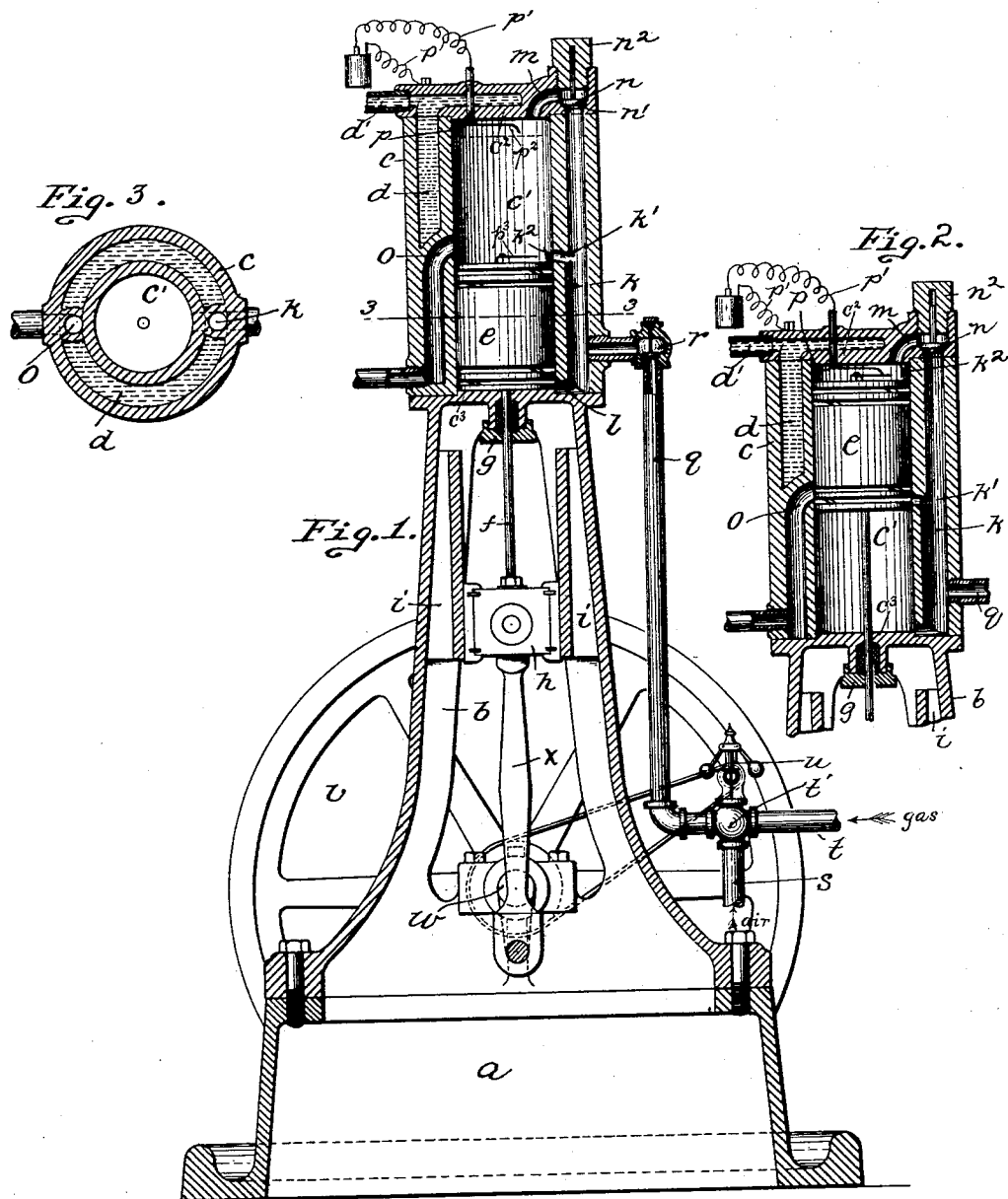


(No Model.)

J. D. RUSS.
GAS ENGINE.

No. 586,321.

Patented July 13, 1897.



Witnesses:

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UNITED STATES PATENT OFFICE.

JOHN D. RUSS, OF RAHWAY, NEW JERSEY, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO MAXWELL WYETH & CO., OF BROOKLYN, NEW YORK.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 586,321, dated July 13, 1897.

Application filed January 29, 1896. Serial No. 577,224. (No model.)

To all whom it may concern:

Be it known that I, JOHN D. RUSS, a resident of Rahway, in the county of Union and State of New Jersey, have invented a new and useful Improvement in Gas-Engines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to gas-engines.

The perfect gas-engine cycle consists of four distinct operations—viz., intake of fresh charge, compression, explosion, and exhaust. It has been the aim of all designers of these engines to embody these four cycles in as few strokes of the piston as possible, as only one of the above operations is actually power-producing. The four-cycle engines employ four strokes to accomplish this perfect cycle, while the so-called “two-cycle” engines have utilized crank-cases, accessory cylinders, and pumps, or employ a differential piston to gain their end; but in all these engines the intricate mechanism has prevented high speed, as well as caused difficulty in operation and management.

The object of my invention, therefore, is by the use of one plain cylinder without accessory contrivances to accomplish in one revolution the four operations of this perfect cycle.

My invention comprises, generally stated, a cylinder closed at both ends and having a piston therein, an automatic valve-controlled port leading to a space behind or below the piston and between said part of the piston and lower head or back of cylinder, a passage with open communication to and leading from before-mentioned space behind or below the piston through an automatically valve-controlled port into head of cylinder, whereby the explosive mixture is first admitted into the lower portion of cylinder, and then forced by the action of the piston into the upper part of the cylinder, where it first expands, cleaning cylinder of the old gases, and where it is afterward compressed and exploded.

To enable others skilled in the art to make and use my invention, I will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a sectional elevation of my im-

proved engine. Fig. 2 is a like section of a part of the engine, showing the piston at the upper end of its stroke. Fig. 3 is a section on the line 3 3, Fig. 1.

Like letters indicate like parts in each of the figures.

I have illustrated my invention as applied to the upright or vertical form of engine, although it is apparent that it is equally applicable to the horizontal type.

The base *a* has bolted thereto the standard or open column *b*, which supports the cylinder *c*. The cylinder *c* is surrounded by the water-jacket *d*, which is shown clearly in Fig. 3. The cylinder *c* is closed at its upper and lower ends by the cylinder-heads *c*² *c*³. Within the cylinder *c* is the piston *e*, which can be either hollow or solid. The piston *e*, when in its lowest position, is at the bottom of the cylinder *c*, close to the cylinder-head *c*³, but at its highest position there remains a space between the upper cylinder-head *c*² and the upper end of the piston for the compression of the explosive mixture. The cubic contents of the upper portion of the cylinder when the piston *e* is at its lowest “dead-point” is larger than the cubic contents of lower portion of cylinder when the piston is at its highest dead-point—that is, the space between the upper head *c*² of the cylinder and top of piston, when said piston is at the lowest dead-point, is greater than space between the lower head *c*³ of the cylinder and the bottom of said piston when said piston is at its highest dead-point. This is due to the clearance just mentioned in the upper portion of the cylinder for the compressed explosive mixture. The piston-rod *f* passes down through a suitable stuffing-box *g* in the standard *b*, said piston-rod being connected to the cross-head *h*, moving in suitable guides *i*.

Formed within the walls of the cylinder *c* is the pipe or passage *k*, said passage communicating by means of the port *l* with the lower end of the piston-chamber *c*¹ of the cylinder *c*. The upper end of the passage *k* communicates with the by-passage *m*, leading into the upper end of the piston-chamber *c*¹. A check-valve *n* engages with the seat *n*¹ at the upper end of the passage *k*, the stem of said

valve moving in the recess formed in the plug n^2 . The plug n^2 is threaded and engages with the threaded openings in the cylinder c .

The exhaust-port o leads from the piston-chamber c' and is uncovered by the piston when part way on its downstroke. An auxiliary port k' leads from the passage k into the piston-chamber c' , said port being uncovered when the piston is at its lowest point. A deflector k^2 on the piston e tends to direct any of the explosive mixture entering by the port k' up within the piston-chamber c' .

Water is supplied to the water-jacket d by means of a pipe d' .

The explosion may be caused by an electric spark or by a hot tube or other igniting means. I have illustrated a means for exploding by means of electricity. The rod p passes down through a suitable opening in the cylinder-head c^2 , and attached to the lower end of said rod is a piece of flat steel p^2 , bent as shown. Another piece of flat steel p^3 is attached to the top of the piston. When the piston reaches its highest dead-point, these two pieces of steel meet, establishing the current, and when they start to separate a spark is formed, which explodes the charge. The wires p' are connected up to a suitable battery.

The pipe q conveys the explosive mixture to the cylinder, and at the upper end of said pipe is the check-valve r , which is operated by the action of the piston, as will be fully hereinafter set forth. The pipe q is in communication with the air-pipe s and gas-pipe t . The valve t' controls the gas-supply to the pipe q , and this valve is connected up with the ball-governor u , which regulates the speed of the engine by opening and closing the gas-inlet. By having a governor located to regulate the supply before it enters the cylinder said governor regulates the fresh mixture before it enters the engine. When the gas-inlet is completely closed, nothing but air passes through the cylinder, and consequently a great saving in gas is obtained.

The fly-wheel v is mounted on the shaft w , and the pitman x is connected up to a suitable crank.

The operation of my improved engine is as follows: With the piston in the position shown in Fig. 1 the explosive mixture admitted through the port l by the previous upstroke of the piston has been forced up through the passage k , the check-valve n being unseated, into the space above said piston. The admission of the mixture above the piston acts to expel the foul gases caused by the previous explosion through the exhaust-port o . The auxiliary port k' admits a further quantity of the explosive mixture as said piston uncovers said port in its descent; but, however, before the fresh mixture has opportunity to escape through the exhaust-port the piston begins to ascend and closes said exhaust-port. As said piston continues to ascend the automatic check-valve r in the pipe q is raised by the suction caused by the ascent of said piston.

This permits a fresh charge of the explosive mixture to enter by the port l the lower end of the cylinder below the piston. The ascent of the piston compresses the explosive mixture in the upper end of the cylinder above the piston, the check-valve n being held in its seat by the pressure of the explosive mixture upon it. By the employment of the passage k , communicating at its upper end with the space above the piston and controlled at its upper end by the check-valve n when the piston ascends, the explosive mixture is prevented from passing back again into said passage, and consequently "back-firing" is prevented. This back-firing is a great source of trouble in many gas-engines, and is a premature explosion of the new charge occurring before the piston reaches its highest dead-point, which tends to retard the power of the engine. By taking the fresh charge alone through an inlet, such as the auxiliary port k' in the side of the cylinder, said charge would sometimes come in contact with part of the old charge before it is "dead" and reaches the exhaust and would be prematurely exploded; but by letting in the new charge first at the upper end of the cylinder through a valve which is released as soon as the piston uncovers the exhaust-port it drives the old charge straight down toward the exhaust-port, so that when the auxiliary inlet-port k' is uncovered, through which the main portion of the incoming charge rushes, the old charge is entirely dead and mostly exhausted. If the inlet-port at the upper end of the cylinder was alone employed, though there would be no back-firing, it would take longer for the charge to enter, said inlet-port being somewhat removed from the compression of the mixture caused by the descent of the piston. Thus it will be seen that by the combination of the two inlet-ports all loss of power from back-firing is avoided and higher speed is obtained from the rapidity with which the fresh charges can be taken into the exploding portion of the cylinder.

When the piston has reached the position shown in Fig. 2, an electric spark ignites the gases, whereby the piston descends and the power is produced. The descent of the piston seats the valve r , and the fresh explosive mixture which was below the piston is compressed and driven up through the passage k to the upper end of the cylinder to be again compressed and exploded in the manner hereinbefore set forth. By having the lower end of the cylinder closed and leaving no clearance between the lower end of the piston and the lower cylinder-head the compression from the downstroke is powerful and uniform and compresses directly on the valve at the entrance to the upper or exploding portion of the cylinder. This insures prompt and immediate action. I thus provide a passage of such cubic contents as to hold the fresh mixture when compressed by the downward stroke of the piston to a desired pressure. This pres-

sure carries the fresh charge into the upper end of cylinder through valve *n* and port *k'* at the proper time, leaving the passage *k* always full of fresh mixture at atmospheric pressure, the piston being at lowest dead-point. The cubic contents displaced on descent of piston expands in the upper portion of the cylinder and obtains the economy claimed.

The valves are opened and closed automatically, so that no power is required to operate same and there is no friction to be overcome. The action of the piston itself causes the admission and discharge of the gases.

As there is an explosion every revolution, and as the ignition can only take place when the piston on reaching the upper or dead point commences to release the compressed charge there is no danger of premature explosion or back-firing.

In my improved engine the same upstroke both sucks in the fresh mixture to the lower portion of the cylinder and compresses the fresh charge already in the upper part of the cylinder to the point of ignition, while the same downstroke carries the power of explosion and also exhausts the foul gases by admitting the fresh charge under pressure. In this manner the perfect cycle is obtained in one revolution and continues independently, while the simplicity of construction makes it possible to obtain the high speed of steam-engines. It may also be noted that the piston is cushioned at each end of its stroke, which, with an explosion every revolution, gives steadiness of motion and removes all annoyance due to jarring.

I do not limit myself to the exact construction set forth, but claim such equivalent constructions as will give like results.

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

1. In gas and like engines, the combination of a cylinder closed at both ends, a piston therein, said cylinder having a port communicating with the space below the piston and above the lower head of said cylinder, a passage leading therefrom to the space above said piston when said piston is at its highest point, and a valve at the upper end of said passage, substantially as set forth.

2. In gas and like engines, the combination of a cylinder closed at both ends, a piston therein, said cylinder having an automatically valve-controlled port communicating with the space below the piston and above the lower head of said cylinder, a passage leading therefrom to the space above said piston when said piston is at its highest point,

and a check-valve at the upper end of said passage, substantially as set forth.

3. In gas and like engines, the combination of a cylinder closed at both ends, a piston therein, said cylinder having a port communicating with the space below the piston and above the lower head of said cylinder, a passage leading therefrom to the space above said piston when said piston is at its highest point, a check-valve at the upper end of said passage and an exhaust-port opened and closed by said piston itself, substantially as set forth.

4. In gas and like engines, the combination of a cylinder closed at both ends, a piston therein, said cylinder having a port communicating with the space below said piston and above the lower head of said cylinder, and a valve-controlled passage leading therefrom to the space above said piston, the cubic contents of the upper portion of said cylinder when the piston is at its lowest dead-point being larger than the cubic contents of lower portion of said cylinder when piston is at highest dead-point, substantially as set forth.

5. In gas and like engines, the combination of a cylinder closed at both ends, a piston therein, said cylinder having a port communicating with the space below the piston and above the lower head of said cylinder, a passage leading from said port to the space above said piston when said piston is at its highest point, a valve controlling said passage, and an auxiliary port between said valve and said port leading from said passage to the piston-chamber and controlled by said piston, substantially as set forth.

6. In gas and like engines, the combination of a cylinder closed at both ends, a piston therein, said cylinder having a port communicating with the space below the piston and above the lower head of said cylinder, a passage leading from said port to the space above said piston when said piston is at its highest point, a valve controlling said passage, an auxiliary port between said valve and said first-mentioned port leading from said passage to the piston-chamber, and an exhaust-port just above said auxiliary port, both said exhaust-port and auxiliary port being controlled by said piston, substantially as set forth.

In testimony whereof I, the said JOHN D. RUSS, have hereunto set my hand.

JOHN D. RUSS.

Witnesses:

ANDREW J. HALIDAY,
CHAS. H. LAMBERT.