No. 716,069. Patented Dec. 16, 1902.

J. P. E. LIET.

EXPLOSION MOTOR.

(Application filed Sept. 23, 1901.)

(No Model.)

Fig. 1

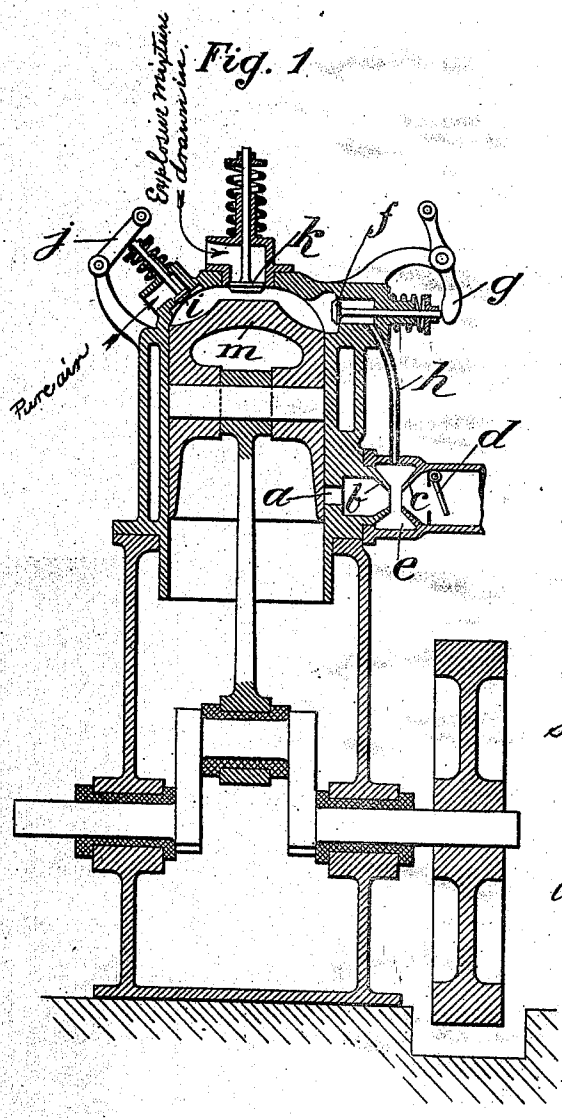


Fig. 3

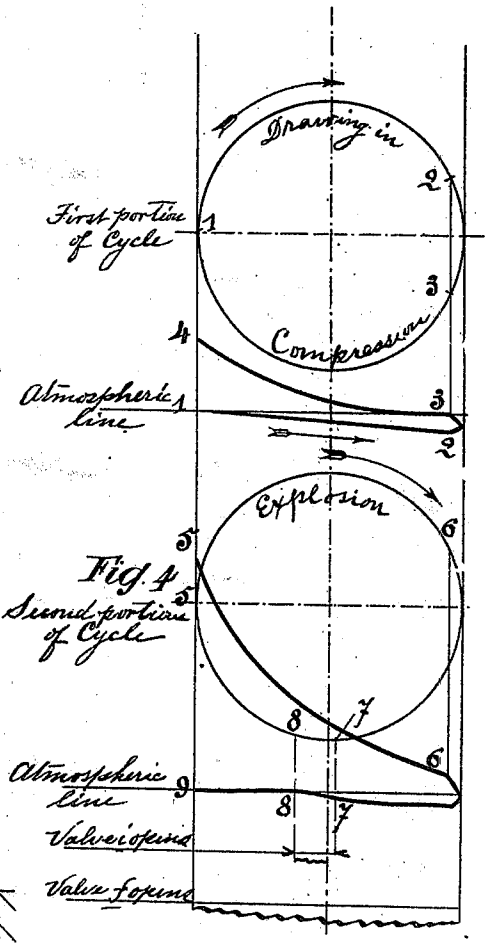
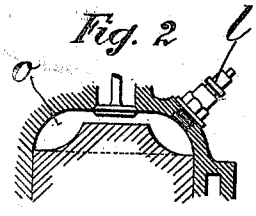


Fig. 4

Fig. 2



Witnesses:
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UNITED STATES PATENT OFFICE.

JULIEN PAUL ETIENNE LIET, OF PARIS, FRANCE.

EXPLOSION-MOTOR.

SPECIFICATION forming part of Letters Patent No. 716,069, dated December 16, 1902.

Application filed September 23, 1901. Serial No. 76,173. (No model.)

To all whom it may concern:

Be it known that I, JULIEN PAUL ETIENNE LIET, a citizen of the Republic of France, residing at Paris, France, have invented certain new and useful Improvements in or Relating to Explosion-Motors, (for which I have made application in Great Britain under No. 17,806, dated September 5, 1901,) of which the following is a specification.

In the explosion-motors now in use the expulsion of the combustion products is not complete, the space between the piston and the bottom of the cylinder remaining at the end of the stroke filled with combustion products, with which the fresh explosive charge mixes on entering the cylinder on the following charging period. Hence it follows that the value of the gas mixture, and consequently the effective power of the engine, is diminished, while the ignition also becomes irregular in consequence of its taking place sometimes in the midst of burned gases. These drawbacks are obviated by the present invention, in which the "exhaust-valve," properly speaking, is dispensed with, the exhaust taking place through an opening provided in the front part of the cylinder toward the end of the piston-stroke. Through this opening the combustion-gases escape into an ejector, producing a vacuum, which then sucks in the combustion-gases contained in the upper part of the cylinder, while at the same time fresh air is drawn into the cylinder through a valve arranged on the combustion-chamber. In this way at the commencement of the suction period the combustion-chamber is quite free from combustion products and contains fresh air only, constituting a part of the explosive mixture. The efficiency and the effective power of the motor are increased, and a perfect ignition is insured.

In the accompanying drawings, Figure 1 shows a longitudinal section of a motor constructed according to the present invention. Fig. 2 is a section of the combustion-chamber on a plane at right angles to that of Fig. 1. Figs. 3 and 4 are theoretical diagrams illustrating the mode of operation of the motor.

In the front part of the cylinder and near the end of the piston-stroke an opening *a* is provided, through which the interior of the cylinder communicates with an ejector consisting of two conical nozzles *b* and *c*, arranged axially and converging toward each other. The ejector is provided with a valve *d*, connecting when in its opened position the valve-chamber with the atmosphere, and a vacuum-chamber *e*, surrounding the conical parts *b* and *c*, before mentioned. The connecting-valve *d* may be an automatic valve, or it may be controlled mechanically. In the back part of the cylinder a spring-valve *f* is arranged, which is actuated by a lever *g*, controlled by the motor, the valve-chamber communicating, through a tube *h*, with the vacuum-chamber in the ejector. Another spring-valve *i*, actuated by a lever *j*, controlled by the motor, is arranged in the back part of the cylinder on the opposite side to the valve *f*. An admission-valve *k*, acting, as usual, automatically, is also placed in the back part of the cylinder. The ignition device *l*, Fig. 2, is also arranged in the bottom of the cylinder, which, as shown in Fig. 1, is interiorly formed concave, the back of the piston being made convex with a concave annular recess, so as to provide at the end of the stroke an annular space *o* between the cylinder end and the piston.

The mode of operation is as follows: The motor is of the four-stroke variety. In its forward movement the piston draws in the explosive mixture through the admission-valve *k*, which opens automatically. The suction takes place from 1 to 2, Fig. 3—that is to say, up to the time when the rear edge of the piston reaches the ejector-orifice *a*. After having entirely uncovered the ejector-orifice *a* the piston returns and closes the same. This period is marked by the points 2 to 3 of the diagram, the pressure within the cylinder becoming at 3 equal to the atmospheric pressure. On its further return movement the piston compresses the mixture from the point 3 to point 1 of the diagram, the pressure on the end of the return stroke being marked by the ordinate 1–4. At the end of the return stroke the mixture is ignited by the ignition device *l*, whereupon the piston is driven forward until its rear edge again reaches the orifice *a* in the side of the cylinder. The working stroke of the piston extends from 5 to 6 of the diagram Fig. 4, the pressure at the commencement of the explo-

sion being represented by the ordinate 5–9. After the orifice *a* has been uncovered the gases escape under great pressure into the ejector-nozzles *b* and *c*, opening thereby the valve *d* and producing a vacuum in the chamber *e* around the nozzles. Then the piston returns and closes the orifice *a*, while the valve *d* is closed by the atmospheric pressure. On this return movement of the piston the two valves *f* and *i* at the end of the cylinder are opened by their respective controlling mechanisms, and the rear part of the cylinder is put into communication with the vacuum-chamber *e*. The vacuum produced previously in this chamber causes the combustion-gases to be sucked energetically into the chamber through one of these valves *f*, while fresh air enters the cylinder through the other valve *i*. Owing to the annular shape of the chamber *o*, formed between the piston and cylinder end, the entering air thoroughly sweeps the combustion-gases out. At the end of the cycle the valves *i* and *f* are closed and the same operations are repeated.

From the foregoing explanation it will be seen that at the end of the cycle fresh air only is contained in the combustion-chamber instead of combustion products or combustion products and air, as in motors hitherto used. The fresh gas will not, therefore, be mixed with combustion products, and the effective power of the engine will be at its maximum in view of the fact that the whole mixture is combustible. The ignition always taking place in a medium of fresh gas will be a very reliable one.

The ejector of the motor described above has an analogous object to the condenser of a steam-engine—viz., to produce a vacuum in the cylinder. It may be constantly cooled in order to insure a perfect vacuum. The movement of the piston *m* is transmitted to the motor-shaft by a connecting-rod in the usual manner.

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

In an explosion-motor the combination of an outlet-orifice arranged at the outer end of the cylinder, an ejector communicating with the said orifice, a vacuum-chamber around the said ejector, a valve arranged at the rear end of the cylinder, a valve-chamber in connection with this valve and communicating with the vacuum-chamber, means for actuating the said valve, a second valve arranged in the rear end of the cylinder and a corresponding valve-chamber communicating with the atmosphere, substantially as described.

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

JULIEN PAUL ETIENNE LIET.

Witnesses:
PAUL BACON,
EDWARD P. MACLEAN.