

Dec. 7, 1926.

1,610,000

T. J. FAY

VAPORIZER

Filed March 25, 1922

2 Sheets-Sheet 1

Fig. 1.

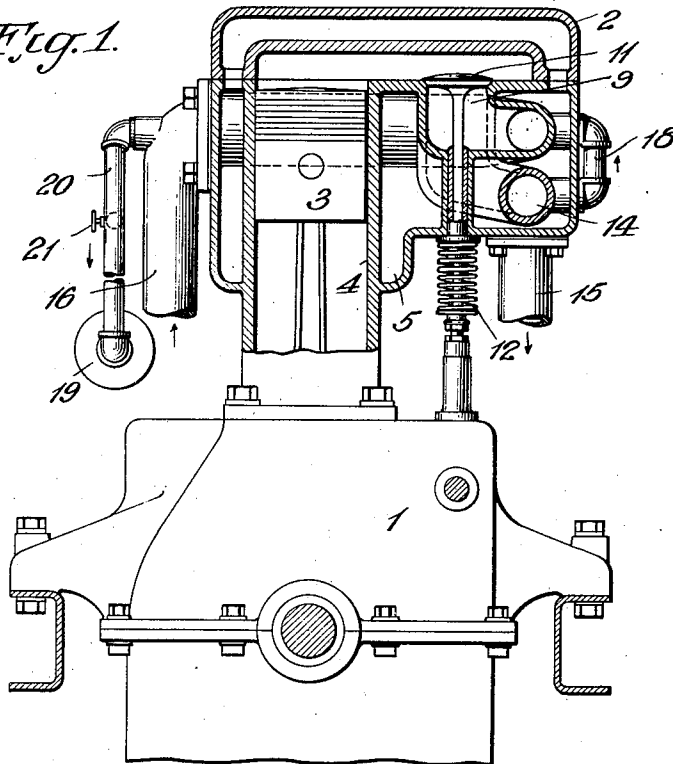
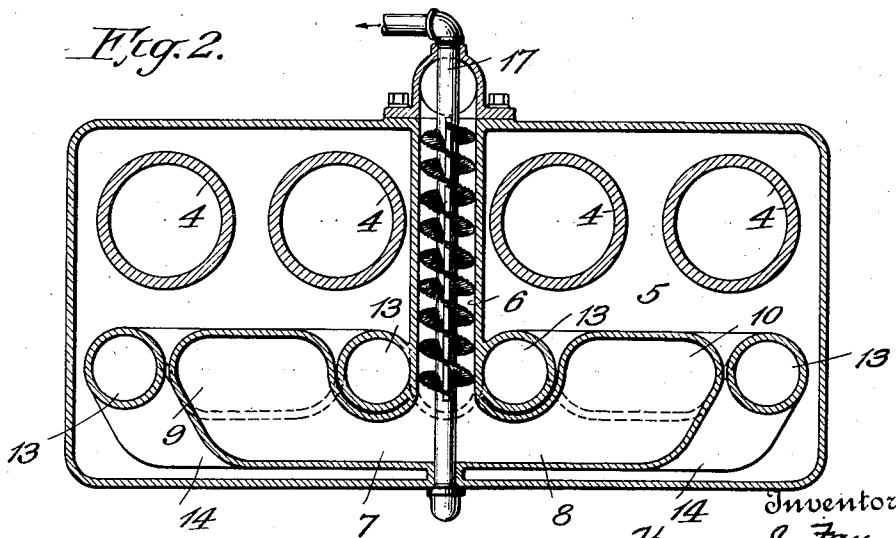


Fig. 2.



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2 Sheets-Sheet 2

Fig. 3.

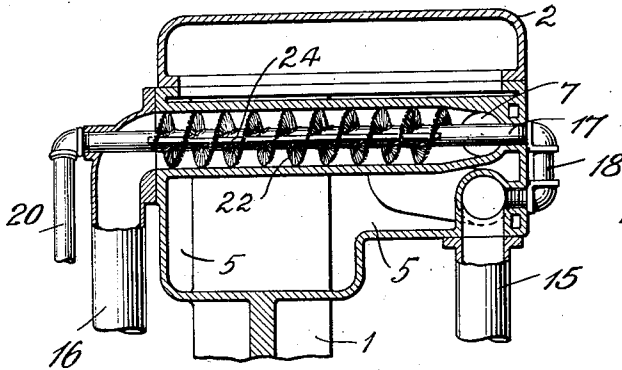


Fig. 5.

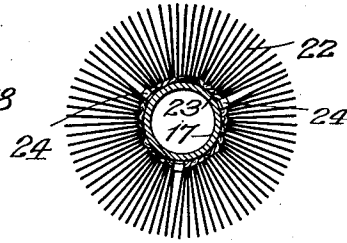


Fig. 4.

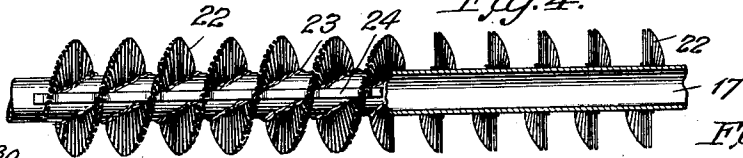


Fig. 8.

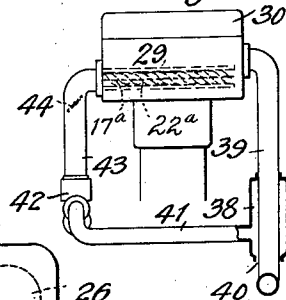


Fig. 7.

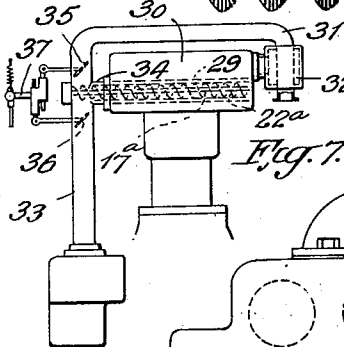
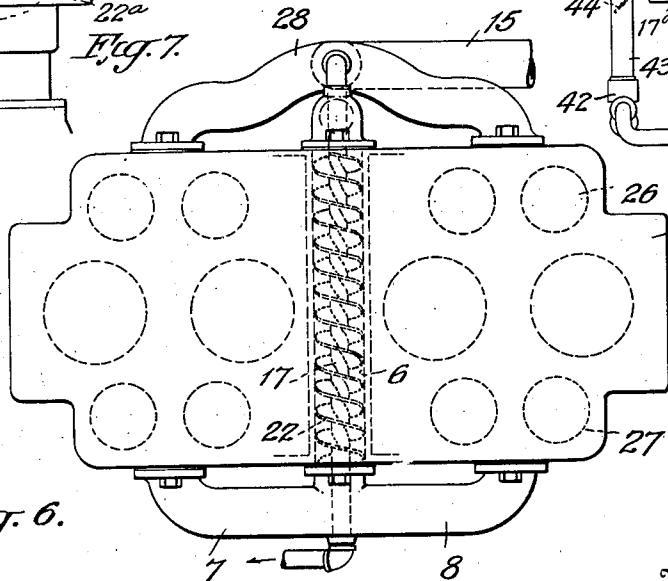


Fig. 6.



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VAPORIZER.

Application filed March 25, 1922. Serial No. 546,665.

This invention relates to the vaporization and carburetion of liquid fuels for internal combustion engines.

A considerable portion of our present grade of engine fuel passes through the intake-manifolds of automobile engines in liquid form. It is difficult to design a manifold that will distribute uniformly to all of the cylinders this liquid portion of the mixture furnished by the carbureter. No matter what condition the fuel is in when it reaches the cylinder, it must be vaporized before it can be burned. The most effective way yet found of improving distribution and combustion is to apply heat in some form or other. This makes it desirable to know how much heat to introduce and how to introduce it to get the best results. The ideal manifold would accordingly be one that produced a mixture dry enough to distribute evenly and burn well in the cylinders, with the least possible heating of the mixture itself.

Attempts have been made to vaporize the liquid fuel in the intake manifold by conducting the intake mixture through a conduit that passes through the water jacket used for cooling the cylinders, but the temperature of the boiling water in the jacket is too low to properly and fully vaporize the heavy liquid fuels which it is now necessary to accept and use. Other attempts have been made to vaporize the liquid fuel by heating the same before or after mixture with the air, but since the exhaust gases range in temperature from about 300° Fahr. to about 1500° Fahr. dependent upon the speed and running conditions of the engine, the heat derived from the exhaust gases is too variable and uncertain to be relied upon alone. The lower end of the range of temperatures above given is too low to be effective in vaporizing many of the fractions of petroleum that are offered to the public as fuel. With the higher temperatures, the fuel content per unit volume is decreased to such an extent that the maximum power of the engine is not developed.

There is sufficient heat in the exhaust gases so that if the proper method of utilization can be found, it will make possible the satisfactory use of fuels considerably heavier than the present "power" gasoline without seriously limiting the power, efficiency or flexibility of motor vehicles, or resulting

in any of the difficulties that are now due to poor manifolding systems.

An object of the invention is to provide an improved method and apparatus for vaporizing the liquid fuel prior to its admission to the engine cylinders, with which the fuel will be distributed uniformly to all the cylinders, with which a mixture may be obtained which is dry enough to distribute evenly and burn well in the cylinders with the least possible heating of the mixture itself, and which enables the satisfactory and efficient use of relatively heavy fuels. A further object is to provide an improved manifold which will accomplish the above objects and also check "flare backs" through the intake manifold which occur where the valves are leaky and the mixture is lean. A further object is to provide an improved method and apparatus for vaporizing liquid fuel by which the exhaust gases may be effectively and efficiently utilized and controlled for heating the intake gases and mixture under various operating conditions of the engine, which may be adapted to present designs of engines without material changes in their construction and design, and the apparatus of which is simple, compact, durable, and inexpensive. Other objects and advantages will be apparent from the following description of an embodiment of the invention and the novel features will be particularly pointed out in claims.

The invention comprehends the heating of the intake gases or mixture by a heat interchange with the exhaust gases, and stabilizing or tempering the heated gases or mixture by a further heat interchange with the cooling liquid of the engine. In the conduit in which the last named heat interchange occurs I preferably dispose a plurality of bristles of heat conducting material which extend transversely across the conduit into close proximity to or in contact with the walls through which the heat interchange is effected. These bristles may be advantageously arranged in a helical row extending axially along the conduit so as to give to the lighter portions of the mixture a slightly swirling movement and so as to be impinged upon themselves by the heavier portions which comprise largely the incompletely vaporized fuel. The helical passage formed by the bristles also increases the effective length of the passage for the intake mixture during

the period of the heat interchange and stabilization. The heat in the bristles will cause a vaporization of the liquid collected thereon and its absorption into the intake gases.

5 This insures the passage to the cylinders of a completely vaporized fuel having the proper temperature. The bristles check flare-backs along the intake conduit by cooling the burning gases below the combustion tem-
10 perature. The invention also comprehends various details and arrangements of parts which will be explained in connection with the following description of embodiments of the invention.

15 In the accompanying drawings:

Fig. 1 is a fragmentary sectional elevation of an engine to which my improved vaporizer has been applied.

Fig. 2 is a transverse horizontal section
20 through the same.

Fig. 3 is a sectional elevation of a portion of the same.

Fig. 4 is an elevation partially in section of the exhaust pipe by-pass carrying the
25 bristles.

Fig. 5 is a transverse section through the same.

Fig. 6 is a plan of a slightly different type of engine having the improved vaporizer applied thereto.
30

Fig. 7 is an elevation of a portion of an engine showing a further modification of the vaporizer; and

Fig. 8 is an elevation of a portion of an engine showing a still further modified embodiment of the vaporizer.
35

In the embodiment illustrated in Figures 1 to 5, an engine 1 is provided with a removable head 2, a plurality of reciprocating pistons 3 in cylinders 4, and surrounded by a water jacket 5. An intake conduit 6 extends transversely through the water jacket 5 between two of the cylinders 4, and at one end is provided with branches 7 and 8 which
45 extend in opposite directions to one another to intake ports 9 and 10.

The intake ports are controlled in a suitable manner by valves 11 which are pressed against their seats in a suitable manner, such as by springs 12. Exhaust ports 13 from the cylinders connect with exhaust cross-conduits 14 which unite into a common exhaust conduit 15 leading to a suitable muffler, not shown. The end of the conduit 6, which is
55 opposite from the branches 7 and 8, is connected by a pipe or conduit 16 to a suitable carbureter, (not shown) in which the liquid fuel and air are mixed in a well-known manner. A small pipe 17 passes axially
60 through conduit 6 from one side of the engine to the other, one end of the pipe 17 being connected by pipe 18 to the exhaust conduit 14, the other end of the pipe 17 passing through the wall of pipe 16 and being connected to a suitable muffler 19 by means of a

pipe 20 having therein a suitable controlling valve 21. A portion of the exhaust gases from the conduit 14 will be diverted through the pipe 18 and the pipe 17, which in effect form a by-pass, then through the pipe 20 to the muffler 19, the amount of the exhaust gases which pass through these conduits being controlled by the valve 21. A plurality of bristles 22 of metal or other suitable heat-conducting material are anchored along
75 corresponding ends to a braided strip 23 which is wound helically around the portion of the pipe 17 which passes through the conduit 6, the bristles extending radially outward from the periphery of the pipe 17 into close proximity to or in contact with the inner wall of the conduit 6. The braid 23 is anchored to the periphery of the pipe 17 in a suitable manner, such as by strips 24 which extend lengthwise of the pipe 17 and clamp the braid to the pipes. As the intake gases composed of air and fuel pass through the conduit 6, the lighter or completely vaporized portions of the mixture will partially pass between the bristles and along the conduit, and partially will be given a swirling movement corresponding somewhat to the helical passage formed by the helical row of bristles. The heavier particles will impinge against and collect upon the bristles since, because of their inertia, they will not partake materially of the swirling movement, and since the bristles upon the pipe 17 will be heated by the heat from the exhaust gases passing through the pipe 17, the heavier or unvaporized particles of the mixture will be heated and fully vaporized and absorbed into the passing mixture. By a manipulation of the valve 21 a greater or less proportion of the exhaust gases may be admitted through the pipe 17 in order to vary the temperature of the bristles for various fuel and running conditions.

In the embodiment illustrated in Fig. 6, the engine 25 is provided with exhaust valves 26 along one face of the engine and with intake valves 27 along the opposite face of the engine. The conduit 6 passes through the water jacket of the engine from side to side and the branch intakes 7 and 8 lead to the intake ports 27 beneath the intake valves. The pipe 17 is connected to the exhaust manifold 28 and passes axially through the conduit 6 and to a small muffler in the manner similar to that disclosed in Figure 1. The bristles 22 are secured in a helical row to the pipe 17 in the manner shown in Figure 4 and serve a similar purpose.
110

In use, I have found that the intake gases will be completely vaporized in passing through the conduit 6 and that the temperature in the conduit 6 is substantially uniform under various running conditions of the engine, the heat interchange between the water of the water jacket and the bristles serv-
125

ing to stabilize or temper the heat imparted to the bristles by the exhaust gases passing through the pipe 17. I have found that the mixture entering the engine cylinders is sufficiently dry to insure uniform distribution and to burn well and with a maximum of efficiency. When lean mixtures are being used flare-backs occasionally take place along the intake conduit or manifold, but I have found that the bristles serve to cool the burning gases below the combustion temperature and thus extinguish the flare-back before it passes for any considerable distance along the manifold.

In the embodiment illustrated in Figure 7, the intake conduit 29 extends through the water jacket of the engine 30, as in the embodiment disclosed in Figures 1 to 6. A core 17^a is disposed axially of the conduit 29 and is provided with a helical row of metallic bristles 22^a which extend radially of the conduit 29 and into contact with or in close proximity to the walls of the conduit. A conduit 31 passes through a chamber 32 included in the exhaust conduit or manifold and extends to the opposite side of the engine where it unites with the usual intake conduit 33, a common passage 34 connecting the union with the adjacent end of the conduit 29. Suitable valves 35 and 36 in the conduits 31 and 33 control the relative proportions of the gases passing therethrough which are admitted into the common intake conduit 34, the valves being controlled in a suitable manner from a common operating member 37. The other end of conduit 31 is open for the admission of air thereto, the air which passes through the pipe being heated by a heat interchange with the exhaust gases in the chamber 3, and the hot air obtained in this manner is mixed with the fuel mixture coming through conduit 33, and this new mixture passes through conduit 34 and the conduit 29 where a complete mixing is effected, the fuel being completely vaporized. The temperature of the mixture is stabilized or tempered by a heat interchange with the cooling liquid in the water jacket the interchange being facilitated and controlled by the bristles.

In the embodiment illustrated in Figure 8, the engine 30 is similar to that of Figure 7, and is provided with the intake conduit 29 passing through the water jacket and having therein the helical row of bristles 22^a. A casing 38 surrounds a portion of the exhaust conduit 39 and is provided at its lower end with an opening 40 through which cold air enters the casing. The casing is connected by a conduit 41 to a carburetor 42 of any suitable construction, where the fuel is added, and a conduit 43 extends from the carburetor to the conduit 29 for conducting the mixture of heated air and fuel through the water jacket to the intake valves

of the engine. A suitable valve 44 controls the conduit 43 for regulating the amount of mixture passing through the conduit 29. The air entering the casing 38 through the opening 40 will be heated by the exhaust gases in the exhaust conduit which pass through the casing, and will be conducted to the carburetor for the addition of the liquid fuel. The mixture is then conducted through conduit 29 where a complete mixing and vaporization takes place, the temperature of the mixture being stabilized or tempered by a heat interchange with the liquid in the water jacket of the engine, as in the embodiments before disclosed in Figures 1 to 7. The stabilization and mixing are facilitated by the bristles 22^a and "flare backs" are checked.

The intake to the various cylinders is intermittent and consequently the movement of the mixture of fuel and air is intermittent. The bristles serve to convert the intermittent rushes of the mixture into a more uniform movement so that the fuel carried thereby will not tend to settle out in the interval between admissions to the cylinders. The action of the bristles may be compared somewhat to the action of the twigs, leaves and branches of trees in breaking up rushes of air into a more uniform and less violent movement. This enables the uniform heating of every particle of the fuel. If an excess of fuel is carried by the mixture beyond that which can be properly vaporized, the excess is removed by the bristles, heated and reapplied to the moving mixture, the bristles in this respect acting in the manner of an auxiliary reservoir of fuel. The bristles extend transversely of the axis of the conduit so that there is no continuity of surface extending axially of the conduit which by capillary action would carry liquid fuel through the conduit without vaporization. The bristles also extend in all directions transversely across the direction of flow so that there will not be a direct passage through the conduit.

I claim:

1. In a fuel vaporizer for internal combustion engines having a water jacket, an exhaust conduit, and a fuel intake conduit with a portion passing through the water jacket, a heating conduit passing through the portion of the fuel intake conduit in the water jacket and connected to the exhaust conduit whereby at least a portion of the exhaust gases may be passed through said heating conduit, and baffle members extending across the intake conduit between the walls thereof and the heating conduit, in heat interchanging relation with both, for tempering the heat imparted to the gases passing through the intake conduit.

2. In a fuel vaporizer for internal combustion engines having a water jacket, an

exhaust conduit and a fuel intake conduit with a portion passing through the water jacket, a heating conduit passing through the portion of the fuel intake conduit in the water jacket and connected to the exhaust conduit whereby at least a portion of the exhaust gases may be passed through said heating conduit, and bristles of heat conducting material in said intake conduit and arranged along the periphery of the heating conduit.

3. In a fuel vaporizer for internal combustion engines having a water jacket, an exhaust conduit and a fuel intake conduit with a portion passing through the water jacket, a heating conduit passing through the portion of the fuel intake conduit in the water jacket and connected to the exhaust conduit whereby at least a portion of the exhaust gases may be passed through said heating conduit, and baffle members extending across the intake conduit between the walls thereof and the heating conduit, in heat interchanging relation with both, for tempering the heat imparted to the gases passing through the intake conduit, said baffle members having their surfaces substantially out of contact with one another in a direction along the conduit, whereby travel along the conduit, by capillary action upon said surfaces, of liquid fuel collecting upon the members from the intake gases will be prevented.

4. In a fuel vaporizer for internal combustion engines having a water jacket, an exhaust conduit and a fuel intake conduit with a portion passing through the water jacket, a heating conduit passing through the portion of the fuel intake conduit in the water jacket and connected to the exhaust conduit whereby at least a portion of the exhaust gases may be passed through said heating conduit, and bristles of heat conducting material in said intake conduit and arranged helically along the heating conduit; said bristles extending in directions transverse to the heating conduit.

5. In a fuel vaporizer for internal combustion engines having a water jacket, an exhaust conduit and a fuel intake conduit with a portion passing through the water jacket, a heating conduit passing through the portion of the fuel intake conduit in the water jacket and connected to the exhaust conduit whereby at least a portion of the exhaust gases may be passed through said heating conduit, and bristles of heat conducting material carried by the heating conduit in said intake conduit and extending in directions transverse to the heating conduit.

6. In a fuel vaporizer for internal combustion engines having a water jacket, an exhaust conduit and a fuel intake conduit with a portion passing through the water

jacket, a heating conduit passing through the portion of the fuel intake conduit in the water jacket and connected to the exhaust conduit whereby at least a portion of the exhaust gases may be passed through said heating conduit, and bristles of heat conducting material in said intake conduit and arranged along the heating conduit, said bristles extending across the intake conduit in close proximity to the walls thereof and to the heating conduit.

7. In a fuel vaporizer for internal combustion engines, a fuel intake conduit leading to the combustion chamber and having a heated wall, spaced bristles of heat conducting material in said intake conduit and arranged helically along the heated wall.

8. In a fuel vaporizer for internal combustion engines, a conduit through which the fuel mixture passes, and a helical row of bristles of heat conducting material extending along said conduits.

9. In a fuel vaporizer for liquid cooled explosion engines, an intake conduit having walls in heat interchanging relation with both exhaust gases and the cooling liquid, and baffle members in said conduit, each in heat interchanging relation with both walls so as to temper the heating action of the exhaust gases and the cooling liquid upon the intake gases and insure a more uniform temperature of the latter.

10. In a fuel vaporizer for liquid cooled explosion engines, an intake conduit having walls in heat interchanging relation with both exhaust gases and the cooling liquid, and baffle members in said conduit, each in heat interchanging relation with both walls so as to temper the heating action of the exhaust gases and the cooling liquid upon the intake gases and insure a more uniform temperature of the latter, said baffle members having their surfaces substantially out of contact with one another in a direction along the conduit whereby travel along the conduit, by capillary action upon the members, of liquid fuel collecting upon the members from the intake gases will be prevented.

11. In a fuel vaporizer for liquid cooled explosion engines, means for heating at least a portion of the intake gases by heat interchange with the exhaust gases, a conduit through which the heated intake gases pass to the engine cylinders having a portion of its walls in heat interchanging relation with the cooling liquid of the engine, and baffle members arranged along the said conduit and substantially out of contact with one another whereby travel along the conduit, by capillary action upon the members, of liquid fuel collecting upon the members from the intake gases will be prevented.

12. In a fuel vaporizer for liquid cooled explosion engines, means for heating at least a portion of the intake gases by heat inter-

change with the exhaust gases, a conduit through which the heated intake gases pass to the engine cylinders having a portion of its walls in heat interchanging relation with the cooling liquid of the engine, and bristles of heat conducting material arranged along and extending transversely of said conduit.

13. In a fuel vaporizer for liquid cooled explosion engines, means for heating at least a portion of the intake gases by heat interchange with the exhaust gases, a conduit through which the heated intake gases pass to the engine cylinders having a portion of its walls in heat interchanging relation with the cooling liquid of the engine, and bristles of heat conducting material arranged along and extending transversely of said conduit, and into close proximity to the walls of said conduit.

14. In a fuel vaporizer for liquid cooled explosion engines, means for heating at least a portion of the intake gases by heat interchange with the exhaust gases, a conduit through which the heated intake gases pass to the engine cylinders having a portion of its walls in heat interchanging relation with the cooling liquid of the engine, and a helical row of bristles of heat conducting material extending axially along the conduit with the bristles disposed transversely of the conduit.

15. In a fuel vaporizer for internal combustion engines, a conduit through which the fuel and air mixture passes to the cylinders, and numerous small bristles disposed along the conduit and extending transversely across the conduit in all directions so as to form a barrier to direct passage of the mixture through the conduit.

16. In a fuel vaporizer for internal combustion engines, a conduit through which the fuel and air mixture passes to the cylinder having a heated wall, and numerous small bristles disposed along the conduit and extending transversely across the conduit in all directions, so as to form a barrier to direct passage of the mixture through the conduit, said bristles being in at least close proximity to the heated wall.

17. In a fuel vaporizer for internal combustion engines an intake conduit for conveying the mixture of air and fuel to the combustion chambers, and baffle means in said conduit for effecting a more complete vaporization of the fuel, said means comprising a plurality of bristles disposed to extend transversely of the length of the conduit and arranged to oppose direct passage of the mixture through the conduit, whereby any liquid fuel held in suspension in the air passing along the conduit will impinge upon said bristles as the mixture passes about them during its travel along the conduit.

18. In a fuel vaporizer for an explosion engine, means for supplying a fuel and air mixture to said engine and including an intake conduit having a wall in heat interchanging relation with the heat of combustion of the engine, and a plurality of bristles of heat conducting material in heat interchanging relation with said conduit wall, extending in directions transversely of the conduit and in positions to oppose direct passage of the mixture through the conduit, whereby any liquid fuel held in suspension in the air passing along the conduit will impinge upon said bristles as the mixture passes about them during its travel along the conduit, the heat of said bristles from the heat interchange increasing the vaporization of the liquid fuel particles which impinge thereon.

19. In a fuel vaporizer for internal combustion engines, an intake conduit for conveying the mixture of air and fuel to the combustion chambers, and baffle means in said conduit for effecting a more complete vaporization of the fuel, said means comprising a plurality of bristles disposed to extend transversely of the length of the conduit and arranged to oppose direct passage of the mixture through the conduit, whereby any liquid fuel held in suspension in the air passing along the conduit will impinge upon said bristles as the mixture passes about them during its travel along the conduit, the bristles being arranged in a spiral row along the length of the conduit so as to give the mixture a slight rotation while also permitting it to pass through the spaces between adjacent bristles.

20. In a fuel vaporizer for an explosion engine, means for supplying a fuel and air mixture to said engine and including an intake conduit having a wall in heat interchanging relation with the heat of combustion of the engine, and a plurality of bristles of heat conducting material in heat interchanging relation with said conduit wall, extending in directions transversely of the conduit and in positions to oppose direct passage of the mixture through the conduit, whereby any liquid fuel held in suspension in the air passing along the conduit will impinge upon said bristles as the mixture passes about them during its travel along the conduit, the heat of said bristles from the heat interchange increasing the vaporization of the liquid fuel particles which impinge thereon, the bristles being arranged in a spiral row along the length of the conduit so as to give the mixture a slight rotation while also permitting it to pass through the spaces between adjacent bristles.

In witness whereof, I hereunto subscribe my signature.

THOMAS J. FAY.