June 22, 1965 M. Y. A. M. SERRUYS 3,190,275

EXPLOSION ENGINES

Filed March 25. 1963 3 Sheets-Sheet 1

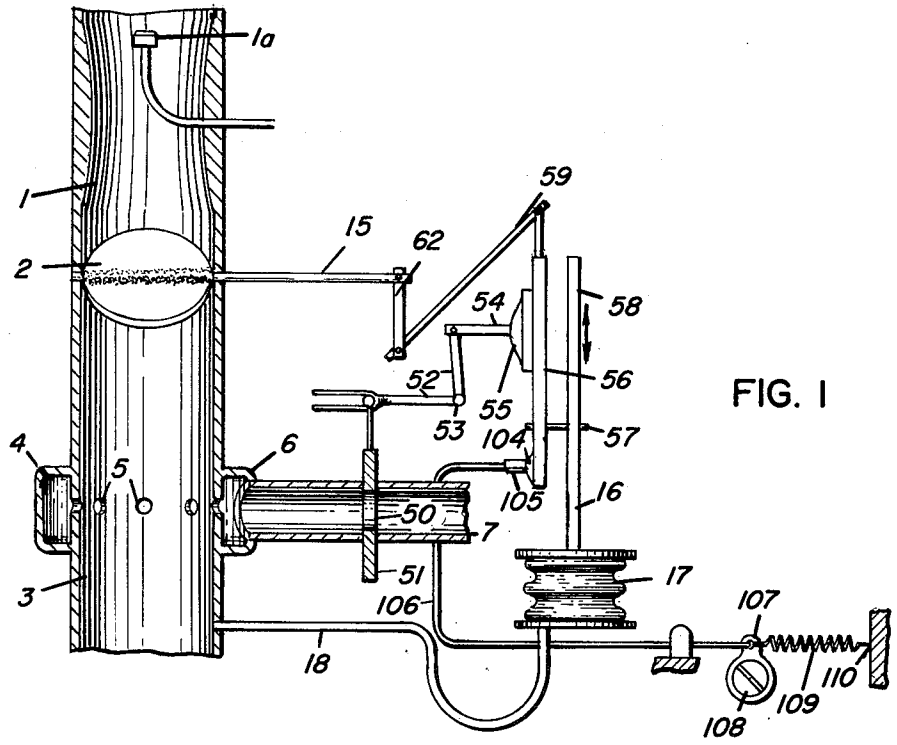
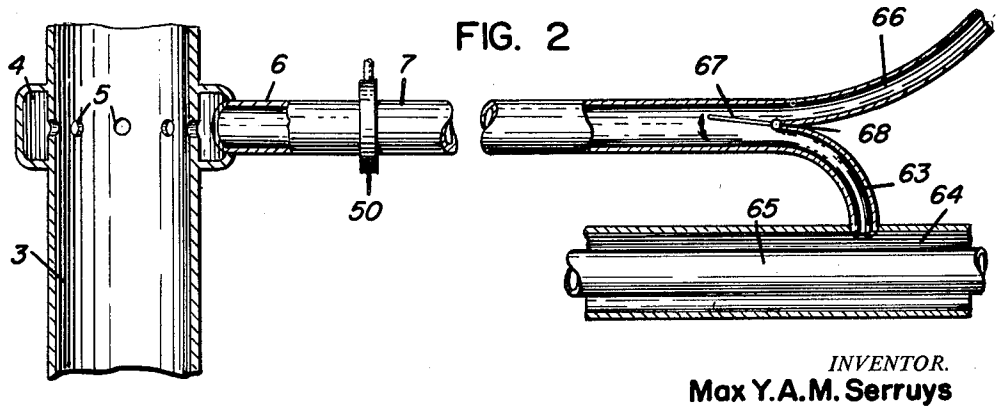


FIG. 1

FIG. 2



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EXPLOSION ENGINES

Filed March 25, 1963 3 Sheets-Sheet 2

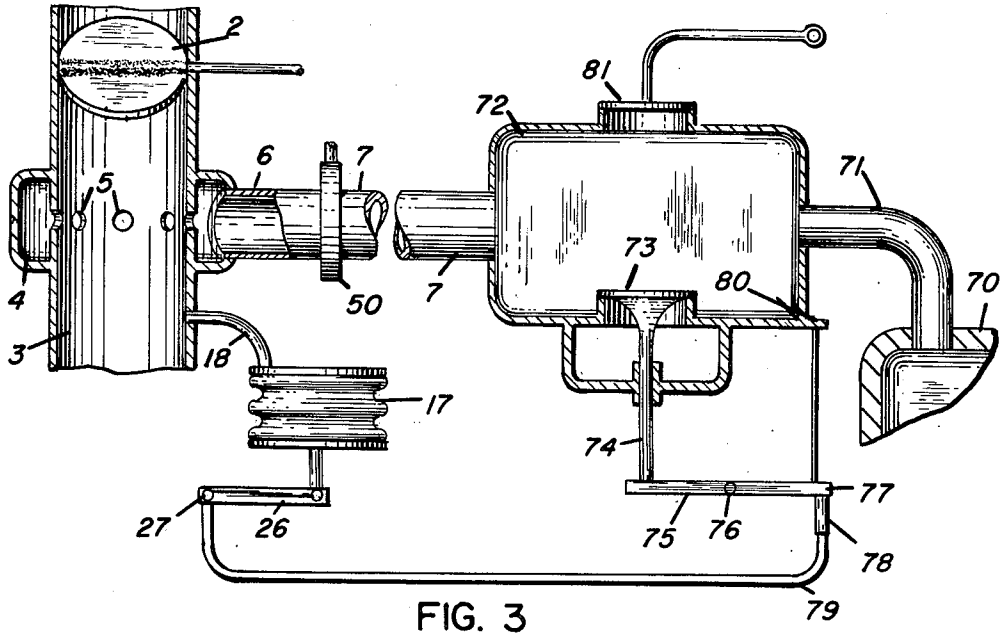

FIG. 3

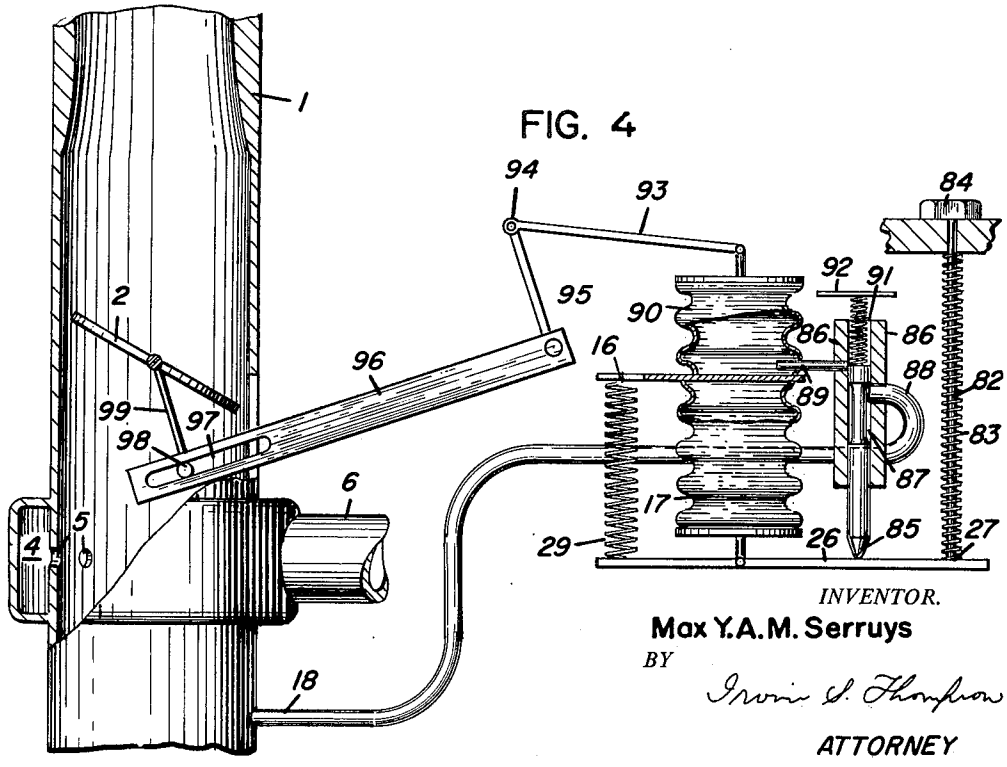

FIG. 4

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EXPLOSION ENGINES

Filed March 25, 1963 3 Sheets-Sheet 3

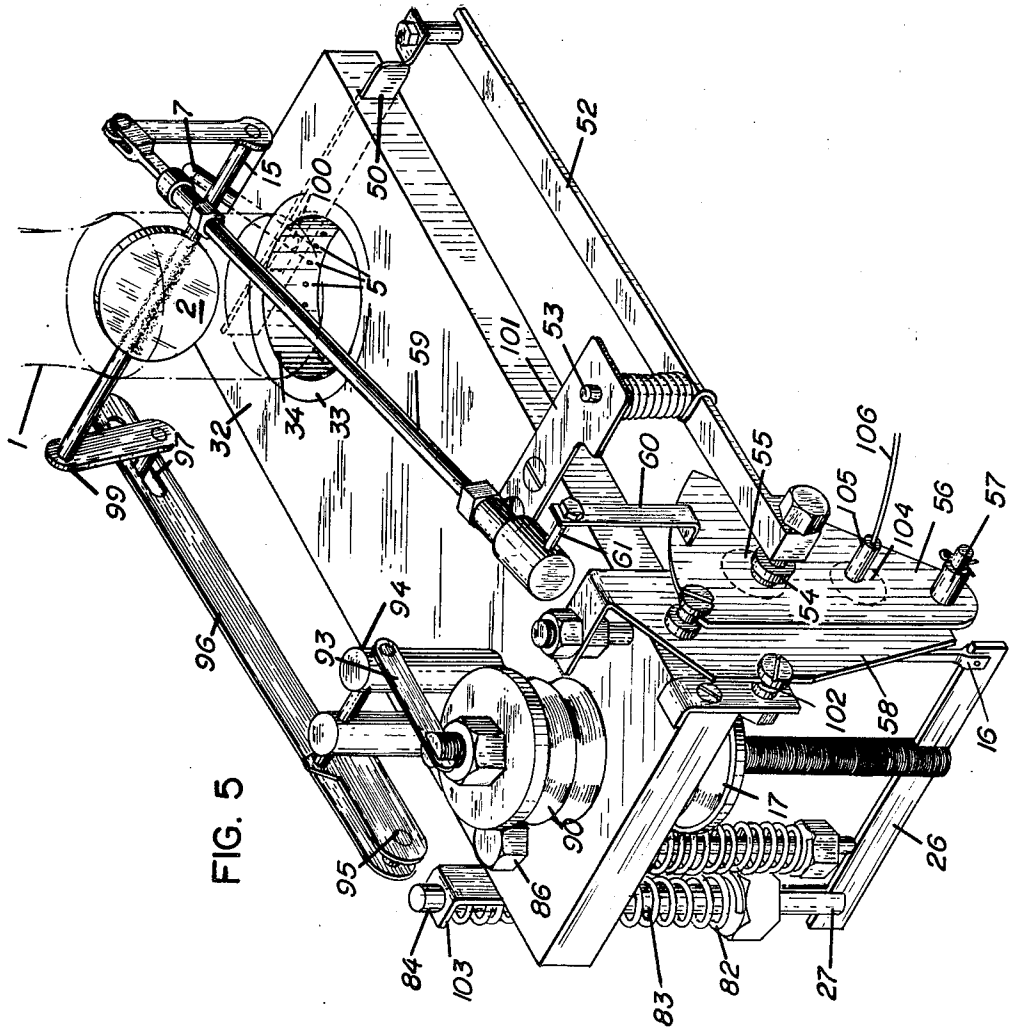

FIG. 5

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EXPLOSION ENGINES

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6 Claims. (Cl. 123—124)

The present invention has for its object to reduce the pollution of the atmosphere by explosion engines and accessorily to improve the efficiency of these engines.

It consists essentially in supplying these engines with a vaporized mixture containing the highest possible excess of air, or at least the lowest possible excess of fuel, without thereby causing any defective operation of the engine, and especially irregularity of the ignition, and to that end to perfect the homogenization of the said vaporized mixture before its admission to the engine, whenever this becomes necessary because of a bad atomization of the petrol by the carburetor.

It is in fact known that the ignition of a mixture containing a small excess of fuel or a fortiori, a more or less large excess of air, does not ignite readily and uniformly under the action of the spark from the sparking plug and does not burn regularly and rapidly unless it is very homogeneous.

Accessorily and according to the invention, means are provided:

(1) To reduce the losses of pressure of the admission at high flow-rates of gas, and thus at high power, so as to attenuate, eliminate, or even reverse the loss of pressure which may result, especially at high speeds of rotation, from the use of mixtures having a small excess of fuel or even a more or less considerable excess of air.

(2) To reduce the upward passage of oil between the pistons and cylinders, either by lowering the pressure obtaining in the engine crank-case below the ambient pressure, or by creating a back-pressure at the exhaust by a variable closure of the latter.

(3) To prevent a too-complete closure of the butterfly throttle valve to the gases of the carburetor during decelerations, such closure being liable to generate excessive pressure drops such that the ignition or the combustion becomes irregular or completely ceases.

(4) To improve the adjustment of the advance of the ignition, which is never really at an optimum value with the known arrangements, irrespective of the speed of rotation and the load.

(5) To re-cycle the gases from the crankcase into the engine.

More precisely, the means employed in accordance with the invention to reduce the pollution of the atmosphere by the exhaust gases and the gases from the crankcase of explosion engines, or to improve the thermal efficiency of these engines, are as follows, these means being frequently capable, as will be observed, of fulfilling a dual purpose and being capable of use separately or simultaneously in various combinations:

(a) In order to obtain the desired proportions of air and fuel, according to the invention the adjustment of the carburetor may be changed by increasing preferably the diameter of the venturi and by adapting the diameters of the main fuel jet and of the air mixing jet so that, taking into account the action of the other means employed, there is normally an excess of air of 10% to 40%, and especially in the case of starting-up from cold, with no load, during deceleration, when picking-up and on full load, or again an excess of air or an excess of fuel which is as small as possible.

(b) Still with the object of obtaining the most favourable proportion of the fuel and the air in the mixture admitted to the engine, there is provided on the downstream side of the carburetor a supplementary admission of air, mixed when so desired with gas from the crankcase, controlled:

(1) either by two throttle devices, cocks or slide-valves in series, one of which is operated directly or indirectly by the rotation of the butterfly-valve of the carburetor, while the other is operated directly or indirectly by the movements of a deformable system (bellows, diaphragm, piston sliding in a cylinder) subjected on the one hand to the pressure drop existing in the admission pipe, and on the other hand to an opposing spring or by a device responsive to the speed of rotation of the engine;

(2) or by a single throttle device for the flow of additional gas (cock or slide-valve) actuated by a feeler held elastically in contact with a cam capable of carrying out two different movements (two rotations, two translation movements, or one rotation and one translation movement), one operated by the rotation of the butterfly-valve of the carburetor, the other by the action of the pressure drop existing in the admission pipe downstream of the carburetor (or operated by a device responsive to the speed of rotation of the engine).

(c) In conjunction or not with the means referred to at (a) and (b) above, and always so as to obtain the most favourable proportions of air and fuel, advantage can be taken of the action on this proportion of the variable throttle devices of the flow of carburetted mixture eventually employed as indicated below so as to perfect the homogeneity of the mixture; these throttle members act particularly, as will be seen, at heavy loads (small pressure drops) and at low rates of flow of gas, so as to prevent the mixture from becoming excessively rich under these conditions.

It will be noted that while the means (a) (adjustment of the carburetor) is not always necessary, it is almost never sufficient to obtain a perfect proportioning, irrespective of the conditions of working (speed of rotation and load), but that results which are already more satisfactory can be obtained by conjointly operating the means (a) and (b), and that the means (c) (variable additional flow of air proportioned as a function of two variables representing the working condition of the engine) is in principle sufficient by itself to obtain a result which is always perfect (and still more so in conjunction with (a) and (b)).

(d) In order to perfect the homogeneity of the mixture of fuel and air, it is possible, according to the invention:

either (1) to deliver the additional air into the admission pipe downstream of the carburetor and through small orifices directed almost radially and uniformly distributed along the periphery of this pipe, and preferably after prior heating of this additional air;

or (2) to utilize variable throttle means for the flow of carburetted gases passing out of the carburetor (flaps, butterfly, cock) automatically regulated so as to wire-draw the carburetted stream mainly at low rates of flow and at low pressure drops, that is to say under the conditions for which the carburetor itself provides a poor atomization and a mixture which is particularly heterogenous;

or (3) to homogenize the mixture simultaneously by means of the additional air and by the variable throttle devices of the carburetted flow intended to supply the engine.

(e) In order to eliminate from the crankcase the gases which are normally evacuated to the atmosphere, according to the invention these gases can be directed to-

wards the suction of additional air so that they contribute to the heating of the carburetted mixture and burn with that mixture.

(f) In order to prevent the passage of oil between the pistons and cylinders, which facilitate evacuation of various hydrocarbons through the exhaust, it is possible:

either (1) to create a pressure drop in the engine crankcase or to put the latter in communication with the suction of additional air opening downstream of the carburetor, and preferably to limit this pressure drop by restricting the intake of additional air to be mixed with the gases of the crankcase by means of a valve or other suitable device coupled to a member supplying a force which is more or less proportional to the pressure drop existing in the admission pipe, so that the pressure drop in the crankcase may be for example two-thirds of the pressure drop existing at the same moment in the admission pipe, a clapper valve preferably also permitting the gases in the crankcase to pass out into the open air or to be directed to the air filter, in the event of an over-pressure in the said crankcase;

or (2) to create a variable throttling of the exhaust (for example at the outlet of the muffler) preferably regulated by a device with an opposing spring responsive to the pressure drop existing in the admission pipe, and eliminating the said throttle or its effects when the said pressure drop is annulled or becomes sufficiently small;

or (3) to utilize the arrangements of (2) and (3) above simultaneously.

(g) In order to prevent the discharge through the exhaust of substantial quantities of petroleum vapours at the moment of deceleration, a device responsive to the pressure drop existing in the admission pipe is caused to act in the direction of opening, either directly or preferably through the intermediary of a servo-motor (for example by pressure drop) on the butterfly-valves of the carburetor or on the stop which fixes the minimum opening of this butterfly-valve.

(h) In order to obtain the most reliable and most uniform ignition which may be compatible with the proportions produced by the other elements of the invention, there may be provided according to the invention, a second cam rigidly fixed to the same support as the cam which is actuated in two different directions by the butterfly-valve of the carburetor and by the pressure drop in order to regulate the additional air and to cause this second cam to act on a second feeler so as to adjust the advance of the ignition or to perfect the adjustment obtained by conventional means, depending on the particular object envisaged by the invention.

The foregoing arrangements will be illustrated by the accompanying drawings, in which:

FIG. 1 is a diagrammatic view of the arrangements of a carburetor equipped for the application of the invention.

FIG. 2 is a diagram explaining the method of heating of the additional air.

FIG. 3 illustrates the method of extraction of the additional air from the crankcase.

FIG. 4 is concerned with the mechanism for reopening the butterfly-valve of the carburetor.

FIG. 5 is a perspective view of the whole of the device which, in association with the carburetor, ensures the regulation of the fuel supply mixture to the engine.

In FIG. 1 the carburetor is shown by its main elements: the throat or choke tube **1**, the fuel jet or nozzle **1***a*, and the butterfly-valve **2**.

The calibrated orifices of the carburetor, main orifices and slow-running orifices, are determined so as to reduce the excess of fuel to a value less than 5%, or to eliminate the excess altogether.

As shown in FIG. 1, between the carburetor represented by its choke-tube **1** and its butterfly-valve **2**, and the admission pipe **3** leading the carburetted mixture to the engine is mounted the annular member **4** comprising holes **5** for the introduction of additional air. The annular member **4** is coupled to an air-admission conduit **6** communicating by pipe **7** with the air filter of the engine.

The air admission pipe **7** comprises a regulating device constituted by a sliding valve **50** with an orifice **51**. This slide-valve is actuated by a bell-crank lever **52** pivoted at **53** and actuated by a feeler **54**, the extremity of which is preferably spherical and is applied elastically against a cam **55**.

The cam **55** is carried by a segment **56** pivoting about a shaft **57**. The shaft **57** is mounted on a slide **58** arranged to move vertically.

The movement of the slide **58** is effected by the rod **16** coupled to the bellows **17** through the agency of the lever **26**, this bellows being actuated by the pressure drop downstream of the carburetor, which is communicated to the bellows **17** by the pipe **18**. The segment **56** pivoting on the slide **58** and carrying the cam **55** is operated by the lever **60** pivoted at **61**. This lever **60** is in fact connected by the crank-arm **59** to the arm **62** fixed to the rod **15** of the butterfly-valve **2** of the carburetor.

It can thus be seen that the movement of the slide-valve **50** is simultaneously controlled in dependence on the opening of the butterfly-valve **2** and the pressure drop downstream of the carburetor.

The additional air thus admitted to the orifices **5** in quantities determined according to the conditions of operation of the engine is preferably pre-heated so as to facilitate evaporation of the residues of liquid petrol and also in order to compensate for the influence of external conditions, in particular the ambient temperature. This pre-heating which can with advantage attain an average temperature of 150° C. is effected by the engine exhaust.

To this end, as shown in FIG. 2, the admission pipe **7** for the additional air is coupled by a pipe **63** to a sleeve **64**, open at least at one extremity, mounted around the hot portion of the exhaust pipe **65**.

It is an advantage to provide for a regulation of the temperature of the air admitted at **7** by means of a pipe **66** connected to the pipe **63** and delivering to the atmosphere or preferably to the air filter. The temperature of the air admitted at **7** is regulated by the mixture of the air heated in the sleeve **64**, drawn-in at **63**, with the exterior air admitted at **66**, by means of a regulating flap **67** pivoted at **68**. The regulator **68** may be controlled by a thermostat in accordance with the exterior temperature.

The additional air admitted to the orifices **5** by the pipe **7**, and the flow of which is regulated by the slide-valve **50**, can be extracted wholly or in part from the crankcase **70** (FIG. 3) with the object of reducing the upward passage of oil and of vapors rich in hydrocarbons which tend to be produced as a result of the difference in pressure between the crankcase and the cylinders during the admission phase of the engine.

This extraction of the additional air from the crankcase **70** is effected by a pipe **71** comprising a device necessary for limiting the pressure drop in the crankcase **70** and for avoiding adverse effects on the lubrication of the pistons of the engine. This device consists of a box **72** interposed between the conduits **71** and **7**, and comprising a valve **73** which puts the box **72** in communication with atmospheric air when the admission pressure becomes less than a pre-determined value.

On the other hand, the valve **73** is controlled by the pressure drop downstream of the carburetor. To that end, the rod **74** of the valve **73** is actuated by a lever **75** pivoted at **76**, and the extremity **77** of which is actuated by the sheath **78** of a flexible cable **79** fixed on the one hand to a fixed point **80** and on the other to the extremity **27** of the lever **26** actuated by the bellows **17**.

Thus, the pressure drop which tends to open the valve **73** is automatically balanced by the force which is transmitted to it by the lever **75**, as long as the pressure drop does not exceed a predetermined fraction of the pressure drop existing in the admission pipe downstream of the carburetor, for example two-thirds, and the valve **73** re-

mains closed as long as this fraction is not reached.

On the box 72 there is also provided a clapper-valve 81 playing the part of a blow-valve, permitting the crankcase 70 to communicate with the atmosphere or with the intake of the air filter, but preventing the return of atmospheric air into the crankcase.

On the other hand, there is an advantage in causing the re-opening of the butterfly-valve 2 of the carburetor in the event of the pressure drop on the downstream side of the carburetor reaching a value greater than that which should normally be obtained during slow running while hot, especially in the case where the engine is driven by the vehicle.

FIG. 4 shows a form of construction of the device which ensures this re-opening by the effect of the depression communicated by 13 to the bellows 17.

At the extremity 27 of the lever 26 forming the balance actuated by the bellows 17 is mounted a sliding rod 82 which is urged downwards by a spring 83. This spring 83 is given an initial tension which is sufficient for its action to be predominant during slow running while hot, and for the rod 82 to be retained towards the bottom by a stop 84.

On the lever 26 is supported a slide-valve 85, sliding in the cylinder 86 and provided with a recess 87. The cylinder 86 comprises an orifice which communicates by a pipe 88 with the pressure drop tapping point 18 and is furthermore in communication by 89 with a bellows 90 acting as a servo-motor (and taking the place of the bellows 17*a* while carrying out a very different function). The cylinder 86 is in communication with the atmosphere at its upper extremity 91. The piston 85 is urged downwards by the spring 92.

The upper part of the bellows 90 is coupled to a link-rod 93 pivoted at 94 and connected at 95 to a crank-arm 96 having an elongated slot 97. In this slot 97 is mounted a stud 98 fixed to a crank-arm 99 rigid with the shaft of the butterfly-valve 2.

When the rod 82 is at the bottom of its travel against the stop 84 (the position shown), the pressure drop at 88 cannot be transmitted to the bellows 90, the passage 89 being on the contrary in communication with the atmosphere through the space left free at the upper portion of the piston 85.

If the pressure drop becomes great enough to lift the rod 82 by the action of the bellows 17 and the lever 26, while compressing the spring 83, the piston 85 is pushed upwards. The recess 87 comes opposite the passage 89 and puts the bellows 90 into communication with the pressure drop in the conduit 88. The bellows 90 contracts and causes the opening of the butterfly-valve 2 by means of the crank-lever 93 and the arm 96.

The slot 97 is made long enough so that the butterfly-valve 2 of the carburetor can always open fully, irrespective of the contraction of the bellows 90.

There is sometimes also an advantage in connecting the ignition of the engine to the regulation of the additional air obtained by the slide-valve 50. To this end, there is associated with the segment 56 carrying the cam 58, a second cam of appropriate shape, shown diagrammatically at 104. Against this cam is applied a feeler 105, the movements of which are transmitted by a flexible or kinematic transmission 106 to produce a correction of the advance of the ignition, for example by rotation of the distributor 108 provided with an arm 107. Arm 107 is urged in one direction by spring 109 fixed at 110.

Thus, the control action of valve 51 by cam 55 is associated to a variation in the ignition advance, by means of cam 104 and cable 106, which causes a rotation of the ignition distributor housing.

The embodiment of the various arrangements described above can be effected as shown in FIG. 5 on a plate 32 interposed between the carburetor 1–2 and the engine admission pipe 3.

In this plate there is pierced at 33 a cylindrical channel

receiving a tubular part 34 provided with holes 5 for the introduction of additional air. This annular part 34 is in communication with a drilled passage 100, to which is coupled the pipe 7. On this passage 100 is mounted the regulating slide-valve 50 actuated by the lever 52.

On the plate 32 are mounted the bellows 17 and 90 and the fixing members for the various parts of the mechanism: part 101 carrying the articulation 53, the guiding member 102 for the slide 58, the support 103 of the rod 82 with its spring 83 and of the slide-valve 85.

It will be noted that this unit of compact construction and small dimensions can be conveniently mounted on an engine without any modification of the latter. It can of course be given numerous alternative forms of construction.

What I claim is:

1. In an internal combustion engine having an ignition and a carburetor comprising an engine inlet and a throttle valve; the improvement comprising a regulating unit coupled to said throttle valve, additional air supply means disposed downstream of said carburetor, means sensitive to the pressure drop existing in said inlet conduit, control means connected to said regulating unit and to said pressure drop sensitive means for regulating, when the engine propels an associated vehicle, the quantity of additional air supplied to said additional air supply means and, when the engine is propelled by an associated vehicle, for slightly reopening the throttle valve and for retarding the advance of the ignition.

2. An internal combustion engine as claimed in claim 1, in which said pressure drop sensitive means comprises a bellows having a restraining spring, and in which said additional air supply means comprises at least one variable valve upon which said control means acts.

3. An internal combustion engine as claimed in claim 1, and a cam, means mounting the cam for two conjoint but independent movements, said additional air supply means comprising at least one variably opening valve controlled by the conjoint movements of said cam, one of said cam movements being controlled by the position of the carburetor throttle valve and the other one of said movements being controlled by the pressure drop sensitive means.

4. An internal combustion engine as claimed in claim 1, in which said pressure drop sensitive means begins to function when the pressure drop slightly exceeds the pressure drop which normally exists during engine idling in order to effect a slight reopening of the carburetor throttle valve and a retardation in the advance of the ignition.

5. An internal combustion engine as claimed in claim 4, and a slide rod controlled by said pressure drop sensitive means, and two servomotors actuated by said rod, one said servomotor acting to reopen said throttle valve and the other said servomotor acting to retard the advance of the ignition.

6. In an internal combustion engine having a carburetor having a throttle, the improvement comprising the carburetor having a plate on its downstream side, said plate being in communication with the fuel inlet conduit of said engine and having an orifice communicating with said conduit, said orifice being defined by a cylindrical portion having perforations therethrough for the admission of additional air into said conduit, said conduit being provided with regulating valve means, a bellows fastened to said plate, a second conduit communicating with the interior of said bellows and with said fuel inlet conduit for rendering said bellows responsive to the pressure drop in said inlet conduit, a platform movable in a vertical direction and moved by the bellows in response to said pressure drop, a second plate pivotally mounted on said platform, a cam carried on said second plate, control means connected between the throttle of said carburetor and said second plate for controlling the position of said second plate in accordance with the position of the throttle, and a pivoting feeler bearing on said cam and

connected in controlling relationship with said regulating valve means.

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