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ULTRASONIC CARBURETOR

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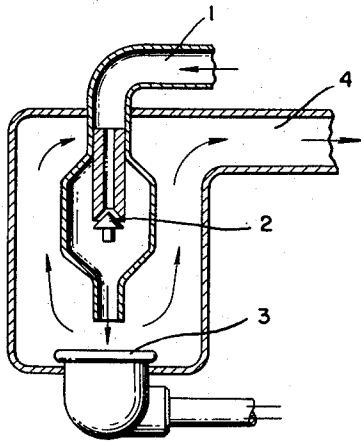


FIG 1

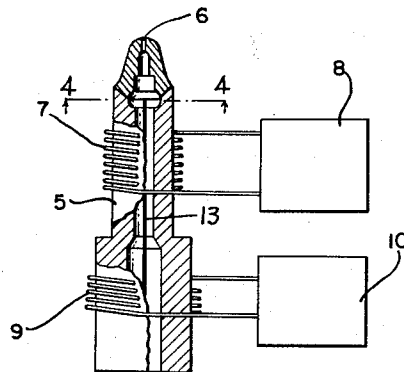


FIG 2

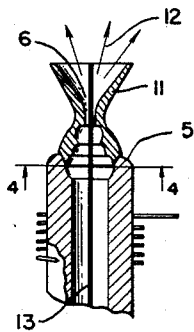


FIG 3

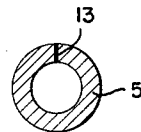


FIG 4

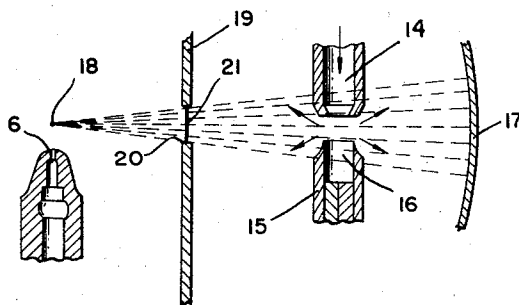


FIG 5

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1

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ULTRASONIC CARBURETOR

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6 Claims. (Cl. 239—102)

This invention relates to engine carburetors and more particularly is concerned with the application of ultrasonic vibration for intensifying atomization of fuel mixtures.

As well known in the art, it is possible to atomize by intensive ultrasonic vibration liquids whenever the amplitude of vibration of the ultrasonic transducer surface is so great that the thereby produced alternating pressure causes cavitation phenomena within the liquid under treatment. By readily evaporating liquids such as, for instance, motor fuel gasoline, such cavitating action begins at ultrasonic energy outputs of one watt per square centimeter. Since the fuel dispersion and droplet distribution created by conventional carburetors is not completely satisfactory, particularly not in high efficiency engines and for low fuel consumption, the application of more intensive atomization means is very desirable.

Therefore, it is the primary object of this invention to provide a carburetor which utilizes ultrasonic vibration for better atomization of the fuel mixture.

Other objects and advantages of the invention will become apparent from the following detailed description of some preferred embodiments when read in connection with the accompanying drawing in which

Fig. 1 is a diagrammatic longitudinal section through a preferred form of a carburetor according to this invention;

Fig. 2 is a diagrammatic showing of a carburetor nozzle body provided with a coil for ultrasonic excitation;

Fig. 3 shows diagrammatically a carburetor nozzle body of modified construction also provided with a high frequency coil;

Fig. 4 is a cross-section on the line 4—4 of Figs. 2 and 3 showing a longitudinal slot in the nozzle body filled with insulating material for reducing eddy currents;

Fig. 5 is a diagrammatic showing of an arrangement employing an ultrasonic generator actuated by the exhaust gases of the engine.

Referring to Fig. 1 of the drawing, there will be noted inlet tube 1 through which, controlled by valve 2, engine fuel at a desired rate enters in droplets into the carburetor. These fuel droplets fall upon the carburetor plate 3 which actually is an ultrasonic transducer vibrating at ultrasonic frequency. This vibrator causes complete atomization of the fuel which then is carried by the intake suction in the intake manifold 4 under admixture of air, as in conventional carburetors, into the cylinders of the internal combustion engine. The excitation of transducer 3 is provided by electric connection to a high frequency circuit not shown.

In an embodiment as shown in Fig. 2, the dispersing action of a common fuel nozzle is retained and ultrasonic atomization is additionally applied for intensifying the fuel mixture preparation. To achieve this end according to this invention, the nozzle body 5 is preferably made of magnetostrictive material. When excited by ultrasonic frequency, the nozzle 6 vibrates together with nozzle body 5. Excitation is derived from coil 7 which is fed

2

from a high frequency generator 8. Premagnetization, if necessary, is effected by coil 9 energized from a battery 10. Ultrasonic influence is thus substantially restricted to the small area of nozzle 6. In order to obtain a larger area for ultrasonic action, or better, a larger atomization area, an arrangement according to Fig. 3 can be employed. It will be noted that here the nozzle 6 has a funnel-like extension 11 in front of nozzle 6. Such shape with its increased outlet area causes additional atomizing of the fuel, because ultrasonic energy is radiated in the direction of the arrows and thus into the combustible mixture 12. For highest efficiency it is advisable to calculate the configuration of the funnel outlet according to acoustic laws and give it a shape that assures within the combustible mixture the desirable direction of ultrasonic radiation. A further increase in effectiveness of atomization can be gained by designing extension 11 so that its natural frequency is in resonance with the ultrasonic frequency imparted to nozzle body 5.

In order to avoid unnecessary eddy current losses in nozzle body 5 it is advisable to employ a construction in which the nozzle body is partly or completely slotted as indicated at 13 in Figs. 2 and 3 and as shown in section in Fig. 4. This slot is preferably filled with an insulating material. The nozzle body in this instance is preferably made from a material as generally used for the construction of magnetostrictive devices, such as Invar or nickel. It will be understood that for exciting the nozzle it is also possible to employ a suitable separate transducer as commercially obtainable. Moreover, the disclosed construction lends itself to a design in which the nozzle proper is of another material as the nozzle body. This is to be preferred, because at high loading known magnetostrictive materials are too soft to withstand the great forces imposed on them by cavitation phenomena. Thus it is advisable to use for the nozzle 6 a hard metal, such as the tungsten carbide material known under the trademark Widia, or the like, and such material is referred to when reciting "hard metal" in the specification and the claims. However, in such construction it is of importance that the nozzle is intimately joined to the nozzle body 5 by brazing or otherwise in order to assure ultrasonic pass-over from one part to the other without substantial losses.

Still another method of obtaining the benefit of ultrasonic atomization of engine fuels is depicted in Fig. 5. Here an ultrasonic generator actuated by compressed air or by the pressure of the exhaust gases of the engine is employed. The exhaust gases leave outlet 14 under high pressure, impinge upon the edges of resonator 15 and excite the resonance space 16 to forceful ultrasonic vibration in a manner well known in the art. Ultrasonic vibration spreading in directions of the arrows reaches to a considerable extent the reflector 17 and is converged by this reflector so that ultrasonic energy is concentrated at 18 in front of nozzle 6. The combustible mixture entering through nozzle 6 is thus exposed to high-amplitude ultrasonic vibration and is atomized by this vibratory action.

In order to prevent the exhaust gases from entering the carburetor chamber and disturb orderly progression of the pressure phases within this chamber or cause premature ignition, it is advisable to arrange the ultrasonic generator in a space separated from the carburetor by a partition 19 provided with an aperture 20. This aperture in turn is preferably closed by a diaphragm 21 of sheet mica or aluminum foil, or another material having little mass and high tensile strength and being very thin in order to avoid as much as possible loss of ultrasonic energy. The separation of the ultrasonic source from the carburetor chamber may take other forms and very effective is a diaphragm consisting of two foil sheets of material suitable spaced whereby the space therebetween

is filled with a suitable gas, preferably under pressure, so that the diaphragm unit assumes the shape of a lens and assists in focusing the penetrating ultrasonic radiation in point 18.

Practical experiments have shown that by applying ultrasonic atomization as provided by this invention, the droplet size of the so atomized engine fuel is considerably smaller than after dispersion by a carburetor of conventional construction.

The present invention has been described as utilized for atomizing engine fuel, but it is to be understood that this is only one field of application and that its teachings can be made useful for other purposes as well, for instance, in connection with spraying devices for lacquers and paints and in other fields where atomization of liquids into fine mists is essential.

Ultrasonic vibration causes not only atomization of liquid droplets, but it becomes also effective in condensing fogs and mists when the vibration is of the proper condensing frequency. Thus it is possible to atomize liquids into a finely distributed spray by the means shown in Figs. 1 to 4 and then to condense this spray by an arrangement somewhat similar to that shown in Fig. 5. Such procedure can be made useful in applying finishes to surfaces by spraying, in that ultrasonic energy concentration is focused at a point near the surface to which the finish is to be applied and which lies within the spray. Then, if the ultrasonic vibration is of the proper frequency the spray will readily be condensed on the surface. When using compressed air spray guns of conventional construction it is possible to drive an ultrasonic generator as shown in Fig. 5 from the same compressed air source and to arrange this generator adjacent to the spray nozzle such that the ultrasonic radiation emanating from it is concentrated at a point where quick condensation of the sprayed liquid is desirable.

From this description of a few embodiments of the invention it will become apparent that other modifications are possible which do not depart from the true spirit and scope of this invention as limited only by the appended claims.

What is claimed is:

1. In a carburetor for ultrasonic atomization of engine fuel, an intake nozzle body of magnetostrictive material being provided with a longitudinal slot filled with insulating material, a nozzle of non-magnetostrictive hard metal intimately joined to said nozzle body for free pass-over of ultrasonic energy from said nozzle body to said nozzle, a coil surrounding said nozzle body and adapted to be energized by high frequency electric energy for imparting magnetostrictive vibration to said nozzle body and nozzle whereby to atomize engine fuel passing therethrough, and means for connecting said coil to a high frequency electric energy source.

2. In a carburetor for ultrasonic atomization of engine fuel, an intake nozzle body of magnetostrictive material being provided with a longitudinal slot filled with insulation material, a nozzle of non-magnetostrictive hard metal intimately joined to said nozzle body for free pass-over of ultrasonic energy from said nozzle body to said nozzle, said nozzle having an outward extension for directing ultrasonic energy radiation into the space in front of said nozzle, a coil surrounding said nozzle body and adapted to be energized by high frequency electric energy for imparting magnetostrictive vibration to said nozzle body and nozzle whereby to atomize engine fuel passing therethrough, and means for connecting said coil to a high frequency electric energy source.

3. In a carburetor for ultrasonic atomization of engine fuel, an intake nozzle body of magnetostrictive material being provided with a longitudinal slot filled with insulation material, a nozzle of non-magnetostrictive hard metal intimately joined to said nozzle body for free pass-over of ultrasonic energy from said nozzle body to said nozzle, said nozzle having an outward extension whose natural frequency is in resonance with the ultrasonic frequency imparted to said nozzle body, a coil surrounding said nozzle body and adapted to be energized by high frequency electric energy for imparting magnetostrictive vibration to said nozzle body and nozzle whereby to atomize engine fuel passing therethrough, and means for connecting said coil to a high frequency electric energy source.

4. In a device for ultrasonic atomization of a liquid, an intake nozzle body of magnetostrictive material being provided with a longitudinal slot filled with insulating material, a nozzle of non-magnetostrictive hard metal intimately joined to said nozzle body for free pass-over of ultrasonic energy from said nozzle body to said nozzle, a coil surrounding said nozzle body and adapted to be energized by high frequency electric energy for imparting magnetostrictive vibration to said nozzle body and nozzle whereby to atomize a liquid passing therethrough, and means for connecting said coil to a high frequency electric energy source.

5. In a device for ultrasonic atomization of a liquid, an intake nozzle body of magnetostrictive material being provided with a longitudinal slot filled with insulation material, a nozzle of non-magnetostrictive hard metal intimately joined to said nozzle body for free pass-over of ultrasonic energy from said nozzle body to said nozzle, said nozzle having an outward extension for directing ultrasonic energy radiation into the space in front of said nozzle, a coil surrounding said nozzle body and adapted to be energized by high frequency electric energy for imparting magnetostrictive vibration to said nozzle body and nozzle whereby to atomize a liquid passing therethrough, and means for connecting said coil to a high frequency electric energy source.

6. In a device for ultrasonic atomization of a liquid, an intake nozzle body of magnetostrictive material being provided with a longitudinal slot filled with insulation material, a nozzle of non-magnetostrictive hard metal intimately joined to said nozzle body for free pass-over of ultrasonic energy from said nozzle body to said nozzle, said nozzle having an outward extension whose natural frequency is in resonance with the ultrasonic frequency imparted to said nozzle body, a coil surrounding said nozzle body and adapted to be energized by high frequency electric energy for imparting magnetostrictive vibration to said nozzle body and nozzle whereby to atomize a liquid passing therethrough, and means for connecting said coil to a high frequency electric energy source.

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