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CONTROLLING DEVICE FOR INTERNAL COMBUSTION ENGINES

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Fig. 2

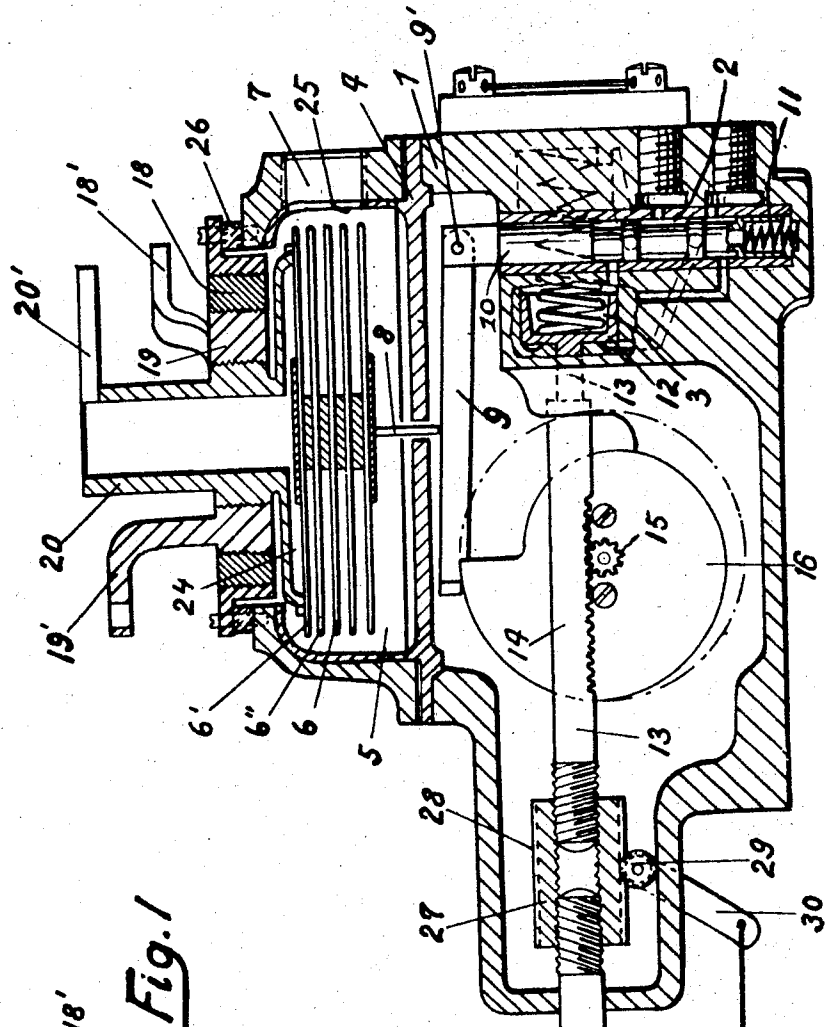
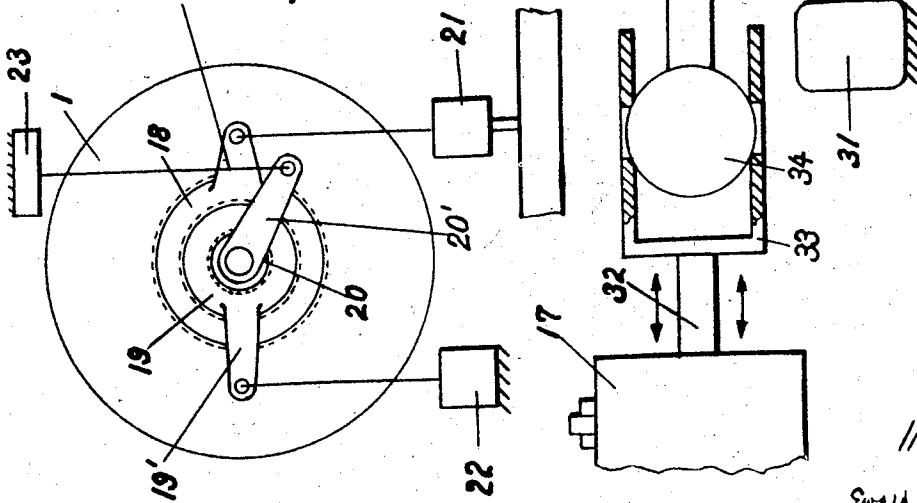


Fig. 1



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CONTROLLING DEVICE FOR INTERNAL COMBUSTION ENGINES

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9 Claims. (Cl. 123—140)

This invention relates to improvements in controlling devices, more particularly for fuel pumps of internal combustion engines.

Especially in aircraft engines the fuel supply depends on several factors of motor operation, on the air density within the induction pipe and on the exhaust counterpressure which naturally varies in dependence on the altitude at which the aircraft is flying.

The object of the invention is to provide a simple and reliable controlling device by means of which the fuel quantity delivered by the pump is controlled automatically in dependence on the different factors as functions of engine operation.

A further object of the invention is to facilitate the adjustment of the controlling device and to promote reliable operation.

The invention and its aims and objects will be readily understood from the following description of an embodiment in which reference is made to the drawing in which

Fig. 1 is a diagrammatic plan view of the controlling device;

Fig. 2 is a sectional view of the device.

In the embodiment shown, the controlling device comprises a casing 1 in which is arranged a fluid pressure relay 2, e. g. a sliding valve, as well as the servo-motor 3. A chamber 5 for a capsule or bellows system 6 communicates with the induction pipe of the combustion engine (not shown) through an opening 7. The capsule system 6 comprises a number of single capsules or diaphragms 6, 6', 6''. Each contains a certain volume of gas of a predetermined density. If the density of air in the chamber 5, i. e. in the induction pipe of the motor decreases, then the capsules 6, 6', 6'', expand, thereby displacing the slide valve 2, by means of a pin 8, extending through a wall 4 and a lever 9 linked at 9' to the valve 2. By a downward movement of the pin 8 the lever 9 is moved clockwise, resulting in a downward displacement of the valve 2, thereby allowing in a well known manner the passage of a pressure fluid, e. g. oil, to the left side of the servo-motor so that its piston 12 will be moved to the right. To the piston rod 13 is connected an adjusting member 32 in a manner herein-after more fully explained, this adjusting member being adapted in a well known manner to vary the effective stroke of the fuel pump 17, thereby varying the quantity of fuel fed to the motor.

When adjusting the effective stroke of the fuel pump by means of the member 32, a restoring

action is exerted at the same time on the valve 2. The piston rod 13 is provided with a toothed rack 14 engaging a pinion 15 fastened to a cam-disc 16, rotatably mounted in the casing 1. One end of the lever 9 rests on said disc as shown in Fig. 2 so that upon each rotation of the disc corresponding to the movement of the piston rod, this end of the lever 9 will be displaced upwardly or downwardly. In the case above mentioned in which the piston rod moves to the right, the disc will be rotated clockwise so that corresponding to the curve of the disc, the lever 9 will be swung counter-clockwise around a pivot-point represented by the pin 8. In this case the valve 2 is pushed upwardly into its middle or neutral position by means of a spring 11. Obviously, the valve will be restored by a downward movement in case of a left-hand movement of the servo-motor piston 12.

From the foregoing explanation it follows that the stroke of the piston depends not only on the capsule stroke, but also on the restoring influence, i. e. on the form given to the cam-disc 16. Therefore, by the choice of the curve it is possible to achieve a stroke of the piston 12 and the adjusting member 32 which corresponds to the fuel quantity needed by the motor for any existing air density.

The dependency of the quantity of fuel on the air density is different for each type of motor, each motor type having a certain characteristic with reference to the most favourable fuel consumption.

The entire controlling device may be easily adapted to the special motor characteristic by changing the form of the cam 16. For this reason it may be advisable to arrange the cam 16 in a manner so that it may be exchanged. Furthermore, it is possible to arrange several cams side by side so that any cam may be set into operation by an axial displacement of the entire cam body.

In view of the fact that the form of the cam is essential for an exact control of the fuel supply in accordance with the motor characteristic, it is desirable to have a long cam surface which—as experience has taught—may be manufactured with greater exactness than a short one. For this reason according to the invention the customary restoring cam directly fastened to the piston rod is replaced by a rotary cam disc having a long cam path which in spite of its length may be arranged within the smallest space.

With reference to the restoring operation as explained above the advantage is to be noted that

the distance between the point of engagement of the cam 16 and the lever 9 and its pivot axis 9' is materially greater than the distance between the point of engagement of the capsule system 6 and lever 9 from its pivot axis 3'. Therefore, the point of engagement of the cam 16 and lever 9 has a greater stroke than the point of engagement of the capsule system 6 and lever 9, thereby increasing the exactness of the controlling operation.

If it is desired to control the fuel supply not only in accordance with the air density in the induction pipe, but also in accordance with the exhaust counter pressure, the temperature of the exhaust gases, the percentage of carbon-oxide of said gases and any other factors or functions of engine operation, according to the invention, these additional controlling movements may be transmitted to the capsule system 6 in such a manner that this system is displaced as a whole independently of the existing air density. For this purpose the capsule system 6 is not fixedly attached to said casing 1, but is supported by means of adjusting members adapted to be adjusted by the corresponding additional controlling factor and to displace the capsule system as a whole, thereby transmitting the additional controlling movement to the lever 9 and to the adjusting member 32 of the fuel pump in the manner above explained.

As adjusting members for the additional controlling movements, there are provided in the embodiment shown two screw rings 18 and 19, the outer ring 18 being screw threaded into the casing 1, while the inner ring 19 is screw threaded into the outer ring. Into the inner ring 19 by means of a thread of a different or opposite pitch than the first screw thread is screw threaded a supporting member supporting the capsule system 6 by means of a thread of a different or opposite pitch to the second screw thread. Each of the screw rings may be independently rotated by means of arms 18' and 19', respectively. Furthermore, the supporting member 20 may likewise be rotated by means of an arm 20'. Any rotation of the ring 18 or 19 or of the supporting member 20 results in a vertical displacement of the entire capsule system 6.

As indicated schematically in Fig. 1, the arms 18', 19' and 20' are connected in any convenient manner with the corresponding control devices 21, 22, 23, respectively which are responsive to various functions of engine operation. The control device 21, e. g. may be responsive to the temperature of the exhaust gases (in the exhaust conduit of the motor).

The inner end of the supporting member 20 forms with the upper capsule 6' a chamber 24 which communicates with the atmosphere so that atmospheric pressure exists in this chamber and any change in said pressure influences the capsule system 6. By reason of this additional chamber in front of the capsule system 6 being in communication with the atmosphere there is obtained a correction for the variation in exhaust back pressure with any change in altitude.

It is to be noted that the controlling device according to the invention permits controlling the fuel supply in accordance with a plurality of individual factors or functions of engine operation without the necessity of providing for each factor a special controlling device.

As explained above the chamber 5 communicates with the induction pipe of the motor through an opening 7. The capsule system 6 in

said chamber is provided to control the servomotor 8 in accordance with the air density in the induction pipe. As is well known, the air density is a function of the temperature; therefore, it is important that the air in the chamber 5 surrounding the capsule system 6 is caused to have the same temperature as the air in the induction pipe by permitting a small amount of air to enter the chamber 5 by any suitable means. For this purpose, means are further provided to protect the air in the chamber 5 against any heating from outside as e. g. from the heat radiated by the motor cylinders.

In the embodiment shown the casing wall of the chamber 5 is provided with a heat-insulating layer or lining 25, e. g. a rubber layer having, if desired a good reflecting coating of, for example, aluminum bronze. Besides this another heat-insulating layer 26 is provided to prevent a transmission of heat from the wall of the casing 1 to the adjusting members 18, 19, 20 of the capsule system 6. Likewise the wall 4 may be of heat insulating material such as, moulding material having a fabric insertion so as to act at the same time as a shock absorber or vibration dampen.

In many cases it may be desired to vary the length of the connecting rod between the piston 12 of the servo-motor and the adjusting member 32 of the fuel pump 17. Therefore, according to the invention, a turn buckle 27 is inserted in said controlling rod, said turn buckle having in a well-known manner a left-hand screw and a right-hand screw so that upon rotation of the buckle in one direction the connecting rod is shortened and upon rotation in opposite direction the connecting rod will be lengthened. The buckle 27 may be rotated automatically during the controlling operation of the controlling device to vary the effective length of the connecting rod by any controlling device responsive to some additional function of engine operation which is to be taken into consideration.

In case of such an automatic control of the effective length of said controlling rod the turn buckle 27 is provided with teeth 28 in the manner of a gear, said teeth extending axially over the entire length of the buckle. (See Fig. 2.) 29 is a worm or spur gear rotatably mounted in the casing 1 and meshing with the teeth 28, so that, upon rotation of the worm, the buckle 27 will also be rotated. To the axis of the worm 29 is fastened an arm 30 which may be connected in any suitable manner with an additional controlling device, schematically shown at 31. If the piston rod 13 is displaced by the piston 12 in the manner described, the teeth 28 of the buckle 27 slide in the worm 29 without any rotation of the buckle 27. On the other hand in spite of a longitudinal displacement, the buckle 27 may at any time be rotated by rotation of the worm 29. The device 31 may be adjusted in accordance with the (B. t. u.) heat content of the fuel per quantity unit, in accordance with the speed of the engine or of any other factor.

If for any reason the controlling device fails to operate, it is desirable that the pilot may be able to manually actuate the adjusting member 32 of the fuel pump 17. As long as the member 32 is rigidly connected with the piston 12 of the servo-motor, the manual operation demands great exertion of strength. For this reason it is advisable to provide means by which the connection between the adjusting member 32 and the piston 12 may at any time be broken.

In the embodiment shown this means comprises

a yieldable fork 33 frictionally engaging a ball 34 fixed to one end of the rod connected to the piston rod 13 by means of the above mentioned turn buckle 27. In case of need the shanks or limbs of the fork 33 may be easily released out of their engaging relation with the ball 34.

The present invention is not restricted to the particular embodiment shown and described. Instead of a hydraulic relay a pneumatic or electric relay may be used without departing from the spirit of the invention as defined in the appended claims.

What I claim is:

1. A controlling device for the fuel supply means of internal combustion engines, comprising a casing divided into two parts by a wall forming an insulated chamber in one part, a bellows system provided in the insulated part of the casing and forming a pressure responsive device, a pilot valve in the other part of the casing, a piston in the other part of the casing controlled by said pilot valve, a rod connected to the piston and extending through the casing to the fuel supply means, means extending from the insulated part of the casing for transferring the movement of the bellows system to the pilot valve, and a cam in the other part of the casing operatively connected to the transfer means to return the pilot valve by the transfer means to its initial position after a displacement of the piston due to a movement of the bellows system.

2. A controlling device according to claim 1, in which an independently adjustable device is provided in the rod, and means are provided to operate the adjustable device in dependence upon a function of the engine operation such as the temperature of the exhaust gases, the back pressure of the exhaust gases and the composition of the exhaust gases.

3. A controlling device according to claim 1, in which means are provided in the form of a supporting member in the insulated chamber for suspending the bellows system in said insulating chamber, and in which means are provided in

the casing to adjust the position of the supporting member relative to the transfer means.

4. A controlling device for the fuel supply means of internal combustion engines, comprising an element for adjusting the fuel amount delivered to said engine, a servo-motor operatively connected to said element, a valve connected to control said servo-motor, and a pressure responsive system connected to act upon said valve, said system including a bellows responsive to air intake pressure and temperature, and means forming a chamber connected to the atmosphere, said bellows being arranged so that the end thereof opposite to the valve connection constitutes a flexible end wall of said chamber.

5. A device according to claim 4, in which said chamber is provided with a rigid wall serving as a mounting for the bellows.

6. A device as claimed in claim 4, in which means are provided for displacing said bellows and said chamber as a whole in response to any additional function of engine operation such as the temperature of the exhaust gases, the back pressure of the exhaust gases and the composition of the exhaust gases.

7. A device as claimed in claim 4, including a tube which is connected to the outer wall of said additional chamber and an external housing enclosing said bellows and said chamber, said tube being axially adjustable in said housing.

8. A device as claimed in claim 4, including a screw-threaded tube connected to the outer wall of said chamber and an external housing enclosing said bellows and said chamber, said tube being screw threaded into said housing for adjustment thereof.

9. A device as claimed in claim 4, including a carrier for the pressure responsive system, an external housing for enclosing said system and separately adjustable control members responsive to further functions of engine operation and disposed between the carrier and said external housing, said control members arranged to support the carrier.

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