No. 806,610. PATENTED DEC. 5, 1905.

J. WILLIAMS, JR.

GAS ENGINE.

APPLICATION FILED APR. 23, 1904.

4 SHEETS—SHEET 1.

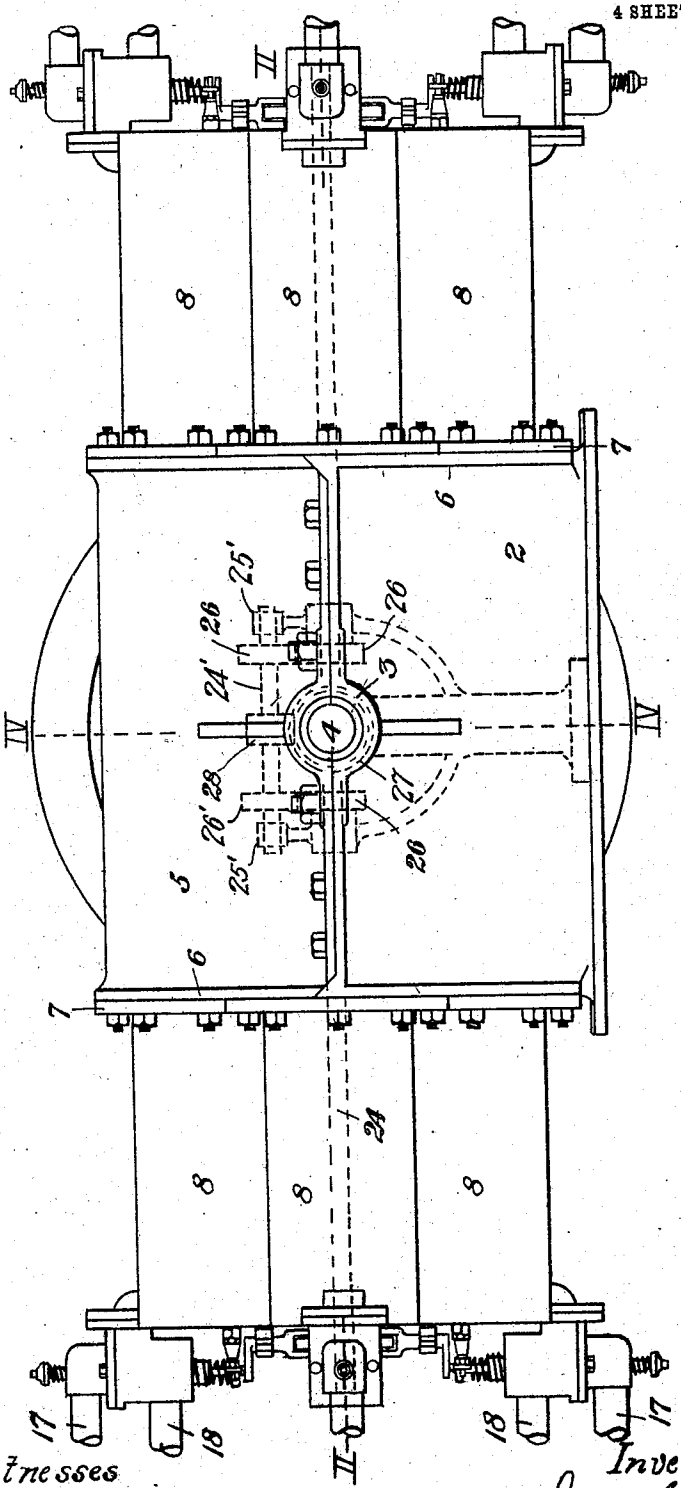


Fig. 1

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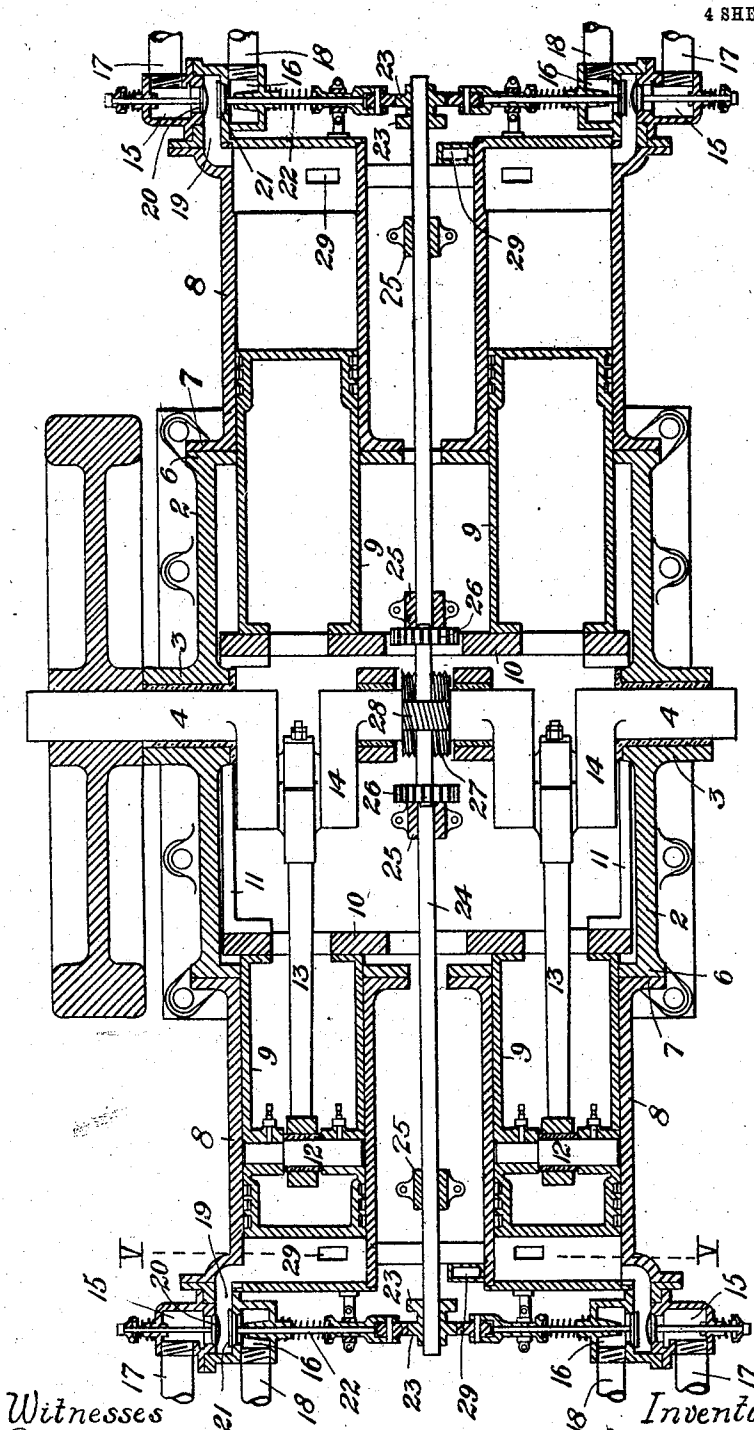
4 SHEETS—SHEET 2.

Fig. 2.

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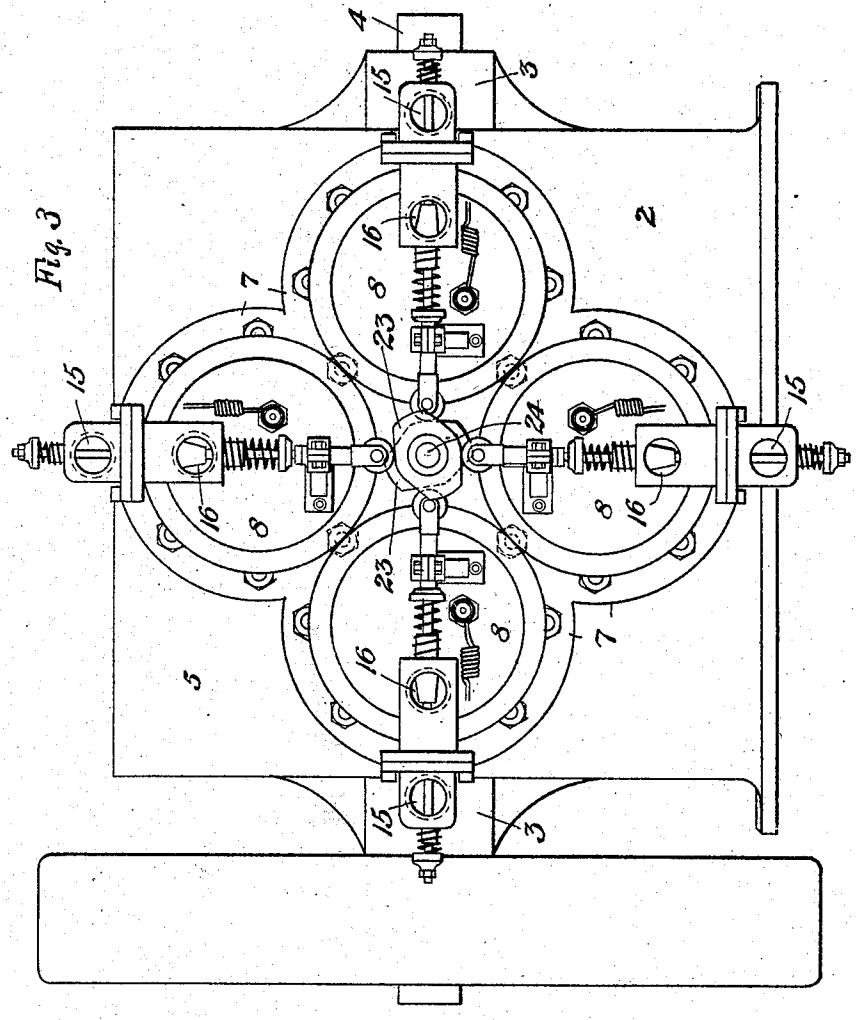
4 SHEETS—SHEET 3.

Fig. 3

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4 SHEETS—SHEET 4.

Fig. 4.

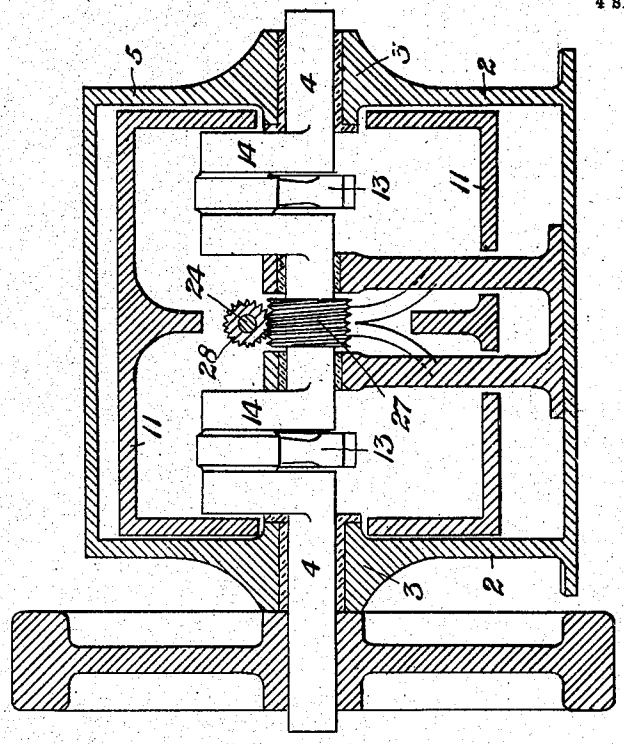
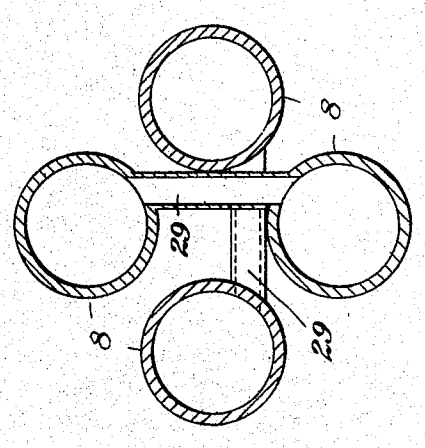



Fig. 5.

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# UNITED STATES PATENT OFFICE.

JOSEPH WILLIAMS, JR., OF PITTSBURG, PENNSYLVANIA.

## GAS-ENGINE.

No. 806,610. Specification of Letters Patent. Patented Dec. 5, 1905.

Application filed April 23, 1904. Serial No. 204,559.

*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 certain new and useful Improvements in Gas-Engines, of which the following is a specification, reference being had therein 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 horizontal longitudinal section thereof on the line II II of Fig. 1. Fig. 3 is an end view. Fig. 4 is a cross-sectional view on the line IV IV of Fig. 1. Fig. 5 is a vertical cross-section on the line V V of Fig. 2.

My invention relates to the class of explosive-engines; and it is designed for the purpose of providing an engine capable of imparting an impulse to the main shaft at each stroke front and back, whereby the power is imparted to the main shaft through the medium of a plurality of pistons arranged in oppositely-located series, mounted in suitably-arranged cylinders, and connected by an intervening reciprocating frame. In these cylinders are produced cycles of operations through four strokes of the piston and two complete revolutions of the crank-shaft, the operations of admission, compression, explosion, and exhaust being performed successively in each cylinder or its explosive-chamber, receiving an igniting-spark once during two revolutions at the proper moment.

The engine is designed to transmit power generated in the explosion-chamber in a constant succession of strokes imparted to the crank-shaft, thereby obviating the usual delay incident to the functions as carried out in engines of single or double cylinder construction, and the transmission of the forces is maintained throughout the connected piston structure by means of an intervening frame, thus securing equal strain on the working parts of the engine and main shaft, while fully utilizing the generated power.

The invention also refers to the means whereby pairs of the cylinders are connected so as to insure simultaneous explosions therein and assist in scavenging the chambers.

Referring now to the drawings, 2 is the main frame or base of the engine, provided with journal-bearings 3 at each side adapted to support the main crank-shaft 4. An upper shell or frame 5 is secured upon the lower base 2, providing upper bearings for the shaft and likewise inclosing, with the base 2, the entire crank-shaft chamber. At each end of the framework 2 and 5 on opposite sides of the shaft are flanges 6, providing bases on common vertical planes, to which by flanges 7 the cylinders 8 are bolted. These cylinders, preferably four in number at each end of the engine, are equally arranged, as shown in Fig. 3, and are each adapted to receive a piston 9. There are thus eight entire cylinders and a corresponding number of pistons, four on each side. At their inner ends each of said four pistons is secured to common plates 10 10, whereby the four pistons of each set are rigidly connected, and the opposite sets of pistons are connected by means of intervening longitudinal bars or frames 11 of any suitable construction, as clearly shown in Fig. 2. By this arrangement two of the cylinders and their pistons on each side of the shaft are located in the same horizontal plane, while the other pistons and cylinders are located equally above and below said plane, midway between them and in alinement vertically with the longitudinal center of the engine. Two of the horizontally-alining pistons on one side are provided with wrist-pins 12, to which are attached connecting-rods 13, connected at their other ends with the crank-pins of cranks 14 of the main shaft 4. By this construction it will be seen that if an explosion occurs first in the chambers of one pair of horizontally-disposed cylinders, then at the next stroke in the chambers of the corresponding cylinders on the other side of the shaft, then on the next stroke in the vertically-arranged cylinders on the other side of the shaft, (between the first pairs of cylinders,) then on the next or fourth stroke in the corresponding pair of vertically-arranged cylinders on the other side, in four strokes or two complete revolutions of the main shaft there will have occurred four corresponding explosions, occurring in each pair of the eight cylinders successively. Upon the next half-stroke or fifth the first pair of cylinders will operate and the action will be continuous, as described. It therefore follows that with proper valve and igniting mechanism the functions of suction, compression, explosion, and exhaust will be performed successively and that each complete cycle will occur in regular order and that the resulting power of the explosions will be cor-

respondingly imparted to the main shaft in a regular equal manner.

Each cylinder is provided at its outer end with a valve-casing comprising a fuel-inlet chamber 15 and outlet-chamber 16, connected to suitable inlet and exhaust pipes 17 and 18 and communicating through a common port 19 with the interior explosion-chamber of the cylinder 8. The explosive mixture is automatically admitted by a spring-controlled valve 20, the products of combustion being released by a valve 21, mounted on stem 22, provided with a bearing device, as a roller, at its inner end and actuated by a suitable cam 23. The cams 23 for each pair of valves are mounted, as shown, on the outer opposite ends of independent cam-rods 24 24, located in suitable bearings 25 and operated through pairs of pinion-gears 26 26 and worm-gearing 27 28 from the main shaft 4. Pinions 26′ are mounted on shaft 24′, carried in bearings 25′, the shaft 24′ being driven by its worm-wheel 28, actuated from main shaft 4 by gear 27.

The explosion-chambers of the oppositely-located pairs of cylinders are connected by means of communicating ports 29, (clearly shown in Figs. 2 and 5,) so that should the igniter in either chamber fail to operate combustion therein will be communicated by the explosion in the other chamber. By this means an explosion is always insured and the highest efficiency of the engine maintained. The communicating ports 29 also facilitate equalization of the pressure and volume of the explosive mixture and likewise assist in supporting either chamber from the other in case of any valve derangement at either side.

The construction and operation of the various subsidiary elements of the invention—to wit, the valve-actuating gearing, the inlet and exhaust valves, the igniter, the cooling elements, and governor—do not *per se* form essential portions of the present invention, and it will be understood that these may be adopted or utilized within the province of the designing engineer or builder.

If desired, a single pitman may be used, connected merely to the reciprocating piston-frame and with the crank, as will be readily understood. The cylinder-and-piston construction of one side only may also be used with good results, as will be understood, by merely eliminating the sets of cylinders and pistons of the other side.

The operation of the invention will be readily understood from the foregoing description and its advantages will be appreciated by all those familiar with this class of engines. It insures an impulse upon the cranks at each stroke and provides ample time for the performance of the various functions of each cycle. The engine is perfectly balanced. It is very compact in construction, considering the available power, and is well adapted to installation with motor-vehicles. It is comparatively cheap, simple in construction, durable, and not liable to get out of order.

Changes and variations may be made in the design, proportions, or the various other details by the skilled mechanic, but all such are to be considered as within the scope of the following claims.

What I claim is—

1. In a gas-engine, the combination with a crank-shaft, of oppositely-disposed series of cylinders, communicating mixture-ports connecting the opposite cylinders, pistons therein connected by an intervening framework, and a pitman provided with a crank-bearing and pivotally connected with the moving piston structure, substantially as set forth.

2. In a gas-engine, the combination with a crank-shaft, of oppositely-disposed series of cylinders, communicating mixture-ports connecting the opposite cylinders, pistons therein connected by an intervening framework, and a pitman provided with a crank-bearing and pivotally connected with one of the pistons, substantially as set forth.

3. In a gas-engine, the combination with a crank-shaft, of oppositely-disposed series of cylinders, communicating mixture-ports connecting the opposite cylinders, pistons mounted therein, a frame rigidly connecting all of the pistons, and a pitman provided with a crank-bearing and pivotally connected with a piston at one side, substantially as set forth.

4. In a gas-engine, the combination with a crank-shaft of oppositely-disposed series of pairs of cylinders, communicating mixture-ports connecting the opposite cylinders, pistons mounted therein, a framework connecting all of the pistons, and pitmen connected with the crank-shaft and with one of said pairs of pistons, substantially as set forth.

5. In a gas-engine, the combination with a central crank-shaft, of oppositely-disposed series of pairs of cylinders, communicating mixture-ports connecting the opposite cylinders, pistons therefor, a framework rigidly connecting all of the pistons, and pitmen connected with the cranks of the shaft and with one of the pairs of pistons, substantially as set forth.

6. In a gas-engine, the combination with a central crank-shaft, of oppositely-disposed series of pairs of cylinders, communicating ports connecting said pairs of cylinders with each other, pistons mounted in said cylinders, a framework rigidly connecting all of the pistons, and pitmen connected with the cranks of the shaft and with one of the pairs of pistons, substantially as set forth.

7. In a gas-engine, the combination of a main framework constituting an inclosing case, a main shaft mounted in bearings therein and provided with cranks, oppositely-disposed pairs of cylinders extending outwardly from each end of said framework, correspond-

ing pistons mounted therein, and pitmen connecting the pistons of one pair with the cranks, substantially as set forth.

8. In a gas-engine, the combination of a main framework constituting an inclosing case, a main shaft mounted in bearings therein and provided with cranks, oppositely-disposed pairs of cylinders extending outwardly from each end of said framework, corresponding pistons mounted therein, and pitmen connecting the pistons of one pair of cylinders with the cranks, with means for controlling the admission and exhaust to and from each of said cylinders, substantially as set forth.

9. In a gas-engine, the combination of a main framework constituting an inclosing case, a main shaft mounted in bearings therein and provided with cranks, oppositely-disposed pairs of cylinders extending outwardly from each end of said framework, corresponding pistons mounted therein, and pitmen connecting the pistons of one pair of cylinders with the cranks, means for controlling the admission and exhaust to and from each of said cylinders, and communicating ports between said oppositely-disposed cylinders constituting each pair, substantially as set forth.

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

JOSEPH WILLIAMS, JR.

Witnesses:
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C. M. CLARKE.