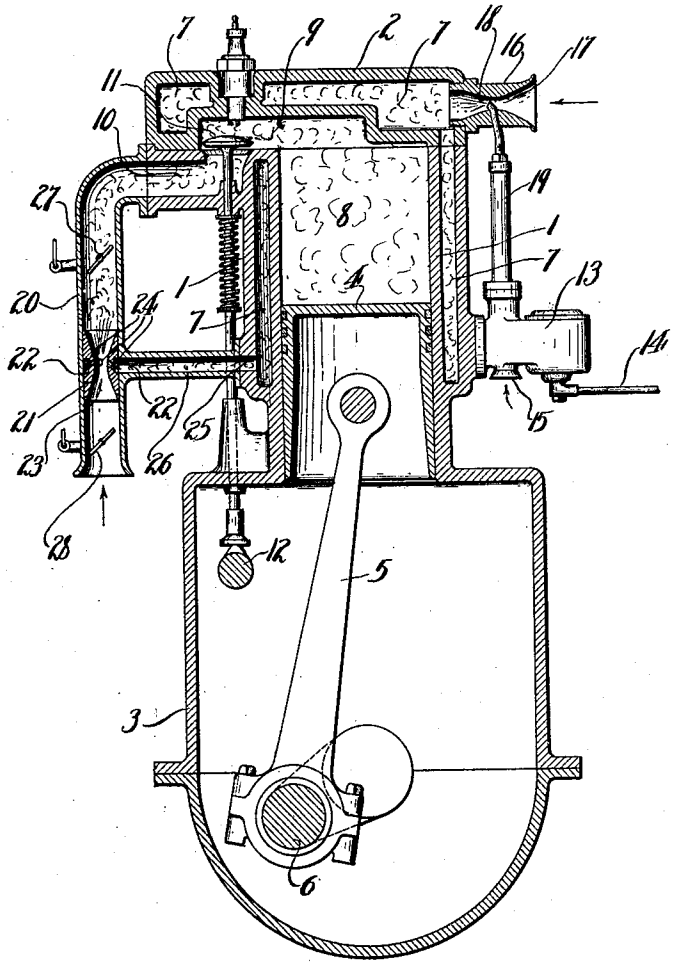
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FUEL DELIVERY SYSTEM FOR INTERNAL COMBUSTION ENGINES

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FUEL DELIVERY SYSTEM FOR INTERNAL COMBUSTION ENGINES

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This invention relates, generally, to method of and means for delivering fuel mixtures to internal combustion engines.

This invention has for its principal object to provide a novel method of and means for delivering a combustible mixture of air and liquid fuel to the cylinders of internal combustion engines, whereby atomized liquid fuel with a primary portion of air is initially delivered into a chambered jacket surrounding the engine cylinder or cylinders so that the heat of combustion during engine operation may be utilized to superheat an initial fuel mixture in aid of more perfect vaporization of the liquid content thereof, while at the same time utilizing the cold initial mixture as a cooling medium to surround the engine cylinder or cylinders whereby the heat generated during combustion of the fuel mixture in the latter may be absorbed, and whereby the temperature drop incident to vaporization of the initial fuel mixture may also be a factor in attaining and maintaining the engine in cooled condition during operation thereof.

The invention also has for a further object to provide, in connection with the means above characterized for treating the initial fuel mixture, means for delivering the treated fuel mixture into the engine cylinder or cylinders together with an admixed secondary or auxiliary proportion of cool air, whereby the air content of the final fuel mixture is increased and the temperature of the latter is lowered to thereby increase the density of the same and thus render it more efficient.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following detailed description of the same.

An illustrative embodiment of an arrangement of fuel treating and delivery means according to this invention is shown in the accompanying drawing in connection with a cylinder of an internal combustion engine, the same being shown in vertical section.

Referring to the drawing, the reference character 1 indicates a cylinder of an internal combustion engine, 2 the head thereof, and 3 the engine crank case. Reciprocable in said cylinder 1 is a piston 4, connected by the connecting-rod 5 to the crank shaft 6 of the engine, said piston being shown on its descending fuel mixture induction stroke.

The walls of cylinder 1 and its head 2 are provided with intercommunicating jacketing chambers 7 to surround the cylinder bore 8 and firing chamber 9. Communicating with the firing chamber 9 is a fuel mixture intake passage 10, which is opened and closed in conventional manner by a valve 11, timed actuation of which is controlled by a cam shaft 12, or in any other usual or suitable manner.

The novel means for preparing and delivering a combustible fuel mixture to the firing chamber 9 and cylinder bore 8 comprises any suitable form of carburetor 13 to which a liquid fuel is delivered through the supply pipe 14 leading from a liquid fuel supply, and by which said liquid fuel is atomized and mixed with an initial proportion of air admitted through its air intake 15. Connected with the head 2, with its inner end communicating with the upper portions of said jacketing chambers 7, is a Venturi member 16 having its outer end communicating with the atmosphere. Leading into the restricted portion of the Venturi passage 17 provided by said member 16 is a jet 18. Said jet 18 is connected with the discharge of said carburetor 13 by a suitable conduit pipe 19. Connected in communication with the intake passage 10 is an intake conduit or manifold 20, having its free extremity open to the atmosphere. Arranged within said intake conduit or manifold 20 is a Venturi member 21 having an external annular passage 22 from which radially extend, into communication with the restricted portion of the Venturi passage 23 of said member 21, a plurality of jet passages 24. The cylinder 1 is provided with an outlet opening 25 leading from the lower portions of the jacketing chambers 7. The annular passage 22 is connected in communication with said outlet opening 25 by a suitable conduit pipe 26. A suitable form of throttle valve 27 is mounted in said intake conduit or manifold 20 above the Venturi member 21 thereof.

In the operation of the novel fuel delivery system, under suction of the engine piston during engine running conditions, approximately only the quantity of air sufficient to lift and atomize the liquid fuel at the jet of the carburetor 13 is entered through the air intake 15 of said carburetor; usually such amount of air approximates above five per cent of the total air content ultimately contained in the fuel mixture delivered into the firing chamber of the engine cylinder. The atomized mixture of liquid fuel and air thus formed at the carburetor 13 constitutes an initial wet fuel mixture. The engine suction also operates to induct into the upper portion of the jacketing chambers 7, through the passage 17 of the Venturi member 16, an additional proportion of air, which acting on the jet 18 carries and mixes therewith the initial wet fuel mixture discharged by the carburetor to produce a primary wet fuel mixture. This added air increases the volume of the primary wet fuel mixture delivered into the jacketing chambers 7, the amount of added air approximating ten per cent of the total air content ultimately contained in the final fuel mixture delivered into the firing chamber of the engine cylinder. The primary wet fuel mixture in entering the upper regions of the jacketing chambers 7 is caused to first traverse the walls of the firing chamber, which, under engine running conditions, are highly heated by the heat generated during firing and combustion of the fuel mixture delivered thereinto to drive the piston. The cold primary wet fuel mixture, in thus contacting with these hot walls, takes up the heat transferred therethrough with marked cooling effect on the walls. The heat thus taken up aids in evaporating the liquid constituent of the primary wet fuel mixture so as to convert the same into a gaseous mixture. The primary fuel mixture thus subjected to evaporation by heat, adds to its inherent comparatively low temperature, the additional cooling effects consequent upon evaporation. The fuel mixture circulates through and around the jacketing chambers 7 which envelop the cylinder 1 with like cooling effects upon the walls of the latter, and with continued evaporating effect upon the liquid fuel, until the resulting comparatively dry gaseous fuel mixture is discharged through the outlet opening 25 to pass to the Venturi passage 23 of the Venturi member 21, and thence through the conduit 26, annular passage 22 and jet passages 24. It will thus be apparent that the jacketing chambers 7 of the cylinder 1 and its head 2, provide a vaporizing and expansion means for the initial wet fuel mixture, while at the same time the ability of said wet fuel mixture to absorb heat renders the same an effective circulatable cooling agency for movement around the hot internal walls of the engine cylinder and its head. The wet fuel mixture being delivered at the top or head of the cylinder travels downwardly around the walls of the cylinder until it finally escapes at the lower regions of the jacketing chamber surrounding the latter. It will be obvious that the jacketing chambers may be internally shaped in any desired manner calculated to direct and assure the circulating movement of the introduced fuel mixture from the hottest upper regions thereof to the lower regions and uniformly around the cylinder walls; to such purpose spiral baffles or like directing agencies may be provided within the interior of the jacketing chamber around the cylinder 1.

The rich comparatively dry gaseous fuel mixture, produced in the manner above described, is drawn into the Venturi passage 23 in the intake conduit or manifold 20, where it is mixed with cool air which enters the open end of the latter. Said cool air both dilutes the rich mixture and desirably lowers its temperature. The diluting cool air, under general engine running conditions, approximates about eighty-five per cent of the air content of the ultimate fuel mixture which is carried by the intake conduit or manifold 20 into the intake passage 10, and thence into the firing chamber 9 and engine cylinder interior 8 when the admission valve 11 is opened.

A manipulatable choke valve 28 of suitable form may be arranged in the intake conduit or manifold 20 below the Venturi member 21, which may be wholly or partially closed during the starting of the engine so as to assure delivery of a rich fuel mixture to the firing chamber and cylinder of the latter for starting purposes.

While I have shown but a single cylinder in the drawing for the purpose of illustrating the principles of operation and structure involved in the present invention, it will be obvious and therefore understood that these principles of operation and structure are equally applicable to all engines of the multi-cylinder type.

It will also be understood that, although I have specified approximate relative proportions of initial atomizing air, auxilary air and final diluting and cooling air entering into the fuel mixture at different stages of its preparation, such proportions are to be taken as illustrative, the same being more or less widely variable as may be desired, and according to the particular grade or kind of liquid fuel utilized as the combustible constituent of the fuel mixture.

By reason of the high heat available at the wall surfaces of internal combustion engine firing chambers and cylinders, the method of fuel mixture preparation afforded by the present invention is especially efficient when utilizing liquid fuel constituents comprising low grade or comparatively heavy oil.

I am aware that many changes could be made in the above described operations and structures as well as in the details thereof without departing from the scope of this invention, and therefore it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:—

1. Means for preparing and delivering gaseous fuel mixtures to the cylinders of internal combustion engines, comprising an engine cylinder having a jacketing chamber enveloping the walls thereof, a carburetor for producing a fuel mixture, means for connecting said carburetor in communication with said jacketing chamber whereby the fuel mixture is caused to circulate through the latter in contact with the hot cylinder walls with cooling effect upon the latter and vaporizing effect upon the fuel mixture, said cylinder having a fuel mixture admission means communicating with the interior thereof, an intake conduit leading to said admission means, means to conduct the vaporized fuel mixture from said jacketing chamber to said intake conduit, and means associated with said intake conduit for mixing additional air with the fuel mixture conducted therethrough for delivery into said cylinder.

2. Means for preparing and delivering gaseous fuel mixtures to the cylinders of internal combustion engines, comprising an engine cylinder having a jacketing chamber enveloping the walls thereof, a carburetor for producing a wet fuel mixture, a Venturi member leading into said jacketing chamber, a fuel mixture jet entered within the restricted portion of the passage of said Venturi member and fed by said carburetor, said Venturi member operating to admit auxiliary air with said wet fuel mixture into said jacketing chamber, whereby the fuel mixture is caused to circulate through said jacketing chamber in contact with the hot cylinder walls with cooling effect upon the latter and vaporizing effect upon the fuel mixture, and means to conduct the vaporized fuel mixture from said jacketing chamber into the cylinder interior.

3. Means for preparing and delivering gaseous fuel mixtures to the cylinders of internal combustion engines, comprising an engine cylinder having a jacketing chamber enveloping the walls thereof, a carburetor for producing a wet fuel mixture, a Venturi member leading into said jacketing chamber, a fuel mixture jet entered within the restricted portion of the passage of said Venturi member and fed by said carburetor, said Venturi member operating to admit auxiliary air with said wet fuel mixture into said jacketing chamber, whereby the fuel mixture is caused to circulate through said jacketing chamber in contact with the hot cylinder walls with cooling effect upon the latter and vaporizing effect upon the fuel mixture, said cylinder having a fuel mixture admission means communicating with the interior thereof, an intake conduit leading to said admission means, means to conduct the vaporized fuel mixture from said jacketing chamber to said intake conduit, and means associated with said intake conduit for mixing additional air with the fuel mixture conducted therethrough for delivery into said cylinder.

In testimony, that I claim the invention set forth above I have hereunto set my hand this 5th day of February, 1931.

ERNEST R. GODWARD.