No. 636,478. Patented Nov. 7, 1899.

J. WILLIAMS, JR.

GAS ENGINE.

(Application filed Aug. 10, 1898.)

(No Model.) 3 Sheets—Sheet 1.

Fig. 1.

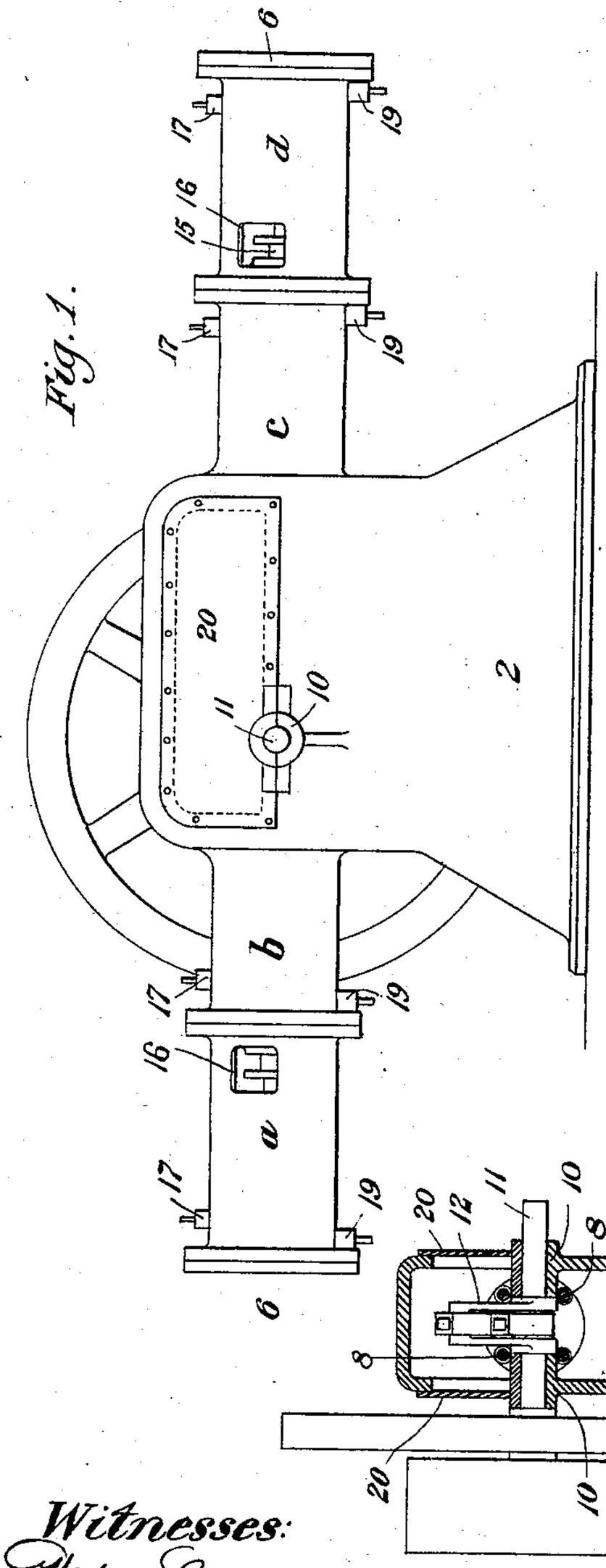

Fig. 2.

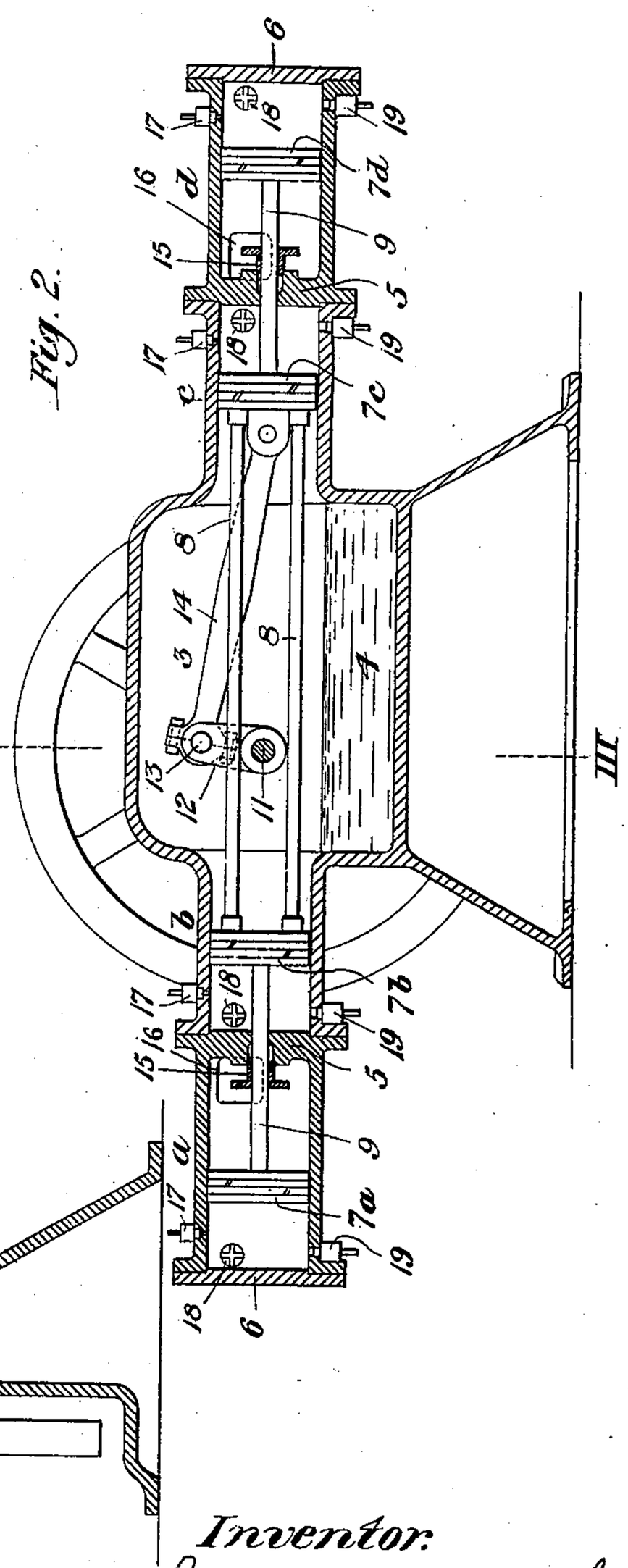

Fig. 3.

Witnesses:
Watson Large.
P. J. Edwards

Inventor:
Joseph Williams Jr.
by C. M. Clarke
his Attorney.

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Fig. 4.

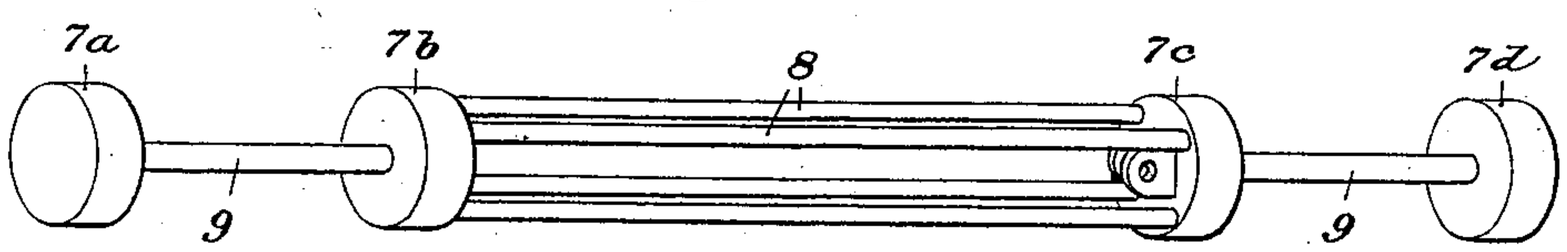


Fig. 5.

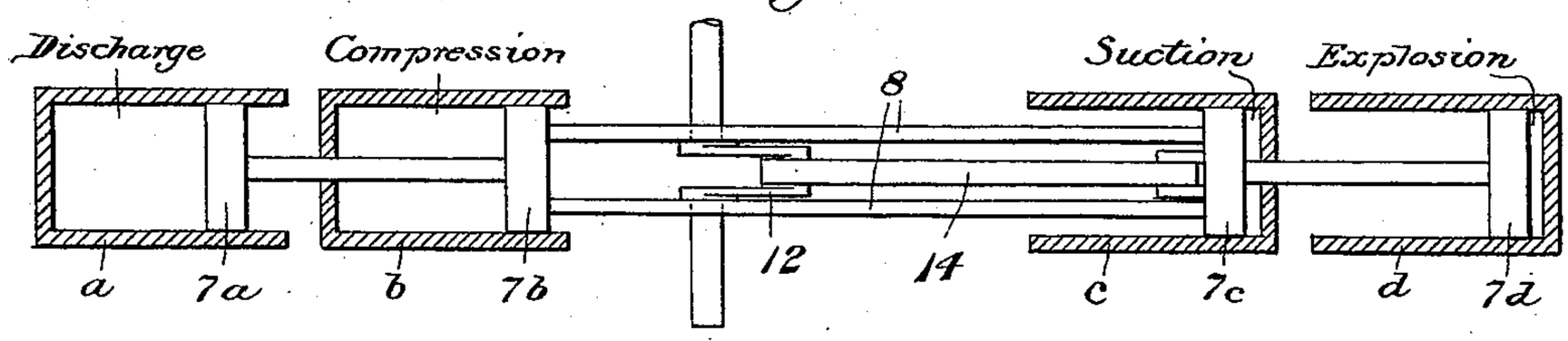


Fig. 6.

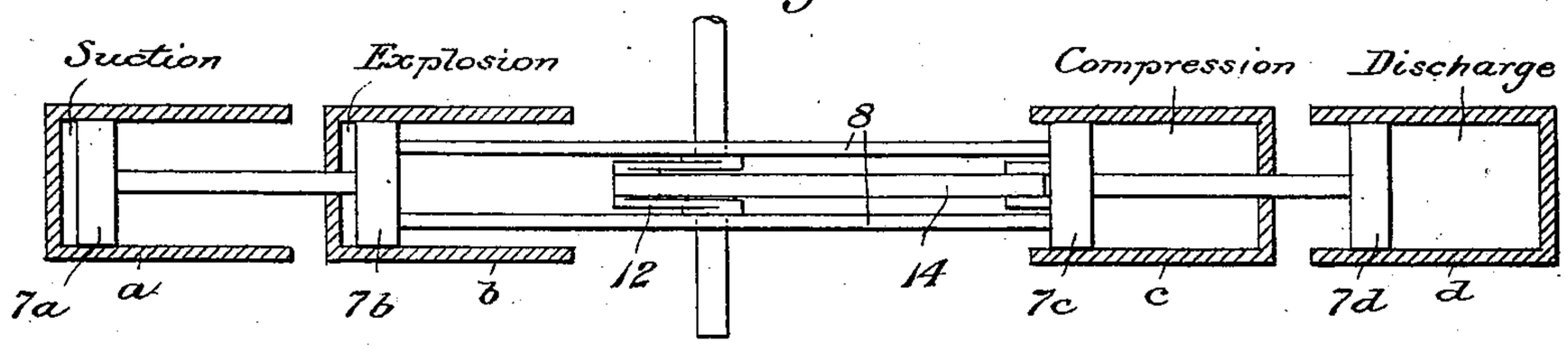


Fig. 7.

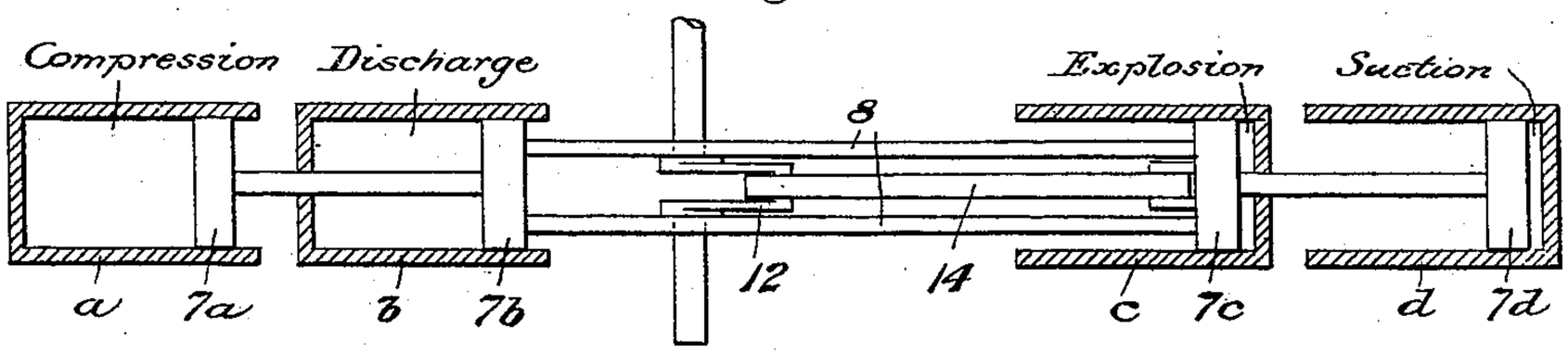
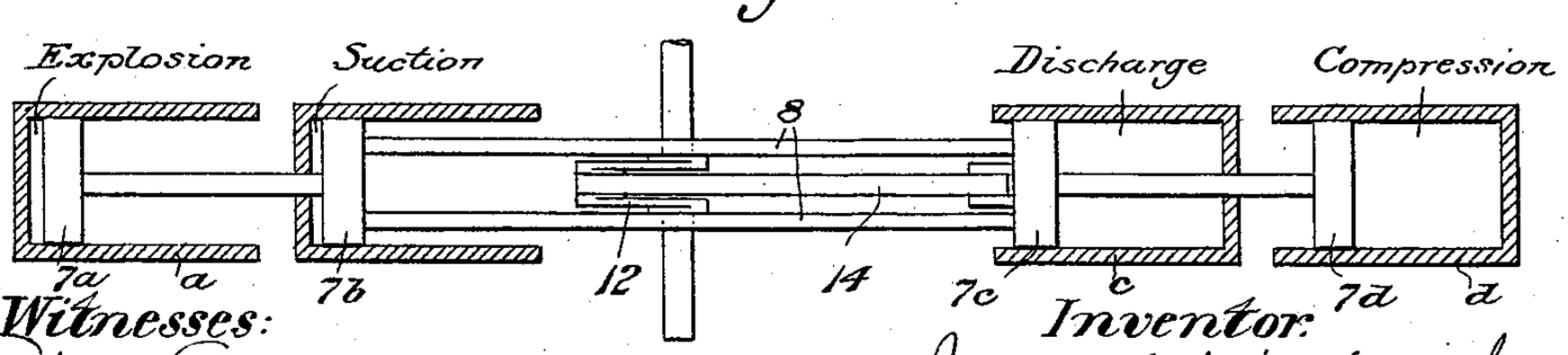


Fig. 8.



Witnesses:
Watson Large.
L. F. Edwards

Inventor:
Joseph Williams Jr.
by O. M. Clarke
His Attorney.

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(No Model.) 3 Sheets—Sheet 3.

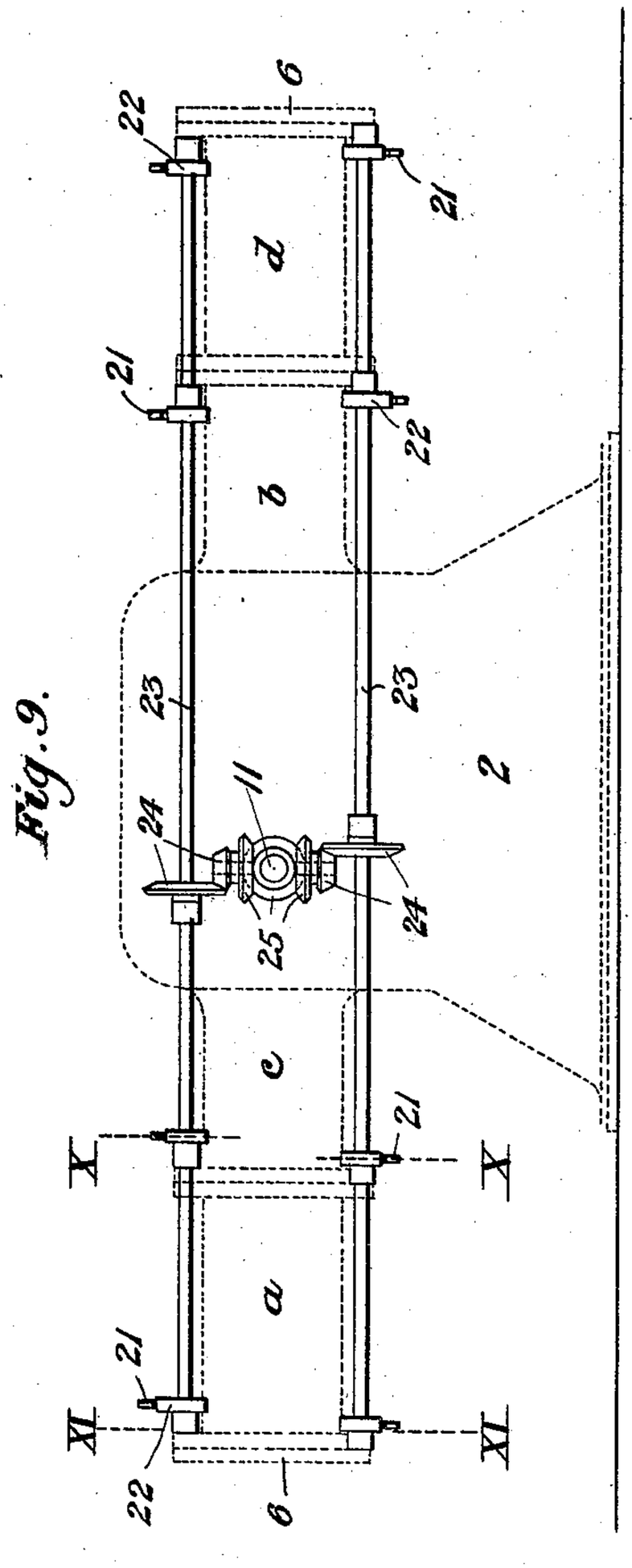

Fig. 9.

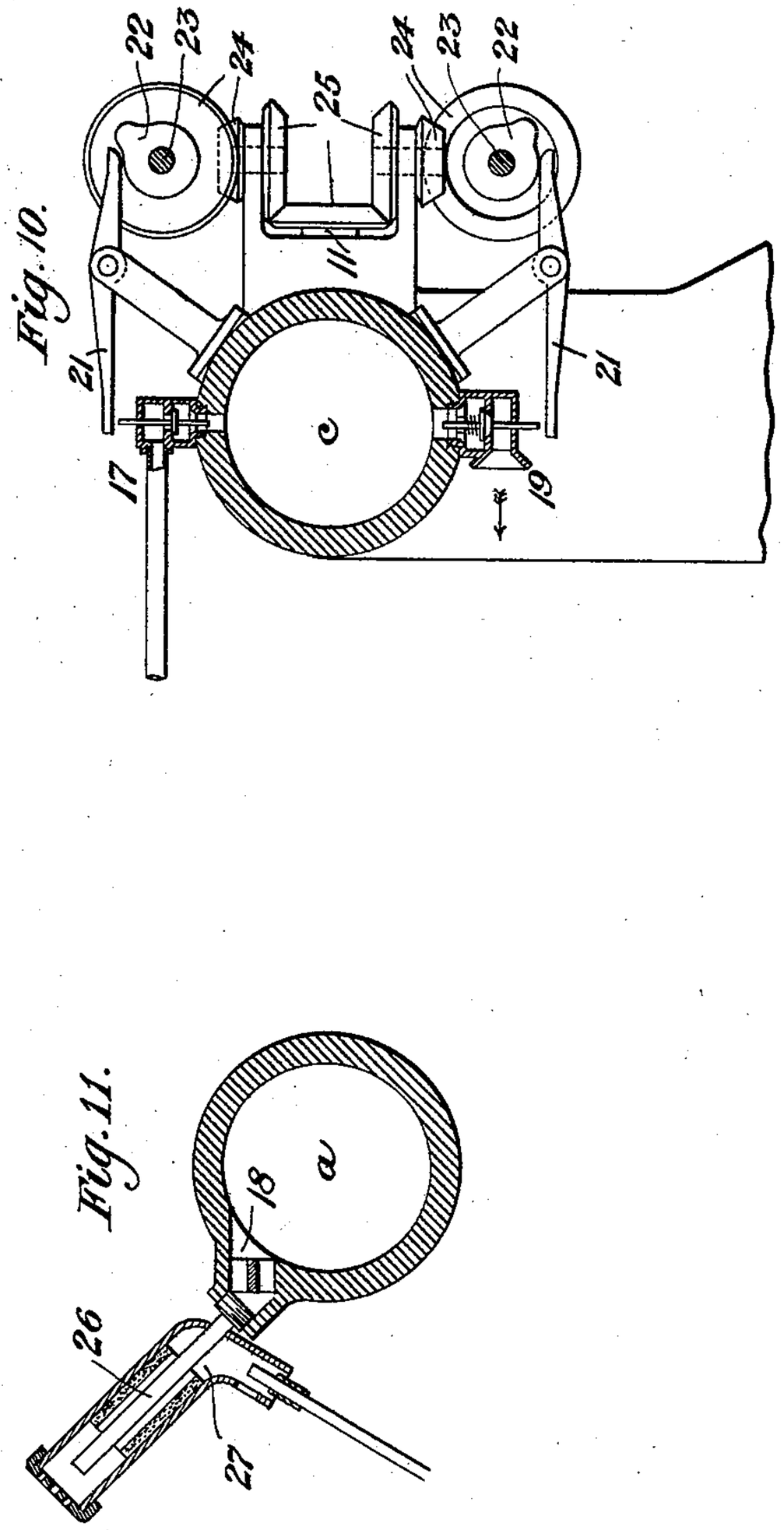

Fig. 10.

Fig. 11.

Witnesses:
J. A. Beatty
C. C. Butterfield.

Inventor:
Joseph Williams Jr
by O. M. Clarke
his Attorney.

UNITED STATES PATENT OFFICE.

JOSEPH WILLIAMS, JR., OF PITTSBURG, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 636,478, dated November 7, 1899.

Application filed August 10, 1898. Serial No. 688,323. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH WILLIAMS, Jr., a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a new and useful Improvement in Gas-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a view in side elevation of my improved gas-engine. Fig. 2 is a longitudinal vertical section. Fig. 3 is a cross-section on the line III III of Fig. 2. Fig. 4 is a detail perspective view of the piston. Figs. 5 to 8, inclusive, are diagrammatic views illustrative of the successive operations performed by the engine. Fig. 9 is a view in side elevation, showing the valve-operating mechanism. Fig. 10 is a cross-section, on an enlarged scale, taken on the line X X of Fig. 9. Fig. 11 is a similar view taken on the line XI XI.

My invention relates to explosive-engines, and is designed for the purpose of obtaining an engine capable of receiving an impulse at each stroke and for the purpose of applying the resultant force to a common main shaft through the medium of a plurality of pistons centrally arranged in tandem and mounted in a series of similarly-arranged cylinder-chambers, wherein is produced a cycle of explosions, the operations of explosion, discharge, suction, and compression being performed successively, as shall be hereinafter described.

The engine is designed to transmit the power generated in the explosion-chambers in a constant succession of strokes, thereby obviating the usual delays incident to the performance of the functions when performed in engines of single or double cylinder construction, and the transmission of the forces is maintained in a common central line, thus avoiding unequal strain on the working parts of the engine and main shaft.

Referring to the drawings, 2 is the base of the engine, upon which, and preferably made integral therewith, are the oppositely-disposed single-acting cylinders *b c*. Between the cylinders is a crank-chamber 3, the bottom of which constitutes an oil-reservoir 4, adapted to contain a lubricant for oiling the working parts.

To the ends of the cylinders *b c* are secured the supplemental cylinders *a d*, the inner heads 5 of such cylinders constituting outer heads for cylinders *b c*, while the outer cylinders *a d* are closed by heads 6. Mounted in each cylinder, respectively, are the pistons 7^a, 7^b, 7^c, and 7^d, the inner of which, 7^b and 7^c, are rigidly connected by any suitable intervening structure, as rods 8. As shown in the drawings, these rods, four in number, are so disposed as to leave considerable intervening space in both horizontal and vertical planes, thus permitting passage of the main shaft, crank, and pitman.

Supplemental piston-rods 9 connect the outer pistons 7^a and 7^d with the inner ones, 7^b 7^c, whereby the four pistons are thus rigidly connected in one structure and are designed to operate as one within the various cylinder-chambers.

Mounted in suitable bearings 10 in the frame of the engine is the main shaft 11, provided with cranks 12, arranged in line with the cylinder. Connected to one of the inner piston-heads 7^c and to the crank by wrist-pin 13 is the connecting-rod 14, by which motion is transmitted to the shaft due to the explosions in either direction, either directly on the forward stroke or through the intervening rods 8 on the backward stroke.

By a suitable arrangement of valve-gearing it is designed that an explosion shall occur in each of the cylinder-chambers in succession at each half-stroke or within two revolutions of the crank, thereby producing a continuous action, by which time the first cylinder-chamber will be again ready to operate.

Referring to Figs. 5 to 8, inclusive, the operation through two revolutions of the crank is illustrated, each cylinder performing its functions, as indicated. Thus in Fig. 5 when an explosion takes place in cylinder *d*, succeeding an explosion in cylinder *a*, the explosion will produce a discharge of the products of combustion in cylinder *a*, while the operations of compression and suction are going on in cylinders *b* and *c* during the stroke of the piston. The return stroke is caused by an

explosion in cylinder *b*, accompanied by a discharge in cylinder *d*, while suction and compression are being produced in cylinders *a* and *c*, in a similar manner on the next stroke explosion in cylinder *c*, discharge in *b*, suction in *d*, and compression in *a*, while on the fourth stroke the explosion will occur in *a*, discharge in *c*, suction in *b*, and compression in *d*, thus completing the cycle, when the cylinder *d* will be again ready to explode at the fifth stroke, the operation continuing in regular order and producing a steady, continuous, and powerful action of the engine. Each cylinder and its contained piston constitutes a single-acting engine, and by reason of the construction of the assembled pistons each piston-head is acted upon independently in succession, the motion being transmitted through the connecting-rod to the crank. Between the inner and outer cylinders are the stuffing-box glands 15 for packing the piston-rods, openings 16 being left in the sides of the cylinders for adjustment, which openings are suitably located in the sides of the castings forming the cylinders *a* and *d* and permit of access to the stuffing-boxes 15.

The gas and air inlet and outlet valves are indicated at 17 and 19, such valves being operated by pivoted levers 21, adapted to depress the valves to open communication with the interior of the cylinder in a manner usual to this class of valves. The levers 21 are mounted in such a manner that their opposite ends project into the path of a series of cams 22, mounted on shafts 23, which shafts are actuated through gearing 24 25 from the main shaft. The cams are set upon the shafts adjustably, and their operation through the levers is timed to correspond to the cycle of operations already described, so as to admit to the cylinders the mixture of gas and air through valves 17 and to allow the products of combustion to escape therefrom through valves 19. Ignition of the gas is provided by port 18, through which the mixture passes to a tube 26, located within the zone of combustion of a heating device 27.

The sides of the main frame are preferably left open for convenience of construction and are covered by sheet-iron plates 20 for confining the oil.

The advantages of my invention will be appreciated by those skilled in the art of gas-engines, and while changes and modifications may be made in the design or proportions I desire to include all such changes as within the scope of my invention.

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

1. A four-cycle explosion-engine comprising four cylinders in line provided with pistons rigidly connected, and also provided with valves and igniting devices so operated and timed that the four separate steps of suction, compression, explosion and exhaust take place successively in each cylinder, whereby the engine receives an impulse with every stroke, substantially as set forth.

2. A four-cycle explosion-engine consisting of a main frame provided with oppositely-disposed inner cylinders and an intervening crank-chamber, supplemental outer cylinders beyond the inner cylinders, such cylinders being provided with valves and igniting devices and means whereby such valves are operated so that the four separate steps of suction, compression, explosion and exhaust take place successively in each cylinder, and a series of rigidly-connected pistons mounted in the cylinders with a connecting-rod secured to the crank and to such piston structure, substantially as set forth.

3. A four-cycle explosion-engine consisting of a main frame provided with oppositely-disposed inner cylinders, an intervening crank-chamber, supplemental outer cylinders beyond the inner cylinders, pistons mounted in the inner cylinders having intervening rigid connections with clearance-spaces for the shaft, crank and connecting-rod, a connecting-rod secured to one of the inner pistons and to the crank of the engine, pistons mounted in the outer cylinders on rods secured to the inner pistons, and valves and igniting devices so operated and timed that the four separate steps of suction, compression, explosion and exhaust take place successively in each cylinder whereby the engine receives an impulse with every stroke, substantially as set forth.

In testimony whereof I have hereunto set my hand.

JOSEPH WILLIAMS, JR.

Witnesses:
J. F. MCKENNA,
C. M. CLARKE.