March 10, 1936. H. E. BUCKLEN 2,033,753

GASEOUS FLUID VAPORIZER AND MIXER

Filed April 4, 1930 4 Sheets-Sheet 1

Fig. 1.

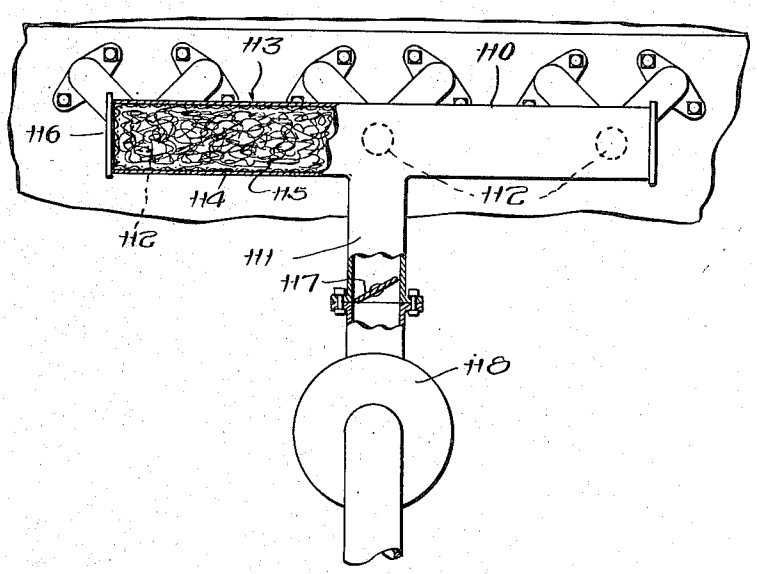
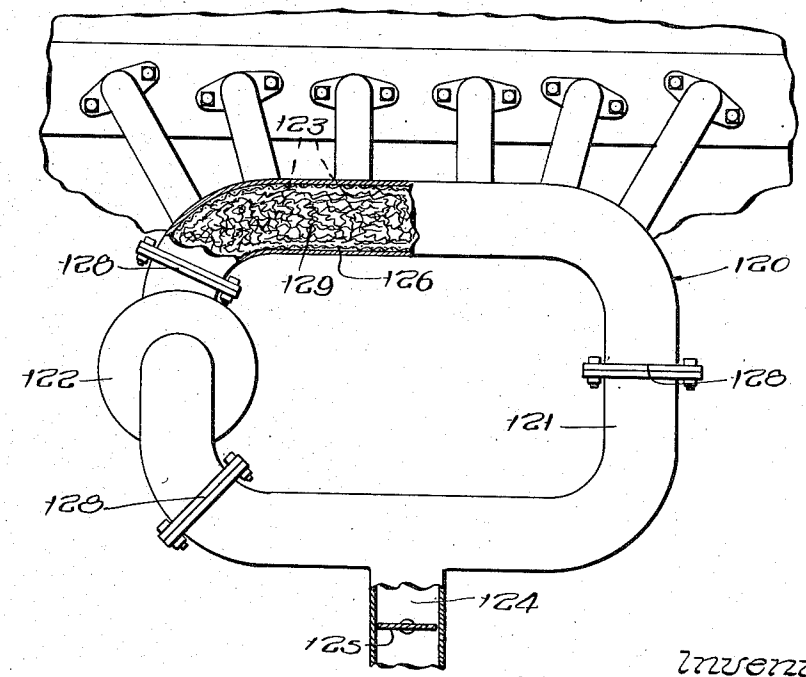


Fig. 2.



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Fig. 3.

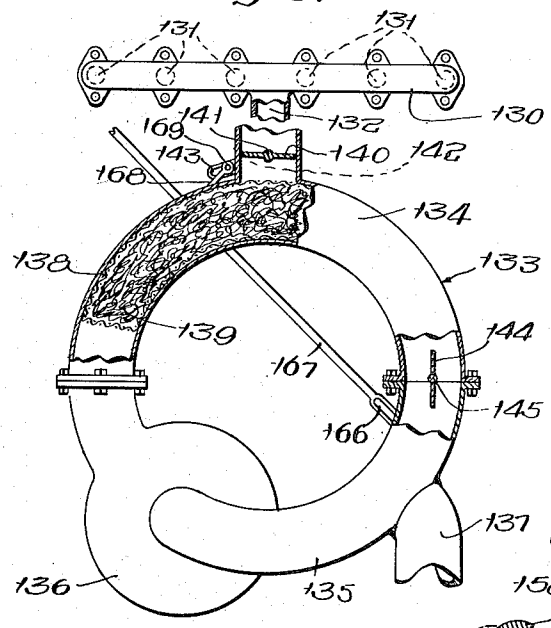


Fig. 4.

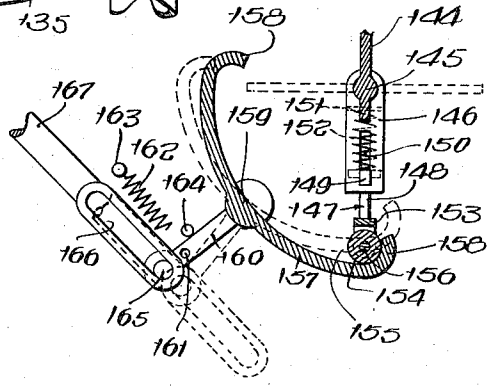
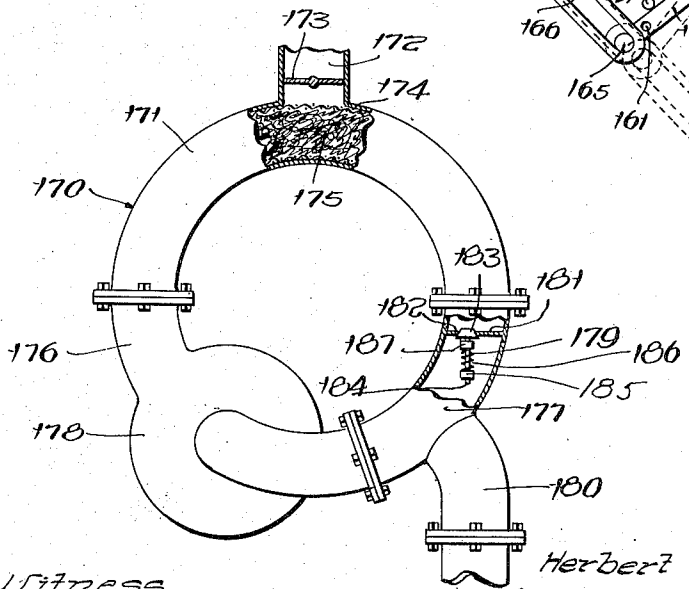


Fig. 5.



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GASEOUS FLUID VAPORIZER AND MIXER

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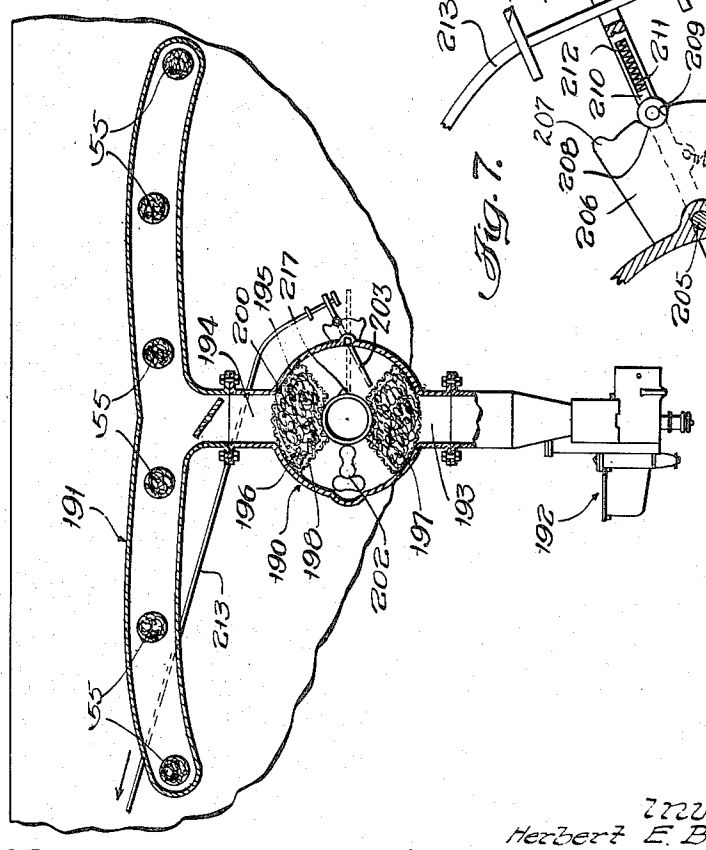


Fig. 6.

Fig. 7.

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Fig. 8.

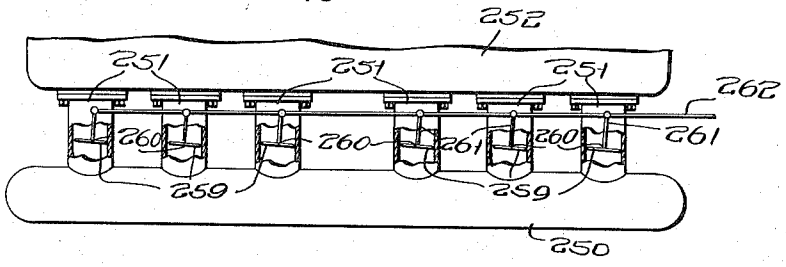
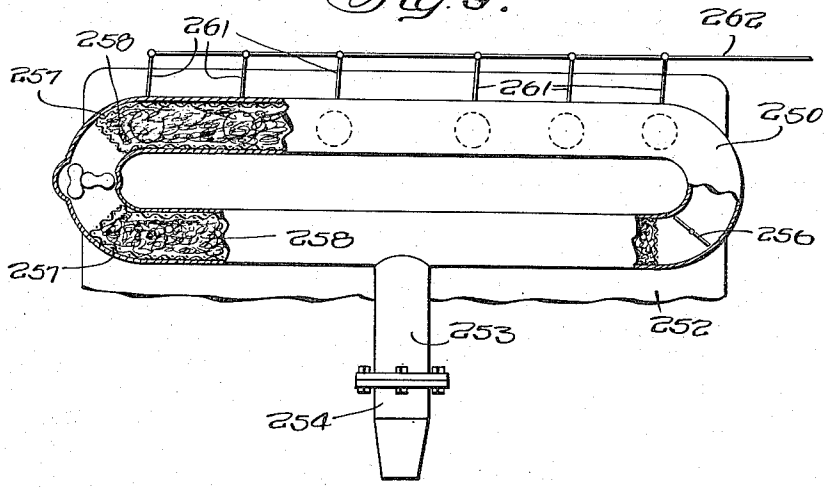


Fig. 9.



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Patented Mar. 10, 1936

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UNITED STATES PATENT OFFICE

2,033,753

GASEOUS FLUID VAPORIZER AND MIXER

Herbert E. Bucklen, Elkhart, Ind.

Application April 4, 1930, Serial No. 441,453

12 Claims. (Cl. 123—119)

This invention relates to gaseous fluid vaporizers and mixers for liquid fuel, and more particularly to an improved means for securing a more intimate mixture of hydrocarbon fluid and air.

While the invention is herein disclosed as being applied to intake manifolds of internal combustion engines, it is to be understood that it is not limited thereto inasmuch as it may be utilized wherever it is desired to efficiently vaporize and mix hydrocarbon fluids for combustion purposes such for example as in oil burning furnaces and the like.

When a mixture of hydrocarbon fluid and air traverses an intake manifold employed with mechanisms of the classes of engines above referred to, there is a distinct tendency on the part of such fluid particularly where the fluid originates from the heavier oils, to become condensed into globules of appreciable size, this tendency being especially great in the region of the manifold where the effects of friction and cooling are most marked. Upon the feeding into the combustion chamber of a mixture comprising such globules, even though a sufficient quantity of highly vaporized fluid be present for purposes of combustion, the combustion of the globules is necessarily imperfect, resulting in a lack of efficient combustion and an accumulation of carbon within the combustion chamber and associated parts.

Heretofore, attempts have been made to alleviate such a condition but they have been only partially successful. The majority of the devices employed to combat the above outlined condition have been in the nature of variegated arrangements of fine mesh screens interposed in the intake manifold or conduit for intersecting the globules and breaking them up in the course of their passage through such conduit as they are carried by the vaporized fluid following. Where the screens have been positioned to extend transversely of the conduit, they only serve to break up the relatively large globules into smaller ones but the resultant vaporized fluid comes through in streams of such close proximity to each other due to the generally fine mesh of the screens employed that there is a great tendency on the part of the resultant smaller globules to unite and reform larger globules. Thus while a number of the large globules are partly broken up initially, the fluid finally introduced into the combustion chamber contains a large portion of globules which are not minute enough to assure combustion of maximum efficiency so that a relatively large amount of carbonization is present.

In instances where the fine mesh screens are interposed in the intake conduit in the form of lam nations in parallel relation with the conduit axis, the globules have a tendency to merely travel along the wire strands and emerge at the discharge ends of such devices in globules of substantially original size due to the molecular adhesion of the particles forming the globules to one another. Here again the result is the introduction of a fluid into the combustion chamber of such a character that the resultant combustion is imperfect and deposits of carbon soon accumulate within the combustion chamber and the associated parts.

With the above in view, the chief feature of my invention comprises the provision of a novel means for the intake manifolds or conduits of mechanisms of the character described wherein the globules of the hydrocarbon fluid are positively and effectively broken up and delivered to the combustion chamber of such minute character as to insure perfect combustion of the fluid whereby resultant difficulties heretofore encountered due to carbonization are reduced to a minimum. To this end, I have found that by interposing metallic filaments of the character of minute shavings such for example as steel shavings or steel wool, in the intake conduit or passage of mechanisms of the character above referred to, the globules initially introduced into said manifolds or conduits at the receiving ends thereof are broken up, or shredded and in this manner delivered to the combustion chamber.

A microscopic analysis of the characteristics of metallic filaments of the character of steel shavings or steel wool discloses such filaments as having finely barbed edges, the sizes and shapes of the barbs being variegated in accordance with the depth of paring employed to produce such filaments. Such filaments are also usually of helical character, the pitch being determined by the depth and width of the paring employed in their production.

Whereas in the case of a smooth filament, a globule of liquid has a tendency to travel therealong as a unit or if intersected by such a filament in transverse relation, the globule has a tendency to reform upon leaving the filament, this is not the case with filaments of the character of steel shavings or steel wool. The latter, owing to the barbs thereon actually break up or shred the liquid globule so that upon the encountering of such a filament by a liquid globule either lon-

gitudinally or transversely thereof, the barbs cut up or shred the globule whereupon it leaves the filament in the form of very minutely divided particles. By the positioning of the metallic filaments in an intake manifold or conduit so that a relatively large number of filaments must be engaged by the hydrocarbon fluid globules, the complete vaporization of the globules and mixing thereof with air being introduced into the manifold or conduit simultaneously with the introduction of the fluid hydrocarbon, is assured to a degree of maximum efficiency.

Another feature of importance in connection with the employment of metallic filaments of the character described, is in the arrangement of the filaments in a promiscuously intertwined loose mass wherein the apertures and interstitial spaces permitting the passage of air therethrough extend promiscuously through the mass. Thus the initial hydrocarbon fluid and intermixed air in passing through the mass impel the globules picked up thereby from the walls of the manifold or conduit through the mass whereby a relatively large number of filaments are encountered thereby assuring of complete breaking up, cutting up, and shredding of the globules. That is to say, inasmuch as there are no direct paths through the mass there is no possibility of one or more globules of entering the mass as such and emerging in globular form. The promiscuity of the interstitial spaces also produces a considerable volleying of the gaseous particles thereby insuring of complete vaporization and admixture of the carburated fluid.

A further feature of importance in this invention resides in the fact that by the provision of a loose mass of filaments of the character described, particularly in the case of internal combustion engines, the mass is adapted to vibrate under the pulsations of the engine so that the filaments have individual movement relative to one another. Such movement coupled with the large number of filaments employed prevents the passage through the mass of globules which might otherwise obtain uninterrupted passage, this entirely eliminates the emergence of globules other than in finely and minutely shredded condition.

In carrying out the invention in accordance with the above outlined principles, I have provided various forms of intake manifolds or conduits of novel construction and arrangement of parts particularly applicable to internal combustion engines.

Still another feature of my present invention resides in a novel means for providing a continuous and rapid movement of the gaseous fuel mixture through the mixing device. In an automobile engine, the velocity of movement of the gas through the intake manifold and associated conduits, varies greatly from time to time depending upon the speed of the engine and the load under which it is operating. Naturally, the shredding of liquid or gaseous globules in passing through the mass of intertwined filaments increases with the velocity of the gas in passing through the same.

I have therefore provided, in one form of my invention, an endless circulating conduit containing my improved mixing device, and through which conduit I continuously recirculate the gaseous fuel so as to pass it through the mixer at a high velocity, and to thereby obtain a thorough mixing of the fuel at all speeds and conditions of operation of the engine.

Other and further objects and advantages will appear from the following detailed description of the several preferred embodiments of my invention disclosed in the accompanying drawings, in which:

Figure 1 is an elevation of an intake manifold for an internal combustion engine, a portion of the manifold being broken away to illustrate the position of the removable gaseous fuel vaporizer and mixer, the manifold; an elevation of an intake manifold for internal combustion engines, a portion of the manifold being broken away to illustrate the position of the removable gaseous fuel vaporizer and mixer shown in Figure 1 and, including an impeller for introducing the gaseous fluid charge into the manifold under pressure;

Figure 2 illustrates a modified form of intake manifold with parts in section and embodying my invention, the manifold being of the recirculating pressure type employing an impeller;

Figure 3 illustrates a further modified form of intake manifold embodying my invention and designed to introduce gaseous fluid charge to the body portion of such manifold when the engine with which it is employed is operating and further disclosing a novel control means for such form of manifold;

Figure 4 is an enlarged view of a portion of the control mechanism employed with the modified form of manifold disclosed in Figure 3;

Figure 5 is a further modified form of intake manifold appliance embodying the principles of my invention, this form being of the recirculating pressure vaporizer and mixer type having a novel automatic control valve embodied therein;

Figure 6 illustrates another modified form of intake manifold appliance embodying the principles of my invention, the appliance being in the nature of an attachment adaptable to intake manifolds of present construction and having an impeller for introducing a charge under pressure to the combustion chambers of an engine when it is operating and having a novel control valve for permitting the introduction of a charge upon starting of the engine;

Figure 7 is an enlarged detail view illustrating the control valve mechanism shown in Figure 6;

Figure 8 is a plan view of a fragmentary portion of an engine block with an intake manifold of novel construction illustrated more or less diagrammatically, and embodying the principles of my invention as applied to the block and having a novel control valve construction and common operating means therefor for each of the outlet ports of such manifold, illustrating such portions of the manifold in section; and

Figure 9 is a side elevation of a fragmentary portion of an engine block showing a manifold of the character disclosed in Figure 8 applied to the block and illustrating parts of the manifold in section.

As hereinbefore stated, the main feature of this invention is the introduction of the novel gaseous fluid vaporizer and mixer comprising metallic filaments preferably of the form of steel shavings or steel wool, interposed in the intake manifold or other suitable conduit designed to conduct gaseous fluid to a combustion chamber, with a view to completely break up or shred globules of hydrocarbon fluid previously formed and which may collect or accumulate in such conduit and which would otherwise be introduced into the combustion chamber in such form as to result in imperfect combustion.

In Figures 1 and 2, I have illustrated one application of the instant invention. In this case I have provided an intake manifold having a substantially cylindrical body portion 110 open at both ends and being provided with a centrally disposed inlet port 111 and six outlet ports 112, the manifold being adapted to be employed with a six cylinder engine. It will be, of course, understood that the number of outlet ports may vary with the number of conduits required by the particular engine to which the device is to be applied. The vaporizer and mixer, generally indicated at 113, in this case comprises a cylindrical reticulated coarse mesh screen container 114 filled with a promiscuously intertwined loose mass of metallic filaments 115 either in the nature of steel shavings, preferably of the character of steel wool. Container 114 is provided at its ends with planar coarse mesh screen portions, which are suitably secured to the cylindrical body portion thereof. The ends of the body 90 of the manifold are provided with removable end closures 116 adapted to snugly fit against the inner periphery of the body portion 110. Preferably, the end closures 116 are provided with suitable means to frictionally retain them in position at the ends of the body portion 110. A suitable gasket may be interposed between the closure and the end of the body portion to insure of a tight fit so as to prevent leakage of gaseous fluid at the ends of the body portion 110. At the entrance of the inlet port 111, the usual butterfly valve 117 is provided.

When the engine is in operation so that carbureted hydrocarbon fluid and air are being drawn up into the intake manifold, the condensed globules of the fluid tending to collect in the inlet port 91 are drawn upwardly toward the vaporizer and mixer 93 at a relatively high speed by the suction draft. In order that the globules of the hydrocarbon fluid may not reach the combustion chambers or cylinders in globular form, they must pass through the vaporizer and mixer 93, and since this member comprises a plurality of promiscuously intertwined metallic filaments in a loose mass it will be at once apparent that each globule passing through the member will collide with a plurality of the filaments.

Due to the irregularity of these filaments and their nonsymmetrical arrangement, the impacts or collisions take place in a promiscuous manner. In other words, no globule of hydrocarbon fluid can possibly pass through the vaporizer and mixer 93 in a direct or through path since the apertures and interstitial spaces extending through the loose mass of filaments do so in a promiscuous manner.

In many internal combustion engines of present day construction, the intake manifold is positioned in such a manner that one end thereof is usually in proximity to some one or other accessory positioned on the dash board of the vehicle or the respective end of the manifold may be positioned in proximity to the dash board itself so that the end of the manifold adjacent such dash board is generally inaccessible for the insertion of a device of the character of the vaporizer and mixer 113. For this reason the removable end closures 116 have been provided. Then again some manifolds are mounted upon the right hand side of the engine while others are mounted on the left hand side thereof. By providing removable closures for both ends of the manifold body 110, it will be at once apparent that the manifold may be mounted either on the right or the left hand side of the engine without impairing accessibility to the body portion.

While the vaporizer and mixer 113, and this is the case in all modifications disclosed, is primarily intended for obtaining vaporization and mixing of the gaseous hydrocarbon fluid, it will of course be evident that the body of filamentous metal will also act as a filter. Such foreign particles as may find their way into the filamentous mass must be removed when such an accumulation is excessive. Thus by making the vaporizers and mixers employed in each instance removable, accumulated foreign matter may be blown out by the application of air pressure thereto or the vaporizer and mixer in each instance may be readily replaced by a new one of similar character.

Intake manifolds of the construction disclosed in Figure 1 quite readily permit the introduction of the full charge of hydrocarbon fluid and air into those cylinders or combustion chambers which are located adjacent or in proximity to the inlet port thereof. Those cylinders or combustion chambers positioned remotely from the inlet port of the manifold do not receive the full benefit of the charge. For this reason I have provided a suitable impeller or pump 118 driven in any suitable manner from a moving part of the engine to accelerate the speed with which the charge enters the intake manifold body portion 110, thereby considerably improving the amount of charge which is taken in by those cylinders or combustion chambers which are positioned remotely from the inlet port.

In Figure 2, I have provided a modified form of intake manifold embodying the vaporizer and mixer of the present invention and being adapted to efficiently distribute an intimate mixture of hydrocarbon fluid and air to the combustion chambers or cylinders with equal efficacy whereby the maximum charge is introduced into each of the combustion chambers or cylinders so that each cylinder or combustion chamber receives the full benefit of the charge. In this case, the intake manifold body portion 120 comprises a continuous endless conduit 121 having a suitable impeller 122 driven from the water pump shaft or other movable part of the engine, interposed therein. The upper portion of the body 120 is provided with the usual outlet ports 123 while the lower portion is provided with the usual inlet port 124 having a butterfly control valve 125 therein. The inlet port 124 has connection with the lower portion of the body 120 centrally thereof so that gaseous hydrocarbon fluid may be delivered to the outlet ports 123 either through the left hand branch of the body portion 120 or through the right hand branch. The impeller 122 may be interposed in either branch and for purposes of the instant disclosure I have chosen the left hand branch. The vaporizer and mixer in this case comprises a flexible reticulated coarse mesh screen container 126 having a promiscuously intertwined loose mass of metallic filaments 127 disposed therein. Inasmuch as the container 126 is flexible, and the body portion 120 is made up of sections, it will be apparent that the vaporizer and mixer may be very readily inserted into the upper portion of the body 120 and into the lower portion thereof with facility at the joints 128 prior to the assembly of the manifold.

In operation, upon starting of the engine in the usual manner, that is by energizing an electric motor which has operative connection with

the fly wheel associated with the crank shaft of the engine, gaseous hydrocarbon fluid will be drawn to the outlet ports of those cylinders or combustion chambers whose pistons are on their suction strokes through the right hand branch of the continuous or endless conduit 121. As soon as the engine begins to run, the impeller 122 is operated causing the gaseous fluid to take a path through the left hand branch of the continuous or endless conduit 121. The impeller 122 is driven at a rate of speed which will tend to impel fluid to the upper portion of the conduit 121 at a speed considerably greater than that required in the normal operation of the engine. Thus when the engine is running, a continuous circulation is set up in the continuous or endless conduit 121, gaseous fluid being drawn off at the outlet ports 123 as required and a similar amount to that drawn off being taken into the continuous circulation at the inlet 124. Due to the presence of gaseous hydrocarbon fluid in the continuous conduit 121 and the rapid recirculation of this fluid in the conduit, it will be evident that each cylinder or combustion chamber as it requires its charge will receive the full benefit of such charge at the required period.

In addition, due to the continuous rapid circulation of the gaseous hydrocarbon fluid in the endless conduit 121 through the metallic filaments 127 disposed therein, such charges as are drawn into the cylinders or combustion chambers will be highly and efficiently vaporized and thoroughly mixed with air prior to their introduction into the cylinders or combustion chambers.

Under certain conditions, more or less abnormal, such as excessive high speed or the like for example, the rate of utilization or demand through the outlet ports 123 may exceed the rate of discharge of the impeller 122. In such a case recirculation will cease and the gas will be delivered to the outlets 123 through two parallel paths or branches, both communicating with the inlet and outlet and with each other, the branch including the impeller 122 defining a supercharger path and the other branch 121 defining a suction path, both supplying gas to the outlets 123.

Referring now to Figure 3, I have illustrated a further modified form of intake manifold construction. This structure comprises the usual body portion 130 provided with outlet ports 131 and a centrally disposed inlet port 132. The vaporizer and mixer in accordance with the salient principles of this invention, is embodied in a second body portion 133 (which I have shown considerably enlarged relative to the body portion 130). Body portion 133 comprises a substantially circular continuous or endless conduit comprising an upper portion 134 and a lower portion 135. The lower end of inlet port 132 which may be connected to the upper portion 134 in any suitable manner, constitutes the outlet port of the upper portion 134 and is disposed centrally of said upper portion. The lower portion 135 has interposed therein a suitable impeller 136 and is provided with a suitable inlet port 137 disposed eccentrically with respect to the lower portion 135.

The vaporizer and mixer in this instance comprises a flexible cylindrical reticulated coarse mesh screen container 138 filled with a loose mass of promiscuously intertwined metallic filaments 139 disposed in the upper portion 134 and extending substantially the entire length of this upper portion so that a portion of the screen container 138 extends across the opening of the lower end of inlet port 132. A butterfly control valve 140 is positioned in the inlet port 132 adjacent its lower end upon a transversely extending shaft 141, one end of which extends outwardly beyond the outer periphery of the inlet port or conduit 132 and has secured thereto at one end thereof a lever 142, the other end of lever 142 being provided with a longitudinally extending slot 143.

In order to facilitate the description of this modification, I shall refer to that portion of the endless or continuous conduit disposed to the left of inlet port 137, the left hand branch, and that portion disposed to the right of inlet port 137 and extending up to the inlet port 132, the right hand branch.

A butterfly retarding valve 144 is mounted for rotative movement upon a pin 145 adjacent the lower end of the upper portion 134 in the right hand branch, and one end of the pin 145 extends outwardly beyond the outer periphery of the conduit.

Referring now more particularly to Figure 4, I have illustrated a novel control mechanism for the retarding valve 144. A substantially U-shaped lever 146 has the legs thereof secured at their ends to the outwardly extending end of pin 145. A plunger 147 comprising a cylindrical rod 148 extending upwardly through the intermediate portion of the lever 146 is provided at its upper end with a carrier 149 positioned for sliding movement between the leg portions of lever 146 and has a lug 149 projecting therefrom into a slot 150 provided in one leg of lever 146 and extending longitudinally thereof. An abutment plate 151 is disposed intermediate the legs of the lever 146 and is suitably secured thereto adjacent the upper end thereof in proximity to the pin 145. A coil spring 152 is positioned between the abutment plate 151 and the upper side of the plunger portion and is adapted to normally exert a downward pressure upon the plunger portion thereby normally urging the rod 148 outwardly of the lower end of the lever 146. The lower end of lever 146 is provided with a fork 153, the intermediate portion of which is integrally associated with the end of the rod 148, fork 153 carrying a roller 154 having end peripheral flanges such as 155, upon a transversely extending axle 156.

Roller 154 has engagement with a U-shaped cam lever 157 having slightly inwardly extending end portions 158, lever 157 being pivoted upon a pin 159 extending therethrough centrally thereof, and is provided with an outwardly extending arm 160 extending from the pivot portion thereof. Arm 160 is provided at its free end with a transverse recess 161 through which one end of a coil spring 162 extends, this coil spring being adapted to have its other end suitably anchored to a pin 163 suitably secured to the outer periphery of the continuous body portion 133. Another pin 164 is likewise suitably secured to the outer periphery of the body portion 133 and has a stop to limit the upward rotation of the arm 160. The extreme end of arm 160 is provided with a laterally extending pin 165 which is adapted to have sliding movement in a longitudinally extending slot 166 at the lower end of a control rod 167 extending back to the interior of the body associated with the chassis frame upon which the engine is mounted for accessibility and controlled

by either the hand or foot of an operator of the vehicle. Rod 167 has a rigid upwardly extending arm 168 positioned adjacent the lever 142, and the free end of arm 168 is provided with a suitable pin 169 extending into the slot 143 of lever 142.

Impeller 136 is operatively associated with the water pump shaft or other driven part of the engine.

Due to the fact that the left hand branch of the body portion 133 is normally closed due to the stationary condition of the impeller 136 prior to the starting of the engine, the charge required by the engine is permitted to pass up through the right hand branch of the body portion 133. Thus at this time the retarding valve 144 is maintained in open condition for purposes of free passage of the carbureted hydrocarbon gaseous fluid through the right hand branch. When however the engine has once begun to run and the impeller is being actuated, the charge will be transmitted through the left hand branch of the continuous body portion 133 due to the influence of the impeller. The function of the impeller 136 being to impart a full charge to each of the cylinders or combustion chambers, it is then desirable to cut off the right hand branch in order that the entire charge be transmitted directly to the body portion 130. Thus at the normal idling position of the control valve 140, the retarding valve 144 and its associated parts are in the full line position as illustrated in Figures 12 and 13. When it is desired to accelerate the engine, rod 167 is moved downwardly thereby opening the control valve 140 and when rod 167 has moved to the extent that the upper end of slot 166 is in engagement with the pin 165, further downward movement of the rod 167 will swing the cam lever 157 about its pivot. Cam lever 157 is so constructed that the roller due to the pressure of spring 152 upon the plunger portion of the rod 148 will always tend to seek a position in abutment with the end portion 158 after the roller has passed the central point of the cam lever. Thus as the arm 160 is swung downwardly by the rod 167 against the tension of spring 162, roller 167, owing to the inclination of the cam lever 157 will ride in a direction toward the upper end portion 158 of the cam lever 157 and as soon as it has passed the central point of the cam lever 157, the spring 152 will exert sufficient pressure to automatically continue the swinging movement of the lever 146 in the upward direction, thus rotating the retarding valve 144 to the dotted line position illustrated in Figure 4.

When rod 167 is permitted to move upwardly, control valve 140 will return to the idling position and as soon as the lower end of the slot 166 abuts the pin 165 on arm 160, the lever 157 will be rotated about its pivot clockwise as viewed in Figure 13 causing the roller 154 to ride downwardly therealong and to automatically abut the lower end 158 of cam lever 157 after it has passed the center of the lever 157. Thus upon opening of the control valve 140 slightly beyond idling position, retarding valve 144 will be automatically closed cutting off the right hand branch of the body portion 133 and permitting the impeller to assume the transmission and impulsion of carbureted hydrocarbon fluid to the combustion chambers at speeds above idling speed, and when the control valve 140 is returned to idling position, retarding valve 144 will be automatically returned to open position whereby the charge will be conducted through the right hand branch of the body portion 133 to the cylinders or combustion chambers.

Owing to the position of the screen container 138 and its associated filaments 139 in the upper portion 134, it will be at once apparent that the vaporizer and mixer will function to efficiently vaporize and mix the air and gaseous hydrocarbon fluid being conducted through either the right or left hand branches of the body portion 133. It will be further evident, that this modified form of intake manifold construction is particularly desirable where it is desired that the engine have prompt or quick pickup which is accomplished by imparting additional momentum to the hydrocarbon particles and air or the mixture prior to their introduction into the combustion chamber or cylinder so that the charges will be introduced into the cylinders or combustion chambers under pressure. Thus during that period of running of the engine when full charges to the combustion chambers or cylinders are most desirable, each cylinder will receive the full benefit of the charge under pressure. During the idling period, when only a small charge is required, each cylinder will only receive a minimum charge since the impeller will be ineffective at this time and the charge will therefore be the result merely of the suction of the pistons of the cylinders.

It may be desirable to employ an intake manifold construction which provides for automatic control of a recirculating vaporizer and mixer and for such a device, reference may be had to Figure 5. As in the case of the modification disclosed in Figures 3 and 4, the distributing conduit body portion employed is of the character designated at 130 in Figure 3. In this case the body portion 170 comprises an upper portion 171 similar in character to portion 134 of the previous modification and having at its uppermost part an outlet port 172 containing a butterfly control valve 173. Disposed within this upper portion 171 is a flexible reticulated coarse mesh screen container 174 filled with a loose mass of promiscuously intertwined metallic filaments 175, the screen container 174 having a portion thereof extending across the opening of the outlet port 172. The lower portion of the body portion 170 comprises two sections 176 and 177, section 176 being provided with a suitable impeller 178 while section 177 is provided with a check valve or retarding valve 179 and an inlet port or conduit 180. Sections 171, 176 and 177 are suitably connected together and form a substantially cylindrical continuous or endless conduit of circular cross section and circular configuration.

Section 177 is provided with a partition 181 extending transversely thereacross at a point adjacent the connection between the upper end of section 177 and the upper portion 171. Partition 181 is provided with a valve seat 182 and is tapered at this seat to snugly seat a valve head 183 of the retarding valve 179. Valve head 183 is supported for reciprocating movement upon a rod or stem 184 which is in turn supported in suitable bracket 185.

A coil spring 186 has its upper end in abutment with a collar 187 in proximity to the head 182 and surrounds the stem 184, having its lower end seated upon the upper face of the lower bracket 185. This spring 186 is adapted to constantly normally urge the valve head 183 into position upon its seat 182.

Impeller 178 in this case is preferably independently driven at a speed which will cause it

to impart additional momentum to the gaseous hydrocarbon fluid charge normally demanded by the combustion chambers or cylinders at the various speeds of the engine.

In operation, with the control or throttle valve 173 in idling position, the impeller 178 is set in motion prior to starting of the engine. At this time those cylinders or combustion chambers whose pistons are on their downward or suction strokes will be filled with charges of gaseous hydrocarbon fluid under pressure and upon filling of those cylinders, a pressure is set up in the left hand branch of the body portion 170 and in the upper portion of the right hand branch above the retarding valve 179.

When sufficient pressure has been built up in the aforementioned portions of the body portion 170 to overcome the upward pressure of the coil spring 186, retarding valve 179 will be automatically opened, and continuous circulation set up in the endless body portion 170. When the control or throttle valve 173 is further opened upon starting of the engine, it will be apparent that the demand for sufficient charges to the combustion chambers or cylinders at this time will be greater than normal and the pressure in the aforementioned portions of the body portion 170 will be considerably relieved permitting automatic closing of the retarding valve 179. During this interval, the gaseous hydrocarbon fluid will be impelled to the combustion chambers or cylinders by the impeller 178 under pressure. When the engine is running and consuming only normal operating charges, pressure will be again built up in the left hand branch of the conduit 170 and the upper portion of the right hand branch sufficiently to again open the retarding valve 179 and set up continuous circulation of the gaseous hydrocarbon fluid in the body portion 170. During the running of the engine, when an excessive demand is imposed upon the circulating gaseous hydrocarbon fluid such as is required for quick pickup, the retarding valve 179 will again automatically close and the excessive demand accommodated by the action of the impeller 178 by the impulsion thereof of gaseous hydrocarbon fluid under pressure. Thus the modified form of intake manifold of the instant construction will normally operate as a recirculating pressure vaporizer and mixer and under excessive demand by the combustion chambers or cylinders of the engine will automatically operate to induce charges to the combustion chambers or cylinders under pressure.

In Figures 6 and 7 I have disclosed another modified form of intake manifold construction embodying the principles of the instant invention in the nature of an attachment for manifolds of present construction together with a novel control means for the retarding valve. In this case, the vaporizer and mixer comprises a unit 190 interposed between the usual intake manifold 191 and the usual carburetor 192. Unit 190 comprises an inlet port 193 and an outlet port 194 having a continuous or endless body portion 195 disposed therebetween. The body portion 195 has interposed therein two vaporizers and mixers 196 and 197 of arcuate shape, vaporizer and mixer 196 being disposed in the upper portion of the body portion 195 and extending across the outlet port 194 while vaporizer and mixer 197 is disposed in the lower portion of the body portion 195 and extends across the inlet port 193. As in the case of the preceding modifications where the body portion comprises a substantially circular continuous member, vaporizers and mixers 196 and 197 comprise flexible reticulated coarse mesh screen containers 198 and 199, respectively, each being filled with promiscuously intertwined metallic filaments 200 and 201 respectively. Vaporizers and mixers 196 and 197 are each of sufficient lengths to occupy approximately one-fourth each of the body portion 195. As viewed in Figure 6, the body portion 195 between the left hand ends of the vaporizers and mixers 196 and 197, is provided with an impeller 202 which for purposes of simplifying the disclosure is herein merely diagrammatically illustrated, the impeller 202 being of the rotary blower type. Impeller 202 is, of course, so positioned as to impel the gaseous hydrocarbon fluid mixture from the carburetor 192 to the manifold 191. The impeller in this case is operated by any suitable connection to the water pump shaft, fan shaft, or other suitable moving parts. The impeller 202 may also be driven by other means, such as an air jet turbine, electric motor or any other suitable or available means, as desired.

In the right hand branch of the body portion 195 between the right hand ends of the vaporizers and mixers 196 and 197, there is disposed a novel side hinged retarding valve 203. This valve comprises a plate portion 204 suitably hinged to the outer right hand side of the body portion 195 by means of a pin 205, and has a portion thereof extending into the conduit of the body portion 196 on one side of the pivot pin 205 and another portion extending outwardly of the body portion 195 on the other side of the pivot pin 205. A guide plate 206 suitably secured to the outer periphery of the body portion 195 extends radially outwardly and circumferentially of the body portion in proximity to the normal sweep of the outer end of the plate portion 204. This guide plate 206 is provided at its ends and upon its outer arcuate edge with radially outwardly projecting lugs 207 and adjacent its upper end has a notch 208. The outer end of the retarding valve plate 204 carries thereon a double acting sliding roller 209 carried by a slidable carriage 210 suitably slidably connnected to the outer end of the retarding valve portion 204 as by means of a pin and slot connection 211, roller 209 being adapted to ride along the outer arcuate edge of the guide plate 206. The carriage 210 is normally spring projected toward the pivot pin 205 by means of a spring 212 whereby the roller 209 is constantly urged into engagement with the outer edge of the guide plate 206. Adjacent the extreme outer end of the retarding valve portion 204, a control rod 213 has one end thereof extending through a recess 214 in the portion 204 and is provided at its extreme end with a suitable stop member 215. A second stop member 216 is also suitably supported upon the rod 213 in spaced relation to the stop member 215, these stop members being disposed on either side of the outer end of the retarding valve portion 204 and permitting lost motion between the rod 213 and the said end portion 204 of the retarding valve. The inner end of the plate portion 204 of the retarding valve is adapted in closed position to abut a suitable stop seat 217 provided on the inner periphery of the right hand branch of the conduit of the body portion 195.

A coil spring 218 is suitably anchored to the outer periphery of the body portion 195 at one end thereof and has its other end suitably connected with the outer end of the retarding valve

portion 204 to normally urge the retarding valve to close position.

Control rod 213 extends upwardly and rearwardly into the body portion of the vehicle preferably through the instrument board thereof for manual operation by the operator of the vehicle.

Assuming that the engine is at a standstill prior to starting, the control rod 213 is pulled by the operator of the vehicle in the direction of the arrow in Figure 15. The lower stop member 215 upon engaging the outer end of the retarding valve portion 204, will move the valve to the full line position illustrated in Figures 15 and 16 against the tension of the coil spring 218. When the roller 209 reaches the lower edge of the notch 208, its spring 212 will cause it to drop into the notch 208 and thereby retain the retarding valve in said open position. The control rod 213 may then be moved in a direction opposite to that indicated by the arrow until the operator feels that the upper stop member 216 is in abutment with the outer end of the retarding valve portion 204. The engine may then be started in the usual manner that is by the energization of the usual starting motor. Since the left hand branch of the body portion 195 is substantially closed off by the inactivity of the impeller 202 during the starting period, the hydrocarbon gaseous fluid mixture may freely pass through the vaporizer and mixer 197, the right hand branch of the body portion 195, the vaporizer and mixer 196, and up into the manifold 191. As soon as the engine has begun running, the impeller 202 will operate at a speed sufficient to cause the gaseous hydrocarbon fluid mixture to be conducted through the left hand branch of the body portion 195, and at this time the control rod 213 may be further pushed by the operator in a direction opposite to that indicated by the arrow in Figure 6 thereby unseating the roller 209 from the notch 208 and permitting the coil spring 218 to swing the retarding valve to closed position in abutment with the stop seat 217 at which time roller 209 will rest upon the curved convex edge of the guide plate 206.

Additional vaporizers and mixers 55 may be provided in the outlet ports of the manifold 191 to provide additional atomizing of the gaseous fluid and to insure of vaporization and mixing to a maximum degree of efficiency.

Thus during the starting period, the retarding valve 203 of the instant modified form of unit 190 permits of free passage of the fuel mixture into the intake manifold 191 while during the running of the engine, the impeller 202 goes into action and impels the gaseous fluid to each of the cylinders or combustion chambers in such a manner as to give each of the cylinders or combustion chambers the full benefit of the charge at all times.

Referring now more particularly to Figures 8 and 9, I have disclosed therein a further modified form of intake manifold embodying the principles of the instant invention, in which parts thereof have been illustrated more or less diagrammatically. In the modified form of intake manifold construction disclosed in the instant figures, the manifold comprises a body portion 250 constituting a continuous or endless conduit the upper portion of which is provided with outlet ports 251 suitably secured to the usual block or head 252 of an internal combustion engine. The lower portion of the continuous body 250 is provided with a centrally disposed inlet port 253 suitably connected with the outlet port 254 of the usual carbureter. The left hand branch of the body portion 250 contains an impeller 255 of the rotary blower type which for purposes of simplification has been only diagrammatically illustrated. The right hand branch of the body portion 250 is provided with a butterfly valve 256.

This modified form of manifold is also provided with one or more vaporizers or mixers in accordance with the instant invention, the vaporizers and mixers comprising reticulated coarse mesh screen containers 257 filled with promiscuously intertwined loose masses of metallic filaments 258 either in the nature of steel shavings or steel wool.

The intake manifold of the instant illustration may be caused to function in one of two ways at the selection of the user. It may be employed as a recirculation pressure vaporizer and mixer or as a pressure vaporizer and mixer. In the former case, the valve 256 is maintained in closed position during the starting period and the impeller energized independently of any moving part of the engine prior to the starting to initially impel a charge or charges to those cylinders or combustion chambers whose pistons are on their downward or intake strokes.

When the engine has once started, the valve 256 is immediately opened and the mixture of air and gaseous hydrocarbon fluid in the body portion 250 continuously recirculated and drawn off through the outlet ports 251 to the cylinders or combustion chambers as required. In the second case, where the impeller 255 is operatively associated with some moving part on the engine, the valve 256 is maintained in open position to permit of the passage of initial charges to the cylinders or combustion chambers of the engine during the usual starting period. As soon as the engine begins to run, the valve 256 may be suitably closed either manually or automatically, and the impeller 255 then takes up the burden of supplying a sufficient mixture of air and gaseous hydrocarbon fluid to the cylinders or combustion chambers under pressure.

Due to the fact that in the event that this modified form of intake manifold is employed merely as a pressure vaporizer and mixer, certain of the cylinders would be remotely disposed with reference to the inlet port 253 and in the event that the manifold of the instant construction would be employed as a recirculating pressure vaporizer and mixer, the positioning of a throttle or control valve in the inlet port 253 would be rather remote for effectively controlling the gaseous fluid intake to the cylinders or combustion chambers for accelerating and decelerating the speed of the engine, I have provided a novel throttle or control valve means. Generally speaking, this comprises the positioning of the speed control element in proximity to the cylinders or combustion chambers.

In carrying out this novel control mechanism, I have provided a butterfly control or throttle valve 259 in each of the outlet ports 251, preferably for rotary movement about vertical axes or shaft 260. A series of upwardly extending bell crank levers 261 either suitably secured to the upper ends of the axes or shafts 260 or constituting continuations of the upper ends of the axes or shafts 260 formed integrally therewith, have upper ends suitably connected together for movement in unison by means of a connecting rod 262. Rod 262 extends to the inner side of the vehicle body for accessibility and control by the operator of the vehicle and may have two

branches, one extending to the instrument channel board for control by the hand of an operator, and the other extending to the toe board for operation by the foot of the operator, the two branches being suitably arranged for independent manipulation in any desired well known manner.

By placing the throttle or control valves 259 in the outlet ports 251, they are capable of prompt and effective control of the flow of gaseous hydrocarbon fluid to the cylinders or combustion chambers at points where they will most effectively promptly operate to suddenly increase or decrease the flow of the gaseous hydrocarbon fluid thereby causing the engine to be promptly responsive to the desires of an operator of a vehicle as occasion demands.

As has been hereinbefore stated in the brief descriptions of the various embodiments of my invention, I have found that the usual intake manifolds now generally employed, where they are separate from the exhaust manifolds, may be readily inverted by placing the inlet port or conduit thereof in a direction pointing upwardly instead of downwardly as is now the custom. By moving the usual carburetor to a position above the body of the intake manifold and interposing between the outlet port of the carburetor and the inlet port of the manifold, a direction change conduit, it is possible to convert the usual manifold now generally employed from an up-draft manifold to one of the downdraft type. It is to be understood, therefore, that all of the above described structures are equally as applicable to down draft carburetion systems as to the more conventional systems. However, as has been hereinbefore pointed out, a mere inversion of such manifolds, while certain advantages accrue therefrom, will not eliminate the formation of large globules of hydrocarbon fluid due to condensation of the fluid along the walls of the conduits. By embodying the salient feature of the present invention in such an intake manifold, however, complete vaporization and mixing of the gaseous hydrocarbon fluid in and with the air stream may be advantageously accomplished.

Referring now generally to all the modifications disclosed, since each and all of them employ vaporizers and mixers in accordance with the main feature of the instant invention, an oil feed dropping mechanism may be employed with the intake manifolds disclosed, particularly with those of the recirculating pressure type, for lubricating valve stems and the upper portions of the combustion chambers or cylinders.

It is to be further noted that the metallic filaments may be made from rust proof metal and where filaments of this character are employed, water may be introduced into the intake manifold and thoroughly worked or vaporized by the air and hydrocarbon gaseous fluid stream, particularly with internal combustion engines, so as to gain slow, long drawn-out explosions in the cylinders or combustion chambers. The advantages of the introduction of water vapor into an admixture of hydrocarbon gaseous fluid and air for combustion purposes in internal combustion engines is well known and will therefore not be herein discussed.

While I have illustrated various embodiments of my invention, the main feature of the invention is the introduction of a novel agent for attaining complete and positive breaking up, cutting up, or shredding of hydrocarbon gaseous fluid globules which tend to form and accumulate in intake manifolds adapted to conduct hydrocarbon gaseous fluid mixtures to combustion chambers. This novel feature comprises the interposition in various portions of the conduits of manifolds in the path of flow of the gaseous fluid of metallic filaments in the nature of parings of steel. It is to be noted that such parings may comprise various grades from coarse steel shavings to fine steel wool. The parings need not be of fixed or definite proportions and size throughout but may be of irregular contour or cross section and various grades of parings may be combined in any form in any of the embodiments illustrated.

It is also to be observed that the presence of the filamentary material acts as a filter in catching and retaining road dirt and the like, thus preventing cylinder scouring, valve pitting and other road dirt annoyances, and also serves to dampen the propagation of noises originating in the valves. Further, the presence of the filamentary material aids in securing easy starting, the material acting somewhat as a wick or absorbing medium in that a certain amount of fluid is always present by virtue of capillary attraction exerted by the filaments. The screen or cartridge containing the material is removable and can be replaced when dirty or clogged.

The filamentous metal may be of nickel steel of such strength so as not to crumble due to excessive fluid draft therethrough and in the case where they are employed in intake manifolds of internal combustion engines, they should be of sufficient strength to withstand vibration and consequent physical impacts relative to one another due to the vibrations and pulsations of the engine.

While I have disclosed variously shaped containers for retaining the filamentous metal in the path of fluid draft, it will be understood that the shapes of these containers may be widely varied without departing from the essence of the invention. Instead of being spherical or cylindrical in form, the containers may be of frusto-conical formation or of any irregular contour or configuration so as to readily accommodate themselves to the configurations of the places where they are adapted to be seated.

Due to the promiscuous intertwining of the metallic filaments in a loose mass providing passages or interstitial spaces extending promiscuously therethrough, it will be apparent that a fluid stream traveling therethrough is thrown helter skelter therefrom. This volleying of the fluid stream in a conduit results in a clean sweeping of the walls of the conduit thereby preventing accumulations of hydrocarbon fluid thereon. Then too, by providing metallic filaments in a loose mass, no material obstruction or back pressure result to the fluid stream.

A further feature of importance is the simplicity of construction and the cheapness of manufacture of the various embodiments of the invention.

The advantages and results of the employment of metallic filaments of the character of steel shavings or steel wool for shredding the globules of gaseous hydrocarbon fluid thereby thoroughly vaporizing and mixing the carbureted fluid, may be briefly summarized as follows:

Economy of fuel consumption due to perfect combustion;

Perfect combustion and consequent carbonization reduction;

Easier and faster cold weather starting of internal combustion engines;

Prevention of back-fire from reaching carbureter; and

Permits of use of cruder fuel.

While I have disclosed various modifications or embodiments of my invention, I do not wish to be limited thereto. As will be understood by those skilled in the art, certain changes other than those above outlined may be made therein without departing from the essence of the invention or the spirit and scope of the appended claims.

What I claim and desire to secure by Letters Patent is:

1. In combination, an intake manifold comprising a body portion having a series of outlet conduits extending therefrom, a gaseous fluid vaporizer and mixer for liquid fuel comprising an elongated promiscuously intertwined loose mass of metallic filaments and an elongated flexible reticulated container therefor disposed in and adapted to conform to the shape of said body portion and in operative association with each of said outlet conduits, an inlet conduit associated with said body portion, and an impeller associated with said inlet conduit for maintaining a uniform distribution of vaporized fluid to said outlet conduits.

2. An intake manifold comprising an endless conduit, an inlet conduit, an outlet conduit, a fluid mixer in said endless conduit, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, and a retarding mechanism for controlling the flow of fluid through said endless conduit and operative to maintain a substantially constant pressure in the portions of said endless conduit in which said fluid mixer is disposed.

3. An intake manifold comprising an endless conduit, an inlet conduit, an outlet conduit, a fluid mixer in said endless conduit, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, and a retarding mechanism for controlling the flow of fluid through said endless conduit, said retarding mechanism comprising valve means operative to vary the amount of circulation according to the pressure in said outlet conduit.

4. A recirculating pressure gaseous vaporizer and mixer for liquid fuel comprising an intake manifold comprising an endless conduit, an inlet conduit, an outlet conduit, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, and biased valve means operative to provide for circulation of fluid in the inlet conduit only when the pressure therein exceeds a given value.

5. A recirculating pressure gaseous vaporizer and mixer for liquid fuel comprising an intake manifold comprising an endless conduit, an inlet conduit, an outlet conduit, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, an elongated mass of promiscuously intertwined loose mass of metallic filaments disposed in said endless conduit, one end of said elongated mass of metallic filaments being disposed adjacent the impeller, and valve means disposed adjacent the other end of said mass of filaments and operative to govern the circulation of fluid in said endless conduit.

6. A recirculating pressure gaseous vaporizer and mixer for liquid fuel comprising an endless conduit, an inlet conduit, outlet conduit means, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, means for varying the fluid demand on said outlet conduit means, and means associated therewith for controlling the circulation in said endless conduit.

7. A recirculating pressure gaseous vaporizer and mixer for liquid fuel comprising an endless conduit, an inlet conduit and an outlet conduit, both connected with said endless conduit, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, a promiscuously intertwined loose mass of metallic filaments disposed adjacent said outlet conduit, a throttle valve in said outlet conduit adjacent said mass of metallic filaments and operative to determine the demand on said endless conduit, and valve means for controlling the circulation in said endless conduit.

8. A recirculating pressure gaseous vaporizer and mixer for liquid fuel comprising an intake manifold including an inlet connection, an outlet connection, a curved branched circuit including two connected arcuate branches communicating with the inlet and outlet connections, means in each of said branches for striating a fluid stream, said means comprising a curved cartridge having a portion disposed in each of said arcuate branches, and an impeller in one of said branches disposed adjacent one end of one of said cartridge portions and arranged to direct gas toward said outlet connection through the portion of said striating means in said one branch, said other branch affording direct communication between said inlet and outlet whereby gas may flow through both of said branches toward the outlet connection when the demand at the outlet exceeds the discharge of said impeller, the impeller acting to circulate the surplus gas through said branches when the discharge from said impeller exceeds the demand at the outlet.

9. In combination with an internal combustion engine having inlet valves and a manifold to said inlet valves, of combustible mixture producing means including a carburetor, and two connecting conduits between the mixture producing means and the manifold, each of said connecting conduits having means therein for striating a fluid stream, and one of said connecting conduits having fluid propelling means therein.

10. In combination with an internal combustion engine having inlet valves and a manifold communicating therewith, of combustible mixture producing means including a carburetor and two connecting conduits between the mixture producing means and the manifold, said conduit having therein means for striating a fluid stream, and one of said connecting conduits having fluid propelling means therein and the other of said connecting conduits having a flow restriction therein in communication with the discharge from said propelling means.

11. In combination with an internal combustion engine having inlet valves and a manifold communicating therewith, of combustible mixture producing means including a carburetor and two connecting conduits between the mixture producing means and the manifold, means in both of said connecting conduits for striating a fluid stream, said means comprising a filamentary cartridge having portions disposed in both of said

connecting conduits, and fluid propelling means in one of said connecting conduits, the other of said connecting conduits having a flow restriction therein in communication with the discharge from said propelling means.

12. An intake manifold comprising an endless conduit, an outlet conduit, an inlet conduit, a fluid mixer in said endless conduit, a shiftable control valve between the inlet end of said inlet conduit and the outlet end of said outlet conduit for controlling the amount of fluid withdrawn through the latter from the inlet conduit, an impeller associated with said endless conduit for normally maintaining gaseous fluid in rapid circulation in said endless conduit, and separate valve means disposed in said endless conduit and serving to govern the pressure developed therein by said impeller.

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