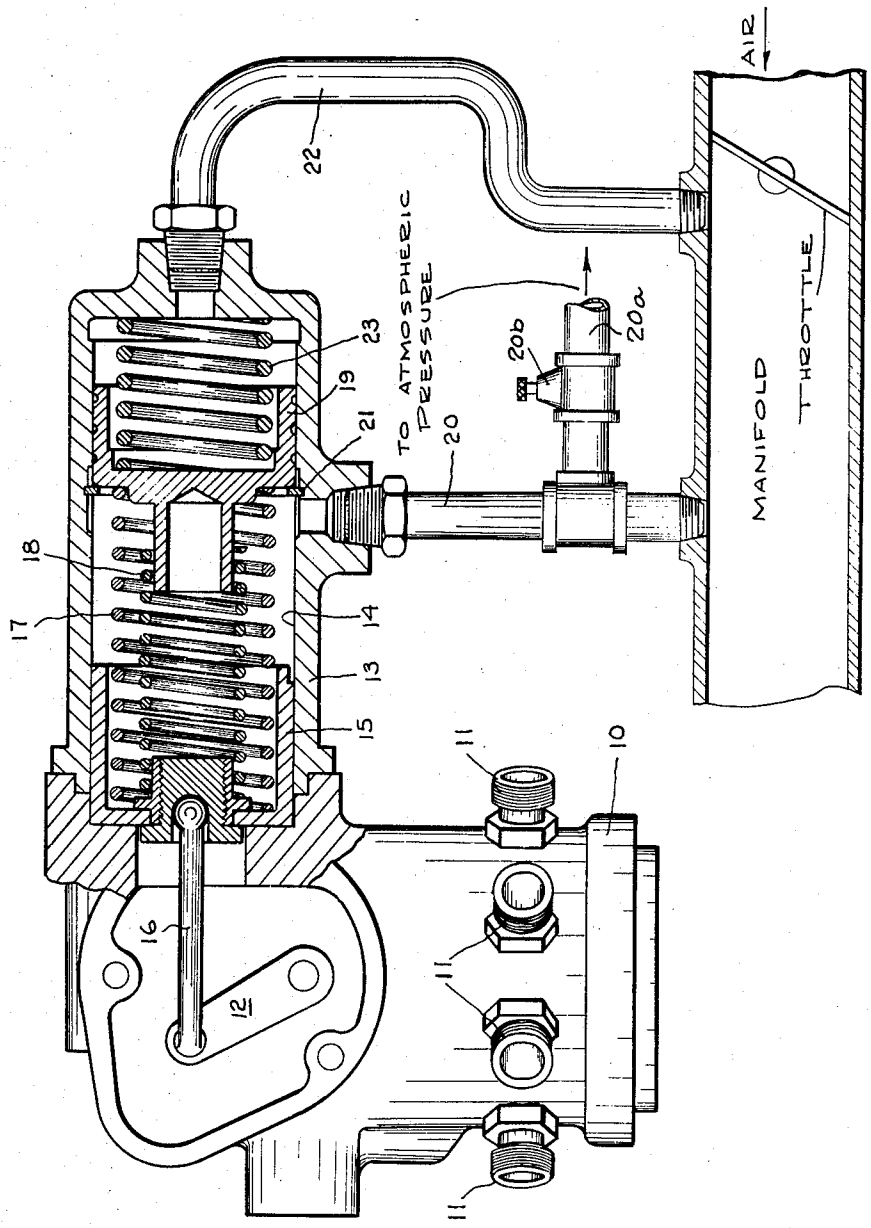
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FUEL INJECTION APPARATUS

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FUEL INJECTION APPARATUS

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This invention relates to fuel injection apparatus and more particularly to such apparatus for spark ignition type internal combustion engines and has particular reference to the provision of means for controlling the quantity of fuel delivered so that upon deceleration of the engine, the quantity of fuel delivered to the engine is less than idle fuel quantity.

An object of the invention is to provide new and improved fuel injection apparatus embodying means for automatically reducing the quantity of fuel delivered to the engine upon deceleration of the engine.

Another object is to provide a device of the type set forth which is relatively simple and inexpensive in construction and efficient in operation.

Other objects and advantages of the invention will be apparent from the following description taken in connection with the accompanying drawings. It will be understood that changes may be made in the details of construction and arrangement of parts without departing from the scope of the invention as set forth in the accompanying claims, as the preferred form has been given by way of illustration only.

Referring to the drawing, the drawing is a side view partially in section of the apparatus embodying the invention.

In engines, an air throttle valve is positioned in the entrance to the manifold and controls the entrance of air into the manifold thereby increasing and decreasing the engine speed. Rapid closing of the throttle valve, when the engine is running at a relatively high speed, results in abnormally high vacuum in the manifold beneath the throttle valve. This high vacuum is employed in the present invention to effect a cutting off of the fuel during this deceleration period.

Referring more particularly to the drawing, the apparatus shown comprises the fuel injection pump **10** of any desired type, for example, that shown in application Serial No. 503,072 filed April 22, 1955, by Nystron, et al., now Patent 2,828,728 issued April 1, 1958.

This pump **10** has the outlets **11**, one of which is adapted to be connected to each of the combustion chambers for supplying fuel thereto. The pump is also provided with the operating lever **12** for controlling the quantity of fuel delivered by the pump, which quantity is automatically controlled by the control **13** which comprises a cylinder **14**, in which is positioned the piston **15**, which is operatively connected to the lever **12** by the link **16**.

The control is provided with the springs **17** and **18** with the spring **17** engaging the inner surface of piston **15** at one end and its opposite end engaging a stop **19**. Spring **18**, which is within spring **17**, is shorter than spring **17** and, therefore, adapted to operate only after movement of piston **15** a sufficient distance for spring **18** to engage stop **19** and the spring seat or the inner side of the piston.

Cylinder **14** is connected by the line **20** to a source of modulated engine vacuum whereupon, changes in said vacuum upon movement of the throttle, varies the position of piston **15** against the force of springs **17** and **18** to thereby vary the fuel quantity delivered by the pump **10**.

This source of modulated engine vacuum may be provided as set forth in application Serial No. 539,987, filed October 12, 1955, or may be provided by connecting a line **20***a* from atmospheric pressure to line **20** with a valve **20***b* in said line **20***a* whereby an atmospheric pressure bleed into line **20** is provided.

The stop member **19** also comprises a piston in a portion of the cylinder **14**, or this might be a separate cylinder, beyond the connection of line **20** to cylinder **14** and the stop **21** such as a snap ring, is provided for limiting the movement of piston **19**.

Cylinder **14** is connected beyond piston **19** to a source of engine manifold vacuum by line **22** and the movement of piston **19** by this vacuum is opposed by spring **23**.

The modulated engine vacuum is always a little lower than the true engine vacuum.

During the cranking of the engine, a very low vacuum is provided and, therefore, the springs **17** and **18** move the piston **15** to the position shown in the drawing whereby the pump control lever **12** is in position to provide a rich mixture for starting the engine. The operating or control lever **12** is shown in full load position.

When the engine starts, the modulated engine vacuum increases depending on starting conditions and the true engine vacuum through line **2** is higher than the modulated engine vacuum in line **20**, however, the force of spring **23** is sufficient to counteract the true engine vacuum in line **22**.

Under normal operating conditions, upon deceleration of the engine, the true engine vacuum increases considerably while the modulated engine vacuum stays approximately the same and because of this increase in the true engine vacuum, this vacuum is sufficient to overcome the force of spring **23** thereby releasing the force of piston **19** against springs **17** and **18** and allows movement of piston **15**, link **16** and operating lever **12** to lower than idle or normal lean running position and according to the setting of the pump control, moves the pump control to lower than idle position or to fuel cutoff position, as desired.

It will thus be seen that when the engine slows down so that when the car is running at the lowest speed, the vacuum in the manifold returns to the normal idle mixture vacuum and piston **19** is returned to normal running position and returns the spring to normal running position which in turn positions piston **15** and the pump control to normal running position.

It will be seen from the foregoing that upon deceleration of the engine, the pump control can be moved to less than idle or to cutoff position, as desired.

From the foregoing it will be seen that I have provided new and improved means for obtaining all of the objects and advantages of the engine.

I claim:

1. In a device for controlling the fuel pump for reducing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, pressure operated means operatively connected to said control for setting said control to provide correct air/fuel ratio, said pressure operated means being adapted to actuate said control according to manifold pressure modified by an atmospheric bleed, resilient stop means and auxiliary pressure means operatively connected to manifold pressure or vacuum and actuated thereby for adjusting said stop means for allowing said control to move to a position outside its normal operating range during deceleration of the engine to thereby reduce the quantity of fuel supplied to the engine.

2. In a device for controlling the fuel pump for reduc-

ing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, a member having a chamber, two spaced manifold pressure operated members in said chamber, one of said members being connected to said control, the other of said members being a stop for said member connected to said control during normal operation of the engine, said chamber between said pressure operated members being connected to engine manifold pressure or vacuum modified by an atmospheric bleed and said chamber behind the pressure operated member remote from said control being connected directly to engine manifold pressure or vacuum, whereby upon deceleration resulting from rapid closing of the engine throttle, the high vacuum created in the engine manifold will effect movement of said member remote from said control to reduce the quantity of fuel supplied to the engine.

3. In a device for controlling the fuel pump for reducing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, a chamber, two spaced manifold pressure operated members in said chamber, one of said members being connected to said pump control, said chamber between said pressure operated members being connected to engine manifold pressure or vacuum modified by an atmospheric bleed, said pressure operated member not connected to said control acting as an adjustable stop for the pressure operated member connected to said control to limit the movement of said member, said pressure operated member not connected to said control being adjusted by manifold pressure or vacuum under deceleration conditions whereby said member connected to said control may move to a position outside its normal operating range during deceleration of the engine to thereby reduce the quantity of fuel supplied to the engine.

4. In a device for controlling the fuel pump for reducing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, a member having a chamber, two spaced manifold pressure operated members in said chamber, one of said members being connected to said control, means connecting said chamber between said pressure operated members to engine manifold pressure or vacuum modified by an atmospheric bleed and means connecting said chamber behind the pressure operated member remote from said control directly to engine manifold pressure or vacuum and resilient means between said pressure operated members, whereby upon deceleration resulting from rapid closing of the engine throttle, the high vacuum created in the engine manifold will effect movement of said member remote from said control to reduce the quantity of fuel supplied to the engine.

5. In a device for controlling the fuel pump for reducing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, a chamber, two spaced manifold pressure operated members in said chamber, one of said members being connected to said control, means connecting said chamber between said pressure operated members to engine manifold pressure or vacuum modified by an atmospheric bleed, said pressure operated member not connected to said control acting as an adjustable stop for the pressure operated member connected to said control to limit the movement of said member, said pressure operated member not connected to said control being adjusted by manifold pressure or vacuum under deceleration conditions whereby said member connected to said control may move to a position outside its normal operating range during deceleration of the engine to thereby reduce the quantity of fuel supplied to the engine and resilient means between said pressure operated members.

6. In a device for controlling the fuel pump for reducing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, a member having a chamber, two spaced manifold pressure operated members in said chamber, one of said members being connected to said control, means connecting said chamber between said pressure operated members to engine manifold pressure or vacuum modified by an atmospheric bleed and means connecting said chamber behind the pressure operated member remote from said control directly to engine manifold pressure or vacuum and a pair of resilient means of different lengths between said pressure operated members, whereby upon deceleration resulting from rapid closing of the engine throttle, the high vacuum created in the engine manifold will effect movement of said member remote from said control to reduce the quantity of fuel supplied to the engine.

7. In a device for controlling the fuel pump for reducing the quantity of fuel supplied an internal combustion engine during deceleration thereof, said device being adapted to be operatively connected to the pump control and comprising, a chamber, two spaced manifold pressure operated members in said chamber, one of said members being connected to said control, means connecting said chamber between said pressure operated members to engine manifold pressure or vacuum modified by an atmospheric bleed, said pressure operated member not connected to said control acting as an adjustable stop for the pressure operated member connected to said control to limit the movement of said member, said pressure operated member not connected to said control being adjusted by manifold pressure or vacuum under deceleration conditions whereby said member connected to said control may move to a position outside its normal operating range during deceleration of the engine to thereby reduce the quantity of fuel supplied to the engine and a pair of resilient means between said pressure operated members.

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