

July 31, 1945.

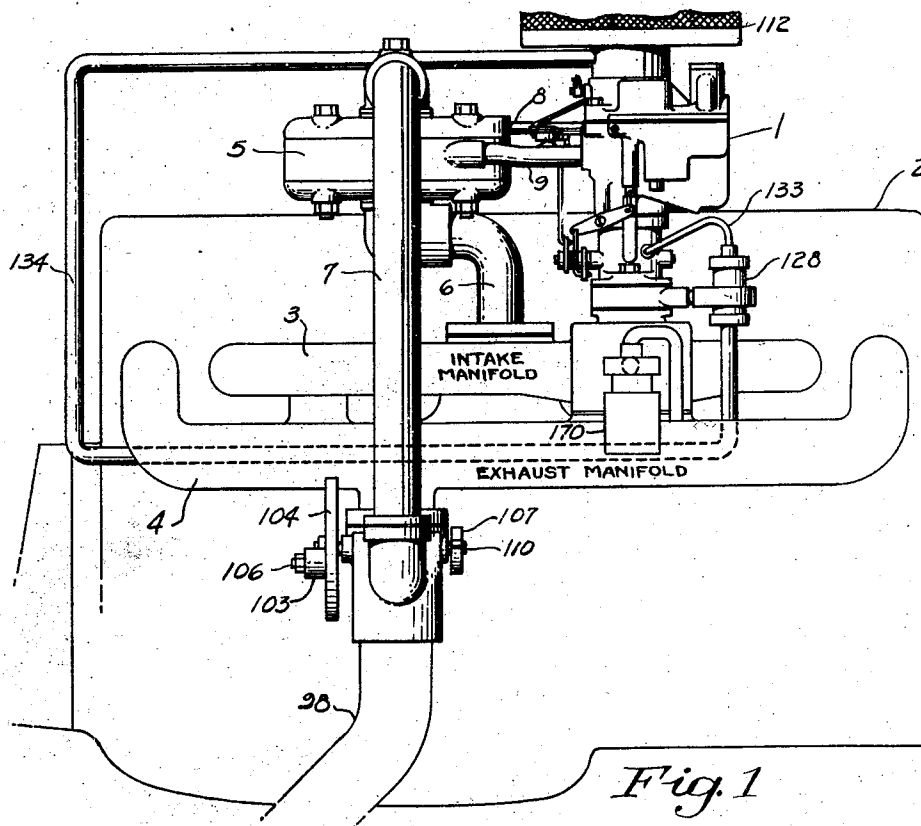
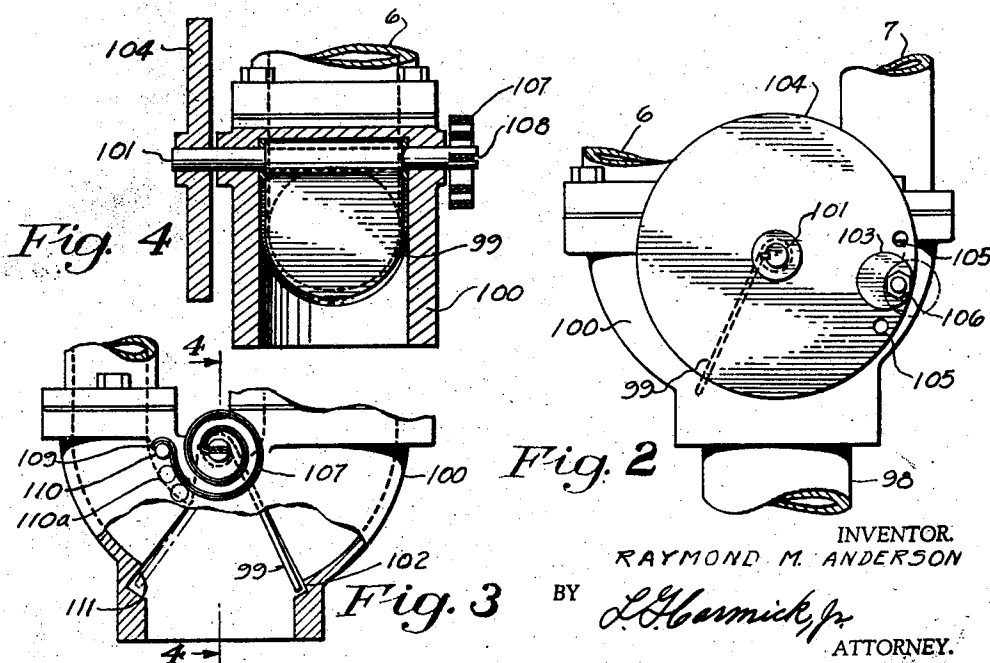
R. M. ANDERSON

2,380,374

INTERNAL-COMBUSTION ENGINE CHARGE FORMING APPARATUS

Filed Nov. 25, 1942

3 Sheets-Sheet 1



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3 Sheets-Sheet 3

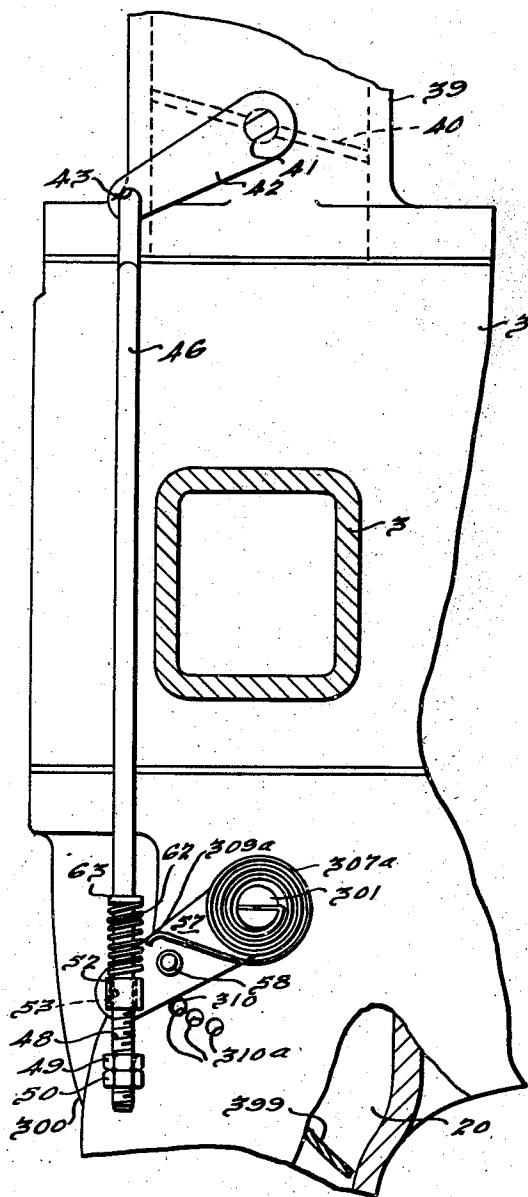


FIG. 9.

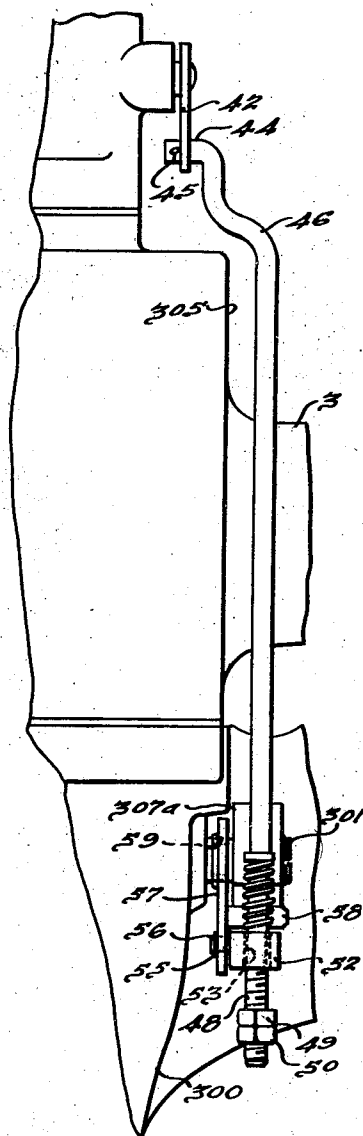


FIG. 10.

INVENTOR

RAYMOND M. ANDERSON

BY

L. H. Carmick, Jr.
ATTORNEY

UNITED STATES PATENT OFFICE

2,380,374

INTERNAL-COMBUSTION ENGINE CHARGE
FORMING APPARATUSRaymond M. Anderson, Detroit, Mich., assignor
to Evans Products Company, Detroit, Mich., a
corporation of Delaware

Application November 25, 1942, Serial No. 466,835

22 Claims. (Cl. 123—122)

This invention is a continuation-in-part of my co-pending application, Serial No. 279,394, filed June 16, 1939, for Internal combustion engine charge forming apparatus and relates to such apparatus and more particularly to certain improvements in automatic heat controls for a fuel mixture heater or in exhaust gas flow regulating valve units and their controls for heating the induction manifold system of internal combustion engines, not only as they may be used with the particular charge forming apparatus of my above identified parent application, but to such improved heat controls or valve units per se, or as they may be used in various other arrangements or with other types of internal combustion engines.

The disclosure of the first embodiment of this invention in the specification and drawings herein is identical with and embodies the disclosure of the exhaust gas flow regulating valve unit in my above identified parent application, which has claims to various other charge forming features and combinations and has certain claims to combinations which include this exhaust gas flow regulating valve unit as an element thereof, but rather broadly set forth and, along with other limitations and elements relative to the special or specific charge forming apparatus of that invention, such as the long mixture heating passage to carry a small part of the total air supply or the separate supplies of auxiliary volatile fuel; whereas, as noted above, the invention of this application, including its first embodiment which may be considered as a division of the said parent application, relates to the more specific aspects and features of my improved automatic heat controls or exhaust flow regulating valve units, either per se or in combination with ordinary or any types of internal combustion engines and their manifolding, and without regard to the rest of the special charge forming apparatus of said parent application.

In general, the objects of this invention are to provide improved, simplified, and more accurate or flexible thermostatic or automatic heat controls or valve control units for the heating of the induction intake manifolding systems of internal combustion engines or a heated part thereof by a regulated flow of exhaust gases.

More specific objects are to provide such heat control units which are particularly well adapted to give sufficient fuel vaporizing heat metered as needed and a substantially constant limiting temperature, satisfactory operation, and economy in internal combustion engines operating on low

grade or heavier fuels or in cold weather, or else to provide designs adapted for ordinary engines operating with ordinary gasoline and under usual conditions to give a higher economy due to more heat except at heavy load or full throttle conditions, to reduce or eliminate valve pounding, to give a safety valve or blow-off valve effect by the exhaust gas pressure acting to open the valve against a biasing force preferably by a weight tending to hold the valve closed, to provide a resilient thermostat tending to open the valve for less heat, this thermostat preferably being a bi-metallic coil carried by and moving with the valve to act in only one direction through an initial lost motion connection so that it does not act on the valve at its lower temperatures, to provide an improved and adjustable arrangement of inertia disc and biasing weight on the valve, to provide a manual adjustment for the operation or range of the thermostat and particularly to thus adjust or to move the valve responsive to engine load conditions preferably by a throttle operated connection including a lost motion to give full volumetric efficiency at heavy loads, to provide a resilient or cushion stop to limit closing motions of the valve and this resilient stop being formed by the thermostat itself, and to provide, in combination with a valve held closed by a weight or the like, a separate spring or yielding stop to define the valve closed position and to operate at all times.

In the drawings, in which like numerals are used to designate like parts in the several views throughout:

Fig. 1 is a general view showing in elevation an embodiment of the charge forming and regulating apparatus of the above identified parent application as a whole and as it appears installed on or applied to a conventional, present-day, automotive vehicle gasoline engine, with the economizer air supply conduit being shown somewhat schematically or diagrammatically to simplify this figure, and this figure including and showing an application of a first embodiment of the exhaust gas flow regulating valve unit of the invention;

Fig. 2 is a detail end elevation view of this exhaust gas regulating unit as viewed from the left in Fig. 1;

Fig. 3 is a fragmentary and elevation of the other side of this exhaust gas regulating unit with portions being broken away;

Fig. 4 is a vertical sectional view of the valve unit taken on the line 4—4 of Fig. 3;

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 6 but with ports of the exhaust manifold

shown in plan and not sectioned, this figure showing a second embodiment of this invention and its application in conventional manifolding;

Fig. 6 is a front elevational view of the organization of Fig. 5, but with portions being broken away and shown in section, this figure showing the application of the second embodiment of my improved valve control to a well known type of mixture heater and valve or hot spot in the intake manifold and the associated exhaust manifold and connections;

Fig. 7 is a section taken on the line 7—7 of Fig. 6;

Fig. 8 is a part end and part sectional view taken on the line 8—8 of Fig. 6;

Fig. 9 is a part end and part sectional view taken on a line like Fig. 8, but showing a third embodiment or other or additional features which may be employed and a slight change in the bimetallic coil; and

Figure 10 is a front elevational view or a view looking from the left in Fig. 9.

While in general the exhaust heat control valve units or the like within the purview of this invention may be applied to or used in combination with various sorts of internal combustion engine intake manifolding system heaters, yet, since the specific design of the first embodiment hereof is particularly well adapted for satisfactory operation with a particular manifolding system to vaporize heavy or low grade fuels in a small part of the total air supply at higher limited temperatures, I have included herein those portions of the drawings and specification of my above identified parent application which relate more directly to the present invention and I have briefly summarized herein the rest of the organization of such parent application; however, I intend to include herein by reference the balance of the disclosure of this parent application in order to give, if desired, a complete understanding of this particular embodiment or application of the present invention.

However, as noted above, it is to be understood that this invention, and particularly the broader aspects of the first or divisional embodiment hereof is not intended to be limited or necessarily restricted to use with this particular sort of internal combustion engine charge forming arrangement, since it will be generally apparent to those skilled in this art and will be seen by analogy with my second embodiment that the relative proportions, biasing forces, temperature ranges, and the like, can be changed to use this general design in engine mixture heaters having quite different requirements, such as conventional engines using ordinary gasoline.

As shown in the general organization view of Fig. 1 the charge forming and regulating apparatus of the said parent application is applied to a conventional type of automobile or truck gasoline engine 2 having the usual exhaust manifold 4, exhaust pipe 98, the usual intake manifold 3 drawing in air and fuel from an intake conduit and carburetor of the down-draft type having the conventional air cleaner 112 and having the usual throttle and choke therein. Carburetor unit 1 is here a special multi-fuel type, as generally described herein.

In Fig. 1, unit 128 is a special economizer to supply metered heated air from the schematically shown pipe 134 into the intake beyond the throttle under the control of the movable throttle plate through the conduit 133.

Number 170 is an anti-detonation unit to meter

exhaust gas into the intake manifold only under heavy load conditions.

It is to be understood that these two units are not material to the present invention.

Closely adjacent the multi-fuel carburetor 1 is mounted a compact, flat vaporizer heater unit 5, which is externally jacketed to provide an exhaust gas space entirely surrounding the inner coiled or flat spiral mixture heating passage. The exhaust gases flow to and from this heater 5 by connections 6 and 7 respectively, which pipes may also support the heater. Thus, the desired heating flow of exhaust gases is controllably bypassed from and back to the exhaust manifold 4 and exhaust pipe 98 by the valve unit 103, etc., which forms the first embodiment of this invention. This valve unit is controlled by the exhaust gas temperature and flow rate. Inside of the heater 5 is a flat, spiral air and fuel mixture heating and vaporizing passage, the inner end of which is supplied by a passage including pipe 8 with a small part (5% to 10%) of the engine's total air supply from the intake conduit between the choke and air cleaner and with a main varying metered fuel supply of oil or gasoline as selected by suitable snap action valves in the carburetor unit 1, and as mixed or atomized by the mixture atomized by a primary venturi at the entrance to pipe 8 and forming a part of the combined carburetor unit 1.

Thus, in this specific embodiment of the parent application, the major part of the engine's air supply is sucked down through the intake conduit (comprising the riser, the mixing chamber, and the intake manifold) in the usual fashion, while a small proportion (preferably about 5% and less than 10% of the total air supply) is drawn through a separate passage, which includes horizontal connections 8 and 9 and the substantially horizontal, tortuous, mixture-heating passage in the heater 5. This passage is supplied by the above noted primary venturi from one of the two heavy and light fuel bowls in the carburetor 1 as selected by snap action valves. This super-rich mixture is heated to a high temperature so that the sprayed fuel is partly gasified, partly vaporized, and the balance finely divided. For the sake of simplicity, this condition is hereinafter referred to as "vaporized."

It will be seen that, for starting and until the engine has come up to temperature, only gasoline or the like will be supplied to the vaporizer-heater unit's venturi for discharge into the annular space in the composite inner venturi of the multi-venturi set of the main mixing chamber (none of which are shown here). Manually operated or automatically controlled valves may control the change-over from gasoline to heavy fuel, or vice versa, at starting or at other times, as is well known in this art.

Another feature of the parent application is the provision of auxiliary fuel supplying means to supply volatile unheated fuel directly into the intake conduit concurrently with the varying supply of the high temperature, super-rich, air-fuel mixture into the intake conduit. It is particularly desirable to supply a compensating or limited flow of volatile fuel (which is relatively constant at normal running speeds) in conjunction with the hot, rich oil-air mixture so that the proportion of volatile fuel to the total fuel is large at low speeds and small at higher speeds and loads. Similarly, it is desirable to have an idling supply of volatile fuel only.

Carburetor unit 1 also contains an entirely

conventional type of compensating jet assembly and idling assembly and also embodies a conventional accelerator pump, all operating only on gasoline to continuously supply auxiliary volatile fuel, together with the main vaporized light or heavy fuel supply through the heater 5 which also goes into the same main mixing chamber venturi.

It is quite important that the temperature of the super-rich heated mixture be maintained within reasonably close limitations. In the present embodiment it has been found that, although better results are obtained the more closely the mixture temperature is regulated, satisfactory results are obtainable with variations up to 50 degrees F. In the present embodiment a close regulation is accomplished by regulating the flow of exhaust gas through the by-pass circuit which includes the vaporizer-heater.

Referring to Figs. 2, 3 and 4, it is seen that the unbalanced exhaust regulating valve 99, which is preferably pivoted at one edge by being fixed on rockable pin 101 journaled in the side walls of the Y fitting 100, may seat against a shoulder 102 to close this leg of the Y fitting to force all of the exhaust gas around through the vaporizer-heater. When wide open, valve 99 seats against shoulder 111. To prevent fluttering and pounding on its seat, this valve is inertia damped by a comparatively heavy fly wheel 104 fixed on its pin 101. This wheel carries a weight 103 adjacent its periphery to bias the valve toward its closed position against seat or shoulder 102. It will be noted that a bolt 103 secures this weight to the wheel in any one of the plurality of holes 105 so that the weight is adjustable angularly around the periphery of the wheel; and since the bolt hole in the weight itself is eccentric, the weight may be moved in or out radially, both of which movements permit a nice adjustment of the effective lever arm of the weight acting on the valve so that the temperature setting may be varied for different installations, for different fuels, for winter and summer operation, etc. In addition, the pin 101 is fixedly connected to the inner end of a bimetallic coiled spring 107, the outer hooked end of which 109 is fixed to pin 110 which may be adjustably secured in any one of a plurality of holes 110a to give a further adjustment for the temperature setting or calibration for this valve unit.

Bimetallic temperature responsive member 107 is set to hold the valve in position against seat 102 to direct all exhaust gas through the heater 5 set at low temperatures and at temperatures slightly above the desired setting, which, as noted above, may be about 400 degrees F., to move the valve toward seat 111 to an extent dependent on the temperature and the pressure exerted on the valve. It will be apparent that since this bimetallic element is mounted adjacent the fitting 100 its action will be responsive to exhaust gas temperatures. The butterfly type valve 99 itself is responsive to the rate of flow of the exhaust gas, which is a function of engine load-speed conditions.

It will be apparent that in normal operation this exhaust gas regulator valve will occupy some intermediate position dependent upon the exhaust gas temperature and flow rate to limit and to regulate the exhaust gas made available to the vaporizer-heater and consequently the mixture temperature.

In the first embodiment just described I have provided a heat controlling exhaust valve unit

which is designed to provide a relatively high but limited, or constant, when possible, temperature for the heater. However, it will be seen that this design could be readily modified to provide a lower and variable temperature, as for use with an ordinary gasoline automobile engine hot spot. Also, in this first form my heavy inertia disc or wheel 104 will practically eliminate valve pounding, and its offset weight 103 will tend to hold the valve closed for maximum heating, even when the bimetallic strip 107 is cold and does not exert any appreciable valve opening effect, so that this weight gives a safety or blow-off valve effect, permitting a sudden increase in exhaust gas pressure or flow to open the valve to a controlled amount and thus prevent undue heating, and to have a heating gas flow regulating action to give a more constant heating or temperature in the heater 5. This weight also acts with a progressively decreasing torque, due to its decreasing effective lever arm, as it opens so that it is strongly held closed at low exhaust flow rates and more easily held open when it is open at high exhaust flow rates to correct for the decreasing effective area of the valve 99.

I prefer a weight, such as 103, to a spring to bias my valve since a weight aids by the inertia or damping effect and is simpler and not adversely affected by the high temperature. The several holes 105 permit the effective lever arm of the weight and also its change in lever arm as it moves to be varied while the rotational adjustment of eccentric weight 103 gives a second and finer adjustment for calibration or the like. If desired, and as shown in the second embodiment, portion 109 can merely loosely engage pin 110 so that the thermostat is only a one-way action to open the valve, and the various features of this second embodiment may be employed here or the features of this first embodiment, such as the use of the inertia wheel 104 and the adjustable weight 103 may be used in the design of the second embodiment.

Referring to the second embodiment of my invention, Figs. 5, 6, 7 and 8 in particular, illustrate the central parts of an intake manifold and an exhaust manifold, together with the combined mixture heater or hot spot, and its exhaust gas flow regulating valve. Before proceeding to the more detailed description of these parts, it should be noted that the structure of the exhaust and intake manifolding, the hot spot or heater, and the valve itself, are of a conventional and well known form, in fact, these figures illustrate the structure employed in the present Chevrolet automobile or truck engine and show how that conventional structure may be easily modified to embody my invention in the controls for the exhaust flow regulating valve. Thus, the particular structure of the manifolding, the heater, and the valve proper, form no part of this invention per se, and enter into this invention as environment or background therefor, or in combination with my improved features.

As shown, the intake manifold 3 (the ports not being shown), has the central, integrally cast hot spot or heater portion 305 which, as is understood, is to be used with a down-draft carburetor throttle barrel or intake riser mounted on its upper portion, so that the intake riser pipe, or throttle barrel 39 as shown in Fig. 9, may be matched to opening 14 and suitably secured, as by bolts through the bolt holes 14a. Thus, the air and carburetted fuel will flow down and in the directions indicated by the double headed arrows

through the exhaust jacketed and heated chamber 13 which is in the form of a tube having a closed bottom 15 and arranged so that, adjacent its bottom, the air-fuel mixture splits three ways, one part going rearwardly through the opening 12 and the connecting rearwardly extending passage 11 having the opening 10 adapted to be connected with the common opening to the two center Siamesed intake ports, and the other two parts going left and right into the left and right two openings 16 and into the two end portions of the intake manifold 3 to go on to the two remaining pairs of ports (not shown) of the six cylinder engine.

The conventional exhaust manifold 4 has the usual ports, two of which are indicated at 4a, and its central portion is shaped to direct the exhaust gases forwardly by its converging walls having the point 22. These forwardly directed exhaust gases flow into the valve housing 300, where the flow is controlled by the unbalanced, swingable valve 399, so that when the valve is open or in the position shown at 399' in Fig. 7, the flow will be mostly straight down through the opening 20 into the usual exhaust pipe, while, when the valve is practically closed, as shown at 399 in Fig. 7, almost all of the exhaust gas flow will be diverted or by-passed upwardly through the passage portion 17 around the conduit or passage 11 and into the annular passage 19 past the valve and so to the exhaust pipe. Note that the paths of the exhaust gases are shown by the single headed arrows.

The bottom 15 of the heating tube 13 is provided with a cast-in portion 21 to form a stop for the upper end of the unbalanced valve 399 to thus define its closed or heating position, in which there will be a slight leakage flow since the other end of the exhaust valve does not quite seat on the adjacent wall portion 302 which would otherwise be the closed position valve seat. When the valve is entirely open it seats against the wall portion or seat 311.

It will be appreciated that the unbalanced valve 399 will be biased toward its open or non-heating position by the exhaust gas pressure thereon as a function of the exhaust gas flow rate.

The valve 399 has a curved shape as shown and has the oppositely struck out portions 399a which are suitably secured, as by welding shown at 301a, to the pivot shaft 301, which is journaled in and extends through the side walls of the valve body 300. As used in this Chevrolet construction, one end of this shaft has thereon the biasing and inertia weight with the offset portion 303 and the reduced end portion 304 having a hole therein to receive the shaft and be secured thereon as by the cotter pin 304a or the like which extends through a corresponding hole in shaft 301. The other outside end of shaft 301 is slotted, as at 308, to receive the suitably secured inner end of the coiled bimetallic strip 307 having its other or free end acting against a relatively fixed abutment.

As noted above, the foregoing detailed structure is identical with the Chevrolet hot spot, manifold, and valve unit, except for the particular arrangement and action of the weight 303, the thermostat 307, and the adjustable thermostat abutment 310, and this portion of the disclosure will indicate how easily this well known control unit may be modified to embody my invention and thus have a different and improved operation.

I have modified this conventional heat control unit so that the valve is always biased toward closing position, as in my first embodiment, pref-

erably a weight acting on a decreasing effective lever arm as the valve is opened. If desired, this weight may be made adjustable as in my first form. Also the yielding or resilient thermostat acts to open the valve for less heat preferably through a one-way connection, and an initial lost motion with suitable adjustments.

Thus, instead of the offset weight portion 303 extending up and a little to the rear so that it would bias the valve toward open position with a progressively increasing biasing effect as the valve is opened, as is done in the Chevrolet arrangement, my offset weight portion 303 is mounted in an angular position so that when the valve is closed it is substantially in the position 303 as shown in Fig. 7 so that it tends to always bias the valve toward closed or heating position with a progressively decreasing biasing effect as the valve is opened or so the weight is moved toward the position as shown at 303' in Fig. 7.

Referring to the arrangement of the thermostat which is carried by, and always movable with, the valve member or its valve shaft 301, my bimetallic coiled strip does not resist opening movements of the valve or tend to close the valve, as in the above noted Chevrolet construction but acts in the opposite direction, the coiled bimetallic strip 307 being arranged and wound in such a direction that its free and slightly hooked end portion 309 tends to move counter-clockwise, as seen in Fig. 8, as it is heated by the exhaust gas so that, after it takes up the lost motion between the moving end 309 and the relatively fixed abutment or pin 310, it will start to bias the valve toward its open or non-heating position.

I have provided means to manually adjust the range or action of the thermostat in connection with the initial lost motion. Obviously, the adjustment may be great enough to take up all of the initial lost motion if this should be desirable in any particular design.

Thus, the position of the abutment pin 310 may be manually adjusted by suitable means, as my mounting it in one of the several holes 310a to thus manually adjust or pre-set the range of the thermostat or the point at which it will push off from pin 310 and thus start biasing the valve. This manual adjustment will be useful for calibration or for setting the unit for different fuels or for different climatic conditions such as cold or hot weather.

It will be seen that my resilient thermostat can act on the valve in only one direction and thus has a one-way action, preferably through an initial lost motion connection. Also the thermostat, which acts in the same direction as the exhaust gas pressure or flow, may not always be operating since an increased exhaust gas pressure will hold the valve open to a degree where 309 does not engage pin 310.

It will be noted that when the thermostat is hot, as it will be during normal operations, it will limit closing motions of the valve and thus serve as a resilient or cushioning stop, preventing the pounding of the valve on its seat or against its end stop 121 due to the flutter induced by pulsations in the exhaust gas flow acting to intermittently bias the valve open.

However, in cases where the weight of the valve itself and the parts moving therewith including the thermostat and the weight 303 do not provide enough inertia dampening to eliminate this objectionable pounding sufficiently, I may provide a resilient or spring cushioning stop to limit or define the valve closed or heating posi-

tion and to act at all times, even when the thermostat 307 is not acting on the valve, as when it is too cold.

Thus, I have provided the leaf spring 30, bent or curved as shown and having its upper end secured on the inner flat side of the offset weight portion 303 by the two screws or the like, 31 and 32. The lower or free end portion of the spring 30 extends out or away from the weight to yieldingly engage the end of the pin 37, whose inner end portion is threaded to the received in the corresponding tapped and threaded hole 26 in the boss 25 cast on the exhaust manifold 4 as shown. The stop or abutment forming rod 27 may be locked in any desired adjusted position by the lock nut 28 engaging the same threaded portion. It will be seen that the point at which the spring 30 engages or starts to act may be adjusted by bending the spring in or out, as is well known in connection with leaf springs, by having screw 32 formed with a portion such as a lock nut thereon, to engage on the inner side of the spring 30 so that as screw 32 is screwed in or out it will adjust the free end of spring or, as shown, by screwing the stop rod 27 in or out and locking it in the desired position by nut 28. When the cushioning stop 27 and 30 is used I may eliminate stop 21, move it further over or otherwise change the valve design or shape.

As shown in Figs. 9 and 10, I may slightly modify and add to the structure of Figs. 5 to 8, so that the manual adjustment of the position of the abutment engaged by the free end of the bimetallic spring (here designated as 307a) is done by the throttle.

In Figs. 9 and 10 the structure is identical with Figs. 5 to 8 except as noted. The bimetallic spring 307a is shaped or bent slightly differently, so that its free end 309a is slightly further around or higher. The intake riser portion or throttle barrel 39 mounted on the heater portion 305 has the usual throttle therein actuated by a suitable manually operated linkage (not shown) and is mounted on the throttle shaft 41, the exposed end of which has suitably fixed thereto a swingable link 48, having in its free end a hole 43 to receive and journal therein the bent-over upper end portion 44 of the link rod 46 suitably held in this hole, as by the cotter pin 45. It will be seen that rod 46 may be bent or otherwise shaped to clear the interfering heater portion 305. The lower end portion of rod 36 is threaded, as at 48, and carries thereon the adjustable abutment forming nut 49 held by a lock nut 50. As shown, this lower portion of the rod above the nut 49 is freely slidable in and through the opening 53 through the swivel block 52, whose reduced pin forming end portion 55 is pivotably mounted or swivelled in a suitable hole formed in the free end portion of the downwardly inclined link 57, the other end of pin portion 55 being peened over to secure it in link 57. Link 57 carries, intermediate its end, pin 58 suitably fixed thereto, as by an end portion projecting through a hole in the link, and then being peened over. Thus, pin 58 supplies a relatively fixed but adjustable abutment corresponding in its general functions to pin 310 in Fig. 8.

The downward or counter-clockwise position or motion of link 57 is limited by pin 310, whose position may be adjusted as by the holes 310a. The other, or fixed pivot end of link 57, has a bearing forming hole 59 to receive and pivot it on the shaft 301 inside of the bimetallic strip

307a, thus saving an extra pivot and permitting a more compact and neater assembly.

Link 57 may be made sufficiently thick and heavy so that it is biased by its own weight and thus held to prevent vibration and clicking or pounding. If desired, spring 62 may be mounted on the rod 46 between the suitably fixed collar or abutment 63 thereon and the swivel block 52 on the link 57 so that this weak spring yieldingly holds link 57 against its stop 310 except when the throttle is opened.

It will be seen that I have provided here a lost motion connection, so that when the throttle 40 is substantially fully opened as under full load conditions the rod 46 will be listed until it takes up the lost motion and the nut 49 engages the swivel block on the link 57 to lift the link or swing it clockwise and to thus similarly move the pin 58. This will change the range or starting point of the thermostat 307a or, considered in another way, rod 46 will push the valve 399 open through the resilient thermostat 307a when the throttle is opened wide. The amount of this lost motion can be adjusted by moving nut 49 along the threaded portion 48 and locking it in position by lock nut 50. It will also be apparent from these teachings that throttle operated connections of this nature may be readily arranged to act directly on the valve or valve member through some other projection from the valve shaft such as the valve weight 303.

Thus, in Figs. 9 and 10 I have disclosed an arrangement whereby the range or action of the thermostat is adjusted or changed in accordance with engine load conditions preferably by throttle movement and also preferably, but not necessarily, through a lost motion connection so that there is normal or full heating up to substantially wide open throttle although this point can be adjusted as desired.

A number of other changes or modifications within the scope of this invention will become apparent to those skilled in this art from the foregoing teachings. For example, in either embodiment there may be other sorts of thermostats, or cushion stops, a balanced valve may be used to eliminate the exhaust gas pressure biasing effect, within the broader scope a spring or other biasing means may be used in lieu of the weight. The weight or the like may be on the same end of the valve shaft with the thermostat, the thermostat may be shielded or otherwise controlled to regulate the cooling air flow thereover or the transfer of heat thereto, and, of course, the several parts may be of various proportions and designs.

Although the foregoing description of the three illustrated embodiments is necessarily detailed, yet it is to be understood that this detailed description and the specified terminology is not intended to be restrictive and that various omissions, rearrangements or other modifications of parts in addition to those mentioned herein, may be employed without departing from the scope or spirit of the invention as claimed herein.

I claim:

1. A heat control for the manifolding system of internal combustion engines, including means to heat the air-fuel mixture and connections for supplying exhaust gases from the exhaust manifold to said heating means, comprising an unbalanced swingably pivoted diversion valve to divert the flow of exhaust gas through said heating means when closed and being arranged to be biased toward open position by the pressure of

exhaust gases thereon, exhaust gas temperature responsive means biasing said valve toward open position, and an inertia weight carried by said valve to prevent fluttering by inertia damping and acting to bias said valve toward closed position.

2. An exhaust gas valve unit to control the flow of exhaust gases through an internal combustion engine air-fuel mixture heater comprising an unbalanced valve biased toward its non-mixture heating positions by the pressure of the exhaust gases thereon, means to bias said valve toward its mixture heating position, and a thermostat heated by the exhaust gases to bias said valve toward its non-heating positions.

3. A heat control for the induction manifold-ing systems of internal combustion engines including a heater and connections for supplying exhaust gases from the exhaust manifold to said heater, comprising a valve to divert the flow of exhaust gases through said heater when closed, automatic control means to bias said valve toward open position in accordance with operating conditions of the engine, and a weight to bias said valve towards its closed position.

4. The organization as set forth in claim 3, in which said weight is mounted to have progressively decreasing effect as the valve is opened.

5. A heat control for an internal combustion engine mixture heater, including an unbalanced valve for diverting exhaust gases from the exhaust manifold through the mixture heater; said valve being adapted to be opened to by-pass the exhaust gases away from the mixture heater by the pressure of the gases thereon, a thermostat also biasing said valve toward open position when hot, and a weight biasing said valve toward closed position.

6. An exhaust gas valve unit to control the flow of exhaust gases through an internal combustion engine mixture heater, comprising a valve, means to bias said valve toward mixture heating position, and a thermostat having a lost motion connection with said valve to start to bias it toward non-mixture heating position only after a predetermined temperature rise.

7. An exhaust control for an internal combustion engine induction manifolding system heater, comprising a swingably pivoted valve to divert exhaust gases through said heater when closed, a heavy inertia disc fixed to rotate concentrically with said valve to damp out flutter or pounding by its inertia, and means to automatically control said valve in accordance with engine operating conditions, including a thermostat and a valve biasing weight mounted in an eccentric position on said disc.

8. The organization as set forth in claim 7 in which said weight is itself an eccentric, adjustably mounted so that the effective lever arm and position of the weight can be adjusted.

9. A heat control for the air-fuel mixture heater of an internal combustion engine having a movable throttle, said control comprising a valve unit for controlling the diversion of exhaust gases through the mixture heater and including a valve, biasing means including a thermostat biasing said valve toward its non-heating position, and throttle operated means for applying a force to said valve as said throttle is opened to assist said thermostat in moving the valve toward its non-heating position.

10. A valve and automatic control unit for an air-fuel mixture heater of an internal combustion engine having a movable throttle, said unit

comprising a valve for controlling the flow of exhaust gases through the heater, biasing means including a resilient thermostat for controlling said valve, and means for modifying the action of said thermostat in accordance with throttle position, including a one way connection acting between said throttle and said resilient thermostat.

11. A valve and automatic control unit for an air-fuel mixture heater of an internal combustion engine having a manually movable throttle, said unit comprising a valve for regulating the diversion of exhaust gases through the heater, biasing means for controlling the position of said valve and including a coiled bimetallic strip having one end acting on said valve, and means including a one way connection to positively move the other end of said bi-metallic strip only when the throttle is moved in one direction.

12. A heater for the air-fuel mixture induction system of an internal combustion engine, said heater including a valve to regulate the flow of exhaust gas through said heater, and an automatic control therefor, said control comprising biasing means for controlling the actuation of said valve and including a coiled bi-metallic strip thermostat having one end acting on said valve and biasing said valve only towards its non-heating position, and means, including a one way, lost motion, to manually adjust the position of the other end of said strip to thus modify the action of said thermostat in accordance with operating conditions.

13. A heater for the air-fuel mixture in the induction system of an internal combustion engine, said heater including a valve to control the flow of exhaust gases through said heater and an automatic control therefor, including a resilient thermostat acting between said valve and a relatively fixed support through a lost motion connection to bias said valve toward its non-heating position only after said thermostat has reached an intermediate higher temperature, and means to manually adjust the position of said support to thus modify the action of said thermostat.

14. An automatically controlled heat regulating valve unit for an air-fuel mixture heater in the induction system of an internal combustion engine, said unit comprising an unbalanced valve biased toward its non-heating position by the flow of exhaust gases and controlling said flow, a thermostat also biasing said valve toward its non-heating positions, means to bias said valve toward its heating position, and a yielding or cushion stop determining the extreme heating positions of said valve to prevent its pounding.

15. An automatically controlled heat regulating valve unit for an air-fuel mixture heater in the induction system of an internal combustion engine, said unit comprising an unbalanced valve biased toward its non-heating position by the flow of exhaust gases and controlling said flow, biasing means to automatically control the position of said valve including a thermostat and means tending to hold said valve in its extreme heating position, and a yieldable cushion stop to prevent valve pounding, comprising a relatively fixed abutment and a spring fixed with respect to and always movable with said valve to yieldingly engage said abutment only as the valve moves to its extreme heating positions.

16. The organization as set forth in claim 15, including means to manually adjust the normal relative positions of said spring and abutment

to thus pre-set the maximum heating exhaust gas flow.

17. An exhaust gas heater for the induction system of an internal combustion engine, including a valve to controllably divert the flow of exhaust gases through said heater when closed and biased toward its open positions by the exhaust gas pressure thereon, means to bias said valve toward closed position and a resilient thermostat heated by the exhaust gases and, when hot, biasing the valve toward its open position and yieldingly resisting closing movements of the valve whereby the thermostat also serves as a resilient stop to limit the closing movements of the valve and prevent pounding during normal operation.

18. An exhaust gas heater for the induction system of an internal combustion engine, including a valve to controllably divert the flow of exhaust gases through said heater when closed and biased towards its open positions by the exhaust gas pressure thereon, control means to variably bias said valve and including a thermostat having a lost motion and one-way operating connection between said valve and a relatively fixed member, so that said thermostat acts upon the valve in only one direction and not at the cold or lower end of its temperature range.

19. An automatically regulated exhaust gas heater unit for the induction system of an internal combustion engine, including a swingably pivoted valve to divert exhaust gases through said heater when closed, and means to variably bias said valve in accordance with engine operating conditions and including exhaust gas pressure acting to open said valve and a coiled bi-metallic strip thermostat biasing the valve toward its open position and having its inner end fixed to said valve member so that the thermostat is entirely carried thereby, and a relatively fixed but adjustably movable member to be freely engaged by the other end of said thermostat

which thus actuates the valve in only one direction in accordance with its temperature and the adjusted position of said relatively fixed member, and whereby the valve may be swung open by the exhaust gas pressure without resistance from said bi-metallic strip.

20. A heat control valve unit to automatically regulate the flow of heating exhaust gases through a heater in the intake manifold of an internal combustion engine having a movable throttle comprising a valve and valve controlling and actuating means responsive to temperature, and means moving with said throttle and connected to act through and to aid or increase the action of said temperature responsive valve controlling means to cause said valve to be moved toward non-heating position only at substantially full throttle positions to thereby obtain full volumetric efficiency and performance under heavy loads and open throttle and yet to have maximum heating and economy at all lesser throttle openings.

21. A heat control for a heater in the induction manifold of an internal combustion engine comprising a valve to control the flow of exhaust gases to said heater and means to automatically control the operation of said valve including a temperature responsive means acting to bias said valve only toward its non-heating positions.

22. A heat control for a heater in the induction manifold of an internal combustion engine comprising an unbalanced valve to control the flow of exhaust gas to said heater and biased towards its non-heating position by increased exhaust gas flow and means to automatically control the operation of said valve in accordance with engine operating conditions including a weight always biasing said valve toward its heating positions and temperature responsive means biasing said valve toward its non-heating position to thus aid said increased exhaust gas flow.

RAYMOND M. ANDERSON.