Dec. 30, 1952 C. J. SNYDER ET AL 2,623,617

HALF MOTOR CUTOUT

Filed Dec. 16, 1949 2 SHEETS—SHEET 1

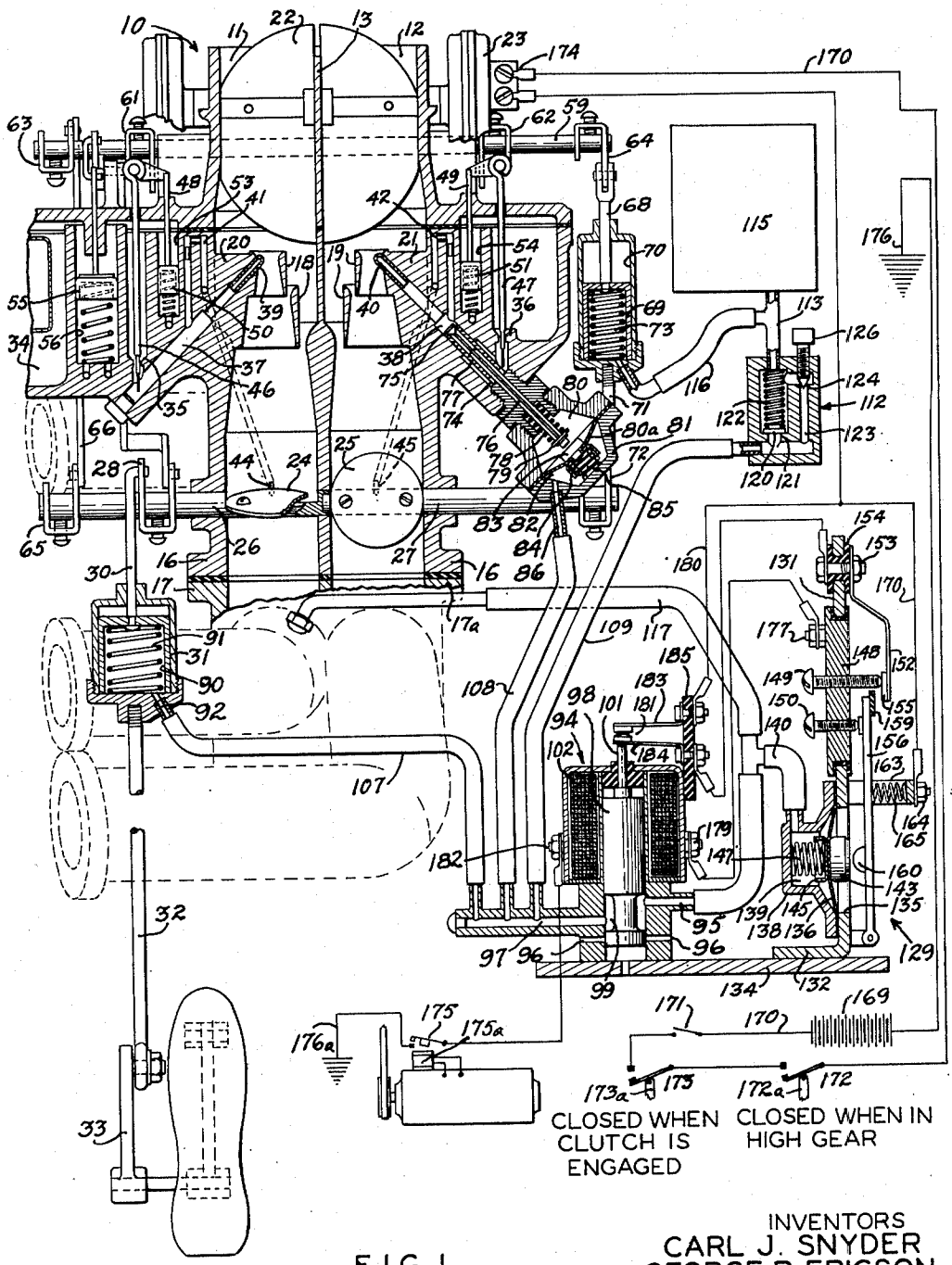


FIG. 1.

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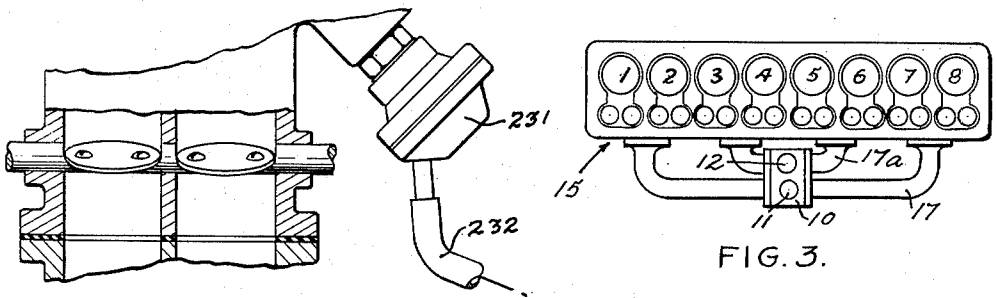


FIG. 3.

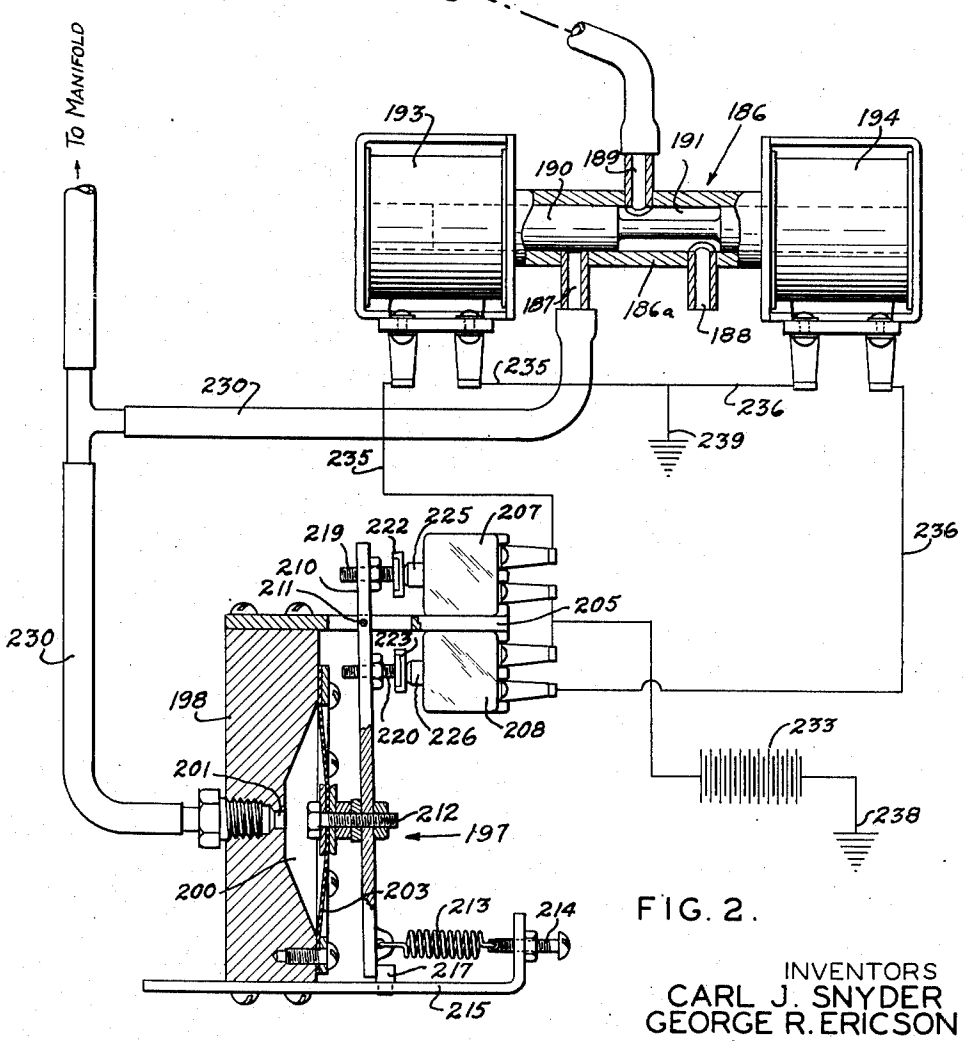


FIG. 2.

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HALF MOTOR CUTOUT

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Application December 16, 1949, Serial No. 133,429

22 Claims. (Cl. 192—.062)

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This invention relates to internal combustion engines and consists particularly in means for increasing the efficiency of such engines, principally by securing greater fuel economy during partial load operation.

In conventional internal combustion engines, sufficient power is necessarily provided to permit satisfactory operation under maximum load conditions, such as during acceleration or while ascending grades. Much driving, however, is done under partial rather than maximum load conditions, and during such partial load periods, there is an excess of power available. Since the power produced is to some extent a function of the number of cylinders in operation, and since the amount of fuel consumed is also, to some extent, a function of the number of cylinders operating, by operating only the number of cylinders commensurate to the power requirement, during these periods of operation in which power requirements are low the amount of fuel consumed can be proportionately reduced.

The object of this invention, accordingly, is to obtain greater fuel economy in automobile engines, particularly by increasing their efficiency during periods of partial load, as while operating at low speeds on the level, or while descending grades. We achieve this object by three operations.

First, the fuel is cut off from one or more cylinders, or groups of cylinders under such light load conditions; as an example, when an 8-cylinder automobile is driven on a level road at speeds less than 40 miles per hour, a substantial fuel saving can be achieved by eliminating the supply of fuel to four cylinders, and increasing the load on the remaining four.

There are numerous methods of cutting out the supply of fuel to one or more cylinder groups, but on engines having a separate manifold for each cylinder group, the problem is simplified by interrupting the supply of fuel to one manifold while continuing to supply the other. In this connection, it should be noted that it is not practical to cut off the supply of fuel to one manifold merely by closing the throttle, because the advantage of transferring the load to the other group of cylinders would be outweighed by the increased pumping loss resulting from closing of the throttle valve.

The second operation is designed to eliminate pumping loss in the cylinder group from which the fuel is cut off and consists in opening the throttle valve leading to the group of cylinders during such times as their fuel supply may be cut off.

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The third operation is to compensate for the cutting off the second group of cylinders by increasing the first throttle opening when the supply of fuel to the second group of cylinders is turned off.

Since the degree of throttle opening is proportional to the load, and since the manifold suction is an inverse function of the degree of throttle opening, we utilize manifold suction as the motivating force for cutting off the supply of fuel, for opening the throttle valve leading to the group of cylinders from which the fuel supply has been cut off, and for increasing the other throttle opening.

Another object of the invention is to provide a combination of vacuum responsive and electromechanical means for turning on and off the supply of fuel to the secondary group of cylinders.

A further object of the invention is to provide means for shutting the fuel off at one value of suction and on at another, it being highly undesirable to have the valve turn on at the same suction at which it turns off, because the frequent opening and closing of the valve would cause too frequent acceleration of the engine.

A still further object of the invention is to provide means whereby the engine will operate on all eight cylinders whenever it is idling, whenever the choke valve is not fully opened, whenever the car is not in high gear, and whenever the clutch is disengaged. We achieve this object by arranging electrical circuit breakers for operation by the generator cut out relay, the choke valve shaft, the gear shift mechanism, and the clutch operating mechanism.

Other objects and advantages of the invention will appear by reading the specification in connection with the drawings in which:

Fig. 1 shows a vertical section through the device;

Fig. 2 shows a fragmentary vertical section and elevation of a different form of the device.

Fig. 3 is a plan view of a conventional eight-cylinder internal combustion engine.

Referring now to Fig. 1, a carburetor of the dual down-draft type is generally indicated at 10. Carburetor 10 is formed with two parallel mixture conduits 11 and 12, separated by wall structure 13. Mixture conduits 11 and 12 have air inlets at their upper ends and mixture outlets at their lower ends on which is formed flange 16 for attachment to the engine primary intake manifolds 17 communicating with four cylinders, and 17a communicating with the remaining four cylinders of a conventional eight-cylinder internal combustion engine 15, best shown in Fig. 3,

on which the cylinders are indicated by the consecutive numerals 1–8 inclusive. Series of venturis 18 and 19, respectively, are supported centrally of conduits 11 and 12 by ribs 20 and 21.

Admission of air to conduits 11 and 12, respectively, is governed by split unbalanced choke valve 22, which is controlled by a conventional automatic choke control device 23.

Separate throttle valves 24 and 25 respectively control the discharge of fuel mixture from conduits 11 and 12. Throttle valves 24 and 25 are mounted on separately rotatable shafts 26 and 27, shaft 26 being journalled in the walls of mixture conduit 11 and shaft 27 being concentric with and journalled at one end in shaft 26 and at its other end in the outer wall of mixture conduit 12. Throttle 24 is adapted for pedal operation, a lever 28 being rigidly secured at one end to shaft 26 for rotation therewith. A piston rod 30 connects the outer end of arm 28 with vacuum cylinder 31, which is connected by a rod 32 to accelerator pedal 33, so that as accelerator pedal 33 is depressed, throttle 24 is moved toward open position.

A float controlled constant level fuel bowl 34 communicates respectively, with venturis 18 and 19 by means of metering orifices 35 and 36, passageways 37 and 38 and main nozzles 39 and 40. Additional restricted passageways 41 and 42, respectively, connect fuel outlet passages 37 and 38 with idle ports 44 and 45. Flow of fuel through metering orifices 35 and 36 is controlled by stepped metering pins 46 and 47, respectively, which are connected by piston rods 48 and 49 to suction operated pistons 50 and 51, for operation therewith. Pistons 50 and 51 are slidably mounted in cylinders 53 and 54 which communicate with the mixture conduits posterior to the throttle. An accelerating pump piston 55 is slidably mounted in a pump cylinder 56 formed in fuel bowl 34. Accelerating pump 55 receives fuel from the fuel bowl 34 and discsharges it into the mixture conduits 11 and 12 by inlet and outlet valves and passageways (not shown).

A countershaft 59 extending parallel to shafts 26 and 27 is journalled in the upper portion of the carburetor structure and is provided with arms 61 and 62, formed with extensions for engaging the nether side of the horizontal portion of piston rods 48 and 49 so that when countershaft 59 is turned the metering pins will be raised regardless of the suction acting on pistons 50 and 51. At its opposite ends, countershaft 59 is provided with arms 63 and 64, arm 63 being connected by link 66 to a similar arm 65 on the outer end of throttle shaft 26 so that any rotary movement of throttle 24 and shaft 26 is transmitted to countershaft 59.

A variable length link consisting of piston rod 68, piston 69, cylinder 70, and cylinder rod 71 connects the outer end of arm 64 with the outer end of a similar arm 72 secured to the outer extremity of throttle shaft 27. Coil spring 73 normally urges piston 69 upwardly to fully extend link 68—71, which, when fully extended is the same length as link 66, so that the position of throttle 25 corresponds to that of throttle 24. Cylinder 70 communicates with manifold 17 through a suction inlet port and associated passageways and connections which will be described later so that when suction is sufficiently high to overcome the force of spring 73, piston 69 will be drawn downwardly, as shown in Fig. 1, thereby shortening link 68—71. Under low suction conditions spring 73 urges piston 69 to its uppermost position thereby lengthening link 68—71. When link 68—71 is fully lengthened, as indicated above, its length is such that any rotary movement of countershaft 59 is transmitted via arm 63, link 68—71 and arm 72 to secondary throttle shaft 27. When, due to the action of suction on piston 69, link 68—71 is shortened, as described above, secondary throttle 25 is held at its fully open position, as shown in Fig. 1, regardless of the position of primary throttle valve 24.

For the purpose of stopping the flow of fuel through nozzle 40 into secondary mixture conduit 12 during predetermined high suction conditions a suction operated poppet valve 75 is provided in passageway 38. Valve 75 is formed with an elongated fluted stem portion 76 slidably mounted for sealingly seating in a tubular casing 77, which is sealingly fitted into fuel passageway 38. Openings 74 are formed in cylindrical casing 77 adjacent metering orifice 36 to permit the flow of fuel into casing 77. A coil spring 78, on stem 76 is compressed between the lower end of casing 77 and a shoulder 79 on stem 76, thus normally urging poppet valve 75 into its seated position against the upper end of cylindrical casing 77. The lower end of stem 76 projects into cavity 80, which is sealingly covered by resilient diaphragm 80*a* to form a pumping chamber. Cup 81 is sealingly secured to and cooperates with diaphragm 80*a* to form a suction chamber 82. Diaphragm 80*a* is provided with a central button 83 on its upper surface to contact the end of valve stem 76, and a central cup-shaped spring seat 84 on its lower surface. Coil spring 85, seated in chamber 82 normally urges diaphragm 80*a* towards the base of stem 76, thereby raising valve 75 from its seat, to permit the passage of fuel from fuel bowl 34 into mixture conduit 12.

Suction chamber 82, is connected with intake manifold 17 through suction inlet port 86 and associated passage and valve means which will be described in detail below, so that when the valve means are opened to permit free communication, diaphragm 80*a* will be drawn downwardly against spring 85, spring 78 will urge stem 76 and valve 75 into seated position, and a charge of fuel will be drawn from bowl 34, through metering orifice 36, openings 74, casing 77, and into pumping chamber 80. When pressure increases within suction chamber 82, as and for the purpose described below, spring 85 urges diaphragm 80*a* outwardly, against the end of stem 76, thereby unseating valve 75, and forcibly discharging the fuel contained in pumping chamber 80 into mixture conduit 12, so as to sufficiently wet the manifold which, of course, dries out when valve 75 is closed. It should be noted that diaphragm 80*a*, when withdrawn by vacuum, does not suck any air through nozzle 40, since valve 75 is closed before complete withdrawal of diaphragm 80*a*.

In order that the primary throttle 24 may be automatically opened an additional amount to compensate for the shutting off of fuel to the secondary bank of cylinders, a suction powered device comprising cylinder 31 and piston 90 slidably mounted therein is interposed in the link 30—32 between throttle shaft arm 28 and accelerator pedal 33, piston 90 being secured to piston rod 30, and cylinder 31 being secured to rod 32. A spring 91 normally urges piston 90 towards its uppermost position in cylinder 31. However, when suction is applied to piston 90, through suction inlet 92, piston 90 is drawn downward, thereby shortening link 30—32, and

causing primary throttle 24 to open a slight additional amount.

Communication between intake manifold 17 and suction cylinders 31 and 70 and suction chamber 82 is regulated by solenoid valve 94 which is adapted, in a manner to be described below, to permit communication of manifold vacuum to cylinders 31 and 70 and suction chamber 82 when manifold vacuum increases above a predetermined value, such as 11 inches Hg; and to vent cylinders 31 and 70, and suction chamber 82 to the atmosphere when manifold vacuum decreases below a different predetermined value, such as 5 inches Hg. Valve 94 consists of a tubular housing, having suction inlet port 95, vents 96 communicating with the atmosphere, and outlet port 97. A cylindrical closure member 98, formed with an annular groove 99 and a stem 101 is slidably mounted in the housing. Closure member 98 normally remains in its lowermost position due to the action of gravity, so that annular groove 99 provides free communication between outlet port 97, and atmospheric vents 96. A solenoid 102 is provided to elevate closure member 98, so that when fully raised, annular groove 99 provides communication between suction inlet port 95 and outlet port 97.

Hose 107 connects outlet port 97 with suction inlet port 92 on cylinder 31; hose 108 connects outlet port 97 with inlet port 86 on diaphragm suction chamber 82. A third hose 109 connects outlet port 97 with a one-way retarding valve 112, the outlet 113 of which communicates with reservoir 115 and with suction cylinder 70 by means of flexible connection 116. An additional tubular connection 117 provides communication between primary intake manifold 17 and inlet port 95 of valve 94, so that when closure member 98 is in its uppermost position manifold suction is communicated to cylinder 31 and suction chamber 82, respectively, by flexible tubes 107, and 108, and to cylinder 70 by flexible tube 109, one-way retarding valve 112, and flexible connection 116.

In order to retard the rate of opening of secondary throttle 25, and thereby prevent objectionable backfiring when it is opened, and yet to permit instantaneous closing, a one-way retarding valve 112 is provided. One-way retarding valve 112 contains a one-way, disk type check valve 120, normally urged against its seat 121 by light coil spring 122. Passageway 123, formed with restricted orifice 124 by-passes valve 120, and provides restricted communication through one-way retarding valve 112. A screw 126 is provided for manually varying the effective area of restricted orifice 124. The purpose of one-way retarding valve 112 is achieved by reducing the rate of evacuation of cylinder 70, since due to the action of spring 122 on disk 120, evacuation must be accomplished through restricted orifice 124 thereby reducing the rate at which secondary throttle 25 is moved toward its fully opened position; rate of movement of piston 69 is further decreased due to the necessity of evacuating reservoir 115 as well as cylinder 70 before piston 69 can be drawn to its lowermost position. When manifold suction is reduced, and hose 109 is vented to the atmosphere through valve 94, the differential in pressure is sufficient to lift disk 120 from its seat, so that the full increased pressure is transmitted instantaneously to cylinder 70, thereby urging piston 69 upwardly to lengthen link 68—71, and thus returning throttle 25 to pedal control.

For controlling the operation of solenoid 102 of valve 94, a suction operated electrical contact mechanism 129 is provided. Contact mechanism 129 consists of an upstanding frame 131 formed with a flange 132 at its base for attachment to a plate 134 which also serves as a base for valve 94, and as a bottom stop for valve closure member 98. A circular opening 135 is formed in frame 131 to permit free movement of yieldable diaphragm 136, which is sealingly secured against frame 131 by cup 138, the hollow interior of which serves as a suction chamber 139. Suction chamber 139 communicates with primary intake manifold 17 through tubes 140 and 117. A button 143 is centrally secured to diaphragm 136 by means of cup shaped clamping member 145 which also serves as a seat for coil spring 147. Normally diaphragm 136 is urged outwardly by coil spring 147 in opposition to manifold vacuum in suction chamber 139. A terminal block 148 is mounted in frame 131 and is insulated therefrom by a dielectric material. Screws 149 and 150 are secured in block 148 and serve as contact points. A resilient metal strip 152 is secured to frame 131 by terminal screw and nut 153, terminal 153 and strip 152 being electrically insulated from frame 131 by insulating sleeve 154, and is formed with a contact point 155 on its free end, which is normally urged against an extremity of screw 149. A contact arm 156 is hingedly secured to frame 131 near its base, and at its upper end has a pad 159 of insulating material adapted to register with the free extremity of strip 152, and a contact point adapted to register with the outer end of screw 150; arm 156 is also formed with a projection 160 adapted to register with diaphragm button 143, so that under low suction conditions spring 147 urges arm 156 away from screw 150 and against strip 152, thus breaking the contact between contact point 155 and screw 149. Terminal bracket 163 extends outwardly from frame 131 and carries terminal 164 at its outer end. A coil spring 165, mounted on bracket 163 urges arm 156 away from strip 152 and toward screw 150, in opposition to spring 147, so that when manifold suction in chamber 139 increases to a predetermined low value, such as 5 inches Hg, contact 155 is free to abut against screw 149, and when manifold suction increases to a higher value, 11 inches Hg for example, arm 156 makes contact with screw 150.

Electrical energy for the operation of solenoid valve 94 is provided by a storage battery indicated at 169, and is conducted to solenoid 102 through a circuit including a conductor 170, manual switch 171, gear shift operated switch 172, clutch operated switch 173, choke operated switch 174, suction operated switch 129, generator cut out relay switch 175, and grounds 176 and 176a.

Gear shift switch 172 is operatively connected to the gear shift mechanism by a linkage means 178, so that it is closed only when the automobile is in high gear, and is open at all other times, since, normally, load conditions at other times require eight cylinder operation. Clutch switch 173 is operatively connected to the clutch operating mechanism by a linkage means 179, so that it is closed only when the clutch is engaged, and open at all other times; the function of switch 173 is to assist in a smooth transition from eight cylinder operation in second gear to four cylinder operation in high gear; that is, to prevent a

momentary change to four cylinder operation while the clutch is disengaged for shifting, and a sudden return to eight cylinder operation on re-engagement of the clutch. Choke operated switch 174 is operatively connected to the choke operating mechanism 23, so that it closes only when choke valve 22 is fully opened; at all other times switch 174 remains opened, so that solenoid 102 cannot be energized and the engine must operate on all eight cylinders until it is fully warmed up. Switch 175 is operated by the generator cut-out relay 175a so that when the engine is operating at a low speed, such as during idling, switch 175 is opened, solenoid 102 is thus de-energized and the engine operates on all eight cylinders at such low speeds. Circuit 170 is connected to switch apparatus 129 at terminals 164 and 177 and to the solenoid winding 102 at terminals 179 and 182, so that when switches 171, 172, 173, 174, and 175 are closed and manifold vacuum in suction chamber 139 is sufficiently high to permit spring 165 to urge arm 156 into contact with contact screw 150 the circuit is completed through switch mechanism 129 via terminal 164, bracket 163, spring 165, contact arm 156, contact screw 150, terminal block 146, and terminal 149, and solenoid 102 is energized, thereby lifting closure member 98.

A shunt circuit 180 including switches 181 and 155—149 by-passes switch 156—150 under certain conditions, which will be described in detail below. Switch 181 consists of two resilient contact strips 183 and 184 secured to non-conducting terminal block 185, which is secured to solenoid coil 102 and is so positioned with respect thereto that upward movement of valve plunger stem 101 forces contact strip 184 upward and into engagement with contact strip 183, therefore completing shunt or holding circuit 180, so that when manifold vacuum decreases below 11 inches Hg, and contact 150—156 opens, solenoid 102 will remain energized, receiving its energy through holding circuit 180, which remains closed until manifold vacuum decreases to 5 inches Hg—at which point arm 156 urges point 155 out of contact with contact screw 149.

Operation of the device of Fig. 1 is as follows:

When the driver shifts into high gear, switch 172 on the gearshift linkage closes, and when the clutch is let out, clutch switch 173 closes, thereby, completing the circuit as far as vacuum operated switch 129. At this time, and until an increase in suction, the engine is operating on eight cylinders, throttle control being entirely manual. When manifold suction reaches approximately 5 inches Hg, pivoted arm 156 is urged inwardly by spring 165, permitting contact 155—149 to close. When manifold vacuum reaches approximately 11 inches Hg, arm 156 is moved inwardly sufficiently far to make contact with contact screw 150, thereby closing a circuit through solenoid 102. This raises plunger 98, thereby closing by-pass switch 181, and connecting solenoid valve inlet port 95 with outlet port 97. Snatcher pump suction chamber 82, auxiliary throttle cylinder 70, and primary throttle cylinder 31 are thus simultaneously evacuated, so that primary throttle 24 is opened an additional amount, secondary throttle 25 is opened completely, and the snatcher pump valve 75 is closed. It should be noted, in connection with primary throttle cylinder 31, that its spring 91 is slightly stronger than spring 147, so that a greater value of suction will be required to increase the opening of throttle 24 than was required to close contacts 155—149, to avoid sudden or instantaneous decreases in manifold vacuum, which would cause opening of these switches and consequent inoperativeness of the entire cut-off system. The engine thus operates on the primary bank of cylinders, even though manifold suction decreases below 11 inches Hg at which point contact 150—156 is opened, since contact 150—156 is by-passed by shunt circuit 180. However, when manifold suction declines below 5 inches Hg, contact 149—155 is opened, thereby breaking the shunt circuit 180, and permitting plunger 98 to drop by its own weight to vent outlet port 97 to the atmosphere by means of radial vent ports 96. When this occurs the springs in primary throttle cylinder 31 and secondary throttle cylinder 70 urge the pistons into the extended position, and the spring in snatcher pump suction chamber forces its diaphragm and valve into the open position, and causes a fuel discharge into secondary mixture conduit 12. The primary throttle is thus returned to its normal eight-cylinder operating position, and the auxiliary throttle is also returned to its normal eight-cylinder position for manual control in unison with the primary throttle.

Figure 2 illustrates another form of suction operated switch and solenoid valve. Valve 186 consists of a tubular casing 186a closed at each end, formed with suction inlet port 187, atmospheric vent port 188, and suction outlet port 189. A cylindrical closure member 190, formed with an elongated annular groove 191, is slidably and sealingly mounted in tubular casing 186a. The length of annular groove 191 is such that when closure member 190 is in one extreme position, as shown in Figure 2, outlet port 189 is in communication with vent port 188, and when closure member 190 is in the other extreme position, outlet port 189 is in communication with suction inlet port 187; the length of groove 191 being substantially less than the distance between suction inlet port 187, and vent port 188, the two ports are never in communication with each other. At the end of tubular casing 186a, solenoids 193 and 194, are mounted so that when solenoid 193 is energized, closure member 190 is drawn in to it, and groove 191 offers free communication between the suction inlet and outlet ports 187 and 189 respectively. When solenoid 194 is energized closure member 190 is drawn toward the opposite end of casing 186a, as shown in Figure 2 and groove 191 provides communication between outlet 189 and vent 188.

Solenoids 193 and 194 are controlled by suction operated switch mechanism 197, which consists of block 198, formed with suction cavity 200 and suction inlet 201, a diaphragm 203, sealingly secured to the periphery of cavity 200, a bracket 205 carrying micro-switches 207 and 208, an arm 210 pivotally secured to bracket 205 at 211 and centrally secured to diaphragm 203 by bolt 212. Arm 210 is normally biased outwardly from diaphragm 203 by coil spring 213, which is secured at one end to arm 210 and adjustably secured at its other end, by screw 214 to bracket 215. Stop 217 on bracket 215 limits outward, or counterclockwise movement of arm 210. Screws 219 and 220, formed with bearing surfaces 222 and 223 are adjustably secured to arm 210 on opposite sides of pivot 211, so as to at all times abut against spring loaded actuating plungers 225 and 226 respectively, of micro-switches 207 and 208. Switches 207 and 208 are conventional micro-switches so constructed that when the actuating plungers 225 and 226 are permitted to move outward past a predetermined point the

contacts open, and when the plungers are forced inwardly beyond the same point, the contacts close. As arranged in the present device, with arm 210 pivoted between the two switches 207 and 208, any rotary movement of arm 210 causes an application of pressure to one of the micro switch actuating plungers , 225 or 226, and a release of pressure on the other plunger, so that, when bearing screws 219 and 220 are properly adjusted, one switch closes simultaneously with opening of the other.

Suction cavity 200 of switch mechanism 197, and suction inlet port 187 of valve 186 communicate with the intake manifold through tubular passages 230. Outlet port 189 communicates with fuel valve actuating diaphragm suction chamber 231 (identical with suction chamber 82 of Figure 1), through tubular passage 232 and may be connected to other suction operated devices such as cylinders 70 and 31 of Figure 1.

Electrical energy for the operation of solenoids 193 and 194 is provided by battery 233 to independent circuits 235 and 236. Circuit 235 includes, in addition to ground 238 and battery 233, micro-switch 207, solenoid winding 193, and common ground 239. Circuit 236 consists of ground 238, battery 233, micro-switch 208, solenoid winding 194 and common ground 239.

Operation of the device of Figure 2 is as follows:

When manifold suction is below a predetermined low value such as 5 inches Hg, spring 213 urges arm 210 in a counterclockwise direction against stop 217, thereby causing bearing surface 222 to move away from micro-switch 207 so as to permit outward movement of plunger 225, and consequent opening of switch 207; at the same time bearing surface 223 moves toward microswitch 208 thereby urging plunger 226 inwardly and closing switch 208. Thus solenoid 193 is de-energized and solenoid 194 is energized, and closure member 190 is drawn toward solenoid 194, thereby closing suction inlet port 187 and permitting outlet port 189 to communicate with vent port 188.

When manifold vacuum increases to a predetermined value, the differential between the pressure within suction chamber 200 and amospheric pressure on the outer surface of diaphragm 203 is sufficient to overcome the force of spring 213, so that arm 210 is rotated clockwise through a small arc about pivot 211 and bearing surface 222 urges plunger 225 inwardly, thereby closing switch 207, and bearing surface 223 permits outward movement of plunger 226 and consequent simultaneous opening of switch 208. This circuit 235 through solenoid 193 is closed, and circuit 236 through solenoid 194 is opened, so that solenoid 193 is energized while solenoid 194 is de-energized, and closure member 190 is drawn toward solenoid 193, thereby closing vent 188 and permitting communication between suction inlet port 187 and outlet port 189.

We claim:

1. In an internal combustion engine having a plurality of cylinders, a carburetor having a plurality of mixture conduits for providing a fuel mixture to said cylinders, separate manifolds leading from said mixture conduits to said cylinders, a source of fuel, separate metered passageways for carrying said fuel from said source to said mixture conduits, and suction responsive valve means within one of said passageways for cutting off the flow of fuel through said passageway, said valve means comprising a cylindrical casing open at each end and sealingly mounted in said passageway, radial inlet ports communicating with said fuel source, a poppet type closure member adapted to sealingly seat in one end of said casing, said closure member being formed with a multilateral stem for slidable mounting within said casing, and spring means for urging said closure member toward seated position, and means for operating said valve including means forming a suction chamber, a diaphragm sealingly covering said suction chamber, spring means in said suction chamber for urging said diaphragm against said valve stem to open said valve, and passage means leading from said suction chamber to one of said manifolds.

2. In an internal combustion engine having a plurality of cylinders, a carburetor having a plurality of mixture conduits for providing a fuel mixture to said cylinders, separate manifolds leading from said mixture conduits to said cylinders, a source of fuel, separate metered passageways for carrying said fuel from said source to said mixture conduits, and valve means responsive to a predetermined increased value of manifold suction for cutting off the flow of fuel through said passageway, said valve means comprising a cylindrical casing open at each end and sealingly mounted in said passageway, radial inlet ports communicating with said fuel source, a poppet type closure member adapted to sealingly seat in one end of said casing, said closure member being formed with a multilateral stem for slidable mounting within said casing, and spring means for urging said closure member toward seated position, and means for operating said valve including means forming a suction chamber, a diaphragm sealingly covering said suction chamber, spring means in said suction chamber for urging said diaphragm against said valve stem to open said valve, and passage means leading from said suction chamber to one of said manifolds.

3. In an internal combustion engine having a plurality of cylinders, a carburetor having a plurality of mixture conduits for providing a fuel mixture to said cylinders, separate manifolds leading from said mixture conduits to said cylinders, a source of fuel, separate metered passageways for carrying said fuel from said source to said mixture conduits, and valve means responsive to a predetermined increased value of manifold suction for cutting off the flow of fuel through said passageway and to a predetermined decreased value of manifold suction for permitting the flow of fuel through said passageway, said valve means comprising a cylindrical casing open at each end and sealingly mounted in said passageway, radial inlet ports communicating with said fuel source, a poppet type closure member adapted to sealingly seat in one end of said casing, said closure member being formed with a multilateral stem for slidable mounting within said casing, spring means for urging said closure member toward seated position, and means for operating said valve including means forming a suction chamber, a diaphragm sealingly covering said suction chamber, spring means in said suction chamber for urging said diaphragm against said valve stem to open said valve, and passage means leading from said suction chamber to one of said manifolds.

4. In an internal combustion engine having a plurality of cylinders, a carburetor having a plurality of mixture conduits for providing a fuel

mixture to said cylinders, separate manifolds leading from said mixture conduits to said cylinders, a source of fuel, separate metered passageways for carrying said fuel from said source to said mixture conduits, and valve means responsive to a predetermined increased value of manifold suction for cutting off the flow of fuel through said passageway, said valve means comprising a cylindrical casing open at each end and sealingly mounted in said passageway, radial inlet ports communicating with said fuel source, a poppet type closure member adapted to sealingly seat in one end of said casing, said closure member being formed with a multilateral stem for slidable mounting within said casing, and spring means for urging said closure member toward seated position, and pumping means associated with said suction responsive valve means for forcibly injecting an increment of fuel into the mixture conduit fed by said valved passageway when manifold suction decreases to said predetermined value, said pumping means comprising a pumping chamber in constant communication with said valve casing, said resilient diaphragm forming one wall of said pumping chamber, fuel being drawn into said pumping chamber from said valve casing by the action of suction on said diaphragm and being forced out by said diaphragm spring means.

5. In an internal combustion engine having a plurality of cylinders, a carburetor having a plurality of mixture conduits for providing a fuel mixture to said cylinders, separate manifolds leading from said mixture conduits to said cylinders, a source of fuel, separate metered passageways for carrying said fuel from said source to said mixture conduits, and valve means responsive to a predetermined increased value of manifold suction for cutting off the flow of fuel through said passageway and to a predetermined decreased value of manifold suction for permitting the flow of fuel through said passageway, said valve means comprising a cylindrical casing open at each end and sealingly mounted in said passageway, radial inlet ports communicating with said fuel source, a poppet type closure member adapted to sealingly seat in one end of said casing, said closure member being formed with a multilateral stem for slidable mounting within said casing, spring means for urging said closure member toward seated position, and pumping means associated with said suction responsive valve means for forcibly injecting an increment of fuel into the mixture conduit fed by said valved passageway when manifold suction decreases to said predetermined value, said pumping means comprising a pumping chamber in constant communication with said valve casing, said resilient diaphragm forming one wall of said pumping chamber, fuel being drawn into said pumping chamber from said valve casing by the action of suction on said diaphragm and being forced out by said diaphragm spring means.

6 In an internal combustion engine having a plurality of cylinder groups, a carburetor having a plurality of mixture conduits for forming a fuel mixture for said cylinder groups, a pedal controlled throttle in one of said mixture conduits, separate manifolds connecting said mixture conduits and said cylinders, an auxiliary throttle in another of said mixture conduits, independent concentric shafts for mounting said throttles, linkage means operatively connecting said throttles, said linkage means comprising a countershaft provided with two cranks, a crank on the shaft of each of said throttles, a link of fixed length connecting the crank on the pedal controlled throttle shaft to one of said countershaft cranks, a link of variable length connecting the other countershaft crank to the crank on said auxiliary throttle shaft, and means responsive to predetermined increased values of manifold suction for shortening said variable link during periods of such predetermined suctions for the purpose of holding said auxiliary throttle open regardless of the position of said pedal controlled throttle.

7. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a plurality of mixture conduits for forming a fuel mixture for said cylinder groups, a pedal controlled throttle in one of said mixture conduits, separate manifolds connecting said mixture conduits and said cylinders, an auxiliary throttle in another of said mixture conduits, independent concentric shafts for mounting said throttles, linkage means operatively connecting said throttles, said linkage means comprising a countershaft provided with two cranks, a crank on the shaft of each of said throttles, a link of fixed length connecting the crank on the pedal controlled throttle shaft to one of said countershaft cranks, a link of variable length connecting the other crankshaft crank to the crank on said auxiliary throttle shaft, and means responsive to predetermined increased values of manifold suction for shortening said variable link during periods of such predetermined suctions for the purpose of holding said auxiliary throttle open regardless of the position of said pedal controlled throttle, said suction responsive means comprising a cylinder pivotally secured at its closed end to the auxiliary throttle crank, a piston slidably mounted in said cylinder, a connecting rod fixedly secured to said piston at one end and pivotally secured to said second countershaft crank, means connecting said cylinder to a source of manifold suction, and a coil spring in said cylinder for normally biasing said piston outwardly to lengthen said variable link.

8. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the manifold for shutting off the supply of fuel to one of said conduits, passageways for connecting said suction responsive means to one of said manifolds, valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, solenoid means for actuating said valve, a source of electrical energy for said solenoid, and contact means responsive to suction in the manifold for energizing said solenoid.

9. In an automotive vehicle having a transmission, gear shift controls, a generator provided with a cut-out relay, an internal combustion engine having primary and secondary cylinder groups, a carburetor having a source of liquid fuel and primary and secondary mixture conduits for separately forming a fuel mixture for each of said cylinder groups, primary and secondary manifolds respectively connecting said conduits and said cylinder groups, means responsive to suction in the primary manifold for shutting off the supply of fuel to said secondary con-

duits, passageways for connecting said suction responsive means to said primary manifold, valve means interposed in said passageway for controlling communication between said primary manifold and said suction responsive means, solenoid means for actuating said valve, an electrical circuit comprising said solenoid and a source of electrical energy therefor, contact means responsive to suction in the primary manifold for breaking said circuit, and additional contact means associated with said generator cut-out relay for breaking said circuit.

10. In an automotive vehicle having a transmission, gear shift controls, a generator provided with a cut-out relay, an internal combustion engine having primary and secondary cylinder groups, a carburetor having a source of liquid fuel and primary and secondary mixture conduits for separately forming a fuel mixture for each of said cylinder groups, primary and secondary manifolds respectively connecting said conduits and said cylinder groups, means responsive to suction in the primary manifold for shutting off the supply of fuel to said secondary conduits, passageways for connecting said suction responsive means to said primary manifold, valve means interposed in said passageway for controlling communication between said primary manifold and said suction responsive means, solenoid means for actuating said valve, an electrical circuit comprising said solenoid and a source of electrical energy therefor, contact means responsive to suction in the primary manifold for breaking said circuit, and additional contact means associated with said generator cut-out relay for breaking said circuit, and a third contact means actuated by said gear shift controls for closing only when in high gear.

11. In an automotive vehicle having a transmission, gear shift controls, a clutch, a generator provided with a cut-out relay, an internal combustion engine having primary and secondary cylinder groups, a carburetor having a source of liquid fuel and primary and secondary mixture conduits for separately forming a fuel mixture for each of said cylinder groups, primary and secondary manifolds respectively connecting said conduits and said cylinder groups, means responsive to suction in the primary manifold for shutting off the supply of fuel to said secondary conduits, passageways for connecting said suction responsive means to said primary manifold, valve means interposed in said passageway for controlling communication between said primary manifold and said suction responsive means, solenoid means for actuating said valve, an electrical circuit comprising said solenoid and a source of electrical energy therefor, contact means responsive to suction in the primary manifold for breaking said circuit, and additional contact means associated with said generator cut-out relay for breaking said circuit, a third contact means actuated by said gear shift controls for closing only when in high gear, and a fourth contact means actuated by said clutch for closing only when said clutch is engaged.

12. In an automotive vehicle having a transmission, gear shift controls, a clutch, a generator provided with a cut-out relay, an internal combustion engine having primary and secondary cylinder groups, a carburetor having a source of liquid fuel and primary and secondary mixture conduits for separately forming a fuel mixture for each of said cylinder groups, a thermostatically controlled choke valve for regulating the admission of air to said conduits, primary and secondary manifolds respectively connecting said conduits and said cylinder groups, means responsive to suction in the primary manifold for shutting off the supply of fuel to said secondary conduits, passageways for connecting said suction responsive means to said primary manifold, valve means interposed in said passageway for controlling communication between said primary manifold and said suction responsive means, solenoid means for actuating said valve, an electrical circuit comprising said solenoid and a source of electrical energy therefor, contact means responsive to suction in the primary manifold for breaking said circuit, and additional contact means associated with said generator cut-out relay for breaking said circuit, and a third contact means actuated by said gear shift controls for closing only when in high gear, a fourth contact means actuated by said clutch for closing only when said clutch is engaged, a fifth contact means actuated by said thermostatically controlled choke valve for closing only when said choke valve is fully opened.

13. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, a throttle in each of said conduits, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the first of said manifolds for shutting off the supply of fuel to the second of said conduits and for simultaneously fully opening the throttle in said second conduit, additional means responsive to suction in the first manifold for additionally opening the throttle in the first manifold to compensate for the inoperativeness of the second cylinder group, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means.

14. In an internal combustion enging having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, a throttle in each of said conduits, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the first of said manifolds for shutting off the supply of fuel to the second of said conduits and for simultaneously fully opening the throttle in said second conduit, additional means responsive to suction in the first manifold for additionally opening the throttle in the first manifold to compensate for the inoperativeness of the second cylinder group, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, and solenoid means for actuating said valve.

15. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, a throttle in each of said conduits, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the first of said manifolds for shutting off the supply of fuel to the second of said conduits and for simultaneously fully open-

ing the throttle in said second conduit, additional means responsive to suction in the first manifold for additionally opening the throttle in the first manifold to compensate for the inoperativeness of the second cylinder group, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, and solenoid means for actuating said valve, a source of electrical energy for said solenoid, and contact means responsive to suction in the manifold for energizing said solenoid.

16. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the manifold for shutting off the supply of fuel to one of said conduits, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, said valve means comprising a substantially vertical tubular casing closed at its lower end, a suction inlet port formed in said casing, a suction outlet port formed in said casing below said suction inlet port, and atmospheric vent ports formed in said casing below said suction outlet port, and a closure member slidably mounted in said casing, said closure member being formed with an annular groove of sufficient width to permit communication only between adjacent ports.

17. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the manifold for shutting off the supply of fuel to one of said conduits, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, said valve means comprising a substantially vertical tubular casing closed at its lower end, a suction inlet port formed in said casing, a suction outlet port formed in said casing below said suction inlet port, and atmospheric vent ports formed in said casing below said suction outlet port, and a closure member slidably mounted in said casing, said closure member being formed with an annular groove of sufficient width to permit communication only between adjacent ports, and a solenoid coil mounted on said casing for elevating said closure member.

18. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the manifold for shutting off the supply of fuel to one of said conduits, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, said valve means comprising a substantially vertical tubular casing closed at its lower end, a suction inlet port formed in said casing, a suction outlet port formed in said casing below said suction inlet port, and atmospheric vent ports formed in said casing below said suction outlet port, and a closure member slidably mounted in said casing, said closure member being formed with an annular groove of sufficient width to permit communication only between adjacent ports, and a solenoid coil mounted on said casing for elevating said closure member, a source of electrical energy communicating with said solenoid, and contact means for de-energizing said solenoid when suction in the first manifold is less than a predetermined value, said contact means comprising a frame, a contact point insulatedly mounted on said frame, a contact arm pivotally secured to said frame, spring means for urging said contact arm against said point, said contact arm and point being connected in series with said solenoid coil, relatively stronger spring means for urging said contact arm away from said point, and means responsive to manifold suction for neutralizing the effect of said stronger spring when manifold suction exceeds a predetermined value.

19. In an internal combustion engine having a plurality of cylinder groups, a carburetor having a source of liquid fuel and a plurality of mixture conduits for separately forming a fuel mixture for each of said cylinder groups, manifolds connecting said conduits and said cylinder groups, means responsive to suction in the manifold for shutting off the supply of fuel to one of said conduits, passageways for connecting said suction responsive means to one of said manifolds, and valve means interposed in said passageways for controlling communication between said manifold and said suction responsive means, said valve means comprising a substantially vertical tubular casing closed at its lower end, a suction inlet port formed in said casing, a suction outlet port formed in said casing below said suction inlet port, and atmospheric vent ports formed in said casing below said suction outlet port, and a closure member slidably mounted in said casing, said closure member being formed with an annular groove of sufficient width to permit communication only between adjacent ports, and a solenoid coil mounted on said casing for elevating said closure member, a source of electrical energy communicating with said solenoid, and contact means for de-energizing said solenoid when suction in the first manifold is less than a predetermined value, said contact means comprising a frame, a contact point insulatedly mounted on said frame, a contact arm pivotally secured to said frame, spring means for urging said contact arm against said point, said contact arm and point being connected in series with said solenoid coil, relatively stronger spring means for urging said contact arm away from said point, and means responsive to manifold suction for neutralizing the effect of said stronger spring when manifold suction exceeds a predetermined value, and a second pair of contacts mounted on said frame and being separately connected in series with said solenoid and a solenoid actuated switch, said second pair of contacts being arranged for closing and opening at a relatively lower predetermined value of manifold suction, said solenoid actuated switch being arranged to close when the solenoid is energized so that said valve closure member is raised when the first

contact closes at a predetermined value of suction and is lowered by gravity when said second contact opens at predetermined relatively lower value of suction.

20. In an internal combustion engine, having a plurality of cylinder groups and separate manifolds leading thereto, means responsive to suction in said manifolds for shutting off the supply of fuel to one of said cylinder groups, a solenoid actuated valve for controlling the admission of suction to said suction responsive means, and suction responsive contact means for energizing said solenoid when manifold suction increases to a predetermined value, and for de-energizing said solenoid when suction decreases to a predetermined lower value.

21. In an internal combustion engine having primary and secondary cylinder groups, a carburetor having primary and secondary mixture conduits for separately forming a fuel mixture for said cylinder groups, primary and secondary manifolds leading from said mixture conduits to said cylinder groups, normally manually operable throttle valves in said mixture conduits, a source of liquid fuel communicating with said mixture conduits, means responsive to a predetermined increase in primary manifold suction for interrupting the supply of fuel to said secondary mixture conduit and for substantially fully opening the throttle valve therein, and additional means responsive to a predetermined decrease in primary manifold suction for forcibly injecting an increment of fuel into said secondary mixture conduit.

22. In an internal combustion engine having primary and secondary cylinder groups, a carburetor having primary and secondary mixture conduits for separately forming a fuel mixture for said cylinder groups, primary and secondary manifolds leading from said mixture conduits to said cylinder groups, normally manually operable throttle valves in said mixture conduits, a source of liquid fuel communicating with said mixture conduits, means responsive to a predetermined increase in primary manifold suction for interrupting the supply of fuel to said secondary mixture conduit and for simultaneously substantially fully opening the throttle valve therein and increasing the opening of the primary throttle valve, and additional means responsive to a predetermined decrease in primary manifold suction for forcibly injecting an increment of fuel into said secondary mixture conduit.

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