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Eckert

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[54] **FUEL METERING DEVICE FOR INTERNAL COMBUSTION ENGINES**

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[52] **U.S. Cl.** ..... **261/36 A**, 261/40, 261/67, 261/DIG. 74

[51] **Int. Cl.** **F02m 7/16**

[58] **Field of Search** ..... 261/36 A, 67, 40, DIG. 74, 261/41 B, 41 R, 41 A, 68, 66, 69 R

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[57] **ABSTRACT**

A fuel metering device for an internal combustion engine wherein the fuel feed pressure of the device is determined by the static height of the fuel in a vessel from which a fuel line leads to a suction tube, is improved by providing therein at least two vessels of different filling level, means for feeding fuel into each of the vessels, valve means for connecting the vessels alternatingly or simultaneously with the fuel line, and control means for actuating the valve means in dependence on characteristic data of the engine.

15 Claims, 5 Drawing Figures

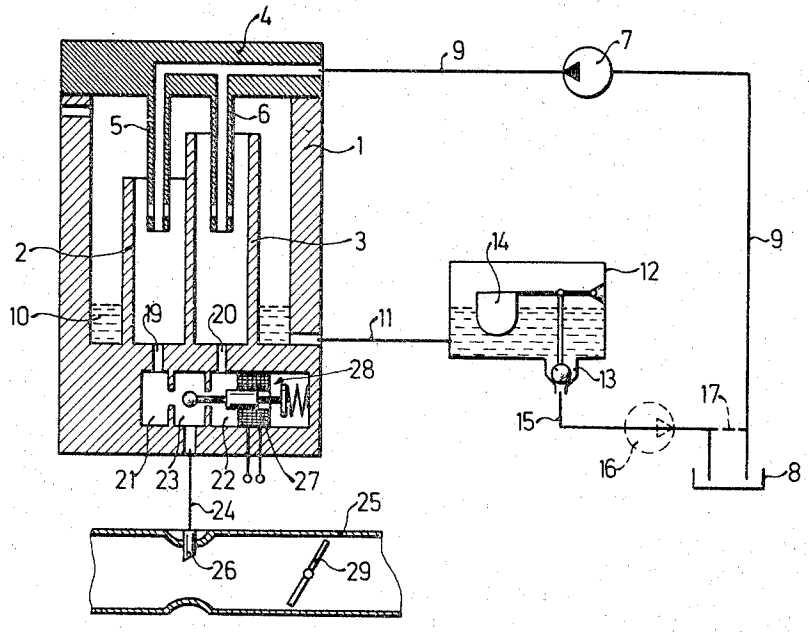


Fig.1

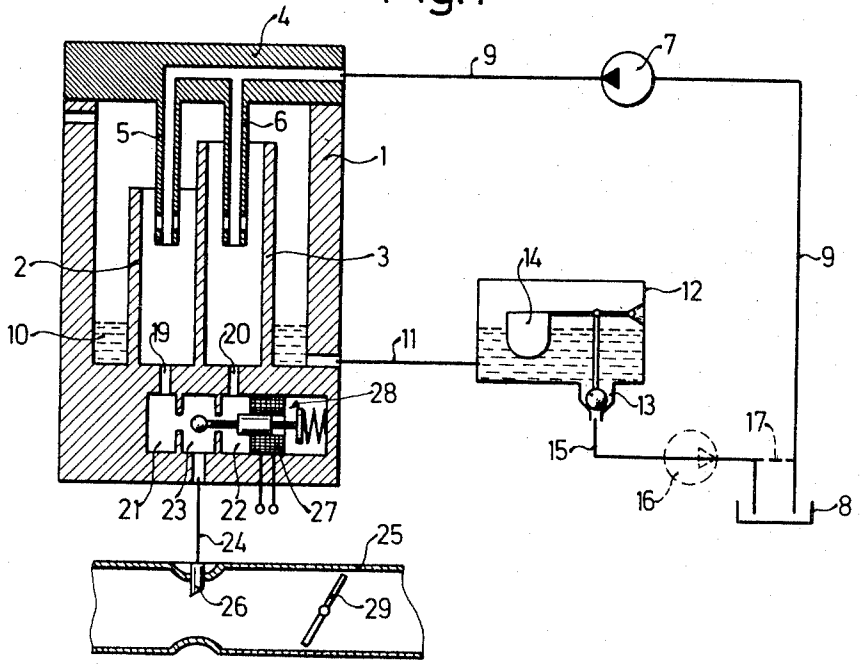


Fig.2

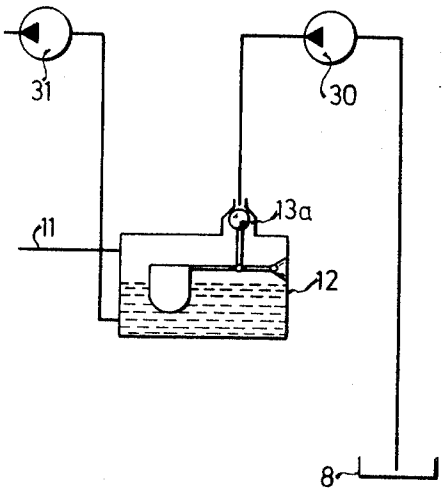


Fig.3

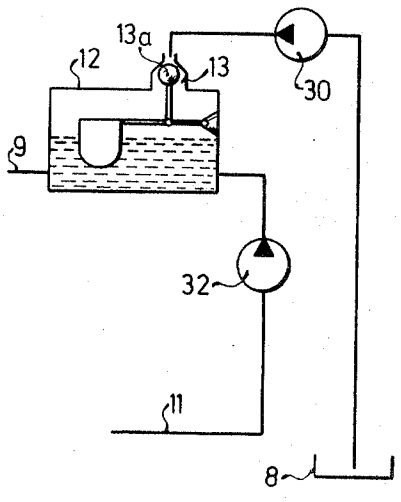


Fig. 4

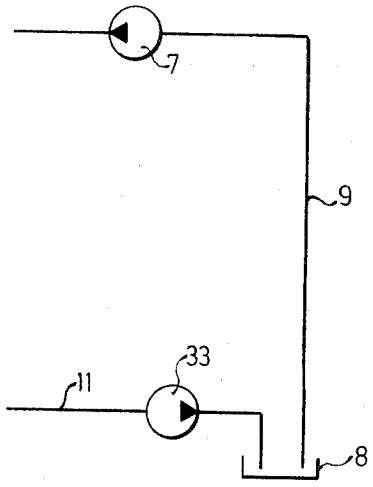
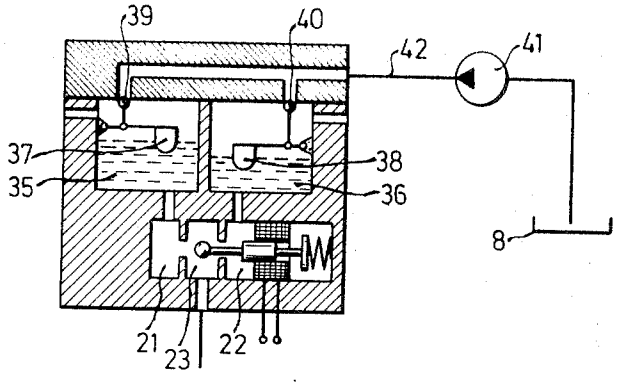


Fig. 5



FUEL METERING DEVICE FOR INTERNAL COMBUSTION ENGINES

BACKGROUND OF THE INVENTION

This invention relates to a fuel metering device for internal combustion engines in which the fuel feed pressure is determined by a constant static height of the fuel in a vessel from which a fuel line leads to a suction pipe.

Under present-day technical requirements, the purpose of such fuel metering device is to provide in an Otto engine, automatically and under all operational conditions, a favorable fuel/air mixture ratio, in order to burn the fuel as completely as possible and thereby to avoid or notably reduce the production of toxic exhaust gases while maintaining an optional performance of the internal combustion engine at the smallest possible consumption of fuel. To this end it is necessary to meter the fuel in amounts corresponding very accurately to the requirements of every operating condition of the internal combustion engine. This means that a variation in the normal proportions of air and fuel must be attainable, in dependence on such engine data as speed, load and temperature.

OBJECT AND SUMMARY OF THE INVENTION

In the case of the known fuel metering devices of the initially mentioned type (i.e., carburetors), very costly means are usually provided to meet the stated requirements, whereas it is an object of the invention to provide a fuel metering device of the type initially referred to which renders the above-mentioned data-dependent variation of the fuel/air ratio attainable by very simple means.

This object is achieved according to the invention, in that at least two vessels of different filling height are provided which can be supplied with fuel and which are connectable alternatingly or simultaneously with a fuel supply line by means of a valve operated in dependence on the characteristic engine data, and wherein this valve operates preferably together with electric means, and the controlled switchings take place in a cycle. When the control shifts take place at a high enough frequency, any number of intermediary potentials can come into effect between the two pressure potentials impressed by the difference in filling height, depending upon which actual magnitude of the fuel/air ratio is desired. The actual magnitude is detected by known means, for instance by an oxygen sampling device in the flow of exhaust gases. Electronic devices can be used in particular for the automatic control system, which can be arranged in a known manner in a centralized control unit. By shifting to differential pressure levels, a multiplicative control is obtained, independently of carburetor systems coupled at the outlet side, such as a Stromberg system, and also independently of a variety of possible subsequently arranged injection lines and/or chokes. After shifting, the respective set pressure level is immediately effective without any significant transition periods.

Further objects and advantages of the invention will become apparent from the ensuing description of preferred but merely exemplary embodiments taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents schematically a sectional view of a first embodiment of the fuel metering device according to the invention;

FIG. 2 shows a fuel feed pump- and flushing tank arrangement different from that employed in the embodiment shown in FIG. 1;

FIG. 3 shows yet another fuel feed pump- and flushing tank arrangement;

FIG. 4 shows a simplified fuel feed pipe arrangement employed in lieu of the fuel pump- and flushing arrangement shown in the preceding figures; and

FIG. 5 shows another embodiment of the fuel metering device according to the invention, all of FIGS. 2 to 5 being highly schematical sectional views.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

In a housing 1, two vessels 2 and 3 are grouped which can be filled to different levels with fuel. The lid 4 of housing 1 is provided with fuel feed inlet pipes 5 and 6, the mouths of which dip respectively into the vessels 2 and 3. A fuel pump 7 is adapted for pumping fuel out of a reservoir 8 and conveying it via a feed line 9 and the pipes 5 and 6 into the vessels 2 and 3. Overflowing fuel accumulates in a chamber 10 surrounding vessels 2 and 3 and flows via a fuel return line 11 into a flushing tank 12, whose outlet 13 is controlled by the float 14, and back to reservoir 8 via line 15. In dependence on the static level existing between the flushing tank 12 and the fuel reservoir 8, a pump 16 can be interposed in the feed line 15, as shown by dotted lines.

Alternatively, fuel line 15 may also be connected by means of a bridging line 17 (shown by a dashed line) to the branch of fuel line 9 extending from reservoir 8 to the suction side of pump 7.

Owing to this arrangement, the vessels 2 and 3 are always maintained full in a simple manner, and any fuel fed into them in excess will overflow and leave chamber 10 to be reintroduced into the fuel cycle. The vessels 2 and 3 are connected by way of ducts 19 and 20 with chambers 21 and 22 of a solenoid valve 28 which in turn connects the chambers 21 and 22 alternatingly or simultaneously with a chamber 23, which latter is linked by way of a line 24 to a nozzle 26 arranged in a suction tube 25. An exciter coil 27 constitutes the electrically energizable member of the solenoid valve 28 and is energized by a control unit (not shown) which is adapted for processing engine data. Depending on the volume of air flowing through the suction tube 25, which volume is controlled by a throttle valve 29, and depending on whether chamber 21 or chamber 22 is connected with chamber 23, a different amount of fuel will be mixed with this air. In the arrangement shown in FIG. 2, fuel is conveyed from the fuel reservoir 8 by means of pump 30 to the flushing tank 12 and from the latter by means of a pump 31 to the housing 1 (shown in FIG. 1). Excess fuel being recycled from housing 1 is fed into flushing tank 12 via fuel return line 11 in the same manner as shown in FIG. 1.

In the arrangement shown in FIG. 3, excess fuel is withdrawn from chamber 10 via fuel return line 11 and conveyed by means of a pump 32 to the flushing tank 12, from which tank it is recycled due to gravity via line 9 into the housing 1. Consumed fuel is replaced by means of pump 30 which conveys fuel from the reser-

voir 8 to the flushing tank 12 in the same manner as shown in FIG. 2. In both arrangements, the discharge line of pump 30 is controlled by a float valve 13*a*.

FIG. 4 represents a highly simplified modification of the arrangement shown in FIG. 1. In this case, the fuel is conveyed from the reservoir 8 by means of a pump 7 and via a feed line 9 to the housing 1, and the fuel accumulating in the chamber 10 is recycled by means of a pump 33 via a line 11 into the fuel reservoir 8.

In the second embodiment of the device according to the invention, represented in FIG. 5, the differential filling height is not obtained by overflowing vessels, but rather by means of flushing tanks 35 and 36, whose floats 37 and 38 actuate the valves 39 and 40, which in turn control the flow of fuel into the tanks. The fuel is conveyed by means of a pump 41, which aspirates fuel from the reservoir 8, and which conveys the fuel through a line 42 to the valves 39 and 40. From tanks 35 and 36, fuel will reach a suction tube (not shown) in the same manner as in the first arrangement described hereinbefore, via a solenoid valve having chambers 21, 22 and 23.

What is claimed is:

1. In a fuel metering device for an internal combustion engine wherein the fuel feed pressure of the device is determined by the static height of the fuel in a vessel from which a fuel line leads to a suction tube, the improvement comprising at least two vessels of different filling level, means for feeding fuel into each of said vessels, valve means for connecting said vessels alternatingly or simultaneously with said fuel line, and control means for actuating said valve means in dependence on characteristic data of said engine.

2. The improvement as described in claim 1, wherein said control means comprises an electrically energizable member.

3. The improvement as described in claim 2, wherein said control means is adapted for cyclic actuation of said valve means.

4. The improvement as described in claim 1, comprising means for controlling the static height of fuel in each of said vessels in order to maintain differential static heights of fuel in said vessels and comprising means for recycling overflowing fuel.

5. The improvement as described in claim 4, wherein said means for controlling the static height of fuel in each of said vessels comprise overflow means.

6. The improvement as described in claim 4, wherein said means for controlling the static height of fuel in each of said vessels comprise floating valve means.

7. The improvement as described in claim 4, wherein said means for feeding fuel into said vessels comprise pump means.

8. The improvement as described in claim 4, wherein said means for feeding fuel into said vessels comprise a flushing tank.

9. The improvement as described in claim 4, wherein said means for feeding fuel into said vessels comprise pump means, a flushing tank fed by said pump means, said valve means controlling the flow of fuel to and from said flushing tank.

10. The improvement as described in claim 9, wherein said valve means comprise float means in said flushing tank.

11. The improvement as described in claim 4, wherein said means for recycling overflowing fuel comprise pump means.

12. The improvement as described in claim 4, wherein said means for recycling overflowing fuel comprise a flushing tank.

13. The improvement as described in claim 4, wherein said means for recycling overflowing fuel comprise pump means, a flushing tank fed by said pump means, said valve means controlling the flow of fuel to and from said flushing tank.

14. The improvement as described in claim 13, wherein said valve means comprise float valve means in said flushing tank.

15. The improvement as described in claim 14, wherein said float valve means are disposed for controlling the flow of fuel into said flushing tank.

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