This invention relates to speed modulating devices for motor vehicle engines, and more particularly to an automatic device for admitting supplemental air into the intake manifold of a motor vehicle engine primarily to tend to maintain a uniform vehicle speed and incidentally to effect a saving in fuel costs.

I am aware that numerous types of auxiliary air inlet valves for motor vehicle engines have been developed principally for the purpose of effecting a saving in fuel costs. These valves have been of several types and, so far as I am aware, all possess inherent disadvantages which more than outweigh their advantages. For example, valves of the type referred to of which I am aware possess the disadvantage of rendering the fuel mixture too lean under substantial load conditions on the vehicle engine, thus materially reducing the engine power when needed. Moreover, such devices are inherently disadvantageous in practice for the reason that they tend to result in too high a vehicle idling speed, thus requiring frequent disengagement of the clutch of the vehicle when moving in slow traffic.

The present device has for its principal object the provision of a novel control mechanism which tends to render uniform the speed of travel of a motor vehicle for a given throttle opening and under varying load conditions.

More specifically, an object of the invention is to provide a valve mechanism which functions automatically, at any given throttle opening, to admit supplemental air into the intake manifold when the vehicle is traveling under light load conditions, as when going down hill, and which functions to completely cut off the admission of auxiliary air during increased load conditions, as when the vehicle is traveling up-hill, thus resulting in a marked tendency for the vehicle to travel at a uniform speed for a given throttle position.

A further object is to provide a mechanism of the character referred to which is inoperative at idling engine speeds, thus preventing excessive idling speeds and eliminating the necessity for frequently disengaging the clutch of the vehicle when traveling in slow traffic.

A further object is to provide an auxiliary air valve of the character referred to which functions at the relatively high vacuum present when the vehicle engine is idling to cut off the admission of auxiliary air into the intake manifold, and which automatically functions to admit auxiliary air under varying vacuum conditions in the intake manifold between the relatively high idling vacuum and a substantially lower predetermined vacuum below which the vehicle engine demands maximum explosive efficiency incident to increased load conditions.

A further object is to provide a valve mechanism of the character referred to which functions to cut off the admission of supplemental air at intake manifold vacuum conditions which are present at normal idling speeds, but which functions to admit supplemental air above and below such vacuum conditions.

A further object is to provide a valve mechanism which possesses the inherent desirable characteristics referred to and which incidentally increases fuel mileage and thus reduces fuel costs.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawing I have shown two embodiments of the invention. In this showing—

Figure 1 is a side elevation of a motor vehicle carburetor and intake manifold showing a part of the vehicle engine, the manifold being broken away.

Figure 2 is an enlarged axial sectional view through the valve mechanism.

Figure 3 is a sectional view on line 2—3 of Figure 2, and,

Figure 4 is a view similar to Figure 2 showing a modified form of the invention.

Referring to Figure 1, the numeral 10 designates a portion of a motor vehicle engine having a conventional intake manifold 11 for supplying a combustible fuel mixture to the several cylinders of the engine. Such fuel is provided through the normal functioning of the usual carburetor 12 in the riser 13 of which is arranged a conventional throttle 14. While the arrangement shown is conventional for a down-draft carburetor of the type now in common use, it will become apparent that the present invention is not limited in its use to any particular forms of carburetor or intake manifold.

Referring to Figures 1 and 2, the present invention comprises a preferably conical valve body 15 having a cylindrical upper end 16 which is externally threaded for reception in the flange of a cap 17. This cap is provided with an axial threaded portion 18 to be received in a tapped opening 19 formed in the bottom of the intake manifold 11 preferably in axial alignment with the riser 13. The cap 17 is further provided with an axial tubular portion 20 formed integral with the threaded portion 18 and of somewhat smaller diameter than the latter to facilitate its intro-
duction through the opening 19. The upper end of the tubular member 20 terminates in close proximity to the throttle valve 14 for a purpose to be described.

It will be noted that the opening 21 through the tubular member 20 communicates at its lower end with the interior of the valve body 15 to receive air therefrom. Such air is admitted into the valve body 15, under conditions to be referred to, through a lower axial opening 22 formed in a threaded extension 23. This extension may have a pipe 24 (Figure 1) leading to the crank case of the motor vehicle or directly communicating with the atmosphere through a suitable air cleaner. However, the particular source of air supply forms no part of the present invention and need not be illustrated in detail.

The interior of the valve body is provided around the upper end of the opening 22 with a valve seat 25. A floating valve element 26 is arranged within the valve body 15, the valve element 26 preferably being conical and corresponding in taper to the taper of the valve body 15. The lower end of the valve element 26 forms a valve 27 adapted to engage the seat 25, and within the valve face 27 the lower end of the valve element 26 is preferably provided with a recess 28 for a purpose to be described. In order to assist in the proper operation of the device in the manner to be referred to, the valve element 26 is preferably provided with a plurality of annular recesses 29 formed in its outer face.

A compression spring 30 has its lower end engaging the inner face of the bottom of the valve element 26, the diameter of the spring preferably equalizing the diameter of the face of the valve element 26 which it engages. The upper end of the spring fits around a depending cylindrical member 31 preferably formed integral with the cap 17. The mounting of the spring tends to minimize lateral movement of the valve element 26 when the latter is in its open or intermediate position. The spring 30 is loaded to a predetermined extent to be referred to later and the spring tension may be adjusted by turning the key on the end plate 17 upwardly and downwardly on the upper end 16 of the valve body. A jam nut 32 is provided for securing the cap 17 in any desired position in accordance with the desired loading of the spring 30.

The upper end 33 of the valve element 26 also acts as a valve and is engageable with a valve seat 34 formed on the lower face of the cap 17. Under predetermined relatively low vacuum conditions in the intake manifold the valve 27 engages the seat 25, and under higher vacuum conditions, for example at idling speeds of the vehicle engine, the valve 33 engages the seat 34. Under intermediate vacuum conditions, the valve element 26 occupies variable intermediate positions between the two positions referred to for the admission of supplemental air into the intake manifold, as will be described in detail later.

The form of the invention shown in Figure 4 comprises parts substantially identical in structure and function to the form shown in Figure 2 and includes other structural features to perform additional functions. The valve body, cap and spring in Figure 4 are similar in construction to corresponding parts previously described and have been indicated by the same reference numerals. In place of the valve element 26, the form of the invention shown in Figure 4 is provided with a somewhat similar conical valve element 35 having a valve 36 at its lower end engageable with the seat 25 and a valve 37 at its upper end engageable with the seat 34. Instead of the recess 28, the valve element 35 is provided in its lower end with an axial opening 38 there through and the interior of the valve element 35 is provided with a valve seat 39 engageable by a poppet valve 40. This valve may be provided with an upstanding cylindrical flange 41 for reception in the lower end of the spring 30.

The form of the invention shown in Figures 1, 2 and 3 is as follows:

It will be apparent that the valve element 26 functions as a pressure responsive member and its movements and positions will depend upon differential pressures existing above and below such element. When a motor vehicle engine is idling, tests have indicated that there will be a vacuum of approximately 18 inches of mercury present in the intake manifold, this vacuum varying with different engines as will be apparent. In the present device, the tension of the spring 30 and its relation thereto is so designed that the differential pressure affecting the valve element 26 under the vacuum conditions present when the motor vehicle engine is idling will be sufficient to overcome the tension of the spring 30 and thus move the valve element 25 upwardly to engage the valve face 23 against the valve seat 34. As previously stated, the tension of the spring is adjustable in accordance with the position of the cap 17 on the valve body and the proper tension is provided whereby the valve face will engage the seat 25 at the existing vacuum existing under idling engine conditions. Thus when the engine is idling, it will be apparent that air is prevented from entering the intake manifold through the passage 21.

While conditions in different engines will vary as is well known, in an average installation the designing of the parts including the spring 30 are such that it requires an intake manifold vacuum of at least 10 inches of mercury to move the valve member 26 to unseat the valve 27 against the tension of the spring 30. Under practically all load conditions there will be present in the intake manifold a vacuum of less than 10 inches of mercury, and under such load conditions it will be apparent that the valve 27 engages the seat 25 and thus prevents the admission of air into the intake manifold.

At intake manifold vacuums between approximately 10 inches and approximately 18 inches the valve element 26 will occupy intermediate positions with both of its valves 27 and 33 spaced from their respective seats, thus admitting air into the intake manifold, the air flowing through the space between the outer surface of the valve element 26 and the inner surface of the valve body 15. It will be apparent that due to the conical shape of the parts referred to, the cross-sectional area between the element 26 and valve body 15 will increase as the spring 30 is progressively compressed, thus providing for the admission of air at progressively increasing rates until the valve 33 engages the seat 34. The grooves 29 are provided to increase the surface friction of the air against the conical outer face of the valve element 26, thus increasing the efficiency of the valve in maintaining the valve 27 off its seat. The recess 28 also is provided to increase air friction against the valve 26 for the same purpose.

It will be apparent that the vacuum present in the manifold when the engine is idling is rela-
tively high and the degree of vacuum is lower than the idling vacuum under most operating conditions. Therefore the valve mechanism indicated in Figure 2 is effective for admitting air under most operating conditions other than idling conditions or when the vehicle engine is traveling under a substantial load. If the vehicle is traveling at high speed and under a light load whereby a vacuum of greater than 16 inches of mercury will be present in the intake manifold, the valve 33 will engage the seat 34 to cut off the admission of air, and under such conditions the vehicle will function in accordance with conventional operation without the admission of auxiliary air.

Assuming that the vehicle is traveling on a level highway with a vacuum in the intake manifold of 14 inches of mercury, for example, the valve element 25 will occupy a position intermediate its two limits of movement and auxiliary air will be admitted into the intake manifold. If the vehicle now starts to ascend a slight grade and the operator does not change the position of the throttle, the increased load conditions on the engine for the given throttle opening will reduce the degree of vacuum in the intake manifold and the valve 21 will move toward its seat to restrict the admission of supplemental air into the intake manifold. If the increased load is sufficient to reduce the manifold vacuum to approximately 10 inches of mercury or less the valve 27 will engage its seat 25 to completely cut off the admission of supplemental air.

On the other hand, if it is assumed that the vehicle is traveling on a level highway with a vacuum of approximately 14 inches of mercury in the intake manifold and the vehicle then starts to descend a grade, the decreasing of the load on the engine in proportion to the throttle opening will increase the degree of vacuum and will move the valve element 26 upward to a greater extent. Under the grade descending conditions the cutting off of the auxiliary air will provide a richer mixture for the engine to satisfy the demand for greater power, thus tending to prevent the vehicle speed from being retarded. Under the grade descending conditions referred to, the admission of a greater percentage of air into the intake manifold will decrease the power developed by the engine and thus tend to decrease the speed.

As previously stated, the tubular member 20 preferably extends to a point adjacent the carburetor throttle, thus providing a flow of air which is counter to the flow of the explosive mixture. This action not only dilutes the explosive mixture but it also tends to retard the flow of the explosive mixture from the carburetor to the engine cylinders which is desirable under the conditions in which supplemental air is admitted to the engine. The arrangement referred to possesses an additional advantage in that the supply of air at the remotest possible point from the engine cylinders with the counter-flow referred to assures a homogeneous mixing of the auxiliary air with the explosive mixture from the carburetor before the resulting mixture reaches the engine cylinders.

Aside from the functioning of the valve 40 and auxiliary parts, the form of the invention shown in Figure 4 is identical with that previously described, the valves 36 and 37 engaging their seats 25 and 34 under the same conditions that the valves 27 and 33 in Figure 2 engage the corresponding seats. For intake manifold vacuums up to 18 inches of mercury, or the vacuum under idling engine conditions, the valve 40 remains on its seat 39 and moves as a unit with the element 35.

5 It will be apparent that the valve 31 engages the seat 34 under idling engine conditions, atmospheric pressure acting on the lower faces of the valve 40 and the lower and side surfaces of the valve element 35. When the valve 31 engages its seat under the conditions described, atmospheric pressure acting against the lower face of the valve 40 tends to unseat it, but the area of this valve, being less than the total area of the valve 40 and the surface of the element 35 acting upon by air pressure, the valve 40 will remain on its seat. The relative areas of the surfaces of the parts are so designed, however, that the valve 40 will move off its seat by further compressing the spring 30 if the intake manifold vacuum increases substantially above the vacuum present under idling engine conditions. It is preferred that the valve 43 be unseated, after the valve 37 has engaged the seat 34, to again admit air into the intake manifold at a manifold vacuum of at least 22 inches of mercury. Under such conditions excessively high vacuums incident to very high vehicle speeds and under light load conditions will result in the admission of additional air into the intake manifold.

The form of the invention illustrated in Figure 4 auxiliary air valve will be admitted into the intake manifold at all manifold vacuums above approximately 10 inches of mercury except in the range of vacuum conditions which are present when the engine is idling, under which latter conditions it is highly desirable to cut off the admission of air to prevent high idling speeds with the accompanying necessity for the frequent disengagement of the vehicle clutch when traveling in slow traffic.

It will be apparent that the present device is particularly desirable for use with heavy trucks and buses to assist in maintaining uniform vehicle speeds for given positions of the engine throttle. For a given position of the throttle the admission of auxiliary air will be increased or will be completely cut off depending on variations in the load conditions on the engine. In this connection it is obvious that intake manifold vacuums are dependent upon load conditions in proportion to the position of the throttle. When load conditions increase, the cutting off of the auxiliary air results in supplying normal fuel charges to the engine to increase the power generated thereby to satisfy increased power demands. When the power demands decrease, additional air will be supplied to decrease the forces of the explosives of the engine, thus tending to retard vehicle speeds. It will be apparent that as an incident to the operation of the present device, the dilution of the explosive mixture a substantial portion of the time during which a vehicle is being operated results in material fuel savings.

It is well known that the use of a motor vehicle engine as means for retarding vehicle speed when descending steep grades is highly desirable, and this is particularly true in heavy trucks and buses. Ordinarily, a carburetor throttle is returned to idling position when descending steep grades in which case the engine acts as a vacuum pump to tend to retard vehicle speed. In the present construction, and particularly the construction shown in Figure 4, the high vacuum conditions which will be present will permit the
admission of air into the engine to cause the latter to act in part as a compression pump to tend to retard vehicle speed. This is advantageous in that it materially reduces the heat otherwise generated in the cylinders of the engine and the admission of cool air further tends to provide a cooling effect.

It will be apparent from the foregoing that the present construction provides two independent and balanced inlets, one for fuel and air, and the other for auxiliary means, thereby reducing the noise of the motor, particularly in worn engines.

It is to be understood that the forms of the invention herewith shown and described are to be taken as preferred examples of the same and that various changes in the shape, size and arrangement of parts may be resorted to without departing from the spirit of the invention or the scope of the subjoined claims.

I claim:

1. A control valve mechanism for an internal combustion engine having an intake manifold, comprising a valve casing having an outlet and an inlet for communicating respectively with the intake manifold and the atmosphere, a valve element in said casing biased in one direction toward said inlet to a normal position and having a valve face operable in said normal position for closing said inlet, said valve element having cooperating faces constructed and arranged to meter the flow of air through said casing when said valve element is moved away from said normal position whereby the rate of flow of air through said casing progressively increases as said valve element moves away from said normal position, said valve element having an opening therethrough, and an auxiliary valve normally closing said opening and constructed and arranged to be opened to permit the passage of air from said inlet to said outlet when the pressure in the intake manifold drops below a predetermined point.

2. A control valve mechanism for an internal combustion engine having an intake manifold, comprising a valve casing having an outlet and an inlet for communicating respectively with the intake manifold and the atmosphere, a valve element in said casing biased in one direction toward said inlet to a normal position and having a valve face operable in said normal position for closing said inlet, said casing and said valve element being constructed and arranged to meter the flow of air through said casing when said valve element is moved away from said normal position whereby the rate of flow of air through said casing progressively increases as said valve element moves away from said normal position, said valve element having a second valve face constructed and arranged to close said outlet when the pressure in the intake manifold drops below a predetermined point, said valve element being biased therethrough, and an auxiliary valve normally closing said opening and constructed and arranged to be opened to permit the passage of air from said inlet to said outlet when the pressure in the intake manifold drops to a point substantially below said predetermined point.

3. A control valve mechanism for an internal combustion engine having an intake manifold, comprising a valve casing having an outlet and an inlet in its respective ends for communicating respectively with the intake manifold and the atmosphere, the inner surface of said casing being tapered to decrease in size toward said inlet, and a valve element in said casing having its outer face tapered to correspond with the taper of the inner surface of said valve casing and provided at one end with a valve face normally engageable with said casing to close said inlet, a spring biasing said valve element to said closed position, the tapered faces of said valve and said casing substantially contacting with each other in such closed position and serving to meter the passage of air through said casing when said valve element moves away from said closed position to a point substantially below said predetermined point.

4. A control valve mechanism for an internal combustion engine having an intake manifold, comprising a valve casing having an outlet and an inlet in its respective ends for communicating respectively with the intake manifold and the atmosphere, the inner surface of said casing being tapered to decrease in size toward said inlet, a valve element in said casing having its outer face tapered to correspond with the taper of the casing and said valve element having cooperating faces constructed and arranged to meter the flow of air through said casing when said valve element is moved away from said normal position whereby the rate of flow of air through said casing progressively increases as said valve element moves away from said normal position, said valve element having a second valve face constructed and arranged to close said outlet when the pressure in the intake manifold drops below a predetermined point, said valve element being biased therethrough, and an auxiliary valve normally closing said axial opening and movable to open position when the pressure in the intake manifold drops to a point substantially lower than a predetermined point.

5. A control valve mechanism for an internal combustion engine having an intake valve manifold, comprising a valve casing having an outlet and an inlet in its respective ends for communicating respectively with the intake manifold and the atmosphere, the inner surface of said casing being tapered to decrease in size toward said inlet, a valve element in said casing having its outer face tapered to correspond with the taper of the inner surface of said valve casing and provided at one end with a valve face normally engageable with said casing to close said inlet, a spring biasing said valve element to said closed position, the tapered faces of said valve and said casing substantially contacting with each other in such closed position and serving to meter the passage of air through said casing when said valve element is moved away from said normal position whereby the rate of flow of air through said casing progressively increases as said valve element moves away from said normal position, said valve element having an axial opening through the first named end thereof, and an auxiliary valve normally closing said axial opening and movable to open position when the pressure in the intake manifold drops to a point substantially lower than a predetermined point.
a spring biasing said valve element to said closed position, the tapered faces of said valve and said casing substantially contacting with each other in such closed position and serving to meter the passage of air through said casing when said valve element moves away from said closed position whereby the rate of flow of air through said casing progressively increases as said valve element moves away from said closed position, the other end of said valve element having an end valve face engageable with said casing to close said outlet when the pressure in the intake manifold drops below a predetermined point, said valve element being provided in the first named end thereof with an axial opening, and an inwardly opening auxiliary valve engaged by said spring to be normally held in a position closing said axial opening, said auxiliary valve being movable to open position against the tension of said spring when the pressure in the intake manifold drops to a point substantially lower than said predetermined point. LEWIS JONES.