Feb. 17, 1959 E. OLSON 2,873,732

FUEL INDUCTION SYSTEM

Filed Sept. 10, 1956 3 Sheets-Sheet 1

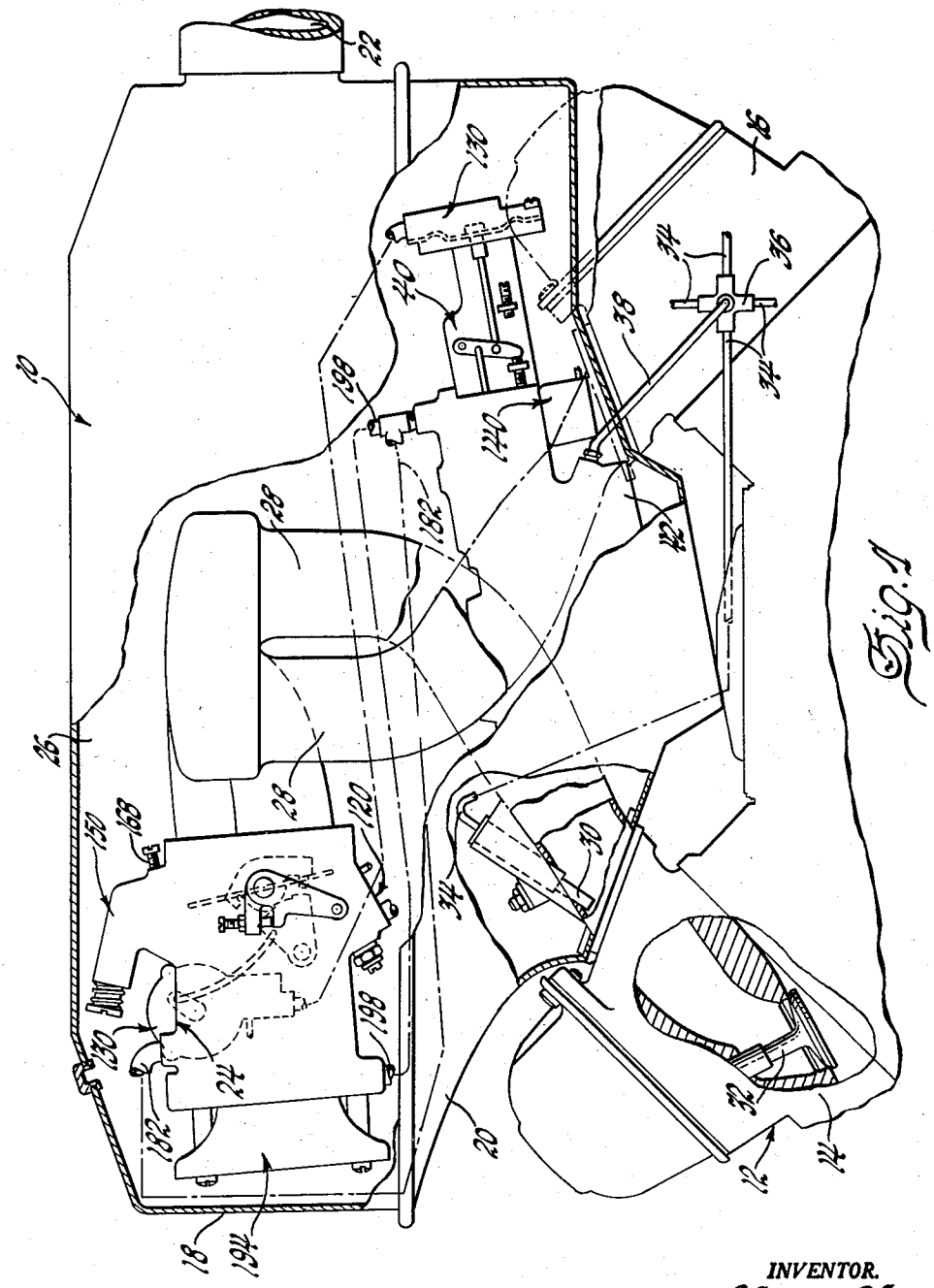


Fig. 1

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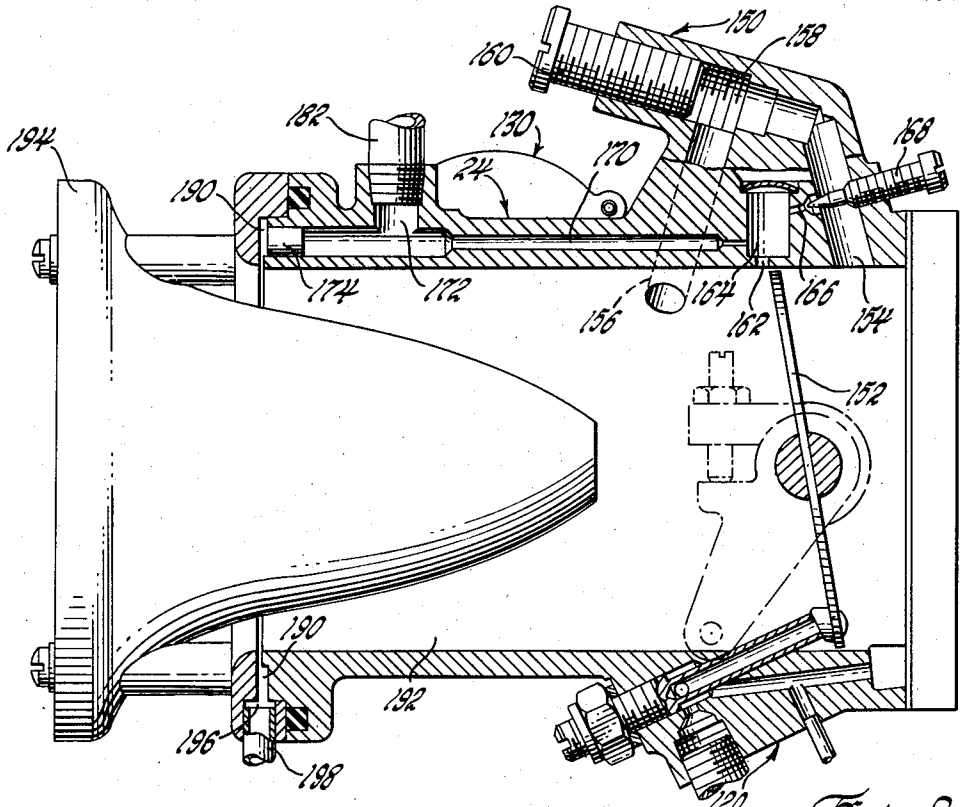


Fig. 2

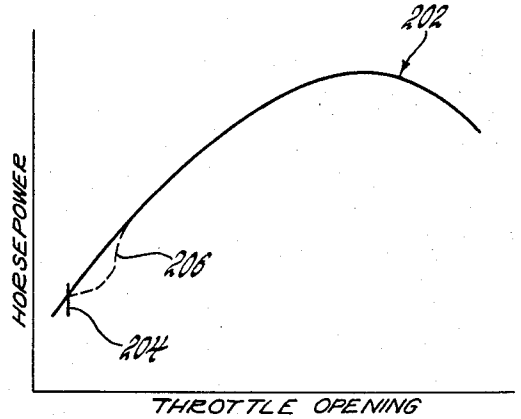


Fig. 3

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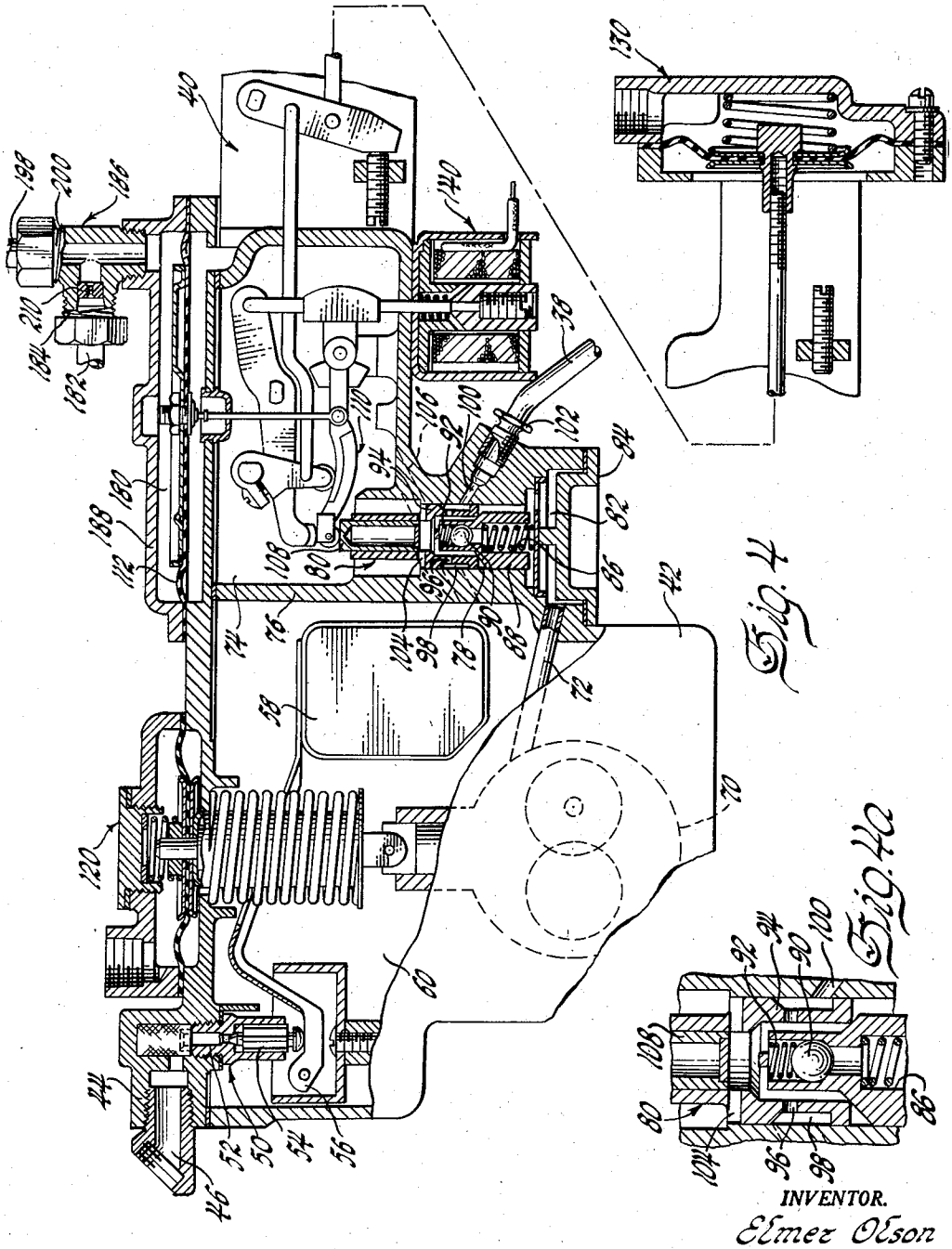


Fig. 4

Fig. 4a

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2,873,732

FUEL INDUCTION SYSTEM

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Application September 10, 1956, Serial No. 608,797

10 Claims. (Cl. 123—119)

The present invention relates to a fuel induction system of the type in which fuel is supplied in proportion to the mass of air flowing therethrough. The present invention is an improvement in the fuel induction system of the type shown in copending application Serial No. 608,853 Dolza, filed September 10, 1956.

In the present type fuel induction system, the mass of air flowing through the system is indicated by vacuum forces induced by the flow of air through various parts of the induction passage. The vacuum thus produced is conveyed to a vacuum actuated fuel control device wherein the quantity of fuel supplied increases with an increase in vacuum, indicative of increased air flow.

In fuel induction systems of the same mass air flow type not utilizing the present invention, during idling a vacuum signal is transmitted to the vacuum responsive fuel control member fixing the quantity of fuel being supplied to the engine for proper idling. Thereafter, in opening the throttle from its idling position there is a temporary drop in control vacum prior to the induction passage air flow increasing sufficiently to raise the vacuum signal to that obtained at the time of idling. As the result of this vacuum drop an incorrect signal is temporarily fed to the vacum responsive fuel controlling mechanism reducing the quantity of fuel supplied and thereby leaning the combustible mixture to an extent causing a drop or lag in engine power at a time when increased power is being demanded.

The present improved fuel induction system includes means whereby the objective of a smoother flow of power is realized in effecting the transition from idling to normal running operation. The objective of smoother power flow is achieved in the present device by providing a system in which it is possible to delay the drop in idling vacuum until such time as the normal air flow through the induction system is adequate to relay an accurate indication of engine fuel requirements to the fuel controlling mechanism.

Further objects and advantages of the present invention will be apparent from a perusal of the detailed description which follows.

In the drawings:

Figure 1 is a partially broken away elevational view of an engine utilizing the subject fuel induction system;

Figure 2 is a partially sectioned view of the venturi and vacuum control signal passages;

Figure 3 is a graph illustrating the function of the present invention;

Figure 4 is a partially sectioned view of the fuel control metering system; and

Figure 4*a* is an enlarged fragmentary view of the fuel metering valve disclosed in Figure 4.

The present fuel induction system, except as will hereinafter be specifically described, is the same as that shown and described in copending application Serial No. 608,853 Dolza, filed September 10, 1956. Accordingly the system will be described in detail only in relation to the mechanism which specifically constitutes the subject

matter of the present invention, or such other mechanism as is necessary to an understanding of said invention.

Referring to Figure 1, the subject type fuel induction system indicated generally at **10** is shown mounted on a V-type engine **12**. The fuel induction mechanism is disposed above and substantially intermediate the cylinder banks **14** and **16**. It is, of course, to be understood that the invention is in no way limited by the cylinder configuration and is equally adapted to in-line or other type engines.

In general the fuel induction system is housed in a shroud consisting of an upper casing **18** and a lower casing **20**. Disposed within the shroud is an air inlet opening **22** which preferably has an air cleaner, not shown, associated therewith. Air in the shroud casing **22** is drawn into an air horn casing indicated generally at **24**. Air from the air horn **24** passes into a plenum chamber **26** from whence the air is delivered through manifold passages **28** to the respective engine cylinders as described in copending application Serial No. 608,853 Dolza, filed September 10, 1956.

Fuel nozzles **30** are mounted in the lower ends of manifolds **28** adjacent the intake valves **32** of the respective cylinders and supply fuel thereto when the intake valves are open. Fuel is supplied through a conduit **34** to each fuel nozzle **30** from a fuel manifold **36** which is in turn supplied by a conduit **38** from a fuel supplying and metering device indicated generally at **40**. The fuel nozzles are more fully described in copending application Serial No. 608,895, filed September 10, 1956, Dolza et al.

The fuel supplying and metering device **40**, as shown in Figure 4, is mounted in a housing which includes a case **42** and a cover **44**. A conduit **46** is formed in cover **44** and is supplied with fuel from a low pressure make-up pump, not shown. A float controlled valve mechanism **50** is also disposed in cover **44** and communicates with conduit **46** through a passage **52** to which filtered fuel is supplied in accordance with the vertical position of the valve member **54** as determined by the position of a pivoted float actuated arm **56**. In the normal manner, as float **58** is raised and lowered a valve **54** will shut off or admit fuel into a fuel reservoir **60** provided in casing **42**.

A constant displacement type pump **70** which is driven at engine speed is mounted in the fuel reservoir and is adapted to pump fuel from the reservoir **60** to a conduit **72** leading generally to a metering chamber **74**.

Chamber **74** is separated from the fuel reservoir by a partition **76**. A bore **78** is formed in the casing of chamber **74** and is adapted to support therein a fuel metering valve **80**, the details of which are described in the aforementioned copending application Serial No. 608,853, filed September 10, 1956, Dolza et al. Suffice it to say that conduit **72** supplies fuel to a chamber **82** defined by valve **80** and a removable plug **84**. The fuel passes from chamber **82** through a central conduit **86**, formed in a slidable plug portion **88** of the valve **80**, to a ball check valve **90** seated upon the upper end of the plug **88**. Valve **90** blocks the flow of fuel through conduit **86** with a force determined by the rate of a spring **92** which presses upon the ball check valve **90**. The valve **80** also includes a cylindrical sleeve **94** having a plurality of circumferentially disposed ports **96** therein which communicate the fuel flowing around ball check valve **90** to an annularly relieved portion **98** of sleeve **94**. The annularly relieved portion **98** of sleeve **94** thereafter communicates with a passage **100** in the casing wall into which is threaded an adapter plug **102** connecting with the fuel manifold supplying conduit **38**.

Sleeve **94** also has a set of peripherally disposed bypass or spill ports **104** above the ports **96**. Ports **104** communicate the interior of sleeve **94** to the chamber **74** and thence through a passage **106** back to the fuel

reservoir. To control the quantity of fuel bypassed through valve **80** back to reservoir **60** and hence the quantity of fuel supplied to the fuel nozzles, a cylinder **108** closed at the upper end is slidably mounted in sleeve **94**. The open end of cylinder **108** terminates proximate spill ports **104** in sleeve **94**. Fuel pressure within the valve body and which, as noted, is proportional to engine speed tends to move the cylinder **108** upwardly to open ports **104** and thereby bypass fuel to the reservoir.

A linkage mechanism indicated generally at **110** and controlled by a diaphragm **112** exerts a force on top of the valve, as generally described in the aforementioned copending application Serial No. 608,853, filed September 10, 1956, which is proportional to the quantity of air flowing through the system. Thus it will be seen that the quantity of fuel supplied to the nozzles **30** by metering valve **80** is proportional to the differential effect of engine speed, as manifested by fuel pressure, and the quantity of air flowing through the system, as manifested by vacuum acting on diaphragm **112**.

Other features of the subject type system such as the coasting shutoff mechanism **120** as well as the fuel enrichment devices **130** and **140** are described in detail in copending application Serial No. 608,853, filed September 10, 1956. Since these devices are not directly pertinent to the subject invention no further reference will be made thereto.

In Figure 2 an idle air bleed device **150** is provided in air horn casing **24** for bypassing air around a throttle **152** during the idle operation of the system. Device **150** includes a passage **154** terminating posteriorly of the throttle valve **152**, a second passage **156** terminating anteriorly of the throttle and a passage **158** connecting posterior-anterior passages **154** and **156**. An adjustable valve **160** is mounted in the air horn casing **24** and provides a means whereby the quantity of bypass air may be varied.

Disposed in parallel with the idle air bleed device **150** is passage means for sensing the quantity or mass of air flowing through idle air bleed. The quantity sensing means includes a passage **162** communicating with the induction passage bore immediately anterior of throttle **152**. Passage **162** connects with a somewhat larger chamber **164** in turn connected through a passage **166** to air bleed passage **154**. Thus as idle air passes through passage **154** a vacuum is created in chamber **164** proportional to the quantity of said idle air. An adjustable needle valve **168** is mounted in the air horn casing and projects into passsage **166** in order to vary the magnitude of the low air flow vacuum signal which is created during idling.

In order to convey the low air flow vacuum signal from the air horn **24**, an axial passage **170** is formed in the casing **24** and terminates in a perpendicularly disposed threaded boss **172**. For ease of manufacture, passage **170** may be drilled or cored through the casing **24** and thereafter blocked off at the upper end by a plug **174**.

Thus, with the throttle valve closed, as shown in Figure 2, air will be bypassed through passages **156**, **158** and **154** creating a low air flow vacuum signal in chamber **164** and passage **170**. This vacuum signal is conveyed to the diaphragm chamber **180** by a conduit **182** which connects with one nipple **184** of a T-plug **186** threadedly mounted in the vacuum chamber cover **188**.

Upon the opening of throttle **152** the low air flow vacuum signal gradually reduces until it is essentially nonexistent or at least has little further fuel control influence on the system. Therefore, additional means is provided whereby a high air flow vacuum signal will be transmitted to diaphragm chamber **180** to maintain the control of metering valve **80**. To this end an annular chamber **190** is formed adjacent the throat of a venturi **192**. The venturi itself is shown and described in copending application Serial No. 609,021, filed September 10, 1956, Barr. It is enough to say with regard to the venturi at this point that it is formed by the straight sided cylindrical air horn **24** into which projects a shaped plug **194** resulting in an annular venturi of a type uniquely adapted to provide adequate air flow through the system. The annular chamber **190** peripherally communicates at its radially inner end with the venturi throat. Casing **24** is formed with an opening **196** in communication with the annular chamber **190** and which opening is adapted to receive one end of conduit **198**, the other end of which connects with the remaining nipple **200** of T-plug **186**.

During conditions of low air flow, as at idling as described above, the air flow through venturi **192** is so low as to create virtually no vacuum in the annular chamber **190**. However, as air flow increases during the transition from idling to normal operation the quantity of air flow through the venturi progressively increases and with it the magnitude of vacuum in annular chamber **190**. Thus, the relationship between the vacuum signals in chambers **164**, and **190** is generally such that as one increases the other decreases with the increasing vacuum force tending to provide the fuel controlling signal in diaghragm chamber **180**.

As already noted, however, before the advent of the present device, the transition from the idle vacuum signal to the normal, or high flow, vacuum signal has resulted in a temporary drop in vacuum in the diaphragm chamber **180**. This situation is graphically illustrated in Figure 3 where horsepower is plotted against throttle opening to provide a power curve **202**. Assuming the engine to be idling at point **204** it has been found, prior to the present invention, that in opening the throttle from idling position instead of the power following the solid curve there actually developed a loss or lag in power as shown by the dash curve portion **206**. This power loss or lag reflects the temporary drop in induction passage vacuum in making the transition from a low to a high air flow condition during the transitionary operation noted.

The present invention avoids this drop by providing separate passage means for conveying the high and low flow vacuum signals to the diaphragm, as already described, and further in providing means within the idle vacuum signal system whereby the vacuum control chamber is prevented from dropping too rapidly before the high flow vacuum signal reaches a value adequate to reflect the actual fuel requirements of the engine.

To this further end, an orifice **210** has been provided in nipple **184** of the T-plug **186**. The orifice **210** is calibrated so as to insure that as throttle valve **152** opens and thereby reduces the vacuum force in chamber **164**, the drop in vacuum or increase in pressure in conduit **182** is communicated very slowly to the diaphragm chamber **180**. The fuel leaning effect of the vacuum drop thus being delayed until the high air flow vacuum signal in annular chamber **190** is adequate to maintain the vacuum signal in diaphragm chamber **180** at least substantially constant during the transition from idling to normal running operation.

It is to be understood that the delay in vacuum drop occasioned by the use of orifice **210** takes place over a very short space of time but the delay need only be long enough until air begins flowing through the venturi in a quantity sufficient to at least match the idle air flow signal.

While it has been convenient to connect both conduits **182** and **192** to a common T-plug **186** it is equally possible that both of the conduits be individually connected to the casing **188** if this is desired. Similarly for ease of manufacture it is proposed to locate the orifice **210** in the T-plug as shown. Here again the construction may be modified to provide the orifice elsewhere in the low air flow vacuum signal system. It is, of course, obvious that

the orifice 210 is removably disposed in the system such that various size orifices may be provided to more closely match the operating characteristics of particular engines.

It is apparent that additional structural modifications may be made within the scope of teaching of the present device.

I claim:

1. A fuel control system comprising an induction passage; a venturi in said passage; valve means for controlling the flow of air through said passage; passage means for bypassing air around said valve when the valve is closed for idling operation; a nozzle posterior of said valve for supplying fuel to said induction passage; a control device for supplying fuel to said nozzle, said device including a fuel metering valve and diaphragm means connected to said valve and adapted to control the fuel flow therethrough in proportion to the mass of air flowing through said induction passage; first conduit means connecting said bypass passage with said diaphragm means; second conduit means communicating with said venturi and similarly connecting with said diaphragm means; and means provided in said first conduit for restricting the rate of vacuum change between said diaphragm means and the bypass passage.

2. A fuel control system comprising an induction passage; a venturi in said passage; valve means for controlling the flow of air through said passage; means for bypassing air around said valve when the valve is closed for idling operation, said bypass means including a first passage communicating with the induction passage posteriorly of the throttle, a second passage communicating with the induction passage anteriorly of the throttle and connecting with the first passage, and a third passage connected to said second passage; a nozzle posterior of said valve for supplying fuel to said induction passage; a control device for supplying fuel to said nozzle, said device including a fuel metering valve, a pump supplying fuel to said valve in proportion to engine speed, and diaphragm means connected to said valve and adapted to control the fuel flow therethrough in proportion to the mass of air flowing through said induction passage; first conduit means connecting said third passage with said diaphragm means; second conduit means communicating with said venturi and similarly connecting with said diaphragm means; and means provided in said first conduit for restricting the rate of vacuum change between said diaphragm means and the third passage.

3. A fuel control system comprising an induction passage; a venturi in said passage; valve means for controlling the flow of air through said passage; a first passage means for bypassing air around said valve when the valve is closed for idling operation; a second passage means in parallel with and adapted to provide a vacuum force proportional to the quantity of air flow through said first passage means; a nozzle posterior of said valve for supplying fuel to said induction passage; a control device for supplying fuel to said nozzle, said device including a fuel metering valve and diaphragm means connected to said valve and adapted to control the fuel flow therethrough in proportion to the mass of air flowing through said induction passage; first conduit means connecting said second passage means with said diaphragm means; second conduit means communicating with said venturi and similarly connecting with said diaphragm means; and means provided in said first conduit for restricting the rate of vacuum change between said diaphragm means and the second passage means.

4. A fuel control system comprising an induction passage; a venturi in said passage; means associated with and adapted to create a vacuum force proportional to the flow of air through said venturi; valve means for controlling the flow of air through said passage; passage means for bypassing air around said valve when the valve is closed for idling operation; said bypass passage means including means for creating a vacuum force proportional to the flow of air therethrough; a nozzle posterior of said valve for supplying fuel to said induction passage; a control device for supplying fuel to said nozzle, said device including a fuel metering valve and diaphragm means connected to said valve and adapted to control the fuel flow therethrough in direct proportion to the mass of air flowing through said induction passage; first conduit means for communicating the vacuum force in the bypass passage means with said diaphragm means; second conduit means communicating said venturi vacuum with said diaphragm means; and means for delaying the vacuum drop in said first conduit during the initial opening movement of the throttle valve from its idling position.

5. A fuel control system as defined in claim 4 in which said vacuum drop delaying means comprises an orifice disposed in said first conduit.

6. A fuel induction system of the type in which fuel is supplied in direct proportion to the mass of air flowing through the system and comprising an induction passage, a nozzle supplying fuel to said passage, a valve controlling the flow of fuel to said nozzle, vacuum responsive means for controlling the position of said valve to supply fuel proportionately with the mass of air flowing through said induction passage, said means including a diaphragm exposed to atmospheric pressure on one side and vacuum on the other, first and second conduits connected intermediate the vacuum side of said diaphragm and the induction passage, said first passage being adapted to transmit a low air flow vacuum signal to said diaphragm to control said valve during the idling operation of said system, said second passage being adapted to transmit a high air flow vacuum signal to said diaphragm during the normal operation of said system, and means in said first passage to delay the vacuum drop therein during the transition from idling to normal operation.

7. A fuel induction system of the type in which fuel is supplied in direct proportion to the mass of air flowing through the system and comprising an induction passage, first and second means associated with said passage to respectively produce high and low air flow vacuum signals, a nozzle supplying fuel to said passage, a valve controlling the flow of fuel to said nozzle, vacuum responsive means for controlling the position of said valve to supply fuel proportionately with the mass of air flowing through said induction passage, said means including a diaphragm exposed to atmospheric pressure on one side and vacuum on the other, first and second conduits connected in parallel intermediate the vacuum side of said diaphragm and the induction passage, said first passage being adapted to transmit the low air flow vacuum signal to said diaphragm to control said valve during the idling operation of said system, said second passage being adapted to transmit the high air flow vacuum signal to said diaphragm during the normal operation of said system and means in said first passage to delay the vacuum drop therein during the transition from idling to normal operation.

8. A fuel induction system of the type in which fuel is supplied in direct proportion to the mass of air flowing through the system and comprising an induction passage, a nozzle supplying fuel to said passage, a valve controlling the flow of fuel to said nozzle, vacuum responsive means for controlling the position of said valve to supply fuel proportionately with the mass of air flowing through said induction passage, a linkage mechanism articulating said vacuum responsive means to said valve, first and second conduits connected intermediate the vacuum responsive means and the induction passage, said first passage being adapted to transmit a low air flow vacuum signal to said vacuum responsive means to control said valve during the idling operation of said system, said second passage being adapted to transmit a high air flow vacuum signal to said vacuum responsive means during the normal operation of said system, and means in said first pas-

sage to delay the vacuum drop therein during the transition from idling to normal operation.

9. A fuel induction system of the type in which fuel is supplied in direct proportion to the mass of air flowing through the system and comprising an induction passage, a nozzle supplying fuel to said passage, a valve controlling the flow of fuel to said nozzle, vacuum responsive means for controlling the position of said valve to supply fuel proportionately with the mass of air flowing through said induction passage, said means including a diaphragm having vacuum and atmospheric chambers associated therewith, first and second conduits connected intermediate the diaphragm vacuum chamber and the induction passage, said first passage being adapted to transmit a low air flow vacuum signal to said diaphragm to control said valve during the idling operation of said system, said second passage being adapted to transmit a high air flow vacuum signal to said diaphragm during the normal opeartion of said system, and means in said first passage to delay the vacuum drop therein during the transition from idling to normal operation.

10. A fuel induction system of the type in which fuel is supplied in direct proportion to the mass of air flowing through the system and comprising an induction passage,

first and second means associated with said passage to respectively produce high and low air flow vacuum signals, a nozzle supplying fuel to said passage, a valve controlling the flow of fuel to said nozzle, vacuum responsive means for controlling the position of said valve to supply fuel proportionately with the mass of air flowing through said induction passage, said means including a diaphragm having vacuum and atmospheric chambers associated therewith, a linkage mechanism articulating said diaphragm to said valve, first and second conduits connected intermediate the diaphragm vacuum chamber and the induction passage, said first passage being adapted to transmit a low air flow vacuum signal to said diaphragm to control said valve during the idling operation of said system, said second passage being adapted to transmit a high air flow vacuum signal to said diaphragm during the normal operation of said system, and an orifice in said first passage to delay the vacuum drop therein during the transition from idling to normal operation.

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