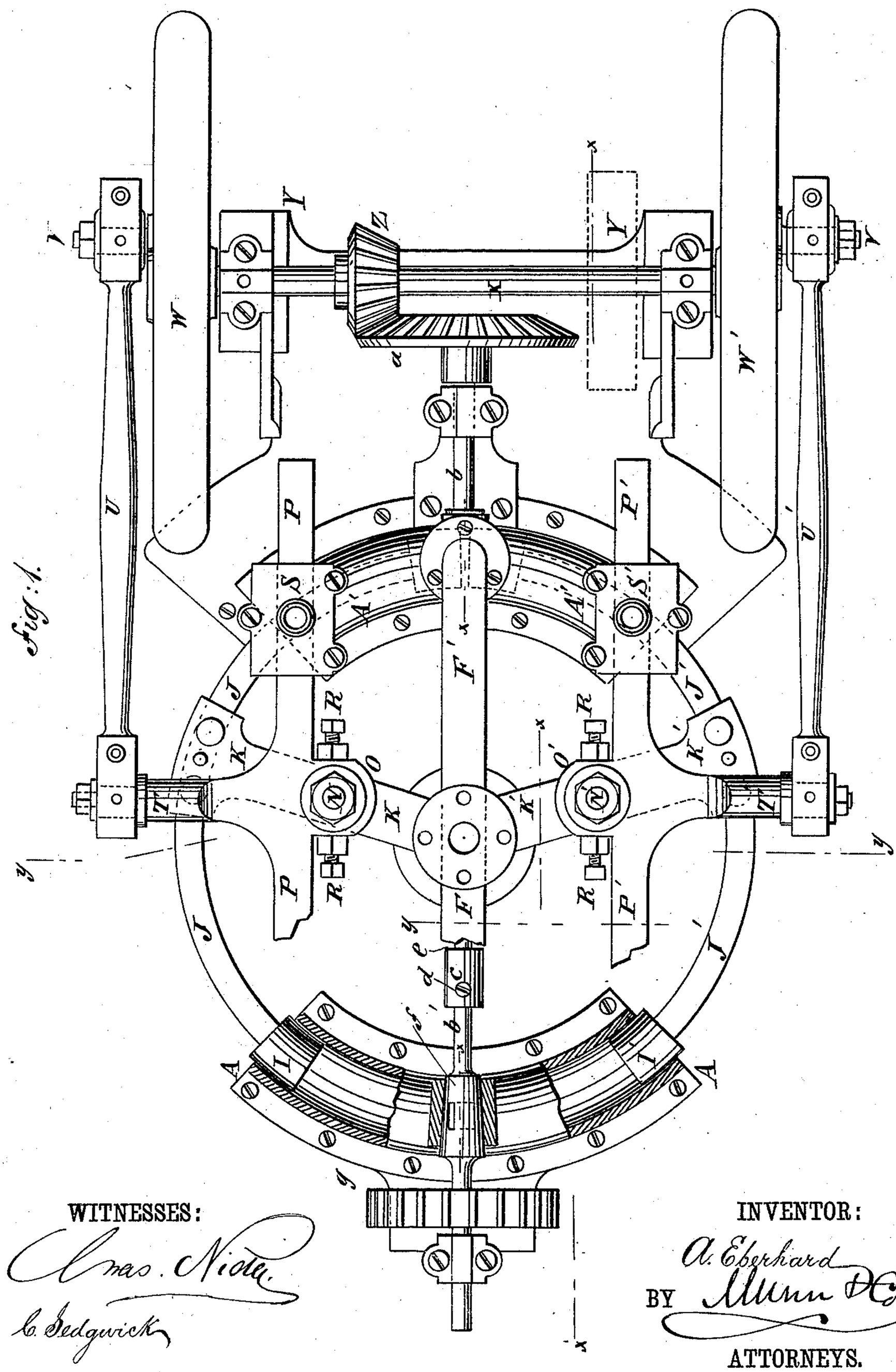
(No Model.) 3 Sheets—Sheet 1.

# A. EBERHARD.

## STEAM ENGINE.

No. 290,871. Patented Dec. 25, 1883.




WITNESSES:

Chas. Nichols.

C. Sedgwick

INVENTOR:

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ATTORNEYS.

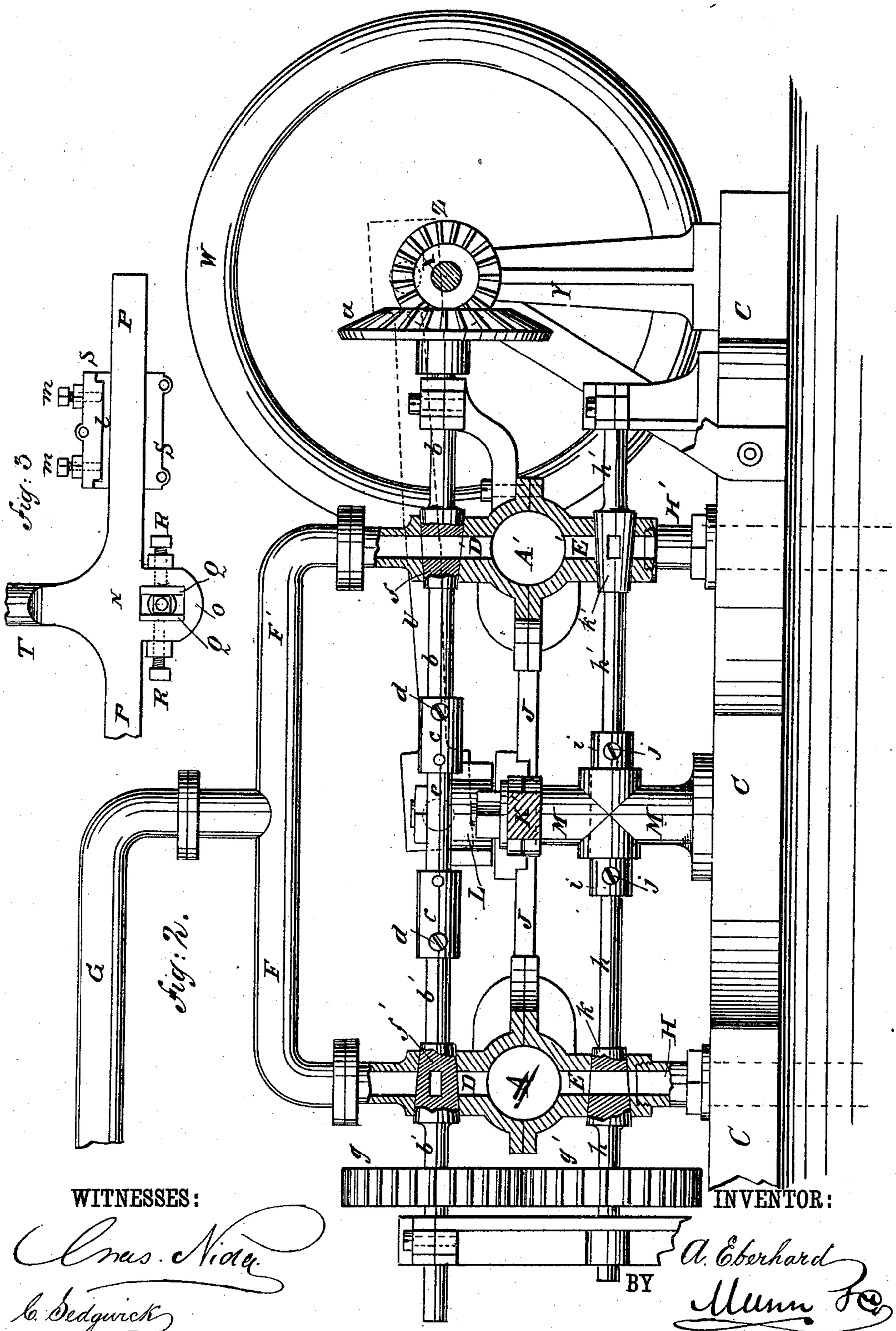
(No Model.)

3 Sheets—Sheet 2.

# A. EBERHARD.

## STEAM ENGINE.

No. 290,871. Patented Dec. 25, 1883.




WITNESSES:

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3 Sheets—Sheet 3.

# A. EBERHARD.

## STEAM ENGINE.

No. 290,871. Patented Dec. 25, 1883.

*Fig: 4.*

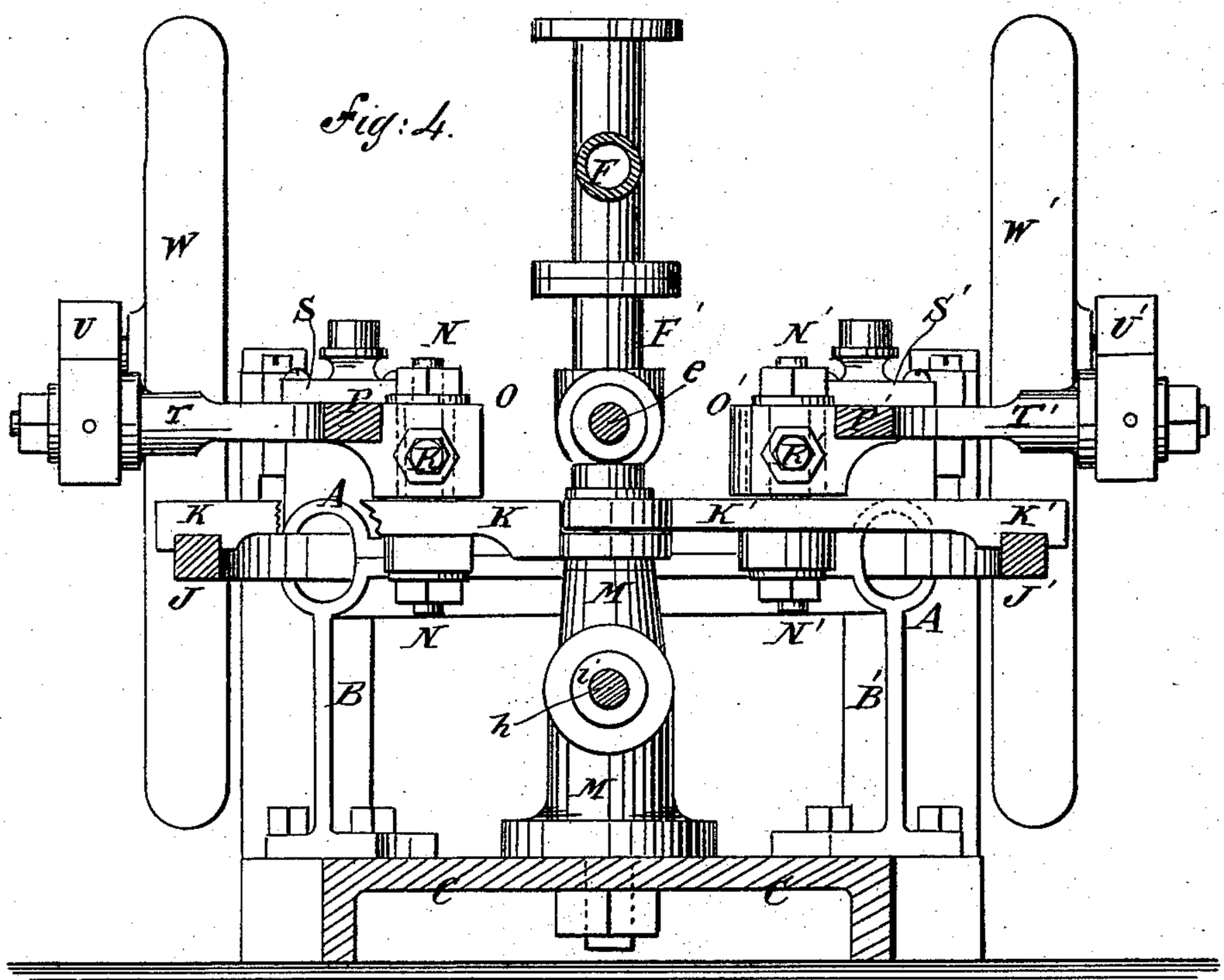
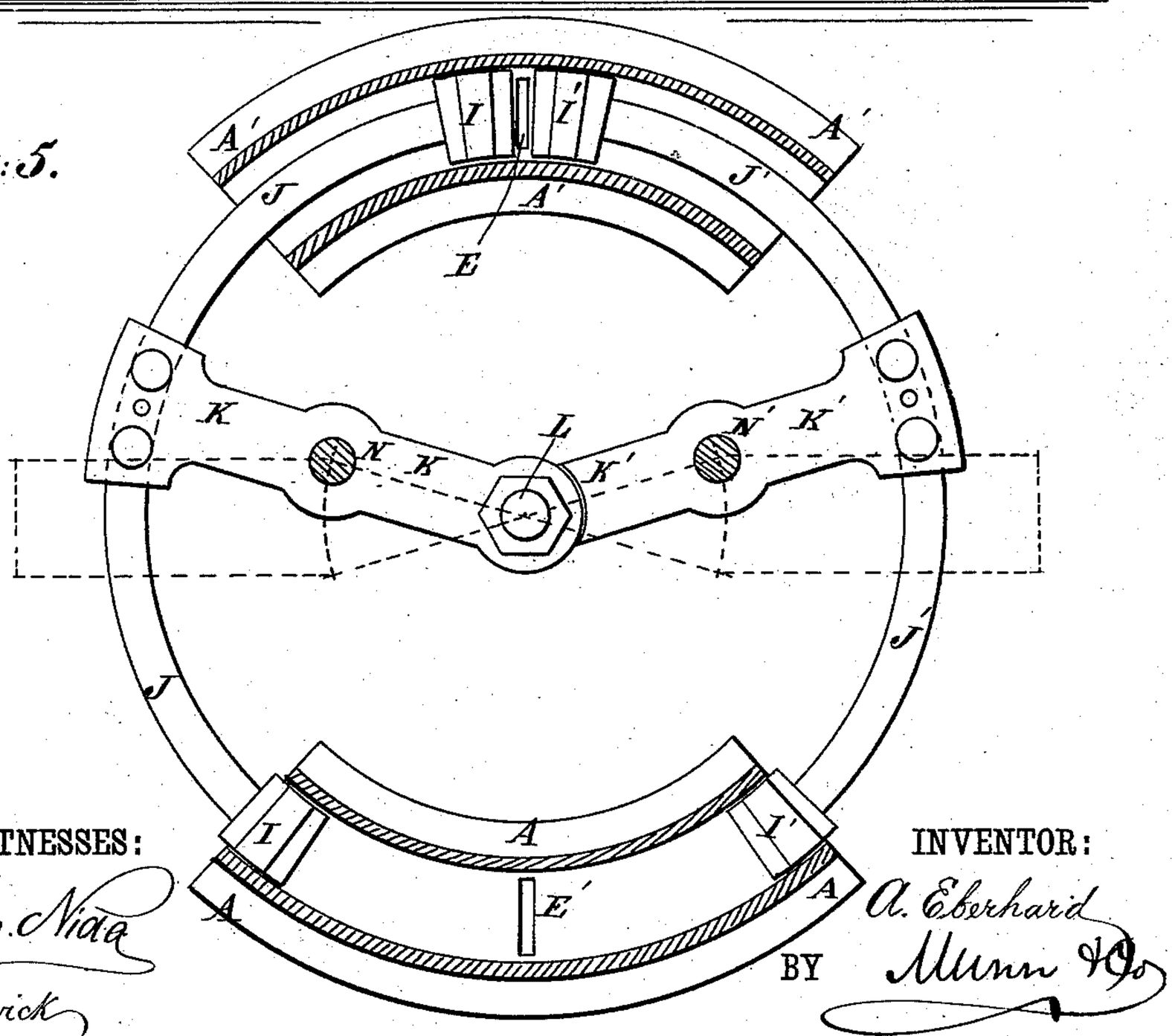



*Fig: 5.*




WITNESSES:

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# UNITED STATES PATENT OFFICE.

ANTON EBERHARD, OF PHILADELPHIA, PENNSYLVANIA.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 290,871, dated December 25, 1883.

Application filed July 20, 1883. (No model.)

*To all whom it may concern:*

Be it known that I, ANTON EBERHARD, of the city and county of Philadelphia, and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engines, of which the following is a full, clear, and exact description.

Reference is to be had to the accompanying drawings, forming part of this specification, in which similar letters of reference indicate corresponding parts in all the figures.

Figure 1, Sheet 1, is a plan view of my improvement, parts being broken away. Fig. 2, Sheet 2, is a sectional side elevation of the same, taken through the broken line *x x x x x*, Fig. 1. Fig. 3. Sheet 2, is a plan view of a part of one of the cross-heads. Fig. 4, Sheet 3, is a sectional end elevation of the improvement, taken through the broken line *y y y*, Fig. 1. Fig. 5, Sheet 3, is a sectional plan view of the steam-cylinders, showing the pistons, piston-rods, and piston-rod levers in plan view.

The object of this invention is to promote efficiency and economy in the use of steam.

The invention consists in a steam-engine constructed with two cylinders curved upon the arc of a circle, and having four pistons connected in pairs by curved piston-rods connected by levers with the slotted lugs of cross-heads provided with pivot-arms carrying the inner ends of pitmen, the outer ends of which are connected by crank-pins with the fly-wheels of the drive-shaft.

With the inlet and outlet ports of the two curved cylinders and the drive-shaft are connected four valves, which are connected in pairs by valve-rods, and the said valve-rods are connected with each other and with the drive-shaft by gear-wheels, whereby the said valves will be opened and closed automatically and at the proper times, as will be hereinafter fully described.

A A′ are two steam-cylinders, which are made in the form of arcs of circles, and of a length a little less than a quarter of a circle. The cylinders A A′ are placed directly opposite each other, and in the circumference of the circle of which they form arcs, as shown in Figs. 1 and 5. The cylinders A A′ are attached to the upper ends of standards or other supports, B B′, secured to the bed-plate or base C of the machine. The cylinders A A′ are open at both ends, and have inlet-ports D D′ in the centers of their upper sides, and outlet-ports E E′ in the centers of their lower sides. The inlet-ports D D′ are connected with the ends of the branches F F′ of the inlet steam-pipe G, and the outlet-ports E E′ are connected with the outlet steam-pipes H H′.

Within each of the cylinders A A′ are placed two pistons, I I′. The corresponding pistons of the two cylinders are connected by piston-rods J J′, which are curved upon the arc of the circle of which the said cylinders form a part, so that the pistons of the two cylinders will always move in opposite directions.

To the centers of the curved piston-rods J J′ are bolted the outer ends of two levers, K K′, the inner ends of which are halved to each other, and are pivoted to a bolt, L, formed upon or attached to the upper end of the standard M. The lower end of the standard M is secured to the base C in the center of the circle of which the cylinders A A′ form a part. The middle parts of the levers K K′ are thickened, and have holes formed through them to serve as bearings for the pivots N N′, which are secured in place by washers and nuts applied to their lower ends. The upper parts of the pivots N N′ are squared, pass through slots in the lugs O O′, formed upon the inner sides of the centers of the slides or cross-heads P P′, and have washers and nuts applied to their upper ends. By this construction the cross-heads P P′ will be moved back and forth in straight lines by the movements of the levers K K′ through the arcs of circles. The sides of the slots in the lugs O O′ are faced with bearing-plates Q Q, to lessen the friction, and which are held up against the squared upper parts of the pivots N N′ by set-screws R R, so that the wear can be readily taken up. The end parts of the slides P P′ slide in bearings S S′, attached to the ends of the cylinders A A′ or other suitable supports, and which are provided with friction-plates *l*, held forward against the said slides P by set-screws *m*.

Upon the upper parts of the slides P P′, directly opposite the lugs O O′, are formed out-

wardly-projecting arms T T′, to the outer ends of which are pivoted the ends of the pitmen U U′. The other ends of the pitmen U U′ are pivoted to crank-pins V V′, attached to the fly-wheels W W′, secured to shaft X, which revolves in bearings in supports Y, attached to the base C. The fly-wheels W W′ may be made with flat faces to receive belts for giving motion to the machinery to be driven; or power may be taken from the engine by means of a pulley or gear-wheel attached to the shaft X, as indicated in dotted lines in Fig. 1.

To the shaft X is attached a small beveled-gear wheel, Z, the teeth of which mesh into the teeth of a larger gear-wheel, *a*, attached to the outer end of the valve-rod *b*. The inner end of the valve-rod *b* is connected with the inner end of the valve-rod *b′* by sleeves *c*, set-screws *d*, and a connecting-rod, *e*, or other suitable couplings.

Upon the parts of the valve-rods *b b′* that pass through the steam-inlet pipes F F′ are formed, or to them are attached, valve-plugs *f f′*, the ports of which are at right angles with each other, as shown in Fig. 2, so that steam will be admitted into the cylinders A A′ alternately, or twice to each cylinder during each revolution of the valve-rods *b b′*.

To the outer part of the valve-rod *b′* is attached a gear-wheel, *g*, the teeth of which mesh into the teeth of the gear-wheel *g′*, attached to the outer part of the valve-rod *h*. The gear-wheels *g g′* are of equal size, so that the two sets of valve-rods will be revolved at equal speed. The inner end of the valve-rod *h* is connected by a sleeve, *i*, and set-screws *j* with the inner end of the corresponding valve-rod, *h′*.

Upon the parts of the valve-rods *h h′* that pass through the steam-outlet pipes H H′ are formed, or to them are attached, valve-plugs *k k′*, the ports of which are at right angles with each other and with the ports of their corresponding inlet-valve plugs, *f′ f*, as shown in Fig. 2. With this arrangement, as the inlet-valve of each cylinder is opened, the outlet-valve of the said cylinder will be closed, and the other cylinder will have its inlet-valve closed and its outlet-valve opened, so that as steam is received into one cylinder it will be exhausted from the other.

I do not abandon or dedicate to the public any patentable feature set forth herein and not hereinafter claimed, but reserve the right to claim the same either in a reissue of any patent that may be granted upon this application or in other applications for Letters Patent that I may make.

Having thus described my invention, I claim as new and desire to secure by Letters Patent—

1. A steam-engine constructed substantially as herein shown and described, and consisting of two cylinders curved upon the arc of a circle, and four pistons connected in pairs by curved piston-rods connected by levers with slotted lugs of cross-heads provided with arms carrying the inner ends of pitmen, the outer ends of which are connected by crank-pins with the fly-wheels of the drive-shaft, as set forth.

2. In a steam-engine, the combination, with the curved cylinders A A′, the curved piston-rods J J′, and the pitmen U U′, connected with the drive-shaft X by the crank-pins V V′ and fly-wheels W W′, of the levers K K′ and the cross-heads P P′, having slotted lugs O O′ and pivot-arms T T′, substantially as herein shown and described, whereby the reciprocating motion of the piston-rods is changed into rotary motion, as set forth.

3. In a steam-engine, the combination, with the curved cylinders A A′, the inlet-ports D D′, the outlet-ports E E′, and the drive-shaft X, of the valves *f f′ k k′*, the valve-rods *b b′ h h′*, and the gear-wheels *g g′ a* Z, substantially as herein shown and described, whereby the valves will be opened and closed automatically and at the proper times, as set forth.

4. The cross-heads P P′, having slotted lugs O O′ on the inner sides of their centers, in combination with the pivots N N′, squared at their upper ends and passing through said slots, and the levers K K′, provided with middle bearings for said pivots, whereby the cross-heads may always move in straight lines, as described.

ANTON EBERHARD.

Witnesses:
JOSEPH F. MARCER,
JACOB MORLOK.