May 27, 1958 W. F. ISLEY 2,836,163

CONTROL FOR INTERNAL COMBUSTION ENGINE

Filed Feb. 18, 1957

FIG. 1.

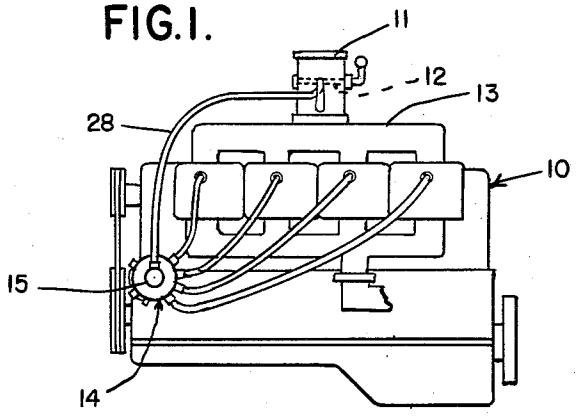
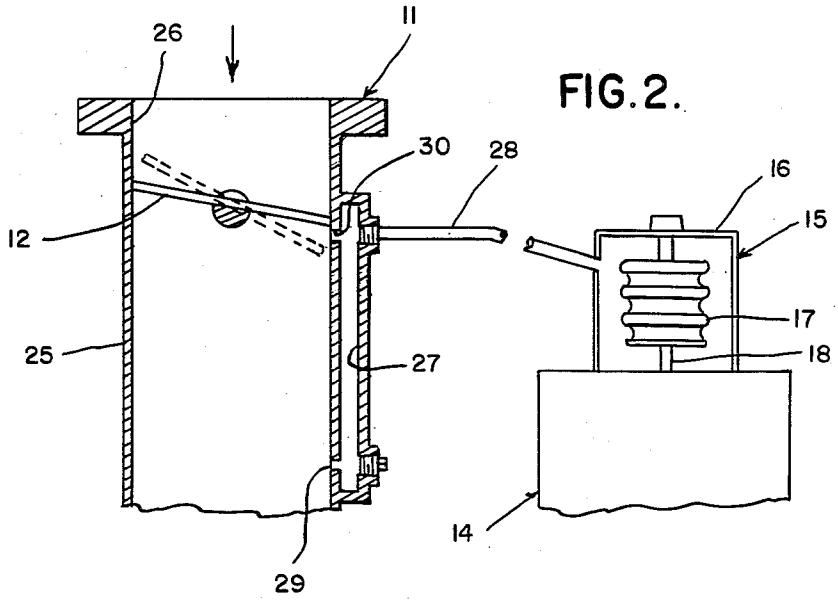


FIG. 2.



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CONTROL FOR INTERNAL COMBUSTION ENGINE

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3 Claims. (Cl. 123—140)

My invention relates to pressure controls for fuel injection type internal combustion engines, and more particularly to a pressure sensing means associated with an engine throttle valve control and operative to progressively sense varying pressures in the air intake manifold as the throttle valve is operated.

Normally, present conventional fuel injectors meter fuel at a fixed rate or stroke relative to given manifold pressures. However, since the volumetric efficiency of an engine varies with engine speed, at any given manifold pressure, a proper injector calibration for one engine speed may be too lean or too rich for other engine speeds. Analyses of fuel metering characteristics of injection systems at varying speeds and manifold pressures indicate that a substantial reduction in specific fuel consumption may be achieved with a conventional fuel injector which is speed responsive without resorting to inefficient compromise calibration; that is, the pressures introduced to the injector control may be so regulated that the injector stroke will vary proportionately with engine speed so as to match the engine volumetric efficiency variations.

An object of my invention is to improve fuel injection control by providing a variable pressure sensing means automatically regulatable in response to engine speed.

Another object of my invention is to simplify fuel injection control by providing a pressure sensing means for automatic transmission of varying pressures in the intake manifold as the throttle position is progressively changed.

A further object of my invention is to improve engine operation by providing a simplified speed responsive control which produces a gain in engine economy especially at low engine speeds and loads.

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

Fig. 1 is a side elevational view of a preferred internal combustion engine incorporating my invention, and

Fig. 2 is a cross sectional diagrammatic view of the pressure sensing system used in the engine of Fig. 1.

An internal combustion engine **10** is illustrated as having an air induction system including an air intake pipe **11**, a conventional throttle valve **12** operable therein, an air intake manifold **13**, and a conventional fuel injector **14** provided with a pressure responsive control mechanism **15**.

Operation of the injector **14** is well known in the art, and it will suffice to note that the control mechanism **15** preferably comprises a pressure housing **16**, a pressure sensitive bellows **17** supported therein and operable to actuate a pin shaft **18** connected to the injector **14** in such a manner that actuation of the shaft **18** inward toward the injector **14**, due to a decrease of pressure in the housing **16**, effects a decrease in fuel delivery providing for a fuel/air mixture leaning and actuation of the shaft **18** outward, due to an increase of pressure in the housing **16**, effects an increase in fuel delivery providing for a richer fuel air mixture.

The air intake pipe **11** comprises a housing **25** having an air intake passage **26** in which the throttle valve **12** operates, and a pressure sensing passage **27** openly communicating by means of a conduit **28** or other means with the control mechanism pressure housing **16** and terminating in two ports **29** and **30**. Port **29** opens preferably into the air intake passage **26** downstream of the throttle valve **12** and will always sense manifold pressure. Port **30** opens into the air intake passage **26** approximately at the throttle valve **12** and is disposed in such a position that when the throttle valve **12** is almost closed during idle engine operation, port **30** will be in a position downstream of the valve **12** to sense manifold pressure only, but when the throttle valve is opened to the dotted line position of Fig. 2 and beyond, port **30** will be in a position upstream of the valve **12** to sense intake air pressure. Since passage **27** connects the ports **29** and **30**, manifold pressure from port **29** will consequently be biased by the higher intake air pressure from port **30**, resulting in higher pressure in the pressure housing **16**, having the richening effect noted previously.

As the throttle valve **12** is opened progressively wider, intake air pressure and manifold pressure correspondingly approach the same value, until the two are equal at wide open throttle and the enriching effect becomes zero.

By properly selecting the location of the port **30**, this enrichening effect may be provided to begin at some desirable speed and load condition.

This throttle blade angle control principle may be adapted for use as a speed control in the following manner: as an example, the basic injector calibration may be revised so that below 2000 R. P. M. and at no engine load, the setting is as lean as is possible commensurate with smooth engine operation for these conditions. This revised calibration gradually approaches the original calibration as the manifold pressure increases until the two are the same at wide open throttle. The throttle blade control then serves to increase the pressure in the housing **16** at speeds above 2000 R. P. M. to enrich the fuel flow to the requirements for these high speeds.

Since the calibration normally utilized in fuel injection systems is arranged to compromise the low speed operation by an over-rich condition in order to satisfy the high speed operation, it will be seen that the above described throttle blade speed control will save the difference in fuel delivery now being wasted by this compromise. Analysis indicates that this appears to be about a ten percent savings in the lower manifold pressure range of the operating conditions.

Although I have described but one preferred embodiment of my invention, it will be apparent to one skilled in the art to which the invention pertains that various changes and modifications may be made therein without departing from the spirit of the invention or the scope of the appended claims.

I claim:

1. In an internal combustion engine having an air induction system including an intake manifold having an air intake, and a throttle valve operable therein, a fuel injection system including a pressure responsive control means, pressure sensing means operatively connecting said manifold, and said control means to actuate said control in response to variable pressures, and a second speed control means progressively modifying the pressure in said sensing means during a predetermined range of said throttle valve operation, said speed control means comprising a pressure sensing port open to said manifold downstream of said throttle valve and a second

pressure sensing port open to said manifold approximately at said throttle valve and disposed to be positioned downstream of said throttle valve when same is closed and to be positioned upstream of said throttle valve when same is opened beyond a predetermined position, and means openly connecting said parts to said pressure responsive control means.

2. In an internal combustion engine having a fuel injection system including a pressure responsive control means and an air inducting system comprising an air intake housing having an air intake passage, a throttle valve operable therein, a pressure sensing means comprising a passage in said housing and openly communicating with said pressure responsive control means, said pressure sensing passage terminating in a port open into said air intake passage downstream of said throttle valve and a second port open into said air intake passage approximately at said throttle valve, said second port disposed to be positioned downstream of said throttle valve when same is closed and to be positioned upstream of said throttle valve when same is opened beyond a predetermined position, whereby to modify the pressure in said sensing means effective on said control means

during a predetermined range of said throttle valve operation.

3. In an internal combustion engine having an air induction system including an intake manifold having an air intake, and a throttle valve operable therein, a fuel injection system including a pressure responsive control means, and a speed control means comprising a pressure sensing means operatively connecting said pressure responsive control means at all times with pressure downstream of said throttle valve and a second pressure sensing means operatively connecting said pressure responsive control means with pressure downstream of said throttle valve when same is closed and upstream of said throttle valve when same is open beyond a predetermined position.

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