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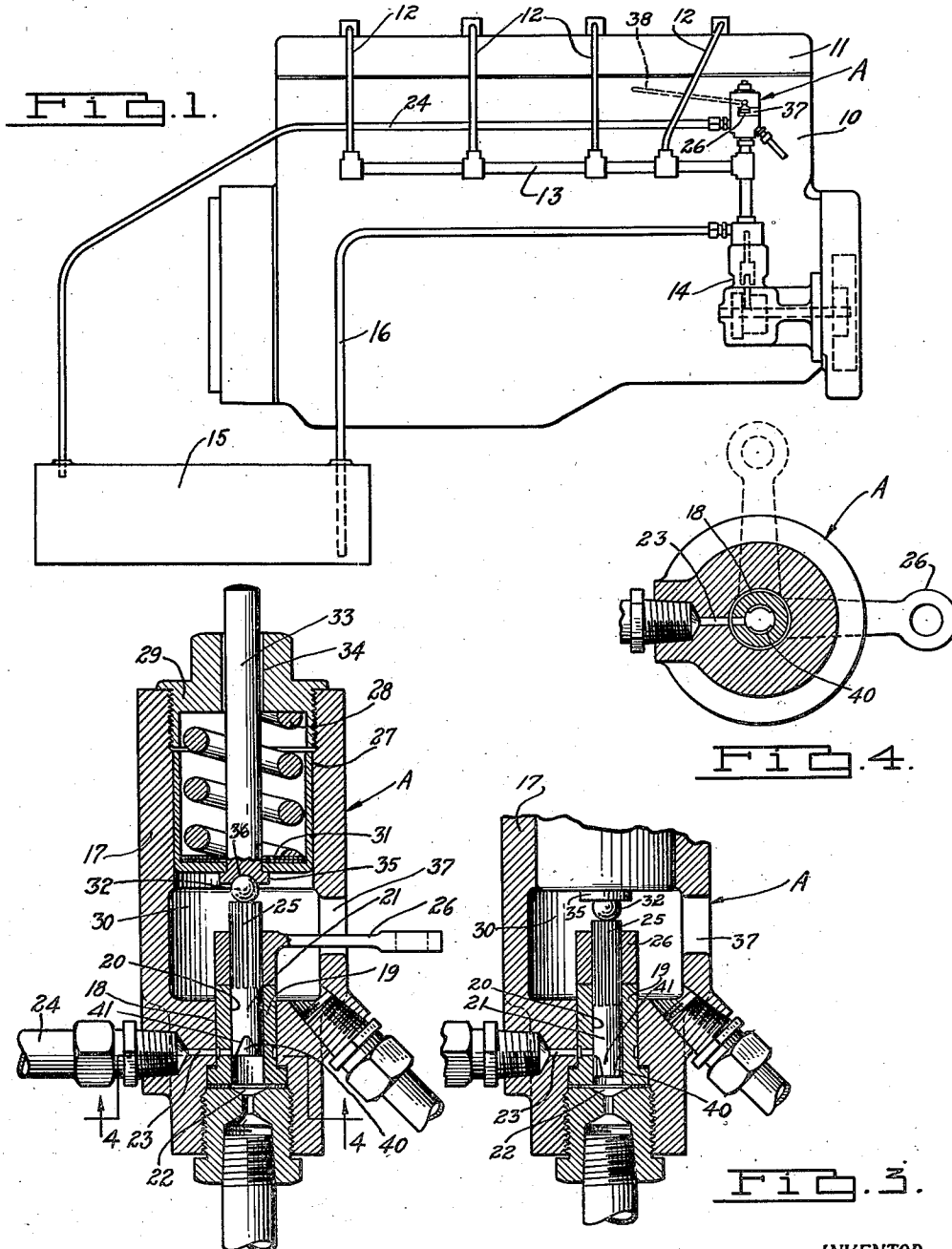


Fig. 2.

Fig. 3.

Fig. 4.

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4 Claims. (Cl. 137—153)

My invention relates to an internal combustion engine of the compression ignition type which is usually provided with a fuel supply line or "rail" and a fuel pump or other suitable means for applying pressure to the fuel in the supply line. More particularly my invention relates to the means for controlling the fuel injection of an engine of the aforesaid type.

The quantity of fuel injected into the cylinders of an engine of the aforesaid type is controlled by varying the fuel injecting period. The usual manner in which this is accomplished is by varying the initial fuel pressure in the fuel supply line and the period in which the fuel valve is held open. The initial fuel pressure is referred to herein as that pressure in the supply line at the beginning of fuel injection for any cylinder of the engine.

It is the object of my present invention to control the quantity of injected fuel in an engine of the compression ignition type by providing a novel pressure controlling device for regulating the initial fuel pressure in the fuel supply line.

Another object of my invention is to construct a pressure regulator for the purpose specified that may be readily and economically manufactured, and which can be very readily assembled with an engine. Furthermore, my device may be readily serviced and maintained in accurate adjustment with a minimum of labor and expense.

A further object of my invention is to facilitate the operation of a pressure regulator for controlling the initial fuel pressure in the fuel supply line of an engine of the compression ignition type by providing means for actuating the regulator with a minimum of effort and in which wear is reduced to a minimum thereby materially eliminating the necessity for frequent adjustment or replacement of the working parts of the pressure regulator. As a part of this object, I have provided a pressure controlling valve which is balanced against side thrusts from the pressure of the fuel.

A still further object of my invention is to increase the general efficiency of an engine of the character specified by providing readily adjustable means for accurately regulating the initial fuel pressure in the fuel supply line.

This application provides improvements on my co-pending application Ser. No. 487,398, filed October 9, 1930.

For a more detailed understanding of my invention, reference may be had to the accompanying drawing which illustrates one form which my invention may assume, and in which:

Fig. 1 is a side elevational view of an engine of the compression ignition type equipped with a fuel pressure regulator constructed in accordance with my invention,

Fig. 2 is a vertical sectional view of the fuel pressure regulator,

Fig. 3 is a fragmentary sectional view thereof showing another position of the valve, and

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 2.

In order to illustrate my invention, I have illustrated my novel fuel pressure regulator in connection with an internal combustion engine of the compression ignition type provided with a constant pressure fuel injection system. Such an engine comprises a cylinder block or casting 10 of the usual construction having a cylinder head 11. As is the usual case with engines of this character, the fuel is conducted to the engine cylinders by means of the conduits 12 which are preferably connected to a common fuel supply line or "rail" 13. A suitable fuel pump 14 is utilized for supplying the "rail" with fuel under a predetermined pressure, the pump being connected with a fuel tank 15 or other suitable sources of fuel supply by means of the pipe or conduit 16.

Connected at any suitable point in the fuel supply line but preferably intermediate the pump and the first adjacent conduit 12, is a fuel pressure regulator A for controlling the initial fuel pressure in the fuel supply line or "rail". This pressure regulator consists of a casing 17 having a valve chamber 18 in which a valve guide 19 is secured, said guide being provided with a bore 20 in which valve 21 of the plunger type is reciprocatingly operated. The casing is provided with an inlet opening 22 communicating with the bore 20, and with an outlet opening 23 normally closed or covered up by the valve 21, a conduit 24 being provided for connecting the outlet opening with the fuel tank 15.

The upper end of the valve 21 is splined as at 25 or otherwise suitably connected with an operating lever 26. A yieldable means is provided for exerting a downward force on the valve and is constructed of a cup 27 yieldingly urged against the end of the valve by a compression spring 28. One end of the spring bears against the under face of a cap nut 29 secured to the casing for closing the open end of the chamber 30, the cup being slidably supported in said chamber. The force of the spring 28 may be adjusted by inserting shims 31 or other suitable spacing members in between the bottom of the cup 27 and the other end of the spring. A ball 32 or other suitable antifriction device may be interposed between cup 27 and upper end of the valve 21. Preferably, I provide a stud or tappet 33 guided by the central hole 34 in the cap nut, said tappet having an enlarged head 35 provided with a ball recess 36 in which the ball 32 is seated. The tappet may be constructed of hardened steel or other suitable material.

The lever arm 26 projects through an opening 37 in the wall of the casing and is adapted to be manually operated by means of a rod or other suitable connection 38. (See Fig. 1). The hub of the lever 26 is internally splined for connection with the splined end of the valve 21. The lower portion of the valve is cut away as at 40 (see Figs. 2 and 3). As illustrated, one embodiment of my invention comprises a pair of diametrically opposed V-shaped annular recesses that provide an inclined opening edge 41 cooperating with the outlet port 23. This pair of grooves, being exposed to the fuel pressure at inlet opening 22, serves to balance the valve 21 against side thrusts. As shown in Fig. 2 the valve is adjusted to operate the engine on full load and it will be seen that the spring 28 is compressed the maximum amount before the outlet port is uncovered by the valve. When the valve is adjusted to the position as shown in Fig. 3 the spring 28 need only be compressed a minimum amount to uncover the outlet port, operating the engine under minimum load conditions. Preferably when the valve is positioned as shown in Fig. 3, the valve is opened when the pressure of the fuel in the system reaches a certain predetermined pressure which is preferably not sufficient to open the valve controlling the injection of the fuel into the engine cylinders. As the valve is rotated from the Fig. 3 position by means of the manually actuated lever 26 the outlet port 23 is progressively and increasingly covered, providing corresponding increases in the initial fuel pressure. Various degrees of initial fuel pressure in the system provide for various amounts of injected fuel, thereby providing various engine load operations intermediate the minimum and maximum engine loading conditions as controlled by the valve adjustments shown in Fig. 3 and Fig. 2 respectively.

It will be thus noted that I have provided a means for accurately controlling the initial fuel pressure in the fuel supply of the fuel ignition system, which is constructed of a minimum number of parts, that may be readily assembled, and in which wear is reduced to a minimum. In contrast with the usual custom of varying the spring resisting means by some suitable form of control acting on the spring, I have provided means automatically or manually actuated for varying the position of the valve relative to the outlet port 23, whereby the force closing the valve is varied, thereby varying the maximum fuel pressure that is maintained in the fuel line. In other words my initial fuel pressure control is responsive to the fuel pressure in the system, i. e., the pressures in the fuel supply system are utilized for regulating the regulable means for providing selective predetermined pressure in the fuel supply system. Furthermore, the employment of an anti-friction device, such as the ball 32 intermediate the valve and said spring permits the valve to be adjusted with a minimum effort.

Due to the fact that the variation of the yieldable means is responsive to the fuel pressure in the system, it is only necessary to overcome friction of the plunger in its bearing and the end thrust against the antifriction device intermediate the valve and spring to effect control of engine output.

Although I have illustrated but one form of my invention and have described in detail but

a single application thereof, it will be apparent to those skilled in the art to which my invention pertains that various modifications and changes may be made therein without departing from the spirit of my invention or from the scope of the appended claims.

What I claim as my invention is:

1. In a fuel supply regulator, a casing having a fuel inlet and a fuel outlet, a valve in said casing, said valve having a portion thereof acted on by the pressure of the fuel entering said inlet, a spring acting on said valve for opposing movement of said valve under the action of said fuel pressure, said valve having a groove associated with said outlet for regulably controlling passage of fuel from the inlet to the outlet, and means for rotatably adjusting said valve to adjust said groove with respect to said outlet whereby to vary the pressure of the fuel at said inlet, said valve having a second groove diametrically opposite the first said groove for balancing the side thrust produced by the fuel pressure acting on said valve.

2. In a fuel supply regulator, a casing having a fuel inlet and a fuel outlet, a valve in said casing, said valve having a portion thereof acted on by the pressure of the fuel entering said inlet, a spring acting on said valve for opposing movement of said valve under the action of said fuel pressure, said valve having a groove associated with said outlet for regulably controlling passage of fuel from the inlet to the outlet, and means for rotatably adjusting said valve to adjust said groove with respect to said outlet whereby to vary the pressure of the fuel at said inlet, said valve having a second groove diametrically opposite the first said groove for balancing the side thrust produced by the fuel pressure acting on said valve, said first groove having substantially an inverted V-shape.

3. In a fuel supply regulator, a casing having a fuel inlet and a fuel outlet, a valve in said casing, said valve having a portion thereof acted on by the pressure of the fuel entering said inlet, a spring acting on said valve for opposing movement of said valve under the action of said fuel pressure, said valve having a groove associated with said outlet for regulably controlling passage of fuel from the inlet to the outlet, and means for rotatably adjusting said valve to adjust said groove with respect to said outlet whereby to vary the pressure of the fuel at said inlet, and means for balancing the side thrust produced by the fuel pressure acting laterally of said valve on said groove.

4. In a fuel supply regulator, a casing having a fuel inlet and a fuel outlet, a valve in said casing, said valve having an end acted on by the pressure of the fuel entering said inlet, a spring acting on said valve for opposing movement of said valve under the action of said fuel pressure, said valve having a groove open to said end and associated with said outlet for regulably controlling passage of fuel from the inlet to the outlet, and means for rotatably adjusting said valve to adjust said groove with respect to said outlet whereby to vary the pressure of the fuel at said inlet, said valve having a second groove open to said end for producing a fuel pressure thrust laterally on said valve in opposition to that produced by said first groove.

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