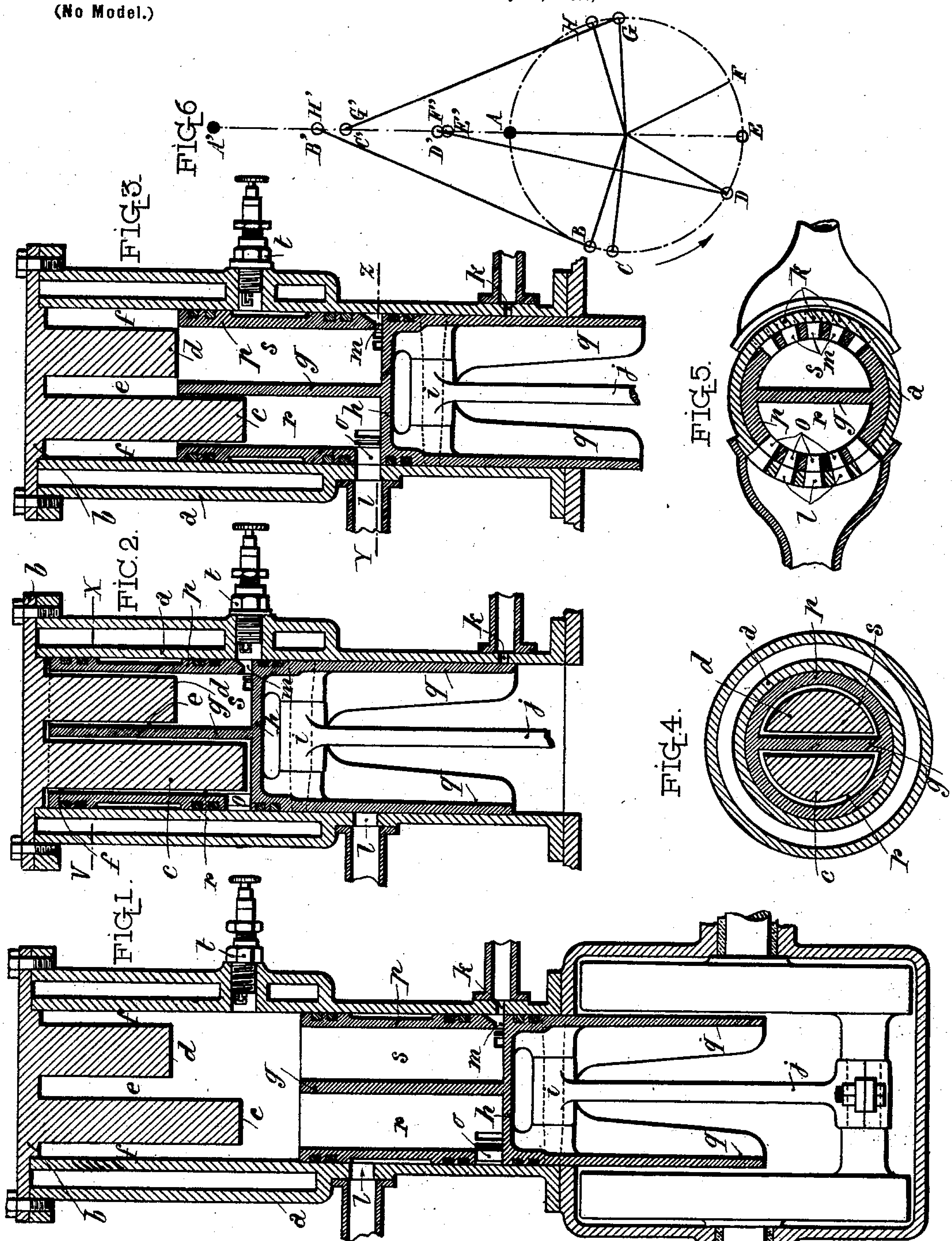
No. 689,791. Patented Dec. 24, 1901.

E. CAILLAVET.

EXPLOSIVE GAS MOTOR.

(Application filed May 24, 1901.)

(No Model.)



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EUGÈNE CAILLAVET, OF VILLENEUVE-SUR-LOT, FRANCE.

EXPLOSIVE-GAS MOTOR.

SPECIFICATION forming part of Letters Patent No. 689,791, dated December 24, 1901.

Application filed May 24, 1901. Serial No. 61,787. (No model.)

To all whom it may concern:

Be it known that I, EUGÈNE CAILLAVET, a citizen of the Republic of France, residing at Villeneuve-sur-Lot, France, have invented certain new and useful Improvements in or Relating to Explosive-Gas Motors, (for which I have made application for Letters Patent in Great Britain, No. 8,776, dated April 29, 1901; in France, No, 305,001, dated October 31, 1900; in Germany, No. 123,726, dated November 23, 1900, and in Belgium, No. 156,197, dated April 27, 1901,) of which the following is a specification.

The present invention relates to a gas-engine in which all the operations take place automatically during one revolution of the crank-shaft under natural conditions—that is, without the aid of any particular mechanism, such as pumps, valves, levers, cams, gear, springs, or the like.

In the accompanying drawings, Figure 1 is a longitudinal section through the motor-cylinder, showing the piston in the suction position. Fig. 2 is a similar section, the piston being shown in the ignition position. Fig. 3 shows the piston in the exhaust position. Fig. 4 is a transverse section on the line V X of Fig. 2. Fig. 5 is a transverse section on the line Y Z of Fig. 3. Fig. 6 shows a diagrammatic sketch of the different positions of the piston during the revolution of the crank-shaft.

The cylinder *a* can be provided externally with any convenient means for cooling—as, for instance, with ribs or with a water-jacket. The bottom of the cylinder is closed by means of a cover *b*, which is furnished with two plugs *c d* of semicircular cross-section, said plugs being separated by a diametral space *e* and surrounded by an annular space *f* along the inner circumference of the cylinder and communicating with the central diametral space *e*. The plugs *c d* extend into the interior of the cylinder *a* and are of unequal length for a purpose hereinafter explained.

The cylinder *a* of this motor does not contain any valves; but the admission and exhaust ports *k* and *l* are arranged diametrically opposite to each other in the walls of the cylinder and at a certain height, so as to comply with the requirements necessary for the operation of the piston.

The piston *p* comprises one portion which is entirely cylindrical and furnished with segments arranged in such a manner that the chamber formed by the interior of the piston and of the cylinder is air-tight whatever the position of the piston during the operation may be except during admission or exhaust. These segments are arranged according to the present system so as to be prevented from rotation with regard to the piston.

The piston *p* is divided in two compartments *r s* by a diametral partition *g* and is also provided with a transverse partition *h*. Beneath the transverse partition *h* is placed a journal *i*, which serves to connect the piston to the connecting-rod *j*. Immediately above the partition *h* the piston *p* is provided with admission and exhaust ports *m o*, arranged diametrically opposite to each other and having convenient section, so as to coincide in the required position with the ports *k l* of the cylinder. The admission-ports *k* of the cylinder are arranged in an arc of a circle side by side and five in number in the present construction, as shown in Fig. 5. This number of course can be varied at will. These ports are placed at a height so as to exactly coincide with the corresponding openings in the piston when the latter is at the beginning of its stroke, Fig. 1. The exhaust-ports *l* of the cylinder, in the present case also five in number, are situated so as to coincide with the corresponding openings *o* of the piston at the completion of the half-stroke of the latter, Fig. 3. Beneath the partition *h* at the sides of the connecting-rod *i* the piston *p* is provided with inner flanges or lugs *q* of such a length as to cover the admission-ports *k* at the end of the piston-stroke, or, better, at the arrival of the piston at the bottom of the cylinder, Fig. 2. The purpose of these lugs is to prevent the gases formed and remaining in the suction-pipe from being lost or contaminated by their contact with the atmosphere, as would be the case if the inner opening *k* of the cylinder were left open. The length of the piston *p* is also arranged to cover the exhaust-openings *l* when the piston has arrived at the end of its return stroke, Fig. 1. When the piston *p* is at the end of its stroke—that is, at the bottom of the cylinder—the plugs *c d* enter the interior of the compartments *r s* of the piston, one of the plugs *c* entering the corresponding compartment *r*, so as to entirely fill the latter except for a small clearance necessary for the play of the piston for preventing friction and to allow the gas a free circulation between the plug *c* and the internal walls of the piston-chamber *r*. The other plug *d* projects into the corresponding compartment *s* only to a certain extent, leaving a free space in a portion of the compartment *s* and, as in the former case, a certain annular space between the plug and the internal walls of the cylinder for the same purposes. The clearance left thereby in the compartment *s* is necessary at the arrival of the piston at the end of its return stroke to receive the gases which are compressed therein and to cause the gases to be mixed in this space. The ignition can be effected by an incandescent tube or by an electric candle *t*, either of which has to be placed in proximity to the compartment *s*, in which the admission and the compression of the gases are effected, and toward the bottom as near as possible to the transverse partition *h*, where the gases are pure. The electric igniter could also be placed at the bottom of the plug *d*, so as to be in contact with the pure gases compressed in the remaining space of the corresponding compartment *s*.

The operation of this motor is as follows: Supposing the piston *p* is at the middle of its stroke, as shown at Fig. 3, the exhaust-ports *l* of the cylinder will coincide with the openings *o* of the piston, so as to allow of a communication of the interior of the cylinder *a* and piston *p* with the outer atmosphere. In further turning the fly-wheel in the direction of the arrow indicated in Fig. 6 the ports *l* will be closed, and on continuous motion a vacuum is produced until the piston *p* or its admission-openings *m* coincide with the ports *k* of the cylinder. At this moment carbureted air passes into the compartment *s* (see Fig. 1) until the pressure in the latter is equal to atmospheric pressure. If this compartment *s* has a greater capacity than the volume of the gas admitted, the gas will all remain in this compartment *s*. On further rotation the piston is caused to return, thereby closing the admission-openings *k* of the cylinder and compressing the gas until its exhaust-ports *o* are in communication with the exit *l* from the cylinder, Fig. 3, which allows the escape of the air contained in the compartment *r* until the pressure in the latter is equal to normal pressure. However, as this compartment has also a greater capacity than the volume displaced by the piston-stroke from the foregoing extreme position to the openings of the ports *l* only a part of the contents of the compartment *r* will escape. At this position the escaping gas will be air; but after an explosion the products of combustion will escape. On further motion the piston closes the apertures *l* and compresses the remainder of air contained in the bottom part of the cylinder and in the exhaust-compartment *r*, as well as the gas admitted into the gas-compartment *s*, as the latter, always under slight compression, could not have been displaced. A short time before the end of the total compression the mixture is put in contact, through the admission-openings *m* of the piston, with the ignition apparatus, thus causing the explosion. The piston is impelled by the action of the expanding gas to the beginning of its forward stroke until the exhaust-ports of the cylinder *l*, Fig. 3, are opened, allowing the escape of the gas, whereby the internal pressure in the cylinder is reduced to atmospheric pressure. The momentum acquired causes the piston to close the exhaust-ports and continue the suction-stroke until it again uncovers the admission-ports *k*, thereby allowing of the admission of fresh gases, which, replacing the products of combustion, enter into the compartment *r*, where they accumulate until the internal pressure is equalized. The fresh gases once admitted and not being capable of communicating with the atmosphere cannot be exhausted before their utilization.

From the foregoing it is clear that, except at the moment of admission and exhaust of the gases, the interior of the cylinder is absolutely closed up, and owing to the combination of the plugs *c d* with the partition *g* of the compartments *r s* the fresh gas after admission does not mix with the products of combustion remaining in the cylinder.

The operations of this motor take place regardless of the direction of rotation of the fly-wheel and are always uniform.

It is obvious that instead of having two compartments in the piston and two plugs in the cylinder any convenient number and shape of these features could be provided for. Moreover, the plugs could be made solid or hollow and could be provided with means for cooling by means of water circulation or the like.

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

1. In an explosion-engine the combination of a hollow piston divided longitudinally into two compartments having openings for exhaust and admission on the surface, a cylinder having corresponding inlet and exhaust ports and two plugs adapted to compress the gases in the compartments.

2. In an explosion-engine the combination of a hollow piston divided longitudinally into two compartments having openings for exhaust and admission on the surface, a cylinder having corresponding inlet and exhaust ports, two plugs adapted to enter said compartments on the return stroke of the piston and means for igniting the explosive mixture in the cylinder substantially as described.

3. In an explosion-engine the combination of a hollow piston divided longitudinally into two compartments having openings for exhaust and admission on the surface, a cylinder having corresponding inlet and exhaust

ports, two plugs adapted to enter said compartments on the return stroke of the piston, means for igniting the explosive mixture in the cylinder, lugs on the piston adapted to cover the admission-inlet and means for igniting the explosive mixture in the cylinder substantially as described.

4. In an explosion-engine the combination of a hollow piston divided longitudinally into two compartments having openings for exhaust and admission on the surface, a cylinder having corresponding inlet and exhaust ports, two plugs adapted to enter said compartments on the return stroke of the piston, lugs on the piston to cover the admission-inlets, means for igniting the explosive mixture within the cylinder and means for cooling the cylinder substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EUGÈNE CAILLAVET.

Witnesses:
ACHILLE MARILLIER,
JEAN ROBELET.