

[54] **FLUIDIC FUEL INJECTION SYSTEM
HAVING PULSE EXTENDER**

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F02d 4/08

[58] Field of Search 123/119 R, 103 R;
137/87.5; 261/DIG. 69

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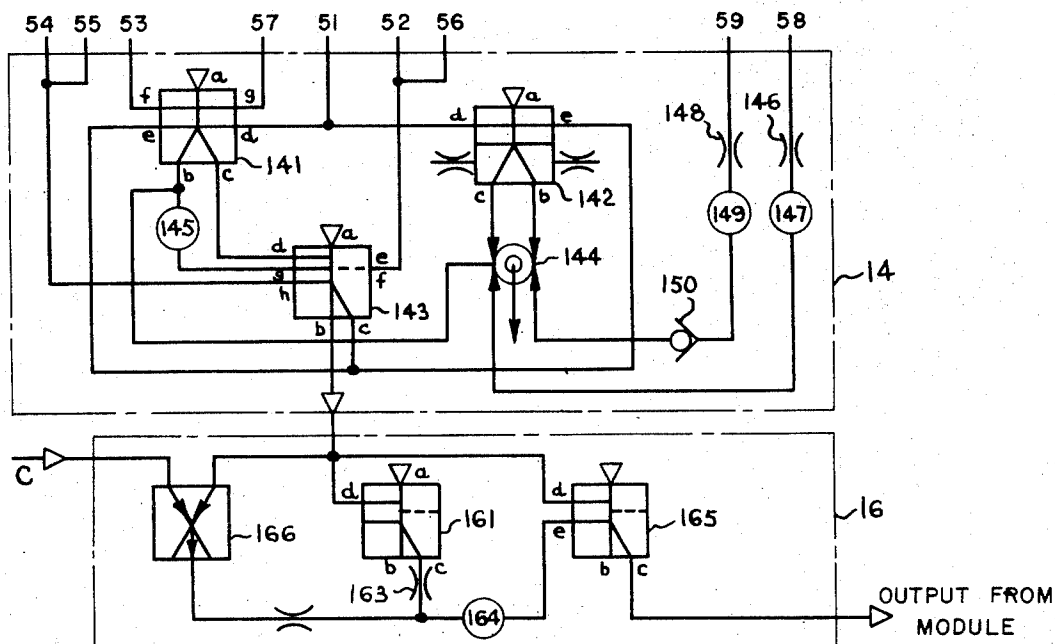
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[57] **ABSTRACT**

A fluidic fuel injection system is illustrated and described having fluidic means to modulate the duration of the normally generated injection pulse. The pulse extender receives the normally generated injection pulse and applied that pulse through gating means to the fuel injection controlling device. The pulse extender also receives a signal indicative of an engine operating parameter such as for instance, an engine temperature, and stores a signal which is a function of the duration of the normally generated injection controlling pulse and the engine variable. Following termination of the normally provided injection controlling pulse, the stored signal is then communicated to the fuel injection controlling devices to provide for prolongation, in a predetermined controlled manner, of delivery of fuel.

7 Claims, 4 Drawing Figures



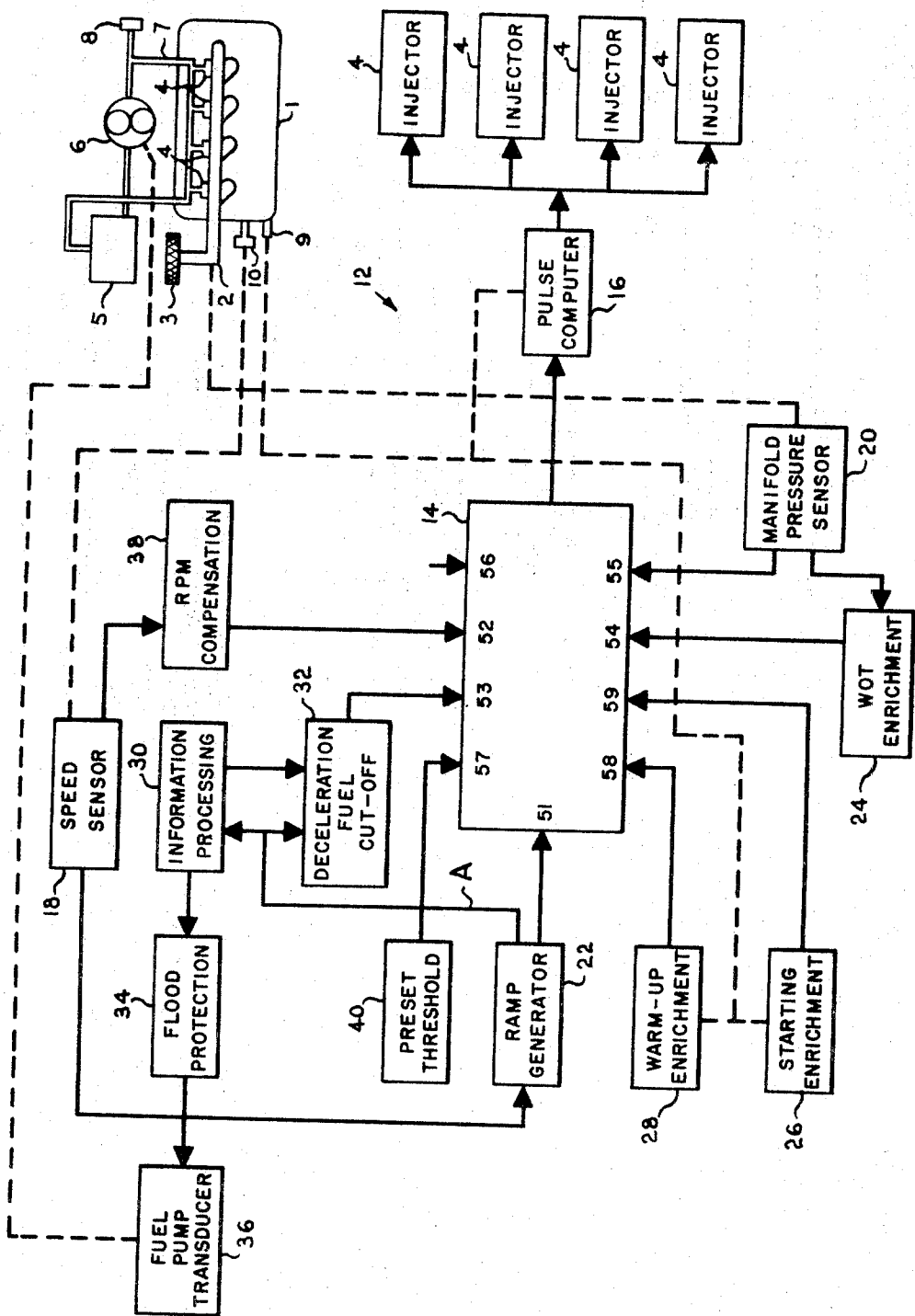
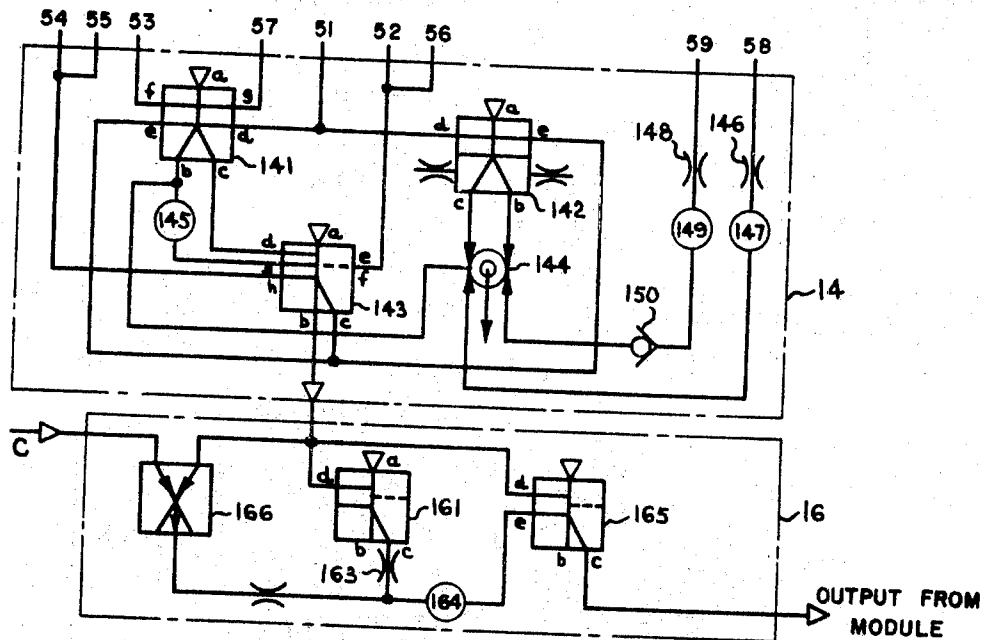
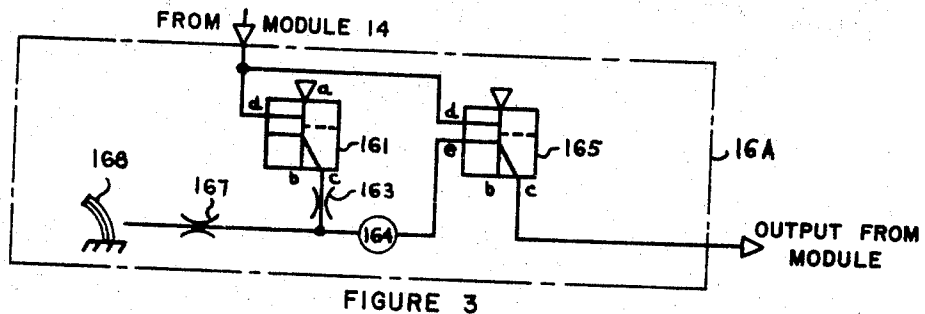
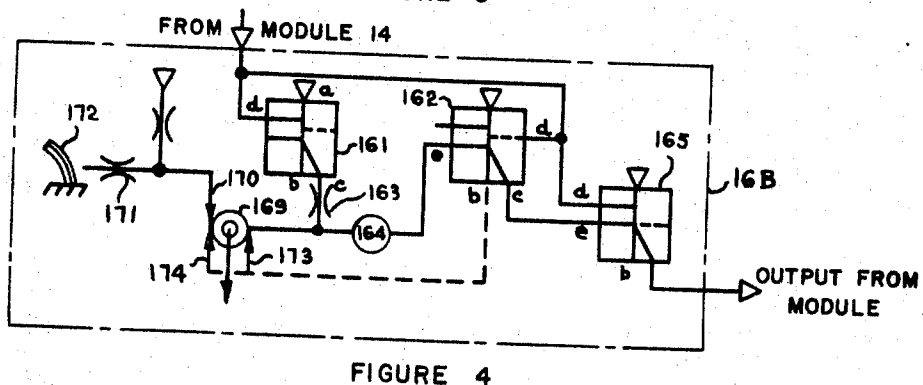


FIGURE 1



FLUIDIC FUEL INJECTION SYSTEM HAVING PULSE EXTENDER

CROSS REFERENCE TO RELATED APPLICATION

The present application is related to applicant's co-pending, commonly assigned patent application Ser. No. 239,678 entitled "Fluidic Injection Induction System Having Transient Engine Condition Responsive Means To Controllably Effect The Quantity Of Fuel Injected" filed on the same date as this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention is related to the field of fluidically controlled fuel delivery systems and in particular to that portion of the above-noted field which is concerned with the intermittent delivery of metered quantities of fuel to an internal combustion engine, also termed fuel injection.

2. Description of the Prior Art

The prior art in the above-noted field teaches that the delivery of fuel to an engine may be adequately accomplished by fluidically computing a time duration which corresponds to the duration of fuel delivery and by directly delivering fuel in accord with the computed time duration. This is most readily done by using the pressurized fuel as a source of computing fluid. However, a difficulty arises in applying this technique to internal combustion engines in that the maximum time period available for computation decreases as speed increases and a limitation arises from the need for a minimum quiescent period in which the chargeable fluidic time determinative element may become discharged. This results in a maximum speed limitation imposed on the fuel system which is substantially lower than the maximum engine speed. It is therefore an object of the present invention to provide a fluidic means for interfacing between a fluidic fuel injection system and a fuel delivery means to provide for controllably extending the injection controlling pulse duration. It is a further object of the present invention to provide such a device which may be utilized with computational fluids other than the fuel. It is a further object of the present invention to provide a means for extending the duration of a normally provided fuel injection controlling pulse which extension may be made responsive to a dynamic engine variable. It is a still further object of the present invention to provide such a pulse extender which is responsive to variations in engine temperature levels.

SUMMARY OF THE PRESENT INVENTION

The present invention is comprised of fluidic circuitry which is capable of receiving the normally generated fuel injection controlling pulse and of communicating that pulse to a fuel delivery means while also storing that pulse duration as a signal for application to the fuel delivery controlling means following termination of the normally generated fuel injection controlling pulse. In addition, the circuitry of the present invention is capable of receiving a signal indicative of an engine variable, such as temperature and of modulating and otherwise influencing the storage characteristics so as to controllably vary the time duration of application of a signal to the fuel delivery controlling means following the termination of the normally provided fuel injection controlling pulse.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 illustrates the present invention as utilized in a block diagram of a fluidic fuel system applied to a four-cylinder spark ignition internal combustion engine.

FIG. 2 illustrates a fluidic circuit diagram of the pulse generator and pulse computer or extender of the present invention.

FIGS. 3 and 4 illustrate modified fluidic circuits for the pulse extender portion of FIG. 2.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, the fluidic fuel injection system incorporating the present invention is illustrated in a block diagram form and associated with an internal combustion engine 1. The engine 1 includes an intake manifold 2, having air cleaner 3 mounted thereon, and a plurality of fuel injectors 4 mounted on the manifold 2. The fuel injectors 4 are supplied from fuel reservoir or tank 5 with fuel which is pressurized by pump 6 and supplied through conduit means 7. Fuel pump 6 is illustrated as a constant delivery pump but other forms are well known. A pressure regulator 8 is illustrated in fluid communication with the conduit means 7 in order to provide a relatively uniform pressure at each of the injector valve means 4. An engine temperature sensor 9 is illustrated herein as associated with the engine 1 and is arranged to communicate a temperature signal to the temperature responsive fluidic circuitry as illustrated by the dashed lines. In addition, an engine speed sensor is illustrated as communicating with the engine pulley 10 to generate a speed signal and the manifold pressure sensor is illustrated as communicating with the intake manifold 2 to generate a signal indicative of the air pressure within the engine intake manifold 2.

The fluidic fuel injection system of the present invention is illustrated in FIG. 1 by the block diagram which is generally denoted as 12. The fluidic fuel injection system 12 is comprised of a fluidic monostable multivibrator circuit 14 which feeds fluidic pulses to the pulse computer or extender 16 according to the present invention which in turn computes an injection pulse for application to the various injector valves 4. For the sake of example, the injector valves may be as illustrated in co-pending commonly assigned patent application Ser. No. 837,217 — "Gaseous Controlled Fluidic Throttling Valve" — Jerome G. Rivard or Ser. No. 170,162 — "Gas Injection Liquid Flow Control Valve" — Clarence E. Vos, in the embodiment illustrated, the pulse computer 16 applies the computed pulse to each of the injectors 4 simultaneously. This permits simultaneous injection of all injector valves 4. It would also be possible to provide a sequential injection system by selective AND gate coupling between one or more injectors 4 and the speed sensor 18. This would provide not only sequential injection in the event that the injectors 4 were individually coupled to the speed sensor through AND gate means, but could also be used to provide for group injection by combining two or more injectors and coupling them to the speed sensor for sequential injection of the various groups.

The monostable multivibrator 14 receives a plurality of inputs which are representative of the various operating conditions of the engine and are tailored to be representative of the preselected performance criteria

for the internal combustion engine 1 to which the fuel system of the present invention is coupled. In the fuel system of the present invention, the primary inputs are by means of the speed sensor 18 and the manifold pressure sensor 20. The speed sensor 18 is coupled to ramp generator 22 which feeds an initiating input signal to input terminal 51 of the monostable multivibrator 14. The manifold pressure sensor 20 receives a signal indicative of manifold pressure from the intake manifold 2 and applies this signal, suitably altered in accordance with the performance criteria previously mentioned, to the input terminal 55 of the monostable multivibrator 14. A signal is also communicated to the wide open throttle enrichment means 24 by the manifold pressure sensor 20 to provide a control fluid flow at input terminal 54 of the monostable multivibrator 14. Signals from the temperature sensor 9 are applied to the starting enrichment means 26 and the warm-up enrichment means 28. This temperature signal is operative to provide a selected form of fluid flow from the starting enrichment means 26 at the input terminal 59 of the monostable multivibrator 14 and it is also operative to provide for a selected warm-up enrichment fluid flow from the warm-up enrichment means 28 at input terminal 58 of the monostable multivibrator 14. Ramp generator means 22 also provides information signals for the information processing network 30 and the deceleration fuel cutoff network 32. The information processing network 30 provides a control signal indicative of engine speed and engine operational conditions to the flooding protection circuit 34 which, in turn, controls the fuel pump transducer 36. The fuel pump transducer merely operates to convert the fluid signal from the flooding protection circuit 34 into a suitable electrical or mechanical signal for application to the fuel pump 6. Information from the information processing network is also provided to the deceleration fuel cutoff circuit 32 to generate a control fluid flow at input terminal 53 of the monostable multivibrator 14. Speed sensor 18 also provides a signal for application to the rpm compensation circuit 38 which in turn provides a control fluid flow at the input terminal 52 of the monostable multivibrator 14. A preset threshold mechanism 40 provides a control signal for receipt by input terminal 57 of monostable multivibrator 14 to condition the response of monostable multivibrator 14 to the output of ramp generator 22 so as to correspond to a selected phase relationship between the engine speed sensor 18 and the initiation of the fuel injection controlling pulse by the pulse computer 16.

The system as hereinabove described operates as follows. Signals from the speed sensor 18 are applied to ramp generator 22 where they are converted to a ramp signal for application to the monostable multivibrator 14. A fluid signal having a predetermined level is also applied to monostable multivibrator 14 by the preset threshold means 40 and switching takes place when the ramp signal exceeds the preset threshold. The monostable multivibrator 14 will remain in its switched, or unstable, state for a period of time depending upon the signal received at input terminal 55 from the manifold pressure sensor 20. Further control signals may be applied by the warm-up enrichment mechanism 28 and the rpm compensation means 38. In the event of a deceleration, the deceleration fuel cutoff means 32 will apply an inhibiting signal to prevent further pulse generation by the pulse generator means monostable mul-

tivibrator 14. In order to prevent engine flooding, the information processing unit 30 and the flooding protection circuit 34 may be arranged to respond to conditions which would otherwise generate engine flooding to modulate or terminate the output of the fuel pump 6. The output of the warm-up enrichment means 28 and the rpm compensation means 38 may be arranged to be fluid signals having a level indicative of the desired compensation or enrichment and may be combined with the signal from manifold pressure sensor 20 to affect the duration of the pulse produced by pulse generator means monostable multivibrator 14. The pulse generated by the pulse generator means monostable multivibrator 14 therefore has a duration which represents the quantity of fuel required by the engine for operation consistent with its predetermined operational requirements. This duration will not, however, necessarily be directly indicative of the requirement and to generate the injection command pulse which is directly indicative of the fuel requirement, computer or extender 16 is arranged to receive the output signal from the monostable multivibrator 14, and also a signal from an engine parameter sensor such as, for instance, engine temperature sensor 9 to generate an output pulse having a duration which may differ from the duration of the pulse generator means 14 pulse and which is directly indicative of the engine fuel requirement. By "representative" is meant that a pulse whose duration when multiplied by a factor which may be one but which may also be greater than one and which is determined by an engine operating parameter will yield the duration of fuel flow required by the engine to satisfy the predetermined operational characteristics of the engine. By "indicative" is meant a pulse whose duration is equal to the duration of fuel flow required by the engine.

Additionally, the present fluidic circuit includes a cold starting enrichment means 26 which also receives a temperature signal, in this instance from engine temperature sensor 9, and may also be arranged to receive a signal indicative that the engine is in the "start" mode to provide a fluid signal at monostable multivibrator 14 input terminal 59 to provide for the lengthening of the time during which the monostable multivibrator 14 is in an unstable state to provide further quantities of fuel to enrich the air/fuel mixture received by the engine during its starting operation. It will be readily understood that the number and location of temperature sensors may vary from system to system depending on the performance requirements of the associated engine.

While the ramp generator 22 is operative to provide essentially a pulse having a monotonically increasing magnitude, the various other fluidic subcircuits which feed information into the enumerated input terminals of the monostable multivibrator circuit 14 are arranged to provide fluid signals having variable magnitudes which represent the operational conditions of the associated engine. In other words, ramp generator 22 provides a digital input while the various other fluidic circuits provide analog inputs for the monostable multivibrator 14 which responds to these various inputs to provide an output pulse having a duration representative of the fuel injection quantity.

Referring now to FIG. 2, particular fluidic circuits will be described for the pulse generator means monostable multivibrator circuit 14 and for the pulse computer 16 of the present invention. It will be appreciated

that the specific fluidic circuits and elements described hereinbelow are intended to be illustrative of the present invention and that various modifications and changes in the circuitry will be readily apparent. Departures from specific circuitry to achieve specific goals such as cost reduction use of commercially available elements and matching to specific fuel requirements are anticipated and their inclusion herein is intended. It should also be noted that the specific fluidic circuits and elements described hereinbelow are described with reference to a system which utilizes a compressible fluid (for instance air) as the computational fluid and as a consequence, the various recited volumes, restrictions, and bleeds are shown with this computational fluid in mind. The man of ordinary skill in this art will readily recognize that other fluids and other forms of fluid impedance may be substituted. In addition, additional fluid impedances check valves and the like may be inserted as necessary to provide signal tailoring and flow direction control to suit particular requirements.

The pulse generator means monostable multivibrator 14 is comprised of first and second bistable fluidic amplifiers denoted as 141 and 142, monostable fluidic amplifier 143, and fluidic vortex device 144 having a vented output as illustrated. The fluidic amplifiers 141, 142, 143, are comprised of a source of power fluid denoted by the suffix letter *a* and also illustrated by a triangular fluid entry port, a pair of outlet passages denoted by the suffix letters *b* and *c*, and a plurality of control ports denoted by the suffix letters *d* through *h*, as appropriate. The output passages *b* and *c* of fluidic device 141 are communicated to control ports *d* and *g* of fluidic device 143. Control ports *d* and *g* are control ports arranged to one side of the fluidic device 143 and fluid flow therethrough is operative to bias fluid flow from the main nozzle, *a*, of device 143 to the output passage *c* of device 143 which, in this instance, is illustrated as being a nonpreferred fluid flow outlet passage. In the absence of a biasing control fluid flow, fluid flow from the device 143 would be through the outlet passage, *b*, which is illustrated as being the preferred fluid flow outlet passage. As illustrated, passage *b* is indicated as having a "memory" associated therewith. Monostability in a fluid amplifier may be obtained through geometry of the device, use of the Coanda effect in a selected outlet passage or through self-biasing fluid flow. The use of "memory" in this context is intended to mean any of the possible means of achieving a preferred fluid flow passage condition. Fluid flow in passage *c* of the device 143 is communicated back to the control ports *e* of devices 141 and 142, while fluid flow in passage *b* of device 143 is communicated to the pulse computer 16. A fluid volume, or fluid capacitance, 145 is illustrated intermediate the outlet passage *b* of device 141 and the control nozzle *g* of device 143.

The output passages *b* and *c* device 142 are arranged to provide for fluid swirl within vortex device 144 and are so arranged that fluid flow from passage *b* of device 142 would generate a clockwise fluid swirl within vortex device 144 while fluid flow from passage *c* of device 142 would generate counterclockwise swirl within vortex device 144. The restricted vents illustrated on the element 142 may be required for impedance matching with the vortex device 144. The outer wall outlet port or passage of vortex amplifier 144 is communicated to the fluid volume 145 intermediate the volume 145 and

output passage *b* of fluid amplifier 141. As is known, the presence of swirl within a vortex device is operative to vary the ease with which fluid may flow through the outer wall port or passage of the device.

Input terminal 51 of monostable multivibrator 14 is communicated to control nozzles *d* of fluidic elements 141 and 142. Control nozzle *f* of fluidic element 141 is communicated to input terminal 53 of monostable multivibrator 14, control nozzle *g* of fluidic element 141 is communicated to input terminal 57 of monostable multivibrator 14, control nozzle *e* of fluidic element 143 is communicated to the input terminal 52 of the monostable multivibrator 14, control nozzle *f* is communicated to input terminal 56 of monostable multivibrator 14, control nozzle *h* is communicated to input terminals 54 and 55, in parallel, of the monostable multivibrator 14. For convenience input terminals 52 and 56 and control nozzles *e* and *f* of device 141 are shown interconnected. Input terminals 58 and 59 are communicated to additional control nozzles associated with the vortex device 144. Intermediate input terminal 58 and the nozzle of vortex device 144 with which it is associated is situated a fluid restriction 146 and a fluid volume 147 which are operative to convert a pulse signal input received at input terminal 58 into a fluid level signal for application to the vortex device 144. Intermediate input terminal 59 and the control nozzle of vortex device 144 with which it is associated is situated a fluid restriction 148 a fluid volume 149 and a check valve 150 which may be required to prevent back flow from variable restrictor vortex device 144. The fluid restriction 148 and the fluid volume 149 are herein operative to convert a pulse signal received at the input terminal 59 to a fluid level signal for application to the vortex device 144.

The monostable multivibrator 14 as hereinabove described operates as follows. A fluid ramp signal is received at input terminal 51 and is communicated to the control nozzle *d* of each of the fluid amplifiers 141 and 142. Application of this signal to the control nozzle *d* of amplifier 142 is operative to cause main fluid flow from the main nozzle *a* to exit from the device through outlet passage *b* and to thereby generate a clockwise swirl within the vortex device 144. The application of the ramp signal to control nozzle *d* of the fluidic element 141 in conjunction with the threshold preset fluid level established at input terminal 57 will be operative to switch fluid flow from the main nozzle *a* to the output passage *b* when a predetermined (pressure) relationship exists between the instantaneous level of the ramp and the level of pressure received at input terminal 57. Fluid flow through outlet passage *b* of fluidic element 141 will be operative to charge the fluid volume 145 at a rate which is a function of the compressibility of the fluid in use and the size of the volume. Fluid flow through the outlet passage *b* of fluidic element 141 will occur only upon termination of fluid flow from outlet passage *c* of element 141 and this will terminate the fluid pressure signal ordinarily received by control nozzle *d* of element 143. In the absence of a fluid signal at either of control nozzles *d* and *g*, fluid flow from the main nozzle *a* of element 143 will be through the preferred outlet passage *b* of element 143 and will appear as a pressure signal to the pulse computer. As fluid flow from outlet passage *b* of element 141 begins to charge the volume 145, the fluid pressure appearing at control nozzle *g* of element 143 will begin to increase. When the level of fluid signal appearing at control nozzle *g* of

element 143 reaches a value which may be controlled by the value of the relatively high pressure signals received at input terminals 52 or 56, or relatively low pressure signals received at input terminals 54 and 55, the fluid flow from the main nozzle will be switched from outlet passage *b* to outlet passage *c* which is arranged in a feedback arrangement to provide a fluid pressure signal at the control nozzle *e* of the fluid elements 141 and 142. The presence of a fluid pressure signal in outlet passage *c* of element 143 will signal the termination of the pulse received by the pulse computer 16 and will also cause the fluid elements 141 and 142 to switch so that fluid flow will appear in outlet passages *c* of each of elements 141 and 142. The presence of fluid flow in outlet passage *c* of element 141 will be operative to maintain the bias of fluid element 143 so as to maintain fluid flow through outlet passage *c*. Additionally, the presence of fluid flow in outlet passage *c* of element 142 will oppose the clockwise swirl previously established in vortex device 144 by flow from passage *b* of element 142 and from input terminal 58 so that there will appear a state of no fluid swirl which may be followed by the generation of a weak counterclockwise fluid swirl should engine operating temperature not have been reached. During the time period where there is substantially no swirl within the vortex element 144, the fluid pressure previously accumulated in volume 145 will be rapidly vented into the vortex device and the volume 145 will be discharged. The appearance of the next ramp signal at input terminal 51 will reinitiate this process to generate an additional pulse for receipt by pulse computer 16. This next succeeding pulse will have a duration which is a function of the pressure signals received at the control nozzles *e*, *f*, and *h* of fluidic element 143, as well as the rate of charge of the fluid volume 145. The input terminals 58 and 59 are arranged to provide additional swirl inducing or inhibiting fluid flows at the vortex device 144 to modulate the swirl rate and to therefore provide a modulating fluid flow which may either add to or subtract from the fluid flow ordinarily entering the fluid volume 145 during charging and pulse forming process.

The pulse computer or extender 16 according to the present invention is comprised of a fluidic device 161 having a main fluid jet *a*, a pair of outlet passages *b* and *c*, a control nozzle *d* and a fluidic OR gate 165. Fluidic device 161 is arranged to receive at its control nozzle *d* the fluid pulse generated at outlet passage *b* of fluidic element 143 in the pulse computer 14. Receipt of this pulse is operative to bias fluid flow from the main fluid nozzle *a* of fluidic device 161 to outlet passage *c*, where it is communicated to control nozzle *e* of OR gate fluidic device 165 through a bleed or fluid restriction 163. Intermediate the bleed 163 and the control nozzle *e* of fluidic device 165 is situated a fluid capacitance or volume 164.

The pulse from outlet passage *b* of fluidic device 143 of pulse computer 14 is also applied to one input of the OR gate 165, control nozzle *d* so as to provide an output signal which is substantially in phase with the pulse produced by the pulse generator 14. The pulse produced by pulse generator 14 is also operative to direct fluid flow through the outlet passage *c* of the fluidic element 161 to charge the volume 164. When the volume has reached a critical charge dependent upon fluid compressibility and volume, a pressure pulse will also appear at control nozzle *e* of fluidic device 165 and, in

the presence of an output pulse from the pulse generator 14, would not alter or affect operation of the OR gate 165. However, upon termination of the pulse produced by pulse generator 14, fluid flow in the fluid device 161 would switch from the outlet passage *c* to the outlet passage *b* due to the monostable effect of the device discussed hereinabove and the charging of volume 164 would terminate. The accumulated charge in this volume would continue to apply a pressure pulse to the control nozzle *e* of the fluidic element OR gate 165 so as to cause it to generate an injection command pulse for a period of time following the termination of a pulse produced by pulse generator 14. Additionally, AND gate means 166 is illustrated as arranged to receive the pulse signal from pulse generator 14 as well as a signal from an engine operating condition sensor to generate an output signal for additionally effecting the charging of volume 164. AND gate 166 is of the passive type and may be arranged to pass a signal whose magnitude is directly related to the magnitude of the signal received from the associated engine sensor during the receipt of a pulse from pulse generator 14 so as to provide a variable multiplicative factor in the relationship of the pulse computer output pulse and the pulse generator output pulse. In the herein illustrated embodiment, AND gate 166 is arranged to receive a signal indicative of engine temperature, through inlet conduit *C*.

Referring now to FIGS. 3 and 4, two alternative circuit configurations for the pulse computer 16 are illustrated. Each makes use of the pair of fluidic monostable multivibrator devices 161, 165, with the fluid restriction and fluid chargeable volume 163, 164. However, the AND gate mechanism 166 and the associated engine sensor signal are replaced by alternative means of varying the charge accumulated by the volume 164. In FIG. 3, this is illustrated as a nozzle 167 communicating with volume 164 and arranged to direct fluid at a bimetal member 168. By placing the bimetal 168 in an environment whose temperature is determined to be of significance in the injection pulse computation process, the bimetal 168 can be arranged to vary the rate at which the volume 164 may be charged and discharged by varying the nozzle opening from a fully closed to a fully open position in the known fashion. Thus, for injection pulses which would differ at most only slightly from the pulses generated by the generating means 14, bimetal 168 could be arranged to provide a substantially wide open exit port for nozzle 167 to hold the charging of volume 164 to an absolute minimum and to assist in the discharging of that volume upon termination of the pulse received from pulse generator 14. Conversely, in those situations where the sensed temperature would require a substantial lengthening of the injection pulse as compared to the pulse generated by pulse generator 14, the bimetal 168 could substantially close the exhaust port of nozzle 167 so that the volume 164 could be charged to a maximum amount and the discharge time of that volume could be maintained at a maximum value.

In the FIG. 4 embodiment, an additional fluidic monostable multivibrator device 162 has been interposed between fluidic element 161 and OR gate 165. Device 162 is arranged to receive the signal from volume 164 at its control nozzle *e* so that it will bias fluid flow to the nonpreferred outlet passage *c* which is communicated to the control nozzle *e* of OR gate 165. Control nozzle *d* of fluidic element 162 may be in fluid

communication with the pulse produced by the pulse generator 14. In this FIG. 4 embodiment, the rate of charge and discharge of the volume 164 is influenced by communicating that volume to the exhaust orifice of a fluid vortex device 169 in which counterclockwise swirl may be induced by control nozzle 170. The nozzle 170 is provided with the energizing fluid in the above-described fashion. A further nozzle 171 is situated intermediate nozzle 170 and the source of fluid supply and is arranged to direct a fluid stream toward a bimetal device 172. The amount of swirl introduced in vortex device 169 by nozzle 170 is therefore inversely related to the amount of closure of nozzle 171 provided by bimetal 172. Bimetal 172 may be situated in a suitable temperature environment so as to provide by its response to that temperature the desired fluid swirl pattern in vortex device 169. Additionally, alternative swirl nozzles 173, 174 are shown communicating with the preferred outlet passage *b* of fluid element 162. Swirl inducing nozzles 173 and 174 are illustrated as being alternative connections which may be used when desired to either oppose or aid the swirl induced by nozzle 170 in suitable instances where the charging and/or discharging of the volume 164 is to be enhanced.

I claim:

1. A fluidic fuel control system for an internal combustion engine comprising:

a plurality of sensory means responsive to the operating conditions of the engine operative to generate a plurality of fluidic signals, each of said signals having a variable characteristic indicative of the sensed operating condition;

a source of pressurized fluid;

first fluidic means responsive to said sensory means and receiving fluid from said source, operative to generate a first pulse signal having a duration indicative of the engine fuel requirements;

second fluidic means responsive to said first fluidic means and receiving fluid from said source, operative to generate a second pulse signal having a duration related to, but longer than, the duration of said first pulse signal and which is representative of the engine fuel requirement; and

fuel delivery means responsive to said second pulse signal operative to deliver fuel to at least a portion of the engine for a period of time substantially corresponding to the duration of said second signal.

2. In an internal combustion engine fluidic fuel control system of the type having fuel supply means, first fluidic means to generate a signal indicative of the engine fuel requirement and further fluidic means respon-

sive to the first mentioned fluidic means operative to control the fuel supply means, the improvement in said further fluidic means comprising;

fluidic signal storage means for receiving and storing the first fluidic means signal and operative to generate a further fluidic signal following termination of the first fluidic means signal having a duration related to the first signal duration by a storage factor; and

fluidic gating means responsive to said signal storage means further fluidic signal and to the first fluidic means signal operative to generate a fuel supply means control signal whenever the first fluidic means signal or said storage means further signal is present.

3. The system as claimed in claim 2 wherein said storage means includes maximal limiting means operative to limit the amount of signal stored and hence the duration of said further fluidic signal to a predetermined maximum value.

4. The system as claimed in claim 3 wherein said storage means further include sequencing means operative to maintain the storage means in a condition of full charge for the duration of the first fluidic means signal whereby the full amount of the stored signal is available to generate said further fluidic signal.

5. The system as claimed in claim 3 including inhibiting means operative to prevent generation of said further fluidic signal whenever the first fluidic signal duration is less than a predetermined amount.

6. The system as claimed in claim 4 wherein said storage means comprises a fluid receiving chamber.

7. The system as claimed in claim 6 wherein said storage means include a fluidic gating amplifier having a preferred and a nonpreferred fluid outlet passage, a power nozzle and at least two opposed control nozzles, one of the control nozzles being adjacent the preferred fluid outlet passage and the other control nozzle being adjacent the nonpreferred outlet passage, conduit means communicating the nonpreferred outlet passage with said gating means and further conduit means intercommunicating said chamber with the first fluidic means and with the one control nozzle and said sequencing means comprise conduit means intercommunicating the first fluidic means with the other control nozzle whereby fluid discharge from the fluidic gating amplifier will be from the preferred outlet passage in all cases except the combined presence of a control fluid from the one control nozzle and the absence of a control fluid flow from the other control nozzle.

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