Nov. 13, 1928. 1,691,615

L. C. SMITH

FUEL VAPORIZER

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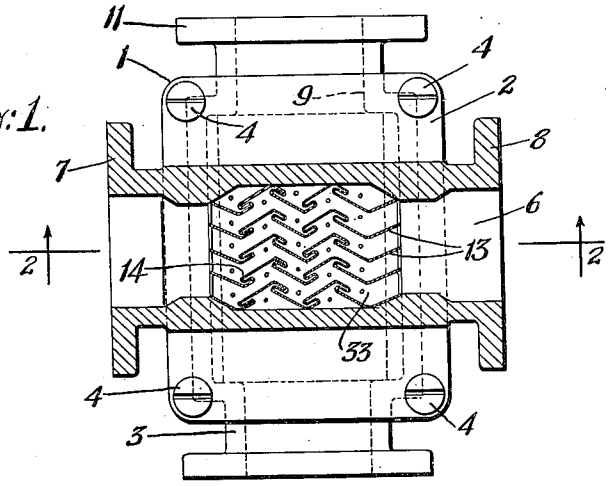


Fig:1.

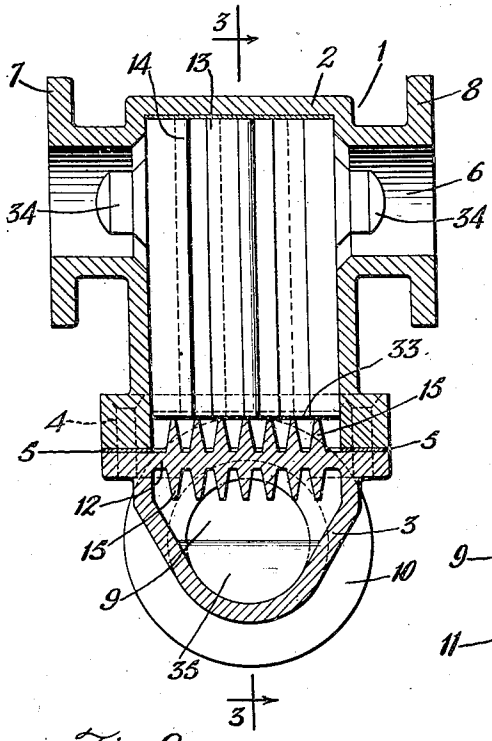


Fig:2.

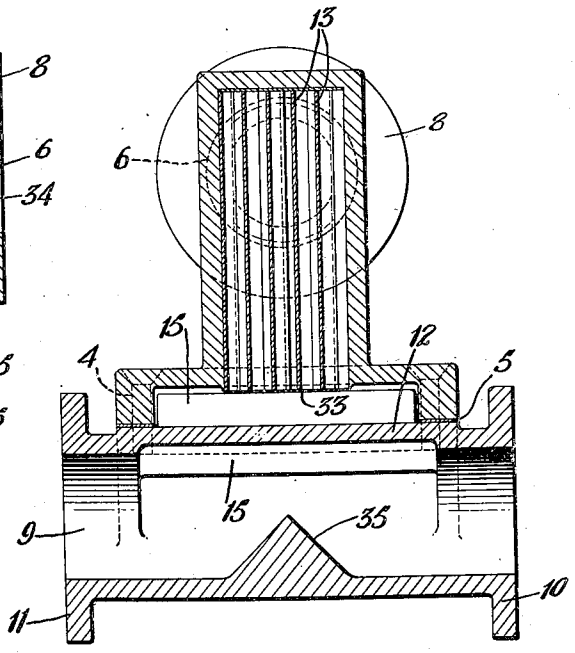


Fig:3.

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Fig. 4.

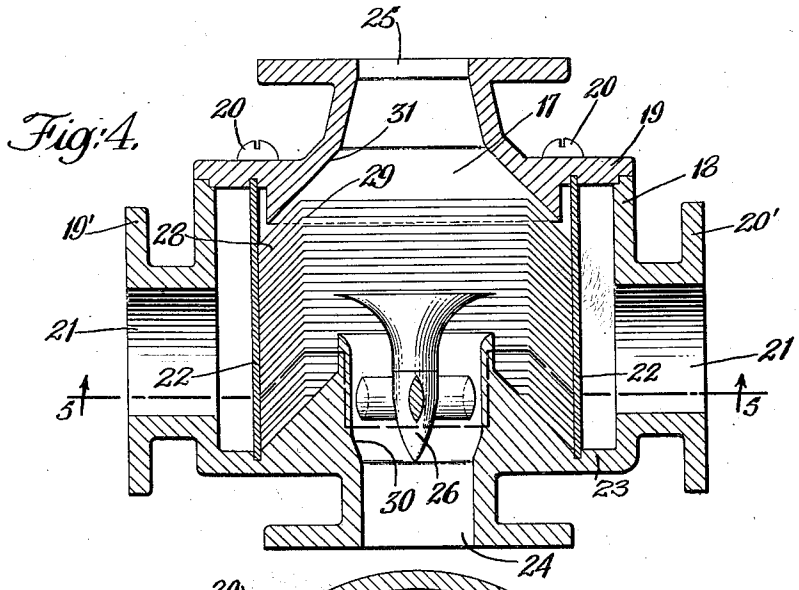
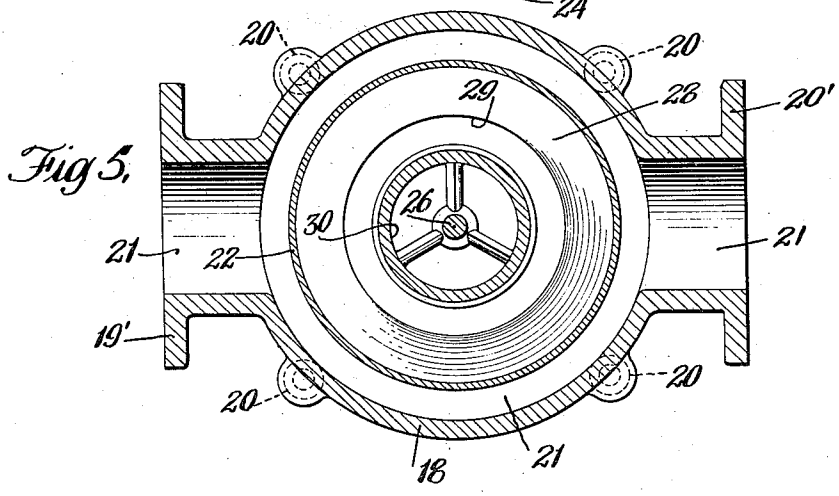


Fig. 5.



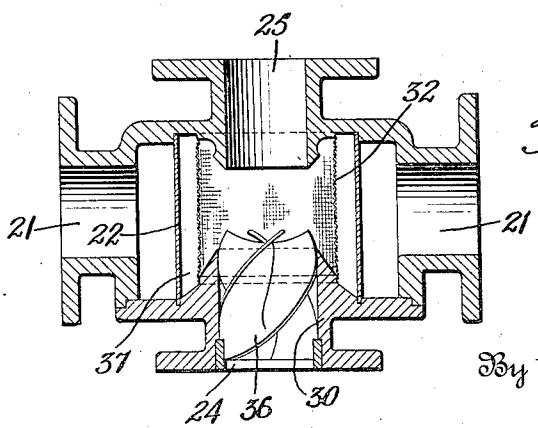


Fig. 6.

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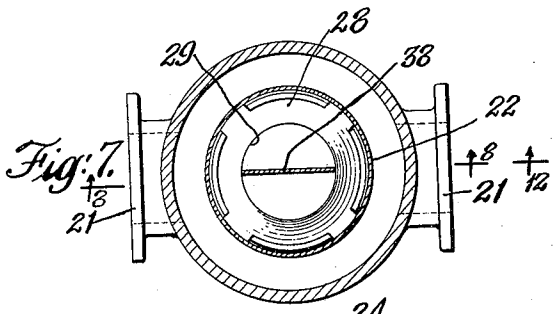


Fig: 7.

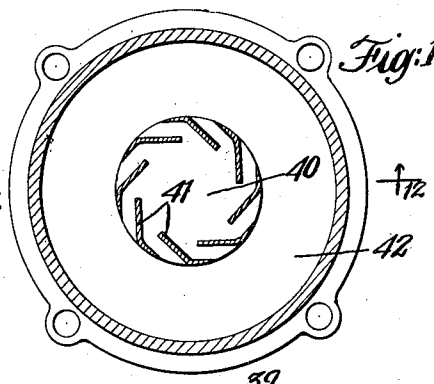


Fig: 11.

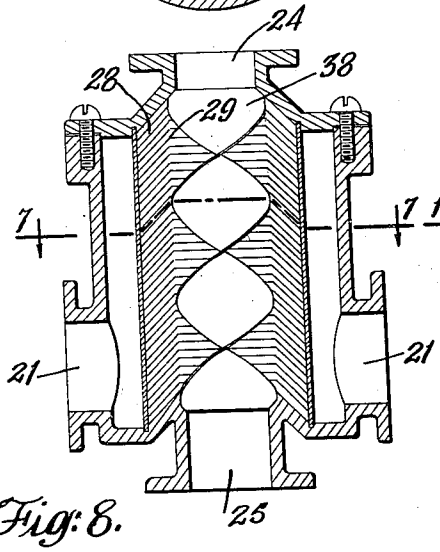


Fig: 8.

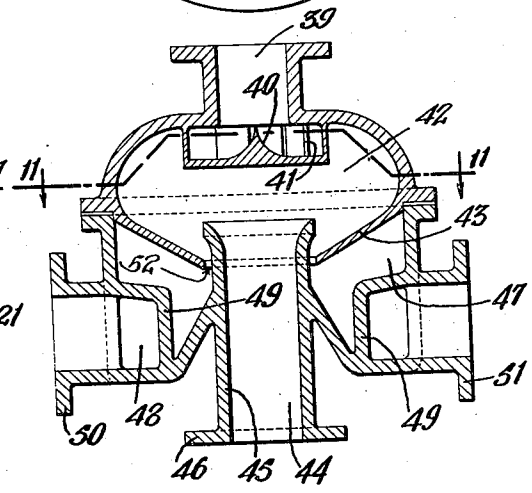


Fig: 12.

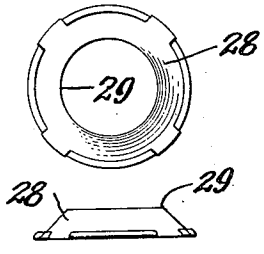


Fig: 9.

Fig: 10.

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UNITED STATES PATENT OFFICE.

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FUEL VAPORIZER.

Application filed April 15, 1921. Serial No. 461,684.

This invention relates to fuel vaporizers, for internal combustion engines, and particularly to devices and methods for completely vaporizing mixtures of fuel and air carrying entrained liquid particles without substantial temperature change. Combustible mixtures as ordinarily prepared by the carburetion of air with liquid fuel, consist of mixtures of air, fuel vapor, and unvaporized particles of fuel carried in suspension. It is well known that such mixtures cannot be burned efficiently without being completely vaporized. Especially is this true where such mixtures are employed in internal combustion engines, where not only loss of efficiency results from incomplete vaporization, but a great variety of engine troubles, such as fouling of the cylinders by the formation of carbon and interference with proper cylinder lubrication by the lubricant dissolving in the liquid fuel.

Good practice, therefore, demands that mixtures carrying entrained liquid particles, generally spoken of as "wet" mixtures be completely vaporized, or "dried" before being introduced into the cylinders. This is ordinarily accomplished by heating the entire mixture up to the point where the liquid content becomes vaporized; but during the time required for the vaporizing of the liquid content, the gaseous or vapor content is heated greatly in excess of its original temperature. The mixture is thus expanded, and the volumetric efficiency or capacity of the engine is diminished.

I have found that this difficulty can be avoided by applying heat not to the entire mixture, but only to the liquid content of the mixture. The separation of the liquid content is accomplished by causing the mixture to traverse a non-rectilinear path, the relatively heavy spray particles being thrown out of the mixture by virtue of their inertia. The particles are then collected and conducted away from the mixture, and after being heated out of the presence of the gaseous content of the mixture, they are returned to the same in the form of vapor. The temperature of the resulting product is this substantially unchanged, and all the advantages of complete vaporization are attained without loss of volumetric efficiency.

In carrying out my invention, I provide for a change in direction of flow of the fuel mixture, by bends, baffles, or other deflecting means. The relatively heavy liquid particles are thrown out of the mixture as the latter is deflected. I provide also means for intercepting or collecting the liquid and conducting it to a heated surface; and this collecting means being interposed between the main mixture current and the heated surface, protects the former from being heated by the latter, but allows the liquid after volatilization by the heated surface to quickly return to the main mixture current; and I have accomplished all this by means which permits of a very short and unobstructed connection between the carburetor and the engine cylinders, and which gives instant vaporization response to varying throttle conditions.

With these and other objects in mind, I have devised an apparatus embodying my invention, the same being described in the following specification and illustrated in the accompanying drawings, of which—

Figure 1 is a horizontal section of a device embodying the invention;

Figure 2 is a vertical section taken on the line 2—2 of Fig. 1;

Figure 3 is a vertical section taken on the line 3—3 of Figure 2;

Figure 4 is a vertical sectional section of a modified form of the device;

Figure 5 is a horizontal section taken on the line 5—5 of Figure 4;

Figure 6 is a vertical section of a further modification of the device;

Figure 7 is a horizontal section of a further modification, taken on the line 7—7 of Figure 8;

Figure 8 is a vertical section taken on the line 8—8 of Figure 7;

Figure 9 is a detail in plan view of one of the frustro-conical collectors employed in the device shown in Figure 7;

Figure 10 is a side elevation of the part shown in Figure 9;

Figure 11 is a horizontal section of a further modification, taken on the line 11—11 of Figure 12;

Figure 12 is a vertical section taken on the line 12—12 of Figure 11.

1 denotes a casing made up of hollow sections 2 and 3 secured together by screws 4 or by other suitable means, a gasket 5 being interposed between the abutting surfaces of sections 2 and 3. Section 2 provides a horizontal passageway 6 for the fuel mixture and

has flanged ends 7 and 8, whereby it may be inserted in the intake manifold of an internal combustion engine, or between the carbureter and the intake manifold. Section 3 provides a passageway 9 for the exhaust gases of the engine and has flanged ends 10 and 11, whereby it may be inserted in the exhaust manifold. Passageways 6 and 9 are separated from one another by a wall 12, preferably integral for convenience, with section 3. Passageway 6 is provided with a plurality of vertical baffles 13 which sharply deflect the course of the fluid passing therethrough, the vertical grooves 14 in baffles 13 collecting the liquid particles as they are thrown out of the mixture. Wall 12 is provided with a plurality of ribs 15 upon either side to facilitate heat exchange; ribs 15 do not extend far enough into passage 6 to intercept the current of fuel mixture passing therethrough. Resting upon the upper edges of ribs 15 in passageway 6 is a perforated plate 33, which serves as a support for baffles 13. Deflectors 34 may be provided in passageway 6 to distribute the incoming current over baffles 13, and to catch any particles in the outgoing current that may not have been arrested by the baffles 13. A deflector 35 may be provided in passage 9 to direct the flow of exhaust gas against wall 12 and ribs 15.

In operation the liquid particles entrained in the fuel mixture are thrown out upon baffles 13 as the mixture is deflected into a non-rectilinear path by the baffles, the liquid collecting in grooves 14 draining down upon wall 12 and settling between ribs 15, out of the path of the fuel mixture. The heat supplied to wall 12 and ribs 15 by the exhaust gases thus vaporize the liquid without heating the fuel mixture passing through passage 6, and the vapor rises and returns to the fuel mixture, which thus emerges from baffles 13 completely vaporized.

In Figures 4 and 5 is shown a modification of the device in which the fuel mixture passageway 17 is vertical. A casing 18, preferably cylindrical in form and having flanged openings 19′ and 20′ is adapted to be connected in the exhaust pipe or manifold of the engine. Casing 18 has a cover 19 secured thereon by screws 20. Passageway 17 extends through casing 18 and is separated from exhaust passage 21 which surrounds passageway 17, by an annular vertical wall 22, which is held between cover 19 and the bottom 23 of casing 18. Flanged openings 24 and 25, in line with passageway 17, are provided in cover 19 and bottom 23 respectively, and are adapted to be connected in the path of the fuel mixture after it leaves the carbureter, the fuel mixture entering passageway 17 through opening 24. A deflector 26 in the form of an inverted bell-shaped baffle, is centrally disposed in the path of the incoming vapor to direct the flow annularly in the direction of wall 22. Adjacent the inner surface of wall 22, and extending inwardly and upwardly are a plurality of thin parallel sheet metal walls 28 of frustro-conical shape, shown in detail in Figures 9 and 10, and whose inner edges 29 determine a portion of the passageway 17. Opening 24 is constricted, to increase the velocity of the mixture, and its wall 30 extends a short distance beyond where edges 29 begin. A tapering wall 31 above the topmost edge 29 gradually narrows the passage 17 until outlet 25 is reached.

In operation the mixture is conducted through opening 24 and against deflector 26, which directs it annularly at right angles to its normal direction of flow. As the mixture thus emerges from between wall 30 and deflector 26, the heavy spray particles are thrown against and between edges 29, where the liquid collects upon walls 28 and is conducted down the same until it comes into contact with wall 22. The latter being constantly heated by the exhaust gases, the liquid on the inside will readily evaporate and the vapor will return to the mixture. It will be observed that no part of the path 17 of the fuel mixture is in contact with heated wall 22, the passage 17 being determined by opening 24, wall 30, edges 29, wall 31 and opening 25. Hence, while the liquid content of the fuel mixture will readily be vaporized, the temperature of the mixture itself will not be affected.

In Figure 6 is shown a further modification of the device based upon a structure analogous to that of the foregoing, and in which the paths of mixture and of exhaust gas are respectively the same as in the previous form. In place of the inverted bell-shaped deflector 26 is substituted a helical baffle 36, which projects a short way beyond wall 30, and which, by imparting a rapid whirling movement to the incoming column of mixture, throws out the heavy liquid particles by centrifugal force. These are caught upon cylindrical screen 32, instead of walls 28, and the liquid trickles down and is collected in the space 37 where it is heated by wall 22.

In Figures 7 and 8 is shown a further modification upon the form of device shown in Figures 4 and 5, in which a helical baffle 38 extends the entire length of passage 17, except the constricted portion adjacent inlet 24 and outlet 25, and in this form the diameter of the helix which determines the outer edges of baffle 38 is substantially the same, allowing only a reasonable clearance, as the diameter of inner edges 29 of walls 28. Thus the entire volume of vapor passing through is necessarily constrained to follow a helical path, and the liquid particles are thrown out by centrifugal force, and are

caught upon and between edges 29 and walls 28, and vaporized as described in connection with the form of device illustrated in Figures 4 and 5.

In Figures 11 and 12 is shown a modification of the device, in which a downwardly directed current of mixture, entering the device through flanged opening 39, is deflected laterally and annularly by a deflector 40, the latter being somewhat similar in design and operation to deflector 26. The mixture is at the same time given a whirling movement by non-radial vertical baffles 41, and as it thus emerges into an enlarged chamber 42, the liquid particles are thrown out by centrifugal force and settle upon the lower wall 43 of chamber 42. The mixture outlet from chamber 42 is provided by a passage 44, the cylindrical wall 45 of which begins at a point in the interior of chamber 42 and extends to flanged outlet 46. The lower wall 43 of chamber 42 is frustro-conical in form, sloping downwardly toward a central opening 52 through which passes the cylindrical wall 45. Opening 52 is larger than cylindrical wall 45, leaving an annular space surrounding the latter; and the liquid particles which collect upon the surface of wall 43 run down through this annular space into an annular chamber 47 surrounding cylindrical wall 45. An annular passage 48 surrounds chamber 47 and is separated from the latter by a wall 49, and passage 48 is provided with flanged openings 50 and 51 for connection with the exhaust manifold or pipe. The liquid thus vaporized in chamber 47 returns to chamber 42 in the form of vapor, passing up through the annular space between opening 52 and wall 45, and thence out through passage 44. It will be seen that neither chamber 42 nor passage 44 are exposed to the heat of passage 48, and the gaseous and vapor content of the fuel mixture is protected from heating and consequent expanding.

It will be seen that the form of device illustrated in Figures 1, 2 and 3 is adapted to a horizontal flow of the mixture, and inlet and outlet may be interchangeable. The form illustrated in Figures 4 and 5 is adapted to upward flow of the mixture; for downward flow the frustro-conical walls 28 should be reversed and the entire device inverted. The form illustrated in Figure 6 is adapted to vertical flow of the mixture, and will be in upright or inverted position, according to direction of flow. The form shown in Figures 7 and 8 is adapted to vertical flow of the mixture, and inlet and outlet may be interchangeable. The form illustrated in Figures 11 and 12 is adapted to downward flow of the mixture. In all forms of the device, the inlet and outlet for exhaust gas are interchangeable.

The various devices herein described and illustrated are but a few of the many forms in which my invention may be embodied, and the following claims are not to be considered as limited to any one of the specific forms disclosed. With regard to the language of the claims, the term "gas" includes dry vapors, or mixtures of dry vapors and gases, as well as the so-called perfect gases. The term "volatilize" is used to denote the conversion into gas of any substance which is not a gas. The substance with which I am dealing (such as the product of the ordinary carbureter), is a mixture of gas and liquid particles entrained therein; which is not, strictly speaking, either a liquid or a gas. Hence the term "volatilize" may be applied with as much propriety to denote the conversion of such a mixture into a gas as if applied merely to its liquid constituent. The terms "vapor" and "mixture" are used in the ordinary sense as understood by persons familiar with internal combustion engines. The term "to blanket" is used to signify the interposition of a heat insulating means; i. e., the heating surface whereon the collected fuel particles are vaporized is "blanketed" from the gaseous content of the fuel-air mixture by the liquid conducting means and by the dead-air space thereby afforded.

What I claim is:

1. A device for volatilizing the entrained liquid particles carried by a gas mixture comprising a conduit, a plurality of closely spaced liquid-collecting plates lining at least a portion of the walls of said conduit and acting as a blanket therefor, means for externally heating the blanketed portion of said walls, and means in the path of flow of the mixture to deflect the liquid particles onto said collecting plates.

2. A device for volatilizing the entrained particles of liquid carried by a gas mixture comprising a conduit, a plurality of closely spaced liquid-collecting plates lining at least a portion of the walls of said conduit and acting as a blanket therefor, said plates sloping downwardly and away from the center of said conduit to permit the liquid to flow by gravity outwardly into contact with the walls of said conduit, means for heating the blanketed walls of said conduit, said walls adjacent the collecting plates being relatively thin.

Signed at New York city, in the county of New York and State of New York this 8th day of April A. D. 1921.

LESTER C. SMITH.