

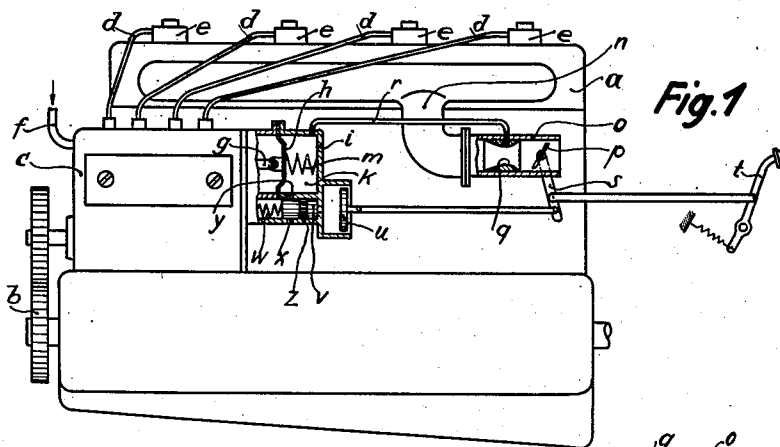
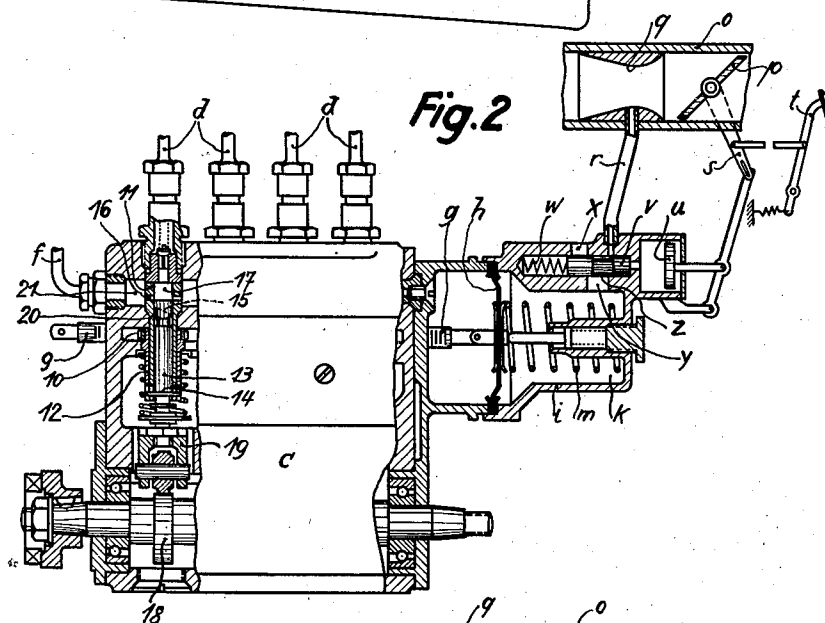
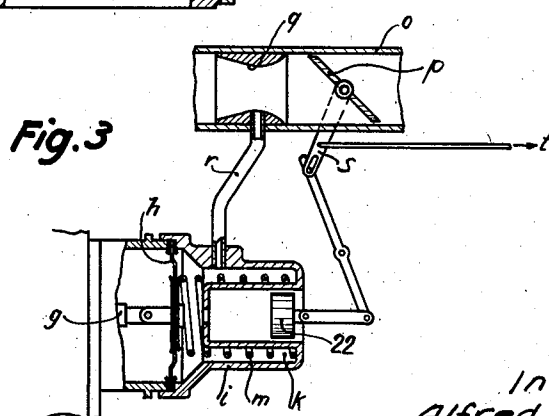
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FUEL REGULATOR FOR ENGINES

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FUEL REGULATOR FOR ENGINES

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This invention relates to the regulation of the fuel supply for internal combustion engines and more particularly to an arrangement for the regulation of the fuel supply for an automotive Diesel engine of the type provided with a servo-motor acting in conjunction with a manual regulating means for controlling the engine.

It has heretofore been proposed to provide a servo-motor actuated by pressure dependent upon the speed of the engine for controlling the fuel supply pumps of such engines. The pressure controlling the servo-motor is commonly taken from the intake manifold, but as heretofore constructed the variation in pressure in such manifold is effective in the servo-motor only after a certain time lag. It thus occurs that when the operator opens the accelerator throttle the pressure within the manifold is transmitted to the servo-motor only after an appreciable period, during which period the fuel supply is not in proportion to the air supply and not in accordance with the requirements of the engine.

It is one of the objects of this invention to overcome the above mentioned defect and reduce as far as possible the time lag between the actuation of the manually-adjustable throttle valve and the resultant movement of the pneumatically operated servo-motor, and to insure that upon adjustment for greater fuel charges the servo-motor temporarily adjusts the fuel pump to give a greater injection than normally corresponds to the altered adjustment of the manually controlled regulator.

To this end it is a feature of this invention to provide means coupled with the manually adjustable regulating member whereby upon adjustment of the regulating member for increased injection, the pressure within the servo-motor is increased more rapidly than would be the case by adjustment of the regulating member alone.

Other objects and features of this invention will in part be obvious and in part pointed out in connection with the accompanying detailed description.

To the attainment of the aforesaid objects, the invention still further resides in the novel details of construction, combination and arrangement of parts, all of which will first be fully described in the following detailed description and then pointed out in the appended claims, reference being had to the accompanying drawing in which:

Fig. 1 shows in side elevation an internal combustion engine equipped in accordance with this invention, parts being broken away to show in-

terior construction; Fig. 2 shows in connection with parts of Fig. 1, a modified form of the invention; and Fig. 3 indicates another modified form.

Referring to Fig. 1, reference letter *a* indicates a conventional four-cylinder injection type engine. A multi-cylinder injection pump, operated by the engine through gears *b*, is designated at *c*. Fuel supply conduits *d* lead from pump *c* to nozzle holders *e* arranged in the cylinder heads. The fuel is led from a container, not shown, to the injection pump by means of conduit *f*. The amount of fuel supplied by the individual pumps may be simultaneously changed in a well known manner by adjustment of a regulating rod *g* common to all individual pumps. The occurrence of this change upon adjustment of the regulating rod will be described later in connection with Fig. 2.

The end of the regulating rod *g* protruding at the right of the pump housing is connected to the reinforced middle part of a diaphragm *h*, the rim of which is inserted between a flange on the right side wall and the pump housing and a box-like portion *i*. A spring *m* is arranged in the chamber *k* defined by the diaphragm *h* and the portion *i* on the opposite side of the diaphragm. The spring *m* acts to press the diaphragm to the left and push the regulating rod linked thereon to the left, in which position the pumps are adjusted for the greatest output.

Attached to the air intake pipe *n* common to all cylinders is a flanged pipe *o* containing a throttle valve *p* shown in its closed position. A venturi *q* is positioned beyond the pressure valve in the direction of flow of the suction air, and a passage *r* connects the venturi at its narrowest point with the interior of the chamber *k*.

A lever *s* attached to the pressure valve *p* is connected by rods leading on one side to the manually adjustable pedal *t*, and on the other side to a piston *u* fitting with some clearance in a cylindrical extension of the member *i*. The chamber formed by this extension and in which the piston *u* reciprocates is connected with a bore in part *i* containing a slide valve *v*. A spring *w* holds the slide valve in the position shown. In this position the slide valve *v* closes a passage *x* leading to the atmosphere. A passage *y* connects the chamber *k* with the interior of said bore. The valve *v* is provided with an annular groove *z*.

The operation of the form of the device described above is as follows: If the driver desires to increase the speed of the engine, the accel-

erator pedal *t* is depressed. This opens the throttle valve *p*. The low pressure previously existing behind the throttle valve because of the suction of the engine is decreased. After a certain time lag the low pressure of the chamber *k* of the motor would normally adjust itself through the passage *r* to the increased pressure in the suction pipe and thereby permit the spring *m* to push the diaphragm center, and the regulating rod of the injection pump connected therewith, somewhat to the left, that is in the direction of increased fuel supply.

In order to decrease the time lag occurring in this regulating procedure the piston *u* is adjusted simultaneously with the opening of the throttle valve *p*, thereby compressing the air in its cylinder so that the slide valve *v* is forced by this pressure to the left against the force of spring *w*. Upon this movement the annular groove *z* of the slide valve *v* registers with the passages *x* and *y* so that the chamber *k* is thereby connected with the outer air. The low pressure previously existing in the chamber *k* is then quickly increased to that of the atmosphere. The spring *m* is effective at the moment to move the diaphragm and the connected regulating rod in the direction of increased fuel injection, which results in the greatest possible fuel supply. In the meantime, if the driver continues to hold the foot lever depressed, the air pressure in the cylinder containing piston *u* has escaped around the loosely fitting piston. The spring *w* thereupon returns the slide valve to the position shown, the connection between the chamber *k* and the outer air is interrupted, and the regulation by means of the suction in the intake manifold, which was deliberately suspended over a short speed-up period, is now resumed.

The second form of the invention disclosed in Fig. 2 differs substantially from the first only in that, when the slide valve *v* effects connection of the regulating chamber *k* with the outer air, the conduit *r* is closed and thereby prevents part of the outer air flowing into the chamber from being sucked off through said conduit.

Fig. 2 shows the regulating rod *g* toothed and meshed with a toothed ring 10. One such ring is provided for each pump and fastened on a shell 12 slid over the cylinder bushing 11 thereof. The lower end of each shell protrudes over the cylinder bushing and is provided with slits into which project cross pieces 14 attached to the accompanying pump piston 13. Upon turning the shells, the pistons 13 are rotated. This results in the adjustment of the control surface 15 on the piston head relative to the opening 16 in the stationary cylinder bushing. This adjustment produces an increase or decrease in the effective stroke of the piston 13 which is actuated by a cam 18 through a cross head 19. The cross head 19 is held in position by a groove 20. The openings 16 of all pump cylinders are connected to a common suction chamber 21 in the pump housing.

In the embodiment of Fig. 3, a rapid actuation of the diaphragm *h* and regulating rod *g* upon speeding up of the engine is attained by a piston 22 fitting closely in a cylinder in the regulating housing. This piston forces the air content of said cylinder into the regulating chamber *k* upon opening the pressure valve *p*, so that a more rapid and higher pressure increase results than would be possible through conduit *r* alone.

In all the above examples, the suction of the engine is utilized to operate the servo-motor and

a spring serves to effect return movements thereof. It will be obvious that any other source of fluid pressure, either above or below atmospheric pressure, may be used to operate the servo-motor, provided this pressure varies in accordance with the speed of the engine. Also fluid pressure may be used in place of the return spring.

It will be clear from the above description that the invention provides a construction which reduces or eliminates the time lag between the actuation of a manually operated speed control device and the response of a fuel supply regulating servo-motor to increased speeds. Furthermore, a brief period of maximum fuel supply is automatically provided each time the engine is manually accelerated.

Although there are herein described but three exemplary embodiments of the invention, it will be obvious that other modifications and embodiments within the scope of the appended claims will occur to those skilled in the art.

What is claimed is:

1. In regulators for the fuel supply of an internal combustion engine, a fuel supply device, a regulating member for varying the quantity of fuel supplied by said device, a chamber, a movable member responsive to pressure variations in said chamber, means connecting said movable member to said regulating member, a conduit connecting said chamber and the intake manifold of said engine, a cylinder adjacent said chamber, a piston reciprocative in said cylinder, a throttle valve in said manifold, manual means to actuate said throttle valve, means connecting said throttle valve actuating means and said piston to move the latter to compress the air in said cylinder upon movement of said throttle valve to open position, means responsive to said compressed air for increasing the pressure in said chamber, and means providing a leakage of air from said cylinder whereby after a predetermined time pressure in said cylinder is reduced and the pressure in said chamber returns to dependence upon pressure conditions in said manifold.

2. In regulators for the fuel supply of an internal combustion engine, a fuel supply device, a regulating member for varying the quantity of fuel supplied by said device, a chamber, a movable member in said chamber responsive to pressure variations therein, means connecting said movable member to said regulating member, a conduit connecting said chamber and the intake manifold of said engine through which pressure in said chamber and manifold tends to equalize, a passage between said chamber and the atmosphere, a valve controlling said passage, a throttle in said manifold, manual means to actuate said throttle, means actuated by movement of said throttle to open position to open said valve thereby connecting said chamber with the atmosphere, and means automatically closing said valve after a predetermined time lag.

3. In regulators for the fuel supply of an internal combustion engine, a fuel supply device, a regulating member for varying the quantity of fuel supplied by said device, a chamber, a movable member in said chamber responsive to pressure variations in said chamber, a conduit connecting said chamber and the intake manifold of said engine through which pressure in said chamber and manifold tends to equalize, a passage between said chamber and the atmosphere, a valve controlling both said passage and said conduit, said valve normally permitting communication between said chamber and said manifold

while closing communication between said chamber and the atmosphere, a throttle in said manifold, manual means to actuate said throttle, means actuated by movement of said throttle
5 to open position to move said valve thereby obstructing said conduit between said chamber and said manifold, and opening said passage between said chamber and the atmosphere, and means automatically returning said valve to normal position after a predetermined time lag.
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4. In regulators for the fuel supply of an internal combustion engine, a fuel supply device, a regulating member for varying the quantity of fuel supplied by said device, a diaphragm connected to said regulating member, a chamber
15 having one end closed by said diaphragm, said

diaphragm being responsive to pressure variations in said chamber, a conduit connecting said chamber and the intake manifold of said engine, a cylinder in constant communication with said chamber, a piston reciprocative in said cylinder, a throttle valve in said manifold, manual
5 means to actuate said throttle valve, and means connecting said throttle valve actuating means and said piston to move the latter to compress the air in said cylinder upon movement of the throttle to open position, whereby pressure in said
10 chamber is momentarily increased to thereby actuate said regulating means to increase the fuel supply independently of the equalization of pressure effected through said conduit.
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