

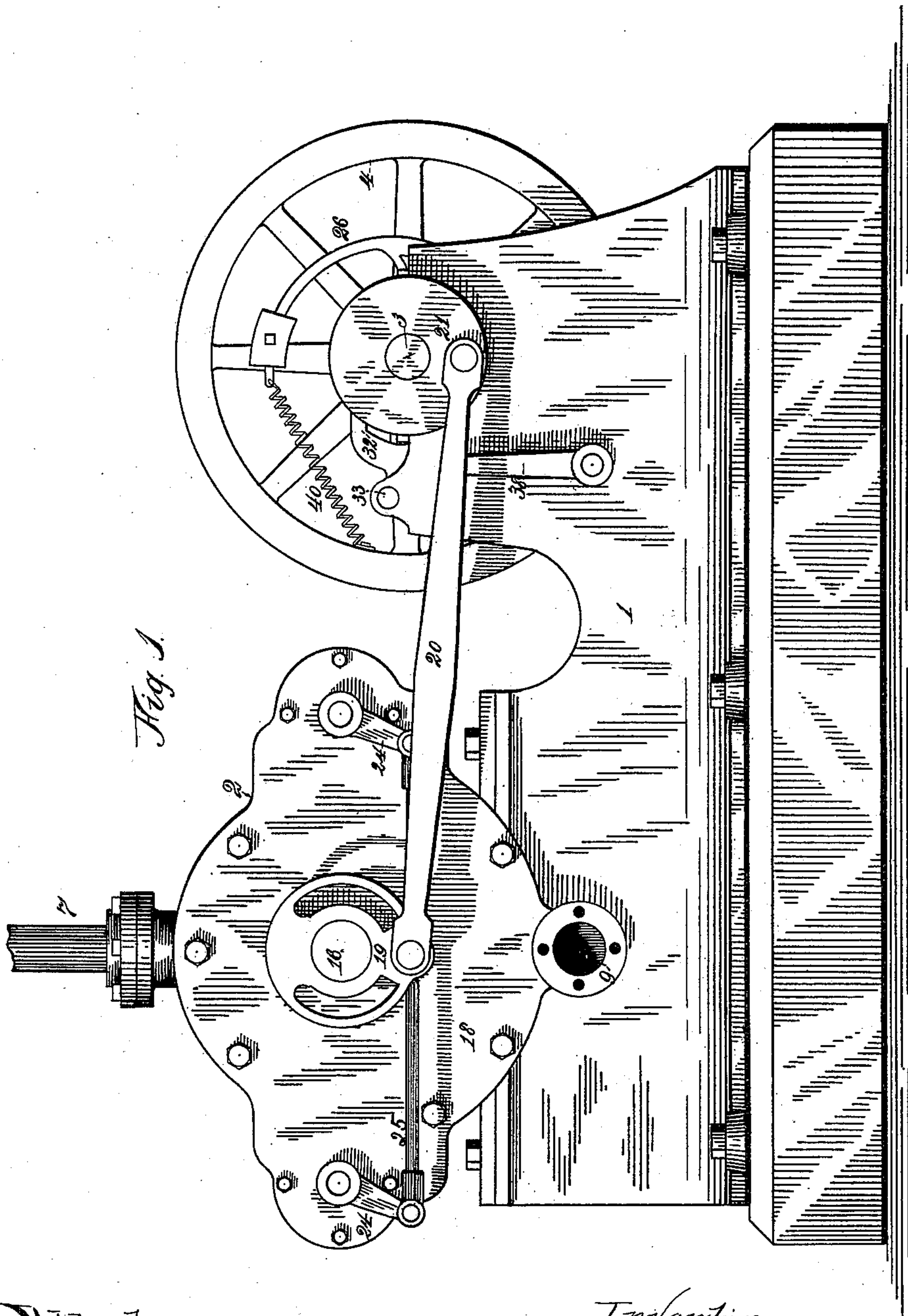
(No Model.)

4 Sheets—Sheet 1.

S. L. BATES.  
STEAM ENGINE.

No. 418,548.

Patented Dec. 31, 1889.



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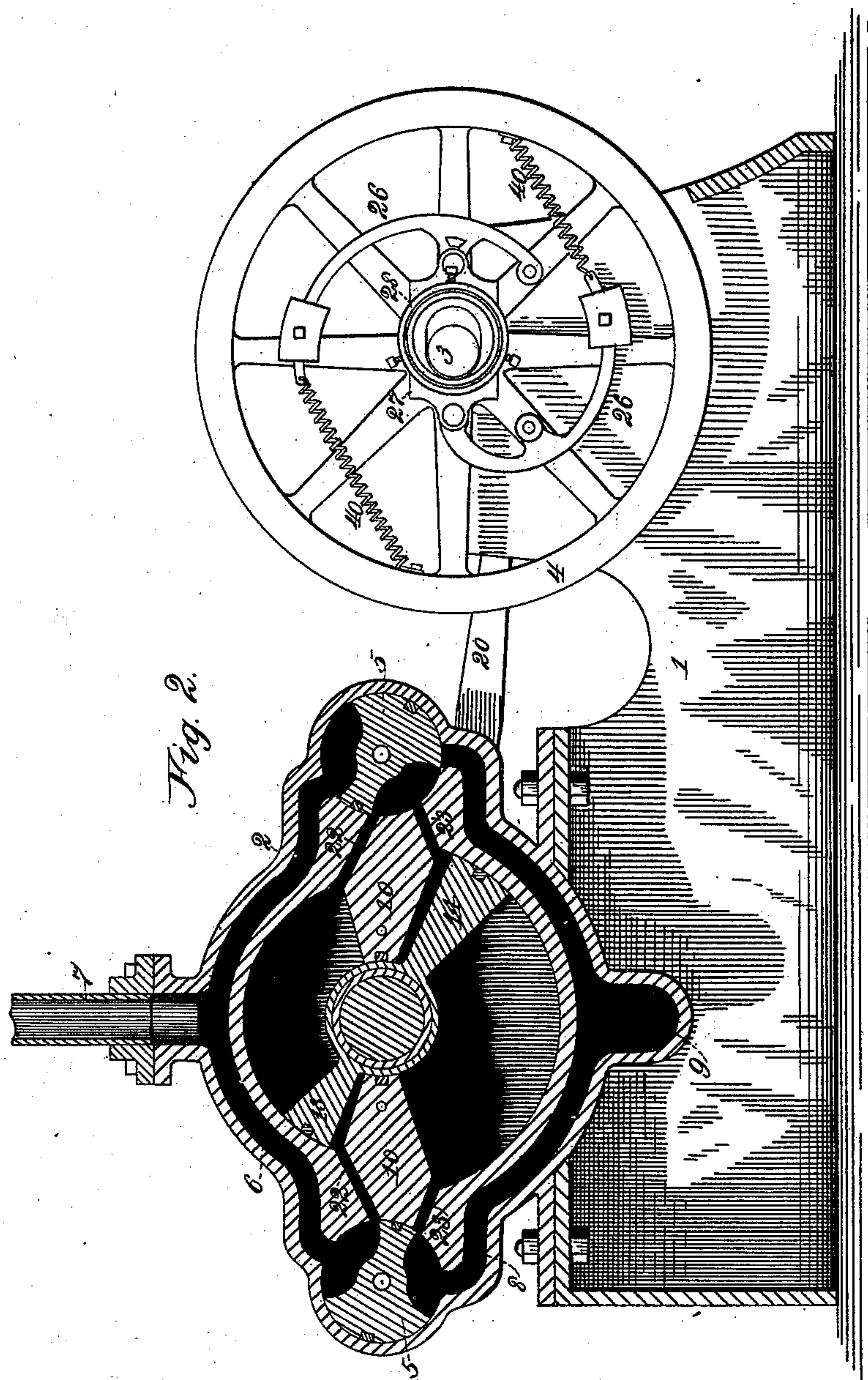
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4 Sheets—Sheet 2.

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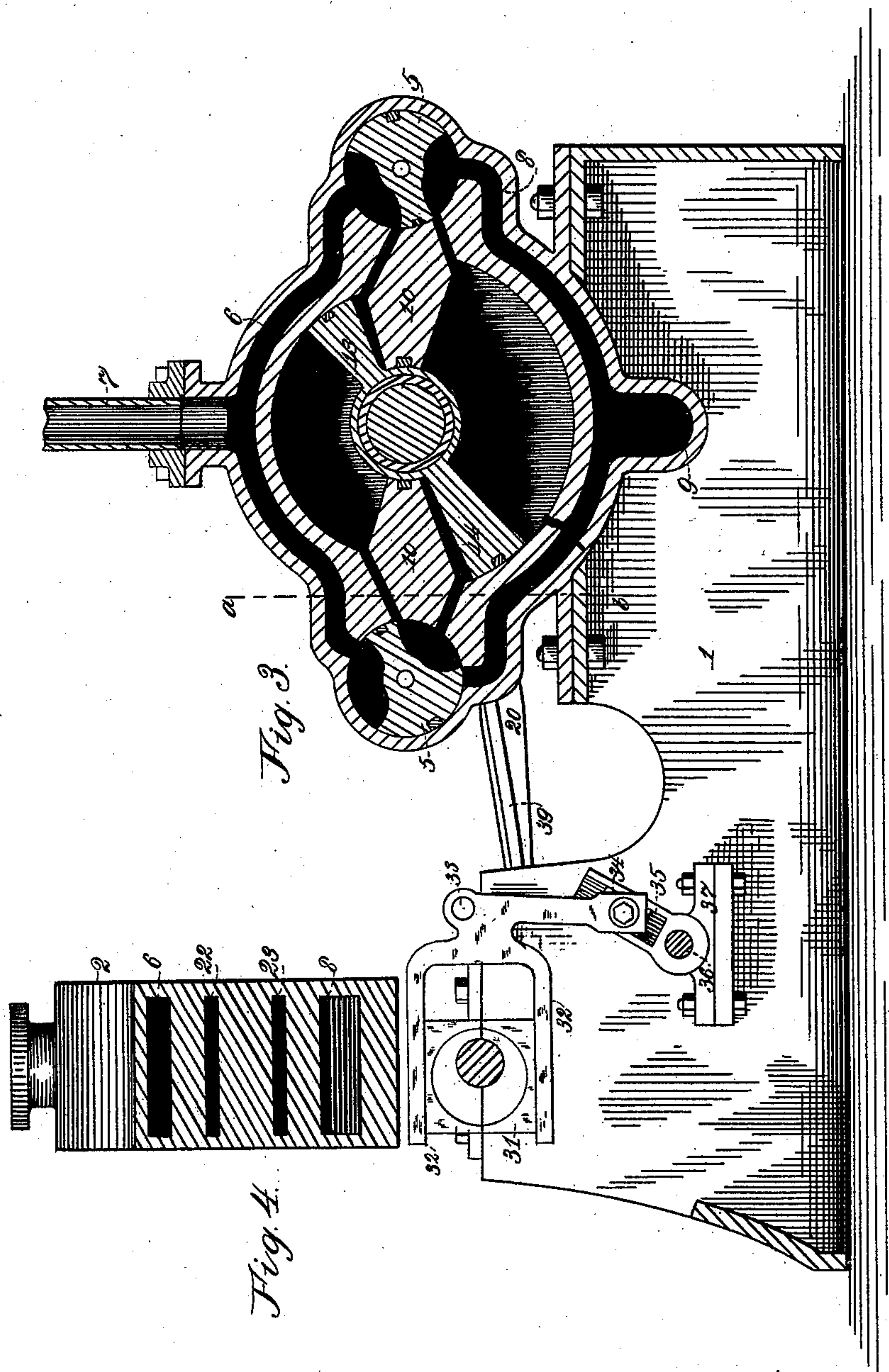
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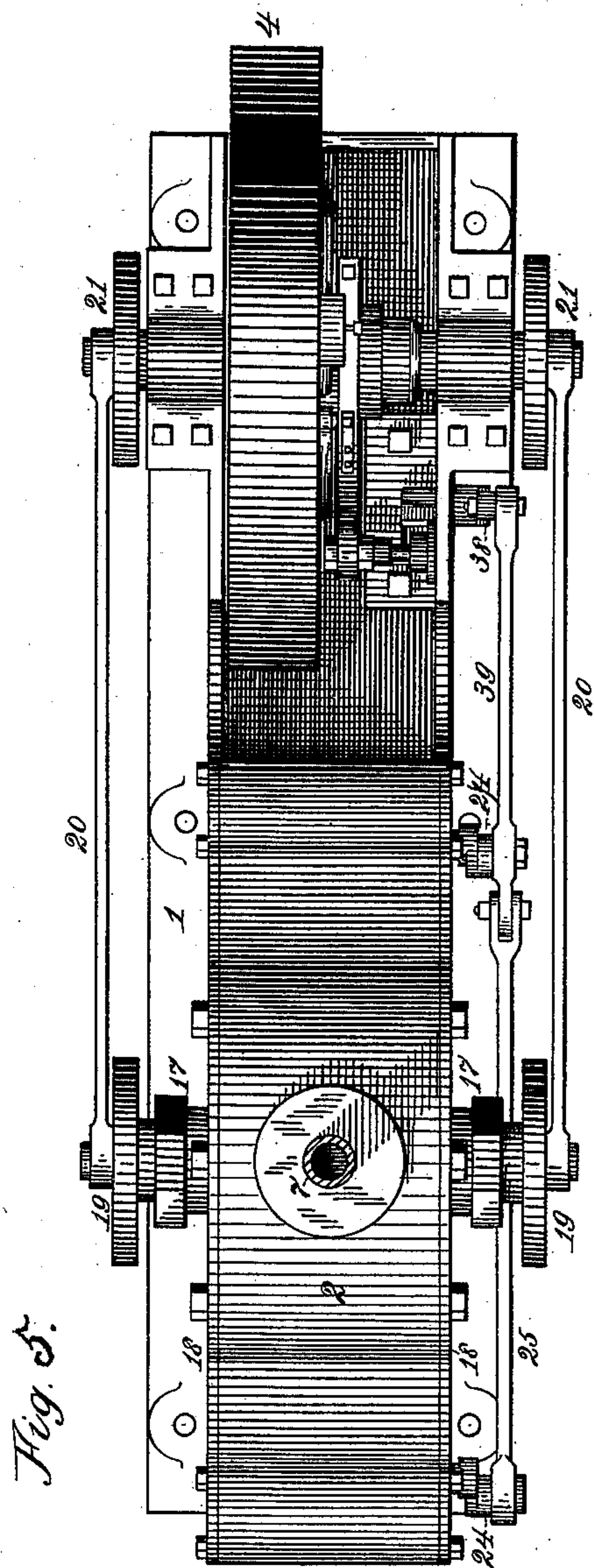
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4 Sheets—Sheet 4.

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# UNITED STATES PATENT OFFICE.

SAMUEL L. BATES, OF CEDAR RAPIDS, IOWA.

## STEAM-ENGINE.

SPECIFICATION forming part of Letters Patent No. 418,548, dated December 31, 1889.

Application filed February 15, 1889. Serial No. 299,979. (No model.)

*To all whom it may concern:*

Be it known that I, SAMUEL L. BATES, a citizen of the United States, residing at Cedar Rapids, in the county of Linn and State of Iowa, have invented certain new and useful Improvements in Steam-Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to steam-engines having a vibrating piston; and the object of my invention is to provide for a double or compound action of the engine by a suitable construction of the cylinder and piston, and in general to improve engines of this class.

The invention consists in the construction, combination, and arrangement of parts, as hereinafter fully set forth and claimed.

In the accompanying drawings, forming a part of this specification, Figure 1, Sheet 1, is a side elevation of an engine embodying my invention. Fig. 2, Sheet 2, is a central longitudinal section of the same. Fig. 3, Sheet 3, is a central longitudinal section of the same as seen from the side opposite to that in Fig. 2; and Fig. 4, a fragmentary transverse section of the cylinder in the line *ab*. Fig. 5, Sheet 4, is a plan view of the engine.

Referring to the drawings, 1 is the bed of the engine, upon one end of which is mounted the cylinder 2, and at the other end, in suitable boxes, the crank-shaft 3. Between the two sides of the bed is mounted the belt-wheel 4, which is also a balance-wheel and serves as a support for the governor and eccentric, hereinafter to be described. The cylinder is oblong in shape, the middle portion being partially circular, as shown, and the ends being extended to form seats or chests for the valves 5, mounted therein. In the upper part of the shell forming the cylinder and steam-chests is an induction-port 6, leading from the steam-pipe 7 to the steam-chest above mentioned. A similar eduction-port 8 leads from said steam-chests to an exhaust-outlet 9.

In the middle part of the cylinder, between inwardly-extending abutments 10, is mounted the piston 13 14, which vibrates in a vertical plane. The central portion of the piston is

partially round in cross-section, as shown, and is provided with two radial wings 13 and 14, whose outer extremities fit the bores of the cylinder above and below the abutments, respectively. The faces of the abutments which impinge upon the central portion of the piston, as well as the outer sides and ends of the piston-wings, are provided with packing-strips, hereinafter to be described. The piston terminates at each end in trunnions 16, which are mounted in suitable stuffing-boxes 17 in the cylinder-heads 18. Outside of the boxes are cranks 19, and from these connecting-rods 20 extend to cranks 21 on the crank-shaft 3. As the piston vibrates but a part of a revolution, the cranks on the piston are necessarily somewhat longer than those on the crank-shaft.

Between the induction and eduction ports above described are shorter ports 22 and 23, leading from the steam-chests to the upper and lower compartments of the cylinder, respectively.

In practice I use rotary steam-valves of the peculiar form in cross-section shown, one wing being comparatively narrow and the other wide, with cavities on opposite sides to allow for the flow of steam to and from the steam-chests and cylinder. The stems of these valves are provided with suitable cranks 24, coupled by a connecting-rod 25. Instead of the common eccentric to actuate the valves, I use in practice an automatic governor, the construction of which is as follows:

To the balance-wheel 4 are pivoted two weighted arms 26 in the usual way, and to these is intermediately connected a plate 27, having an annular flange 28. The plate is slotted, as shown, to allow for the necessary movement across the shaft 3. This annular flange 28 forms the eccentric ring. The eccentric ring is fitted to a box 31, mounted to slide between the arms 32 of a bell-crank lever pivoted to the bed by a stud 33. The other arm of the lever extends downwardly, and connects by another sliding box 34 with the arm 35 of a rock-shaft 36, mounted in a suitable box 37. The opposite end of the rock-shaft has an upwardly-extending arm 38, to which is coupled a connecting-rod 39, also coupled to the connecting-rod 25. Suitable



springs 40 serve to counteract the centrifugal action of the gravity-arms 26.

The operation of the engine will now be clearly seen. In Figs. 2 and 3 the engine is represented as taking steam at the end farther from the belt-wheel and in the upper portion of the cylinder. The valve at the other end has already opened to allow the exhaust-steam to pass out and through the proper port into the lower portion of the cylinder, where it acts upon the longer wing of the piston. As the piston travels in the direction indicated by the arrows, the valves move forward, as shown by the arrows, until the inner wing of the one nearer the belt-wheel is between the intermediate ports 22 and 23, and the corresponding part of the other valve lies between the ports 6 and 22. The opposite wing of this valve at the same time covers the eduction-port 8, as shown by the position of the valve at the other end of the cylinder. In other words, the relative positions of the valves are exactly reversed, the engine taking live steam in the upper part, exhaust-steam in the lower part, and exhausting finally through the eduction-port 7 in the reverse order from that indicated in the drawings. This construction is such as to produce a compound engine in very compact form, and of such a nature as to effect economically a high development of power.

The packing for the abutments corresponds to that at the sides of the piston and valve.

The construction, as will be seen, is such as to admit of the piston vibrating through nearly the half of a circle. Being double, the power is not only increased, but the piston is balanced, or, more strictly speaking, the strain upon its trunnions is equalized. It is further to be noticed that the working capacity of the engine depends largely upon the stroke of the piston as compared with the stroke of the crank of the crank-shaft, and this more especially as the crank approaches the dead-centers. In the case of a piston vibrating through, say, ninety degrees, there is but little change in the comparative leverage of the piston-crank as it approaches the termini of its stroke, and at the same time there is a great loss of leverage on the part of the other crank as it approaches the dead-centers.

It is therefore desirable to make the gain of the one compensate as far as possible the loss of the other, and this is effected by extending the relative stroke of the piston. Thus if the piston passes through one hundred and forty-five degrees, as in the case of this engine, the loss of power in passing the dead-centers is comparatively small, since the leverage of the piston-cranks increases greatly toward the termini of its stroke.

It will be seen by reference to the drawings that the box inclosing the eccentric ring is free to move back and forth between the guides of the bifurcated arm 32. An advantage gained by this arrangement is in the freedom which is afforded the eccentric to shift according to the requirements of the engine and the action of the governor-arms. As ordinarily constructed the shifting of the eccentric involves also the shifting of the valve in its seat; but in this case at two points in the revolution of the shaft the eccentric is perfectly free to slip in line with the guides of the bell-crank arm without reference to the position of the valves, and consequently the governor responds very quickly and easily to the demands of the engine.

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

In an engine, the combination of the vibrating piston and its cylinder having suitable abutments, said piston having crank-and-rod connection with the crank-shafts of a belt-wheel, the valves arranged in said cylinder and having rod-and-crank connection with each other, the eccentric-ring, the sliding box carrying said ring, the bell-crank lever having arms between which said box slides, and a second sliding box connected to said bell-crank lever and to a rock-shaft, said rock-shaft being connected by an arm to a rod, in turn connected to the connecting-rod between the cranks of the said valve, substantially as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

SAMUEL L. BATES.

Witnesses:

S. W. BRAINERD,  
FREDK. G. CLARK.