Nov. 18, 1958 L. C. DERMOND 2,860,616

ATMOSPHERIC NOZZLE CONTROL

Filed May 31, 1957 2 Sheets-Sheet 1

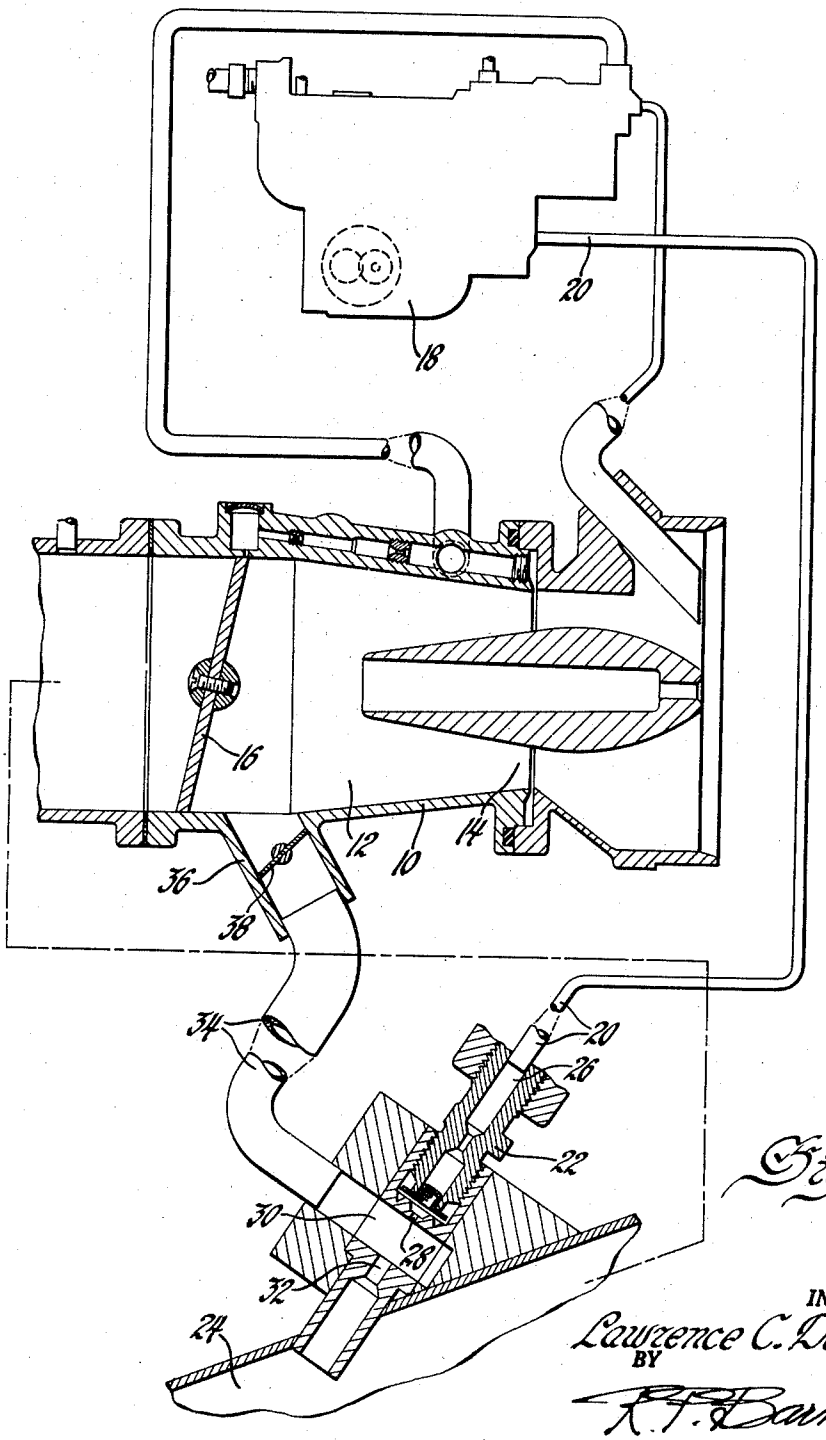


Fig. 1

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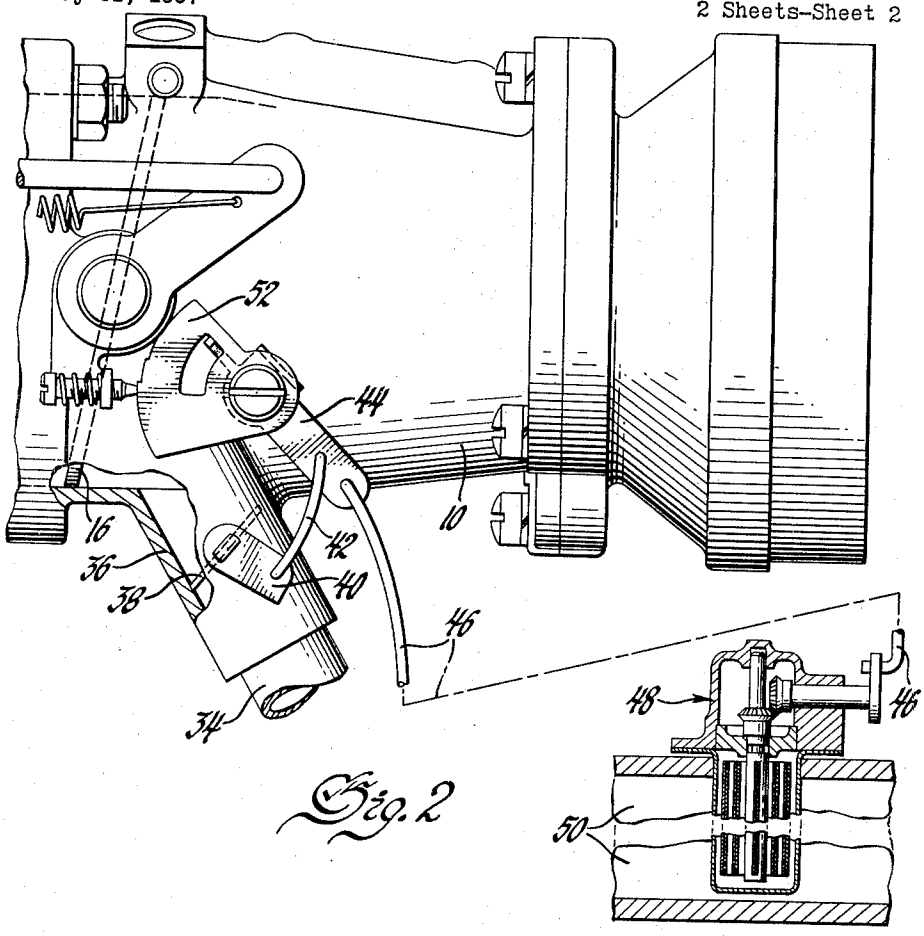


Fig. 2

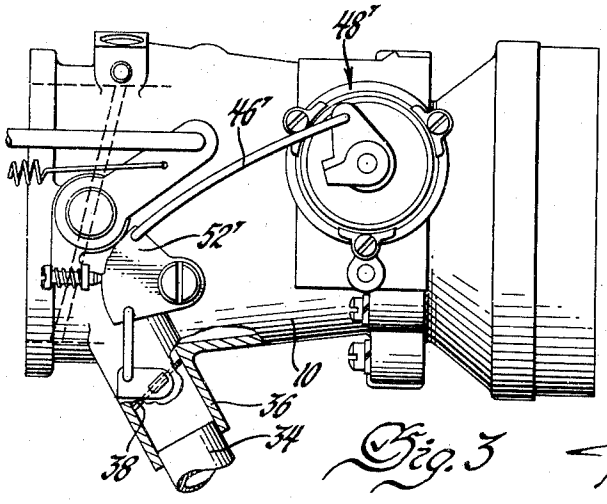


Fig. 3

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United States Patent Office 2,860,616
Patented Nov. 18, 1958

2,860,616

ATMOSPHERIC NOZZLE CONTROL

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Application May 31, 1957, Serial No. 662,928

5 Claims. (Cl. 123—119)

The present device relates to an improved fuel injection system of the mass air flow type and more particularly such system employing an atmospheric type nozzle.

The present fuel injection system is of the type shown in copending application Serial No. 608,893, Dolza, filed September 10, 1956. In the noted Dolza system a fuel nozzle is utilized in which atmospheric reference air is introduced into the nozzle fuel stream in order that the fuel flow through the nozzle is not affected by the variations in manifold depression to which the nozzle is subjected.

While under normal operating conditions it is desirable that the fuel flow through the nozzle be unaffected by manifold vacuum, it has been found that this force may be utilized under certain operating conditions to provide fuel enrichment. With the engine cold it has been found necessary to provide means for enriching the normal fuel-air mixture of a fuel injection system. In the Dolza system noted this is achieved by a temperature responsive mechanism which causes the mechanical advantage of a fuel control linkage to be changed to insure fuel enrichment for a given time interval.

In the present device a simple means has been provided whereby manifold vacuum may act directly on the nozzle fuel stream to thereby facilitate cold running enrichment. The present device may be used alone or in combination with the previous device which achieved fuel enrichment by altering the mechanical advantage of the fuel metering linkage.

In the present device the cold running fuel enrichment is realized by providing an engine temperature responsive valve adapted to cut off the flow or bleed of atmospheric reference air to the fuel nozzle as long as the engine is cold, and further to gradually restore the flow of such air as the engine temperature increases.

The details as well as other objects and advantages of the present invention are set forth in the description which follows.

In the drawings:

Figure 1 shows a fuel injection system embodying the present invention;

Figure 2 shows the subject invention in greater detail; and

Figure 3 is a modified form of temperature control device.

The fuel injection system functions in the same manner as in the aforenoted copending application except as will be specifically described herein. In general, the fuel injection system comprises an air intake casing **10** having air induction passage **12** formed therein. A venturi **14** is formed in said induction passage which also includes a throttle valve **16** disposed posteriorly of said venturi. A fuel metering mechanism is shown generally at **18** and is adapted to supply metered quantities of fuel to the individual cylinder fuel supply conduits **20**. The quantity of fuel supplied to the fuel conduits **20** is proportional to the mass of air flow through induction passage **12** as described in detail in the aforenoted copending application.

Each fuel conduit **20** terminates in a nozzle **22** supported upon and partially projecting within the individual cylinder intake passages **24**. Each fuel nozzle **22** includes a fuel inlet passage **26** which terminates in a fuel metering orifice **28**. The fuel from metering orifice **28** is projected in a stream across the enlarged chamber **30** where it is targeted through a larger orifice **32**. The chamber **30** is adapted to communicate with a conduit **34** which communicates at its other end with the air intake casing **10** to provide reference air to the nozzle **22**. The orifice **32** in the nozzle **22** has no metering effect on the fuel flow through the nozzle but does meter the quantity of air which is mixed with the fuel stream prior to its injection into the intake passage **24**. As already noted, under normal operating conditions the reference air in chamber **30** neutralizes the manifold vacuum force acting on the end of the nozzle **22** and thereby stabilizes the metered fuel flow.

It is to be noted that air conduit **34** communicates with the air induction passage **12** intermediate the throttle valve **16** and the venturi **14**. In this way all air flowing to the cylinders of the engine passes through the venturi **14** and insures a maximum metering signal for the fuel metering control device **18**.

As best seen in Figure 1, a boss **36** is formed on the intake casing **10** to which the air conduit **34** is suitably connected. A rotatable valve member **38** is disposed in boss **36** and is adapted to control the quantity of air flow through conduit **34**. As seen in Figure 2, a lever **40** is fixed to the valve **38** and is articulated through link **42**, lever **44** and link **46** to an engine temperature responsive device **48**. The temperature responsive element **48** may be disposed within the manifold exhaust cross-over passage **50** in order to respond closely to the natural engine temperature, or may be disposed on the air intake casing **10** as shown in Figure 3.

While it is preferable to communicate the air conduit **34** with the induction passage **12** intermediate the throttle valve **16** and the venturi **14**, it is possible to communicate the conduit with the passage at any point anterior to the throttle valve. In other words, it is possible to communicate the air conduit **34** with the air induction passage **12** anteriorly of the venturi **14** if desired.

Under normal operating conditions valve **38** will be opened whereby the pressure differential existing between the air induction passage **12** anteriorly of throttle **16** and the cylinder intake passage **24** proximate nozzle **22** will cause air to flow or be bled through conduit **24** and nozzle chamber **30**. In this way the manifold vacuum acting on the nozzle **22** will be neutralized and have no effect on the quantity of metered fuel flowing through the nozzle. However, with the engine cold the valve **38** will be closed, as shown in Figure 1, cutting off the supply of reference air to the metering nozzle as a result of which the manifold depression acting on the nozzle **22** will cause the flow of fuel through the nozzle to be increased thereby enriching the fuel-air ratio while the engine is cold.

As the engine temperature increases valve **38** will progressively open under the influence of the temperature responsive element **48** permitting the gradual flow or bleed of air through conduit **34**. When the engine has reached its normal operating temperature valve **38** will be completely opened under which condition manifold vacuum will no longer have any enrichment effect on the fuel flowing through the nozzle **22**.

In either of the modifications of Figures 2 or 3 a fast idle cam **52** or **52'** is pivotally mounted on the induction casing **10** and suitably articulated to the temperature responsive element **48** or **48'** by a link **46** or **46'** in order to control the idle position of the throttle valve **16** in accordance with engine temperature in the well known manner.

I claim:

1. A fuel injection system for an internal combustion engine comprising an air intake passage for supplying air to the individual cylinders of the engine, a throttle valve in said passage for controlling the quantity of air flow therethrough, means for supplying a metered quantity of fuel to the passage posteriorly of said throttle, said means including a nozzle disposed in said passage proximate the individual cylinders of the engine, a conduit communicating said nozzle with said intake passage anteriorly of said throttle, the pressure differential across the throttle normally causing air to flow through said conduit whereby manifold vacuum acting on said nozzle normally has no effect on the quantity of fuel flowing therethrough when the air flow through said conduit is unrestricted, a valve disposed in said air conduit, and engine temperature responsive means connected to said valve for restricting the quantity of air flow through said conduit in inverse proportion to the temperature of said engine.

2. A fuel injection system for an internal combustion engine comprising an air intake passage for supplying air to the individual cylinders of the engine, a throttle valve in said passage for controlling the quantity of air flow therethrough, means for supplying a metered quantity of fuel to the passage posteriorly of said throttle, said means including a nozzle disposed in said passage proximate the individual cylinders of the engine, a conduit communicating said nozzle with the intake passage anteriorly of said throttle whereby manifold vacuum acting on said nozzle normally has no effect on the quantity of fuel flow therethrough when air flow through said conduit is unrestricted, a valve disposed in said air conduit, engine temperature responsive means connected to said valve for restricting the quantity of air flow through said conduit in inverse proportion to the temperature of said engine, and means for controlling the idling position of the throttle valve, said latter means being connected to said temperature responsive means.

3. A fuel injection sytsem for an internal combustion engine comprising an intake casing, an air induction passage formed in said casing for supplying air to the individual cylinders of the engine, a throttle valve in said passage for controlling the quantity of air flow therethrough, means for supplying a metered quantity of fuel to the passage posteriorly of said throttle, said means including a nozzle disposed in said passage proximate the individual cylinders of the engine, a valve disposed in said intake casing and communicating with the induction passage anteriorly of the throttle valve, a conduit communicating said nozzle with said valve whereby the air in said conduit will bleed through said nozzle when the valve is open, and engine temperature responsive means connected to said valve for reducing the quantity of air bled through the nozzle in inverse proportion to the temperature of said engine permitting the manifold vacuum acting on the nozzle to increase the quantity of fuel flow when the engine is cold.

4. A fuel injection system for an internal combustion engine comprising an air intake passage, a venturi formed in said passage, a throttle valve in said passage posteriorly of said venturi for controlling the quantity of air flow therethrough, a plurality of cylinder intake passages communicating with said air intake passage, means for supplying a metered quantity of fuel to each of said cylinder intake passages in accordance with the mass of air flow through said venturi, said means including a nozzle disposed in each of said cylinder intake passages proximate said cylinder, a conduit communicating each nozzle with said intake passage anteriorly of said throttle valve, the pressure differential between the air intake passage and each cylinder intake passage adjacent the nozzle causing air to bleed through the conduit to prevent manifold vacuum from modifying nozzle fuel flow, said air conduit communicating with said air intake passage intermediate said throttle valve and said venturi, a valve disposed in said air conduit, and temperature responsive means for controlling said valve to decrease the quantity of air bleed through said conduit in inverse proportion to engine temperature whereby manifold vacuum will increase nozzle fuel flow when the engine is cold.

5. A fuel injection system for an internal combustion engine comprising an air intake passage for supplying fuel to the individual cylinders of the engine, a throttle valve in said passage for controlling the quantity of fuel flow therethrough, means for supplying a metered quantity of fuel to the individual cylinders of the engine in accordance with the mass of air flow through said air intake passage, said means including a nozzle disposed in said air intake passage posteriorly of said throttle and proximate each cylinder of the engine, and engine temperature responsive means permitting manifold vacuum to act on said nozzle to increase the quantity of fuel flow therethrough in inverse proportion to engine temperature, said temperature responsive means being adapted to vent said nozzle to the intake passage anteriorly of the throttle valve to cause manifold vacuum to be ineffective to control when the engine reaches its normal operating temperature whereby said fuel supplying means solely determines the quantity of fuel flow through said nozzle.

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