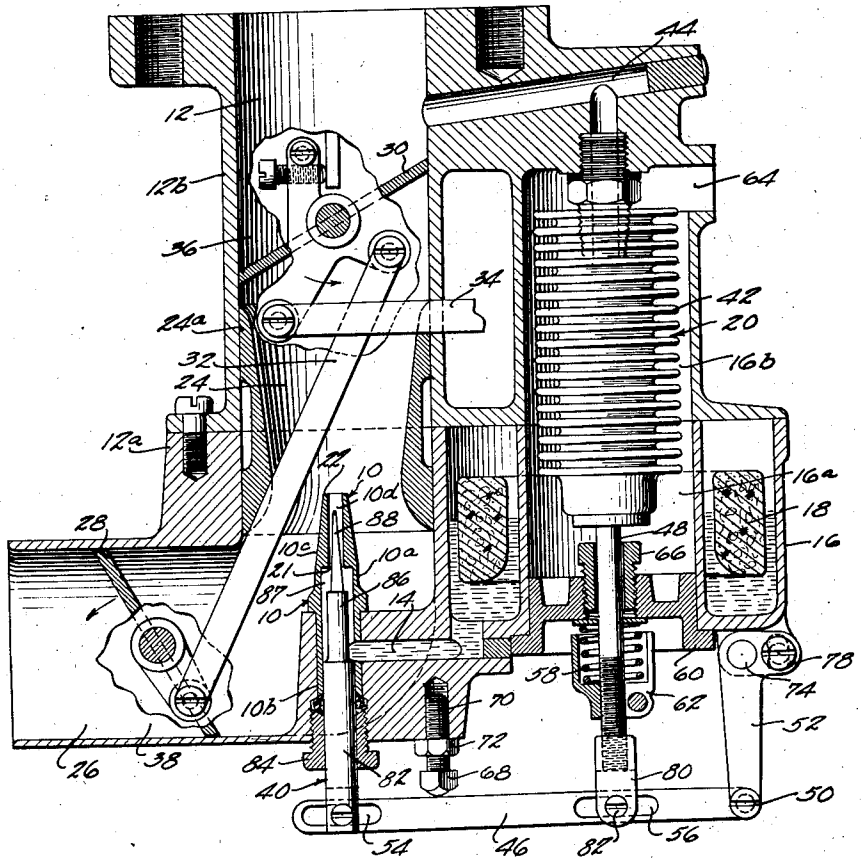
March 22, 1932. A. MOORE 1,850,307

CARBURETOR

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Fig. 1.



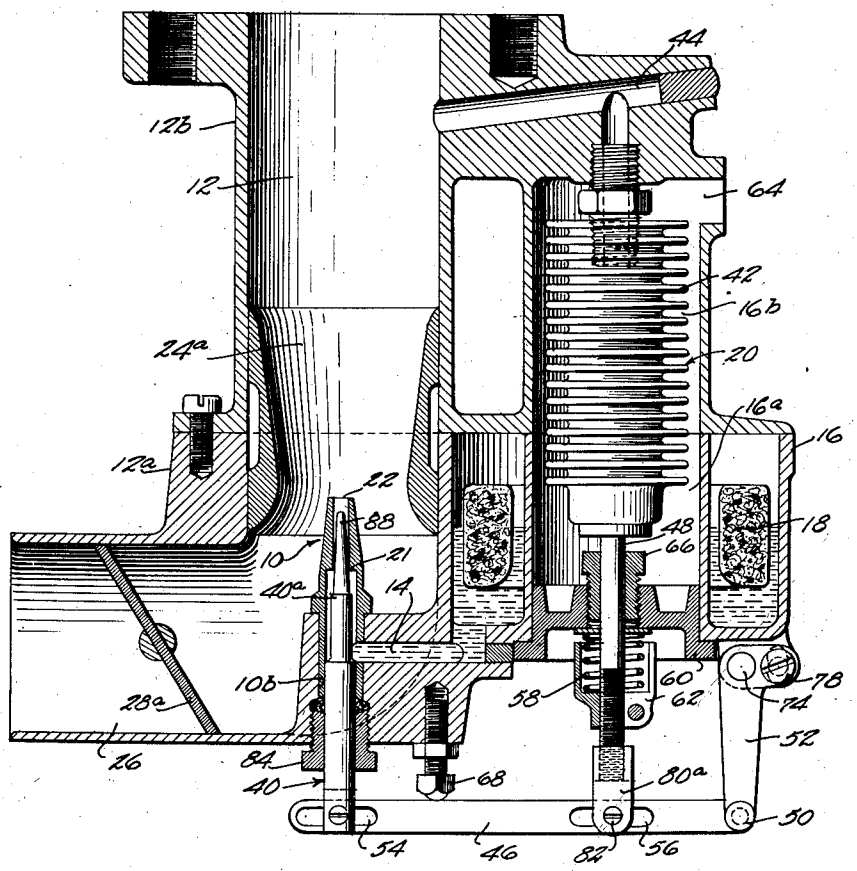
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FIG. 2.



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Patented Mar. 22, 1932

1,850,307

UNITED STATES PATENT OFFICE

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CARBURETOR

Application filed July 30, 1928. Serial No. 296,276.

My invention relates to fuel metering and supplying apparatus for internal combustion engines, and particularly transportation engines subject to wide momentary variations in power and speed; and the same has for its object more particularly to provide a simple, efficient and reliable apparatus which meters the fuel in response to variations in the intake pressure on the cylinder side of throttle or air controlling means, and delivers said fuel to the intake in accordance with the engine requirements.

Another object of said invention is to provide an apparatus of the character specified in which a single fuel jet is relied on at all engine loads and speeds, including idling, for supplying the requisite fuel without reliance upon the use of compensating or idling jets and/or like expedients.

Another object of said invention is to provide an apparatus of the character specified in which the fuel jet is disposed and controlled to supply the requisite fuel to the air stream throughout the operating range of the engine, and upon acceleration without appreciable fuel lag relative to the air, whereby to prevent "stumbling" in the operation of the engine.

Further, said invention has for its object to provide an apparatus of the character specified in which a drop in pressure below atmospheric is constantly maintained about the mouth of the fuel jet to effect the delivery of fuel from a constant level fuel chamber in its usual position relative to said jet throughout the operating range of the engine, while controlling the fuel jet orifice in synchronism with the variations in intake pressure within the intake conduit above the throttle, whereby to balance said drop in pressure about the fuel jet and the opening thereof to properly meter the fuel.

Other objects will in part be obvious, and in part be pointed out hereafter.

To the attainment of the aforesaid objects and ends my invention consists in the novel combinations and arrangement of parts hereinafter more fully described, and then pointed out in the claims.

In the accompanying drawings:

Figure 1 is a sectional elevation of one form of device constructed according to and embodying my said invention; and

Fig. 2 is a view similar to Fig. 1 showing a modification.

In apparatus embodying my invention I provide a fuel jet orifice of variable cross-section having a maximum cross-sectional area of an order of magnitude such as to supply fuel to the air by induction at the higher loads and speeds in proportions to produce a mixture for approximately maximum power, and capable of being controlled to decrease the extent of opening thereof at part throttle positions for supplying fuel to the air stream by induction in proportions to produce a mixture of approximately maximum economy.

The extent of opening of the fuel passage is varied throughout the operating range of the engine for supplying by the inductive effects of the engine the requisite fuel to the engine in quantities metered in accordance with the requirements of the engine at different speeds and loads.

In the apparatus of my invention, the opening of the fuel orifice is adjusted in accordance with the requirements to effect a balance between size of fuel opening and the reduction in pressure about the fuel jet due to the inductive effects of the engine, so that the fuel and air ratio throughout the operating range of the engine more nearly approximates the theoretical value therefor, and the said reduction in pressure may be accentuated to effect delivery of fuel from the float chamber throughout the operating range of the engine while maintaining the fuel metering characteristics of the jet by orifice area variation.

Referring to the drawings, the fuel jet or nozzle 10 disposed within the intake conduit 12 communicates through the passage 14 with the fuel receptacle or float chamber 16, the latter being of the constant level type in which the supply of fuel thereto is controlled by the usual valve actuated by the float 18.

The conduit 12 is formed in part in two castings 12^a and 12^b secured together by suit-

able fastening means. The float chamber 16 in the casting 12^a is preferably annular in form to provide a space 16^a therein registering with a space 16^b in the casting 12^b to form a bellows receiving chamber 20, the lower edge portions of the upper casting 12^b serving to close the float chamber 16.

The nozzle 10 consists of a lower tubular portion 10^a secured within a bore 10^b in the lower casting 12^a, and communicating with the passage 14, and of a tip portion 10^c having a relatively constricted passage 10^d therethrough. The lower end 21 of the passage 10^d is located below the fuel level within the chamber 16, and the outer end 22 thereof is located above said fuel level, the end of the nozzle 10 extending into the Venturi passage 24 of the member 24^a.

The air admitted to the intake conduit 12 through the horizontal opening 26 in the casting 12^a is preferably controlled by the throttle valve 28 located below the nozzle 10, and by the throttle valve 30 located above or beyond said nozzle, providing above the throttle 30 a region of maximum reduction of pressure, and between said valves a region wherein fuel nozzle 10 is located having a pressure of a value intermediate between that of the atmospheric pressure below valve 28 and the pressure above valve 30, the valve 28 serving as a gate for maintaining a reduction of pressure about the fuel nozzle 10.

The valves 28 and 30 are preferably connected by the link 32 to work in unison, and are preferably manually operated by a link 34 extending to a point convenient for actuation. The size of the passage 12 at the point 36 where the valve 30 is located is slightly less than that of the passage at the point 38 where the valve 28 is located. When the throttle 30 is slightly cracked the throttle 28 will open to a slightly greater extent so that a reduction of pressure can be maintained about the jet 10 at the idling period for effecting the lifting of the fuel from its level in the chamber 16 to the tip 22 of the nozzle, without causing excessive reduction in pressure about the jet 10 and thereby preventing undue enrichment of the charge mixture. As the throttle 30 opens, the throttle 28 likewise opens until under maximum power conditions both throttles are open to the maximum extent. The velocity of the air through the Venturi passage 24 as the throttle opens becomes effective in maintaining reduction of pressure about the fuel nozzle 10 for lifting fuel. By this arrangement upon acceleration of the engine the fuel nozzle 10 is subjected to a greater reduction in pressure than in the case of the usual carburetor, and air velocity upon acceleration is somewhat retarded by the two valves 28 and 30 so that fuel impoverishment or lag is reduced, and stumbling of the engine upon acceleration largely prevented. Further, in view of the initially relatively larger reduction in pressure acting on the fuel jet compared to that acting on the ordinary carburetor fuel jet, upon acceleration, the inertia of the fuel, or the tendency thereof to travel at its velocity prior to acceleration, tends to effect the delivery thereof to the air stream without lagging, even though upon acceleration the fuel orifice is increased in size and more fuel is delivered.

The extent of opening of nozzle 10 is regulated by a modulating valve pin 40, and provision is made for operating said pin 40 in response to variations in the pressure difference between the engine intake pressure and the pressure of the amtosphere.

In the form shown, the interior of a pressure responsive member, such as the bellows or expansible-contractible element 42 disposed within the chamber 20 communicates through the inclined drainage channel 44 with the passage 12 leading to the intake manifold, and the bellows 42 operates a lever 46 by means of stem 48; and lever 46, pivoted at 50 to the adjustable arm 52, actuates the fuel modulating pin 40. Pivotal connections are preferably made by slots 54, 56, in lever 46 to facilitate adjustments.

Contracting movement of bellows 42 responsive to pressure reduction in passage 12 moves valve 40 toward its closing position. Such movement is opposed by the adjustable tension spring 58 encircling stem 48 and interposed between the base 60 closing the lower end of the chamber 20 and the adjustable screw collar 62 on stem 48. The bellows chamber 20 has an opening 64 in its wall for admitting air to the interior thereof. Stem 48 is guided and bellows 42 kept straight by a guide bushing 66 adjustably threaded in an opening in the base portion 60, and constituting an adjustable stop for limiting the expanding movement of the bellows 42 and retaining the same under initial tension.

As the pressure in bellows 42 rises, the bellows (shown contracted at Fig. 1) expands, and valve 40 further opens by this movement, which is assisted by the spring 58.

The contracting movement of the bellows is limited by the adjustable stop 68 threaded at 70 into the casting 12^a and locked in position by a nut 72. As the bellows contracts, the lever 46 engages stop 68. The leverage of the member 46 is controlled by adjustment of the arm 52 which is pivoted at 74 to a depending portion of the closure 60. The arm 52 is provided with an arcuate slot 76 receiving the screw 78. When the screw is loosened, the arm 52 may be swung about its pivot 74 to adjusted position and secured by the screw 78. In order to adjustably vary the extent of movement of the pin 40 upon operation of the bellows, the pivotal connection between the stem 48 and lever 46 in-

cludes a member or clevis 80 threaded on the end of the stem 48 and carrying a pivot pin 82 riding in the slot 56. When the pivot pin 82 and lever 46 are disconnected from the member 80, the latter may be adjusted through one or more 180° turns and the parts reconnected thereto. The angularity of the lever 46 is thus adjusted which controls the extent of movement of the pin 40 for a given movement of the bellows.

The valve 40 has a cylindrical base portion 82 sliding within the bushing or bearing 84 secured within the bore 10^b in the casting 12^a of the device, a relatively constricted intermediate portion 86 disposed within the tubular portion 10^a of the fuel nozzle and providing therewith an annular space 87 for the passage of the fuel, and a calibrated tapered end portion 88 extending into the cylindrical orifice or opening 21 of the fuel jet 10, and adapted to vary the size of the opening 21 between the minimum and maximum limits by axial movement for the purpose above described.

The tapered end portion 88 of the modulating valve 40 working in the opening 21 provides an annular orifice at 21 of variable cross-section located below the level of the fuel in the constant level chamber. The constricted character of the said annular orifice upon passage of fuel therethrough tends to disintegrate the fuel, while the portion 22 of the passage beyond the same is preferably made of relatively greater cross-sectional area, even greater than the area of the fuel jet orifice of the ordinary carburetor, to facilitate the passage of the fuel therethrough in a finely divided state and its delivery to the air stream duly metered without subjecting the same to frictional resistance or capillary effects resulting from constriction of the portion of the fuel jet above the fuel level as is the ordinary practice. Hence, by making the portion of the fuel jet below the fuel level the most constricted portion thereof and capable of variation, the reduction of pressure maintained about the fuel jet by the lower throttle and the Venturi means is rendered more effective for lifting the fuel through the distance required, and upon acceleration for preventing lagging of the fuel relative to the air stream. Further, when the engine is at rest it is not necessary to completely close the fuel orifice passage because the tip of the nozzle 10 is above the fuel level in the float chamber.

The valve 40 is actuated in substantially exact synchronism with the variations in the intake pressure above the throttle 30. The value of the intake pressure above the throttle 30 approaches the atmospheric pressure as the throttle opens, and varies directly with the throttle opening. Hence the value of the intake pressure or of the intake depression (the differential between the intake pressure and atmospheric pressure) varies with the load imposed on the engine, and also to a lesser extent with the speed, the throttle being opened to admit more air as the load requirements increase. The bellows 42 controls the pin 40 to meter the fuel in accordance with the engine requiremnts, without the entire dependence placed in the ordinary carburetor upon variations in pressure reduction at the fuel orifice for lifting the fuel to the tip of the fuel nozzle, which at low power operation interferes with correct fuel metering.

In Fig. 2 I have illustrated a modification in which the fuel nozzle 10 is subjected to full intake depression above the throttle 28^a actuated manually in the usual manner and controlling the admission of air, the throttle above the fuel jet, such as the throttle 30 at Fig. 1, being dispensed with. In this latter form, because of the greater intake depression, or greater reduction of pressure about the nozzle 10, the taper 88 of the pin 40^a is calibrated to form a relatively smaller fuel discharge orifice at idling than in the form shown at Fig. 1, or, if so desired, the member 80^a may be adjusted to vary the movement of the pin 40^a to obtain such smaller fuel orifice at idling. In such event the taper of the pin can be the same as that shown at Fig. 1. As the throttle 28^a opens to admit more air to satisfy the load requirements, the intake depression decreases and the extent of opening of the fuel nozzle increases. The increased air velocity through the Venturi passage 24^a as the throttle 28^a opens compensates for the reduction in intake depression and produces sufficient reduction of pressure about the fuel nozzle 10 to cause the elevation of fuel from the float chamber 16 through the slight distance to the tip of the nozzle 10. In this form of the invention, which in other respects is like the form shown at Fig. 1, the single fuel nozzle, without the use of idling or compensating jets for supplementing the same, effectively delivers fuel duly metered to the air stream in synchronism with variations in intake depression throughout the operating range of the engine.

The quantity of fuel required for a given engine throughout the operating range may be readily ascertained, and the inclination of the tapered portion 88 designed accordingly to vary the opening 21 to supply the requisite fuel as the bellows moves between its limits.

With my invention the ordinary choke operated from the dash is omitted. In starting the two throttles shown at Fig. 1, or the single throttle shown at Fig. 2, are opened to an extent as not to spoil moderate choking effect. The modulating pin is wide open when the engine is at rest. When the engine is turned over a relatively rich mixture is drawn into the cylinders. As the engine speeds up, upon ignition thereof, the modu-

lating pin automatically moves towards orifice restricting position, due to the resulting increase of intake depression.

Among the features of advantage obtained are simplicity of construction, enabling expensive and troublesome idling and compensating jets and the like to be dispensed with and yet metering the fuel accurately for all requirements by means of the modulating pin operated by pressure differential and in substantially inverse relation thereto; there is no appreciable loading up of fuel on the intake passage walls at periods of engine deceleration; and the fuel is self-regulating at all loads and speeds, and efficiently delivered into the air stream. For example, the fuel nozzle can be of opening area adapted, when such entire area is in use, for full load operation at low engine speed, and as the engine speeds up, for example, in accelerating, the excess supply of fuel which would result from increased air velocity past a jet of fixed opening is avoided by intake depression being increased by increased piston speed, causing the fuel inlet opening to be reduced by movement of the modulating valve adapted to produce this effect. The fuel jet discharges at low engine loads into a region of relatively low pressure, the reduction of pressure, however, being greater in the form shown at Fig. 2 than in that shown at Fig. 1. This reduction of pressure together with the relatively constricted annular orifice through which the fuel passes into the enlarged tip portion aids materially in securing a thorough atomizing of the fuel including the heavier ends thereof, and the delivery thereof to the air stream into homogeneous admixture therewith.

I claim:

1. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, means for controlling the air supply through said conduit, a fuel jet in said conduit subject to the pressure reduction therein beyond said air controlling means, a constant level fuel chamber communicating with said fuel jet and having a fuel level below the discharge end of said jet, and a valve movable axially within said fuel jet, and forming a relatively constricted annular orifice of variable cross-section at a point below the level of the fuel in said chamber; the portion of said fuel jet beyond said annular orifice being of relatively enlarged cross section to permit of the free passage of fuel in a finely divided state therethrough from said annular orifice into the air stream, and means responsive to variations in pressure reduction in said conduit resulting from movement of said air controlling means for actuating said valve to vary said annular orifice in inverse relation to the variations in pressure reduction.

2. In a fuel supplying and metering apparatus for internal combustion engines, air inlet means, means for restricting the extent of opening of the air inlet means, a venturi beyond said air inlet restricting means and traversed by the air stream passing the restricting means, fuel supplying means terminating in said venturi between the air inlet restricting means and the engine cylinders, a constant level fuel chamber communicating with said fuel supplying means and having the fuel level thereof below the discharge end of said fuel supplying means, a metering orifice in said fuel supplying means below the fuel level, a calibrated modulating pin for controlling the extent of opening of the metering orifice of said fuel supplying means, and a pressure responsive device having a passage independent of the fuel supply passages for transmitting the variations in intake pressure above said air inlet restricting means and resulting from the movement thereof for actuating said modulating pin and controlling the same to effect a balance between the extent of opening of the fuel supplying means and the reduction of pressure about the discharge end thereof, whereby to meter the fuel in accordance with the engine requirements.

3. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a fuel jet therein, air controlling throttles in said conduit at opposite sides of said fuel jet interconnected for joint operation, and the lower thereof serving to maintain a reduction of pressure about said fuel jet for elevating fuel, and means responsive to the variations in the differential between the atmospheric pressure and the pressure in said conduit above the upper throttle for controlling the extent of opening of said fuel jet in inverse relation to the variations in pressure differential resulting from throttle movement.

4. In a fuel supplying and metering apparatus for internal combustion engines, an air condiut, a fuel jet therein, air controlling throttles in said conduit below and above said fuel jet interconnected for joint operation; the lower of said throttles providing a relatively greater opening in said conduit than the upper of said throttles for a given movement of said upper throttle and serving to maintain a reduction of pressure about said fuel jet for elevating the fuel, and means for varying the passage of fuel through said jet in substantially inverse relation to the variations in intake depression substantially over the range thereof.

5. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a fuel jet therein, air controlling throttles in said conduit below and above said fuel jet interconnected for joint operation; the lower of said throttles providing a relatively greater opening in said conduit than the upper of said throttles for a given

movement of said upper throttle and serving to maintain a reduction of pressure about said fuel jet for elevating the fuel, and means responsive to the variations in the differential between the atmospheric pressure and the pressure in said conduit above said upper throttle for controlling the extent of opening of said fuel jet.

6. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a fuel jet therein, a constant level fuel chamber for said fuel jet, air controlling throttles in said conduit at opposite sides of said fuel jet, and the lower thereof serving to maintain a reduction of pressure about said fuel jet, means for actuating said throttles in unison, means associated with said fuel jet for maintaining a reduction of pressure about the same as said throttles open wider, and means responsive to the variations in the differential between atmospheric pressure and the intake pressure above the upper of said throttles for controlling the extent of opening of said fuel jet in inverse relation to the variations in pressure differential resulting from throttle movement.

7. In a fuel supplying and metering apparatus for internal combustion engines, air inlet means, a fuel jet therein, valves in said means below and above said jet for restricting the extent of opening of the air inlet means and maintaining a reduction of pressure about said fuel jet, means for actuating said valves in unison, a constant level fuel chamber communicating with said fuel jet, and having the fuel level thereof below the discharge end of said fuel jet, a modulating pin for controlling the extent of opening of said fuel jet, and a pressure responsive device subject to the variations in the difference between the atmospheric pressure and the intake pressure above the upper of said restricting valves for actuating said modulating pin and controlling the same to effect a balance between the extent of opening of said fuel jet and the reduction of pressure about the discharge end thereof, whereby to meter the fuel in accordance with the engine requirements.

8. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a venturi therein, a fuel jet having the discharge end thereof in said venturi, means below said jet for controlling the air supply through said conduit and maintaining a reduction of pressure about the discharge end of said jet, a constant level fuel chamber for supplying fuel to said jet having a fuel level below the discharge end of said jet, a member movable axially within said jet and forming therein a constricted orifice of variable cross-section below said fuel level; said jet having relatively enlarged discharge portion beyond said orifice for the free passage of fuel in a finely divided state, and means responsive to variations in the difference between the atmospheric pressure and the intake pressure for actuating said member to vary the extent of opening of said annular orifice in substantially inverse relation to the last named variations in difference of pressure.

9. In a fuel supplying and metering apparatus for internal combustion engines, a plurality of parts forming an air conduit; one of said parts having an annular fuel chamber therein, and the other of said parts having an opening therein registering with the central opening in said annular fuel chamber; a fuel jet carried by one of said parts and extending into said air conduit, and a pressure responsive device for controlling said fuel jet disposed within the chamber formed by said registering openings.

10. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a venturi therein, a fuel nozzle having the discharge end thereof disposed in said venturi at the restriction thereof, and having a metering orifice, a constant level chamber for said fuel nozzle having a fuel level in proximity to said discharge end and submerging said metering orifice, means at the atmospheric side of said venturi for controlling the air flow through said venturi and said conduit, and maintaining a reduction of pressure about the discharge end of the fuel nozzle, intake pressure reduction and air flow through the venturi varying relatively inversely to maintain a flow of fuel from said constant level chamber into said conduit, and means for controlling the fuel flow through said metering orifice in inverse relation to the variations in intake depression to counteract the inductive effects of the intake depression as the same approaches the greater values thereof.

11. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, means for controlling the air supply through said conduit, a fuel passage terminating in said conduit beyond the air controlling means for subjecting the fuel to the pressure reduction therein, a constant level fuel chamber communicating with said fuel passage and having a fuel level below the discharge end of the fuel passage, a valve movable within said fuel passage and forming a relatively constricted orifice of variable cross-section at a point below the level of the fuel in said chamber, the portion of said fuel passage beyond said orifice being of relatively enlarged cross-section to allow free passage of fuel in a finely divided state therethrough from said orifice into the air stream, and means for actuating said valve to vary said orifice in inverse relation to the variations in pressure reduction.

12. In a fuel supplying and metering apparatus for internal combustion engines, an

air conduit, a fuel jet therein, air controlling throttles in said conduit at opposite sides of said fuel jet, and the lower thereof serving to maintain a reduction of pressure about said fuel jet, means for actuating said throttles in unison, and means responsive to the variations in the differential between atmospheric pressure and the intake pressure above the upper of said throttles for varying the passage of fuel through said fuel jet in inverse relation to the differential variations substantially throughout the range thereof.

13. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a fuel jet therein, a constant level fuel chamber for said fuel jet having a fuel level in proximity to the discharge end of said fuel jet, air controlling throttles in said conduit at opposite sides of said fuel jet, and the lower thereof serving to maintain a reduction of pressure about said fuel jet of reduced value compared to the pressure reduction above the upper throttle, means for actuating said throttles in unison, a venturi receiving said fuel jet for maintaining a reduction of pressure about the same as said throttles open wider, and means responsive to the variations in the differential between atmospheric pressure and the intake pressure above the upper of said throttles for varying the passage of fuel through said jet in inverse relation to the differential variations substantially over the range thereof.

14. In a fuel supplying and metering apparatus for internal combustion engines, an air conduit, a venturi therein, a fuel jet having the discharge end thereof in said venturi, throttles above and below said jet for controlling the air supply through said conduit and maintaining a lesser reduction of pressure about the discharge end of said jet than that above the upper throttle, a constant level fuel chamber for supplying fuel to said jet having a fuel level below the discharge end of said jet, a member movable axially within said jet and forming therein a constricted orifice of variable cross-section below said fuel level, said jet having a relatively enlarged discharge portion beyond said orifice for the free passage of fuel in a finely divided state, and means responsive to the variations in pressure reduction above the upper throttle for actuating said member to vary the extent of opening of said orifice in substantially inverse relation to said variations in pressure reduction.

In testimony whereof I have signed my name hereto.

ARLINGTON MOORE.

CERTIFICATE OF CORRECTION.

Patent No. 1,850,307. Granted March 22, 1932, to

ARLINGTON MOORE.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 5, line 69, claim 8, strike out the word "annular"; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 26th day of April, A. D. 1932.

(Seal)

M. J. Moore,
Acting Commissioner of Patents.