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FUEL-AIR MIXTURE CONTROL FOR INTERNAL COMBUSTION ENGINES

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Fig. 1

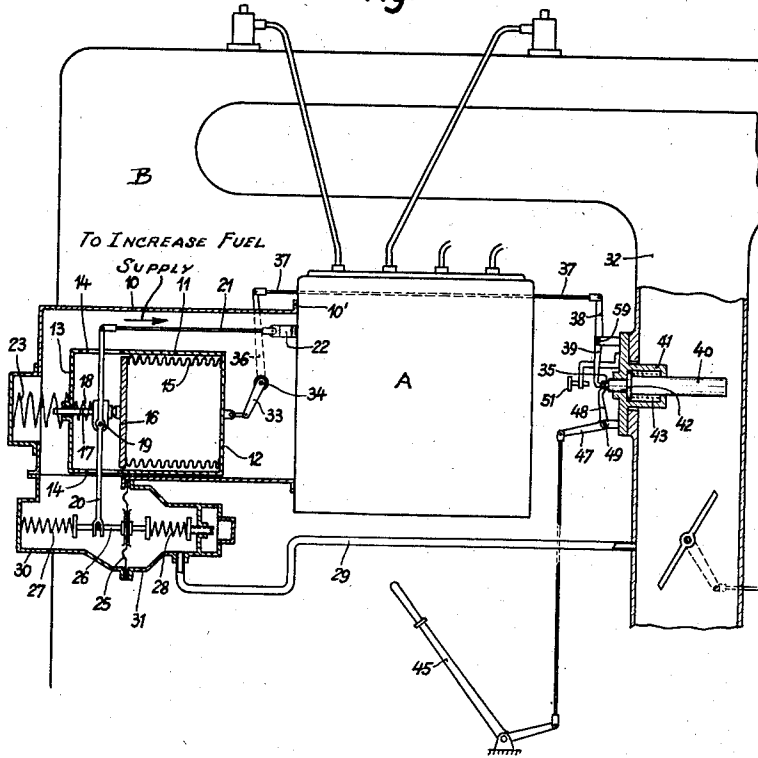
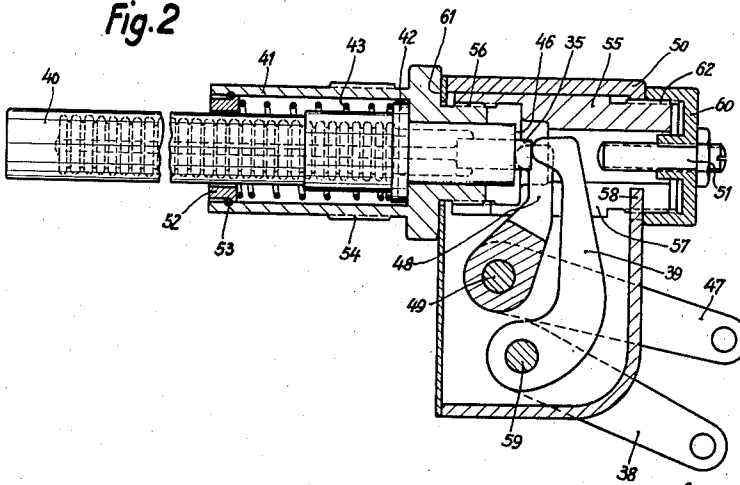


Fig. 2



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FUEL-AIR MIXTURE CONTROL FOR
INTERNAL COMBUSTION ENGINES

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9 Claims. (Cl. 123—136)

The present invention relates to devices for adjusting the ratio between air and fuel supplied to internal combustion engines of the type wherein a thermostat is provided influencing the mixture formation according to requirements.

The function of the thermostat usually is to adapt the fuel supply to the air charge, which varies with the temperature. In certain circumstances, it is very desirable with devices of this type however, to be able to adjust the control member acting on the fuel supply, independently of the temperature prevailing in the supply pipe of the engine. For instance, during the take-off of an aircraft or during flight when under full or substantially maximum load, the internal combustion engine should preferably be driven with a richer mixture than the mixture control, set with regard to normal conditions, would deliver consequent on existing operating conditions (air pressure and air temperature). Similar demands are also made of motor vehicles, especially those provided with charging blowers.

The problem characterised above is solved by the fact that according to the invention, the thermostat is arranged so as to be movable.

The invention is more particularly described with reference to the accompanying drawing, which illustrates one form of construction by way of example and in which:

Figure 1 is a diagrammatic representation, and Figure 2 illustrates a practical form of construction of thermostat shown diagrammatically in Figure 1.

In a casing 10, which is adapted to be secured by a flange 10' with the casing of an injection pump A of an internal combustion engine B a housing 11 having end walls 12 and 13 is mounted so as to be longitudinally displaceable therein. In the interior of the housing 11 there is provided a bellows like metal diaphragm 15, which is securely attached at one end to the wall 12, and which, with an end plate 16 fitted to its free end, is adapted to adjust the position of a displaceable spindle 17 which is guided in the end wall 13, and is loaded by a spring 18. To this spindle is fitted a bracket having a pivot 19 for a two-armed lever 20 which extends through a slot 14 in the housing 11.

One arm of the lever 20 is connected in known manner by means of a link rod 21 with the usual control member 22 of injection pump A while the other arm of the lever has a pin and slot connection with a spindle 26 carrying a diaphragm 25. Movement of the rod 21 and control member 22 to the right in the direction of the arrow in

Fig. 1 increases the fuel supply delivered by pump A. The diaphragm 25 and the spindle 26 are accommodated, together with a spring 27 serving to guide the shaft, in a casing part 30, which part is attached to the casing 10 and is provided with a cover 31. In the hollow space of this cover which is connected by a pressure supply pipe 29 with an air feed pipe 32 of the internal combustion engine B, there is disposed a return spring 28, which abuts against an adjustable support in the cover 31.

A lever 33 is flexibly connected to the end wall 12 of the housing 11, and is pivoted to a spindle 34, which penetrates the casing 10 and is connected outside the casing with a lever 36. The lever 36 is connected by a link rod 37 with one arm 38 of a lever, the other arm 39 of which, under the action of a spring 23 operating on the end wall 13 of the housing 11, is positively connected with the adjusting member 35 of a thermostat 40. This thermostat has a collar 42 engaged by one end of a helical spring 43 which is surrounded by a bush 41, through which the thermostat is carried so as to be longitudinally displaceable, and which is inserted through an opening in the wall of the air feed pipe 32. A bell-crank lever 47, 48, pivoted about a pivot pin 49, engages on the outwardly projecting end surface 46, of the thermostat and is flexibly connected to a manually operated setting member 45.

The method of operation of the device is as follows: When the speed of an internal combustion engine accelerates, the pressure in the air feed pipe 32 drops and this applies also to the hollow space of the cover 31, which space is in communication with the pipe 32. Consequently, the diaphragm 25 is displaced within the hollow space in the cover by the outer air pressure until, the force of the spring 28 maintains equilibrium between the pressure difference operating on the diaphragm 25 and the force of the weaker spring 27. This movement of the diaphragm 25 causes rocking movement of the lever 20 about the pivot 19, and a displacement of the control rod 22 into that position consistent with a decrease in the supply of fuel to the engine. The same thing occurs when the airstream is throttled by a throttle valve located in advance of the point of connection of the pressure supply pipe 29 with the air feed pipe 32. The function of the diaphragm 25 is thus to adapt the supply of fuel to the number of revolutions of the engine, which varies with the position of the throttle valve, and to avoid exceeding the maximum number of revolutions

admissible under and with each of a number of different circumstances.

When the atmospheric air pressure drops, and thus the weight of air sucked in by the engine per stroke decreases, the bellows diaphragm 15 expands within the housing 11 and displaces the pivotal axis 19 of the lever 20 in such a way that the supply of fuel is likewise diminished by displacement of the control rod 22.

The same control movement takes place when the weight of air fed per stroke of the internal combustion engine diminishes by reason of the fact that the air temperature rises. Under such circumstances the housing 11 is displaced by the expansion member 35 of the thermostat 40 against the force of the spring 23 operating on the end wall 13, and by this means the pivotal point 19 of the lever 20 is likewise so displaced that it moves the control rod into a position in which the supply of fuel is throttled. If the aforesaid action of the members 15, 25, 35 or of one of them is to be temporarily suspended and more fuel is to be supplied in view of particular demands to be made of the engine, which differs from those of normal operation, then the thermostat 40 is moved by the setting lever 45 against the force of the spring 43. This movement is followed, under the action of the spring 23, by the housing 11 and the parts connected therewith, the control rod 22 being so moved that the supply of fuel is increased. The spring 43 must be stiffer than the spring 23, so that, after the setting lever 45 has been returned into its original position consistent with normal operations, the control rod 22 can again take up its normal position determined by the position, at the time of return, of the expansion member 35 and of the remaining adjusting members 15 and 25. By reason of this relatively greater stiffness the control rod can follow any alterations in the positions of the adjusting members while the lever 45 remains in its normal or inoperative position.

In the operation of vehicles for aircraft, especially in the case of internal combustion engines with a charging blower it is often desirable, after a predetermined temperature has been reached by the air flowing to the cylinders, to prevent further decrease in the supply of fuel. This requirement can be met by the provision of an adjustable stop 51 in the path of movement of the lever arm 39. This stop terminates the adjusting movements of the thermostat after a predetermined limit of temperature, which can be set to suit varying conditions, has been reached so that in the event of an expansion of the temperature sensitive member 35 of the thermostat occurring as a result of further rise in temperature, the thermostat 40 is pushed further into the air feed pipe against the action of the spring 43, without in any way affecting the mixture control.

In the example of construction shown in Fig. 2, the thermostat 40, together with the spring 43 located between the collar 42 and a guide ring 52, are inserted into the sleeve 41 the unit being held therein by means of a snap ring 53. The sleeve has a thread 54 by which it is screwed into a bore in the air feed pipe 32 of Fig. 1. In that part of the sleeve 41 which projects outwardly from the pipe 32 and which has a thread 56, there is guided so as to be longitudinally displaceable a temperature sensitive part of the thermostat 40 terminating in the end surface 46. On to the thread 56 there is screwed a tubular hollow element 55 having a longitudinal slot 57. Through this slot project the lever arms 48 and 39 already

described with reference to Fig. 1, and an extension 58 of a hollow cap 60, on which the pivots 49 and 59 of the lever arms are mounted. By virtue of the extension 58, the cap 60 is guided on the hollow element 55 so that it is longitudinally displaceable, but is incapable of rotation; the cap, however, can be rocked slightly relatively to the bush 41, into any desired position, i. e., a position suitable for the connection of the rods, for instance, of the link rod 37, without jamming of the levers 39 and 48 on the side surfaces of the slot 57. The cap is firmly pressed on to an end surface 61 of the bush 41 by means of a cap nut 60, which is screwed on to a thread 32 on the outer end of the hollow member 55. The adjustable stop 51 described in Fig. 1, is fixed in the cap nut 60. The lever arm 48 is bifurcated at that end which bears on the end surface 46, so that it embraces the adjusting member 35, which projects from this end, and the part adjacent thereto of the lever arm 39.

With the parts serving for the occasional displacement of the thermostat 40, e. g., the bell crank lever 48, 47, further regulating devices serving for the control of the internal combustion engine may be connected, e. g., a throttle valve operating on the air feed may be provided in the pipe 32, or a control member influencing the air delivery of a charging blower.

We declare that what we claim is:

1. A fuel controlling device for internal combustion engines, comprising at least one element for controlling the fuel supply to said engine, a thermostat in the air feed to said engine the temperature sensitive element of which thermostat is adapted to displace said control element on variation in temperature of said air feed, manually operable means for adjusting the position of said thermostat bodily to vary the basic temperature at which said temperature sensitive element displaces said control means, and means associated with said manually operable means for varying the volume of air fed to said engine.

2. A fuel controlling device for internal combustion engines comprising a holder, at least one element carried by said holder for controlling the fuel supply to said engine, a thermostat associated with said holder for bodily displacement therewith, and having a temperature sensitive element adapted to displace said control element, resilient loading means between said thermostat and said holder, and means for displacing said thermostat relatively to said holder against said resilient load to vary the relationship between said temperature sensitive element and said control element to vary the extent of displacement of said control element by said temperature sensitive element while still leaving said latter element under the control of said temperature sensitive element.

3. A fuel controlling device for internal combustion engines having an air feed pipe comprising at least one element for controlling the fuel supply to said engine, a thermostat extending across the path of air feed to said engine, the temperature sensitive element of which thermostat is operatively connected with said control element to displace said control element on variation in temperature of said air feed, a bushing within which said thermostat is resiliently mounted for relative longitudinal displacement therein, a hollow cap associated with said bushing and within which said temperature sensitive element extends, a pivot for said control element on said hollow cap, and a lever on said hollow

cap for displacing said thermostat bodily within said bushing to vary the extent of displacement of said control element by said temperature sensitive element without destroying said operative connection between said temperature sensitive element and said control element.

4. A fuel controlling device as claimed in claim 3 and wherein said control element comprises a lever pivotally mounted to said hollow cap and wherein said lever is bifurcated at one end to embrace the other control lever and the temperature sensitive element whereby said control lever is positively engaged with said temperature sensitive element and said bifurcated lever is engageable with the end of the body of said thermostat.

5. A fuel controlling device as claimed in claim 3 and wherein said hollow cap is rockable slightly relatively to said bushing for assisting in the assembly of the elements associated therewith.

6. A fuel controlling device as claimed in claim 3 and including a hollow tubular element within said hollow cap rotatably fitted on said bushing, said hollow tubular element receiving said hollow cap so as to permit of relative longitudinal displacement therewith, and means whereby after said cap has been slightly rocked into position suitable for installation, said cap is secured in adjusted position on the bushing of said thermostat.

7. A fuel controlling device as claimed in claim 3 and wherein stop means are provided for limiting the adjustment movements of the temperature sensitive element of said thermostat after a predetermined temperature has been reached whereby in the event of further dis-

placement of said temperature sensitive element relatively to the body of said thermostat the latter is bodily displaceable against its resilient load.

8. A fuel controlling device as claimed in claim 3 and wherein adjustable stop means are provided for limiting the adjustment movements of the temperature sensitive element of said thermostat after a predetermined temperature has been reached and the resilient mounting of the thermostat includes a spring carried by said bushing whereby in the event of further displacement of said temperature sensitive element relatively to the body of said thermostat the latter is bodily displaceable against its resilient load.

9. A fuel controlling device for internal combustion engines, having an air feed pipe, operable in varying altitudes and by which the fuel supply is controlled both by means influenced by the speed of the engine or by a value dependent thereon such as the pressure in the air feed pipe or a pressure difference produced in said pipe, and by an adjusting member influenced by atmospheric air pressure, comprising a control rod for the fuel supply of said engine, adjusting means corresponding to variations in air pressure operatively connected to said control rod, a thermostat, the temperature sensitive element of which is positively connected with said control rod to displace the latter on variation in air temperature and means for bodily adjusting the position of said thermostat relative to said control member to vary the extent of displacement of said control rod by said temperature sensitive element.

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