No. 745,703. PATENTED DEC. 1, 1903.

G. WESTINGHOUSE.

GAS ENGINE.

APPLICATION FILED DEC. 24, 1900.

NO MODEL. 2 SHEETS—SHEET 1.

Fig. 1.

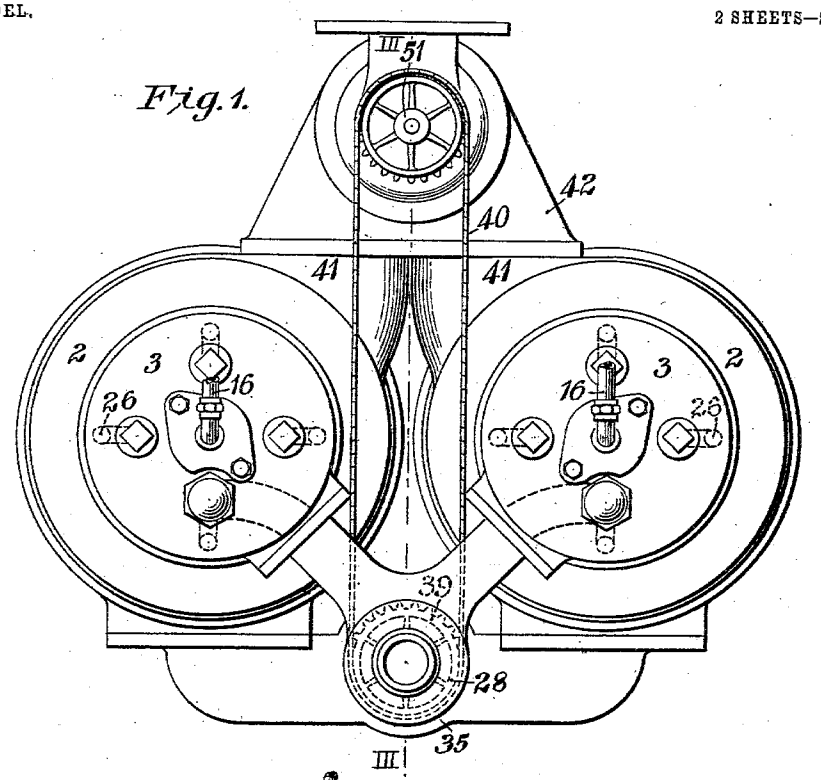
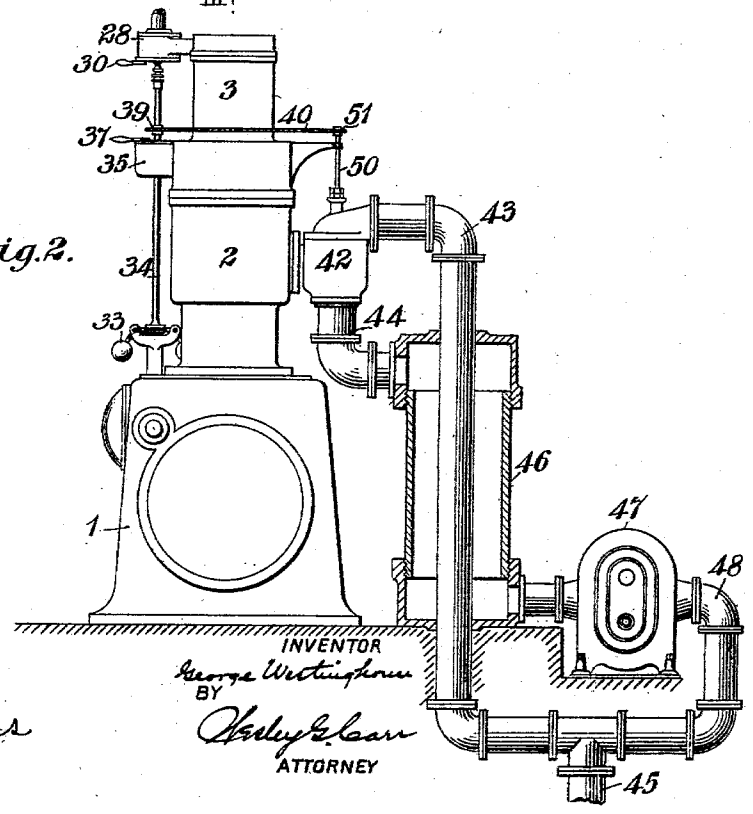


Fig. 2.



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NO MODEL. 2 SHEETS—SHEET 2.

Fig. 3.

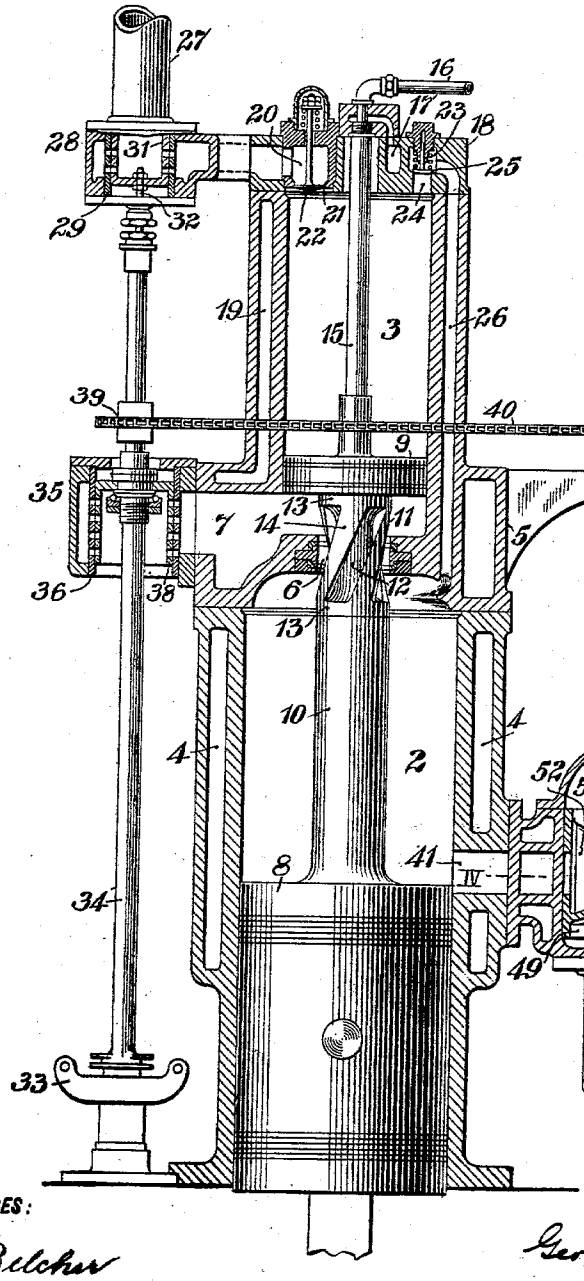
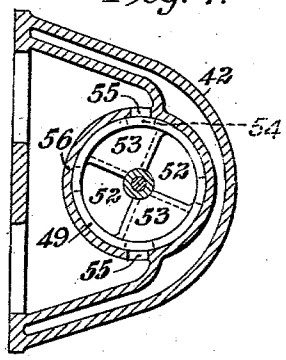


Fig. 4.



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UNITED STATES PATENT OFFICE.

GEORGE WESTINGHOUSE, OF PITTSBURG, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 745,703, dated December 1, 1903.

Application filed December 24, 1900. Serial No. 40,840. (No model.)

To all whom it may concern:

Be it known that I, GEORGE WESTINGHOUSE, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented new and useful Improvements in Gas-Engines, of which the following is a specification.

My invention relates to internal-combustion or explosion gas-engines; and it has for its object to provide a two-cycle engine of this character which shall be simple, compact, and substantial in construction and which shall be provided with means whereby scavenging of the explosion-cylinder shall be effected after each explosion and whereby premature explosions shall be avoided.

With these ends in view I have devised the engine shown in the accompanying drawings, in which—

Figure 1 is a plan view, and Fig. 2 a side elevation, of the engine, a portion of the attachments shown in the latter figure being in section. Fig. 3 is a longitudinal sectional view of the engine on a plurality of different planes, so as to show the interior of the compression and power cylinders and the inlet and exhaust valves; and Fig. 4 is a transverse section on line IV IV of Fig. 3.

The engine shown embodies two explosion-cylinders and suitable coöperating parts, the pistons in said cylinders being actuated alternately by the explosions in the cylinders, as is usual in engines of this character; but so far as my present improvements are concerned the engine might have a single cylinder or more than two, if desired. The engine is also shown as of the vertical type and for convenience will be so described, without, however, any intention of limiting the invention to engines of that type.

The base 1, which, as here shown, constitutes the crank-case of the engine, is mounted upon a suitable foundation and directly supports the explosion-cylinders 2, which in turn support the pumping-cylinders 3, employed for supplying gas to the explosion-cylinders. The walls of the cylinders 2 may be provided with chambers 4 for the circulation of a cooling liquid, as is usual in gas-engines, and the head-plate 5, which is formed as an integral part of the cylinder 3, may be provided with a cylindrical opening 6, leading to the lower end of the cylinder 3, which lower end communicates with a lateral chamber 7. The piston 8, which operates in the explosion-cylinder 2, is connected by suitable means, well known in the art, to the main shaft of the engine (not shown) for the purpose of operating the same. The piston 9, operating in the cylinder 3, is connected to the piston 8 by means of a hollow stem 10, which embodies at its upper end, adjacent to the piston 9, a valve 11, comprising a central tubular portion 12, two cylindrical heads 13, and spirally-disposed wings 14, connecting the two heads. This stem 10 and its valve 11 may be cooled by means of liquid supplied and circulated therethrough by means of pipes 15 and 16, the pipe 15, which surrounds the pipe 16, being in communication with a chamber 17 in the head-plate 18 of the cylinder 3. This chamber 17 may communicate with chambers 19 in the side walls of the cylinder 3 or directly with some outside receptacle for receiving or supplying liquid. The head-plate 18 is provided with a gas-receiving chamber 20, having a port 21, opening into the upper end of the cylinder 3, and a downwardly-opening valve 22, which may be spring-pressed toward its seat, as is usual. The head 18 is also provided with a chamber 23, that has a port 24, which opens into the cylinder 3 and is normally closed by a spring-pressed upwardly-opening valve 25. The chamber 23 is in open communication with the upper end of explosion-chamber 2 by means of one or more passages 26. The chamber 20 receives gas from a suitable source through a supply-pipe 27 and a regulating-valve 28. The amount of gas admitted through the valve 28 may be regulated by adjusting the bushing 29 by means of a handle 30, as shown in Fig. 2. The valve-piston 31 is mounted upon the upper end of a rod 32, which is vertically adjusted in accordance with the speed of the engine by the action of the governor 33 upon the governor-shaft 34. The valve 35 for supplying air to the chamber 7 also comprises a bushing 36, that may be adjusted circumferentially by means of a handle 37 and a valve-piston 38, that is non-rotatively mounted upon the governor-shaft 34, so as to be adjusted vertically thereby in accordance with the speed of the engine. The governor-shaft

34 is also provided with a sprocket-wheel 39, which drives a sprocket-chain 40, the purpose of which will be hereinafter specified. The exhaust-port 41 of each explosion-cylinder communicates with a valve-casing 42, the upper end of which is connected to a pipe 43 and the lower end to a pipe 44. The pipe 43 connects directly with an exhaust or waste pipe 45, and the pipe 44 connects with a drum 46, which surrounds a portion of a pipe 43 and which is connected to an exhaust-pump 47, the exhaust-port of which communicates with the pipe 45 by means of a pipe 48. The valve-casing 42 contains a cylindrical valve 49, which is mounted upon the lower end of a shaft 50, the latter being rotated by means of a sprocket-wheel 51 at its upper end and the sprocket-chain 40, driven from the sprocket-wheel 39 on the governor-shaft 34. The valve 49 is divided by radial partitions into two opposite chambers 52, which are closed at the bottom and open at the top, and two opposite chambers 53, which are closed at the top and open at the bottom. The curved side wall of each of the chambers 52 and 53 is provided with a port 54. These ports register intermittingly with corresponding ports 55 in the side walls of the cylindrical shell 56 of the valve-casing. The rotation of the valve is so timed by means of the gearing that the ports 54, opening into the chambers 52, will register with the ports 55 when the exhaust-ports 41 are first uncovered, so that the products of combustion then exerting a maximum pressure will rush out through the valve and pipes 43 and 45. Further rotation of the valve will bring the ports 54, which open into the chambers 53, into communication with the ports 55, thus connecting the exhaust-ports 41 through pipe 44 and drum 46 to the pump 47, which will suck out the remaining products of combustion and insure the introduction of a charge of fresh air to take the place of such products. This valve mechanism is employed in order to economize in the size of the pumping apparatus employed, it being obvious that if the gas is permitted to escape when under pressure without passing through the pump a less quantity will have to be withdrawn by the pump in order to produce the desired partial vacuum in the cylinders, by virtue of which the requisite supply of air is drawn in to mix with the gas which is introduced from the compressing-cylinder. I wish it to be understood, however, that my invention is not limited to the employment of a valve between the pump and the explosion-cylinders, since all of the products of combustion may pass through the pump, if desired.

The valve 11 is so constructed as to permit of this action until the return stroke of the pistons brings the lower head 13 of the valve 11 into engagement with the walls of the opening 6.

During the downward movement of the pistons caused by an explosion, which is effected in the upper end of the cylinder 2, gas will be drawn into the cylinder 3 by reason of the partial vacuum formed therein, which permits the pressure of gas to unseat the valve 22. The amount of gas thus drawn in will be sufficient to combine with the air in cylinder 2 to constitute a suitable mixture for the next explosion. When the pistons are again moved upward, the inlet air and gas ports will be closed, as will also the exhaust-ports 41, and compression of the gas in the cylinder 3 will be effected to such an extent as to unseat the valve 25 and force the gas through the passages 26 into cylinder 2 to mix with the air already therein. The upward movement of the piston 8 will also serve to compress the mixture sufficiently, so that when the pistons reach the limit of their upward stroke the ignition of the mixture may be effected to again drive the piston downward.

The invention has been described in connection with a single engine and a single exhausting-pump 47. It is obvious, however, that in a station where a number of these engines are employed a pump 47 of suitable capacity may be utilized for exhausting the products of combustion from and drawing air into the explosion-cylinders of all of the engines, and the use of this general arrangement in connection with several engines is expressly included in the invention.

The construction and arrangement of parts may obviously be varied within considerable limits without departing from my invention, and I therefore desire it to be understood that limitations are not to be imposed otherwise than by the state of the art.

I claim as my invention—

1. In a gas-engine, the combination with a power-cylinder and its piston, of means for introducing air and gas successively into one end of said cylinder, a pump connected to the exhaust-port at the other end of said cylinder for withdrawing the products of combustion and a rotary valve between the exhaust-port and the pump.

2. In a gas-engine, the combination with a power-cylinder and its piston having inlet-openings for air and gas at one end, means for effecting admission of air and gas through said ports successively and an exhaust-port at the other end of the power-cylinder, of a pump connected to the exhaust-port and a rotary valve located between the exhaust-port and the pump and gearing between the same and the governor-shaft.

3. In a gas-engine, the combination with a power-cylinder and its piston, of means for introducing air and gas successively at one end of the cylinder, a pump for withdrawing the products of combustion from the other end of the cylinder and a rotary valve for controlling the connection between the exhaust-port and pump.

4. In a gas-engine, the combination with a

power-cylinder having inlet-ports for air and gas at one end, of a piston operating in said cylinder and having a valve device for controlling the air-inlet port, a pump for exhausting the products of combustion from said cylinder and a rotary valve between the exhaust-port and the pump.

5. In a gas-engine, the combination with a power-cylinder having air and gas inlet ports at one end and an exhaust-port at the other, of a piston and a valve for the air-inlet port operated directly thereby, an exhaust-pump connected with the exhaust-port and a rotary valve for automatically making and breaking pipe connection between the pump and the exhaust-port.

6. In a gas-engine, the combination with a power-cylinder and a gas-pumping cylinder in alinement with each other, pistons in the respective cylinders and a stem rigidly connecting the same and provided with a valve device for governing the air-inlet to the power-cylinder, of an exhaust-pump connected to the exhaust-port of the power-cylinder and a rotary valve between the exhaust port and the pump.

7. In a gas-engine, the combination with a power-cylinder and a gas-pumping cylinder in alinement with each other, of pistons in said cylinders, a stem rigidly connecting said pistons and provided with a valve for governing the air-inlet to the power-cylinder, an exhaust-pump connected to the exhaust-port of the power-cylinder, a governor-shaft and a valve interposed between the exhaust-pump and the exhaust-port and gearing between said valve and the governor-shaft whereby the valve is rotated intermittingly to put the pump into communication with the exhaust-port and cut it off therefrom.

8. In a gas-engine, the combination with a power-cylinder having air and gas inlet ports at one end and an exhaust-port at the other end, of a gas-pumping cylinder provided with means for introducing gas through the gas-inlet port into the power-cylinder, pistons in the respective cylinders, rigidly connected by a stem which embodies a valve device for opening and closing the air-inlet port, an exhaust-pump for withdrawing the products of combustion from the power-cylinder, a rotary valve interposed between the pump and the cylinder and gearing between said valve and the governor-shaft for operating the former to periodically cut off communication between the exhaust-port of the cylinder and the pump.

9. In a gas-engine, the combination with one or more explosion-cylinders and means for admitting air and gas successively thereto, of an exhaust-pump connected with the exhaust-ports of the explosion cylinder or cylinders, and a rotary valve device operated from the governor-shaft and a casing therefor having ports arranged to permit of the escape of the products of combustion when under pressure without passing through the pump and to then connect said ports with the pump.

In testimony whereof I have hereunto subscribed my name this 13th day of December, 1900.

GEO. WESTINGHOUSE.

Witnesses:
JAMES B. YOUNG,
WESLEY G. CARR.