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J. L. LOWRY.

STEAM PUMPING ENGINE.

No. 350,755. Patented Oct. 12, 1886.

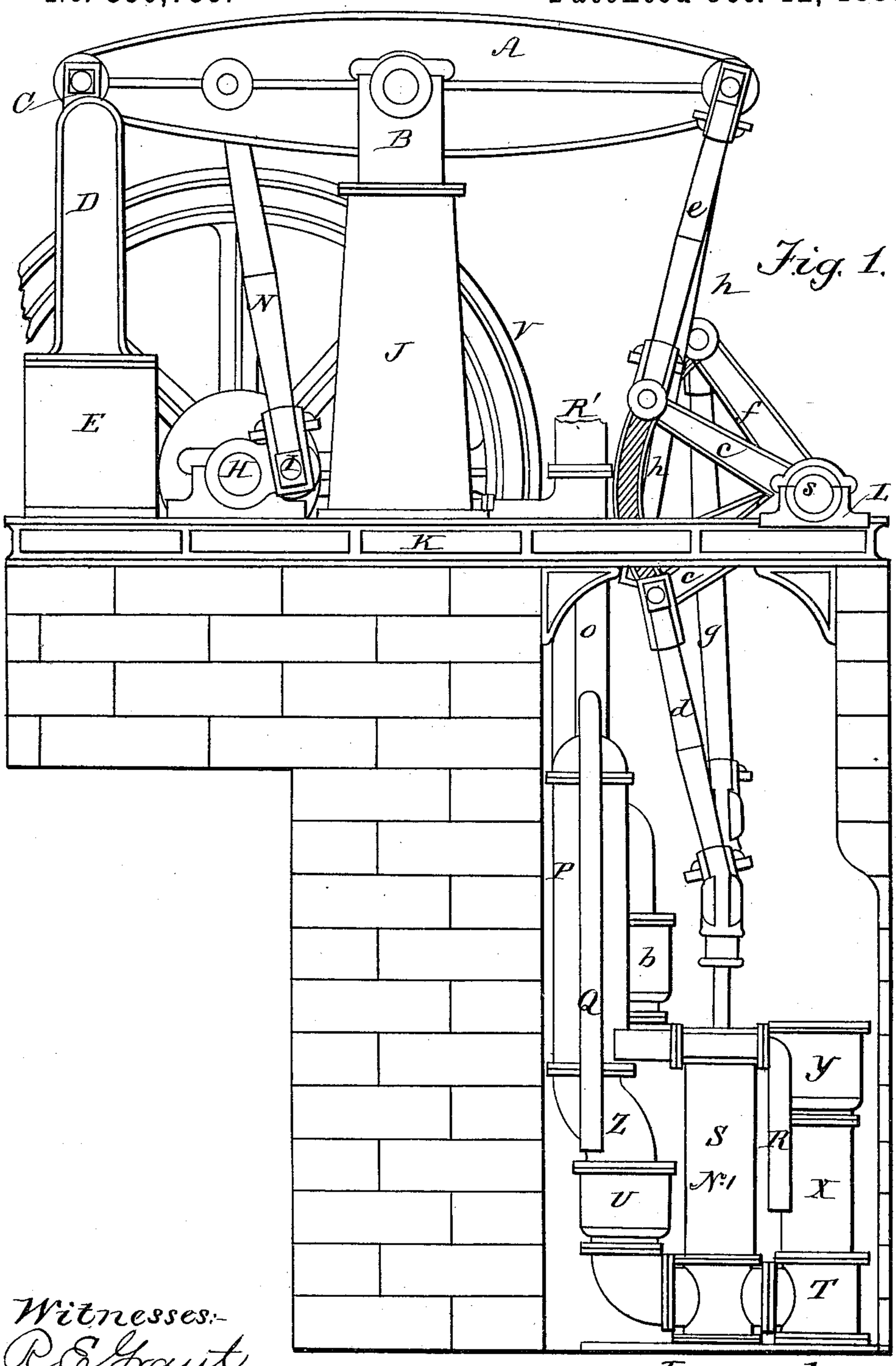

Fig. 1.

Witnesses:-
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C. H. Zimmerman

Inventor:
Joseph L. Lowry,
by Johnson and Johnson

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J. L. LOWRY.

STEAM PUMPING ENGINE.

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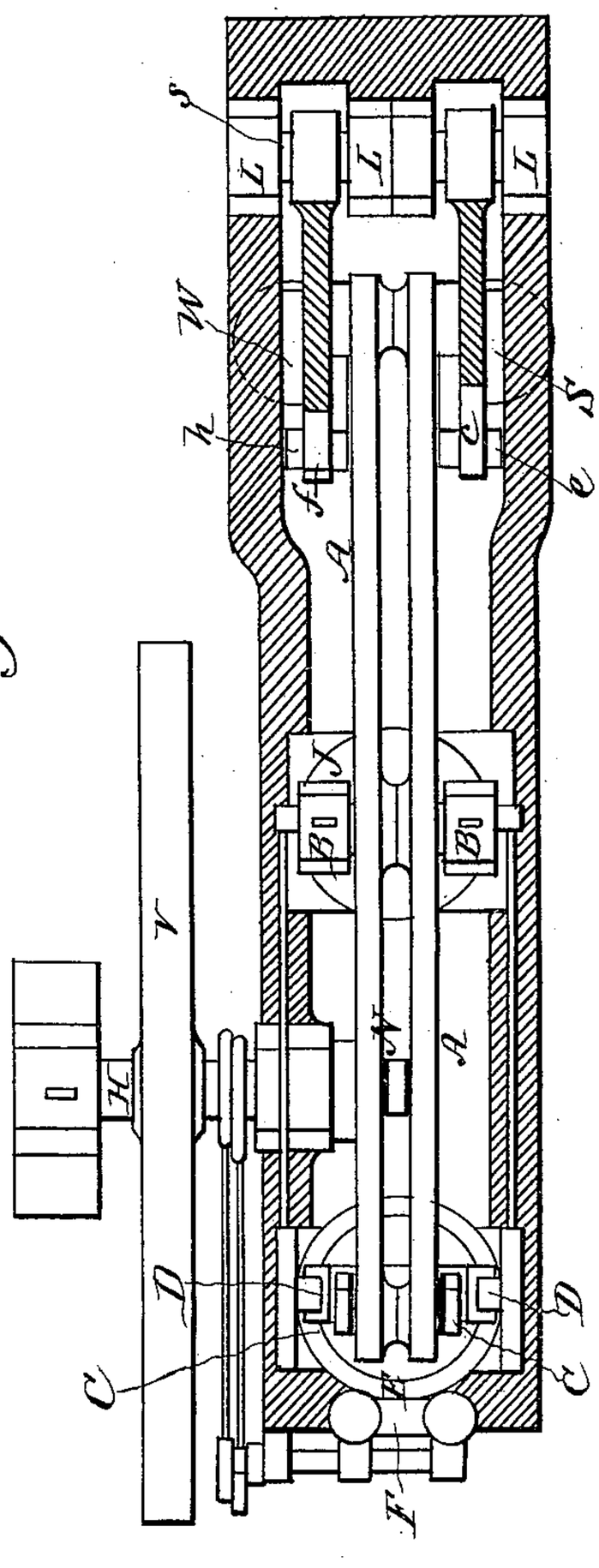
Fig. 2.



Witnesses:-
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(No Model.) 6 Sheets—Sheet 3.

J. L. LOWRY.

STEAM PUMPING ENGINE.

No. 350,755. Patented Oct. 12, 1886.

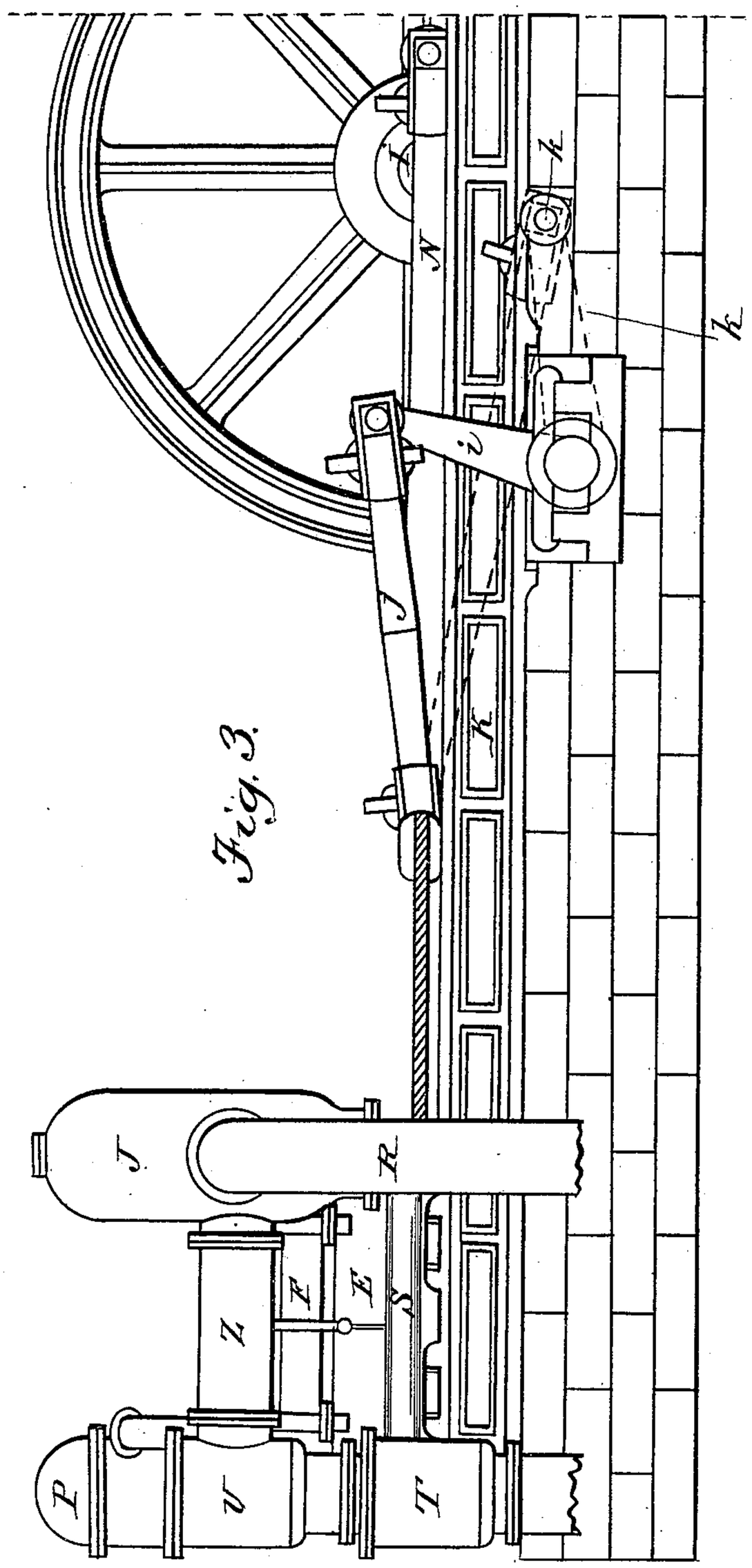

Fig. 3.

Witnesses:-
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(No Model.) 6 Sheets—Sheet 4.

J. L. LOWRY.

STEAM PUMPING ENGINE.

No. 350,755. Patented Oct. 12, 1886.

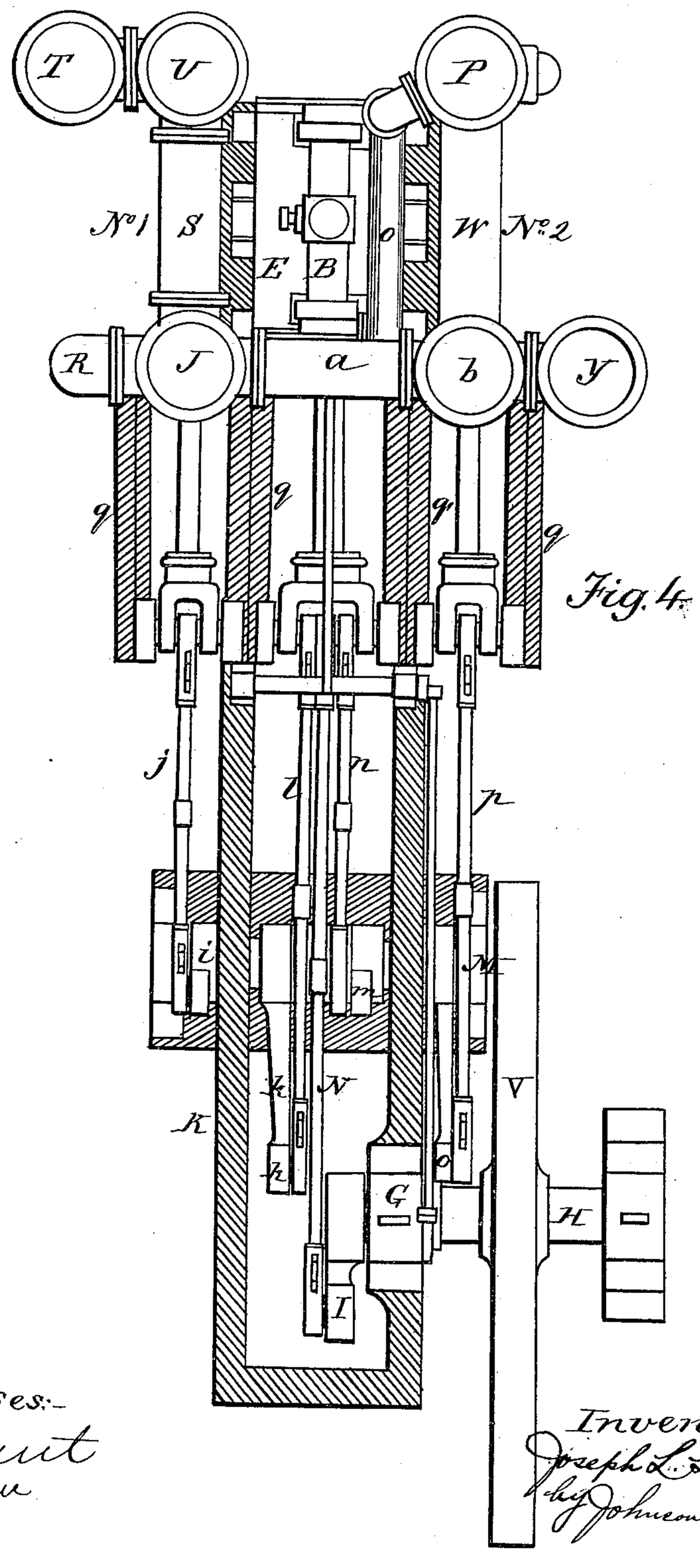

Fig. 4.

Witnesses:-
R. E. Grant
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(No Model.) 6 Sheets—Sheet 5.

J. L. LOWRY.

STEAM PUMPING ENGINE.

No. 350,755. Patented Oct. 12, 1886.

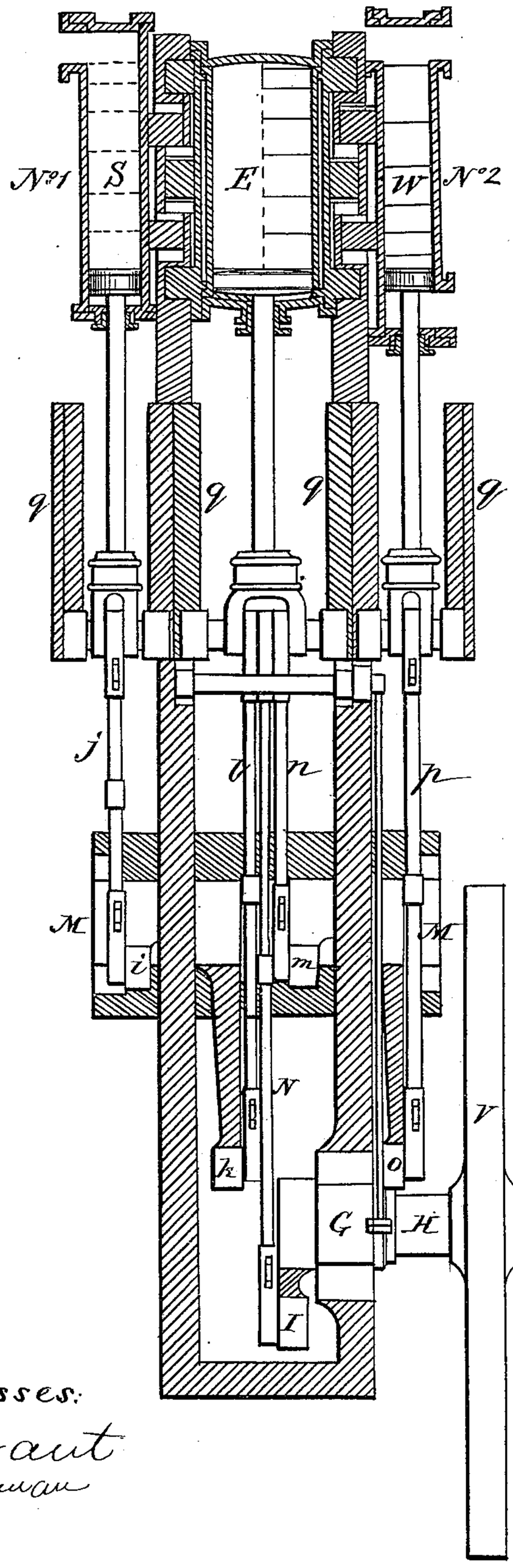

Fig. 5.

Witnesses:
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(No Model.)

6 Sheets—Sheet 6.

J. L. LOWRY.

STEAM PUMPING ENGINE.

No. 350,755.

Patented Oct. 12, 1886.

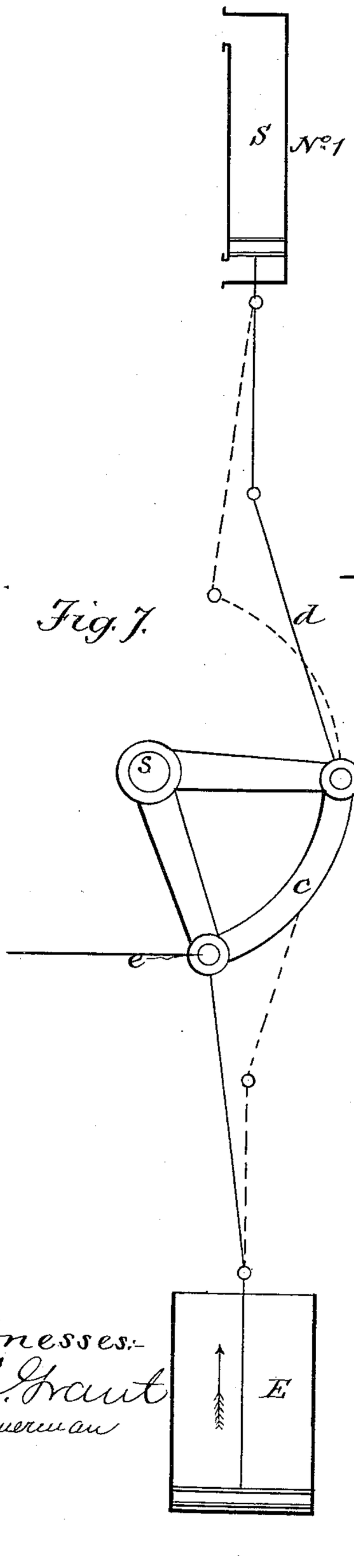

Fig. 7.

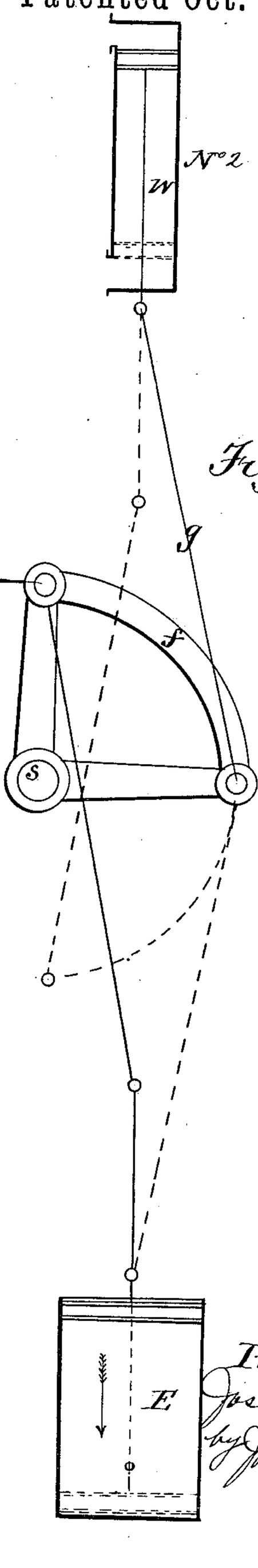

Fig. 6.

Witnesses:-
R. F. Gaut
C. H. Zimmerman

Inventor:-
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UNITED STATES PATENT OFFICE.

JOSEPH L. LOWRY, OF PITTSBURG, PENNSYLVANIA.

STEAM-PUMPING ENGINE.

SPECIFICATION forming part of Letters Patent No. 350,755, dated October 12, 1886.

Application filed June 5, 1885. Serial No. 167,737. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH L. LOWRY, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Steam-Pumping Engines, of which the following is a specification.

This invention relates to that class of steam-pumping engines in which the steam is used expansively to operate the pumps, and particularly the engine patented to me March 10, 1868, No. 75,284, and May 13, 1884, No. 298,596.

The invention herein consists in the combination, with a steam-cylinder and with a pump, of certain devices, hereinafter described, by which the piston of the steam-cylinder is connected to the pump-piston, and by the use of which devices the expansive force of the steam, when cut off at an early part of the stroke, is utilized to the best possible advantage.

In carrying out my invention, I dispense with the series of expanding-chambers and weighted plungers formerly employed and patented by me, and in place of them I use a leverage-connection, through which the power in the steam-cylinder is communicated to the pump, and in such a manner that when the steam is at its maximum pressure the force transmitted to the pump will be at its minimum, and so that as the pressure of the steam diminishes during expansion the leverage, and consequently the power applied to the pump, is proportionately increased.

The economical results of engines constructed according to my present invention are superior to those obtained from engines constructed according to my inventions previously referred to, the speed can be increased, and the engines are simpler, cheaper, and more durable.

In the drawings, Figure 1 represents a side elevation of a vertical pumping-engine embodying my improvements; Fig. 2, a plan view of the same. Fig. 3 represents a side view of a horizontal pumping-engine, also provided with my improvements; Fig. 4, a plan view of the same. Fig. 5 represents a plan view similar to Fig. 4, but with portions of the cylinders in section, showing the relative distances traveled by the pistons in full and dotted lines. Fig. 6 represents a diagram showing the positions of the leverage-connections at the commencement of a forward stroke, and Fig. 7 a similar diagram showing the positions of such connections at the commencement of a return-stroke.

Similar letters of reference where used in the different figures indicate corresponding parts.

A is the working-beam of the vertical engine, journaled in the pillow-blocks B.

C are the links connecting the beam to the steam-cylinder cross-head, which slides back and forth in guides D.

E is the steam-cylinder, provided with steam-supply pipe F.

V is the fly-wheel, mounted on shaft H, provided with the crank I and pillow-block G.

N is the connecting-rod between the crank I and the beam.

K is the bed-plate of the engine, upon which the air-vessel J rests, and also forms a supporting-column for the beam.

O is the exhaust-steam pipe of the engine, which enters the condenser P, provided with an injection-pipe, Q, and with a nozzle, R, connecting it to the pumps, as will be more fully described.

A shaft, S, is provided and mounted in pillow-blocks L, secured to the bed-plate of the engine, and on this shaft are journaled two quadrant or leverage connections, *c* and *f*, adapted to work two separate pumps, S and W. (See Figs. 6 and 7.) The pump S is provided with induction and eduction chambers T and U, and with an eduction-pipe, Z. A rod, *d*, connects the quadrant *c* with the cross-head of pump S, and a similar rod, *e*, connects the said quadrant with the beam. In like manner the pump W is provided with the induction-pipe X, the induction-chamber Y, the eduction-pipe Z, and the eduction-chamber *b*. A rod, *g*, connects the cross-head of pump W with the quadrant *f*, and a similar rod, *h*, connects the said quadrant to the working-beam.

In Fig. 1 I have shown the vertical plunger-engine at half-stroke, the quadrant *c* operating pump S, No. 1, and the quadrant *f* operating pump W, No. 2. In the horizontal engine shown in Figs. 3, 4, and 5, the quadrants *c* and *f* are replaced by the bell-cranks *k i* and *m o*, which form leverage-connections having

similar functions, and are provided with rods *j* and *p*, by which they are connected to the pumps S and W, respectively. Rods *l* and *n* are provided, which connect the ends *k* and *m* of the said bell-crank levers to the cross-head of the steam-cylinder.

The horizontal pumps are provided with guides *q* and with the delivery-main R.

The action of the quadrants and bell-cranks, being similar, may be described at once with reference to the diagram shown in Figs. 6 and 7. At the commencement of the stroke the steam presses upon the piston in cylinder E with its full or maximum force, but does not transmit that full force to the piston in the pump W on account of the leverage-connection *f*, interposed between them, which only allows the force of the steam to be transmitted to the said pump in the proportion existing between and measured by radial lines drawn from the center of the shaft on which the said leverage-connection is journaled to the center lines of the rods which connect the leverage-connections to the steam-cylinder and pump cross-heads, respectively, and which radial lines are drawn at right angles to the said center lines. As the steam-piston moves in the direction of the arrow in Fig. 6, the pressure of the steam diminishes by expansion; but the leverage-connection is moved so that it is enabled to exert more force upon the pump-piston until the position shown by the dotted lines in Fig. 6 is reached, when the pressure of the steam is least and its power over the piston in pump W is greatest. The pumps employed are single-acting, and the pump S is operated by the return-stroke of the piston in the steam-cylinder E in the same manner as pump W was operated by the forward stroke, with the single exception that the connecting-rods are attached to opposite ends of the leverage-connection, as shown in Fig. 7, where the piston in steam-cylinder is ready to move in the direction of the arrow. The opposite ends of the pumps not used for raising water are utilized as air-pumps for removing the condensed steam from the condenser P, to which they are connected. I prefer to arrange the two quadrants *c* and *f* so that they move through arcs of 67.5 degrees and 82 degrees, respectively, during one stroke of the steam-piston, as I find those proportions give good working results; but I do not confine myself to them, as other proportions will also work very well.

In constructing horizontal engines with bell-cranks *k i* and *m o*, I prefer to make the arms *k* and *o* longer than the arms *i* and *m*, so that the same length of stroke can be used for the pumps and steam-cylinder, as shown by dotted lines in Fig. 3, in which the dotted bell-crank *k* is shown longer than the bell-crank *i*, shown in full lines. The object or reason for making the arms of the bell-cranks of the horizontal engine of unequal length is, that as both the arm of power and the arm of resistance are connected to cross-heads operating on the same side of the bell-crank shaft, the difference in the angle requires the arm on the opposite side of the crank-shaft to the cross-head to be about one foot longer to give an equal length of stroke to the pump as the steam-cylinder. It will be observed that Figs. 6 and 7 illustrate the principle of action in the two arms which operate on different sides of the quadrant-shaft, and can therefore be of equal length. These figures, being correct, illustrate the action in the vertical pumping-engine.

I may construct the pumping-engine without a fly-wheel; but I prefer to use the fly-wheel as a more effective means of regulating the admission and exhaust of the steam from the cylinder.

The vertical engine is provided with the delivery-main R′.

Referring to the relation of the quadrants or bell-cranks and shafts, it will be observed that they are for the purpose of increasing the resistance or load of the pump-head on the piston at the beginning of the stroke when the steam in the cylinder is at its maximum pressure, and correspondingly reduce the resistance or load of the pump on the steam-piston in proportion as the steam in the cylinder has become reduced in pressure by expansion.

It will also be observed that an important advantage of my improvement is the provision whereby each pump can be run separately when it is not desired to run both pumps.

My present improvement has the important advantages of not only permitting the pump-heads to gradually lose leverage from the beginning to the end of the stroke, but at the same time permits the steam to gradually gain leverage from the beginning to the end of the stroke, thereby increasing the leverage sixteen times.

My present improvement will permit the steam to be worked expansively to any desired limit without the aid of either a fly-wheel or extra-weighted plungers.

My improved engine requires two quadrants or bell-cranks, two shafts for the quadrants, four pillar-blocks for quadrant-shafts, and four connecting-rods for the two pumps and each rod of different length.

My improved engine requires two connecting-rods for the piston—one to connect to each of the two quadrants or bell-cranks. One of the said rods is connected to the forcing-pump quadrant at an angle of some seventy degrees, and the other piston connecting-rod is coupled to the lifting-pump quadrant at an angle of ninety degrees from the pump-rod connection.

The superiority of connecting the piston to the quadrants in the plan of engine shown consists in the uniform gain of leverage by the steam-piston from the beginning to the end of the stroke, and equal to the gradual decreasing leverage of the pump on the piston or quadrant from the beginning to the end of the stroke.

In my patent of March 10, 1868, No. 75,283, the arrangement of the leverage is such that

the piston only gains four times the leverage, while in my patent of May 13, 1884, the steam is permitted to be expanded with the same leverage to any desired limit.

The main difference between the engine patented to me March 10, 1868, and my present engine consists in the arrangement of two instead of one quadrant, and the necessary connecting-rods by which the leverage of the steam-piston is increased from, say, four to sixteen times, and as a consequence permitting the steam to be worked expansively in a like proportion without the aid of either fly-wheel or extra-loaded plungers, while at the same time permitting the engine to be operated to a much higher speed than could be done with heavy loaded plungers, as in my patent of May 13, 1884, thus saving in cost of construction, because a small engine at high speed will raise equal volume of water with a larger engine working at slower speed.

I claim—

1. In a steam-pumping engine, the combination of the steam-cylinder E, the single-acting pumps S and W, with leverage-connections consisting of the quadrants *c* and *f*, and their connecting-rods *d e g h*, having such relation to each other and to said leverage as to transmit the least force to the pumps when the steam-pressure is greatest, and to increase said force proportionally as the pressure of the steam decreases during expansion, and the condenser, also connected to said pumps, substantially as herein set forth.

2. In a steam-pumping engine, the combination of the steam-cylinder E and its connections, a single acting pump adapted to force water during the forward stroke, a single-acting pump adapted to force water during the return-stroke, and the quadrants *c* and *f*, connected to the said pumps, substantially as described and shown, and for the purpose set forth.

3. In a steam-pumping engine, the combination of the steam-cylinder E, the pumps S and W, and the leverage-connections interposed between the said steam-cylinder and pumps, consisting of bell-cranks *k i* and *m o*, in which the arms are of unequal length, substantially as set forth.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

JOSEPH L. LOWRY.

Witnesses:
JOHN S. KENNEDY,
JOHN W. BLACK.