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DUAL CARBURETOR SYSTEM

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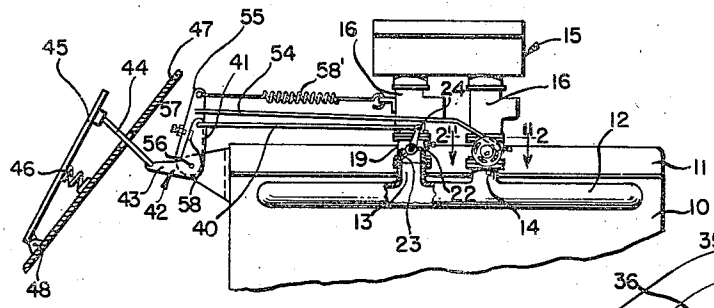


FIG. 1.

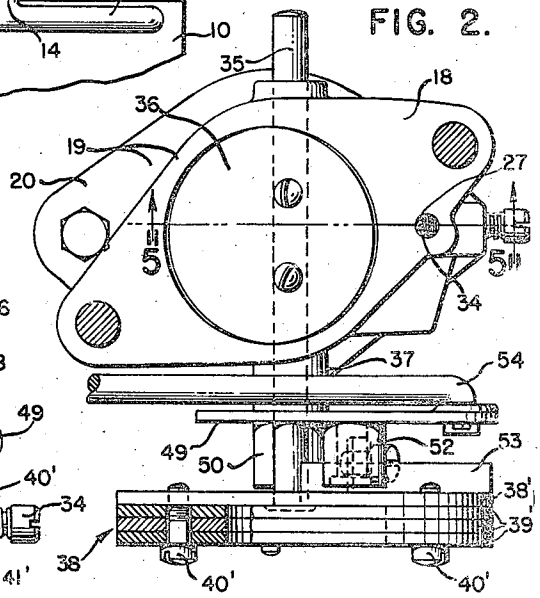


FIG. 2.

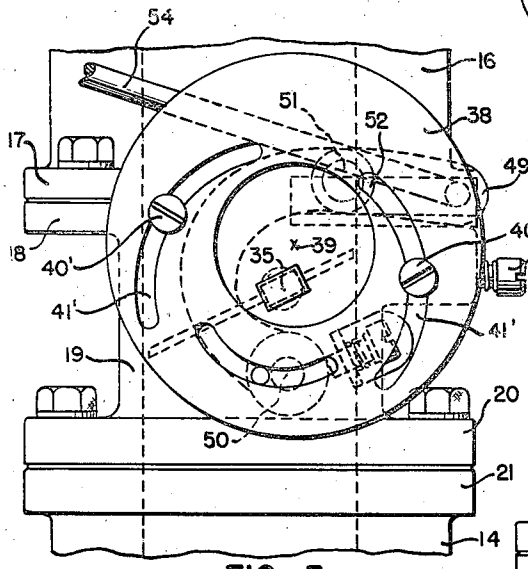


FIG. 3.

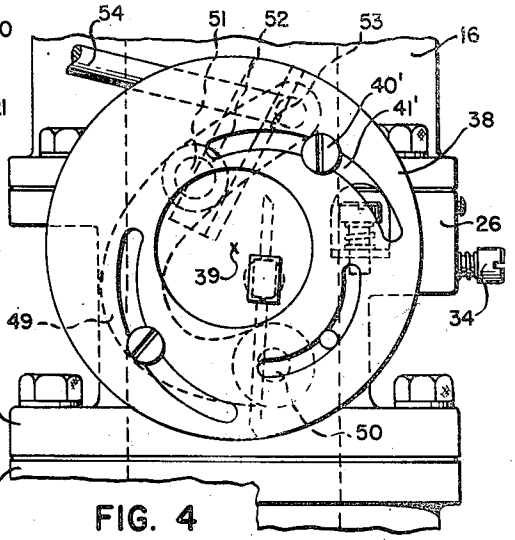


FIG. 4

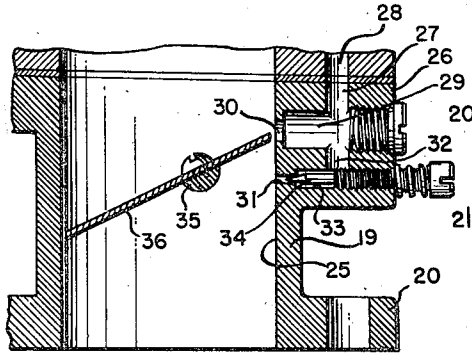


FIG. 5

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DUAL CARBURETOR SYSTEM

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11 Claims. (Cl. 123—127)

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This invention relates to an improved internal combustion engine fuel system and control apparatus therefor.

More particularly the invention pertains to improved control apparatus for the throttle valves of the carburetors of a dual carburetor system of the character which has a pair of carburetors discharging fuel mixture into a single intake manifold.

One of the main objects of the invention is to provide in a dual carburetor system of this kind, throttle control apparatus which, during initial throttle opening actuation positively opens the throttle valve of one carburetor, hereinafter referred to as No. 1 carburetor, and subsequently conditions the throttle valve of the other carburetor, hereinafter called carburetor No. 2, to open in response to the application of a predetermined engine suction thereon.

Another object of the invention is to provide in carburetor No. 2 a suction responsive throttle valve which controls the idle port of this carburetor and which maintains, while in idle position, an idle fuel discharge in carburetor No. 2 even though the throttle valve of carburetor No. 1 is closed thereby assuring feeding of an idle discharge from carburetor No. 2 at all times in order to supply sufficient liquid fuel to the air admitted to the manifold through carburetor No. 2 before the suction controlled throttle valve thereof is opened enough to feed gasoline from the main jet of carburetor No. 2.

A further object of the invention is to provide a counterweight for biasing the throttle valve of carburetor No. 2 toward its closed position when it is disposed between its fully closed and a predetermined open position and which biases the throttle valve of carburetor No. 2 toward its open position when disposed in a more open position than said predetermined open position in order to hold the throttle of carburetor No. 2 from closing at a lower speed than that at which it would open from a closed position.

An additional object of the invention is the provision of variable stop mechanism for positively limiting opening of the throttle valve of carburetor No. 2 in accordance with the extent of positive opening of the throttle valve of carburetor No. 1, and which positively closes the throttle valve of carburetor No. 2 simultaneously with, and in accordance with, the extent of positive closing of the throttle valve of carburetor No. 1.

Other objects of the invention are to provide in a carburetor which may be used as the single carburetor of an internal combustion engine, a throttle valve which is responsive to total pressure differential on its respectively opposite sides; to provide throttle valve mechanism and control apparatus therefor which when employed in a dual carburetor system, or alone, serves to delay the transfer from idling to main jet operation until sufficient velocity has been obtained past the main jet to properly and smoothly operate the latter; to provide mechanism of this kind which prevents detonation when operating at full load with a compression ratio substantially higher than normally used and to thereby obtain an increase in thermal efficiency at part open throttle.

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An illustrative embodiment of the invention is shown in the accompanying drawing, in which:

Fig. 1 is a fragmentary side elevational view of an internal combustion engine having a dual carburetor system equipped with throttle valve control apparatus embodying the invention.

Fig. 2 is an enlarged horizontal sectional view of the throttle body portion of carburetor No. 2 taken on line 2—2 of Fig. 1.

Fig. 3 is a side elevational view of the throttle body portion illustrated in Fig. 2, showing the throttle valve thereof in closed position.

Fig. 4 is a view similar to Fig. 3 showing the throttle valve thereof in open position.

Fig. 5 is a vertical sectional view taken on the line 5—5 of Fig. 2.

The improved internal combustion engine fuel system and control apparatus therefor embodying my invention is illustrated in the drawing as applied to an engine having an engine block 10 provided with a cylinder head 11 and an intake manifold 12. The intake manifold 12 has a pair of inlet ducts or risers 13 and 14 on which are mounted primary and secondary carburetors hereinafter referred to as carburetor No. 1 and carburetor No. 2 respectively. Carburetors No. 1 and No. 2 have their air inlets connected with a common air cleaning and silencing device generally designated by the numeral 15. Each carburetor includes a substantially identical main body portion 16 which is provided on its lower extremity with a flange 17, adapted to be attached to a corresponding flange 18 at the upper end of a throttle body 19. Each throttle body 19 has a flange 20 at its lower extremity adapted to be secured by bolts to a corresponding flange 21 formed on the upper extremity of each of the risers 13 and 14.

The throttle body of the primary carburetor No. 1 includes a throttle shaft 22 having a throttle blade 36 fixed thereto. Mounted on the external end of the shaft 22 is a control lever 24. With

the exception of the throttle mechanism, the throttle bodies of carburetors No. 1 and No. 2 are substantially identical and, as shown in the illustrations of the throttle body of the carburetor No. 2, each throttle body includes a central fuel mixture passage 25. The wall of each throttle body is thickened at 26 and provided with a downwardly extending passage section 27 which communicates with a registering passage 28 leading through the wall structure of the main body portion of the carburetor. The passage section 27 communicates with a chamber 29 located in the thickened wall portion 26 of the throttle body and having a port 30 leading to the fuel mixture passage 25. The fuel mixture outlet port 31 which communicates with the fuel mixture passage 25 at a location below the port 30 is also provided in the wall structure of the throttle body and connected by angularly disposed passage sections 32 and 33 with the chamber 29. The port 31 is adjustably controlled by a needle valve 34 having a stem portion extending through the passage section 33. The above mentioned fuel and air passages constitute an idle fuel mixture and transfer system which is well known in the art.

Journalled in opposite apertures formed in the wall structure of the throttle body of carburetor No. 2 is a throttle shaft 35 on which is mounted an off-center throttle valve 36 which is adapted to be urged toward an open position by engine suction. The edge of the throttle valve 36 registers with the lower portion of the port 30 when the valve is in closed position and is arranged to leave the upper portion of this port open to admit air under engine suction to the chamber 29 where it mixes with fuel supplied through the passage sections 27 and 28 from the main body of the carburetor in a conventional manner well known in the art of carburetion. When the valve is closed engine suction is applied at the port 31 so as to induce the flow of fuel mixture into the fuel mixture passage 27 at a point on the down stream side of the throttle valve 36. As the throttle valve 36 is open its edge sweeps the port 30 so as to gradually decrease the flow of air therethrough as the air flow past the throttle increases thus effecting a gradual transfer from idle fuel mixture supply to the fuel mixture passage, to normal operating conditions at open throttle.

The throttle shaft 35 extends through a boss 37 provided on the exterior of the throttle body and it has an externally protruding end portion on which is fixed a counterweight 38 comprising a support disc 38' fixed to the throttle shaft, and adjustable disc-shaped weights 39'. The weights 39' are adjustably fixed to the support plate 38' by screws 40' which extend through arcuate slots 41' in the weights, the center of curvature of the slots being offset from the center of the support disc 38'. The counterweight 38 is fixed to the throttle shaft 35 at a location eccentric with respect to its center 39. As shown in Fig. 1, the center 39 of the counterweight is disposed above the axes of the throttle shaft and to the right of a vertical plane containing the same when the throttle valve 36 is in closed position. With this construction, the counterweight tends to urge the throttle valve toward its closed position until the throttle valve and the weight has been turned counterclockwise to a predetermined open position. When the throttle valve is opened beyond said predetermined open position the counterweight tends to urge the throttle valve toward a further open position.

The throttle valve of carburetor No. 1 is positively controlled both during opening and closing movements by a rod 40 pivotally attached at one end to the lever 24 and at its opposite end to an arm 41 of a bell crank 42 which has a second arm 43 pivotally connected to an auxiliary rod 44. The auxiliary rod 44 is adapted to be shifted by foot pressure applied on an accelerator pedal 45 which bears against the opposite end of the rod 44 in order to rotate the bell crank 42 in a counterclockwise direction as viewed in Fig. 1 and to thereby positively open the throttle valve 23 of carburetor No. 1. Closing movement of throttle valve 23 of carburetor No. 1 is effected by the action of the spring 46 bearing between the pedal 45 and the toe board 47 on which the accelerator is pivotally mounted at 48.

Opening and closing movement of the throttle valve 36 of carburetor No. 2 is controlled by a variable stop mechanism including an arcuately shaped lever 49 pivotally mounted at 50 on a support extending from the side wall of the throttle body. Lever 49 has an inwardly extending pin 51 on which is journalled a roller 52 for engaging an abutment 53 mounted on the inner side of the counterweight 38 and disposed at an angle to the radius of a disc which comprises the counterweight. The abutment 53 comprises an angle-shaped bracket having a side disposed to engage the roller 52. The lever 49 has an end portion pivotally connected by a link 54 with a lever 55 which is pivotally mounted at 56 in concentric relationship with the pivotal mounting of the bell crank 42. The lever 55 includes a laterally extending flange 56 in which is threaded an adjustable set screw 57. The end of the set screw 57 registers with and is adapted to abut a flange 58 on the upstanding arm 41 of the bell crank 42. A spring 58' normally urges the lever 55 in a clockwise direction about its pivotal support 56 thereby urging the link 54 rightwardly as viewed in Fig. 1, in order to urge the roller 52 rightwardly against the inclined abutment 53 so as to thereby yieldably hold the throttle valve 36 in a closed position. The set screw 57 is adjusted so that its end is spaced from the flange 58 on the bell crank 42 in order to accommodate initial opening movement of the throttle valve 23 of carburetor No. 1 during initial depression of the accelerator pedal 45 without permitting the throttle valve 36 of carburetor No. 2 to move from its closed position. As soon as the throttle valve of carburetor No. 1 has been opened beyond this predetermined open position, the flange 58 of the bell crank engages the set screw 57 thereby rotating the lever 55 in a counterclockwise direction against the action of the spring 58'.

Rotation of the lever 55 in a counterclockwise direction during this further opening of the throttle valve of carburetor No. 1 from said predetermined open position causes the lever 49 to be correspondingly rotated about its pivotal support 50 thereby moving the roller 52 rightwardly so as to accommodate opening of the throttle valve 36 of carburetor No. 2 under the influence of engine suction existing in the fuel mixture passage of carburetor No. 2 and against the action of the counterweight. When the throttle valve of carburetor No. 1 has been opened and the lever 55 has been rotated in a counterclockwise direction sufficiently to accommodate rotation of the throttle shaft 35 and counterweight 38 to

bring the center 39 of the counterweight on the left side of the vertical plane containing the axes of the throttle shaft 35, as illustrated in Fig. 4, then the counterweight assists in further opening movement of the throttle valve 35 as such movement is accommodated by further rightward movement of the roller 52.

With the foregoing control apparatus, the throttle valve of carburetor No. 1 is initially opened a predetermined amount independently of the throttle valve of carburetor No. 2 and while the latter throttle valve remains closed. The supply of an idling fuel mixture is continued under these conditions by the idling system of carburetor No. 2 in order to assure a sufficient supply of fuel to the air admitted to the manifold through carburetor No. 2 during subsequent initial opening of the throttle valve thereof and before the latter throttle valve is opened enough to feed fuel from the main jet of carburetor No. 2.

The counterweight biases the throttle valve of carburetor No. 2 toward its closed position when it is disposed between its fully closed and a predetermined open position. This counterweight also biases the throttle valve of carburetor No. 2 toward its open position when disposed in a more open position than said predetermined open position. Thus the throttle valve of carburetor No. 2 is held against closing at a lower speed of engine operation than that at which it would open from a closed position.

The variable stop mechanism which controls the opening movement of throttle No. 2 does not positively open it but permits it to open in accordance with the extent of positive opening of the throttle valve of carburetor No. 1 and then only when conditions exist which require the feeding of fuel from the main jet of carburetor No. 2. This variable stop mechanism, however, positively closes the throttle valve of carburetor No. 2 simultaneously with, and an amount corresponding to the extent of positive closing of the throttle valve of carburetor No. 1.

With the foregoing fuel system and control therefor, mechanical operation at low speed is attainable by relying mainly on only one of the two carburetors to supply fuel mixture to the manifold 12. During high speed operation of the engine, the other carburetor is automatically brought into operation.

The throttle and control mechanism of carburetor No. 2 can be employed to advantage in an internal combustion engine having a single carburetor. In this case, the accelerator controlled stop 49 serves to variably limit opening of the throttle valve under control of the operator. As the accelerator pedal is initially depressed, the stop 49 is moved away from the abutment 53 thus accommodating opening of the throttle valve under the action of the total pressure differential and against the action of the counterweight. This could be conveniently accomplished with the structure shown in the drawing by using the set screw to secure the levers 55 and 41 together, the rod 40 being omitted. The counterweight may be conveniently disposed in angular position and predetermined in weight and inertia to provide ample time for the attainment of sufficient velocity past the main jet and flow of fuel to the outlet of the latter to produce proper main jet operation before the supply of fuel mixture by the idling system is discontinued. This obviates the condition of roughness in engine operation which results from suddenly, positively opening the throttle from its idle position.

Throttle valve and control apparatus embodying invention may be used in a single carburetor system of an engine having an increased compression ratio to increase the thermal efficiency during operation at part load. In this case, the counterweight would be so disposed in angular position as to urge the throttle valve to its closed position throughout its entire range of throttle movement. With this construction, there is provided a restriction to the flow of fuel mixture from the carburetor at all speeds. This restriction permits the use of a higher compression ratio which compensates for the decrease in maximum power output produced by the restriction and also increases the thermal efficiency of the engine.

Although but one specific embodiment of the invention is herein shown and described, it will be understood that various changes in the sequence of operations, steps and materials employed may be made without departing from the spirit of the invention.

It is claimed:

1. In an internal combustion engine having an intake manifold, a fuel mixture supply system including first and second carburetors each having a fuel mixture outlet communicating with said intake manifold, a throttle valve in said first carburetor, control apparatus for positively opening and closing the same at the will of an operator, an off-center throttle valve freely rotatably mounted in said second carburetor adapted to open in response to the total pressure differential on respectively opposite sides thereof, control apparatus for said last mentioned throttle valve operable by said control apparatus of said first mentioned throttle valve throughout a portion of its operating range, said second mentioned control apparatus including a variable abutment for positively closing said second mentioned throttle valve simultaneously with closing movements of said first mentioned throttle valve and so constructed and arranged as to variably accommodate opening of said second mentioned throttle valve by said pressure differential in accordance with the extent of opening of said first mentioned throttle valve beyond a predetermined initially open position, and means for yieldably holding said last mentioned throttle valve in its closed position until a predetermined total pressure differential is applied thereon including a member so constructed and arranged as to urge said last mentioned throttle valve toward its closed position during the initial portion only of its range of opening movement.

2. In an internal combustion engine having an intake manifold, a fuel mixture supply system including first and second carburetors each having a fuel mixture outlet communicating with said intake manifold, a throttle valve in said first carburetor, control apparatus for positively opening and closing the same at the will of an operator, an off-center throttle valve freely rotatably mounted in said second carburetor adapted to open in response to the total pressure differential on respectively opposite sides thereof, control apparatus for said last mentioned throttle valve including an element engageable with and operable by said first mentioned control apparatus during all but its initial stage of throttle valve opening movement, said second mentioned control apparatus including a variable abutment for positively closing said second mentioned throttle valve simultaneously with closing movements of said first mentioned throttle valve and so con-

structed and arranged as to variably accommodate opening of said second mentioned throttle valve by said pressure differential in accordance with the extent of opening of said first mentioned throttle valve beyond a predetermined initially open position, and means connected with said second mentioned throttle valve for biasing it toward closed position when disposed between its closed and a predetermined open position and toward a further open position when open beyond said predetermined position.

3. In an internal combustion engine having an intake manifold, a fuel mixture supply system including first and second carburetors each having a fuel mixture outlet communicating with said intake manifold, a throttle valve in said first carburetor, control apparatus for positively opening and closing the same at the will of an operator, an off-center throttle valve freely rotatably mounted in said second carburetor adapted to open in response to the total pressure differential on respectively opposite sides thereof, means connected with said second mentioned throttle valve for biasing it toward closed position when disposed between its closed and a predetermined open position and toward a further open position when open beyond said predetermined position, and control apparatus for said last mentioned throttle valve operable by said control apparatus of said first mentioned throttle valve throughout a portion of its operating range, said second mentioned control apparatus including a variable abutment for positively closing said second mentioned throttle valve simultaneously with closing movements of said first mentioned throttle valve and so constructed and arranged as to variably accommodate opening of said second mentioned throttle valve by said pressure differential in accordance with the extent of opening of said first mentioned throttle valve beyond a predetermined initially open position.

4. In an internal combustion engine having an intake manifold, a fuel mixture supply system including first and second carburetors each having a fuel mixture outlet communicating with said intake manifold, a throttle valve in said first carburetor, control apparatus for positively opening and closing the same at the will of an operator, an off-center throttle valve freely rotatably mounted in said second carburetor adapted to open in response to the total pressure differential on respectively opposite sides thereof, means connected with said second mentioned throttle valve for biasing it toward closed position when disposed between its closed and a predetermined open position and toward a further open position when open beyond said predetermined position, and control apparatus for said second throttle valve including an element engageable with and operable by said first mentioned control apparatus during all but its initial stage of throttle valve opening movement, said second mentioned control apparatus including a variable abutment for positively closing said second mentioned throttle valve simultaneously with closing movements of said first mentioned throttle valve and so constructed and arranged as to variably accommodate opening of said second mentioned throttle valve by said pressure differential in accordance with the extent of opening of said first mentioned throttle valve beyond a predetermined initially open position.

5. In an internal combustion engine having an intake manifold, a fuel mixture supply system including a primary carburetor and a secondary carburetor having main and idling fuel jets and each having a fuel mixture outlet communicating with said manifold, manually operable means for positively controlling the flow of fuel mixture from said primary carburetor at the will of an operator, means for controlling the flow of fuel mixture from said secondary carburetor and the flow of liquid fuel from the idling jet thereof including a throttle valve in said outlet of said secondary carburetor normally urged toward open position by the total pressure differential in said outlet on respectively opposite sides of said throttle valve during operation of said engine, and means for yieldably holding said throttle valve against opening from its idling position until said pressure differential reaches a predetermined value including a weight member so constructed and arranged as to yieldably urge said throttle valve toward its closed position during a portion only of its range of opening movement.

6. In an internal combustion engine having an intake manifold, a fuel mixture supply system including a primary carburetor and a secondary carburetor having main and idling fuel jets and each having a fuel mixture outlet communicating with said manifold, manually operable means for positively controlling the flow of fuel mixture from said primary carburetor at the will of an operator including a throttle valve in the outlet of said primary carburetor, means for controlling the flow of fuel mixture from said secondary carburetor and the flow of liquid fuel from the idling jet thereof including a throttle valve in said outlet of said secondary carburetor normally urged toward open position by the total pressure differential in said outlet on respectively opposite sides of said throttle valve during operation of said engine, means for opposing opening of said second mentioned throttle valve until said pressure differential reaches a predetermined value, mechanism for releasably holding said second mentioned throttle valve closed, said mechanism being engageable by said manually operable means during opening of said first mentioned throttle valve thereby beyond a predetermined open position for releasing said second mentioned throttle valve and thereafter variably limiting opening thereof in accordance with opening movement of said first mentioned throttle, and means on said second mentioned throttle valve for biasing it toward a closed position when disposed between its closed and a predetermined open position and toward an open position when opened beyond said predetermined open position in order to hold said second mentioned throttle valve against closing from a more open position than said predetermined position at a lower engine speed than that at which it opens from a closed position.

7. In an internal combustion engine having an intake manifold; a fuel mixture supply system including a primary carburetor and a secondary carburetor having main and idling fuel jets and each having a fuel mixture outlet communicating with said manifold, manually operable means for positively controlling the flow of fuel mixture from said primary carburetor including a throttle valve and control linkage for the latter, an off-center throttle valve in said secondary carburetor having a rotatively mounted shaft, said off-center throttle valve being normally urged toward open position by the total pressure differential on respectively opposite sides thereof during operation of said engine, a weight member fixed to said shaft having its center of mass so located with respect to the axis of said shaft as to urge said second mentioned throttle valve toward a closed position

when the latter is disposed between its closed and a predetermined open position and toward an open position when opened beyond said predetermined open position, an abutment on said weight member, and means for variably limiting opening of said second mentioned throttle valve under said pressure differential including a stop element rotatably mounted on said shaft and engageable with said abutment, said latter means comprising a control linkage for rotating said stop and having an element engageable with the control linkage of said manually operable means only when the latter is between its wide open throttle and a predetermined partially open throttle positions, and including a spring for yieldably urging said stop into throttle closing engagement with said abutment throughout the entire range of closing movement of said second mentioned throttle when the control linkage of said manually operable control means is ineffective to urge said stop reversely.

8. In an internal combustion engine having an intake manifold, a fuel mixture supply system including a carburetor having main and idling fuel jets and having a fuel mixture outlet communicating with said manifold, means for controlling the flow of fuel mixture from said outlet and the flow of liquid fuel from said idling jet including a throttle valve in said outlet normally urged toward open position by the total pressure differential in said outlet on its respectively opposite sides, and means for retarding opening of said throttle valve from its idle position in order that said main jet may be in normal operation as feeding of fuel from said idle jet is discontinued, said means having a member so constructed and arranged as to urge said throttle valve toward its closed position throughout only a portion of its normal range of opening movement.

9. In an internal combustion engine having an intake manifold, a fuel mixture supply system including a carburetor having main and idling fuel jets and having a fuel mixture outlet communicating with said manifold, means for controlling the flow of fuel mixture from said outlet and the flow of liquid fuel from said idling jet including a throttle valve in said outlet normally urged toward open position by the total pressure differential in said outlet on its respectively opposite sides, manually operable means for positively urging said throttle valve toward its closed position and adapted to variably limit opening movement of said throttle, and means yieldably opposing opening of said throttle valve in response to said pressure differential during opening of said throttle valve from its idling to a predetermined partially open position, said latter means being so constructed and arranged as to urge said throttle valve in an opening direction after movement thereof beyond said predetermined partially open position.

10. In an internal combustion engine having an intake manifold, a fuel mixture supply system including a carburetor having main and idling fuel jets and having a fuel mixture outlet communicating with said manifold, means for controlling the flow of fuel mixture from said outlet and the flow of liquid fuel from said idling jet including a throttle valve in said outlet normally urged toward open position by the total pressure differential in said outlet on its respectively opposite sides, manually operable means for positively urging said throttle valve toward its closed position and adapted to variably limit opening movement of said throttle, and means yieldably opposing opening of said throttle valve in response to said pressure differential, said latter means including a counterbalancing member conveniently predeterminable in weight, angular position and inertia.

11. In an internal combustion engine having a plurality of cylinders, an intake manifold having a plurality of outlet ports for supplying fuel to certain of said cylinders, a pair of carburetors communicating with said manifold, a manually operated throttle for one of said carburetors, a second throttle for the other carburetor, means responsive to suction as determined by the attainment of a predetermined engine speed for operating said second throttle to open position, a common manually operable control member for said throttle valves, means mechanically interconnecting said throttle valves with each other and with said control member including an element for positively opening and closing said first throttle valve and an element for only positively closing said second throttle valve, and means connected with said second mentioned throttle valve for biasing it toward closed position when disposed between its closed and a predetermined open position and toward a further open position when open beyond said predetermined position.

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