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[54] **THERMOSTATICALLY CONTROLLED AIRFLOW REGULATOR**
8 Claims, 2 Drawing Figs.

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123/140 MC, 123/179 A, 123/119 D
[51] **Int. Cl.** **F16k 31/00,**
F03g 7/06
[50] **Field of Search** 123/140
MC, 179 A, 119 D; 251/11

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ABSTRACT: A housing has a passage provided with a surface portion defining a valve seat. An inlet and an outlet terminate in this surface portion and each have an exposed cross section. A cup-shaped member of insulating material is located in the aforementioned passage longitudinally spaced from the valve seat. An electric heating device is arranged in the cup-shaped member and a bimetallic coil is located in the passage partly received in the cup-shaped member and having a freely movable end portion capable of movement circumferentially of the passage in response to temperature fluctuations. A rotary valve member engages the valve seat and is connected with the end portion so as to be rotated by the latter with corresponding variations in the exposed cross sections of the inlet and outlet.

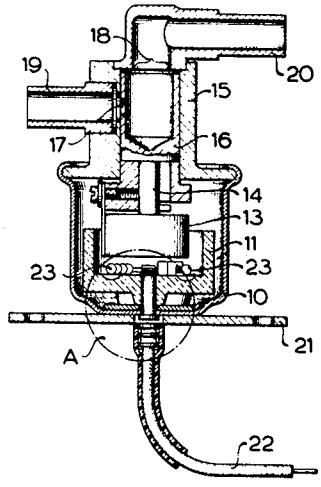


FIG.1

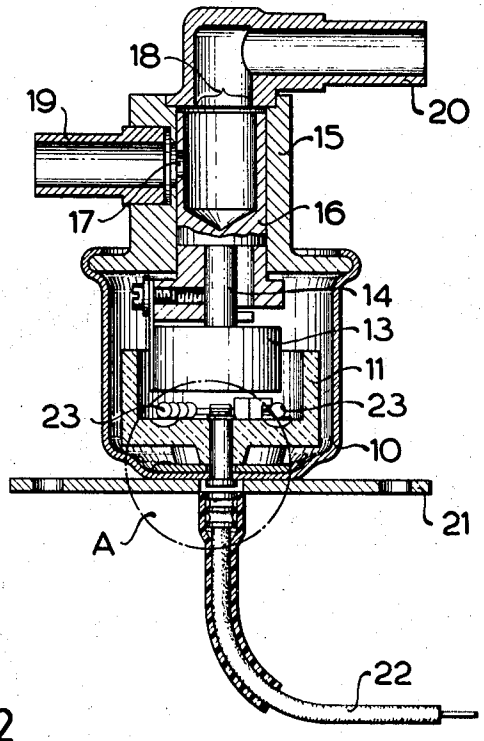
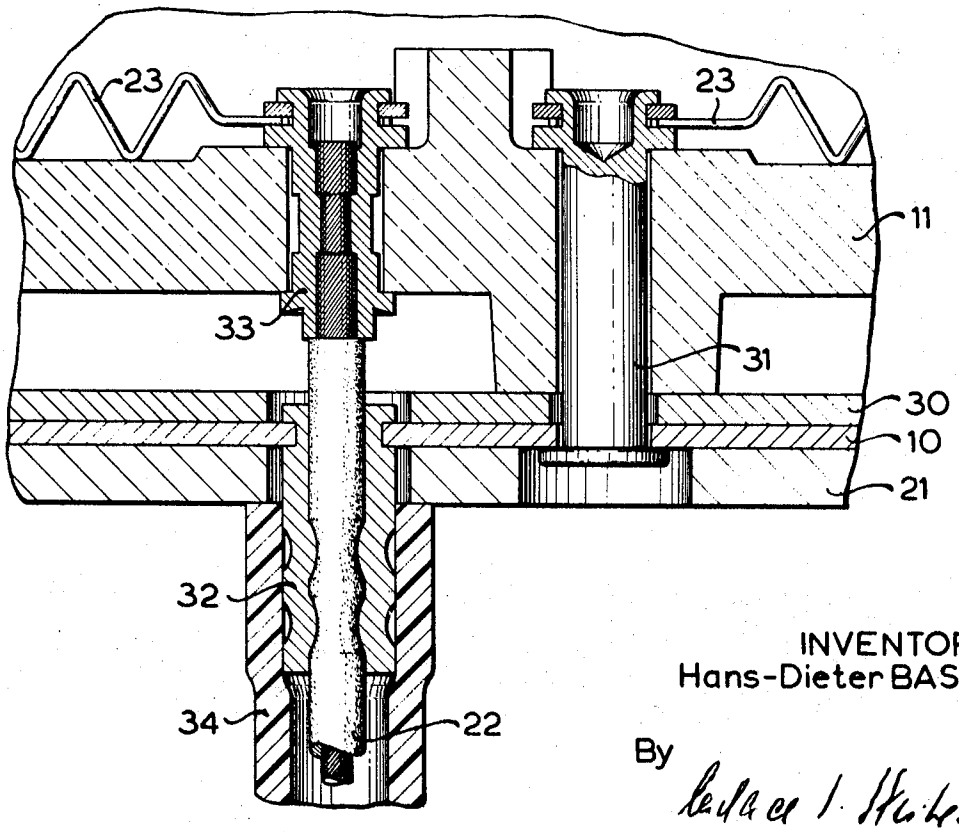


FIG.2



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THERMOSTATICALLY CONTROLLED AIRFLOW REGULATOR

BACKGROUND OF THE INVENTION

The present invention relates generally to a thermostatically controlled airflow regulator, and more particularly to such an air flow regulator for use with combustion engines utilizing fuel injection.

Combustion engines, especially those utilizing fuel injection, are advantageously provided with airflow regulators which have the purpose of facilitating the start-up of the combustion engine when the latter is cold. Among airflow regulators for carburetors some are known utilizing bimetallic coils which can be heated and which control a valve cross section to permit the input of a richer mixture when the engine with which they are associated is cold, with the richness of the mixture—including the airflow—being controlled by the device in dependence upon the heating action afforded by the device. The known prior art devices are, however, exclusively usable with combustion engines utilizing conventional carburetors, which is to say that they cannot be employed with combustion engines utilizing fuel injection*.

*combustion engines with fuel injection usually have separate means to enrich the mixture during the start-up period by injecting more fuel. To control a special start-up injecting process means a greater effort. Thus, although it is highly desirable that a device of the above mentioned type be available for combustion engines utilizing fuel injection to control the air-fuel-rate during the start-up period, no such device has heretofore become known, it being emphasized that the known prior art devices cannot simply be employed in combustion engines utilizing fuel injection. start-up period by injecting more fuel. To control a special start-up injecting process means a greater effort.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to provide a device of the type under discussion which is particularly suitable for use with combustion engines having fuel injection.

More particularly it is an object of the invention to provide a device of the type under discussion which is not only suitable particularly for use with combustion engines having fuel injection, but which is also simple and sturdy in its construction.

A concomitant object of the invention is to provide such a device which is so constructed that it can be readily produced in large series.

In pursuance of the above objects, and others which will become apparent hereafter, one feature of the invention resides, briefly stated, in a thermostatically controlled airflow regulator, particularly for use with combustion engines having fuel injection, which comprises in combination a housing having a passage provided with a surface portion defining a valve seat. Inlet means and outlet means are provided in this surface portion and each have an exposed cross section. A cup-shaped member of insulating material is also provided in the passage spaced longitudinally of the same from the valve seat and an electrical heating device is located in the cup-shaped member. A bimetallic coil is arranged in the passage partly received in the member and having a free movable end portion capable of movement circumferentially of the passage in response to temperature fluctuations in the ambient temperature. A rotary valve member engages the valve seat and is connected with the end portion of the bimetallic coil so as to be rotated by the latter as the bimetallic coil undergoes temperature fluctuation, with corresponding variations in the exposed cross sections of at least one of the inlet means and outlet means as these cross sections are progressively more covered or progressively more exposed by the rotating member.

According to an embodiment which I currently prefer, the rotary valve member itself may be at least partially in form of a hollow body provided with an air inlet or conduit which has a terminal opening axially of the rotary valve member.

As mentioned before, the device is to be especially suitable for production in large series. For this purpose it is especially advantageous if the cup-shaped member of insulating material is riveted to the bottom wall closing the passage in the housing, and if these rivets are at least in part used for establishing the electrical contacts with the electric heating device located in the cup-shaped member.

During the operation of the combustion engine with which the device according to the present invention is associated, the electric heating device is continuously energized. In order to save heating effort and of course electrical consumption, and also to obtain an advantageous temperature relationship, it is advisable that the heating effect of the heating device decreases as the temperature increases. This can be accomplished in a very simple manner by making the body of the electric heating device of a resistive material whose resistance has a positive temperature coefficient.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a sectional elevation through a device according to one embodiment of the invention, and

FIG. 2 is a fragmentary detail view of the area surrounded in FIG. 1 by the circle identified as A.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing now the drawing in detail it will be seen that reference numeral **10** identifies a housing of a device according to the present invention. Located in this housing, or more particularly in the internal elongated passage surrounded by the housing and clearly visible in FIG. 1, is a cup-shaped member **11** of insulating material such as ceramics. Secured to the inner side of the bottom wall of the member **11** is a body or electric heating device **23**. Also located in the passage is a bimetallic coil **13** whose particular construction is not believed to require detailed discussion because such bimetallic coils are of course well known to those skilled in the art. It is pointed out, however, that the bimetallic coil **13** projects in part into the open side of the cup-shaped member **11** and that a free end portion of the bimetallic coil **13** is connected in suitable manner with a pin or stem **14**. It is immaterial how this connection is accomplished as long as it is understood that expansions or contractions of the bimetallic coil **13** in response to changes in the ambient temperature —occasioned by the operation of the device **23** —causes a rotary movement of the stem **14***.

*A similar bimetallic coil used in a carburetor to control an auxiliary airflow is shown in the DT-AS1 291 938 The stem **14**, in turn, is rigidly connected with a turnable valve member **16** which is sealingly positioned in a valve seat **15** provided as a part of the passage in the housing **10**. In the illustrated embodiment the valve member **16** is configurated as a hollow cylinder

Reference numeral **17** identifies an inlet opening which terminates in the surface portion bounding the valve seat **15**, and reference numeral **18** identifies an outlet opening which also terminates in a surface bounding the valve seat **15**. It should be pointed out in this connection that the definition I wish to use for the surface of surface portion surrounding or bounding the valve seat **15** is to include all surfaces within whose confines the valve member **16** is turnable, so that the surface portion in which the outlet **18** is provided is included in this definition. Air is supplied in an incoming sense through the nipple **19** which is in suitable manner secured with an air supply conduit or the like, and air is passed on out of the device from the outlet **18** via the nipple **20** to a suitable conduit or the like. The valve member **16** together with the inlet **17** and the outlet **18** provides for variable flow cross sections, meaning that as the valve member **16** turns about its longitudinal axis and that of the passage in the housing **10**, under the urging of the pin **14**, the cross sections of the inlet **17** and the outlet **18** vary.

Reference numeral 21 is a flange by means of which the device may be secured to a combustion engine or to another suitable support, for instance the chassis of a motor vehicle with whose combustion engine the device is to cooperate. Reference numeral 22 identifies a supply cable via which electrical energy is supplied to the device 23 to energize the same in order to produce heat.

The fragmentary enlarged detail view in FIG. 2, showing the area which is surrounded in FIG. 1 by the circle identified as A, shows that in the embodiment of FIGS. 1 and 2 I have utilized a simplified and currently preferred way of securing the device 23 to the housing or member 11. In particular, the housing 11 has located within it on its bottom wall a plate 30 which is clearly shown in FIG. 2 but which is also illustrated in FIG. 1. The cup-shaped member 11 of insulating material is supported on the plate 30 and is rigidly connected with the bottom wall of the housing 10 via a rivet 31 penetrating the bottom wall of the cup-shaped member 11, the plate 30 and being secured in the flange 21. The rivet 31 is of electrically conductive material and is connected with the heating device 23 in electrically conductive relationship so that one end of the device 23 is connected with mass—namely with the housing 10—via the rivet 31.

FIG. 2 also shows clearly that the energy supply cable 22 enters the interior of the housing 10 via a suitable bushing 2 and is riveted to the bottom wall of the cup-shaped member 11 by means of a contact rivet 33. The supply of electrical energy to the device 23 takes place from the cable 22 via the rivet 33 to which, as FIG. 2 clearly shows, the device 23 is also electrically conductively connected. A conduit or tube 34 of insulating material surrounds a portion of the cable 22 adjacent the flange 21 in order to protect it against mechanical damage.

The device according to the present invention operates in a manner which will already have been understood from the description and from the drawing thus far discussed. However, for the sake of completeness it is summarized that assuming the combustion engine with which the device is to be used, being in cold condition, the valve member 16 is so positioned that the inlet 17 has an unobstructed cross section. Of course, as FIG. 1 shows the valve member 16 has a corresponding opening which can register with the inlet 17 in dependence upon the angular position of the valve member 16. If the configuration of the valve member 16 were other than hollow as in the illustrated embodiment, a different solution would have to be chosen, but such solution would be well within the skill of those conversant with the art.

In any case, with the inlet completely unobstructed, an excess of air and fuel can be supplied to the combustion engine, that is the mixture will be very rich. This facilitates start-up and operation of the combustion engine after start-up but while the engine is still cold.

As soon as the engine has reached a minimum number of rotations per minute, that is when it operates smoothly, electrical energy is supplied via the cable 22 to the heating element or heating device 23. The device is thus energized, producing heat which slowly warms up the bimetallic coil 13. In response to such warming up, the coil 13 slowly expands with its free end which is connected with the pin or shaft 14, tending to move circumferentially of the coil 13 and of the passage, and thus rotating the pin 14. This evidently results in corresponding rotation of the valve member 16, with registry between the inlet opening of the same and the inlet 17 thus being subjected to displacement whereby the free cross section of the inlet 17 decreases. If the ambient temperatures are not extremely low, then the free cross section of the inlet 17 will be zero under stationary circumstances. During the entire operation of the combustion engine, that is as long as the combustion engine is started and runs, the heating element 23 will be energized so that the cross section of the inlet 17 will be unobstructed totally or in part only when the combustion engine is either cold or when extremely low ambient temperatures exist.

It will be appreciated that the present invention provides for a thermostatically controlled airflow regulator which is particularly suitable for use with combustion engines having fuel injection, and which, also in accordance with one of the stated objects of the invention, provides for excellent results while being simple in its construction and very well suited for mass production in large series.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in a thermostatically controlled airflow regulator, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should, and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters patent is set forth in the appended claims:

1. A thermostatically controlled airflow regulator, particularly for use with combustion engines having fuel injection, comprising in combination, a housing having a passage provided with a surface portion defining a valve seat; inlet means and outlet means in said surface portion and each having an exposed cross section; a cup-shaped member of insulating material in said passage spaced longitudinally of the same from said valve seat; an electric heating device in said cup-shaped member; a bimetallic coil in said passage partly received in said member and having a freely movable end portion capable of movement circumferentially of said passage in response to temperature fluctuations; and a rotary valve member engaging said valve seat and connected with said end portion for rotation thereby with corresponding variations in the exposed cross sections of said inlet means and outlet means.

2. An airflow regulator as defined in claim 1, said valve member having an axis and being at least in part of hollow configuration; and wherein one of said means communicates with the hollow interior of said valve member in axial direction of the latter.

3. An airflow regulator as defined in claim 1, said passage having a transverse endwall longitudinally spaced from said valve seat, and said cup-shaped member overlying said endwall and having an open side facing towards said valve seat; and securing means securing said member to said endwall.

4. An airflow regulator as defined in claim 3, said securing means comprising rivets at least some of which are at least in part electrically conductively connected with said electric heating device and adapted to be connected to a source of electrical energy.

5. An airflow regulator as defined in claim 1, said heating device having a variable heating capacity which decreases in response to an increase in the temperature of said heating device.

6. An airflow regulator as defined in claim 5, said heating device comprising an electric heating element.

7. An airflow regulator as defined in claim 6, said electric heating element consisting at least essentially of a material the electrical resistance of which has a positive temperature coefficient.

8. An airflow regulator as defined in claim 1, said member consisting at least in part of electrically insulating material.

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