L. A. CHARLES.

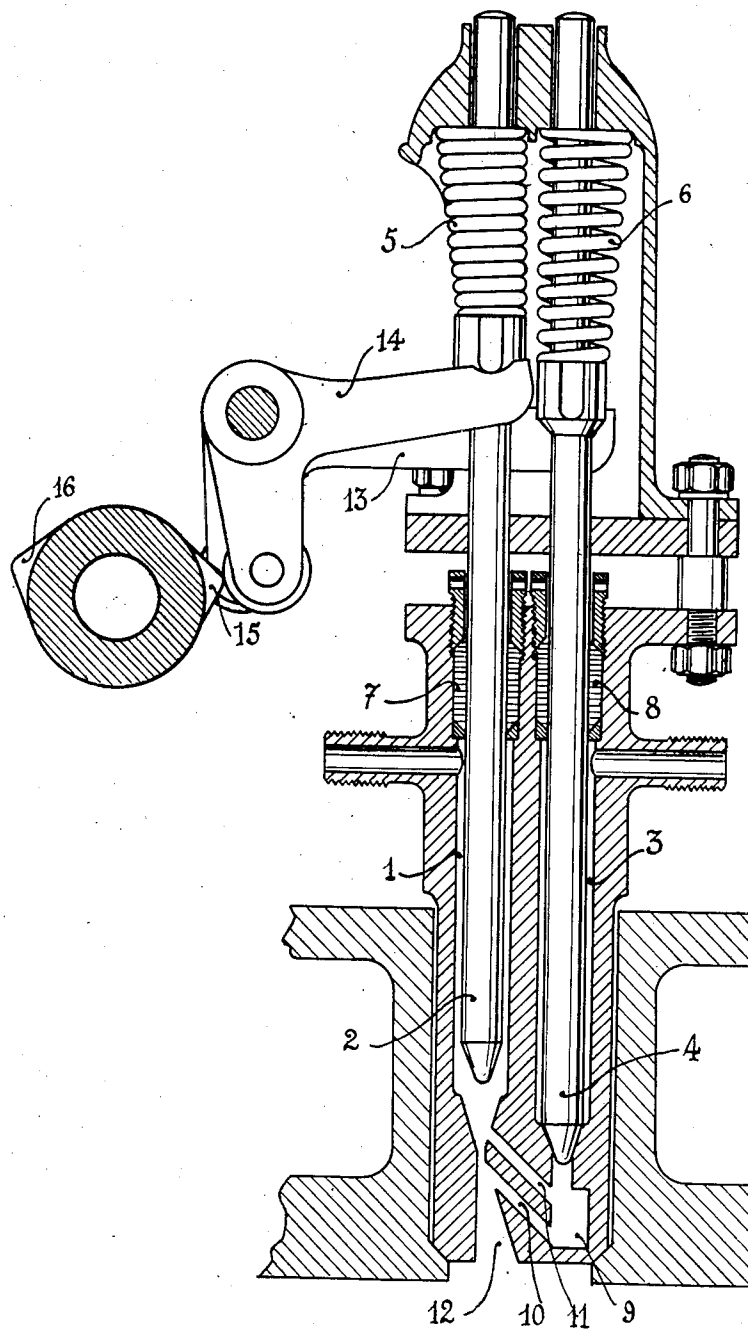
INJECTOR FOR INTERNAL COMBUSTION ENGINES.

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1,400,264.

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Fig. 1



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UNITED STATES PATENT OFFICE.

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INJECTOR FOR INTERNAL-COMBUSTION ENGINES.

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Application filed April 26, 1919. Serial No. 293,040.

To all whom it may concern:

Be it known that I, LOUIS AUGUSTE CHARLES, a citizen of the French Republic, residing at 18, Rue Fazilleau, Levallois-Perret, Seine, France, have invented certain new and useful Improvements in Injectors for Internal-Combustion Engines, of which the following is a specification.

This invention has for its object to provide an improved apparatus for injecting liquid fuel into the cylinders of internal combustion engines, more particularly of the Diesel type, which is designed to allow of using the fuel under the best conditions for efficiency in all internal combustion engines, and more particularly in engines working at a high angular speed, and subjected to widely varying fluctuations of speed and load. This is more particularly the case with engines for airplanes, airships, motor tractors, marine tow boats, etc.

In order to obtain the best result under all conditions from an internal combustion engine mounted in an airplane or airship, it is necessary to vary the amount of fuel that is injected, and also the amount of air that is strictly necessary for said injection: (1) according to the load on the engine, and (2) according to the altitude, because the variations of the altitude entail the in-drawing of air of variable pressure and consequently a cylinder charge containing variable weights of air.

It has been proposed to attain the best possible yield by maintaining the cylinder charges of air at a constant degree of carburation and of admitting at each injection only the air that is strictly necessary. This result is effected according to the present invention by means of an injector constructed as follows: The fuel which is maintained with a low head at a distribution orifice, flows under the action of this head into a small intermediate reservoir during a determined period of the cycle where the pressure in the cylinder is lower than the pressure of the atmosphere. This reservoir communicates through two pipes or passages of suitable dimensions and direction with a converging-diverging duct that is always in direct communication with the cylinder and into which flows during the period of injection, compressed air taken from a constant-pressure reservoir. The two pipes connecting the intermediate fuel reservoir to the converging-diverging injection air duct open one above the other below the contracted neck of the said duct in such a manner that the said compressed air will flow equally through the two pipes opening into the intermediate reservoir, through the said reservoir, and will carry the fuel into the cylinder.

The phases of distribution of the fuel and the injection air are regulated by means of two cams of variable profile. The accompanying drawing illustrates by way of example a constructional form of this invention.

As shown, the improved injector comprises a compressed air chamber 1, adapted to be closed by a needle valve 2, and a fuel chamber 3 adapted to be closed likewise by a needle valve 4. The two needle valves are normally held against their seats by springs 5 and 6 respectively, and they extend respectively through stuffing boxes 7, 8 that serve to close in the upper ends of the said chambers. In the prolongation of, and at the lower part of the fuel orifice there is provided an intermediate fuel reservoir 9 which communicates through two inclined passages 10 and 11 with a converging-diverging duct 12 arranged in the axis of and below the compressed air orifice. This duct opens at its lower end into the cylinder. These two passages that establish communication between the intermediate reservoir and the converging-diverging duct are inclined in such a manner that the maximum quantity of fuel which is to be injected into each cylinder charge is situated at rest in the reservoir 9, and will not flow into the converging-diverging duct. The two needle valves 2 and 4 are operated by rocking levers 12 and 13 driven by means of cams 14 and 15 having varying profiles.

When the fuel needle valve 4 is lifted (during a determined period of the cycle wherein the pressure in the cylinder is less than the atmospheric pressure), the fuel will be caused to flow by the action of its own head and the diminution of pressure at the orifice, into the intermediate reservoir 9, whereupon the fuel needle valve 4 will close immediately the quantity of fuel has passed through which is suitable for the load on the engine at that moment. The compressed air needle valve 2 will then open at the end of the compression period, and the

air will be allowed to pass through into the converging-diverging duct. The inclined passage 11 establishes communication between the converging portion of the duct 12 and the upper part of the intermediate fuel reservoir 9 (above the level of the liquid), so that the pressure acting upon the upper level of the fuel is practically equal to that which acts upon the air outlet. The pressure in the converging-diverging duct increases continuously from the orifice to the top of the converging portion, and then diminishes in a likewise continuous manner from the top of the diverging portion to the cylinder. The inclined passage 10 establishes communication between the diverging portion of the duct 12 and the lower part of the intermediate fuel reservoir 9. The arrangement is such that if P_1 be the mean pressure at the upper level of the fuel (practically the pressure at the outlet of the compressed air), and if P_2 be the mean pressure of the diverging portion communicating with the lower part of the intermediate reservoir, then as P_1 is greater than P_2, the fuel will flow in the diverging portion approximately with the pressure P_1 (having due regard to the variations of P_1 during the flow), and with a speed equal to P_1-P_2, the fuel will then be carried into the cylinder by the air flowing in the converging-diverging duct. The direction of the liquid jet in the diverging portion incloses with the direction of outflow of the air an angle comprised between 11 and 12 which promotes the sub-division of the fuel so that the latter enters in a vesicular state into the cylinder.

The improved injection apparatus has always the advantage of not admitting any fuel into the cylinder at a wrong time if there should be any leakage at the bottom of the air valve 2, such admission occurring with ordinary injectors in the same circumstances. As a matter of fact in the improved apparatus the air which would flow out at a very low pressure in the case of a partial want of tightness of the air valve 2, would flow out at a low velocity through the converging-diverging duct 12 without generating in the two inclined passages 10 and 11, a difference of pressure that would be sufficient to produce an outflow of fuel from the intermediate reservoir 9.

What I claim is:—

Injecting apparatus for internal combustion engines comprising a passage for the compressed air, a needle forming a valve in this passage, a convergent divergent air passage of continuously varying cross section arranged below the needle and emptying directly into the motor, a passage for the non-compressed fuel, a needle forming a valve in said fuel passage, an intermediate reservoir below the last mentioned needle for the fuel, two passages establishing communication between the intermediate reservoir and the convergent divergent air passage respectively above and below the narrowest cross section, the two passages being parallel and inclined in a direction reverse to the air current, and two cams of variable profile controlling the two needles distributing the air and fuel.

In testimony whereof I have signed my name to this specification.

LOUIS AUGUSTE CHARLES.