

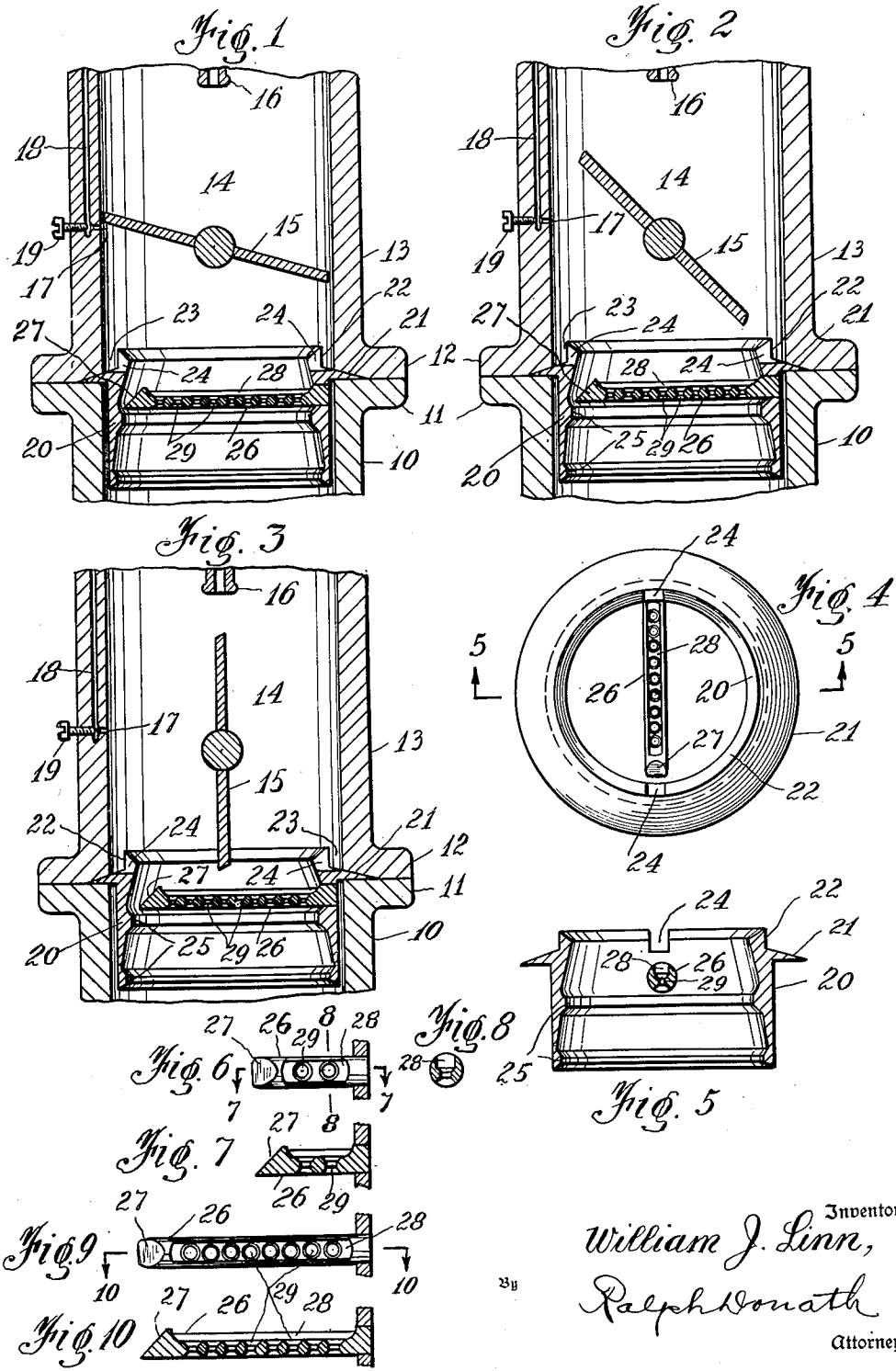
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W. J. LINN
LIQUID FUEL ATOMIZER

2,614,037

Filed Dec. 13, 1950

2 SHEETS—SHEET 1



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2 SHEETS—SHEET 2

Fig. 11

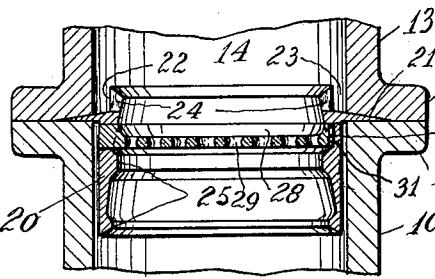


Fig. 14

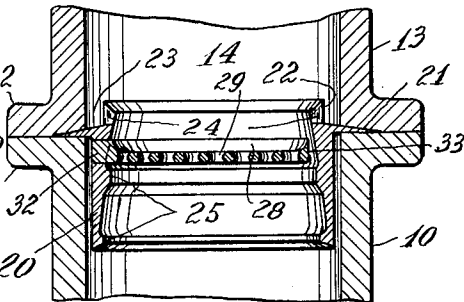


Fig. 12

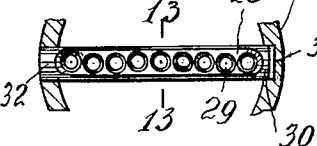


Fig. 13

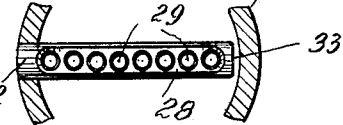


Fig. 15

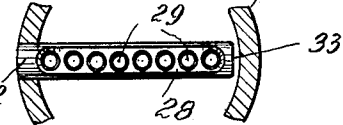


Fig. 16

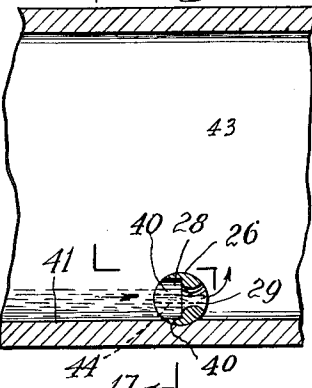


Fig. 17

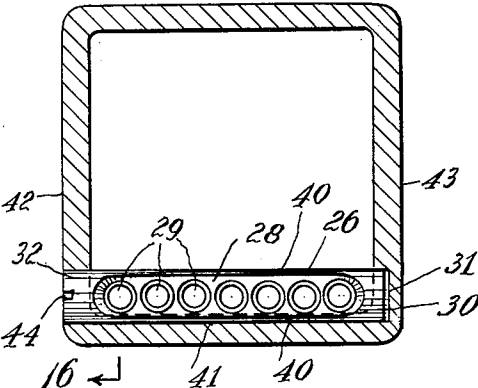


Fig. 20

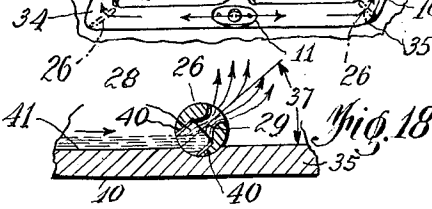
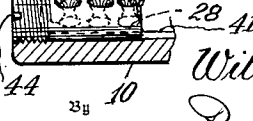


Fig. 19



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UNITED STATES PATENT OFFICE

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LIQUID FUEL ATOMIZER

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11 Claims. (Cl. 48-180)

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This invention relates to liquid fuel atomizers and fuel and air mixers and particularly to devices of this type as used in connection with fuel and air charging duct in carburetors and manifolds of internal combustion engines for improving the degree of mixing and the quality of the explosive mixture delivered to the combustion chamber.

There have been various devices suggested for this purpose, none of which, however, completely and successfully atomizes the liquid fuel and mixes it with air to the degree necessary to prevent unatomized fuel from passing into the combustion chamber of the engine cylinders. Unatomized liquid fuel, usually in the form of small droplets is not only uneconomical but undesirable from the standpoint of engine efficiency. The liquid fuel collected in the combustion chamber of the engine passes around the piston rings during the compression stroke of the engine and into the crankcase where it dilutes the oil. As is well known, condensed fuel also accumulates on the bottom of the intake manifold which eventually flows into the crankcase, thereby reducing the lubricating qualities of the oil, causing increased friction and excessive carbon built up and loss of thermal and mechanical efficiency.

The present invention is designed to avoid these difficulties by more effectively atomizing the liquid fuel in the air and fuel charging duct. This is achieved by the use of one or more diffuser means, preferably in the form of elongated rods or cylindrical bars disposed substantially centrally of the axis of the duct when inserted between the carburetor flange and the intake manifold flange or, when used in the intake manifold, on the bottom of the duct. These diffuser means, when inserted between the carburetor flange and the intake manifold flange, preferably project inwardly of the duct on a line normal to a tangent at its point of attachment with the duct wall and terminate in close proximity of the inner wall of the duct. This is an improvement upon the liquid fuel atomizer described in my copending application Serial No. 84,820, filed April 1, 1949, now Patent No. 2,589,946, issued March 18, 1952.

The diffuser means of this invention may also be disposed across the bottom of the duct, for instance, when used in manifolds of internal combustion engines.

The diffuser means of this invention is provided with a U-shaped cavity or channel which is adapted to gather a portion of the incoming

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stream of fuel and air and passes through one or more Venturi openings, the number of which depend on the length of the diffuser and the size of the fuel and air charging duct, extending from the base of the U-shaped cavity or channel to the side of the rod opposite the openings of the cavity or channel.

When using diffusing means inserted between the flanges of the carburetor and the intake manifold, the atomizing and diffusing of the liquid fuel and air may be more effectively accomplished by combining the diffuser means with a sleeve and collecting well for the unatomized fuel or by adding a flow velocity changing means, such as a venturi for alternately accelerating and decelerating the fuel and air mixture. Preferably such a structure is made up of a tubular sleeve adapted to be disposed in the duct through which a stream of air and fuel passes between the carburetor and the intake manifold and having attachment means on the exterior of the sleeve for mounting it in the duct. A baffle surface and a flange are provided on the exterior of the sleeve to define with the wall of the duct a well adjacent the periphery of the duct. The flange is provided with at least two oppositely disposed openings to the interior of the well. A diffuser bar is fixed to protrude from the interior of the tubular sleeve from a point directly below the opening in the flange and toward the opposite wall of the duct with the U-shaped cavity or channel portion extending from a point adjacent the wall of the duct toward the opposite wall of the duct and with its open top facing the incoming stream of fuel and air mixture. The free end of the cylindrical rod which is not fixed to the duct wall may be provided with a semi-ovoid plane face formed by cutting through the cylinder at an acute angle to its elements, said face being so placed as to be impinged upon by the incoming stream of fuel and air.

The efficiency of his combination results from the considerable turbulence which is created in the fuel and air stream and by the collection and discharge of unatomized fuel from the well into the cavity or channel of the diffuser rod and from thence into the stream of air and fuel. This combination acts to collect the unatomized fuel which tends to collect on the walls of the duct and discharge it into the stream of fuel and air which is broken up by the diffuser rod at the point of introducing the unatomized fuel, thereby creating a median turbulence which causes the fuel to be more completely atomized and in-

termixed with the air than has heretofore been possible. This median turbulence is accentuated by the fraction of the fuel and air stream which passes through the passage or passages in the diffuser rod.

Slightly modified cylindrical diffuser rods may be used without affecting the efficiency of the same in which said modification consists in substituting the semi-ovoid, plane-faced free end by a straight free end which is adapted to come in close proximity of the wall of the sleeve or which slightly penetrates the said wall of the sleeve.

My diffuser means may also be used advantageously in sleeves representing, for instance, an intake manifold. As is well known, condensed liquid fuel accumulates on the bottom of the intake manifold which is usually carried by the onrushing air-stream in an unatomized condition to the firing chamber of the engine thereby causing wet spark plugs, excessive wear of the piston rings and dilution of the oil in the crankcase, thus considerably reducing the efficiency and performance of the engine.

When using diffuser means of my invention for intake manifolds, the diffuser means are mounted through the walls of the bottom portion of the manifold, preferably at the elbow portions and the center portion of the manifold in a manner, with slight exceptions, as the ones heretofore described for diffuser means for sleeves mounted between the flanges of the carburetor and the intake manifold.

It is essential that the diffuser means be substantially of a size of about one sixth the internal diameter of the sleeve.

In the accompanying drawings illustrating present preferred embodiments of the invention:

Figure 1 is a vertical section through an air and fuel charging duct having the diffuser means and Venturi sleeve combination according to this invention with the butterfly valve of the carburetor in closed or idling position.

Figure 2 is a section similar to Figure 1 with the butterfly valve partly open.

Figure 3 is a section similar to Figures 1 and 2 with the butterfly valve in wide open position.

Figure 4 is a top plan view of the sleeve and diffuser means of the invention.

Figure 5 is a section on line 5—5 of Figure 4.

Figure 6 is a top plan view of one embodiment of the diffuser means according to this invention.

Figure 7 is a section on line 7—7 of Figure 6.

Figure 8 is a section on line 8—8 of Figure 6.

Figure 9 is a top plan view of another embodiment of the diffuser means.

Figure 10 is a section on the line 10—10 of Figure 9.

Figure 11 is a vertical section through an air and fuel charging duct having a Venturi sleeve mounted between the flanges of the carburetor and the intake manifold showing another embodiment and assembly of the diffuser means as used in this invention.

Figure 12 is a top plan view of the diffuser means mounted in a Venturi sleeve shown in Figure 11.

Figure 13 is a section on line 13—13 of Figure 12.

Figure 14 is a section similar to Figure 11 showing a modification of the mounting of the diffuser means in the Venturi sleeve.

Figure 15 is a top plan view of the diffuser

means mounted in the Venturi sleeve shown in Figure 14.

Figure 16 is a fragmentary, longitudinal section through an intake manifold of an internal combustion engine taken on line 16—16 of Figure 17, showing the diffuser means slightly embedded in the bottom wall of the intake manifold.

Figure 17 is a section on line 17—17 of Figure 16.

Figures 18 and 19 show sections similar to sections 16 and 17 with the exception that the diffuser is mounted in the wall of the manifold at an angle with one of the ends of the diffuser threading engaging the manifold wall.

Figure 20 is a perspective view of an intake manifold indicating in dot and dash lines the position of the diffusers in the intake manifold.

Referring to the drawings, there is illustrated a manifold inlet 10 having a flange 11 connected to a flange 12 of a carburetor 13 thereby forming a passage 14 hereinafter entitled a "fuel and air charging duct." A butterfly valve 15 is located in the carburetor body between the flange 12 and the fuel jet 16. An idling jet 17 communicates by a passage 18 with a fuel chamber (not shown) of the carburetor and furnishes fuel for idling when the butterfly valve 15 is near closing position (see Figure 1). An adjusting screw 19 serves to regulate the free area of the idling jet 17 and with it the amount of fuel supplied and the speed of the idling motor.

The carburetor combination just described is generally old and will supply only partially atomized fuel to the engine. A combination of this type is subject to all of the undesirable qualities which have been mentioned earlier as characteristic of ordinary carburetors and which are solved by this invention.

A sleeve 20 is inserted into the fuel and air charging duct 14 by means of a baffle piece 21 inserted between the inner edges of the carburetor flange 12 and the intake manifold flange 11. The baffle piece 21 in addition forms a radial baffle surface extending between the sleeve 20 and the internal wall of the fuel and air charging duct about the periphery of the sleeve. A flange 22 extending vertically above the baffle piece forms with the baffle piece and the internal wall of the duct a well 23 surrounding the upper end of the sleeve (viewing Figures 1 through 3). Openings 24 are provided in the flange 22 which extend from the well 23 to the interior of the sleeve. Restricting ridges 25 may be provided in the interior of the sleeve to produce a Venturi action on the incoming stream of fuel and air and thereby alternately accelerate and decelerate the mixture. These ridges 25 may be sharp and undercut, thereby causing any liquid fuel which flows along the sleeve wall to be detached from the walls due to the abrupt changes of direction at the ridges and the additional turbulence in the fuel and air stream caused by the abrupt change.

A cylindrical diffuser bar or pin 26 projects inwardly in the fuel and air charging duct on a line normal to a tangent to the point at which it is attached to the duct wall and terminates at a point adjacent the interior wall of the duct. A semi-ovoid plane face 27 is formed on the end which terminates adjacent the interior wall of the duct. This plane face is formed by cutting through the cylinder at an acute angle to its elements. This plane face 27 is preferably placed in the duct so that it is impinged upon by the in-

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coming stream of fuel and air. A U-shaped cavity or channel 28 extending longitudinally of the diffuser bar or pin 26 is provided to collect a portion of the incoming fuel and air and carry it to a series of Venturi passages 29 which extend from the bottom of the U-shaped cavity or channel 28 to the opposite side of the diffuser rod 26. The two ends of each passage 29 are flared as shown in the drawings thereby providing a restricting portion which acts as a small venturi and alternately accelerates and decelerates the mixture of fuel and air passing through the passages 29.

The diffuser bar 26 described above is more clearly illustrated in Figures 9 and 10. A second embodiment of the diffuser bar or pin is shown in Figures 6 and 7.

In this second embodiment which is used for small size fuel and air charging ducts the only change is the use of a single (not shown) or a pair of passages 29 extending from the cavity or channel 28 to the bottom of the diffuser pin.

In operating an internal combustion engine having the device of this invention, the liquid fuel is introduced into the air and fuel duct 14 from the jet 16, where it is picked up by a stream of air and carried along the duct. As is well known, a considerable amount of the fuel remains in the form of large droplets which impinge on the walls of the duct. This portion of the unatomized fuel is collected in the well 23 and discharged through the openings 24 into the U-shaped cavity or channel 28 or onto the semi-ovoid plane face 27. The fuel and air mixture which passes along the duct picks up the liquid fuel and propels it through the Venturi passages 29 and through the interior restricting ridges 25 of the sleeve 20, thereby causing the fuel to be additionally broken up and mixed with the stream of fuel and air.

At idling speeds, the fuel is drawn through the passage 18 and the idling jet 17 and follows the same path described above.

The turbulent currents caused by the diffuser means and those caused by the flow changing means cooperate with each other to set up secondary or compound turbulence in the interior of the sleeve and duct. This increased turbulence acts to atomize the fuel and to intermix it with the fuel and air stream to an extent heretofore impossible to attain.

In Figures 11, 12 and 13, I have shown a modification of the diffuser means in which both ends of said diffuser means are supported in the wall of the sleeve. The end 30 freely penetrates a prepared pocket 31 in the wall of sleeve 20 while the opposite end 32 is fixedly secured in said wall.

In Figures 14 and 15 I have illustrated another slight modification of the diffuser means of this invention in which the free end 33 is in parallel alignment with the fixed end 32.

Figures 16, 17 and 18 illustrate another form of the diffuser means of the invention. These figures show the diffuser means as applied to an intake manifold of an engine.

Many attempts have been made to obtain a more complete combustion in internal combustion engines by additionally atomizing the fuel and air mixture as it issues from the carburetor and especially the heavy fuel in the form of droplets which adheres to the inner walls of the carburetor and the intake manifold. As is well known this heavy fuel finds its way into the combustion chamber and crankcase thereby causing excessive carbon, sticking of the valves, wet spark plugs,

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dilution of the oil in the crankcase, etc. These disadvantages have been nearly avoided by inserting my diffuser means of this invention between the carburetor and the intake manifold flanges as described above, but extensive tests have shown that, due to the condensation of the fuel mixture as it passes through the intake manifold again causes liquid fuel to accumulate, but this time, on the bottom of the manifold which also eventually finds its way to the combustion chambers of the engine with the same disadvantageous result as described above. In order to overcome these drawbacks I have provided diffuser means positioned within the intake manifold. These diffuser means are substantially of the same construction as the ones described previously and illustrated in Figures 11, 12 and 13, with the exception that they are mounted on the bottom of the manifold and preferably slightly embedded in the bottom wall of the manifold in a manner as shown in Figures 16, 17, 18 and 19 and positioned, preferably, in the elbow portions 34, 35 and the center portion 36 of the manifold as indicated in dot and dash lines in Figure 20.

In operation, the diffuser means in the intake manifold serve to re-atomize the liquid fuel which accumulated through condensation on the bottom interior of the intake manifold in the following manner: The air and fuel mixture stream issuing from the carburetor forces any condensed liquid fuel, which settles on the bottom of the manifold, through the channel 28 and through a series of Venturi passages 29 of the diffuser means 26 thereby causing the condensed liquid fuel to again atomize after which it is delivered to the combustion chambers of the engine in a nearly perfect atomized condition.

Figure 20 illustrates a perspective, diagrammatic view of an intake manifold in which the arrows indicate the direction of the flow of the fuel issuing from the carburetor (not shown) into the combustion chambers of the engine. It is needless to mention that the carburetor is secured to the flange 11 (Figure 20) of the intake manifold. As will be noted, the diffusers 26, when used in an intake manifold, are slightly embedded in the bottom portion of the manifold (Figures 16 to 19 inclusive) so that one of the sides 40 of the diffuser channel 28 comes in alignment with the bottom 41 of the manifold but, if so desired, the diffuser 26 may be embedded in the bottom portion 41 of the manifold in an angular position 37 as best shown in Figure 18 of the drawings and to ascertain positively the degree of this angular position one end of the diffuser bar is threaded as at 38 which is adapted to engage a tapped hole 39 through the bottom portion of the side walls 42, 43 of the manifold. Due to the fact that the position of the diffusers, in reference to the channel 28 including the Venturi passages 29, can not be visualized after they are in place, I have provided a screw-driver slot 44 (Figures 17 and 19) which is in alignment with the channel 28 and the Venturi passages 29 and by means of which the diffuser bar 26 may be readily regulated to any desired angle.

While I have illustrated and described my invention, I do not desire to be limited to the structural details so illustrated and described; but intend to cover all forms and arrangements which fall within the terms employed in the definitions of my invention constituting the appended claims.

I claim:

1. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine

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comprising a tubular sleeve through which a stream of air and fuel mixture passes and at least one diffuser bar projecting inwardly from the interior of the tubular sleeve, said diffuser bar having a channel portion extending from a point adjacent one end to a point adjacent the other, said diffuser bar being fixed in the duct so that the open part of the channel faces the incoming stream of air and fuel mixture and a plurality of passages extending from the base of the channel to the side of the diffuser bar opposite the incoming stream of fuel and air mixture.

2. A liquid fuel atomizer as claimed in claim 1 in which the diffuser bar is substantially cylindrical in cross section and has one end fixed to the internal wall of the duct and the other end has a semi-ovoid plane face formed by cutting through the cylinder at an acute angle to its elements, said plane face being so placed as to be impinged upon by the stream of fuel and air mixture.

3. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine comprising a tubular sleeve adapted to be disposed in the duct through which a stream of fuel and air passes between the carburetor and the engine, attachment means on the sleeve for mounting it in the duct, a baffle surface and flange on said sleeve defining with the wall of the duct a well adjacent the periphery of the duct, a pair of oppositely spaced openings through the flange to the interior of the well, and a diffuser bar projecting inwardly from the interior of the sleeve at a point directly below the opening in the flange toward the center of the duct, said diffuser bar having a U-shaped channel extending from a point adjacent one end to a point adjacent the other, said bar being fixed in the duct so that the open top of the channel faces the incoming stream of air and fuel mixture and extends from a point adjacent the wall of the duct and directly below the openings in the flange and a plurality of Venturi-shaped passages extending from the base of the U-shaped channel through the body of the diffuser bar to the side opposite the incoming stream of the fuel and air mixture.

4. A liquid fuel atomizer as claimed in claim 3 in which the diffuser bar is substantially cylindrical in shape and has one end fixed to the internal wall of the duct at a point below the openings in the flange and on the other end has a semi-ovoid plane face formed by cutting through the cylinder at an acute angle to its elements, said plane face being so placed as to be impinged upon by the stream of liquid fuel.

5. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine comprising a tubular duct through which a stream of fuel and air mixture passes, a diffuser bar projecting inwardly from the interior of the duct, said diffuser bar having a U-shaped channel extending from a point adjacent one end to a point adjacent the other, said diffuser bar being fixed in the duct wall so that the open channel faces the incoming stream of fuel and air and a plurality of parallelly disposed and equally spaced passages extending from the base of the channel to the side of the diffuser bar opposite the incoming stream of fuel and air mixture, and each passage has a flared entrance and exit.

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6. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine comprising a rectangular tubular member through which a stream of fuel and air mixture passes, diffuser bars projecting inwardly from the wall of the rectangular tubular member, said diffuser bars having a U-shaped channel portion extending from a point adjacent one end to a point adjacent the other, said diffuser rod being fixed in the tubular member so that the open part of the channel faces the incoming stream of fuel and air mixture and a plurality of parallelly disposed Venturi passages extending from the base of the channel to the side of the bar opposite the incoming stream of fuel and air mixture.

7. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine as claimed in claim 6 in which each cylindrical diffuser bar projects inwardly and is fixedly secured at one end to one of the side walls of the rectangular tubular member and the other end is inserted in a socket in the opposite side wall.

8. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine as claimed in claim 7 in which the cylindrical diffuser bar projects inwardly and is superimposed in an arch-like, longitudinal groove in the bottom wall of the rectangular tubular duct, said arch-like groove to coincide with the outside face of said cylindrical bar.

9. A liquid fuel atomizer as claimed in claim 8 in which the depth of the arch-like longitudinal groove in the bottom wall of the duct is not more than one-eighth the diameter of said diffuser bar.

10. A liquid fuel atomizer as claimed in claim 9 in which the diffuser bar is substantially cylindrical in shape and has one end threadingly fixed to one of the side walls of the duct and the other end is inserted in a socket in the opposite side wall, the threaded end of the diffuser bar is provided with a screw-driver slot which is in alignment with the center of the U-shaped channel and the Venturi passages, thereby indicating the angular position of the diffuser bar within the duct.

11. A liquid fuel atomizer for a fuel and air charging duct of an internal combustion engine comprising at least one diffuser bar projecting inwardly from the interior of the duct, said diffuser bar having a channel portion extending from a point adjacent on the end to a point adjacent the other end, said diffuser bar being fixed in the duct so that the open part of the channel faces the incoming stream of fuel and air mixture, and a plurality of passages extending from the base of the channel to the side of the diffuser bar opposite the incoming stream of fuel and air mixture.

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