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**Schubeck**

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[54] **CARBURETOR COLD ENRICHMENT CONTROL**


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[52] **U.S. Cl.** .............. **261/39 B**; 123/119 F; 261/52

[51] **Int. Cl.** .............................................. **F02m 7/24**

[58] **Field of Search** ........ 261/50 A, 52, 39 B, 39 A; 123/119 F


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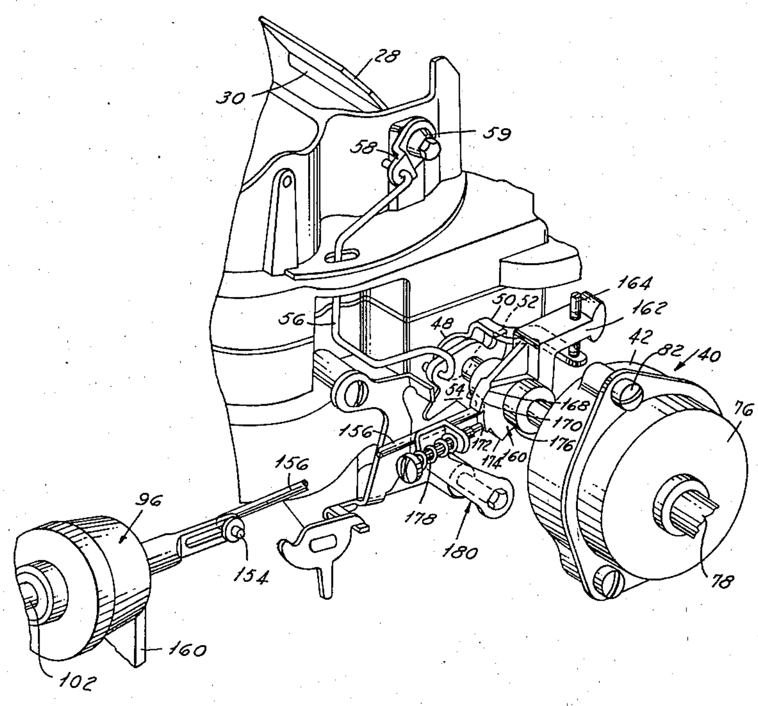
[57] **ABSTRACT**


A carburetor has a conventional bimetallic coiled spring that for cold engine starts and running urges a fast idle cam to a cold position to increase the idle speed to sustain engine operation. A separate lever connected to the choke valve is pulled by engine vacuum to move the choke valve wide open, to lean the air/fuel mixture and reduce emissions. For starting purposes, the separate lever is returned to the cold start position dictated by the fast idle cam.


**13 Claims, 6 Drawing Figures**



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SHEET 1

FIG. 1

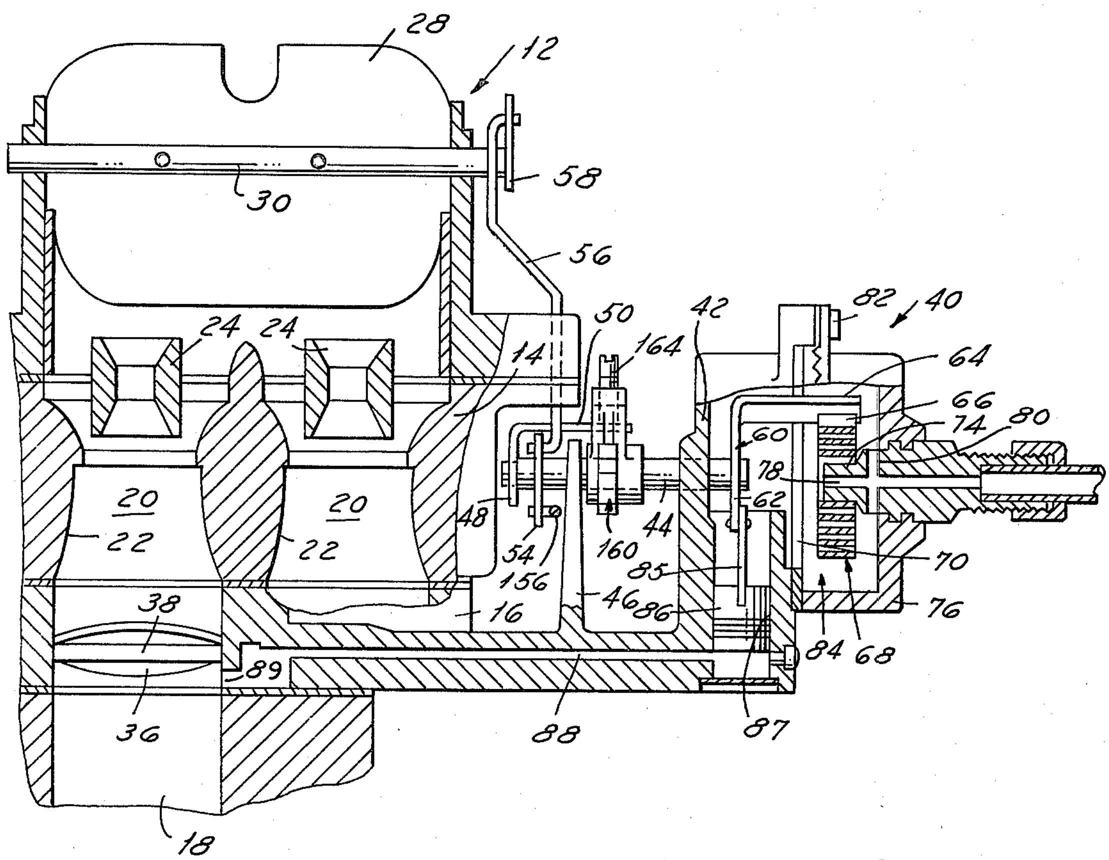


FIG. 3

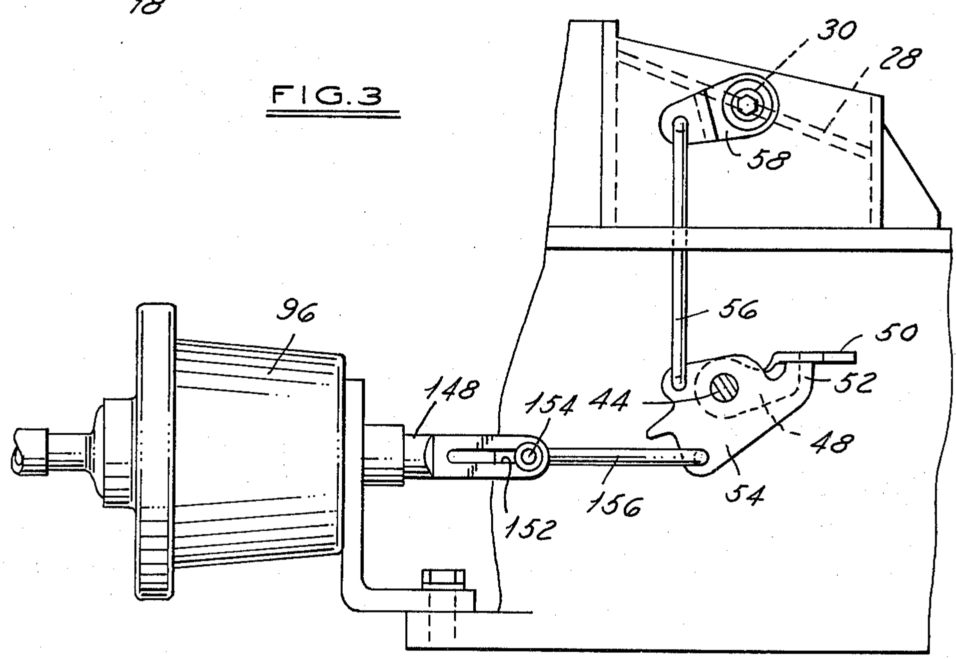

FIG. 2

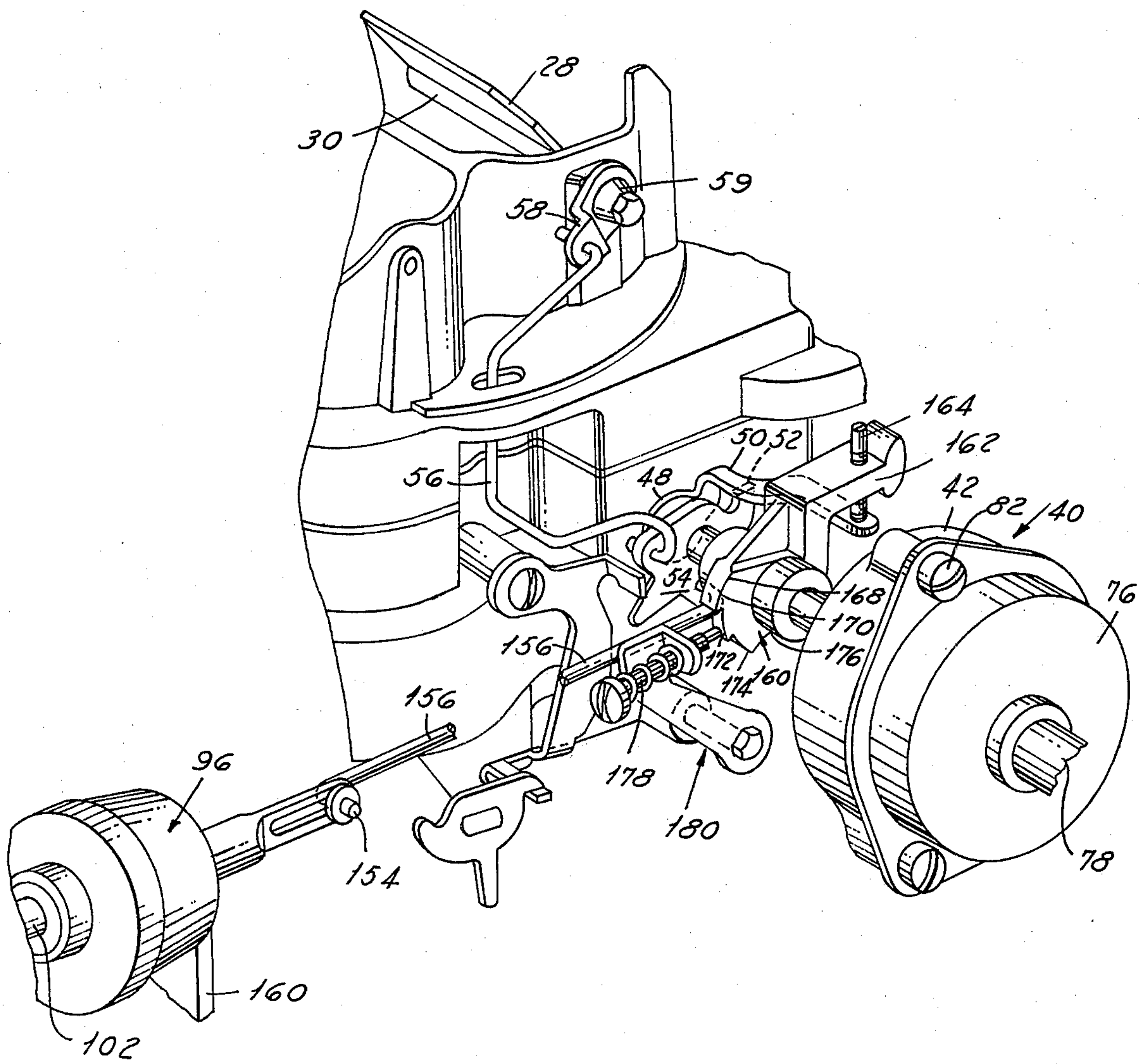
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FIG. 4

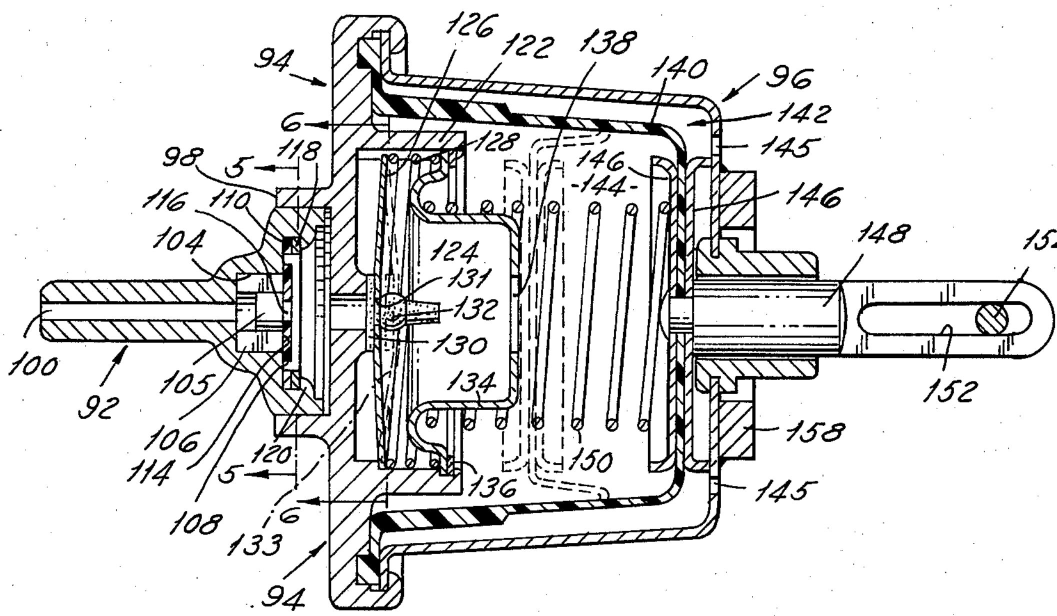



FIG. 5

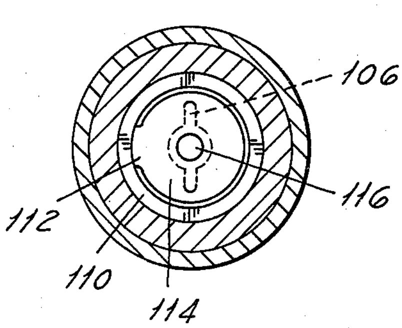
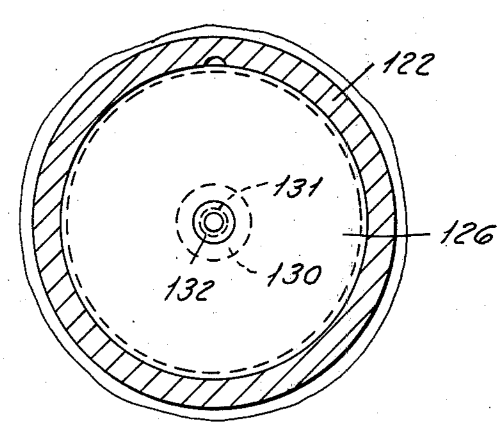



FIG. 6



# CARBURETOR COLD ENRICHMENT CONTROL

This invention relates in general to a motor vehicle type carburetor. More particularly, it relates to a construction for controlling the opening of the choke valve independently of the positioning of the throttle valve by the fast idle cam during cold engine operation.

Most conventional carburetors have an automatic choke system for enriching the carburetor air/fuel mixture during cold engine operation to maintain good engine driveability. In most instances, a fast idle cam operably rotated by a thermostatically responsive coiled spring is positioned in the path of closing movement of the throttle valve. During cold engine operation, the throttle valve will be opened wider than the normal engine idle speed position to allow sufficient fuel/air mixture into the engine to sustain engine operation. Simultaneously, the coiled spring moves the choke valve towards a closed position for engine starting, and immediately after the engine has reached a sustained operation, a servo cracks open the choke valve to a position leaning the air/fuel mixture.

The basic automatic choke construction described above is sometimes supplemented by an additional servo mechanism. The latter, after the initial cracking open of the choke valve, pulls open the choke valve to an essentially inoperative position, to reduce emissions. The choke valve, however, in the above instances generally is interconnected with the fast idle cam mechanism. Therefore pulling open the choke valve also causes the fast idle cam to be rotated to an inoperative position. This then permits closure of the throttle plates to their normal engine idle speed position. If, however, the engine operating temperature is still below normal, closure of the throttle plates at this time may decrease the fuel/air mixture flow to a level causing engine stalling. Naturally this is undesirable.

This invention partially separates the fast idle cam mechanism from the choke pulloff servo means. The choke valve can be opened wide to an inoperative position shortly after engine starting, during cold engine operations, to reduce emissions by leaning out the mixture. The throttle valve, however, can be maintained in a fast idle position to permit sufficient flow of air/fuel mixture to sustain engine operation. For restarting, the choke valve can be closed down to a position determined by the fast idle cam.

It is an object of the invention, therefore, to construct a carburetor with a cold enrichment control that provides a limited interconnection between the usual carburetor fast idle cam mechanism and the choke valve pulloff mechanism to permit some independent operation of each with respect to the other, to reduce emissions while maintaining engine driveability.

It is another object of the invention to provide a carburetor cold enrichment control of the type described above that permits opening of the choke valve to an essentially inoperative position soon after the engine has reached a sustained operating condition, to lean the mixture to decrease emissions, without disturbing the fast idle position of the throttle valve as determined by the position of the fast idle cam controlled by a thermostatically responsive coiled spring, to provide increased air/fuel mixture flow during cold engine operation.

Other objects, features and advantages of the invention will become more apparent upon reference to the succeeding, detailed description thereof, and to the drawings illustrating the preferred embodiment thereof, wherein:

FIG. 1 is a cross-sectional view of a portion of a carburetor embodying the invention;

FIG. 2 is a perspective elevational view of the carburetor shown in FIG. 1; and

FIG. 3 is a side elevational view of a portion of the FIG. 2 showing.

FIG. 1 is obtained by passing a plane through approximately one-half of a known type of two-barrel, downdraft type carburetor. The portion of the carburetor shown includes an upper air horn section **12**, an intermediate main body portion **14**, and a throttle valve flange section **16**. The three carburetor sections are secured together by suitable means, not shown, over an intake manifold indicated partially at **18** leading to the engine combustion chambers.

Main body portion **14** contains the usual air-fuel mixture induction passage **20** having fresh air intakes at the air horn ends, and connected to manifold **18** at the opposite ends. The passages are each formed with a main venturi section **22** containing a booster venturi **24** suitably mounted for cooperation therewith, by means not shown.

Air flow through passages **20** is controlled in part by a choke valve **28** unbalance mounted on a shaft **30** rotatably mounted on side portions of the carburetor air horn, as shown. Flow of fuel and air through each passage **20** is controlled by a conventional throttle valve **36** fixed to a shaft **38** rotatably mounted in flange portion **16**. The throttle valves are rotated in a known manner by depression of the vehicle accelerator pedal, and move from idle speed positions essentially blocking flow through passages **20** to wide open positions essentially at right angles to the position shown.

Choke valve **28** rotates from a closed position to the nearly vertical, essentially inoperative position shown. In this latter position, the choke valve provides the minimum resistance to airflow. The rotative position of choke valve **28** is controlled in part by a semiautomatically operating choke mechanism **40**. The latter includes a hollow housing portion **42** that is cast as an integral extension of the carburetor throttle flange. The housing is apertured for supporting rotatably one end of a choke valve control shaft **44**. The other end of shaft **44** is rotatably supported by a casting **46**. A lever **48** is fixed on the left end portion of shaft **44** and has a finger portion **50**. The finger portion constitutes a stop and overlies and is in the path of rotative movement of a tang **52**. The tang is formed on a choke valve pivot link **54** that is pivotally connected to the end of a rod **56**. Rod **56** at its other end is pivoted to a link **58** fixed on choke valve shaft **30**. A torsion choke return spring, not shown, is secured to choke shaft **30** under a cover **59**. The spring constantly urges the shaft and valve towards a closed position. It will be clear that rotation of shaft **44** in a clockwise direction will engage finger **50** against tang **52** to correspondingly rotate choke valve **28** to open the carburetor air intake, while rotation of shaft **44** and lever **48** in the opposite direction will not affect movement of the choke valve.

An essentially L-shaped thermostatic spring lever **60** has one leg **62** fixedly secured to the right hand end portion of shaft **44**. The other lever leg portion **64** is secured to the end **66** of a coiled thermostatic spring element **68** through an arcuate slot, not shown, in an insulating gasket **70**. The inner end portion of the coiled spring is fixedly secured on the end of a nipple **74** that is formed as an integral portion of a choke cap **76** of heat insulating material. Nipple **74** is bored as shown to provide hot air passages **78** and **80**, passage **78** being connected to an exhaust manifold heat stove, for example. Cap **76** is secured to housing **42** by suitable means, such as the screw **82** shown, and defines an air or fluid chamber **84**.

As thus far described, it will be clear that the thermostatic spring element **68** will contract or expand as a function of the changes in ambient temperature conditions of the air entering tube **78**, or, if there is no flow, the temperature of the air within chamber **84**. Accordingly, changes in ambient temperature will rotate the spring lever **60** to rotate shaft **44** and lever **48** in one or the other directions, as the case may be.

The leg **62** of spring lever **64** is pivotally fixed to the rod **85** of a piston **86**. The latter is movably mounted in a bore **87** in housing **42**. The under surface of piston **86** is acted upon by vacuum in a passage **88** that is connected to the carburetor main induction passages **20** by a port **89** located just slightly below throttle valve **36**. Piston **86**, therefore, is always subject to the vacuum existing in the intake manifold passage portion **18**.

A cold engine start of a motor vehicle requires a richer mixture than a warmed engine start because considerably less fuel is vaporized. Therefore, the choke valve is shut or nearly shut to increase the pressure drop thereacross and draw in more fuel and less air. Once the engine does start, however, then the choke valve should be opened slightly to lean the mixture to prevent engine flooding as a result of an excess of fuel.

The choke mechanism described above automatically accomplishes the action described. That is, on cold weather starts, the temperature of the air in chamber **84** will be low so that spring element **68** will contract. This will rotate shaft **44** and lever **48** in a counterclockwise direction away from link **54**, permitting the choke return spring to move choke valve **28** to a closed or nearly closed position, as desired. Upon cranking the engine, vacuum in passage **88** will not be sufficient to move piston **86** to open the choke valve. Accordingly, the engine will be started with a rich mixture. As soon as the engine is running, high vacuum in passage **88** moves piston **86** downwardly and rotates shaft **44**, lever **48** and link **54** a slight amount so that choke valve **28** is slightly opened so that the mixture is then leaned.

FIGS. **2** and **3** show the carburetor as including a supplemental servo device **96** connected to the choke valve link **54**. The details of construction as shown in FIGS. **4–6**. Servo **96** has a three piece housing consisting of a lefthand check valve and a vacuum line adapter portion **92**, a main body portion **94**, and a cup shaped shell portion **96**.

Portion **92** has a press fit within an annular flange **98** projecting from body portion **94**, and contains a vacuum passage **100**. The latter is connected by a tube **102** (FIG. **2**) to the carburetor bore at a location below the throttle valve to be subject to manifold vacuum at all times.

Passage **100** communicates with an enlarged stepped diameter bore **104** containing a sintered metal annular plug **105**. The wall of the housing portion defining bore **104** contains an axially extending keyway like slot **106** (see FIG. **5**) communicating around the left end of plug **105** with passage **100**. Seating at times against the right end of restrictor **105** is a thin elastomeric check valve



**108**. It has an outer ring **110** connected by a flexible neck portion **112** (FIG. **5**) to an inner flexible disc **114**. The disc **114** has a central hole **116** constituting a flow opening. The total restriction to flow through the sintered metal restrictor **106** is chosen to provide the desired delay in communication of vacuum in line **100** to the opposite side of check valve **108**, as will become clearer later. The check valve is held against the recess shoulder of housing portion **92** by a retaining ring **118**. The latter is held in place as shown by the staked end **120** of the housing.

Body portion **94** contains an annular flange **122** and a central vacuum passage **124**. A Belleville type bimetal disc **126** is floatingly mounted within flange **122**, and is biased towards the left by a spring **128**. The central portion of disc **126** has an elastomeric valve **130** fixed to it that is adapted to seat against the passage **124** to control flow through it. In assembly, an enlarged flexible integral portion **132** of the valve is pulled through a small hole **131** in disc **126** until the valve is seated, as shown.

The bimetal disc **126** is responsive to ambient temperature changes of the servo to flip over-center from the full line position shown, to the dotted line position **133**, in a known manner, at say, temperature levels above 75°F, for example, to open passage **124**. Reduction of the ambient temperature below the predetermined level will again flip-flop the disc to close passage **124**.

The disc spring **128** is seated against a cup shaped spring retainer **134**. The latter is held in place in the ring flange **122** by a ring **136**, and has a central aperture **138**.

The housing portions **94** and **96** together define a hollow interior. Between them is clamped the edge of an annular flexible diaphragm **140** that divides the interior into an air chamber **142** and a vacuum chamber **144**. Holes **145** in housing portion **96** permit a free communication of chamber **142** with the ambient air pressure surrounding the servo.

A pair of retainers **146** fixedly mount a plunger or link **148** on the diaphragm, a spring **150** normally biasing the plunger to the position shown. The plunger has a lost motion connection to choke lever **48** consisting of an elongated slot **152** that receives the bent end **154** of a link **156** pivotally connected to lever **54**.

Completing the construction, a pair of bosses **158** are welded to housing portion **96** for the attachment of a mounting brake **160** that is adapted to be secured at its opposite end to a portion of the throttle valve body portion of the carburetor.

In operation, below 75°F ambient, the bimetal disc **126** remains in a valve closed position as shown, and no vacuum is applied from passage **100** into servo chamber **144**. Therefore, the servo **90** is inoperative. The choke valve is initially closed by the torsion spring, and cracked open upon engine startup by the pulldown servo **86**. Increases in choke housing temperature, caused by the increases in exhaust manifold heat, cause the bimetal **68** to slowly unwind and move lever **48** against tang **52** to move open the choke valve. This is permitted by the sliding movement of the pin **154** in slot **152**. The entire choking action will then be controlled solely by the coil **68**.

Assume now that the ambient temperature is above 75°F. Initially, the same operation occurs as above described. Check valve **108** will still be seated because of the pressure differential acting on opposite sides. Therefore, bleed of air can only occur through the hole **116** past the sintered restrictor **106**. However, now vacuum can be applied to chamber **144** because the thermostatically responsive disc **126** has now flipped over center to position **133**. This unseats valve **130** and opens passage **124**. Manifold vacuum in passage **100** now is applied slowly, as determined by the combined restrictions of restrictor **106** and hole **116**, to begin drawing diaphragm **140** and plunger **148** to the left. This will continue without any effect on the choke valve until the pin **154** is engaged by the end of slot **152**. Continued leftward movement of the plunger until it bottoms, at dotted line position **162**, against retainer **134**, will then rotate link **54** away from finger portion **50** of lever **48** and positively open the choke valve.

The maximum delay is scheduled in this case to be approximately forty seconds. It will vary, of course, from the maximum to a minimum as a function of the initial position of the pin **154** in the slot **152**, upon engine startup, which will depend upon the initial ambient temperature conditions affecting the force of coil **68**.

Assume now that the engine is shut off, or quickly accelerated, so that the manifold vacuum decays suddenly. It is desirable at this time that the servo **90** recycle itself so as to be in a position to provide the desired choking action when restarted or the acceleration phase terminated. The check valve **108** provides this action since the sudden change in pressure conditions now places the higher pressure level in passage **100**, and a lower vacuum in chamber **144**. This bends or deforms the check valve outwardly to the right off its seat to permit free communication between passage **100** and chamber **144** by flow around the sintered restrictor **106** through the slot **105**. This immediately permits spring **150** to stroke the diaphragm and plunger **148** to the right to the positions shown.

In summary, therefore, below an ambient temperature level of 75°F, the choke hot air system provides the only control for choking functions. The bimetal coil **68** will unwind, therefore, only as a function of the increased heating by the hot air from passage **78**.

Above 75°F, however, the conventional exhaust manifold stove heat system constitutes the primary choke control, while the vacuum operated servo device **90** acts as the supplemental force to pull open the choke valve faster than were it being controlled by the primary control alone. This leans the fuel/air mixture earlier than with conventional choke arrangements, and, therefore, lowers undesirable emissions outputs.

Turn now to the means for controlling the fast idle speed position of the throttle valve. As stated previously, during cold engine operation, it is necessary to open the throttle valve wider to allow sufficient extra air/fuel mixture to prevent the engine from stalling due to the extra friction, greater viscosity of the lubricant, etc. As best seen in FIGS. **1** and **2**, rotatably mounted on shaft **44** is a conventional fast idle cam **160**. The cam has a projection **162** on one side in which is adjustably mounted a screw **164**. The screw engages the finger portion **50** of lever **48**. The projection **162** also contains a recess, now shown, in which is pressed a weight or ball of predetermined mass. The mass and its location is chosen such that the cam will always fall by gravity in a clockwise direction to follow the movement of lever **48**. This will rotate the cam clockwise progressively as the temperature of the bimetal **68** increases.



The opposite side of cam **160** is formed with an edge **168** having three steps **170, 172** and **174.** Each contiguous step in counterclockwise circumferential succession has a face that is of less radial extent than the previous one, the last step **174** being followed by an opening **176.** The steps and opening constitute abutments or stops in the path of movement of a screw **178.** The screw is adjustably mounted on a lever **180** fixed to throttle shaft **38.** The radial depth of opening **176** is chosen such that when the fast idle cam is rotated to engage the screw **178** in the opening, the throttle valve shaft will have rotated the throttle valve to its normal engine idle speed position essentially closing the throttle valve. Engagement of the screw with each of the steps **170, 172** and **174**, as the cam rotates upon temperature decreases, then will progressively locate the idle speed position of the throttle valve at a more open position.

Briefly, in operation, the temperature of bimetal **68** determines the rotative position of lever **48.** Gravity causes cam screw **164** to engage finger portion **50** upon temporary movement of screw **178** in a counterclockwise direction by opening the throttle plate. This determines which step **170, 172** or **174,** or whether opening **176,** will be engaged by screw **178,** and, therefore, what the idle speed position of throttle valve **36** will be.

In overall operation, between temperature levels of say 75°F. and 100°F., the bimetallic coiled spring **68** will have rotated lever **48** to some clockwise position similar to that shown in FIG. **2.** Subsequent depression of the accelerator pedal will pivot the throttle valve shaft **38** counterclockwise to move screw **178** away from the fast idle cam **160.** This will permit the cam to fall by gravity against the finger portion **50** of lever **48.** Release of the accelerator pedal then permits the screw to engage whichever step is opposite the screw. This then locates the throttle valve for a fast idle throttle setting predetermining the volume of air/fuel mixture to flow into the engine during cold engine operation at this temperature.

Simultaneously, the clockwise rotation of lever **48** will abut the finger portion **50** with the tang **52** of link **54** to open the choke valve by the correct amount for starting at this temperature. Upon engine starting, engine vacuum is applied to piston **86,** which rotates choke shaft **44** a predetermined amount. This rotates lever **48,** moving portion **50** against tang **52** to crack open the choke valve by the same degree. The cranking mixture then is leaned to a less rich mixture preventing stalls. Shortly after this operation, vacuum applied through the delayed portion of servo **96** pulls the link **54** clockwise an amount opening the choke valve **28** to an inoperative essentially vertical position. This lessens the emission of undesirable elements by leaning the mixture considerably. This operation is permitted without causing stalls of the vehicle because of the freedom of link **54** to pivot clockwise away from the finger portion **50** of lever **48.** Thus, even though the choke valve is fully open, the throttle valve is still maintained in a fast idle speed position, to maintain sufficient flow to sustain engine operation during cold engine conditions.

While the invention has been shown and described in its preferred embodiment, it will be clear to those skilled in the arts to which it pertains that many changes and modifications may be made thereto without departing from the scope of the invention.

I claim:

1. A cold engine enrichment control for use in a carburetor having an air/fuel induction passage open at one end to clean air at essentially atmospheric pressure and connected to an engine intake manifold at the opposite other end to be subject to the changes in engine vacuum, a throttle valve mounted for movement across the other end between closed and fully open positions to control the flow of fuel and air through the passage, and a choke valve anterior of the throttle valve mounted for movement across the one end between closed and open inoperative positions to control the flow of air into the passage, the control including first means operably connected to the choke valve and operable above a predetermined temperature upon the engine attaining a running condition to move the choke valve to an open inoperative position to increase airflow and decrease emissions, and second temperature responsive means operably positioned in the path of closing movement of the throttle valve and variably movable as a function of temperature changes independently of the first means to restrict the closing movement of the throttle valve to maintain the throttle valve open to a beyond normal engine idle speed position to increase the flow of the air/fuel mixture, to prevent engine stallings.

2. A control as in claim 1, the first means including an engine vacuum servo operable to pull open the choke valve.

3. A control as in claim 1, the second means including a throttle shaft, a lever secured to the throttle shaft, a fast idle cam rotatably mounted on the shaft and having an abutment surface with varying radial extent steps engagable individually by the lever, and a temperature responsive member effecting rotation of the cam as a function of temperature changes to determine the open position of the throttle valve.

4. A control as in claim 3, the first means comprising an engine vacuum controlled servo operable to pull open the choke valve.

5. A control as in claim 4, the first means also including a second engine vacuum actuated servo to move the choke valve to an initial slightly open position less than the inoperative position prior to the first servo moving the choke valve.

6. A control as in claim 3, including a bimetallic temperature responsive coiled spring having an end rotatably movable as a function of temperature changes, a member rotated by the spring and engaged by the fast idle cam to restrict the rotative movement of the cam as a function of the movement of the spring.

7. A control as in claim 6, including means on the first means interacting with the member to prevent return movement at times of the first means to a closed choke position.

8. A control as in claim 7, the first means comprising an engine vacuum actuated servo operable to pull open the choke valve.

9. A control as in claim 8, the first means also including a second engine vacuum actuated servo to move the choke valve to an initial slightly open position less than the inoperative position prior to the first servo moving the choke valve.

10. A control as in claim 9, including an engine heat source operably connected to the coiled spring to warm the spring as a function of engine temperature changes.

11. A cold enrichment control for a carburetor having an air/fuel induction passage open at an air end to air at essentially atmospheric pressure and connected at its opposite engine end to an engine intake manifold to be subject to the changing vacuum levels therein, the air end having a choke valve rotatably mounted for movement across the air end between a closed position and an open position wherein the choke valve is inoperative to restrict the flow of air into the passage, and a throttle valve secured to a shaft rotatably mounted posterior of the choke valve for movement of the throttle valve across the passage between a normal essentially closed engine idle speed position and beyond towards a wide open throttle position to control the volume of flow of an air/fuel mixture through the passage as a function of the position of the throttle valve, the control comprising means operable during cold engine operations to position the choke valve independently of the position of the throttle valve, to improve emissions while minimizing engine stalling, the last mentioned means including,

abutment means secured to the throttle shaft, a second shaft, a fast idle cam rotatably mounted on the second shaft and having an edge formed with steps progressively greater in radial extent than one which when engaged by the abutment means would permit closure of the throttle valve to the normal engine idle speed position, whereby the throttle valve will be progressively opened beyond the latter position as a function of the particular step engaged by the abutment means, spring means biasing the abutment means and throttle valve towards a closed position and into individual engagement with one of the steps, a thermostatically responsive coiled spring operatively rotating the fast idle cam to positions operatively moving the throttle valve to positions progressively more open than the normal idle speed position as a function of decreases in temperature from a predetermined level, first means operatively connected to the choke valve, engine vacuum actuated servo means connected to the first means to open the choke valve to the inoperative position upon the engine attaining a normal running condition, and means providing a limited unidirectional interconnection between the fast idle cam and choke valve permitting opening of the choke valve and operation of the fast idle cam independent of each other.

12. A control as in claim 11, the last mentioned means including stop means operatively connected to the fast idle cam and engagable with the first means to control the return movement of the choke valve towards a closed position as a function of temperature changes upon engine shutdown.

13. A control as in claim 12, including second vacuum actuated servo means operatively connected to the fast idle cam to effect engagement of the first means to crack open the choke valve beyond a closed position in response to engine start-up.

* * * * *