(No Model.) 3 Sheets—Sheet 1.

J. S. WALCH.

EXPLOSIVE GAS ENGINE.

No. 590,080. Patented Sept. 14, 1897.

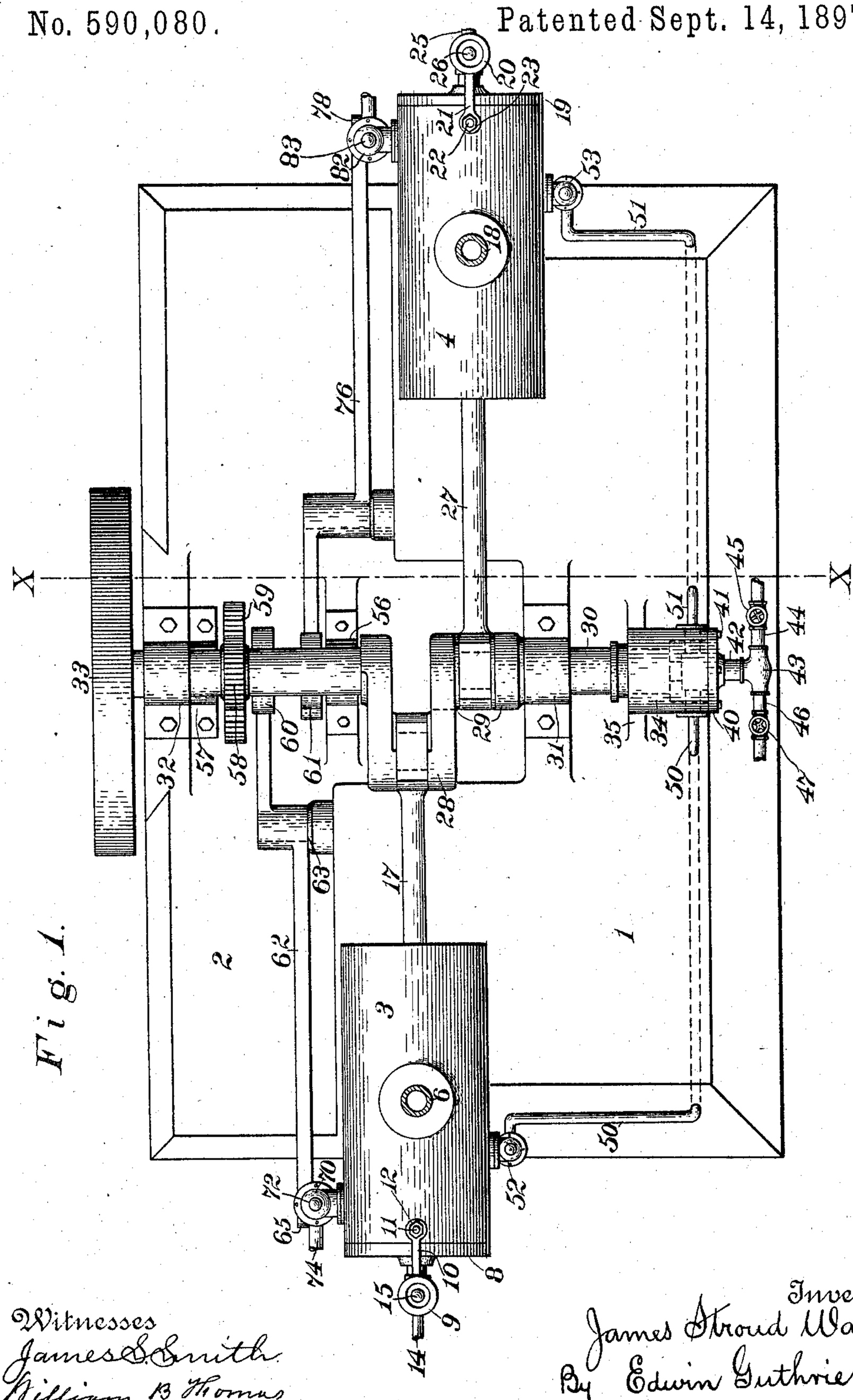

Fig. 1.

Witnesses
James L. Smith.
William B. Thomas

Inventor
James Stroud Walch.
By Edwin Guthrie.
Attorney

(No Model.) 3 Sheets—Sheet 2.

J. S. WALCH.

EXPLOSIVE GAS ENGINE.

No. 590,080. Patented Sept. 14, 1897.

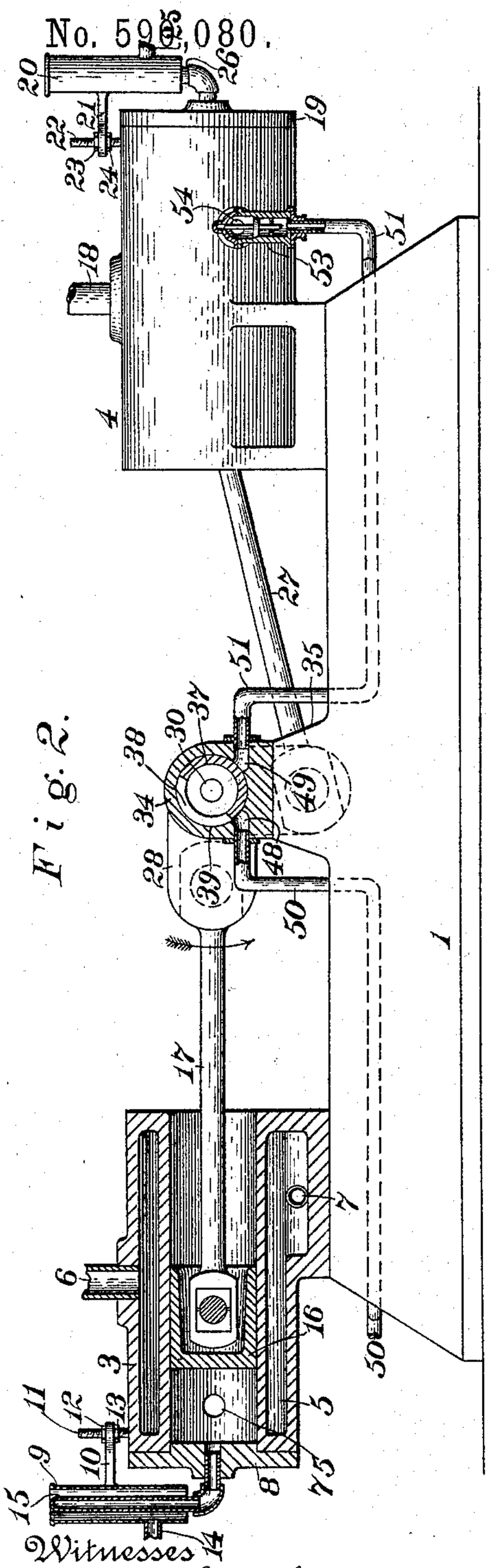

Fig. 2.

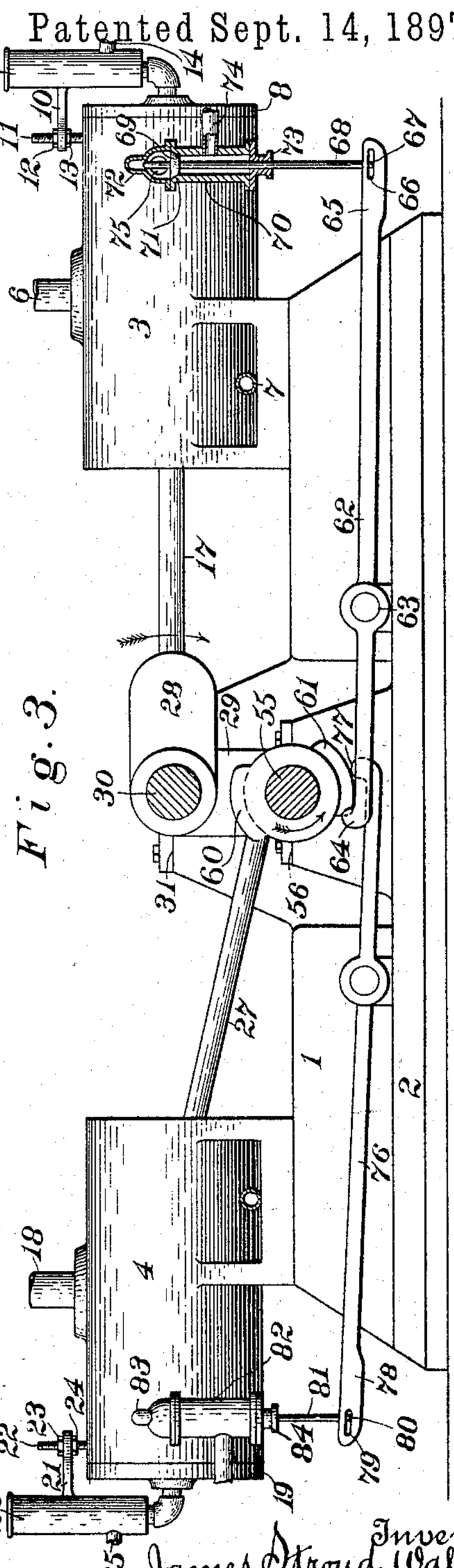

Fig. 3.

Witnesses
James B. Smith.
William B. Thomas

Inventor
James Stroud Walch.
By Edwin Guthrie
Attorney

(No Model.) 3 Sheets—Sheet 3.

J. S. WALCH.

EXPLOSIVE GAS ENGINE.

No. 590,080. Patented Sept. 14, 1897.

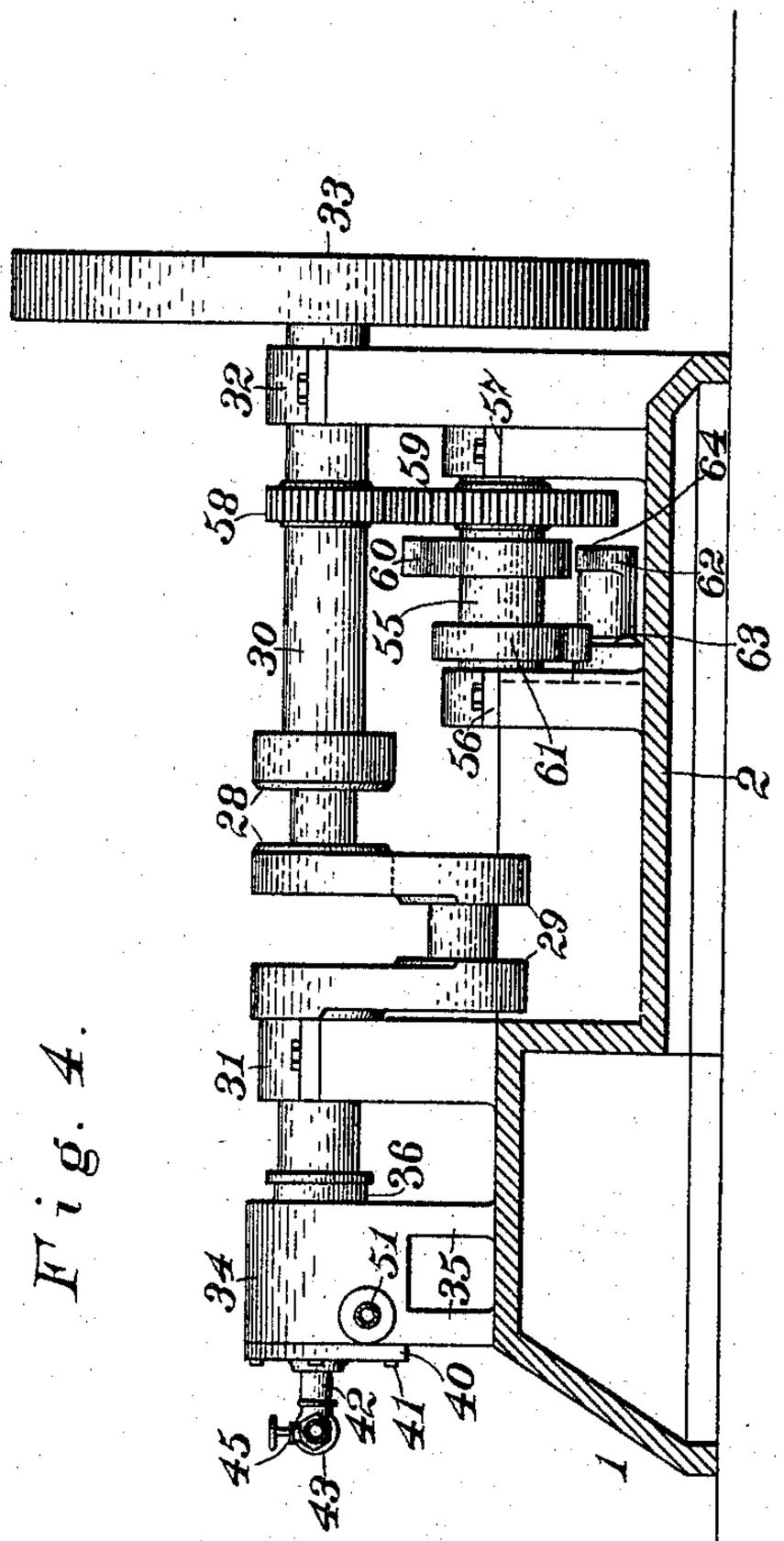

Fig. 4.

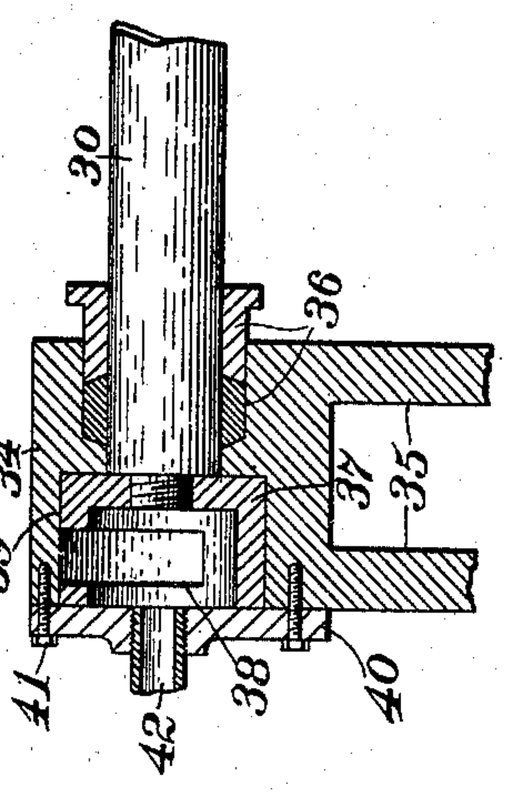

Fig. 5.

Witnesses
James S. Smith
William B. Thomas

Inventor
James Stroud Walch,
By Edwin Guthrie
Attorney

UNITED STATES PATENT OFFICE.

JAMES STROUD WALCH, OF PROVIDENCE, RHODE ISLAND.

EXPLOSIVE-GAS ENGINE.

SPECIFICATION forming part of Letters Patent No. 590,080, dated September 14, 1897.

Application filed January 23, 1897. Serial No. 620,371. (No model.)

To all whom it may concern:

Be it known that I, JAMES STROUD WALCH, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Explosive-Gas Engines; and I do 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, reference being had to the accompanying drawings, and to the figures of reference marked thereon, which form a part of this specification.

My invention relates to explosive-gas engines, and has for its object the production of a prime mover operated by the ignition of mixed gases within the cylinders and belonging to that class of gas-engines which deliver to crank-shaft and fly-wheel one impulse at the beginning of each revolution, wherein a rotary valve attached directly to the crank-shaft is employed to cut off the supply of gaseous fuel at a certain point of the piston movement.

Each constituent element of my invention is described in detail and its individual office, together with the mode of operation of the whole, fully explained hereinafter.

Referring to the accompanying drawings, wherein like numbers are used to designate like parts throughout the several views, Figure 1 represents a top plan of my invention. Fig. 2 represents a side view, partly in vertical section and omitting the fly-wheel, from the right of position in Fig. 1. Fig. 3 represents a side view from left of position in Fig. 1, partly in vertical section, the fly-wheel, bearings, and gearing being omitted for sake of clearness. Fig. 4 represents a vertical cross-section on plane indicated by line X X, Fig. 1, all parts beyond the shafting being omitted; and Fig. 5, a vertical mid-sectional view of rotary valve and shaft connection. The scale of drawing has been slightly increased in the last figure.

Considering Fig. 1, numeral 1 designates the frame or bed casting having a lateral extension 2. (See also Fig. 4.) Secured to bed 1, with their axes in the same horizontal plane, parallel but not alined, are cylinders 3 and 4. The cylinders are duplicates in construction and operation, and the immediate attachments of both are of the same form. A description of one each of the twin parts will answer for all.

Regarding cylinder 3 on the left of Fig. 2, numeral 5 marks the water-space, enabling the cylinder to be jacketed by water and its temperature controlled. A pipe 6 serves the jacket and a water-pipe 7 or other outlet permits circulation. To cylinder-head 8 and the cylinder is attached the customary form of igniting device, consisting of a combustion-tube 9, lined with refractory non-conducting material and open at both ends. Tube 9 is attached to arm 10, which possesses an eye near its outer end admitting a threaded pin 11, projecting from cylinder 3. Nuts 12 and 13 engage the pin above and below arm 10, and the adjustment vertically of tube 9 is provided for. Entering tube 9 is the tip of a gas-pipe or Bunsen burner 15, the flame from which maintains in a sufficiently-heated condition the ignition-tube 14, communicating with cylinder 3 through head 8. Interiorly the cylinder is provided with a trunk-piston 16, within which is pivoted one end of a connecting-rod 17.

The elements above described are of known construction and each cylinder is supplied with them. Those visible in connection with cylinder 4 are numbered water-jacket service-pipe 18, cylinder-head 19, combustion-tube 20, arm 21, threaded pin 22, nuts 23 24, Bunsen burner 25, ignition-tube 26, and connecting-rod 27.

Connecting-rod 17 from cylinder 3 is pivotally attached to crank 28, and rod 27 from cylinder 4 operates crank 29. The two cranks (see Figs. 2 and 3) are customarily arranged at ninety degrees, although their relative positions may be otherwise fixed within the purview of my invention. The cranks drive a shaft 30, (best shown in Fig. 1,) revoluble in suitable bearings 31 32 and carrying at one extremity a fly-wheel 33 of adequate weight.

Terminating the shaft at its remaining extremity is the rotary-valve mechanism composed exteriorly (see Figs. 2, 4, and 5) of an appropriate casing 34, upheld by standards 35 from frame 1. Casing 34 is provided with a stuffing-box 36, through which shaft 30 passes

and within which it rotates gas-tight. Fixed upon the end of shaft 30 is the cup-shaped rotary valve 37, having the circumferential slot 38 to permit the passage of gas, as hereinafter explained. Valve 37 fits closely but movably within a bored chamber 39 of the casing, and a head 40, fixed in place by machine-screws 41, closes the chamber. Engaging a screw-threaded central orifice through a head 40 is a short pipe 42, terminating outwardly in a T 43. A short pipe 44 leads to a cock 45, through which air may be admitted. Another short pipe 46 connects the T with a cock 47, from which suitable connections lead to a supply of hydrocarbons.

It will be observed here that the quantities of air and gas entering the hollow or mixing chamber of the rotary valve may be regulated. I reserve the right in practice to fix the rotary valve upon the extremity of the cam-shaft mentioned below. The operation is the same in either case, the speed of rotation being reduced one-half in the latter instance and the extent of slot 38 limited accordingly.

Considering Fig. 2, it will be seen that casing 34 possesses two lateral orifices—left 48, right 49—and pipes 50 51 connect those orifices respectively with check-valves 52 53, governing openings into the cylinders near their closed ends. (See also Fig. 1.) But one of such openings is shown, (marked 54 in Fig. 2.) Any form of check-valve may be employed.

As my invention is customarily made a cam-shaft 55 is supported in suitable bearings 56 57, (see Fig. 4,) parallel with and directly beneath the crank-shaft 30. A gear-wheel 58, fixed upon the crank-shaft, engages a gear-wheel 59, which is fixed upon the cam-shaft. The gearing is so proportioned that two revolutions of the crank-shaft take place during one revolution of the cam-shaft. The relative motions of the two shafts are those usually adopted in engines of the class to which my invention belongs to operate the exhaust-valves alternately during every second stroke of the pistons.

Cam 60 in Fig. 3 shows the general contour of both, cam 61 being partly concealed in that figure. The two cams are effectively secured upon shaft 55. Cam 60 is arranged for operating a lever 62, which has a fulcrum 63 upon extension 2 of the bed 1, an upturned and rounded end 64, and a weighted end 65. A longitudinal slot 66 is formed through end 65 of the lever, and engaging the slot is a pin 67, projecting from the stem 68 of an exhaust-valve 69.

Number 70 marks the casing of the exhaust-valve, providing a valve-seat 71, a stem-guide 72, a stem entrance-sleeve 73, and an exhaust-pipe 74. Exhaust-port 75 in cylinder 3 is shown in both Figs. 2 and 3.

Continuing the inspection of Fig. 3, there will be seen a second lever in all respects usually though not essentially a duplicate of lever 62 and marked 76. It possesses an upturned rounded end 77, a weighted end 78, having slot 79, and the slot engages a pin 80, projecting from the stem 81 of an exhaust-valve for cylinder 4. Casing 82, having a stem-guide 83 and stem entrance-sleeve 84, incloses the valve and is similar at every point with that described as attached to cylinder 3. It is believed to be unnecessary to show the exhaust-port of cylinder 4. Cam 61 is shown actuating lever 76.

The operation of my invention may be explained as follows: Assuming the rods 17 27 to be in the positions shown in Fig. 2, further rotation of the fly-wheel by hand or otherwise withdraws piston 16 in cylinder 3 and causes slot 38 of the rotary valve to register with orifice 48 in casing 34. (Direction of motion indicated by arrow.) Gas-cocks 45 47 being properly set a charge of mixed gases is drawn into the cylinder. Upon the return of piston 16 the charge is compressed and exploded in the ordinary way, forcing the piston forth again. Upon its second return the piston drives the burned gases through port 75, gears 58 59 having caused cam 60 to operate valve 69 by means of lever 62. (See Fig. 3.) Moving outwardly once more a new charge is drawn in by the piston 16, slot 38 being again turned into communication with casing-orifice 48. Weighted ends 65 78 of levers 62 76 keep the exhaust-valves closed during inhalation. During explosion both exhaust and check valves remain seated under pressure. Examining now the action of the parts relating to cylinder 4 during the operation above described for cylinder 3 it will be understood that precisely the same steps are taken in an exactly similar mechanical process, like steps following each other in like order for opposite cylinders, which explode alternately at the beginning of each revolution of the fly-wheel. Upon starting the engine end 78 of lever 76 is raised by hand or foot in order that cylinder 4 may not take gas until after the charge in cylinder 3 has been fired. The operation then proceeds regularly for both cylinders. Fig. 3 may be taken to represent the position of the visible working parts when cylinder 3 is about exploding and cylinder 4 has been one-half exhausted. By using two cylinders the excessive heating of either is avoided, while an impulse is available for every revolution. Manifestly instead of placing the cylinders at opposite ends of frame 1 they may be arranged side by side.

Considering Fig. 2, in view of the foregoing explanation of operation it will be observed that the ingoing mixed gases are cut off by the rotary valve a little before the piston 16 reaches its outermost point, the relative extent of slot 38 of valve 37 appearing in Fig. 5. At its outermost point of travel, therefore, the piston encounters a slight back pressure from the atmosphere. Exhaust-valve 69 is held against this exterior pressure by the weighted lever. While the back pressure

upon the pistons is small to the square inch, there is sufficient in the aggregate to give them each an impulse inward at every stroke, which materially adds to the smooth-running quality of the engine.

I am aware that two-cylinder gas-engines are used having ignition and exhaust mechanism constructed practically as shown hereinabove, and I do not claim those features individually.

What I do claim, and desire to secure by United States Letters Patent, is—

1. In an explosive-gas engine, the combination of a bed, a cylinder secured to said bed and provided with an inlet-port, a check-valve arranged to govern said inlet-port, an igniting device, said cylinder having an exhaust-port, an exhaust-valve arranged to govern said exhaust-port, a revoluble crank-shaft, a revoluble cam-shaft, gearing connecting said shafts, mechanism driven by said cam-shaft and constructed and placed to operate said exhaust-valve, a hollow rotary valve attached to one of said shafts and having a circumferential slot, a suitably-supported casing possessing an orifice and stuffing-box, said casing having a cylindrical bore adapted to receive said rotary valve, devices for closing said casing and for delivering mixed gases to said rotary valve interiorly, and a pipe connecting said check-valve and casing-orifice, substantially as described.

2. In an explosive-gas engine, the combination of a bed, cylinders secured to said bed and provided with inlet-ports, check-valves arranged to govern said inlet-ports, igniting devices, said cylinders having exhaust-ports, exhaust-valves arranged to govern said exhaust-ports, a revoluble crank-shaft, a revoluble cam-shaft, gearing connecting said shafts, mechanism driven by said cam-shaft and constructed and placed to operate said exhaust-valves, a hollow rotary valve attached to said crank-shaft and having a circumferential slot, a suitably-supported casing possessing orifices and a stuffing-box, said casing having a cylindrical bore adapted to receive said rotary valve, devices for closing said casing and for delivering mixed gases to said rotary valve interiorly, gas cocks and piping adapted to regulate the quantities of gases supplied to said rotary valve, and pipes connecting said check-valves and casing-orifices, substantially as described.

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

JAMES STROUD WALCH.

Witnesses:

ALFRED HENRY CROSS,

WILLIAM CHADWICK.