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AUXILIARY ACCELERATOR CONTROL FOR FUEL INJECTION ENGINE

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2 Sheets-Sheet 1

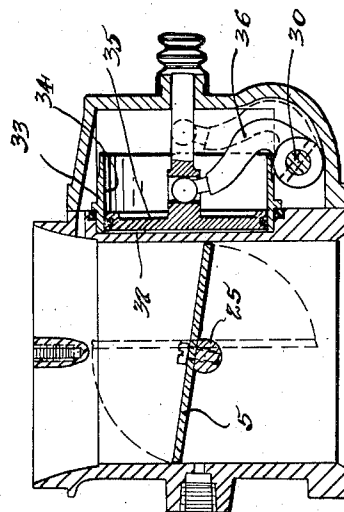
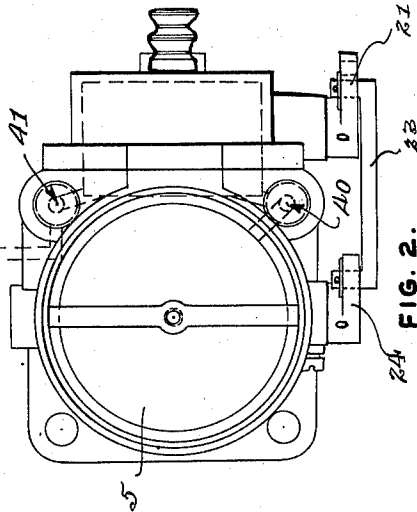
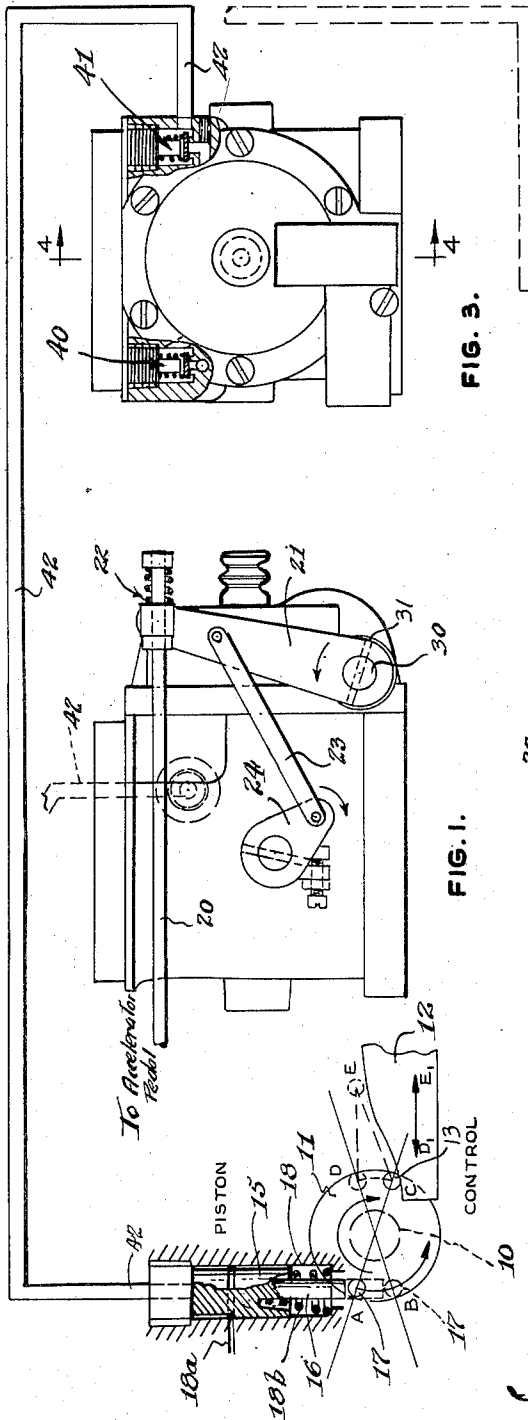


FIG. 4.

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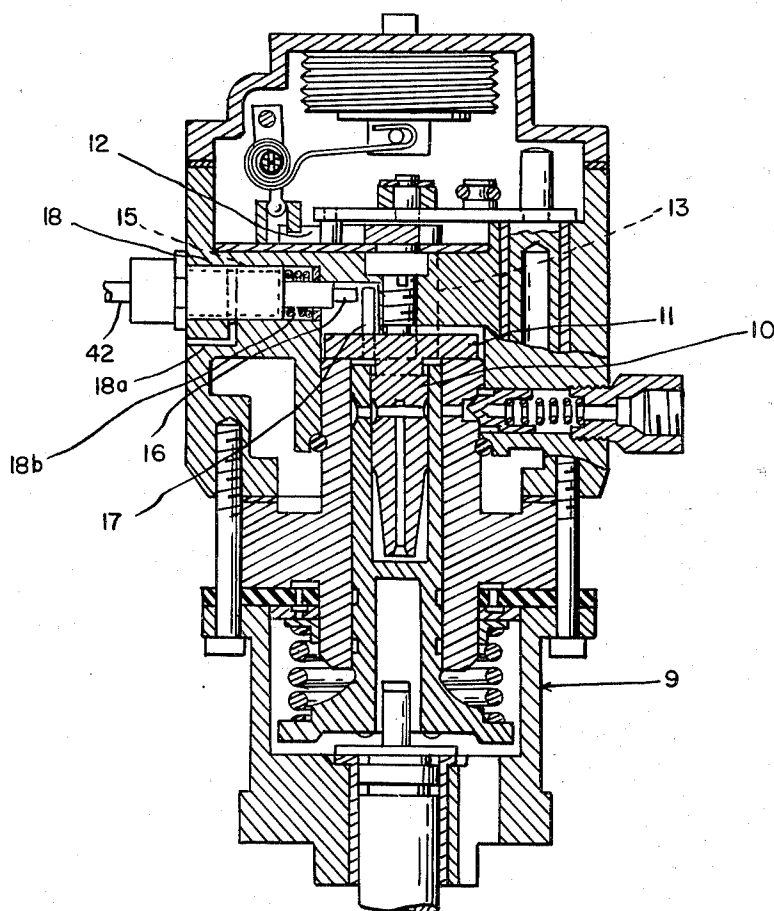
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2 Sheets-Sheet 2

FIG. 5.



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1

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AUXILIARY ACCELERATOR CONTROL FOR FUEL INJECTION ENGINE

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5 Claims. (Cl. 123—139)

My invention relates to an engine control or regulator device and more particularly to a control device adapted for application with a fuel injection engine.

In fuel injection engines, especially of the type illustrated in my Patent No. 2,667,840, dated Feb. 12, 1954, entitled "Fuel Injection Apparatus and Control Mechanism Therefor" and in my copending applications for patent Serial No. 454,274, filed Sept. 7, 1954 and entitled, "Fuel Injection Metering Control Apparatus," and Serial No. 478,250, filed Dec. 29, 1954 entitled, "Fuel Injector Apparatus for Internal Combustion Engine," the fuel injection pump is driven by the engine and embodies a metering valve to vary the fuel being supplied to the engine in response to the action of a pressure sensitive diaphragm assembly in response to the air density in the intake manifold serving the internal combustion engine. In both of these applications for patent and in the issued Patent No. 2,667,840, the fuel metering valve is rotated to vary the fuel injected into the engine, said valve being adjusted by angularly adjusting a circular disc carried by the valve so that as the air throttle of the engine is opened, the air density in the manifold varies and causes the fuel metering valve to open to inject more and more fuel to maintain an optimum fuel and air ratio. This mechanism serves adequately for ordinary engine operation, but in some cases where the air throttle is suddenly opened for rapid acceleration of the engine, we find that there is a lag in the mechanism so that for a short while the engine is not getting enough fuel to maintain this optimum fuel and air ratio, resulting in a delayed acceleration of the engine.

It is an object of my invention to improve the accelerating characteristics of a fuel injection engine of the aforesaid type and for other types of fuel injection engines as well, by providing means operable on suddenly accelerating said engines to momentarily increase the fuel supplied to the engine, and to thus offset the tendency of the fuel control mechanism of the injection pump to lag and render a too lean ratio of fuel to air.

Another object of my present invention is to facilitate the starting of a fuel injection engine by momentarily increasing the fuel being delivered to the engine to substantially the maximum displacement of the fuel pump, and this invention serves to maintain full displacement fuel delivery with the air throttle either open or closed.

The application of the present invention to a metered fuel delivery provides for an immediate delivery of a maximum of fuel in suddenly opening the air throttle to produce the optimum fuel and air ratio when supplying a maximum of air, thus enabling the engine torque to keep pace with the throttle, thereby resulting in smooth engine acceleration without subjecting the moving engine parts and power transmission parts to an undue strain, causing excessive wear of said parts.

This invention also enables one to accelerate only with fuel being delivered through the regular or standard fuel injector nozzles and thus avoids the necessity of having

2

additional or extra injection means and the complex control mechanism for linking same to the regular or standard injection means so that said auxiliary injection is only operated when needed.

Without the present invention and in engines having conventional air throttle and injection pump arrangements to supply the fuel and air to an internal combustion engine, the sudden opening of the air throttle may cause the air to lead, or the fuel injection to lag, thus upsetting the optimum fuel and air ratio. Also, for engine starting, the fuel delivered through the spray nozzles will be reduced by the comparably low-speed pump operation which results in hard starting. Under these conditions, the quick opening of the air-throttle, with depression of the accelerator pedal, will move the pump control to full displacement and thus overcome the fuel deficiency of correct ratio. Or with a cold engine, some fuel remains unvaporized which must be counterbalanced by an excess of fuel which the accelerating system can supply. Also for engine warm up, unvaporized or unburned fuel must be counterbalanced by excess fuel input which the accelerating system will supply upon depression of the accelerator pedal.

For a more detailed understanding of my invention reference may be had to the accompanying drawing illustrating a preferred embodiment of my invention in which like parts throughout the several views are referred to by like characters, and in which

Fig. 1 is a side elevational view of my improved device.

Fig. 2 is a top plan view thereof.

Fig. 3 is an end view taken normal to Fig. 1,

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3, and

Fig. 5 is a sectional view of the valve operated by the mechanism comprising the invention.

In the accompanying drawings I have diagrammatically illustrated the conventional fuel metering valve structure as employed with the aforesaid copending applications for patent as well as in the issued patent referred to above, the valve itself being illustrated in cross-section in Fig. 5 and identified in Fig. 3 by the reference character 10 having an enlarged circular flange 11 carrying a pin 13 actuable by a cam 12, said cam being moved in a manner set forth in the aforesaid applications for patent as the air throttle is opened up to angularly adjust the valve to increase the fuel delivery of a fuel injector pump 9 to the engine.

As the said cam is moved, it will cause the pin to move in an anti clockwise direction as viewed in plan from the position "C" to position "D." On suddenly opening the air throttle 5, the normal action of the cam 12 is lagging behind slightly and therefore one does not obtain the full delivery of fuel as required for such instantaneous acceleration.

My invention contemplates other means for quickly acting on the valve 10 to open same in advance of the cam actuation and this comprises a piston or plunger 15 having a shaft 16 which engages a second pin 17 on the adjustable valve flange 11, said piston moved by pressure in the bore 18 to thus move the pin 17 from position "A" to position "B," thereby advancing the angularly adjustable valve ahead of the cam action to open the valve and deliver the required amount of fuel necessary to maintain the optimum fuel and air ratio to efficiently accelerate the engine.

The operation of the piston or plunger 15 is accomplished in a very simple manner as will be now described: The air throttle 5 comprises a conventional butterfly valve in the air intake duct leading to the engine air intake manifold and is actuated by means of the linkage illus-

3

trated in Fig. 1. The rod 20 connected with the foot accelerator pedal engages a pivoted lever 21 by a lost motion connection 22 and by link 23 to lever 24 attached to the butterfly valve shaft 25. The lever 21 is pivoted to the casing on shaft 30 to which said lever is pinned as at 31.

Formed on the side of the air intake duct is a circular recess or pocket 32, and a cylindrical pipe section or sleeve 33 is fitted into this recess or pocket to form a compressor cylinder 34. A piston 35 is reciprocally supported in this compressor cylinder and is moved "in" and "out" of the cylinder by a lever 36 secured to shaft 30. A one-way intake valve 40 of conventional construction controls the air intake to the compressor cylinder and a conventional outlet valve 41 provides for a control of the compressed air from cylinder 33 as the piston 35 is advanced to the outlet line or conduit 42, which line or conduit leads to the top of piston 15. A very small bleed opening 18a is provided to bleed air pressure from the top of piston 15 to the atmosphere, so that a normal slow advance of the air throttle will not advance the piston 15. A sudden opening of air throttle 5 causes a rapid advance of the piston 35 and a quick pressure rise of the air in line 42, thus advancing the piston 15 and suddenly opening the fuel delivery to the engine. The piston 15 has an easy or loose fit in the cylinder 18 and provides for a slow leakage of air past the piston 15 to the bleed opening 18a. A light spring 18b is preferably employed to return the piston 15 to its uppermost position in cylinder 18 during normal operation of the engine. It will be noted that slight adjustments of the air throttle 5 during normal engine operation results in very little variation in air pressure in line 42 and also because during part throttle or full throttle engine operation, the pin 17 is disposed quite a distance from the shaft 16 any slight movement of piston 15 is insufficient to engage said shaft 16 with the pin 17. This accessory mechanism is thus operative when suddenly accelerating the engine from idling operation to full throttle operation. In accelerating from a part throttle engine operation to full throttle, the pin 17 is only engaged and actuated by shaft 16 if the fuel valve position is adjusted for insufficient fuel delivery, that is, if same lags too much by reason of the lag in operation of said cam 12.

The above construction is usable in starting engines of the fuel ignition type and as noted above, serves to momentarily supply additional fuel on acceleration until such time as the cam 12 catches up.

It will be apparent to those skilled in the art to which my invention pertains that various changes and modifications may be made therein without departing from the spirit of my invention and the scope of the appended claims.

I claim:

1. In a fuel injection engine having an air induction means and an air throttle, a fuel injector means for delivering fuel to said engine, an adjustable fuel metering valve for varying the fuel delivery of said fuel injector means, means operable in response to operation of said air throttle to adjust said fuel metering valve whereby to maintain an optimum fuel and air ratio for engine operation, and a secondary means operable only by a sudden and rapid opening of the air throttle in rapidly accelerating engine operation to momentarily open the fuel metering valve independently of the operation of the first mentioned fuel metering valve control means.

2. In a fuel injection engine having an air induction means and an air throttle, a fuel injector means for delivering fuel to said engine, and adjustable fuel metering valve for varying the fuel delivery of said fuel injector means, means operable in response to operation of said air throttle to adjust said fuel metering valve whereby to maintain an optimum fuel and air ratio for engine operation, and a secondary means operable only by a

4

sudden and rapid opening of the air throttle in rapidly accelerating engine operation to momentarily open the fuel metering valve independently of the operation of the first mentioned fuel metering valve control means, said secondary means comprising a separate fluid pressure system having a fluid pressure pump and a pressure actuated means connected with said fuel metering valve, and means actuating said fluid pressure pump upon suddenly and rapidly opening said air throttle to activate said pressure actuated means to momentarily open said fuel metering valve in advance of the normal opening of same by said first mentioned valve operating means.

3. In a fuel injection engine having an air induction means and an air throttle, a fuel injector means for delivering fuel to said engine, an adjustable fuel metering valve for varying the fuel delivery of said fuel injector means, means operable in response to operation of said air throttle to adjust said fuel metering valve whereby to maintain an optimum fuel and air ratio for engine operation, and a secondary means operable only by a sudden and rapid opening of the air throttle in rapidly accelerating engine operation to momentarily open the fuel metering valve independently of the operation of the first mentioned fuel metering valve control means, said secondary means comprising a separate fluid pressure system having a fluid pressure pump and a pressure actuated means connected with said fuel metering valve, and means actuating said fluid pressure pump upon suddenly and rapidly opening said air throttle to activate said pressure actuated means to momentarily open said fuel metering valve in advance of the normal opening of same by said first mentioned valve operating means, said fluid pressure pump mounted on said air induction conduit in juxtaposition to said air throttle, the means for actuating said pump comprising linkage operable by said air throttle actuating means.

4. In a fuel injection engine having an air induction means and an air throttle, a fuel injector means for delivering fuel to said engine, an adjustable fuel metering valve for varying the fuel delivery of said fuel injector means, means operable in response to operation of said air throttle to adjust said fuel metering valve whereby to maintain an optimum fuel and air ratio for engine operation, and a secondary means operable only by a sudden and rapid opening of the air throttle in rapidly accelerating engine operation to momentarily open the fuel metering valve independently of the operation of the first mentioned fuel metering valve control means, said secondary means comprising a separate fluid pressure system having a fluid pressure pump and a pressure actuated means connected with said fuel metering valve, and means actuating said fluid pressure pump upon suddenly and rapidly opening said air throttle to activate said pressure actuated means to momentarily open said fuel metering valve in advance of the normal opening of same by said first mentioned valve operating means, and a relatively small diameter bleed opening in said separate fluid pressure system serving to nullify relatively slight variations of fluid pressure in said system, and to time the duration of such advance opening of said fuel metering valve.

5. In a fuel injection engine having an air induction means and an air throttle, a fuel injector means for delivering fuel to said engine, an adjustable fuel metering valve for varying the fuel delivery of said fuel injector means, means operable in response to operation of said air throttle to adjust said fuel metering valve whereby to maintain an optimum fuel and air ratio for engine operation, and a secondary means operable only by a sudden and rapid opening of the air throttle in rapidly accelerating engine operation to momentarily open the fuel metering valve independently of the operation of the first mentioned fuel metering valve control means, said secondary means comprising a separate fluid pres-

sure system having a fluid pressure pump and a pressure actuated means connected with said fuel metering valve, and means actuating said fluid pressure pump upon suddenly and rapidly opening said air throttle to activate said pressure actuated means to momentarily open said fuel metering valve in advance of the normal opening of same by said first mentioned valve operating means, said pressure actuated means comprising a fluid pressure actuated piston, a pin carried eccentrical-

ly on said metering valve and engaged by said piston when pressure actuated to advance said fuel metering valve, said piston and pin operable to positively adjust said metering valve to only open same.

References Cited in the file of this patent

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