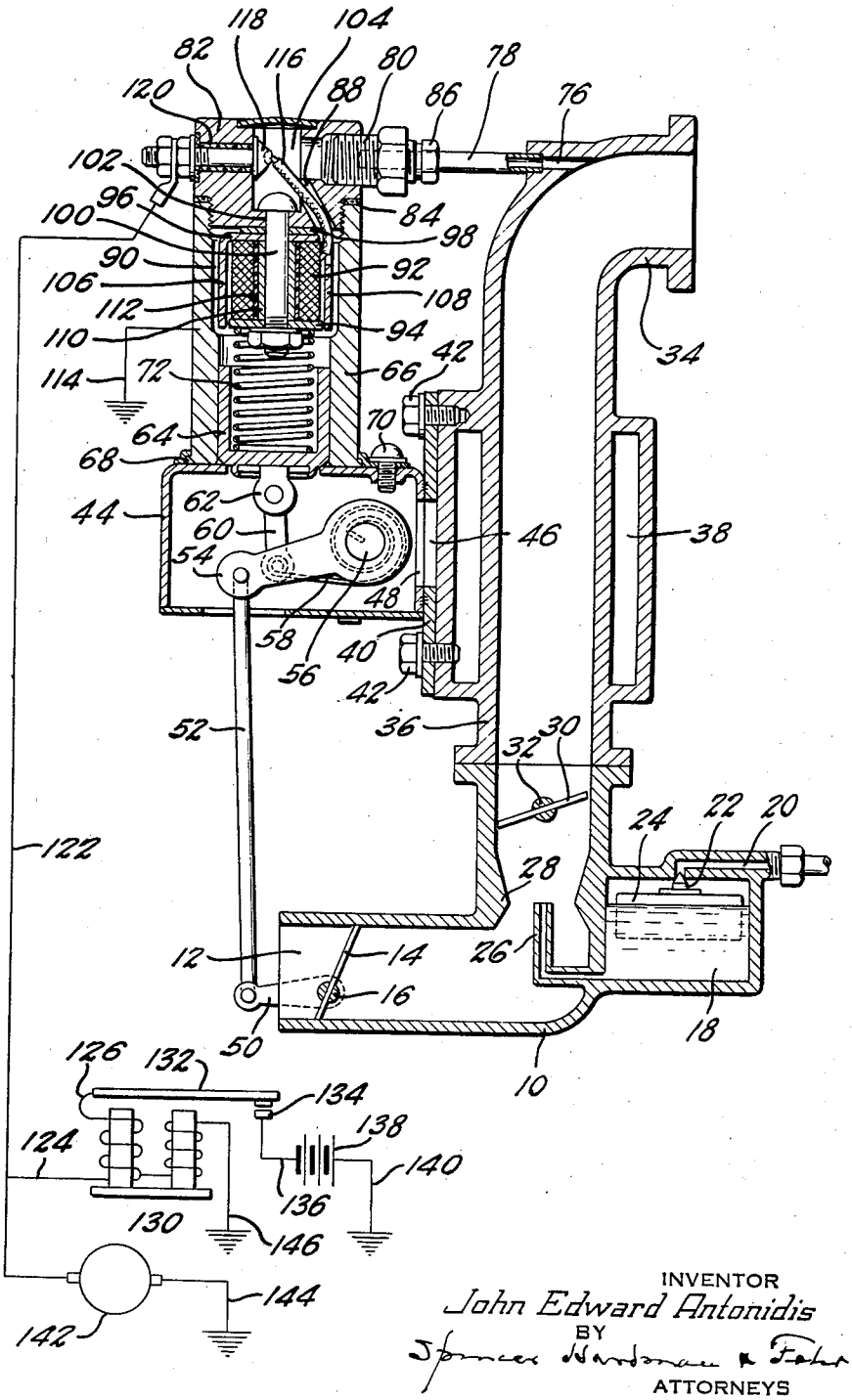
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AUTOMATIC CHOKE

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AUTOMATIC CHOKE

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The present invention relates to means for controlling automatically the ratio of fuel and air in the combustible mixture supplied by the carburetor of an internal combustion engine to such engine and more particularly to that form of device in which an automatic air or choke valve is provided which is controlled jointly by the action of a thermally responsive element and a suction operated device to modify the effect of such thermally responsive element.

Devices of this same character have been designed heretofore in which an unbalanced air valve is provided at the air intake of the carburetor which the flow of ingoing air tends to open and thermally responsive means are provided which are operative to hold such air valve closed at low temperatures to facilitate starting. A suction operated element is provided which is operable when the engine starts to run to move the air valve toward open position to prevent the formation of a too rich mixture when the engine is running under its own power. It has been found that upon opening of the throttle and the consequent reduction of engine suction, this suction operated means is inoperative to hold the air valve open sufficiently and during the warming up period, the thermostat is likely to move the valve to vary the closed position, with the result that under such operating conditions, the mixture would become too rich and cause loading of the engine.

More specifically, it is an object of the present invention to provide means to prevent the closing of the air valve sufficiently to bring about the difficulty referred to upon opening of the throttle with a consequent reduction of suction, or in other words, an additional means other than the suction operated member is provided which will hold the air valve open to the proper degree when the engine runs under its own power, even if the suction effective on the suction operated device falls to such a degree that the suction is not sufficient to accomplish this function.

According to the present invention, this object is attained by the provision of an electromagnet which is effective upon the suction operated piston to hold the latter in the position to which it is moved by a high suction even if the throttle is opened and to prevent the return of the air valve toward its closed position sufficiently to cause too great enrichment of the mixture under the operating conditions referred to. This electromagnet is energized by the generator when the engine is operated at a predetermined speed so that when the engine is operating at such speed, the magnet will be effective to hold the air valve open to the desired degree notwithstanding a drop in suction.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred embodiment of the present invention is clearly shown.

The figure is a vertical section through a device constructed in accordance with the present invention and showing the carburetor with which the device is incorporated in more or less diagrammatic form.

Referring to the drawing, the deference character **10** indicates the body of the carburetor which is provided with an air intake **12** controlled by an unbalanced air valve **14** secured to a shaft **16** which is off-set as shown in the drawing in such a way that the flow of air into the carburetor tends to open the valve. The carburetor is provided with a float chamber **18** to which fuel is supplied through a conduit **20** and the flow of such fuel is controlled by a valve **22** carried by a float **24** which is operative to maintain a constant level of fuel in the chamber **18** in the conventional manner. Fuel is supplied to the manifold passage within the port of the carburetor through a nozzle **26** which terminates adjacent the most restricted portion of a Venturi tube **28** formed in the mixture passage and the flow of mixture from the carburetor is regulated by a throttle valve **30** secured to a shaft **32** journalled in the carburetor body **10** and operated in the usual manner.

The carburetor is secured in the conventional manner to an intake manifold **34** which has a vertical riser pipe **36** extending upwardly from the carburetor and surrounding this pipe is a chamber **38** through which exhaust gases are intended to pass and which constitutes what is generally known in the art as a "hot spot." The control unit for regulating the movement of the air valve **14** is secured to a plate **40** which is adapted to be secured directly to the hot spot by machine screws **42** and secured to this plate **38** in any desirable way, is a housing **44** within which a thermostat, hereinafter more specifically described, is positioned. The plate **40** has an opening **46** which registers with an opening **48** formed in the housing **44** to permit the direct radiation of heat from the wall of the hot spot to effect the heating of the thermostat in accordance with the temperature of the hot spot.

It will be understood that the housing **44** could be secured directly to the exhaust manifold rather

than attached to a hot spot around the riser of the intake manifold as shown, the specific location of the control unit with reference to the heating chamber not being a part of this invention.

The valve 14 is adapted to be operated by an arm 50 which is secured to the shaft 16 and is pivotally connected with a link 52 extending upwardly to an arm 54, which is secured to a shaft 56 journalled in the housing 44 for rotation. Connected at one end to this shaft is a coil thermostat 58 of bimetallic type, the other end of which is secured to the lower end of a link 60, the upper end of which is pivotally connected to a short arm 62 which extends downwardly from and is secured to a piston 64, which is formed of steel and is slidable within a cylinder 66 of brass or some other non-magnetic material. This cylinder is positioned above the housing 44 and is secured thereto by a retaining collar which lies above a flange 68 formed at the lower end of the cylinder and is held in position with respect to the housing 44 by a screw 70 which extends through the collar and is threaded into the wall of the housing 44 as shown in the drawing.

The piston above referred to is normally held in the bottom of the cylinder in which it slides by a spring 72 which is received between the end of the piston and a magnet construction hereinafter more fully described and the piston is adapted to be lifted by the action of engine suction when the throttle valve is closed and the suction between such valve and the engine is high, a suction passage being provided between the riser of the manifold and the cylinder 66 for this purpose. As shown in the drawing, this suction passage or conduit comprises a bore 76 formed in the wall of the riser of the manifold which communicates with a tube 78 which extends into a nipple 80 screwed into a plug 82 which is screwed into the top of cylinder 66, packing washer 84 being provided to prevent leakage at the joint between the plug and cylinder. A stuffing box 86 surrounds the tube 78 and is screwed into the nipple 80 to form a leak-proof joint between the tube and the nipple. The recess in which the nipple 80 is threaded connects directly with a passage 88 formed in the wall of plug 82 and this passage 88 communicates with the interior of the cylinder 66 and the space 90 is provided around the magnet hereinbefore referred to, to permit the communication of the suction from the passage 88 to the space within the cylinder immediately above the piston 64. Obviously, when engine suction is relatively high with the throttle in closed or nearly closed position, the piston 64 is lifted and the lifting of the piston is effected through the thermostat, itself, and the linkage connecting the shaft 56 with the shaft 16 to move the valve toward open position. When the engine is not running and the temperature is relatively low, the thermostat will hold the valve closed with a degree of pressure determined by the degree of temperature. One end of the thermostat which is connected to the link 60 would remain fixed under such conditions and the contracting action of the thermostat due to the variations in temperature would enable such thermostat to rotate the shaft 56 and through the connecting linkage above referred to, can move the valve toward closed position and hold it closed with a pressure depending upon the force of the thermostat, which in turn is dependent upon the engine temperature. When the engine begins to run, assuming that upon starting of the engine the valve is being held closed by the thermostat in the manner described, the lifting of the piston 64 pulls upwardly on the end of the thermostat which is attached to the link 60 and through the medium of the thermostat, itself, lifts the lever 54 to open the valve 14 to a degree dependent upon the movement of the piston under the influence of suction and the degree of contraction of the thermostat at the time the lifting of the piston takes place.

As pointed out previously, if the throttle is opened after the engine begins to run, the suction at the points between the throttle and the engine drops quickly and if the throttle is opened wide, this suction becomes almost negligible. As soon as this reduction in suction takes place, the spring 72 will move the piston 64 downwardly and through the medium of linkage previously described, would move the valve 14 toward closed position. If such an action takes place, the valve 14 would restrict the admission of air to the carburetor to such an extent that an undesirable enrichment of the mixture would occur, the mixture becoming too rich to satisfactorily operate the engine and the engine would, therefore, load and run irregularly. To prevent this action of the piston upon opening of the throttle during the warm-up period, the applicant has provided an electromagnet which he has positioned within the cylinder 66 immediately above the piston 64, which is effective to hold the piston in its upper position against the action of the spring when the throttle is opened as previously referred to.

The magnet comprises a winding 92 which, when the device is assembled, is held between an end plate 94 at the bottom of the winding, and two plates 96 and 98 at the top of said winding, the whole assembly being held in position by a bolt 100, which extends through all of the parts above described and also through an orifice 102 in the plug 82, the head of the bolt being received within the recess 104 formed in the plug 82. Obviously, when the nut on said bolt is tightened up, the whole magnet assembly is held securely together and tightly against the lower face of the plug 82.

The elements 96 and 98 have downwardly extending portions 106 and 108 respectively, which extend substantially parallel with the periphery of the winding 92, and lie partly around the winding. The winding surrounds a sleeve 110 and is separated therefrom by a cylindrical layer of insulating material 112.

One end of the magnet winding 92 is grounded through the connection 114 while the other end is connected by a wire 116 to a binding post 118 which is secured in the wall of the plug 82 and is separated therefrom by a sleeve of insulating material 120. The binding post 118 is connected by a wire 122 to a wire 124 leading to the winding 126 of the usual cut-out relay indicated in its entirety by the reference number 130. The winding 126 is connected with a movable contact 132 which cooperates with a fixed contact 134 connected by wire 136 with a battery 138 grounded by the connection 140. The wire 122 leads to the generator 142 which is grounded at 144 and the winding 126 is grounded by the connection 146.

The operation of the above described mechanism should be entirely obvious. When the engine is at rest and the temperature relatively low, the parts are in the position shown in the drawing with the valve 14 held in closed position

by the action of the thermostat. If it be assumed that the engine be started under these conditions as soon as it starts to run under its own power, the suction becomes effective on the piston **64** to lift said piston and move the valve **14** toward open position. When the engine is operating at a predetermined speed which, in conventional installations, is relatively low, the action of the generator energizes the cut-out relay and moves the contact **132** into engagement with the contact **134** which closes the circuit between the battery and the magnet winding **92**, thus energizing the magnet of which said winding is a part. When the piston **64** has been lifted against the force of spring **72**, by suction, as previously described, the magnet attracts such piston which is made of steel, and exerts a force thereon to hold it in its lifted position.

If, after the engine is operating under its own power with the piston lifted and the magnet energized as described, the throttle is opened relatively wide, the suction drops to an almost negligible quantity. If the magnet above the piston **64** were not employed, the force of the spring **72** and the thermostat would force the piston **64** downwardly far enough to close the valve **14** to a position where the mixture would be too rich for engine operation. The force of the magnet, however, is such that this action is avoided and the valve is held in the proper open position to prevent the too great enrichment of the mixture above referred to. After the temperature of the engine rises sufficiently, the thermostat holds the valve **14** in fully open position and the magnet really has no effect on the valve which would be held open by the thermostat without the magnetic action. It is during the warm up period in which the magnet is primarily useful to obtain proper mixture ratios.

While the embodiment of the present invention as herein disclosed, constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

What is claimed is as follows:

1. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, and a throttle for controlling the flow of said mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, means for normally holding the said element in position to enrich the mixture when the engine is not running at low temperatures, means operated by the engine for moving the said element toward a position to lean the mixture and another means operable by the engine for holding the said element in its mixture leaning position, said last named means being ineffective to move the said element from its mixture enriching position.

2. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, and a throttle for controlling the flow of said mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, thermally responsive means for normally holding the said element in position to enrich the mixture when the engine is not running at low temperatures, means operated by the engine for moving the said element toward a position to lean the mixture and another means operable by the engine for holding the said element in its mixture leaning position, said last named means being ineffective to move the said element from its mixture enriching position.

3. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, and a throttle for controlling the flow of said mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, thermally responsive means for normally holding the said element in position to enrich the mixture when the engine is not running at low temperatures, suction operated means for moving the said element toward a position to lean the mixture and another means operable by the engine independently of engine suction for holding the said element in its mixture leaning position, said last named means being ineffective to move the said element from its mixture enriching position.

4. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, and a throttle for controlling the flow of said mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, thermally responsive means for normally holding the said element in position to enrich the mixture when the engine is not running at low temperatures, suction operated means for moving the said elemen toward a position to lean the mixture and means operable by the generator for holding the said element in its mixture leaning position, said last named means being ineffective to move the said element from its mixture enriching position.

5. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, and a throttle for controlling the flow of said mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, thermally responsive means for normally holding the said element in position to enrich the mixture when the engine is not running at low temperatures, suction operated means for moving the said element toward a position to lean the mixture and means operable by the generator when operating at a predetermined speed for holding the said element in its mixture leaning position, said last named means being ineffective to move the said element from its mixture enriching position.

6. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, and a throttle for controlling the flow of said mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, means for normally holding the said element in position to enrich the mixture when the engine

is not running at low temperatures, means operated by the engine for moving the said element toward a position to lean the mixture and another means operable by the engine for holding the said element in its mixture leaning position, said last named means being effective only after the first mentioned means has moved said element to its mixture leaning position.

7. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture, said mechanism comprising an element for controlling the admission of one of the components of said mixture to the mixture passage, thermally responsive means for holding said element in position to enrich the mixture when the temperature is low and the engine inoperative, engine operated means for moving said element toward a position to lean the mixture when the engine is started under such low temperature conditions, and another engine operated means for maintaining said element in its mixture leaning position while the engine is operating under its own power.

8. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture, said mechanism comprising an element for controlling the admission of one of the components of said mixture to said mixture passage, thermally responsive means for holding said element in position to enrich the mixture when the temperature is low and the engine inoperative, means operable by engine suction for moving said element toward a position to lean the mixture when the engine is started under such low temperature conditions, and another engine operated means for controlling the position of said element independently of the engine suction.

9. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture, said mechanism comprising an element for controlling the admission of one of the components of said mixture to said mixture passage, thermally responsive means for holding said element in position to enrich the mixture when the temperature is low and the engine inoperative, a generator, means operable by engine suction for moving said element toward a position to lean the mixture when the engine is started under such low temperature conditions, and means operable by the generator for also controlling the position of said element.

10. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture, said mechanism comprising an element for controlling the admission of one of the components of said mixture to said mixture passage, thermally responsive means for holding said element in position to enrich the mixture when the temperature is low and the engine inoperative, a generator, means operable by engine suction for moving said element toward a position to lean the mixture when the engine is started under such low temperature conditions, and means operable by the generator for maintaining said element in its mixture leaning position.

11. In a charge forming device for internal combustion engines having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture, said mechanism comprising an element for controlling the admission of one of the components of said mixture to said mixture passage, thermally responsive means for holding said element in position to enrich the mixture when the temperature is low and the engine inoperative, a generator, an electromagnet in circuit with said generator and energized thereby when the engine is in operation, and a piston connected to said element and operable by engine suction to move said element to its mixture leaning position, said piston also comprising the armature of said electromagnet and being adapted to occupy a position so far from the magnet winding, when said element is in position to enrich the mixture, that the magnet is ineffective to move said element from such position.

12. In a charge forming device for an internal combustion engine having a mixture passage, means for supplying fuel and air thereto to form a combustible mixture, mechanism for automatically controlling the proportions of fuel and air in said mixture, said mechanism comprising an element for controlling the admission of one of the components of said mixture to said mixture passage, thermally responsive means for exerting a force on said element, when the temperature is relatively low, to hold said element in position to enrich the mixture, means responsive to the suction of the engine for moving said element toward a position to lean the mixture when the temperature is such that the thermally responsive means tends to hold said element in mixture enriching position and means responsive to engine speed for maintaining said element in its mixture leaning position after it has been moved thereto.

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