No. 809,292. PATENTED JAN. 9, 1906.

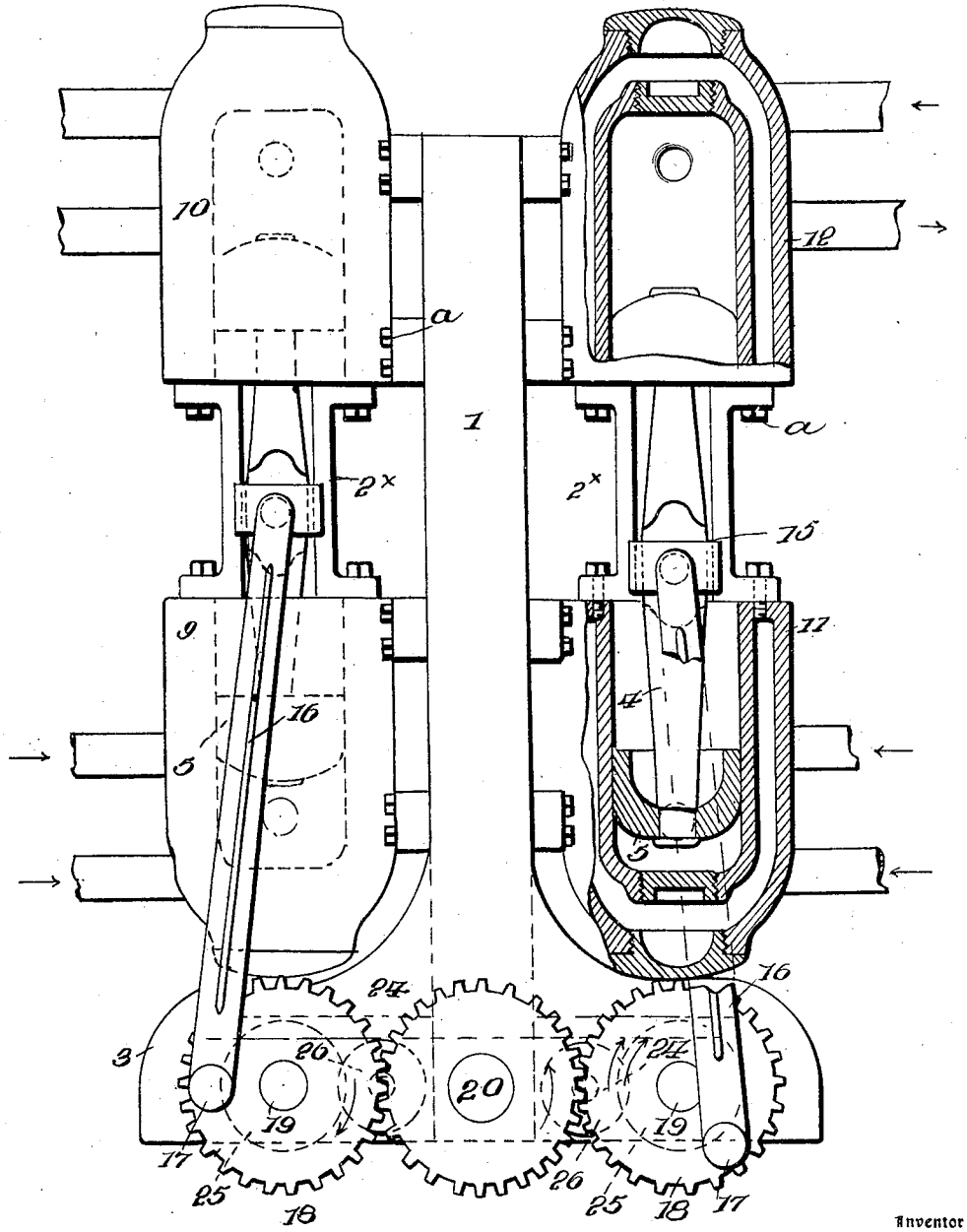
W. T. FOX.

GAS ENGINE.

APPLICATION FILED AUG. 17, 1904.

2 SHEETS—SHEET 1.

Fig. 1.



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2 SHEETS—SHEET 2.

Fig. 2.

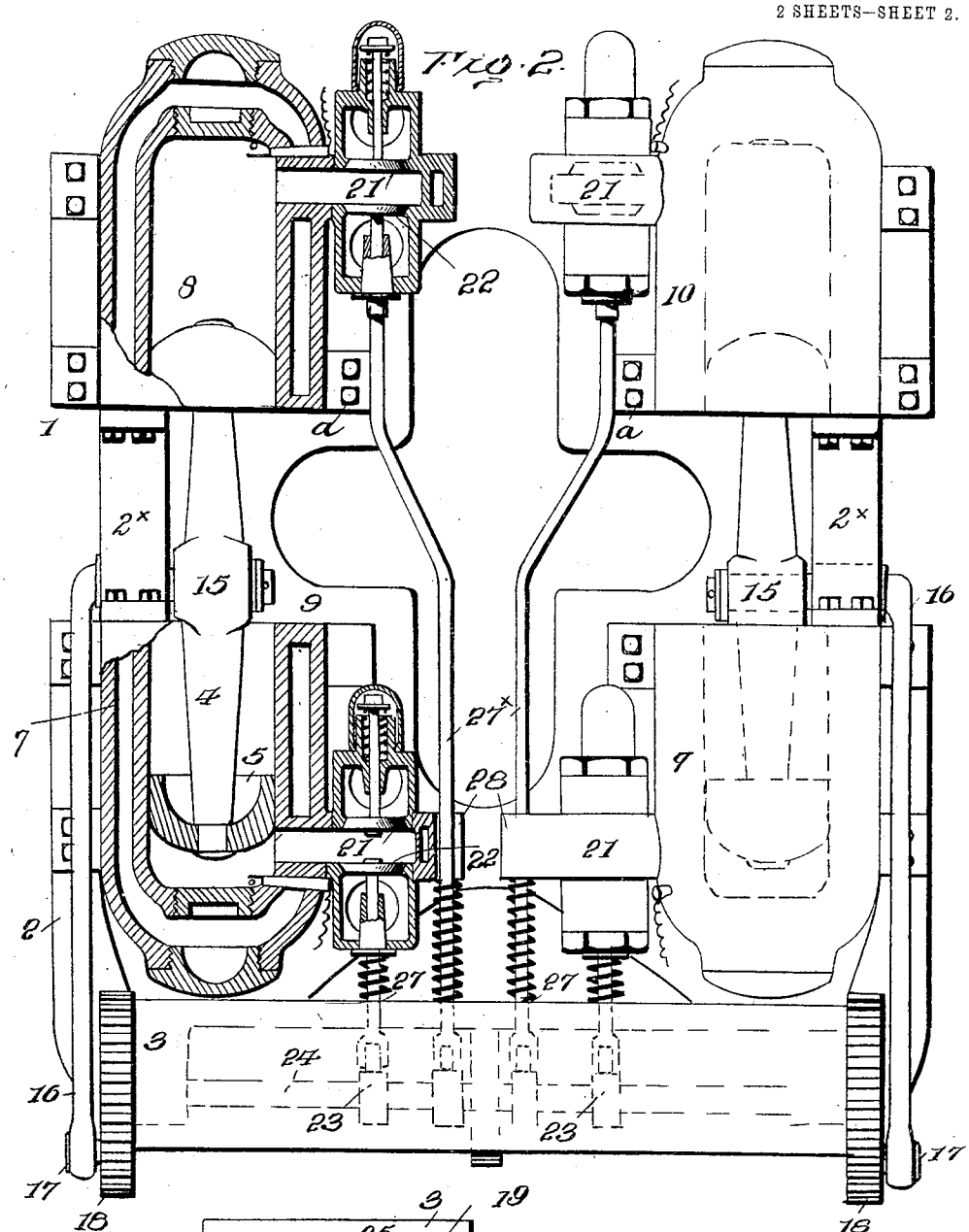
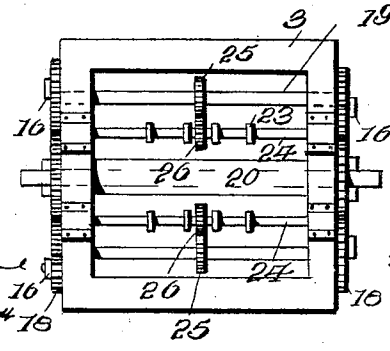


Fig. 3.



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UNITED STATES PATENT OFFICE.

WILLIAM T. FOX, OF ROCHESTER, NEW YORK.

GAS-ENGINE.

No. 809,292. Specification of Letters Patent. Patented Jan. 9, 1906.

Application filed August 17, 1904. Serial No. 221,051.

To all whom it may concern:

Be it known that I, WILLIAM T. FOX, a resident of Rochester, in the county of Monroe and State of New York, 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 pertains to make and use the same.

The invention relates to gas-engines of the multicycle type, and has for its object to provide a compact, economical, and efficient construction.

The invention consists in the construction hereinafter described and pointed out.

In the accompany drawings, forming part of this specification, Figure 1 is an end elevation, partly in section. Fig. 2 is a side view, partly in section. Fig. 3 is a bottom plan on a reduced scale.

Numeral 1 indicates a frame having members 2, which frame may be supported from a base 3 or in any usual or preferred manner. To said frame are secured, in the present instance, eight cylinders arranged in four pairs, each pair having a double piston-rod 4, common to the members of the pair and provided with suitably-packed pistons 5, one for each cylinder. The six cylinders shown are denoted by numbers 7 to 12, inclusive, the odd numbers being appropriated to those on the lower side and the even numbers to those on the upper side, substantially as indicated in the drawings. Two of the eight cylinders used, one upper and one lower, are not shown. By preference the base has a central extension or post situated between the cylinders, two pairs being fixed on each side, as indicated. This construction facilitates indefinite multiplication of the cylinders, the base, post, and shafts being suitably extended and the necessary adjuncts supplied. The cylinders are separately connected to this post and can be detached singly for repairs, and cylinders may be kept in stock to be substituted for any that become defective.

a indicates bolts securing adjacent ends of the cylinders to the frame.

15 denotes a hub of the rod 4, to which is pivoted a connecting-rod 16, loosely coupled with a wrist-pin 17 on a gear-wheel 18, fixed to a shaft 19, supported to rotate in bearings in the frame.

$2^{\times}$ denotes piston-rod guides fixed to the cylinders.

As indicated in the drawings, there are two crank-shafts 19 and four gears 18, one on each end of each shaft and each suitably connected to a double piston-rod 4.

20 indicates the main shaft journaled in the frame and designed to transmit power derived from the explosion of gas, vapor, carbureted air, or the like. It has gears in mesh with gears 18, as shown, by which it is driven.

Each cylinder has an automatically-operated air and gas admission valve 21 and an exhaust-valve 22, each being of any usual or preferred form. The exhaust-valves are opened by cams 23, fixed on shafts 24, and each driven through the medium of a gear 25, engaged by a pinion 26.

27 denotes the short stems of the lower exhaust-valves, and $27^{\times}$ the longer stems of the upper valves.

28 indicates guides for the stems $27^{\times}$, which may be fixed to the valve-casing, the said casing being secured on the cylinder in any usual manner.

In operation an explosive fluid is admitted at each admission-valve in proper succession once for every two revolutions of the main shaft or of a gear 18. The gears 18 and shafts 91 turn oppositely to the main shaft, which they drive, both shafts 19 turning in the same direction and all turning in the same time. The exhaust-valve-opening cams and the spark-producing devices are constructed and arranged, respectively, to open said valves in succession, one at every quarter-revolution of the shafts and to suitably produce ignition of compressed gas. Beginning in this description with cylinder 7 and assuming that an explosion has just occured therein, the double piston and connected gear on shaft 18 are moving, as indicated by arrows. The pistons of the paired cylinders 7 and 8, moving as assumed, the products of a previous explosion are being expelled from cylinder 8 through its exhaust-port. When the piston has traveled one-fourth its path, an explosion is produced in one of another pair of cylinders, and so through the several pairs, eight explosions being produced at each double reciprocation of the pistons or each double rotation of the shafts. The first return of the pistons after expelling products from cylinder 8 draws gas into said cylinder and expels products from cylinder 7. The next travel of the pistons draws gas into cylinder 7 and compresses previously-admitted gas in cylinder

8. An explosion in cylinder 8 then returns the pistons a second time. The explosions occur in the several cylinders alternately every two reciprocations of the pistons—that is, every two revolutions of a shaft—and an explosion occurs, as stated, at every quarter-revolution of a shaft.

The cylinders are separately cast and bolted to the frame, as indicated at *a*. Being cast in simple form the work can be economically and accurately done.

The connection of pistons by the means of rods and gears with the main shaft provides for a simple, compact, and efficient assemblage and operation of the parts.

Though it is preferred for the sake of strength and steadiness of action to provide gears on both ends of the shafts, as shown, the mechanism would be operative were they provided on one end only and simple cranks substituted for gears 18.

The arrangement of the cam-shafts with respect to the coöperating crank-shafts is a simple one and contributes to a compact form of the machine, especially when combined with the described arrangement of cylinders in pairs, as represented.

It is obvious that my method of construction is adapted for the use, if desired, of a larger number of cylinders and more frequent explosions in combination with correspondingly multiplied and suitably-arranged valve-opening cams and sparking devices without other change than increase of the length of the frame and the shafts. On the other hand, if the cooling-jacket shown in the drawings be used it would be practicable to use two pairs of cylinders and utilize an explosive at every stroke of the piston to drive the main shaft, the inlet and exhaust valves being supplied in usual manner and as required for the operation, the invention therefore being independent of the particular number of cylinders.

Having thus described my invention, what I claim is—

1. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main or driving shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof.

2. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main or driving shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof, the several shafts being parallel and operatively connected by gears.

3. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main or driving shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof, the several shafts being parallel and operatively connected by gears situated at both ends of the shafts.

4. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main or driving shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof the several shafts being parallel and operatively connected by gears, and the valve-actuating cam-shafts situated between and parallel to the said crank-shafts.

5. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main driving-shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof the several shafts being parallel and operatively connected by gears, and the valve-actuating cam-shafts situated between and parallel to the said crank-shafts, said cam-shafts having gears fixed thereon and driven by pinions on the crank-shafts.

6. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main driving-shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof, the several shafts being parallel and operatively connected by gears, and the valve-actuating cam-shafts situated between and parallel to the said crank-shafts, said cam-shafts having gears fixed thereon and driven by pinions on the crank-shafts, all of said shafts being situated in approximately the same plane.

7. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main driving-shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof, the several shafts being parallel and operatively connected by gears, and the valve-actuating cam-shafts situated between and parallel to the said crank-shafts, said cam-shafts

having gears fixed thereon and driven by pinions on the crank-shafts, all of said shafts being situated in approximately the same plane and in the base below the cylinders.

8. In a gas-engine, the cylinders having each a piston and arranged in four pairs, a rigid rod connecting the pistons of each pair, two crank-shafts one for each double pair, a main or driving shaft operatively connected to the crank-shafts, and means for successively exploding gas in the cylinders to drive said main shaft at every quarter-rotation thereof, the several shafts being parallel and operatively connected by gears, and the valve-actuating cam-shafts situated between and parallel to the said crank-shafts, said cam-shafts having gears fixed thereon and driven by pinions on the crank-shafts, all of said shafts being situated in approximately the same plane and in the base below the cylinders, and a post rising from the base, the pairs of cylinders being fixed to opposite sides of said post.

9. In a gas-engine, the base, the central post, and the several cylinders separately fixed to the post on opposite sides thereof and detachable singly therefrom.

10. In a gas-engine, the base, the central post, the several cylinders separately fixed to the post on opposite sides thereof, and piston-rod guides detachably fixed to cylinders having pistons with a rigid rod common to the pistons of two cylinders.

11. In a gas-engine, the base having the central post, the cylinders arranged in pairs, the pistons, piston-actuating shafts, and the valve-actuating rods, all said shafts being situated in the base and said rods situated between the cylinders.

In testimony whereof I have signed this specification in the presence of two subscribing witnesses.

WILLIAM T. FOX.

Witnesses:
ROY C. WEBSTER,
GEORGE D. WILLIAMS.