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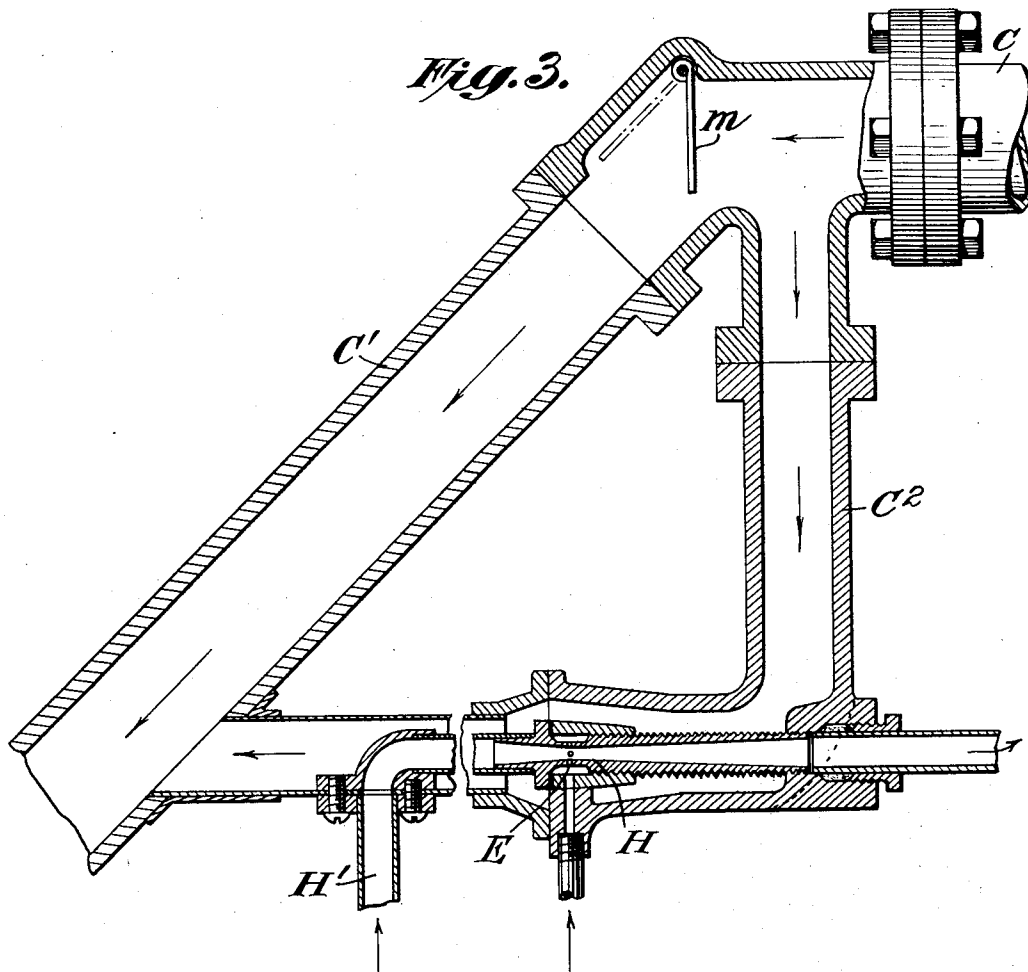
K. R. MANVILLE

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METHOD OF AND APPARATUS FOR FORMING AN EXPLOSIVE MIXTURE

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INVENTOR
Keith R. Manville
BY Redding & Greeley
ATTORNEYS

UNITED STATES PATENT OFFICE.

KEITH R. MANVILLE, OF ELMHURST, NEW YORK, ASSIGNOR TO INTERNATIONAL MOTOR COMPANY, OF NEW YORK, N. Y., A CORPORATION OF DELAWARE.

METHOD OF AND APPARATUS FOR FORMING AN EXPLOSIVE MIXTURE.

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To all whom it may concern:

Be it known that I, KEITH R. MANVILLE, a citizen of the United States, residing at Elmhurst, Long Island, in the State of New York, have invented certain new and useful Improvements in Methods of and Apparatus for Forming an Explosive Mixture, of which the following is a specification, reference being had to the accompanying drawings, forming a part hereof.

Various expedients have been resorted to in the past for the purpose of securing practically complete vaporization of liquid fuel particles for internal combustion engines. These expedients have been characterized by the disregard of certain fundamental requirements where maximum thermal and volumetric efficiency is to be secured. Further, certain physical limitations in the art have been imposed on such devices owing to the impossibility of metering the fuel when at a vaporization temperature. Ideal conditions require the metering of the fuel at a temperature below the boiling point, the carburetion of primary air with vaporized fuel at a temperature beyond the end point of the fuel's distillation (with gasoline 450° F. or above), and the introduction of the mixture thus formed into the cylinder as a dry gas cooled to the dew point. The object of the present invention is to provide a method of and apparatus for practicing and accomplishing the conditions described which shall be entirely practical for manufacture and susceptible of commercial application, especially to motor vehicles and the like.

In accordance with the invention it is proposed to meter the fuel at the source of supply in accordance with accepted practice, to lead it to the venturi through a feed pipe which is heat insulated from the metering device, to subject the fuel in the jet to a temperature near or beyond the end point and the primary air to the same temperature, as by heat derived from the exhaust gases, leading the mixture thus formed to the inlet manifold while permitting its temperature to drop to that point which gives the greatest thermal and volumetric efficiency and adding, in the preferred form, secondary air of a predetermined temperature to assist in bringing the mixture to the desired temperature. The

apparatus for practicing the method includes elements for giving the conditions described by devices which are simple, inexpensive and thoroughly dependable under conditions of use to which motor vehicles are subjected.

In the accompanying drawings two embodiments of the invention are illustrated, by way of example. In these drawings:

Figure 1 is a view partly in section and partly in side elevation of so much of a cylinder of an internal combustion engine and the improved apparatus as is necessary for an understanding of the application of the invention, the showing being somewhat diagrammatic.

Figure 2 is a detailed sectional view of the exhaust pipe and primary air inlet taken on the plane indicated by the line 2—2 of Figure 1 and looking in the direction of the arrows.

Figure 3 is a somewhat modified construction whereby the volume of exhaust gases employed for heating is controlled automatically at different engine speeds.

The cylinder *a* is provided with an inlet manifold *b*, an exhaust manifold *c*, an inlet valve *b'*, and an exhaust valve *c'* all of which may be of any suitable form and arrangement. The source of fuel supply is indicated as a float chamber *d* from which the liquid fuel is metered through a port *d'* controlled by a needle valve *d''*. It is necessary to proper metering of liquid fuel that it should not boil and accordingly all vaporization thereof must be effected at points beyond the metering point. This fact has led generally to the provision of devices for vaporizing the fuel beyond the nozzle since no means have been proposed for heat insulating the metering device from the nozzle. In accordance with the present practice a departure is made in that it is proposed to subject the nozzle *e* to a heat which may bring its temperature to a point above the end point of the fuel's distillation, in present day gasoline, 450° F. or above. For convenience, it is proposed to derive this heat from the exhaust gases discharged through the manifold *c*. In the form of apparatus illustrated in Figure 1 the exhaust pipe *c'* is formed with a by-pass *c''* into which extends the nozzle *e*, which is subjected to heating by the exhaust

gases. It is evident that such high heating of the jet would bring the liquid fuel at the metering point d' to a boiling point and, accordingly, heat insulation is interposed between the nozzle and the metering device. Such insulation may take different forms but a simple construction is shown in Figure 1. There, the fuel pipe is composed of two sections d^3 and e' separated by a length of heat insulating material which may be made up of laminated rings f of asbestos or the like bolted together and to the pipe sections d^3 , e' , respectively, as by bolts f' . Within the laminations f may be embedded a heating coil g and, if desired, a short section of copper pipe g' or the like whereby heat may be applied for the purpose of vaporizing a starting charge. In practice, however, it will be evident that the insulated section described will prevent heat from the jet pipe e traveling by conduction to the metering port d' .

The nozzle of the jet e is disposed in proximity to a venturi h to which primary air is led through an air pipe h' which may be built around the exhaust pipe c' as shown clearly in Figs. 1 and 2. This air pipe h' extends into the branch c^2 of the exhaust pipe and receives the jet e and passes out through the wall of the by-pass to convey the mixture to the inlet manifold b . At the point where the pipe h' discharges into the manifold b a nozzle h^2 may be formed and disposed in proximity to a venturi section b' , secondary air of any predetermined temperature being led over the nozzle for the purpose of further diluting the mixture and bringing it to the most efficient temperature prior to introduction into the cylinder. A throttle valve i may be disposed in the inlet manifold b beyond the venturi b' . This throttle valve may be connected through a link k to a second throttle valve l disposed within the exhaust pipe c' between the ends of the by-pass c^2 so that the throttle may cause more or less of the exhaust gases, by volume, to be diverted through the by-pass. At low speeds, for instance, when the throttle valve i is practically closed, the throttle valve l will be practically closed and practically the entire volume of exhaust gases will pass through the by-pass c^2 .

From the description given the method proposed will be understood. It involves a metering of the liquid fuel at a temperature below the boiling point, the carburetion of the primary air by vaporized fuel picked up from the jet at a temperature above the end point, and the subsequent cooling of the mixture thus formed to a point which insures maximum thermal and volumetric efficiency when introduced into the cylinder. This temperature is known as the dew point.

In the form of apparatus shown in Figure 3 it is proposed to practice the same method

although the piping of the exhaust pipe is such as to maintain automatically the desired volume of exhaust gases in and around the jet at different speeds of the motor. The exhaust manifold C discharges into the main exhaust pipe C' past a gravity hung baffle m at high velocities, that is, at high engine speeds. The gases will pass the baffle m with comparatively little deflection. At lower engine speeds, however, the baffle m will deflect a greater volume of gases through the by-pass C^2 and over the venturi H disposed therein. Fuel passes up to the jet E from a heat insulated pipe as heretofore described and is raised at the jet to a temperature above the end point of distillation by the heat of the exhaust gases passing over the pipe H' . Air entering the pipe H' is conveyed therethrough to the venturi H and subjected to the heat of the exhaust gases in the manner heretofore indicated. The mixture thus formed may be introduced into the inlet manifold and later cooled as before described.

Changes in construction of the apparatus having to do with matters of design and arrangements of parts may be made without departing from the spirit of the invention since the apparatus illustrated herein is intended to be merely by way of example and of somewhat conventional character, the improved method being susceptible of successful practice in other types of apparatus which enable the same conditions to be obtained.

What I claim is:

1. The combination with the exhaust and inlet passage of an internal combustion engine of apparatus for forming an explosive mixture which includes a metering device, an air intake pipe passing through the exhaust passage, a fuel conduit passing through the exhaust passage and terminating within the air intake pipe within the exhaust passage, said air intake pipe quitting said exhaust passage and being exposed to atmospheric temperature for an appreciable distance and terminating in a nozzle in the inlet passage.

2. The combination with the exhaust passage and inlet passage of an internal combustion engine of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air heating chamber surrounding the exhaust passage, an air intake pipe leading from the chamber and passing through the by-pass, a fuel conduit passing through the by-pass and terminating in a jet within the air intake pipe in the by-pass, said air intake pipe quitting the by-pass and being exposed to atmospheric temperature for an appreciable distance and terminating in a nozzle in the inlet passage.

3. The combination with the exhaust passage and inlet passage of an internal com-

bustion engine of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air heating chamber surrounding the exhaust passage, an air intake pipe leading from the chamber and passing through the by-pass, a fuel conduit passing through the by-pass and terminating with a jet within the intake pipe in the by-pass, said air intake pipe extending out of the by-pass to be exposed to atmospheric temperature and entering into the inlet passage, a nozzle carried with the end of the air intake pipe within the inlet passage and means to admit additional air to the inlet passage.

4. The combination with the exhaust passage and inlet passage of an internal combustion engine of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air heating chamber surrounding the exhaust passage, an air intake pipe leading from the chamber and passing through the by-pass, said air intake pipe being formed with a venturi passage, a fuel conduit passing through the by-pass and terminating with a jet within the air intake pipe in proximity to the venturi passage, a pipe section communicating with the metering device, a pipe section communicating with the fuel conduit, heat insulating material interposed between said pipe sections, said air intake pipe quitting the by-pass and terminating in a nozzle in the inlet passage after being exposed to atmospheric temperature.

5. The combination with the exhaust passage and inlet passage of an internal combustion engine of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air heating chamber surrounding the exhaust passage, an air intake pipe leading from the chamber and passing through the by-pass, a fuel conduit passing through the by-pass and terminating with a jet within the air intake pipe in the by-pass, a pipe section communicating with the metering device, a pipe section communicating with the fuel conduit, heat insulating material interposed between said pipe sections, said air intake pipe quitting the by-pass and being exposed to atmospheric temperature for an appreciable distance and terminating in a nozzle in the inlet passage, and means to control the flow of exhaust gases in the by-pass dependent on the flow of the mixture in the inlet passage.

6. The combination with the exhaust passage and inlet passage of an internal combustion engine, of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air heating chamber surrounding the exhaust passage, an air intake

pipe leading from the chamber and passing through the by-pass, a fuel conduit passing through the by-pass and terminating with a jet within the air intake pipe in the by-pass, a pipe section communicating with the metering device, a pipe section communicating with the fuel conduit, a heat insulating section interposed between said pipe sections, said air intake pipe quitting the by-pass and being exposed to atmospheric temperature for an appreciable distance and terminating in a nozzle in the inlet passage and an electric heating coil within said heat insulating section and operable to vaporize fuel within the metering device and jet.

7. The combination with the exhaust passage and inlet passage of an internal combustion engine of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air intake pipe heated by the exhaust from the engine, a fuel jet heated by the exhaust in the by-pass and disposed in the air intake pipe, means to control the flow of exhaust gases through the by-pass dependent upon the speed of operation of the engine, a nozzle in the inlet passage and a connection between the nozzle and air intake pipe maintained at substantially atmospheric temperature.

8. The combination with the exhaust passage and inlet passage of an internal combustion engine of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, an air heating chamber surrounding the exhaust passage, an air intake pipe leading from the chamber and passing through the by-pass, a fuel conduit passing through the by-pass and terminating in a jet within the air intake pipe in the by-pass, said air intake pipe quitting the by-pass and being exposed to atmospheric temperature for an appreciable distance and terminating in a nozzle in the inlet passage, and means to admit relatively cold air to the intake dependent upon the speed of operation of the engine.

9. The combination with the exhaust passage and inlet passage of an internal combustion engine, of apparatus for forming an explosive mixture which includes a metering device, a by-pass formed in the exhaust passage, means to control the flow of exhaust gases through the by-pass dependent upon the speed of operation of the engine, an air heating chamber surrounding the exhaust passage, an air intake pipe leading from the chamber and passing through the by-pass, a fuel conduit passing through the by-pass and terminating with a jet within the air intake pipe in the by-pass, a pipe section communicating with the metering device, a pipe section communicating with the fuel conduit, a heat insulating section

interposed between said pipe sections, said air intake pipe quitting the by-pass and being exposed to atmospheric temperature for an appreciable distance and terminating in a nozzle in the inlet passage, means to admit⁵ relatively cold air to the intake dependent upon the speed of operation of the engine, and an electric heating coil within said heat insulating section and operable to vaporize fuel within the metering device and jet.¹⁰

This specification signed this 27th day of April, A. D. 1922.

KEITH R. MANVILLE.