

May 6, 1958

E. J. MARTIN
FLUID MIXING MEANS

2,833,530

Filed June 1, 1955

3 Sheets-Sheet 1

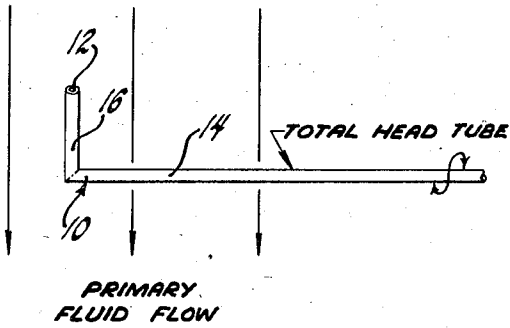


Fig. 1

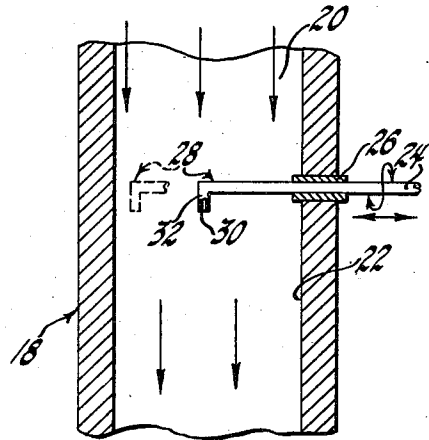


Fig. 2

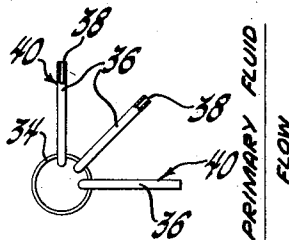


Fig. 3

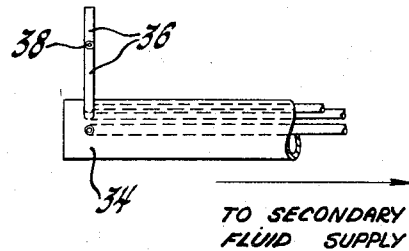


Fig. 4

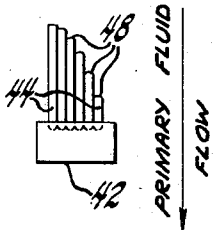


Fig. 5

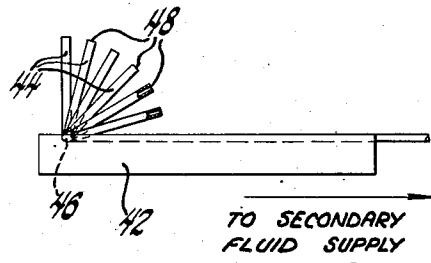


Fig. 6

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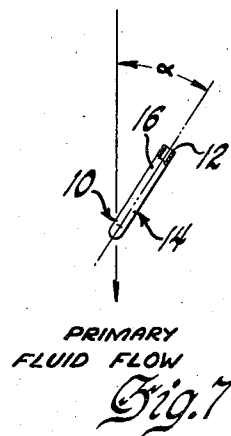
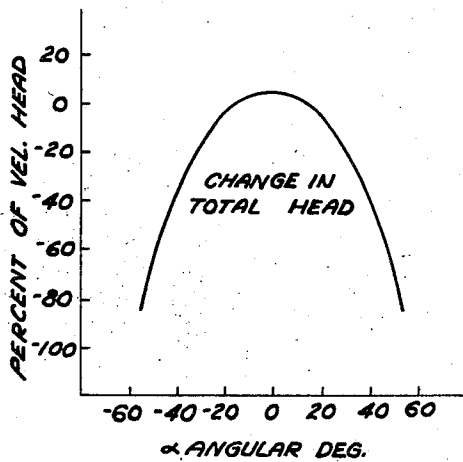
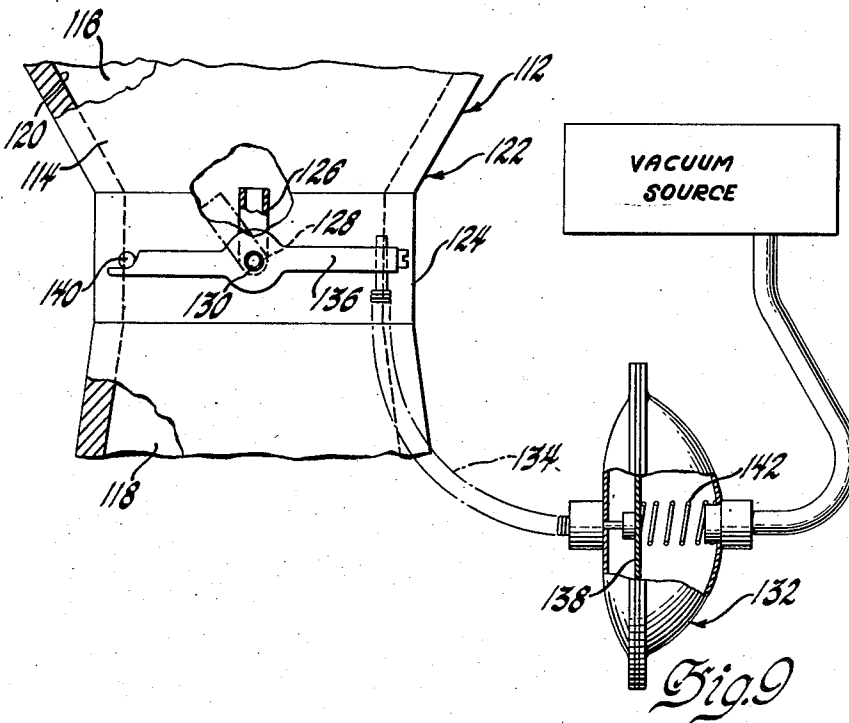
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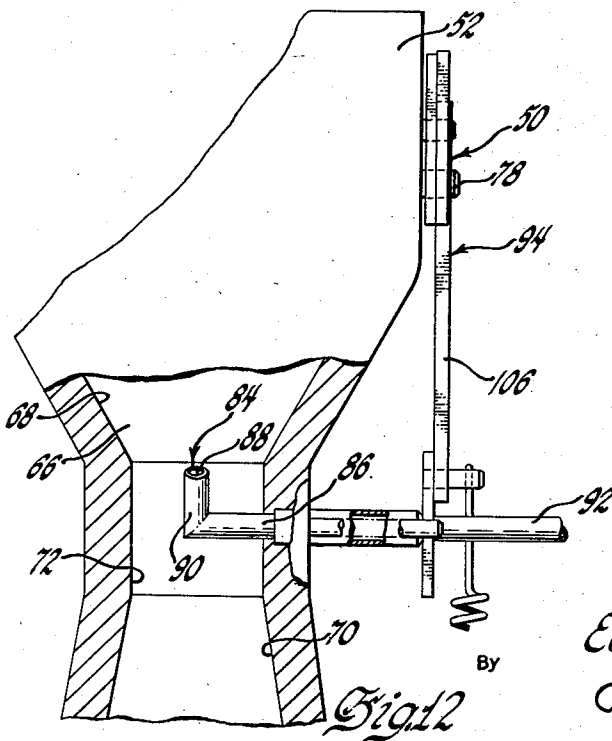
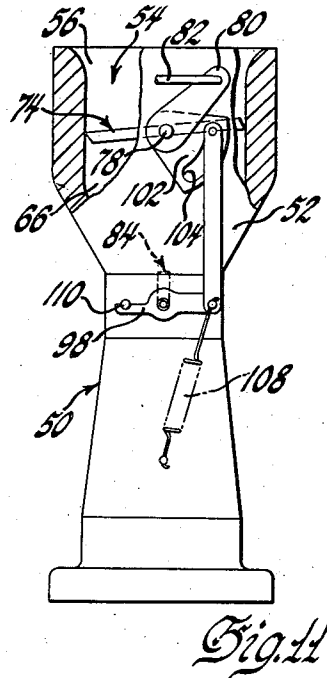
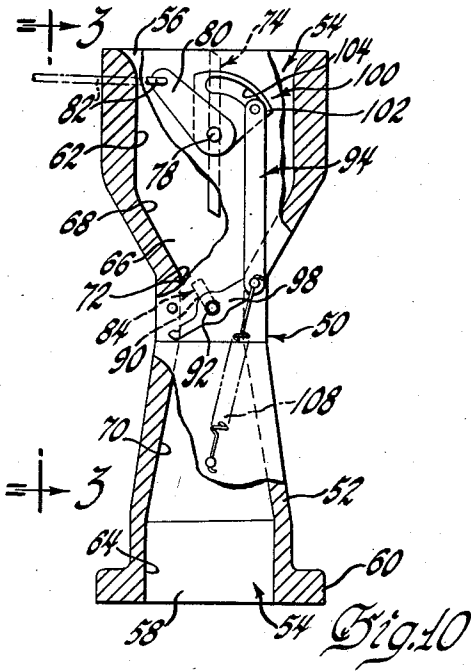
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Filed June 1, 1955

3 Sheets-Sheet 3



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FLUID MIXING MEANS

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Application June 1, 1955, Serial No. 512,444

4 Claims. (Cl. 261—65)

The present invention relates to means for continuously mixing one fluid with another and more particularly to means for aspirating a liquid into a gaseous medium.

It is often desirable to mix a fluid such as a gas or liquid with another fluid by means of a continuing process. One means of doing this is to place a jet in a stream of primary fluid so that the secondary fluid may be discharged from the jet and mixed with the primary fluid as it flows past the jet. With such an operation, it is very difficult, if not impossible, to obtain the exact proportions desired between the fluids. This is especially true where there is a considerable variation in the volume of fluids handled and where it is desired to vary the proportions. Heretofore, it has been the practice to mount the jet in the stream of primary fluid in some fixed relation thereto and to vary the amount of secondary fluid discharged from the jet by varying the pressure or head in the secondary fluid and/or in the primary fluid and also the size of the jet. Although this has proved very effective in some installations it is very difficult, if not impossible, to readily make the above enumerated adjustments and to maintain all of the variable factors within the prescribed tolerances.

It is now proposed to provide means for mixing one fluid with another fluid and means for readily and accurately adjusting the proportions between the various fluids. This is to be accomplished by placing a jet in a stream of the primary fluid so that the jet may be readily moved within this stream. As the primary fluid flows past the jet, the movement of the fluid will create a pressure in the fluid in the immediate vicinity of the jet which may be termed a velocity head. It is a well known fact that the velocity of a fluid is a maximum in the center of the stream and a minimum adjacent the edges thereof. If the jet can be moved toward and away from the edge of the stream of primary fluid, the velocity head at the jet resulting from the primary flow may be readily varied thus affording an easy means for controlling the rate of discharge of the secondary fluid. It is also a well accepted fact that when an obstruction such as a tube is placed in a fluid flow, the pressure on the upstream side of the obstruction will be considerably larger than on the downstream side of the obstruction. Thus if the angular disposition of the jet with respect to the stream of fuel can be controlled, the velocity head at the jet may be varied over a wide range. This will also allow an easy means of controlling the rate of discharge of the secondary fuel. It should be noted that the size and shape of the jet and also the pressures in the various fluids may remain constant while the proportions of the resultant mixture are varied. Since the pressures, etc., do not have to be varied, they may be more accurately controlled. Thus it will not only be possible to provide an easily controlled mixture but also an accurately controlled one.

The combustible mixture for an internal combustion engine of the spark ignited type is normally formed by a carburetor wherein the air flows past one or more

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fuel jets so that the liquid fuel will be aspirated into the air. In order to obtain certain operating characteristics of the engine, it is desirable to vary the amount of fuel aspirated into the air so as to provide a combustible charge of the desired richness. Heretofore, this has been accomplished by means of numerous special purpose jets and choke valves that operate in conjunction with the main fuel jet. This results in a very complicated set of control means, etc., to insure the desired operating characteristics.

It is now proposed to provide a carburetor having a jet which will supply the fuel in any desired quantity for any desired air-fuel ratio. This jet may be mounted so as to be readily movable with respect to the air flow so as to vary the velocity head present at the fuel jet. In addition, means may be provided for automatically varying the position of the jet in response to some engine operating characteristics such as the throttle setting or intake manifold vacuum.

In the three sheets of drawings:

Figure 1 is a side view of a nozzle for a fluid mixing device embodying the present invention.

Figure 2 is a cross sectional view of a fluid mixing device embodying a different form of the present invention.

Figure 3 is an end view of a nozzle embodying another form of the invention.

Figure 4 is a side view of the nozzle in Figure 3.

Figure 5 is an end view of another nozzle embodying another form of the present invention.

Figure 6 is a side view of the nozzle shown in Figure 5.

Figure 7 is an end view of the nozzle illustrated in Figure 1.

Figure 8 is a graph showing the operating characteristics of a nozzle such as shown in Figures 1 and 7.

Figure 9 is a fragmentary side elevational view of a carburetor embodying one form of the invention.

Figure 10 is a side view of a carburetor embodying the present invention and having portions thereof broken away.

Figure 11 is a side view of the carburetor in Figure 10 but showing the carburetor in a different operating condition.

Figure 12 is a fragmentary front elevational view on an enlarged scale of a portion of the carburetor in Figure 10 with portions thereof being broken away.

Referring to the drawings in more detail, the present invention may be employed wherever it is desired to mix one or more fluids with another fluid. This may be accomplished by employing one or more jets that are disposed in a flow of primary fluid so that it will flow past the jet. Thus as the primary fluid flows past the jet and the secondary fluid is discharged from the jet, the two fluids will be mixed with each other. It is a well known fact that as a fluid flows past an object, the fluid will build up a maximum pressure on the leading side of the object and at the same time, a minimum pressure will be built up on the trailing side thereof. The magnitude of the increase and decrease of the fluid pressure will vary with the velocity of the flow, and the pressure around the exterior of the object will be somewhere between the maximum and minimum pressures depending upon the point at which the pressure is taken. Thus if a tube extends across the stream of fluid so that an orifice in the tube will be disposed in the flow, the pressure present at the orifice will be a function of the location of the orifice on the tube with respect to the direction of flow. Since the magnitude of the pressure will affect the quantity of fluid discharged from the orifice, the rate at which the fluid is discharged may be varied by varying the angular disposition of the orifice with respect to the fluid flow.

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In order to take advantage of this effect, the secondary fluid nozzle shown in Figures 1 and 7 may be employed. This nozzle may be a jet 10 that comprises an orifice 12 in a tube 14 disposed in the primary fluid and extending transversely thereof. In the present instance the orifice 12 is formed in the end of an arm 16 disposed at right angles to the main body of the tube 14. Thus if the inlet to the tube 14 is connected to a source of secondary fluid, the secondary fluid may flow through the tube 14 and out of the orifice 12 and into the primary fluid where the two will mix with each other. The velocity head or the pressure in the primary fluid adjacent the orifice 12 will be a function of the angle at which the arm 16 is disposed with respect to the direction of flow of the primary fluid. As previously pointed out, the velocity head will be a maximum when the arm 16 extends toward the direction of the primary flow and a minimum when the arm 16 extends with the primary fluid flow. If the angle between the arm 16 and the primary fluid flow is represented by alpha, the variations in the velocity head may be seen by reference to Figure 8. As may be seen from the graph, when alpha is zero, the velocity head is a maximum and as alpha increases, the velocity head decreases. Since the velocity head or primary fluid pressure at the orifice 12 will affect the rate of discharge of the secondary fluid, it will thus be seen that the ratio between the volume of primary fluid and the volume of secondary fluid may be readily controlled by the simple expedient of rotating the tube 14.

As an alternative the fluid mixing device in Figure 2 may be employed. In this device the primary fluid flows through a housing 18 having a passage 20 therethrough. This passage 20 may be defined by a wall 22 having any desired shape such as a cylindrical one. A tube 24 may be mounted in a bushing 26 in the wall 22 of the passage so that the outlet end of the tube 24 will form a jet 28 disposed in the flow of primary fluid. The outlet end of the tube 24 may have an orifice 30 therein through which the secondary fluid may be discharged. In the present instance this orifice 30 is in the end of an arm 32 projecting from the tube 24 parallel to primary flow. It is therefore apparent that as the primary fluid flows past the jet 28, a velocity head will be formed which will tend to aspirate the fuel from the tube 24 and form a mixture of the primary and secondary fluids.

It is well known that the velocity of the primary fluid will be a maximum in the center of the passage 20 while it will be substantially zero at the wall 22 of the passage 20, and that in between these points the velocity of the primary fluid will be some place between these two values. Accordingly, if the tube 24 slides axially through the bushing 26, the jet 28 will move toward or away from a wall 22 of the passage 20 and the velocity head at the jet 28 will vary. As a consequence, the volume of secondary fuel discharged from the tube 24 will vary even though the quantity of primary fluid flow through the passage 20 remains constant. If desired, the tube 24 may be rotated similar to that in the first embodiment. Thus it may be seen that the proportion of the primary and secondary fluids in the resulting mixture may be readily varied.

Another embodiment of the present invention is shown in Figures 3 and 4. This embodiment may be used where it is desired to mix several secondary fluids with a primary fluid or where it is desired to mix only one secondary fluid with the primary fluid. As seen in Figures 3 and 4, a supporting sleeve 34 extends into the flow of primary fluid so as to be substantially normal to the direction thereof. A plurality of arms 36 extend radially from this sleeve 34 at any desired location. The outer ends of these arms may have an orifice 38 therein to form jets 40 for discharging fluid into the primary fluid. Each of these arms 36 may be an elbow on the end of a separate secondary tube 38 inside of the sleeve 34. In this embodiment the various secondary elbows are all disposed

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in a plane substantially normal to the axis of the sleeve 34. Each of these tubes 38 may be connected to a separate source of secondary fluid so that several secondary fluids will be aspirated from the jets 40 and mixed with the primary fluid. On the other hand all of the secondary tubes 38 may be connected to a single source of secondary fluid so that just one secondary fluid will be mixed with the primary fluid. By rotating the secondary jets 40 or moving them towards or away from a wall of the passage, the quantities of secondary fluid mixed into the primary fluid will be varied. It is, of course, to be understood that the angular disposition of the various arms 36 may be adjusted so that the proper proportions of each secondary fluid will be provided.

Figures 5 and 6 illustrate another embodiment of the present invention which is similar to that shown in Figures 3 and 4 for dispersing one or more secondary fluids into a primary fluid. In this embodiment a supporting sleeve 42 projects into the stream of primary fluid flow substantially normal to the direction thereof. A plurality of secondary fluid tubes 44 are disposed inside of the sleeve 42 with one end thereof being connected to one or more sources of secondary fluids. The opposite ends of the secondary tubes 44 have elbows 46 which project from the sleeve 42 so as to extend into the fluid flow. The outer end of each of these elbows 46 may have an orifice 48 so that the secondary fluid in the source to which the tubes 44 are connected, will be aspirated into the primary fluid. Instead of being disposed in a plane, these elbows are spirally disposed about the sleeve so that the angular disposition thereof will allow proper mixing of the fluids. The sleeve 42 may be moved in the primary flow so that the velocity head at the orifices 48 will be varied to give the desired proportion of fluids in the resultant mixture.

Another embodiment of the present invention is shown in Figures 10, 11 and 12. In this embodiment the invention is incorporated into a carburetor 50 suitable for use on an internal combustion engine. This carburetor 50 includes a housing 52 having a passage 54 extending vertically therethrough. The upper end of the passage 54 forms an intake 56 that may draw air directly from the atmosphere or be connected to an air cleaner so as to draw filtered air therethrough. The other end of the passage 54 may form an opening 58 in flange 60 on the lower end of the housing 52. This mounting flange 60 may be suitable for attaching the carburetor to the intake manifold of the engine so that the opening 58 will communicate with the distribution passages in the manifold. Thus the air may flow from the atmosphere or air cleaner through the inlet 56, the passage 54 and the opening 58 into the intake manifold where it will be distributed to the various cylinders of the engine. Although the passage 54 may be disposed in any position, in the present instance it is vertical so the air will flow downwardly therethrough.

The inlet and outlet portions 62 and 64 of the passage 54 may be substantially cylindrical with the outlet end 64 being of slightly smaller diameter than the inlet. These two end portions 62 and 64 may be interconnected with each other by means of a venturi 66. The upstream end of the venturi 66 may comprise an inwardly convergent conical portion 68 while the outlet end comprises an outwardly divergent conical portion 70. The two conical portions 68 and 70 are in turn interconnected with each other by means of a throat 72 having a reduced diameter of any desired shape such as a cylinder. Thus as the air flows through the passage 54, a zone of high velocity-low pressure will be created in the throat 72.

A throttle valve 74 may be provided for controlling the speed of the engine by throttling the volume of air flowing through this passage 54 and into the engine. In the present instance the throttle valve 74 is located in the intake portion 62 of the passage 54 and is of the so-called butterfly type wherein a disc is mounted on a shaft 78

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that extends transversely of the passage 54. The position of this valve 74 may be controlled by rotating a lever 80 mounted on the outer end of the shaft 78. If a control linkage 82 is attached to the lever 80, the throttle valve 74 may be opened by pulling the linkage 82 to the left and closed by pushing it to the right, as seen in Figure 10.

In order to mix fuel with the air in the passage 54 and thereby form a combustible charge, a fuel jet 84, for aspirating fuel into the air, may be disposed in the low pressure zone located in the throat 72 of the venturi 66. In the present instance this jet 84 is formed by a tube 86 that extends through a wall of the housing 52 so that an orifice 88 in the tube 86 will be disposed in the venturi throat 72. The orifice 88 may be formed in the tube 86 at any desired point. However, in the present instance it is in the end of an arm 90 disposed at right angles to the rest of the tube 86. Thus if the tube 86 is connected to a fuel line 92, the fuel may flow from a source of fuel through the fuel line 92 and tube 86 to the orifice 88. As the air flows through the passage 54, a zone of reduced pressure will be formed in the throat 72 of the venturi 66 which will cause fuel to be discharged through the orifice 88 and aspirate into air in the passage 54. Since the pressure drop in the throat 72 is a function of the air flow therethrough for any given position of the orifice 88, the amount of fuel drawn therefrom will vary with the quantity of air passing through the venturi 66 and thereby result in a substantially constant ratio between the quantity of fuel and the quantity of air. In order for this condition to prevail, the head of the fuel in the tube 86 should remain as nearly constant as possible.

Since an engine is normally operating at part throttle a large majority of time, it is preferable that the fuel jet 84 be set to give an air-fuel ratio providing maximum economy. Thus the engine will be operating mostly on an economical charge. However, it should be noted that there are some engine operating conditions where it may be desirable to employ a considerably richer mixture than is required for most economical operation. For example, in order to obtain maximum performance or power from the engine, a very rich mixture is desirable. Accordingly, the jet 84 may be arranged to give the maximum economy by the proper relationship between the air pressure at the orifice, the size of the orifice 88, and the fuel pressure at the orifice. In order to provide a richer mixture, the fuel tube 86 may be moved so as to vary the velocity head present at the orifice 88. Although the jet 84 may be moved axially and/or angularly, in the present embodiment it is shown as being rotatably mounted. As may be seen from Figure 8, the velocity head will be a maximum when alpha is zero and the velocity head will fall off rapidly as the angle alpha increases thereby resulting in a much richer mixture. Since maximum power is normally only desired when the throttle is fully open, the position of the tube 86 may be controlled by a linkage system 94 which is interconnected with the throttle valve 74 so that the tube 86 will be automatically moved to the maximum power position whenever the throttle valve 74 is fully open. In the present instance this linkage 94 includes an arm 98 on the tube 86 that is adapted to be rotated by the shaft 78 and move the fuel jet 84 a corresponding amount and a lost motion mechanism 100 to allow part throttle movement of the throttle valve 74 without effecting the fuel jet's 84 position. This lost motion mechanism 100 includes a plate 102 on the throttle shaft 78 that has an arcuate slot 104 therein and a link 106 connected to the arm 98 and the plate 102 by means of a pin in the slot 104. Thus a limited amount of motion of the plate 102 may occur without effecting the position of the jet 84. However, as the throttle valve 74 moves to its fully opened position, the end of the slot 104 will engage the pin and any further movement of the throttle valve 74 towards its fully opened position

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will result in a corresponding movement of the link 106. As a consequence, movement of the throttle valve 74 at or near the fully opened position will also cause rotation of the fuel jet 84. Accordingly, the orifice 88 will be positioned so as to provide the maximum power air-fuel ratio when the throttle valve 74 is fully open. A spring 108 may be connected to the arm 98 so as to bias the arm 98 against a stop 110 and thereby retain the jet 84 in maximum economy position unless effected by the linkage 94.

Another embodiment of the present invention is illustrated in Figure 9. In this embodiment a carburetor 112 substantially the same as in the first embodiment is employed. That is to say, the carburetor 112 includes a housing 114 having an inlet 116 and an outlet 118 which are interconnected by means of a passage 120 having a venturi 122 with a throat 124 of reduced diameter. The fuel jet 126 may be formed by the open end of an elbow 128 on the end of a tube 130 connected to a source of fuel so that fuel may be discharged into the passage 120. The opposite end of the tube 130 may be connected to the source of fuel. When the engine is called upon to deliver maximum power, the throttle valve 74 will be open and the intake vacuum will be small. Thus a pressure device 132 responsive to the intake manifold vacuum may be interconnected to the fuel jet 126 by a Bowden wire 134 attached to an arm 136 on the tube 130. The pressure device 132 may include a piston or diaphragm 138 having one side exposed to atmospheric pressure and the other side to the intake vacuum. Thus when the throttle valve is fully closed, the manifold vacuum will be high causing the diaphragm 138 and Bowden wire 134 to twist the arm 136 against the stop 140 thus insuring the jet 126 being maintained in the most economical position. However, as the throttle valve is opened the manifold vacuum will drop. As the throttle valve approaches the fully opened position, the vacuum will drop until such time as the spring 142 will overcome the effects thereof. At this point the spring 142 will cause the Bowden wire 134 to rotate the arm 136 and the tube 130. This will, in turn, rotate the fuel jet 126 so that when the throttle valve is fully opened, the fuel jet 126 will have been rotated sufficiently to cause the maximum power air-fuel ratio to be provided.

It is to be understood that, although the invention has been described with specific reference to particular embodiments thereof, it is not to be so limited since changes and alterations therein may be made which are within the full intended scope of this invention as defined by the appended claims.

What is claimed is:

1. A carburetor comprising a housing having a passage extending therethrough, a throttle valve mounted on a shaft extending transversely of said passage for controlling the volume of air flow therethrough, a fuel jet mounted on said housing and including a portion rotatably disposed in said passage, said portion including an orifice for discharging said fuel into said air, lost motion means interconnecting said throttle valve and said fuel jet for causing said valve and said portion to rotate together, said means including a plate on said shaft having an arcuate slot and a link having a pin riding in said slot.

2. A carburetor comprising a housing having a passage extending therethrough, a throttle valve mounted on a shaft extending transversely of said passage for controlling the volume of air flow therethrough, fuel jet means mounted on said housing and including a portion rotatably disposed in said passage, said portion including an orifice for discharging fuel into said passage, lost motion means interconnecting said throttle valve and said fuel jet means, and spring means cooperating with the lost motion means for normally biasing said fuel jet means portion to a maximum fuel economy position, said lost motion means being adapted to rotate said jet means portion to a maxi-

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mum fuel flow position as the throttle approaches wide open position.

3. A carburetor comprising a housing having a passage extending therethrough, a throttle valve mounted on a shaft extending transversely of said passage for controlling the volume of air flow therethrough, fuel jet means mounted on said housing and including a portion rotatably disposed in said passage, said portion including an orifice for discharging fuel into said passage, lost motion means interconnecting said throttle valve and said fuel jet means, positive stop means, and spring means normally biasing said fuel jet means into engagement with the stop means to position the jet means portion for maximum fuel economy, said lost motion means being adapted to rotate said jet means against the force of said spring to increase fuel flow as the throttle approaches wide open position.

4. A carburetor comprising a housing having a passage extending therethrough, a throttle valve mounted on a shaft extending transversely of said passage for controlling the volume of air flow therethrough, fuel jet means mounted on said housing and including a portion rotatably disposed in said passage, said portion including an orifice for discharging fuel into said passage, lost motion means interconnecting said throttle valve and

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said fuel jet means, an arm, said fuel jet means extending exteriorly of said housing and being fixed to said arm intermediate the ends thereof, positive stop means disposed on said housing, and spring means connected to one end of said arm and normally biasing the other end of said arm into engagement with the stop means to provide maximum economy fuel flow through said jet means, said lost motion means including an arm articulated to said one end of the arm and adapted to rotate said arm against the force of said spring to move said jet means to increase the flow of fuel therethrough as the throttle approaches wide open position.

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