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2 Sheets-Sheet 1



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CARBURETOR AND CARBURETION SYSTEM
FOR INTERNAL COMBUSTION ENGINES

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2 Sheets-Sheet 2

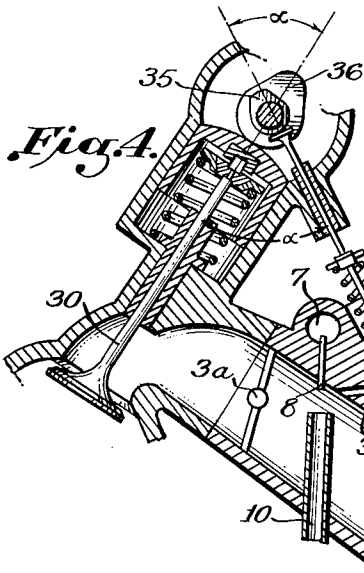


Fig. 4.

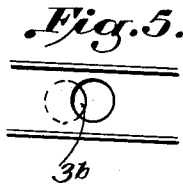


Fig. 5.



Fig. 6.

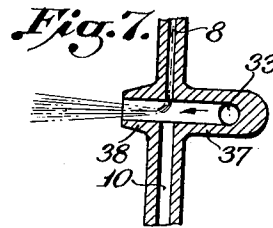


Fig. 7.

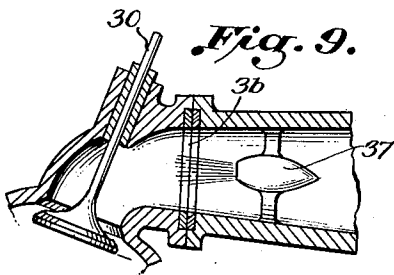


Fig. 9.

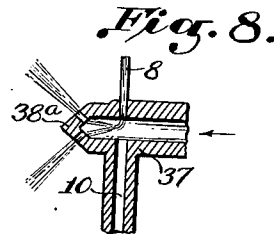


Fig. 8.

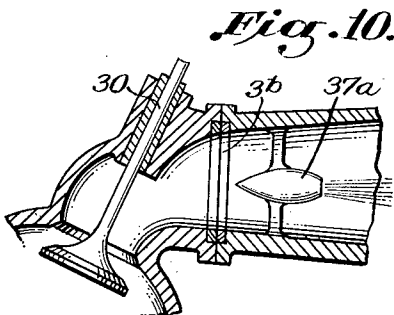


Fig. 10.

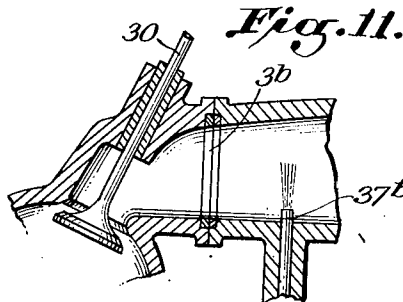


Fig. 11.

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CARBURATOR AND CARBURATION SYSTEM FOR INTERNAL COMBUSTION ENGINES

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15 Claims. (Cl. 123—119)

This invention provides a system of carburation for an internal combustion engine characterized in that the fuel is made to flow under pressure in a continuous stream from a jet of constant section with a delivery rate which varies as a function of the speed of the engine and of the variation of the density of the air in the suction conduit, said stream passing through a chamber in communication with the engine intake conduit, and said fuel is at predetermined intervals atomised and intimately mixed with the air for carburation by the impingement on said stream of a strong jet of air under pressure, the discharge of which is intermittent and in phase with the opening of the engine intake valve, the duration of discharge of the atomising air jet being a predetermined fraction of the duration of the suction phase.

The invention further provides a carburettor for effecting carburation according to the aforesaid system, which carburettor is characterised by a continuous circuit for circulation of the fuel, a reservoir, a delivery pump from which extends to each cylinder intake, a duct ending with a jet of gauged section directed into a cavity in communication with the cylinder intake, a collector for excess fuel disposed opposite the jet, and a conduit recycling the fuel from the collector to the reservoir; and a nozzle associated with means to provide intermittent jets of compressed air directed to impinge on the stream of fuel between the jet and the collector.

The means to provide jets of compressed air may be a distributor device adapted to regulate the duration, the discharge phase and optionally the pressure of the jets of compressed air in relation to the speed of the engine.

The carburettor as aforesaid may include means for automatically regulating the state of the jet fuel in order to keep constant the proportion of fuel to air in the mixture, notwithstanding variation of the speed of the engine and/or variation of the pressure of the air in the intake conduit.

In a carburettor as aforesaid, the rate of delivery of the jet of fuel may be made to vary as a function of the speed of the engine, by varying the pressure of the jet, as by mechanically connecting to the engine a fuel delivery pump and an excess fuel recycling pump when fitted.

It is known that in types of carburettors commonly in use at the present time there is provided in the suction manifold of the engine a throat in which the flow of air acquires a greater velocity and consequently a pressure which is lower than atmospheric pressure. In the most restricted section of the throat is introduced a small tube with a gauged outlet aperture, through which the fuel is drawn in, the fuel mixing with the air in movement and being atomised, thus constituting the mixture which is drawn into the engine. However, in order that this may function properly at various speeds, it is necessary that at all times the ratio by weight between the air drawn in and the fuel in suspension should remain constant, and that moreover the perfect mixing of the two elements should be ensured. It has been attempted to obtain constancy of this ratio by various means, but these have attained the object only partially. In order to ensure intimate mixing of the elements it has always hitherto been attempted to increase the fineness of atomisation, avoiding at all costs the formation of large globules and drops. Nevertheless, carburettors constructed on the basis of such informatory principles have considerable defects: In particular, the weight ratio is never maintained at all points of the curve of utilisation, discontinuity increasing in the case of rapid opening or closing of the throttle or like control means.

Atomisation of the fuel obtained by sub-atmospheric pressure is deficient, particularly when, as in engines having a high volumetric capacity which are not supercharged, it has been necessary to adopt throats of large diameter with the object of reducing load losses.

In the case of multi-cylinder engines having manifolds connecting the several cylinder intakes, the presence of the mixture in the interconnection passages gives rise to considerable lack of uniformity of distribution of the mixture in the several cylinders.

In high speed engines (that is, those having a high volumetric capacity), the limited homogeneity of the mixture, caused by defective atomisation, affects the regular operation of the engine to a greater extent with higher speed; the duration of the phases immediately preceding and following the ignition decreases in inverse proportion to the increase of the speed; this results in inferior performance or higher consumption of fuel, the latter not being completely utilised in the expansion phase. In order to obtain correct mixing of the air with the fuel, injection systems are also used in addition to sub-atmospheric pressure carburettors. These systems, while achieving the desired object, require complex apparatus the operation of which is delicate, and therefore they are expensive; in addition, they are not well suited for application to multi-cylinder engines of small individual cylinder capacity and running at high speeds, in which it is difficult to adjust the members with the necessary accuracy for the extremely small amounts of fuel which are required for each cylinder. Injection devices are scarcely suitable for high speed engines, in view of the necessity of increasing the frequency of the alternating movements of certain members. The functioning of the small auxiliary pumps, which is sufficiently accurate when using a heavy fuel, for example fuel oil, becomes particularly critical when it is necessary to use, for example, petrol which is devoid of any lubricating characteristic.

The mechanical system of carburation forming the subject of the present invention provides the following advantages:

- (a) Homogenous atomisation, with very fine dispersion.
- (b) Perfect mixing of atomised fuel and air drawn in by the engine, with the formation of an explosive mixture which is also suitable for very rapid cycles.
- (c) Atomisation in each cylinder limited solely to the suction phase of that cylinder.
- (d) Absence of atomised fuel from the manifolds connecting several cylinder intakes.
- (e) Exact adjustment of the amount of fuel even in engines having small cylinder capacity.
- (f) Low unit consumption of fuel.
- (g) Automatic regulation of the strength of the mixture in any contingency (acceleration, rapid throttling, and so on), even in the case of barometric variations (variations of altitude).

Some embodiments of means for carrying out the invention will be described by way of example and without limitation, with reference to the accompanying diagrammatic drawings, in which:

Figure 1 is the longitudinal section of one embodiment. Figure 1a is a view of a detail.

Figure 2 shows in longitudinal section an alternative embodiment.

Figure 3 shows part of another embodiment, which will be referred to as an atomisation unit.

Figure 4 shows in longitudinal section an alternative embodiment of the mechanism for the regulation of the opening and closing of the discharge of air under pressure.

Figures 5 and 6 show a guillotine valve.

Figures 7 and 8 show the particular of two shapes of the atomising unit.

Figures 9 to 11 show some dispositions of the atomising unit.

Referring to Figure 1 of the drawings, a cylinder intake part 1 extends towards the air intake in the form of a tubular conduit 2, in which there is provided at the outer end a normal throttle valve 3 or other suitable regulation means; in a suitable lateral cavity in

85 The variant shown in Figure 3 is applicable, when

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there are intake passages extending in a direction parallel or substantially parallel, to the axis of the cylinder (as in radial engines).

In this case a tube 28 for receiving the jet of fuel coming from a jet 29 can be incorporated in the wall of the intake manifold, thus gaining the advantage of leaving completely free the aperture inside the intake conduit.

The carburettor control throttle 3 of the construction shown in Figs. 1-3, is placed before the injector; if the engine function with a semishut throttle (slow rate) the injector is subjected to the variations of the pressure (depressions) which take place behind the throttle 3 when the aforesaid throttle passes from its maximum opening to its shutting position, that is to say, a slow running position.

The aforementioned depressions are such that the capacity of the continuous yet sprayed by the tube 4 increases with rise of the depression.

The construction shown in Fig. 1 counterbalances this effect which would vary the fuel ratio, by means of special devices which originate a depression in the collecting cup 11, this depression being similar to that which takes place behind the throttle 3; the aforementioned duct 10 which has a sufficiently large section allows the abovementioned conditions to be obtained.

The construction shown in Fig. 2 on the contrary comprises a fuel tank (not shown in the drawing) which is connected with that part of tube 2 that is situated behind the throttle so as to balance the pressure of the two chambers, the connection being obtained by means of an adequate duct.

The construction shown in the Fig. 4 is such that the equalization of the aforementioned pressure is no more necessary, as the throttle 3a is placed between the jet spray nozzle and the intake or suction valve 30.

It should also be noted that in determined case the regulation of the opening and closing of the discharge of air under pressure intended for atomising the jet of fuel may be effected, instead of by means of rotary bodies or similar means, directly by the valve control mechanism (rockers, tappets or the like), the movement of which may effect the opening and the closing of the means for discharging air to the atomiser.

On account of this device, the pressure variations of the duct 1 do not interfere with the aforementioned jet spray nozzle. A slide valve with one gate 3b (Fig. 5) or with two gates 3c (Fig. 6) is more convenient than a throttle in this special construction.

The device which operates the intermittent air outflow may be obtained for instance by means of a piston valve 31 as shown in Fig. 4. The said valve 31 is kept in its seat by means of the spring 32 and shuts the outflow orifice 33 of the feeder duct 34 for the air under pressure. The opening of the valve 31, cuts the fuel jet, the aforementioned opening being in adequate phase with the opening of the valve 7. The control of the valve 31 may be had by means of a secondary cam 35, the said cam 35 being mounted on the same shaft of the cam 36, the cam 36 operating the valve 7.

In this case every jet spray nozzle is furnished with a valve of the same type of 31.

This device does not require the special lubricating apparatus which is necessary for the constructions shown in Figs. 1-3, constructions which comprise a rotating lining 4.

The cam shaft can also operate little volumetric compressors, the volumetric compressors comprising a cylinder and piston, and causing the intermittent air jet to be obtained, the said jet being in phase with the opening of the intake valves. The aforesaid construction is not shown in the drawing, its performance being obvious. The reversal of the piston can take place by means of springs; the compression may be operated by secondary cams with the interposition of adequate devices. Every injector of this construction is provided with a volumetric compressor.

It must be noted that the jet spray nozzle is preferably formed of a single part 37 (Figs. 7-11) and the outflow orifice has nozzles 8 which can spray more or less open jets.

The construction shown in Fig. 8 has a nozzle 38a with surrounding holes, the axis of the nozzle converging with the axis of the injector; a large injector outflow cone is thus obtained.

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The injector of the variant construction shown in Fig. 9 sprays the atomized fuel in the midst of the tube 2.

The tube 2 and the injector 37a are coaxial in the construction shown in Fig. 10 but the atomized fuel jet and the intaken air stream have opposite directions.

The injector 37b of the construction shown in Fig. 11 is placed in the inferior part of the intake tube 2 and the axis of the cone of the atomized fuel is transversal with respect to the motion of the air intaken from the cylinder: the injector 37b can be also placed so as to spray in a lateral direction with respect to the intake tube 2.

The different constructions shown in the drawing are selected according to the characteristics and particulars of the engine to which the invention has to be fitted.

I claim:

1. A system of carburation for an internal combustion engine, characterised in that the fuel is made to flow under pressure in a continuous stream from a jet of constant section with a delivery rate which varies as a function of the speed of the engine and of the variation of the density of the air in the suction conduit, said stream passing through a chamber in communication with the engine intake conduit, and said fuel is at predetermined intervals atomised and intimately mixed with the air for carburation by the impingement on said stream of a strong jet of air under pressure, the discharge of which is intermittent and in phase with the opening of the engine intake valve, the duration of discharge of the atomising air jet being a predetermined fraction of the duration of the suction phase.

2. A carburettor for effecting carburation as claimed in claim 1, characterised by a continuous circuit for circulation of the fuel, a reservoir, a delivery pump from which extends to each cylinder intake a duct ending with a jet of gauged section directed into a cavity in communication with the cylinder intake, a collector for excess fuel disposed opposite the jet, and a conduit recycling the fuel from the collector to the reservoir; and a nozzle associated with means to provide intermittent jets of compressed air directed to impinge on the stream of fuel between the jet and the collector.

3. A carburettor according to claim 2, wherein the device adapted to regulate the duration, the discharge phase, and optionally the pressure of the jets of compressed air in relation to the speed of the engine.

4. A carburettor according to claim 1, including means for automatically regulating the delivery of the jet of fuel in order to keep constant the proportion of fuel to air in the mixture, notwithstanding variation of the speed of the engine and/or variation of the pressure of the air in the intake conduit.

5. A carburettor as claimed in claim 1, wherein the delivery of the jet of fuel is caused to vary as a function of variation of pressure of the air for carburation, by means such as a manometric bellows adapted, on variation of the pressure in the intake conduit to control a valve which effects gradual opening or closing of an orifice provided in the fuel delivery duct for diverting a part of the fuel stream to the reservoir, the volume of said diverted part increasing or decreasing with the degree of vacuum set up in the intake conduit after the throttle or other regulating means.

6. A carburettor as claimed in claim 1, wherein the collector serves to conduct the collected excess fuel by gravity into a float chamber which communicates with a fuel tank, by means of a float valve, and with the delivery pump.

7. A carburettor as claimed in claim 1, wherein the collector includes a recycling pump by which collected excess fuel is delivered to a fuel tank.

8. A carburettor as claimed in claim 1, wherein the rate of delivery of the jet of fuel is made to vary as a function of the speed of the engine, by varying the pressure of the jet, as by mechanically connecting the delivery pump and the excess fuel recycling pump, to the engine.

9. A carburettor as claimed in claim 1, wherein for each cylinder of an engine there is provided a fuel jet and an atomising air supply means in phase with the intake period of the cylinder.

10. A carburettor as claimed in claim 1, wherein a distributor for compressed air is constituted by a rotary

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hollow body with gauged apertures to the interior of which air is supplied by a compressor.

11. A carburettor according to claim 1 characterized in that the control and the intermittent outflow devices for the air under pressure comprises a valve controlled by the movement which operates the intake valve.

12. A carburettor according to claim 1 characterized in that the fuel outflow nozzle consists of a single part, the outflow orifice of the atomized mixture having a nozzle so shaped as to direct and/or distribute the jet.

13. A carburettor according to claim 1 characterized in that the motion axis of the atomized fuel has a parallel direction with regard to the stream of the intaken air of the cylinder.

14. A carburettor according to claim 1 characterized

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in that the fuel injector axis is parallel but has an opposite direction with respect to the stream of the intaken air of the cylinder.

15. A carburettor according to claim 1 characterized in that the fuel outflow nozzle has a transversal direction with regard to the direction of the stream of the intaken air of the cylinder.

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