March 7, 1967 H. B. NILES 3,307,838

CARBURETOR FOR INTERNAL COMBUSTION ENGINE

Filed Aug. 21, 1964 2 Sheets-Sheet 1

Fig. 1.

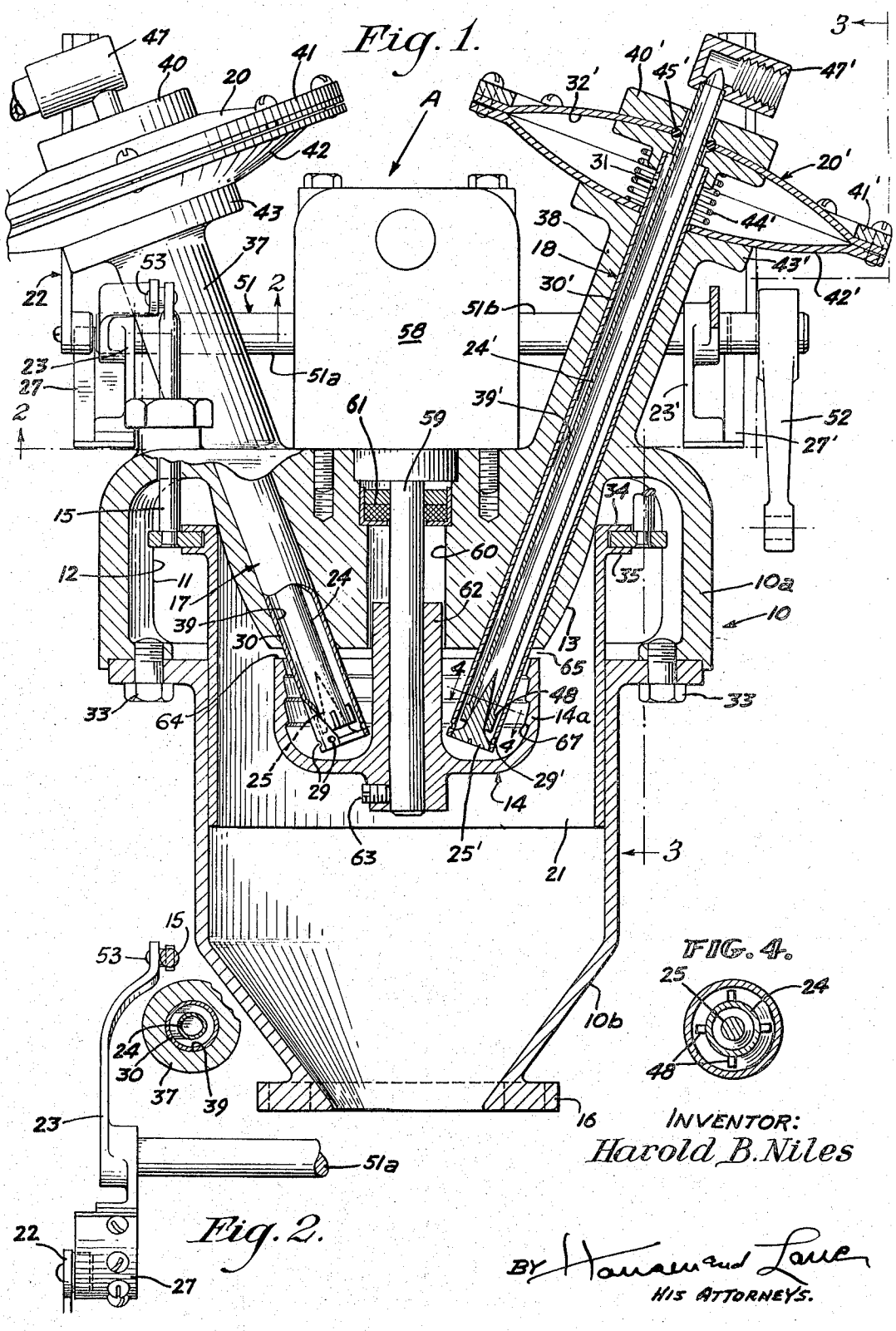


FIG. 4.

Fig. 2.

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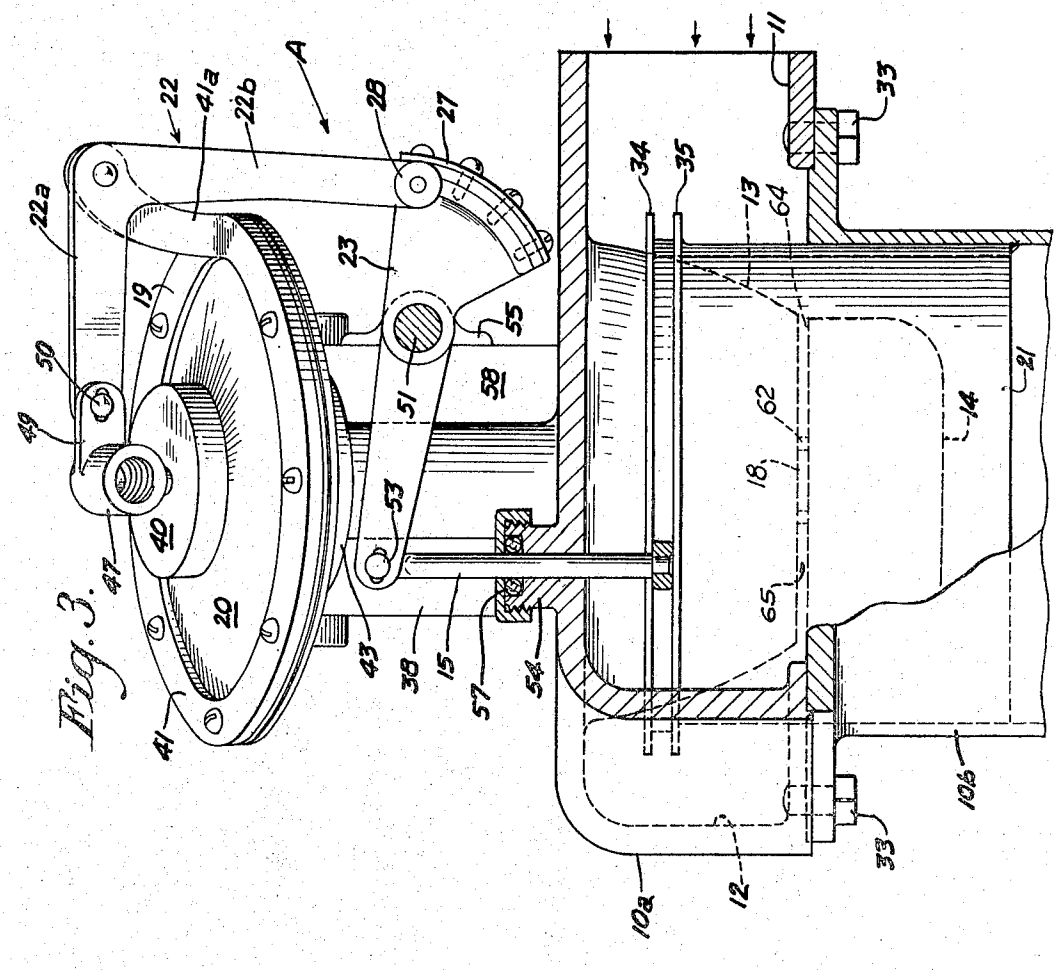


Fig. 3.

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CARBURETOR FOR INTERNAL COMBUSTION ENGINE

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13 Claims. (Cl. 261—50)

The present invention relates to a carburetor for an internal combustion engine, and pertains more particularly to a carburetor wherein one or more pressure sensitive nozzles are mounted to discharge controlled quantities of fuel into a rapidly rotating cup mounted co-axially within an intake air stream of annular cross sectional shape.

Important factors in the combustion efficiency of an internal combustion engine are the completeness of vaporization of the fuel, and the thoroughness of mixing of the fuel and air in the mixture which is fed into the combustion chamber or chambers of such engine.

In the past, numerous efforts have been made to improve the completion of vaporization of the liquid fuel, and the thorough intermixing of the components of the fuel-air mixture.

An object of the present invention is to provide an improved carburetor for an internal combustion, liquid fuel engine.

Another object of the invention is to provide a carburetor wherein a pressure responsive fuel flow control nozzle is mounted to discharge metered quantities of liquid fuel interiorly of a power driven rotary cup mounted coaxially within an intake air stream of annular cross sectional shape, whereby fuel fed into the cup is carried by centrifugal force up the peripheral wall of the cup to its rim, where the fuel is sheared off in the form of a fog-like mist or vapor directed transversely across and into the intake air stream for entrainment in the air stream.

A further object of the invention is to provide an improved carburetor for an internal combustion, liquid fuel engine wherein intake air for the engine is admitted in a generally cylindrical stream flowing around and past the rim of a power driven, high speed, rotary cup mounted substantially coaxially within the air stream, pressure responsive means being provided for feeding controlled amounts of liquid fuel into the cup for transference by centrifugal force in the form of a thin film to the rim of the cup, where the fuel is sheared off in the form of fog-like vapor which is driven by centrifugal force radially outwardly into the passing air stream, wherein this vapor is entrained and conducted into the combustion chamber or chambers of an engine upon which the carburetor is mounted. The terms vapor, vaporize, etc., are used throughout the present description and accompanying claims to designate the form in which the fuel leaves the rim of the cup, since the discharged fuel is either in the form of a true gas, or in the form of a mist of fog-like particles of minute, substantially micron, size.

A further object of the invention is to provide improved, pressure responsive fuel flow control and vaporization mechanism for a carburetor for an internal combustion, liquid fuel engine.

The foregoing objects of the invention will be apparent from the following description and the accompanying drawings, wherein:

FIG. 1 is a view partly in elevation and partly in longitudinal medial section of a carburetor embodying the invention and having two metering nozzles mounted therein.

FIG. 2 is a fragmentary sectional view taken along line 2—2 of FIG. 1.

FIG. 3 is a fragmentary sectional view of the throttle lever taken along line 3—3 of FIG. 1.

FIG. 4 is an enlarged, sectional view taken along line 4—4 of FIG. 1.

Brief description

Briefly, the invention comprises a carburetor A with a housing **10** having an air inlet **11** open to the atmosphere and in open communication with an annular channel **12** surrounding a generally inverted, frusto-conical housing portion **13**. A power driven rotary fuel cup **14** is mounted coaxially of the frusto-conical portion **13**, and two fuel nozzles **17** and **18** extend into the fuel cup **14**. The admission of fuel through these nozzles is controlled in part by a cam-actuated, bell crank lever **22**, and in part by a pressure sensitive diaphragm **20**. Incoming air is controlled by a cylindrical throttle sleeve **21**, fitted for axial movement in a cylindrical lower housing portion **10***b*, and axial adjustment of the sleeve is controlled by a link **15** pivotally connected to one end of a throttle lever **23**.

As the throttle lever **23** is moved counterclockwise away from its closed position of FIG. 3, the throttle sleeve **21** is moved downwardly to provide an annular opening between the frusto-conical housing portion **13** and the upper end of the throttle sleeve, while simultaneously an inner fuel tube **24** is elevated free of a valve needle **25** by an eccentric cam plate **27** on the throttle lever **23** acting on a roller **28** on one arm of the bell crank lever **22**, the other arm of which is connected to the fuel tube **24**. This action allows fuel from the fuel tube **24** to flow through apertures **29** in the lower end of an outer, pressure responsive tube **30** into the rotating fuel cup **14**. Thence this fuel is carried by centrifugal force in the form of a thin sheet, up the inner side of the rapidly rotating cup to its rim, where it is sheared off in the form of vapor and discharged into the surrounding intake air stream flowing downwardly past the cup.

Variations in pressure within the carburetor throat surrounding the fuel cup are transmitted through the apertures **29**, and vent holes **31** provided in the upper end portion of the pressure responsive tube **30**, into a diaphragm chamber **32**, wherein pressure changes cause movement of the spring biased diaphragm **20** to move the outer pressure responsive tube **30** and the valve needle **25** on its lower end to vary the fuel flow into the rotary fuel cup **14**.

Detailed description

Referring to the drawings in greater detail:

The illustrative carburetor A comprises the two-part, stationary housing **10**, consisting of the upper housing portion **10***a*, and lower housing portion **10***b*. These housing portions are fitted together in sealed relation, and are removably interconnected by cap screws **33**. The air inlet **11** opens into the annular air channel **12** surrounding the upper end of the downwardly extending frusto-conical housing portion **13**. The upper part of the lower housing portion **10***b* is cylindrical and is mounted coaxially with the frusto-conical upper housing portion **13**. A usual mounting flange **16** is provided at the lower end of the lower housing portion **10***b* for connection to the intake manifold of an engine (not shown) upon which the carburetor is to be mounted.

The throttle sleeve **21** has an axially sliding, substantially air tight fit in the lower housing portion **10***b*, and a pair of peripheral flanges **34** and **35** around its upper end provide a groove therebetween to receive the head on the lower end of the throttle sleeve control link **15**.

A pair of upwardly diverging extensions **37** and **38** extend from the top of the upper housing member **10***a* and the nozzles **17** and **18** are mounted in holes **39** extending substantially axially through these extensions and through the frusto-conical housing portion **13**.

Since the two fuel nozzles 17 and 18 are identical, the same reference numerals are used to designate corresponding parts thereof, those for the right hand nozzle in FIG. 1 being distinguished by the addition of the prime (').

Fitted for axial slidable movement in each of the holes 39 is the pressure responsive tube 30, the lower end of which projects downwardly into the rotary fuel cup 14 and is closed by a cap having the tapered fuel metering needle 25 extending coaxially upwardly into the outer tube 30. The combined fuel discharge and vent openings 29 are provided at the lower end of the outer tube 30, the total cross sectional area of these openings being sufficient to permit venting without interfering with the flow of fuel or other liquid therethrough.

The upper end of the pressure responsive tube 30 is closed by, and is connected coaxially to, a fitting 40 mounted centrally of the flexible diaphragm 20, which is secured and sealed marginally, by a mounting ring 41, to a rigid, dished member 42 to form the diaphragm chamber 32 therebetween. The dished member 42 is mounted in sealed relation on the concave upper side of a flange 43 provided around the upper end of each of the upper housing extensions 37 and 38. A light coil spring 44 surrounds the upper portion of the pressure responsive tube 30 within the diaphragm chamber 32, and is held in compression between the flexible diaphragm 20 and the dished member 42. The vent openings 31 in the upper end portion of the pressure responsive tube 30 communicate the interior of the diaphragm chamber 32 with the space between the two tubes 24 and 30 and thence, through the lower end apertures 29 with the interior of the throttle sleeve 21.

Mounted coaxially within the pressure responsive tube 30, and spaced inwardly therefrom, is the smaller diameter fuel inlet tube 24. This latter tube is fitted for axial, slidable movement in an opening provided therefore in the diaphragm fitting 40, and is sealed thereto by a conventional sealing O ring 45. An internally threaded hose connection fitting 47 is provided on the upper end of the fuel tube 24 for the connection of a usual flexible fuel hose through which liquid fuel or other liquid is fed under required pressure from a supply thereof, such as the fuel tank of an automobile. A plurality of centering fins 48 are provided on the lower end of the fuel tube 24, and ride on the interior of the pressure responsive tube 30.

The lower end of the fuel tube 24 seats on the fuel metering needle 25 in the closed condition of the throttle, and the fuel tube 24 and pressure responsive tube 30 move relatively, coaxially of each other to provide required metering and control of the fuel, as will be made apparent later herein.

For throttle control of fuel flow, the hose connection fitting 47 is provided with an ear 49 formed integrally thereon, the ear 49 having a slightly elongated slotted opening therein to receive a pivot pin 50 by which the ear is pivotally connected to the end of one arm 22*a* of the bell crank lever 22. The latter is pivotally mounted on a bracket arm 41*a* on the ring 41 which secures the rim of the flexible diaphragm 20 to its dished support member. The cam roller 28 on the lower end of the bell crank lever arm 22*a* rides on the eccentric cam plate 27 at one end of the throttle lever 23, which is secured to a conventional throttle shaft 51.

The latter is journaled in usual bearings 55 affixed to the housing of a cup drive motor 58, the shaft 51 having a throttle lever 52 also affixed thereon for operation by usual throttle lever control linkage (not shown) in a well known manner. The other end of the throttle lever 23 is provided with a slightly elongated opening to receive a pivot pin 53 by which the throttle lever is pivotally connected to the throttle sleeve control link 15. The link 15 is mounted for axial slidable movement in a hole provided therefor in a boss 54 on the upper housing member

10*a*, and is sealed thereto by a conventional O sealing ring 57. The headed lower end of the link 15 rides in the groove between the flanges 34 and 35 of the throttle sleeve 21 for axial movement of the sleeve upon adjustment of the throttle lever 23.

The inverted, frusto-conical portion 13 of the upper housing member 10*a* has a preferably smooth, slightly convexly curved peripheral surface, and the upper end of the throttle sleeve 21 seats in sealing relation against this surface when the throttle lever is in its closed condition as shown in FIGS. 1 and 3.

A fuel cup drive motor 58 is mounted with its drive shaft 59 extending coaxially through an axial hole 60 provided therefor in the frusto-conical upper housing portion 13, and is sealed thereto by a seal 61. The fuel cup 14 has an elongated hub 62 which fits snugly onto the motor shaft 59 and is retained thereon by a set screw 63.

The rim 64 of the fuel cup 14 is preferably of substantially the same diameter as the lower end of the frusto-conical member 13, and is spaced slightly axially therefrom to provide a fuel passage 65 (FIG. 1) therebetween. The peripheral wall 14*a* of the fuel cup 14 is substantially cylindrical, and its juncture with the cup bottom is preferably rounded, so that fuel discharged onto the bottom of the rotating cup will be spread thereon in a thin sheet by inertia at impact due to the rotation of the cup, and will then be driven by centrifugal force radially outwardly and thence to the interior of the cup wall, over which it spreads in a thin sheet. The inner face of the cup wall preferably is provided with one or more shallow, annular corrugations 67, which structure tends to assist in the vaporization of fuel or other liquid fed into the rapidly rotating cup. The film of fuel or other liquid on the interior of the cup wall is moved by centrifugal force toward the cup rim 64, where it is sheared off in the form of vapor and flung tangentially outwardly into the annular stream of intake air flowing past the cup.

Operation

The operation of the illustrative carburetor A is as follows:

With each of the fittings 40 and 40' connected to a source of desired liquid, such as gasoline, under required pressure, the cup drive motor 58 is energized to drive the fuel cup 14, and the throttle shaft 51 is moved rotatively to adjusted position to swing the throttle lever 23 (FIG. 3) in a counterclockwise direction from its illustrated closed condition. This lowers the throttle sleeve 21 to admit intake air between the upper end of the sleeve 21 and the frusto-conical housing portion 13, which air is drawn past the spinning fuel cup 14 and thence through the lower housing portion 10*b* and usual intake manifold (not shown) into the combustion chamber or chambers of an engine upon which the carburetor is mounted. The engine on which the carburetor A is mounted is then started in a usual manner.

Simultaneously with the opening of throttle sleeve 21, the eccentric cam 27 on the other end of the throttle lever 23, acting on the cam roller 28, swings the bell crank lever 22 clockwise, thereby raising the inner fuel tube 24 clear of the tapered valve needle 25 and permitting fuel to flow through the apertures 29 into the rotating fuel cup 14 for vaporization of the fuel or other liquid, and entrainment of resultant vapor in cup as explained previously herein.

Supplemental fuel control is accomplished by movement of the diaphragm 20 in response to pressure changes within the diaphragm chamber 32. As engine speed increases, the intake manifold pressure decreases, and suction from the zone surrounding the fuel cup 14 is transmitted through the apertures 29, the space between the inner fuel tube 24 and outer pressure responsive tube 30 and vent holes 31 to the diaphragm chamber 32. This action urges the diaphragm 20 downwardly to thereby lower the outer tube 30 and its valve needle 25, thereby tending to increase the fuel flow. Conversely, increase of

intake manifold pressure permits the spring **44** to move the diaphragm **20** and attached pressure responsive tube **30** upwardly to decrease the fuel flow and thus lean out the fuel-air mixture. Axial movement of the pressure responsive tube **30** during operation is controlled by the pressure of the spring **44**, the diameter and flexibility of the diaphragm **20**, and the size of the diaphragm chamber **32**. When the throttle lever **23** is in its closed condition, the inner fuel tube **24** is lowered thereby to a point where low intake manifold pressure resulting from closing off the air flow by the throttle sleeve **21** does not unseat the lower end of the fuel tube **24** from the valve needle **25**, thereby avoiding an overrich mixture and resultant high percentage of CO in the exhaust gases during idling, decelerating, or on downhill runs.

While both nozzles **17** and **18** in the illustrated form A of the invention have been described previously herein as being operated from the same throttle shaft **51**, and as both using a common fuel, an important advantage of the invention resides in its ability to feed a plurality of liquids, either selectively or jointly, into the fuel cup **14**. For example, it will be assumed that as shown in FIG. 1 the hose connecting fitting **47** of the left hand nozzle **17** is connected to a supply of either water, alcohol, kerosene, or other liquid under suitable pressure, while that **47'** of the right hand nozzle **18** is similarly connected to a supply of other desired liquid, such as gasoline.

It will be assumed further that the two portions of the throttle shaft **51** visible on opposite sides of the cup motor **58** are actually two independently rotatable throttle shafts, one controlling each of the nozzles **17** and **18**, and each independently controlled, either manually or automatically.

Then, in that case, an engine upon which such carburetor is mounted can be started on gasoline fed through one of the nozzles as explained previously herein, and the other liquid can be fed independently through the other nozzle into the rotating fuel bowl, wherein it is either mixed in desired proportions with the gasoline, as would be the case if water for example were the secondary liquid. However, if kerosene for example were the secondary liquid, the engine could be started on gasoline and then run on kerosene. Obviously, additional nozzles can be added if desired, so that an engine upon which a three nozzle carburetor were mounted could be started on gasoline, and then switched over to run on kerosene with water admitted through a third nozzle if desired. Since such modifications and the manner of constructed and operating them will be well within the capabilities of any routine worker in the art, conversant with the presently described and illustrated form of the invention, the details of such modifications are omitted from the present disclosure.

The present invention provides an improved carburetor for an internal combustion engine, and one wherein the flow of liquid fuel or other liquid or liquids to the carburetor can be accurately controlled, and wherein the richness of the mixture is automatically responsive to variations in intake manifold pressure. This latter feature also provides automatic enrichment of the mixture with variations in ambient atmospheric pressure, as with changes in elevation or altitude. During dynamometer tests of an engine employing a carburetor embodying the present invention, exhaust gas analysis showed an extremely high CO_2 reading, indicating a high degree of complete combustion, which should be a factor in reducing smog producing pollutants in the exhaust. As mentioned previously herein, the fuel cup is driven to rotate at high speed. For example, with a cup having a diameter of the order of 1½–2 inches, optimum rotative speed would be of the order of 8000–14,000 r.p.m.

The carburetor of the present invention is relatively simple to manufacture, and with highly effective vaporization characteristics. In observation tests during running, the interior of the throttle sleeve **21** showed no moisture whatever, indicating that the vapor discharged by the fuel cup is completely entrained in the intake air stream. A very important feature of the invention resides in the fact that no preheating of the intake air is required, and the power loss resulting from such preheating is thus avoided.

While I have illustrated and described a preferred embodiment of the present invention, it will be understood, however, that various changes and modifications may be made in the details thereof without departing from the scope of the invention as set forth in the appended claims.

Having thus described the invention, what I claim as new and desire to protect by Letters Patent is defined in the following claims.

1. A carburetor for an internal combustion engine comprising:

a housing having an air inlet and an outlet formed for connection to an engine intake manifold for drawing a stream of intake air through the housing,

an annular chamber in the housing openly communicating with the air inlet,

an inverted, frusto-conical member mounted with its upper end coaxially within the annular chamber, and with its truncated end directed toward the housing outlet,

a rotary fuel cup having a peripheral wall terminating in a rim surrounding the open end of the fuel cup, the fuel cup being mounted with the rim thereof spaced slightly from the truncated end of the frusto-conical member, the cup being rotatable coaxially of the frusto-conical member,

a fuel nozzle mounted to discharge metered quantities of fuel into the fuel cup,

drive means for rapidly spinning the fuel cup about its axis to discharge, in vapor form, from the rim of the cup, by centrifugal force, liquid fuel fed into the fuel cup by the nozzle, for entrainment of such fuel vapor in a stream of intake air flowing from the air inlet through the annular chamber, past the frusto-conical member and the fuel cup toward the housing outlet, and

throttle means mounted to control the flow of intake air through the housing.

2. An arrangement according to claim **1** wherein the diameter of the fuel cup is substantially the same as that of the truncated end of the frusto-conical member.

3. An arrangement according to claim **1** wherein the fuel nozzle projects from the truncated end of the frusto-conical member into the fuel cup.

4. An arrangement according to claim **1** wherein the fuel nozzle extends from a point exteriorly of the housing endwise through the frusto-conical member and projects from the truncated end of the frusto-conical member into the fuel cup.

5. An arrangement according to claim **1** wherein the open end of the fuel cup is directed toward the truncated end of the frusto-conical member.

6. An arrangement according to claim **1** wherein the fuel nozzle is one of the plurality of similar fuel nozzles.

7. A carburetor for an internal combustion engine comprising:

a housing having an air inlet and an outlet formed for connection to an engine intake manifold for drawing a stream of intake air through the housing,

an inverted, frusto-conical member mounted coaxially within the housing and with its truncated end directed toward the housing outlet,

a rotary fuel cup mounted with the open end thereof directed toward and spaced slightly from the truncated end of the frusto-conical member, the cup being rotatable coaxially of the frusto-conical member,

a fuel nozzle mounted to discharge metered quantities of fuel into the fuel cup,

drive means for rapidly spinning the fuel cup about

its axis to discharge from the rim surrounding the open end of the cup, by centrifugal force, liquid fuel fed into the fuel cup by the nozzle for entrainment of such fuel in a stream of intake air flowing from the air inlet through the housing, past the frusto-conical member and the fuel cup toward the housing outlet, and

throttle means mounted to control the flow of intake air through the housing.

8. An arrangement according to claim 7 wherein the fuel nozzle is inserted in a hole extending endwise through the frusto-conical member at an angle of inclination to the axis of the latter member.

9. A carburetor for an internal combustion engine comprising:

a housing having an air inlet and an outlet formed for connection to an engine intake manifold for drawing a stream of intake air through the housing,

an inverted, frusto-conical member mounted in the housing with its truncated end directed toward the housing outlet,

a portion of the housing being in the form of a cylindrical chamber coaxial with the frusto-conical member,

a throttle valve sleeve fitted for axial slidable movement in the cylindrical chamber portion and movable therein from an open position to a closed position,

a rotary fuel cup mounted with the open end thereof directed toward and spaced slightly from, the truncated end of the frusto-conical member, the cup being rotatable coaxially of the frusto-conical member,

a fuel nozzle mounted to discharge metered quantities of fuel into the fuel cup, and

drive means for rapidly spinning the fuel cup about its axis to discharge from the rim of the cup by centrifugal force fuel fed in liquid form into the fuel cup by the nozzle for entrainment of such fuel in a stream of intake air flowing from the air inlet through the annular chamber, past the frusto-conical member and the fuel cup toward the housing outlet.

10. A carburetor for an internal combustion engine comprising:

a generally upright housing having an air inlet at its upper end and an outlet at its lower end formed for connection to an engine intake manifold for drawing a stream of intake air downwardly through the housing,

a frusto-conical member mounted in axially upright position within the housing with its truncated end directed downwardly toward the housing outlet,

a rotary fuel cup mounted with the open end thereof directed upwardly toward, and spaced slightly from, the truncated end of the frusto-conical member, the cup being rotatable coaxially of the frusto-conical member,

a fuel nozzle inserted downwardly through the frusto-conical member and with its lower end projecting into the fuel cup to discharge metered quantities of fuel into the fuel cup,

drive means for rapidly spinning the fuel cup about its axis to discharge from the rim surrounding the open end of the cup, by centrifugal force, liquid fuel fed into the fuel cup by the nozzle for entrainment of such fuel in a stream of intake air flowing from the air inlet downwardly through the housing, and

throttle means mounted to control the flow of intake air through the housing.

11. A carburetor for an internal combustion engine comprising:

a housing having an air inlet and an outlet formed for connection to an engine intake manifold for drawing a stream of intake air through the housing,

an inverted, frusto-conical member mounted coaxially within the housing and with its truncated end directed toward the housing outlet,

a rotary fuel cup mounted with the open end thereof directed toward and spaced slightly from the truncated end of the frusto-conical member, the cup being rotatable coaxially of the frusto-conical member,

a fuel nozzle mounted to discharge metered quantities of fuel into the fuel cup,

adjustable fuel metering means in the nozzle,

drive means for rapidly spinning the fuel cup about its axis to discharge from the rim surrounding the open end of the cup, by centrifugal force, liquid fuel fed into the fuel cup by the nozzle for entrainment of such fuel in a stream of intake air flowing from the air inlet through the housing, past the frusto-conical member and the fuel cup toward the housing outlet,

throttle means mounted to control the flow of intake air through the housing, and

actuating means operatively interconnecting the throttle and the fuel metering means, whereby, upon a selected movement of the throttle means the fuel metering means is adjusted proportionately thereto.

12. An arrangement according to claim 11 wherein the fuel nozzle comprises a larger diameter outer tube and a smaller diameter inner tube inserted in, and spaced inwardly from the outer tube, and the two tubes are axially movable relative to each other for controlling the metered flow of liquid fuel therethrough.

13. A carburetor for an internal combustion engine comprising:

a housing having an air inlet and an outlet formed for connection to an engine intake manifold for drawing a stream of intake air through the housing,

an inverted, frusto-conical member mounted coaxially within the housing and with its truncated end directed toward the housing outlet,

a rotary fuel cup mounted with the open end thereof directed toward and spaced slightly from the truncated end of the frusto-conical member, the cup being rotatable coaxially of the frusto-conical member,

a fuel nozzle mounted to discharge metered quantities of fuel into the fuel cup,

adjustable fuel metering means in the nozzle,

pressure responsive valve means in the nozzle operating in conjunction with the fuel metering means and open by communicating with the interior of the housing for changing the fuel metering rate in response to pressure changes within the housing,

drive means for rapidly spinning the fuel cup about its axis to discharge from the rim surrounding the open end of the cup, by centrifugal force, liquid fuel fed into the fuel cup by the nozzle for entrainment of such fuel in a stream of intake air flowing from the air inlet through the annular chamber, past the frusto-conical member and the fuel cup toward the housing outlet, and

throttle means mounted to control the flow of intake air through the housing.

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