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CONTROL FOR INTERNAL COMBUSTION ENGINES

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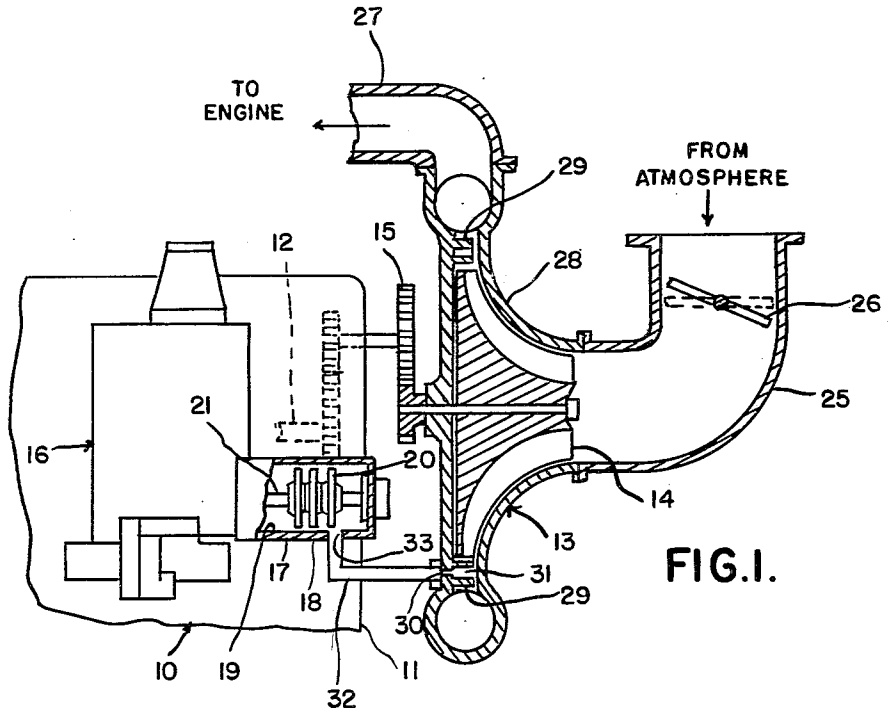


FIG.1.

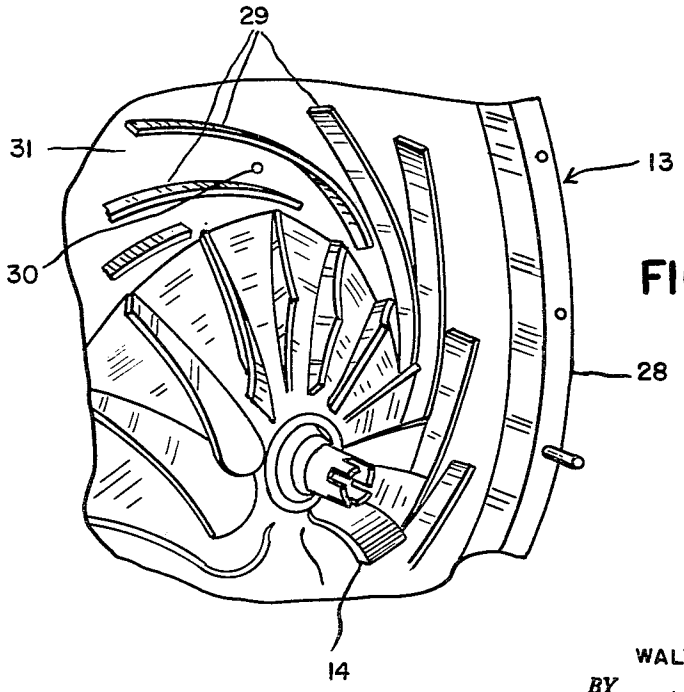


FIG.2.

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CONTROL FOR INTERNAL COMBUSTION ENGINES

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4 Claims. (Cl. 123—140)

My invention relates to controls for internal combustion engines and more particularly to a pressure causing means for operating a fuel injection pressure responsive control adapted to a supercharged internal combustion engine.

In the development of pressure responsive controls for fuel injection systems, one of the primary considerations is the location of pressure sensing probes for most effectively controlling the system in response to varying engine operation. Heretofore, the air induction system manifold pressure was the basis for control. However, in supercharged engines, fuel requirement at a constant manifold pressure increases with decreased engine speed; therefore, the metering control must provide enrichment with decreasing speed. If the basic injector calibration is tailored to the engine requirements at the lower operating engine speeds, the usual manifold pressure control normally results in overrich mixtures in the higher engine speed operating ranges.

Many different solutions to this problem have been put forward, generally resulting in the provisions of more and more complex controls, in which manifold pressure is balanced in one way or another against various other induction system pressures at different ranges of engine operation. Such controls are of course more expensive, more difficult to adapt to standard manufacture, and less readily serviced, adjusted, and maintained than is desired. In addition, such methods generally produce only approximations to the desired control pressures, which, although adequate for some purposes, do not generally produce satisfactory fuel injection control during all ranges of engine operation.

In analyzing injector control requirements from this position, certain correlated facts were recognized. Particularly, it was realized that since, in an engine driven supercharger, the air flow mass output is directly proportional to the engine speeds, the air flow between the vane sections of the diffuser housing is also a direct function of the engine speed. The normal function of the supercharger diffuser is to convert the kinetic head of the induction system air flow to a static head, and since this energy conversion is gradual through the diffuser, at any given section in the diffuser the static head will be inversely proportional to the air flow mass through that section. For a given cross-section of the diffuser, as the airflow mass increases, the velocity must also increase, thereby resulting in a pressure reduction much as is produced by a venturi. A static pressure probe located in the diffuser, between any two diffuser guide vanes, would then provide a decreasing pressure signal with an increasing air flow mass, so that as the engine speed increases, the static pressure sensed by this probe decreases.

It will be seen that this type of pressure signal is similar to the type of pressure characteristic desired for use with fuel injectors on supercharged fuel injection engines, in which, as previously noted, fuel requirement at constant manifold pressure increases with decreased engine speed and decreases with increased engine speed.

An object of my invention, as indicated in the foregoing discussion, is to improve fuel injection control by utilizing pressure variations in the diffuser of an engine driven supercharger for varying fuel injection in response to engine speed.

Another object of my invention is to simplify fuel injection control by providing a pressure responsive control device actuated in response to static pressure obtained in the diffuser of the engine driven supercharger.

A further object of my invention is to provide for effective and more accurate fuel injection control by constructing an engine driven supercharger having a static pressure probe located between two diffuser vanes and connecting the probe to a pressure responsive fuel injection control means.

A more complete understanding of my invention may be had by reference 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 fragmentary side elevational view of a preferred internal combustion engine with the supercharger and the fuel injection control shown substantially in section, and

Fig. 2 is a fragmentary perspective view of the supercharger interior indicating a preferred static pressure top location.

In Fig. 1, an internal combustion engine **10** is illustrated as having a crankcase **11**, a crankshaft **12**, and a supercharger **13** provided with an impeller **14** driven from said crankshaft by any means such as gear train **15**. A conventional fuel injection pump **16** is mounted in any convenient location and is provided with a pressure responsive control **17**, which may be of any desired type, but for purposes of convenience is illustrated here as comprising a housing **18** having a pressure control chamber **19**. A pressure responsive bellows **20** is supported in the chamber **19** and longitudinally actuates a shaft **21** in response to pressure changes in the chamber **19** in a manner well-known to one skilled in the art.

The fuel injection pump operation is also well known in the art, and it will suffice to note that the shaft **21** is connected to the pump in any desired manner so that actuation of the shaft **21** to the left or inward, due to expansion of the bellows **20** from decreased pressure in the chamber **19**, will effect a decrease in fuel pump metering delivery to the engine; and actuation of the shaft **21** to the right or outward, due to compression of the bellows **20** from increased pressure in the chamber **19**, will effect an increase in fuel pump metering delivery.

The supercharger **13** is a part of the air induction system having an air intake duct **25** in which a conventional throttle valve **26** operates, and a supercharged air intake manifold **27**. The supercharger **13** comprises a housing **28** connected between the duct **25** and the manifold **27**. The impeller **14** is rotatably supported in the housing **28**, and a plurality of conventional diffuser guide vanes **29** are provided in close association with the impeller **14**, preferably between the impeller **14** and the housing connection to the manifold **27**.

A static pressure sensing orifice **30** is provided in the housing and is open to a venturi-like air passage **31** defined by two adjacent diffuser vanes **29**, preferably as indicated in Fig. 2. A conduit **32** openly connects the orifice **30** with a pressure inlet port **33** provided in the housing **18** of the control **17**.

The basic calibration of the injection pump **16** is preferably tailored to the engine fuel requirement at the lower engine operating speeds. As the engine speed increases, producing a corresponding increase in speed of the impeller **14**, air flow through the diffuser passage **31** increases, resulting in a static pressure signal drop at the

orifice 30, as previously explained. The decreased pressure thus produced in the control chamber 19 causes an expansion of the bellows 20 and an actuation of the shaft 21 to the left, reducing the fuel metering rate of the injection pump 16 and leaning out the fuel/air mixture.

By the proper selection of the basic injection pump calibration and the location of the pressure sensing orifice, the metering of fuel may be accurately tailored to meet the engine fuel requirements throughout the entire operating range of the engine 10.

Although I have described and illustrated 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. An internal combustion engine having an air induction system including a supercharger, and a fuel injection means including a pressure responsive control means, said supercharger comprising an engine driven air impeller, diffuser guide vanes associated therewith, and pressure sensing means operable to sense static pressure in the area of said diffuser guide vanes, and means operatively connecting said pressure sensing means to the aforesaid pressure responsive control means.

2. An internal combustion engine having an air induction system including a supercharger, and a fuel injection means including a pressure responsive control means, said supercharger comprising a housing having an air inlet and air outlet, an engine driven impeller rotatably supported in said housing and operable to increase air flow velocity through said housing, diffuser guide vanes supported in said housing and defining venturi-like air passages associated with said impeller, and a pressure sensing means comprising an orifice in said housing and open to one of said diffuser air passages for sensing static air pressure therein, and means operatively connecting said sensing means to the aforesaid pressure responsive control means.

3. In an internal combustion engine having an air induction system including a supercharger, and a fuel injection means including a pressure responsive control means, said supercharger comprising a housing having an air inlet and an air outlet, an engine driven impeller rotatably supported in said housing and operable to increase air flow velocity through said housing, diffuser guide vanes supported in said housing and defining venturi-like diffuser air passages associated with said impeller, and a pressure sensing means comprising an orifice in said housing and open to one of said diffuser air passages for sensing static air pressure therein, said pressure responsive control means comprising a control housing having a pressure chamber, a control element actuated in response to pressure changes in said pressure chamber, and means openly communicating said sensing means orifice with said pressure chamber.

4. In an internal combustion engine having an air induction system including a supercharger, said supercharger comprising an engine driven air impeller and diffuser guide vanes associated therewith, a fuel injection means for said engine and having a pressure responsive control means, and means actuating said control means in response to the static pressure of air flowing through said diffuser guide vanes.

No references cited.