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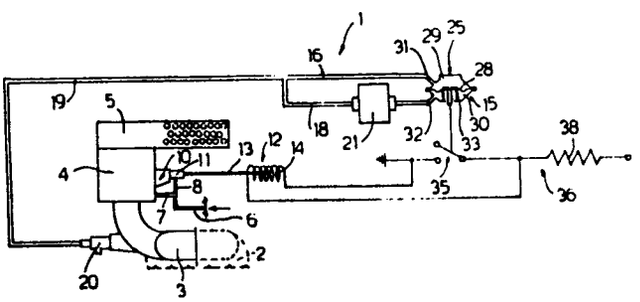
(54) An acceleration phase fuel enrichment device for a vehicle engine.

(57) A device (1) is described for fuel enrichment during acceleration, able to replace or to be positioned alongside the accelerator pump; the device consists of a supplementary fuel jet (10) in the carburretor (4) controlled through an electromagnet (12) by an electropneumatic actuator (15) provided with two chambers (29, 30) separated by an element (28) movable against the action of a spring (33) and both connected to the induction manifold (3) by means of respective tubes (16, 18) in one of which is positioned a delay valve (21).



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An acceleration phase fuel enrichment device for a vehicle engine

The present invention relates to a device for enrichment of the fuel-air mixture strength formed by a carburettor of a heat engine of a vehicle, able to intervene during the acceleration phase whereby to guarantee the maximum development of power by the engine.

It is known that for the purpose of reducing the fuel consumption and pollution, modern engines are designed in such a way as to utilise a particularly lean fuel-air mixture; however, not only for questions of performance but also for reasons of safety (considering the necessity of being able rapidly to perform an overtaking manoeuvre) it is necessary to enrich the mixture rapidly in such a way as to increase the power which the engine can develop when the accelerator pedal is fully depressed; it is known that in conventional engines this function is performed by the accelerator pump, which is directly actuated by a decisive pressure exerted on the accelerator pedal; however the operation of accelerator pumps cannot be sufficiently rapid, or rather may be insufficient, especially in engines utilising lean mixtures and/or in particular operating conditions, such as during cold running immediately after starting.

The object of the invention is that of providing an enrichment device for heat engines, operable to enrich the air-fuel mixture strength during acceleration, with rapid and certain intervention, which has a high reliability, a low cost, and which can be positioned alongside the normal accelerator pump without altering its function.

The said object is achieved by the invention in that it relates to an acceleration phase fuel enrichment, device for an engine of a

vehicle, characterised by the fact that it includes, in combination, an electropneumatic actuator comprising a pair of opposite chambers of variable volume separated in a fluid tight manner by an element movable against the action of resilient means, which are housed within the interior of one of the said chambers; a pair of tubes connecting the interior of the said chambers of the actuator with the induction manifold of the engine; a delay valve positioned along one of the said tubes; and a supplementary fuel jet formed in the carburettor of the engine and the opening of which is controlled by the actuation of the said electropneumatic actuator.

For a better understanding of the invention a non-limitative description of its embodiment is now given with reference to the attached drawing, in which:

Figure 1 schematically illustrates an enrichment device formed according to the invention; and

Figure 2 illustrates on an enlarged scale a schematic sectional view of a detail of the device of the invention.

With reference to Figure 1 there is generally indicated, with the reference numeral 1, an enrichment device for a heat engine 2 of any known type and only partially illustrated in broken outline for simplicity; the engine 2 is provided with an induction manifold 3, a carburettor 4 of any known type connected to the manifold 3 upstream of the engine 2, an air filter 5 of known type surmounting the carburettor 4, and a fuel supply duct 6 for supplying a fuel, for example petrol, including, according to the invention, a pair of terminal branches 7 and 8, the first of which terminates in the carburettor 4 to supply this in the conventional known way, not illustrated for simplicity, and the second of which goes on to supply a supplementary fuel jet 10 forming an integral part of the

device 1, but mounted securely on the carburettor 4, for example comprising a nozzle of known type and not illustrated for simplicity disposed in the vicinity of the normal nozzle or jet of the carburettor 4, between this and a shutter device 11, of any known type, for example a needle valve, controllable externally of the carburettor 4 and not illustrated in detail for simplicity.

According to the invention, the device 11 is controlled by an electromagnet 12 forming part of the device 1 and comprising a core or movable armature 13 mechanically connected to the supplementary jet 10 in such a way that the translation of this core causes the actuation of the device 11 with consequent opening and closure of the jet 10, and an inductor 14 operable to attract the core or movable armature 13 when it is excited, in such a way as to cause displacement thereof; the device 1, in addition to the jet 10 and the electromagnet 12, further includes an electropneumatic actuator 15, a pair of tubes or pneumatic lines 16 and 18 connected together in such a way as to join into a single line 19, a vacuum take-off 20 of known type, connecting the line 19 to the interior of the manifold 3 and therefore communicating to the tubes 16 and 18 the vacuum existing in the manifold 3, and a pneumatic delay valve 21 of known type, which is therefore not further described for simplicity, disposed in series along the tube 18. With reference also to Figure 2, the actuator 15 comprises a casing 25, preferably made in sheet metal, and constituted by two facing half-shells 26 and 27 joined together, and a movable element 28 housed within the casing 25 in such a way as to define therein two adjacent chambers 29 and 30, of variabe volume, sealingly separated in a fluid-tight manner by the movable element 28, which is preferably constituted by a deformable membrane, for example of rubber, clamped along the perimetral edge between the half-shells 26 and 27; the chambers 29 and 30 are connected to the tubes 16 and 18 respectively through respective outlet spigots 31 and 32 in the chamber 30, or rather in

that connected to the tube provided in series with the delay valve 21 there is housed a helical compression spring 33 against the action of which the membrane 28 is movable. To the actuator 15 is connected an electrical switch 35 forming part of an electrical supply circuit 36 for the electromagnet 12; the displacement of the element 28 causes opening or closure of the switch 35 and consequently activation or disactivation of the electromagnet 12; according to the invention the connections between the actuator 15, switch 35 and electromagnet 12 are effected in such a way that the jet 10 is activated following an alteration in the rest condition of the electromagnetic means defined by the electromagnet 12 and the associated circuit 36 taking place as a consequence of a movement of the element 28 in such a sense as to compress the spring 33. For this purpose the switch 35 is integrally formed with the actuator 15 which, for this reason, is indicated as being electropneumatic, and the circuit 36 is formed in such a way that the electromagnet is excited when the switch 35 is open; in particular the circuit 36 has the inductor coil 14 disposed in parallel with respect to the switch 35 and includes a resistor 38 disposed upstream of the switch 35; this latter includes a first metal conductor contact 39 provided with an electrical wire 40 for connection to the circuit 36, which contact is fixed in an electrically insulated manner on the half-shell 27 by means of a collar 41, and projects into the interior of the chamber 30 towards the element 28 and coaxially with the spring 33, and a second conductive metal contact 42 fixed rigidly onto the movable element 28 by means of a plate 43 and projecting into the chamber 30 towards the contact 39, coaxially therewith; the two contacts 39 and 42 are able to cooperate together to make electric contact upon compression of the spring 33 and the contact 42 is likewise connected to the circuit 36, for example through an electrical wire 44 which connects it electrically to the casing 25, which can be connected to earth in a known manner.

In use, the jet 10 is normally closed and this is obtained by holding the electromagnet 12 excited, which holds the device 11 in the closure position; in these conditions the fuel enters the carburettor 4 only through the duct 7 and the vehicle proceeds under normal operating conditions. When the user desires to accelerate he presses the accelerator pedal opening the butterfly valve of the carburettor 4 and consequently causes a variation (in particular a reduction) in the vacuum in the manifold 3; this pressure variation in the manifold 3 is transmitted through the take-off 20 and the line 19 to the tubes 16 and 18, and from these to the chambers 29 and 30 of the actuator 15, but because of the presence of the delay valve 21 it arrives in the chamber 30 after a certain time lapse with respect to the moment at which it arrives in the chamber 29, a lapse which depends on the calibration of the valve 21 and which can therefore be adjusted at will; following the delay in the transmission of the pressure variation in the chamber 30 there is created an imbalance between the pressure in the two chambers of the actuator 15, which produces displacement of the element 28 in a sense such as to compress the spring 33 in that the chamber 29 is under a greater pressure (smaller vacuum) than the chamber 30. Consequently, the switch 35 is closed since the two contacts 39 and 42 come into contact with one another, and the inductor coil 14 is short circuited causing de-energisation of the electromagnet 12 and consequent opening of the supplementary jet 10; in these conditions the fuel arrives in the carburettor 4 both from the duct 7 and from the duct 8, that is to say it arrives in greater quantity and therefore produces the desired enrichment of the mixture during acceleration; when the transient due to the presence of the valve 21 is finished, the pressure in the chambers 29 and 30 reach equilibrium producing opening of the switch 35 with consequent re-energisation of the electromagnet 12 and closure of the supplementary jet 10.

From what has been described the advantages connected with the enrichment device according to the invention will be evident; since the enrichment phase corresponds exactly to the period of opening of the supplementary jet 10 and this corresponds exactly to the duration of the pressure transient in the chambers 29 and 30, which is a function only of the calibration of the valve 21, by consequently dimensioning the jet 10 and the valve 21 suitably it is possible to produce an enrichment of the fuel-air mixture strength with great metering precision without waste of fuel and only for the time effectively necessary to obtain the impulse of the engine 2; the device is moreover very reliable and of simple construction and can equally well be put alongside or as a replacement of the normal accelerator pumps according to the requirements of different vehicles. Finally, it is clear that variations and modifications to what has been described can be introduced without by this departing from the scope of the invention; for example the circuit 36 can be formed differently, and the control of the jet 10 can be effected in a different manner, for example in a way such as to cause opening thereof following excitation of the electromagnet 12 rather than following its de-energisation as in the example described.

(Dr. Ing. PRATO Roberto)

CLAIMS

1. An acceleration phase fuel enrichment device for a vehicle engine, characterised by the fact that it comprises in combination: an electropneumatic actuator (15) having a pair of opposite chambers (29, 30) of variable volume, separated in a fluid-tight manner by an element (28) movable against the action of resilient means (33) which are housed within one of the said chambers (29, 30); a pair of tubes (16, 18) connecting the interior of the said chambers of the actuator (15) with the induction manifold (4) of the engine; a delay valve (21) disposed in one of the said tubes (18); and a supplementary fuel jet (10) formed in the carburettor (4) of the engine and the opening of which is controlled by the actuation of the said electropneumatic actuator (15).

2. A device according to Claim 1, characterised by the fact that the said resilient means are constituted by a compression spring (33) housed within the interior of the said chamber (30) connected to the tube (18) provided with the said delay valve (21).

3. A device according to Claims 1 or 2, characterised by the fact that it includes electromagnetic means (12) for opening the said supplementary fuel jet (10), which are activated by the displacement of the said movable element (28) in a direction such as to deform the said resilient means (33).

4. A device according to Claim 3, characterised by the fact that the said electromagnetic opening means comprise an electromagnet (12) the core of which is mechanically connected to the said supplementary fuel jet (10) in such a way that the translation of the said core causes opening and closure of the said jet, an electric supply circuit (36) for the said electromagnet (12), and a

switch (35) the closure and opening of which are controlled by the said electropneumatic actuator (15).

5. A device according to Claim 4, characterised by the fact that the said switch (35) is incorporated in the said electropneumatic actuator (15) the said chambers (29, 30) of variable volume being delimited by a casing (25) provided, on the side of the chamber housing the said spring (33), with a first contact (39) of conductive material projecting into the interior of this chamber (30) and electrically insulated from the said casing (25), and the said movable element (28) carrying a second contact (42) of conductive material fixed thereto and projecting into the part of the said chamber (30) housing the spring (33) coaxially with the first contact (39) and able to contact this, the said contacts (39, 42) being electrically connected to the said circuit (36).

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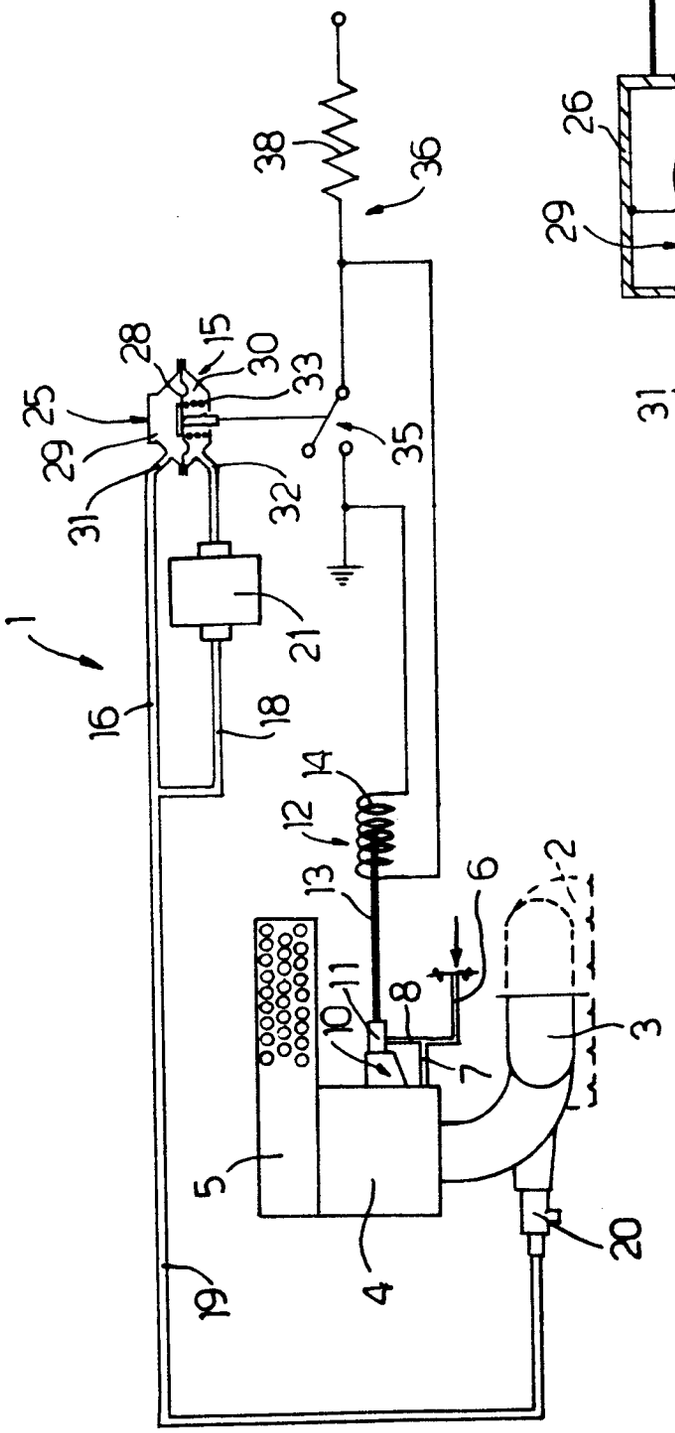

Fig.1

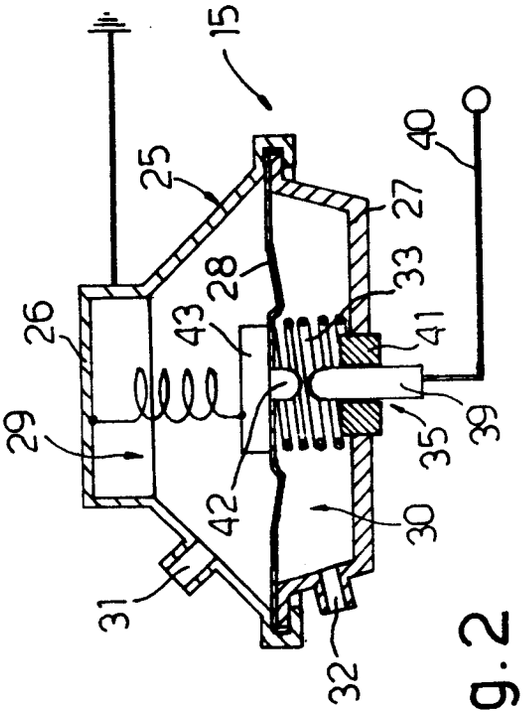

Fig.2