Dec. 25, 1928. 1,696,881

E. R. GODWARD

VAPORIZER FOR LIQUID FUEL

Filed April 1, 1924 2 Sheets-Sheet 1

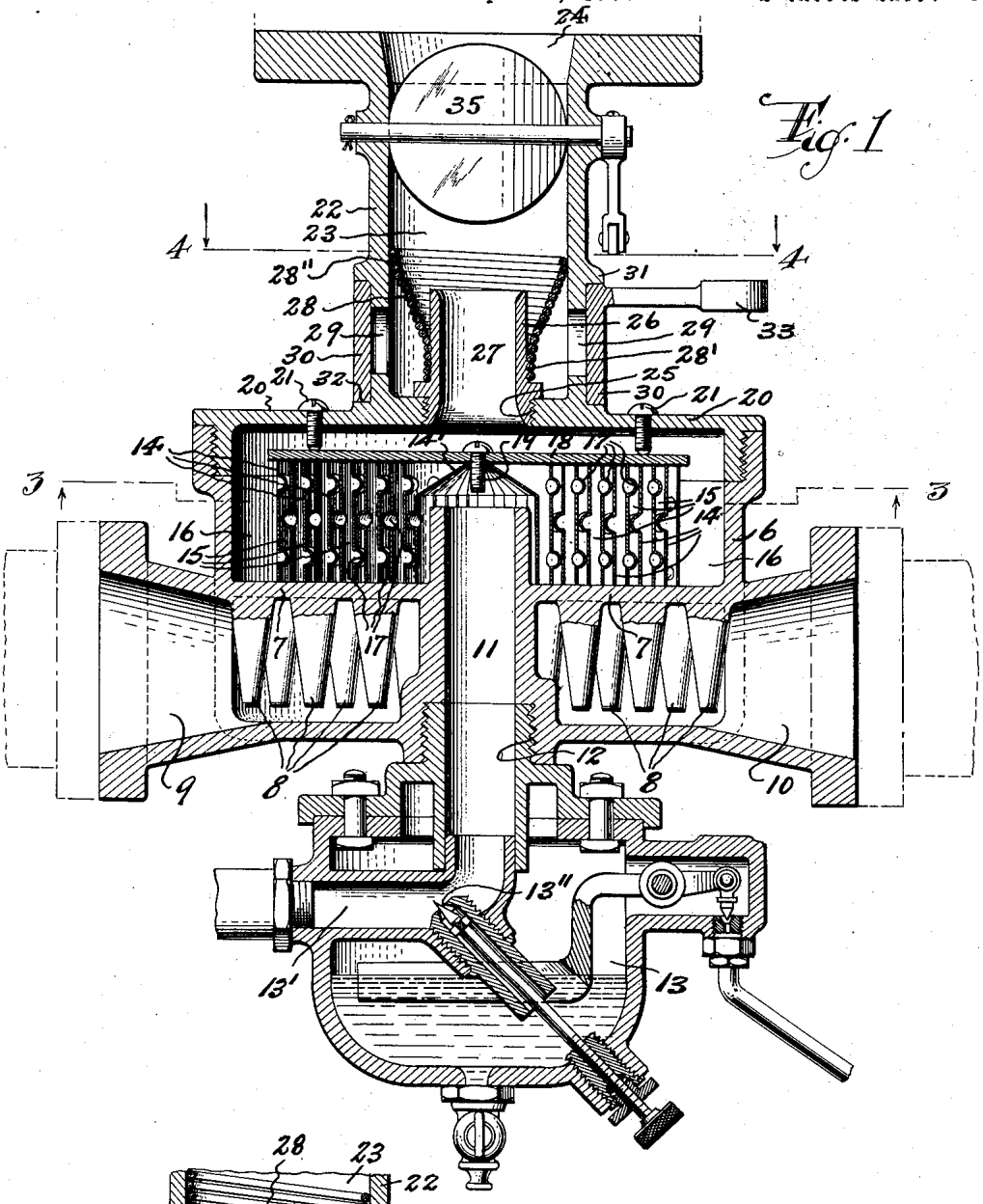

Fig. 1

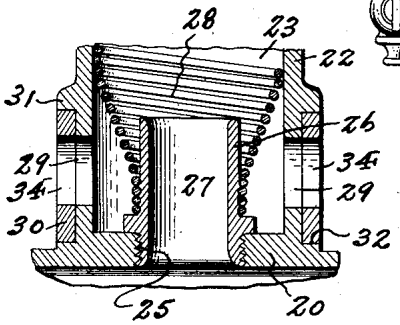

Fig. 2

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Fig. 3

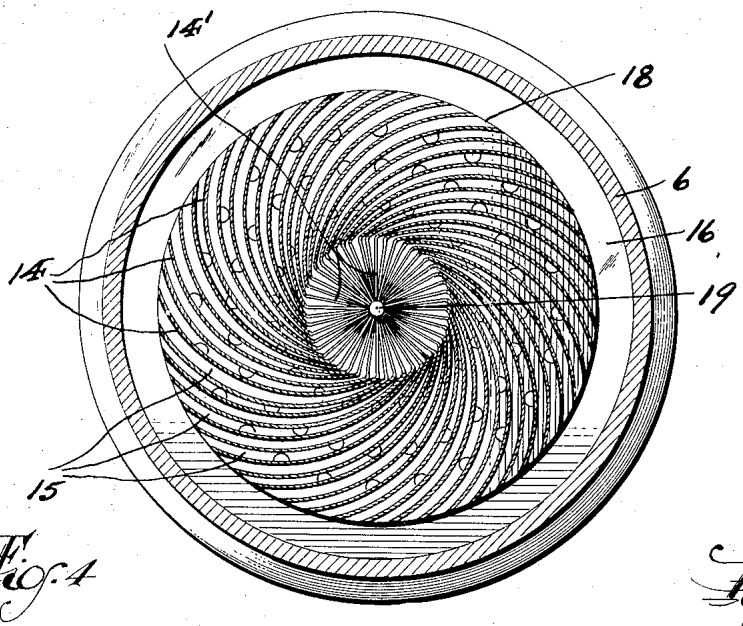


Fig. 4

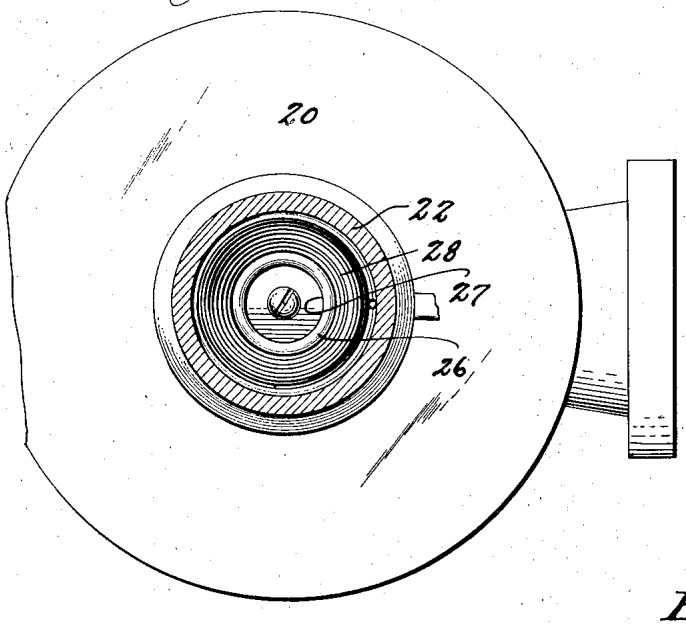
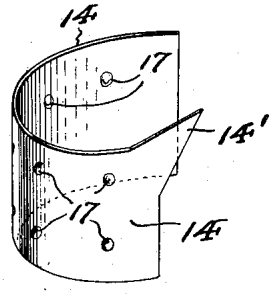


Fig. 5



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UNITED STATES PATENT OFFICE.

ERNEST R. GODWARD, OF NEW YORK, N. Y., ASSIGNOR TO THE ECLIPSE PETROL ECONOMIZER SYSTEM COMPANY, LIMITED, OF CHRISTCHURCH, NEW ZEALAND, A CORPORATION OF NEW ZEALAND.

VAPORIZER FOR LIQUID FUEL.

Application filed April 1, 1924. Serial No. 703,380.

This invention relates, generally, to improvements in fuel vaporizers for use in connection with internal combustion engines, and for other uses; and, the invention has reference, more particularly, to a novel construction of vaporizing device involving and adapted to apply the general principles of the character of vaporizer apparatus which is shown and described in my co-pending application for United States Letters Patent, filed August 26th, 1921, Serial No. 495,757.

This invention has for its principal object to provide in combination with a vaporizing means, having a perpendicular liquid fuel supporting means of extensive surface area and providing a plurality of outwardly extending curved passages, together with a heat transfer means, a secondary means for receiving the vaporized fuel, said secondary means having devices for controlling the admission thereinto of atmospheric air for intermixture with the vaporized fuel prior to its delivery to the point of combustion, such, for example, as the cylinders of an internal combustion engine.

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

With the various objects of this invention in view, the same consists, primarily, in the novel vaporizer for combustible fuel hereinafter set forth; and, the invention consists, furthermore, in the novel arrangements and combinations of the various devices and parts, as well as in the details of the construction of the same, all of which will be hereinafter more fully described, and then finally embodied in the claims appended hereto.

The invention is clearly illustrated in the accompanying drawings, in which:—

Figure 1 is a vertical longitudinal section of the novel vaporizer device made according to and embodying the principles of this invention; Figure 2 is a fragmentary vertical longitudinal section showing the operation of the air admission means into the secondary mixing chamber; Figure 3 is a detail horizontal section, taken on line 3—3 in said Figure 1; Figure 4 is a detail horizontal section, taken on line 4—4 in said Figure 1; and Figure 5 is a perspective view of one of the plates of the primary vaporizing chamber.

Similar characters of reference are employed in all of the hereinabove described views, to indicate corresponding parts.

Referring now to said drawings, the reference character 6 indicates an outer casing or main body, preferably of cylindrical shape. The interior of said casing or main body 6 is transversely divided by a horizontal partition 7 to provide above the same a primary vaporizing chamber and below the same a heating chamber, said partition 7 serving as the hot-plate of the vaporizer means. Said partition or hot-plate 7 is provided on its under side with a plurality of depending heat conducting fingers or projections 8 which extend into said heating chamber. Leading into said heating chamber is an intake opening 9, through which a hot fluid may be introduced into said heating chamber, such, for example, as the hot exhaust gases discharged from an internal combustion engine. Leading out of said heating chamber is an outlet opening 10 for discharging the hot fluid from said heating chamber.

Extending centrally upward through the bottom of said casing or main body, to pass through said heating chamber and through the partition or hot-plate 7 is a fuel intake conduit 11, the discharge outlet of which terminates within said primary vaporizing chamber above said partition or hot-plate 7. The lower external extremity of said fuel intake conduit 11 is provided with an internally threaded socket-portion 12 adapted to receive the attachment of a liquid fuel atomizing device 13, which may be of any well-known or desired construction adapted to produce and deliver into said vaporizing chamber a rough or initial mixture of liquid fuel and air, commonly known as atomized fuel.

Arranged within the interior of said vaporizing chamber, so as to surround the discharge outlet of said fuel intake conduit 11, and so as to rest upon and engage with their bottom edges said partition or hot-plate 7, is a combined fuel supporting and heat conducting means. This fuel supporting and heat conducting means comprises a plurality of vertical plate sections 14 which are curved from end to end so that when assembled together

they provide a convoluted arrangement radiating outward from the center toward the sides of the vaporizing chamber. Said vertical plate sections 14 are spaced apart one from another to provide intermediate outwardly leading passages 15, the inner or receiving ends of which converge toward the fuel intake conduit 11, and the outer or discharge ends of which terminate short of the side walls of said casing or main body 6, to thus provide an annular outgoing passage 16. The said plate sections 14 may be maintained in properly spaced apart relation by means of spacing bosses or tits 17 which are struck out from the bodies of the plates, or which are otherwise provide to form spacing elements. The upper sides of said passages 15 are closed by a top-plate 18 which is engaged upon the upper edges of said assembled plate sections 14. The inner ends of said plate sections 14 are provided with radial inwardly projecting tongues 14′ at their inner upper corners which converge toward the vertical axis of the plate section assembly. The top-plate 18 is provided with a depending central stud 19, which may be formed by a screw as shown in the drawings. The extremities of the tongues 14′ impinge upon said stud 19, and thus the top-plate 18 is held against lateral displacement. The upper end of said vaporizing chamber is closed by a cover-plate 20, which is suitably secured to said casing or main body 6, by being threaded thereinto, or in any other manner found convenient or desirable. Said cover-plate 20 is provided with set-screws 21, which extend downwardly into said primary vaporizing chamber to engage said top-plate 18 to thereby hold the same and the convoluted arrangement of plate sections 14 against vertical displacement from the operative assembled relation above described.

In the drawings the plates 14 are, for the purposes of greater clarity of illustration, shown more widely separated than would be the case in practice; and, furthermore, it is desirable to mention that the illustration shown in Figure 1 is no criterion as to the height of the plates 14, as the same may be made considerably higher than therein shown, and the casing 6 proportionately increased in height to accommodate the same. In fact the number, spacing and height of the plates 14 are variable factors, and may be arranged, as to such characteristics, according to the capacity of the vaporizer or the kind of work to be done thereby.

Connected with and extending upwardly from said cover-plate 20 is a cylindrical member or extension 22, the interior of which provides a secondary mixing chamber 23 provided at its upper end with a discharge opening 24, which may be connected in communication with the intake manifold of an internal combustion engine, or with other delivery means for conducting the vaporized fuel to the desired point of combustion. Said cover-plate 20 is provided with a centrally located internally threaded opening 25 in which is secured a tubular nipple 26 adapted to provide a communicating passage 27 between the interior of said vaporizing chamber and the upper portion of said secondary mixing chamber 23, thereby providing the discharge outlet of the former and the intake of the latter. Said nipple 26 extends upwardly into the interior of said secondary mixing chamber 23. Engaged with said nipple 26, so as to extend between the same and the sides of the secondary mixing chamber 23 is an automatic valve means in the form of an inverted conical spiral spring 28, the lower end of which is anchored or secured to said nipple. The fixed attachment of said spring 28 to the nipple 26 may be effected by providing the former with a cylindrical lower end portion 28′ of a size or diameter adapted to embrace the nipple, the latter having a spiral groove in its outer surface of a pitch equal to the pitch of the convolutions of the cylindrical end portion 28′ of the spring, so that the spring end portion 28′ may be threaded on to the nipple. The upper end of said spring 28 is provided with a cylindrical free end portion 28″ of a size or diameter adapted to normally engage the wall surface of said secondary mixing chamber 23, and so as to slidingly bear against the same. The tension of said spring 28 normally maintains its convolutions closed one upon another, so that said spring provides a normally closed wall or valve device separating the lower end of said secondary mixing chamber from the upper end thereof.

Provided in the side walls of said extension 22, adjacent to the lower end of the same are one or more air intake ports 29, which lead from the atmosphere into the lower end of said secondary mixing chamber 23 below or at the outer side of said valve spring means 28. A means is provided for manually controlling the opening and closing of said air intake ports 29. This means comprises an external valve sleeve 30 which surrounds the lower portion of said extension 22, so as to be capable of rotation thereon. Annular shoulders 31 and 32 are provided in connection with said extension 22 to retain the valve sleeve 30 in proper assembled and operative relation to said extension, and said sleeve is provided with an outwardly projecting lever arm 33 by means of which the same may be manipulated. Said valve sleeve 30 is provided with one or more valve ports 34, which by the manipulation of said sleeve 30 may be brought into registration with the air intake ports 29 according to need.

The discharge end of said secondary mixing chamber 23 is provided, above the automatic valve spring 28, with a pivoted throttle or butterfly valve 35.

In operation, when, for example, the va-

porizer device is connected by its discharge end in communication with the cylinders of an internal combustion engine, the interior of the vaporizing device, and the liquid fuel atomizing device serving the same, is subjected to the effects of the suction strokes of the pistons in the engine cylinders. Upon such occurrence, air is caused to enter the air intake 13′ of the liquid fuel atomizing device 13 to thereupon atomize the liquid fuel delivered by the fuel nozzle 13″, to thereby produce an initial mixture of air and liquid fuel, which is carried upward through the fuel intake conduit into the center of the fuel supporting and heat conducting means formed by the assembled plate sections 14, to thence flow outward through the passages 15. The curvature of the plates 14 tends to impart a centrifugal or whirling action to the fuel mixture, whereby the wet particles of liquid fuel suspended in the air stream are thrown upon the plate surfaces, and are caused by the air friction to be spread thereon. The lighter particles of fuel are quickly vaporized and absorbed into the air current, while the heavier wet particles deposited on the plate surfaces are acted upon by gravity and thus tend to descend on the plates 14, and in thus descending meet with an increasing temperature, due to the conduction of heat by the plates upwardly from the hot plate 7, thereby enabling the wet particles not only to spread out but to also find that degree of heat best calculated to vaporize the same and return the same for absorption by the air stream. All of the above described operations are in accord with the principles set forth in my aforesaid prior application for United States Letters Patent. It follows, therefore, that the liquid fuel is thoroughly evaporated, absorbed into the air stream to provide a combustible gas which escapes from the plates 14 and passages 15 into the discharge passages 16 of the vaporizing chamber, whence it is drawn upward through the passage 27 into the secondary mixing chamber 23. When it is desired to serve to the engine cylinders a rich combustible gas, the valve sleeve 30 is so manipulated as to close the air intake ports 29, and consequently an undiluted combustible gas is discharged through the outlet 24. Under normal engine running conditions, however, it is desirable to increase the ratio of air volume to vaporized fuel. Ordinarily this is done by increasing the volume of air admitted through the air intake of the liquid fuel atomizing device. Such practice, however, possesses certain disadvantages which it is the object of this invention to overcome, for under such practice an excess of cold air is carried into and through the vaporizing chamber with the result that the heat transferred thereto is dissipated by being absorbed by the air, whereas it is desirable that such heat be conserved so that its effects may be devoted without necessary loss or waste to the function of liquid fuel vaporization. To this end, therefore, the air intake of the fuel atomizing device is suitably sized to provide, substantially, only such volume of air as is adequate to serve as a vehicle for carrying the liquid fuel into the vaporizing chamber, cool air being subsequently added to the combustible gas discharged from vaporizing chamber, as the same passes through the secondary mixing chamber 23, to thus increase the oxygen content of the combustible gas to a desired normal proportion or ratio. This is accomplished by adjusting the valve sleeve 30 so as to admit atmospheric air into the lower portion of the secondary mixing chamber 23, at the outer side of the automatic valve spring 28. The control and admission of the desired proportionate volume of this atmospheric air into the upper portion of the mixing chamber 23 is automatically attained by the operation of said valve spring 28, which opens under air pressure when the pressure within the secondary mixing chamber is reduced under the pull of the suction strokes of the engine. It will be understood that the suction of the engine pistons will always reduce the pressure within the secondary mixing chamber, vaporizer and liquid fuel atomizing device so that said vaporizer and atomizing device will function at all times, but when the air intake ports 29 are opened, the atmospheric air pressure will distend the spring 28, thus separating its coils and allowing additional air to rush directly into the secondary mixing chamber. The amount or degree of distention or opening of the spring 28 will be proportional to the pressure reduction produced by the suction strokes of the pistons, which, of course, varies with the speed of the engine and throttle conditions in the manner familiar to those skilled in the art. It will therefore be evident, that the automatic valve spring, being normally closed by its inherent tension, is very sensitive and quickly responsive to variations of pressure within the secondary mixing chamber, and consequently automatically governs the admission of air for intermixture with the combustible gas in such manner, that the functioning of the vaporizer and liquid fuel atomizing device is not only uninterrupted and uninterfered with, but is in reality benefitted, not alone by the conservation of heat, as above mentioned, but for the further reason that a less volume of air traversing the vaporizing devices keeps the air friction within the latter from becoming excessive.

I claim:—

The combination with a fuel vaporizer and a secondary mixing chamber, of a fuel vaporizer discharge passage extending axially into said secondary mixing chamber, an automatic air admission valve formed by an inverted conical closed spiral spring fixed at

its lower end in concentric relation to said discharge passage with its upper free end movably engaging the wall of said secondary mixing chamber whereby its convolutions may open under externally applied air pressure, the walls of said secondary mixing chamber having air admission ports below said spiral spring valve, and a manually rotatable valve sleeve having ports registerable with said air admission ports to admit atmospheric air to the exterior side of said spiral spring valve.

In testimony, that I claim the invention set forth above I have hereunto set my hand this 21st day of March, 1924.

ERNEST R. GODWARD.