

[54] **PRESSURE DEPENDENT DECELERATION CUTOFF FOR AN INTERNAL COMBUSTION ENGINE FUEL DELIVERY SYSTEM**

[75] Inventor: **Junuthula N. Reddy**, Horseheads, N.Y.

[73] Assignee: **The Bendix Corporation**, Southfield, Mich.

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[51] Int. Cl. **F02m 51/00**

[58] Field of Search **123/97 B, 32 EA, 32 AE**

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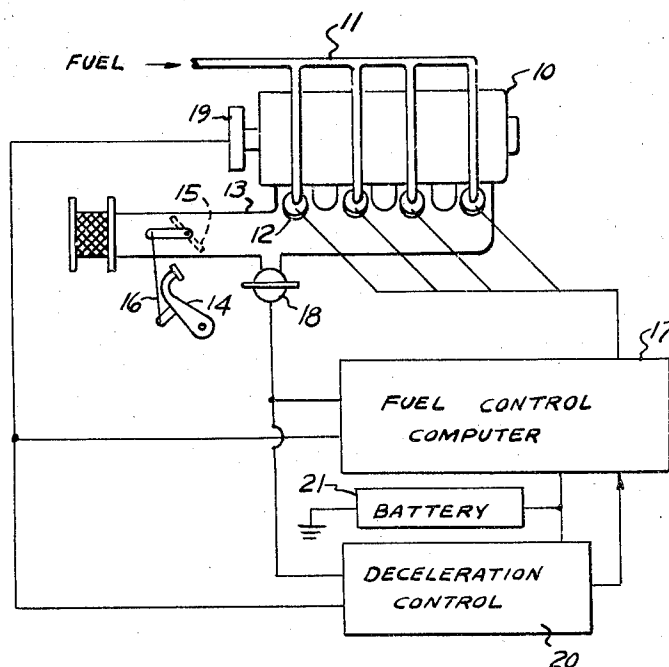
Primary Examiner—Laurence M. Goodridge

Attorney, Agent, or Firm—Gerald K. Flagg; William S. Thompson

[57] **ABSTRACT**

This invention relates to an electronic deceleration control, responsive to engine operating condition sensors, cooperating with an electronic fuel control computer for an internal combustion engine for curtailing or terminating the fuel delivery to the engine under selected engine operating conditions indicating an operator's demand for deceleration. The deceleration control restores normal fuel delivery to the engine in response to a second set of selected engine operating conditions indicating the demand for deceleration has been terminated. The inventive control responds to signals indicative of the engine speed and the intake manifold absolute pressure, and computes the first time derivative of the intake manifold pressure, giving an immediate indication of the deceleration demand independent of throttle position or a minimum manifold pressure. This control system, cooperating with an electronic fuel injection control system for an internal combustion engine, substantially reduces the exhaust emissions during the period of deceleration.

26 Claims, 8 Drawing Figures



SHEET 1 OF 4

FIG. 1

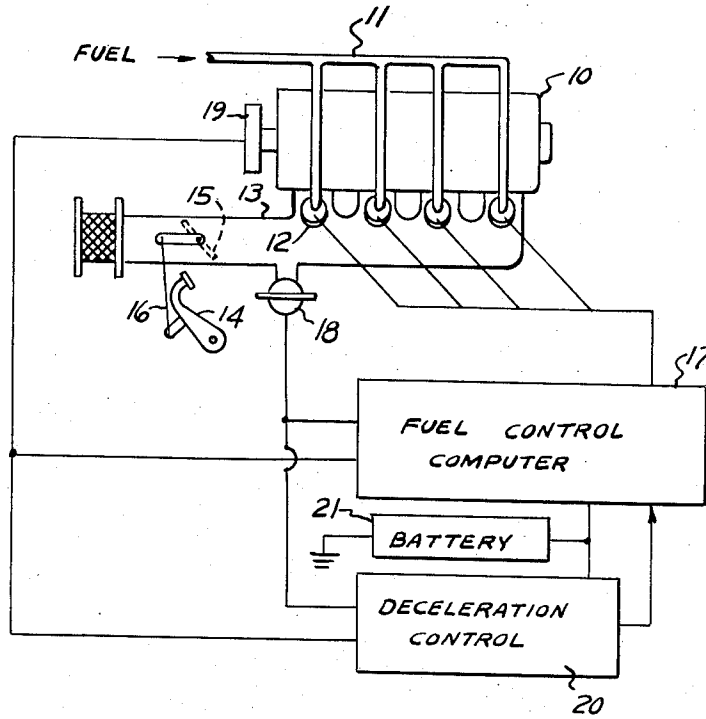


FIG. 2

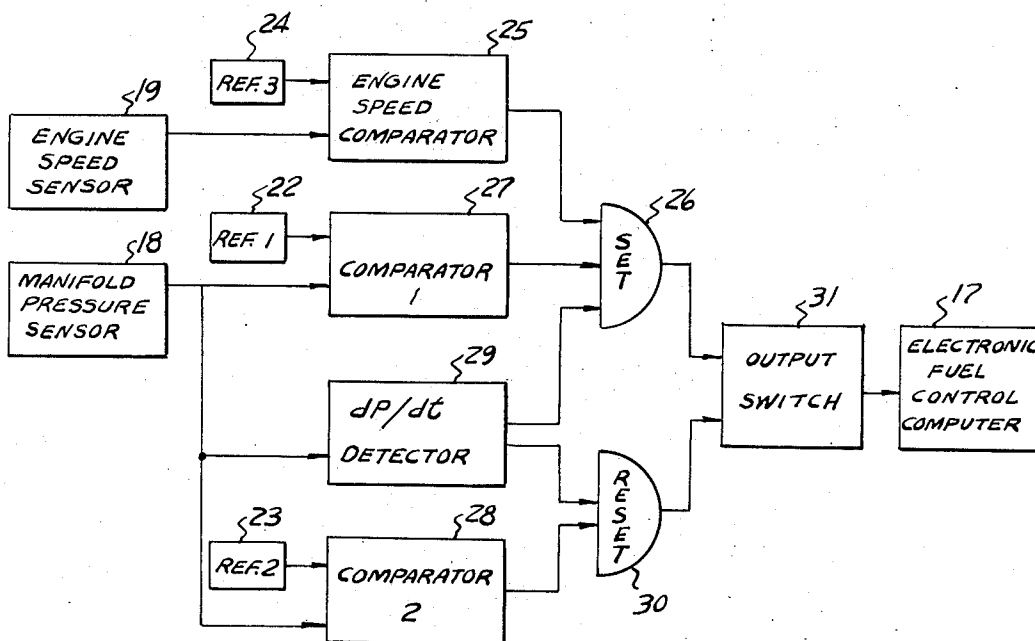


FIG. 3

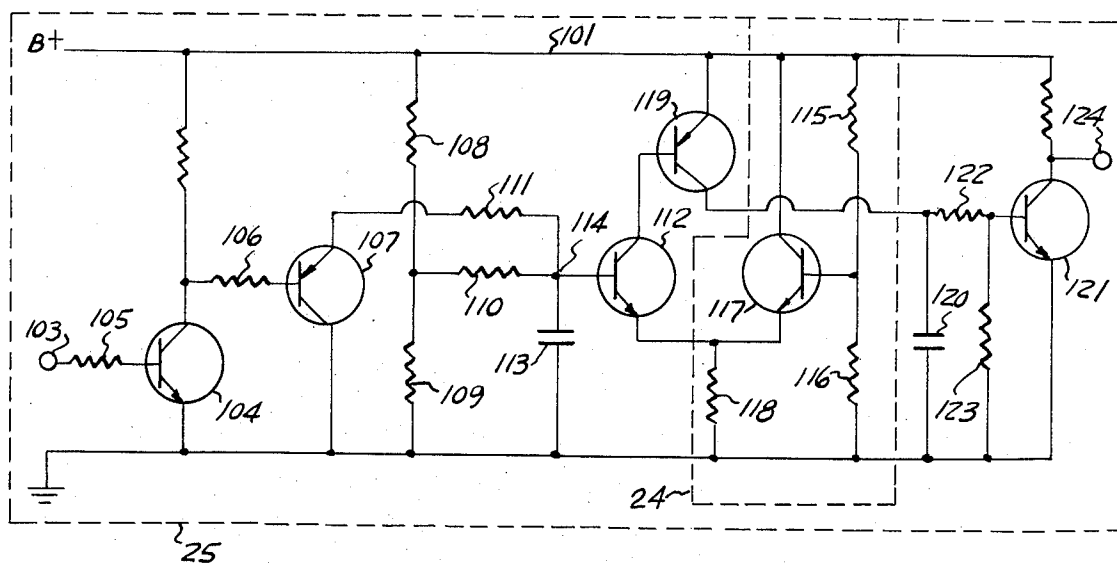


FIG. 5

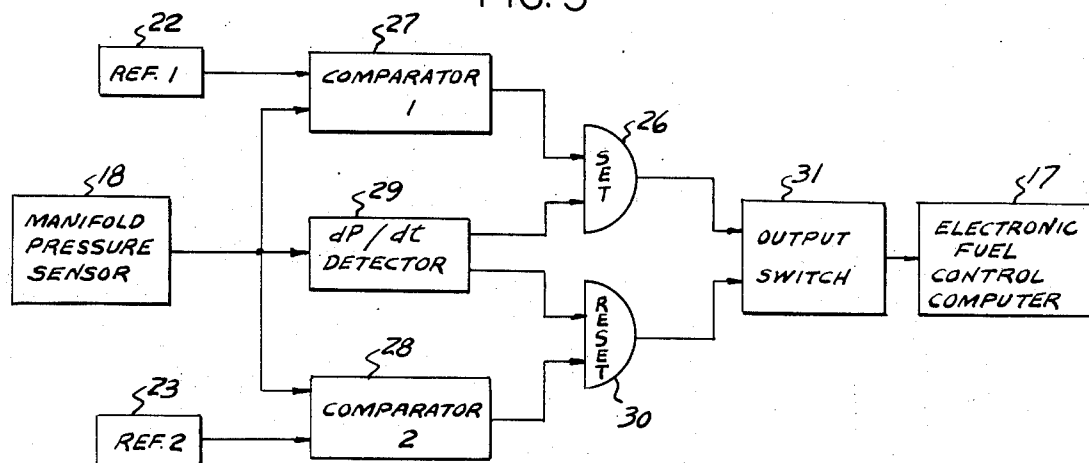


FIG.6

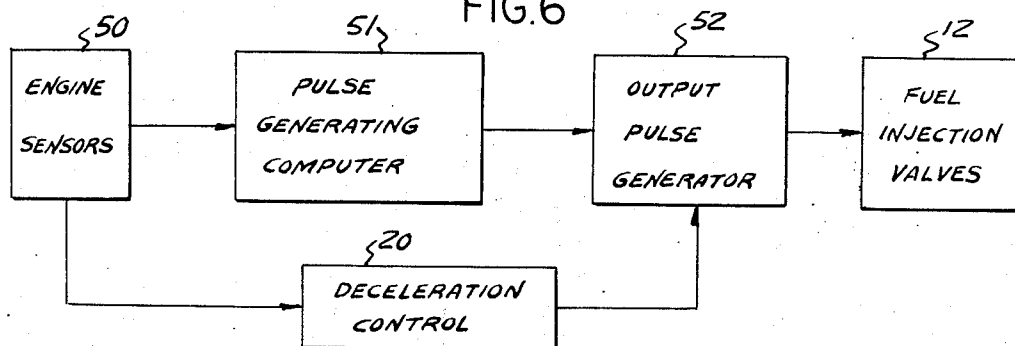


FIG. 4

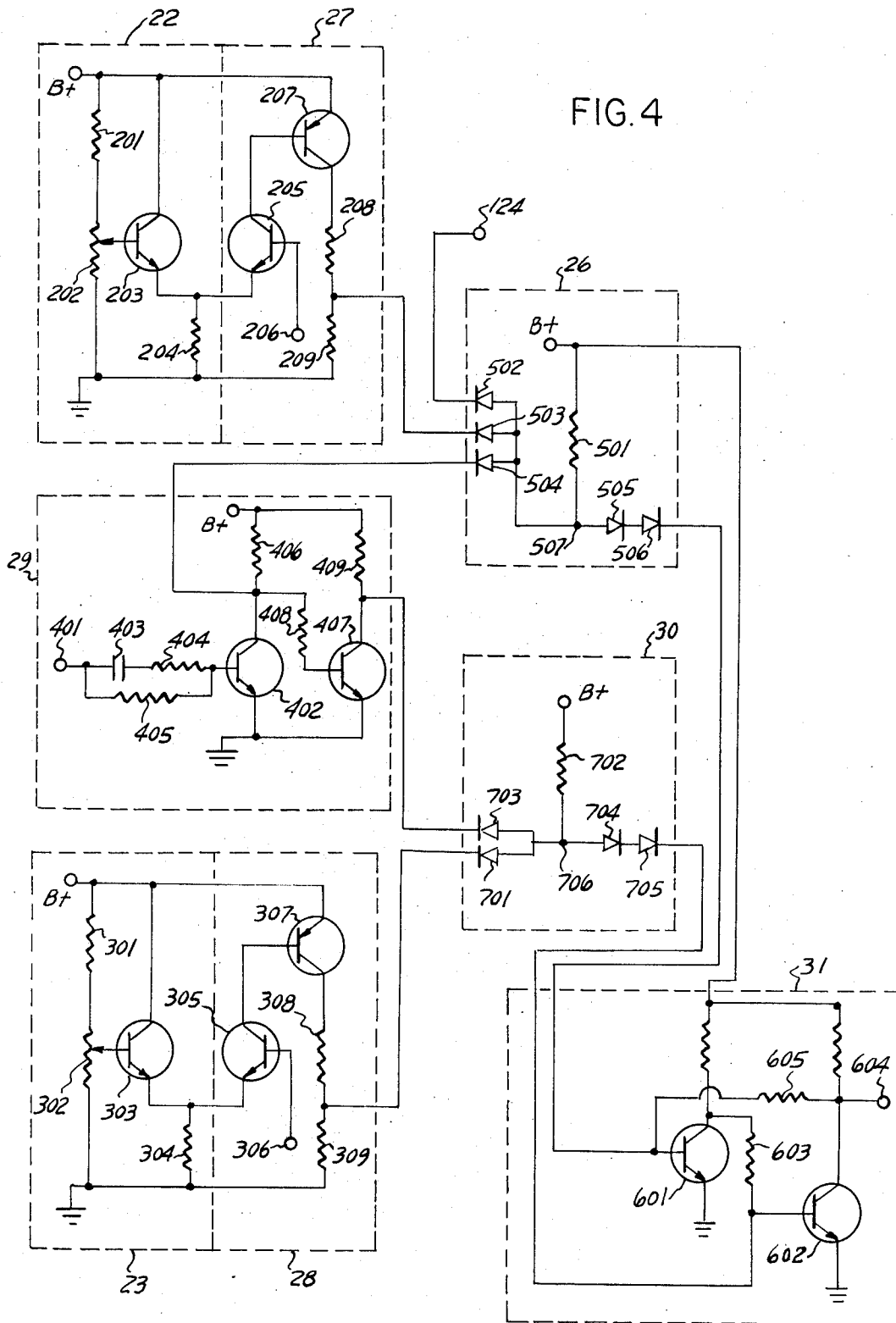


FIG. 7

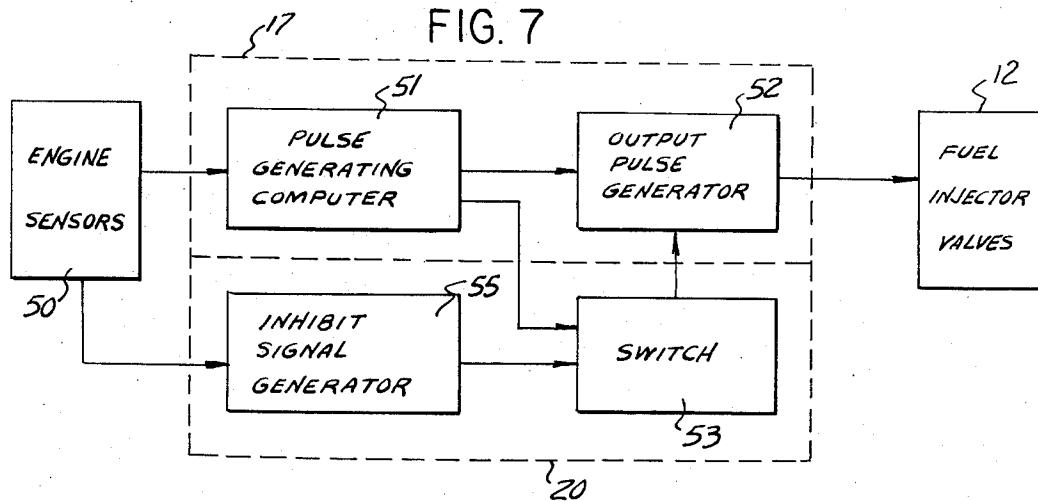
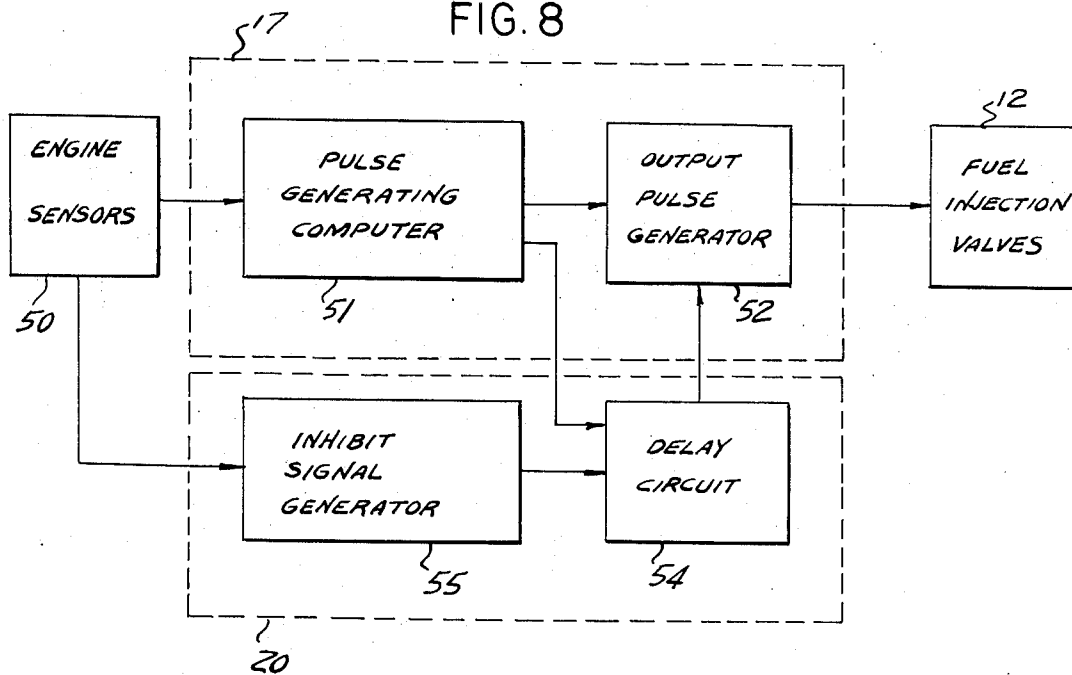


FIG. 8



PRESSURE DEPENDENT DECELERATION CUTOFF FOR AN INTERNAL COMBUSTION ENGINE FUEL DELIVERY SYSTEM

BACKGROUND OF THE INVENTION

This invention relates to a deceleration electronic control responsive to engine operating parameters, and cooperating with an electronic fuel control system of an internal combustion engine, for curtailing or terminating fuel delivery to the engine, under selected engine operating conditions indicative of the operator's demand for deceleration. More particularly, the invention relates to an electronic control, wherein the fuel delivery to the engine is curtailed or terminated when the operator has demanded deceleration by manually changing the position of the intake manifold throttle valve, reducing the air flow to the engine, causing the intake manifold pressure to decrease. Unless the fuel delivery is curtailed or terminated at the same time the air delivery to the engine is reduced, excessive fuel is injected into the system, providing the engine with an air/fuel mixture incapable of complete combustion within the engine. This type of operation wastes fuel and adds to the total exhaust emissions from the engine. Simple termination of the fuel delivery to the engine during deceleration eliminates the incomplete combustion problem and is a satisfactory solution to the emission problem for internal combustion engines which are not equipped with thermal or catalytic reactors in the exhaust systems as the final remover of exhaust pollutants. Automotive emission standards of the future might require such reactors on all internal combustion engines; therefore, their operating characteristics must also be considered. Most of these thermal and catalytic reactors are designed to operate efficiently at elevated temperature. Terminating fuel delivery to the engine terminates combustion and the air ejected by the engine into the exhaust system is relatively cold, tending to cool the reactors. Cooling the reactors degrades their pollutant removal efficiency and results in undesirable pollutants being emitted from the exhaust system of the engine for a finite period of time after the fuel delivery to the engine has been restored. Curtailment of fuel delivery during deceleration coupled with an advance or retardation of the ignition spark would eliminate both the incomplete combustion problem and the emission of cold air into the reactors. Just enough fuel needs to be injected into the system to maintain the temperature of the reactors, while the advance or retardation of the ignition spark provides for the complete combustion of the injected fuel without adding power to the engine. The ignition spark may be advanced or retarded depending upon the characteristics of the individual type of engine and its ignition system.

The prior art, as represented in U.S. Letters Patent No. 3,596,640, issued Aug. 3, 1971, to George V. Bloomfield, and No. 3,612,013, issued Oct. 12, 1971, to Charles C. Gambill, describe electronic fuel injection control circuits with provisions for curtailing or terminating fuel delivery to the engine upon an operator's demand for deceleration, and restoring said fuel delivery after predetermined engine operating conditions have been fulfilled. The prior art shows the use of various means for determining the operator's demand for deceleration. These means may be used singularly

or in conjunction with the rotational speed of the engine to determine the operator has requested deceleration. Several systems use an electrical switch mechanically linked with the operator's accelerator pedal as an indicator of the operator's demand for deceleration. Other systems use an electrical switch activated by a low manifold absolute pressure in conjunction with the speed of the engine as operating parameters indicative of the operator's demand for deceleration. The electrical switch mechanically linked to the accelerator pedal or throttle valve has the disadvantage that the signal is given only when the pedal or valve is at or near the curb idle position, i.e., when the operator has removed all pressure from the accelerator pedal. A deceleration demand in which the operator has only partially relaxed his pressure on the accelerator pedal would not be sensed by the deceleration control circuit. The control circuits which obtain their signals from the manifold pressure sensors have much the same disadvantage, because a deceleration demand in which the throttle valve is partially closed will not always result in a manifold pressure low enough to trigger the sensor. This system also has a built-in delay between the time the demand occurs and the time the signal indicative of the demand is received by the control circuit. The objective of the present invention is to overcome the deficiencies of the prior art by providing a deceleration control circuit for curtailing or terminating the delivery of fuel to the engine which is immediately responsive to changes in the engine's operating conditions indicative of the operator's demand for deceleration, and which restores normal fuel delivery to the engine in response to a second set of engine operating conditions indicative of the termination of the deceleration demand. The deceleration demand may be automatically terminated after the engine has come to a curb idle speed, and the manifold pressure stabilizes or the operator manually reopens the throttle valve.

SUMMARY OF THE INVENTION

The invention is a deceleration control cooperating with an electronic fuel control system of an internal combustion engine for curtailing or terminating the fuel delivery to the engine when the engine speed is above a determinable value, the manifold absolute pressure is above a first determinable value, and the time rate of change of the manifold pressure becomes negative, indicating the operator has demanded deceleration, and to restore normal fuel delivery to the engine after the manifold absolute pressure has returned above a second determinable value and the time rate of change of the manifold pressure becomes positive indicating the operator has terminated the demand for deceleration.

Advantages of the inventive control circuit are immediate response to the operator's demand for deceleration, response to a deceleration demand for conditions other than a closed throttle, and deactivation only after the demand for deceleration has terminated, which are effective in substantially reducing the exhaust emissions of an internal combustion engine with electronic fuel injection. Another advantage is that no new sensors or moving parts are required by this deceleration control.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic of an Electronic Fuel Control System with the inventive Deceleration Control.

FIG. 2 is a block diagram of the Deceleration Control.

FIG. 3 is a circuit diagram of the engine speed reference signal generating circuit and the engine speed comparator.

FIG. 4 is a circuit diagram of a preferred embodiment of the Deceleration Control.

FIG. 5 is a block diagram of an alternate embodiment of the Deceleration Control, responsive to signals from the manifold absolute pressure sensor only.

FIG. 6 is a block diagram of a Fuel Control System, operative to terminate fuel delivery to the engine in response to signals from the Deceleration Control.

FIG. 7 is a block diagram of a Fuel Control System operative to curtail fuel delivery by systematically terminating some of the fuel injection pulses generated by the Fuel Control Computer during deceleration.

FIG. 8 is a block diagram of a Fuel Control System operative to curtail fuel delivery by curtailing the length of the fuel injection pulses generated by the Fuel Control Computer during deceleration.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, an internal combustion engine, the electronic fuel control system, and the deceleration control circuit are shown in schematic form. The system is comprised of an internal combustion engine 10 with an input fuel system 11 delivering fuel to a set of electrically activated fuel injector valves 12 located on the intake manifold 13. The air flow to the engine 10 is controlled by the operator's throttle control 14, shown as a foot pedal, which activates through linkage 16 a valve 15 in the throat of the air intake manifold 13. The amount the throttle valve 15 is opened is indicative of the operating speed of the engine under normal operating conditions. The fuel delivery to the engine 10 is controlled by the Fuel Control Computer 17 which responds to the signals from engine sensors indicating engine operating conditions such as the intake Manifold Absolute Pressure Sensor 18, the Engine Speed Sensor 19, and others not shown. The Fuel Control Computer 17 computes the correct amount of fuel required for efficient operation of the engine and produces electrical signals, indicative of the engine fuel requirements, which activate fuel injector valves 12. The fuel injector valves inject fuel into the intake manifold 13 upstream of the engine's intake valves. The inventive Deceleration Control 20 is an electronic control circuit responsive to signals of the Manifold Absolute Pressure Sensor 18 and the Engine Speed Sensor 19 which produces an inhibitory signal indicative of the operator's demand for deceleration. This inhibitory signal controls the Fuel Control Computer 17 by changing its mode of operation so that the signals transmitted to the fuel injector valves 12 are indicative of this demand for deceleration and fuel delivery to the engine is curtailed or terminated. The deceleration control also terminates its inhibitory signal in response to signals from the engine sensors indicating the demand for deceleration has ended. Power source 21 provides electrical power to the Fuel Control Computer 17 and the Deceleration Control 20. The power source 21 may be a bat-

tery as shown or may be other electrical power sources such as the alternator or generator of a present-day motor vehicle. It will be understood that this representation is illustrative and other arrangements are known and utilized. Furthermore, it is well known in the art of electronic fuel control computers that computer 17 may control one or more injection valves 12 arranged to be activated singularly or in groups of varying numbers in a sequential as well as a simultaneous mode of operation.

FIG. 2 is a block diagram of the Deceleration Control 20. This control consists of three reference signal circuits generating electrical signals indicative of the determinable engine operating parameters. Reference 1, Signal Generating Circuit 22, generates an electrical signal indicative of the electrical signal generated by the intake Manifold Absolute Pressure Sensor 18 for a predeterminable absolute pressure in the manifold. The pressure which is indicative of the signal generated by Reference 1, Circuit 22, lies between the intake manifold pressure with the engine operating at curb idle speed and the nominal intake manifold pressure with the engine operating at cruise speed. For a typical automotive internal combustion engine the signal generated by the Reference 1, Circuit 22, would be the nominal intake manifold pressure at curb idle engine speed plus 50 torr. Reference 2, Signal Generating Circuit 23, generates an electrical signal indicative of the electrical signal generated by the intake Manifold Absolute Pressure Sensor 18 for a predeterminable absolute pressure which is less than the nominal intake manifold pressure of the engine operating at curb idle speed. Again, for a typical automotive internal combustion engine, the signal generated by the Reference 2, Circuit 23, would be the nominal intake manifold pressure at curb idle engine speed minus 50 torr. Since the operating parameters of the various types of internal combustion engines will vary considerably, the signals generated by the Reference 1 and 2 circuits will have to be determined for each individual type of engine.

Reference 3, Signal Generating Circuit 24, is an engine speed reference circuit and generates an electrical signal indicative of a predeterminable engine speed which is greater than the curb idle speed of the engine. The signal from the Reference 3, Circuit 24, and the Engine Speed Sensor 19 are transmitted to the Engine Speed Comparator 25 which generates an electrical signal when the signal received from the Engine Speed Sensor 19 is indicative of an engine speed faster than the predetermined speed represented by the signal generated by the Reference 3, Circuit 24. The signal generated by the Engine Speed Comparator 25 is transmitted to the Set Circuit 26, which is an AND logic circuit with three input gates.

Comparator 1 Circuit 27 receives signals from the Manifold Pressure Sensor 18 and the Reference 1 Circuit 22 and generates a signal when the manifold pressure signal is greater than the signal generated by the Reference 1 Circuit 22. The output signal from Comparator 1 indicative of a manifold absolute pressure greater than the predetermined value established by the Reference 1 circuit is also transmitted to the Set Circuit 26.

Comparator 2 Circuit 28 receives signals from the Manifold Pressure Sensor 18 and the Reference 2 Signal Generating Circuit 23 and generates a signal when the manifold absolute pressure signal is greater than the

signal generated by the Reference 2 Circuit 23. The output signal from the Comparator 2 circuit indicative of a manifold absolute pressure greater than the predetermined value established by Reference 2 Circuit 23 is transmitted to the Reset Circuit 30. The Reset circuit 30 is an AND logic circuit with two input gates.

The time rate of change (dP/dt) Detector 29 is a differentiating circuit which detects the time rate of change of the signal from the Manifold Pressure Sensor 18 and generates two electrical signals, one indicative of a decreasing pressure in the manifold or the time rate of change (dP/dt) of the manifold pressure is negative, and the second signal indicative of when manifold pressure is increasing or the time rate of change (dP/dt) is positive. The first signal indicating a decreasing pressure (dP/dt , negative) is transmitted to the Set Circuit 26, and the second signal indicating an increasing pressure (dP/dt , positive) is transmitted to the Reset Circuit 30. When the manifold pressure is not changing or is increasing or decreasing slowly, the output signal from the dP/dt Detector 29 is indicative of an increasing pressure, or dP/dt positive.

The Set Circuit 26 receives signals from the Engine Speed Comparator 25, Comparator 1 Circuit 27, and the dP/dt Detector 29 and generates an output signal when the engine speed is greater than the speed determined by the Reference 3 Circuit 24, the manifold pressure is higher than the pressure determined by the Reference 1 Circuit 22, and the time rate of change of the manifold pressure is negative. This signal is transmitted to an Output Switch 31 where it switches the Output Switch to its set state and causes the Output Switch to transmit an inhibitory signal to the Fuel Control Computer 17.

Output Switch 31, which may be a Bistable Multivibrator, is normally in the reset state controlled by a positive signal from the time rate of change Detector 29 and the output signal from the Comparator 2 Circuit 28. Normal engine operating parameters including curb idle conditions trigger the Reset Circuit 30 which prevents the Deceleration Control 20 from producing a deceleration demand signal. It is only when the three conditions are fulfilled, that is, when the engine speed is higher than a predetermined value, the manifold absolute pressure is higher than a predetermined value, and the manifold pressure is decreasing, indicative of an operator's demand for deceleration, that a signal is produced by the Set Circuit 26. The signal from the Set Circuit 26 sets the Output Switch 31 in the second state, which generates an inhibitory signal which is transmitted to the Electronic Fuel Control Computer 17. The electronic fuel control computer responds to this signal and curtails or terminates fuel delivery to the engine as long as the inhibitory signal is present.

FIG. 3 shows the circuit details of the Reference 3 Engine Speed Reference Circuit 24 and the Engine Speed Comparator 25. The circuit is shown being energized by voltage supply designated B+, applying a potential to a common conductor 101. Common conductor 102 is connected to the negative terminal of the voltage supply which is illustrated as a common ground in FIG. 3. Voltage pulses from the engine speed sensor 19 indicative of the engine speed are transmitted to the input terminal 103. This pulse is communicated to the base of transistor 104 through resistance 105, causing transistor 104 to conduct for the duration of each pulse received. When the transistor 104 is in the nonconduct-

ing state the signal at the collector of transistor 104 is high and is approximately equal to B+, and when the transistor conducts the signal is low and is approximately equal to ground. Conduction of transistor 104 communicates a low signal to the base of transistor 107 through resistance 106 causing transistor 107 to conduct. The potential at the emitter of transistor 107 is determined by the resistive network consisting of resistances 108, 109, 110, and 111. Resistances 108 and 109 form the voltage divider network between B+ and ground, transmitting by means of resistance 110 a bias potential to the base of transistor 112 and one end of the capacitance 113 in the absence of an input signal at terminal 103. Resistance 111 communicates this potential to the emitter of transistor 107. Conduction of transistor 107 provides a relatively low electrical resistance path from the junction 114 between resistance 110 and capacitance 113 to ground, discharging capacitance 113. The capacitance 113 and the resistance 110 form an RC network with a time constant longer than the intervals between pulses received from the engine speed sensor 19 with the engine operating at nominal operating speeds. Therefore, capacitance 113 will not fully recharge between pulses from the speed sensor 19, causing the potential at junction 114 to be less than the potential at the junction of the voltage divider network formed by the resistances 108 and 109. The signal at the junction 114 is inversely proportional to the speed of the engine. That is, the signal is high when the engine speed is low and the signal is low when the engine speed is fast.

Transistor 112 conducts when the potential at its base is higher than the potential at its emitter by one V_{BE} . The potential at the emitter of transistor 112 is determined by the Reference 3 Engine Speed Generating Circuit 24 which is comprised of resistances 115 and 116, transistor 117 and the resistance 118. A voltage divider network, resistances 115, and 116, transmits a signal to the base of transistor 117 causing it to conduct. Current flowing through the transistor 117 flows through the resistance 118 causing an intermediate potential to be formed at the junction between the resistance 118 and the emitter of transistor 117. The value of the intermediate potential is determined by the values of the resistances 115, 116, and the conductance of transistor 117. These values are selected so that, when the engine is operating at speeds greater than a preselected speed, the potential at the base of transistor 112 will be lower than the potential at its emitter, and transistor 112 will be in a nonconducting state.

At low engine speeds, transistor 112 conducts, causing transistor 119 to conduct, transmitting a positive signal to capacitance 120, charging capacitance 120 to a potential approximately equal to B+. This positive potential is also transmitted to the base of transistor 121 through resistance 122, which is in series with the resistance 123 to ground causing transistor 121 to conduct. When transistor 121 conducts, the signal at terminal 124, communicating with the collector of transistor 121, is low, and when transistor 121 is in the nonconducting stage the signal at terminal 124 is high and is approximately equal to B+. Capacitance 120 and resistances 122 and 123 form a long time constant RC network which maintains a positive potential applied to the base of transistor 121 when the current flow through transistor 119 is intermittent due to the inter-

mittent conduction of transistor 112 in response to signals from the engine speed sensor 19.

At high engine speeds, transistor 112 is nonconductive, blocking transistor 119, blocking the current flow to the base of transistor 121. This causes transistor 121 to become nonconductive and the output signal at terminal 124 is high, approximately equal to B+.

The operation of the circuit is such that, when the speed of the engine is above a predetermined level, the output signal from the Engine Speed Comparator 25 is a positive voltage on terminal 124, approximately equal to B+. When the speed of the engine is below the predetermined value, the output signal at terminal 124 is low and is approximately equal to ground.

FIG. 4 shows the circuit details of the Reference 1 Circuit 22, Reference 2 Circuit 23, Comparator 1 Circuit 27, Comparator 2 Circuit 28, dP/dt Detector 29, Set Circuit 26, Reset Circuit 30, and Output Switch 31. These circuits are shown being energized by a voltage supply designated B+. The negative terminal of the voltage supply is connected to a common conductor designated as ground. This voltage supply may readily be the same source of energy illustrated and described with regard to FIG. 3. A man skilled in the art will recognize that the electrical polarity of the voltage supply can be readily reversed. These circuits receive, along with the voltage supply, input signals from the engine sensors as well as the output from the Engine Speed Comparator 25. Referring first to the Reference 1 Signal Generating Circuit 22 and its companion Comparator 1 Circuit 27, an electrical signal is developed by the voltage divider network, consisting of resistances 201 and potentiometer 202 connected between B+ and ground. The signal taken from the slider arm of the potentiometer is communicated to the base of transistor 203, causing transistor 203 to conduct. Transistor 203 in series with resistance 204 forms a voltage divider which communicates a potential intermediate B+ and ground to the emitter of transistor 205. The conductance of transistor 203 is adjusted by potentiometer 202 so that the potential developed across resistance 204 is indicative of a signal from the Manifold Absolute Pressure Sensor 18 for a predetermined pressure. The signal from the Manifold Pressure Sensor 18 is communicated to the Comparator 1 Circuit 27 through terminal 206. Terminal 206 communicates this signal to the base of transistor 205. When the signal from the Manifold Pressure Sensor 18 is a voltage that is higher than the voltage developed across the resistance 204, transistor 205 conducts causing transistor 207 to conduct. Current flowing through transistors 207 flows through the voltage divider network consisting of resistances 208 and 209. When transistor 207 conducts, the output signal taken from the junction between resistances 208 and 209 is a voltage intermediate B+ and ground. The value of this signal is adjusted by appropriate selection of the values of resistances 208 and 209 to produce a signal of sufficient magnitude to activate the Set Circuit 26. When the signal from the pressure sensor 18 is lower than the voltage developed across resistance 204, transistor 205 is blocked. Nonconductance of transistor 205 blocks transistor 207, and the potential at the junction of resistances 208 and 209 is approximately equal to ground potential.

The function of the Reference 1 Signal Generating Circuit 22 cooperating with the Comparator 1 Circuit 27 is to generate and transmit a positive signal to the

Set Circuit 26 when the signal from the Manifold Pressure Sensor 18 is higher than a predetermined value and to terminate said signal to the Set Circuit 26 when the signal from the Manifold Pressure Sensor 18 is lower than the predetermined value.

The Reference 2 Signal Generating Circuit 23 and its companion comparator, Comparator 2 Circuit 28, are identical to the Reference 1 Signal Generating Circuit 22 and its companion Comparator 1 Circuit 27 discussed above. Therefore, the function of the component parts and the operation of the circuit need not be repeated. The output signal of the Comparator 2 Circuit 28 is a high voltage signal transmitted to the Reset Circuit 30 when the voltage signal from the Manifold Pressure Sensor 18 is greater than a predetermined value of the Reference 2 Circuit. This high signal is terminated when the signal from the Manifold Pressure Sensor 18 is less than the predetermined value of the Reference 2 Circuit 23.

The predetermined reference signal of the Reference 1 and Reference 2 Signal Generating Circuits may be the same, but in the preferred embodiment the output signal for the Reference 2 Signal Generating Circuit is indicative of a manifold pressure lower than the pressure indicated by the signal of the Reference 1 Circuit.

Referring to the Time Rate of Change (dP/dt) Detector 29, the signal from the Manifold Pressure Sensor 18 is transmitted to terminal 401. This signal is communicated to the base of transistor 402 through the differentiator network which comprises of capacitance 403 in series with resistance 404 and resistance 405, in parallel with capacitance 403 and resistance 404. The resistances are selected so that a nonfluctuating signal applied to terminal 401 will cause transistor 402 to conduct. The collector of transistor 402 is electrically in series with resistor 406 so that when transistor 402 is nonconductive, the signal at the collector of transistor 402 is approximately equal to B+, and when transistor 402 conducts the signal at this point is approximately equal to ground. When transistor 402 conducts, a low signal is communicated to the Set Circuit 26 and when transistor 402 is blocked a high signal is communicated to the Set Circuit 26. Conductance of transistor 402 also causes a low signal to be communicated to the base of transistor 407 via resistor 408. This causes transistor 407 to block. When transistor 407 blocks, the signal at the collector of transistor 407 is high. This signal is communicated to a gate of the Reset Circuit 30. When transistor 402 blocks a high signal is transmitted to the base of transistor 407, causing transistor 407 to conduct. This causes the signal at the collector of transistor 407 to become low, terminating the high signal being communicated to the Reset Circuit 30.

The differentiator network which comprises capacitance 403 in series with resistance 404 and resistance 405 in parallel with capacitance 403 and resistance 404 is operable to block transistor 402 when the time rate of change (dP/dt) of the signal from the pressure sensor 18 is negative. The value of capacitance 403 and resistances 404 and 405 are selected so that the time rate of change of a decreasing input signal from the pressure sensor must exceed a predetermined rate before it can cause transistor 402 to block. A positive time rate of increase in the signal at terminal 401 is immediately communicated to transistor 402 through capacitance 403 and resistance 404, increasing the conductance of transistor 402 causing no change in the signals trans-

mitted to the Set and Reset Circuits 26 and 30. After a period of time approximately equal to a time constant of the RC network, the potential at the base of transistor 402 returns to its initial value of approximately one diode drop above ground. A negative time rate of change signal from the pressure sensor 18 indicative of a decreasing manifold pressure causes a decreasing potential to be communicated to the base of transistor 402, causing it to block when the rate of decrease exceeds the time constant of the differentiator and reverses the signal communicated to the Set and Reset Circuits 26 and 30, respectively. The signals remain in this state as long as the negative time rate of change signal holds transistor 402 blocked. When time rate of change is less than a predetermined rate, or positive, the circuit reverts to its normal state.

The function of Time Rate of Change Detector 29 is to generate and communicate a positive voltage signal to the Set Circuit 26 when the manifold absolute pressure is decreasing (dp/dt negative) at a rate greater than a predetermined value to terminate said signal when the manifold absolute pressure is increasing or is relatively stable, and to generate and communicate a positive voltage signal to the Reset Circuit 30 when the manifold absolute pressure is increasing.

The Set Circuit 26 is an AND logic gate which responds to signals from the Engine Speed Comparator 25, the Comparator 1 Circuit 27 and the Time Rate of Change Detector 29. The signal from the Engine Speed Comparator 25 is communicated to terminal 124. When the engine speed is less than the predetermined value, the signal at 124 is approximately equal to ground. This low signal is transmitted to one end of the resistance 501 through a gate diode 502, causing the potential at the junction 507 between diode 502 and the resistance 501 to be approximately two diode drops above ground. When the engine speed is greater than the predetermined value, a positive signal appears at terminal 124. However, this signal is blocked by diode 502; therefore, a positive signal at diode 502 has no influence on the potential at junction 507. In a similar manner, when the manifold pressure is less than the predetermined value of the Comparator 1 Circuit 27, the output signal is a low resistance to ground. This signal is communicated to junction 507 through diode 503, and the potential at junction 507 is approximately equal to ground. When the manifold pressure is higher than the predetermined value of Comparator 1 Circuit 27, the output is a positive voltage which is blocked by the diode 503 and has no effect on the potential at junction 507. The signal from Detector 29 to the Set Circuit 26 is low or a ground signal when the time rate of change of the manifold pressure is zero, or positive. This signal is communicated to junction 507 through diode 504, causing junction 507 to have a potential approximately equal to ground. The signal from Detector 29 is a positive voltage when the manifold pressure is decreasing. This signal is blocked by diode 504 and also has no influence on the potential at junction 507. In the absence of a ground or low signal at any one of the input gates, diodes 502, 503, and 504, current flows from B+ through resistance 501 through diode 505 and diode 506 to the base of transistor 601 in the Output Switch 31 shown as a bistable multivibrator. This current flow causes transistor 601 to conduct, which ultimately results in a high output signal from the multivibrator circuit. A low or ground signal at any one of the

input diodes provides a low resistance path from junction 507 to ground, which is operable to terminate the current flow to the base of transistor 601. Termination of the current flow to the base of transistor 601 terminates the set signal to the bistable multivibrator, which will remain in the set state until it receives a reset signal.

The function of the set circuit 26 is to provide a signal to the Output Switch 31, causing the switch to produce an inhibitory signal when the Set Circuit 26 receives signals indicating the engine speed is above a predetermined value, the manifold pressure is above a predetermined value, and the manifold pressure is decreasing. The set signal to the switch 31 will only occur if simultaneous high signals are received at the three input gates, diodes 502, 503, and 504 of the Set Circuit 26.

The set signal transmitted from Set Circuit 26 to the Output Switch 31 illustrated as a bistable multivibrator in FIG. 4 causes transistor 601 to conduct. The conduction of transistor 601 causes a low signal to be communicated to transistor 602 by means of resistance 603. A low signal at the base of transistor 602 turns transistor 602 off, and communicates a high signal approximately equal to B+ to output terminal 604. This high signal is also communicated to the base of transistor 601 by resistance 605 which latches the bistable multivibrator in this state independent of the signal received from the Set Circuit 26 until a high signal is received at the base of transistor 602 from the Reset Circuit 30.

The function of the Reset Circuit 30 is identical to the function of the Set Circuit 26. The reset circuit responds to signals from the Comparator 2 Circuit 28 and Detector 29. When a low or ground signal is transmitted from the output of the Comparator 2 Circuit 28 to the reset circuit's first gate, diode 701, diode 701 conducts and provides a low resistance path between the junction 706 and ground. A high signal received at diode 701 from the Comparator 2 Circuit 28, indicative of the speed above the predetermined value, is blocked by diode 701 and has no influence on the potential at junction 706. Likewise, a low signal from Detector 29 to the reset circuit causes diode 703 to conduct, again providing the low resistance path to ground for the current flowing through resistance 702. A high signal from Detector 29 indicative of an increasing manifold pressure is blocked by diode 703 and removes the low resistance path to ground from junction 706. High signals received at both input gates, diode 701 and 703, permits current to flow from B+ through resistance 702 through the two diodes 704 and 705 to the base of transistor 602, causing transistor 602 to conduct and resets the bistable multivibrator in its initial state. The two diodes 704 and 705 are used in this circuit to elevate the potential required at junction 706 to make transistor 602 conduct above the potential of the highest low signal at an input gate. A low signal at either gate, diodes 701 or 703, or both, results in a lower resistance path to ground, approximately two diode drops, and terminates the current flow to the base of transistor 602. As described above, high signals occurring at both diodes 701 and 703 apply a positive signal to the base of transistor 602, causing it to conduct. Conduction of transistor 602 generates a low signal which is communicated to output terminal 604 and to the base of transistor 601 by means of resistance 605. The low signal at the base

of transistor 601 blocks the conductance of transistor 601, which produces a high signal which is communicated to the base of transistor 602 through resistance 603 and latches multivibrator in the reset mode and terminates the high signal at terminal 604.

As seen from the above descriptions of the circuit details, the deceleration control circuit accomplishes the objectives of the invention. An inhibitory signal is developed when the engine speed is above a predetermined level, the manifold absolute pressure is above the predetermined level, and the manifold pressure is decreasing. This inhibitory signal remains until the engine operating parameters return to a normal state. The normal state as defined by this circuit is when the manifold absolute pressure has returned to or is above a predetermined value and the manifold pressure is increasing.

An alternate embodiment of the inventive Deceleration Control 20 is illustrated in FIG. 5. The embodiment is entirely dependent upon the signals from the Manifold Pressure Sensor 18. As in the previous embodiment reference manifold pressure signals are developed in the Reference 1 Signal Generating Circuit 22 and Reference 2 Signal Generating Circuit 23. The signals from the Manifold Pressure Sensor 18 is compared with the Reference 1 and Reference 2 signals in the Comparator 1 Circuit 27 and the Comparator 2 Circuit 28, respectively, which produce output signal when the manifold absolute pressure signal is greater than the reference signal. The manifold pressure signal is also transmitted to the Time Rate of Change Detector 29 which produces two signals indicative of whether the manifold pressure is increasing or decreasing. The signal from the Comparator 1 Circuit 27 and the decreasing pressure signal (dP/dt negative) are communicated to the Set Circuit 26 which generates a signal when it receives simultaneous signals indicating a pressure above the predetermined value and that the pressure is decreasing. The signal from the Set Circuit 26 triggers the Output Switch 31 to change state and produce a fuel inhibit signal which is communicated to the Fuel Control Computer 17. The Output Switch 31 remains in this state until it receives a signal from the Reset Circuit 30. The Reset Circuit 30 responds to simultaneous signals from the Comparator 2 Circuit 28 indicating the manifold pressure is above a second predetermined value and a signal from the Detector 29 indicating the manifold pressure is increasing (dP/dt positive) generating a signal resetting the Output Switch 31 to its initial state. This signal terminates the fuel inhibit signal being transmitted to the Fuel Control Computer 17 restoring normal fuel delivery to the engine. This embodiment, as well as the one previously described, are functional control systems based upon predetermined manifold absolute pressures and the manifold pressure time rate of change for determining the operator's demand for deceleration.

It will be apparent to one skilled in the art that signals from other engine sensors may be added to the set and reset circuits to still further refine the determination of the operator's demand for deceleration.

The signals from the Deceleration Control 20 can be used to terminate or modify the signals from the Fuel Control Computer 17 to the injector valves 12 as previously indicated. The deceleration signal can be transmitted directly to the output stage of the Computer 17 to block the fuel injection signals generated, preventing

operation of the fuel injector valves. This type of circuit is shown in block form in FIG. 6. Signals from the Engine Sensors 50 are transmitted to the Pulse Generator Computer 51 and the Deceleration Control 20. The Pulse Generator Computer 51 responding to the signals from the engine sensors computes the proper fuel requirements for efficient operation of the engine and generates an electrical pulse, the duration of which is indicative of the computed fuel requirements. Output Pulse Generator 52 responding to the signals from the Pulse Generating Computer 51 generates an output signal capable of activating the injection valve 12, providing fuel delivery to the engine. The Pulse Generating Computer 51 and the Output Pulse Generator 52 comprise the Fuel Control Computer 17 shown in FIG. 1. The Output Pulse Generator 52 also responds to the signal from the Deceleration Control 20. When the Output Pulse Generator 52 receives the signal from the deceleration control indicative of an operator's demand for deceleration, the signal received is operable to block the generation of output signals terminating the engine fuel delivery.

Alternatively, the signal from the deceleration control can be used to curtail or reduce the fuel delivery to the engine during the deceleration period. FIG. 7 shows a block diagram of such a system. As in FIG. 6, the Engine Sensors 50 supply signals indicative of the engine's operating parameters to both the Pulse Generating Computer 51 and the Inhibit Signal Generator 55. The Pulse Generating Computer 51 generates the fuel requirements of the engine and generates electronic pulse indicative of the computed fuel requirement. This electrical pulse is transmitted to the Output Pulse Generator 52 which produces an output signal capable of activating the fuel injector valves 12.

The signal from the Inhibit Signal Generator 55 indicative of an operator's demand for deceleration activates a Switch 53. Switch 53 responds to the pulses generated by the computer circuit and is operable to produce an inhibitory signal systematically blocking the signals to the fuel injector valve. The switch, in the form of an electrical gate or counter, may produce an inhibitory signal for every other, every third, or every fourth, etc., fuel injection pulse received from the computer. Likewise, the switch may be operable to produce inhibitory signals for two out of three, three out of four, four out of five, etc., signals received from the Computer 51. The function of the Switch 53 is to curtail the fuel delivery to the engine upon a signal from the Inhibit Signal Generator 55 by systematically blocking some of the fuel injection pulses, generated by the Pulse Generating Computer 51. Inhibit Signal Generator 55 and Switch 53 comprises an alternate embodiment of the Deceleration Control 20 shown in FIG. 1.

Another method for curtailing the fuel delivery to the engine in response to a deceleration command is illustrated in FIG. 8. As in the previous figures, fuel injection pulses are transmitted to the Output Pulse Generator 52 in accordance with the fuel requirements of the engine, determined by the Pulse Generating Computer 51 in response to the signals from the Engine Sensors 50. These signal pulses are transmitted to the Output Pulse Generator 52 which activates the fuel injection valves. Pulses are also transmitted to a Delay Circuit 54 which generates an inhibitory pulse a fixed time after receipt of a pulse from the Computer 51. The inhibit pulse is communicated to the Output Pulse Generator

52, controlling the duration of the output pulse being generated by the output pulse generator to a shorter fixed period. The trailing edge of the pulse from the Computer 51 communicated to the delay circuit may be used to reset the delay circuit, terminating the inhibit pulse being transmitted to the Output Pulse Generator 52, and restore the output pulse generator to its normal mode of operation. The signal from the Inhibit Pulse Generator 55 transmitted to the Delay Circuit 54 activates the delay system producing the inhibitory signal. The function of the Delay Circuit 54 is to curtail the fuel delivery to the engine upon a deceleration command by terminating the output pulses from the Output Pulse Generator 52 after a fixed period of time, independent of the signal from the Pulse Generating Computer 51. Inhibit Pulse Generator 55 and Delay Switch comprise an alternate embodiment of Deceleration Control 20 shown in FIG. 1. It should be apparent to one skilled in the art that signals from the engine sensors could also be used to modify the delay period of the inhibitory pulse to further reduce the exhaust emissions during deceleration and subsequent acceleration.

While the invention has been illustrated and described as embodied in a particular type of fuel injection control system, it is not intended to be limited to the details shown, since various modifications and circuit structural changes may be made without departing in any way from the spirit of the present invention.

What is claimed is:

1. In an internal combustion engine fuel control system having an intake manifold pressure sensor means operative to generate pressure dependent signals indicative of engine operating conditions, a fuel control computer operative to generate a set of output signals indicative of the engine fuel requirements for each operational cycle of the engine, and at least one fuel injector responsive to the signals from said computer operative to control fuel delivery to the engine, the improvement comprising:

means responsive to just the pressure dependent signals to indicate a demand for deceleration when the pressure dependent signals are indicative of a manifold pressure above a first predetermined pressure and the pressure is decreasing at a rate faster than a predetermined rate, and to generate an inhibitory signal, said inhibitory signal communicated to the fuel control computer controls the operation of said computer and regulates the fuel delivery to the engine during the deceleration period,

said means further responsive to just the pressure dependent signals to indicate the end of said demand for deceleration when the pressure dependent signals are above a second predetermined pressure and the pressure is decreasing at a rate slower than said predetermined rate, and to terminate said inhibitory signal to said computer and restore normal fuel delivery to the engine.

2. The system as claimed in claim 1 wherein said means for generating said inhibitory signal includes:

first signal generating means responsive to pressure dependent signals operative to generate a first signal indicative of a pressure in the intake manifold above said first predetermined pressure;

second signal generating means responsive to pressure dependent signals to generate a second signal

indicative of a pressure in the intake manifold above said second predetermined pressure;
a time rate of change detector responsive to the pressure dependent signals operative to produce a first rate of change signal indicative that the manifold pressure is decreasing at a rate faster than said predetermined rate and a second rate of change signal indicative that the manifold pressure is decreasing at a rate slower than said predetermined rate; and
a control switch responsive to said first signal from said first signal generating means and the first rate of change signal from said time rate of change detector operative to generate said inhibitory signal, and further responsive to said second signal from said second signal generating means and said second rate of change signal from said time rate of change detector operative to terminate the generation of said inhibitory signal.

3. The system as claimed in claim 2 wherein said first signal generating means comprises:

a first manifold pressure reference circuit operative to generate a first reference signal indicative of said first predetermined manifold pressure; and

a first comparator circuit responsive to said first reference signal and said pressure dependent signal from the manifold pressure sensor operative to produce said first signal when the manifold pressure is higher than said first predetermined pressure established by the first manifold reference circuit; and
said second signal generating means comprises:

a second manifold pressure reference circuit operative to generate a second reference signal indicative of said second predetermined manifold pressure; and

a second comparator circuit responsive to said second reference signal and said pressure dependent signals from the manifold pressure sensor operative to produce said second signal when the manifold pressure is higher than said second predetermined pressure established by the second manifold reference circuit.

4. The system as claimed in claim 3 wherein said control switch comprises:

a set switch operative to produce a signal in response to the coincidence of signals from the first comparator circuit indicating a manifold pressure greater than said first predetermined manifold pressure and the time rate of change detector indicating the dynamic pressure in the manifold is decreasing at a rate faster than said predetermined rate;

a reset switch operative to produce a signal in response to coincidence of signals from the second comparator circuit indicating a manifold pressure greater than said second predetermined manifold pressure and the time rate of change detector indicating the dynamic pressure in the manifold is decreasing at a rate slower than said predetermined rate; and

an output switch, switchable from one state to the other in response to the signals from the set and reset switches, operative to control the output signal of the said fuel control computer.

5. The system as claimed in claim 4 wherein said time rate of change detector comprises:

a capacitance;

a first resistance in series with said capacitance;

a second resistance in parallel with said capacitance and said first resistance, wherein said capacitance, said first resistance and said second resistance comprises a differentiator, said differentiator operative to produce a first differentiated signal when the pressure dependent signal to the differentiator is indicative of a pressure decreasing at a rate faster than said predeterminable rate and operative to produce said second differentiated signal when the pressure dependent signal to the differentiator is a signal indicative of the manifold pressure decreasing at a rate slower than said predeterminable rate; and

a switch cooperating with said differentiator responsive to said first and second differentiated signals operative to produce said first rate of change signal when the manifold pressure is decreasing at a rate faster than said predeterminable rate and operative to produce said second rate of change signal when the manifold pressure is decreasing at a rate slower than said predeterminable rate.

6. The system as claimed in claim 5 wherein said first manifold pressure reference circuit comprises:

- a transistor;
- a resistance in series with said transistor; and
- a voltage divider means connected to said transistor operative to control a current flow through said transistor, and said series resistance, said current operative to develop a reference voltage across said resistance, said reference voltage being an electrical signal indicative of a manifold pressure greater than the manifold pressure with the engine operating at curb idle speed; and

said second manifold pressure reference signal circuit comprises:

- a transistor;
- a resistance in series with said transistor; and
- a voltage divider means connected to said transistor operative to control a current flow through said transistor and said series resistance, said current operative to develop a reference voltage across said resistance, said reference voltage being a signal indicative of a manifold pressure lower than the manifold pressure with the engine operating at curb idle speed.

7. The system as claimed in claim 6 wherein said signal generated by the first manifold pressure reference signal generating circuit is a signal indicative of a manifold pressure 50 torr greater than the manifold pressure with the engine operating at said curb idle speed; and said signal generated by the second manifold pressure reference signal generating circuit is a signal indicative of a manifold pressure 50 torr lower than the manifold pressure with the engine operating at said curb idle speed.

8. The system as claimed in claim 5 wherein said set and reset circuits are AND logic gates operative to produce output signals in response to simultaneous input signals from a plurality of preceding signal sources.

9. The system as claimed in claim 5 wherein said output switch is a bistable multivibrator, switchable from one state to the other, operative in response to a signal from said set switch to generate an inhibit signal; and said multivibrator operative to remain in said inhibit signal generating state until switched to the initial state by a signal from said reset switch, whereby the fuel delivery to the engine is terminated during the

deceleration period and normal fuel delivery is restored after the engine operating conditions return to a normal operating range at the end of the deceleration period.

10. The system as claimed in claim 5 wherein said output switch comprises:

- a bistable multivibrator, switchable from one state to the other, operative to produce an inhibitory signal in response to a signal from said set switch and said multivibrator operative to remain in said signal producing state until switched to its initial state by a signal from said reset switch; and
- a pulse terminating switch responsive to the inhibit signal from said multivibrator and signals from the fuel control computer, operative to systematically terminate from each set of fuel injection signals generated by the fuel control computer, at least one fuel injection signal, whereby fuel delivery to the engine is reduced by the intermittent operation of the fuel injector valve in response to the intermittent signals received from the fuel control computer during the deceleration period, and to restore normal fuel delivery to the engine after engine operating conditions return to the normal state at the end of the deceleration period.

11. The system as claimed in claim 5 wherein said output switch comprises:

- a bistable multivibrator, switchable from one state to the other, operative to produce an inhibit signal in response to signals from said set switch and said multivibrator operative to remain in said signal producing state until switched to its initial state by a signal from said reset switch; and
- a pulse delay circuit, responsive to an inhibit signal from the multivibrator, signals from the fuel control computer, and signals from the engine sensors, operative to reduce the length of the fuel injection signals generated by the fuel control computer, whereby the fuel delivery to the engine is reduced during the deceleration period and normal fuel delivery to the engine is restored after the engine operating conditions return to a normal state of operation at the end of the deceleration period.

12 The system as claimed in claim 5 wherein said sensor means includes an engine speed sensor operative to produce a signal indicative of engine speed, said means for generating an inhibit signal includes:

- a speed reference circuit operative to generate an electrical signal indicative of a predeterminable engine speed;
- a speed comparator responsive to signals from said speed reference circuit and engine speed sensor, operative to generate a signal in response to the signals from the engine speed sensor indicative of an engine speed greater than said predeterminable speed established by the speed reference circuit; and

said set switch further operative to produce a signal in response to the coincidence of signals from the first comparator circuit indicating the manifold pressure is greater than said first reference signal, the speed comparator indicating an engine speed greater than said predeterminable speed, and the time rate of change detector indicating the pressure in the manifold is decreasing at a rate faster than said predeterminable rate.

13. The system as claimed in claim 12 wherein said speed reference circuit comprises:

a transistor, a resistance in series with said transistor, and a voltage divider means connected to said transistor operative to control a current flow through said transistor and said series resistance, said current operative to develop a reference voltage across said resistance, said voltage being a signal indicative of an engine speed greater than the curb idle speed of the engine.

14. The system as claimed in claim 12 wherein said speed comparator circuit comprises:

a first transistor means having a pair of states responsive to signals from the engine speed sensor, operative to be in a first state during the occurrence of a pulse signal from the engine speed sensor and operative to be in a second state during the interpulse period;

a capacitive means responsive to said first transistor means operative to discharge when said first transistor means is in the first state, and operative to recharge when said first transistor means is in the said second state; and

a second switch means having a pair of states responsive to said capacitance means operative to switch between states when the potential across said capacitance means during the recharge interpulse period becomes greater than a preselected value, said preselected value being said potential generated by the engine speed reference circuit.

15. The system as claimed in claim 12 wherein said output switch is a bistable multivibrator switchable from one state to the other operative to generate an inhibit signal in response to signals from said set switch and said multivibrator operative to remain in said inhibit signal generating state until switched to the initial state by a signal from said reset switch, whereby the fuel delivery to the engine is terminated during the deceleration period and normal fuel delivery is restored after the engine operating parameters return to a normal operating range at the end of the deceleration period.

16. The system as claimed in claim 12 wherein said output switch comprises:

A bistable multivibrator, switchable from one state to the other, operative in response to a signal from said set switch to produce an inhibit signal, and said multivibrator operative to remain in said signal producing state until switched to its initial state by a signal from said reset switch; and

a pulse terminating switch responsive to the inhibitory signal from said multivibrator and signals from the fuel control computer operative to systematically terminate from each set of fuel injection signals generated by the fuel control computer at least one fuel injection signal, whereby fuel delivery to the engine is reduced by the intermittent operation of the fuel injection valves in response to the intermittent signals from the fuel control computer during the deceleration period and restore to the engine after operating parameters return to the normal operating state at the end of the deceleration period.

17. The system as claimed in claim 12 wherein said output switch comprises:

a bistable multivibrator, switchable from one stage to the other, operative to produce an inhibitory signal

in response to a signal from said set switch and said multivibrator operative to remain in said signal producing state until switched to its initial state by a signal from said reset switch; and

a pulse delay circuit responsive to the inhibit signal from the multivibrator, signals from the fuel control computer, and signals from the engine sensors operative to reduce the length of the fuel injection signals generated by the fuel control computer, whereby fuel delivery to the engine is reduced during the deceleration period and normal fuel delivery to the engine is restored after the engine operating parameters return to the normal operating state at the end of the deceleration period.

18. A deceleration control operative to control the output signals from a fuel control computer for an internal combustion engine having sensor means including a manifold pressure sensor generating signals indicative of the engine's operating conditions, comprising:

first signal generating means responsive to pressure dependent signals operative to generate a first signal when the manifold pressure is higher than a first predeterminable pressure;

second signal generating means responsive to pressure dependent signals operative to generate a second signal when the manifold pressure is higher than a second predeterminable pressure;

a time rate of change detector responsive to pressure dependent signals from the manifold pressure sensor operative to produce a first rate of change signal indicative of a manifold pressure decreasing at a rate faster than a predeterminable rate and further operative to produce a second rate of change signal indicative of the manifold pressure decreasing at a rate slower than said predeterminable rate;

a control switch responsive to said first signal from said first signal generating means and said first rate of change signal generated by said time rate of change detector operative to generate an inhibitory signal which controls the operation of the engine fuel control computer and regulates the fuel delivery to the engine and further responsive to said second signal generated by said second signal generating means and said second rate of change signal generated by said time rate of change detector operative to terminate said inhibitory signal and restore fuel delivery to the engine.

19. The deceleration control as claimed in claim 18 wherein said time rate of change detector comprises:

an input differentiator circuit and a switch responsive to the pressure dependent signals from the manifold pressure sensor indicative of a changing pressure operative to produce said first rate of change signal in response to an input signal indicative of a manifold pressure decreasing at a rate faster than said predeterminable rate and operative to produce said second rate of change signal indicative of pressure decreasing at a rate slower than said predeterminable rate.

20. The deceleration control as claimed in claim 19 wherein said first signal generating means comprises:

a first manifold pressure reference circuit operative to generate on a first reference electrical signal indicative of a first predeterminable pressure;

a first comparator circuit responsive to signals from said first manifold pressure reference circuit and the signal from the manifold pressure sensor opera-

tive to produce a signal when the signal from the manifold pressure sensor is indicative of a pressure greater than the signal generated by said first manifold pressure reference circuit; and
 wherein said second signal generating means comprises:
 a second manifold pressure reference circuit operative to generate a second reference electrical signal indicative of a second predeterminable pressure; and
 a second comparator circuit, responsive to signals from said second manifold pressure reference circuit and signals from the manifold pressure sensor operative to produce a signal when the signal from the pressure sensor is indicative of a pressure higher than the signal generated by said second manifold pressure reference circuit.

21. The deceleration control as claimed in claim 20 wherein said control switch comprises:

a set switch operative to produce a signal in response to the coincidence of signals from said first comparator, indicating a manifold pressure greater than said first reference signal, and said first signal from the time rate of change detector, indicating the pressure in the manifold is decreasing at a rate faster than said predeterminable rate;
 a reset switch operative to produce a signal in response to the coincidence of signals from the second comparator, indicating a manifold pressure greater than said second reference signal, and the time rate of change detector, indicating the pressure in the manifold is decreasing at a rate slower than said predeterminable rate; and
 an output switch switchable from one state to the other in response to signals from said set and reset switches operative to generate said inhibit signal.

22. The deceleration control as claimed in claim 21 wherein said output switch comprises a bistable multivibrator, switchable from one state to the other, operative to generate said inhibit signal in response to a signal from said set switch; and

said multivibrator operative to remain in said inhibit signal generating state until switched to its initial state by a signal from said reset switch.

23. The deceleration control as claimed in claim 21 further comprising:

a speed reference circuit operative to generate an electrical signal indicative of a predeterminable engine speed;

a speed comparator, responsive to signals from said speed reference circuit and engine speed sensor operative to generate a signal in response to signals from the engine speed sensor indicative of an engine speed greater than said predeterminable speed established by said speed reference circuit; and

said set switch, further operative to produce a signal in response to the coincidence of signals from said first comparator, indicating the manifold pressure

is greater than said first reference signal, said speed comparator, indicating an engine speed greater than said predeterminable speed, and said time rate of change detector, indicating the pressure in the engine manifold is decreasing at a rate faster than said predeterminable rate.

24. The deceleration control as claimed in claim 23 wherein said output switch comprises:

a bistable multivibrator, switchable from one state to the other, operative to generate said inhibit signal in response to said signal from said set switch and said multivibrator operative to remain in said inhibit signal generating state until switched to the initial state by a signal from said reset switch.

25. A deceleration control operative to control the output signals from a fuel control computer for an internal combustion engine having sensor means generating signals indicative of the engine's operating condition, wherein said sensor means includes at least one sensor generating signal having a static component indicative of the magnitude of the signal generated by said at least one sensor at any given time, and one dynamic component indicative of the rate of change of the signal generated by the at least one sensor as a function of time, comprising:

means responsive to the static component of the signal from just one of said at least one sensor for generating condition signals indicative of at least one predetermined engine operating condition;

means responsive to the dynamic component of the signal from the same just one of said at least one sensor for generating rate of change signals indicative of at least two different rates of change in the operating conditions of the engine, a first rate of change signal indicative of the presence of a deceleration condition, and a second rate of change signal indicative of the absence of said deceleration condition; and

means responsive to said condition signals and said first rate of change signal for determining a demand for deceleration and for generating an inhibitory signal controlling the operation of the fuel control computer to curtail fuel delivery to the engine during the period of deceleration, and further responsive to said condition signal and said second rate of change signal for determining the end of said demand for deceleration and terminating said inhibitory signal.

26. The deceleration control of claim 25 wherein said means for generating condition signals generates two condition signals indicative of two different engine operating conditions, a first condition signal determinative that the engine operating conditions are such that fuel delivery to the engine should be curtailed during deceleration and a second condition signal determinative that the engine's operating conditions approximate the curb idle operating condition.

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