No. 809,791. PATENTED JAN. 9, 1906.

J. W. EISENHUTH.

COMPOUND GAS ENGINE.

APPLICATION FILED MAY 25, 1905.

2 SHEETS—SHEET 1.

Fig. 1.

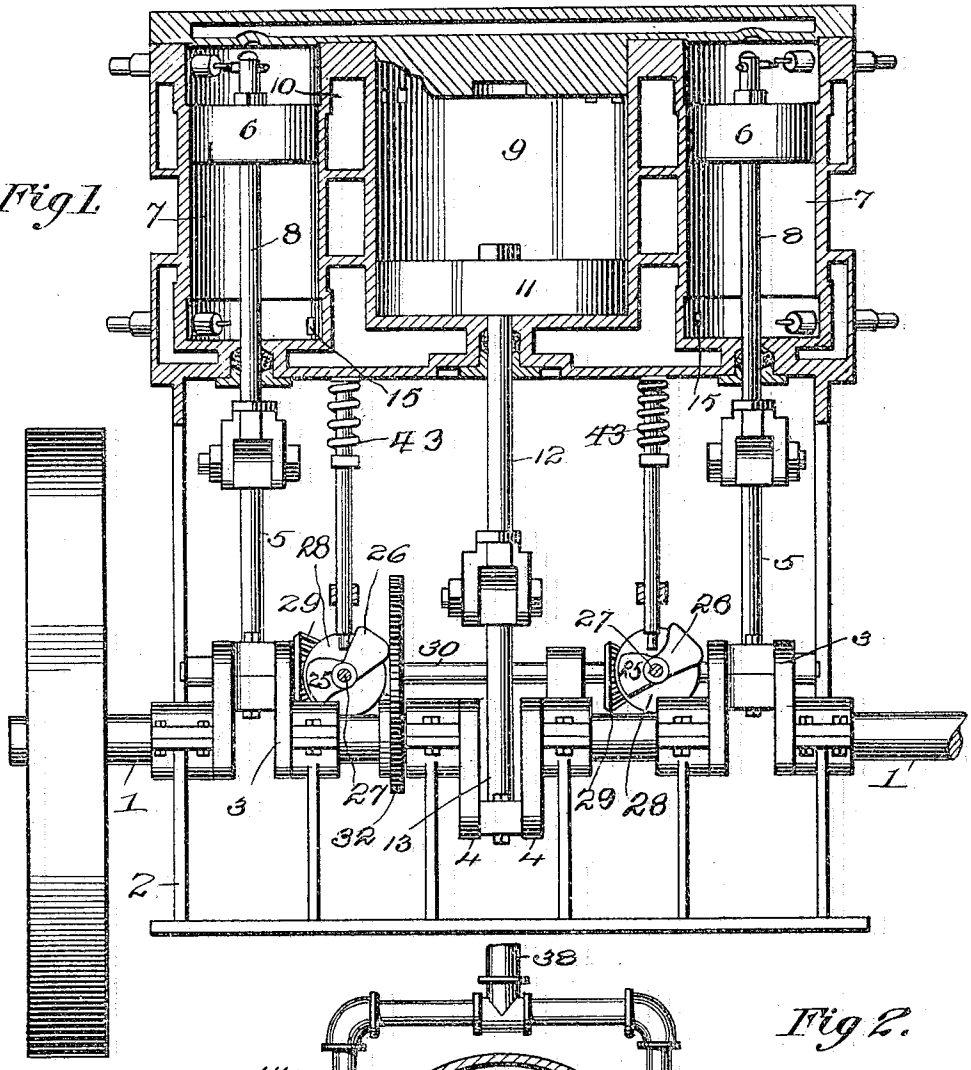
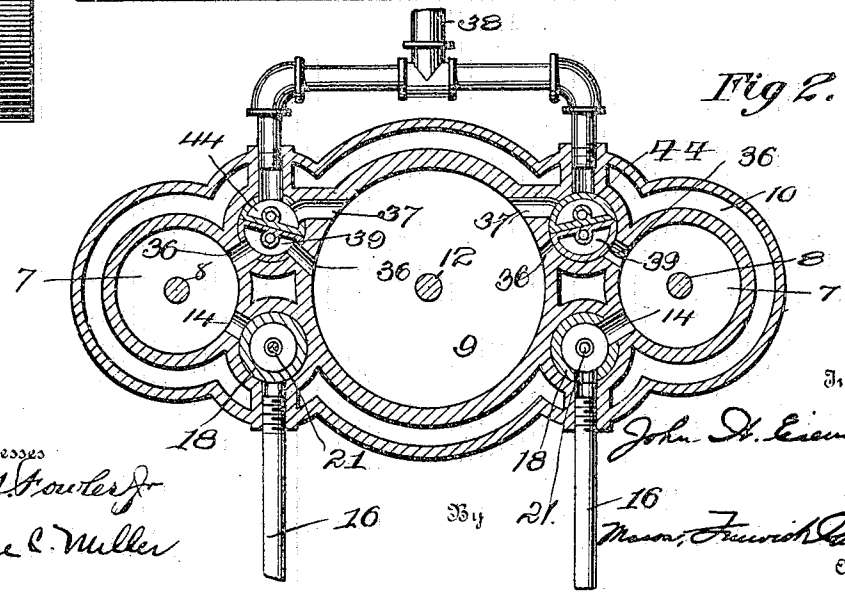


Fig. 2.



Witnesses

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2 SHEETS—SHEET 2.

Fig. 3.

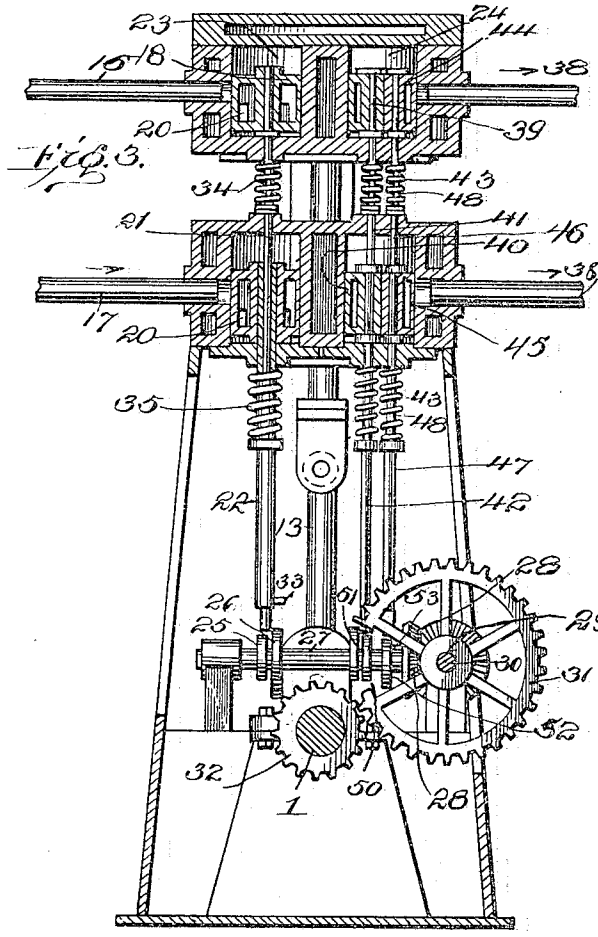


Fig. 4.

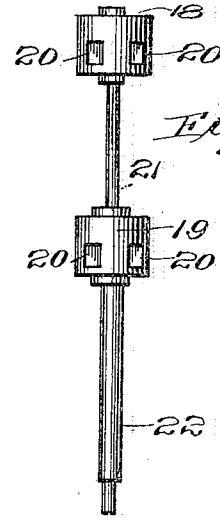


Fig. 6

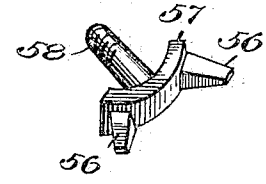
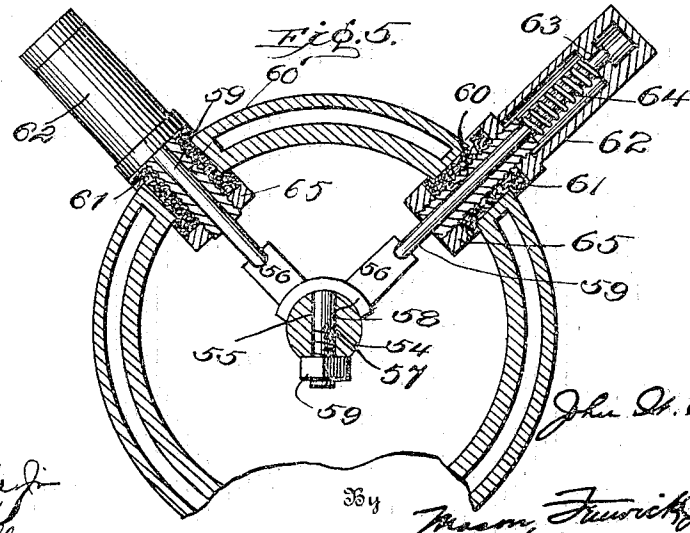


Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN W. EISENHUTH, OF BROOKLYN, NEW YORK, ASSIGNOR TO THE EISENHUTH HORSELESS VEHICLE CO., A CORPORATION OF MAINE.

COMPOUND GAS-ENGINE.

No. 809,791. Specification of Letters Patent. Patented Jan. 9, 1906.

Application filed May 25, 1905. Serial No. 262,301.

To all whom it may concern:

Be it known that I, JOHN W. EISENHUTH, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented certain new and useful Improvements in Compound 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 appertains to make and use the same.

My invention relates to improvements in gas-engines, and more particularly to compound engines.

It consists of certain novel constructions, combinations, and arrangements of parts, as will be hereinafter described and claimed.

In the accompanying drawings, Figure 1 represents a vertical longitudinal section through an engine constructed in accordance with my invention, the parts being shown in side elevation. Fig. 2 represents a horizontal section through the cylinders of my improved engine in a line with one set of valves. Fig. 3 represents a vertical transverse section through one set of valves. Fig. 4 represents a detail side elevation of the valves used in my engine. Fig. 5 represents a detail sectional view through one of the cylinders, showing the manner of mounting the electrodes, and Fig. 6 represents a detail view of the electrodes carried by the piston-heads.

My invention is designed to use an explosive mixture for operating the pistons of an engine and then conveying the partially-spent gases into the low-pressure cylinder for further utilizing the power thereof, thus making a compound engine of the same.

In carrying out the features of my invention the main shaft 1 is supported upon a suitable frame, as 2, said shaft being provided with outer cranks 3 3 and a central crank 4. The power-shaft is provided with a suitable fly-wheel, and the cranks 3 3 are connected with the piston-rods of the high-pressure cylinders by means of the pitmen 5 5. The pistons 6 6 move in high-pressure cylinders 7 7, said pistons being connected to the pitman 5 by means of their piston-rods 8 through the medium of suitable cross-heads. The high-pressure cylinders 7 are preferably formed in the opposite ends of the cylinder structure, a low-pressure cylinder 9 being interposed between them, as clearly seen in Figs. 1 and 2 of the drawings. These cylinders are all preferably surrounded by water-jackets, as 10, to prevent the said cylinders from becoming overheated. The high-pressure cylinders 7 are of course much smaller than the low-pressure cylinder 9, and the low-pressure piston 11 is therefore much larger than the high-pressure piston 6 6. The low-pressure piston 11 is provided with a piston-rod 12, which is connected, by means of a pitman 13, with the crank 4.

The explosive mixture, preferably of gas and air, is first conducted into the high-pressure cylinders, where it is compressed and exploded at the proper time. The partially-spent gases are then conducted through suitable ports into the cylinder 9 for exerting what remaining force they possess upon the large piston 10. To control this action of the gases, I employ valve mechanism which forms an important feature of my invention. The cylinders may be run by explosions at each end thereof, if desired, or at only one end. I preferably employ cylinders which are capable of having an explosion in each end and have so illustrated the invention in the accompanying drawings. Each of the cylinders 7 is provided with an inlet-port, as 14, at its upper end and a similar port 15 at its lower end. These inlet-ports 14 and 15 admit charge of explosive mixture to the ends of the cylinder from feed-pipes 16 and 17, said inlet-ports being regulated by upper and lower valves 18 and 19. These valves are preferably cylindrical in shape and hollow, as illustrated in Fig. 2 of the drawings. The valves are provided with ports, as 20 20, which when the valves are lifted coincide simultaneously with the inlet-pipes and the inlet-ports and permit the mixture to flow into the cylinders. When the valves are dropped, the ports are closed. In order to operate these valves in conjunction with the movement of the pistons, the said upper and lower valves 18 and 19 are provided, respectively, with valve-stems 21 and 22, the valve-stem 22 being larger than the valve-stem 21 and made hollow to receive the same. The valves move in suitable valve-chests, as 23 and 24, and their stems extend downwardly to a point near the power-shaft. In order to lift the valve-stems up and down cams, as 25 and 26, are mounted upon actuating-shafts 27, preferably arranged transversely of the machine, said shafts 27

being provided with bevel-gears, as 28, which mesh with corresponding bevel-gears 29 upon a shaft 30, arranged parallel with the power-shaft 1 and a little to one side thereof. The shaft 30 receives its motion from the main shaft by means of a gear-wheel 31, which meshes with a pinion 32 upon the said power-shaft. It will be seen from Fig. 1 of the drawings that the cams 25 and 26 are preferably lug-shaped projections provided with heads which engage and are secured upon the shafts 27. The contours of these lugs or wings are such as to lift the valve-stems at the proper time. As seen in Fig. 3 of the drawings, the cam 25 is adapted to engage the lower end of the upper valve-stem 21, while the cam 26 is adapted to engage the projection 33 on the lower end of the hollow valve-stem 22. Each of the valve-stems 21 and 22 is normally held in its lower position by means of coil-springs 34 35 engaging collars secured to each of the valve-stems and clearly illustrated in Fig. 3 of the drawings. When the valve-stems are lifted by means of the cams, they are forced against the action of those springs. When the cams cease to lift the said stems, they at once resume their lowered positions. It will be seen that the upper valve-stem passes through the lower hollow valve-stem and is guided in its position thereby. This construction enables me to arrange the valves and their stems with an economical use of space.

Each of the cylinders 7 is connected at its upper and lower ends with the low-pressure cylinder 9 by means of ports 36 36, the said ports being controlled by suitable valves. The low-pressure cylinder is also connected, by means of ports 37, with an exhaust-pipe 38, the said exhaust being controlled by suitable valves. The valves which control the ports 36 and 37 are preferably semicircular hollow valves, as clearly seen in Fig. 3 of the drawings. These valves are provided with flat adjoining faces which slide upon each other. For controlling the ports 36 upper and lower semicircular valves 39 and 40 are used. These valves, like the valves 18 and 19, heretofore described, are provided with valve-stems 41 and 42, the stem 41 extending through the hollow valve-stem 42. These valve-stems are normally held down by means of the coil-springs 43 43, engaging collars upon the said stems. The exhaust-ports 37 are controlled by hollow semicircular valves 44 and 45, which are provided with valve-stems 46 and 47, arranged to telescope with respect to each other in the same manner as heretofore described with the other valve-stems, the springs 48 being used to hold them in their lower positions. As seen in Fig. 2 of the drawings, each of the semicircular valves is provided with suitable ports, registering with the ports 36 and 37 when the valves are lifted, so as to control the passage of the exhaust-gases from the same. The valve-stems 41 and 42 are adapted to be operated by the cams 50 and 51, secured to the shaft 27, heretofore described, while the valve-stems 46 and 47 are engaged and operated by the cams 52 and 53, also carried by the said shafts 27. The movement of the said valves may thus be timed with relation to the movement of the pistons in the cylinders so as to exhaust the vitiated gases at the proper time. In order to explode the gases in the high-pressure cylinder at the proper time, each of the pistons in the said cylinders carries a projection, as 54, the said projections 54 being provided with transverse apertures 55. Electrodes, as 56 56, are secured to a plate 57, said plate having a stud 58 for engaging one of the apertures 55. The stud 58 is held in position by means of nuts, as 59. (Clearly seen in Fig. 5 of the drawings.) The electrodes 56 56 are preferably arranged about at right angles to each other and are tapered outwardly, as seen in Fig. 7. These electrodes as they are carried up and down by the piston-heads are adapted to engage spring-actuated electrodes 59, mounted in the cylinder-casings. The electrodes 59 slide in guide-sleeves 60, which are mounted in suitable insulating-sleeves 61, the said insulating-sleeves being held in position in apertures formed in the cylinder-casings. To the outer end of the sleeve 60 is screwed a cap 62, which receives the outer end of the electrode 59, the said cap being provided with a guide-bearing 63. The inner end of the sleeve 60 is held in position by means of a nut 65. A coil-spring 64, engaging a collar on the electrode 59, holds the same normally in its inner position. The electrodes 56 and 59 are preferably connected with the opposite poles of a battery, so that when the electrodes 56 snap by the electrodes 59 they will produce suitable sparks in the cylinders for exploding the mixture therein. By employing a double electrode of the character described the surety of producing a spark at the proper time is greatly increased, for if one electrode should not operate for some reason the other is almost sure to perform its function.

It will be noted from the above description that I am enabled to produce a compound gas-engine in a very compact form and to arrange its valves so that they are easily operated and fully capable of controlling the gaseous mixture. The parts are also simple in construction and not likely to get out of order easily. It will be observed that by using the low-pressure cylinder that after gases have been partially expended in the high-pressure cylinders they can be further used in the said low-pressure cylinder, thus further exhausting their power. It will thus result that when the vitiated gases leave the low-pressure cylinder they will have little or no remaining power and make a practically noiseless exhaust. It will be obvious that the cylinders may be operated by explosions at only one end, and when thus

used the lower ends of the said cylinder may be left open and the pitman may be connected directly with the pistons without departing in the least from the spirit of my invention.

It will be evident from the drawings that the piston in the low-pressure cylinder will have a movement alternately with that of the pistons in the high-pressure cylinders, the cranks upon the main power-shaft being arranged diametrically opposite each other for this purpose. This renders it possible to use the engine as a compound engine, the low-pressure cylinder exhausting when the charges in the high-pressure cylinders are exploding and expanding and the low-pressure cylinder receiving its power when the high-pressure cylinders are exhausting.

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

1. In a gas-engine, the combination with high-pressure cylinders, of a low-pressure cylinder adapted to be operated by the exhaust from the same, piston-valves mounted in pockets or recesses formed in the engine-casing between said cylinders for controlling the movement of the gaseous mixture, the said valves being arranged in pairs and moving upon each other in said pockets but controlling different ports, telescoping stems secured to the said valves, and cams for engaging the valve-stems so as to reciprocate the valves independently of each other, substantially as described.

2. In a gas-engine, the combination with suitable cylinders, of pistons moving therein for operating a power-shaft, piston-valves for regulating the admission of explosive compounds to the said pistons, the said valves occupying pockets or recesses formed in the engine-frame between the cylinders so as not to be exposed, two valves being arranged to move upon each other in each pocket or recess, valve-stems secured to said valves, one of the said valve-stems passing through the other so that the valves may be operated independently of each other, cams applied side by side upon a cam-shaft and extending in different directions upon the same for engaging the valve-stems to operate the valves, substantially as described.

3. In a gas-engine, the combination with suitable cylinders and pistons operating therein, of piston-valves for admitting explosive mixtures against each end of the said pistons, said valves being hollow and having flat adjoining faces working on each other so that one finds a bearing upon the other, each of the said valves having ports for permitting the gaseous mixtures to pass through them, each valve controlling a different set of ports, springs for moving the valves in one direction and cams for operating them in the other direction, substantially as described.

4. In a gas-engine, the combination with high-pressure cylinders and a low-pressure cylinder, of valves for admitting an explosive mixture to the said high-pressure cylinders, said valves being cylindrical and hollow, valves for discharging the vitiated gases from the said high-pressure cylinders into the low-pressure cylinder, and valves for regulating the exhaust of the said low-pressure cylinder, said valves being semicylindrical in form and sliding upon each other, whereby they may be compactly mounted in the said engine, substantially as described.

5. In a gas-engine, the combination of high-pressure cylinders, a low-pressure cylinder mounted between them and adapted to receive the exhaust from each end of each of the high-pressure cylinders, pistons moving in each of the said cylinders, piston-rods connecting the said pistons with a suitable power-shaft, electrodes mounted in each end of each high-preseure cylinder, coacting electrodes secured to the piston-rods of the high-pressure cylinders and arranged upon each side of the pistons so as to explode the gaseous mixtures upon opposite sides of the pistons, valves arranged in pairs for controlling the gaseous mixtures in the engine, the engine-framing being provided with sockets for receiving the said valves, each pair of valves being adapted to just fill the diameter of the said sockets, the said valves also being formed of hollow casings having suitable ports formed therein and being provided with adjacent bearing-surfaces so that they slide upon each other, and means for moving the said valves independently of each other, substantially as described.

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

JOHN W. EISENHUTH.

Witnesses:

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RUTH J. MITCHELL.