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[33] **Japan**
[31] **43-62901**

[54] **ARRANGEMENT FOR CONTROLLING DISCHARGE OF UNBURNT HYDROCARBONS FROM DECELERATING AUTOMOBILE ENGINE**
2 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** .... **123/117 A,** 123/97 B, 123/102
[51] **Int. Cl.** **F02p 5/04,** F02d 3/00, F02d 11/10
[50] **Field of Search** .... 123/117.1, 97 B; 1/102

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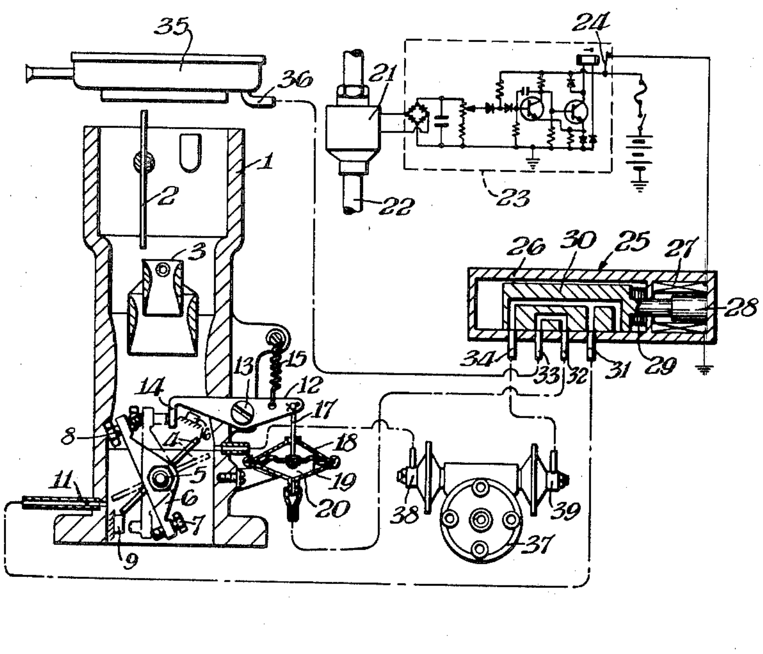
Primary Examiner—Wendell E. Burns
Attorney—Connolly & Hutz

ABSTRACT: An arrangement for controlling discharge of unburnt hydrocarbons from decelerating automobile engine by holding throttle valve of engine carburetor open at position slightly more open that position of valve under idling conditions of engine comprises lever connected to throttle valve for movement therewith. Blocking structure moves into and out of engagement with lever for preventing throttle valve from reaching idling position when blocking structure engages lever. Motivating system operates to move blocking structure into engagement with lever when automobile engine decelerates from above predetermined speed so that throttle valve is held open. Motivating system includes driving device connected to operate blocking structure, speed detector for sensing speed of automobile engine, and speed setter associated with speed detector and driving device for causing driving devices to move blocking structure into engagement with lever when automobile engine decelerates from above predetermined speed.



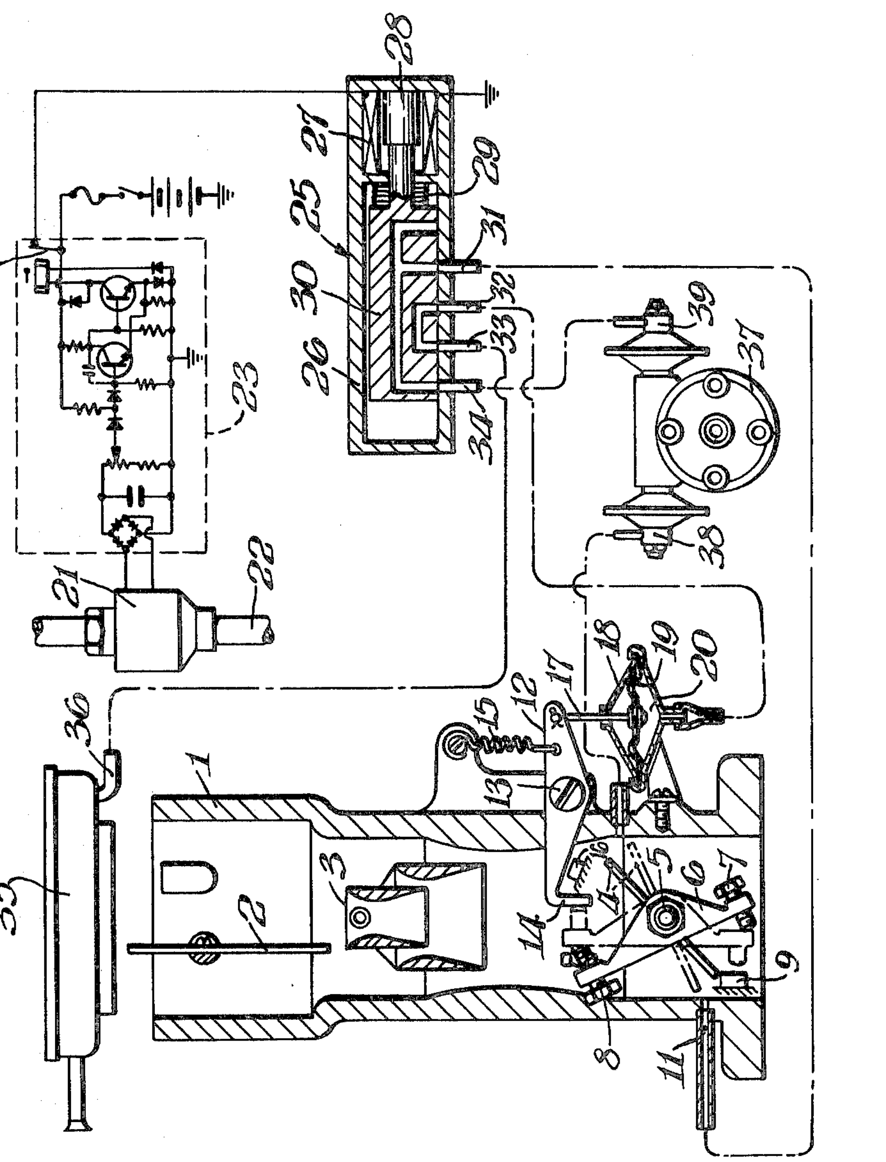

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Fig. 1.

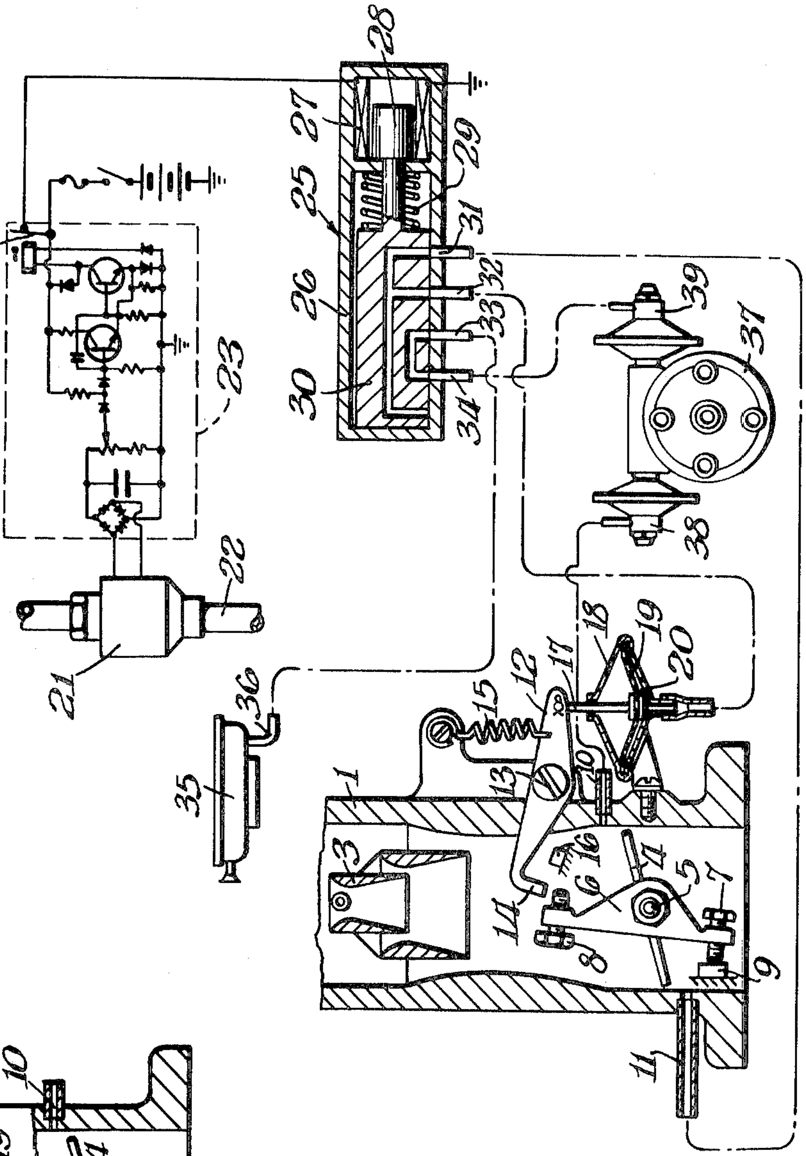
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Fig. 2.

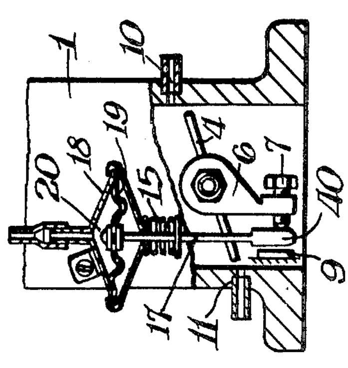
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Fig. 3.

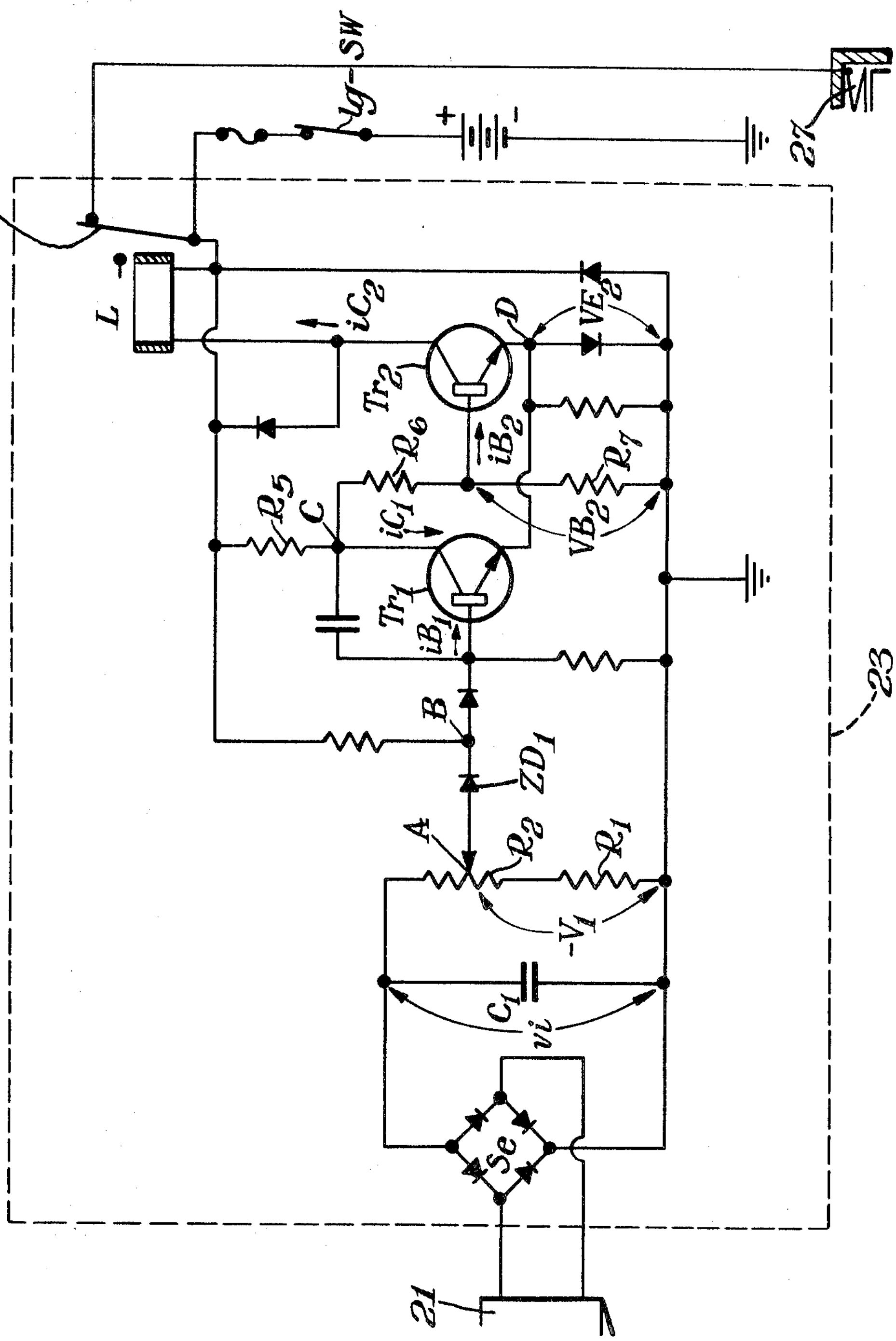
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Fig. 4.

ARRANGEMENT FOR CONTROLLING DISCHARGE OF UNBURNT HYDROCARBONS FROM DECELERATING AUTOMOBILE ENGINE

BACKGROUND OF THE INVENTION

The present invention relates to an arrangement for controlling the discharge of unburnt hydrocarbons from a decelerating automobile engine, and more particularly to an arrangement that performs this function by holding the throttle valve of the engine carburetor at a position slightly more open than the position of the throttle valve under idling conditions.

When the accelerator pedal of an automobile having a gasoline engine and carburetor is released, the throttle valve in the carburetor closes to its least opening in a very short time. The latest opening of the throttle valve occurs under idling conditions. In the meantime the speed of the engine itself and the force of the driving wheel. As a result, the negative pressure in the intake tube sharply rises. In consequence the fresh air decreases in volume thereby hampering a perfect compression of the mixture in the engine cylinders. Moreover, the residual exhaust gas in the cylinders dilutes the fresh air whereby normal combustion in the cylinders is impossible. The atmosphere is then polluted with a large volume of unburnt hydrocarbon discharge.

For the purpose of limiting the discharge of unburnt hydrocarbons under deceleration of a car engine and thereby preventing air pollution, the throttle valve must be kept slightly more open than under idling conditions even though this may detract from the braking effect of the engine. Conventionally, this has been accomplished by extending the time for closing the throttle valve by means of a pneumatic dash pot or by utilizing the high negative pressure generated in the intake tube during deceleration and thereby slightly pulling open the once closed throttle valve by means of a diaphragm or the like.

Due to the nature of a pneumatic dash pot it cannot maintain the throttle valve open by a constant degree for a long time. If the throttle valve is to be kept open for a long time, the degree of opening in the initial period in deceleration must necessarily be large and this will not assure the required deceleration. Further, it would be quite difficult to control the working time of such a small pneumatic dash pot as can be mounted in the carburetor. Moreover, it would be difficult to manufacture a reliable and dependable dash pot for such use.

On the other hand, the throttle valve pulling mechanism like a diaphragm which utilizes the high negative pressure arising in the intake tube under deceleration cannot be prevented from discharging unburnt hydrocarbons in the initial period in deceleration. It is operated by the high negative pressure which arises when the throttle valve closes once to the opening degree in idling time under deceleration. Besides to develop the necessary force to open the once closed throttle valve a diaphragm of considerable size is required. If a small diaphragm is designated to develop a force large enough to open the throttle valve, the design will be stretched. Moreover, the diaphragm would not hold up. Further, when the once closed throttle valve is reopened, an unfavorable "-hunting" phenomenon takes place in which the throttle valve comes to be reclosed because of the natural drop in the negative pressure.

Accordingly, it is an object of the present invention to eliminate the above drawbacks and provide a device which quickly responds to the deceleration of a car engine and immediately shifts the carburetor throttle valve to a constant opening position maintained with stability during deceleration.

SUMMARY OF THE INVENTION

In accordance with the present invention an arrangement is provided for controlling the discharge of unburnt hydrocarbons from a decelerating automobile engine by holding the throttle valve of the engine carburetor open at a position slightly more open than the position of the throttle valve under idling conditions of the engine. The arrangement comprises a lever connected to the throttle valve for movement therewith. Blocking structure moves into and out of engagement with the lever for preventing the throttle valve from reaching its idling position when the blocking structure engages the lever. A motivating system is constructed and arranged to move the blocking structure into engagement with the lever when the automobile decelerates from above a predetermined speed. The throttle valve is then held open. The motivating system includes a drive device connected to operate the blocking structure, a speed deteetor for sensing the speed of the automobile engine, and a speed setter associated with the speed detector and the driving device for causing the driving device to move the blocking structure into engagement with the lever when the automobile engine decelerates from above the predetermined speed.

Brief Description of the Drawing

Other objects and advantages of the present invention in addition to those mentioned above will be apparent to those skilled in the art from a reading of the following detailed description in conjunction with the accompanying drawings wherein:

FIG. 1 is a partial sectional view of one embodiment of the present invention;

FIG. 2 is a partial sectional view similar to FIG. 1 illustrating another sequence in the operation of the present invention;

FIG. 3 is a front elevational view of another embodiment of the present invention with portions broken away to show detail; and

FIG. 4 is a circuit on a larger scale of a car speed setter shown in FIGS. 1 and 2.

DETAILED DESCRIPTION OF THE INVENTION

Referring in more particularity to the drawing, FIGS. 1 and 2 show the fresh air intake passage of a carburetor **1** with a choke valve **2**, a venturi tube **3** and a throttle valve **4** located in the air intake passageway. A shaft **5** of the throttle valve **4** extends out of the carburetor **1** and is fitted with a throttle lever **6**. At both ends of the throttle lever **6** are oppositely mounted an r.p.m. adjust screw **7** and an open-degree adjust screw **8** for the throttle valve under deceleration. When the throttle valve **4** closes to the opening degree in idling time, the tip of the r.p.m. adjust screw **7** is designed to hit a stopper **9**.

Reference numeral **10** identifies a negative pressure take out orifice for negative pressure lead. The orifice is located on the upstream side of the throttle valve **4** when the throttle valve **4** is open to the degree of idling time or less. It is located on the downstream side of the throttle valve **4** when the throttle valve **4** is open to more than the degree of idling time.

Negative pressure take out orifice **11** provides negative pressure lag. Orifice **11** is located on the downstream side of the throttle valve **4** when the opening of the throttle valve **4** is equal to or less than the opening in the idling time. It is located on the upstream side of the throttle valve **4** when the opening of the throttle valve **4** is more than the opening at idling time.

Rotatable arm **12** is pivoted to a shaft **13** connected to the carburetor **1**. At the left end of the arm a bent portion **14** is provided and at the right end of the arm a return spring **15** is fitted which moves the rotatable arm **12** in a counterclockwise direction thereby bringing the left underside of the arm **12** into contact with a stopper **16**, as shown in FIG. **1**. When the rotatable arm or blocking structure is positioned as shown in FIG. **1** and the throttle valve **4** begins to close, the valve ultimately reaches a position slightly more open than at idling time. The tip of the open-degree adjust screw **8** engages the bent portion **14** of the blocking structure **12** to prevent further closing of the valve.

The right side of the rotatable arm **12**, as viewed in FIGS. **1** and **2**, is hinged to the top end of a rod **17**. The bottom end of the rod **17** is linked to a diaphragm **19** installed within a negative pressure multiplier **18**. When the negative pressure in the negative pressure chamber **20** of the negative pressure multiplier **18** is low, the rotatable arm **12** moves counterclockwise around a shaft **13** under the force of a return spring. **15**. The left underside of the rotatable arm **12** then abuts the stopper **16**, as illustrated in FIGS. **1** and **2**. When the negative pressure in the negative pressure chamber **20** is high, the diaphragm **19** displaces downward to pull the rod **17** down and move the rotatable arm **12** clockwise around the shaft **13** against the force of the return spring **15**. Such movement causes the bent portion **14** of the rotatable arm **12** to assume its raised position, as illustrated in FIG. **2**. With the rotatable arm **12** in unblocking position the throttle valve **4** can close the throttle opening since the tip of the open-degree adjust screw **8** for the throttle valve clears the bent portion **14** of the arm **12**.

Reference numeral **21** identifies a car speed detector operated by a speed meter drive cable **22** rotated by the wheels of an automobile. The rotating force can be used to generate a voltage proportional to the car speed. Reference numeral **23** identifies a car speed setter which amplifies the voltage generated by the speed detector and opens or closes a contact through a switching action. As shown in FIG. **4**, it comprises transistors, diodes, rectifiers, resistances, capacitors and a coil. The speed detector **21** rotates at r.p.m. proportional to the car speed to generate an AC voltage. An AC current is full wave-rectified by the selenium-rectifier Se, smoothed by the capacitor C_1, thereby eliminating the pulsation component, and an input voltage Vi is produced.

The input voltage Vi divided by the resistances R_1 and R_2 and as the result the potential at the point A becomes $-V_1$, which is negative with respect to the earth potential.

When an ignition key switch *Ig–Sw* is closed and while the automobile operates at low speed, the potential at the point A is approximately zero, and the potential at the point B becomes positive on account of the Zener diode ZD_1, thereby causing the base current iB_1 to flow the transistor Tr_1. Thereupon the potential at the point C, i.e., the collector potential of the transistor Tr_1 drops, becoming about equal to the potential at the point D, i.e., the emitter potential of the transistor Tr_1. Accordingly, no current flowing in the transistor Tr_2, the coil L is not energized and the contact **24** is open.

When the automobile operates at high speed, the input voltage V_1 rises and in consequence the potential at the point A, i.e., $-V_1$ increases further to the negative side. Thus, the potential at the point B turns negative, making it impossible for the base current iB_1 to flow in the transistor Tr_1. The collector current iC_1 ceases to flow in the transistor Tr_1 and as the result the potential at the point C rises. The potential at the point C is divided by the resistances R_5, R_6 and R_7. Since the base potential VB_2 of the transistor Tr_2 is so set as to become higher than the emitter potential Ve_2 of Tr_2 through division by R_6 and R_7, in the transistor Tr_2 the base current iB_2 flows, and it is made continuous, so that the collector current iC_2 flows therein which energized the coil L to close the contact **24**, thereby energizing the electromagnetic coil **27**. A negative pressure change valve **25** comprises a housing **26** having openings **31**, **32**, **33** and **34**. Then the contact **24** of the car speed setter **23** closes a magnet coil **27** is energized and a core **28** is shifted to the right, as shown in FIG. **1**. Such movement compresses a return spring **29** and shifts a valve **30** to the right. In this state, the opening **31** communicates with the opening **34** and the opening **32** communicates with the opening **33**.

When the contact **24** of the car speed setter **23** opens to deenergize the coil **27**, the return spring **29** moves the valve **30** to the left, as illustrated in FIG. **2**. The opening **31** communicates with the opening **32** while the opening **33** communicates with the opening **34**.

An air purifier **35** is located in the upstream end of the carburetor **1**. An air supply opening **36** supplies air at atmospheric pressure to the opening **33** in the negative pressure change valve **25**.

A distributor **37** has a negative pressure lead device **38** and a negative pressure lag device **39**. The negative pressure lead device **38** communicates with the negative pressure takeout orifice **10** and accelerates the engine ignition timing when a negative pressure develops therein. The negative pressure lag device **39** communicates with the opening **34** of the negative pressure change valve **25** and delays the engine ignition timing when a negative pressure develops therein.

The opening **31** of the negative pressure change valve **25** communicates with the negative pressure take out orifice **11** for the negative pressure lag. The opening **32** communicates with the negative pressure chamber **20** of the negative pressure multiplier **18**.

The function of the device according to the present invention is as follows. While the automobile operates at high speed the car speed detector **21** generates a voltage value representative of the automobile speed. When the speed exceeds a predetermined limit the voltage value thus developed closes the contact **24** to thereby energize the magnet coil **27**. As a result, the valve **30** is shifted to its right-hand position, as shown in FIG. **1**. Then the negative pressure take out orifice **11** for negative pressure lag communicates with the negative pressure lag device **39** while the negative pressure chamber **20** of the negative pressure multiplier **18** communicates with the air supply opening **36** of the air purifier **35** thereby venting it to the atmosphere.

When the negative pressure chamber **20** of the negative pressure multiplier **18** is at atmospheric pressure the return spring **15** causes the rotatable arm **12** to move in a counterclockwise direction until the left underside of the rotatable arm **12** hits the stopper **16**, as shown in FIG. **1**. When the engine is under a considerably high load for accelerated or steady running the throttle valve **4**, as indicated in solid outline in FIG. **1**, is held widely open. With the negative pressure take out orifice **10** for negative pressure lead located downstream from the throttle valve **4** a high negative pressure is developed and transmitted to the negative pressure lead device **38**. The negative pressure take out orifice **11** for negative pressure lag is upstream form the throttle valve **4** and no negative pressure is developed. Accordingly, no negative pressure acts on the negative pressure lag device **39**. As a result, the ignition timing on the distributor **37** is accelerated to meet the high speed operation of the engine. A normal high speed running is thereby guaranteed.

When the automobile decelerates from a high running speed the throttle lever **6** and the throttle valve **4** rotate clockwise from the position indicated in solid outline in FIG. **1**. With the rotatable arm **12** positioned as in FIG. **1**, the tip of the deceleration valve open-degree adjust screw **8** stops at the position indicated by phantom in FIG. **1** where it contacts the bent portion **14** of the rotatable arm **12**. In this condition, the throttle valve **4** is slightly more widely open than at idling time thereby permitting a larger intake of air than in the conventional mechanism. This prevents the discharge of unburnt hydrocarbons under deceleration.

As described above, when the automobile decelerates the throttle valve **4** is positioned as shown in phantom in FIG. **1**. The negative pressure take out orifice **10** for negative pressure lead is upstream from the throttle valve **4** and in consequence only an inconsequential negative pressure (–5—10 mm. Hg) develops. The negative pressure lead device **38** will not act. Meanwhile, the negative pressure take out orifice **11** for negative pressure lag is at that time downstream form the throttle valve **4**. A high negative pressure is developed which is transmitted to the negative pressure lag device **39**. Thus, with a high negative pressure transmitted to the negative pressure lag device **39** the distributor **37** satisfactorily retards the ignition timing to produce a full engine brake effect.

When the car speed drops below a certain limit, for example, 20 km./h., the voltage generated in the car speed detector **21** falls below a certain value which operates to open the contact 24 of the car speed setter 23 thereby deenergizing the magnet coil 27 and moving the valve body 30 of the negative pressure change valve 25 to the left under the force of the return spring 29, as shown in FIG. 2. In consequence, the negative pressure take out orifice 11 for negative pressure lag communicates with the negative pressure chamber 20 of the negative pressure multiplier 18. The negative pressure lag device 39 communicating with the air supply opening 36 of the air purifier 35 and is thereby vented to the atmosphere.

When the negative pressure take out orifice 11 for negative pressure lag is far downstream from the throttle valve 4 a strong negative pressure develops which is transmitted to the negative pressure chamber 20 of the negative pressure multiplier 18. Thereupon, the diaphragm 19 displaces downward to pull the rod 17 and move the rotatable arm 12 clockwise against the return spring 15 to the position of FIG. 2. The bent portion 14 of the rotatable arm 12 is elevated to allow the tip of the deceleration value open-degree adjust screw 8 to pass. The r.p.m. adjust screw 7 hits the stopper 9 thereby enabling the throttle valve 4 to close to the open degree in idling. In idling under this condition the negative pressure take out orifice 10 for negative pressure lead is upstream from the throttle valve 4. A very weak negative pressure (—5—10 mm. Hg) is developed. The negative pressure lead device 38 does not function whereby stable idling is guaranteed.

If in this condition the throttle valve 4 is slightly more open than idling and the car speed is lower than a certain limit (for example, 20 km./h.), in other words it is an extremely light load low speed operation, a negative pressure corresponding to the open degree of the throttle valve 4 develops at the negative pressure take out orifice 10 for negative pressure lead. The negative pressure lead device 38 then acts to accelerate the ignition timing thereby assuring stabilized operation and economical fuel consumption.

Thus, so long as the car speed is below a certain limit the open degree of the throttle valve 4 and the ignition timing remain the same as in a normal engine and the condition remains normal even when the engine stops thereby assuring the low-temperature starting characteristic.

At automobile speeds above a predetermined limit the contact 24 remains closed. As shown in FIG. 1, at decelerations from above the predetermined speed limit the throttle valve 4 stops at a position slightly more open than at idling thereby introducing enough air to reduce the unburnt hydrocarbons. The volume of residual hydrocarbons in the exhaust gas diminishes while the loss in the engine brake effect is compensated for by sufficient delay of ignition timing to guarantee deceleration.

As the car steadily slows down to less than the predetermined speed limit the contact 24 opens and the rotatable arm 12 moves to its unblocking position. The throttle valve 4 then closes to the open degree at idling timing thereby assuring a common very light load low speed operation or idling.

The throttle lever 6 illustrated in FIGS. 1 and 2 may have the r.p.m. adjust screw 7 and the deceleration throttle open-degree adjust screw 8 attached on the same side, such as the side that presently carries the r.p.m. adjust screw 7. Alternatively, as illustrated in FIG. 3, only the r.p.m. adjust screw 7 can be attached with the open-degree adjust screw 8 omitted and with the end 40 of the rod 17 connected to the diaphragm 19 of the negative pressure multiplier 18. The end 40 is movable between the r.p.m. adjust screw 7 and the stopper 9. Under high speed operation and deceleration the negative pressure chamber 20 is at atmospheric pressure and the end 40 of the rod 17 is between the r.p.m. adjust screw 7 and the stopper 9 thereby preventing the throttle valve 4 from closing further than a slightly more open position than at idling. Under low speed operation the rod 17 elevates the end 40 away from between the screw 7 and stopper 9 which allows the throttle valve 4 to close to its idling position.

In the negative pressure multiplier 18, instead of the diaphragm 19 illustrated, a cylinder-plunger combination or a bellows may be employed. The negative pressure is utilized for a mechanical displacement of the arm 12 but it may be utilized to switch an electrical contact to energize pr deenergize a magnet the core of which is adopted to displace the arm connected therewith.

Just like an automobile equipped with an automatic speed change gear when the engine r.p.m. and the car speed are relatively proportional the engine r.p.m. may be used to operate the car speed detector 21. Also, the contact 24 may be designed to energize the magnet coil 27 under low speed operation and deenergize the coil 27 at high speed so that the valve 30 can be switched under the force of the spring 29.

Thus, according to the present invention, under low speed operation of the car engine the throttle valve 4 can be held slightly more open than at idling thereby permitting an ample intake of fresh air and accordingly reducing the discharge of unburnt hydrocarbons resulting in a less polluted atmosphere.

The opening degree of the throttle valve 4 under deceleration is controlled by the positioning mechanism driven by such a device as the negative pressure multiplier 18 which is designed to limit the opening of the throttle valve 4 to a position slightly wider than at idling when the car speed before initiation of deceleration is above a certain speed limit. Therefore, at the same time as the initiation of deceleration the opening of the throttle valve can be set to a position slightly wider than in idling and an effective deceleration in a very short time can be made in the same manner as when the step on the accelerator pedal is temporarily softened for speed change.

Meanwhile, the opening of the throttle valve 4 under deceleration can be instantly set to a definite position by the positioning mechanism with very simplified controls and without any "hunting" or error.

Moreover, the delay of ignition timing for deceleration prevents the engine brake effect from being reduced through a slightly wider opening of the throttle valve 4.

What is claimed is:

1. An arrangement for controlling the discharge of unburnt hydrocarbons from a decelerating automobile engine by holding the throttle valve of the engine carburetor open at a position slightly more open than the position of the throttle valve under idling conditions of the engine, the arrangement comprising blocking means for holding the throttle valve of the engine carburetor open at a predetermined position at least more open than the position of the throttle valve under idling conditions, a driving device connected to the blocking means and motivated by negative pressure for moving the blocking means away from its blocking position, a speed detector for sensing the speed of the automobile, a speed setter responsive to the speed detector constructed and arranged to emit a change signal for deactivating the driving device when the automobile speed sensed by the speed detector is above a predetermined value and for activating the driving device when the automobile speed sensed by the speed detector is below the predetermined value, a negative pressure take out orifice opening to the intake passage of the engine carburetor and located on the downstream side of the throttle valve when the throttle valve is held open by the blocking means, and a distributor having a negative pressure lag device motivated by negative pressure developed at the negative pressure take out orifice whereby the throttle valve is held open by the blocking means at a position at least more open than the position of the throttle valve under idling conditions only when the speed of the automobile is above the predetermined value and the ignition time is retarded during decelerations from speeds above the predetermined value.

2. An arrangement for controlling the discharge of unburnt hydrocarbons from a decelerating automobile engine as in claim 1 wherein the blocking means comprises a rotatable arm free to engage and disengage a throttle lever on the engine carburetor and wherein the driving device is connected to the negative pressure take out orifice during decelerations after the automobile speed sensed by the speed detector is below the predetermined value.