

[54] AUTOMATIC CHOKE CONTROL

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[56] References Cited

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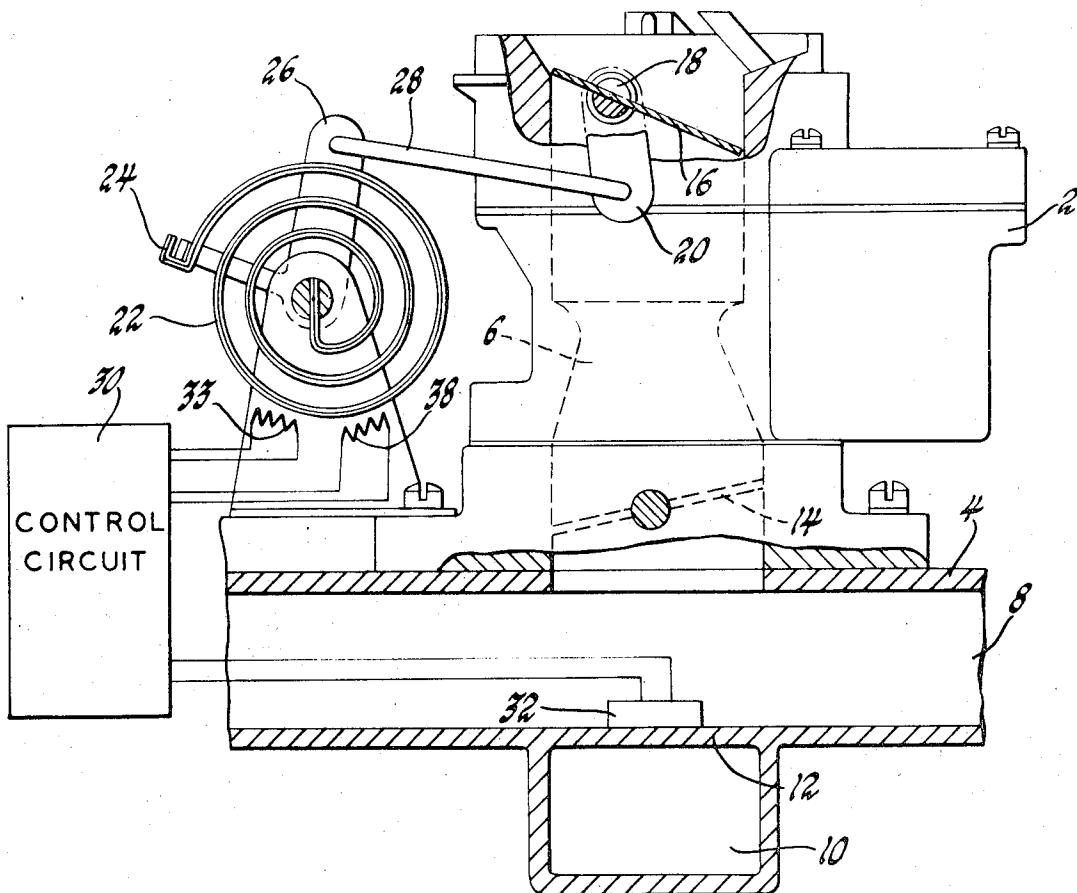
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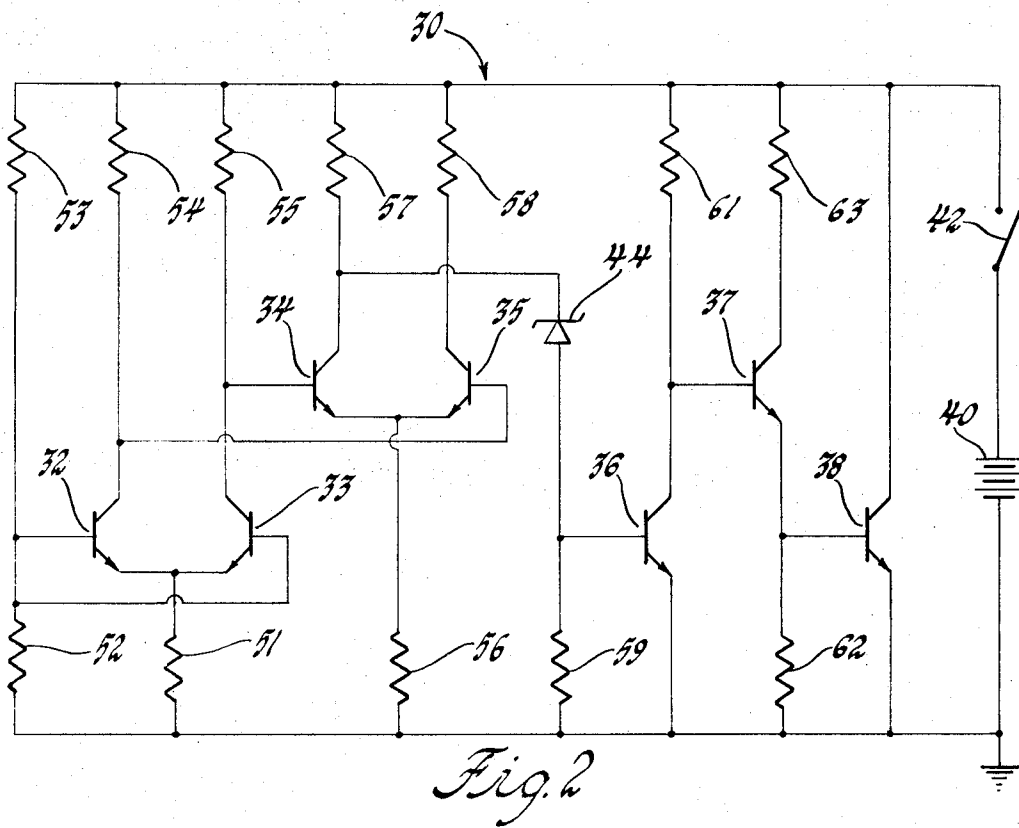
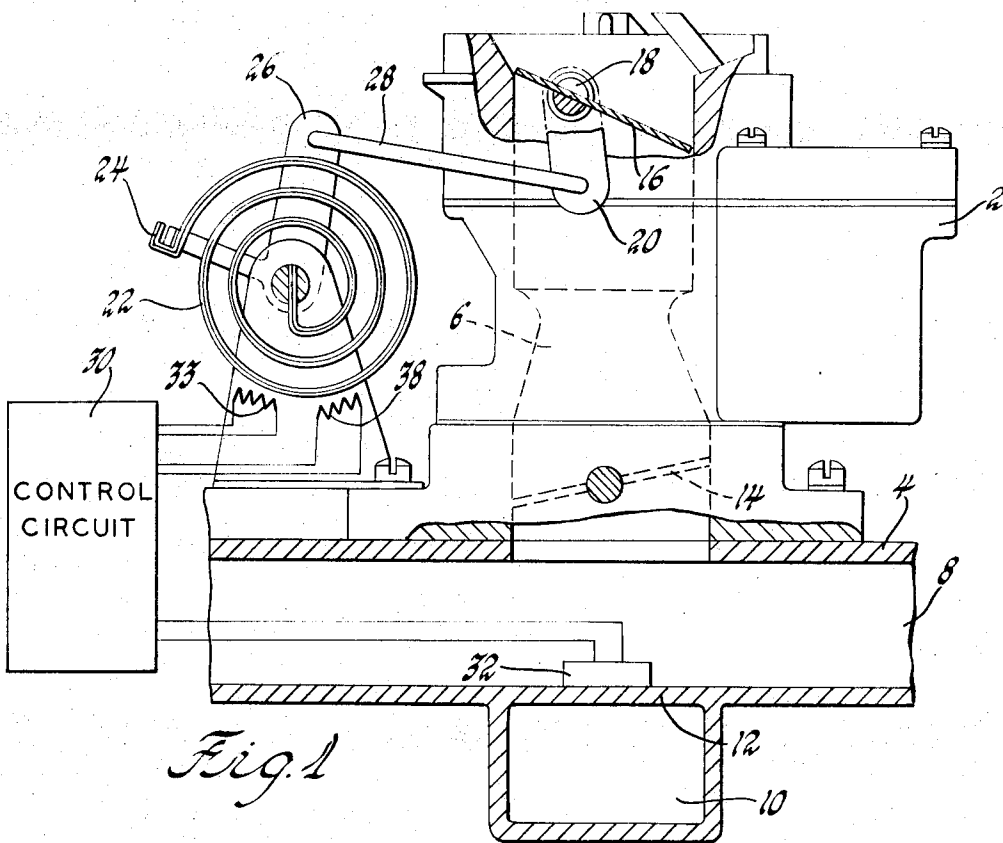
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[57] ABSTRACT

A control for an automatic choke with a bimetallic element to determine choke position. In a feedback control system, electrical signals from a temperature sensor at a control point and another at the bimetallic element are compared; and the difference is used to control electric power to a heater near the bimetallic element so that the temperature of the bimetallic element varies in accordance with the temperature at the control point.

1 Claim, 2 Drawing Figures





AUTOMATIC CHOKE CONTROL

BACKGROUND OF THE INVENTION

It is conventional in an internal combustion engine to provide a choke valve in the air induction passage to enrich the air-fuel mixture for easier starting and smoother running until the engine is warmed up. If exhaust emissions are to be held to a minimum, however, the control of an automatic choke must be quite precise. At all times as the engine is warming up the choke valve should be closed just enough to allow smooth engine operation; any further closing can result in excess undesirable exhaust emissions.

One method of controlling the position of an automatic choke is linking the choke mechanically to a coiled bimetallic spring which is mounted at some point on the engine so that the choke is allowed to open and close in accordance with the temperature at that point. On some engines an exhaust duct runs adjacent the air induction passage downstream from the throttle in order to preheat the air-fuel mixture. The common wall between the exhaust passage and induction passage has been found to be an appropriate point to measure temperature to control the choke. Such a method can introduce other problems, however, such as unwanted limitations on engine configurations and a long, cumbersome linkage.

The long linkage has been eliminated by another approach in which the coiled bimetallic element is placed close to the choke and in thermal proximity with an electrical heater which is connected to a current source through a bimetallic switch at the temperature control point on the engine. The switch closes after the point reaches a predetermined temperature and this allows current to heat up the bimetallic coil and permit the choke to open. This approach, however, also has some disadvantages. For example, there is a time delay before the bimetallic switch closes; and once it does close, continuous full heat is applied to the heater, which wastes current and can lead to early failure of components.

SUMMARY OF THE INVENTION

This invention places the bimetallic element close to the choke so that only a short mechanical linkage is required, but controls its temperature closely in accordance with the control temperature. A temperature responsive element is fixed in thermal contact with the control point, and another is placed in thermal proximity to the bimetallic element. The difference in the current output of the two elements is determined and amplified in a control circuit that varies the flow of current through an electrical heating element in accordance with that difference so that a certain predetermined temperature difference is approximately maintained.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a preferred embodiment of my invention; and

FIG. 2 shows an electric circuit for use in the embodiment shown in FIG. 1.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to FIG. 1, the carburetor 2 is bolted onto manifold 4. Air induction passages 6 and 8 provide for air flow to the engine, not shown. Exhaust passage 10 provides for exhaust gas flow from the engine and

shares a common wall 12 with the air induction passage 8. Within the air induction passage 6 are the throttle 14 and the choke 16. In the position shown the choke 16 inhibits the flow of air past it into the air induction passage 6 and, since it is placed upstream from the point at which fuel is mixed with the air, thus causes the air-fuel mixture to be enriched. The choke 16 can be rotated on its shaft 18 in a clockwise direction to restrict the air flowing through the air induction passage 6 to a lesser degree. A temperature responsive element, in this embodiment a bimetallic coil spring 22, has its center fixed to the carburetor 2 and has a stop 24 on its free end which moves in a circumferential manner about the center in response to changes in temperature. Lever 20 is fixed to the shaft 18 and lever 26, attached to lever 20 through rod 28, abuts on stop 24. The bimetallic spring 22 thus acts to oppose the opening of the choke, and the resistance to choke opening decreases as the spring 22 becomes hotter. Since the choke 16 has more surface area on one side of shaft 18 than the other, the pressure of air flowing through air induction passage 6 during operation of the engine will tend to bias the choke 16 toward the open position and bias lever 26 against the spring 22 at stop 24. Thus the position of the choke is determined by a balance between the air pressure on it and the bias exerted by the bimetallic spring 22 and will be more open at a given throttle position for a high spring temperature than a low spring temperature.

A temperature sensing element 32, in this embodiment a transistor, is fixed in thermal contact with the wall 12 between the air induction passage 8 and the exhaust passage 10. Another temperature sensing element, being in this embodiment a transistor 33 whose characteristics are closely matched to those of transistor 32, is mounted in thermal proximity to the bimetallic spring 22. Transistors 32 and 33 are connected in control circuit 30 to control the flow of electric current to an electric heater 38, which in this embodiment is another transistor that is fixed in thermal contact or proximity with the bimetallic spring 22 in order to heat it and raise its temperature while conducting.

Referring to FIG. 2, battery 40 is a source of electric current at a positive potential for the circuit 30 through the vehicle ignition switch 42. In circuit 30, transistors 32 and 33 have their emitters connected to ground through resistor 51, their bases biased together to a potential determined by a voltage divider connected across the battery 40 and consisting of resistors 52 and 53, and their collectors connected separately to the positive potential through resistors 54 and 55, respectively. Transistors 34 and 35 have their emitters connected to ground through resistor 56, their bases connected to the collectors of transistors 33 and 32, respectively, and their collectors connected separately to the positive potential through resistors 57 and 58, respectively. The collector of transistor 34 is also connected to ground through a Zener diode 44 and resistor 59. Transistor 36 has its emitter grounded, its base connected between Zener diode 44 and resistor 59, and its collector connected to the positive potential through resistor 61. Transistor 37 has its emitter connected to ground through resistor 62, its base connected to the collector of transistor 36, and its collector connected to the positive potential through resistor 63. Transistor 38 has its emitter grounded, its collector connected to

the positive potential and its base connected to the emitter of transistor 37.

Transistors 32, 33, 34 and 35 and their associated biasing resistors 51 through 58 comprise a differential amplifier, converting a particular difference in temperature between transistors 33 and 32 into a corresponding voltage at the collector of transistor 34. Transistors 36 and 37 comprise a switching circuit with a switching level set by Zener diode 44 which varies the impedance of transistor 38 and causes it to conduct only when the temperature of transistor 33 is less than a predetermined amount higher than that of transistor 32. Transistor 38 is chosen for its large current capacity and heat dissipation to effectively heat the bimetallic spring 22.

The operation of the system will now be explained in detail. If the engine has been allowed to cool to a point well below its normal operating temperature the bimetallic spring 22 will have rotated the stop 24 in a clockwise direction to close the choke 16 into the position shown in FIG. 1. When the ignition switch 42 is closed and the engine started, an enriched air-fuel mixture will flow through the air induction passage 8 into the engine. At this time transistors 32 and 33 are at approximately the same temperature and the parameters of circuit 30 have been chosen so that the voltage at the collector of transistor 34 is below the conduction voltage of Zener diode 44. Since Zener diode 44 will not allow any current through it to ground unless its conduction voltage is exceeded, transistor 36 will be cut off, transistor 37 will be driven on into saturation, and transistor 38 will conduct in its active region at an operating point preselected for the maximum benefit in terms of heating and longevity. Power dissipated in transistor 38 heats the bimetallic spring 22 to cause the stop 24 to rotate in a counterclockwise direction and allow the choke 16 to open. The increase in the temperature of the bimetallic spring 22 causes the temperature of transistor 33 to rise, which increases the collector current through it. The effect of the differential amplifier arrangement of transistors 32, 33, 34 and 35 is that an increase of collector current through transistor 33 causes the voltage at the collector of transistor 34 to increase. When that voltage reaches the conduction voltage of Zener diode 44 the Zener diode will begin to conduct and the voltage on the base of transistor 36 will rise. When this latter voltage becomes high enough, transistor 36 will begin to conduct and transistors 37 and 38 will be shut off. However, since the differential amplifier effect will cause the collector voltage of transistor 34 to tend to decrease as the collector current through transistor 32 increases due to the increasing temperature of transistor 32, the voltage at the collector of transistor 34 will not be high enough to turn on transistor 36 until transistor 33 is a certain amount higher in temperature than transistor 32. Thus, when the ignition switch 42 is closed, the circuit will tend to raise the temperature of the bimetallic spring 22 a certain amount higher than that of the wall 12 and to approximately maintain such a temperature difference as the temperature of wall 12 varies. As the wall 12 heats up during normal operating temperature the choke 16 is caused to rotate into its fully open position.

The effect of the invention is to control the opening of the choke in accordance with the temperature at a selected point in the engine in such a way as to allow smooth starting and cold running and yet keep total undesirable exhaust emissions to a minimum. The invention should not be limited to the embodiment described since those skilled in the art would undoubtedly recognize other embodiments of my invention.

I claim:

1. In a control for a choke in an air induction passage for an engine, the engine also having a passage for hot exhaust gases, which passage passes in thermal proximity with the air induction passage at a location downstream from the choke, the control including a temperature responsive element effective to vary the operation of the choke, electrical heating means in thermal proximity with the temperature responsive element, first temperature sensing means in thermal proximity with the said location of the air induction passage, and a source of electric current;

the improvement comprising, in combination:
second temperature sensing means in thermal proximity with the temperature responsive element;
and circuit means controlled by the first and second temperature sensing means so as to vary the impedance from the source of electric current through the electrical heating means in accordance with the difference between the temperature at the point of the air induction passage and the temperature of the temperature responsive element.

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