(No Model.) 3 Sheets—Sheet 1.

C. M. LONG.

STEAM ENGINE.

No. 326,303. Patented Sept. 15, 1885.

Fig. 1.

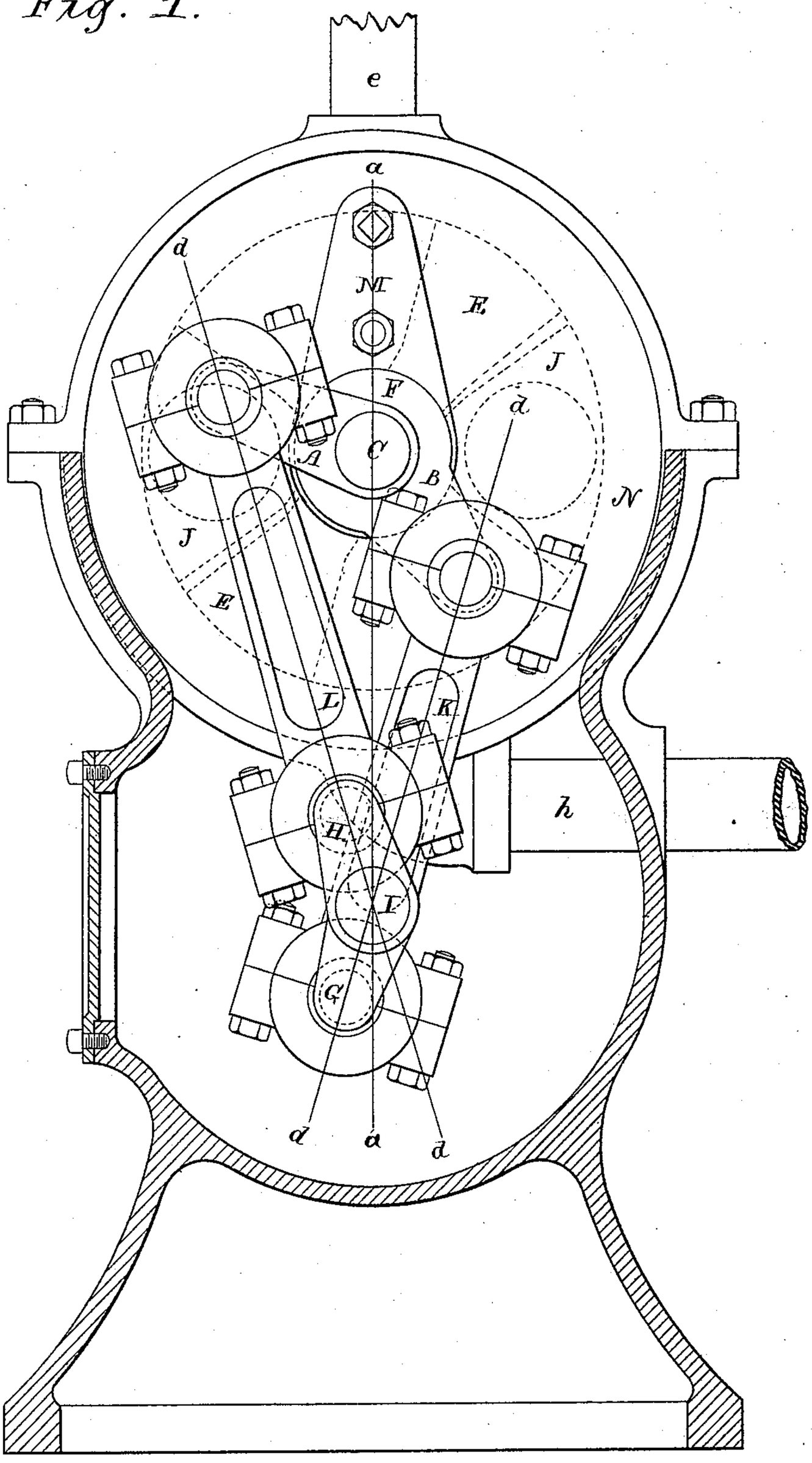

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Fig. 2.

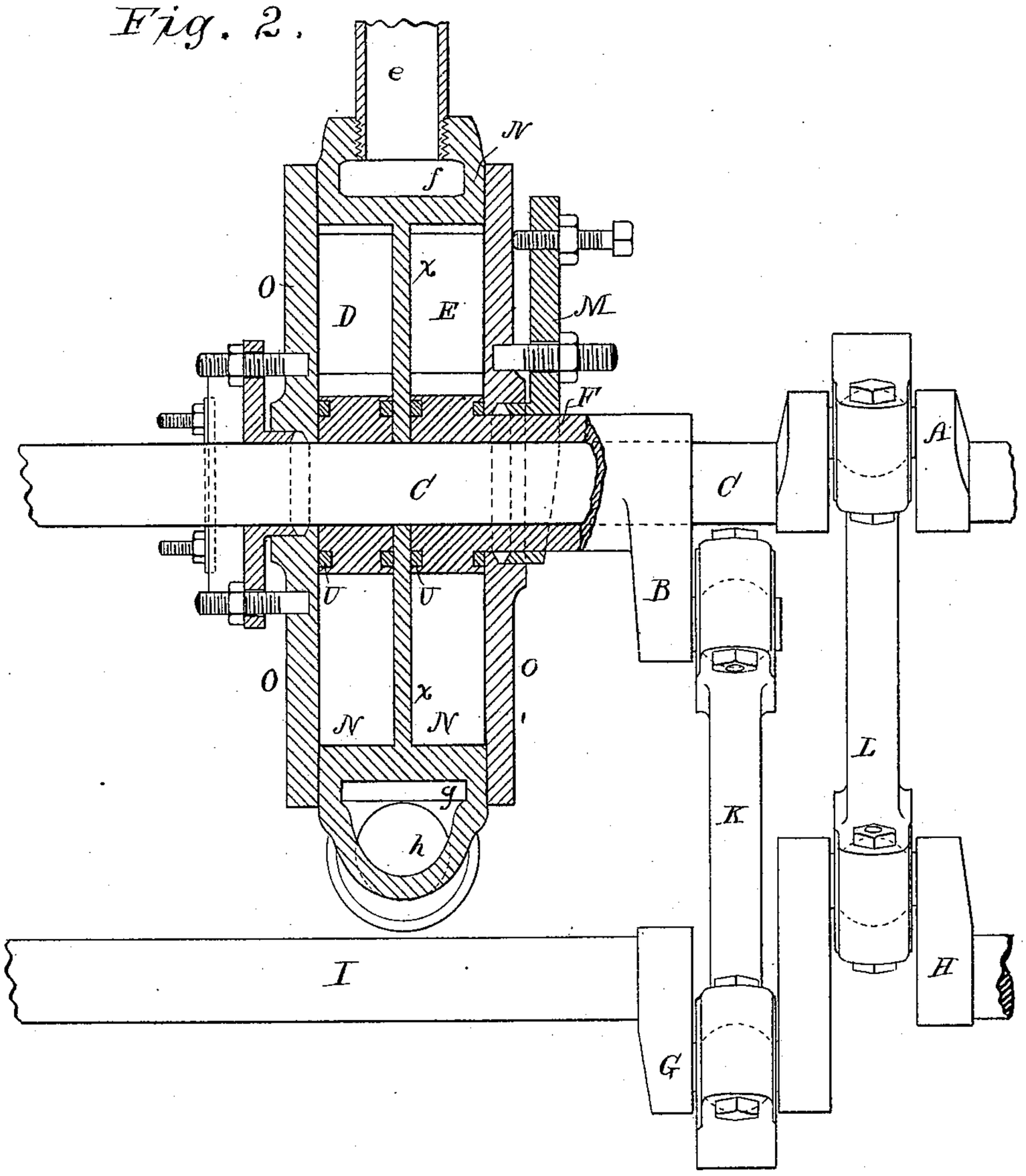

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Fig. 3.

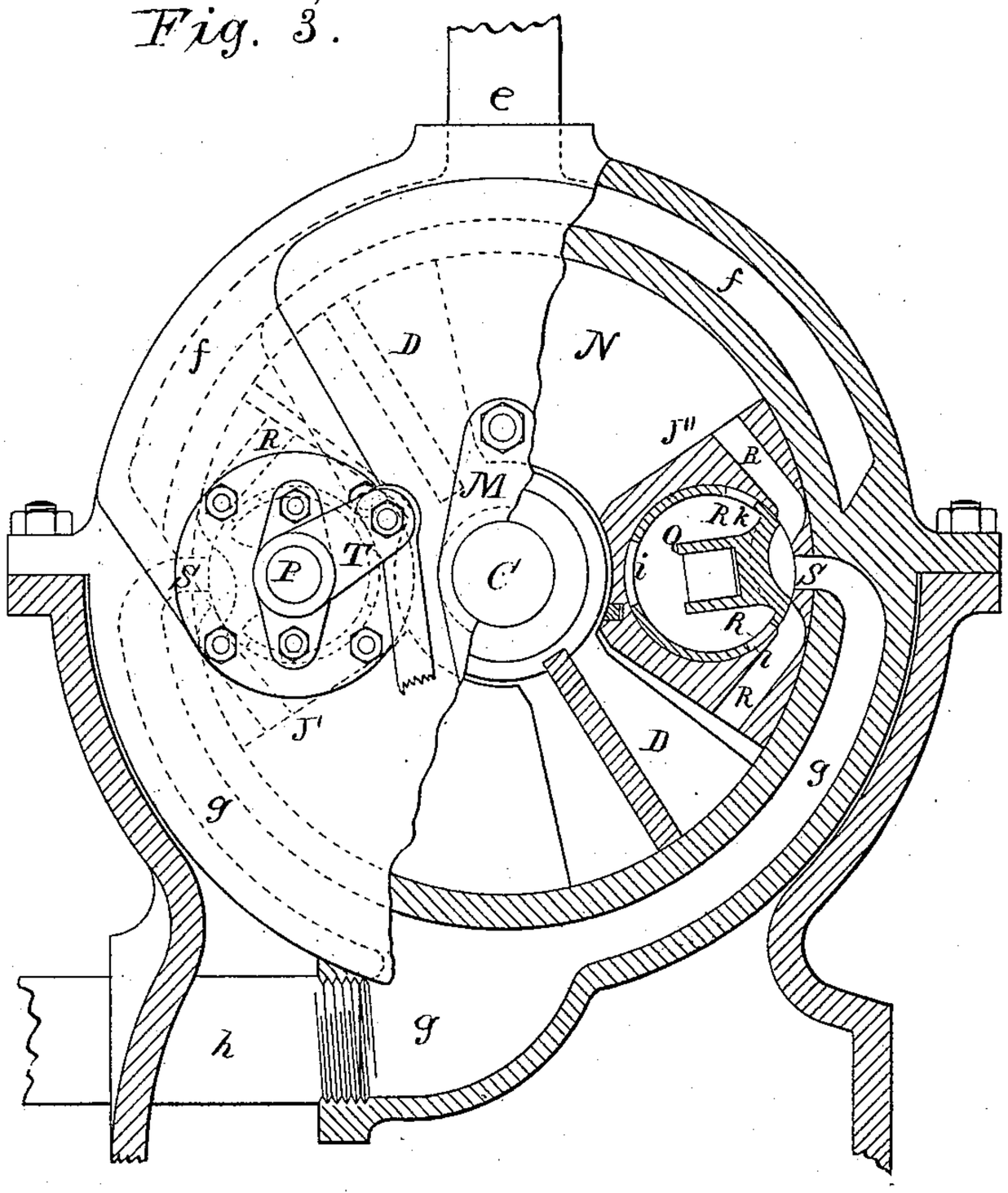
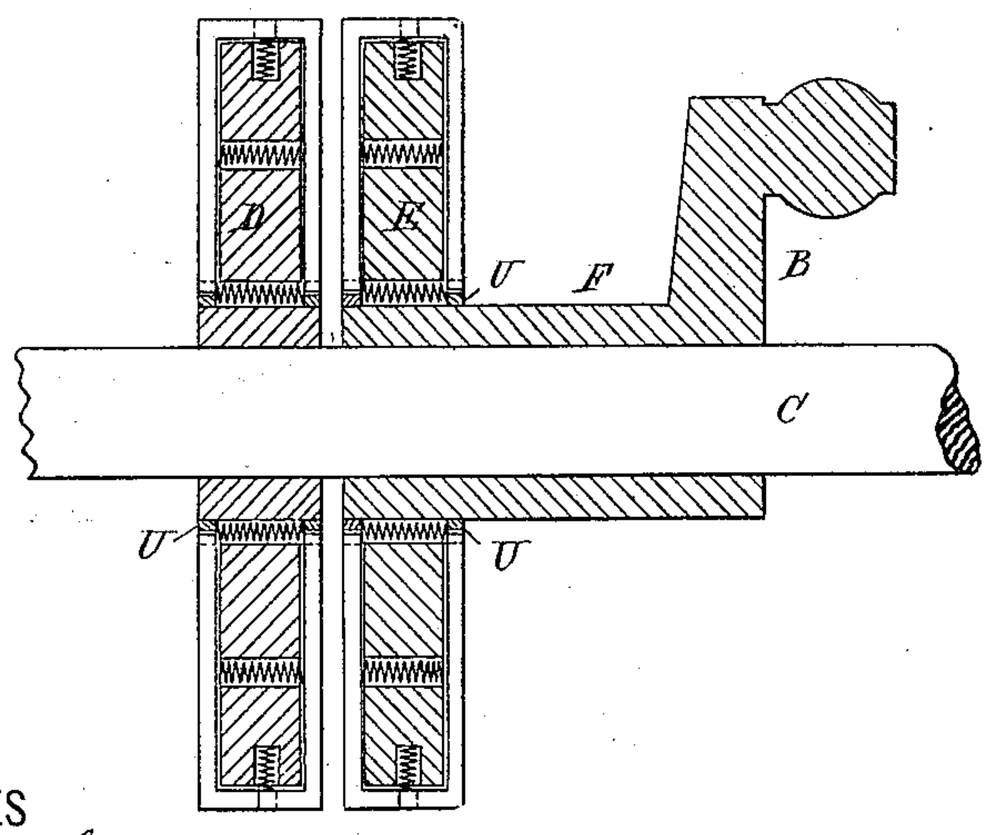


Fig. 4.



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UNITED STATES PATENT OFFICE.

CURTIS M. LONG, OF ALLEGHENY, PENNSYLVANIA.

STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 326,303, dated September 15, 1885.

Application filed July 8, 1885. (No model.)

To all whom it may concern:

Be it known that I, CURTIS M. LONG, a citizen of the United States, and a resident of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Engines of the oscillating-piston type; and I do hereby declare that the following is a full, clear, and exact description thereof, which will enable others skilled in the art to which it appertains to make and use the same.

The object of my invention is the construction of a steam-engine of the oscillating-piston type, accurately balanced by means of duplicate pistons, cranks, pitmen, and crank-arms, which, moving in opposite directions, equalize momentum and strains, and with centers properly placed to avoid jar or shock from suddenly-reversed movements, and to obtain a machine with small friction, high speed, great efficiency, and compactness.

In the drawings, Figure 1 is a side elevation showing cylinder and casing with the working parts resting on centers. Fig. 2 is a front elevation with cylinder in section. Fig. 3 is the reverse side of cylinder, partly in section, showing the septa and valve arrangement. Fig. 4 is a central section of the double piston, showing their construction in two parts with hollow sleeve and packing.

In Fig. 1 the crank-arm A is attached to and is a part of the shaft C, which is oscillated by the piston D, as shown in Fig. 2, and the crank-arm B is a part of the sleeve F and piston E. These crank-arms are placed opposite each other—C being center—at such angles that when they reach their centers or end of stroke the pistons will be even and ready for the return-stroke. The travel of crank-arms and pistons is controlled by the system of cranks G H, and therefore, on account of the angles of pitmen varying at different points on each stroke, the pistons will move part of their strokes at slightly different speeds; and it is for the purpose of accommodating this movement that the duplicate pistons are independent of each other, D being rigidly attached to shaft C, and E to the hollow sleeve and crank-arm B, as before stated, and shown in Figs. 2 and 4.

The pistons D and E move in one cylinder, and are operated by the valves substantially as if they were one and made for the purpose of operating one crank-arm and pitman. The cranks G and H are placed at such angles to plane *a* through shafts I and C as will bring them one to its upper and the other to its lower center at the same time, and as these centers fall both upon the same side of the plane through shafts C and I it follows that the cranks are not exactly opposite.

For economy and compactness, it is a great object to employ one cylinder for inclosing the two double oscillating pistons; but I find it advantageous to separate them slightly in their cylinder, because if brought face to face in contact, owing to the slight variations in speed in certain parts of their movement above referred to, there will be slight overlapping, so that the edges of the pistons against which the steam impinges to drive them will not at all times be in perfect alignment. On account of this slight overlapping of the pistons in their movement, which would cause the steam to impinge upon small portions of their sides instead of only their edges, they would, if in contact, be pressed laterally against the cylinder-heads, which would cause friction and resistance to their free movement. To obviate this difficulty, I insert the web or diaphragm *x*, which may be cast with the cylinder or fixed rigidly to it, between the adjacent faces of the pistons. The result, therefore, is that pressure of the steam can never operate to induce injurious friction in the movement of the pistons, but only to oscillate them. This same result of preventing injurious friction may be accomplished in other ways; but this I deem preferable.

The web is slightly less in width than the extent of travel of the pistons within the cylinder, which insures perfectly even wear upon the web, and prevents the formation of shoulders in the metal near the point of clearance between the septa and the edges of the pistons. The valve-port is in length equal to the thickness of the two pistons and interposed web. The result is that the steam will be admitted equally on either side of the web to drive each piston in substantial unison with the other. It will be seen that by this arrangement, the parts on either side being duplicates of each other, there is obtained, first, a perfect balance against gravity, and, second, a balance

against momentum, the pitmen and cranks moving in opposite directions and at the same velocities, hence each exactly counteracting the effect of the other. The direction of strains is at all times opposite on the cranks G and H, and therefore the shaft I and its bearings are relieved of the friction and pounding that must result from the use of one pitman when the direction of strains is reversed twice in each revolution.

In Fig. 1 the dotted lines inclosing E E indicate the piston attached to hollow sleeve F, and the dotted lines inclosing J J are the septa or partitions that divide the cylinder into its upper and lower working-chambers. The dotted circles within J J are the valve-chambers. K and L are the pitmen, and M the stuffing-box gland. *a* is the plane through axes of shafts, and *d* the planes through shaft I and crank-centers. The duplicated double pistons D and E are shown in Fig. 2, and in section in Fig. 4. N is the cylinder, O cylinder-head.

In Fig. 3 J′ J″ are the septa; P Q, the balanced hollow cylindrical oscillating valve within the septa; R, the steam-ports, and S the exhaust-ports.

I am aware that oscillating valves have been used in engines of this class, but not within the septa, as I use them, so that one valve serves for both pistons without enlarging the cylinder or taking up room outside of it.

e indicates the steam-induction pipe, and *f*, in dotted lines, the steamways in the cylinder leading to the valve. *g* indicates the ways leading to the exhaust-pipe *h*. There is an opening, *i*, in the cylindrical valves, a little larger in area than the combined areas of the two port-openings *k* and *l*, so that the steam-pressure is nearly equalized on all parts of the valves to balance them and to avoid friction, which might hinder their action, but at the same time to leave a slight preponderance of pressure of the valve upon its seat.

The valves are operated by cranks and rods, as shown at T, from eccentrics properly set upon the driven shaft I, Fig. 2. These valves receive steam in their ends and admit steam on opposite sides of the double pistons D and E, and thus force them through the arc of their oscillation, and then admitting steam on the reverse sides force them back to the point of starting. This oscillatory movement is transferred through the crank-arms A and B and pitmen K and L to the driven shaft I, which is rotated thereby, and from which the power may be transmitted by any ordinary means in use.

Fig. 4 shows a central section of the duplicated double pistons D and E with the hollow sleeve F and packing-strips properly adjusted by spiral springs. U are packing-rings held in place by the same means. The ring U shown outside the piston D is let into the cylinder, as shown, Fig. 2.

I am aware that engines with oscillating pistons are not broadly new, and I claim only my improvements upon such engines, which I understand to be as follows:

1. In an engine of the oscillating-piston type, the duplicate double pistons D and E, working side by side within a single cylinder, and the duplicate crank-arms, cranks, and pitmen arranged to work opposite to each other, substantially as and for the purpose set forth.

2. In combination with the cylinder N, the duplicate double pistons D and E, working side by side, and the web *x*, between the pistons, substantially as set forth.

3. The balanced oscillating valves and ports within the septa, in combination with the cylinder N and the duplicate double pistons D and E, substantially as set forth.

4. The combination of the sleeve F, the crank-arm B, and piston E with the crank-arm A, shaft C, and piston D, substantially as and for the purpose described.

In testimony whereof I have hereunto subscribed my name.

CURTIS M. LONG.

Witnesses:
MARCUS S. HOPKINS,
C. P. ELWELL.