No. 119,483.

W. H. Ward's Reversible Rotary Steam Engine.

2 Sheets--Sheet 1.
Patented Oct. 3, 1871.

Fig: 1.

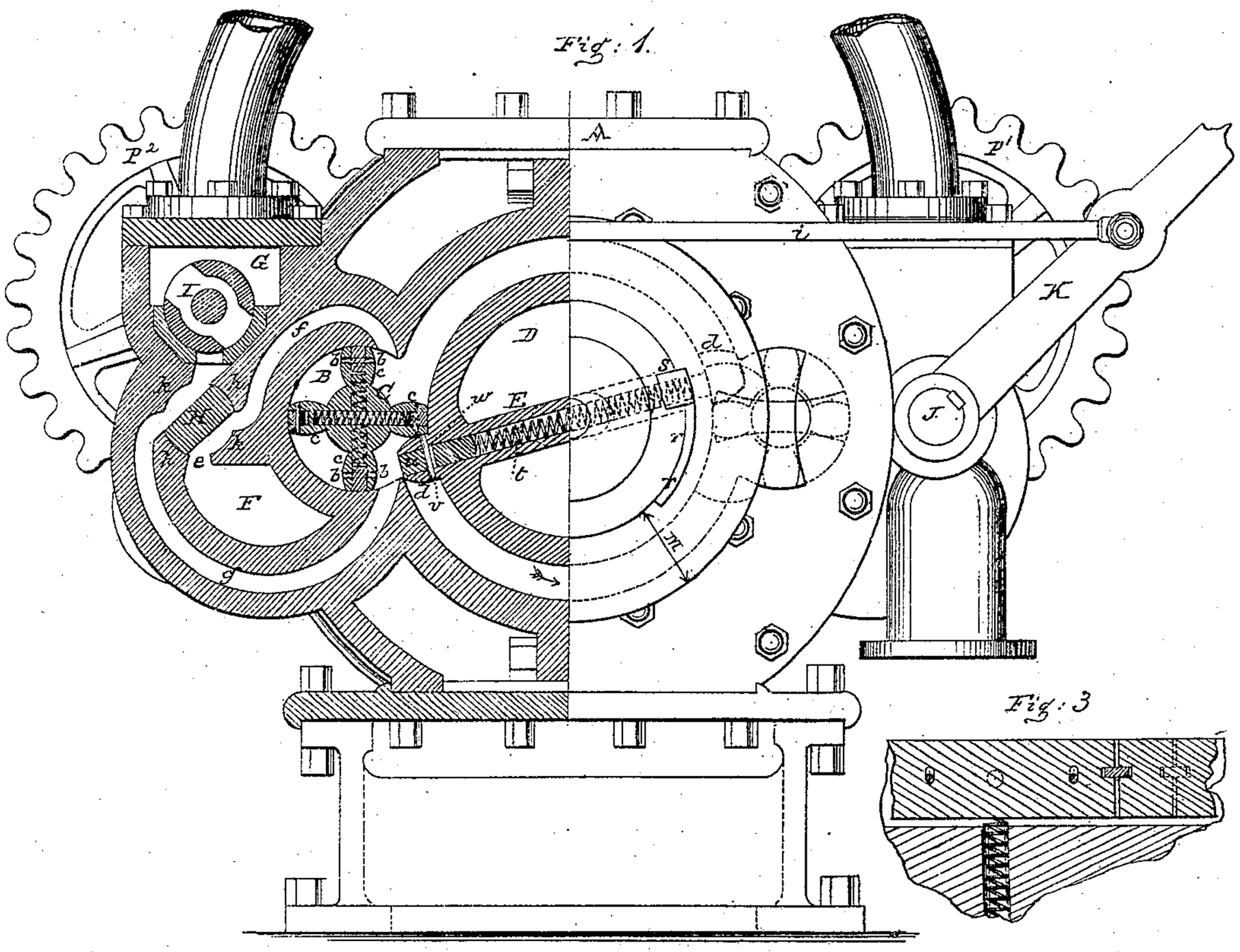
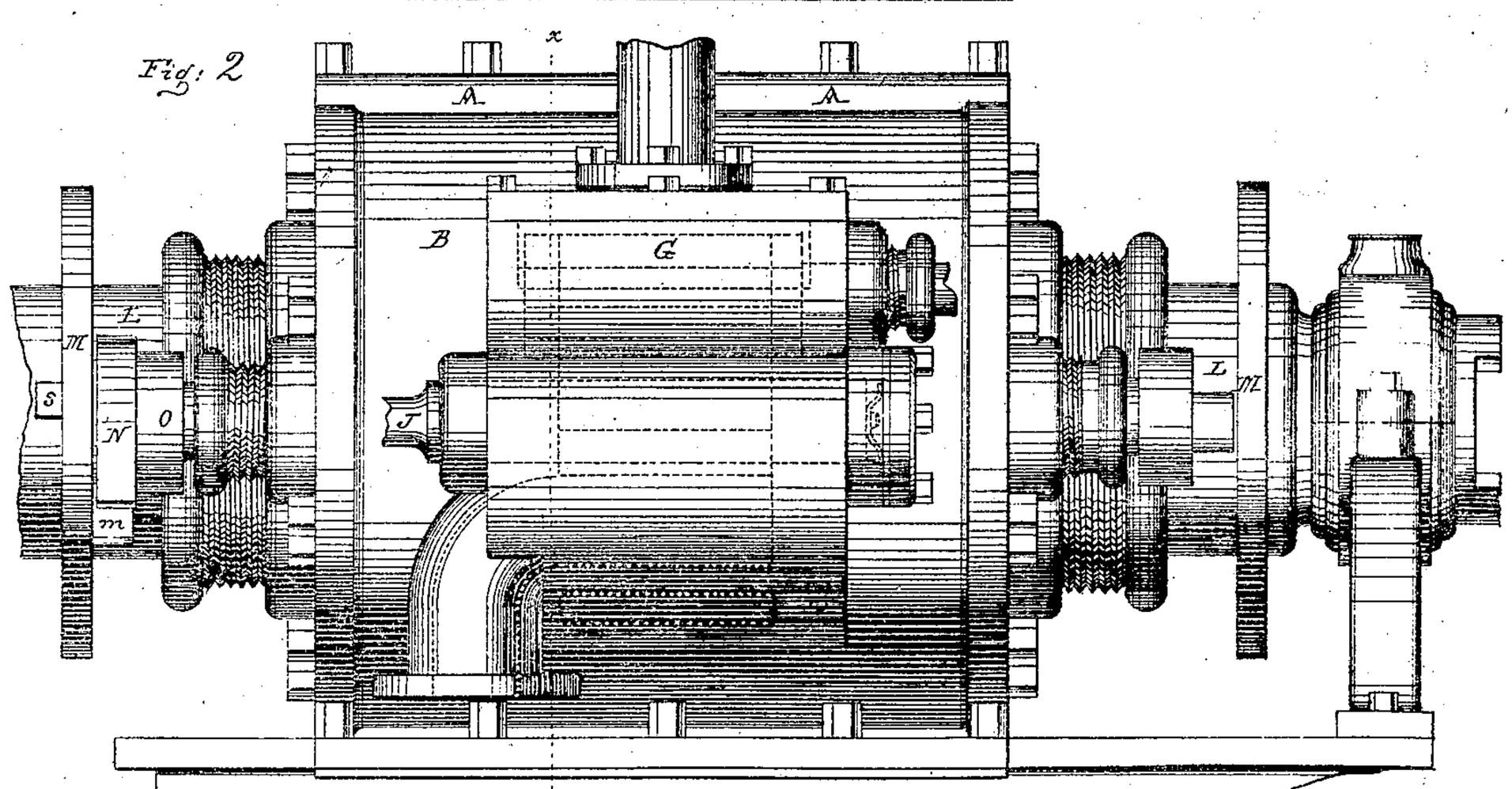


Fig: 3

Fig: 2



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AM. PHOTO-LITHOGRAPHIC CO. N.Y. (OSBORNE'S PROCESS)

No. 119,483.

W. H. WARD'S

2 Sheets--Sheet 2.

Patented Oct. 3, 1871.

Reversible Rotary Steam Engine.

Fig: 4.

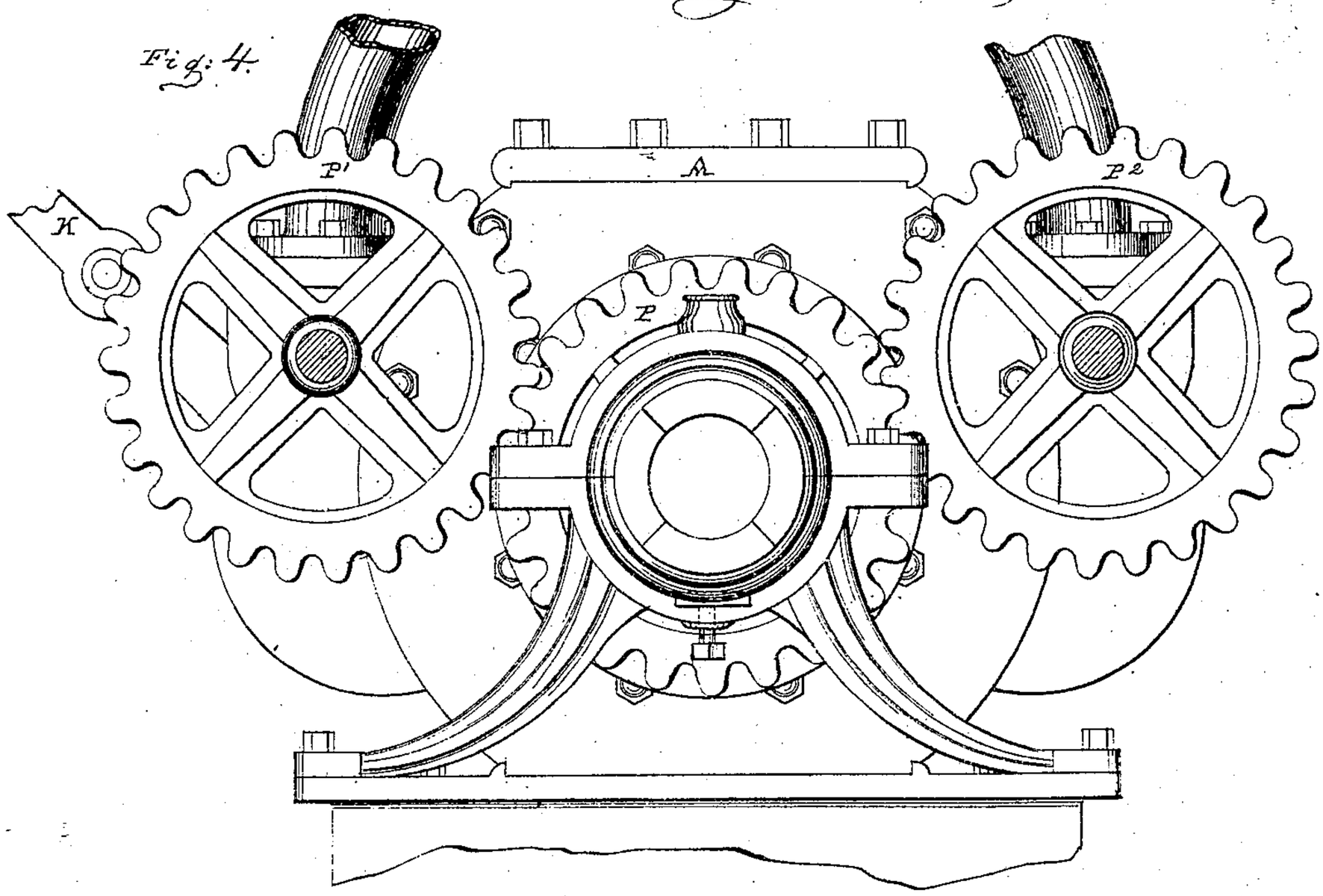
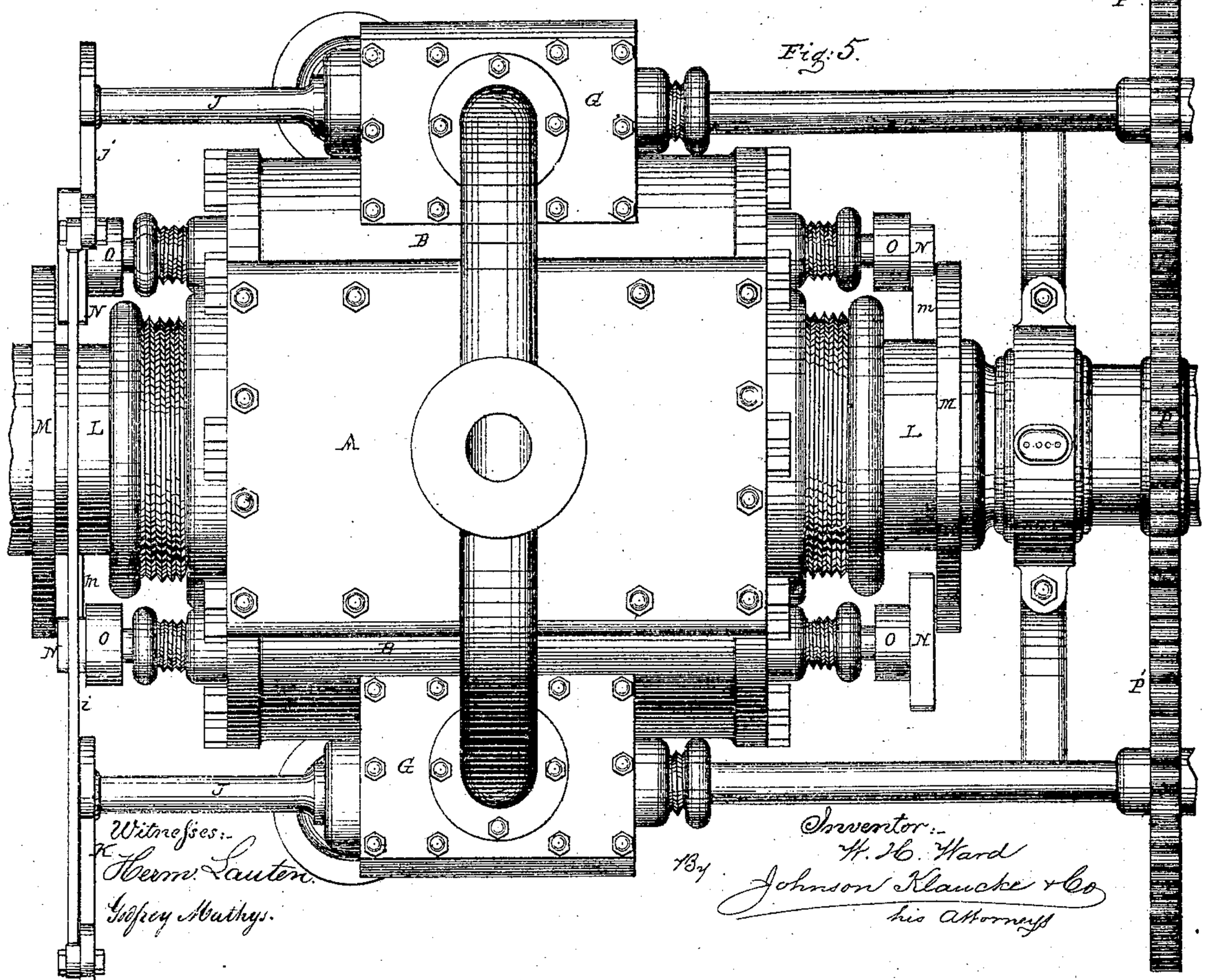


Fig: 5.



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UNITED STATES PATENT OFFICE.

WILLIAM HENRY WARD, OF AUBURN, NEW YORK.

IMPROVEMENT IN ROTARY STEAM-ENGINES.

Specification forming part of Letters Patent No. 119,483, dated October 3, 1871.

To all whom it may concern:

Be it known that I, WILLIAM HENRY WARD, of Auburn, in the county of Cayuga and State of New York, have invented a new and useful Improvement in Reversible Rotary Steam-Engines, of which the following is a specification:

My invention consists in reversing a balanced rotary steam-engine by means of reversing valves operated through a lever and connecting rods. Also, in the means of operating the self-balancing rotating resisters when their contact with the wings of the rotator ceases. And further, in keeping the packing of the wings of the rotating resisters and of the rotator tight by means of a system of spiral springs and openings, as will be more fully described hereafter.

In the accompanying drawing, Figure 1, Sheet 1, is an end elevation of my improved engine, with one lateral half in section on line *x x*, Fig. 2. Fig. 2, Sheet 1, is a front elevation of the same. Fig. 3, Sheet 1, is a detached sectional view of one of the ribs and wings of rotator D on an enlarged scale. Fig. 4, Sheet 2, is an end elevation of the same, showing the opposite end from that shown in Fig. 1. Fig. 5, Sheet 2, is a plan or top view of the same.

A in the drawing represents the rotary case in which the rotator D revolves its wings *d*, being in steam-tight contact with its inner surface. From the case A on each side extend the resister chambers B, in which the resisters C rotate, the wings *c* of which always bear steam-tight against the inner surface of its own chamber and against the outer working-surface of the rotator. This steam-tight bearing is accomplished by the following means: The rotator D is cast hollow, with diametrical ribs E at intervals in its longitudinal length in line with the wings. These ribs E are bored out alternately from the side of one wing and the other, the hole extending through the rotator into the packing slots on one side, but ending at the inner surface of the rotator on the other side, so that these holes open into the packing slots of the wings on alternate sides. On the inside of these ribs, and bearing against the packing at one end, are springs *t*. The packing *u* is loosely held in its slot by means of pins *v*, which play loosely in slots *w* so as to allow for free play of the packing *u* in its slot. The resister C is likewise provided with holes alternately at opposite sides of its wings *c*, which latter are provided with side openings *b* which allow steam to press against the packing and get behind it so as to make it perfectly tight. This packing is held in a similar manner to that of the wings *d* of rotator D. The case A connects with the exhaust ports F by means of passages *f*, and with valve-chests G by means of passages *g*. In the partition between the passages *f* and *g*, and just below the steam-valves I, are openings in which valves H fit steam-tight. These valves are caused to rotate by means of shafts J, supported by suitable bearings, one shaft on each side of the engine. One shaft bears on its outer end a crank, *j*, which, by means of a rod, *i*, is connected to a lever, K, keyed or otherwise firmly connected to the other shaft J, so that the lever K operates both valves H. These valves H, within suitable steam-tight seats, serve to reverse the engine, and have their bearings when the engine rotates in the way indicated by the arrow in Fig. 1 at *h h*; but when the lever K is brought over to reverse the engine their seats are at *k k*, thus changing the connection of the passages connecting the passages *f* to the valve-chests and the passages *g* to the exhaust ports, thereby changing the current of steam against the wings *d* of rotator D and reversing its motion. The opening *e* of the exhaust port F is wider than either of the three other openings of the passages, and thus, when the engine is reversed, the end of the valves H, which closes the exhaust port F, has passed over the same and reopened it to allow the steam to escape, which otherwise would exert a back pressure before the opposite end of the valve H has reopened the passage to the steam-chest, thus allowing all steam from the case A to escape before new steam is admitted again from the valve-chest. It will be understood that the exhaust port is continually unclosed, avoiding all back pressure whatever. L is the rotator-shaft, which, at each end outside of the steam heads, carries a rim, M, which is sufficiently loose on the shaft to rotate without moving laterally, and is operated from a key on shaft, and which carries a tooth, *m*, which comes in sliding contact with cams N, one at each end of the shafts O of the resisters C. The outer edge of the teeth *m* runs parallel with the periphery of rims M, and cams N have convex-shaped sides to correspond to the shape of the teeth *m;* and these cams are set at right angles to each other at opposite ends

of each shaft, so that when one cam at the end of one shaft is in position to come in contact with the tooth *m* of its side the cam at the opposite end of the same shaft is in position parallel with the periphery of the tooth *m* on its side. The rotator revolving in the direction of the arrow shown in Fig. 1, its revolution, by reason of the gear-wheels P P^1 P^2, rotates the left valve, opening the connection with passage *g* at the moment when wing *d* has passed this passage at its inner end and the packing of wing *d* bears against the working surface of case A. The steam now bears against the wing *d* and forces the rotator around. When the opposite wing *d* comes into contact with that wing of resister C which bears upon the working surface of rotator D it carries it with it until the wing *d* has passed the wing *c*, which does not bring the next wing *c* above into contact with the working surface of rotator D; and to accomplish this the rotation of the resister C is taken up at that moment by one cam, N, of its shaft coming at that moment into contact with the tooth *m*, which latter depresses the cam N into a vertical position, while the cam on the opposite end of the same shaft is brought into a horizontal position, ready to be acted upon by tooth *m* at the next half revolution of rim M. The moment the cam N is in a vertical position it has brought the resister C in its necessary and proper position until the next wing *d* comes again into contact with wing *c*, and the operation is repeated. The cams being at right angles to each other at opposite ends of the same shaft the completion of the necessary rotation of the resister is effected from opposite ends of the shaft alternately on each side of the engine. On the inside face of each rim M is formed a slot, *r*, in which fits a key, *s*, on the rotator-shaft L, which key carries the rim M with it in its rotation on the shaft. When the engine is reversed this slot allows the shaft to rotate back, without rotating the rim, for a certain distance, the key *s* traveling in the slot *r* so as to get the wings *d* of rotator D into their proper position before the teeth *m* again operate the cams N on their reversal.

Having thus described my invention, I claim—

1. Reversing a steam-engine by means of valves H, arranged to operate independently of the throttle-valves, substantially as described.

2. In a rotary engine the cams N, arranged on the outer ends of the register-shafts, as shown, in combination with rims M and teeth *m*, to operate substantially as described.

3. The rims M, when provided with a slot, *r*, in combination with a key, *s*, on rotator-shaft L, to operate substantially as described.

4. In a rotary engine the ribs E, open at alternate ends to receive springs *t*, which bear against the packing of the wings *d*, for the purposes described.

5. In a rotary engine the resisters C, when their wings *c* are provided with springs to operate the packing, and with side openings *b* to heighten the same by steam, as described, for the purposes set forth.

W. H. WARD.

Witnesses:
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