No. 837,507. PATENTED DEC. 4, 1906.

S. N. RAPP.

INTERNAL COMBUSTION ENGINE.

APPLICATION FILED MAR. 29, 1905.

3 SHEETS—SHEET 1.

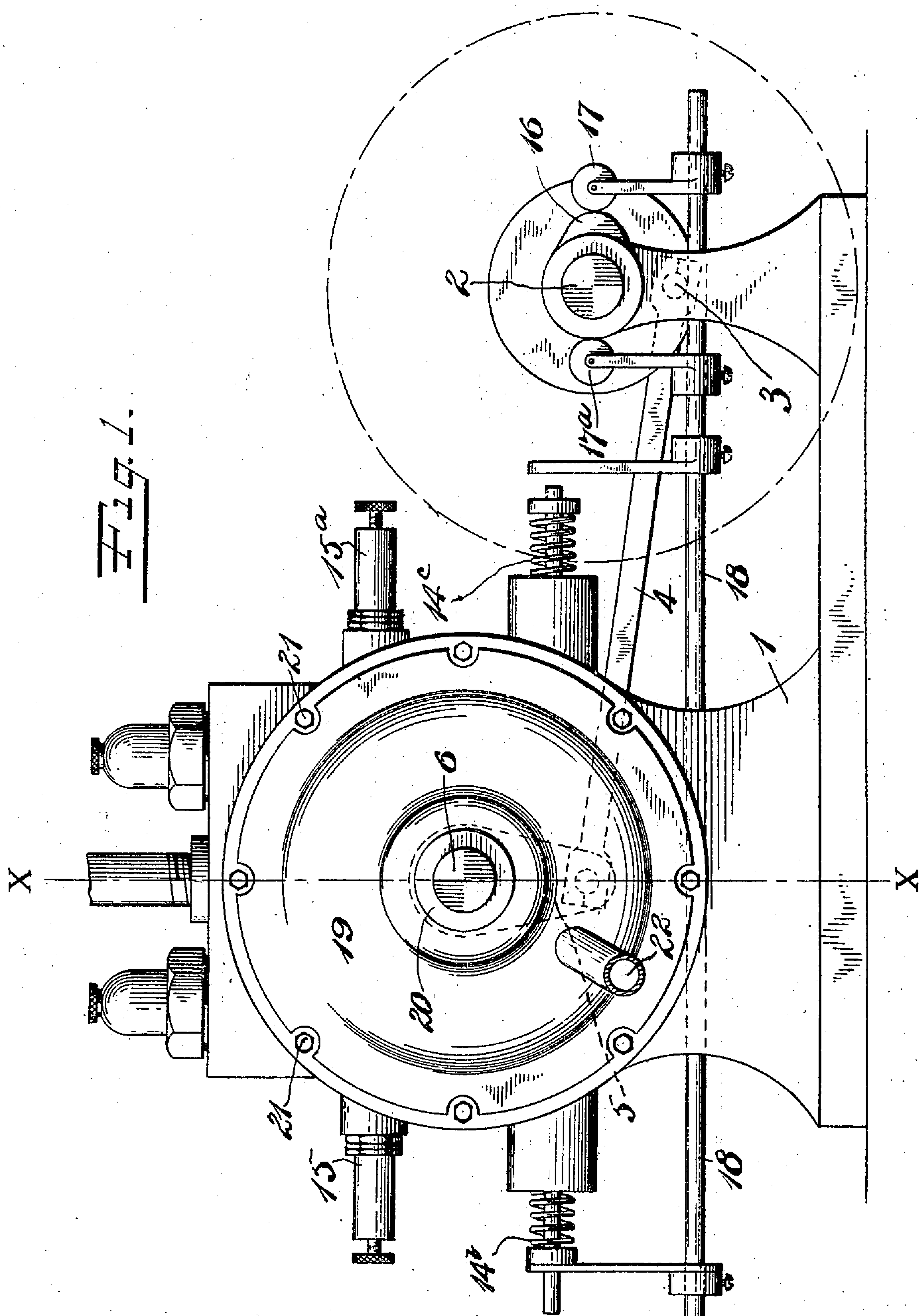

Fig. 1.

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3 SHEETS—SHEET 2.

Fig. 2.

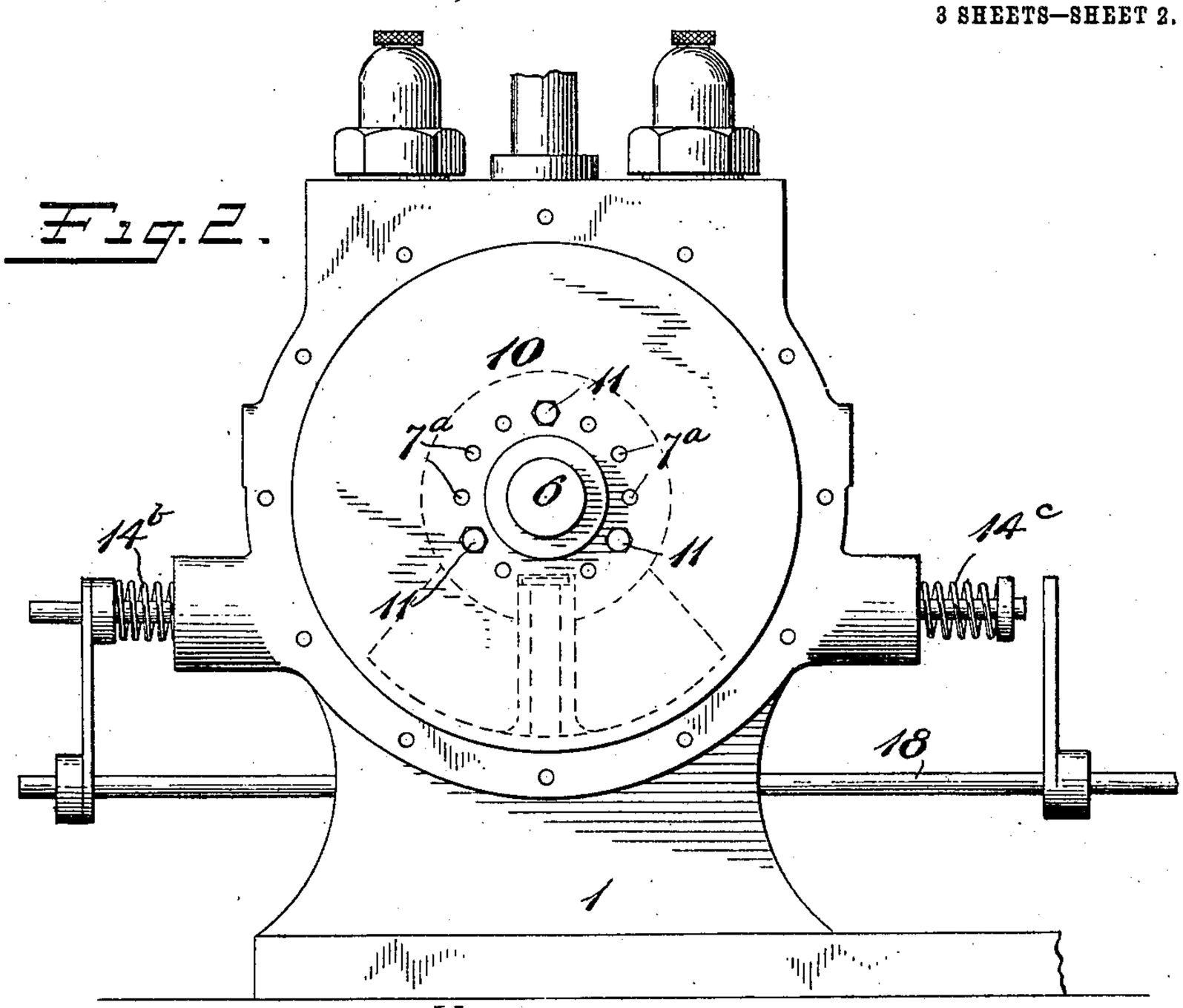
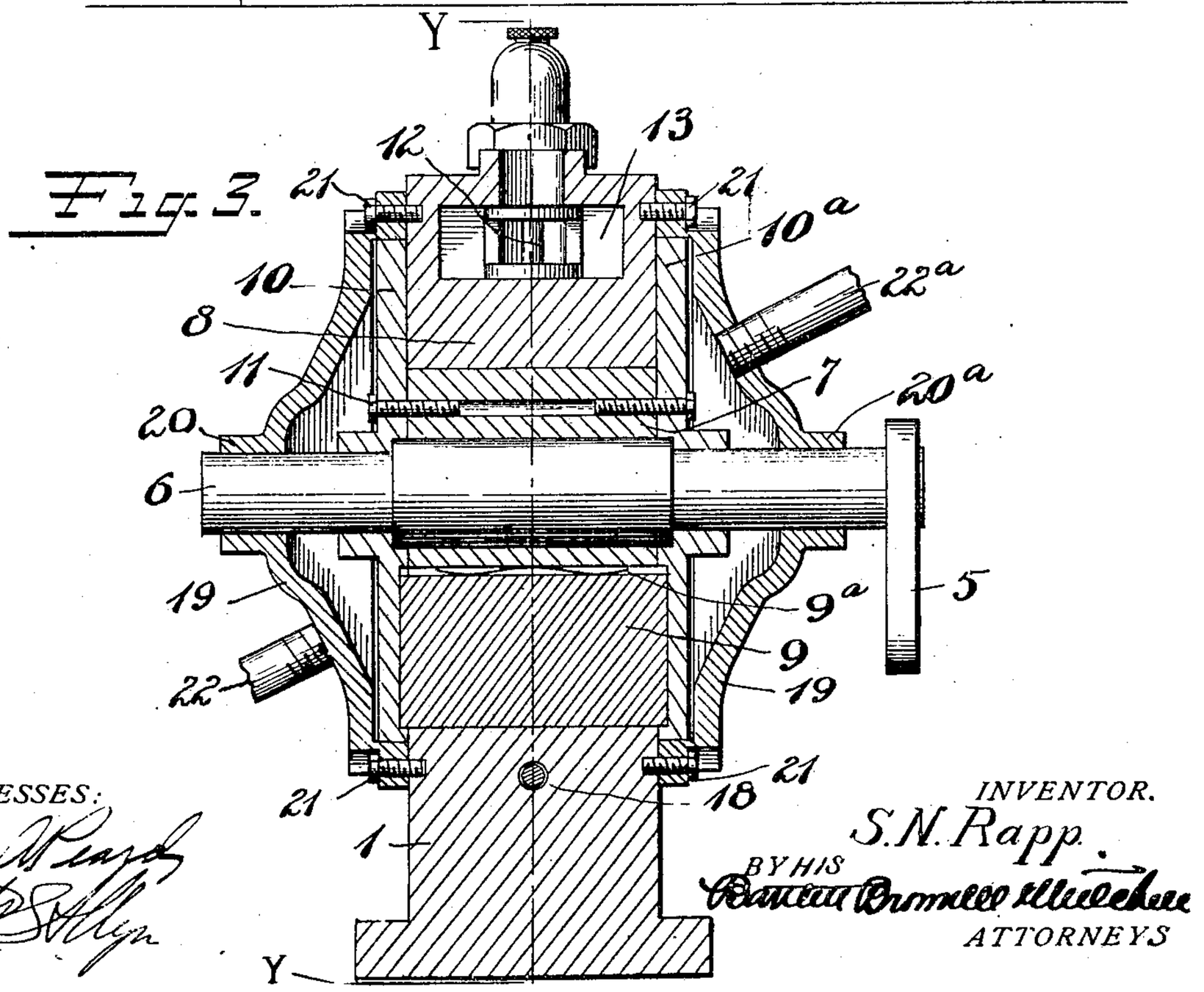


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

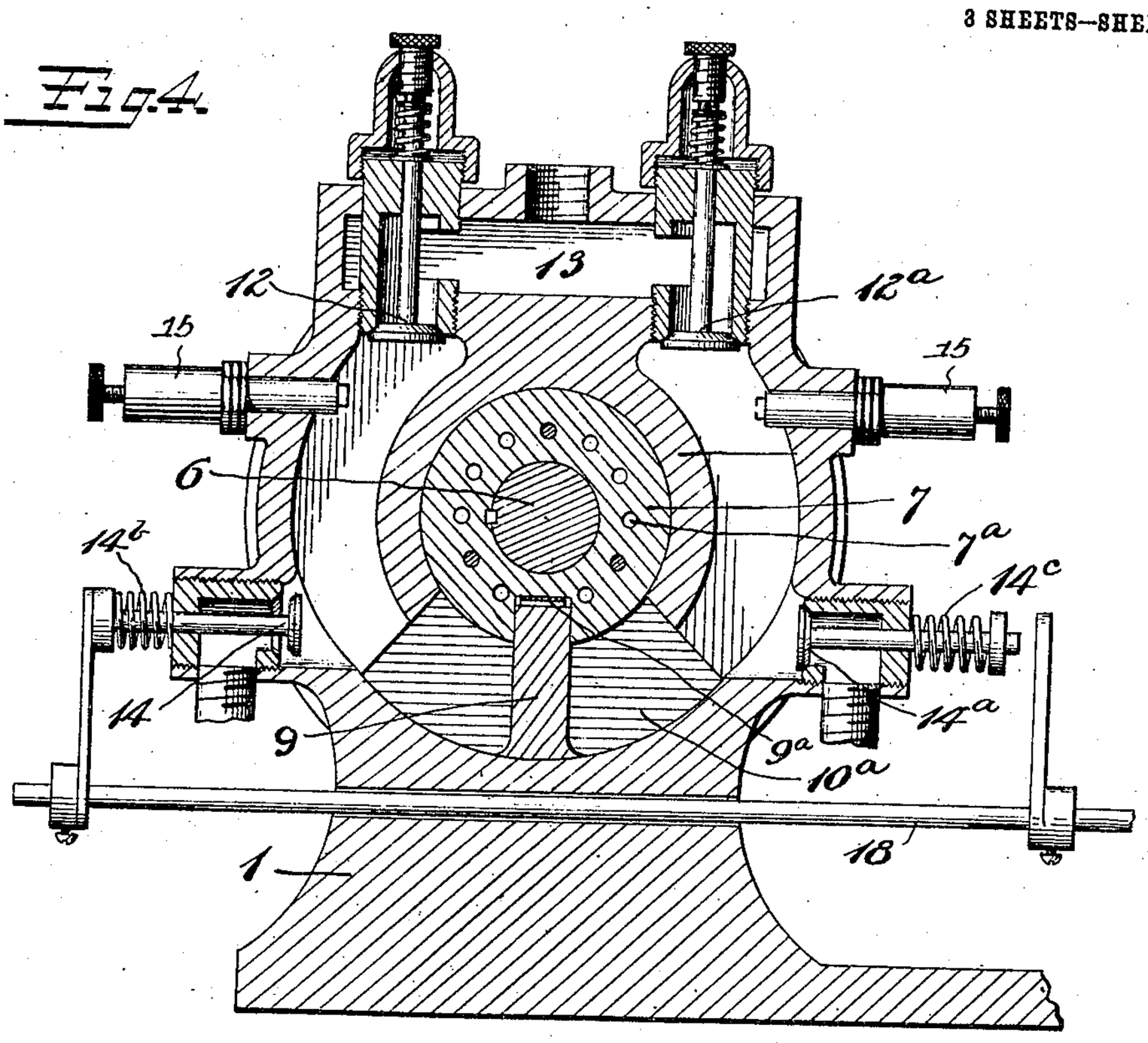


Fig. 5.

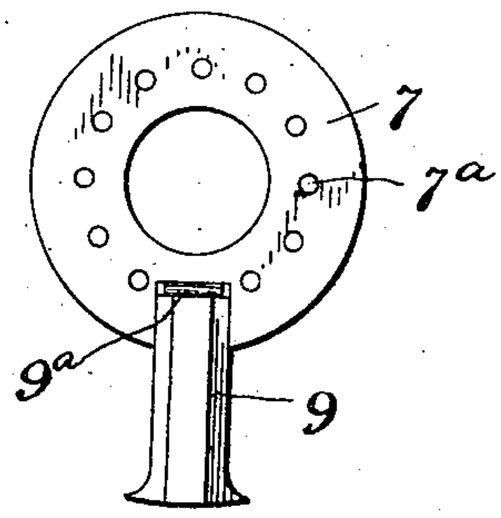
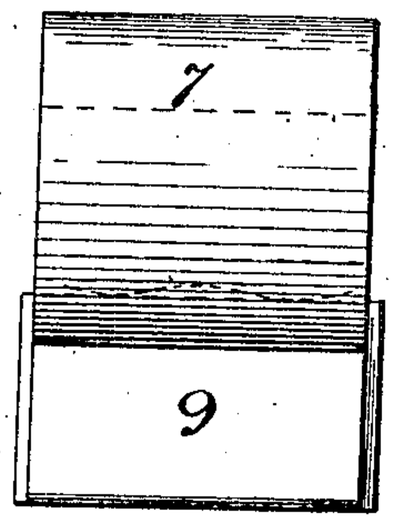


Fig. 6.



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UNITED STATES PATENT OFFICE.

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INTERNAL-COMBUSTION ENGINE.

No. 837,507. Specification of Letters Patent. Patented Dec. 4, 1906.

Application filed March 29, 1905. Serial No. 252,620.

To all whom it may concern:

Be it known that I, SAMUEL N. RAPP, a citizen of the United States, residing at Detroit, Wayne county, Michigan, have invented certain new and useful Improvements in Internal-Combustion Engines, of which the following is a full, clear, and exact description.

My invention relates to improvements in internal-combustion engines of the hydrocarbon type.

The object of the invention is to provide a simple, inexpensive, and effective construction.

The principle of operation is applicable either to the so-called "two-cycle" or "four-cycle" type; but, as shown in the accompanying drawings and as described in the following specification, it corresponds in operation to the two-cycle type in that there is no intermediate exhaust-stroke.

While the invention may be applied to a single-acting engine, in the form shown it is double-acting.

It should be understood that I have set forth only the preferred embodiment of the invention and that it may be modified in a variety of ways without departing from the scope and spirit thereof.

In the accompanying drawings, Figure 1 is a side elevation of the engine. Fig. 2 is a similar view with the fly-wheel shaft and the associated parts detached and with one side plate removed. Fig. 3 is a section on the line X X, Fig. 1. Fig. 4 is a longitudinal section on the plane of the line Y Y, Fig. 3. Fig. 5 is an end view of the piston and piston-supporting hub detached. Fig. 6 is a side elevation thereof.

1 is the engine-frame.

2 is a fly-wheel shaft. 3 is a crank thereon.

4 is a connecting-rod.

5 is an oscillating crank-arm carried by shaft 6.

7 is a hub within which the shaft is suitably secured, as by a key. This hub 7 in operation partakes of an oscillating motion and finds its bearing in the part 8 of the engine-body. Within the interior of this body is a curved or cored-out space constituting the combustion chamber or chambers.

9 is an element which corresponds in function to that of a piston and which will hereinafter be referred to as a "piston," although it partakes of an oscillating motion in a part of the space constituting the combustion-chamber. This piston always forms one end wall of the combustion-chamber. In the particular form shown the piston divides this space into two combustion-chambers, into either or both of which gas may be admitted, as hereinafter explained. The opposite side walls of the body 8 are cut away to a sufficient extent to afford working spaces for the opposite edges of the oscillating piston 9. At each end of the hub 7 is a plate, said plates being indicated by 10 10^a. These plates take a bearing against the flat wall of each side of the body 8 and cover the aforesaid working spaces. The side edges of the piston 9 project through said spaces and slightly into said plates, as best seen in Fig. 3, so that as said piston 9 oscillates the plates will oscillate simultaneously, the entire body, the hub, the piston, and the plates 10 10^a moving as one body. The plates themselves may be fastened securely to the ends of the hub, for example, by means of screws 11.

From the foregoing it will be seen that as the piston 9 oscillates a similar motion will be imparted to the oscillating crank-arm 5, and through the medium of the connecting-rod 4 and crank 3 the fly-wheel shaft 2 will be rotated.

I will now describe the means for admitting gas and exhausting the burned charge.

12 12^a are inlet-valves. In the particular form shown said valves are of the puppet type and are arranged in the head of the engine in communication with the gas-chamber 13, into which a supply of gas may be led from any suitable source. 14 14^a are the exhaust-valves, which respectively control the exhaust of the burned gases on opposite sides of the piston 9. 15 15^a are spark-plugs arranged for the respective combustion-chambers. 16 is a cam on shaft 2. 17 is a roller arranged to be operated by the cam 16. This roller is carried by the rod 18, which leads back to the exhaust-valve 14, so that when said cam engages said roller said valve will be opened. 17^a is a roller, also carried by rod 18 and arranged in the path of movement in the cam 16, so that when the latter engages it the rod 18 will be shifted, causing the exhaust-valve 14^a to open. The exhaust-valves 14 14^a are normally closed by means

packing-rings may be provided wherever desired, or the parts may be so accurately fitted as to obviate the necessity of the same. In the particular form shown I have caused the piston 9 to be spring-pressed at its inner end, so as to force its extreme edge against the circular wall at the opposite side of the chamber within which it moves, thus making an effective gas-tight joint. The spring for pressing said piston against said wall is indicated at 9^a. At each end of the engine-casing I provide what I term an "end cover-plate," said cover-plates being shown at 19 19. These plates are centrally perforated to receive the shaft 6 and afford bearings therefor, the bearings being indicated at 20 20^a. These plates are secured to the stationary part of the engine-body by means of bolts or screws 21.

If desired, the engine may be cooled by water, which may be let in through a pipe 22 to the space between the cover-plate 19 and the end plate 10. It may then flow through the passages 7^a 7^a in the hub 7 to the other side of the engine and into the space between the cover-plate 19^a and the end plate 10^a thence out through the water-pipe 22^a.

The heat of the engine may be utilized as an aid in the generating of the gas just prior to the entrance of the same into the combustion-chambers. As the gas enters the gas-chamber 13 it is warmed, and hence when it passes through the inlet-valves into the combustion-chambers it is in a better condition to ignite. Further than this, should an excess of gasolene flow through the carbureter or mixer and enter said gas-chamber 13 the heat therein will cause it to volatilize all the more readily than would otherwise be the case.

I have not attempted to illustrate or describe the circuit for causing the igniting spark, since such circuits are well understood, it being merely sufficient to say that any ordinary circuit suitable for operating spark-plugs, and preferably whereby the spark may be advanced or retarded, may be employed.

While, as stated, I have shown my invention in a form corresponding somewhat in operation to the two-cycle type of gas-engine, it requires merely the addition of the well-known cam-shaft running at a speed of two to one relatively to the fly-wheel shaft in order to transform the engine into one which operates after the order of the so-called "four-cycle" engine. Such a modification would be so obvious to a mechanic skilled in the art as to require no illustration.

The operation of the engine in the particular form shown is as follows: The piston 9 is in the middle position, and it may be assumed that it is moving to the right. The exhaust-valve 14 is open, and the inert gases are being exhausted. When the piston has moved to the right slightly beyond the position shown in Fig. 4, the exhaust-valve closes, and for the balance of the stroke gas will be drawn in through the valve 12. When the piston has reached the limit of its excursion to the right, ignition occurs in the right-hand combustion-chamber and power is applied to the piston 9, driving it back to the left. This power-stroke lasts for about one-third of the full stroke of the piston, when the exhaust-valve 14^a is opened and the inert gases are free to pass out. When the piston reaches a position slightly to the left of that indicated in Fig. 4, the exhaust-valve 14^a will close, whereupon gas will be drawn in past the valve 12^a. On this entire back stroke of the piston—that is, the stroke to the left—whatever gas is contained in the combustion-chamber on the left-hand side of the piston 9 will be compressed and ignited when the piston reaches the limit of its excursion to the left. Power will then be applied to move the piston to the right—say one-third of its stroke—and so on. During the stroke to the right of course the gas contained in the combustion-chamber on the right of the piston is compressed by the full stroke of the piston. By this arrangement a short vigorous power-stroke is imparted to each side of the piston on each stroke. The compression, however, on the opposite side of the piston occurs during the full stroke.

It will be observed that the piston operates after the manner of a lever, and the length of the same from the axis of oscillation is such that great power may be imparted to the crank. By lengthening or shortening the latter, the said leverage may be varied at will, so that it may be easily ascertained which length of crank will give the most satisfactory results. This describes the operation of the engine when single-acting; but, as shown in the drawings, the engine may be double-acting. Hence the valves 12^a and 14^a and the igniter 15^a will operate alternately with the corresponding elements on the other side, thus imparting to the piston a powerful impulse at each of its extreme positions alternately.

What I claim is—

1. In an engine of the internal-combustion type, a combustion-chamber, an oscillating piston forming one of the walls thereof, an oscillating end plate at each of the opposite side edges of said piston, said plates forming part of the side walls of said combustion-chamber, an inlet-valve and an exhaust-valve, and means connected with said piston for the transmission of power.

2. In an internal-combustion engine, a body provided with a curved combustion-chamber, an oscillating piston forming one end wall of said chamber, a working space for the piston in one side of said body, said piston projecting into said working space, an

oscillating end plate overstanding said working space and closing the same said end plate engaging the piston and oscillating therewith.

3. In an internal-combustion engine, a body provided with a curved combustion-chamber, an oscillating piston forming one end wall of said chamber, a working space in one side of said body, said piston projecting into said working space, an oscillating end plate overstanding said working space and closing the same, a portion of said piston projecting into said end plate.

4. In an internal-combustion engine, a body provided with a curved combustion-chamber, an oscillating piston forming one end wall of said chamber, a working space in one side of said body, said piston projecting into said working space, an oscillating end plate overstanding said clearance-passage and closing the same, a portion of said piston projecting into said end plate, a shaft coincident with the axis of oscillation of said piston and driven thereby, and a cover-plate rigidly secured to the engine-body and spaced apart from said end plate.

5. In an internal-combustion engine, a body provided with a curved combustion-chamber, an oscillating piston forming one end wall of said chamber, a working space in one side of said body, said piston projecting into said working space, an oscillating end plate overstanding said working space and closing the same, a portion of said piston projecting into said end plate, a shaft coincident with the axis of oscillation of said piston and driven thereby, a cover-plate rigidly secured to the engine-body, and a bearing for said shaft, said bearing being carried by said cover-plate.

6. In an engine of the internal-combustion type, a body, a curved combustion-chamber therein, a piston, a working space on each side of said body, a piston in said combustion-chamber dividing the same and projecting into said working space, oscillating plates carried by said piston and covering said working space.

7. In an engine of the internal-combustion type, a body, a curved combustion-chamber therein, a piston, a working space on each side of said body, a piston in said combustion-chamber dividing the same and projecting into said working space, oscillating end plates carried by said piston and covering said working space, stationary cover-plates rigidly secured to opposite ends of said body and covering said end plates and shaft-bearings carried by each of said stationary cover-plates.

8. In an engine of the internal-combustion type, a combustion-chamber, an oscillating piston forming one end wall thereof, an oscillating end plate moving with said piston, a part of said plate forming part of the side wall of said combustion-chamber, an inlet-valve and an exhaust-valve, and means connected with said piston for the transmission of power.

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Witnesses:
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