July 5, 1932. E. R. GODWARD 1,865,515

VAPORIZER

Filed March 6, 1921

Fig. 1

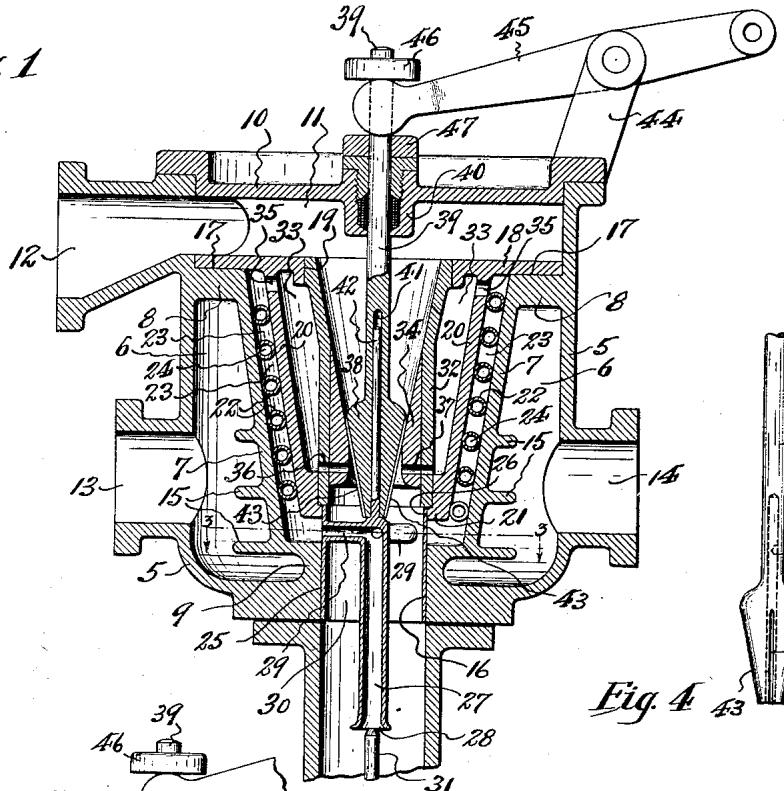


Fig. 4

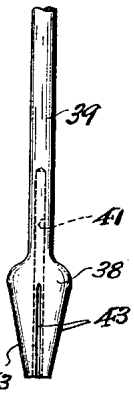


Fig. 2

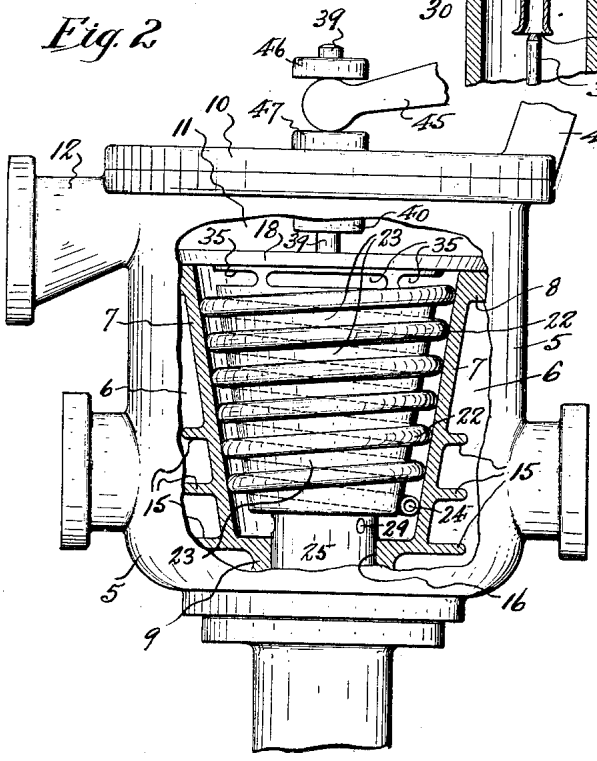
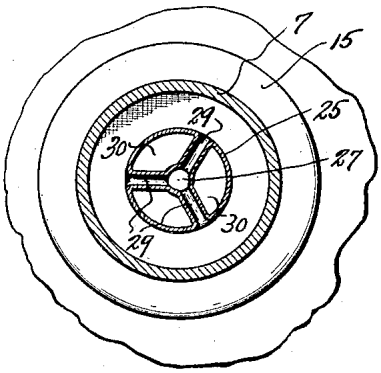


Fig. 3



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UNITED STATES PATENT OFFICE

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VAPORIZER

Application filed March 6, 1931. Serial No. 520,519.

This invention relates to improvements in apparatus for vaporizing fuel mixtures such e. g. as are supplied to internal combustion engines; and the invention has reference, more particularly, to a vaporizer apparatus adapted to submit fuel mixtures to heat while subject to gyratory movement tending to deposit wet fuel particles upon hot supporting surfaces in aid of vaporization thereof, and adapted also to subject the fuel mixture to the effects of expansion preparatory to intermixing the vaporized mixture with cool air to form the final fuel vapor delivered to the engine cylinders.

The invention has for its principal object to provide a compact and efficient form of vaporizer apparatus for the purpose mentioned, in which means is provided for producing an atomized mixture of liquid fuel with an initial quantity of air, and thereupon conducting such initial wet mixture through heated passages with a gyratory movement tending to deposit upon the hot walls of said passages the heavier particles of liquid or raw fuel, whereby said particles may be supported subject to both the vaporizing effects of the heat and the friction of the moving stream of fuel mixture for such time as is required to effect vaporization and return thereof to the gaseous fuel mixture to be formed.

The invention has for a further object to provide a secondary mixing zone to receive the initial vaporized rich fuel mixture and to mix therewith additional cool air to produce the required volume and desired ratio of fuel and air to form the ultimate gaseous fuel for delivery to the engine cylinders, while at the same time reducing the temperature of such ultimate gaseous fuel.

The invention has for a further object to provide means to expand the initial fuel mixture during and in aid of efficient vaporizing treatment thereof.

The invention has for a further object to provide a novel and simple construction of parts making up the vaporizer apparatus, which can be economically produced and easily assembled with a minimum expenditure of time and labor.

Other objects of this invention, not at this time more particularly enumerated, will be understood from the following description of the same.

An illustrative embodiment of this invention is shown in the accompanying drawing, in which:—

Fig. 1 is a vertical longitudinal section of the improved vaporizer apparatus made according to the invention; Fig. 2 is in part a side elevation and in part a vertical sectional view of the same, to more clearly illustrate features of its internal construction; Fig. 3 is a fragmentary horizontal section, taken on line 3—3 in Fig. 1; and Fig. 4 is a fragmentary elevation of a throttle valve means employed in the apparatus.

Similar characters of reference are employed in said views to indicate corresponding parts.

Referring to said drawing, the reference character 5 indicates the main casing or pot. Said casing or pot is preferably formed by casting, in which case its lower portion is cored to provide an annular heating chamber 6 bounded at its inner side by an annular and preferably inwardly and downwardly inclined wall 7 which is joined at its upper end to the external walls of said casing or pot by a shoulder or top flange 8, and at its lower end is connected with the bottom wall of said casing or pot by a neck member 9. The upper end of said casing or pot 5 is open, the opening thus provided being closed by a cover plate 10. The upper interior portion of the casing or pot 5 provides an outlet chamber 11 from which leads outwardly an outlet neck 12 for connection with the intake manifold of an internal combustion engine. Connected with the sides of said casing or pot 5, preferably at opposite points thereof, are neck portions respectively providing inlet and outlet passages 13 and 14 leading into and out of the heating chamber 6, and through which, in connection with suitable delivering and discharging conduits (not shown) a heating medium (such e. g. as the exhaust gases from an internal combustion engine) may be introduced into and circulated through the heating chamber 6, so as to transfer heat to

the internal wall 7 thereof. Formed in connection with the internal wall 7, at the heating chamber side thereof, are a plurality of annular fins 15 which project into said heating chamber 6, and which provide the wall 7 with an increased area of surface for contact with the heating medium circulated through said heating chamber 6, so as to thereby increase the heat absorption capacity and heat conduction efficiency of said wall 7. The neck member 9 is provided with an axial opening 16 which communicates with the interior of the apparatus bounded by said wall 7.

The top of said shoulder or top flange 8 provides a seat 17 upon which is engaged a top plate 18 provided with a central opening 19. Depending from the underside of said top plate 18 is a downwardly tapered annular wall 20 which is inwardly spaced from and preferably parallel to said wall 7; the lower end of said annular wall 20 is provided with a bottom wall 21 which is spaced from the neck member 9. The member formed by said wall 20 and its end wall 21, as supported by the top plate 18, is adapted to nest within the interior of the apparatus defined by the wall 7, thus providing an intermediate annular space of upwardly increasing diameter. Preparatory to inserting in place the nesting member thus formed, a tapered spirally coiled element 22 is inserted to lie with its outer sides against the wall 7, whereupon, when said nesting member is inserted in place its wall 20 will impinge upon the inner sides of said coiled element. It will thus be apparent that by means of said coiled element 22, the interior space between the wall 7 and wall 20 is formed to provide an ascending spiral vaporizing passage 23, increasing in extent as it ascends. The cross-sectional area of said coiled element 22 is somewhat in excess of the width of the space between the walls 7 and 20, so that when the nesting member is forced home the spirally coiled element will be tightly forced into impingement at its opposite sides with the respective walls 7 and 20. Preferably although not necessarily said spirally coiled element is formed of tubing, such as copper tubing, in which event the interior of the tubing may also provide an additional ascending spiral vaporizing passage 24 through which the fuel mixture to be treated may flow, as will subsequently appear.

Mounted within the opening 16 of said neck member 9 is distributor member comprising a tubular shell 25 which extends upwardly through said neck member 9 into an opening 26 provided in the end wall 21 of said nesting member. Depending axially from the interior of said shell 25 is a fuel mixture intake member 27 having a lower open end 28. The upper end of said fuel mixture intake member 27 communicates with radial outlet branches 29, the passages of which extend therefrom to and through the walls of said shell 25, so as to discharge into the lower intake end or ends of the vaporizing passages above described. The interior of said shell 25 provides an air intake passage 30, as will be later understood. Cooperative with the lower open end 28 of said fuel mixture intake member 25 is a liquid fuel supply jet 31, which is supplied with liquid fuel by my suitable form of metering means. Mounted between the opening 19 of said top plate 18 and the opening 26 of the end wall 21 of said nesting member is a tubular discharge conduit 32, the same being spaced from the wall 20 of said nesting member so as to provide intermediate these parts a fuel mixture expansion chamber 33. The lower end of said discharge conduit 32 communicates with the air intake passage 30 provided by said shell 23, while the upper end thereof communicates with the outlet chamber 11 at the top of the casing or pot 5. Fixed within said discharge conduit 32, intermediate its ends, is a Venturi member 34. Provided in the upper end portion of the wall 20 of said nesting member are a plurality of ports 35 to provide communication between the discharge of the vaporizing passages and the interior of said expansion chamber 33. Provided in the walls of said discharge conduit 32, to lead from its lower end portion, are ports 36 which communicate with ports 37 entering laterally through said Venturi member 34 to communicate with the restricted interior portion thereof.

Cooperative with the outer flared end of the Venturi member passage, and adjustably movable longitudinally with relation thereto, is a throttle member 38 shaped to fit said flared end of the Venturi member passage; being for this purpose preferably of inverted conical conformation. Said throttle member 38 is provided with an upwardly extending stem 39 which projects through a stuffing box 40 provided in the cover plate 10 of the pot or casing 5. To guide the longitudinal operative movements of said throttle member 38, the same is provided with an axial opening 41 to receive and slide upon a guide pin 42, which is fixed to and extends upwardly from the distributer member. It will be understood, however, that any other suitable form of guide means for the throttle member 38 may be employed. The exterior face of said throttle member 38 is provided with one or more longitudinal channels or grooves 43, which provide minimum gaseous fuel mixture passages when the throttle member is in closed or seated relation to the outlet end of the Venturi member 34.

Suitable means are provided for manipulating said throttle member 38 at will. Illustrative of such means, the drawing shows a fulcrum post 44 upon which is fulcrumed

an actuating lever 45, having its inner end in operative bearing relation to upper and lower stop shoulders or flanges 46 and 47 which are affixed to the exteriorly projecting end of said throttle member stem 39.

In the operation of the apparatus, the outlet neck 12 is connected in communication with the intake manifold (not shown) of an internal combustion engine. Under the fuel induction strokes of the engine pistons, pressure within the interior of the apparatus is reduced so as to pass an initial fuel mixture through the latter for treatment. The initial fuel mixture comprises a more or less atomized mixture of liquid fuel taken from the supply jet 31, by a comparatively small proportion of ingoing air (about 6 to 8 per cent) which enters the intake member 27. This initial fuel mixture may be termed an initial wet mixture, and the same is discharged by way of the outlet branches 29 of said intake member into the lower end of the ascending spiral vaporizing passages 23. Owing to the spirally ascending arrangement of said vaporizing passages, the initial wet mixture ascending therethrough is caused to take a gyratory path of movement. Such gyratory movement induces a centrifugal force which acts upon the heavier unvaporized wet fuel particles suspended in the stream, whereby such particles are thrown outwardly upon and in contact with the hot wall 7, which is highly heated by contact with hot engine exhaust gases circulated through the heating chamber 6. The wet fuel thus deposited on the hot walls is thereby heat treated to effect vaporization thereof, and owing to the length of the passage a sufficient time factor is provided to adequately allow for complete vaporization of the wet fuel particles, and particularly the low boiling point ends or constituents of the wet fuel employed. It therefore follows, that on vaporization of the wet fuel, the resultant vapor is returned to the fuel mixture streams for discharge from the vaporizing passages per se and ultimate discharge from the apparatus.

The vaporized fuel mixture reaching the upper terminus of the spiral vaporizing passage, is discharged through the ports 35 into the expansion chamber 33. Since the only communication between the vaporizing passage and expansion chamber is at the upper end of the former, gravity of the heavier wet fuel particles downwardly on the walls bounding the vaporizing passage tends to prevent the carrying over of unvaporized fuel particles into the expansion chamber, and consequently the latter receives only the gaseous fuel mixture. This gaseous fuel mixture is comparatively rich, and since the pressure in the expansion chamber is reduced, a resultant expansion of this rich mixture materially aids in thoroughly intermingling and homogenizing the air and gaseous fuel elements constituting the same.

Inasmuch as only a comparatively small quantity of ingoing air is utilized in forming the initial fuel mixture it is desirable to add to the vaporized or gaseous fuel mixture produced therefrom a proportion of diluting and cooling air. This is accomplished as follows:—

Entering through the air intake passage 30 of the shell 25 is a major proportion of air, which varies according to the setting of the throttle member 38. This additional air is drawn through the Venturi member 34, and in passing therethrough sucks the expanded gaseous fuel mixture from the expansion chamber 33 through the ports 36—37 into the Venturi member passage whereby the same is thoroughly mixed with the ingoing air. This ingoing air, being at comparatively low temperature, both cools the hot initial vaporized mixture, whereby its volumetric efficiency is increased, and also adds to the mixture a greater oxygen content, whereby efficient and complete combustion within the engine cylinders is assured.

The ultimate fuel mixture, produced as above described, is discharged through the discharge conduit 32, outlet chamber 11 and outlet neck 12 to the engine intake manifold for delivery to the engine cylinders in the usual manner.

The peculiar throttle structure is of such character, owing to its inverted conical shape, that while cooperative with the passage of the Venturi member 34, to modify the area thereof with desired throttling effect, it nevertheless maintains the necessary restricted character of the Venturi passage at all settings as will be obvious. The provision of the grooved or channeled passages 43 in the throttle member surfaces, provides for a sufficient movement of initial fuel mixture through the vaporizing passage and expansion chamber, and thence through the discharge outlets of the apparatus, to assure delivery of required gaseous fuel mixture for operating the engine under idling or closed throttle conditions.

From the above description it will be apparent that the present invention provides a comparatively simple and yet highly efficient construction and arrangement of vaporizing apparatus; and from the structural standpoint the apparatus is both easy and economical to produce.

I am aware that many changes could be made in the apparatus above-described, and shown in the drawing, as well as in the details of its parts, without departing from the scope of this invention, and it is therefore intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

I claim:—

1. A vaporizer apparatus, comprising means to provide a spirally ascending vaporizing passage the convolutions of which are of successively increasing circumference, means to heat the outer walls of said passage, means to deliver an initial mixture of liquid fuel and a minor proportion of air for gyratory and expanding movement through said vaporizing passage whereby the wet constituents of said initial mixture are deposited upon the hot outer walls of said passage so as to be vaporized by the heat transmitted thereto, means for discharging the vaporized fuel mixture together with a major proportion of air intermixed therewith, and an expansion chamber intermediate said vaporizing passage and said discharge means through which the vaporized fuel mixture is passed from the former to the latter.

2. A vaporizer apparatus, comprising means to provide a spirally ascending vaporizing passage the convolutions of which are of successively increasing circumference, means to heat the outer walls of said passage, means to deliver an initial mixture of liquid fuel and a minor proportion of air for gyratory and expanding movement through said vaporizing passage whereby the wet constituents of said initial mixture are deposited upon the outer hot walls of said passage so as to be vaporized by the heat transmitted thereto, a discharge means including a Venturi member, fuel mixture intake means to conduct the vaporized fuel mixture to the restricted portion of said Venturi member passage, and means to deliver a major portion of air to said Venturi member passage for intermixture with the vaporized fuel mixture passing thereinto.

3. A vaporizer apparatus, comprising means to provide a spirally ascending vaporizing passage the convolutions of which are of successively increasing circumference, means to heat the outer walls of said passage, means to deliver an initial mixture of liquid fuel and a minor proportion of air for gyratory and initial expanding movement through said vaporizing passage whereby the wet constituents of said initial mixture are deposited upon the outer hot walls of said passage so as to be vaporized by the heat transmitted thereto, a discharge means including a Venturi member, fuel mixture intake means to conduct the vaporized fuel mixture to the restricted portion of said Venturi member passage, means to deliver a major portion of air to said Venturi member passage for intermixture with the vaporized fuel mixture passing thereinto, and an additional expansion chamber intermediate the discharge end of said vaporizing passage and said fuel mixture intake means of said Venturi member through which the vaporized fuel mixture is passed from the former to the latter for final expansion.

4. A vaporizer apparatus, comprising means to provide a spirally ascending vaporizing passage the convolutions of which are of successively increasing circumference, means to heat the outer walls of said passage, means to deliver an initial mixture of liquid fuel and a minor proportion of air for gyratory and initial expanding movement through said vaporizing passage whereby the wet constituents of said initial mixture are deposited upon the outer hot walls of said passage so as to be vaporized by the heat transmitted thereto, a discharge means including a Venturi member, fuel mixture intake means to conduct the vaporized fuel mixture to the restricted portion of said Venturi member passage, means to deliver a major portion of air to said Venturi member passage for intermixture with the vaporized fuel mixture passing thereinto, and an additional expansion chamber intermediate the discharge end of said vaporizing passage and said fuel mixture intake means of said Venturi member through which the vaporized fuel mixture is passed from the former to the latter for final expansion, and an adjustable throttle member cooperative with the outlet portion of said Venturi member passage.

5. A vaporizer apparatus, comprising a plurality of concentrically arranged members nested to provide a central discharge conduit, an expansion chamber around said discharge conduit, an outlying heating chamber, and a vaporizing chamber intermediate said heating chamber and said expansion chamber; a spirally coiled element arranged within said vaporizing chamber to form therewith an ascending spirally winding vaporizing passage contiguous to the wall of said heating chamber; means to deliver into said vaporizing chamber for upward gyratory movement through said vaporizing passage an initial mixture of liquid fuel with a minor proportion of air; means of communication between said vaporizing chamber at the upper end of its vaporizing passage and said expansion chamber; means of communication between said expansion chamber and said discharge conduit; and means for mixing a major proportion of air with vaporized fuel mixture drawn from said expansion chamber into said discharge conduit to produce the ultimate fuel mixture discharged from the apparatus by way of said discharge conduit.

6. A vaporizer apparatus, comprising a plurality of concentrically arranged members nested to provide a central discharge conduit, an expansion chamber around said discharge conduit, an outlying heating chamber, and a vaporizing chamber intermediate said heating chamber and said expansion

chamber; a spirally coiled element arranged within said vaporizing chamber to form therewith an ascending spirally winding vaporizing passage contiguous to the wall of said heating chamber; means to deliver into said vaporizing chamber for upward gyratory movement through said vaporizing passage an initial mixture of liquid fuel with a minor proportion of air; means of communication between said vaporizing chamber at the upper end of its vaporizing passage and said expansion chamber; a Venturi member within said discharge member; means of communication between said expansion chamber and the restricted portion of the passage of said Venturi member; and means to deliver additional air through said Venturi member for mixture with vaporized fuel mixture drawn into the latter from said expansion chamber.

7. A vaporizer apparatus, comprising a plurality of concentrically arranged members nested to provide a central discharge conduit, an expansion chamber around said discharge conduit, an outlying heating chamber, and a vaporizing chamber intermediate said heating chamber and said expansion chamber; a spirally coiled element arranged within said vaporizing chamber to form therewith an ascending spirally winding vaporizing passage contiguous to the wall of said heating chamber; means to deliver into said vaporizing chamber for upward gyratory movement through said vaporizing passage an initial mixture of liquid fuel with a minor proportion of air; means of communication between said vaporizing chamber at the upper end of its vaporizing passage and said expansion chamber, a Venturi member within said discharge member; means of communication between said expansion chamber and the restricted portion of the passage of said Venturi member; means to deliver additional air through said Venturi member for mixture with vaporized fuel mixture drawn into the latter from said expansion chamber, and a movable throttle valve cooperative with the discharge end of said Venturi member.

8. In a vaporizer apparatus as defined by claim 7, in which said throttle member comprises an inverted conical body to fit the outlet end portion of said Venturi member, and means to move said conical body toward and away from the latter.

In testimony, that I claim the invention set forth above I have hereunto set my hand this 25th day of February, 1931.

ERNEST R. GODWARD.