June 29, 1954 J. C. RICHARDSON 2,682,392

CARBURETOR

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Fig. 1

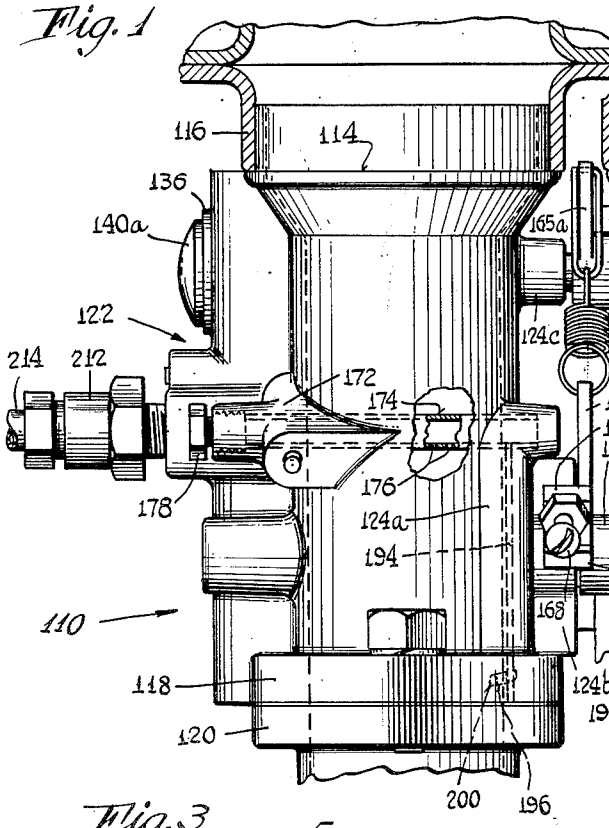


Fig. 2

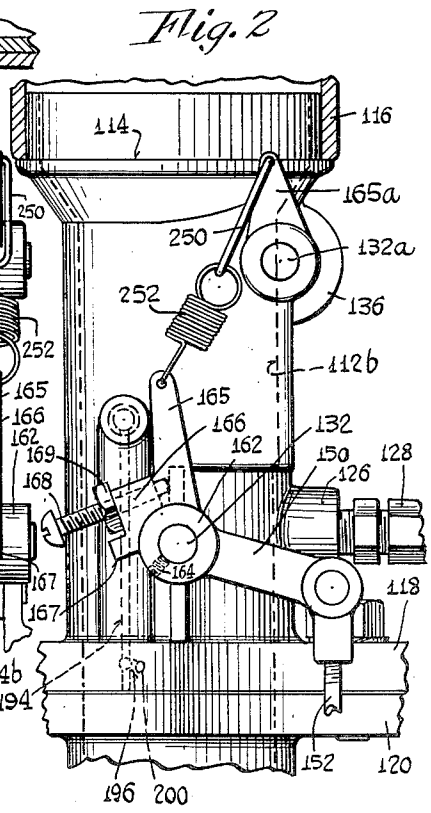


Fig. 3

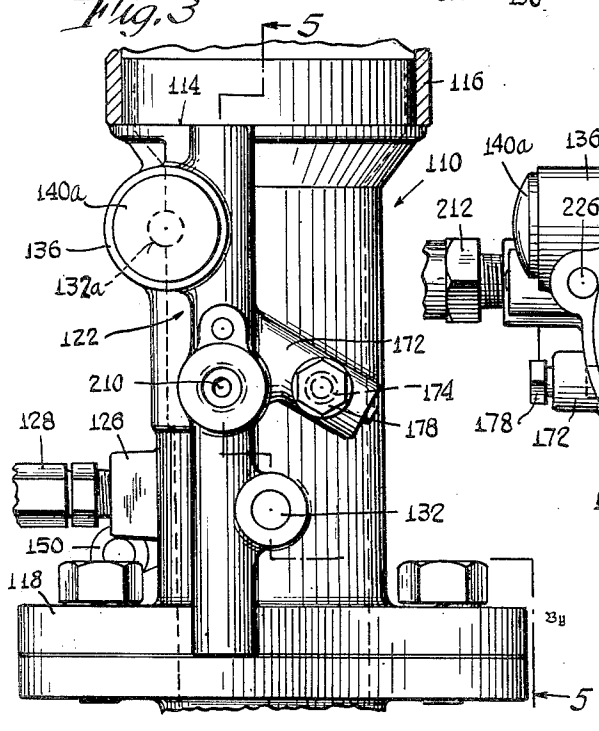
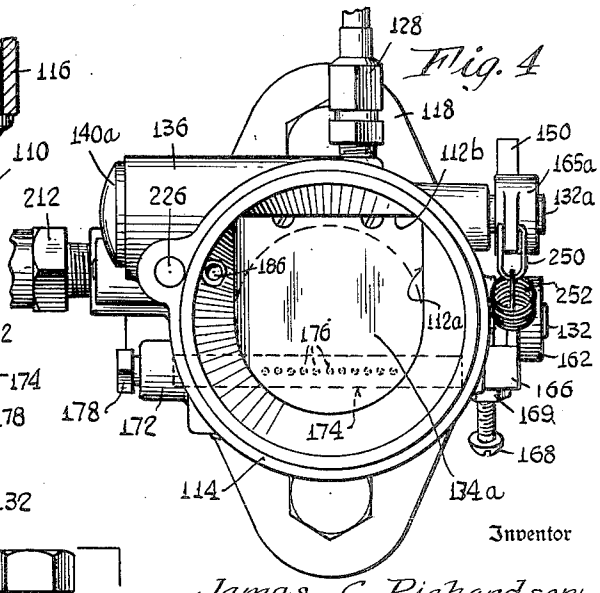


Fig. 4



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CARBURETOR

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Fig. 5

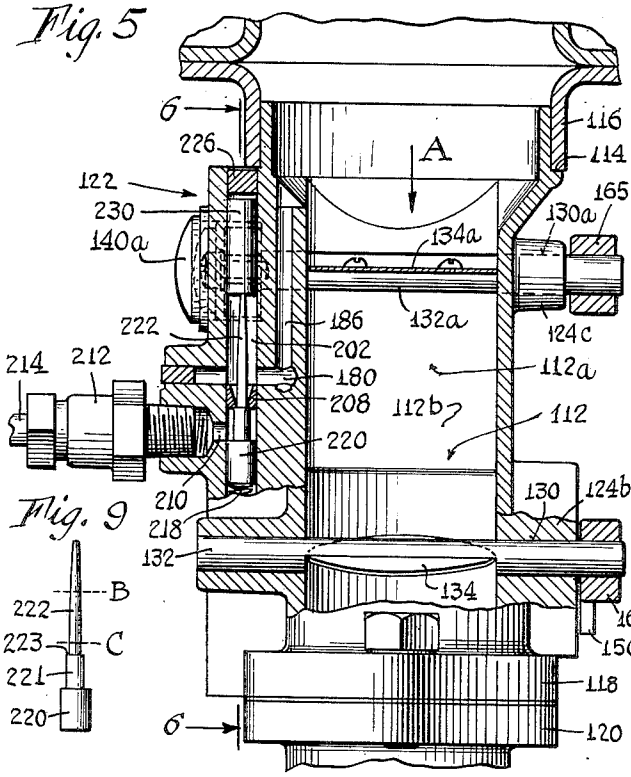


Fig. 6

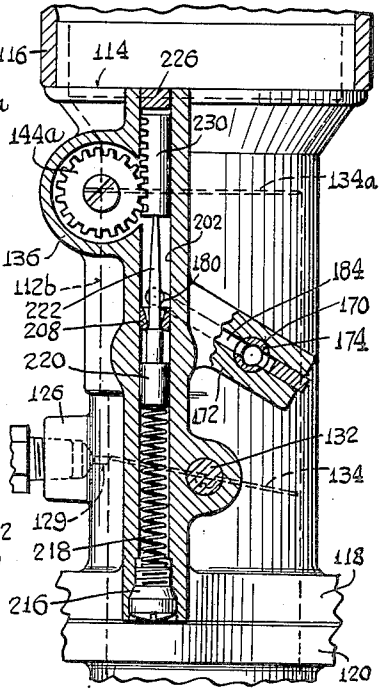


Fig. 9

Fig. 13

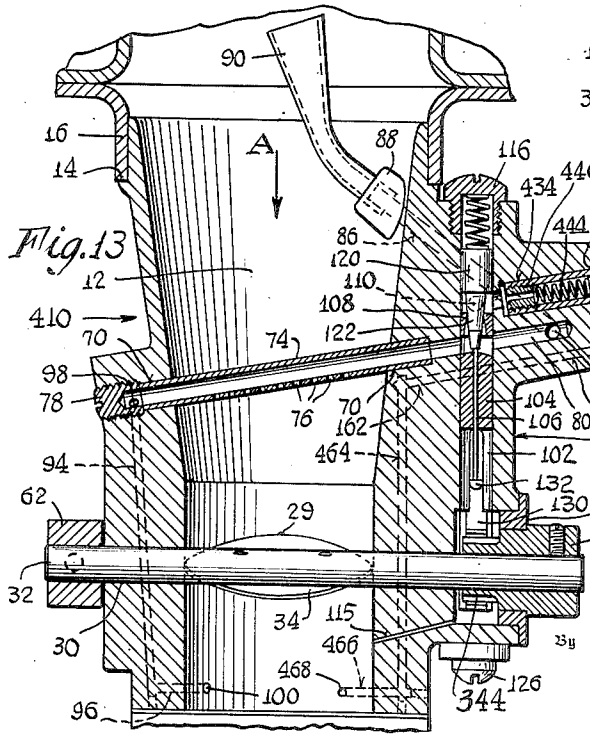


Fig. 7

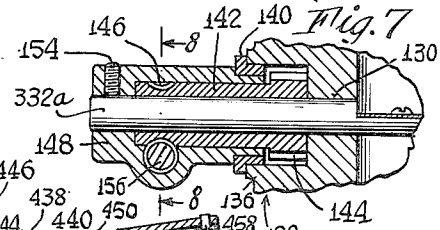
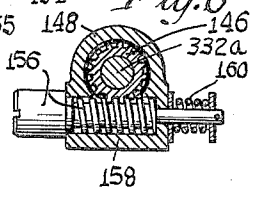


Fig. 8



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CARBURETOR

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Fig. 10

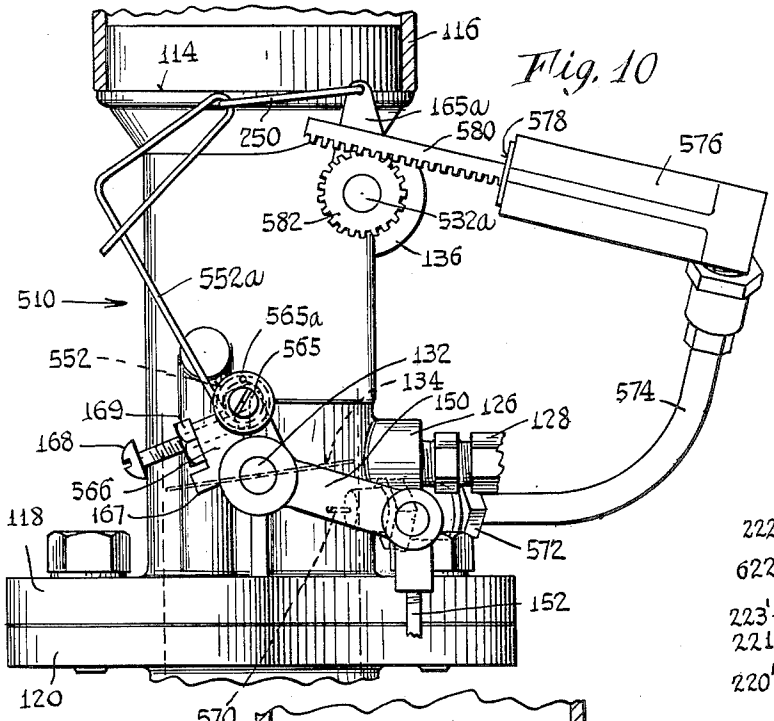


Fig. 12

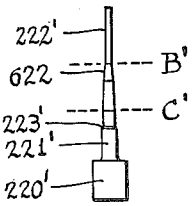
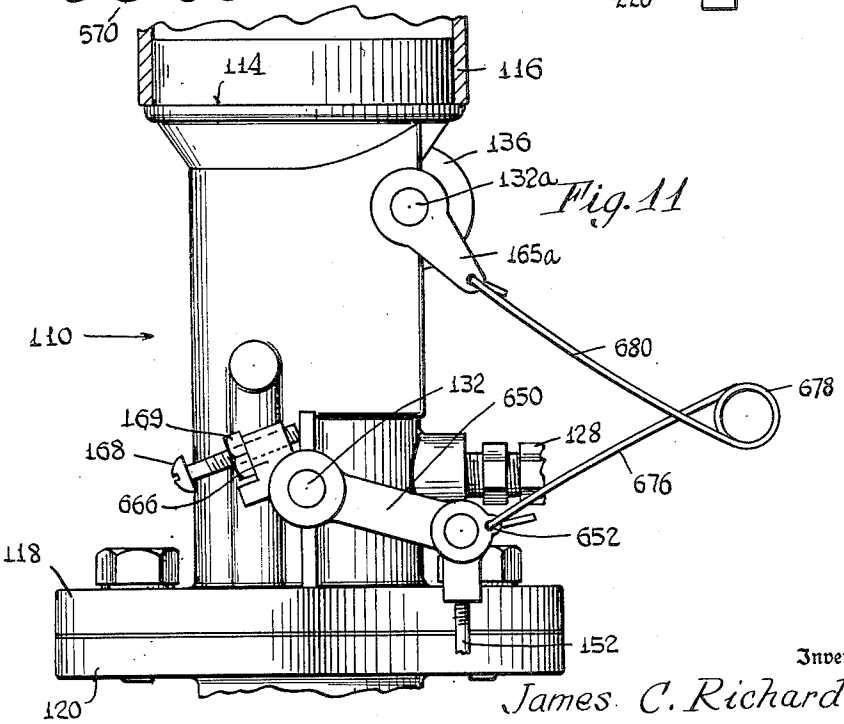


Fig. 11



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UNITED STATES PATENT OFFICE

2,682,392

CARBURETOR

James C. Richardson, Naugatuck, Conn.

Application November 1, 1950, Serial No. 193,343

26 Claims. (Cl. 261—49)

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This invention relates to fuel-air mixing devices or carburetors for internal combustion engines, and particularly to carburetors of the type intended to provide a thorough intermixture between air and a volatile liquid fuel, e. g. gasoline.

This application is a continuation in part of my previously filed copending application Serial Number 160,645, filed May 8, 1950.

Presently used carburetors, in order to give suitable engine performance together with appropriate fuel economy, have been made to include a variety of working parts and controls which are subject to becoming disordered and which require costly and expert repair service when no longer operating properly. In addition the carburetors conventionally used are provided with float chambers and float valves, the latter being peculiarly subject to sticking, and hence constituting a continual source of danger from fire and explosiion.

Appropriate structures for avoiding the complication of the conventional carburetor and float control dangers by taking advantage of fuel pump pressure, are disclosed and claimed in my said copending application, wherein is shown a carburetor provided with an idling jet which stands at a fixed opening, and depends upon cessation of the fuel pump to prevent emission of fuel at the idling jet during periods when the engine is not in use. It has been found, however, that a small but significant number of vehicles employ fuel pumps which are not directly engine driven, but are otherwise operated, as by an auxiliary electric motor. While the circuit for this fuel pump motor is normally tied into the operation of the main ignition switch for the engine, there is no guarantee that, in such an arrangement, the ignition switch will always be opened when the motor is stopped. If the switch should be left closed, the fuel pump will operate to emit fuel at the idling jet while the engine is not in use with consequent flooding of the engine, waste of fuel, and danger of fire from fumes. Such a situation can, of course be readily prevented by putting a control switch in the fuel pump circuit and causing the same to close only in response to crankshaft rotation, manifold depression, or to some other effect which occurs in direct response to running of the engine. This, however, would complicate the car wiring somewhat and should be avoided, if possible, in the interests of standardization.

It is an object of the present invention, therefore, to employ the principles of my copending application, above mentioned, to provide a carburetor which avoids the mechanical complication of present day carburetors, and dispenses with the complex and somewhat dangerous float control by taking advantage of fuel pump pressure, but which also includes in its makeup, an idling arrangement sensitive directly to motor operation, so that fuel feed will be essentially shut off when the motor is not operating, to thus provide for use of the carburetor in connection with fuel pumps which are not driven directly by the motor.

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Another object of the invention, in connection with one form thereof, is the provision of a carburetor having the advantages of the structures of my said copending application, but in which the ratio of fuel to air may be even more accurately and sensitively controlled. In connection with the foregoing object, the invention provides as a feature thereof, means for adjusting the size of the fuel jet orifice in response to movement of a member which senses the speed of flow in the main air stream.

Additional features and advantages will hereinafter appear.

In the drawings:

Figure 1 is a front elevation of the carburetor of this invention including a fragmentary showing of the attached intake manifold, a fragment of the attached air cleaner being also shown in section, and parts being broken away to illustrate interior details.

Fig. 2 is a side elevation of the device of Fig. 1 taken from the right-hand side and looking towards the left.

Fig. 3 is a side elevation of the device of Fig. 1 taken from the left-hand side and looking towards the right.

Fig. 4 is a top view of the device of Fig. 1 with the air cleaner omitted for purposes of clarity.

Fig. 5 is a section taken on line 5—5 of Fig. 3.

Fig. 6 is a section taken on line 6—6 of Fig. 5.

Fig. 7 is a fragmentary sectional view illustrating a mixture adjustment usable with the devices of Figs. 1 to 6.

Fig. 8 is a section taken on line 8—8 of Fig. 7.

Fig. 9 is a separate detail view of the metering pin shown in Figs. 5 and 6.

Fig. 10 is a view similar to Fig. 2 illustrating a modified form of the invention.

Fig. 11 is a view similar to Fig. 2 and illustrates a further modification of the invention.

Fig. 12 is a view similar to Fig. 9 but illustrates a modified form of metering pin.

Fig. 13 is a vertical section of still another modified form of the invention.

In one form of the present invention the carburetor comprises a body member 110 which is preferably a single integral casting. A large passage 112 running through the center of the body 110 constitutes the main air duct and mixing chamber and includes an upper end 112a of noncircular configuration. The upper end of the body 110 is provided with means such as the seat 114 for receiving the collar 116 of a conventional air filter. The lower end of the body 110 is shaped to provide a sealing flange 118 which is bolted to a corresponding flange 120 on the intake manifold. On one side of the body 110 is an integral enlargement or boss 122 which provides for most of the principal operating parts and connections to the carburetor as will hereinafter appear. Small bosses 124a, 124b and 124c are also formed on the opposite side of the body 110. A small boss 126 near the lower end of the body 110 provides for the conventional vacuum connection 128 communicating with a port 129 opening in the air passage 112 for controlling the spark advancing and retarding mechanism.

Throttle valve assembly

The carburetor of this invention is essentially a posterior throttle carburetor, in that the throttle valve is located at a position in the main air stream, downstream from the fuel emission apparatus.

A horizontal bore 130 formed through bosses 122 and 124b rotatably carries the throttle shaft 132 which extends diametrically of the passage 112 at the lower part thereof, and beyond each side of the casting, and has mounted thereon a butterfly valve 134 of the proper size and shape to open and close the main air passage 112. Attached to one end of shaft 132 is a collar 162, fixed thereon by means of a set screw 164. The collar 162 carries an integral operating lever 150 which is connected to a member 152 in the conventional throttle operating linkage (Fig. 2). The collar 162 also carries an integral arm 166 in which is threadedly received a stop screw 168 arranged to engage a surface of the boss 124b to prevent the throttle valve 134 from closing altogether, and for adjusting the size of its minimum opening. A lock nut 169 maintains the adjusted position of screw 168. Arm 166 also includes a stop surface 167 which cooperates with a portion of the boss 124b to prevent opening of the throttle 134 beyond full open position. Arm 166 also includes an integral extension 165 which serves as the operating member for a linkage to be hereinafter described.

Auxiliary air path

Another substantially horizontal bore 170 crosses the throat of the main air passage 112 and extends through a portion 172 of the boss 122 as well as into the upper portion of the boss 124a. A nozzle tube 174 with orifices 176 in the bottom thereof is inserted from the open end of the bore in boss 122 which is then closed with a screw cap 178. Preferably there are several orifices 176 of such size as to total approximately the internal cross section of the tube 174. As seen in Figs. 3 and 4, the tube 174 is not placed across the diameter of the passage 112 but lies to one side thereof for purposes which will hereinafter appear. A plugged bore 184 communicates with the interior of tube 174 and with a vertical bore 186 which opens on the interior of the main air passage 112 near the upper end thereof and is directed oppositely to the direction of the air flow in the passage. It will be seen that the series of openings or passages including bore 186, bore 184, the interior of tube 174, and nozzle openings 176 provide an auxiliary or secondary air path through which a portion of the air which would normally follow the main air passage is detoured.

Flatspot control passage

An additional passage for modifying somewhat the flow in the auxiliary air path above described, consists of a vertical bore 194 in the boss 124a intersecting the end of the tube 174, communicating plugged horizontal bore 196 opening on the main air stream at a port 200 located at the other side of the throttle valve 134 from the nozzle tube 174. Its action upon the flow of air and fuel in the auxiliary air path is identical with that in the carburetor disclosed in my above-mentioned copending application and hence requires no additional description.

Fuel jet, metering assembly, and operating means therefor

A horizontal bore 130a is formed at one side of the upper end 112a of the passage 112 and extends into and through each of the bosses 122 and 124c. Bore 130a rotatably carries a shaft 132a to which is secured an air flap 134a. As shown in Fig. 4 the air flap 134a is noncircular, having one semi-circular edge, and being otherwise outlined by three sides of a rectangle. The upper end 112a of the air passage has an interior outline in cross section similar to and very slightly larger than said air flap outline, and includes one flat wall 112b. The center line of bore 130a and shaft 132a coincides approximately with the wall 112b so that the flap 134a, when in horizontal position, substantially closes the upper end 112a of the air passage except for a small amount of leakage the degree of which is determined by the spacing of the edges of the flap from the walls of the upper end 112a of the passage 112. When the flap 134a is swung down against the flat wall 112b, however, it exposes the full opening of the passages 112, 112a. One end of the shaft 132a extends into a hollow gear housing 136, formed as a part of the boss 122, and carries a gear 144a which is situated within said housing. A cover plate 140a closes the outer end of the housing 136 against undesired entry of foreign matter. A vertical bore 202 extends from the top to the bottom of boss 122 and communicates with the interior of gear housing 136, and with a plugged horizontal bore 180 (Fig. 5). The bore 180 also communicates with the auxiliary air path previously described, for example at the intersection of bores 184 and 186. Located in the bore 202 just below the intersecting bore 180 is a press fitted fuel jet insert 208. A bore 210 formed in the boss 122 intersects the bore 202 just below the jet insert 208 and is provided with a fitting 212 for connection to the fuel line 214 which leads to the conventional fuel pump (not shown). The lower end of the bore 202 is enlarged and tapped to receive a stop screw 216 (Fig. 6) which closes the lower end of the bore 202 and retains the lower end of a compression spring 218, the upper end of which presses against and urges upwardly a cylindrical slide member 220 which fills the bore 202 and is freely slidable therein. The cylinder 220 has an integral rod or projection 222, which is large at the base and becomes smaller towards its tip, and which extends upwardly through and normally closes the orifice of jet 208. Slidably mounted in the upper end of

the bore 202 is a rack member 230, the toothed portion of which is meshed with the spur gear 144a. The lower end of the rack member 230 is in operative abutting relation to the upper end of the metering projection 222 on the cylinder 220. tI will be seen that rotation of the shaft 132a clockwise as shown in Fig. 6 will depress the rack member 230 as well as the projection 222 and cylinder 220 against the force of the spring 218 and thus provide a slowly enlarging annular orifice between the jet 208 and the projection 222. Counterclockwise rotation of the shaft 132a correspondingly retracts the rack 230 and allows spring 218 to raise the metering member 220, 222 and ultimately to return it to the position shown in Figs. 5 and 6. The series of elements just described including spur gear 144a, rack 230, metering member 220, 222 and spring 218 provide for an interconnection between the air flap 134a and the fuel jet orifice for a purpose to be more fully described hereinafter. Any suitable closure member, such as plug 226, is provided for closing the upper end of bore 202. A lever arm 165a is mounted on shaft 132a at the end opposite from the gear 144a. A linkage consisting of link 250 and connected spring 252 is pivoted at its opposite ends to the outer ends of arms 165 and 165a and forms a loose connection between them. Preferably the parts are so arranged that when the flap 134a is full open and the throttle 134 full open (with stop surface 167 against a portion of boss 124b), the spring 252 will be very slightly extended.

The cylindrical slide 220 with its connected metering projection 222 is illustrated in Fig. 9 for the purpose of more detailed study. It will be seen that between the projection and the cylinder is formed an intermediate section 221 having a diameter about $\frac{1}{32}$ inch larger than that of the projection 222 and forming a shoulder 223 which is adapted to seat firmly against the bottom surface of the jet 208. The metering projection 222 has its largest diameter adjacent the shoulder 223 and decreases in diameter in any predetermined manner towards its free end. In the particular form of the element shown in Figs. 5, 6 and 9 the profile of the projection is formed to lie on the circumference of a circle of substantially 13 inches in radius, whose center is positioned substantially $\frac{1}{16}$ inch above the plane of the shoulder 223. When thus formed the projection 222 has about the first ⅛ inch up from the shoulder 223 formed as a cylinder, for all practical purposes, said cylinder terminating approximately at the line C in Fig. 9. Above the line C the projection 222 decreases in diameter at a gradually increasing rate for purposes which will hereinafter appear. The full stroke of the member 220, 222 is about ½ inch in the form of the invention shown, i. e. the distance between shoulder 223 and the dotted line B.

It will be readily appreciated that the principle of pressure injection of fuel employed in my invention requires a much smaller fuel metering orifice than is found in the usual carburetor wherein fuel is merely inducted by the kinetic depression of the air flowing in a venturi adjacent the fuel nozzle. While the most desirable orifice size for carrying out my invention can be readily determined by experiment, it will serve the interests of completeness and clarity to point out that the maximum effective orifice which I have found suitable for use in the ordinary automobile engine having a 1½ inch manifold opening is about .002 square inch. One particular test arrangement which was effectively employed included a jet 208 whose aperture was .0938 inch in diameter, and a rod or projection 222 whose diameter at the level indicated by line B was .0795 inch. Another way of expressing the above structural feature is to state that, for the purposes of the invention, the ratio of the maximum fuel jet opening to the air path diameter (i. e. the intake manifold connection opening) is about 11:10,000, and even at the lowest fuel pump pressures and richest mixtures will never exceed 30:10,000. For comparison this ratio may be placed against the corresponding ratio of about 60:10,000 which is characteristic of the usual kinetic depression (i. e. Venturi suction) operated carburetor having a minimum metering orifice diameter of about .12 inch for the usual vehicle in which the intake manifold opening is 1½ inches and which can not operate with less orifice area. Hence the factor by which these ratios are separated is a minimum of about 2, and in the average case, the area of the fuel opening in the carburetor of the invention will probably be between ⅕ and ⅙ of the area of the most restrictive jet opening in the usual carburetor of comparable size and utility. It will be readily seen, therefore, that the orifice ratio of not over 30:10,000 clearly expresses the character of the carburetor as being for use in a method of direct fuel injection by the fuel pump pressure.

Mixture adjustment

In order to avoid unnecessary complication of Figures 1 to 6, the carburetor has been illustrated as having a structure which provides a fixed angular relationship between the shaft 132a and the gear 144a. While a practical carburetor may be constructed in this fashion, I prefer to provide means for adjusting the angular relationship, and means for this purpose is shown for convenience in Figs. 7 and 8 wherein a fragmentary portion of the boss 122 of body 110 is shown with the bore 130 receiving a shaft 332a which is longer than and replaces the shaft 132a of Figs. 1 to 6. As shown in Fig. 7, shaft 332a projects outwardly of the gear housing 136 and carries a sleeve 142 rotatably mounted thereon. One end of the sleeve lies within the housing 136 and is provided with spur gear teeth 144. The other end has the configuration of a wormwheel 146 and extends through and outside of an apertured cover plate 140 which closes the open outer end of the housing 136 and takes the place of cover 140a of Figs. 1 to 6. Surrounding the outer end of the shaft 332a as well as the sleeve 142 is the drive sleeve 148 which is nonrotatably secured to the shaft 332a by set screw 154. The sleeve 148 extends into the central aperture of the plate 140 and rotatably supports the shaft 332a and the sleeve 142 therein. A worm or screw 156 is rotatably mounted in a socket 158 in sleeve 148, meshes with the wormwheel 146 on the sleeve 142, and is provided with friction means 160 for retaining it in adjusted position. The angular relationship of the air flap 134a to the spur gear 144 is normally fixed, but it can be readily adjusted as desired by means of the worm and wormwheel connection 146, 156 for a purpose which will presently be stated.

Operation in general

As in most carburetors there is an air flow in the direction of arrow A, Fig. 5, through passage 112, which flow is induced by the pumping action of the engine cylinders on intake stroke, and the

speed of this flow is roughly proportional to the engine speed for any given loading. At the same time, in the carburetor of this invention, there is also produced a parallel or auxiliary air current through the passages **186**, **184**, **170**, **174** and **176**. This current is probably essentially proportional to the main air current A by reason of the position of the opening of bore **186** which is so directed as to take an approximate reading of the velocity in the main air stream. Injected into this auxiliary air stream by way of bore **180** is a quantity of liquid fuel such as gasoline which is sprayed through jet **208** in response to the conventional fuel pump pressure and in an amount depending upon the size of the orifice as determined by the metering position of the metering projection **222**.

The liquid fuel under pump pressure, when forced through the tiny orifice at jet **208**, is thoroughly broken up into exceedingly minute droplets and reaches a high state of atomization in the auxiliary air current which retains for the most part its gaseous form and issues into the main air stream at ports **176**. The fuel mixture while still in the auxiliary path is, of course, excessively rich, but when diluted by mixture with the main air current A, it assumes approximately the desired 15 to 1 ratio under most circumstances and is then readily usable by the engine. While because of their size and number, no restriction in area occurs at the openings **176**, it should be noted that the sudden deviation in path together with the break-up of the flow into a plurality of small streams results in the further and practically complete atomization of any possibly remaining droplets of liquid fuel. Also possibly contributing to this effect is the arrangement of the ports **176** at the underside of tube **174**, in a low pressure zone created by the non-streamlined flow about the circular cross section of the tube. This instantaneous reduced pressure probably insures a high vaporization rate of any tiny liquid fuel particles which might remain suspended in the stream.

From the description of the parts of the carburetor and their interaction, it can be seen that the rate of fuel emission from the jet **208** is controlled primarily by the position of the air flap *134a*. When the speed of air stream A (measured in pounds of air per unit time) increases, the air flap *134a* will be depressed to a greater angle from the horizontal thus rotating gear *144a* (or **144**, Fig. 7). Through its mechanical connection with the rack **230**, the metering projection **222** will be depressed to provide a larger orifice at jet **208** whereby added fuel will be admitted in a measured amount into the auxiliary air stream (which is now also speeded up) to maintain it at its initial fuel-air ratio, and thus maintain the desired combustion ratio in the speeded-up main air stream A.

The structure of air flap *134a* and its interconnected parts is arranged to measure with substantial accuracy the amount of air passing through the carburetor, and the air flap moves from approximately horizontal position as shown in Figs. 4 to 6 when the engine is stopped to a vertical depending position under full power conditions. Although the air speed is probably not exactly proportional to the angle of the air flap position, since the effective lever arm changes with the position of the flap, the deviation from the proportional is readily compensated for in the design of the projection **222**, and probably accounts for the slightly curved profile, shown in Fig. 9 which has been found to give good results in use. It will be appreciated, of course, that the exact curve shown is not necessarily the only operative arrangement, but that suitable characteristics may be tailored into the projection **222** by using a series of different tapers, or other outlines, as desired. Since it is the compression spring **218** which in connection with the air speed in the stream A finally determines the angular position of the flap *134a*, an appropriate length and wire size for the spring must be chosen. I have found, for example, that where the parts have the substantial sizes and arrangement shown in Figs. 1 to 6 of the accompanying drawing, a spring having the following characteristics performs admirably:

Wire

Material	wire music
Diameter	.022 in.

Spring

	In.
Outside diameter	.24
Pitch	.1
Free length	2
Initial compressed length	1¼
Minimum length in use	¾

Such a spring exerts forces from about 20 ounces to about 34 ounces over the ½ inch travel of the member **220**, **222** which is suitable for the relationships illustrated in the drawing.

Referring to Fig. 2, it will be seen that advance of the throttle corresponds to counterclockwise rotation of shaft **132** and arm **165**. As the throttle opens, with the engine running, and arm **165** moves to the left, the air speed in the main air stream A increases. This results in a depression of air flap *134a* with consequent rotation of shaft *132a* in a counterclockwise direction to keep the mixture adjusted to the proper ratio as previously described. At the same time, arm *165a* is moved to the left by the rotation of shaft *132a*. Experience shows that arm *165a* will move directly in concert with arm **165** except possibly at the full throttle position where it lags slightly behind. The linkage **250**, **252**, therefore generally retains its same slightly slack position shown in Fig. 2 and enters into the operation, as so far described, to no significant extent, its presence being for the purpose of taking fuel control away from the air flap *134a* under certain special conditions to be described hereafter. It is found, however, that in practice when using the metering spring **218** and member **220**, **222** exactly as shown in Fig. 9 with spring **252** absent, excessive leaning sometimes occurs at high throttle settings causing the engine to pop back through the carburetor. This can only be due to excessive resistance to opening of the flap *134a* by the compressed spring **218**. This effect is corrected when spring **252** is in place, so that it is believed that the linkage **250**, **252** in addition to the special operation hereafter described, also serves to detract somewhat from the force of compressed spring **218** at the wider throttle settings to provide a proper mixture setting under wide open throttle conditions.

The foregoing remarks, of couse, apply to relatively steady running conditions, or to a deliberate increase or decrease in throttle opening where no sudden changes are involved, and running mixtures are called for rather than maximum power.

The adjusting device illustrated in Figs. 7 and 8 provides a convenient means for effecting

slight mixture changes while the engine is running. To increase the richness of the mixture, for example, the screw **156** is rotated in a counterclockwise direction tending to raise the flap **134***a* slightly upstream relative to gear **144**. As a result of this change a given air speed will be able to cause a depression of the flap **134***a* to substantially the same position as formerly which represents a greater angle from zero and hence causes a slightly greater depression of projection **222** with consequent introduction of a larger proportion of fuel. When the screw **156** is rotated clockwise, tending to lower the flap **134***a* slightly downstream with respect to gear **144**, the given air speed will again succeed in depressing the flap **134***a* to substantially the same position as formerly. This represents a smaller angle from the new zero position which causes a smaller depression of projection **222** with consequent introduction of a smaller proportion of fuel.

The foregoing adjustments cause a general enriching or leaning effect which remains constant over the whole range of normal steady operation except for two conditions. In the first place, a full open throttle provides a predetermined slightly enriched mixture by reason of the linkage **250**, **252** coming into play to insure full opening of the air flap **134***a* for full power operation. In the second place, operation in the slow idling range proceeds as usual inasmuch as the projection **222** is essentially cylindrical at this location, so that a slight raising or depression of the projection has no significant effect on the size of the orifice at jet **208**.

It will be noted that the air flap **134***a* is essentially a measuring instrument. Any resistance which it may offer to the flow of air in passage **112**, **112***a* is nominal so far as operation of the carburetor is concerned. It has been found, however, that the flap **134***a* has a deflecting effect on the air stream when at partially open settings, so that air flow around the nozzle tube will probably not be entirely the same at one time as at another. This being the case, the placement of the nozzle tube has been arranged to provide the most uniform operation possible under the various air flows which occur at various settings of air flap **134***a*. The position for tube **174** best suited for overall operation of the carburetor, and consistent with minimum overall dimensions, has been empirically determined and is found to be approximately at the location shown in the accompanying drawings, namely at a position just clearing the tip of the flap and with its axis lying approximately in the plane of the flap when the same is depressed at an angle of about 45° from the horizontal.

Acceleration

When we modify the previously described state of affairs to the extent of opening the throttle rapidly with the intent of developing smooth, quick acceleration of the engine, a different operation of the parts is observed. During a lively throttle opening, the air velocity increase lags just slightly behind the throttle angle position because time is required for the engine to receive its added charge and to pick up speed. At ordinary full economy mixture and under load this speed-up can only take place rather slowly so that full power mixture, substantially richer than ordinary, is required during the accelerating interval for satisfactory performance in this respect. Whereas this exigency is taken care of by automatic pumps or self-emptying wells in the usual carburetor, no such expensive complication of the structure is necessary in the device of this invention.

Referring again to Fig. 2 if the advance of the throttle proceeds deliberately, the arm **165***a* which moves with the air flap **134***a* will be seen to follow exactly the movement of the arm **165** so that the linkage **250**, **252**, as adjusted with a slight amount of play as shown, takes no part in the operation, except at high throttle settings as previously explained. When, however, the throttle opening is lively, the arm **165***a* tends to lag slightly behind the arm **165**. With the linkage **250**, **252** present, however, the flap **134***a* is depressed somewhat more rapidly than the increased air speed alone would normally actuate the same. This results in a rapid increase of the orifice at the jet **208** which is slightly in excess of that called for by the instantaneous air speed, with a consequent enriching of the mixture for smooth acceleration. Once the air speed catches up, however, the flap **134***a* again takes control and sets the mixture at the proper lean economic value as set by the adjustment at screw **156**. Adjustment of the appropriate amount of slack in the linkage **250**, **252** may be effected by slightly changing the clamped radial position of the arm **165***a* on the shaft **132***a*. An appropriate value for the amount of slack in the linkage is found to be that which produces about $\frac{1}{32}$ inch of play when the arm **165***a* finds its normal position at any constant average engine speed. From the foregoing description, it will be appreciated that the linkage **250**, **252** could also consist entirely of loosely connected rigid links. However, the use of spring **252** is preferred, in order to avoid shocks during rapid operation and to provide for any slight differences in the end stop positions of shafts **132***a* and **132**. The spring **252** merely requires sufficient strength to readily operate the shaft **132***a* against the force of spring **218** when employed at a lever arm corresponding to the length of arm **165***a* without very extensive deflection of itself (i. e. of spring **252**). A spring having a force of about one pound at about ¼ inch deflection has been found suitable.

Starting and idling

The carburetor of this invention avoids the complications and disadvantages of the usual strangler or choke valve in the same manner as does the device of my above-mentioned copending application, since the full atomizing effect of the pump pressure at jet **208** as well as the break-up and deflection of the auxiliary air current at orifices **176** brings about substantial atomization of the fluid fuel. This results in substantial equivalence between the apparent mixture (overall weight of fuel to overall weight of air) and the effective mixture (the ratio of the weights on the basis of the part of the fuel which is in substantially gaseous state and hence usable).

In starting the engine, the same is cranked slowly by the starting motor in the usual manner. Very slight depression of the air flap **134***a* occurs in response to the air flow caused by the crank speed of the motor. This depression of the flap **134***a* lifts the shoulder **223** from its sealing position against the jet **208** and permits gasoline to be introduced in the manner previously described. The amount of gasoline metered through the orifice of the jet **208** is determined by the substantially cylindrical portion of the projection **222** between the shoulder **223** and the dotted line A. The difference in area may be substantially .0003 square inch. In one sample carburetor made ac-

cording to the invention, the opening at jet **208** was .0938 inch in diameter while the cylindrical portion of the projection **222** was approximately .0925 inch in diameter. This difference was based upon the fuel required for idling and hence would normally mix with the quantity of air drawn by the engine during idling. Since, however, this portion of the projection **222** is cylindrical, idling fuel is also provided under cranking conditions where there is less incoming air and hence an appropriately rich starting mixture is supplied to the engine. It has been found that a choking action, while very rarely needed with the present carburetor, is sometimes desirable with extreme low temperatures where vaporization of the fuel is difficult to achieve, and in these extraordinary circumstances a slight temporary opening of the throttle with concomitant operation of shaft **132***a* through the linkage **250, 252** is all that is required to provide the necessary extra fuel.

When the charge ignites and the engine begins to operate, its rotation will at once be brought up to idling speed with the increased intake of air corresponding thereto. Since the fuel orifice at jet **208** still remains at its idling setting, the increased depression of flap **134***a* still not having moved the projection **222** so as to put the dotted line C (Fig. 9) below the jet **208**, the mixture is at once leaned to proper idling value. It will be apparent that the previous mentioned adjustment **156**, while controlling the mixture at ordinary running speeds, will have no significant effect upon the idling mixture, for at this position on the projection **222** the effect of the adjustment is merely to displace slightly the cylindrical portion (between the shoulder **223** and the dotted line C) without substantial change in orifice size.

Stopping

When it is desired to stop rotation of the engine the ignition switch is opened in the normal fashion, and cessation of the explosions in the engine cylinders causes the engine to slow down and stop. Under these circumstances the flow of air through the carburetor gradually ceases and the flap **134***a* is allowed to rise toward horizontal position under the influence of spring **218** which, at the same time, moves the member **220, 222** towards closed position. According to the present invention, closed position occurs when the shoulder **223** comes to rest against the bottom surface of the jet member **208**. I have found that when jet **208** has a smooth, lower surface perpendicular to its axis, when its length is sufficient to provide proper guide contact with the interior of the bore **202**, and when the jet **208** is carefully pressed into place so as to remain in alignment with the bore **202**, and further when the shoulder **223** is made as smooth and flat as possible and of very restricted width, a shut-off action can be obtained between the surface of the shoulder and the bottom surface of the jet **208** under the forces produced by spring **218**. The shut-off action obtained is sufficient to prevent any significant amount of liquid fuel from passing the orifice **208** even though the fuel pump is allowed to continue running, for example due to the inadvertent closing of the ignition switch after the engine is stopped, or due to stoppage of the engine for reasons other than opening of the ignition circuit. This same shut-off action can also be obtained if the shoulder **223** assumes a shallow conical form and seats against the corner formed at the juncture of the opening in jet **108** and the lower surface of the jet. While the shoulder or conical shut-off configuration of the metering projection just described constitutes the preferred form of the invention, since it is found to experience very little deterioration because of repeated use, it will be appreciated that a gradual taper formed below the cylindrical portion could be used to shut off the jet **208** by seating the same within the cylindrical opening of the jet if desired.

Figures 10 and 11 represent carburetors very similar in structure to the carburetor of Figs. 1 to 9, each illustrating a slightly modified form of control. In each case the parts which are identical with the parts of Figs. 1 to 9 are designated by the same reference characters.

In Fig. 10 the body or casting **510** is identical with that of Figs. 1 to 4 but includes a passage **570** which communicates with the main air path below the throttle so as to be subjected substantially to intake manifold depression. A tapped hole at the outer end of passage **570** receives a fitting **572** for making connection with a conduit **574** connected to one end of cylinder **576** which slidably receives piston **578**. A rack **580** is connected to the end of piston **578** and meshes with a gear **582** fixedly mounted on shaft **532***a* which is similar to shaft **132***a* of Fig. 5 except for having the added length necessary to receive the gear **582**. Also shown in Fig. 10 is a substitute linkage arrangement including an arm **552***a* for engaging the link **250**, which arm is integral with a torsion spring **552** wound around and supported by the stud **565** and having its end attached to anchor means **565***a* fixed to the stud. The stud **565** is mounted on an arm **566** of the slightly modified throttle lever from which the extension **165** of Fig. 2 has been removed. The spring **552** and arm **552***a* take the place of the spring **252** of Fig. 2 and act in a somewhat similar fashion.

The device of Fig. 10 is intended to operate in a manner very similar to that described for Figs. 1 to 4, the main difference being that the flap position depends not only upon the air speed and the spring pressure under the metering member **220, 222**, but is also affected by manifold pressure and possibly by the torsion of spring **552** at times. This is accomplished by replacing the spring **218** of Fig. 6 with a somewhat weaker spring (not shown) and proportioning the cylinder **576** and its connection means **580, 582** so that under ordinary conditions, such as idling, it supplies approximately the difference between the force of the weaker replacement metering spring and the force of the replaced metering spring **218**. It will be seen that when the manifold depression is strong, i. e. the manifold pressure is low, its effect augments the effect of the replacement metering spring, and when the depression is weak this augmentation disappears somewhat in relation to the degree of pressure rise, to provide a weaker reaction of flap **134***a* and hence a temporarily richer mixture. The greater manifold depressions are associated with closed throttle position or steady throttle at normal speeds. Lesser manifold depressions are associated with rapid opening of the throttle or with full open, maximum power conditions. The action of the piston **578** and rack **580** is, therefore, to produce an enriching effect only at such times as rich mixture is called for to provide high performance, and hence makes possible exceedingly lean operation under normal running conditions. The compensation in this regard is so spectacular, in fact, and the lean mix-

ture usable as a standard setting is so low, that the acceptacle limits of performance would normally be violated if the usual carburetor were adjusted to run on a mixture equivalently lean. The use of the linkage **250**, **552***a*, while not essential, is recommended, for it is found that a slightly brisker response is obtainable than with the other controls alone. The lever arm of link **552***a* is somewhat longer than the lever **165** of Figs. 1 to 4, so that the spring **552** comes into action with smaller relative displacement between shafts **532***a* and **132** than in the previously disclosed forms, and the force exerted by spring **552** is also significantly less. Appropriate dimensional relationships are shown in Fig. 10 of the drawing. One set of examples of the spring pressures found suitable is given as a guide to illustrate the approximate orders of pressures which can be used.

A replacement metering spring to take the place of spring **218** of Fig. 6 may be constructed as follows:

Wire

Material	music wire
Diameter	.016 in.

Spring

	In.
Outside diameter	.24
Pitch	.1
Free length	1¾

The initial compressed length and minimum length in use are, of course, the same as for spring **218** of Fig. 6. Such a spring as the above exerts forces of from about 4 ounces to about 8½ ounces over the ½ inch travel of the metering member **220**, **222**. Spring **552** through arm **552***a* exerts an average force of about 6 ounces at the end of arm **165***a* when moderately deflected, and is just capable of rotating the shaft **532***a* against the force of the replacement metering spring when the manifold is at atmospheric pressure.

At present, the modification shown in Fig. 10 is the preferred form of the invention as being the most accurate metering device, since it is capable of extremely lean, economical operation under ordinary running conditions without impairment of performance at times when performance is necessary.

A device somewhat similar to that of Fig. 10 is shown in Fig. 11. Here, however, the augmentation for the metering spring is arranged to come about through spring pressure, rather than through a sensing of the intake manifold depression, giving somewhat more approximate metering, but nevertheless being fully operative for the purposes of the invention and rather less costly to construct than the device of Fig. 10.

Here the body **110** is the same as used in Figs. 1 to 4, and the reference characters for other identical parts remain the same. The only changes consist in adjusting the angular position of arm **165***a* about the shaft **132***a* to the new position shown, providing a throttle lever having an operating arm **650** for engagement with the throttle linkage member **152** and having an opening **652** for engagement with one arm **676** of a torsion spring **678** the other arm **680** of which engages in the opening in arm **165***a*. The arm **666** of the throttle lever may be devoid of extensions and studs as shown.

Member **152** of the throttle linkage is, of course, normally urged downwardly by the usual foot throttle spring (not shown) to the closed throttle position as shown in Fig. 11. This stresses the spring **678** and hence augments the effect of whatever spring is urging the flap **134***a* and the metering member **220**, **222** towards closed position. As in the case of Fig. 10 this metering spring is a substitute for spring **218** of Fig. 6 and is substantially weaker than spring **218**, relying on the augmentation of force by spring **678** during normal operation. As in the forms of the invention previously described the arm **165***a* and arm **650** will be seen to move almost together under normal conditions of deliberate throttle opening or closing. The augmentive effect of spring **678** therefore changes only very slowly being gradually decreased as full throttle position is approached due to the slightly greater throw of arm **650** as compared with the shorter arm **165***a*. When, however performance and high acceleration are called for, it will be seen that the temporary lag of the arm **165***a* behind arm **650**, when the throttle is rapidly opened, causes a momentary sharp reduction in the augmentive effect of spring **678** on the action of the replacement for spring **218**, with a consequent temporary enrichment of the mixture to provide the power necessary for alert performance. As the arm **165***a* catches up to a position corresponding to the setting of arm **650**, the augmentive effect of spring **678** rapidly increases to its normal value and the mixture rapidly leans to correspond with the normal lean running ratio. While settings for normal running purposes (and consistent with proper acceleration performance when demanded) can not be quite so lean with the device of Fig. 11 as with that of Fig. 10, the carburetor still provides excellent operation combined with simplicity of structure, and demonstrates marked improvement in economy when compared with the best carburetors of conventional passenger car or truck design employing venturis. One set of examples of the spring pressures found suitable for use in the device of Fig. 11 is given as a guide to illustrate the approximate orders of pressures which can be used. A replacement metering spring to take the place of spring **218** of Fig. 6 may be constructed as follows:

Wire

Material	music wire
Diameter	.016

Spring

	In.
Outside diameter	.24
Pitch	.1
Free length	1½

Such a spring as the above exerts forces of from about 2½ ounces to about 7 ounces over the ½ inch travel of the metering member **220**, **222**.

Spring **678** through arms **676** and **680** exerts an average force of about six ounces when operated at an average deflection of about 1¾ inches. In operation, however it should be noted that the effective lever arm of the force of spring **678** about the axis of shaft **132***a* is reduced at higher positions of arm **165***a*, so that the augmenting effect of spring **678** is reduced somewhat at high throttle settings.

The various modifications of Figs. 1 to 11 have been included in order to illustrate the point that the spring **218** des not necessarily have a fixed value, but can be designed to exert a force suited to the manner in which it is used. In general it can be stated that, using a flap of the approximate shape and relative dimensions of the

flap 134a shown in the drawings with a carburetor which fits the usual 1½ inch manifold opening, spring or other pressures which combined will provide an initial torque (clockwise as seen in Figs. 10 and 11) about the axis of shaft 132a or 532a in the neighborhood six ounce-inches will be found satisfactory providing the combined torque remains fairly level over the whole range of normal operations and admits of automatic reduction under accelerating conditions. As will readily be understood this can be accomplished with varying sizes of springs occupying the position of metering spring 218 so long as adequate compensation is provided. This compensation may take the form of the opposition of spring 252 (Fig. 2), the augmentation of spring 678 of Fig. 11, or the combined augmentation of cylinder 576 and opposition of spring 552 as in Fig. 10. The more accurately the torque curve can be made to correspond to values which give a flap angle (of flap 134a) substantially proportional to air speed in the main air path A, the simpler the outline of the metering projection may be. Fig. 12 illustrates a modified metering element similar to the element 220, 222 of Fig. 9. In Fig. 12, however, the guide cylinder is designated 220', the integral rod or projection 222'. Preferably the working portion of the projection beyond the initial cylinder and between the lines B' and C' has a substantially straight taper terminating in a short section 622 of increased taper for high speed operation. The shoulder portion 221' is shown as having the alternative slightly conical seat 223' for shutting off on the corner of the jet insert opening. The form of metering member shown in Fig. 12 operates particularly well with the devices of Figs. 10 and 11 and is shown to illustrate that metering members may be formed in any desired fashion to provide the qualities of performance and economy desired in relation to any particular arrangement for air flap balancing.

Alternate form of the invention

Fig. 13 illustrates the invention as carried out in a carburetor somewhat different from the one shown in Figs. 1 to 6.

The carburetor of this form of the invention comprises a body member 410 which is preferably a single, integral casting. A large passage 12 running through the center of the body 10 constitutes the main air duct and mixing chamber. The upper end of the body 10 is provided with means such as the seat 14 for receiving the collar 16 of a conventional air filter. The lower end of the body 10 is shaped to provide a sealing flange which is bolted to a corresponding flange on the intake manifold. On one side of the body 10 is an integral enlargement or boss 422 which, together with another integral boss 24 on the opposite side, provides for most of the principal operating parts and connections to the carburetor as will hereinafter appear. A port 29 opening in the air passage 12 serves to control the spark advancing and retarding mechanism.

The careburetor of this form of the invention is also essentially a posterior throttle carburetor, in that the throttle valve is located at a position in the main air stream, downstream from the fuel emission apparatus.

A horizontal bore 30 rotatably carries the throttle shaft 32 which extends diametrically of the bore 12 at the lower part thereof, and beyond each side of the casting, and has mounted thereon a butterfly valve 34 of the proper size and shape to open and close the main air passage 12. An enlarged bore 36 is formed in the lower end 38 of the boss 22 in line with the bore 30 to form a gear housing in a manner which will presently appear, and the same is closed at its outer end by a combined cover plate and bushing member 40. Non-rotatably mounted on the end of shaft 32 is a sleeve 342, one end of which is housed in the bore 36 and provided with spur gear teeth 444. The other end extends through and outside the cover plate 40 and has a bearing therein. The sleeve 342 is integral with a throttle operating lever (not shown) which is connected to the conventional throttle operating linkage. The other end of shaft 32 is received in a collar 62 which is fixed thereon, as by means of a set screw.

Another substantially diametric bore 70 crosses the throat of the main air passage 12 and is formed in the upper portion 72 of the boss 422 as well as the upper portion of the boss 24. A nozzle tube 74 with orifices 76 in the bottom thereof is inserted from the open end of the bore in boss 24, which is then closed with a screw cap 78. Preferably there are several orifices 76 of such size as to total approximately the internal cross section of tube 74. A smaller port 80 is drilled in the upper portion 72 of boss 422 in alignment wiht the central opening of the tube 74. A plugged horizontal bore 84 communicates with the bore 80 and with an upwardly sloping bore 86 which opens on the interior of the main air passage 12 in the boss 88 integrally formed therein. Firmly fastened in the boss 88 and extending upwardly therefrom is a funnel shaped air admittance member or air scoop 90 which projects into and parallels approximately the direction of air flow in the main air path, opening in a direction opposite to that of the air flow.

It will be seen that a series of openings or passages including the interior of the air scoop 90, the bore 86, the bore 84, the bore 80, the interior of tube 74 and nozzle openings 76, provide an auxiliary or secondary air path through which a portion of the air which would normally follow the main air passage is detoured.

An additional passage, for modifying somewhat the flow in the auxiliary air path in a manner hereinafter described, consists of a vertical bore 94 in the boss 24, communicating plugged horizontal bore 96 and the communicating, plugged, upwardly sloping bore 98, the bore 96 opening upon the main air stream at a port 100 located at the other side of the throttle valve 34 from the nozzle tube 74, and the bore 98 opening through the screw cap 78 into the interior of tube 74.

A vertical bore 102 starts at the top of the boss 22 and communicates with the enlarged bore or gear housing 36 and with the reduced bore 80 of the auxiliary air path. A guide block 104 is press-fitted in the bore 102 below the reduced bore 80, and the same snugly but slidably receives an operating pin 106. Also located in the bore 102 just above the intersectnig reduced bore 80 is a press-fitted fuel jet insert 108. A bore 110 (indicated in dotted lines) in the upper part of the boss 422 intersects the bore 102 just above the jet insert 108 and is provided with a fitting for connection to the fuel which leads to the conventional fuel pump (not shown). A bore 115 connects the bottom of the gear housing 36 with the air passage 12 to drain off any leakage fuel from the housing 36. The upper end of the bore 102 is enlarged and tapped to receive cap screw 116 which closes the upper end of the bore 102 and retains the upper end of a coil spring 118, the

lower end of which presses against and urges downwardly a plug 120 which fills the bore 102 and is slidable therein. The plug 120 has an integral depending projection 122 which passes through and normally seats in the opening of jet insert 108. The projection 122 includes the base portion of moderate taper and a nose of increased taper for a purpose which will be more fully described hereinafter. The lower end of the nose is flat or otherwise designed for engagement with the upper end of the operating pin 106. A bore 124 parallel to and offset from the bore 102 opens at the bottom of the lower section 38 of the boss 22 and is closed by a screw plug 126. The bore 124 communicates with the gear housing 36, and by a slot 128 with the bore 102. Slidably mounted in the bore 124 is a rack member 130 the toothed portion of which is meshed with the spur gear 44. The upper end of the rack member 130 carries a lateral projection 132 which passes through a slot and underlies the lower end of the operating rod 106 in position to actuate the same. It will be seen that rotation of the shaft 32 to produce opening movement of the throttle butterfly 34 will raise the rack member 130 and with it the operating pin 106 to thereby lift the metering projection 122 and provide a slowly but progressively enlarging annular orifice between the jet and the metering projection. Closing rotation of the shaft 32 retracts the rack 130 and allows spring 118 to depress the metering member 120, 122 and operating pin 106 and ultimately to return them to the position shown in Fig. 13. The series of elements just described, including spur gear 44, rack 130, operating pin 106 and metering member 122 provide for mechanical interconnection between the throttle valve and the main fuel jet orifice for a purpose to be more fully described hereinafter.

The carburetor of Fig. 13 is, in most respects, identical to the carburetor of my said copending application in that it includes separate provisions for introducing the idling fuel and the running fuel, and the main jet orifice is controlled directly by the throttle valve position. To simplify the illustration no adjustment between the throttle angle and main jet operating gear has been shown, since the carburetor is fully operable in that condition providing mixture ratio changes are not desired. The throttle operating sleeve 342 and connected gear 344, therefore, replace the parts previously used at this location. The body casting 410 has been modified somewhat, especially as to the shape of boss 422, to accommodate the novel idling arrangement which will be described in detail hereafter. Otherwise, the carburetor is identical with the one disclosed in my said copending application, and identical parts are identied by the same reference characters.

In place of a settable needle valve which was used in the device disclosed in my said copending case to provide a predetermined idling fuel opening, I employ a movable valve controlled by a combination of a spring and engine depression. A compound bore 434 in the boss 422 communicates with the passage 102 above the jet insert 108 so as to receive fuel under pressure direct from the fuel pump (not shown) through passage 110. Threadedly fixed in the bore 434 is a stepped plug 436 which seals against a shoulder 438 in the bore. The plug 436 is hollow and is provided with an orifice 440 into which is urged a taper pin 442 by means of spring 444, said pin and spring both being carried by the plug 436 and retained therein by an apertured threaded stop screw 446. A transverse passage 448 in the plug connects the interior of the plug, axially outwardly of orifice 440, with an annular groove 450 on the exterior of the plug. The outer end of the plug is enlarged and counterbored to form a cylinder 452 which slidably receives a piston 454 arranged to contact the end of the taper pin which is made of sufficient length to project a short distance into the cylinder 452. A piston actuating passage 456 connects the inner end of the cylinder 452 with the transverse passage 448, and a removable or disablable detent 458 retains the piston within the cylinder. Passages 460, 462, 464 and 466, drilled in the body 410 provide connection between the interior of the stepped bore 434 adjacent the annular groove 450 on the plug 436, and the port 468 opening on the main air stream A.

As in most plain tube carburetors there is an air flow in the direction of arrow A, Fig. 13, through passage 12 which flow is induced by the pumping action of the engine cylinders on intake stroke, and the speed of this flow is roughly proportional to the engine speed for any given loading. At the same time, in the carburetor of this invention, there is also produced a parallel or auxiliary air current through the passages 90, 86, 84, 80, 74, 76. This current is probably much reduced in speed by virtue of its tortuous and high friction path, but is also probably essentially proportional to the main air current A by reason of the position of the inlet funnel 90 which is so directed as to take an approximate reading of the velocity in the main air stream. The speed of the air current through the auxiliary path is, however, probably sufficiently reduced that the depression effect thereof on the liquid fuel jets 108 and 140 can be ignored, especially by comparison with the fuel ejective effect of the pressure due to the conventional fuel pump. This pressure is about 5 p. s. i. in most vehicles and is capable of being very accurately predetermined and of remaining accurate over long periods of service in practically all modern fuel pumps. It is also contemplated that even better results than are described below herein will be obtained if, when the carburetor of this invention is installed, the usual fuel pump spring is replaced by one which increases the fuel pump pressure to a maximum safe value for the fuel system of the particular automobile in question, in order to take the fullest advantage of the benefits of the present invention. It is likewise probable that when use of the invention becomes general, fuel systems having slightly higher safe pressure values will also be installed to put the invention to its fullest use.

The liquid fuel under pump pressure, when forced through the tiny orifices at jet 108 or jet 440 or both, is thoroughly broken up into exceedingly minute droplets and reaches a high state of atomization in the auxiliary air current which retains for the most part its gaseous form and issues into the main air stream at ports 76. The fuel mixture while still in the auxiliary path is, of course, excessively rich, but when diluted by mixture with the main air current A, it assumes approximately the desired 15 to 1 ratio under most circumstances and is then readily usable by the engine.

From the foregoing description it can be seen that since the rate of fuel emission from the jets is not under the control of the air stream as in the ordinary suction nozzle carburetor, provision must be made for increasing fuel flow as the main air stream A increases in speed. This

speed-up of both air streams occurs in response to increased speed of the engine which is brought about by opening the throttle valve 34 as in the ordinary carburetor. Enlargement of the orifice between jet 108 and metering projection 122 occurs in concert with the opening of throttle valve 34 which controls the air flow due to its interconnection therewith by sleeve 342, gear 344, rack member 130, 132 and operating rod 106. The orifice 108, 122 consequently sprays more liquid fuel under fuel pump pressure into the auxiliary air stream. Since the auxiliary air stream is travelling at a proportionately faster rate as determined by the speed of the main air stream, its mixture value remains about the same, and the final mixture with the main air stream also retains its designated fuel-air ratio. The foregoing remarks, of course, apply to a deliberate advance in throttle opening where no sudden changes are involved and running mixtures are called for rather than maximum power.

When we modify the preceding state of facts to the extent of opening the throttle rapidly with the intent of developing smooth, quick acceleration of the engine, a different state of affairs is observed. A lively throttle opening normally does not cause immediate increase in air velocity because time is required for the engine to receive its added charge and to speed up. At ordinary full economy mixture and under load this speed-up can only take place rather slowly, so that a full power mixture, substantially richer than ordinary, is required during the accelerating interval for satisfactory performance in this respect. Whereas this exigency is taken care of by automatic pumps or self-emptying wells in the usual carburetor, no such expensive complication of the structure is found necessary in the device of this invention. It will be noted that a wide-open position of throttle 34 also opens the main jet orifice 108, 122 to its fullest extent. Inasmuch as neither air path has as yet been speeded up, the fuel ejected is much higher in proportion to the air than ordinary so that the auxiliary air path mixture and the final main air path mixture are both enriched substantially beyond normal condition and hence give full power and smooth acceleration performance. Furthermore, the degree of this enrichment, is proportional almost exactly to the difference between present speed and the terminal speed corresponding to the throttle opening so that the enriching effect is promptly decreased as speed picks up and promptly terminated as desired velocity is reached giving just the expenditure of fuel needed for proper performance with none wasted in periods of rich mixture production when there is in fact no demand therefor.

Starting position of the carburetor is merely that in which the throttle valve 34 is closed as far as possible. Under these circumstances the main jet 108, 122 is closed and little if any fuel is allowed to pass therethrough even under fuel pump pressure. In this connection it should be noted that the spring pressure of spring 118, even though not particularly heavy, is sufficient to substantially seal the opening in jet 108 due to the very small taper of the sealing portion of the metering projection 122. Fuel induction, therefore, is effected mainly through the exceedingly minute orifice at the idling jet 440. Normally the setting of this orifice between jet 440 and needle valve 442 is such as to cause a mixture just equal to or slightly richer than the most economical setting possible for the air speeds involved at idling speed of the engine. When the engine is to be started, of course, the cranking speed and induced air speeds in the main and auxiliary air paths are substantially less than at idling speed so that, assuming full fuel pump pressure, the mixture fed to the cylinders would be much richer than the ordinary economical mixture. There may be certain tendencies such as pulsating of the fuel pump at slow engine speeds, or an instantaneous lag in fuel pump pressure build-up which would reduce fuel output at the jet 440 for just a moment, whereby the mixture would be leaned to ideal combustion proportions but whether this occurs or not the range of mixtures which the jet 440 causes to exist in the intake manifold is never such as to prevent firing of the engine, for initial firing can occur very readily over a wide range of mixtures from just slightly leaner than ideal running mixture to quite rich. Once the engine has caught, the mixture present is instantaneously adjusted to proper idling value by the pick-up in air speed through both air paths, which finally steadies down at the speed for which the output of the orifice at jet 440 is accurately set, and the mixture is thereafter automatically taken care of without attention by the operator and without any of the complicated controls normally considered desirable for the starting operation.

The operation of the carburetor shown in Fig. 13 is the same as that of the device disclosed in my said copending application, except that the taper pin 442 is normally urged into the orifice 440 by spring 444 to shut off the idling fuel and hence prevent injection of fuel by the fuel pump in case the same is driven by a power source other than a direct connection to the engine, and in case the fuel pump is inadvertently allowed to continue running when the engine is stopped. When the engine is being cranked or is running under its own power, the engine depression is applied to port 468 and through passages 466, 464, 462, 460, 450, 446 and 456, to the inner end of piston 454. The pressure of the ambient air thereupon overcomes the force of spring 444, and the pitson is forced into contact with the inner end of the cylinder 452. This movement moves the pin 442 inwardly to space the same very slightly from the wall of the surrounding opening 440, thus providing a small idling orifice of a predetermined size. Liquid fuel under fuel pump pressure is forced through the orifice at seat 440 and mixes with whatever leakage air is passing inwardly through the series of passages from 466 to 448 in inverse order, and the mixture issues into the main air stream A at port 468 to provide the proper idling mixture. In order to alter the idling mixture it is necessary merely to alter the depth of the inner recess 455 of pitson 454, or to replace the piston with one having a recess of greater or less depth.

While the idler jet 440, 442, as well as the main jet 108, 122 are illustrated as closing by the seating of a gradually tapered projection in an opening, the improved shut-off principle illustrated in connection with projections 222 or 222' and having a narrow shoulder or cone which shuts off against the face of a jet, as shown in and described in connection with Figs. 5, 6, 9 and 12, may be substittued if desired.

From the foregoing descritpion, it can be seen that this invention provides a carburetor which mixes liquid fuel and air without the necessity for a float chamber, taking the fluid fuel under pressure directly from the fuel pump output, but

in which the pump output will be automatically shut off when the engine is not running, to provide for cases where the intsallation includes a fuel pump not directly controlled by engine movement, and without adding unusual complications to the operating circuit of the fuel pump.

In addition the invention is seen to provide means by which the air and fuel may be very accurately proportioned at all times so as to operate with a high degree of economy, at the same time providing automatic adjustment to higher performance mixtures when called for, with immediate automatic return to accurate economy operation when the high performance demands cease.

Variations and modifications may be made within the scope of the claims and portions of the improvements may be used without others.

I claim:

1. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; a throttle valve in said air path; means providing an auxiliary air path connected in parallel with said main air path and discharging into the same upstream from said throttle; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; movable means for closing said orifice against said pressure fuel supply; and means for moving said closing means to open said orifice to a degree which is a function of the air flow conditions in said air supply path.

2. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; a throttle valve in said air path; means providing an auxiliary air path connected in parallel with said main air path and discharging into the same upstream from said throttle; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering member for controlling the effective size of said orifice; means for sensing the air speed in said main air path and for moving to a position indicative thereof; and means for moving said metering member in accordance with the movement of said sensing means.

3. A carburetor comprising means providing a walled conduit defining an air supply path for connection with the intake manifold of an internal combustion engine; means including a fuel metering orifice for projecting fuel in measured amount into said air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering member for controlling the effective size of said orifice; a rigid flap member normally spring urged into a transverse position interrupting said air supply path, and pivoted to clear said path and to a position indicative of the air speed in said air path; and means for moving said metering member in accordance with the movement of said flap.

4. A carburetor comprising means providing a walled conduit defining an air supply path for connection with the intake manifold of an internal combustion engine; means including a fuel metering orifice for projecting fuel in measured amount into said air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; means on said rod for closing said orifice in one end position of said rod; spring means urging said rod towards its orifice closing position; a rigid flap member normally positioned transversely of said conduit to interrupt said air supply path and pivoted on an axis lying closely adjacent one wall portion of the conduit and so positioned that the flap in swinging away from transverse position will swing downstream into substantial parallelism and close proximity with that wall portion associated with the pivotal axis to clear said path; and means so interconnecting said flap and said rod that said spring, in urging said rod towards orifice closing position, also urges said flap towards path interrupting position.

5. A carburetor comprising means providing a walled conduit defining an air supply path for connection with the intake manifold of an internal combustion engine; means including a fuel metering orifice for projecting fuel in measured amount into said air supply path upstream from said throttle; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; spring means urging said rod towards minimum orifice position; a rigid flap member normally positioned transversely of said conduit to interrupt said air supply path and pivoted on an axis lying closely adjacent one wall portion of the conduit and so positioned that the flap in swinging away from transverse position will swing downstream into substantial parallelism and close proximity with that wall portion associated with the pivotal axis to clear said path; means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards interrupting position; a pivoted throttle valve for controlling the flow of air in said path; crank arms rigidly connected to said flap and said throttle valve to pivot therewith; and a loose linkage connecting said crank arms and having a small amount of slack when the crank arms are at closed position of said throttle and said flap, for moving said metering rod substantially in concert with said throttle whenever said slack is taken up.

6. A carburetor comprising means providing a walled conduit defining an air supply path for connection with the intake manifold of an internal combustion engine; means including a fuel metering orifice for projecting fuel in measured amount into said air supply path upstream from said throttle; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; spring means urging said rod towards minimum orifice position; a rigid flap member normally positioned transversely of said conduit to interrupt said air supply path and pivoted on an axis lying closely adjacent one wall portion of the conduit and so positioned that the flap in swinging away from transverse position will swing downstream into substantial parallelism and close proximity with that wall portion associated with the pivotal axis to clear said path; means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards interrupting position; a pivoted throttle valve;

crank arms rigidly connected to said flap and said throttle valve to pivot therewith; and a loose linkage connecting said crank arms and having a small amount of slack when the crank arms are at closed position of said throttle and said flap, for moving said metering rod substantially in concert with said throttle whenever said slack is taken up, said linkage including a relatively stiff spring capable of fully overcoming said metering rod spring without substantial deformation of itself.

7. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; movable means for closing said orifice against said pressure fuel supply; and means for moving said closing means to open said orifice in response to air conditions in said main air supply path resulting from engine rotation.

8. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering member for controlling the effective size of said orifice; means for sensing the air speed in said main air path and for moving to a position indicative thereof; and means for moving said metering member in accordance with the movement of said sensing means.

9. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering member for controlling the effective size of said orifice; a rigid flap member normally spring urged into a position interrupting said main air supply path, and pivoted to swing to one side to clear said main path to a position indicative of the air speed in said main air path; and means for moving said metering member in accordance with the movement of said flap.

10. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; means on said rod for closing said orifice in one end position of said rod; spring means urging said rod towards its orifice closing position; a rigid flap member normally positioned to interrupt said main air supply path and pivoted to swing to one side to clear said main path; and means so interconnecting said flap and said rod that said spring, in urging said rod towards orifice closing position, also urges said flap towards main path interrupting position.

11. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; spring means urging said rod towards minimum orfice position; a rigid flap member normally positioned to interrupt said main air supply path and pivoted to swing to one side to clear said main path; means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards interrupting position; a pivoted throttle valve; crank arms rigidly connected to said flap and said throttle valve to pivot therewith; and a loose linkage connecting said crank arms and having a small amount of slack when the crank arms are at closed position of said throttle and said flap, for moving said metering rod substantially in concert with said throttle whenever said slack is taken up.

12. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; spring means urging said rod towards minimum orifice position; a rigid flap member normally positioned to interrupt said main air supply path and pivoted to swing to one side to clear said main path; means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards interrupting position; a pivoted throttle valve; crank arms rigidly connected to said flap and said throttle valve to pivot therewith; and a loose linkage connecting said crank arms and having a small amount of slack when the crank arms are at closed position of said throttle and said flap, for moving said metering rod substantially in concert with said throttle whenever said slack is taken up, said linkage including a relatively stiff spring capable of fully overcoming said metering rod spring without substantial deformation of itself.

13. A carburetor comprising a body including means providing an air supply path for connection with the intake manifold of an internal combustion engine; means providing a fuel metering orifice for projecting fuel in measured amount into said air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering member for controlling the effective size of said orifice; a rigid flap member normally spring urged into a position interrupting said air supply path, and pivoted to swing to one side to clear said path to a position indicative of the air speed in said path; a rock shaft to which said flap is rigidly connected and which is rockably mounted on said body to form the pivotal mounting for said flap; and means for moving said metering member in accordance with the movement of said flap, said last-mentioned means including a rotary drive member on said shaft rotatable with respect thereto, and a worm and worm wheel connection between said shaft and drive member forming an adjustable connection for providing enriching or leaning adjustment of the position of said metering member relative to the position of said flap member.

14. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path and including a nozzle tube extending across said main air path and having openings communicating therewith; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; spring means urging said rod towards minimum orifice position; a rigid flap member normally positioned to interrupt said main air supply path and pivoted to swing to one side to clear said main path; means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards interrupting position; a pivoted throttle valve; crank arms rigidly connected to said flap and said throttle valve to pivot therewith; and a loose linkage connecting said crank arms and having a small amount of slack when the crank arms are at closed position of said throttle and said flap, for moving said metering rod substantially in concert with said throttle whenever said slack is taken up.

15. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; a pivoted throttle valve in said air path; means providing an auxiliary air path connected in parallel with said main path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path and including a nozzle tube extending across said main air path upstream from said throttle and having openings communicating with said main air path; a flat spot correction conduit means connected to one end of said nozzle tube and communicating with said main air path at a location on the other side of said throttle valve from said nozzle tube; means providing a fuel metering orifice for projecting fuel in measured amount into said auxiliary air path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size of said orifice; spring means urging said rod towards minimum orifice position; a rigid flap member normally positioned to interrupt said main air supply path and pivoted to swing to one side to clear said main path; means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards interrupting position; crank arms rigidly connected to said flap and said throttle valve to pivot therewith; and a loose linkage connecting said crank arms and having a small amount of slack when the crank arms are at closed position of said throttle and said flap, for moving said metering rod substantially in concert with said throttle whenever said slack is taken up.

16. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a throttle valve in said air path; means for projecting fuel in measured amount into said air supply path including an idling jet providing a metering orifice; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; movable means for closing said orifice against said pressure fuel supply; and means for moving said closing means to open said orifice in response to depression created in said air supply path downstream from said throttle and resulting from engine rotation.

17. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a throttle valve in said air path; means for projecting fuel in measured amount into said air supply path including an idling jet providing a metering orifice; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; movable means for closing said orifice against said pressure fuel supply; and means for moving said closing means to open said orifice in response to depression created in said air supply path downstream from said throttle resulting from engine rotation, said moving means including a cylinder and piston and a conduit means connecting said cylinder at one side of said piston with said air path downstream from said throttle, said conduit means also communicating with said orifice to conduct the fuel discharged therefrom to said air path.

18. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; a throttle valve in said air path; means for projecting fuel in measured amount into said air supply path including an idling jet providing a metering orifice; means providing an auxiliary air path connected in parallel with said main air path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means for projecting fuel in measured amount into said auxiliary air path including a running jet providing a second metering orifice; means for supplying liquid fuel under pressure in excess of atmospheric to both of said orifices; movable means for closing said idling orifice against said pressure fuel supply; and means for moving said closing means to open said orifice in response to depression created in said main air supply path downstream from said throttle and resulting from engine rotation.

19. A carburetor comprising means providing a main air supply path for connection with the intake manifold of an internal combustion engine; a throttle valve in said air path; means for projecting fuel in measured amount into said air supply path including an idling jet providing a metering orifice; means providing an auxiliary air path connected in parallel with said main air path and for inducing a flow in said auxiliary path substantially proportional to the flow in said main path; means for projecting fuel in measured amount into said auxiliary air path including a running jet providing a second metering orifice; means for supplying liquid fuel under pressure in excess of atmospheric to both of said orifices; movable means for closing said idling orifice against said pressure fuel supply; and means for moving said closing means to open said orifice in response to depression created in said main air supply path downstream from said throttle and resulting from engine rotation, said moving means including a cylinder and piston and a conduit means connecting said cylinder at one side of said piston with said main air path downstream from said throttle, said conduct means also communicating with said idling jet orifice to conduct the fuel discharged therefrom to said main air path.

20. A carburetor comprising means providing a walled conduit defining an air supply path for connection with the intake manifold of an internal combustion engine; means including a fuel metering orifice for passing fuel in measured amount into said air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; spring means urging said rod towards minimum orifice position; a rigid flap member normally positioned transversely of said conduit to interrupt said air supply path and pivoted on an axis lying closely adjacent one wall portion of the conduit and so positioned that the flap in swinging away from transverse position will swing downstream into substantial parallelism and close proximity with that wall portion associated with the pivotal axis to clear said path; and means so interconnecting said flap and said rod that said spring, in urging said rod towards minimum orifice position, also urges said flap towards path interrupting position.

21. A carburetor comprising means providing a walled conduit defining an air supply path for connection with the intake manifold of an internal combustion engine; means providing a fuel metering orifice for passing fuel in measured amount into said air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; a rigid flap member normally positioned transversely of said conduit to interrupt said air supply path and pivoted on an axis lying closely adjacent one wall portion of the conduit and so positioned that the flap in swinging away from transverse position will swing downstream into substantial parallelism and close proximity with that wall portion associated with the pivotal axis to clear said path under the influence of air flowing into the intake manifold; means interconnecting said flap and said rod for moving the rod in response to swinging movement of said flap to provide an interconnected metering rod-flap system, in which motion of the flap towards interrupting position corresponds to motion of the rod towards minimum orifice position; and means acting on said system to urge movement of the same in the direction opposite to that resulting from the force of air flowing into the intake manifold.

22. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a pivoted throttle for controlling the air flow in said path; means providing a fuel metering orifice for passing fuel in measured amount into said air supply path upstream from said throttle; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; a rigid flap member normally positioned to interrupt said air supply path and pivoted to swing to one side to clear said path under the influence of air flowing into the intake manifold; means interconnecting said flap and said rod for moving the rod in response to swinging movement of said flap to provide an interconnected metering rod-flap system, in which motion of the flap towards interrupting position corresponds to motion of the rod towards minimum orifice position; and means acting on said system to urge movement of the same in the direction opposite to that resulting from the force of air flowing into the intake manifold, said last-named means comprising a first spring urging said rod towards minimum orifice position, and a second spring interconnecting said system and said throttle.

23. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a pivoted throttle for controlling the air flow in said path; means providing a fuel metering orifice for passing fuel in measured amount into said air supply path upstream from said throttle; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; a rigid flap member normally positioned to interrupt said air supply path and pivoted to swing to one side to clear said path under the influence of air flowing into the intake manifold; means interconnecting said flap and said rod for moving the rod in response to swinging movement of said flap to provide an interconnected metering rod-flap system, in which motion of the flap towards interrupting position corresponds to motion of the rod towards minimum orifice position; and means acting on said system to urge movement of the same in the direction opposite to that resulting from the force of air flowing into the intake manifold, said last-named means comprising a first spring urging said rod towards minimum orifice position, and a second spring interconnecting said system and said throttle and acting in such a direction as to provide force on the system in opposition to said first spring force and in a direction to increase its force in response to throttle opening movement if the system were held immobile.

24. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a pivoted throttle for controlling the air flow in said path; means providing a fuel meter-

ing orifice for passing fuel in measured amount into said air supply path; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; a rigid flap member normally positioned to interrupt said air supply path and pivoted to swing to one side to clear said path under the influence of air flowing into the intake manifold; means interconnecting said flap and said rod for moving the rod in response to swinging movement of said flap to provide an interconnected metering rod-flap system, in which motion of the flap towards interrupting position corresponds to motion of the rod towards minimum orifice position; and means acting on said system to urge movement of the same in the direction opposite to that resulting from the force of air flowing into the intake manifold, said last-named means comprising a first spring urging said rod towards minimum orifice position, and a second spring interconnecting said system and said throttle and acting in such a direction as to provide force on the system in aid of said first spring force and in a direction to decrease its force in response to throttle opening movement if the system were held immobile.

25. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a pivoted throttle for controlling the air flow in said path; means providing a fuel metering orifice for passing fuel in measured amount into said air supply path upstream from said throttle; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; a rigid flap member normally positioned to interrupt said air supply path and pivoted to swing to one side to clear said path under the influence of air flowing into the intake manifold; means interconnecting said flap and said rod for moving the rod in response to swinging movement of said flap to provide an interconnected metering rod-flap system, in which motion of the flap towards interrupting position corresponds to motion of the rod towards minimum orifice position; and means acting on said system to urge movement of the same in the direction opposite to that resulting from the force of air flowing into the intake manifold, said last-named means comprising a spring urging said rod towards minimum orifice position, and means for sensing the degree of manifold depression and for acting to provide a force on said system in aid of said spring and substantially in proportion to the degree of said depression.

26. A carburetor comprising means providing an air supply path for connection with the intake manifold of an internal combustion engine; a pivoted throttle for controlling the air flow in said path; means providing a fuel metering orifice for passing fuel in measured amount into said air supply path upstream from said throttle; means for supplying liquid fuel under pressure in excess of atmospheric to said orifice; a movable metering rod slidable through said orifice for controlling the effective size thereof; a rigid flap member normally positioned to interrupt said air supply path and pivoted to swing to one side to clear said path under the influence of air flowing into the intake manifold; means interconnecting said flap and said rod for moving the rod in response to swinging movement of said flap to provide an interconnected metering rod-flap system, in which motion of the flap towards interrupting position corresponds to motion of the rod towards minimum orifice position; and means acting on said system to urge movement of the same in the direction opposite to that resulting from the force of air flowing into the intake manifold, said last-named means comprising a spring urging said rod towards minimum orifice position, means for sensing the degree of manifold depression and for acting to provide a force on said system in aid of said spring and substantially in proportion to the degree of said depression, and a second spring interconnecting said system and said throttle and acting in such a direction as to provide force on the system in opposition to said first spring force and in a direction to increase its force in response to throttle opening movement if the system were held immobile.

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