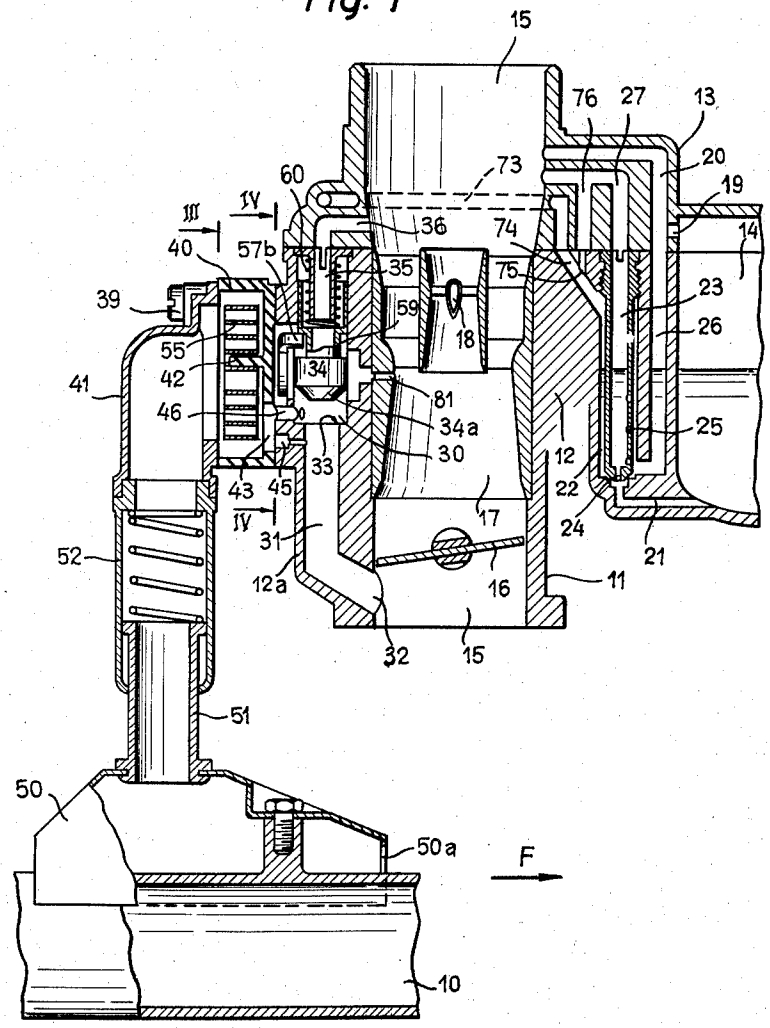
Jan. 13, 1959 F. BELLICARDI 2,868,185

CARBURETTING APPARATUS FOR INTERNAL COMBUSTION ENGINES

Filed May 11, 1956 2 Sheets-Sheet 1

Fig. 1



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2 Sheets-Sheet 2

Fig. 2

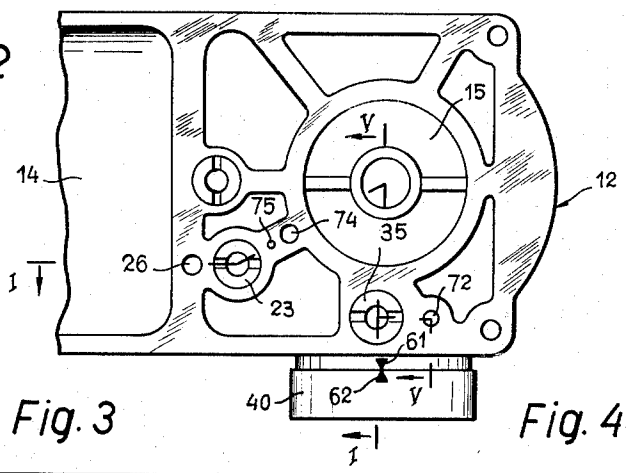


Fig. 3

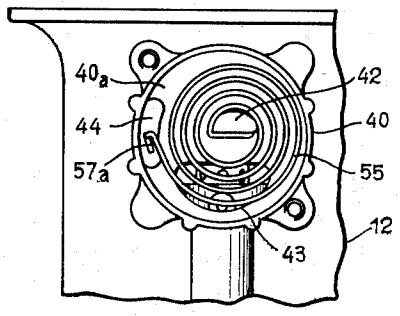


Fig. 4

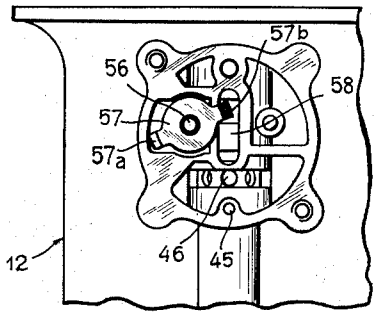


Fig. 5

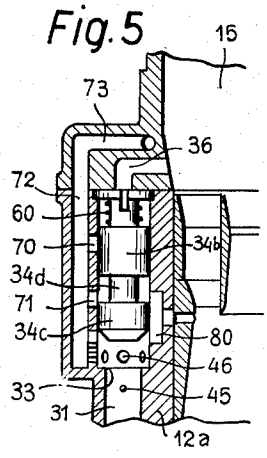


Fig. 6

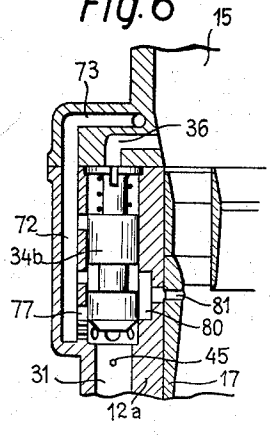
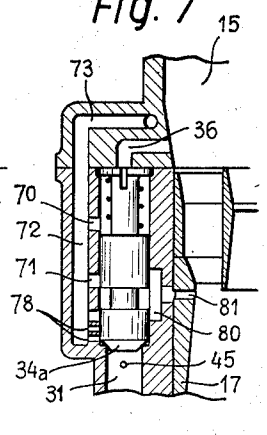


Fig. 7



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CARBURETTING APPARATUS FOR INTERNAL COMBUSTION ENGINES

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Application May 11, 1956, Serial No. 584,352

Claims priority, application Italy May 12, 1955

7 Claims. (Cl. 123—180)

Most carburetors presently in use are equipped with a starter for the purpose of supplying to a motor vehicle engine a relatively rich fuel mixture in order to facilitate cold starting and afford smooth running of the engine till the latter reaches its operational temperature. The starter is operated either by hand or automatically through temperature-responsive means controlling the mixture enriching steps for instance dependently upon the temperature of the exhaust manifold.

The main object of this invention is to provide a thermostatically controlled starter affording a ready engine starting even at very low temperatures as well as a satisfactory operation both when the engine once started is run during a certain period at standstill, whereby the starter is automatically cut-off after three to five minutes and idle running of the engine is smooth the operational temperature having been attained, and when this heating period is omitted, the vehicle being started right after starting the engine. In both cases this starter supplies a mixture dependent in respect of composition and quantity upon the temperature of the engine which runs smoothly under any condition of use.

A further object of the invention is to provide a thermostatically controlled starter which, once it has been cut off as the engine reaches its operational temperature, cannot be coupled again as long as the engine is running, under any conditions of temperature or use of the vehicle.

According to this invention a starter for internal combustion engine carburetors of the type in which the means for supplying the rich mixture required for starting the engine are controlled depending upon the engine temperature through a bi-metallic spiral, is characterised in that the bi-metallic spiral is arranged in a thermo-control duct connected at one end to the carburetor induction passage and ending at its other end by an air scoop adjacent the engine exhaust manifold, so that air continuously flows through the thermo-control duct, moreover the rich mixture control member comprises a slide valve having a piston mounted for axial displacement in a cylinder bored in the carburetor body, the said cylinder connecting with both said conduits as well as with a float chamber in the carburetor, the said piston having a front surface formed as a conical valve adapted to intercept connection between the cylinder and thermo-control duct in a forward axial piston position under the action of resilient return means, connecting means being provided between the bi-metallic spiral and piston, so that the axial piston position depends upon the temperature of air flowing through the said thermo-control duct.

The invention will be described in greater detail with reference to the accompanying drawing which shows a construction thereof, and wherein:

Figure 1 is a vertical cross-sectional view on the broken line I—I of Figure 2 of the device with the associated parts of the carburetor and an internal combustion engine;

Figure 2 is a top view of the carburetor, its cover being removed;

Figure 3 is a side view on plane III of Figure 1;

Figure 4 is a cross-sectional view on line IV—IV of Figure 1;

Figures 5 to 7 are cross-sectional views on the broken line V—V of Figure 2, showing the slide valve in various operative positions.

In the figures an internal combustion engine is depicted by its exhaust manifold 10 securedly fixed to the engine block, the hot combustion gases flowing through said manifold in operation.

The engine is equipped with a carburetor 11 comprising a body portion 12 and cover 13. A chamber 14 for a float, not shown, is bored in the body 12. The body 12 and cover 13 confine together an induction passage 15 controlled in a manner known per se by a throttle valve 16. A Venturi diffuser 17 and a main spray nozzle 18 are arranged ahead of the throttle valve 16 in the passage 15. The top of the chamber 14 connects through a bore 19 with a conduit 20 opening into the induction passage 15 ahead of the Venturi and main nozzle 18. A conduit 21 extends from the bottom of the chamber 14, its other end opening into the bottom of a well 22 seating a starting jet 23. The lower end of the starting jet 23 tightly fits against the said end of the conduit 21 and has a calibrated orifice 24 bored therein. The jet 23 is screwed from the top into the body 12 and has further orifices, such as 25 bored therein along its length, so that the fuel in the chamber 14 can reach the well 22 through the orifices 24 and 25. A further well 26 bored in the body 12 is connected with the bottom portion of the well 22 and connects through conduit 20 with the induction passage 15. The longitudinal bore in the jet 23 connects with a conduit 27 opening into the induction passage 15 ahead the Venturi 17 and main nozzle 18.

It will be easily understood from the above that the carburetor 11 is of the downdraught type which is largely used in automotive constructions. The expressions "ahead" and "past" used heretofore obviously refer to the direction of the air flow through the induction passage 15.

A cylindrical chamber 30 is bored in a wall 12*a* on the carburetor body, its longitudinal axis being parallel with the longitudinal axis of the induction passage 15. The chamber 30, which shall be briefly referred to hereafter as a cylinder, is arranged substantially adjacent the Venturi 17. A conduit 31 extends from the bottom of the cylinder 30 and opens at 32 into the induction passage 15. Its outlet 32 is just past the throttle valve 16. The outlet of the conduit 31 into the cylinder 30 provides a circular seat 33 against which may be tightly pressed a conical end portion 34*a* of a control piston 34 mounted for axial displacement in the cylinder 30. This piston will be described in greater detail hereafter.

A connecting pipe 35 is secured to the top of the cylinder 30 and connects the end top portion of the cylinder 30 with a conduit 36 opening into the induction passage 15 ahead of the Venturi 17. The wall 12*a* has secured thereto, for instance by means of screws 39, a casing 40 and a cover provided with a fitting 41, both of which are hollow. The bottom 40*a* of the casing 40 is flat, a pin 42 extending into the casing 40 from a central portion of the bottom. The bottom 40*a* is further formed with an opening 43, and a further opening 44 (Figure 3) of arcuate form is arranged near the periphery of the casing. The form of the opening 43 is more clearly visible from Figure 3. The opening 43 connects with the conduit 31 through an orifice 45 bored in the wall 12*a* of the body 12 as well as with a lower end portion of the cylinder 30 through orifices 46.

The exhaust manifold 10 supports a casing 50 in which an opening 50*a* is bored in the direction of drive F of the

motor vehicle so that, when the vehicle is travelling an air stream enters the casing 50 through the opening 50*a*. The top portion of the casing 50 has secured thereto a connecting pipe 51 telescopically connected with the cover carrying the fitting 41 through a tubular member 52. A permanent communication is thus established between the casing 50, which will be referred to hereafter as air scoop, and suction pipe 15 through the parts 51, 52, 41, 40, 43, 45, 31 and 32. These parts form together a thermo-control duct defining an air path in which a bi-metallic spiral 55 is arranged according to this invention. More particularly, this bi-metallic spiral 55 is housed by the casing 40. The inner end of the spiral is anchored to the pin 42.

A shallow recess is formed in the wall 12*a* between the bottom 40*a* of the casing 40 and cylinder 30 and receives a rocker 57 swinging about a pivot 56 securedly fixed to the carburetor body 12 (Figures 1 and 4). An arm 57*a* on the rocker 57 is bent at its end towards the casing 40, the said end extending through the opening 44 in the bottom of the casing 40 and serving as an anchoring means for the outer end of the bi-metallic spiral 55. In the embodiment shown the spiral is such that as the air flowing through the thermo-control duct and casing 40 rises in temperature, the spiral tends to close, that is its outer end tends to move in a clockwise direction in Figure 3.

The further arm 57*b* on the rocker 57 (Figures 1 and 4) is bent towards the cylinder 30. This arm extends through an opening 58 in the wall 12*a* and enters an annular recess 59 in the control piston 34. A helical pressure spring 60 (Figures 1 and 5–7) acts to press the piston 34 downwardly and the conical valve 34*a* against the annular seat 33. This spring force is opposed by the bi-metallic spiral 55 acting likewise as a spring on the piston 34 through the rocker 57. With a cold engine the spiral 55 presses downwardly the arm 57*a* (Figure 3) on the rocker 57, so that the arm 57*b* lifts the piston 34 against the force of the spring 60. For the purpose of setting the initial position of the piston 34, the casing 40 is rotatably arranged with respect to the carburetor body 12. More particularly, in order to set the device, the screws 39 are slightly loosened, the casing 40 is angularly rotated to a more favorable position, whereupon the screws 39 are tightened again. Reference marks may be provided on the body 12 and casing 40, such as 61, 62 in Figure 2, in order to denote the accurate position of the casing as ascertained on testing by the manufacturer.

The arrangement of the control slide piston 34 will now be described in greater detail with reference to Figures 5 to 7.

The piston comprises a cylindrical member having full-diameter end portions 34*b*, 34*c* and an intermediate portion 34*d* of reduced diameter, in order to form the above mentioned annular groove 59 receiving the arm 57*b* on the rocker 57. The portion 34*c* may be termed "forward portion" in respect of the circular seating 33, and the piston movement towards the seating 33 "forward movement."

By effect of the configuration of the piston 34 the bore in the cylinder 30 is subdivided into three chambers, namely a forward chamber adjacent the annular seating 33, an intermediate chamber at the annular groove 59 in the piston and rear chamber connecting with the induction passage 15 through conduit 36.

As will be further explained hereafter the purpose of the configuration of the piston 34 and arrangement of further ports and conduits, which will be described hereafter, is to effect a gradual restricting of the fuel and combustion air as the engine heats up from its starting stage, more particularly from a cold condition.

With a cold engine the piston is in its rearmost position (Figure 5). Figure 6 shows the position of the piston 34 at a stage intermeditae starting and normal

operation, Figure 7 showing the position of the piston 34 with a hot normally running engine.

A compensating port 70 and a restricting port 71 are bored in the wall of the cylinder 30 in the path of the rear portion 34*b* of the piston. The ports 70, 71 connect with a supply conduit 72 for the starting mixture bored in the body 12 of the carburetor parallel with the cylinder 30 adjacent the latter. The conduit 72 extends at 73 within the carburetor cover (see also Figure 1) and connects at 74 with the top of the well 22 receiving the jet 23 and connecting through a calibrated hole 75 and passage 76 with the induction passage 15.

The ports 70, 71 are thus controlled by the piston portion 34*b*. The forward piston portion 34*c* controls in turn in part the port 71 and further mixture ports comprising a port 77 followed by two orifices 78. The latter are approximately at the same height as orifices 46. When the port 70 is uncovered it connects with the rear chamber only in the cylinder 30 (Fig. 7). When uncovered, the port 71 connects with the intermediate chamber in the cylinder 30. When uncovered by the forward piston portion 34*c*, the ports 77, 78 connect with the forward chamber in the cylinder 30. An axially extending channel 80 is bored in the wall 12*a* at the same height as both ports 71, 77 and connects through an orifice 81 with the narrowest region of the Venturi diffuser. The axial extension of the channel 80 is such that it can establish communication at one end with the port 71 through the intermediate chamber in the cylinder 30 and at its other end with the port 77 through the forward chamber in the cylinder.

Assuming the throttle valve 16 is on starting in its closed position shown in Figure 1, the engine being started cold, the piston 34 is in the position shown in Figure 5, the compensating port 70 being closed by the rear portion 34*b* of the piston 34, all other ports opening into the cylinder 30 being open. The exhaust manifold is cold.

On driving of the engine by the usual electric starting apparatus (not shown) an underpressure is set up in the induction passage 15 past the throttle valve 16. This underpressure propagates towards the cylinder 30 through the conduit 31. Since the ports 71, 77 are open, an emulsion of the starting mixture is drawn into the cylinder 30 through the conduit 73, 72 from the well 22. At the same time starting air is drawn into the forward portion of the cylinder 30 from the induction passage 15 through orifice 81 and on the other hand from the air scoop 50 through the abovementioned thermo-control duct confined by the parts 51, 52, 41, 40, 43, 45 and 46. A rich starting mixture is thus formed, which reaches the engine through conduits 31 and 15.

Upon starting of the engine, the exhaust manifold 10 is gradually heated by the flow of exhaust gases therethrough. The importance of the abovedescribed bimetallic spiral 55 now becomes obvious. It should first be noted that this spiral is merely responsive to the temperature of the air flowing through the casing 40. In order to more easily reach these conditions, it will be preferable at least for the casing 40 to be made of a heat insulating material, so that the spiral is prevailingly heated by the air stream flowing adjacent the exhaust manifold 10 and by a very slight extent only by direct heat conduction by the component parts of the device. The casing may be made of the material known under the trade name of "Bakelite," though other suitable materials, more particularly synthetic materials may be employed.

The air drawn by the engine through the thermo-control duct is thus heated and impinges upon the bi-metallic spiral 55 which closes its turns and permits movement of the piston 34.

Two possibilities are now open. The driver either allows the engine to heat up, without starting the vehicle.

In this case the exhaust manifold heats up very slowly, this applying also to the air flowing adjacent the manifold, so that it takes some time before expansion of the bi-metallic spiral 55 changes the position of the control piston 34.

Alternatively, the driver starts the vehicle without waiting for the engine to be hot enough. The exhaust manifold 10 then quickly reaches a high temperature, which would imply a foretimely cutting out of the starting device. However, the air entering the scoop 50 through the intake 50*a* with a running vehicle causes the air drawn by the device to heat up at a much slower rate, so that the spiral 55 closes slowly and a rich mixture is supplied to the engine during the necessary period of time for the engine to correctly reach its operational temperature. The practical advantage of both procedures is obvious and need not be further explained.

On heating of the spiral 55 the pressure by the spring 60 gradually moves the piston 34 forward. During this displacement the forward portion 34*c* of the piston 34 gradually closes the port 77 to the position shown in Figure 6, in which the quantity of air drawn into the conduit 31 is not yet substantially reduced, the ports 46 being still open. But the mixture is drawn at a reduced rate through the conduit 72, the orifices 78 only being free. It will be seen that the parts 34*c* and 77 gradually restrict the fuel flow, whereby the mixture supplied to the engine becomes poorer, without its volume being reduced.

Subsequently, the forward portion 34*c* of the piston 31 also starts to gradually restrict the air ports 46 and orifices 78, the rear piston portion 34*b* starting uncovering the port 70. It will be clear that the mixture flowing through the conduit 31 becomes still poorer, its quantity also being reduced. In fact, the ports 46 are partly closed, the port 70 being connected with the conduit 36, thereby making up for the underpressure in the conduit 72.

As the piston 34 moves further forward the conical valve 34*a* is finally pressed against its annular seating 33 (Figure 7), thereby fully cutting out connection between the conduit 31 and cylinder 30. Under these conditions, the conduit 31 further connects with the casing 40 through the orifice 45, so that an air stream further flows through the casing 40 from the air scoop 50.

The passageway 80 and orifice 81 bored at the narrowest region of the Venturi 17 act to afford a smooth increment in acceleration even with a cold engine. Otherwise, an opening of the throttle valve 16 the reduced underpressure would act on the conduit 31 to reduce the quantity of fuel drawn towards this conduit. The mixture supplied by the main nozzle 18 only would be insufficient for a smooth engine acceleration. Through the provision of the orifice 81 the rich mixture is drawn to the cylinder 30 by the underpressure in the restricted region of the Venturi with the throttle valve 16 open, so that no inadequate engine supply is to be feared.

It will be understood that the device described above and illustrated can be modified in various manners. So, for instance it can be further equipped with a hand control acting on the piston 34 or rocker 57. Further modifications can be made without departing from the scope of the appended claims.

What I claim is:

1. In a carbureting apparatus for motor vehicle internal combustion engines, a body, an induction passage in said body, a Venturi in said passage, a throttle valve in said induction passage past said Venturi, a float chamber in said body, a starting fuel well in said body having its lower portion connecting with the float chamber, a slidable piston valve controlling communication between the top portion of said starting well and said induction passage, said valve comprising a cylinder and a piston capable of axial displacement in said cylinder, a conduit connecting the lower end of said cylinder with the induction passage at a point past the throttle valve, said conduit forming within the cylinder a valve seat, a conical valve on the lower end of the piston facing said seat, spring means biasing the piston together with its conical valve toward said seat, means including a casing providing a thermo-control duct through which air is conveyed to the induction passage, said casing having a flat bottom disposed adjacent said cylinder, a passage opening from said casing into said conduit beyond said valve seat to provide continuous flow of air from said casing to said conduit, and a second passage opening from said casing into said cylinder above said valve seat to provide flow of air from said casing to said conduit under control of said valve, a bimetallic spiral in said casing, means anchoring the inner end of said spirial to the bottom of said casing, a pivoted rocker arm operatively connecting the outer end of said spiral to said piston so that the position of said piston is determined by the joint action of said spring and said spiral, said spiral acting in a direction to move said valve toward closed position upon increase of temperature of air flowing through said duct including said casing.

2. In the carbureting apparatus as claimed in claim 1, the piston comprising full-diameter end portions and a reduced diameter intermediate portion whereby the cylinder is subdivided into a front, rear and intermediate chamber, and a bent-over arm on the rocker protruding within the cylinder at the intermediate chamber thereof, said arm engaging the said piston.

3. In the carbureting apparatus as claimed in claim 2, the said cylinder bored within the body parallel with the induction passage, a fuel supply conduit bored within the body adjacent to and parallel with the cylinder, said supply conduit communicating at one end with the well, a fuel port connecting the supply conduit with the intermediate chamber, at least one second port connecting the supply conduit with the front chamber, said ports being controlled from the full diameter portions of the piston, at least one air passage connecting the spiral casing with the front chamber, whereby an air flow may pass from the casing via the conical valve seat towards the conduit connecting the front end portion of the cylinder with the induction passage with the piston in a withdrawn position, passage means connecting the front and intermediate chamber with a narrowest section of the Venturi with the piston in retracted position and connecting the intermediate chamber only with the narrowest section of the Venturi with the conical valve in closed condition in advanced position of the piston, a compensating port connecting the supply conduit with the rear chamber, said compensating port being controlled from the rear full-diameter portion of the piston, and a conduit freely connecting the rear chamber with the induction passage at a point ahead of the Venturi.

4. In a carbureting apparatus as claimed in claim 1, a fixed pin within the casing having an inner end of the casing fixed thereto, said casing being angularly adjustable on the body with respect of the pin.

5. In combination with a motor-vehicle engine having a discharge manifold, a carbureting apparatus for the engine comprising a body, an induction passage within the body, a Venturi within the passage, a throttle valve within the induction passage past the Venturi, a float chamber within the body, a starting fuel well within the body having its bottom portion communicating with the float chamber, a slidable piston valve controlling communication between a top portion of the well and the induction passage, said valve comprising a cylinder and a piston axially slidable within the cylinder, a conduit connecting a front end portion of the cylinder with the induction passage at a point past the throttle valve, said passage forming within the cylinder a valve seat, a conical valve formation at the front end of the piston, spring means urging the piston with its conical valve to engage the seat, means establishing together with the

said conduit a thermo-control duct through which surrounding air may be permanently drawn towards the said point of the induction passage, said thermo-control duct having an end portion extending towards the discharge manifold of the engine, an air scoop on the said end portion of the duct fixedly connected with the manifold, whereby the said air may be heated from the manifold, and a bi-metal spiral within the thermo-control duct acting on the piston oppositely to the spring means, whereby the axial position of the piston depends upon the temperature of the air flowing through the duct.

6. In the combination as claimed in claim 5, the scoop having an air inlet facing the normal direction of travel of the vehicle.

7. In the combination as claimed in claim 5, the thermocontrol duct including a casing enclosing the spiral,

said casing being fixed to the body adjacent the cylinder, and a telescopic connection at an intermediate zone of the duct between the scoop and the casing.

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