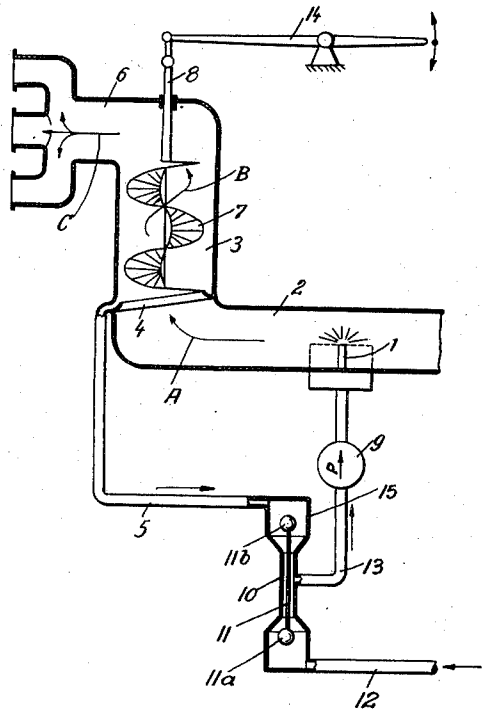
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MEANS FOR CARBURETING AIR FOR COMBUSTION IN AN ENGINE

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MEANS FOR CARBURETING AIR FOR COMBUSTION IN AN ENGINE

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My invention relates to improved means for carbureting air for combustion in an engine.

It is the object of my invention to obtain a fuel-air mixture of superior homogeneity conducive to an improved combustion.

It is well known that the efficiency of an internal combustion engine may be improved by improving the uniformity of distribution of the air-fuel mixture between the different cylinders of the engine. I have found that the uniformity of distribution on the air-fuel mixture conducted by an intake manifold to the different cylinders may be enhanced by supplying to such intake manifold an air-fuel mixture in which the fuel globules are extremely fine.

Therefore, it is an object of my invention to provide a stream of air carbureted by means of a liquid fuel, which stream is substantially free from coarse globules liable to be precipitated on the walls of the intake manifold.

Further objects of my invention will appear from the description of a preferred embodiment thereof following hereinafter, it being understood that such detailed description serves the purpose of illustrating the invention rather than that of restricting or limiting the same.

In the drawing a more or less diagrammatic sectional viwe of the intake conduit leading from the carburetor to the intake manifold and equipped with my novel means is shown.

A carburetor spray nozzle **1** is disposed within an intake conduit **2** adapted to conduct the stream of air to be carbureted and to be supplied to an intake manifold **6** leading to the different cylinders of an internal combustion engine for compression, ignition and combustion therein. A source of liquid fuel under pressure, such as a pump **9**, is connected with the nozzle **1** whereby a stream of liquid fuel is sprayed into the stream of air thereby producing a combined fuel-air stream flowing in the direction of the arrow A. This stream contains fuel globules of different sizes. If this stream is directly supplied to the intake manifold for distribution between the different cylinders, the larger globules are liable to be precipitated at the walls thereof, whereby the percentage of fuel in the mixture is reduced. As a result, some of the cylinders will contain a leaner mixture than others. For the purpose of ensuring a uniform distribution of the fuel between the different cylinders, I subject the fuel-air stream indicated by the arrow A before the same is admitted to the intake manifold to a process in which substantially all fuel globules of a size exceeding a certain limit are separated from the stream and are removed therefrom for subsequent return to the source of fuel **9** and for repeated spraying. Any suitable separating process may be used for that purpose. Thus, the separation of the globules may be effected by conducting the stream in a curved path at a speed causing the larger globules owing to the centrifugal effect to be precipitated on a surface confining the path.

In the embodiment illustrated in the drawing this curved path is a helical path. It will be noted that a vertical cylindrical housing **3** is interposed between the intake conduit **2** and the intake manifold **6**. The housing **3** encases a coaxially disposed helical partition **7** which may be formed by a sheet metal strip similar to a spiral staircase. The sheet metal strip is so shaped that its outer edge slidably contacting the internal wall of the housing **3** is a helix. At its lower end the housing **3** is provided with a circumferential internal flange **4** extending in a slightly inclined plane and forming a trough which at its lowest point communicates with an outlet opening provided in the wall of the housing **3** and connected to a pipe **5**.

The fuel-air stream issuing from the conduit **2** is compelled by the helical partition **7** to flow along a helical path indicated by an arrow B causing the larger globules owing to the centrifugal effect to be hurled against the wall of the housing **3** and to be thus precipitated thereon. The precipitated liquid fuel flows downwardly on the wall and is collected in the trough **4** and returned by the pipe **5** to the pump **9**. In this manner, all fuel globules of a size exceeding a certain limit will be separated from the fuel-air stream so that the fuel-air mixture entering the intake manifold **6**, as indicated by the arrows C, will be substantially free from fuel globules of a size exceeding a certain limit.

Preferably, means are provided which permit of a variation of such limit. Such variation may be effected, for instance, by varying the speed of the stream B and thereby the centrifugal effect thereof. In the embodiment shown, such variation may be effected by changing the pitch of the helix **7**. For this purpose, the lower end of the helix **7** is mounted in fixed relationship to the housing **3**, whereas the upper end of the helix is connected to a vertical rod **8** disposed coaxially in the housing **3** and extending from the upper end thereof being slidably guided in the top wall of the housing. The rod **8** is connected by a suitable connecting link to an adjusting lever **14** which may be angularly adjusted by suitable means not shown. In this manner, the helical partition **7** may be compressed or expanded to thereby change its pitch. As a result, the stream B is subjected to a more or less powerful centrifugal force so that the limit of the size of the globules separated from the stream may be altered.

As the more volatile constituents of the fuel will quicker vaporize than the less volatile constituents, the fuel collecting in the trough **4** consists primarily of the less volatile constitutents. Therefore, it is desirable to feed this fuel directly to the pump **9** rather than to the fuel reservoir, since otherwise the fuel supply stored in the reservoir would gradually undergo a change, the less volatile constituents collecting therein.

In the embodiment shown, this object is achieved by the inclusion in the communication between the pipe **5** and the pump **9** of a container **15** provided with an outlet at its bottom which communicates with the pump **9** through a pipe **13** and is controlled by a floating valve **11***b*. When the liquid level in the container **15** drops, the floating spherical valve member **11***b* will close the communication with the pump **9**. A second spherical valve member **11***a* is provided to control the communication between the pipe **12** leading to the reservoir and the pipe **13** leading to the pump **9**. Both valve members **11***a* and **11***b* are connected by a rod **11** for opposite operation causing one of the valves to open when the other one closes, and vice versa. The total weight of the valve members **11***a* and **11***b* and of the rod **11** is so chosen that it will be carried by the hollow valve member **11***b* when the same is floating on fuel collecting in the container **15**. In order to increase the total buoyancy the valve member **11***a* may be made hollow, too.

Owing to this arrangement it is ensured that when separated fuel collects in the container 15 the valve member 11*a* will close the lower end of pipe 10 and will thus cause the pump 9 to be supplied with the fuel only that has been separated from the fuel-air stream. Only after the quantity of separated fuel collected in the container 15 will have been sprayed by the nozzle 1 again, will the valve 11*b* close the container 15 whereby the communication between the pump 9 and the supply pipe 12 will be re-established to feed the nozzle 1 primarily with fresh fuel.

Normally, the duplex valve 10, 11*a*, 11*b* will be kept in such a floating positon that the fuel supplied through pipe 13 to pump 9 and sprayed by nozzle 1 in the conduit 2 will consist of a major proportion of fuel supplied through pipe 12 and of a smaller proportion constituting the total of the fuel continuously collected by trough 4 and supplied through pipe 5.

The embodiment shown is capable of numerous modifications. Thus, where the diameter of the housing 3 is large enough, the helical partition may be omitted permitting the globules owing to their gravity to drop out of the stream and to collect at the bottom of the housing 3, such botttom being provided with a suitable outlet connected to pipe 5.

The atomization of the fuel may be enhanced by pneumatic or supersonic effects produced by electrical or mechanical means.

From the foregoing description it will appear that the novel method is applicable to internal combustion engines operated with liquid fuels and comprises the steps of spraying a stream of liquid fuel into a stream of air, separating from the fuel-air stream thus formed substantially all fuel globules of a size exceeding a certain limit, removing the separated fuel from the fuel-air stream prior to the entry thereof into the engine, and returning the separated fuel to the air stream for repeated spraying. Therefore, the fuel-air mixture supplied to the cylinders is free from globules of such size as are liable to be precipitated on the walls of the intake manifold and is, the therefore, adapted to be more uniformly distributed between the cylinders thus permitting a higher compression and ensuring a higher efficiency. This is of particular utility when the internal combustion engine is operated at a low speed, for instance at idling speed, since the treatment of the fuel-air stream described results in a more complete combustion than heretofore. The power produced by the engine may be controlled by either directly varying the quantity of the separated fuel globules, or by varying the quantity of atomized fuel permitted to proceed through the intake manifold into the cylinders.

While the invention has been described in connection with a preferred embodiment thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains, and as fall within the scope of the invention or the limits of the appended claims.

What I claim is:

1. In an internal combustion engine the combination comprising an intake manifold, an intake conduit communicating therewith, a carburetor spray nozzle disposed in said conduit, a flexible helical partition within said conduit between said intake manifold and said nozzle, said conduit being provided with a fuel outlet at a point near the bottom end of said helical partition, and adjustable means connected with said partition for variably flexing the same to thereby vary its axial length and its pitch.

2. In an internal combustion engine the combination comprising an intake manifold, a conduit communicating therewith, a carburetor spray nozzle disposed in said conduit, the latter having an upright section located between said nozzle and said manifold, the latter communicating with the upper end of the said upright section, a flexible helical partition within said upright section of said conduit, means connected with said partition for flexing the same to thereby vary the axial length of said partition and the pitch thereof, and an annular trough on the inside of said conduit below said helical partition, said conduit being provided with a fuel outlet communicating with said annular trough.

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