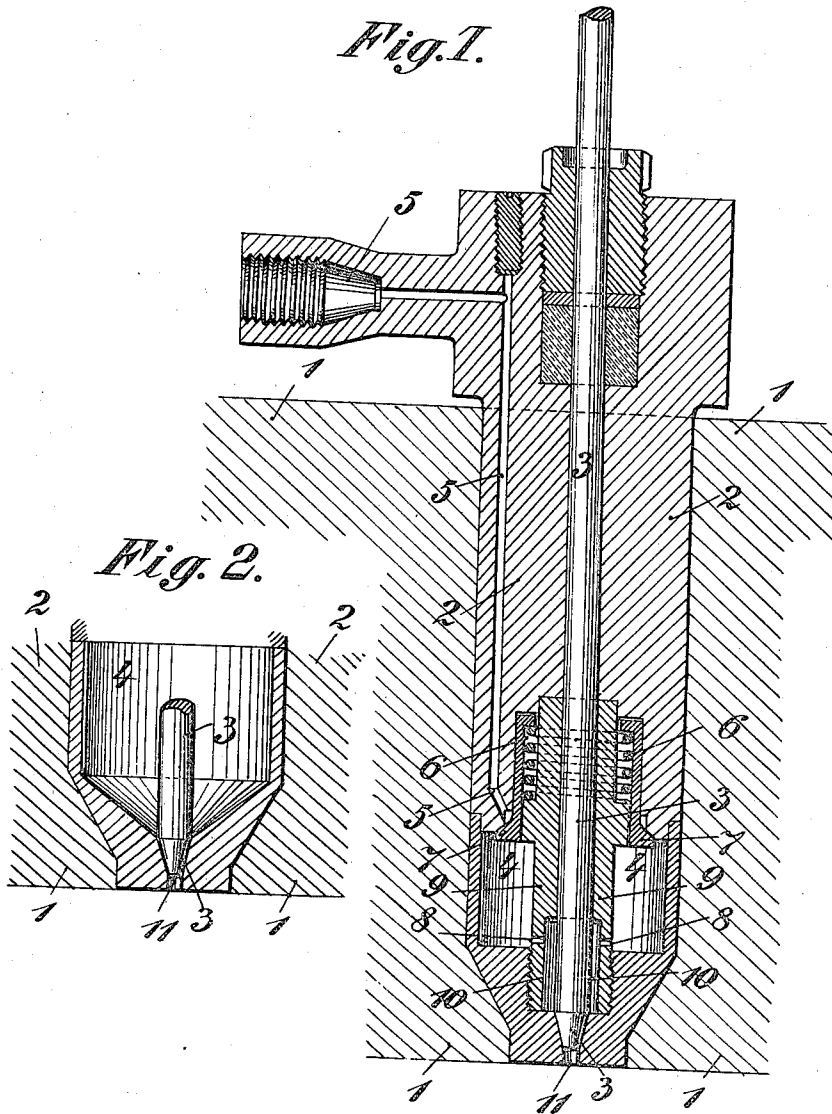


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METHOD OF DRIVING GAS MOTORS USING LIQUID FUEL.
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UNITED STATES PATENT OFFICE.

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METHOD OF DRIVING GAS-MOTORS USING LIQUID FUEL.

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Specification of Letters Patent.

Patented Apr. 29, 1913.

Application filed April 1, 1909. Serial No. 487,184.

To all whom it may concern:

Be it known that I, HENDRIKUS BERNARDUS KRÛTHE, a subject of the Queen of the Netherlands, and resident of Goevorden, in the Kingdom of the Netherlands, have invented certain new and useful Improvements in Methods of Driving Gas-Motors Using Liquid Fuel, of which the following is a specification.

10 This invention relates to a device for working gas motors using liquid fuel, more especially that class of motors in which the liquid fuel is utilized partly for explosion and partly for subsequent gradual combustion under uniform pressure.

15 The invention consists mainly in opening, at the beginning of the suction period, communication between a fuel injection chamber and the engine cylinder so that the vaporized fuel remaining in said chamber from the previous working stroke is allowed to enter the cylinder for the formation of the explosive mixture, while also fresh liquid fuel enters the chamber, such liquid fuel remaining in said chamber during the compression and explosion of the mixture and being subsequently during a portion of the expansion period injected in the cylinder for combustion. The chamber is thereon closed against the cylinder after about one tenth of the expansion period, so that a small quantity of vaporized fuel is left in the chamber for use at the following suction period for forming the explosion mixture in the cylinder. In this manner various essential advantages are attained in this class of gas motor as compared with the existing method of working.

20 By opening communication between the fuel-injection chamber and the cylinder during only part of the expansion stroke, there will be continuous firing avoided during the later stages of the expansion period, while further the usual ejection of unconsumed fuel with the exhaust is also avoided, and consequently great economy of fuel is insured. Further, with the application of my improved method it will be possible to connect the chamber with the cylinder by means of a single valve and so simplify the construction of the engine. By keeping back highly compressed gas in the chamber, the engine can be easily arranged as a two cycle motor.

25 For carrying the invention into effect I provide in the cylinder cover a vaporizing

chamber supplied by the liquid fuel conduit and having a valve so operated as to form communication between such chamber and the engine cylinder during the suction and the compression periods but only during a part of the expansion period.

My invention is embodied in the arrangement shown in the accompanying drawings, and Figure 1 is a vertical section of a portion of the cylinder head fitted with the aforesaid device. Fig. 2 is a vertical section of a modified form of the chamber.

Referring to Fig. 1, the cylinder cover 1 is fitted with a plug 2 in the lower part of which a valve 3 closes the inlet to the cylinder, said valve being mechanically operated through suitable moving parts of the motor. In the lower portion of the plug 2 is formed a chamber 4 into which leads the liquid fuel conduit 5, the latter being normally closed by a valve 7 acted upon by a spring 6. In the center of the chamber 4 there is a sleeve 9 having radial holes 8 which latter lead from said chamber into an internal space 10.

The device is operated as follows: At the beginning of the suction period, valve 3 is mechanically opened. The chamber 4 contains highly compressed gas resulting from the previous working period as will be hereinafter more fully explained. With the open valve the gas will pass through the orifice 11 into the cylinder and there mix with the air drawn in for combustion. During the suction period the valve 7 opens and allows an appropriate quantity of liquid fuel to enter the chamber 4, which remains in the latter. At the following compression period, the mixture in the cylinder becomes compressed until explosion occurs. The pressure from the cylinder during compression has been communicated to the chamber 4 and the heat thereby generated has vaporized a portion of the liquid fuel in the chamber 4. The disposition of the chamber is such as to keep it comparatively cool and for this reason only a portion of the liquid fuel becomes vaporized during the working period. During the next expansion period in the cylinder, the gas from the chamber 4 enters the former and thereby injects the liquid fuel through the holes 8 into the space 10 whence it passes through the orifice 11 into the cylinder for combustion under uniform pressure. After about one tenth of the expansion period the whole of the liquid

fuel has been injected into the cylinder and the valve 3 is then closed. Hereon the combustion gases expand within the cylinder without a further supply of fuel and are then driven out during the period of exhaust. Owing to the closing of the valve 3 after only one-tenth of the expansion, there will naturally remain a certain amount of gas with corresponding high pressure in the chamber 4. At the next following suction period the re-opening of the valve 3 enables such compressed gas to enter the cylinder and there mix with the air to form an explosive mixture as already stated. When a pump is used for the injection of the liquid fuel into the chamber 4 the sleeve 9 with its holes 8 can be dispensed with and the form of chamber shown in Fig. 2 can be adopted. With this arrangement the pump must inject the liquid fuel into the chamber 4 shortly before the beginning of the compression period, that is to say, after the air for combustion has been drawn in. The immediately starting compression prevents the fuel from entering the cylinder. So that at the following expansion all the fuel shall enter the cylinder it is necessary to make the floor of the chamber 4 like a funnel as shown in Fig. 2.

With heavy hydrocarbons and especially in cold weather, a motor worked by the aforesaid method may be difficult to start under certain circumstances. This difficulty can be obviated by providing greater compression in starting. However, greater compression in starting, leads to the difficulty of having to reduce same subsequently by throttling the air admission or by other means. In order to insure the proper starting even under unfavorable condition while applying my improved method of working, I proceed as follows: The motor, whether of the four-cycle or two-cycle type, is started

gas, and is then allowed to draw-in air in the ordinary manner and compress same to the normal pressure. To obtain a higher compression than the normal at the first compression I introduce in the cylinder directly after the beginning of the compression a definite quantity of compressed air so that the compression starts with a pressure above atmospheric pressure and consequently a higher final compression will result. This naturally insures ignition. After one or two working periods the introduction of compressed air into the cylinder is interrupted and the motor is left to work with normal compression.

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

A method of working gas motors using liquid fuel, consisting in firstly placing a chamber in communication with the engine cylinder, whereby vaporized fuel left in such chamber from the previous combustion is delivered into said cylinder, so as to form the explosive mixture in the cylinder, whereupon liquid fuel is introduced in said chamber and retained therein during the compression and explosion of the explosive mixture and then injected into the cylinder during a part of the expansion period for gradual combustion whereupon after a certain expansion the chamber is closed against the cylinder so that a small quantity of vaporized fuel is left in the chamber for use in forming the explosive mixture in the cylinder at the next suction period, all substantially as set forth.

In testimony whereof I have hereunto signed my name this 18 day of March, 1909, in the presence of two subscribing witnesses.

HENDRIKUS BERNARDUS KRYTHE.

Witnesses:

W. A. MANICE,
WM. W. WINGAR.