June 27, 1967 R. L. CRAWFORD, JR 3,327,760

FUEL BYPASS CONTROL FOR AUTOMOTIVE VEHICLE

Filed Sept. 1, 1965

Fig. 1

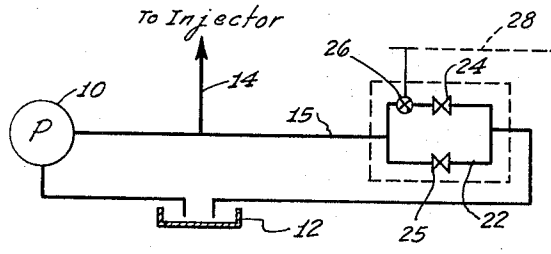


Fig. 2

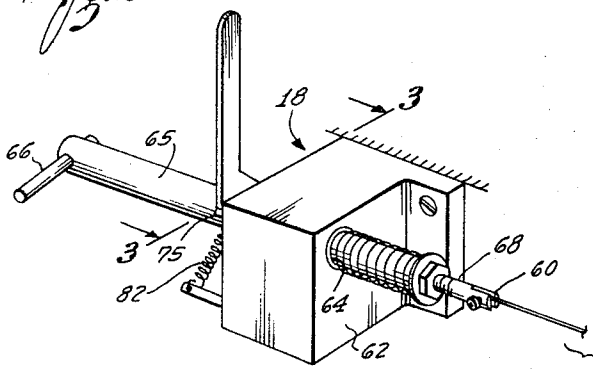
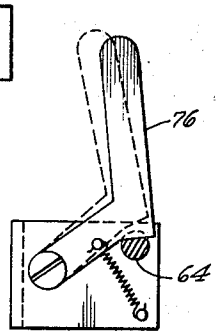


Fig. 3



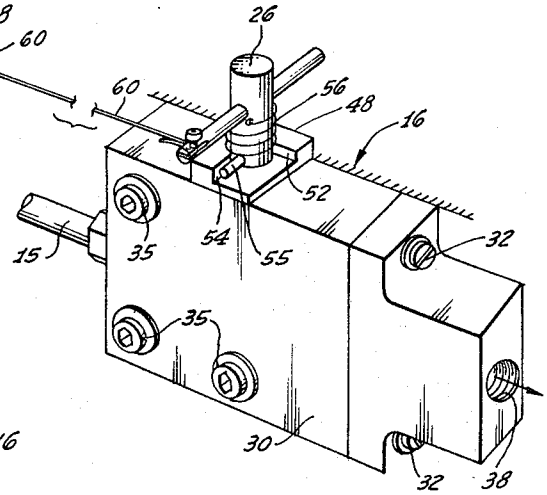
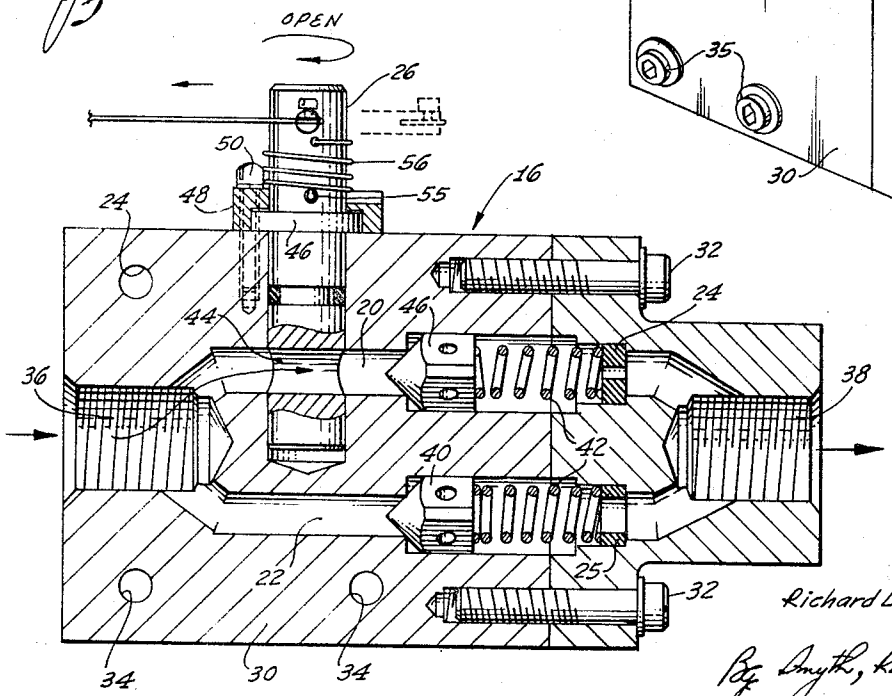


Fig. 4



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United States Patent Office 3,327,760 Patented June 27, 1967

3,327,760

FUEL BYPASS CONTROL FOR AUTOMOTIVE VEHICLE

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Filed Sept. 1, 1965, Ser. No. 484,339
7 Claims. (Cl. 158—36.3)

This invention relates to a fuel system for an automotive vehicle and, more particularly, relates to a fuel injection system having special utility for race cars.

A fuel injection system for a race car commonly comprises a fuel pump having its intake port connected to the fuel tank and having its output port connected both to a fuel injector and to a return line to the fuel tank, whereby the rate of fuel delivery to the engine is determined by the resistance to flow through the return line relative to the resistance of flow through the fuel line. Such a fuel injection system has numerous advantages over a carburetion system, the advantages including: more power output at high engine speeds; increased torque output at low engine speeds; quicker cold starting and warm up; elimination of carburetor throttle plate icing; no back fire; reduction of unburned hydrocarbons in the exhaust during acceleration; wider latitude in the use of fuels; more lively response to throttle; less tendency for vapor lock; better fuel economy; and less space requirement in the engine compartment.

Unfortunately, however, a serious disadvantage, especially for "drag" racers, is that a conventional fuel injection system has a fixed setting for delivering a rich fuel mixture which is optimum for fast driving and with this fixed setting the engine idles very poorly. When such a race car is moving slowly up to a starting line, the fuel mixture is rich instead of lean with the consequence that the engine is badly handicapped with accumulated fuel when the moment arrives for maximum acceleration from the starting line.

The present invention avoids this disadvantage by providing a fuel injection system with two settings, a lean fuel setting and a rich fuel setting, which settings may be used selectively at the discretion of the driver. The lean fuel mixture is employed for approaching the starting line and then the setting is shifted abruptly to the rich mixture for a jackrabbit start.

To carry out this concept successful, one problem is to provide for substantially instantaneous jump to the rich fuel mixture. Another problem is to provide a manual control that may be operated by the driver at the starting line without distracting his attention or interfering with his manipulation of the car controls by his hands and feet. A further problem is to make the concept practical by embodying the invention in a kit that makes it a simple matter to convert a conventional single setting injection fuel system into a selective dual setting system.

The first problem of rapid shift to the rich mixture setting is met by employing a spring-loaded control which may be unlatched to operate with a snap action. The problem of simplifying the operation of the control by the drive is solved by providing a latch mechanism which may be released by a simple knee movement.

The third problem of making the invention practical is solved by providing a kit comprising two easily installed units. The first unit is a simple dual bypass unit that is installed in the return line of the fuel injection system and the second unit is a remote control unit located for the convenience of the driver.

The bypass unit for the return line has an inlet port for communication with the output side of the pump and has an outlet port for communication with the fuel tank, these two ports being interconnected by two parallel passages in the unit. Each of the two passages of the unit is provided with a spring loaded poppet and a restricting orifice or "jet" of a selected size and one of the two passages is additionally equipped with a snap-acting shutoff valve that is operatively connected to the remote control unit.

As the car slowly approaches the starting line, the valve of the bypass unit is open to permit maximum return flow through both of the two passages with consequent reduced fuel flow to the fuel injector. At the starting line the driver closes the bypass valve by remote control to abruptly limit the return flow to a single bypass which is precisely restricted for optimum fuel flow for high speed driving.

The features and advantages of the invention may be understood from the following detailed description together with the accompanying drawing.

In the drawing, which is to be regarded as merely illustrative:

FIG. 1 is a simplified diagram of a fuel injection system incorporating the preferred embodiment of the present invention;

FIG. 2 is a perspective view of the two units of the kit, one unit being the bypass unit for installation in the return line and the other unit being the remote control unit;

FIG. 3 is an elevational view of the remote control unit as viewed along the line 3—3 of FIG. 2; and

FIG. 4 is a longitudinal sectional view of the bypass unit.

FIG. 1 is a simplified diagram of a portion of a fuel system that incorporates the presently preferred practice of the invention. In the diagram, the usual fuel pump **10** has its input side connected to a fuel tank **12** and has its output side connected to a fuel line **14** for supplying the engine, the fuel line being connected to a suitable fuel injector. Also connected to the output side of the pump **10** is a return line **15** back to the fuel tank **12**. It is apparent that the return of flow of fuel to the engine depends upon the resistance to flow through the return line **15** relative to the resistance to flow through the fuel line **14** and that the return of fuel to the engine may be varied by varying the resistance to flow to the return line.

The present invention provides what may be termed a bypass unit or return line unit **16** which is indicated by a rectangle in FIG. 1 that is incorporated in the return line **15** and the invention further includes a remote control unit **18** which is indicated by a small rectangle in FIG. 1. As indicated diametrically in FIG. 1, the bypass unit **16** provides two parallel bypasses **20** and **22** for the fuel line flow, which bypasses are provided with restrictions **24** and **25** respectively. In addition bypass **20** is provided with a cutoff valve **26** which is operatively connected to the control unit **18** as indicated by the broken line **28**. When a race car incorporating the described fuel system approaches the starting line at low speed, the cutoff valve **26** is open for maximum return flow with the consequence that the flow through the fuel line **14** is relatively low to produce a lean mixture that is appropriate for the slow speed of the car. When the car reaches the starting line and the driver accelerates the car to start the actual race, the control unit **18** is manipulated to close the valve **26** and thereby reduce the return line flow with consequent appropriate increase of fuel flow to the engine.

It is apparent that the return line unit **16** and the control unit **18** may be of various constructions in different embodiments of the invention. The initial embodiment of the invention employs the structures shown in FIGS. 2, 3, and 4.

The return line unit **16** has a body **30** which is formed by two blocks of metal interconnected by suitable screws **32**. The metal body has transverse bores **34** (FIG. 4)

whereby the return line unit may be mounted on fixed structure by suitable screws **35** (FIG. 2). The return line unit has an inlet port **36** and an outlet port **38**, both of which are adapted for connection to the return line **15**, and these two ports are interconnected by the two previously mentioned bypasses **20** and **22**. The two previously mentioned restrictions **24** and **25** are in the form of orifice members or "jets" which are suitably sized for the desired restricting effects. In the construction shown the restriction **24** has a smaller orifice than the restriction **25**. Each of the two bypasses **20** and **22** is provided with a poppet **40** under pressure by a spring **42**, the spring backing against the corresponding orifice member **24** or **25**. The two poppets serve as spring loaded check valves that open in a pulsating manner when the fuel flow is relatively low and retract to open positions against spring pressure when the fuel flow is relatively high.

The cutoff valve **26** comprises a rotary valve member which intersects the bypass **20** and is provided with a diametrical bore **44** for fluid flow therethrough. The valve member **26** is sealed by an O-ring **45** and is formed with a circumferential flange **46** for cooperation with a retainer block **48** that is mounted on the body **30** by suitable screws **50**. As best shown in FIG. 2, the retainer block **48** is cut away to provide two radial stop shoulders **52** and **54** which cooperate with a radial stop pin **55** on the valve member **26** at the closed and open positions respectively of the valve member. In the construction shown, a suitable torque spring **56** acts betwen the body **30** and the valve member **26** to urge the valve member to its closed position. The valve member **26** is provided with an operating lever **58** in the form of a radial pin and the outer end of the lever is suitably connected to the remote control unit **18**, for example by a stiff wire **60**.

As shown in FIG. 2, the remote control unit **18** comprises a metal block **62** suitably adapted for mounting on fixed structure of the car at a location convenient for the driver. The block is formed with a bore **64** in which is slidingly mounted a manually operable control member **65** in the form of a smooth rod. One end of the rod **65** is provided with a radial handle **66** and the other end has an axially threaded bore to receive an axially adjustable screw **68** which is attached to the wire **60**. The wire **60** extends through a suitable loom which is not shown in the drawing.

The screw **68** is provided with a lock nut **70** for maintaining selective adjustment of the screw and the lock nut backs against a washer **72**. In the present embodiment of the invention the control member **65** is urged in the direction to open the valve **26** and for this purpose a coil spring **74** acts under compression between the washer **72** and the body **62** of the control unit.

For the purpose of releasably latching the control member **65** at its retracted position, the control member is provided with a transverse peripheral slot **75** for cooperation with a latch member **76**. The latch member **76** is in the form of a thin angular lever which is formed with a heel **78** to engage the slot **75** and is mounted on a suitable pivot **80**. For the purpose of urging the latch member **76** towards its effective position, a suitable tension spring **82** is connected to a radial pin **84** on the latch member and to a second radial pin **85** on the body **62**.

The manner in which the described structure serves its purpose may be readily understood from the foregoing description. While the engine is idling before race time, the driver retracts the control member **65** by means of the handle **66** until the latch member **76** snaps into engagement with the slot **75** of the control member, the various parts then being positioned as shown in FIG. 2. The bypass cutoff valve **26** is closed but is urged towards its open position by the spring **56**. The control unit **18** is so oriented that the driver may use his knee to release the latch member **76** without interfering with the usual manipulation of the car controls for a fast start.

When the control member **65** is released by the latch member **76** the control member is thrust abruptly to the right as viewed in FIG. 2 by the action of the spring **64**. Thus the two springs **56** and **64** cooperate to rotate the valve member **26** to its closed position with a snap action. Obviously either one of the two springs may be omitted if desired. The closing of the valve **26** boosts the fuel delivery to the engine.

It is obvious that the driver may use the invention to change from one of the fuel settings to the other of the fuel settings whenever desired. Thus the device may be used on a pit stop in a long race and the device may also be used to provide two optional settings where a race involves drastic changes in altitude.

My description of the initial embodiment of the invention in specific detail will suggest various changes, substitutions and other departures from my disclosure within the spirit and scope of the appended claims.

I claim:

1. In a fuel system for an internal combustion engine wherein a fuel pump has its intake port connected to a fuel reservoir and its output port connected both to a fuel line to the engine and to a return line to the fuel reservoir, whereby the rate of fuel delivery to the engine is determined by the resistance to flow through the return line relative to the resistance of flow through the fuel line, the improvement to provide initially a relatively low rate of fuel flow to the engine and subsequently to increase the rate of fuel flow of the engine abruptly to meet a given operating condition, comprising:

said return line having means therein to restrict the flow therethrough to a rate to result in a high rate of flow through the fuel line to meet the given operating condition;

a bypass around said restriction to increase the rate of return flow to the fuel reservoir thereby to cause said relatively low rate of fuel flow to the engine;

a manually operable valve to at least partially close said bypass to cause the increased rate of fuel flow to the engine when the given operating condition occurs; and

spring means to close said valve and a latch to hold the valve open in opposition to the spring means, said latch being manually releasable for abruptly closing the valve by the spring means.

2. An improvement as set forth in claim **1** in which said engine is the engine of an automotive vehicle and said latch is positioned for operation by the driver of the vehicle.

3. An improvement as set forth in claim **2** in which said latch is positioned for operation by the knee of the operator.

4. Control means to abruptly increase the rate of fuel delivery to the engine of a vehicle when the vehicle is suddenly accelerated at the starting line of a race, wherein the fuel system for the engine includes a fuel pump having its intake port connected to a fuel reservoir and its output port connected both to a fuel line to the engine and to a return line to the fuel reservoir, whereby the rate of fuel delivery to the engine is determined by the resistance to flow through the return line relative to the resistance of flow through the fuel line, said control means comprising:

a return line unit having an inlet port for connection to the outlet port to the pump and having an outlet port for connection to said return line,

said unit having a first passage and a second passage, each connecting the inlet port of the unit to the outlet port of the unit,

said first passage being restricted for high resistance to flow through the return line when the first passage is used alone thereby to cause a relatively high rate of flow through the fuel line,

said second passage when used jointly with the first passage reducing the resistance to flow through the

return line thereby to reduce the rate of flow through the fuel line;

a valve to control flow through said second passage whereby the valve may be at least partially closed to increase the rate of fuel flow to the engine and may be opened to decrease the rate of fuel flow to the engine;

spring means to close said valve abruptly; and

latch means to hold the valve open in opposition to the spring means, said latch means being manually releasable to increase the rate of the fuel flow to the engine.

5. Control means to abruptly increase the rate of fuel delivery to the engine of a vehicle when the vehicle is suddenly accelerated at the starting line of a race, wherein the fuel system for the engine includes a fuel pump having its intake port connected to a fuel reservoir and its output port connected both to a fuel line to the engine and to a return line to the fuel reservoir, whereby the rate of fuel delivery to the engine is determined by the resistance to flow through the return line relative to the resistance of flow through the fuel line, said control means comprising:

a return line unit having an inlet port for connection to the outlet port of the pump and having an outlet port for connction to said return line,

said unit having a first passage and a second passage each connecting the inlet port of the unit to the outlet port of the unit,

said first passage being restricted for high resistance to flow through the return line when the first passage is used alone thereby to cause a relatively high rate of flow through the fuel line,

said second passage when used jointly with the first passage reducing the resistance to flow through the return line thereby to reduce the rate of flow through the fuel line;

a valve to control flow through said second passage whereby the valve may be at least partially closed

to increase the rate of fuel flow to the engine and may be opened to decrease the rate of fuel flow to the engine;

a control unit separate from the return line unit located for convenient operation by the driver of the vehicle;

manual means included in said control unit and operatively connected to said valve to open the valve to increase the rate of fuel flow to the engine;

spring means urging said valve to closed position; and

latch means incorporated in the control unit to engage said manual means to hold the valve at least partially closed in opposition to the spring means, said latch means being releasable by the driver.

6. A combination as set forth in claim 5 in which said latch means is positioned for release by the knee of the driver.

7. A combination as set forth in claim 5 in which said manual means is a movable member operatively connected to the valve by flexible means;

in which said movable means has a latch shoulder;

in which said latch means is pivoted for movement from a retracted position to a latching position; and

in which a second spring urges said latch means towards its latching position whereby the latch means automatically engages said shoulder to hold the valve open when said manual means is manipulated to open the valve.

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