

[54] **IDLE AIR CONTROL**

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123/124 B, 124, 119 D, 122 AB, 127 A

[56] **References Cited**

UNITED STATES PATENTS

2,623,510 12/1952 Schweizer.....123/140 I

2,803,235	8/1957	Goschel et al.	123/140
3,249,345	5/1966	Gast.....	261/39 D
3,338,568	8/1967	Mangoletsi	123/122 AB
3,444,848	5/1969	Lawrence	123/122

FOREIGN PATENTS OR APPLICATIONS

781,247 2/1935 France.....123/124 A

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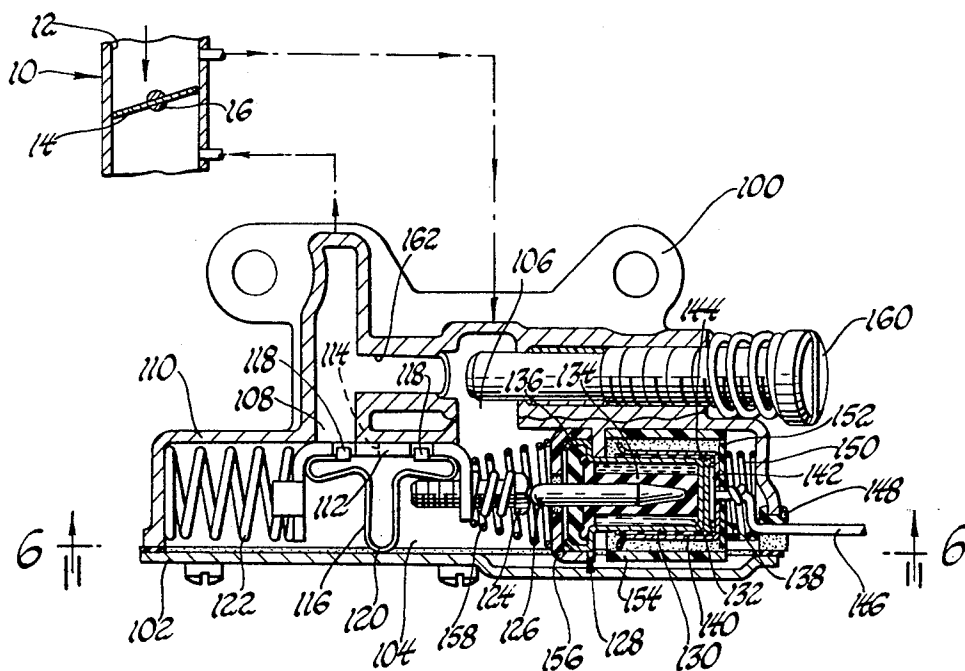
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[57]

ABSTRACT

Idle air flow is bypassed around the closed throttle in an internal combustion engine induction passage and controlled by poppet and slide valve embodiments of an idle air control valve to regulate engine idle speed. The valve are positioned by a power element which is electrically heated to a predetermined temperature during the engine warmup period.

1 Claim, 6 Drawing Figures



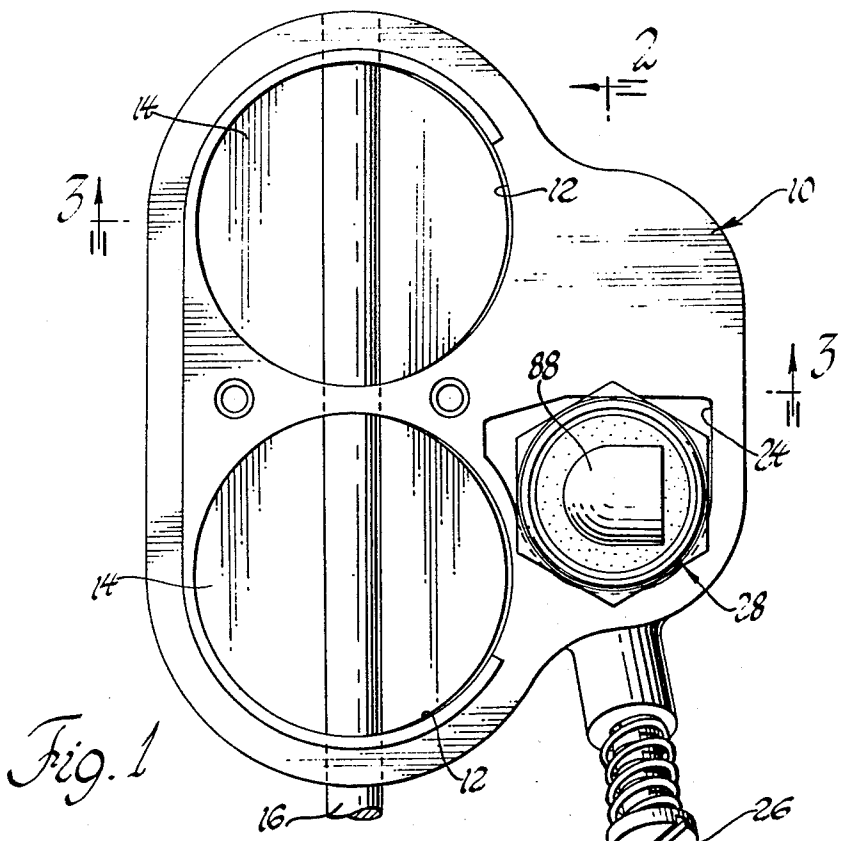


Fig. 1

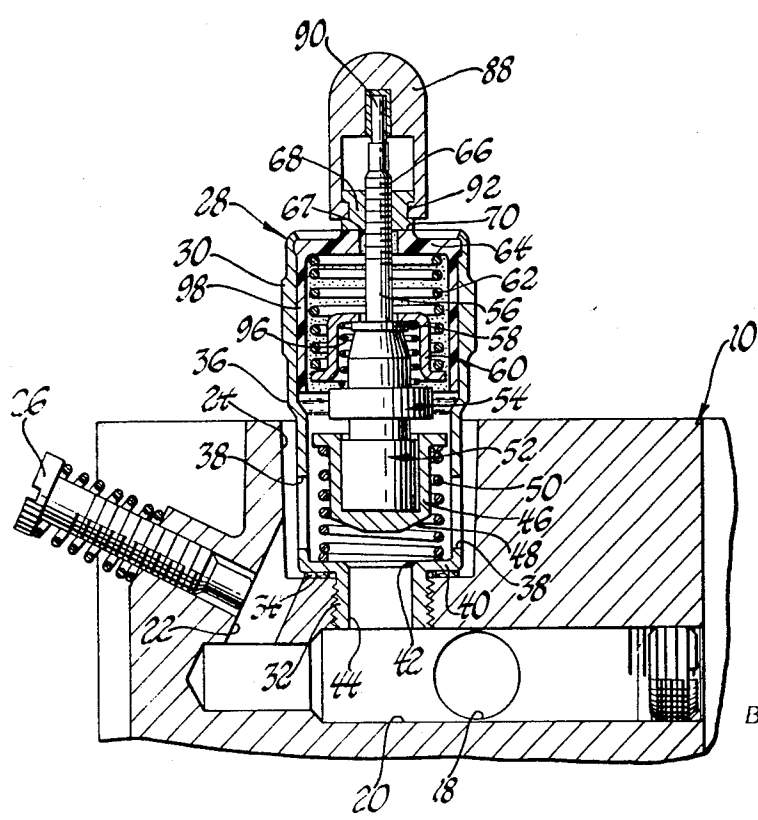
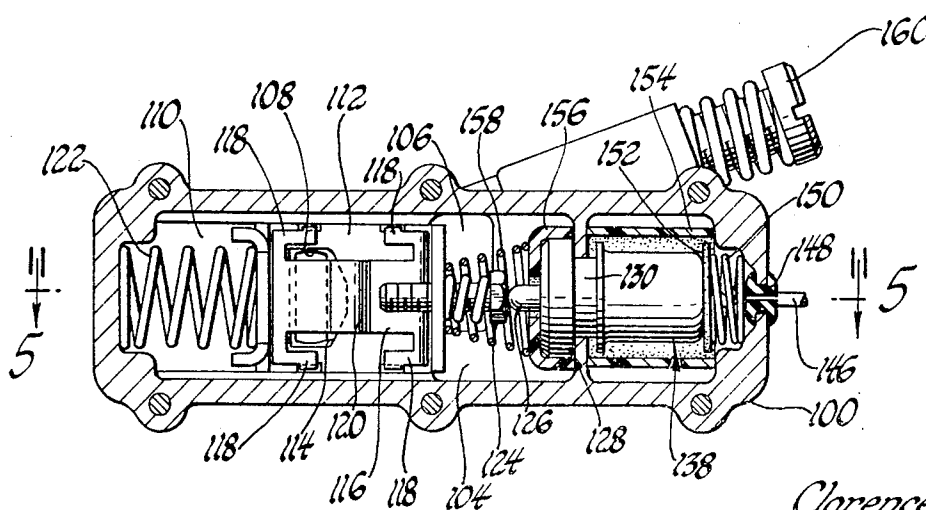
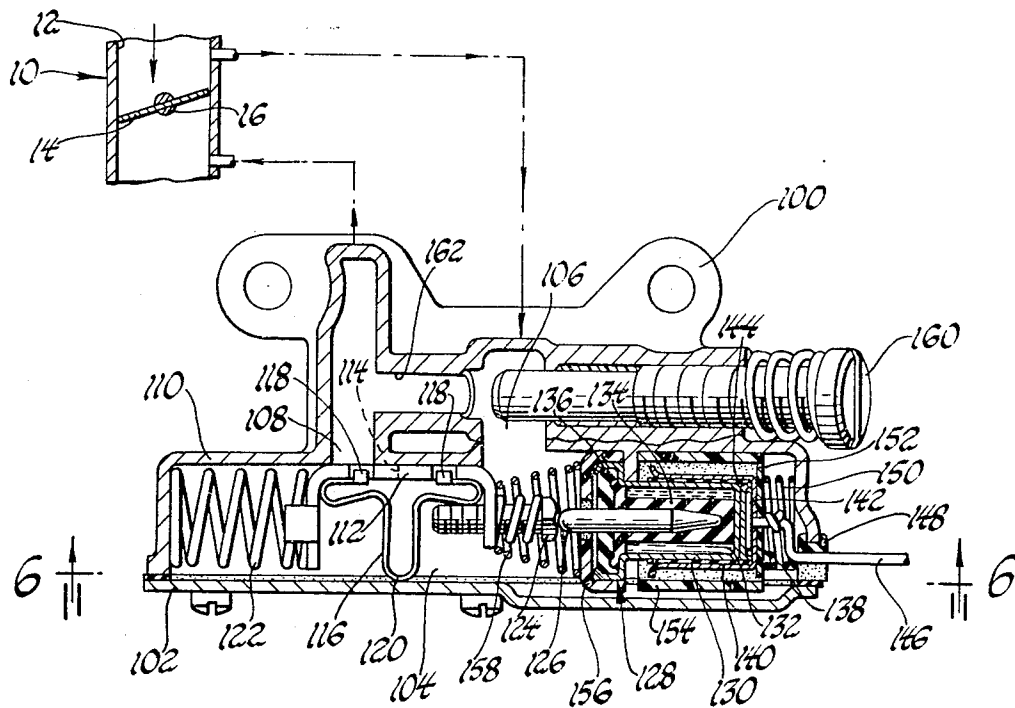


Fig. 2

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IDLE AIR CONTROL

This invention relates to idle speed control of an internal combustion engine and is directed to a valve mechanism which controls the flow of idle air bypassed around the throttle to provide the higher idle speeds required during the period immediately after the engine is started.

This valve mechanism is operated by a heated, temperature responsive element to vary idle speed from the highest idle speeds required for cold operation to curb idle speed over a preselected period of time, dependent essentially only upon the initial temperature. In the embodiments shown herein, this is achieved by positioning the idle air control valve by a power element and by heating the power element with a material having a positive temperature coefficient such that, below a predetermined temperature, electrical current is passed therethrough for heating and such that, above the predetermined temperature, the resistance of the material reduces current flow to a rate which maintains the power element at the predetermined temperature.

The details as well as other objects and advantages of this invention are set forth below and shown in the drawings in which:

FIG. 1 is a top plan view of an induction passage throttle body and illustrates a poppet valve embodiment of the idle air control valve disposed adjacent the throttle bores;

FIG. 2 is a side elevation view of the throttle body, taken in section along line 2—2 of FIG. 1, illustrating the idle air flow passages and the poppet type idle air control valve together with a separate curb idle adjusting screw;

FIG. 3 is a schematic sectional view illustrating the point of discharge from the idle air flow passages into the induction passages, taken generally as indicated by line 3—3 of FIG. 1;

FIG. 4 is a view of a poppet type idle air control valve, similar in most respects to that of FIG. 2, enlarged to show the details of the power element construction;

FIG. 5 is a top plan view of a slide valve embodiment of the idle air control valve, taken in section as indicated generally by line 5—5 of FIG. 6, showing the details of construction of the power element and schematically illustrating the connections to the induction passage;

FIG. 6 is a side elevational view of the slide valve shown in FIG. 5, with the cover removed as indicated generally by line 6—6 of FIG. 5.

Referring first to FIGS. 1—4, a throttle body 10 is provided with induction passages 12 having throttles 14 rotatably disposed on a shaft 16. As shown in FIGS. 2 and 3, an idle air discharge passage 18 discharges into induction passages 12 below throttles 14 from an idle air cross passage 20.

A curb idle air passage 22 discharges from a well 24 formed in throttle body 10 to cross passage 20. The rate of air flow through curb idle air passage 22 is controlled by an adjusting screw 26 to thereby control engine curb idle speed. A poppet type fast idle control valve 28 is received in well 24 and controls air flow from well 24 to cross passage 20 through a path parallel to curb idle air passage 22.

The poppet structure shown in FIG. 4 differs from that shown in FIG. 2 only in the details of certain parts. Therefore, while the FIG. 2 valve is identified as 28, the FIG. 4 valve will be identified as 28'; the parts of valve 28' will be similarly related to the parts of valve 28; and the description of one valve will suffice as the description of the other valve.

Idle air control valve 28 has a housing 30 including a threaded fitting 32 secured in throttle body 10 with a gasket 34 disposed therebetween. Housing 30 has an axially extending peripheral wall 36 with lateral openings 38 permitting air flow into housing 30 from well 24. Housing 30 further includes a transversely extending annular end wall 40 defining a valve seat 42 surrounding an opening 44 connected to cross passage 20.

A cupped receptacle 46 is disposed within housing 30 and has a conically shaped transversely extending portion 48 defining a valve element which cooperates with valve seat 42 to vary the effective area of opening 44 and thereby control fast idle air flow through opening 44 from within housing 30 to

induction passage 12. Receptacle 46 is biased away from valve seat 42 by a spring 50.

As described in greater detail below, receptacle 46 includes a heating element 52 and receives a power element 54 having a plunger 56. A washer or clip 58 is secured to plunger 56 and provides a radially extending flange forming a stop for a spring seat member 60. A spring 62 biases spring seat 60, and thus clip 58 and plunger 56, away from a nylon cover member 64 which closes housing 30. Plunger 56 has a threaded portion 66 which extends through a central opening 67 in cover member 64 and cooperates with a nut 68 bearing against the upper surface 70 of cover 64 to adjust the initial position of plunger 56 and thus of power element 54 and receptacle 46 to thereby adjust valve element 48 relative to valve seat 42.

As shown in greater detail in FIG. 4, power element 54', in a manner similar to power element 54, has a cup 72' received within receptacle 46' and containing a mass of thermally expandable material 74'. A seal 76' retained by a backing member 78' encloses material 74' within cup 72'. Plunger 56' is received by seal 76' and is displaceable axially out from cup 72' upon thermal expansion of material 74'. As plunger 56' is so displaced, clip or washer 58' is axially displaced from backing member 78'.

Heater 52', in a manner similar to heater 52, includes an aluminum cup 80' surrounding power element cup 72' and insulated therefrom by a Mylar sleeve 82'. A sintered barium titanate disc 84' is disposed in the bottom of cup 80' and, together with a copper disc 86', is secured therein by a metal filled epoxy.

As shown in FIGS. 1 and 2, an electrical lead has a terminal cap 88 disposed over the tip 90 of plunger 56. In the FIG. 2 embodiment, a groove 92 in nut 68 retains terminal cap 88 against accidental displacement; in the FIG. 4 embodiment, a pair of spring members 94 engage notches in a terminal cap (not shown).

Cover member 64 is electrically nonconductive so that a path for current flow is defined from terminal cap 88 through plunger 56, washer or clip 58 and spring seat member 60, a light contact spring 96, backing member 78 and power element cup 72, discs 86 and 84 and cup 80 of receptacle 46, and spring 50 to grounded housing 30. As the engine is started and current passes through the heating disc 84, it converts the electrical energy to heat energy and heats the thermally expandable mass 74, thus displacing plunger 56 from power element cup 72. Spring 50 is weaker than spring 62, and valve element 48 approaches valve seat 42 to reduce idle air flow to the engine and thus reduce the engine idle speed. Disc 84 has a positive temperature coefficient such that when a predetermined temperature is reached, current flow therethrough is substantially reduced. Thus disc 84 will maintain power element 54 at the preselected temperature.

Should additional heating of power element 54 occur after valve element 48 is seated on valve seat 42, plunger 56 overcomes spring 62 and nut 68 is lifted away from end wall 70 of cover member 64. A skirt 98 on cover 64 insulates the upper portion of housing 30 to reduce the cooling effect of air flow passing around valve 28 to induction passages 12.

Referring now to FIGS. 5 and 6, a housing 100 is closed by a cover 102 to define a chamber 104 having an inlet opening 106, for receiving air flow from a location in induction passage 12 above throttle 14, and an outlet opening 108 for discharging air flow to induction passage 12 below throttle 14. Outlet opening 108 is disposed in a planar wall 110 of housing 100, and a slide valve member 112 overlies opening 108. Slide valve 112 has a contoured port 114 which cooperates with outlet opening 108 to vary the effective area thereof. A spring 116 has a pair of arms 118 at each end which clip over slide valve 112 and a "U" shaped projection 120 bearing against cover 102 to bias slide valve 112 against wall 110 and prevent air leakage therebetween. Slide valve 112 is biased to the right by a spring 122. A link, here indicated as an adjusting screw 124, extends from slide valve 112 to a plunger 126 of a power element 128.

As in the poppet valve embodiment described above, power element 128 has a cup 130 containing a mass of thermally expansible material 132. A seal 134 held in place by a backing member 136 retains material 132 within cup 130. Power element 128 is received by an aluminum receptacle 138 having a Mylar insulating sleeve 140, a sintered barium titanate disc 142, and an aluminum cap 144. An electrical lead 146 extends through a grommet 148 in housing 100 to heating disc 142, and a path for electrical current is defined through heating disc 142, cap 144 and power element cup 130 to grounded housing 100. A spring 150, with an insulating washer 152, biases receptacle 138 against power element 128 to assure heating of power element 128 by heating disc 142. An insulating sleeve 154 surrounds receptacle 138, and an insulating shield 156, biased by a retainer spring 158 covers power element 128 to prevent cooling of the power element by air flow through housing 100.

In operation, as the engine is started electrical current is supplied through lead 146 and causes disc 142 to heat power element 128; plunger 126 is then displaced from power element cup 130 and moves slide valve 112 toward the left to reduce idle air flow to the engine and thus reduce engine idle speed. Disc 142 has a positive temperature coefficient such that when a predetermined temperature is reached, current flow therethrough is substantially reduced. Thus disc 142 will maintain power element 128 at the preselected temperature.

A curb idle adjusting screw 160 controls air flow through a curb idle air passage 162 parallel to chamber 104, bypassing throttle 14 to control engine curb idle speed.

In each of the foregoing embodiments, the characteristics of the power elements are such that the thermally expansible material begins to expand at about 0° F. and provides about 0.4 inch travel of the plunger for the slide valve and about 0.15 inch travel of the plunger for the poppet valve between 0° F. and 200° F. Similarly, the characteristics of the heating discs are such that their resistance is about 14 ohms at 77° F., about 3 minutes are required to increase the temperature from about 0° F. to about 250° F., and the resistance changes to maintain a temperature of about 250° F.

It will be appreciated that, with the structure set forth herein, a high engine idle speed is provided immediately after

the engine is started and over a period of about 3 minutes, while the engine is warming up, the idle speed is gradually reduced to curb idle speed.

We claim:

1. In an internal combustion engine having an induction passage for air flow to the engine and a throttle in said induction passage movable between open and closed positions for controlling air flow therethrough: means for controlling air flow into said induction passage downstream of said throttle, said means comprising an enclosed housing defining a chamber, said housing having an inlet opening to permit air flow into said chamber, said housing including a planar wall having an outlet opening connected with said induction passage downstream of said throttle; a slide valve overlying said wall and having a contoured port therethrough cooperating with said outlet opening to vary the effective area thereof and thereby control air flow through said outlet opening from said chamber to said induction passage; spring means biasing said slide valve against said housing wall to prevent air leakage therebetween; and means for positioning said slide valve including a power element having a cup secured in said housing, a mass of thermally expansible material disposed in said cup, a seal enclosing said material in said cup, and a plunger received by said seal and displaceable axially from said cup upon thermal expansion of said material; a cupped receptacle receiving said power element cup, said receptacle including heating means for converting the electrical energy of current flow into heat energy; means for passing an electric current through said heating means; spring means biasing said receptacle into thermal contact with said power element cup whereby said power element will be heated by said heating means and said plunger will be displaced from said cup; a link connecting said power element plunger and said slide valve to move said slide valve as said power element is heated and thereby reduce the effective area of said outlet opening, the length of said link being adjustable for adjusting the initial position of said slide valve relative to said power element plunger; and spring means biasing said slide valve to move said slide valve as said power element cools and thereby increase the effective area of said outlet opening.

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