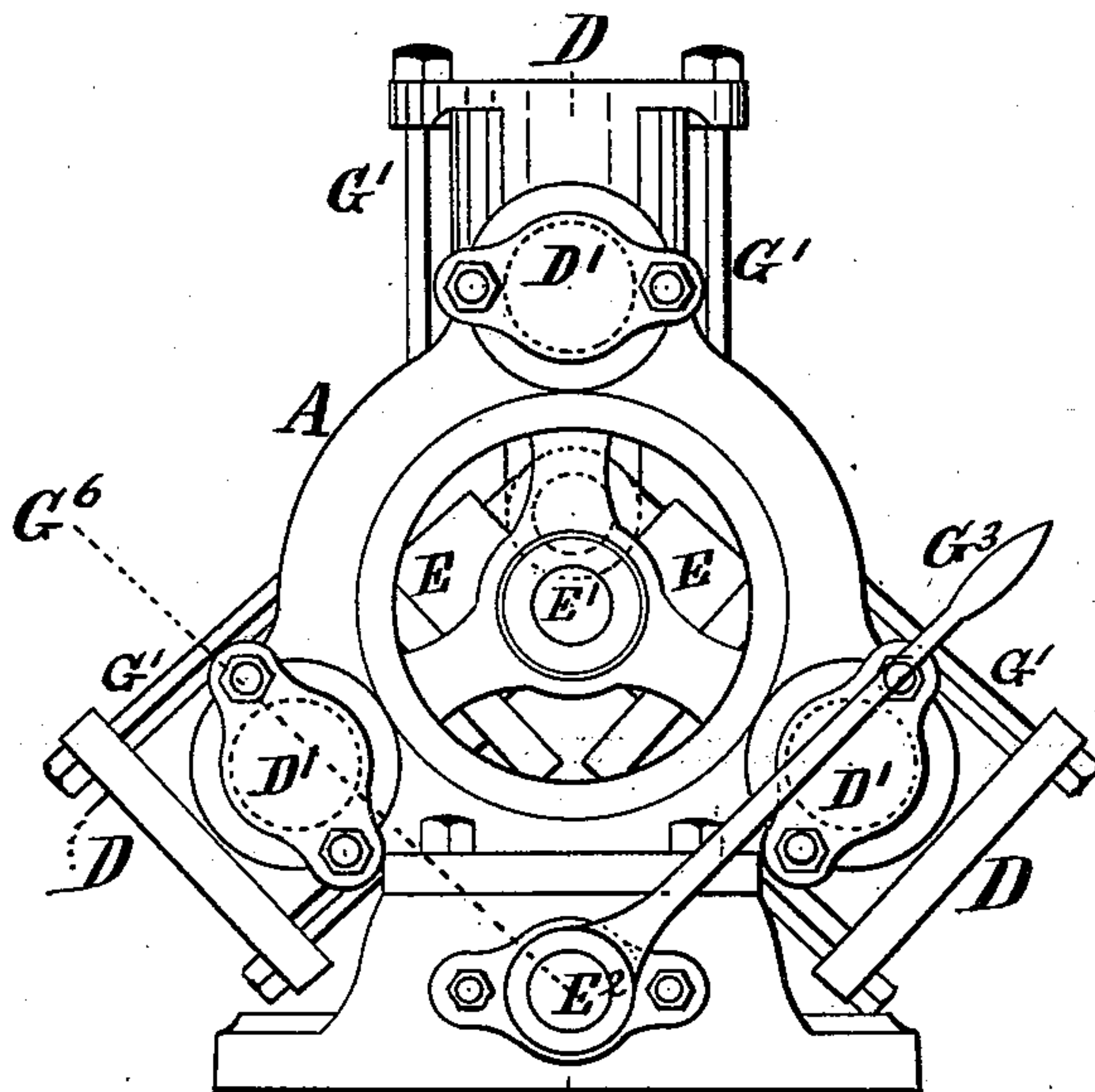


F. A. GARDNER.  
Steam-Engine.

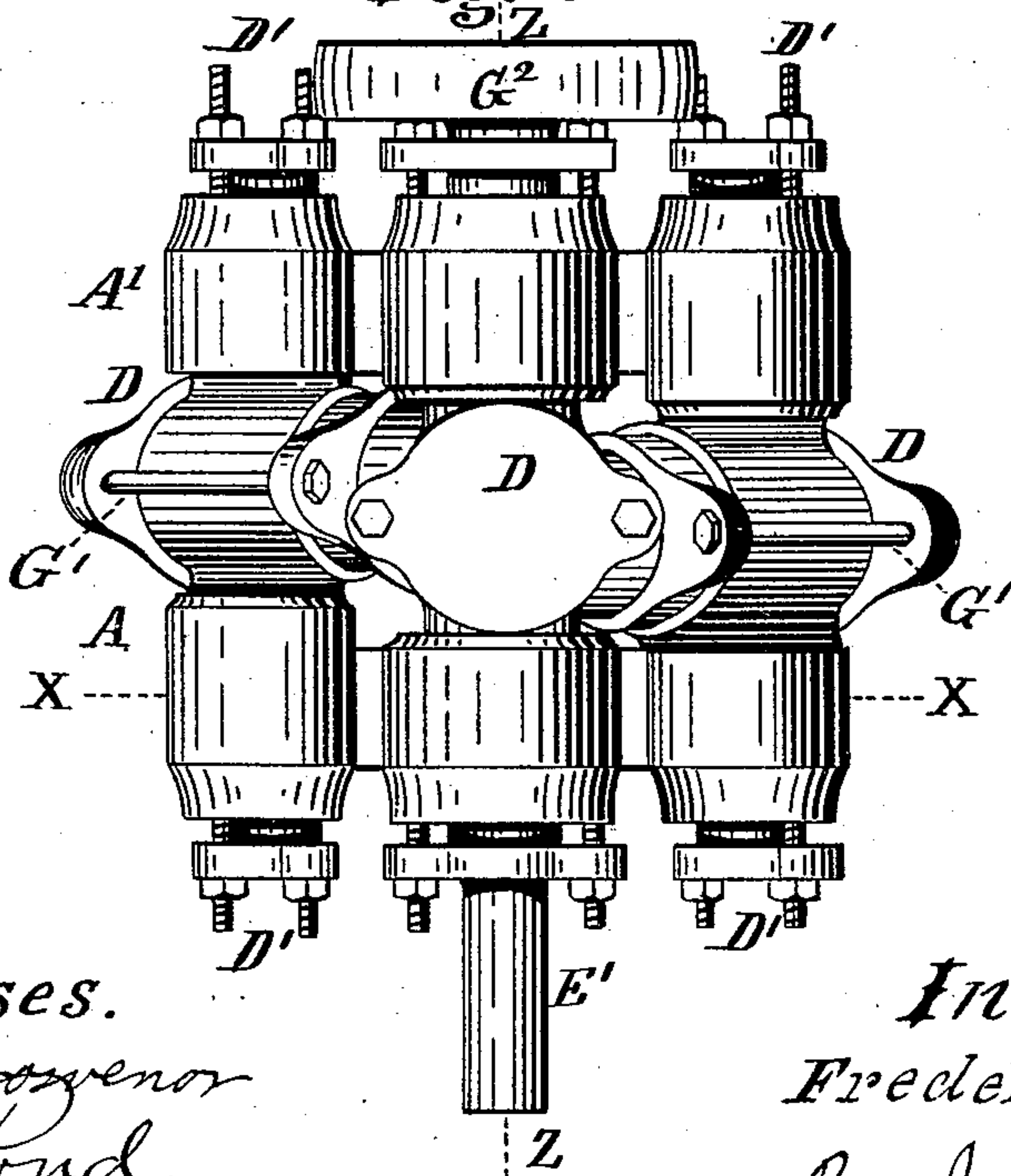
No. 206,555.

Patented July 30, 1878.

*Fig. 1*



*Fig. 2*



*Witnesses.*

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*Inventor.*

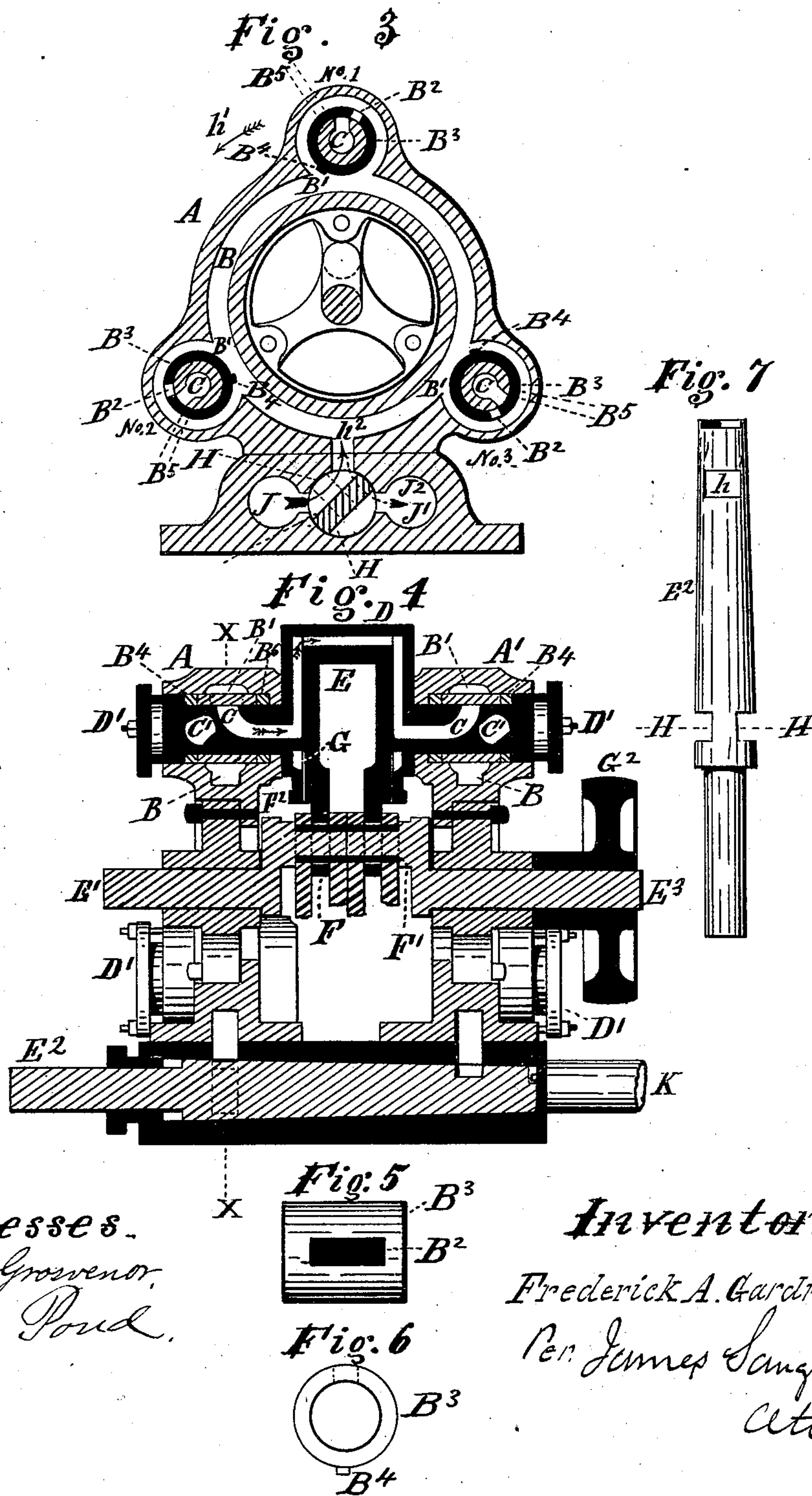
*Frederick A. Gardner.*

*Per. James Sangster*  
*Citty.*

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# UNITED STATES PATENT OFFICE.

FREDERICK A. GARDNER, OF BUFFALO, NEW YORK.

## IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. **206,555**, dated July 30, 1878; application filed June 15, 1878.

*To all whom it may concern:*

Be it known that I, FREDERICK A. GARDNER, of the city of Buffalo, in the county of Erie and State of New York, have invented certain new and useful Improvements in Steam-Engines, which improvements are fully set forth in the following specification and accompanying drawing, in which—

Figure 1 is a side elevation; Fig. 2, a plan or top view; Fig. 3, a section through one of the side frames, through line X X, Figs. 2 and 4, the box and frame for holding the shaft being left off. Fig. 4 is a vertical longitudinal section through line Z Z, Figs. 1 and 2. Fig. 5 is a side view of one of the trunnion-sleeves, showing the port through one side. Fig. 6 is an end view of the same, and Fig. 7 represents a side view of the reversing-valve.

The object of this invention is to produce a simple, reliable engine, having no dead-centers, capable of an easy adjustment when worn, and of being easily reversed.

My invention consists, first, in the combination of three oscillating cylinders, supported on each side by a hollow frame, having steam-passages for conducting the steam from the reversing-valve to the trunnions, so that it enters the cylinders through the frame-passages on one side and leaves them through the frame-passages on the other side, the arrangement being such that, when the engine is working in one direction, the steam will pass in through the steam-passages in the reversing-valve and frame on one side into the cylinders, and out through the steam-passages in the frame and reversing-valve on the other side, and when moving in the reverse direction steam will enter the opposite frame and reversing-valve passages, and, after passing through the cylinders, it will exhaust from the steam-passages in the frame and reversing-valve on the other side of the cylinders, as will more clearly hereinafter appear.

The second part of my invention consists of a double crank arranged in two parts, so that the crank-pin will be divided at or near the center, in combination with a sleeve, to which the outer ends of the pistons are connected, and the perforated pistons and frames of the engine, the arrangement being such that the parts can be easily taken apart when neces-

sary, and so that when one sleeve is worn out it can be replaced by another.

The third part of my invention relates to the valves in the trunnions and the method of packing them; and it consists in the combination of a ring or sleeve with the trunnion, provided with a pin or key to prevent it from turning, and an opening or port corresponding to the trunnion-port, a packing of suitable material on each end, and a gland of the usual construction for tightening it when required.

In the drawings, A A' represent the hollow frames, which support the cylinders and afford the means for conducting steam thereto. B is the main steam-passages therein, and B<sup>1</sup> the steam-passages leading therefrom, through the openings B<sup>2</sup> in the trunnion-sleeves B<sup>3</sup>, into the ports C in the cylinder-trunnions C'. D represents the cylinders, which are supported, by means of the trunnions, in the frames, as shown in Figs. 3 and 4.

The trunnions are made steam-tight by means of the sleeves B<sup>3</sup>, packing B<sup>4</sup> B<sup>6</sup>, and tightening-glands D'. (See Fig. 4.) E represents the pistons, which are in the form of a trunk, and arranged so as to connect directly with the crank E<sup>1</sup> at F, F representing the piston ends, which are without straps and perforated to receive the crank-sleeve, F<sup>1</sup> showing the sleeve, which is placed on the crank, as shown in Fig. 4.

The trunk-pistons are kept steam-tight by means of an ordinary gland, F<sup>2</sup>, and packing G, the glands being held to the cylinder by the bolts G<sup>1</sup>.

G<sup>2</sup> is the driving-pulley, which may be put on either side. G<sup>3</sup> represents the reversing-lever, and E<sup>2</sup> the reversing-valve, which is made tapering, and provided with a depression or steamway, H, on each side near one end, and a depression, h, or chamber near the opposite end on one side, arranged at right angles, or nearly so, to the openings H. (See Fig. 7.) These openings form passages for the steam.

In Fig. 3 the reversing-valve is shown in position for moving the engine in the direction of the arrow h<sup>1</sup>, the steam entering one of the openings H from steam-passage J into frame A in the direction of the curved arrow h<sup>2</sup>, and from thence to the cylinders, which are single-



acting, the steam entering the passages C in the direction of the arrows. (See Fig. 4.) The exhaust-steam, during this operation of the engine, passes out in the direction of the curved dotted-line arrow J<sup>1</sup> from the steam-passage in frame A' through the depression or chamber h, near the opposite end of the reversing-valve. The sleeves B<sup>3</sup> are prevented from turning in their places by means of a feather or its equivalent, B<sup>4</sup>. The passages B<sup>2</sup> in Fig. 3 represent their position (through said sleeves) in frame A, and the dotted lines B<sup>5</sup> show their position in frame A'. The ports C are in the same line in each trunnion on each side of the cylinder, so that when the steam passes into one cylinder through one trunnion-port in one frame, it will exhaust from the next cylinder (in the line of motion of the crank-shaft) through its trunnion-port in the opposite frame, and so on, from one cylinder to another, the steam entering from the passages in one frame and exhausting through the passages in the other frame.

There are two openings running through the base longitudinally to near the end, and each communicating with the reversing-valve chambers H h. An end view of these openings is shown in Fig. 3, inclosing the letters J J<sup>1</sup>. They each communicate with a steam-pipe, K, one to admit steam and one for exhaust.

I claim as my invention—

1. The cylinder-frames A A', provided with the steam-passages B B<sup>1</sup>, in combination with the cylinders D, having trunnions and ports, as specified, and a base provided with longitudinal steam-passages J J<sup>2</sup>, and reversing-valve E<sup>2</sup>, substantially as described.

2. The crank-shaft composed of the parts E<sup>1</sup> E<sup>3</sup>, in combination with the sleeve F<sup>1</sup>, perforated piston ends F, and frames A A', substantially as specified, and for the purposes described.

3. The sleeves B<sup>3</sup>, in combination with the trunnion C', packing B<sup>4</sup> B<sup>6</sup>, tightening-glands D<sup>1</sup>, and frames A A', substantially as and for the purposes specified.

4. The combination of three oscillating cylinders, having trunnions C', removable port-sleeves B<sup>3</sup>, a supporting-frame on each side, having steam-passages leading to the trunnion-ports, a base provided with passages for admitting steam to the passages in the frames A A', and for receiving the exhaust therefrom, and a reversing-valve, all arranged for joint operation, substantially as described.

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Witnesses:

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