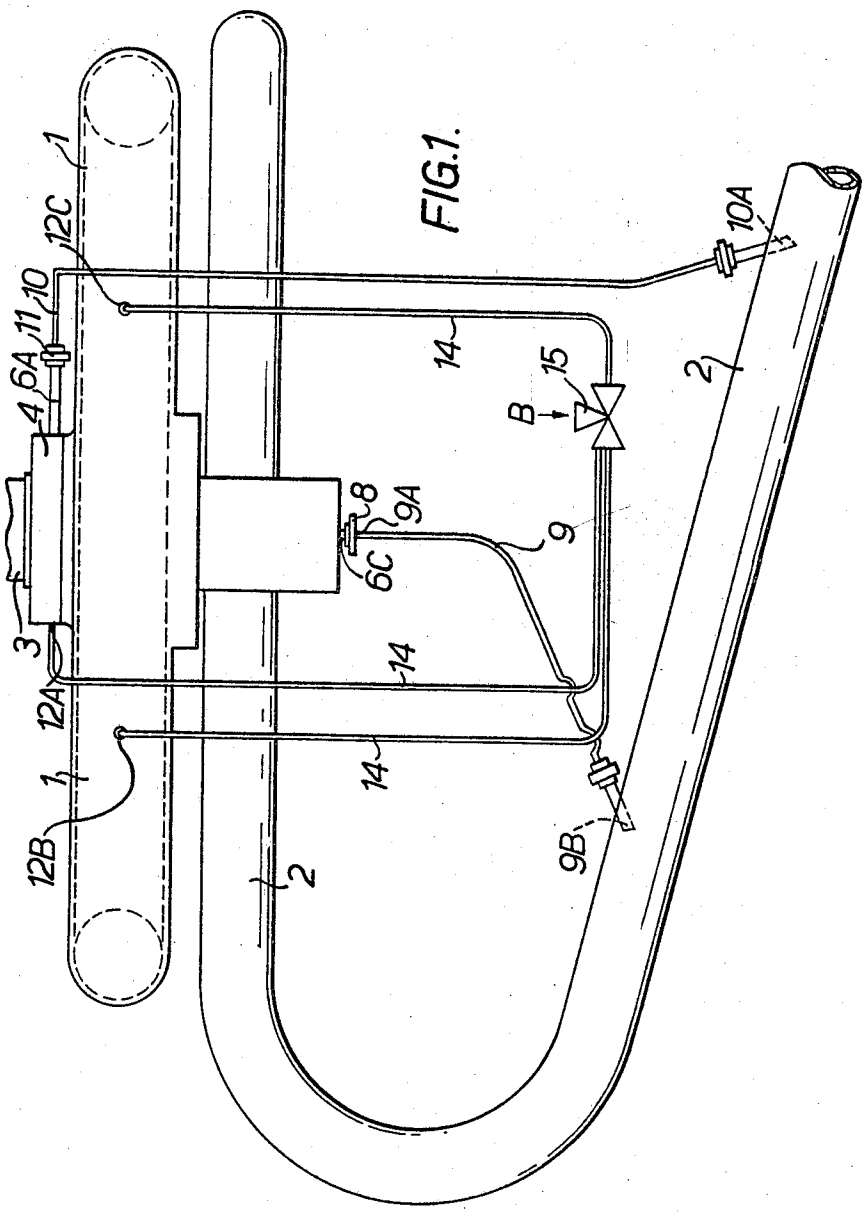
Dec. 9, 1969 D. F. E. FERRIDAY ET AL 3,482,556

INTERNAL COMBUSTION ENGINES

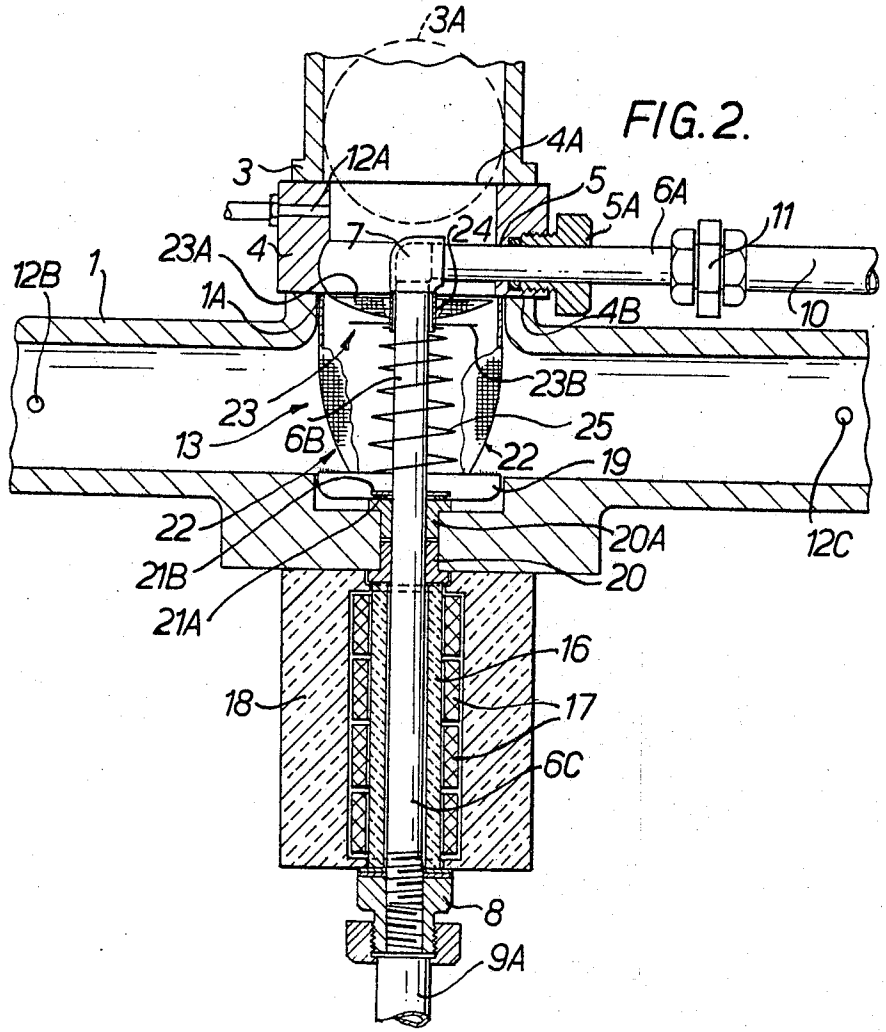
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FIG.1.



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FIG. 2.



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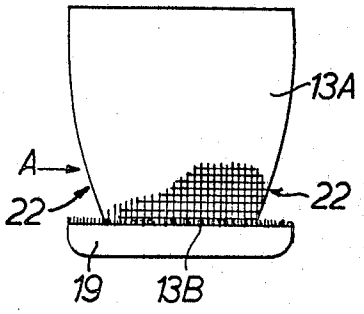


FIG. 3.

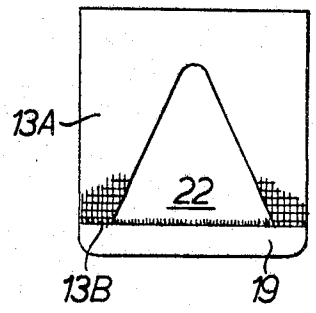


FIG. 4.

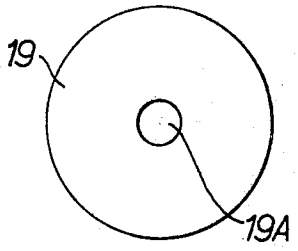


FIG. 5.

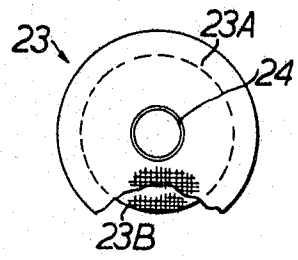


FIG. 6.

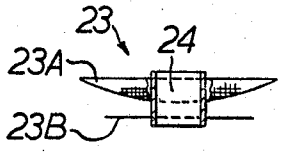


FIG. 7.

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INTERNAL COMBUSTION ENGINES

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Int. Cl. F02m *31/04, 29/00*
U.S. Cl. 123—122 13 Claims

ABSTRACT OF THE DISCLOSURE

A heater and atomizer for fuel-air mixtures in an internal combustion engine comprising a perforated tubular screen and a perforated disc movable lengthwise within the tubular screen responsive to the flow rate of the mixture against a spring bias to vary the amount of screen flow area through which the mixture must pass. A tube for diverted exhaust gases is located on the axis of the tubular screen for heating the mixture. Vacuum relief valves may be located upstream and downstream of the atomizer device.

This invention relates to internal combustion engines, of the general type having one or more than one combustion chamber (for instance a cylinder of a piston and cylinder engine); means for supplying air to the combustion chamber; means for producing finely divided liquid fuel from a supply of liquid fuel, and means for mixing the finely divided fuel with the air to produce a fuel/air mixture (for example one or more than one carburetor); and passage means (for example an induction manifold) for conveying the fuel/air mixture to the or each combustion chamber.

For many years there has existed the problem, in an engine of this general type, of improving fuel consumption, either by reducing fuel consumption for a given power output, or by increasing power output for a given fuel consumption, or both. Other desirable requirements that have long been sought are to improve the starting of the engine and to reduce wear of the engine.

More recently there has been recognised the problem of reducing the quantity of harmful constituents in the exhaust gases of the engine, and particularly the need for reducing emission of carbon monoxide and unburnt hydrocarbons.

It is therefore an object of this invention to provide a solution as far as practicable, to these problems, and in particular to provide an engine in which good fuel consumption is combined with acceptable levels of emission of carbon monoxide and unburnt hydrocarbons.

According to this invention an internal combustion engine comprises:

At least one combustion chamber;

Means for supplying air to the combustion chamber;

Means for producing finely divided liquid fuel from a supply of liquid fuel;

Means for mixing the finely divided fuel with the air to produce a fuel/air mixture;

Passage means for conveying the fuel/air mixture to the combustion chamber or chambers; and

A diffusting device in the passage means for diffusing the fuel/air mixture, characterized in that the diffusing device includes a perforated tubular screen, so disposed in the passage means that the fuel/air mixture passes through the screen, and a perforated disc which is movable lengthwise of and within the tubular screen.

Preferably the tubular screen is a cylinder of wire mesh, the perforated disc being circular and occupying substantially the whole cross-sectional area of the cylinder. Preferably the perforated disc is movable axially of the cylinder and away from the upstream end thereof against spring means. The perforated disc may be dished and a second circular perforated disc of smaller diameter may be provided downstream of the first disc and movable therewith.

Heating means, for example an exhaust heated pipe, may be disposed within the diffusing device for heating the fuel/air mixture passing through the diffusing device.

Preferably movement of the perforated disc away from the open end of the tubular screen is arranged to uncover progressivley a non-perforated outlet opening of the screen.

Preferably at least one air bleed is arranged in the passage means wherbey under some operating conditions extra air can be supplied to the fuel/air mixture, either before, or after, or both before and after, it has passed through the diffusing device, and the air bleed or bleeds may be connected to atmosphere through a known kind of vacuum relief valve. In this manner pressure variations in several parts of, for instance, an induction manifold, can be automatically balanced.

An embodiment of the invention will now be described by way of example, with reference to the accompanying drawings in which:

FIGURE 1 is a general arrangement diagram;

FIGURE 2 is a central vertical section, in somewhat diagrammatic form, through part of the induction manifold of a multi-cylinder petrol (gasoline) engine having a carburettor;

FIGURE 3 is a side elevation of the cup of the diffusing device;

FIGURE 4 is a side elevation of the cup, looking in the direction of the arrow A in FIGURE 3;

FIGURE 5 is a bottom plan of the cup;

FIGURE 6 is a top plan, partly broken away, of diffusing disc device; and

FIGURE 7 is a side elevation, partly in section, of the disc device.

Referring to the drawings, an induction manifold is schematically indicated at **1** and an exhaust pipe at **2**. The lower end of a carburetor **3** is also shown. The construction of a carburetor is very well known and it is therefore not shown. In FIGURE 2 may be seen in dotted line the fully open position of the throttle valve **3A**. Between a manifold inlet opening **1A** and the lower end of the carburetor **3** is a plate **4** with gaskets **4A**, **4B**. The plate **4** is apertured at **5** for passage of a pipe **6A**, which is fixed in the aperture **5** by a brass sealing union **5A**. By means of an elbow **7** the pipe **6A** is connected to a first portion **6B** of a pipe which portion extends through the manifold **1** axially of the lower end of the carburetor **3**, as seen in FIGURE 2, and projects from the manifold as a second portion **6C**. The lower end of the second pipe portion **6C** is connected by a brass union **8** to one end **9A** of a copper tube **9** the other end **9B** of which extends into the exhaust pipe **2** at an angle, as shown in FIGURE 1, in such manner that a ram effect causes some exhaust gas to be diverted into the tube **9**, and through the pipe **6C**, **6B** and **6A**, to a return tube **10** connected by a union **11** to the pipe **6A**. The lower end **10A** of the return tube **10** extends into the exhaust pipe at an angle, as shown, in such manner that a suction effect causes the diverted exhaust gas to re-enter the exhaust pipe **2**. With this arrangement the parts of the pipe **6B**, **6A** which are within the manifold **1** can be heated by passage of exhaust gas.

Also seen in FIGURE 1 are air inlet openings or bleeds **12A**, **12B** and **12C**. The air bleed **12A** is disposed between the carburettor **3** and a diffusing device generally indicated

by 13 in FIGURE 2. Each air bleed 12B, 12C is disposed between the diffusing device 13 and cylinders (not shown) of the engine. These air bleeds are connected by polythene tubes 14 to a vacuum relief device 15; the latter is of well-known construction and is therefore only shown schematically. It has an air inlet, indicated by the arrow B, and it permits air to enter the manifold through the air bleeds 12A, 12B and 12C when the vacuum in the manifold falls below a given pressure. If desired the air bleed 12A can be omitted, or alternatively the air bleeds 12B and 12C can be omitted.

Referring to FIGURE 2, the pipe portion 6C is surrounded by a ceramic jacket 16, which in turn is surrounded by four electrically energised heating coils 17, which in turn are surrounded and enclosed by thermal insulation 18. The coils 17 are connected to the electrical system of the engine by electrical connections (not shown). The connections do not form part of the invention and can be made in any well known manner. By passing current through the coils the pipe portion 6C is heated and the pipe portion 6B is heated by conduction. The fuel/air mixture can in this manner be heated when the engine is started and before the exhaust gas heating can take effect. Advantages of this heating during cold-starting of the engine are that combustion efficiency can be improved; a "leaner" fuel mixture can be used; there is quicker response to ignition, with less wear on the starter motor and less strain on the battery; also less fuel escapes combustion during cold starting, so that crankcase oil is less diluted and emission of carbon monoxide and unburnt hydrocarbons are reduced. Once the engine has warmed up, the heating coils can be switched off, and the pipe portion 6B will be heated by exhaust gas, as described above, and so maintain the advantages of heating the fuel/air mixture as it passes through the diffusing device 13.

The diffusing device 13 is shown in FIGURES 2 to 7. It is generally cup-like shape (see FIGURE 4) and is perforated, being made of steel wire mesh 13A soldered at 13B to a dished base 19 of sheet copper. The base 19 has a central hole 19A through which passes the pipe portion 6B (see FIGURES 2 and 5). The portion 6B also passes through a bore 20 in the manifold 1, being held in position by heat resistant sealing ferrules 20A. Within the base 19 and around the pipe portion 6B is a copper sealing ring 21A and a steel washer 21B, the latter being brazed to the pipe portion 6B.

At each side the cup-like diffusing device is cut away to form a triangular non-perforated opening 22, FIGURES 2, 3 and 4.

The diffusing device 13 also includes a movable perforated disc assembly 23, FIGURES 2, 6 and 7. The assembly 23 comprises a saucer-like disc 23A and a flat disc 23B. Both are of wire mesh and both are brazed on to a collar 24. The collar 24 is slidably mounted on the pipe portion 6B, and is urged into its uppermost position, with the assembly 23 against the elbow 7 which forms a stop, by a compression spring 25 coiled around the pipe portion 6B, as shown in FIGURE 2. The assembly 23 is in this manner freely movable on the pipe and the strength of the spring 25 is chosen such that the assembly 23 can automatically vary its position in accordance with the suction conditions. The diameter of the disc 23A is slightly less than the internal diameter of the cup, and in the uppermost position of the disc 23A shown in FIGURE 2 the fuel/air mixture from the carburettor 3 must pass through the disc 23A. The disc 23B assists in the diffusing action. When the disc assembly 23 is moved down, against the spring 25, it will be understood that some of the mixture can pass through the wire mesh of the cup without passing through the disc 23A. As the assembly 23 is moved further down, the triangular openings 22 are progressively uncovered, so that the mixture can pass through the openings 22 and not through the wire mesh of the cup and of the discs 23A and 23B.

The assembly 23 constitutes in effect a floating diffuser and can move up or down according to the mixtures flow and suction conditions. With increased throttle opening the floating diffuser is moved against the spring 25 and away from the carburettor. With reduced throttle opening the spring pushes the floating diffuser back towards the uppermost position, against the stop formed by the elbow 7, in which position the diffuser device 13 presents its maximum area of wire mesh to the fuel/air mixture.

Although in the embodiment described above the air bleeds 12A, 12B and 12C are connected to atmosphere through the valve 15, they could if desired be simple holes leading directly to atmosphere.

During deceleration and subsequent acceleration it has been found that the air bleeds, with the valve 15, assist in reducing emission of carbon monoxide and hydrocarbons, by promoting good combustion.

What I claim is:

1. An internal combustion engine comprising:
at least one combustion chamber;
means for supplying air to the combustion chamber;
means for producing finely divided liquid fuel from a supply of liquid fuel;
means for mixing the finely divided fuel with the air to produce a fuel/air mixture;
passage means for conveying the fuel/air mixture to the combustion chamber on chambers; and
a diffusing device in the passage means for diffusing the fuel/air mixture, characterized in that the diffusing device includes a perforated tubular screen, so disposed in the passage means that the fuel/air mixture passes through the screen, and a perforated disc which is movable lengthwise of and within the tubular screen.

2. An engine according to claim 1 characterized in that the tubular screen is a cylinder of wire mesh, in that the perforated disc is circular and occupies substantially the whole cross sectional area of the cylinder and in that the perforated disc is movable axially of the cylinder and away from the upstream end thereof against spring means.

3. An engine according to claim 2 characterised in that the perforated disc is dished and in that a second circular perforated disc of smaller diameter is provided downstream of the said first disc and movable therewith.

4. An engine according to claim 2 characterized in that the tubular screen has at least one non-perforated triangular outlet opening, which opening is progressively uncovered on axial movement of the perforated disc away from the upstream end of the cylinder.

5. An engine according to claim 1 characterized in that heating means is disposed in the passage means for heating the fuel/air mixture passing through the diffusing device.

6. An engine according to claim 5 characterized in that the diffusing device surrounds the heating means.

7. An engine according to claim 5 characterized in that the heating means is a pipe through which a heating medium is arranged to pass.

8. An engine according to claim 5 characterized in that the heating means is a first portion of an elongated metallic member having a second portion outside the passage means, the second portion being heated by an electric heating coil.

9. An engine according to claim 7 characterized in that the pipe is connected to an exhaust gas passage of the engine in such manner that hot exhaust gas can pass through the pipe so as to heat it.

10. An engine according to claim 7 wherein the pipe extends lengthwise through, and centrally of, the perforated tubular screen.

11. An engine according to claim 1 characterized in that the passage means has an air inlet opening between the diffusing device and the combustion chamber.

12. An engine according to claim 1 characterized in that the passage means has an air inlet opening between the means for mixing the finely divided fuel with air and the diffusing device.

13. An engine according to claim 1 characterized in that the passage means has a first air inlet opening between the diffussing device, and the combustion chamber and a second air inlet opening between the means for mixing the finely divided fuel with air and the diffusing device, and further characterized in that both air inlet openings communicate with a vacuum relief valve whereby air flow to the passage means through both air inlet openings is controled in accordance with the suction in the passage means.

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DOUGLAS HART, Assistant Examiner

U.S. Cl. X.R.

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