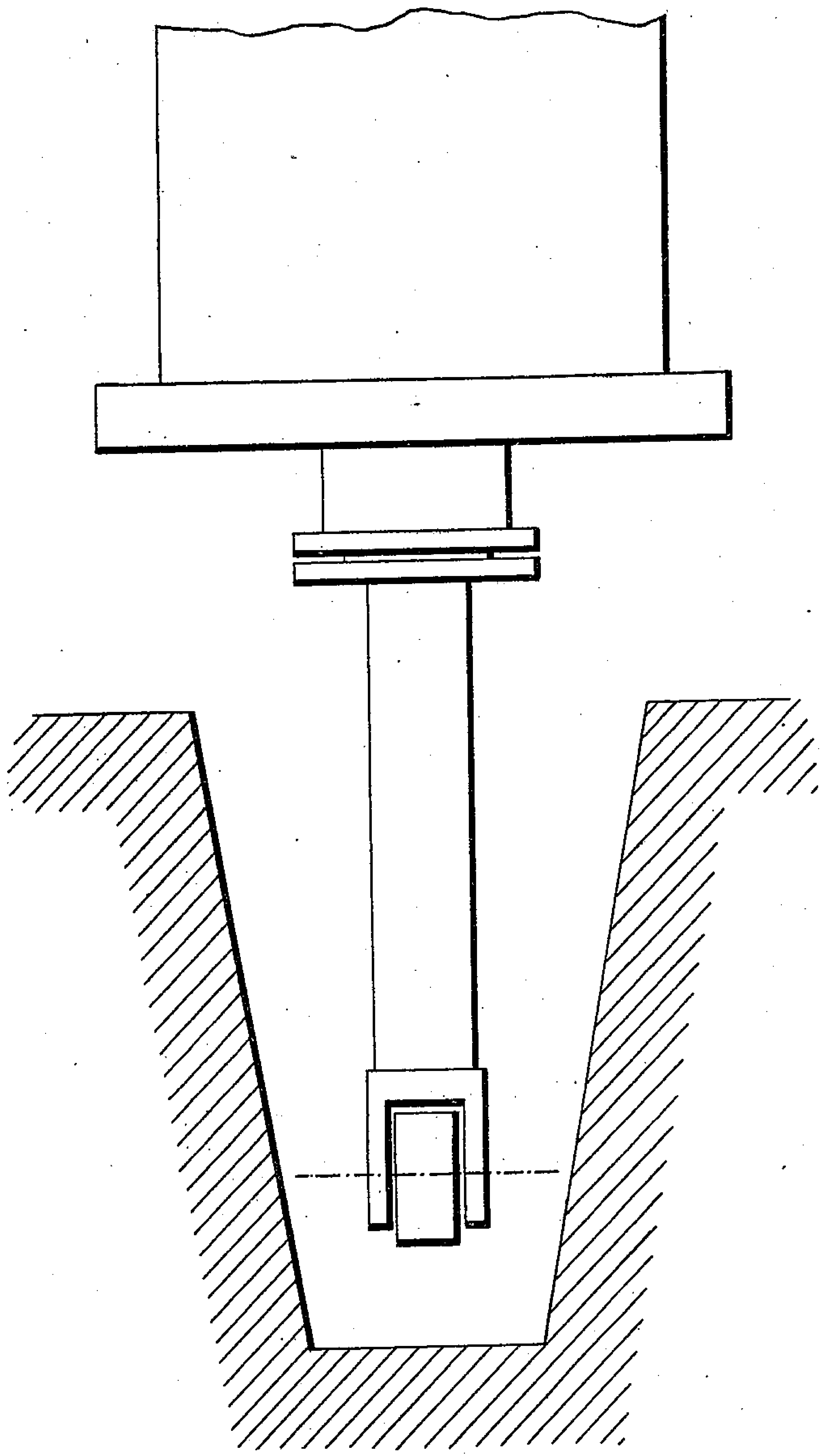
P. B. A. GANOT.

ROTARY ENGINE.

No. 308,249.

Patented Nov. 18, 1884.

Fig: 7



Witnesses.

Jo. L. Coombs

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Atty.

UNITED STATES PATENT OFFICE.

PIERRE BENJAMIN ADOLPHE GANOT, OF PARIS, FRANCE.

ROTARY ENGINE.

SPECIFICATION forming part of Letters Patent No. 308,249, dated November 18, 1884.

Application filed August 6, 1884. (No model.)

To all whom it may concern:

Be it known that I, PIERRE BENJAMIN ADOLPHE GANOT, a citizen of France, residing at Paris, in the Republic of France, have invented an Improved Rotary-Motor Engine worked by steam or other fluid pressure, (for which I have applied for a patent in France, dated the 2d day of July, 1884,) of which the following is a specification.

This invention relates to an improved construction of rotary-motor engine, which will be readily understood on reference to the accompanying drawings. In describing the same I shall only refer to those parts that are new, assuming that those parts not described are of known construction.

Figure 1 shows an elevation of the engine; Fig. 2, a plan, and Figs. 3 to 7, detached details.

A cylinder, A, has two lateral tubular branches, *c c'*, cast thereon, to which are bolted hollow trunnions *a a'*, carried in bearings on the framing C C'. Steam or other fluid pressure enters the trunnion *a* through the pipe *b*, and passes thence through the pipe *b'* to the slide-chest D of the cylinder, and after doing work in the latter it escapes through an exhaust-pipe, *d*, trunnion *a'*, and pipe *d'* to the condenser or into the atmosphere. The pipe *b* being fixed, while the trunnion *a* revolves with the cylinder, a steam-tight joint is formed between the two by a stuffing-box, *g*, a similar stuffing-box being provided for the exhaust-pipe *d'*. The cylinder A has an ordinary piston, with piston-rods T T', extending from each side thereof, passing through stuffing-boxes in the cylinder-covers. Each piston-rod has an elbow at its end, lying in opposite directions and carrying rollers *y* and *z*. Z is a counterpoise for the slide-chest D, which revolves with the cylinder. The slide is worked by an eccentric, the action of which is the reverse of that of an ordinary eccentric. The eccentric disk E is loose on the trunnion or engine shaft, and is held stationary by being connected to the framing by a clutch, while the strap F is carried round by its connection with the slide-chest. The rod G H of the strap is for this purpose hinge-jointed to a lever, *m*, Fig. 1, fixed on the end of a spindle, *x*, Fig. 2, which carries an arm, *n*, pivoted to the rod *t* of the slide, so that, the spindle *x* being carried in bearings on the cylinder, the strap F, rod G, lever *m*, spindle *x*, and arm *n* all revolve with the same. As the strap F revolves upon its disk E, it has a movement imparted to it in the direction O H equal to double the eccentricity O *o*, O being the center of rotation of the whole system and *o* the center of the eccentric disk. This movement is imparted to the slide in a magnified degree, depending upon the proportion between the lever *m* and arm *n*. Assuming this to be two to one, the eccentricity O *o* will be equal to one-fourth the travel of the slide. The eccentricity is, however, rendered adjustable, as will be presently described.

With the mechanism above described the engine can only rotate in one and the same direction. For reversing the direction of motion the following arrangement is employed:

The eccentric disk E is slotted, as shown at Figs. 3, 4, and 5, so as to be capable of assuming a position on the shaft with its center situated the same distance on the other side of the center thereof as that shown on the drawings—that is to say, it is capable of moving double the extent of the eccentricity O *o*. For effecting this adjustment the disk carries two projecting guides, *i i'*, Fig. 4, sliding between two fixed guides on the framing C, and connected to a bell-crank lever, I, pivoted to the framing at K, which lever is moved by a handle, M, and is provided with a catch, so as to assume different positions on the notched fixed segment *u*, whereby the disk E will be shifted in a corresponding manner on the shaft, so as to assume either the position *o*, in which it will affect the forward motion of the engine, or the central position, O, by which the engine will be stopped, or the position *o'*, by which the engine will be reversed.

In moving the eccentric into intermediate positions the slide will act with more or less cut-off. For stopping, the engineer will have to bring the eccentric to the central position at the moment when the piston is at about half-stroke. V U is a curved path formed according to a volute curve, and made of cast iron or other strong material, fixed in the plane of rotation of the piston-rods T T'. On the commencement of motion of the piston, when in the position Fig. 1, the roller y bears against the end V of the curved path, and the pressure thus exerted results in a force reacting in the direction of the dotted line P P′, and with a leverage equal to the distance of this line from the center of rotation of the engine, tending to cause this to rotate, such force being maintained during the entire semi-revolution of the cylinder by the continued advance of the piston, the nature of the volute curve being, as is well known, such that the pressure of y is at every point normal to the curved path and tangential to the developing circle of the curve, of which P′ O is the radius. Thus the reaction produced by the curve V U will effect the continued rotation of the cylinder until it has assumed the opposite position to that shown in Fig. 1, when, the piston having arrived at the end of its stroke, steam will be admitted on the other side thereof by reason of the reversed motion of the slide produced by the eccentric, and the roller z of the piston-rod T will now be made to bear against the curved path, so as to cause the cylinder to turn through the other half-revolution.

It will be seen that the line P P′ will act as the connecting-rod, and the radius O P′ as the crank of an ordinary crank-engine, but with this difference of action, that the angle P P′ O is in this case always constant, and consequently the force tending to produce rotation will also be constant during the entire revolution, instead of varying throughout, as in ordinary crank-engines. The cylinder and other revolving parts act in lieu of a fly-wheel. The motion of the engine is transmitted either by a pulley and strap or by a toothed wheel at a'.

For determining the the radius O P′ of the generating-circle for the volute, assuming the piston to be at the end of its stroke, the difference of length of the two tangents P P′ and S S′ to the circle O P′ will be equal to the stroke of the piston, and this difference of length must be exactly equal to the half-circumference of the circle in question. If therefore the stroke of the piston be = C, the radius required = R, and π the relation between the diameter and circumference, (= about 3.14 15,) we have $\pi R = C$, from which $R = \frac{C}{\pi}$,—that is to say, approximately one-third of the stroke. Having determined the radius, the volute can be developed by well-known geometrical methods, the part thereof to be utilized being that situated between the two tangents P P′ and S S′.

For stationary engines the lower part of the path may be formed as a channel sunk into the ground, as indicated at Fig. 7, so as to reduce the height of the engine.

It will be evident that this construction of engine can be employed for all purposes, whether as stationary, locomotive, marine, or other engine. With the single-volute path described the engine will only be able to revolve in one direction. In order to enable it to be reversed, either a second volute path must be applied within the other, so that the roller can bear either upon the one or upon the other, or the piston-rod must be provided with two rollers operating, respectively, on the one or the other side of a double-volute curve, as shown at Fig. 6. The piston-rod T is here provided with the two rollers, y and y', between which is the double volute V, sufficient play being allowed so that either only the roller y bears upon the inner curve when the motion is forward, as indicated by the arrow N, and as previously described, or only the roller y' bears against the outer curve when the motion is backward, as indicated by the arrow N′, this latter motion being effected by the instroke of the piston. The piston-rod T′ is in this case cranked at B, as shown in the side view, in order to pass round the volute path, which in this case must be fixed by bolts or otherwise on the side opposite to that on which the piston-rod is situated, so as to allow of the free motion of the piston-rods and rollers.

Having thus described the nature of my invention, and the best means I know for carrying the same into practical effect, I claim—

1. The combination of a working-cylinder journaled to rotate in bearings, a piston-rod reciprocating lengthwise in the cylinder and projecting through the end thereof, and a fixed curved path outside the cylinder arranged, substantially as described, to rotate the cylinder by the pressure of the piston-rod against the curved path at a point to one side of the axial line of the cylinder, substantially as described.

2. In combination with a motor-engine the rotation of whose cylinder is effected by the pressure of the piston-rod against a fixed curved path, a stationary eccentric disk having a strap revolving thereon and connected to the engine-slide, the said eccentric disk being loose upon the axis of rotation of the cylinder, but held stationary by connection with the framing, substantially as described.

3. The combination of a working-cylinder journaled to rotate in bearings, a piston-rod projecting through the ends of the cylinder and reciprocating lengthwise thereof, the eccentric E F on the journal of the cylinder, the slide-chest D, carried by and rotating with the cylinder, and having its slide connected with the eccentric and the curved path V U, arranged outside the cylinder to act on the opposite ends of the piston-rod, substantially as described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, this 5th day of July, A. D. 1884.

PIERRE BENJAMIN ADOLPHE GANOT,

Witnesses:

ETIENNE BOUNAR,

JULES LÉGEAR.