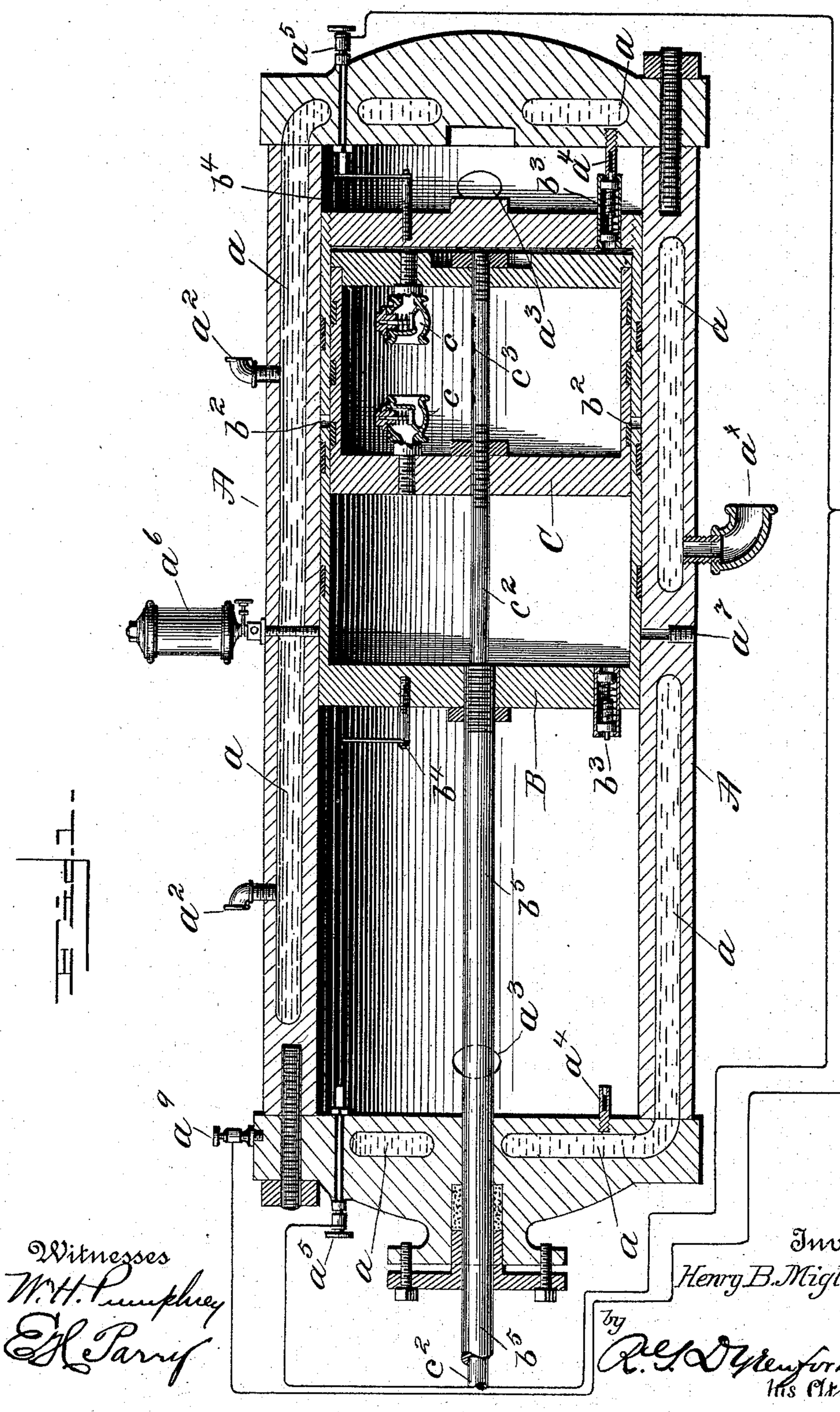
(No Model.)

3 Sheets—Sheet 1.

H. B. MIGLIAVACCA.

GAS ENGINE.

No. 528,105. Patented Oct. 23, 1894.



Witnesses
W. H. Pumphrey
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Inventor,
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by R. S. Dyrenforth,
his Attorneys.

(No Model.) 3 Sheets—Sheet 2.

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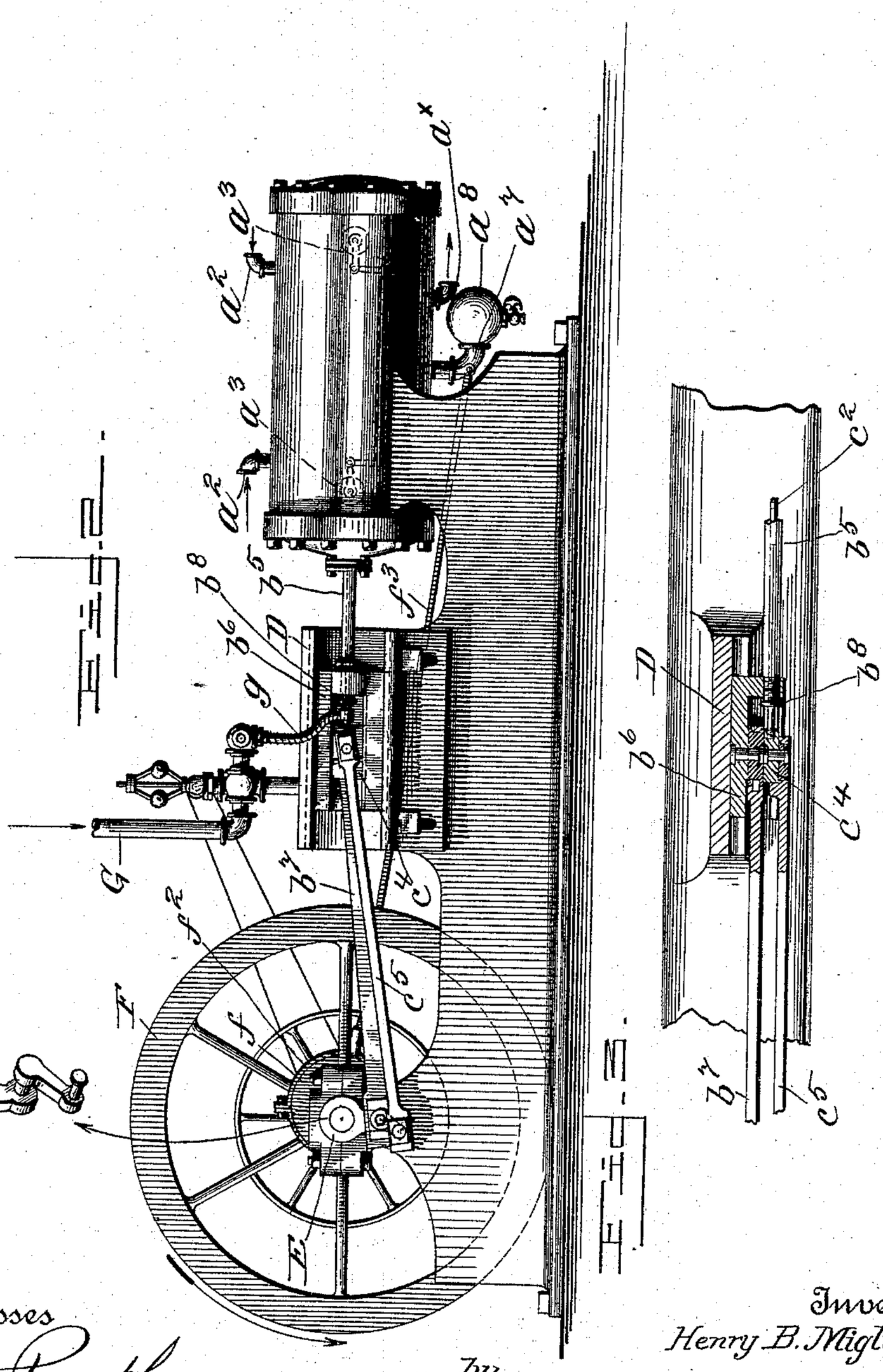

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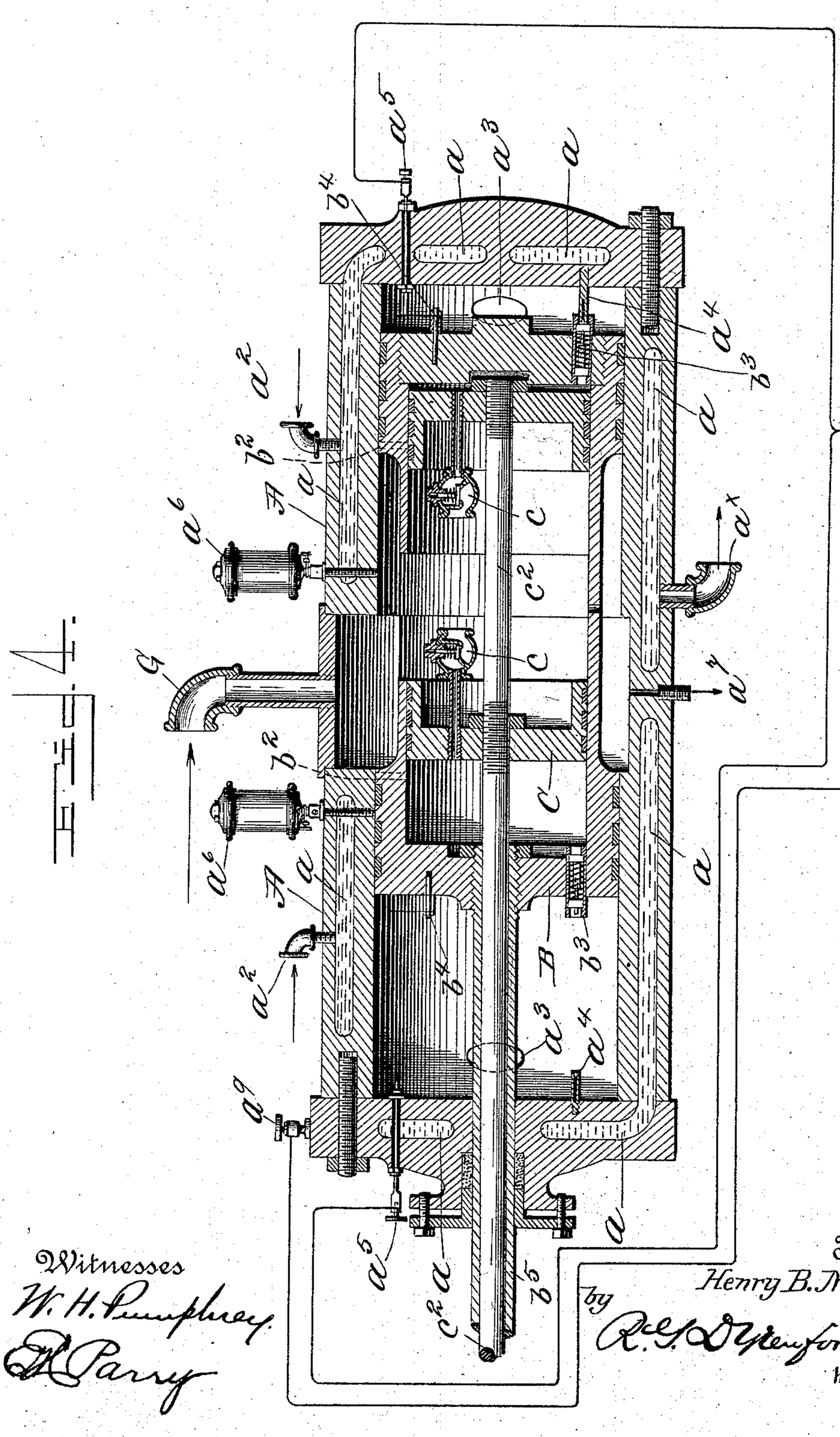

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UNITED STATES PATENT OFFICE.

HENRY B. MIGLIAVACCA, OF NAPA, CALIFORNIA, ASSIGNOR OF ONE-TENTH TO SIRO MIGLIAVACCA, OF SAME PLACE.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 528,105, dated October 23, 1894.

Application filed March 27, 1894. Serial No. 505,269. (No model.)

To all whom it may concern:

Be it known that I, HENRY B. MIGLIAVACCA, a citizen of the United States, residing at Napa, in the county of Napa and State of California, have invented certain new and useful Improvements in Gas-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 gas-engines.

The object is to produce a gas-engine in which the explosion will occur, in sequence, at either end of the stroke, or at both ends of the stroke and in which, by compression of the gas in the same direction and on the same stroke with the power-stroke, there will be advantage in equable distribution of power.

With this object in view, the invention consists in a gas-engine having two pistons, one within the other and acting in the same direction, the inner piston moving more rapidly than the other and compressing the gas within the outer and in the direction of movement of the outer.

The invention consists, furthermore, in the details of construction.

In the accompanying drawings, forming part of this specification, and in which like letters of reference indicate corresponding parts, I show a form of embodiment applied to a double-acting engine.

Figure 1— is a view in vertical longitudinal section, showing a cylinder properly surrounded by water-chambers for cooling, and water-supply, outer and inner pistons, piston-rods therefor, one surrounding the other, oil-supply, inlet for gas through the inner piston-rod, requisite valves, and means for effecting the explosion by the electric-spark. Fig. 2— is a view in side elevation, showing the cylinder with governor to control inflow of gas, two piston-rods, and connecting-rods with double crank, or crank and drag-crank, on the driving-shaft, the rod for the outer piston connected with the crank, and the rod for the inner piston connected with the drag-crank, that is, at a point farther from the center than the connection of the rod of outer piston, also out of line therewith, whereby it will move faster, and give a more extended movement toward the end of the stroke. Fig. 3— is a view in horizontal section, showing the attachment of the piston-rods and connecting-rods to their cross-heads, the piston-rod of the outer piston being attached to a cross-head sliding in a way in a fixed block, and the piston-rod of the inner piston being attached to a cross-head sliding in a way in the cross-head of the outer piston, the inner piston sliding through a stuffing-box toward the end of the outer piston-rod. Fig. 4— is a view in longitudinal section, showing a modification of the invention, in which the inlet for gas, instead of being through the inner piston-rod, is at the circumference of the cylinder, and in which the pistons are open at their sides to admit the gas.

Referring to the drawings, A, designates a cylinder preferably made of iron, and having connected water-chambers, a, for cooling the cylinder, fed through pipes, a^2, discharge being by a pipe $a^\times$. The cylinder has toward its ends, exhaust-valves, a^3, and, at its ends, within, trips, a^4, and electric binding-posts, a^5, insulated from the cylinder, connecting with one terminal of a battery or other source of electricity. Within this cylinder are two pistons, B, and, C. The piston, B, is the outer piston and slides immediately within the cylinder, the interior of which is oiled through a suitable oil-cup, or through suitable oil-cups, a^6, oil also passing to the interior of the outer piston by ducts, b^2, in the piston, and discharge thereof being by a tube or drip, a^7, leading to a receptacle, a^8, provided with a cock to keep it closed against escape of gas.

The piston, B, is made hollow, is provided at its ends with double-valves, b^3, opening in opposite directions, and uninsulated electric terminals, b^4, connecting with the other pole of the battery or other source of electricity by a binding-post, a^9, on the cylinder, and has, within it, free to slide, the piston, C.

The piston, C, is provided, at its ends, with valves, c, the valves opening from pressure within the piston, in excess of the pressure at the ends, outside, and closing by excess of pressure outside the piston at the ends, as by compressed gas between an end of the inner piston and an end of the outer piston.

A suitable governor, as usual, will be placed upon the gas-inlet.

The outer piston is rigidly connected by a sleeve-rod, b^5, to a cross-head, b^6, this being held, in a manner to slide, in a way in a block, D. To the cross-head, is pivoted one end of a connecting-rod, b^7, the other end being pivoted to the inner offset of the double-crank, E, of the driving-shaft, on which is the fly-wheel, F.

The inner piston is rigidly connected by a rod, c^2, in Fig. 1 shown tubular, provided with openings, c^3, into the inner piston, and sliding within the sleeve-rod, that is, within the piston-rod of the outer piston, through a stuffing-box, b^8, toward the outer end of and in the sleeve-rod, with a cross-head, c^4, which slides in a way in the cross-head of the outer piston-rod. To the cross-head, c^4, is pivoted one end of a connecting-rod, c^5, the outer end being pivoted to the outer offset, of the double-crank, that is, to a drag-crank, of the driving-shaft, this outer offset being somewhat out of the radial line of the other.

Upon the shaft of the fly-wheel, there is an eccentric, f, by which, and its strap, f^2, and rod, f^3, the exhaust-valves, a^3, toward each end of the cylinder, are respectively closed at the proper time.

G is the inlet-pipe for gas, upon which there is the usual governor, and, under the arrangement shown in Figs. 1 and 2, a flexible pipe, g, connects with the end of the inner tubular piston.

Under the modification shown in Fig. 4, the gas-inlet-pipe, G, instead of connecting with the inner piston, enters the circumference of the cylinder, and the outer and inner pistons are open at a part of their circumference opposite the inlet, to admit the gas to the inner cylinder.

The operation is as follows: Gas entering the inner piston, and the pistons having moved to the left, whereby gas has entered the space between the end of the inner and outer pistons, to the right, and the pistons being now moving to the right, as shown, the gas will be compressed between the ends of the inner and outer pistons, to the right, the pressure keeping the valve at the right-hand end of the inner piston closed, while the relief of pressure or the suction created between the ends of the inner and outer pistons, to the left, will open the valve at the left-hand end of the inner piston, causing gas to flow into the space between the left-hand ends of the inner and outer pistons, the more rapid movement of the inner piston over that of the outer piston incident to its connection to a point on the crank exterior to that of the outer piston, constantly enlarging this space, up to the end of the stroke. The pistons are now moving together to the right; but, as said, the inner piston moves more rapidly within the outer piston, and, consequently, the gas at the right-hand ends of the pistons is being compressed here. At the end of the stroke, at each end, there will be a space left between the ends of the outer piston and the cylinder. Just before the outer piston completes its stroke, the exhaust-valve, at the end toward which the piston is moving, will be closed, the eccentric being constructed and its movement timed to this effect, and, thereupon, the valve b^3, coming into contact with the trip, a^4, the outer portion of this double-valve will be opened by the trip, and the inner portion will be pushed open by the pressure of the gas, an additional push or acceleration being given to this gas by the extended movement of the inner piston which now immediately takes place by reason of the connection of its piston-rod with the drag-crank, as described, and the gas is quickly forced into the space between the end of the outer piston and the cylinder. At the same time the electric terminations have come into contact, and upon the start of the piston on its back-stroke, the contact is broken. From this, a spark results, the gas is ignited, and the consequent explosion, acting against the end of the outer piston, drives it in the opposite drection. The escape-valve at this end is now immediately opened, and the operations described for this end of the cylinder are reversed, compression taking place at the other. Of course, the explosion closes the inner portion of the double-valve to prevent ignition of any gas remaining within the adjoining chamber of the outer piston. By transposing the connections of the two pistons, the outer piston would move faster than the inner, and providing a properly valved-passage from each space between the ends of the two pistons into the cylinder beyond the end of the outer piston farthest from this space, instead of into the cylinder nearest this space, the compressed-gas would be pushed into the end of the cylinder toward which the stroke is being made, as before, all the valves to act as in the drawings.

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

1. A gas-engine having a power cylinder wholly containing two pistons, one within the other, acting in the same line of motion, substantially as set forth.

2. A gas engine having two pistons, one within the other, acting in the same direction, and at different speeds, whereby the gas is compressed within the outer, substantially as described.

3. A gas-engine having two pistons, one within the other and acting in the same direction, the inner piston moving more rapidly than the outer and compressing the gas within the outer, and in the direction of movement of the outer, substantially as described.

4. A gas-engine having two pistons, one

within the other, acting in the same direction and at different speeds for a portion of the stroke of one, and then in opposite directions for the remainder of the stroke of the same, substantially as described.

5. A gas-engine having two pistons, one within the other, acting in the same direction, and at different speeds, and the valves, whereby gas is admitted and compressed within the outer piston, substantially as described.

6. A gas-engine having two pistons, one within the other, acting in the same direction, and at different speeds, and valves, by which the gas is admitted on each stroke of the pistons, and compressed within the outer piston in the space between its end and the advancing end of the inner piston, substantially as described.

7. A gas-engine having two pistons, one within the other, acting in the same direction, at different speeds, valves, whereby on each stroke of the pistons, the gas will be compressed within the space between the end of the outer piston and the advancing end of the inner piston, and admitted to the space between the opposite end of the outer pistons and the receding end of the inner piston, substantially as described.

8. A gas-engine having two pistons, one within the other, acting in the same direction, and at different speeds, valves, by which the gas is admitted to the space between adjacent ends of the pistons, where it is compressed, and valved-outlets, through which the gas is discharged into the cylinder, substantially as described.

9. A gas-engine having two pistons, one within the other, acting in the same direction, and, at different speeds, admission valves by which the gas is admitted to the space between adjacent ends of the piston where it is compressed, valved-outlets from the piston into the cylinder, through which the gas is discharged, and means for igniting the gas when discharged, substantially as described.

10. A gas-engine having two hollow pistons and piston-rods, one within the other, the inner piston communicating with a source of gas-supply through its hollow rod, and means for compressing the gas and igniting it when compressed, substantially as described.

11. A gas-engine having two hollow pistons and piston-rods, one within the other, and moving at different speeds, the inner piston communicating with a source of gas-supply through its hollow rod, valves by which the gas is admitted to the space within the outer piston between its ends and the ends of the inner piston, where it is compressed, valved outlets through which the compressed-gas is discharged into the cylinder, and an igniting-device, substantially as described.

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

HENRY B. MIGLIAVACCA.

Witnesses:

S. G. HOPKINS,

W. H. PUMPHREY.