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LIQUID FUEL CONDITIONING APPARATUS

Filed Dec. 29, 1933

2 Sheets-Sheet 1

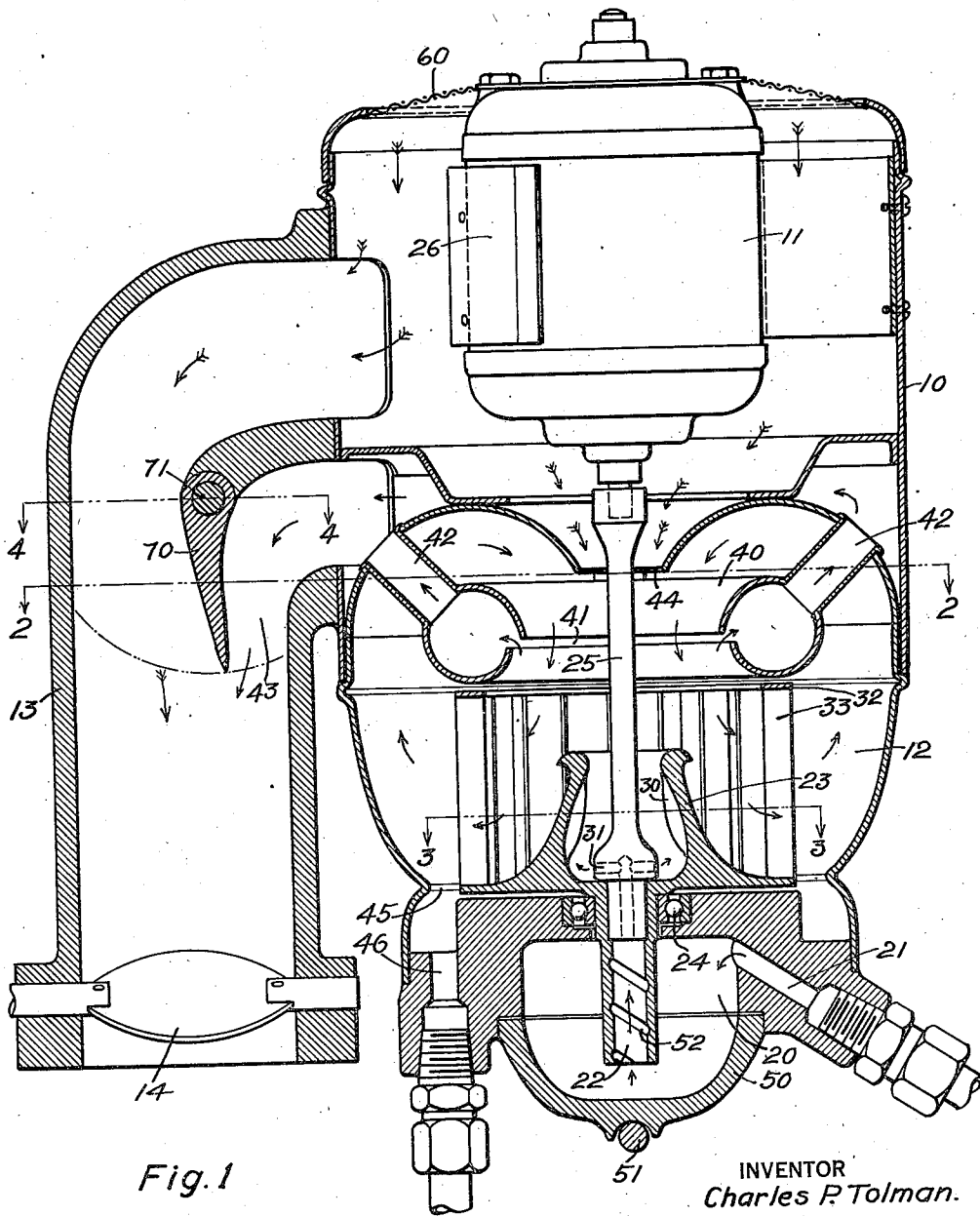


Fig. 1

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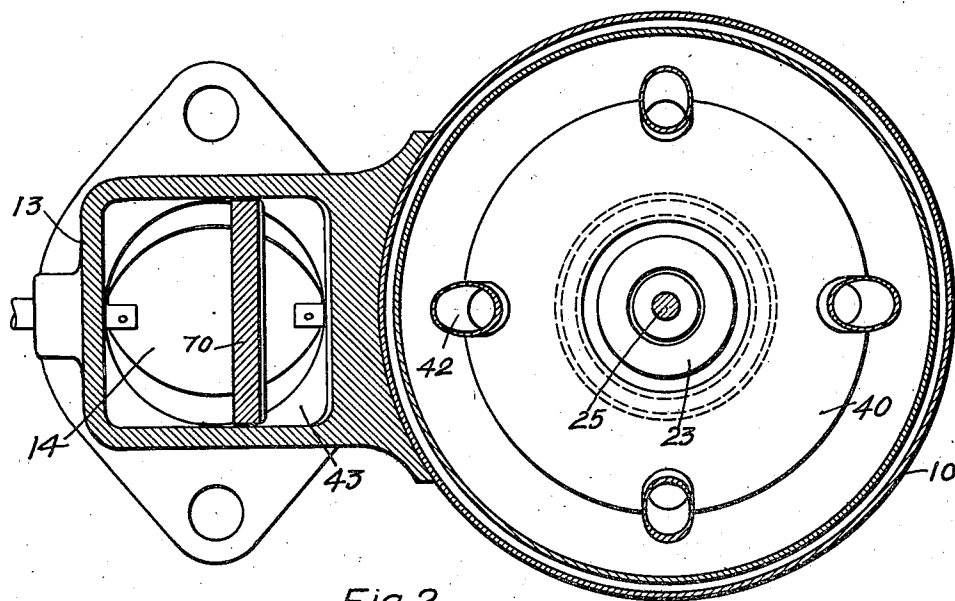


Fig. 2

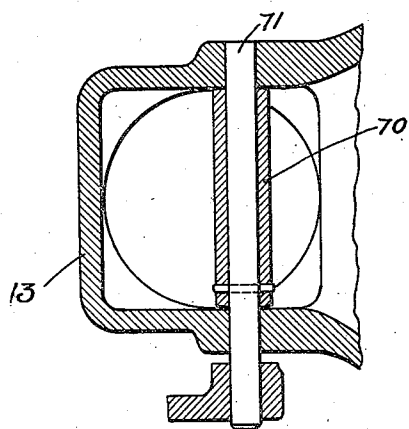


Fig. 4

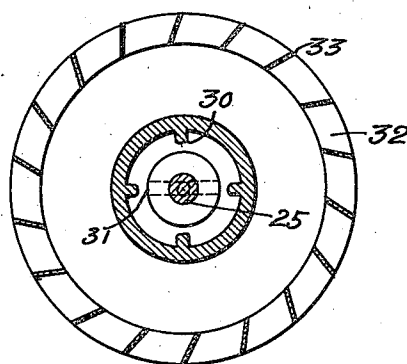


Fig. 3

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LIQUID FUEL CONDITIONING APPARATUS

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13 Claims. (Cl. 261-91)

The present invention relates to fuel conditioning devices wherein gasoline or heavier liquid fuels are acted upon to produce such a condition of the fuel as will be suitable for its use in internal combustion engines.

Amongst the general objects of the invention are the following:—

To provide a uniform or better fuel-and-air mixture for the engine; to provide a better mixture both as regards the ratio of fuel to air and also the intimacy with which the fuel and the air are intermixed; to accomplish these results by separating the function of fuel-air mixing from the function of finally proportioning the ratio of the fuel-and-air mixture.

A further object is to maintain in a mixture chamber a substantial excess of fuel-mixture wherein the air is well saturated or loaded with vaporized and/or nebulized fuel, and then to extract from this mixing or saturation chamber a controlled amount of this dispersed or loaded vapor-fuel in air, and mix the same with the main air supply, whereby to maintain a definite or standardized final proportion of fuel-and-air mixture for delivery to the engine.

Another object is to provide for improved uniformity of fuel-mixture delivered to the engine under the variety of engine operating conditions; also to provide power-driven means for this initial dispersion of the fuel to produce a substantial nebulizing of the fuel and thereby to produce a fuel-saturated air mixture, or at least sufficiently fuel-saturated or loaded for the purposes described; and furthermore to provide means for collecting the excess of nebulized fuel and redelivering it to the fuel supply means.

Other advantages will be apparent from the construction and the method hereinafter set forth.

Referring to the drawings:

Fig. 1 represents a vertical section of the apparatus embodying this invention;

Figs. 2, 3, and 4 are sectionalized detailed views taken on the lines 2-2, 3-3 and 4-4 respectively in Fig. 1.

In Fig. 1, 10 represents the main casing enclosing an electric motor 11, and a saturation chamber 12; and from the main casing there extends a pipe 13 which constitutes the outlet for the final mixture of air-and-oil vapor, leading to the manifold of the engine (not shown). The throttle valve 14 controls the quantity of fuel-and-air mixture leading to the manifold, in the usual manner.

In the lower part of the main casing is a fuel

supply chamber 20 into which the fuel is pumped through the pipe 21, the direction of the inflow of the fuel being shown by full arrows and the fuel then proceeds through the pipe 22 into a revolving cup 23, which is suitably mounted to rotate on ball bearings 24.

The pipe 22 and cup 23 are mounted fast upon a shaft 25, which extends downwardly from the electric motor 11 and are turned thereby. The upper end of the electric motor is suitably clamped to the main casing by band 26 so that when current is supplied to the electric motor it will rotate at the desired speed to turn the cup 23 and parts attached thereto.

The interior of the cup 23 is formed with small vanes 30 shown also in Fig. 3. The orifices 31 form means for the oil or gasoline to flow from the pipe 22 into the cup 23, and the vanes 30 assist in giving the fuel in the cup a whirling action to throw the fuel outwardly from the cup by centrifugal action as the fuel rises up the sides and overruns the rim of the cup. Also attached to the cup framework and pipe 22, which turn with the shaft 25, is an outer fan 32, having blades 33, these blades also being shown in Fig. 3.

The purpose of this fan 32 is, by its rapid rotation, to act upon the fuel which is thrown out from the cup 23 in nebulized form and to mix therewith a relatively limited amount of air, and to cause this nebulized fuel-and-air to circulate round and round in the mixture chamber 12 in a manner indicated diagrammatically by the tailless arrows in Fig. 1. The fan 32 also assists nebulization by breaking up heavier particles which may be thrown out from the cup 23.

Located in the upper portion of this mixture chamber 12 is an annular doughnut shaped collecting ring 40, which extends horizontally around the interior portion of the mixture chamber and has formed in its inner periphery a slot 41 as a port for the fuel conditioned air to enter into the interior of the collecting ring.

From the collecting ring the fuel conditioned air goes through ports 42 into the space in the main casing just above the mixture chamber 12 and then out into the passageway 43 as again shown by the tailless arrows.

Air enters at the top of the mixture chamber 12 through openings 44, the incoming air being indicated by feathered or tail arrows shown in Fig. 1.

By the means described, the fuel which is nebulized by the cup 23 and the revolving fan 32 becomes mixed with the air in the mixture cham-

ber and sufficient fuel is constantly pumped from the fuel pump and into the revolving cup 23 so as to constantly supply fuel for this nebulizing process, and also thereby to maintain in the mixture chamber 12 a constant supply of a substantially saturated air-and-fuel mixture, which is far in excess of the amount required for later mixing with the main air supply to provide the desired fuel-and-air mixture for the engine.

The constant rotation of the nebulizing device causes a sort of vortex motion of the saturated mixture of fuel-and-air within the saturation or mixture chamber 12, and the port 41 in the collecting ring 40 is adapted to be so located as to collect the fuel from a point of substantially the most finely nebulized fuel in this saturation chamber or from whatever point may prove to be the most advantageous condition of the fuel to be extracted.

In this circulating motion of the saturated mixture, the heavier particles go outwardly towards the outer wall of the saturation chamber and all the excess of the fuel collects at the bottom of the mixture chamber and runs out through the ports 45 and through a pipe 46 back to the main fuel supply or to the pump as may be desired.

The bottom of the fuel chamber 20 is formed with a detachable cup 50 which is held in place by a ball 51, tightly against the casing, this construction enabling the cup 50 to be removed for cleaning and other purposes.

This cup 50 also is adapted to hold an auxiliary supply or reservoir of fuel when the pump has stopped operating and the electric motor has stopped operating.

At the beginning of a new operation of the pump and the electric motor, the internal grooves 52 in the pipe 22 initially pick up fuel from the auxiliary supply which remains in the cup 50, carry this fuel up into the cup 23 and thereby supply it to the nebulizing apparatus, so as to start the fuel mixing operations in a preliminary way in case the delivery of fuel from the fuel pump is delayed.

The main supply of air for the final mixture enters the main casing through screens 60 formed in the top of the main casing and this air goes through the upper portion of the pipe 13 as shown by the feathered arrows, and mixes with the saturated fuel coming from the collecting ring, at a point just below the proportioning valve 70 shown in the pipe 13. This proportioning valve is pivoted on the shaft 71 at a point which will permit of metering the amount of nebulized fuel extracted from the saturation chamber, and also permits approximate proportioning of the air and nebulized fuel mixture, the shape of these parts, as adapted for this purpose, being shown in Fig. 2.

It will thus be seen that the function of mixing the fuel and air to a substantially saturated degree is separated from the function of finally proportioning the ratio of fuel-and-air mixture; that is, the saturated mixture which comes into the pipe 13, from the collecting ring, as shown by the full arrows, in Fig. 1, mixes with the incoming air drawn from the main air supply, as indicated by the feathered arrow in pipe 13, and the proportioning of the two is fixed and predetermined by a proper adjustment of the proportioning valve 70.

By maintaining in the mixture chamber a substantial excess of fuel mixture wherein the air is well saturated or loaded with the nebulized fuel, there can then be extracted from this satu-

ration chamber a controlled amount of this nebulized fuel mixture so as to mix the same with the main air supply.

It is to be understood of course that the main fuel pump is so arranged as to provide a sufficient excess of fuel to take care of this nebulizing process to a sufficient degree to provide for the proportioning effect referred to.

Among some of the advantages which result from the objects above set forth and from the constructions and methods described, the following will be appreciated by those familiar with devices of this character:—

Storage reservoirs and float valves and needle valves are dispensed with; automatic air valves or supplementary fuel nozzles are eliminated; no choke valve is necessary; increase of horse power is obtained by operating with substantially atmospheric pressure at the intake valves; a saturated mixture is produced which is independent of the pull of the engine; the mechanism for extracting the nebulized fuel can be adjusted to collect the extracted fuel from a point where the fuel is in its most suitable condition for mixing with the intake of air, such, for example, as at substantially the point of most finely nebulized vapor; the fuel feed is independent of the motor requirement; and heavier fuels than ordinarily used in certain types of engine may be utilized by the present invention. As compared with ordinary carbureters the fuel supply is improved during rapid engine acceleration and the likelihood of engine-stalling is diminished.

A much more uniform fuel condition is produced, due to the separation of the function of nebulizing the fuel into air, and the function of mixing the fuel-saturated air with the incoming atmospheric air in definite proportion.

By this method the mixture is accomplished by the combination of two streams of air; one fuel laden, the other atmospheric, as contrasted with the usual practice of combining a jet of liquid fuel with a stream of atmospheric air, the latter two of which are not similarly responsive. The importance of this distinction resides in the fact that two streams of air are similarly responsive to changes in influencing conditions such as suction, pressure and the like whereby a desired proportion of the two is substantially maintained regardless of changes in speed of the engine to which the device is attached. In the usual practice as referred to, a jet of liquid is combined with a stream of air, thus two fluids of dissimilar responsiveness are involved with resulting variation in mixture and consequent deficiency in engine performance, which is particularly marked upon starting, during changes in engine speed and upon substantial changes in atmospheric pressure.

An optimum ratio of air-and-fuel is substantially maintained independent of change in speed of the motor or rate of change in the motor speed, and also independent of variations in atmospheric pressure.

By selecting the finer particles of liquid fuel and rejecting the coarser particles, there is a resulting improvement with regards to the destruction of the oil film in the engine cylinder and a lessening of the dilution of the crank case oil which might otherwise be produced by excess of large size fuel particles. And an improved combustion of the fuel is produced which aids in reducing carbon and ignition and lubrication troubles, as well as tending to reduce the carbon monoxide produced during combustion.

In the description and claims herein, it is of course to be understood that the words used to indicate the condition of the fuel in the so-called mixture-chamber or saturation-chamber 12 are only approximate designations. That is, the fuel in said chamber only needs to be in a finely divided condition, whether as vapor or as nebulae or floating particles; and it is sufficient if the air in this chamber is charged or loaded or impregnated with fuel to a substantially uniform degree. These factors should be given consideration where such terms are used as, —nebulizing device, or nebulized fuel, or saturation-chamber, or fuel-loaded air and similar phrases.

It will further be noted that in the operation of the present invention a certain amount of vaporization of the fuel will take place during the nebulization and mixing; but it is desirable that the vaporization be limited, since if the mixture is predominately one of air and nebulized fuel, (that being substantially a mechanical mixture,) such a mixture is more easily maintained at a uniform proportion than one involving a large proportion of vapor. The tendency for a slower rate of combustion of a mixture of air and finely nebulized particles of fuel is advantageous.

Where vaporization occurs, this vaporization naturally tends to increase with temperature in any such process, but, since the vaporization during nebulization produces a lowering of the temperature, (that is, a sort of refrigerating effect,) the mixture chamber, together with the adjacent apparatus, the mixture itself and the incoming fuel, will all be cooled owing to this lowering of the temperature. This refrigerating effect cuts down the tendency to further vaporization. Thus, for example, if in hot weather the tendency to vaporize is greater, yet under the conditions which obtain in this invention, the greater will be the cooling effect opposing such vaporization.

The operation of this apparatus therefore automatically restricts or diminishes or limits vaporization and consequent variations in mixture under varying outside operating temperatures.

It will be understood that I do not limit myself to the specific placement and relationship of the several parts of the preferred embodiment of the invention as shown in the accompanying drawings inasmuch as the objects of the invention may be attained by other structures which will be apparent to those skilled in the art. Furthermore, the arrangement of the elements of the structure can, and might preferably be determined by the environment in which the invention is to be utilized.

What is claimed is as follows:

1. In a device of the character described, the combination of a saturation chamber communicating with the atmosphere at its upper end, a fuel cup mounted within said chamber for rotation on a vertical axis, power means to rotate said cup, means concentric with the rotary axis of said cup and communicating with the bottom thereof to feed liquid fuel upwardly into the cup as an incident to rotation thereof, a fan arranged to rotate with said cup to agitate and mix the atmosphere within the chamber, with fuel overflowing from, and thrown outwardly from the edge of said cup, an annular fuel collecting ring supported within said chamber and formed with a circumferential port providing communication between the interior of the chamber and the in-

terior of the fuel ring, and a manifold connected to said fuel ring and opened to the atmosphere adjacent one end, and arranged to be connected with a fuel consuming means at its other end.

2. In a device of the character described, the combination of a saturation chamber communicating with the atmosphere at its upper end, a fuel cup mounted within said chamber for rotation on a vertical axis, power means to rotate said cup, means concentric with the rotary axis of said cup and connected with the bottom thereof to feed a liquid fuel upwardly into the cup as an incident to rotation thereof, means arranged to rotate with said cup to agitate and mix the atmosphere within the chamber with fuel overflowing from the upper edge of the cup, an annular fuel collecting ring supported within said chamber and formed with a port providing communication between the interior of the chamber and the interior of the fuel ring, a manifold connected to said fuel ring and opened to the atmosphere adjacent one end, and arranged to be connected with a fuel consuming means at its other end, and manually settable means to differentially control the proportions of fuel and air flowing from said fuel ring and the open end of the manifold respectively, to the fuel consuming means.

3. In a device of the character described, the combination of a saturation chamber communicating with the atmosphere at its upper end, a fuel cup mounted within said chamber for rotation on a vertical axis, power means to rotate said cup, means to feed a liquid fuel upwardly into the cup as an incident to rotation thereof, means to agitate and mix the atmosphere within the chamber with fuel overflowing, and thrown outwardly from, the upper edge of the cup, an annular fuel collecting ring supported within said chamber and formed with a port providing communication between the interior of the chamber and the interior of the fuel ring, a manifold connected to said fuel ring and opened to the atmosphere adjacent one end, and arranged to be connected with a fuel consuming means at its other end, and means to differentially control the proportions of fuel and air flowing from said fuel ring and the open end of the manifold respectively, to the fuel consuming means.

4. In a device of the character described, the combination of a saturation chamber communicating with the atmosphere, means to supply liquid fuel to said chamber, power actuated means to recirculate the atmosphere of the chamber and to saturate the same with nebulized fuel, a manifold connected adjacent one of its ends to said chamber and having a contiguous opening to the atmosphere, the opposite end of said manifold being arranged to be connected to a fuel consuming means, and a manually settable valve to regulate the area of the opening between the chamber and manifold to meter the amount of nebulized fuel passing from said chamber to the fuel consuming means.

5. In a fuel conditioning device, the combination of a fuel conditioning chamber communicating with the atmosphere and including connections with a source of liquid fuel, means within the chamber operable to nebulize fuel and to maintain a closed circulation of air independent of the through-put of air, to maintain a mixture in which the fuel normally exceeds the explosive proportion, and metering means effective to control a flow of said non-explosive mixture into an

optimal quantity of atmospheric air to produce an explosive mixture.

6. In a fuel conditioning device adapted to supply an internal combustion engine, the combination of a fuel conditioning chamber communicating with the atmosphere, means to supply liquid fuel to said chamber, and positively driven means to nebulize the liquid fuel into a recirculating body of air within said chamber to provide a constant supply of substantially saturated mixture of fuel and air substantially independently of the suction effect of the engine.

7. In a fuel conditioning device adapted for attachment to an internal combustion engine, the combination of a fuel conditioning chamber, including means operable to recirculate liquid fuel and air to form a substantially saturated mixture in which the fuel normally exceeds the explosive proportion, a conduit communicating with said chamber and the atmosphere, adjacent one of its ends, and arranged to be connected with an internal combustion engine at its other end, and manually setttable means to differentially control the proportions of conditioned fuel flowing from said chamber, and atmospheric air from said conduit to provide an explosive mixture for use in said engine.

8. In a fuel conditioning apparatus, the combination of a chamber communicating with the atmosphere, means to supply liquid fuel to said chamber at a point substantially axially thereof, means to throw said fuel radially outwardly toward the walls of said chamber and to induce an accompanying recirculation of air in a path intersecting the plane of the dispersing fuel, the said recirculating air being effective to entrain fine nebulae of said fuel, the coarse nebulae collecting on the walls of the chamber and flowing downwardly and thence back to the said supply of liquid fuel, a collecting ring within said chamber, a closed passage extending from the interior of said collecting ring to the exterior of said chamber, said collecting ring having a port located in the flowing portion of the path of said recirculating air substantially spaced from the walls of said chamber through which a mixture of fine nebulae in air may be drawn from the interior of the chamber, thence through said ring and passage to the exterior of the chamber.

9. In a device of the character described, the combination of a saturation chamber communicating with the atmosphere, means to supply liquid fuel to said chamber, power actuated means to recirculate the atmosphere of the chamber to

maintain the same substantially saturated with nebulized fuel, a manifold connected adjacent one of its ends to said chamber and having a contiguous opening to the atmosphere, the opposite end of said manifold being arranged to be connected to a fuel consuming means, and valve means to differentially and inversely adjust the respective areas of the opening between the chamber and manifold and the opening between the atmosphere and the manifold.

10. In a device of the character described, the combination of a fuel chamber communicating with the atmosphere, means to supply liquid fuel to said chamber, power actuated means within said chamber to nebulize said fuel in a turbulent body of air, and means to proportionately mix atmospheric air, and nebulized fuel in air, to form a mixture suitable for delivery to an internal combustion engine at atmospheric pressure.

11. In a fuel conditioning device adapted for attachment to an internal combustion engine, the combination of a fuel conditioning chamber including means operable to recirculate liquid fuel and air within said chamber to form a conditioned, normally non-explosive mixture, and power means, to actuate said last mentioned means.

12. In a fuel conditioning device, the combination of a fuel conditioning chamber including means operable therein to nebulize liquid fuel and to recirculate the body of air within said chamber to form an intimate mixture of fuel and air means, to actuate said last-mentioned means, and metering means to control the flow of said mixture of fuel and air from said chamber for subsequent mixture with an optimal quantity of atmospheric air to produce an explosive mixture.

13. In a fuel conditioning device adapted for attachment to an internal combustion engine, the combination of a fuel conditioning chamber, including means operable to recirculate liquid fuel and air to form a mixture in which the fuel normally exceeds the explosive proportion, a conduit communicating with said chamber and the atmosphere adjacent one of its ends, and arranged to be connected with an internal combustion engine at its other end, and means to differentially control the proportions of conditioned fuel flowing from said chamber, and atmospheric air from said conduit, to provide an explosive mixture for use in said engine.

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