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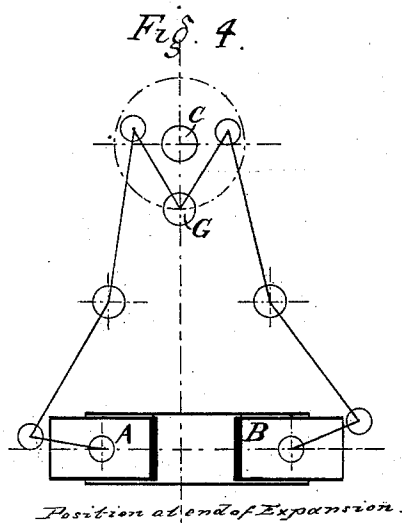
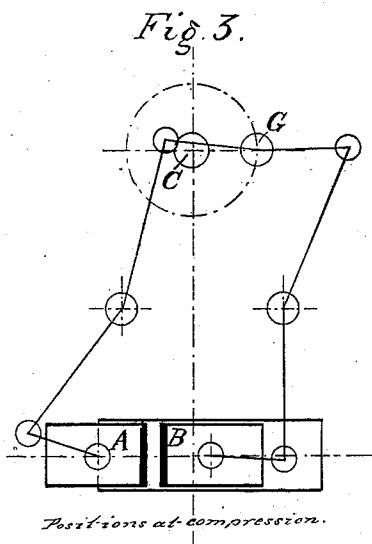
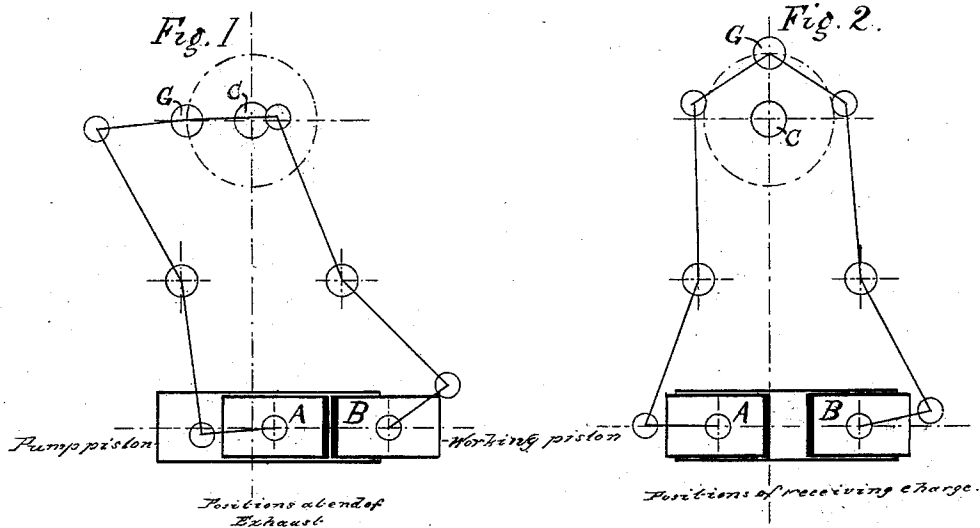
3 Sheets—Sheet 1.

J. ATKINSON.

GAS ENGINE.

No. 336,505.

Patented Feb. 16, 1886.



Witnesses:

E. E. Allen
J. W. Jones

Inventor:

Jas. Atkinson
By atty J. M. Kalo

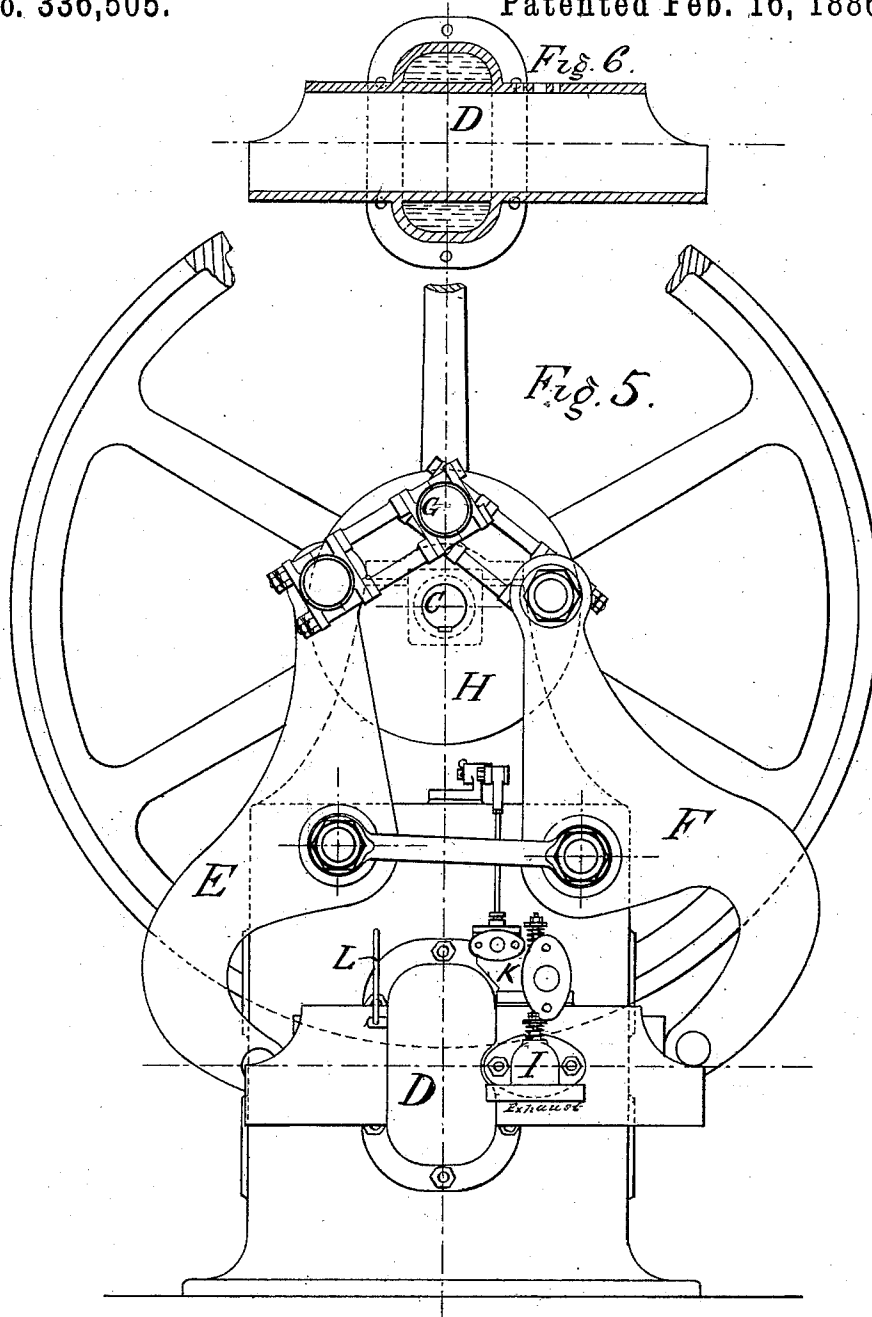
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Witnesses:-
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J. Domet

Inventor:
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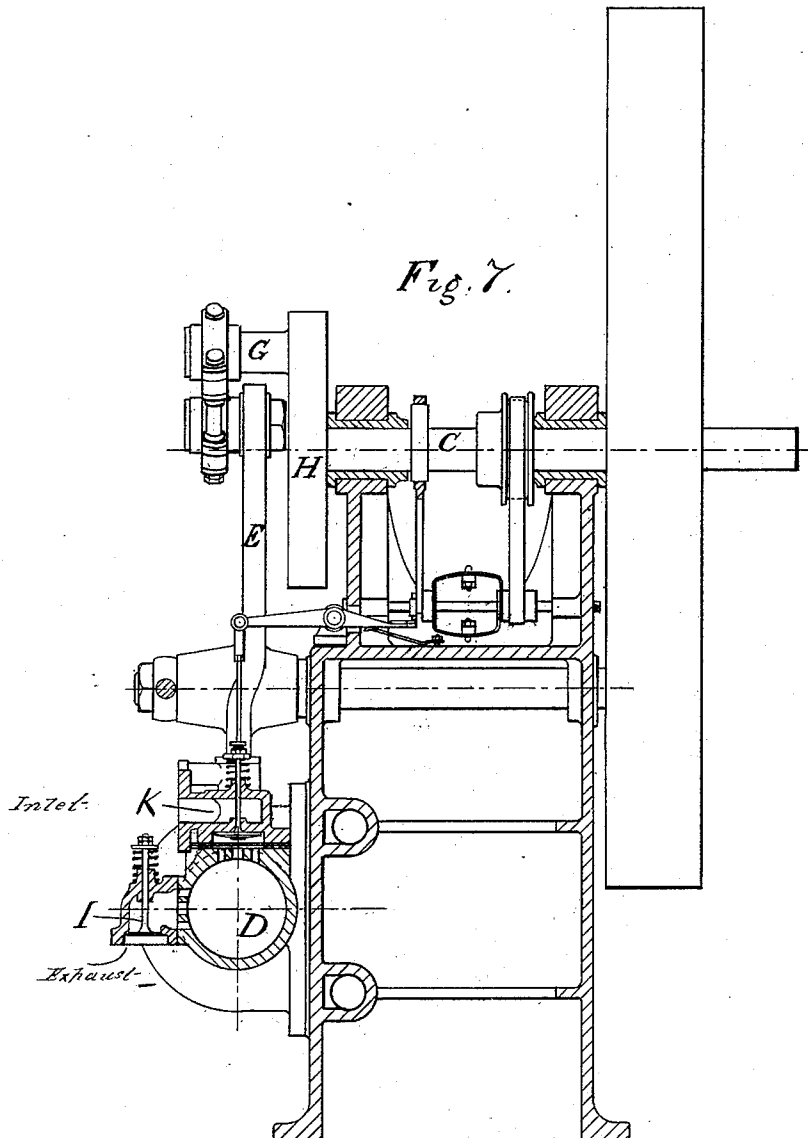
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Witnesses:
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Inventor:-
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UNITED STATES PATENT OFFICE.

JAMES ATKINSON, OF HAMPSTEAD, COUNTY OF MIDDLESEX, ENGLAND.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 336,505, dated February 16, 1886.

Application filed May 20, 1885. Serial No. 166,131. (No model.) Patented in England February 28, 1885, No. 2,712; in France May 21, 1885, No. 169,071, and in Belgium May 30, 1885, No. 69,074.

To all whom it may concern:

Be it known that I, JAMES ATKINSON, a subject of the Queen of England, residing at Hampstead, in the county of Middlesex and Kingdom of England, have invented new and useful Improvements in Gas-Engines, (for which I have applied for Letters Patent in Great Britain, No. 2,712, bearing date February 28, 1885,) of which the following is a specification.

This invention relates to and consists in a novel arrangement of parts forming a gas-engine of the compression type.

As hitherto constructed compression gas-engines may be broadly divided into two types. In one type the same piston (or pistons) is used alternately as a pump and as a working piston, requiring more than one revolution to complete the cycle of operations. In the other type an independent pump is used.

In this invention I employ a cylinder open at each end, fitted with two pistons, which have a peculiar differential motion as regards each other, which causes one of them to operate as a working-piston and the other as a pump-piston, in such a manner that in one cylinder and during one revolution only of the main shaft, they draw in the combustible mixture, compress it, ignite it, develop its expansive force, and expel it.

In the accompanying illustrations a suitable arrangement of this invention is shown. Figure 1 diagrammatically shows the positions of these pistons and of the crank-pin at the termination of the exhaust; Fig. 2, the capacity of the charge; Fig. 3, the space for compression of the charge, and Fig. 4 the capacity for the expansion of the charge after ignition, being four different positions of one revolution of the main crank-shaft C. A representing the pumping-piston, and B the working-piston. Fig. 5 is a vertical front elevation of the complete engine. Fig. 6 is a front section through the cylinder D. Fig. 7 is a vertical section at right angles with Fig. 5.

In this arrangement I use a horizontal cylinder, D, fixed near the base of the engine and fitted with the pump-piston A and the working-piston B. Each of these pistons is connected by a rod or link to the lower end of a beam,

the pumping-piston A being connected to the beam E, and the working-piston B to the beam F. These beams vibrate on centers fixed in the main framing of the engine, above the open mouths of the cylinder, and are extended above these centers, where their upper ends are coupled by short connecting-rods to one crank-pin, G, in a crank-disk, H, fixed on the main shaft C, which works between the upper ends of the beams E and F. The connecting-rods are made very short, (say one and one-half times the throw of the crank-pin.) The angularity of the rods and beams causes the pistons to have a differential motion as regards each other. They are quite close together when at one end of the cylinder, (hereinafter called the "preparing end,") as shown in Fig. 1. The results of the last working charge having been driven through the self-acting exhaust-valve I into the exhaust-pipe as the crank-pin G revolves, the working-piston B being at the preparing end of the cylinder, moves very slowly toward the other end, (hereinafter called the "working end.") At the same time the pumping-piston A travels very rapidly, so that the pistons leave a considerable space between them, into which combustible mixture is drawn through the self-acting suction-valve K, this position being shown in Fig. 2. The working-piston B now begins to travel faster than the pumping-piston A, covering the port to the admission-valve K, until they arrive at the termination of their strokes at the working end of the cylinder D, when the pistons are closer together and have compressed the combustible mixture to a suitable pressure, as shown in Fig. 3. At about this time the pumping-piston A uncovers the ignition-port, admitting some of the compressed charge to the inside of the small tube L, which is kept red-hot by means of an external flame and fires the combustible mixture admitted to its interior, thus igniting the charge. The piston A now remains almost stationary, while the working-piston B is rapidly passing from the working end to the preparing end of the cylinder D, thus giving a very quick expansion. At the termination of this expansion the position of the pistons and crank-pin are as shown in Fig. 4. The pumping-piston A now commences to overtake the working-pis-

ton B, driving out the products of combustion through the exhaust-valve I, the opening to the valve K being now uncovered by the piston B, when the pistons again arrive at the positions shown in Fig. 1, thus completing the cycle of operations during one revolution of the crank-shaft.

I prefer to make the space between the pistons, into which the ignited gases are expanded, as shown in Fig. 4, greater than the space into which the combustible mixture is drawn, as shown in Fig. 2, thus carrying the expansion to a further extent than in gas-engines as hitherto constructed. The relative proportions of these spaces and the capacities between the pistons when at the extremes of their strokes are obtained by suitably proportioning the levers, rods, and working centers, the short connecting-rods between the crank-pin and the upper ends of the beams being chiefly the cause of the great difference in the relative speeds of the pistons, and the level of the main shaft as regards the upper ends of the beams principally determines the relative spaces for the combustible charge and for expansion. The admission-port and the exhaust-port are at the preparing end of the cylinder, and the admission and exhaust are chiefly controlled by the working-piston covering or uncovering their ports. They have self-acting valves to prevent the passage of air, gas, or the exhaust passing in the wrong direction; also the exhaust-pipe may be provided with a self-acting valve admitting air to the exhaust-pipe, so as to prevent the momentum of the exhaust drawing unignited gas and air through the engine into the exhaust-pipe; but it might be allowed to draw a little air only through the very small space between the pistons at the termination of their strokes when in the position shown in Fig. 1.

The ignition may be caused by other means than by the ignition-tube L, previously mentioned. This, however, is a very simple and certain method, and has the great advantage of being very accurately timed by the pumping-piston passing the ignition-port.

By the inspection of Fig. 3 it will be observed that the working-piston B completes its stroke (when at the working end of the cylinder) slightly before the pumping-piston A completes its stroke. This insures the ignition-port being fully open at the right time and causes the pumping-piston A to remain practically stationary until the working-piston B has traveled far enough to have very materially reduced the high initial pressure.

The cylinder may be placed vertically or inclined, and more than one cylinder may be connected, so as to form a combined engine.

The working-gear may be differently arranged to suit different circumstances—as, for instance, the beams may vibrate from one end, with the cylinder placed between the shaft and these beam-centers, or the shaft between the cylinder and the beam-centers, the essential point being to get the peculiar differential motion

of the two pistons. No working gear is necessary, as all the valves may be self-acting. It may, however, be desirable to control the gas-supply so that no gas may pass into the engine, excepting at the desired time, also for the purpose of governing the engine.

The engine may be arranged to run in either direction, as started; but if required to be reversible, so as to work both ways, the spaces for drawing in the combustible charge and for expansion should be made equal, or about equal.

It will be observed that the preparing end of the cylinder works cooler than the working end, and that only a very small portion of the cylinder requires to be water-jacketed; also the expansion of the ignited charge is completed two to four times as rapidly as in other engines, (making the same number of revolutions of the crank-shaft in the same time,) consequently a much greater percentage of the heat developed by the ignition of the charge is absorbed in transmitting power to the crank-shaft and less wasted in being transmitted to the water in the jacket. It is well known that in gas-engines as hitherto constructed one-half and over of the total number of units of heat in the gas burned in the engine is wasted in this manner, and by developing the power in the manner described in my invention at such a greatly-increased speed a most important economy is effected. By my invention, also, the working parts of the engine are very much simplified and rendered more durable. There is no slide-valve, which is such a constant source of trouble in most other engines. The suction and exhaust valves are simple self-acting lift-valves, and are not subject to any material pressure. Slight leakage past them has very little effect upon the working of the engine. There are no delicate or intricate parts in connection with the engine, and the cost of production is materially reduced.

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

1. In a gas-engine, the combination, with the open-ended cylinder, of the two pistons and beams connected therewith centrally pivoted and connected to the same crank at their outer ends, as set forth.

2. In a gas-engine, the combination, with the open-ended cylinder, the two pistons working therein with different relative velocities, but each making the complete stroke in the same time, of the centrally-pivoted beams connected to said pistons and to the same crank at their outer ends, as set forth.

3. In a gas-engine, the combination, with the open-ended cylinder and pistons moving therein at the differential velocities, herein set forth, and beams connected to said pistons and at one end and to a single crank at the other, of an ignition-tube located and adapted to operate as described.

4. In a gas-engine, the combination, with the cylinder and differentially-moving pistons

connected to beams working from the same crank, of the admission-valve constructed and applied to be automatically operated by the movement of the pistons, and an exhaust-valve also constructed and applied to be operated by the pistons.

5 In a gas-engine, the pistons A B, working in a cylinder which is open at both ends, completing their strokes at the same times,
10 connected directly with the crank-pin of the driving-shaft, so as to maintain a certain po-

sition in relation to the crank-pin at every part of its revolution and in such a manner as to work with a differential rate of motion to allow the admission, compression, ignition, expansion, and expulsion of the working-fluid to be performed automatically between said pistons, as set forth. 15

JAMES ATKINSON.

Witnesses:

ARTHUR COLEMAN,
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