

July 21, 1959

J. N. HUMBER ET AL
FUEL INJECTION APPARATUS

2,895,465

Filed April 9, 1957

2 Sheets-Sheet 2

Fig. 3.

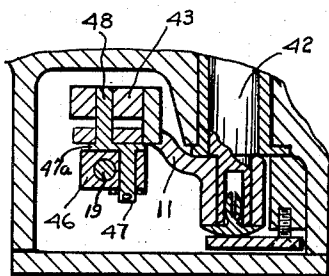


Fig. 4.

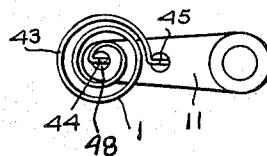


Fig. 6.

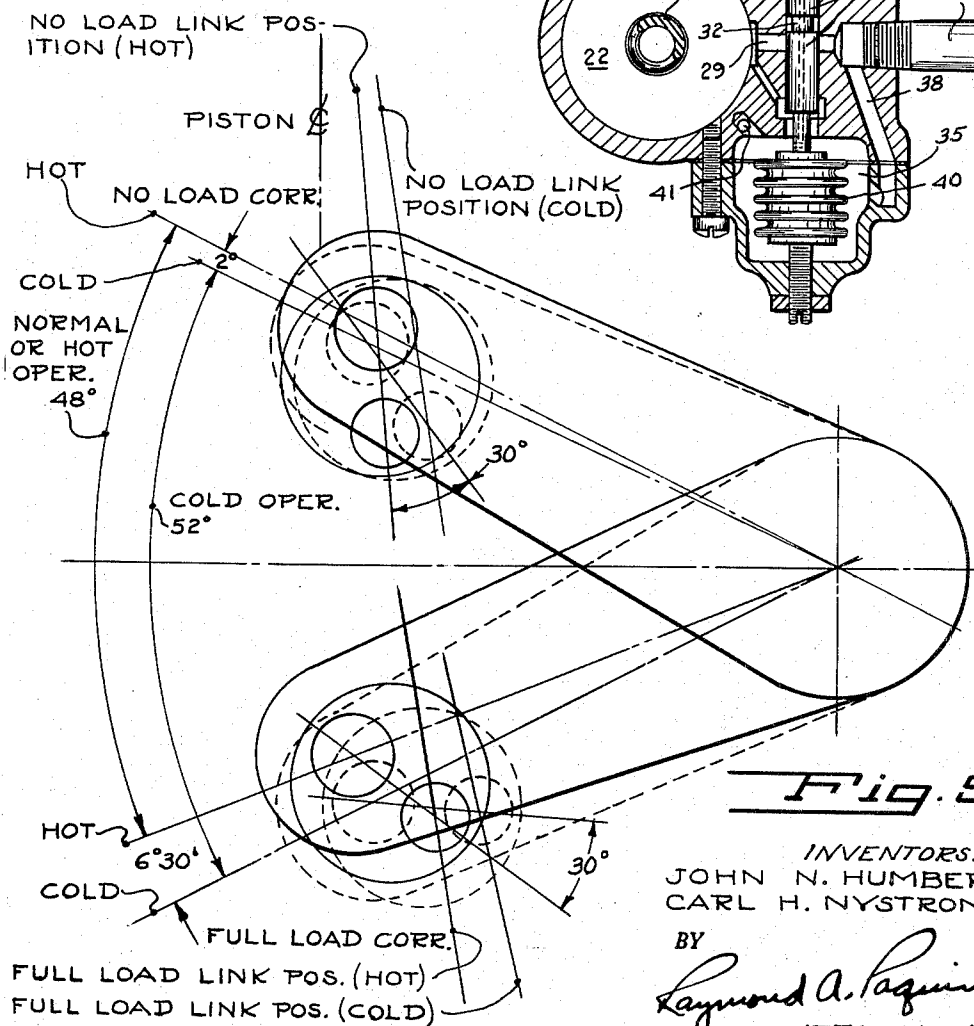
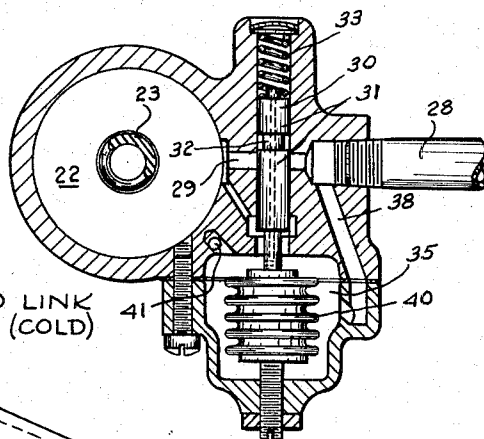


Fig. 5.

INVENTORS.
JOHN N. HUMBER
CARL H. NYSTROM
BY
Raymond A. Piquin
ATTORNEY.

1

2,895,465

FUEL INJECTION APPARATUS

John N. Humber, North Wilbraham, and Carl H. Nyström, West Springfield, Mass., assignors to American Bosch Arma Corporation, a corporation of New York

Application April 9, 1957, Serial No. 651,688

6 Claims. (Cl. 123—140)

This invention relates to new and useful improvements in fuel injection apparatus and has particular reference to improvements in fuel injection apparatus for spark ignition type internal combustion engines and the like.

The principal object of the invention is to provide a fuel injection apparatus of the type set forth having means for automatically adjusting the apparatus to compensate for the altitude at which the apparatus is used.

Another object is to provide temperature compensation for a fuel injection apparatus of the type set forth which automatically provides additional fuel for cold starting of the engine and which reduces such additional fuel as the engine is warmed up.

Another object is to provide a new and improved system for automatically lessening or cutting off the fuel quantity during deceleration of the engine.

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 shown and described as the preferred form has been given by way of illustration only.

Referring to the drawings:

Fig. 1 is a side view, partially in section, of a fuel injection apparatus embodying the invention;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1, looking in the direction of the arrows;

Fig. 3 is a fragmentary view in section taken on line 3—3 of Fig. 1, looking in the direction of the arrows;

Fig. 4 is a fragmentary view of the apparatus shown in Fig. 1;

Fig. 5 is a schematic view illustrating the operation of the temperature compensating arrangement of the invention; and

Fig. 6 is a view similar to Fig. 2, but showing a modified form of the invention.

Referring more particularly to the drawings wherein similar reference characters designate corresponding parts throughout, the apparatus shown for illustrating the invention comprises a fuel injection pump 10 which is of the timed injection variety such as that shown in Patent No. 2,772,668, issued December 4, 1956, and having the control lever 11 for adjusting the quantity of fuel delivered by the pump to each of the engine cylinders.

The control 12 is attached to the pump 10 and comprises a cylinder 13 in which is mounted the piston 14 having the chamber 15, in which is positioned the evacuated bellows 16, which is provided with the peripheral flange or shoulder 17 adapted to engage the retaining ring 18 in the wall of piston 14 surrounding chamber 15 to limit the movement of the bellows 16 in one direction.

The bellows 16 is connected at 16b to bellows bridge 16a which is connected to the fuel pump control 11 by the member 19 which is connected at its opposite ends to the bellows bridge 16a and the fuel pump control lever 11.

2

The bellows 16 is held in position with shoulder 17 engaging ring 18 by means of coil spring 20, which has one end engaging the adjacent end of the bellows 16 and its opposite end engaging the end 21 of piston 14.

In cylinder 13, adjacent the end thereof opposite piston 14, is provided a second piston 22 which has one end engaging spring 23 which is a relatively light spring and which has one end engaging the end wall 24 of housing 12 and its opposite end engaging piston 22. Snap ring 24a limits the movement of piston 22.

Between pistons 14 and 22 are positioned the coil springs 25 and 26 with one of the springs 25 being longer than the other of the springs 26.

Cylinder 13, between pistons 14 and 22 is connected by line 27 to a source of modulated or controlled vacuum. This source of vacuum or pressure is, during normal operation of the engine, manifold pressure or vacuum but during idle operation and cold engine operation, that is, during engine warm up periods, the manifold vacuum or control pressure is modulated, that is, the control pressure is increased, thereby moving piston 14 which moves pump control 11 to an increased fuel delivery position.

Cylinder 13 is connected directly by line 28 to the engine manifold or other source of direct engine vacuum and line 28 is connected by duct or passage 29 to cylinder 13 on the side of piston 22 adjacent end wall 24, whereby passage 29 is normally connected to cylinder 13 between piston 22 and end wall 24 and communicates with cylinder 13 at all times due to a groove connecting passage 29 and cylinder 13.

Passage 29 extends through boss 12a on the housing 12 and in said boss 12a is provided the axially movable valve 30 which is normal to passage 29 and normally closes off said passage. Valve member 30 has spaced lands 31 separated by a reduced portion 32.

In the form of Fig. 2, one end of the valve member 30 engages coil spring 33 and the opposite end of the valve member is connected to diaphragm 34 in chamber 35 and the force of spring 33 is opposed by spring 36, the tension of which may be adjusted through adjusting screw 37.

Line 28 is connected by passage or duct 38 to chamber 35 on the side of diaphragm 34 opposite the valve having the lands 31, whereby springs 33 and 36 on the opposed sides of the diaphragm together with the effects of manifold vacuum in chamber 35 serve to operate the valve as hereinafter described.

Chamber 35a, on the side of diaphragm 34 opposite chamber 35 is connected to pump sump 35b by means of passage 41 in the wall of the housing for control 12. Chamber 35a is also connected by passage 35d to cylinder 13 between piston 22 and end wall 24.

The form shown in Fig. 2 which employs the spring 36 is that form of the invention normally employed at sea level, whereas in the form shown in Fig. 6, the evacuated or aneroid bellows 40 replaces the spring 36 and thereby provides altitude compensation for the valve and this is the form of the invention which would normally be employed at altitudes substantially higher than sea level.

Chamber 35 is provided on the side of diaphragm 34 opposite spring 36 or bellows 40 with the bleed 41 to atmosphere through chamber 35b as previously described.

The pump control lever 11 is connected at one end to pump control shaft 42 and its opposite end is connected to member 19 by means of link block 46 to which the end of member 19 is connected and block 46 is in turn pivotally mounted on pivot pin 47 of member 47a which also has pin 48 integral therewith and connected to end 44 of the bimetallic or thermostatic member 43, which member is coiled and has its opposite ends 44 and

3

45 secured to pin 48 and member 11 respectively as shown in Fig. 4, and the link block 46 has the pin 47 extending therethrough, and the pin 48 is connected to and through bimetallic member 43 as previously described whereby as the engine temperature changes from cold to warm or normal operating temperature, the angular positions of pins 47 and 48 will change as shown schematically in Fig. 5.

In operation it will be seen that with the evacuated bellows positioned in chamber 15 in piston 14, that any substantial change in altitude will vary the length of the bellows and such change in length of the bellows will alter the position of pump control lever 11 to compensate for variation in altitude or atmospheric pressure at which the engine is operating.

Under normal operating conditions the bellows bridge 16a merely serves as a connecting means between member 19 and piston 14. Also stop 17 is normally retained in engagement with stop ring 18. Spring 20 serves to control the rate of expansion of the bellows and thereby controls the amount of compensation provided thereby. By controlling the rate and load of the spring the amount of compensation for any particular engine may be controlled.

In Fig. 1, the pump control 11 is shown in full load position.

Any increase in manifold vacuum, which increase would occur at less than full load conditions would be sensed through line 27 and move piston 14 upwards against springs 25 and 26. The rate and extent of travel of piston 14 is controlled by springs 25 and 26.

During normal operating range of the engine piston 22 is retained against stop 24a by spring 23 and at such times piston 22 acts as a spring seat for springs 25 and 26.

During such operation the pressures in chamber 35b and cylinder 13 between end 24 and piston 22 are equal, both being vented to atmosphere.

It will also be seen that because of the thermostatic or bimetallic member 43, that when the engine is started under cold conditions, that the position of the quantity control lever 11 of the pump will be adjusted to an increased fuel position and, that as the temperature of the engine increases, the length of the bimetallic member 43 will be automatically varied by the change in incoming atmosphere air temperature.

For reducing or cutting off the fuel quantity on deceleration of the engine, it will be seen that due to the increase in engine vacuum during such deceleration, that such increased vacuum upon diaphragm 34 through passage 38 will effect movement of the valve 36 until the reduced portion 32 is aligned with passage 29 and such increased vacuum will thereupon effect movement of piston 22 until it engages wall 24 and also effect movement of piston 14 upwardly which will thereby move fuel control lever 11 to a less fuel position or cut off the supply of fuel according to the adjusted position. During this time passage of atmospheric pressure through passage 35d is cut off by the end of valve 30.

It will be seen that with the bellows 40 as shown in Fig. 6, that the position of the valve 30 will be controlled to compensate for variations in altitude at which the apparatus is being employed.

This valve 30 and the altitude adjustment or compensation obtained by bellows 40 only serve to provide deceleration at altitudes other than sea level.

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

We claim:

1. In a device of the character described, a fuel injection pump having a control member, said control member having a pressure chamber, a first pressure actuated means in said pressure chamber and operatively connected to said control member, a second pressure actuated means in said pressure chamber, said first and

4

second pressure actuated means being operatively connected to manifold pressure or vacuum and actuated thereby, resilient means between said first and second pressure actuated means, the connection of said pressure actuated means to manifold pressure or vacuum comprising a line connecting said pressure chamber between said first and second pressure actuated means to a source of pressure for actuating said first pressure actuated means, and a second line connecting said pressure chamber on the side of said second pressure actuated means remote from said first pressure actuated means to a source of pressure for actuating said second pressure actuated means and pressure operated valve means for controlling the connection of said second line to said pressure chamber.

2. In a device of the character described, a fuel injection pump having a control member, said control member having a pressure chamber, a first pressure actuated means in said pressure chamber and operatively connected to said control member, a second pressure actuated means in said pressure chamber, said first and second pressure actuated means being operatively connected to manifold pressure or vacuum and actuated thereby, resilient means between said first and second pressure actuated means, the connection of said pressure actuated means to manifold pressure or vacuum comprising a line connecting said pressure chamber between said first and second pressure actuated means to a source of pressure for actuating said first pressure actuated means, and a second line connecting said pressure chamber on the side of said second pressure actuated means remote from said first pressure actuated means to a source of pressure for actuating said second pressure actuated means, pressure operated valve means for controlling the connection of said second line to said pressure chamber, and altitude compensating means for adjusting the position of said valve means.

3. In a device of the character described, a fuel injection pump having a control member, said control member having a pressure chamber, a first pressure actuated means in said pressure chamber and operatively connected to said control member, a second pressure actuated means in said pressure chamber, said first and second pressure actuated means being operatively connected to manifold pressure or vacuum and actuated thereby, resilient means between said first and second pressure actuated means, the connection of said pressure actuated means to manifold pressure or vacuum comprising a line connecting said pressure chamber to a source of pressure for actuating said first pressure actuated means, and a second line connecting said pressure chamber to a source of pressure for actuating said second pressure actuated means and valve means for controlling the connection of said second line to said pressure chamber, and thermally actuated means operatively connected to said first pressure actuated means and to said control lever for varying the relative positions thereof.

4. In a device of the character described, a fuel injection pump having a control member, said control member having a pressure chamber, a first pressure actuated means in said pressure chamber and operatively connected to said control member, a second pressure actuated means in said pressure chamber, said first and second pressure actuated means being operatively connected to manifold pressure or vacuum and actuated thereby, resilient means between said first and second pressure actuated means, the connection of said pressure actuated means to manifold pressure or vacuum comprising a line connecting said pressure chamber to a source of pressure for actuating said first pressure actuated means, and a second line connecting said pressure chamber to a source of pressure for actuating said second pressure actuated means and valve means for controlling the connection of said second line to said

5

pressure chamber, and altitude compensating means for adjusting the position of said valve means, and thermally actuated means operatively connected to said first pressure actuated means and to said control lever for varying the relative positions thereof.

5. In a device of the character described, a fuel injection pump having a control lever, a control cylinder for said fuel injection pump comprising first and second chambers, a first pressure actuated member in said first chamber and operatively connected to said pump control lever, a second pressure actuated member in said second chamber, lines connecting said first and second chambers with manifold pressure or vacuum and pressure actuated valve means for controlling the pressure in said second chamber.

6. In a device of the character described, a fuel injection pump having a control lever, a control cylinder for said fuel injection pump comprising first and second chambers, a first pressure actuated member in said first

6

chamber and operatively connected to said pump control lever, a second pressure actuated member in said second chamber, lines connecting said first and second chambers with manifold pressure or vacuum and pressure actuated valve means for controlling the pressure in said second chamber, and altitude compensating means between said control lever and said first pressure actuated means.

References Cited in the file of this patent

UNITED STATES PATENTS

2,447,267	Mock	Aug. 17, 1948
2,618,222	Davies et al.	Nov. 18, 1952
2,667,840	High	Feb. 2, 1954
2,749,898	Isley	June 12, 1956

FOREIGN PATENTS

530,668	Great Britain	Dec. 17, 1940
---------	---------------	---------------