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REGULATION OF THE QUANTITY OF FUEL IN COMBUSTION ENGINES

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Fig. 1

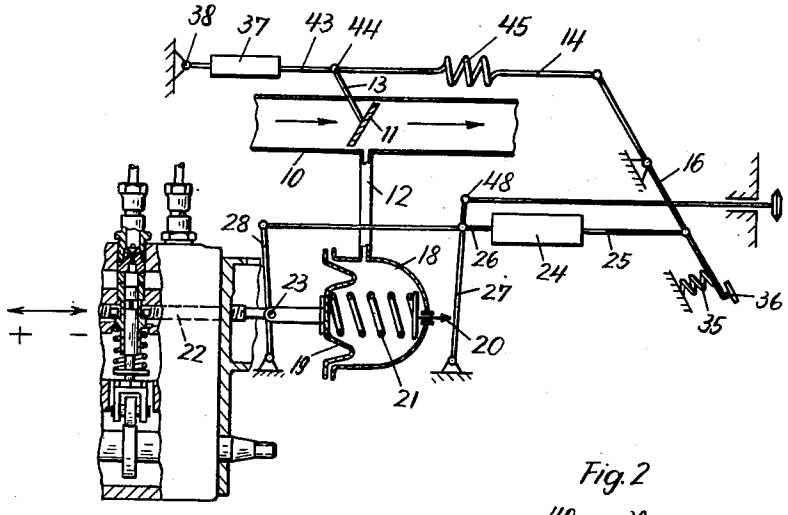
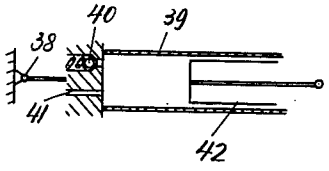


Fig. 2



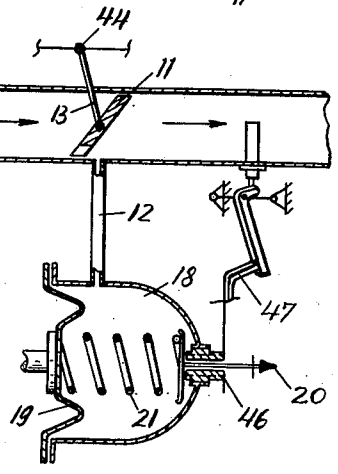


Fig. 3

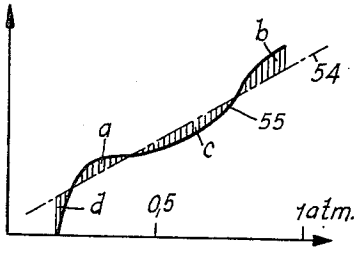


Fig. 4.

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REGULATION OF THE QUANTITY OF FUEL IN COMBUSTION ENGINES

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12 Claims. (Cl. 123—140)

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The present invention relates to a device for regulating the quantity of fuel in combustion engines, particularly combustion engines with fuel injection for motor vehicles, in response to variations in the pressure of a pneumatic medium, e. g. the depression existing behind a throttle controlled by the driver, in the intake manifold of the engine. The main purpose of the invention is to save fuel, as well as to obtain a particularly favorable proportion between the quantities of fuel and air during the transitional phases of regulation. By connecting the injection controlling device of a combustion engine, e. g. the control rod of the fuel injection pump, direct with the so-called accelerator, and by operating a throttle in the admission pipe by means of a suitable control device, in accordance with the desired quantity of fuel, a temporary enrichment of mixture will be produced as desired upon depressing the accelerator, i. e. upon causing the engine to accelerate, which is proportionate to the inertia of the regulating device. Upon releasing the accelerator, an impoverishment of mixture will ensue immediately because the quantity of air will adjust itself to the quantity of fuel only with a certain delay. In the case of motor vehicle engines or other fast running engines, however, this regulation cannot be readily applied, because the extent to which the cylinders are filled, at least in the absence of a supercharger, is dependent upon the number of revolutions made by the engine, and the full quantity of fuel may only be used at a medium speed, i. e. when the engine makes a medium number of revolutions. Moreover, in small-size diesel engines, regulation of the quantity of fuel to be injected responsive to the depression in the intake manifold has been provided in such a way that this depression causes the shifting of the control rod of the injection pump by means of a diaphragm acting against a spring. Inertia of the regulating device, however, causes the regulation of the quantity of fuel to follow the setting of the throttle only with a certain delay. To obtain working regulation transitions in these known engines, a basic setting corresponding to a rich mixture has to be chosen which involves a high fuel consumption. These disadvantages will be prevented by this invention. The invention is essentially characterized by the fact that when passing over to another load, i. e. by increasing or decreasing the accelerator setting, regulation of the quantity of fuel receives an additional and transitional regulating impulsion toward a larger or smaller quantity of fuel, respectively. This

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will occur, for example, when the fuel quantity control member, normally influenced by the pneumatic medium through an interposed flexible coupling such as a spring-loaded diaphragm, is deliberately shifted temporarily to a different position, the influence of the pneumatic medium being by-passed and such deliberate shifting being imparted either forcibly or with a certain amount of yield.

The shifting is hereby obtained particularly by an auxiliary device which yields when movement is slow, whereas it acts rigidly or substantially rigidly when in fast operation. This auxiliary device may be designed more or less as a dash-pot device.

A delaying device for the quantity of air to be increased, may be moreover provided, if required, in addition to the fuel accelerating device. Under certain circumstances it may be also suitable to provide a further device for the voluntary or temperature-controlled regulation of the basic setting of the regulating device or for changing the interdependence between the position of the quantity controlling member and the pressure of the pneumatic medium.

All details and features of the invention are outlined in the following descriptions of some examples of embodiment in conjunction with the drawing, wherein:

Fig. 1 is an example of embodiment of the invention.

Fig. 2 is a part of Fig. 1, but on a larger scale.

Fig. 3 is a portion of a further example of embodiment of the invention.

Fig. 4 is an example of a characteristic of the preferred regulating device according to the invention.

A conduit 12 is connected with intake manifold 10 of a combustion engine otherwise not shown in the diagram, near throttle 11. Throttle 11 is connected with accelerator 16 of the engine through the rods 13, 14. The conduit 12 leads to the housing 18. The latter is closed on the one side by a leather diaphragm 19. A spring 21 is provided between diaphragm 19 and an adjustable stop 20 in the housing 18. Regulation rod 22 of an injection pump generally designated P is exteriorly coupled with diaphragm 19. On the regulation rod 22 there is a stop 23. Adjustment pedal 16, through a flexible intermediate member 24, is in contact with stop 20 by rods 25, 26, 27 and with stop 23 by rods 25, 26, 28. The intermediate member 24 consists of a spring dash-pot. Under normal circumstances the throttle will be held in idle or closed adjustment by spring 35.

When operating the accelerator 16 by pushing down pedal 36, throttle 11 will open. When the engine is running, a certain depression of greater or lesser value will be produced in intake manifold 10 due to the flow of the air sucked in. This depression will be transmitted in an increased value through conduit 12 to housing 18 and act on regulating rod 22 of the injection pump due to the retraction of diaphragm 19 against the action of spring 21, whereby a strong depression will result in the supply of a small quantity of fuel and a small depression in the supply of a high quantity of fuel. By pushing pedal 36 all the way down the rods from 24 to 27 and, together with them, stop 20 will also be shifted to the left, whereby regulating rod 22 of the injection pump will also be moved to the left through the shifting of spring 21 and diaphragm 19. This will cause an enrichment of the mixture. Spring dash-pot member 24 allows full freedom of movement of pedal 36 while acting, when in fast motion, almost as though piston 32 and cylinder 30 were rigidly assembled. Yet, movements of stop 20 and of regulation rod 22 to the left, as well as movements of stop 23 and of regulation rod 22 to the right, may be coupled with the movement of the pedal and of the throttle as firmly as desired by suitable choice of the dash-pot 24, of the lever lengths etc., so as to make it possible to control the duration of enrichment or impoverishment of the mixture, respectively.

If it is desired that the throttle opens with delay, a delaying member 37 may be installed on the operating rods 13, 14 of the throttle 11 according to Figs. 1 and 2. This delaying member may comprise a cylinder 39 swivelling around a fixed point 38. Cylinder 39 is provided with a return valve 40 which opens easily to the exterior and with a calibrated bore 41. In the cylinder 39 a piston 42 is slidable in axial direction and is connected through rod 43 with a joint 44 connecting the rods 13, 14. Rod 14 is moreover provided with a spring 45. As will clearly appear, by pushing pedal 36 all the way down, throttle 11 opens with delay through the stretching of spring 45 and the delayed yielding of device 37, so that the positions of throttle 11 and of regulating rod 22 will correspond to one another only conditionally. When the pedal is released, the lever 26 will immediately shift regulation rod 22 to the right through stop 23, thus decreasing the quantity of fuel injected, and the throttle as provided in the embodiment according to Figs. 1 and 2 will also be shifted without delay in the direction of closure, because the inward movement of piston 42 will readily cause the opening of return valve 40.

According to Fig. 3, in housing 18 a threaded bushing 46 is provided by which the initial tension of spring 21 and hereby the basic setting of the regulation may be adjusted, for example in accordance with the air temperature, such as the temperature of the outer ambient air or of the air sucked into the manifold. This can be done such as by connecting the threaded bushing through a lever 47 or the like, with a thermostat T, which continuously changes the prime setting of the regulation. In some instances, however, it may be sufficient to provide the threaded bushing with two settings, such as "summer," "winter," or the like.

Finally, an adjustable choke C may also be provided for hand actuation as shown at 48 in Fig. 1. However, since the inertia of the regulating device is per se somewhat greater when cold, the choke is not absolutely necessary. The diagram (Fig. 4) shows the influence of the regulation on the formation of the mixture. The vertical axis corresponds to the quantity of injected fuel per working stroke, the horizontal axis to the absolute pressure existing in the manifold.

The curve 55 (Fig. 4) shows the formation of mixture produced when adopting a characteristic of regulation which is particularly recommended. Line 54 shows a constant proportion of air and fuel mixture. The shaded surfaces *a* and *b* between line 54 and curve 55 correspond to the enrichment of mixture when the engine idles and at full load, the surface *c* corresponds to the impoverishment of mixture at medium load. The regulation provides for the complete cessation of fuel injection from a predetermined depression onward in the manifold. This happens when the vehicle coasts downhill, and the engine is driven by the wheels, with the throttle closed. Surface *c* shows the fast impoverishment of mixture when the vehicle is running downhill. The use of the invention is also of advantage particularly with engines where a light fuel, such as gasoline and the like, is atomized into the manifold by the action of highly accelerated compressed air.

The invention is not restricted to the outlined example of embodiment.

What I claim is:

1. Regulating device for injection internal combustion engines comprising an actuating lever, a throttle valve in the engine intake manifold, a fuel quantity control member, means responsive to ambient pressure in the intake manifold for influencing the control member, including a diaphragm operatively engaging the control member and a spring pre-loading the diaphragm, means responsive to movement of the actuating lever for temporarily additionally influencing the control member, and means resiliently connecting the actuating lever with the throttle valve for delayed-action movement therewith in at least one direction.

2. Regulating device for injection internal combustion engines comprising an actuating lever, a throttle valve in the engine intake manifold, a fuel quantity control member, means responsive to ambient pressure in the intake manifold for influencing the control member, including a diaphragm operatively engaging the control member and a spring pre-loading the diaphragm, means responsive to movement of the actuating lever for temporarily additionally influencing the control member, and means included in the throttle valve actuating means and comprising, between the actuating lever and throttle valve, a spring and a delayed-action device connected to the throttle valve to permit slow movement of the throttle in at least one direction.

3. Regulating device for injection internal combustion engines comprising an actuating lever, a throttle valve in the engine intake manifold, a fuel quantity control member, means responsive to ambient pressure in the intake manifold for influencing the control member, including a diaphragm operatively engaging the control member and a spring pre-loading the diaphragm, means responsive to movement of the actuating lever for temporarily additionally influencing the control member, and means included in the throttle valve actuating means and comprising, between the actuating lever and throttle valve, a spring and a delayed-action device connected to the throttle valve, whereby the throttle valve follows the actuating lever with delay in the

opening direction of the valve but without delay in the closing direction.

4. Regulating device for injection internal combustion engines comprising an actuating lever, a throttle valve in the engine intake manifold, a fuel quantity control member, means responsive to ambient pressure in the intake manifold for influencing the control member, including a diaphragm operatively engaging the control member and a spring pre-loading the diaphragm, means responsive to movement of the actuating lever for temporarily additionally influencing the control member, means resiliently connecting the actuating lever with the throttle valve for delayed-action movement therewith in at least one direction, said last-named means including a piston, linkages connecting the piston with the throttle valve, and a cylinder pivoted on a fixed point of the engine and wherein the piston is slidable, the cylinder having at least one end bore connecting the inside of the cylinder with the atmosphere, the said bore being provided with a lightly sprung relief valve, and the piston being actuated inwardly of the cylinder when the throttle valve moves in the closing direction.

5. Regulating device as in claim 1 including means for adjusting the force exerted by the preloading spring on the diaphragm.

6. Regulating device as in claim 5 comprising a seat for the spring, a threaded bushing rotatably connected to the seat, a rotatable lever connected to the bushing to impart rotary and axial movement thereto, and a thermostat controlling the movements of the lever.

7. Regulating device as in claim 6 wherein the thermostat is positioned inside the intake manifold.

8. Regulating device as in claim 6 wherein the thermostat is influenced by the ambient temperature.

9. Regulating device as in claim 1 including a

driver-operated device for directly influencing the control member upon overcoming the forces acting on the control member.

10. Regulating device as in claim 9 in which the driver-operated device comprises an actuating element connected to the actuating lever and in which the diaphragm preloading spring also opposes the movement of the actuating element.

11. Regulating device as in claim 10 further comprising a seat for the spring, the actuating element being constructed and arranged for movement in one direction to displace the spring seat against the spring and in the other direction to displace the fuel supply control member against the spring, a pair of levers each pivoted at one end to a fixed point, and a rod pivotally connecting the other free ends of the levers with the actuating element and being of such length that when the spring is fully extended one of the levers engages an abutment of the spring seat while the other engages an abutment of the control member.

12. Regulating device as in claim 1 wherein the means responsive to ambient pressure in the intake manifold is so connected to the control member as to cut off abruptly the fuel supply in the intake manifold when the pressure drops below a predetermined value.

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