

Dec. 29, 1936.

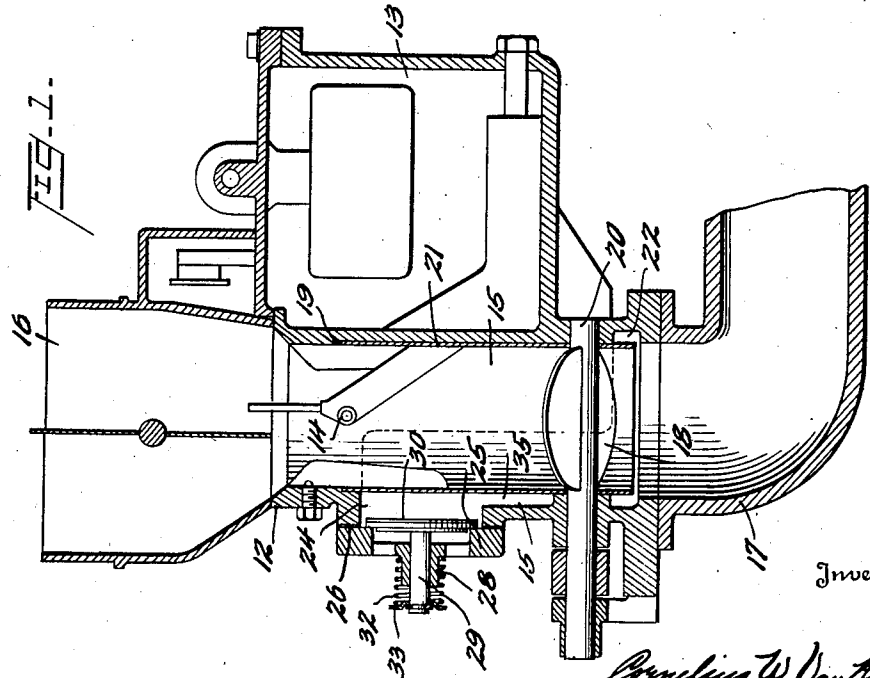
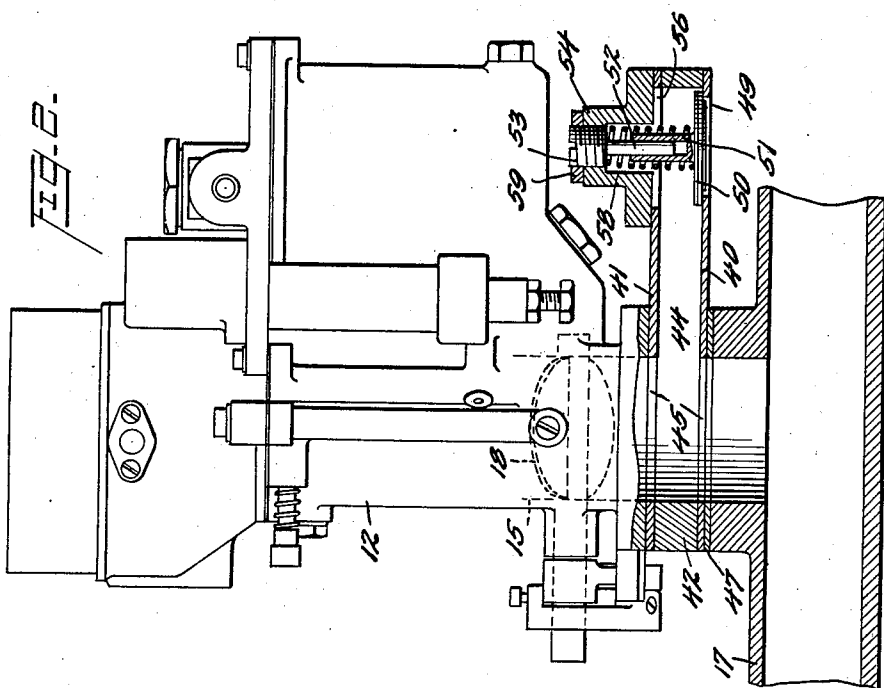
C. W. VAN RANST

2,065,773

INTERNAL COMBUSTION ENGINE

Filed March 21, 1932

2 Sheets-Sheet 1



Inventor

Cornelius W. Van Ranst,

334 Watson, Coit, Mann & Grindle
Attorneys

Dec. 29, 1936.

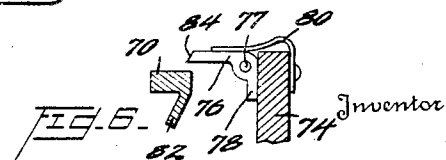
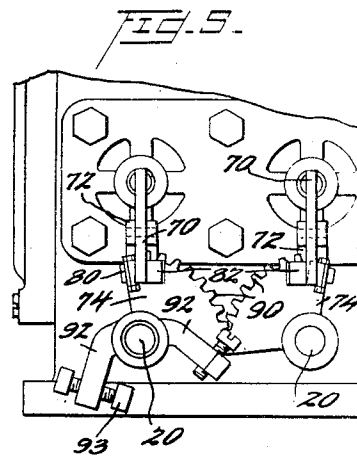
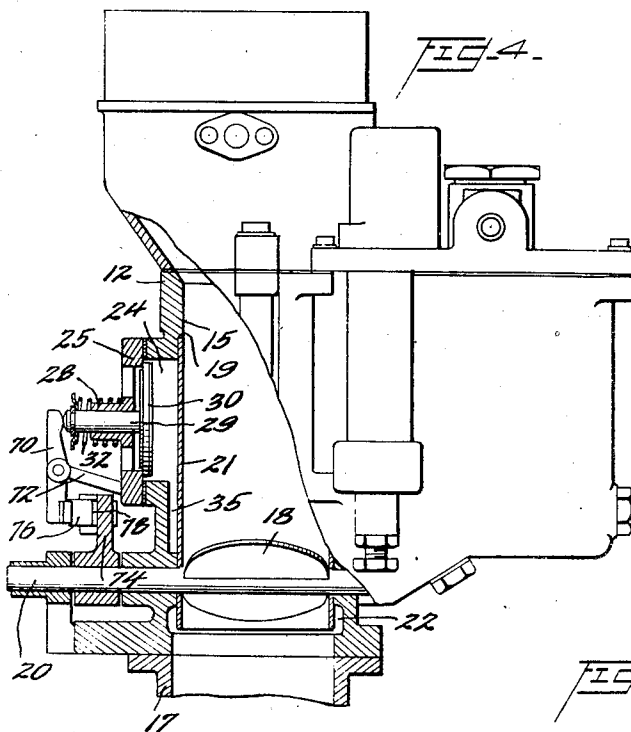
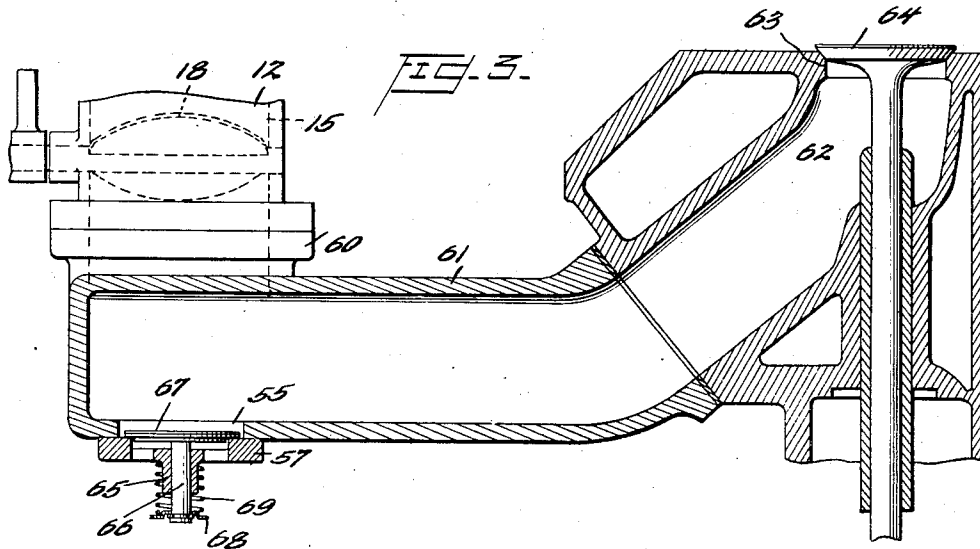
C. W. VAN RANST

2,065,773

INTERNAL COMBUSTION ENGINE

Filed March 21, 1932

2 Sheets-Sheet 2



Inventor
Cornelius W. Van Ranst,

By *Whitton, Erit, Moore & Brundage*
Attorneys

UNITED STATES PATENT OFFICE

2,065,773

INTERNAL COMBUSTION ENGINE

Cornelius W. Van Ranst, Detroit, Mich., assignor
to Packard Motor Car Company, Detroit, Mich.,
a corporation of Michigan

Application March 21, 1932, Serial No. 600,346

6 Claims. (Cl. 123—124)

This invention relates to internal combustion engines and more particularly to fuel supply apparatus therefor. It is an object of the invention to provide means for automatically regulating the character of the combustible mixture to ensure smooth performance of the engine under operating conditions encountered principally in the use of such engines for driving motor vehicles.

It is frequently advisable in the operation of a motor vehicle to abruptly reduce the speed of the engine to a minimum by throttling the fuel supplied thereto with the load disconnected from the engine. For instance, in motor vehicles employing free wheeling, the motor is abruptly decelerated by throttling the mixture whenever it becomes unnecessary to supply driving power to the vehicle and in vehicles not employing free wheeling it is common to disengage the vehicle clutch and reduce the speed of the motor by throttling when coasting or changing the gear ratio. With either arrangement the speed of operation of the motor is abruptly reduced to the idling speed and the load is removed.

Under these conditions the motor is no longer driven by movement of the vehicle and frequently dies, the immediate cause of dying being the momentary feeding to the motor of a mixture ratio so rich that combustion cannot be ensured. Continued operation of the motor can, of course, be ensured by increasing the minimum idling throttle opening but this is objectionable since unnecessarily high engine idling speed results. It has been found in at least two instances that the engine idling speed necessary to prevent dying was so high as to suggest the advisability of employing a vacuum arrangement to retard the ignition so as to reduce the idling speed within reasonable limits.

A number of factors contribute to the tendency of a motor to die under the conditions mentioned. One of these factors is the existence of abnormally low pressure in the intake manifold, it being well understood that the throttling of the mixture produces a high vacuum in the intake passage, the degree of vacuum being greater for higher engine speeds. Thus when the engine is running at a speed substantially above the idling speed, and the throttle is suddenly closed, an appreciable increase in the vacuum in the intake passage occurs tending to draw any liquid fuel adjacent the throttle valve into the passage. This condition is accentuated when down draft carburetion is employed as hereinafter explained.

A further factor in the momentary delivery of

an excessively rich mixture to the engine is the inertia of the liquid fuel supplied thereto. For instance, it is quite evident that the column of fuel passing through the main jet supply conduit in an engine operating at increased speeds attains an inertia of movement resulting in the discharge of a certain amount of fuel after the throttle has been closed. As the result of the increased depression in the intake manifold incident to the closing of the throttle this addition of fuel is almost invariably drawn into the engine.

In down draft carburetion the problem is much more acute, since liquid fuel, whether issuing from the pump or the main nozzle, falls sooner or later into the manifold by gravity, whereas in up draft carburetors it may possibly fall out of the air stream and be discharged through the drain tube. When an accelerating pump or well is employed, liquid fuel is delivered into the carburetor venturi at a predetermined rate and for a predetermined length of time. It is evident, however, that after the pump is completely discharged an additional amount of time is required to entirely consume this liquid fuel. If the throttle is closed before the fuel is entirely burned, the walls of the manifold will retain the wet fuel and since the only air thereafter entering the carburetor, namely that passing through the idling jet, is already charged with an amount of fuel necessary to produce a combustible mixture, this air takes up the liquid fuel in passing through the manifold and is thereby enriched to such an extent as to be practically incombustible.

Regardless of the factors which produce this undesirable condition, the immediate cause of motor dying is due to an excessively rich mixture and thus the difficulty may be best overcome by momentarily decreasing the ratio of liquid fuel to air. In the present invention the desired result is accomplished by admitting air to the intake manifold to effect the necessary dilution of the mixture so that the proper proportions may be delivered to the engine.

It is therefore an object of the invention to provide automatically operable means for ensuring admission of air to the passage connecting the engine and the carburetor at a point intermediate the throttle valve and the engine for a brief period and only immediately following the closing of the throttle valve while the engine is operating at a fairly high speed. It is a feature of the invention that air admission may be made directly dependent upon the existence of an abnormally low pressure in the intake passage, this condition being largely responsible for the delivery of the

excessively rich and practically incombustible mixture.

It is a more specific object of the invention to provide an inwardly opening valve normally closing an auxiliary air port communicating with the intake passage intermediate the throttle valve and the engine, this valve being loaded to a sufficient extent to prevent operation thereof under the influence of the low pressure in the intake passage until this pressure has been lowered to an extent possible only under such conditions of operation as result in the delivery of an excessively rich mixture to the engine, namely the abrupt closing of the throttle valve while the engine is running at a relatively high speed with no load.

Further objects and features of the invention will be apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical sectional view through a carburetor of the down draft type and an associated portion of the intake manifold of an internal combustion engine illustrating a preferred form of the invention;

Figure 2 is an elevational view partly in section of a carburetor and intake manifold illustrating a modified form of the invention;

Figure 3 is a sectional view of an intake manifold and valve chamber illustrating a further modification;

Figure 4 is an elevational view partly in section of a carburetor of the type shown in Figures 1 and 2 of another modification;

Figure 5 is a fragmentary end elevation of the arrangement shown in Figure 4; and

Figure 6 is a detailed sectional view of certain parts illustrated in Figure 4.

In order to facilitate an understanding of the invention the several modified forms thereof shown in the drawings are described in detail hereinafter. It will nevertheless be understood that the use of specific language in this description is not to be construed as limiting the scope of the invention and that various changes and alterations can be made without departing from the underlying principles of the invention.

Referring to Figure 1 of the drawings it will be observed that the carburetor indicated generally at 12 is of more or less conventional type and comprises a liquid fuel chamber 13 and a fuel jet 14 disposed in the passage 15, the air entering at 16 passing downwardly, being mixed with the fuel, and discharging into the intake manifold 17 on which the carburetor is seated. It will be understood that the manifold communicates with the engine cylinders in the usual manner, the delivery of the combustible mixture to the engine being controlled by suitable valves (not shown) operating in timed relation with the engine. A throttle valve 18 is arranged within the passage 15 adjacent the lower end of the latter, this valve consisting of the usual valve plate supported on the rotatable spindle 20, the latter being mounted in a conventional manner in the passage 15 and being rotatable to position the valve plate for determining the quantity of flow of combustible mixture.

The application of the invention to this type of carburetor may be readily effected by the insertion of a sleeve 21 into the passage 15, the upper end of the sleeve engaging an annular shoulder 19 formed on the interior of the passage and the lower portion of the sleeve being spaced from the wall of the passage 15 to provide an

opening therebetween, the passage being provided with an annular recess 22 for this purpose.

Adjacent the upper end thereof the passage 15 is provided with a port 24 against which is secured a valve seat 25, a gasket 26 being interposed between the valve seat and the port to prevent leakage. The valve seat 25 is of substantially annular shape and is provided with a centrally arranged valve guide 28 in which a valve stem 29 is slidably supported, the head 30 of the valve being normally retained in engagement with the seat 25 by means of a coil spring 32 interposed between a washer 33 carried by the outer end of the valve stem and the inner portion of the guide 28. The port 24 communicates with the annular recess 22 in the passage 15 through a recess 35 formed in the wall of the passage adjacent the port.

It will be observed that by reason of the provision of the sleeve 21, the port 24 communicates with the intake manifold 17 intermediate the throttle valve 18 and the engine and thus the closing or partial closing of the throttle tending to lower the pressure in the intake manifold effects a corresponding reduction in the pressure exerted on the inner face of the valve 30 and if the pressure is lowered sufficiently, the valve 30 will be automatically opened against the action of the spring 32. It is important, however, for the purpose of the present invention that the strength of the spring be sufficient to resist opening of the valve 30 except when the pressure between the throttle and the engine has been reduced to the abnormally low value existing only momentarily when the engine is operating at a relatively high speed, and with no load and is then suddenly decelerated by closing the throttle. Under these conditions the engine slows down to the idling speed, but before the idling speed is reached the valve 30 is held open by the reduced pressure for a sufficient period of time to ensure that the excessively rich combustible mixture resulting from any of the factors hereinbefore mentioned is diluted to an extent permitting substantially complete combustion thereof. Once the idling speed is reached the valve 30 remains closed and an auxiliary supply of air is no longer introduced into the manifold, the carburetor being adjusted to supply a mixture satisfactory for idling when a state of equilibrium is once reached. It is quite obvious that the strength of the spring will depend on a number of factors, principally the design of the carburetor and engine to which the device is applied, but may be readily determined under any given conditions. For instance, in the application of the device to an engine operating between 300 and 3600 R. P. M. and developing a mercury depression of 15 inches at 300 R. P. M., 17 inches at 400 R. P. M., and 22 inches at 800 R. P. M., the device operated satisfactorily when the valve was so loaded as to open with a manifold depression of 18 inches of mercury. Since a manifold depression higher than that existing at desirable idling speed is present only when the throttle is closed at higher speeds, under which conditions the factors inducing engine dying are active, it is apparent that this invention has no effect whatever on the general performance of the carburetor other than the prevention of engine dying.

Figure 2 of the drawings illustrates a modified form of the invention applied to the same type of carburetor shown in Figure 1, including the passage 15 for the combustible mixture and the throttle valve 18, the carburetor being associated

with the intake manifold 17. In this arrangement the device for introducing excess air intermediate the throttle and the engine is interposed between the carburetor and the manifold, no modification of either being required. The device preferably comprises a pair of plates 40 and 41 spaced adjacent their peripheral portions by a member 42 interposed therebetween to form a closed chamber 44, the plates 40 and 41 being apertured as indicated at 45 to conform to the interior of the passage 15 and to afford communication between the chamber 44 and the passage. The plate 41 is in close contact with the lower machined face of the carburetor and a gasket 47 is interposed between the plate 40 and the inlet portion of the intake manifold to prevent leakage, the parts being secured together in any convenient manner.

The plate 40 is provided with a port 49 affording communication between the chamber 44 and the atmosphere, this port being normally closed by a valve 50 having a hollow stem 51 slidably supported on a stud 52 carried by an element 53 threaded in a member 54. An aperture 56 is provided in plate 41 through which the valve stem and stud extend, the member 54 being secured in position against the plate 41 to close this aperture. A coil spring 58 abutting the threaded element 53 surrounds the stem 52 and engages the head of the valve to retain the valve in port-closing position.

It will be observed that the chamber 44 communicates with that portion of the inlet passage intermediate the throttle valve 18 and the engine and the function of the device is thus identical with that shown in Figure 1, the strength of the spring 58 being regulated by adjustment of the threaded element 53 so that the spring is loaded to an extent sufficient to prevent admission of excess air to the manifold except when a condition of abnormally low pressure exists in the manifold as hereinbefore described. Once suitable adjustment of the spring has been effected, the element 53 may be locked in position by a nut 59 threaded thereon.

Referring to Figure 3 of the drawings, it will be observed that the major portion of the carburetor has been omitted for convenience, but it will be understood that the carburetor may be of any conventional type and is provided with the usual throttle valve 18 located in the fuel mixture passage 15 and is supported on the inlet portion 60 of the intake manifold 61. The outlet portion of this manifold communicates with a valve chamber 62 terminating in a port 63 with which a poppet valve 64 cooperates, the valve 64 being raised in timed relation to the operation of the engine to periodically admit a charge of fuel to the cylinders.

In this form of the invention a port or opening 55 is formed in the manifold 61, and a valve seat 57 cooperating with this port carries a valve guide 65 in which the stem 66 of a valve 67 is slidably supported. A coil spring 69 surrounds the valve stem and acts between the seat 57 and a washer 68 carried by the valve stem to normally retain the valve in engagement with the seat to prevent admission of air to the intake through the port 55. The strength of the spring 69 is such as to permit the inwardly opening valve to be automatically operated when the throttle is abruptly closed with the engine running at high speed as in the other modified forms of the invention.

A further modification, shown in Figures 4,

5, and 6, departs to some extent from the previously described forms of the invention in the provision of mechanical means for effecting automatic opening of the auxiliary air port when conditions require dilution of the combustible mixture. The constructional features are quite similar to those shown in Figure 1, a port 24 communicating with the atmosphere being provided in the passage 15, this port being normally closed by a valve 30 which is retained in position on the seat 25 by means of a coil spring 32. By reason of the provision of the sleeve 21 and the recesses 35 and 22 in the wall of the passage 15, the port is placed in communication with the passage and the intake manifold intermediate the throttle valve 18 and the engine. In this arrangement, however, the spring 32 is preferably sufficiently strong to retain the valve 30 in port-closing position regardless of the degree of vacuum existing in the intake manifold 17, the valve being opened by means of a lever 70 engaging the valve stem 29, this lever being fulcrumed on a member 72 extending outwardly from the valve seat 25 and preferably formed integrally therewith. The spindle 20 of the throttle valve carries an arm 74 which is secured thereto in any convenient manner, the arm 74 carrying a pawl 76 which is pivotally mounted on the arm as at 77. The pawl is provided with an abutment portion 78 to limit movement thereof in one direction, a spring 80 secured to the arm 74 engaging the pawl to normally retain the same with the abutment 78 in contact with the arm.

The outer end of the lever 70 is formed with a cam portion 82 as shown more particularly in Figure 6 of the drawings, the lever and the cam portion thereof being positioned in the path through which the pawl 76 moves as the spindle 20 of the throttle valve is rotated. In Figure 6 the arm 74 is shown in the position which it occupies when the throttle is fully closed and as the throttle is moved toward a partially opened position, the pawl 76 contacts with the lever 70 and is deflected thereby, turning on its point of pivotal support 77 against the action of the spring 80 so that the position of the lever 70 is not affected. It will be observed, however, that in returning to the position shown in Figure 6 corresponding to closed throttle, the outer bevelled face 84 of the pawl will contact with the cam portion 82 of the lever 70 and since the pawl is unable to rotate in a counterclockwise direction by reason of the provision of the abutment 78, the outer end of the lever 70 will be cammed to the left as shown in Figure 6 and Figure 4 to depress the stem 29 of the valve 30 against the action of the spring 32 to open the port 24 and admit air to the intake below the throttle valve 18. Thus when the throttle is moved from open to closed or idling position, the valve 30 will be momentarily opened but will be again closed when the idling position is reached, this momentary opening of the valve 30 being sufficient to dilute the excessively rich mixture during the brief period of abnormally low pressure in the intake manifold as described more fully in connection with the other modified forms of the invention. It will be observed, however, that in this as in the other modifications, operation of the carburetor in the normal way is not interfered with and excess air is admitted only as the throttle is being moved to

closed position and immediately before closed position is reached.

The manner in which this modified arrangement may be applied to a carburetor of the duplex type having two fuel delivery passages arranged side by side is shown in Figure 5 of the drawings in which each of the throttle valve spindles 20 is provided with an arm 74 having cooperating toothed portions 90 thereon, each of these arms cooperating with the associated lever 70 in the manner hereinbefore described. It will of course be understood that movement of the throttle valve spindle to closed and fully opened positions may be limited by the provision of a suitable abutment arm 92 carried by one of the throttle valve spindles and cooperating with a fixed abutment 93 provided on the base portion of the carburetor.

In all of the forms of the invention hereinbefore described it is an essential feature that a blast of air is momentarily directed into the passage for the fuel mixture intermediate the throttle valve and the engine, the blast being of sufficient duration and quantity to reduce the excessively rich mixture developed on abrupt closing of the throttle to that degree of leanness required for proper combustion.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In fuel mixture supply apparatus for use with internal combustion engines, the combination with a passage through which a mixture of combustible fuel and air is delivered to the engine, of throttling means in said passage movable to a position in which the quantity of mixture is reduced to a minimum and a condition of relatively low pressure is temporarily established in that portion of the passage intermediate the throttling means and the engine, and means automatically operable to reduce the richness of the mixture in the passage while the said condition exists and for a brief period only, said last named means comprising an auxiliary air port communicating with said passage, a valve normally closing said port, and means connecting said valve and throttling means operable to open said valve momentarily as said throttling means is moved into the said position only.

2. In fuel mixture supply apparatus for use with internal combustion engines, the combination with a passage through which a mixture of combustible fuel and air is delivered to the engine, of throttling means in said passage movable to a position in which the quantity of mixture flowing in said passage past said throttling means is appreciable but reduced to the minimum required for idling and a condition of relatively low pressure is temporarily established in that portion of the passage intermediate the throttling means and the engine, and positively actuated means associated with the passage for de-

livering excess air to the mixture therein while the said condition exists and for a brief period only.

3. In fuel mixture supply apparatus for use with internal combustion engines, the combination with a passage through which a mixture of combustible fuel and air is delivered to the engine, of a throttle valve in said passage adapted to be positioned to restrict the mixture flowing in said passage past said valve to a minimum but appreciable flow and temporarily establish a condition of abnormally high vacuum in that portion of the passage intermediate the valve and the engine, and positively actuated means associated with the said portion of the passage operative on the initial establishment of the said condition only for delivering excess air to the mixture therein for a brief period only.

4. In fuel mixture supply apparatus for use with internal combustion engines, the combination with a passage through which a mixture of combustible fuel and air is delivered to the engine, of throttling means in said passage movable to a position in which a minimum but appreciable quantity of mixture is delivered through said passage past said throttling means and a condition of relatively low pressure is temporarily established in that portion of the passage intermediate the throttling means and the engine, and positively actuated means automatically operable to reduce the richness of the mixture in the passage while the said condition exists and for a brief period only.

5. Apparatus for use in an internal combustion engine comprising a passage through which a combustible mixture may be delivered to the engine, a throttling means operable to control the quantity of mixture delivered through said passage, an auxiliary air port in said passage, an inwardly opening valve associated with said port, and means including connections between said throttling means and said valve operable on movement of said throttling means into minimum fuel delivery position only for first opening and then closing said valve.

6. In fuel mixture supply apparatus for use with internal combustion engines, the combination with means through which a mixture of combustible fuel and air is delivered to the engine, of a device associated with said means operable to restrict the mixture flowing through said means to a minimum but appreciable flow and temporarily establish a condition of abnormally high vacuum in that portion of said means intermediate the device and the engine, and positively actuated means associated with the said portion of said first named means operative on the initial establishment of the said condition only for delivering excess air to the mixture therein for a brief period only.

CORNELIUS W. VAN RANST.