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[33] France
[31] Nos. 101,784 and 102,501

[54] **CARBURATION DEVICE FOR INTERNAL COMBUSTION ENGINES FOR AUTOMOBILE VEHICLES**
5 Claims, 7 Drawing Figs.

[52] U.S. Cl. 123/117, 123/97, 123/124
[51] Int. Cl. F02p 5/04; F02d 9/00: F02m 73/04
[50] Field of Search 123/117.1, 97B, 124

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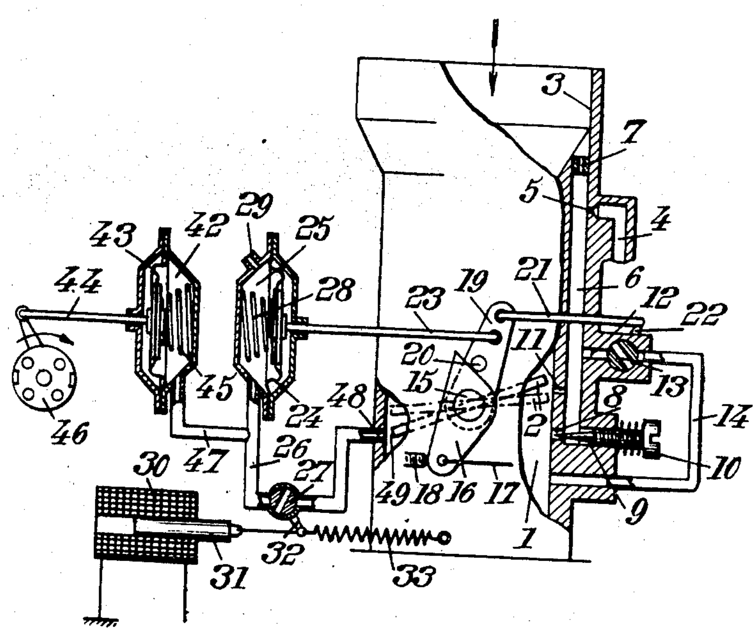
ABSTRACT: The carburation device comprises means for limiting the pollution of the atmospheric air by the exhaust gas, these means being adapted simultaneously to increase the flow rate of the air/fuel mixture and to increase the richness of this mixture, during periods of deceleration. In the case of a spark ignition engine, means are preferably provided for retarding the ignition during these periods of deceleration, without retarding the ignition during normal high speed operation.



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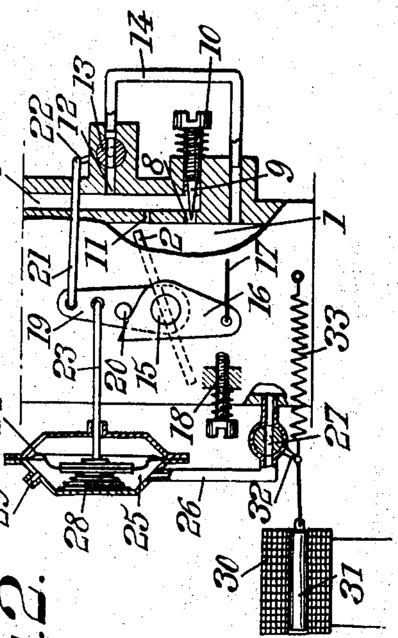

Fig.2.

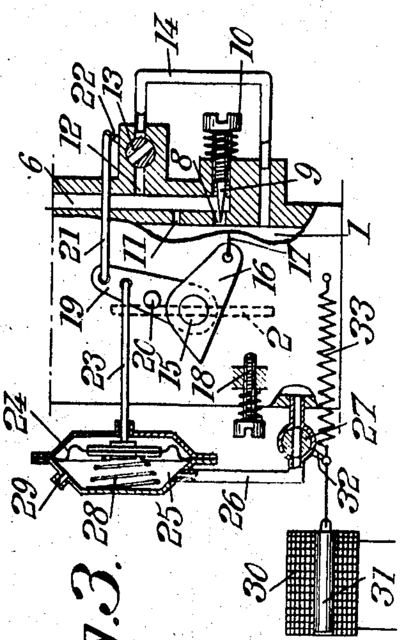

Fig.3.

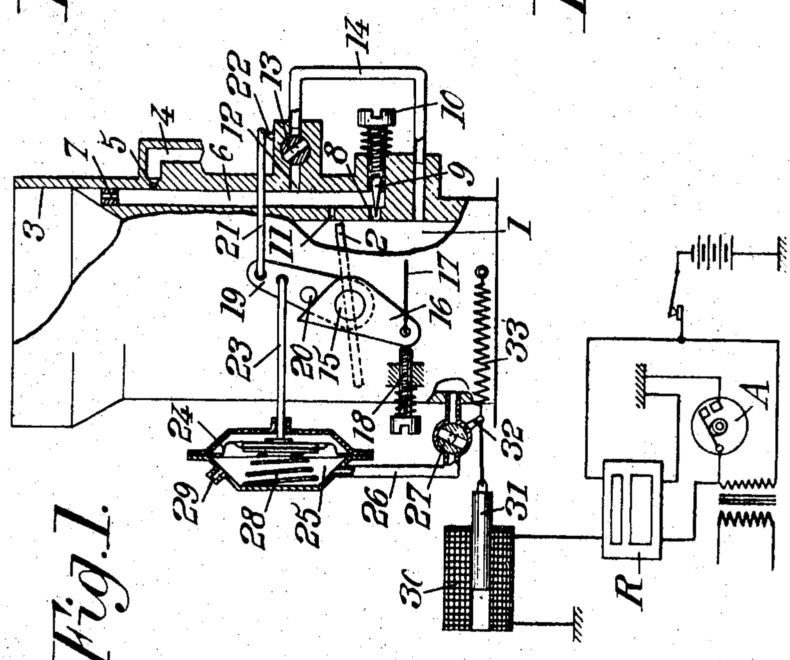

Fig.1.

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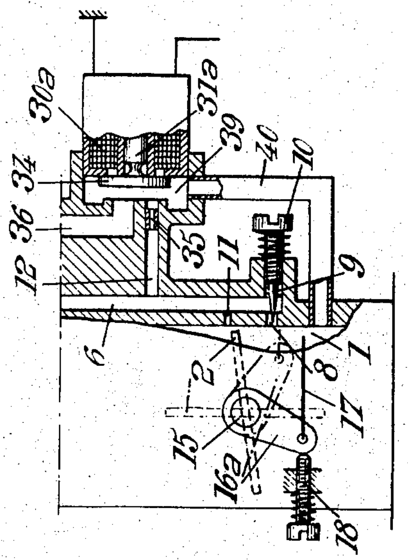

Fig. 5.

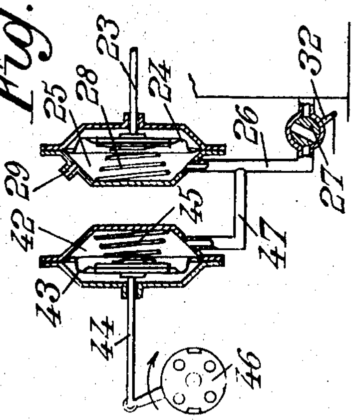

Fig. 6.

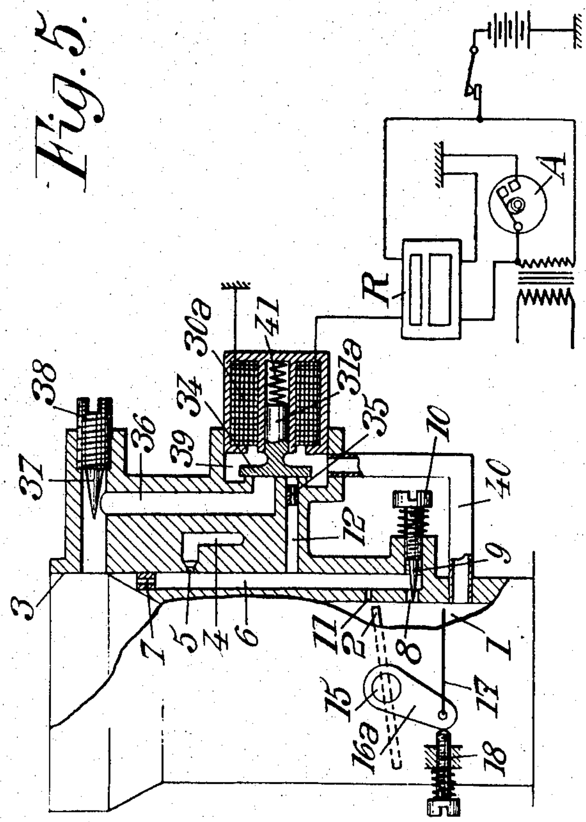

Fig. 4.

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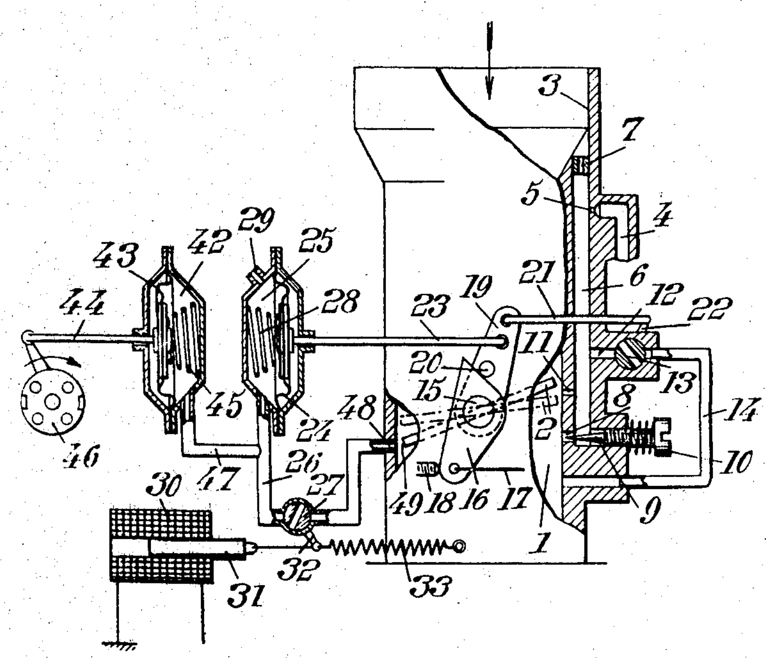
Fig.7.



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CARBURATION DEVICE FOR INTERNAL COMBUSTION ENGINES FOR AUTOMOBILE VEHICLES

The present invention relates to carburation devices, for internal combustion engines for automobile vehicles, of the type that comprise means for limiting the pollution of the atmospheric air by the exhaust gas.

It is known that one of the most harmful conditions, with respect to atmospheric pollution, resides in the deceleration of the vehicle, that is to say the periods of operation where the engine is driven by the vehicle. The principal throttling member then occupies its idling position, but as the engine is running at a much higher speed than the idling speed, the charges introduced into the combustion chambers, at each suction, are too small to be able to be ignited, more especially as they remain mixed with residual exhaust gases. The result is a production of free hydrocarbons, in the exhaust gas, whose quantity is much too high.

To limit this quantity, it has been envisaged to maintain during deceleration the throttling member slightly open in order to increase the charge introduced into the combustion chamber and thus to permit the ignition of the charge at each cycle. This is effected due to various devices of which one of the most common actuates the throttling member by a vacuum system subjected to the vacuum (strictly speaking, partial vacuum) prevailing in the manifold, the communication between the vacuum system and the manifold being itself controlled by a device sensitive to the speed of the engine. This latter device can be of the centrifugal mechanical type or of the electronic type.

Nevertheless, the composition of the mixture supplied to the engine during deceleration, for a slight opening thus given to the throttling member beyond its idling position, depends essentially on the regulation which has been executed to obtain a mixture that is suitable in quality and in quantity for acceleration or stabilized speeds of the engine. Now, it happens that, during deceleration, the composition of the optimum mixture for avoiding pollution is not necessarily the same as the composition which is necessary during acceleration or stabilized speed. During acceleration, the weight of the mixture introduced into the combustion chamber is relatively high for the engine first turns slowly and ignites easily, even if this mixture is considered as lean. On the contrary, during deceleration, for the same positions of the throttling member, the weight of the mixture introduced is relatively small due to the high speed of the engine, and ignition is difficult.

An object of the present invention is to render these carburators such that they deliver a mixture that is always suitable for the operating conditions of the engine, whether this be at constant speed or during acceleration or deceleration.

For this purpose, the carburation devices according to the invention, which comprise means adapted to increase the flow rate of the air/fuel mixture during periods of deceleration, are characterized by the fact that these means are such that they increase simultaneously the richness of this mixture.

In the case of a spark ignition engine, these means are moreover arranged so that they retard the ignition during periods of deceleration, that is to say, in general, when simultaneously the speed of the engine is greater than a predetermined limit and the vacuum in a zone of the admission conduit is high (in absolute value).

Now, during normal operation, in particular at stabilized speeds, these means continue to retard the ignition which is only necessary during deceleration, which tends to increase slightly the consumption of the engine.

To mitigate these disadvantages, these carburation devices are characterized by the fact that the zone where the vacuum is taken is situated downstream of the principal throttling member disposed in the admission conduit, for the positions of this member comprised between the idling position proper and the position of minimum opening imposed during deceleration, but upstream of this member for the other operating conditions.

The invention will be well understood from the following specific description, given merely by way of example, of particular embodiments of carburation devices arranged according to the present invention. The description of these embodiments is given with reference to the accompanying drawings, in which:

FIG. 1 shows schematically, partly in elevation and partly in vertical section, a carburation device established according to a first embodiment of the invention, in the position of its elements corresponding to idling;

FIG. 2 and 3 show certain of the elements of FIG. 1, in the positions corresponding respectively to deceleration and to wide open operation;

FIG. 4 shows, similarly to FIG. 1, a carburation device established according to a second embodiment of the invention;

FIG. 5 shows certain of the elements of FIG. 4, in the position of deceleration (the position of wide open operation being shown schematically in broken lines for the throttling member);

FIG. 6 shows a device adapted to regulate the advance of the ignition of the engine, this device being able to be combined for example with the carburation device of FIG. 1—3; and

FIG. 7 shows, similarly to FIG. 1, a carburation device established according to a third embodiment of the invention.

The carburation devices shown in the drawings are of the down-draught type, and are intended for internal combustion engines.

With regard to the carburation device in its overall aspect, it comprises a principal conduit 1 provided with a throttling device 2 and an air inlet 3. The principal fuel feed system has not been shown since it does not form part of the invention, but there has been shown the idling system which takes off the fuel, from a judiciously chosen place, through a passage 4 possibly provided with a calibrated orifice 5, as shown in the drawings. This passage 4 opens into a vertical passage 6 which communicates, on the one hand, with the air inlet 3, preferably by a calibrated orifice 7, and on the other hand, with the conduit 1 downstream of the throttling member 2 by at least one orifice such as 8 generally regulable by the cone 9 controlled by a screw 10. Moreover, at least one orifice 11 permits, in the known manner, the progressive switch over from the operation on the idling circuit to the operation on the principal fuel feed system.

In the passage 6, between the orifice 5 and the orifice 8, opens a passage 12 leading to an obturation member or stopcock 13. This stopcock 13, when it is open, permits the passage 12 to communicate with a passage 14 which opens into the conduit 1 downstream of the throttling member 2 (FIGS. 1 to 3 and 7).

This throttling member 2 is fixed to an axle 15 rigid with a lever 16 which can be controlled by the driver by means of a rod 17. The idling position of the throttling member 2 is determined by a regulable screw 18 in the known manner.

Also mounted freely on this axle 15 is a lever 19 which comprises an abutment 20 adapted to cooperate with the lever 16 to drive the throttling member 2 in the direction of its opening, when this lever 19 is displaced in the counterclockwise direction as shown in the FIGS.

On the other hand, the action of the driver via the rod 17 permits the total opening of the throttling member 2 without any corresponding reaction on the lever 19. This lever 19 is connected to a rod 21 which is connected to a lever 22 connected to with the stopcock 13 and which permits the establishment or the cutoff of the communication between the passages 12 and 14. The lever 19 is also connected by a rod 23 to a diaphragm 24 forming the movable wall of a chamber 25 connected by a passage 26 to the principal conduit 1 downstream of the throttling member 2. In this passage 26, a stopcock 27 has been provided permitting the establishment or the cutoff of the communication between the conduit 1 and the chamber 25. A spring 28 tends to displace the diaphragm

24 towards the right of FIGS. 1 to 3 and 7, and a very narrow orifice 29 can be provided for permanently putting this chamber 25 into communication with the atmosphere.

The stopcock 27 can be actuated by a means, sensitive to the speed of the engine, which preferably comprises an electromagnet 30 including a movable core 31 connected to a lever 32 connected to the stopcock 27. A spring 33 tends to displace the core 31 towards the right of FIGS. 1 to 3 and 7, and, when the electromagnet 30 is excited, the core 31 is displaced towards the left of these figures against the action of the spring 33.

The operation of the electromagnet system sensitive to the speed of the engine and in particular to its deceleration is already known and has been described in U.S. Pat. No. 3,455,260 filed on Oct. 24, 1966 by Andre Louis Mennesson for "Fuel feed devices for internal combustion engines." This system is sensitive to the number of impulses produced by the ignition breaks, and has an electric relay adapted to make the current flow in the electromagnet 30 each time that the speed of the engine is greater than a predetermined value and to cut off this current each time that the speed of the engine is lower than that predetermined value.

The relay in question has been indicated at R in FIG. 1, the device A representing schematically the ignition breaker.

The device then operates in the following manner.

During idling operation, the elements of the carburator occupy the position of FIG. 1. The throttling member 2 is in the position in which its opening is regulated by the screw 18, and the richness of the mixture introduced into the engine is determined, on the one hand, by the calibrated orifice 5 sucking in the fuel, and on the other hand, by the calibrated orifices 7 and 11 delivering the air, as well as by the calibrated orifice 8 which regulates the suction section towards the conduit 1.

In the course of the progressive opening of the throttling member 2, it is known that the orifice 11 or its analogues, if several such orifices exist, pass progressively from upstream to downstream of the throttling member 2, thus increasing the section of the orifices placed downstream of the throttling member 2 and decreasing the airflow cross section placed upstream of this same throttling member. There results, at the same time as the increase of the cross section around the throttling member 2 that regulates the airflow, an increase of the quantity of the fuel delivered by the orifices 8 and 11. This combination permits a suitable richness of the total mixture drawn in by the engine during the opening stroke of the throttling member 2 to be obtained, until the principal system begins to feed the fuel.

In these operating conditions, the electromagnet 30 is not excited as long as the speed of the engine does not reach the predetermined limit. Thus, the communication between the chamber 25 and the conduit 1 is cut off by the stopcock 27. During this time, the orifice 29 maintains atmospheric pressure in the chamber 25, the spring 28 pushes the diaphragm 24 towards the right of the figure, and the lever 19 occupies its position the farthest right in the figure thus positioning the rod 21 to close the stopcock 13.

If, after having driven at relatively high speed, the driver allows the accelerator control to return to the idling position, it can be seen that, since the speed is then greater than the predetermined speed which is in general of the order of 1300 to 1400 r.p.m., the electromagnet 30 is excited. The core 31 is displaced towards the left of the figures, causing the rotation of the stopcock 27 which then puts the conduit 1 in communication with the chamber 25. This has the effect of creating in this chamber a sufficient vacuum to overcome the force of the spring 28 and to displace the diaphragm 24 towards the left of the figures, which pulls the lever 19 in this movement as well as the rod 21 and the stopcock 13. The effect of this action is to limit (by the action of the abutment 20) the closing of the throttling member 2 which can no longer return completely to its idling position, on the one hand, and on the other hand, to establish the communication between the passages 12 and 14, which permits a part of the fuel mixture formed in the passage 6 to pass through the passage 14 into the conduit 1. This supplementary mixture is added to the mixture that is normally delivered by the orifices 8 and 11.

This position of the various members which is shown in FIG. 2 remains as long as the speed of the engine has not dropped as low as about 1300 to 1400 r.p.m.

As soon as this predetermined speed is reached, the electronic system cuts off the excitation of the electromagnet 30, and then all the members return to the position of FIG. 1, that is to say the idling position.

FIG. 3 represents the position of the members corresponding to the wide open position of the throttling member 2. At this time, it is known that the electromagnet 30 is excited, but, as the vacuum in the conduit 1 is very small, the spring 28 predominates, and the diaphragm 24 moves towards the right of the figure and closes the stopcock 13. It should be noted that the displacement of the lever 19 does not have any effect on the throttling member 2, since the abutment 20 is no longer in contact with the lever 16.

Thus the desired result is achieved: during deceleration, that is to say while the engine is driven by the vehicle and as long as its speed is greater than a predetermined speed, the quantity and the richness of the mixture introduced into the engine are increased, the quantity being principally increased by the supplementary opening of the throttling member 2 and the richness being increased by the opening of the stopcock 13.

FIGS. 4 and 5 represent a slightly different device of more compact construction.

The device used in FIGS. 1 to 3 for assuring a supplementary opening of the throttling member 2, which uses a vacuum system such as 24, 25, is relatively cumbersome, and in addition, it imposes a rather delicate overall regulation to obtain a precise supplementary opening of the throttling member 2 during deceleration.

In FIGS. 4 and 5, the idling system comprises the same elements as in FIGS. 1 to 3, but the electromagnet 30 is replaced by an electromagnet 30*a* which acts on a core 31*a* rigid with a plate 34 adapted to move up against a flange receiving two orifices. One of these orifices is the opening of the passage 12 which can be provided with a calibrated orifice 35; the other is a passage 36 leading into the air inlet 3 and whose section can be regulated by the cone 37 controlled by a screw 38. This plate 34 moves in a chamber 39 in which opens a passage 40 providing communication between this chamber and the conduit 1 downstream of the throttling member 2. The minimum opening of this member is limited solely by the screw 18 which cooperates with a lever 16*a* analogous to the lever 16 of FIGS. 1 to 3.

The electromagnet 30*a* is excited exactly by the same mechanism as the electromagnet 30 of FIGS. 1 to 3.

During idling, the members occupy the positions of FIG. 4. The electromagnet 30*a* is not excited and the core 31*a*, pushed by a light spring 41, applies the plate 34 against the flange which faces it, thus closing the openings of the two passages 12 and 36. The lever 16*a*, which replaces the lever 16 of FIGS. 1 to 3, is at its abutment 18.

It can be seen, in these conditions, that the normal idling of the engine is supplied by the same orifices as in the case of FIG. 1 and that nothing can circulate in the passage 40.

In the course of deceleration, the elements can occupy the positions represented in FIG. 5. As the speed of the engine is greater than the predetermined speed, the electronic device excites the electromagnet 30*a*, which moves the core 31*a* as well as the plate 34 towards the right of the figure. The plate 34 then uncovers the openings of the two passages 12 and 36, which are put in communication with the chamber 39 which communicates freely through the passage 40 with the zone in vacuum of the conduit 1 downstream of the throttling member 2.

Thus there is established a flow, on the one hand, of air through the passage 36, and on the other hand, of fuel mixture through the passage 12.

The flow of air through the passage **36** has the effect of increasing the operating conditions in particular the speed, of the engine, although the throttling member **2** remains in its idling position against the idling abutment **18**. Furthermore, the passage **12** calibrated by the orifice **35** permits a certain quantity of fuel mixture to be delivered which is added to the quantity delivered by the orifice **8**.

By a judicious choice of the calibrated orifice **35** and by a suitable regulation of the screw **38**, the flow rate and the richness of the mixture introduced into the engine during deceleration can thus be increased, as long as the speed of the engine remains above the predetermined speed which acts on the relay R exciting the electromagnet *30a*.

It should be noted that, when the throttling member **2** is wide open (position indicated in dot-dash lines in FIG. 5), the obturation member or plate **34** remains open. That has hardly any importance for, in any case, the vacuum existing in the conduit **1** is very small, and consequently, the suction of fuel or of air through the passages **12** and **36** remains minimal and the flow rate through these passages represents only an extremely small fraction of the flow rate delivered by the principal fuel feed system, so that practically no variation can be observed in the richness of the mixture under wide open conditions.

It should be noted that the embodiment of FIGS. 4 and 5 is simpler than the preceding embodiment and that it is also much more precise: the regulation of the quantity of air is effected by the screw **38** in a simple manner and the regulation of the quantity of fuel is effected by acting on the section of the orifice **35** which can also be adjusted by a regulable screw. Finally, the overall unit can be incorporated in the carburator proper without any system of rods or any coupling of any sort, which considerably increases the mechanical strength or resistance of the overall carburation device and facilitates its manufacture and its cost price.

It is obvious that the operating conditions during deceleration impose particular characteristics on not only on the quantity and the composition of the mixture admitted, but also on other operating factors of the engine, such as the ignition advance. The present invention permits this latter factor to be acted upon by extremely simple means.

FIG. 6 represents one of these means, which simply comprises a chamber **42** provided with a diaphragm **43** actuating a rod **44** against the action of a spring **45**, this rod **44** being connected to the ignition distributor **46**.

The chamber **42** is connected through a passage **47** to the passage **26** of FIGS. 1 to 3, so that the same source of vacuum is exerted in the chamber **42** and in the chamber **25**. In this manner, when the vacuum that acts on the richness of the mixture during deceleration is established in the chamber **25**, the same vacuum is established in the chamber **42** which then displaces the diaphragm **43** and the rod **44** towards the right of the figure, causing the ignition distributor **46** to turn in the direction of the arrow which corresponds, for example, to a supplementary retard of the ignition. It is known that such an ignition retard is favourable to the depollution of the exhaust gas, and it is thus appropriate to cause this retard at the same time as the quantity and the composition of the mixture admitted to the engine are modified.

It can be seen that, in normal operating conditions of the engine, this effect of ignition retard does not exist since the vacuum prevailing in the chambers **25** and **42** is negligible with respect to the effect of the spring **45** or **28**.

If the embodiment of FIGS. 1 to 3 is considered again, as modified according to FIG. 6, it will be noted that in normal operating conditions, and in particular, at rather high stabilized speeds (FIG. 2), a nonnegligible vacuum continues to prevail downstream of the throttling member **2**, and this vacuum is transmitted to the chamber **42** by the intermediary of the passages **26** and **47**. This vacuum moves the diaphragm **43** and the rod **44** towards the right of FIG. 6, causing the ignition distributor **46** to turn in the direction of the arrow according to a process analogous to that which is caused by deceleration. The ignition retard thus caused results, during normal operation, in excessive fuel consumption.

In order to mitigate this disadvantage, according to the embodiment of FIG. 7, which constitutes an improvement of the embodiment described in the preceding paragraph, the opening **48** of the passage **26** in the principal conduit **1** is situated, with respect to the edge **49** of the throttling member **2**, in a manner such that it is downstream of this edge **49** for the positions of the member **2** comprised between idling (position shown in dot-dash lines) and deceleration (position shown in dashed lines), and such that it is upstream of this edge **49** for larger openings of this throttling member **2**.

When the accelerator control is depressed, the throttling member **2** leaves the idling position and moves towards a wider open position. As soon as the throttling member **2** has passed the deceleration position, the opening **48** of the passage **26**, connecting the principal conduit **1** to the chambers **25** and **42**, is located upstream of the throttling member **2** and the vacuum that prevails at the level of this opening **48** is consequently small, and in any case, insufficient to actuate the diaphragms **24** and **43** against the respective actions of the springs **28** and **45** when the stopcock **27** opens. The diaphragm **24** moves towards the right of the figure and closes the stopcock **13**, and the diaphragm **43** moves towards the left of the figure, permitting the ignition advance device **46** to take its normal position. By contrast, during deceleration, the throttling member **2** moves into the position shown in dot-dash lines and the opening **48**, situated then downstream of the throttling member **2**, is subjected to a vacuum which actuates the diaphragms **24** and **43**, according to the process already described.

Accordingly, for all the positions of the throttling member **2** comprised between deceleration and maximum opening, that is to say for all the stabilized speeds higher than an "accelerated idling" speed, the curve of ignition advance becomes normal and is not influenced by the device modifying, during deceleration, the quantity and the composition of the mixture admitted to the engine.

Needless to say, the modification of the flow rate and of the richness of the mixture during deceleration, above a predetermined value of the speed, could be effected by other systems than by electronic means. Mechanical, hydraulic or pneumatic means, sensitive to the speed of the engine or of the vehicle, can easily be envisaged for actuating either the stopcock **27** of FIGS. 1 to 3, 6 and 7, or the obturator plate **34** of FIGS. 4 and 5.

Although the invention has been described with specific reference to particular embodiments, the invention should not be limited thereto, as various modifications are possible without departing from the spirit or scope of this invention.

I claim:

1. A carburation device for a spark ignition internal combustion engine including an ignition distributor, said carburation device comprising, in combination:
   - an admission conduit;
   - flow rate regulating means for regulating the flow rate of the air/fuel mixture delivered by the carburation device to the engine, said flow rate regulating means comprising movable throttling means mounted in said admission conduit for throttling the flow of fluid through said admission conduit;
   - an idling fuel feed system for introducing fuel into said admission conduit, said idling fuel feed system including an idling fuel feed passage opening into said admission conduit via an idling fuel feed orifice downstream of said throttling means;
   - richness regulating means for regulating the richness of said mixture, said richness regulating means comprising an auxiliary passage leading from said idling fuel feed passage into said admission conduit via an auxiliary orifice downstream of said throttling means, and valve means disposed in said auxiliary passage for blocking off and opening said auxiliary passage; and

control means responsive to deceleration of the engine occurring at speeds above a predetermined limit speed for controlling simultaneously said flow rate regulating means and said richness regulating means during periods of deceleration occurring at speeds above said limit speed, said control means comprising, on the one hand, abutment means adapted for cooperating with said throttling means for holding said throttling means in a partially open position during said periods of deceleration occurring at speeds above said predetermined limit speed, thereby increasing the flow rate of said mixture, and on the other hand, means for opening said valve means during said periods of deceleration occurring at speeds above said predetermined limit speed, thereby increasing the richness of said mixture and wherein said control means, in addition to acting on said flow rate regulating means and said richness regulating means, also acts simultaneously on said distributor to retard the ignition during said periods of deceleration occurring at speeds above said predetermined limit speed.

2. A carburation device for an internal combustion engine, said carburation device comprising, in combination:

an admission conduit;

movable throttling means mounted in said admission conduit for throttling the flow of fluid through said admission conduit;

an idling fuel feed system for introducing fuel into said admission conduit, a said idling fuel feed system including an idling fuel feed passage opening into said admission conduit via an idling fuel feed orifice downstream of said throttling means;

flow rate regulating means for regulating the flow rate of the air/fuel mixture delivered by the carburation device to the engine, said flow rate regulating means including a first auxiliary passage communicating with said idling fuel feed passage;

richness regulating means for regulating the richness of said mixture, said richness regulating means including a second auxiliary passage communicating substantially with the atmosphere;

said flow rate regulating means and said richness regulating means comprising a common third auxiliary passage communicating with said admission conduit downstream of said throttling means, and a common valve member for blocking off simultaneously said first and second auxiliary passages and for opening simultaneously said first and second auxiliary passages to put them in communication with said common third auxiliary passage; and

control means responsive to deceleration of the engine occurring at speeds above a predetermined limit speed for controlling simultaneously said flow rate regulating means and said richness regulating means during periods of deceleration occurring at speeds above said limit speed, said control means comprising means for actuating said common valve member to open said first and second auxiliary passages to put them in communication with said common third auxiliary passage during said periods of deceleration occurring at speeds above said predetermined limit speed.

3. A carburation device according to claim 1 said control means being responsive to the pressure in a particular region of said admission conduit, said particular region being located downstream of said throttling means for the positions of said throttling means comprised between the idling position proper and said partially open position imposed during periods of deceleration, and said particular region being located upstream of said throttling means for all other positions of said throttling means, whereby said control means is active only during periods of deceleration occurring at speeds above said predetermined limit.

4. A carburation device according to claim 1 wherein said control means comprises a first lever mounted freely and coaxially with a second lever, said second lever being fixed to said throttling means, said first lever having an abutment arranged to bear against said second lever to effect said partially open position of said throttling means.

5. A carburation device for an internal combustion engine for an automobile, said carburation device comprising, in combination;

flow rate regulating means for regulating the flow rate of the air/fuel mixture delivered by the carburation device to the engine, said flow rate regulating means comprising movable throttling means mechanically linked to an accelerator control actuable by the operator of the engine so that the operator can mechanically control the acceleration and deceleration of the engine;

richness regulating means for regulating the richness of said mixture and

control means responsive to deceleration of the engine occurring at speeds above a predetermined limit speed, for controlling simultaneously said flow rate regulating means and said richness regulating means during periods of deceleration occurring at speeds above said limit speed, during said periods of deceleration occurring at speeds above said predetermined limit speed, and on the other a hand, means for simultaneously changing the richness of said mixture during said periods of deceleration occurring at speeds above said predetermined limit speed, and wherein said control means comprises a first lever mounted freely and coaxially with a second lever, said second lever being fixed to said throttling means, said first lever having an abutment arranged to bear against said second lever to effect said partially open position of said throttling means.