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VACUUM CONTROL FOR FUEL INJECTION ENGINES

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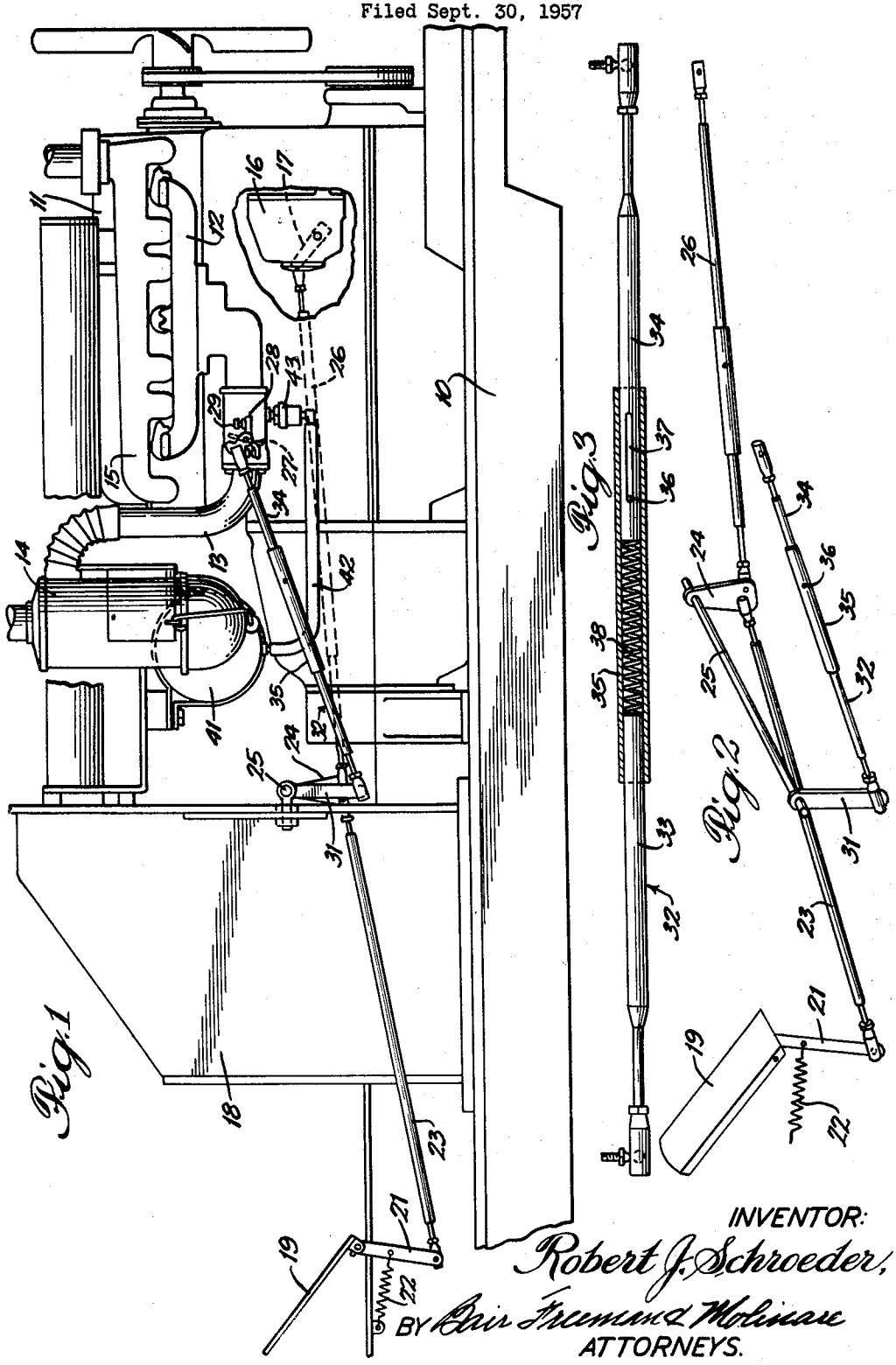


Fig. 1

Fig. 3

Fig. 2

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VACUUM CONTROL FOR FUEL INJECTION ENGINES

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This invention relates to a vacuum control for fuel injection engines, and more particularly to a construction to provide a source of vacuum for operating brakes and similar accessories in vehicles powered by fuel injection engines, such as diesel engines.

In fuel injection engines it is customary to use an open air supply conduit and to control the engine by varying the amount of fuel supplied thereto. This means that the air supply conduit or manifold will remain at substantially atmospheric pressure at all times. Therefore, if vacuum operated accessories, such as brakes, are to be employed, it has been necessary to provide a separate vacuum pump driven by the engine.

It is one of the objects of the present invention to provide a vacuum control for fuel injection engines in which the air supply conduit for the engine is restricted to create a vacuum only during low speed or idling operation of the engine whereby the engine itself serves as a source of vacuum without interference with normal operation or efficiency thereof.

Another object is to provide a vacuum control in which a valve in the air supply conduit is closed by the usual accelerator pedal or other control member for a fuel pump when the control member is moved in a direction to reduce the fuel supply.

According to a feature of the invention, the valve is operated through a resilient link which is arranged to close the valve when the fuel supply is reduced to minimum for idling, and which will yield as the control member moves in a direction to increase the fuel supply.

A further object is to provide a vacuum control in which a vacuum storage tank is provided connected to the air supply conduit posterior to the valve through a check valve opening toward the air supply conduit.

The above and other objects and features of the invention will be more readily apparent from the following description when read in connection with the accompanying drawing, in which:

Figure 1 is a side view with parts broken away of a vehicle embodying the present invention;

Figure 2 is a partial perspective view of the control linkage; and

Figure 3 is a section through a resilient link.

As illustrated in Figure 1, the invention is applied to a tractor or similar vehicle having a frame, indicated generally at **10**, on which there is mounted a fuel injection engine **11**, such as a diesel engine. The engine is provided with an air supply manifold **12**, connected to an air supply conduit **13**, having an atmospheric inlet opening leading through a filter **14**, into the air supply conduit. The engine is also equipped with the usual exhaust manifold **15**, and with a variable fuel pump **16**. As is conventional, the pump **16** supplies fuel under pressure to nozzles discharging into the individual cylinders, and the quantity of fuel supplied is regulated through a control lever **17** on the fuel pump to vary the speed and power delivery of the engine.

The vehicle also includes an operator's seat shown generally at **18**, and a control member **19** in the form of a conventional accelerator pedal which can be easily operated by the foot of an operator seated in the seat **18**. The control member **19** controls the variable fuel pump **16**, and for this purpose has an arm **21** extending below the pivot thereof, and a return spring **22** connected to the arm to urge the pedal **19** to its upper position, as shown in Figure 1, in which the fuel supply is at a minimum and the engine is idling. The arm **21** is connected through a link **23** to a crank arm **24**, secured to a cross shaft **25**, in the engine compartment of the vehicle. A second link **26**, which may be a compressible link, connects the crank arm **24** to the control lever **17** of the variable fuel pump. When the pedal **19** is depressed, the links **23** and **26** will be shifted to the right to turn the control lever **17** clockwise, and increase the supply of fuel to the engine. When the pedal is released by removal of the operator's foot therefrom, or by relaxing of the pressure thereon, the spring **22** will return the pedal to its elevated position and, through the links **23** and **26**, will turn the control lever **17** toward the position shown to reduce the supply of fuel.

In order to create a vacuum in the air supply conduit **13** during low speed running and idling conditions of the engine, a valve **27** is provided in the air supply conduit. The valve as shown is of the usual butterfly type and may have an arm **28** secured thereto engageable with adjustable stops **29** on the air inlet conduit to limit the open and closed positions of the valve. Preferably, the valve is so constructed and the closing stop **29** is so adjusted that sufficient air will leak past the valve when it is in its closed position to permit low speed and idling operation of the engine, even though the valve is closed.

To control the valve, the shaft **25** carries a second crank arm **31**, which is connected through a compressible link **32** to the valve **27**. The link **32** may be constructed, as best seen in Figure 3, of a pair of rods **33** and **34**, and a sleeve **35**, fitted over the ends of the rods. The rod **33** is rigidly secured in the sleeve, and the rod **34** is slidable therein, with its sliding movement limited by a pin **36** carried by the sleeve, and extending through an elongated slot **37** in the rod. A compression spring **38** in the sleeve engages the end of the rod **34** and urges it to the right, as shown in Figure 3, until the pin **36** seats on the left end of the slot **37**. When compression is applied to the link, the rod **34** may move to the left against the spring **38** to limit the compressive force applied through the link.

The crank arm **31** is preferably longer than the crank arm **24**, as shown, and is connected to the valve **27** at such an angle that the valve **27** will be closed at the same time the control lever **17** is moved to the minimum fuel supply position. Thus, at the time when the valve **27** is closed, and as the engine continues to operate, a partial vacuum will be created in the air supply conduit posterior to the valve, and may be utilized for the operation of accessories, such as vacuum brakes and the like.

In order to insure a constantly available supply of vacuum for the operation of such accessories, a vacuum storage tank **41** is provided connected through a conduit **42**, to the air supply conduit **13**, at a point posterior to the valve **27**. A check valve **43** is included in the connection, preferably adjacent to the air supply conduit and opening toward the air supply conduit. The accessories to be operated by vacuum are connected through the usual control valves to the tank **41**.

In operation of the system, when the engine is operating in its normal useful range the pedal **19** will be partially or fully depressed to move the pump control lever **17** partially or fully clockwise from the position

shown, and the valve 27 will be open. Due to the construction of the linkage, it will be seen that the valve 27 will open fully after only partial depression of the lever 19, and preferably when the lever is depressed to approximately one-third throttle position. As the lever 19 is depressed further toward full throttle position the rod 34 will move to the left in the sleeve 35 compressing the spring 38. At full throttle the link 26 may be compressed slightly to insure full throttle opening without the possibility of bending or damaging any of the parts. Thus, in the normal operating ranges, the engine operates in the usual manner without any interference from the vacuum control of the invention.

As the pedal 19 is elevated from the full throttle position, the lever 17 will be turned to reduce the fuel supply to the engine. However, during the first part of this movement, the valve 27 will remain fully open and the spring 38 will expand. When the lever 19 reaches approximately one-third throttle position the pin 36 will engage the end of slot 37 and during further upward movement of the lever the valve 27 and fuel control lever 17 will move simultaneously toward closing position. When the valve 27 is closed or very nearly closed, operation of the engine as it coasts down from high speed and continues to idle will create a partial vacuum in the air supply conduit posterior to the valve.

Another advantageous feature of the invention is that it provides a safety feature in the event that the fuel control means sticks in open position so that the engine tends to run away. If this should occur on an engine equipped with the present invention the air valve 27 will close and the engine will receive insufficient air to form with the relatively large quantity of fuel being supplied a readily combustible mixture. Therefore, the engine will either continue to run at low speed determined by the amount of air passing the valve, or will stop. In any event, the engine will not receive a sufficient air supply with the valve closed to enable it to develop a dangerously high speed.

Under these conditions, air will be withdrawn from the tank 41, past the check valve 43, to produce a partial vacuum in the tank which is available for operation of brakes or other accessories. When the valve 27 is again opened so that the pressure in the air supply conduit again approaches atmospheric, the check valve 43 will close so that the vacuum produced in the tank 41 will be maintained.

While one embodiment of the invention has been shown and described in detail, it will be understood that this is illustrative only and is not to be taken as a definition of the scope of the invention, reference being had for this purpose to the appended claims.

What is claimed is:

1. A vacuum generating means on a fuel injection engine of the type having a variable fuel pump, a movable control member for the pump, and an air supply conduit means, said vacuum generating means comprising a valve in the air supply conduit, a vacuum tank, a vacuum connection between said tank and the air supply conduit downstream from the valve, and linkage connecting the valve to the control member and including a yieldable link, the linkage being constructed and arranged to close the valve as the control member is moved in a direction to reduce the fuel supplied by the pump and to open the valve as the control member is moved in a direction to increase the fuel supply, the valve being fully opened by partial movement of the control member in said last named direction and the yieldable link yielding as the control member is moved further to increase the fuel supply to a maximum.

2. A vacuum generating means on a fuel injection engine of the type having a variable fuel pump, a movable control member for the pump, and an air supply conduit means, said generating means comprising a valve in the air supply conduit means, a vacuum connection to the air supply conduit downstream from the valve, a rocker shaft connected to the control member to be turned thereby, a link connecting the rocker shaft to the fuel pump, and an elastic link connecting the rocker shaft to the valve, the links being so proportioned that when the control member is moved in a direction to increase the fuel supplied by the pump the valve will be fully opened before the fuel supply is increased to a maximum and the elastic link will yield as the control member is moved further to increase the fuel supply to a maximum.

3. In combination with a fuel injection internal combustion engine of the type having an air supply conduit means and a variable fuel pump being controlled by a throttle linkage means including a movable member, a vacuum generating means for operating auxiliary vacuum motor means, comprising: a valve in said air supply conduit means; a vacuum tank; passage means interconnecting said tank and said air supply conduit means downstream of said valve; a check valve in said passage means opening toward said conduit means; and other linkage means for controlling said valve, said other linkage means including a yieldable link connected to said first mentioned linkage means for closing said valve when the movable member is moved to a position reducing the fuel supplied by the pump to a minimum and to adjust the valve to a full open position when fuel supplied by the pump is increased by partial movement of said movable member, after adjustment of said valve to a full open position said yieldable link yielding as the control member is moved further to increase the fuel supply to a maximum.

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