

T. SMALL.
GAS ENGINE.

Patented May 4, 1897.

J. Henderson.

Inventor:
Thomas Small,
by his Attorney,
James Pettie

UNITED STATES PATENT OFFICE.

THOMAS SMALL, OF CAMDEN, NEW JERSEY, ASSIGNOR TO GEORGE J. RICHARDSON, TRUSTEE, OF PHILADELPHIA, PENNSYLVANIA.

GAS-ENGINE.

SPECIFICATION forming part of Letters Patent No. 581,783, dated May 4, 1897.

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To all whom it may concern:

Be it known that I, THOMAS SMALL, a citizen of the United States, and a resident of Camden, county of Camden, State of New Jersey, have invented certain new and useful Improvements in Gas-Engines, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, forming part of the specification.

My invention relates to certain improvements in gas-engines, and has among its objects to provide for the removal from the cylinder of the exploded gases and the products of combustion after each forward stroke of the piston and to secure an explosion at every stroke of the piston, as more fully described hereinafter.

In the accompanying drawings I illustrate certain forms of apparatus embodying my invention.

Figure 1 is a sectional elevation of the cylinder of a gas-engine, illustrating my invention. Fig. 2 is a sectional plan view of the same on the line 2 2, Fig. 1.

In carrying out my invention I propose to so combine with the gas-exploding chamber, a high-pressure exhaust-port for primarily exhausting all the exploded gases above atmospheric pressure, and an exhausting device that the exploding gases will be exhausted from the engine immediately after the piston is driven forward by the explosion of a charge, a new charge simultaneously introduced, and on the return stroke of the piston the new charge compressed for the next explosion, thereby securing an explosion every revolution. In gas-engines of this class the pressure and the quantity of the products of combustion in the cylinder behind the piston vary as the initial pressure varies, and as the means for exhausting these products are usually regulated to exhaust a given quantity of the exploded products, and at the same time to draw in the new charge of air and gas at times when on a given explosion the exploded products are at a minimum, the exhaust mechanism being regulated to exhaust a given quantity of the exploded products greater than the amount that at this given

time is contained in the cylinder, the exhaust will tend to draw into the cylinder an excess of air and gas after exhausting the products of combustion, and may even go so far as to draw out through the main exhaust-pipe a quantity of unexploded gas, thereby creating waste.

In my invention in order to overcome this objection I provide a means for preliminarily exhausting all the products of combustion from the cylinder above atmospheric pressure before the main exhaust-port is opened, so that the only work which the mechanically-operated main exhausting mechanism has to do is to exhaust the products of combustion, which are always at a given uniform pressure. Therefore, as the products of combustion in the cylinder will always be at a uniform pressure, the exhaust mechanism is regulated to exhaust what must always be the given quantity of products of combustion in the cylinder.

In carrying out my invention I provide the high-pressure exhaust port and valve constructed and operated as hereinafter particularly described.

Referring to the drawings embodying my invention, A represents a cylinder of a gas-engine, in which is a piston B, connected by a rod *b* to a crank or other device. At the rear end of the cylinder are two ports *c c'*, for the entrance of air and gas, respectively, which ports are closed by a valve C, adapted to a conical seat at the rear of the cylinder. The valve C is preferably provided with a stem *d*, projecting through and guided by an opening in the cylinder-head and being provided with an adjusting-nut *d'*, between which and the cylinder-head is a coiled compression-spring *d²*, normally acting to hold the valve to its seat and to prevent the escape of the gases from the cylinder.

In Fig. 1 the piston B is shown near the end of its forward stroke and is covering an exhaust-port *e*, connected to the pipe E, which leads to a pump or some similar exhausting device. On the opposite side of the cylinder, at a point slightly in advance of the port *e*, is a high-pressure exhaust-port *f*, closed by a check-valve F, opening outwardly and pro-

vided with a coiled compression-spring f' , surrounding its stem f^2 , the tension of the spring being regulated by a gland-nut f^3 .

The sparking device in the present instance 5 comprises an electrode g , in the form of a tongue laterally projecting from the rod G , which finds a bearing in a collar h and is normally held in the position shown in Fig. 1 by a torsion-spring h' , connected at one end 10 to the rod and at the opposite end to the collar h . The collar is held in place by a gland-nut H , insulated from the collar by a sleeve h^2 , of rubber or other suitable material. The opposite electrode g' is carried by the piston 15 and is in the form of a finger which comes into contact with the tongue g as the piston moves to the rear, the relative positions of the parts being such that before the piston reaches its rear end position the finger g' will have moved the tongue g backward a slight 20 distance against the action of the torsion-spring, and when the piston again starts its forward movement the tongue g will follow it until the tongue is again in its normal position, and the parting of the two electrodes 25 will, in breaking electrical contact, create a spark and ignite the explosive charge.

The terminals of the wires which form the circuit are shown in Fig. 1, one wire x being 30 attached to the rod G and the opposite wire x' being attached to a binding-post on the cylinder.

The operation of the device is as follows: Assuming the piston B to be on its rearward 35 movement, when in the position shown in Fig. 1, and the rear portion of the cylinder to be filled with a charge of gas and air, as herein-after described, the rearward movement of the piston will compress the charge and after 40 the electrodes break contact and explosion takes place the piston will be driven forward. When the piston has been forced forward a sufficient distance to open the port f , the high pressure of the exploded gases opens the 45 check-valve F and allows all pressure above the atmosphere to escape therethrough. Immediately afterward the port e will be uncovered, and the action of the pump exhausts the remaining exploded gases, which are 50 drawn through the said port e , and a partial vacuum is created in the cylinder, simultaneously causing the opening of the valve C and the admittance of a fresh supply of air and gas. In some cases, where the port e and 55 exhaust mechanism are of sufficient size to permit the escape of all the products of combustion, the port f and its check-valve may be dispensed with.

In order to keep the inner mouth of the 60 port e closed while the piston-head is traveling in the rear portion of the cylinder, the walls of the piston-head, especially that portion passing over the mouth of the port e , are sufficiently elongated to at all times cover the 65 mouth of the port e during its passage through the cylinder rearward of the position illustrated in Fig. 1. The object of this construc-

tion is to prevent a useless exhausting operation during the travel of the piston rearward of the position shown in Fig. 1. The pump 70 still operating when the piston moves forward of the position shown in Fig. 1, a partial vacuum will be formed in the exhaust-pipe, which will enable it to operate promptly or as soon as the port e commences to open and 75 to exhaust the exploded gases and the products of combustion.

As is clear from the construction, the piston-rod is connected by the usual crank-arm 80 with a driving-shaft and fly or balance wheel from which the pump or other exhausting device connecting with the exhaust-pipe E is driven. As heretofore stated, any desired form of air-pump or exhausting device for exhausting the exploded gases and products 85 of combustion may be employed.

I have herein described a simple form of apparatus embodying my invention; but it is clear that other forms of apparatus may be 90 employed.

By the use of my invention I secure greater power and greater speed, if desired. The loss of power is reduced to a minimum. The piston is less liable to clog or to become im- 95 peded than in other constructions, as all the products of combustion of each charge are promptly exhausted after each explosion and foreign matter thus removed from the cylinder and explosion-chamber. The amount of gas required is reduced to a minimum, which 100 gas is of the character usually employed in gas-engines.

Having thus described my invention, what I claim, and desire to secure by Letters Pat- 105 ent, is—

1. The combination in a gas-engine, of a cylinder having air and gas inlets, and a main exhaust-port for exhausting the main portion 110 of the products of combustion at the completion of each forward stroke of the engine, said port opening into the cylinder at or about a point coincident with the line of travel of the inner face of the piston when full forward, means for inducing the flow of an explosive charge into the cylinder at the comple- 115 tion of each forward stroke of the piston as the products of combustion are withdrawn from the cylinder, a piston in said cylinder, a high-pressure exhaust-port provided through the walls of the cylinder in advance 120 of the main exhaust-port to permit the escape of the products of combustion above the pressure of the atmosphere and an automatically-operated one-way check-valve provided in said port constructed to open before 125 the main exhaust-port is opened.

2. The combination in a gas-engine of a cylinder having air and gas inlets, and a main exhaust-port for exhausting the main portion 130 of the products of combustion, a piston in said cylinder, a high-pressure exhaust-port, f , opening into the cylinder in advance of the main exhaust-port and a one-way valve in said port, f , substantially as specified.

3. In a gas-engine, a cylinder having a combined compression and explosion chamber, a reciprocating piston with elongated piston-head, B, spring-controlled valve, C, for regulating the admission of air and gas through the inlet-ports, *c*, *c'*, high-pressure exhaust-port, *f*, check-valve, F, provided therein, stem *f*², coiled compression-spring, *f*⁴, and gland-nut, *f*³, main exhaust-port, *e*, for exhausting the main portion of the products of combus-

tion and simultaneously drawing in a new charge and means for igniting the compression charge, substantially as described.

In witness whereof I have hereunto set my hand this 2d day of April, A. D. 1896.

THOMAS SMALL.

Witnesses:

JNO. E. PARKER,
EDMUND S. MILLS.