(No Model.)

3 Sheets—Sheet 1.

A. A. WILLSON.

STEAM ENGINE.

No. 327,910. Patented Oct. 6, 1885

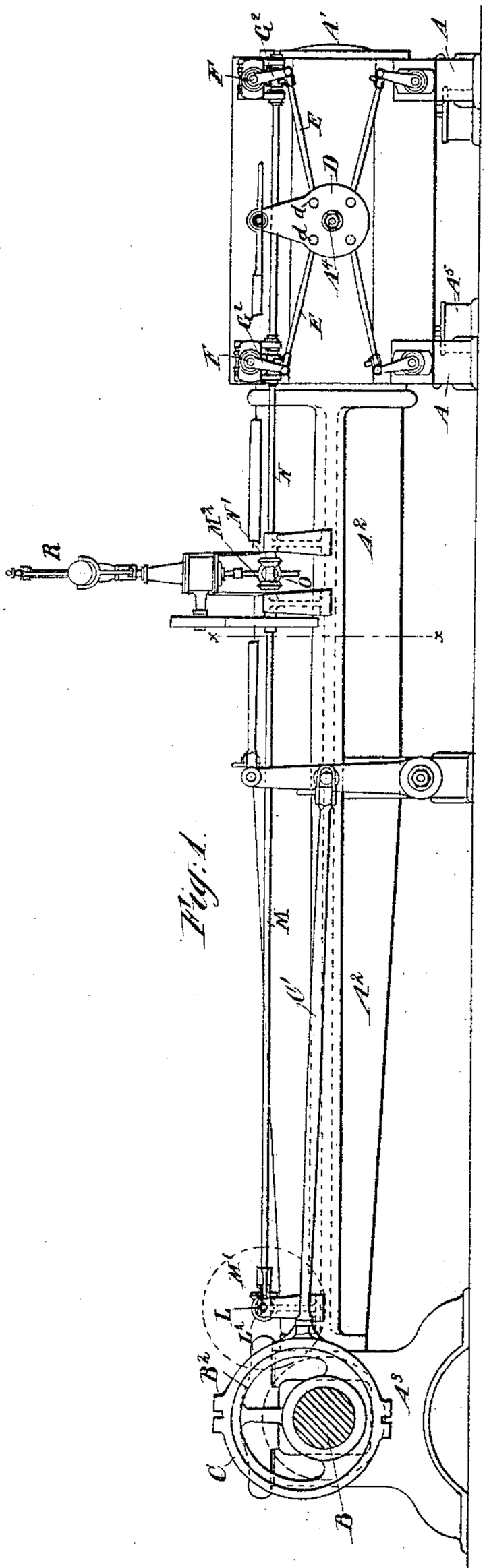

Fig. 1.

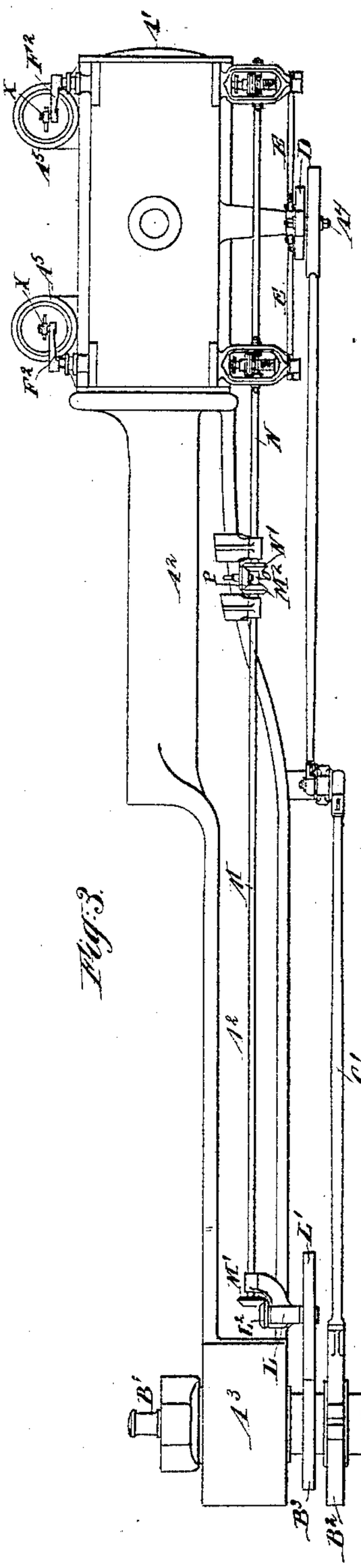

Fig. 3.

Witnesses:
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Charles R. Searle.

Inventor.
Albert A. Willson
By
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Attorney.

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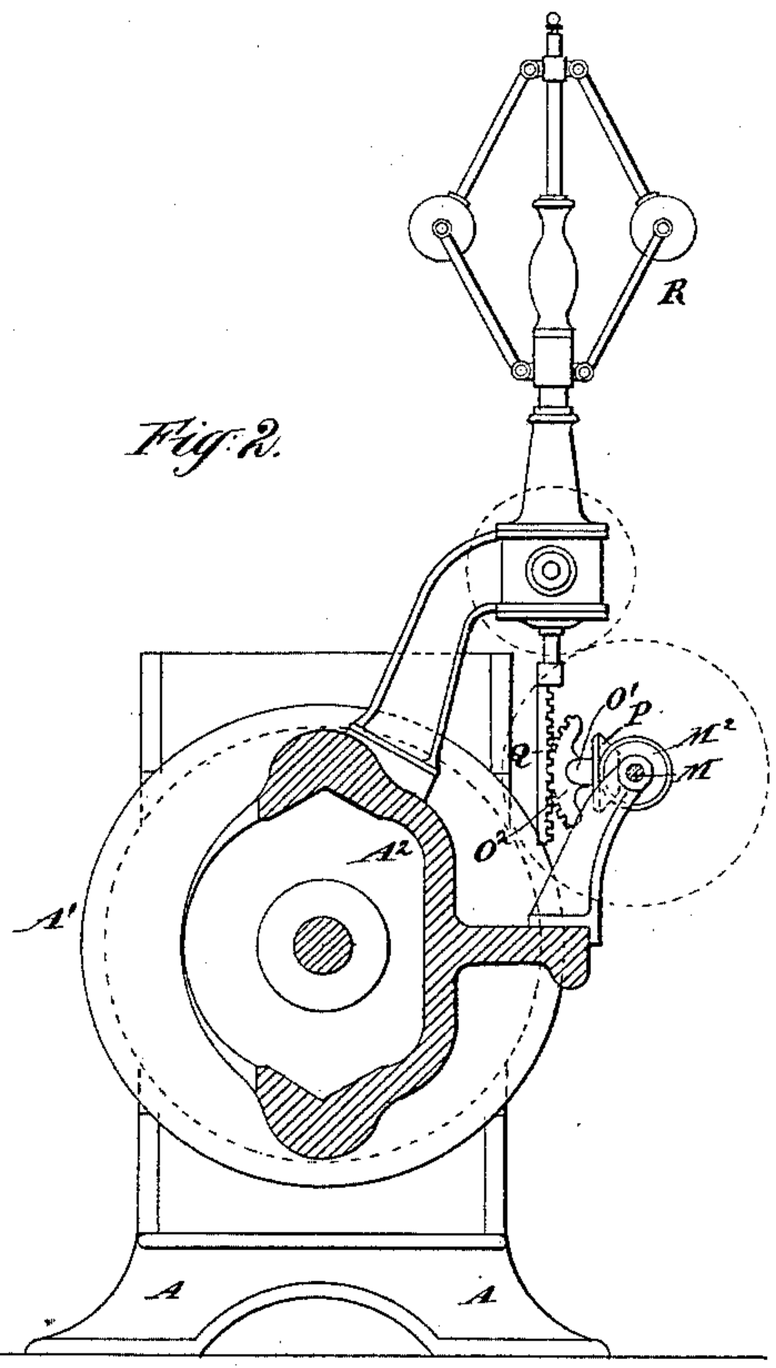

Fig. 2.

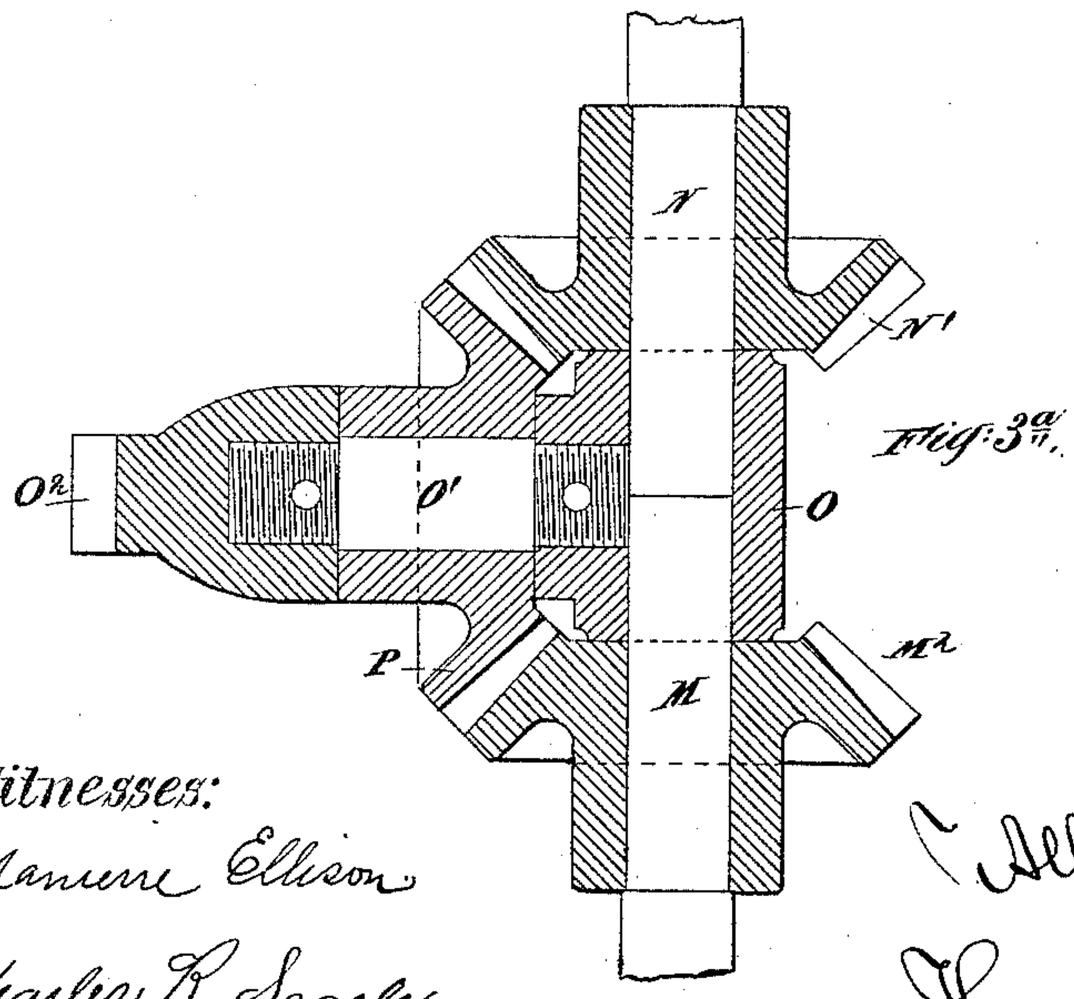

Fig. 3a.

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(No Model.) 3 Sheets—Sheet 3.

A. A. WILLSON.

STEAM ENGINE.

No. 327,910. Patented Oct. 6, 1885.

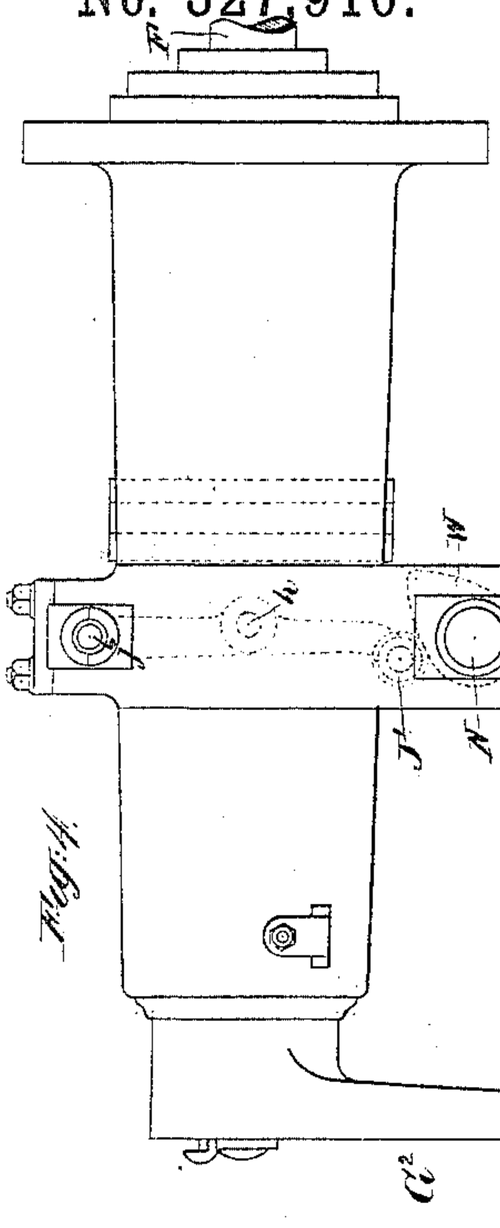

Fig. 4.

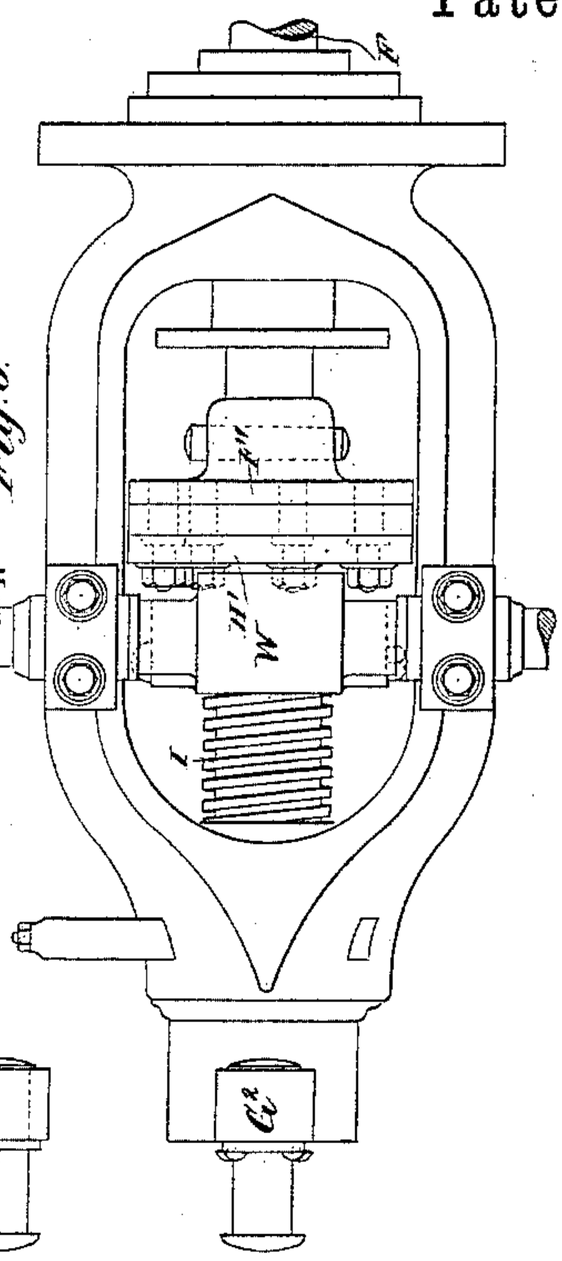

Fig. 6.

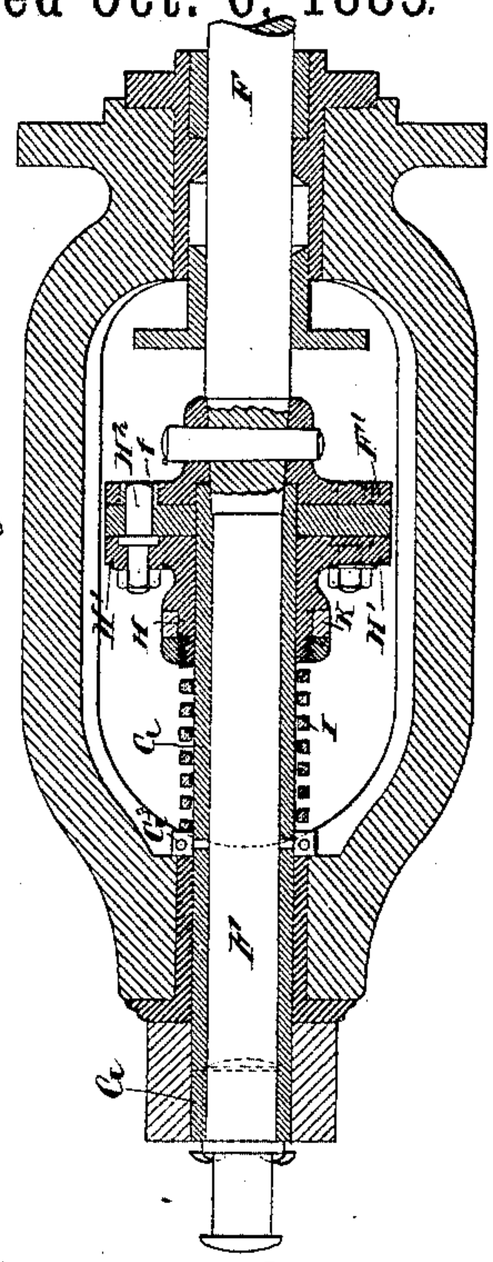

Fig. 7.

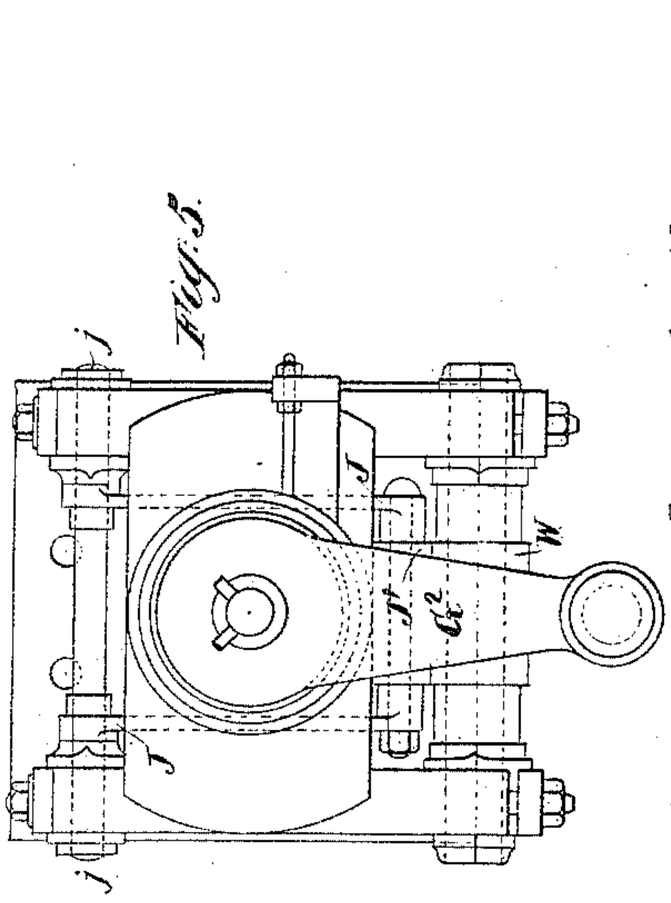

Fig. 5.

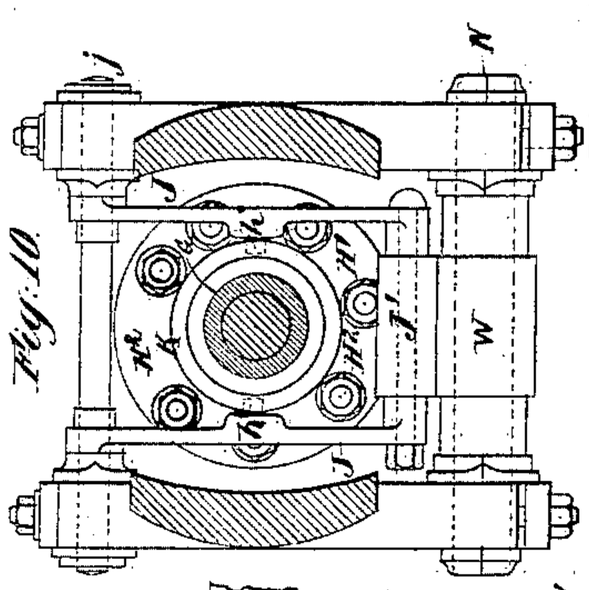

Fig. 10.

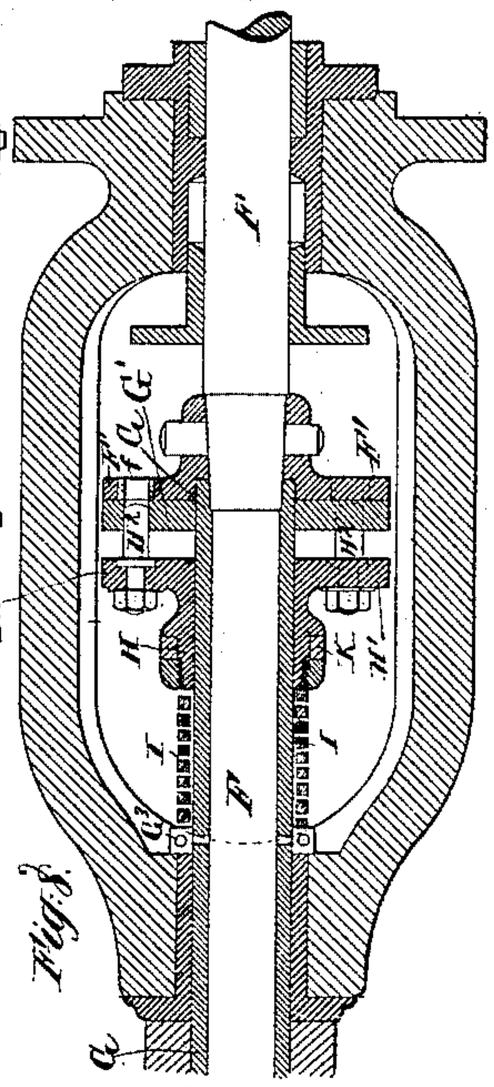

Fig. 8.

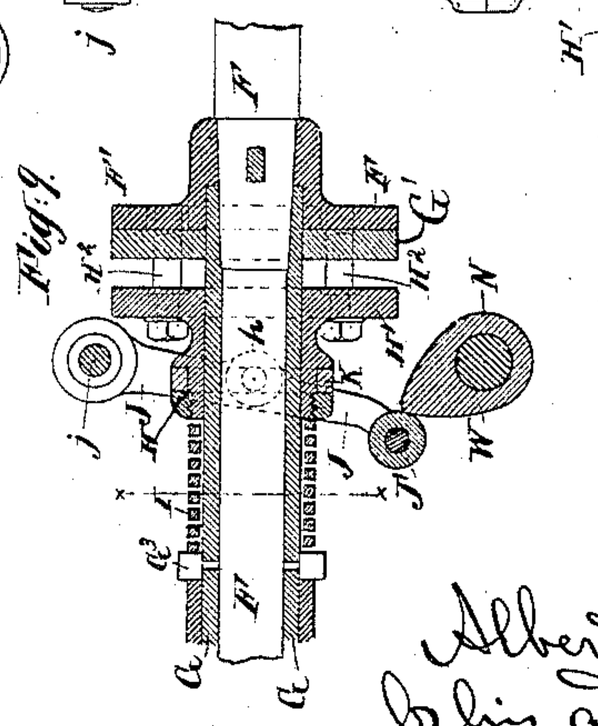

Fig. 9.

Witnesses:
Charles R. Searle,
Maurice Ellison

Inventor:
Albert A. Willson
by his attorney
Thomas Drew Stetson

UNITED STATES PATENT OFFICE.

ALBERT A. WILLSON, OF BROOKLYN, ASSIGNOR TO HIMSELF, AND N. F. PALMER, JR., & CO., OF NEW YORK, N. Y.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 327,910, dated October 6, 1885.

Application filed June 17, 1885. Serial No. 168,915. (No model.)

To all whom it may concern:

Be it known that I, ALBERT A. WILLSON, of Brooklyn, Kings county, in the State of New York, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification.

My improved engine is of the class known as "Corliss," the steam-valves being opened with a uniform amount of lead, and detached, and allowed to close at variable points in the stroke. I provide means for varying the point of cut-off from nothing up to nearly full stroke. I provide means for effecting this wide range of variation automatically by a governor. I will describe it as applied to a horizontal engine.

I effect the opening of the valve by machinery identical with that which performs the corresponding function in the well-known "Corliss" engine. There are two steam-valves, worked independently, each closed by the force of a spring or weight, and which is arrested by an air-cushion. So far all is as in the ordinary Corliss engine.

I effect the liberating of each valve by a cam actuated by a shaft operated by gearing from the main shaft of the engine. The cam is set forward or backward relatively to the main shaft by the action of the governor. When the cam has acted to a certain extent, the valve is liberated. If the cam is set forward relatively to the shaft, the detaching is earlier, and the steam is cut off earlier, so that the steam is worked more expansively. When, on the contrary, the cam is set back, the period of detaching is later, and the steam follows farther, driving the engine with increased power.

The setting of both cams forward and backward is effected by changing the relations of gearing which connects the end of the shaft on which the cams are set with the other and main portion of the shaft. The gearing is controlled by the governor, and the action is automatic.

The accompanying drawings form a part of this specification, and represent what I consider the best means of carrying out the invention.

Figure 1 is a general side elevation, and Fig. 2 a cross-section on the line *x x* in Fig. 1. Fig. 3 is a plan view corresponding to Fig. 1.

The figures represent the novel parts, with so much of the ordinary parts as is necessary to indicate their relations thereto. The succeeding figures represent certain portions on a larger scale.

Fig. 4 is an elevation showing a portion of the valve-gear for one of the steam-valves. It is a view looking longitudinally of the engine. Fig. 5 is a corresponding elevation seen in the same direction as Fig. 1. Fig. 6 is a plan view corresponding to Fig. 4. Fig. 7 is a horizontal section showing the parts before the valve is liberated. Fig. 8 is a horizontal section showing the parts after the valve is liberated. Fig. 9 is a vertical section corresponding to Fig. 8. Fig. 10 is a vertical section on the line *x x* in Fig. 9. Fig. 3ª is a horizontal section of a portion on a larger scale.

Similar letters of reference indicate corresponding parts in all the figures where they occur.

A is the main frame.

A′ is the cylinder, and A^2 A^2 are the frames, rigidly attached thereto, which support the mechanism which operates the steam-valves. A^3 is the bed-plate or main portion of the frame. It supports in substantial pillow-blocks the main shaft B, which receives the power in the ordinary manner on its main crank B′, and, as will be understood, is provided with a fly-wheel and means, as usual, for communicating the power of the engine.

B^2 is an eccentric, which, by means of an eccentric-strap, C, rod C′, and suitable connections, communicates the ordinary rocking motion to the wrist-plate D, which, turning on an arm, A^4, rigidly mounted on the cylinder A′, communicates the proper motion to open and close the exhaust-valves, with which latter this invention has nothing to do. and also communicates through pins *d d* and links E the required motions for opening the steam-valves.

The mechanism for operating the two steam-valves being counterparts of each other, a detailed description of one will suffice for both.

The link E communicates the motion re-

ceived from the wrist-plate to an arm, G^2, keyed on a sleeve, G, which, except for certain pins, H^2, (which will presently be described,) is free to turn loosely on the valve-stem F. It will be understood that this valve-stem, extending through a suitable stuffing-box, operates a Corliss valve, being partially turned in one direction or the other, like a stop-cock. The ordinary Corliss mechanism detaches and liberates the valve only during the opening motion. In my improved machines, on the contrary, my mechanism detaches at any period.

I will first describe the provisions for liberating each valve by the proper cam, and afterward the means for driving the cams and for setting them forward and back by the action of the governor.

A flange, F′, keyed on the valve-stem F, is bored with a number of holes, *f*, arranged irregularly.

A sleeve, H, shorter than G, and fitting loosely thereon, carries a flange, H′, which is equipped with pins H^2, which extend constantly through the flange G′, and at certain periods engage in the holes *f*, the pins H^2 and the holes in G being arranged like the holes *f*. The sleeve H, with its flanges and pins, is subject to the force of a spiral spring, I, which incloses the sleeve and abuts against a collar, G^3, fixed on the sleeve G, and urges the sleeve H toward the flange F′. This arrangement, unless interfered with by some means which shall move the sleeve H axially against the force of the spring I, insures the constant engagement of the pins H^2 in the holes *f*, and compels the valve-stem F and attached valve to turn in both directions with the motion received through the link E, acting on the arm G^2. This motion opens the valve with the proper amount of lead. The parts are adjusted so that the motion derived from this source will also close the valve at or near the end of the stroke. I will describe it as so actuated; but it may, if preferred, be adjusted so that such motion would cause the steam-valve to remain open for a longer period, the cam and its connections being absolutely reliable as a means for detaching and allowing the valve to shut at the right periods.

J is a yoke embracing the sleeve H and serving as a lever. It turns on a horizontal axis, *j*, and takes hold of a ring, K, fitted loosely in a groove in the sleeve H, engaging by means of trunnions *h h*, a little play being permitted to allow for the slight sweep of the lever. Its outer end carries a roller, J′. By acting on this roller by a cam, W, to turn the lever, the sleeve H and its attachments may be moved in opposition to the force of the spring I, so as to disengage the pins H^2 from their several holes *f* in the flange F′. Whenever this takes place the valve-stem F is set free and turns by the action of the ordinary well-known Corliss mechanism—to wit, a weight and link, X, connected to an arm, F^2, on the farther end of the valve-stem. (See Fig. 3.) This figure also shows the cylinder A^5, into which the weight sinks, and is cushioned by air after its descent.

The cam W is keyed or otherwise firmly set on a length of shafting, N, which is supported in fixed bearings, and has near its end a beveled gear-wheel, N′.

On the main shaft B is keyed a spur gear-wheel, B^3, which engages with a similar toothed wheel, L′, fixed on a short shaft, L, which carries a beveled gear-wheel, L^2. This latter engages with a similar beveled gear-wheel, M′, fixed on the end of the shaft M, supported in fixed bearings, and lying at right angles to the main shaft B. Near the opposite end of this shaft M is fixed a beveled gear-wheel, M^2. The shaft N is in line with the shaft M. Each shaft is extended a little beyond its respective gear-wheel, M^2 N′, and forms a support for a short sleeve, O, which has an arm, O′, at right angles thereto, which performs important functions. (See Figs. 1, 2, 3, and 3ª.)

A round bearing is provided on the arm O′ at a proper distance from the axis of motion, on which is supported a loose beveled gear-wheel, P, which engages with both the wheels M^2 and N′. The outer end of the arm O′ is equipped with a toothed segment, O^2, having nicely-cut teeth, which engage in corresponding teeth in a straight rack, Q, which is guided in a strictly vertical motion, and which is raised and lowered by the action of the fly-ball governor R. This governor receives its motion from gearing, as shown, or through other suitable means. As its speed rises above or sinks below the proper level, it raises or lowers the rack Q. This, acting on the toothed segment O^2, turns the sleeve O partially around on its axis formed by the abutting ends of the shafts M and N. While the speed is uniform, the governor holds the rack Q and its connections in a fixed position, and the beveled gear-wheel P will communicate the motion equally from the gear-wheel M^2 to the gear-wheel N′, and the cams W will be brought into action at a certain period in the stroke. The cams are of course set on opposite sides of the axis, so that each will properly serve its connected valve, one controlling the detaching as the piston moves on the outstroke, and the other controlling the detaching as the piston moves in the reverse direction or on the instroke. So long as the motion is uniform the governor-balls revolve at a uniform level, the rack Q remains motionless, and the gear-wheel P simply transmits the motion from the shaft M to the shaft N, giving them exactly equal motions. The shaft N turns in the opposite direction from the shaft M; but this fact is of secondary importance, the cams being set to adapt their action to the revolving in that direction.

Whenever there is any change in the speed, so that the rack Q moves down or up, it gives a corresponding partial rotation to the sleeve O, and raises or lowers the loose beveled gear-wheel P, which communicates

the motion from one shaft to the other. This has the effect to communicate a corresponding but increased change of relation to the shafts M N. For example, suppose the motion to be too slow, so that the rack Q goes down; it lowers the wheel P, and thus sets the driven shaft N backward relatively to the driving-shaft M. This makes the action of the cams to detach the steam-valves take place at a later period in the stroke, the steam follows the piston farther, more steam is consumed, and the engine works with more force. When, on the contrary, the engine works too fast and raises the rack Q, it raises the gear-wheel P, and changes the relations of the motion of the shafts M and N in the opposite direction—that is to say, it sets the driven shaft N forward relatively to the driving-shaft M. This makes the cams act earlier. By liberating the steam-valves and allowing them to shut at an earlier period in the stroke less steam is consumed, and the engine works with less force.

I have determined by trial that this mechanism operates reliably. Every change in the position of the rack is accompanied by a corresponding increase or diminution in the extent to which the steam follows the piston. This occurs equally whether the steam-valves are in the act of being opened or standing still in their widest open position or at any desired stage during the closing movement.

The advantages will be obvious. There are many situations where the steam, even if it can be commanded always of uniform pressure, is required to act with greatly-varying force at different times. By properly proportioning the parts the construction and arrangement shown afford a practical and convenient means of varying the point of cut-off with absolute exactness, not only, as usual, through the early portion of the stroke, but through the whole range from nothing up to full stroke.

Modifications may be made in the forms and proportions within wide limits. The number of pins G^2 and of corresponding holes, *f*, in the flange F′ may be varied; but it is important that they be arranged irregularly, so they will never engage except in one position. There may be other means of driving the governor.

I claim as my invention—

1. In combination with a governor, as R, the shafts M and N and the three bevel gear-wheels M^2 N′ P, arranged to set the shaft N forward and backward as the position of the wheel P is temporarily changed, and with the yoke J, cam W, and connections, as sleeve H and pins H^2, for liberating the main steam-valves, all substantially as herein specified.

2. In combination with a governor, as R, the short sleeve H, having pins H^2, the sleeve G, having perforated flanges G′, turned by proper means to give the desired opening motion, and the valve-shaft F, having flange F′ and holes *f*, arranged to effect the liberation and closing of the valve by the endwise movement of H at any period, as herein specified.

3. In a steam-engine, a train of mechanism, as B B^2 C C′ D E F, for operating the valves to admit steam to act on the piston, means, as X F^2, for closing each valve so soon as liberated, independent mechanism, as the flange H′ and pins H^2, for engaging each valve with the opening means, so as to allow the disengagement at any period in the stroke, an independent train of mechanism, as G G′ I J J′ W N, for determining such period, and a governor to automatically control such mechanism, all combined and arranged for joint operation substantially as herein specified.

In testimony whereof I have hereunto set my hand, at New York city, New York, this 9th day of May, 1885, in the presence of two subscribing witnesses.

ALBERT A. WILLSON.

Witnesses:

E. BROOKES,

M. F. BOYLE.