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W. E. LEIBING

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ENGINE ATTACHMENT

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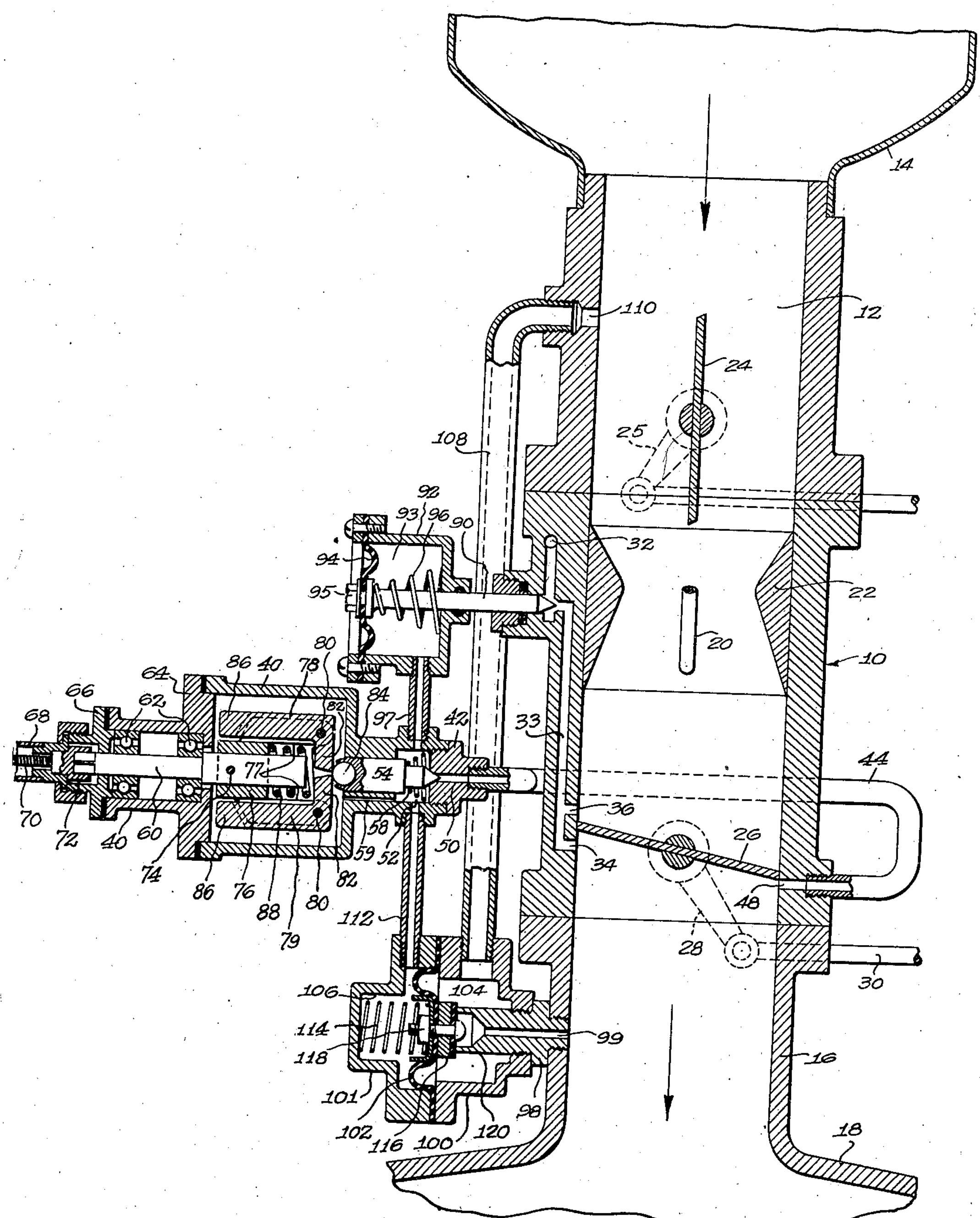

INVENTOR.

William E. Leibing

BY A R McCrady

ATTORNEY.

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ENGINE ATTACHMENT

William E. Leibing, Detroit, Mich., assignor, by mesne assignments, to R. D. Fageol Co., Detroit, Mich., a corporation of Michigan

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This invention relates to an attachment for an internal combustion engine, and more particularly to mechanism associated with the carburetor of such engine and operative under certain conditions to prevent the generation of offensive gases.

Most carburetors in commercial use at the present time comprise an idling nozzle discharging liquid fuel posterior to the throttle when the latter is in closed position, which fuel is mixed with air to form the idling mixture. Undesirable evolution of gases, sometimes called gassing, is likely to occur when the engine is being driven by the momentum of the vehicle, as when a bus is coasting to a stop. It is usually more pronounced in engines of large vehicles than in smaller ones, and is caused chiefly by incomplete combustion of the motive fuel, usually due to an insufficient supply of air, in proportion to the supply of fuel, to the engine.

The operating conditions under which undesirable evolution of gases is likely to occur may be summarized as follows: the throttle is in closed position, the engine speed is above, say, 1000 R. P. M., and the manifold vacuum is high, say, above 24" of mercury. Unless all of these conditions prevail simultaneously, gassing does not usually occur: if the throttle is not fully closed, sufficient air will be supplied to the engine to bring about normal combustion conditions; if the engine speed is below, say, 1000 R. P. M., the volume of air passing the throttle even in its "closed" position will be adequate to prevent any pronounced evolution of gases; and if the manifold vacuum is much below that corresponding to 22 inches of mercury, the amount of fuel being drawn into the induction passage will not be so excessive as to cause any considerable evolution of unburnt gases.

The phenomenon of gassing is to some extent explainable by the fact that while the rate of flow of a fluid through an orifice is, within certain limits, proportional to the difference between the pressures at opposite sides of the orifice, there is a critical point beyond which further increase in such difference produces little or no increase in the rate of flow. In most commercial carburetors, the flow of air past the closed throttle and the discharge of fuel from the idling nozzle are both, under normal conditions of operation, proportional to the degree of manifold vacuum acting upon them. But as the manifold vacuum rises due to abnormal operating conditions, the critical point as to the flow of air is reached before that of the flow of fuel. The result is that at the

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higher manifold vacuums the inflow of air to the engine is restricted and inadequate, while the supply of fuel from the idling nozzle is inordinately high. In some installations, it is sufficient merely to cut off the supply of idling fuel, the device shown in my earlier patent, No. 2,214,964, being one means of accomplishing this purpose.

However, cutting off the supply of liquid fuel to the engine under the conditions above outlined does not necessarily prevent gassing, since in some engines fuel collects in the intake manifold, during normal operation of the engine, in considerable quantity, and when the manifold vacuum rises to an inordinately high value, this fuel is rapidly vaporized, mingling with an inadequate supply of air to produce gassing conditions. In such installations, it is therefore necessary, if gassing is to be prevented, not only that introduction of further fuel be prevented, but that a supply of air, additional to that furnished by the carburetor, be introduced into the manifold in such quantity as to produce either a normal fuel mixture for normal combustion, or a fuel-air mixutre which is too lean to burn at all. Devices for accomplishing this result have been attempted in the prior art, but have not been uniformly successful, because not completely adapted to the design of modern carburetors and engines. Thus, some carburetors include a vacuum controlled acceleration pump, the piston of which is drawn by the force of manifold vacuum to a retracted position, against the force of a compression spring, so that when the manifold vacuum drops to a predetermined value, as will occur when the carburetor throttle is opened, the acceleration pump is actuated by the spring to inject a quantity of fuel into the induction passage of the engine. The prior art devices, in introducing air to the intake manifold to prevent gassing, have sometimes had the effect of also releasing the acceleration pump, causing it to discharge a quantity of fuel and thereby accentuating the condition which they were designed to cure. In the present device, air is admitted to the intake manifold in sufficient quantity to prevent gassing, but not in sufficient quantity to cause actuation of the acceleration pump, if of the vacuum-controlled type. It has been found possible to so control the admission of air that the manifold vacuum may be dropped from any higher value to a value of approximately 13" of mercury, which will prevent gassing while still not causing the acceleration pump to be actuated.

In many installations, it is not sufficient to control the cutting off of the fuel and the introduction of air in terms only of manifold vacuum and throttle position. The speed of the engine is also a necessary criterion under some circumstances. One reason for this is that a fuel-air mixture of given richness will ignite and burn completely in the cylinders if the engine is operating slowly, say at idling speed, but will not ignite and burn completely if the engine is operating at a higher speed.

In some prior art devices, the voltage of the electrical current produced by the automobile generator has sometimes been used as an index of engine speed, to thereby control the point at which auxiliary air was to be introduced to the manifold. In modern types of cars, however, this index is not a satisfactory one, since generators are now often provided with voltage regulators which partially or entirely cut out the operation of the generator when the battery is fully charged, so that under such conditions the voltage output of the generator may be low while the speed of the engine is high.

It is an object of the present invention to provide means responsive to throttle position, manifold vacuum and engine speed to shut off the supply of fuel to the induction passage, or to introduce a supply of air thereto, or to do both of these things, in order to prevent undesirable evolution of gases, and the accompanying evils of crankcase dilution and waste of fuel.

It is a further object of the invention to provide a mechanism responsive to engine operating conditions to lower the manifold vacuum to such point that gassing will be prevented, while still maintaining sufficient manifold vacuum to prevent operation of the acceleration pump and economizer, if of the type which are controlled by manifold vacuum.

It is a further object of the invention to provide mechanism controlled directly by engine speed for cutting off the supply of liquid fuel to the induction passage and for introducing auxiliary air at a controlled rate, to thereby prevent waste of fuel and incomplete combustion thereof in the cylinders.

A further object of the invention is to provide means operated by centrifugal force derived from engine operation for controlling the admission of fuel and air to the induction passage under certain operating conditions.

Further objects and advantages of the invention will be apparent from the following description, taken in connection with the appended drawing, in which the single figure is a schematic view of a carburetor in vertical section, having mechanism associated therewith which embodies the present invention.

Before explaining in detail the present invention it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawing, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also it is to be understood the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawing is shown a downdraft carburetor 10 of known type, comprising an induction passage 12 which leads from an air cleaner 14 to the header 16 of the intake manifold 18. The carburetor may be provided with features commonly found in present-day carburetors, such as a main fuel nozzle 20 discharging in a venturi 22, and a choke valve 24 located in the air horn of

the carburetor and controlled either manually or automatically by means indicated schematically at 25. The carburetor is controlled by a throttle valve 26 by means of a throttle lever 28 and a control rod 30 which connects the throttle lever to the acceleration pedal or other mechanism, not shown, at the operator's station. Fuel may be supplied to the main nozzle 20 from a float chamber or other known mechanism for maintaining a constant head of fuel, which mechanism is not shown in the drawing. Fuel is also supplied from such mechanism to an idling passage, shown as comprising a horizontal passage 32 and a vertical passage 33 in the wall of the carburetor, and terminating in an idling nozzle 34 posterior to the upstream edge of the throttle when the same is in closed position. An air bleed orifice 36 communicates with the idling passage anterior to the closed throttle, in the known manner.

A speed control mechanism is mounted in any convenient location adjacent the engine, and comprises a shell or casing 40 fitted at one end with a nipple 42. The nipple 42 communicates through a conduit 44 with a port 48 located in the carburetor wall just posterior to the downstream edge of the throttle valve 26 when the same is in its closed position, in the same manner and for the same purpose as explained in Leibing Patent 2,214,964, above mentioned, so that the slightest opening of the throttle valve 26 will move the downstream edge of the throttle beyond the port and the port will thereafter be subjected to approximately atmospheric pressure rather than to manifold vacuum, as it is when the throttle is closed.

At its other end, conduit 44 communicates with a passage 50 in the nipple 42, which passage in turn communicates with a vacuum chamber 52 and is controlled by a needle valve 54. The needle valve 54 is reciprocable in a neck 56 formed on the casing 40, and is urged toward open position by a compression spring 58, although normally maintained in closed position by means hereinafter described. A bypass passage 59 connects the chamber 52 to the interior of casing 40, to prevent air-cushion which might interfere with the free movement of valve 54.

A shaft 60 is mounted in bearings 62 within a casing 64 at the rear end of casing 40. A fitting 66 is secured to the rear end of the casing 64, and secures the end of a sheath 68 which houses a flexible cable 70. The cable 70 is secured by means of a fitting 72 to the rear end of shaft 60, and the other end of the cable is secured, in known manner, to a rotating part of the engine, so that when the engine is operating at any given speed, the shaft 60 will be rotated at the same speed, or at some proportional speed.

Secured to the forward end of shaft 60 by means of a pin 74 is a block 76, generally rectangular in cross section, and provided at each of its opposite faces with a pair of forwardly extending arms 77 between which are disposed centrifugally actuated members 78, 79. Each of the members 78, 79 comprises a bellcrank lever, pivoted by a pin 80 to the forward ends of one pair of the arms 77, and terminating in an inwardly extending finger 82. The fingers 82 terminate adjacent each other, and lie in contact with a steel ball 84, which is spun into the rear end of valve 54 and is designed to form a frictionless actuating connection between the fingers and the valve.

The rear ends of members 78, 79 are formed with flyballs 86, which may have their outer surfaces in cylindrical form, to permit them to move outwardly through an appreciable distance without contacting the inner wall of the casing 40. The members 78, 79 are, at any speed of the engine below a predetermined speed, which may be 1000 R. P. M., held in the positions shown in the drawing by means of a compression spring 88 positioned between the block 76 and the fingers 82.

When the engine speed exceeds a predetermined value, the centrifugal force developed by flyballs 86 will force the members 78, 79 outwardly, about their pivots 80, causing the fingers 82 to compress the spring 88, and thereby permitting the spring 58 to open the valve 54. If at such time the throttle valve 26 is in closed position, manifold vacuum will be applied through port 48, conduit 44, and passage 50 to the chamber 52, whence it will be applied to the mechanisms described hereinafter.

The idling fuel passage 32 is controlled by a cutoff valve 90, which is actuated by means of any suitable vacuum control mechanism, which may be of the type disclosed in my patent above identified. Such mechanism is shown very schematically in the drawings, and as so shown comprises simply an air-tight casing 92 which forms a chamber 93. One wall of the chamber 93 is formed by a flexible diaphragm 94, which has the valve 90 secured thereto by any convenient means 95. A compression spring 96 within the casing urges the valve 90 toward its open position. The chamber 93 is connected by a conduit 97 to the chamber 52, so that whenever vacuum exists in the chamber 52 it will be transmitted to the chamber 93 and will tend to cause the diaphragm 94 to move valve 90 to its closed position, thereby shutting off the flow of fuel through the passage 33. The initial tension of spring 96 is such, however, that no movement of valve 90 will take place unless the vacuum exceeds a predetermined value corresponding, say, to 10 inches of mercury.

In order to introduce auxiliary air into the intake manifold, a nipple 98 is fitted in an aperture which may be formed either in the header 16 of the intake manifold or in the carburetor itself at any convenient location posterior to the throttle. The nipple is provided with a calibrated bore 99. Mounted on the nipple 98 is a casing formed of two elements 100, 101 having a flexible diaphragm 102 clamped between them and dividing their hollow interior into two chambers 104, 106. Chamber 104 communicates by means of a conduit 108 with a port 110 in the wall of the carburetor anterior to the choke valve, while chamber 106 communicates by means of a conduit 112 with the vacuum chamber 52, so that vacuum may be applied to the rear surface of diaphragm 102 to move it to the left as viewed in the drawing. Such movement of diaphragm 102 is yieldingly resisted by a compression spring 114, which has such initial tension that no movement of the diaphragm will take place unless the vacuum applied thereto exceeds a predetermined value corresponding, say, to ten inches of mercury.

On the forward face of the diaphragm 102 is mounted a yielding pad 116, which is secured to to the diaphragm by means of threaded means 118 and forms the movable member of the air valve, the fixed member being formed by a cylindrical extension 120 of nipple 98. It will be seen that when a predetermined degree of vacuum exists in chamber 52, it will be communicated to chamber 106, moving the valve member 116 to its open position and permitting air to flow through port 110, conduit 108 and bore 99 to the intake manifold of the engine. The air valve 116 thus cooperates with the fuel valve 90 to produce a non-combustible mixture under what would otherwise be gassing conditions, the amount of air admitted to the induction passage being augmented under such conditions, while the admission of fuel thereto is completely cut off, since under the conditions described there will be no discharge of fuel from the main nozzle 20.

In operation, the carburetor will function in the usual manner so long as the operating conditions of the engine are normal. Whenever the engine speed exceeds the predetermined value for which the spring 88 is designed, the flyballs 86 will move outwardly, overcoming the initial tension of the spring, opening valve 4 and applying to diaphragms 94 and 102 whatever degree of suction may be present in the conduit 44. Such suction, however, will not be sufficient to actuate either of said diaphragms unless and until it exceeds a predetermined minimum for which the springs 96 and 114 are designed or selected, and such minimum will not be reached unless the throttle 26 is in fully closed position, so that the manifold vacuum is transmitted at full strength to the chamber 52.

Upon the simultaneous occurrence of the conditions of engine speed and throttle position above mentioned, however, the valve 54 will open because of engine speed having exceeded the minimum for which it is set, and manifold vacuum of a value sufficient to actuate the diaphragms 94 and 102 will then be transmitted to the chambers 93 and 114. The fuel valve 90 will thereupon be moved to closed position, cutting off further supply of fuel, and valve 116 will be opened, thereby permitting the high manifold vacuum to draw auxiliary air through the conduit 108 into the intake manifold. Such introduction of air, however, is controlled by the diameter of the bore 99 of nipple 98, which is so calibrated in relation to the cubic capacity of the engine and other factors that even though the valve 116 is fully opened, the manifold vacuum existing in the intake manifold will not be dropped below a predetermined value which, for illustrative purposes in connection with this description, is taken as being 13 inches of mercury.

As soon as either of the conditions of engine speed or throttle position above mentioned ceases to obtain, valve 116 will close, cutting off the further introduction of auxiliary air, and valve 90 will open, permitting the idling fuel system to resume its normal operation. If the operator is bringing his vehicle to a stop, the introduction of air will cease as soon as the engine speed has dropped below a predetermined value, since 54 will then close. On the other hand, if the operator opens the throttle slightly, the port 48 will then come to lie on the anterior side of the throttle valve and will be subjected to approximately atmospheric pressure, so that the vacuum in chamber 52 will be insufficient to operate either of diaphragms 94 and 102.

Although the invention has been described with particular reference to a given embodiment thereof, it may be embodied in other forms, and is not to be considered as limited except in accordance with the terms of the following claims.

I claim:

1. In apparatus for preventing generation of

offensive gases in an internal combustion engine having a carburetor with an induction passage, a throttle in the induction passage, and fuel supply means communicating with the induction passage; a vacuum chamber communicating with the induction passage at a point immediately posterior to the downstream edge thereof, said point being swept over by said edge during opening movement of the throttle, a vacuum controlled device independent of said fuel supply means for introducing auxiliary air into the induction passage posterior to the throttle, a separate vacuum controlled device for rendering the fuel supply means inoperative, connecting means between said vacuum chamber and said vacuum responsive devices, and mechanical means controlled in accordance with engine speed for controlling said connecting means.

2. An engine control device comprising a conduit for admitting auxiliary air to the intake manifold of the engine, a valve controlling said conduit, non-electric vacuum responsive means directly connected to and mechanically controlling said valve, and means controlling the application of vacuum to said vacuum responsive means, comprising a conduit connecting said vacuum responsive means to the intake manifold, a valve in said conduit, an engine driven shaft, and centrifugally operated flyballs on said shaft controlling the position of said last mentioned valve.

3. An engine control device comprising a conduit for admitting auxiliary air to the intake manifold of the engine, a valve controlling said conduit, vacuum responsive means controlling said conduit, vacuum responsive means controlling said valve, and means controlling the application of vacuum to said vacuum responsive means, comprising a conduit connecting said vacuum responsive means to the intake manifold, a valve in said conduit, centrifugally operated flyballs on said shaft controlling the position of said last mentioned valve, and a guide member on said shaft rotatable therewith and serving to house and guide said flyballs.

4. For use with an internal combustion engine having a carburetor, said carburetor comprising an induction passage, fuel supply means communicating therewith, and a throttle controlling the induction passage; an auxiliary air passage by-passing said throttle, means comprising a vacuum actuated diaphragm for controlling said air passage, means comprising a vacuum actuated diaphragm for controlling said fuel supply means, and means controlled in accordance with throttle position and engine speed for applying vacuum to said vacuum responsive means.

5. The invention defined in claim 4, wherein said vacuum actuated means is operative to apply vacuum to said responsive means only when the engine speed is above approximately 1000 R. P. M.

6. The invention defined in claim 4, wherein the fuel supply means consists of a fuel duct discharging posterior to the upstream edge of the throttle, and the communication of vacuum to the vacuum actuated means includes a port located immediately posterior to the downstream edge of the throttle when the same is in closed position.

7. In combination with an internal combustion engine carburetor having an induction passage, a throttle controlling the same, a duct supplying fuel to the induction passage, and a valve in said duct; means energized by manifold vacuum and controlled jointly by throttle position and intake manifold vacuum for closing said valve, and

means directly responsive to engine speed for cutting off manifold vacuum from said first mentioned means to render the same inoperative.

8. For use with an internal combustion engine: a carburetor having an induction passage, a throttle controlling the same, and means for supplying liquid fuel to the induction passage; means controlled in accordance with the throttle position and intake manifold vacuum for rendering said first mentioned means inoperative; and engine-driven means utilizing centrifugal force for rendering said second mentioned means inoperative.

9. In combination with an internal combustion engine carburetor having an induction passage, a throttle controlling the same, and fuel supply means communicating with said induction passage; an engine-driven device responsive to centrifugal force, and means actuated by intake manifold vacuum only when the throttle is in substantially fully closed position for rendering said fuel supply means inoperative, said last mentioned means being rendered operative and inoperative by said engine-driven device.

10. In combination with an internal combustion engine carburetor having an induction passage, a thottle controlling the same, and fuel supply means communicating with said induction passage; a vacuum chamber communicating with the induction passage immediately posterior to the downstream edge of the throttle when the same is in closed position, centrifugally operated means for controlling the communication between the vacuum chamber and the induction passage, and vacuum responsive means communicating with said chamber for controlling the introduction of auxiliary air to decrease the vacuum posterior to said throttle.

11. The invention defined in claim 10, comprising in addition vacuum responsive means communicating with said vacuum chamber for controlling said fuel supply means.

12. In combination with an internal combustion engine carburetor having an induction passage, a throttle controlling the same, and fuel supply means communicating with said induction passage; an air passage by-passing said throttle, vacuum responsive means controlling said air passage, a duct connecting said vacuum responsive means to the induction passage at a point immediately posterior to the downstream edge thereof when the throttle is in closed position, said point being swept over by said edge when the throttle is opened, and centrifugally operated means responsive to engine speed for controlling said duct.

13. The invention defined in claim 12, comprising in addition means operative only by vacuum corresponding to thirteen inches of mercury or higher for rendering said fuel supply means inoperative.

14. An engine control device comprising a restricted conduit for admitting auxiliary air at a controlled rate to the intake manifold of the engine to lower the vacuum therein, a valve in said conduit, means responsive to said vacuum to control said valve, and means controlling the application of vacuum to said vacuum responsive means, comprising a conduit connecting said vacuum responsive means to said manifold, a valve in said conduit, and engine driven mechanism operating by centrifugal force to control said last mentioned valve.

15. A control device for an engine including an intake manifold, a carburetor having an induc-

tion passage, a butterfly throttle controlling the same, and a fuel duct discharging adjacent said throttle; comprising an auxiliary passage for admitting air to the intake manifold to lower the vacuum therein, a valve in said auxiliary passage, a pressure responsive element connected to and controlling said valve, a conduit connecting said element to the induction passage posterior to said throttle, a valve controlling said conduit, and engine driven mechanism operating by centrifugal force to control said last mentioned valve.

16. The invention defined in claim 15, wherein said conduit terminates immediately posterior to the downstream edge of the throttle in a port which is swept over by said edge in the opening movement of the throttle.

17. The invention defined in claim 15, comprising in addition a fuel valve in said fuel duct, and means operative when said auxiliary passage is opened to close said fuel valve.

18. A control device for an internal combustion engine including an intake manifold, a carburetor having an induction passage connected to said manifold, a butterfly throttle controlling the induction passage, and a fuel duct discharging into said induction passage adjacent said throttle; comprising an air passage bypassing said throttle to admit auxiliary air to the intake manifold, a valve in said air passage, a pressure responsive element connected to and controlling said valve, a second valve controlling said fuel duct, a pressure responsive element controlling said second valve, a conduit connecting said pressure responsive elements to the induction passage posterior to said throttle, a third valve in said conduit controlling the application of manifold vacuum to both of said pressure responsive elements, and engine driven mechanism operating by centrifugal force to control said third valve.

19. The invention defined in claim 18, wherein said conduit terminates immediately posterior to the downstream edge of the throttle in a port positioned to be swept over by said edge when the throttle is moved from closed to partially opened position.

WILLIAM E. LEIBING.

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