

[54] HIGH VELOCITY CARBURETOR

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Related U.S. Application Data

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[51] Int. Cl. F02m 7/06; F02m 9/06

[58] Field of Search 261/23 A, 44 R, 51, 69 R, 261/DIG. 19, DIG. 74

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Primary Examiner—Tim R. Miles

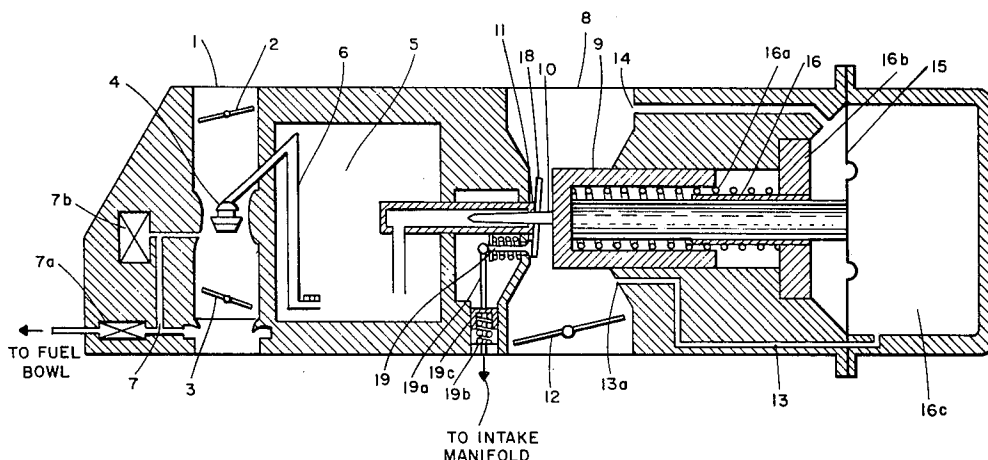
Attorney, Agent, or Firm—Donald L. Johnson; Robert A. Linn

[57]

ABSTRACT

Means for enriching the air/fuel mixture during all accelerations in a multibarrel, high velocity carburetor comprising at least one primary barrel having a conventional venturi construction and at least one secondary barrel which has a cross-sectional area greater than that of the primary barrel and which has means for varying this cross-sectional area in response to engine demand; and the use thereof in a low exhaust emission, spark ignition internal combustion engine system of the lean reactor type, to effect improved driveability. A preferred carburetor has one primary barrel and two variable secondary barrels.

9 Claims, 11 Drawing Figures



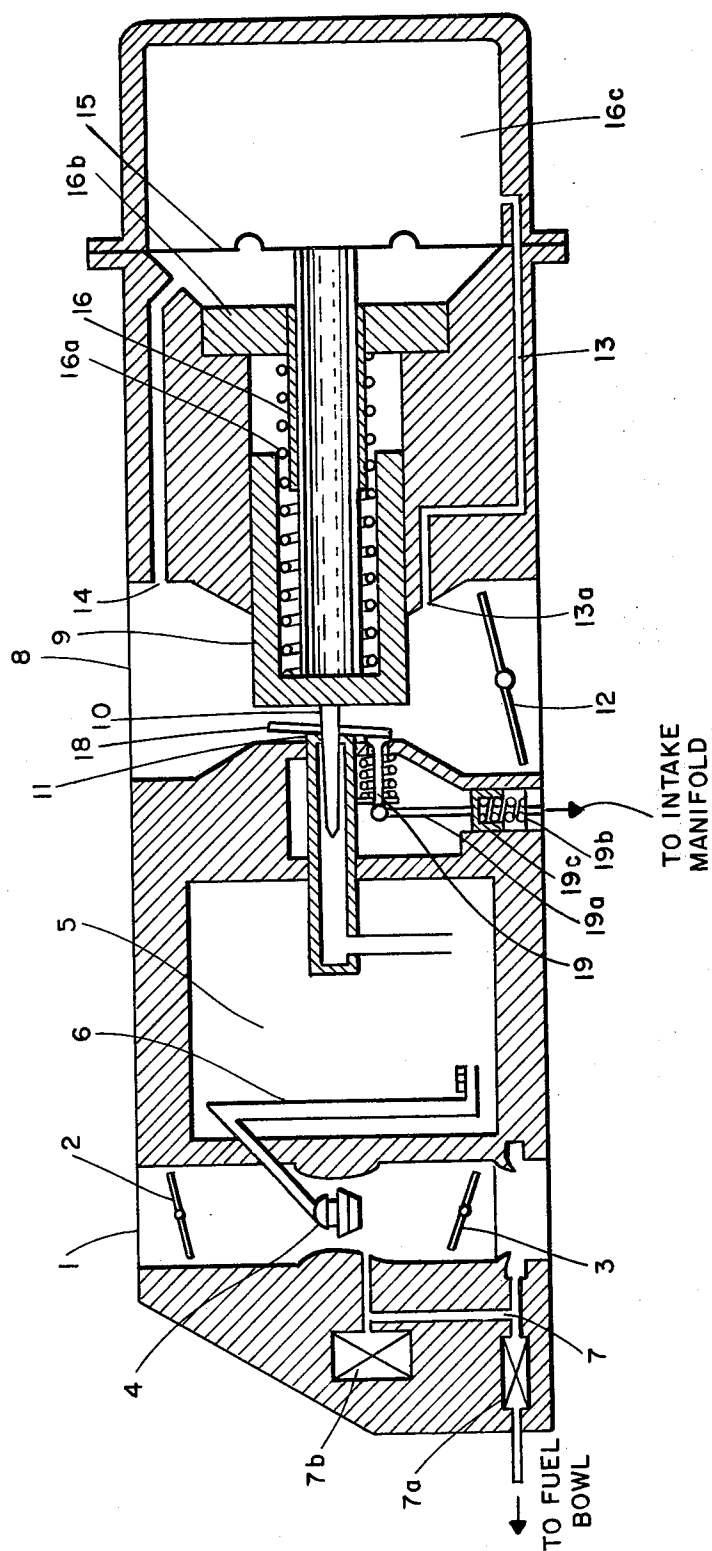


FIGURE 1

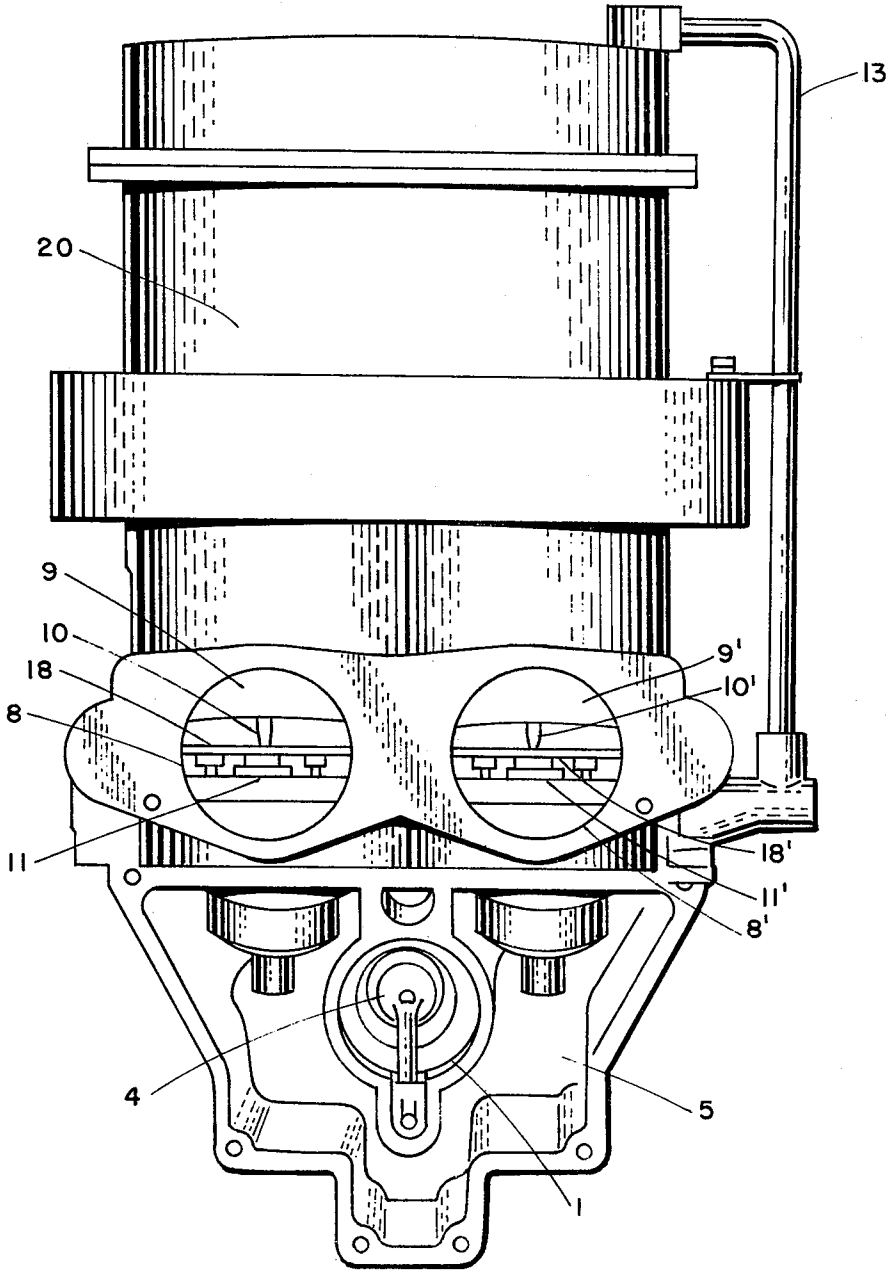


FIGURE 2

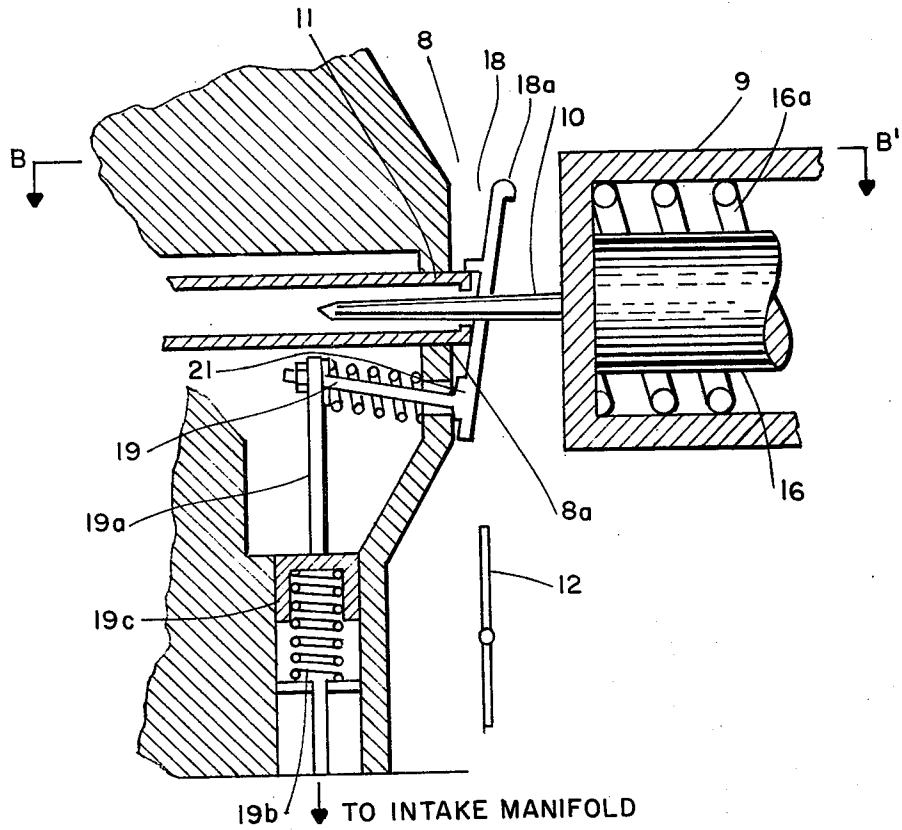


FIGURE 3

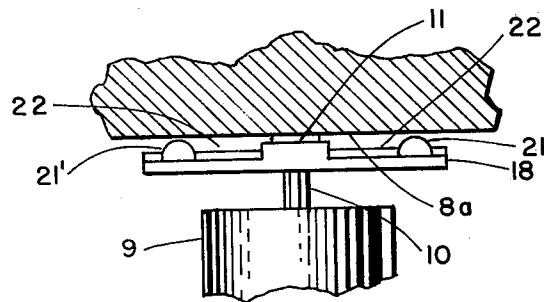


FIGURE 3A

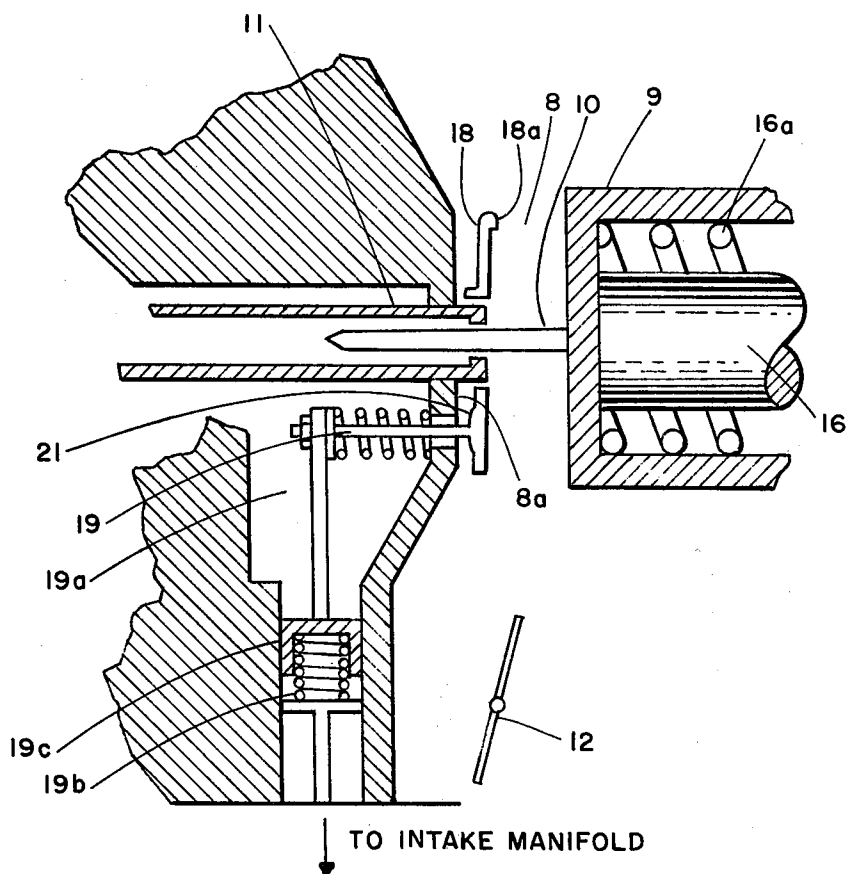


FIGURE 4

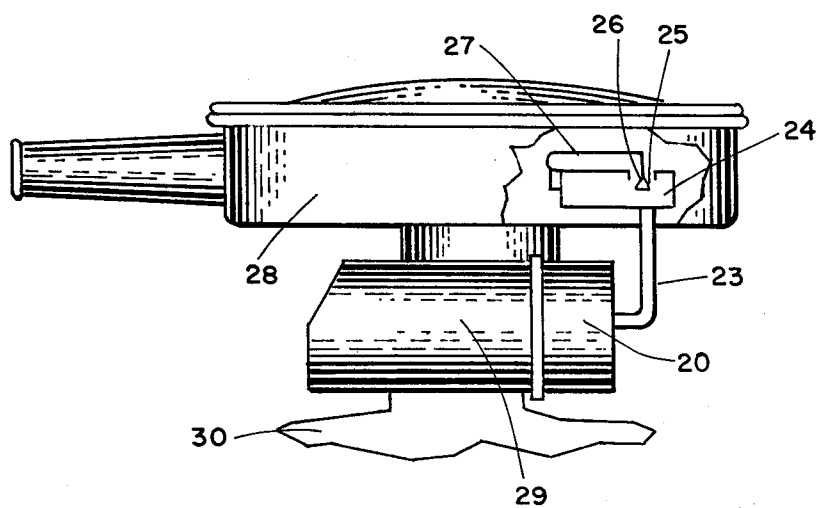


FIGURE 5

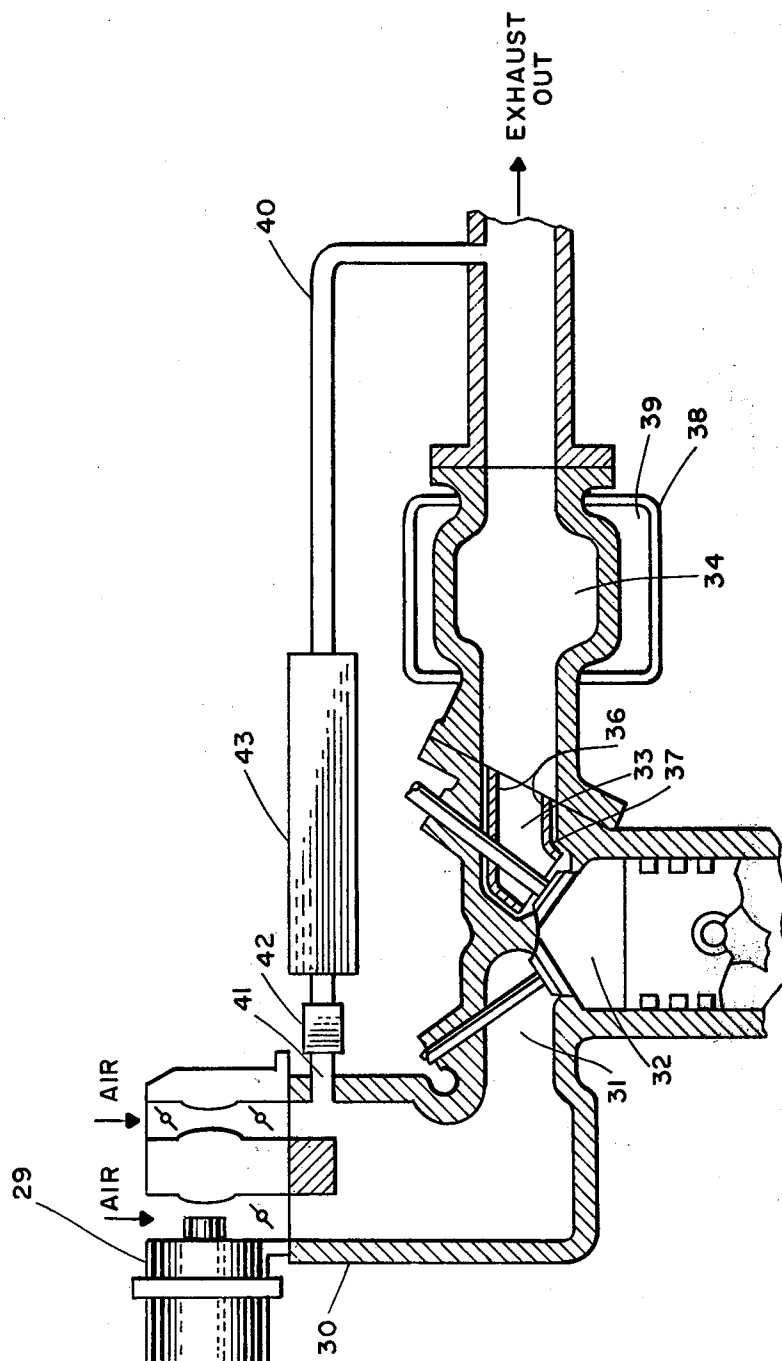
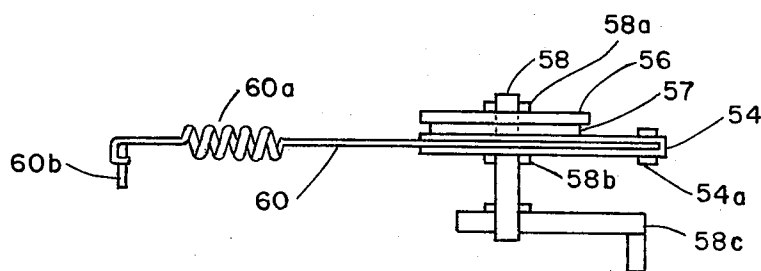
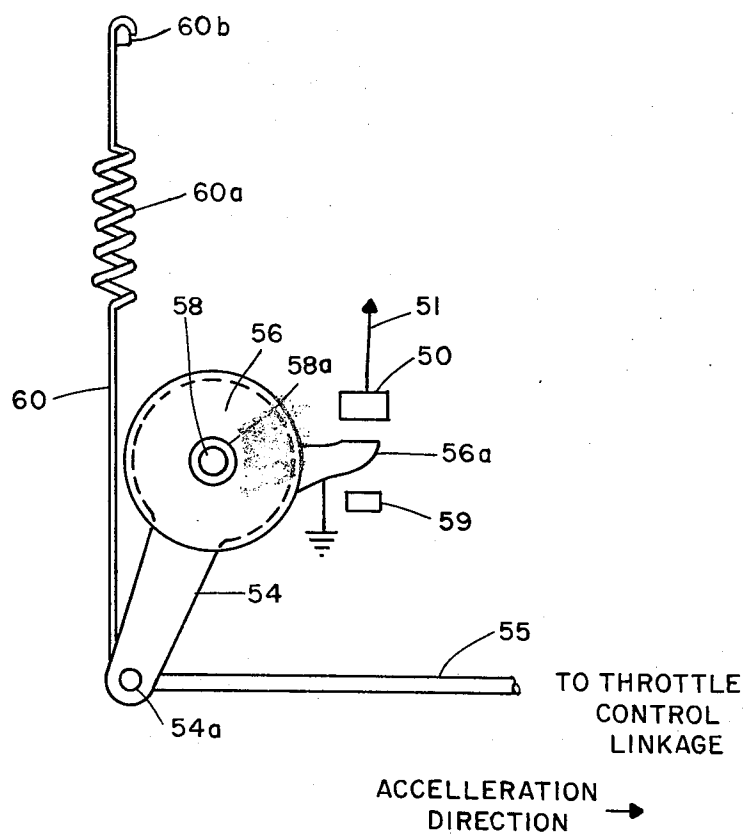


FIGURE 6



HIGH VELOCITY CARBURETOR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of copending application U.S. Ser. No. 157,087, filed June 28, 1971 now U.S. Pat. No. 3,768,787.

BACKGROUND OF THE INVENTION

Ordinary spark-ignition internal combustion engines utilize a carburetor/intake manifold combination as part of their fuel system. In the carburetor, air and fuel are blended and fed into the intake manifold for distribution to the cylinder or cylinders. In order to ensure good engine operation, the air:fuel mixture is kept near and usually slightly higher than the stoichiometric ratio. The use of such rich fuel:air mixtures contributes to undesirable unburned hydrocarbon and carbon monoxide exhaust emissions. Operating an engine using air:fuel mixtures greater than stoichiometric, commonly called a lean mixture, will result in reduction of exhaust hydrocarbon emissions. The ordinary carburetor, however, although capable of providing lean mixtures, is inadequate because (1) it cannot provide these lean mixtures for all engine operating conditions, (2) its fuel/air mixing capability is relatively poor for lean mixtures, and (3) it is ordinarily limited to providing fuel/air ratios down to only about 1:15.5. There are carburetors available, (e.g., DelcoRochester's "Quadra Jet"; also, see U.S. Pat. No. 3,310,045, to E. Bartholomew) which do effect good air/fuel mixing at relatively lean air/fuel ratios. However, such carburetors are somewhat limited in their capacity to provide sufficient air/fuel mixture for high engine demand; these carburetors are relatively complex in structure; and finally, their air/fuel blending characteristics for lean mixtures, for example, air/fuel of 18:1 and higher, may not be adequate for good engine performance. These carburetor limitations in general have an adverse effect on the driveability of an automobile — especially where the engine is equipped with other exhaust emission reducing modifications such as catalytic converters, thermal reactors, etc.

The present invention provides a carburetor of novel design and relatively simple construction featuring a combination of at least one primary barrel of conventional venturi construction and at least one secondary barrel having a cross-sectional area larger than the first barrel and having means whereby the cross sectional area can be varied in response to engine demand. This carburetor affects excellent air/fuel mixing over a wide range of air:fuel ratios, especially in the leaner air:fuel ratios, i.e., 16:1 – 18:1. The variable cross sectional area secondary barrel feature provides sufficient capacity for the carburetor to ensure adequate air/fuel supply to be provided to an engine even at high engine demand. Use of the carburetor of the present invention on a conventional internal combustion engine improves the efficiency of such an engine and reduces undesirable exhaust emissions, especially the hydrocarbons and carbon monoxide. Furthermore, when the present carburetor is used in place of currently available carburetors, with an engine which is modified to further decrease exhaust emissions, for example, with a catalytic converter or a lean reactor system, the driveability of an automobile powered with this new combination is significantly improved.

SUMMARY OF THE INVENTION

A multibarrel carburetor comprising at least one primary barrel having conventional venturi construction and at least one secondary barrel which has a cross-sectional area greater than that of the primary barrel and which has slidable means for adjusting this cross-sectional area, said adjustment being responsive to engine demand via a vacuum signal, whereby improved fuel/air blending, especially at leaner than stoichiometric fuel/air ratios is effected. Additionally, means are provided for enriching the fuel/air mixture from said primary barrel during engine acceleration. In the variable cross-sectional area barrel, the improvement which consists of an enrichment means to provide additional fuel required at rapid acceleration.

A low exhaust emission, lean reactor engine system having improved driveability characteristics.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial section through a schematic illustration of the carburetor of the present invention.

FIG. 2 is a top view of a partial section of a carburetor illustrated in FIG. 1, but having one primary barrel and two secondary barrels.

FIG. 3 is an expanded view of the fuel orifice portion of FIG. 1, secondary barrel, at full throttle.

FIG. 3A is a top view through a section of the FIG. 3 illustration.

FIG. 4 is an expanded view of the fuel orifice portion of FIG. 1, secondary barrel, at part throttle.

FIG. 5 is a schematic illustration showing a temperature responsive means for controlling opening of the secondary barrel before warm-up.

FIG. 6 is a schematic illustration, in partial section, of a preferred internal combustion engine system which utilizes the carburetor of FIG. 3.

FIG. 7 is a partial section view, in reverse, of the primary barrel portion of the FIG. 1 illustration.

FIG. 8 is a partial section view of a portion of the FIG. 7 illustration having acceleration responsive air/fuel enrichment means, shown schematically.

FIG. 9 is a top view of a schematic illustration of a throttle responsive acceleration sensor.

FIG. 9A is a side view of the FIG. 9 sensor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

A preferred embodiment of this invention is a multibarrel, multistage carburetor for a spark ignition internal combustion engine which comprises

- a. at least one primary barrel which includes
 1. a first mixing conduit having a venturi,
 2. a fuel nozzle situated in said venturi to deliver fuel to said first conduit,
 3. a first throttle means mounted in said conduit downstream of said fuel nozzle, said throttle means being manually moveable between opened and closed positions,
 4. choke means situated in said first conduit upstream of said nozzle, said choke means being mounted in said conduit to permit manual movement between closed and opened positions,
 5. a vacuum modulated throttle by-pass which provides required enrichment of and increase in amount of mixture during engine deceleration, and

b. at least one secondary barrel, having no choke means, which includes

6. a second mixing conduit having a cross-sectional area larger than said first mixing conduit,
7. a second throttle means rotatably mounted in said second conduit to permit manual movement between closed and opened positions, said second throttle means being directly linked to said first throttle means so that said second throttle means begins to open when said first throttle means reaches a pre-determined open position,
8. slidably adjustable means situated above said second throttle means, and being positioned to move across the short axis of and into said second conduit, said slidably adjustable means (1) having a needle axially attached to the end of said slidably adjustable means which enters said conduit, and (2) being attached to a vacuum operator at the end opposite said needle, said vacuum operator being responsive to a vacuum signal obtained at a point in said second conduit just above said second throttle means,
9. a fuel orifice for providing fuel to said second conduit, situated in said second conduit upstream of said second throttle means and opposite said slidably adjustable means, the extent of said fuel orifice opening being controlled by the movement of said needle into and out of said orifice as said slidably adjustable means responds to said vacuum operator,
10. a fuel/air mixture enrichment means which comprises a vane situated in and substantially parallel to the long axis of said second conduit, said vane being responsive to manifold vacuum and acting to reduce the cross-section area of said second conduit in the region of the slidably adjustable means at high engine loads, or at any engine operating mode where the intake manifold vacuum is low,

said primary barrel providing fuel/air mixture to said engine at idle and relatively low engine loads and combining with said second barrel to provide fuel/air mixture to said engine at higher engine load. A carburetor having one primary and two secondary barrels is a more preferred embodiment.

Another embodiment of this invention is an improved "lean reactor" engine system having enhanced driveability characteristics featuring the use of a three-barrel carburetor of the present invention. By "lean reactor" is meant an engine system which utilizes lean air/fuel mixtures and exhaust heat conservation means to reduce undesirable exhaust emissions.

Construction and operation of the present carburetor and engine system will be better understood by considering the device as illustrated in the accompanying FIGS. 1-6. The same number is used to designate the same elements in all of the drawings. FIG. 1 is a schematic illustration of the carburetor of the present invention. The primary barrel 1 is of conventional venturi configuration, but of relatively small diameter. It has a conventional choke means 2 above the fuel nozzle 4 and a throttle plate 3 below said nozzle 4. The choke means can be of conventional design with the conventional bimetal coil thermostatic control. The choke means may additionally be ambient temperature modulated by means such as described in U.S. Pat. No. 2,970,825; or in my copending application Ser. No.

80,106, filed Oct. 12, 1970 now U.S. Pat. No. 3,785,624. The nozzle 4 may be of any conventional design; the illustration shows a nozzle having a step design of the type described in U.S. Pat. No. 3,472,495. Such a nozzle permits better fuel/air mixing as well as improved flow under idle conditions. The throttle plate 3 may be of conventional design, but is preferably perforated. A perforated throttle plate also improves fuel/air mixing and permits operation of the engine at idle without necessitating a separate idle fuel system. Conduit 7 and control valve means 7a and 7b comprise a conventional throttle by-pass system. The conventional control valve 7b is responsive to a manifold vacuum signal and in turn controls valve 7a which permits air/fuel mixture to by-pass throttle 3 while said throttle 3 is closed or is being closed, during idle and/or deceleration. This by-pass system reduces the necessity for excess air/fuel enrichment which occurs with ordinary carburetor idle systems during idle and deceleration engine modes. Although the dimensions are not critical, the cross section of the primary barrel venturi conduit 1 is preferably small enough to effect relatively high air velocities of 60-400 feet per second (fps) with air velocities of about between 60 and 80 fps and higher being especially desirable. By maintaining such air velocity in the primary barrel, sufficient suction is obtained in the fuel nozzle 4 area so that it (the nozzle) meters fuel from fuel bowl 5 via fuel conduit 6 during idle operation. Thus, only the primary barrel 1 provides fuel during idle and low engine demand modes of operation. Some exhaust can be recycled into the intake manifold along with the air/fuel mixture from the primary barrel. FIG. 6, which is discussed below, illustrates a suitable exhaust recycle arrangement. This recycling of exhaust reduces nitrogen oxide levels in emitted exhaust.

The secondary barrel conduit 8 has a cross section which is larger than that of the primary barrel 1. Extending into the secondary barrel (or conduit) 8 is a slidably adjustable means 9 for varying the secondary barrel cross section. FIG. 1 illustrates this slidably adjustable means 9 to be a cylinder. This is not meant to limit this slidably adjustable means. Such means might be a plate, hemicylinder, or a movable element of any other configuration, provided it has sufficient rigidity to withstand deflection which might be caused by the high velocity air moving through said secondary conduit 8. One end of said slidably adjustable means 9 is attached via structural member 16 to a diaphragm 15. A spring 16a is set inside slidably adjustable means 9 and against stop 16b. To the other end of slidably adjustable means 9 there is attached a needle valve 10. The needle valve 10 is positioned in the secondary barrel 8 so that it moves in and out of fuel orifice 11 in order to meter fuel into said secondary barrel 8. The slidably adjustable means 9 responds to a vacuum signal obtained through an opening 13a just above throttle 12, which signal is conducted into the chamber 16c, via conduit 13. The port 14 is open to the atmosphere to vent the space 14a in front of the diaphragm 15. The signal thus obtained acts on the diaphragm 15 which in turn moves the slidably adjustable means 9 out of said secondary barrel 8. The spring 16a operates to return said slidably adjustable means 9 as the vacuum in chamber 16c decreases. In operation, when the throttle 12 is closed, there is no vacuum signal and the slidably adjustable means 9 and needle valve 10 are urged for-

ward by the spring 16a, thus closing the fuel orifice 11. As the throttle 12 is opened, a vacuum signal is obtained and acts on the diaphragm 15. The spring 16a which maintains the slidably adjustable means 9 in a closed position when throttle 12 is closed, may be set to maintain any desired vacuum in chamber 16c; a setting conveniently used is one which provides a vacuum or pressure drop of 1.3 to 1.6 inches of mercury. Consequently, the air velocity in the secondary barrel 8 is kept relatively constant and generally at about 300 feet per second, when this barrel is in operation.

The needle valve 10 in the secondary barrel 8 moves into and out of the fuel orifice 11 as engine demand requires, that is, as the throttle 12 in the secondary barrel is opened. This needle valve 10 is necessarily tapered in order to effect good fuel metering control. The secondary barrel can operate with no other elements than these already described. However, in order to improve the performance characteristics of an engine which utilizes the present carburetor, a fuel enrichment means embodied in the vane 18 and its attendant control system elements 19, 19a, 19b, and 19c is provided. This vane 18 is situated in the secondary barrel 8 in position to span the area around fuel orifice 11. It has an opening through which the needle valve 10 extends into the fuel orifice 11. A detailed explanation of the structure and operation of this enrichment vane will be presented below when discussing FIGS. 3, 3a, and 3b. The throttle 3 and primary barrel 1 and throttle 12 and secondary barrel 8 are mechanically linked (linkage not illustrated) so that the primary throttle is opened first to provide fuel/air mixture at idle and low power demand while the second throttle 12 is kept closed; and then when the first throttle 3 is opened about 40%, the linkage actuates the second throttle 12 which then begins to open to supply the additional air/fuel required for higher engine power demand. This mechanical linkage is so arranged that the rate of opening of said second throttle 12 is gradually reduced from initial opening to full open. Although FIG. 1 schematically illustrates one primary barrel and one secondary barrel, combinations involving one or more primary barrels and more than one secondary barrel come within the scope of this invention.

FIG. 2 is a top view in partial section of a carburetor of the present invention having two secondary barrels 8 and 8' and one primary barrel 1. The secondary barrels 8 and 8' are in parallel. The slidably adjustable means 9 and 9' in each of these barrels are illustrated with the needle valves 10 and 10' partially inserted into the fuel orifices 11 and 11', respectively. Each of the two secondary barrels has an enrichment vane 18 and 18'. Each slidably adjustable means 9 and 9' is attached to a separate diaphragm; but only one vacuum chamber (enclosed in housing 20 and controlled via a vacuum signal through an externally mounted conduit 13) serves to control both slidably adjustable means. The conduit 13 by which the vacuum signal is transmitted to the vacuum chamber is shown to be external of the carburetor housing. Although not shown, a common enrichment vane control system (shown as 19, 19a, 19b, and 19c in FIG. 1) is used to control both enrichment vanes 18 and 18'. Individual vacuum chamber and individual enrichment vane control systems could be utilized if desired; but since both secondary barrels operate simultaneously, the common vacuum chamber and enrichment vane control system is simpler, more

efficient and preferred. This three-barrel arrangement is also a preferred embodiment of the present invention.

FIG. 3 is an enlarged view of the fuel orifice portion of the secondary barrel illustrated in Example 1, showing the enrichment vane 18 and the control elements 19, 19a, 19b, and 19c, at full throttle. In the absence of manifold vacuum the piston 19c is urged up by spring 19b. This movement of the piston 19c upward causes the control arm 19a to push lever arm 19 attached to vane 18 at point 21 up, thus urging the bottom edge of the enrichment vane 18 inwardly, to rest against the barrel 8 surface on attachment point 21, causing the leading edge of vane 18 to move out into the secondary barrel conduit 8. This effectively reduces the cross-sectional area through which air passes between the slidably adjustable means 9 and the enrichment vane 18, thereby causing an increase in the vacuum signal which control said slidably adjustable means 9. In response to this increased vacuum signal, the needle valve 10 attached to the slidably adjustable means 9 moves further out of the fuel orifice 11, thereby causing additional fuel to flow into the secondary barrel 8, thus enriching the air/fuel mixture passing through said secondary barrel 8. This means of enriching the air/fuel mixture corrects for the lag in response of the secondary barrel slidably adjustable means which is called for when there is a sudden demand placed on the secondary barrel, such as, for example, when the accelerator pedal is rapidly and/or fully depressed. This enrichment device thus provides the additional fuel which is called for by a rapid acceleration demand and significantly improves the engine driveability. Without such an enrichment device, there is a noticeable response lag when rapid acceleration demand is made and consequent impairment in the driving quality of a vehicle driven by an engine using the present carburetor. The leading edge of vane 18 is illustrated as having a lip 18a. This configuration of the leading edge of the vane 18 reduces the tendency to cause laminar flow and thereby prevents the fuel out of orifice 11 from running down against the barrel wall at 8a. A vane having no lip or equivalent protrusion at its leading edge can be used, if desired. However, the lipped configuration is preferred since it improves fuel flow, increases turbulence and improves fuel/air mixing.

FIG. 3A is a top view of FIG. 3 section through B, B'. This view shows that vane 18 rests on two points of attachment 21 and 21' and slightly away from the wall of the barrel 8. This provides a narrow opening 22 which allows air to pass through and vaporize any fuel which might run down from the orifice 11 along the barrel 8a wall.

FIG. 4 is an enlarged view of the same portion of the secondary barrel as illustrated in FIG. 3, except that the manifold vacuum has been increased, as under part throttle conditions, and the control piston 19c has now been pulled downward, compressing spring 19b. The lower edge of the enrichment vane is thus positioned away from the barrel 8 wall and the leading edge of said vane 18 is moved back towards the barrel 8 wall. This is normally the position that the vane 18 will be in when there is no rapid acceleration demand.

FIG. 5 illustrates a temperature responsive bleed valve for controlling the vacuum in the vacuum chamber which controls the secondary barrel(s) cross-section area of the present carburetor while the engine

is being warmed up. The FIG. 5 illustration shows the bleed valve 26 connected via conduit 23 to the vacuum chamber housing 20 of a three-barrel carburetor of the type illustrated in FIG. 2 mounted in an engine intake manifold 30. The temperature control bleed valve means comprises a simple chamber 24 having an opening 25 in which a valve 26 is situated. The valve is in turn attached to a bimetal element 27 which responds to the air temperature inside the air cleaner housing 28. When the air in the housing 28 is below the normal engine operating temperature, the valve 26 is opened and bleeds vacuum from the carburetor vacuum chamber. This tends to prevent excess fuel being metered into the secondary barrel while the engine is warming up. Once the air in the air cleaner 28 reaches normal engine operating temperature, the bimetal element 27 moves the valve 26 to close the orifice 25, thus sealing the bleed valve. When the bleed valve 27 is closed, the carburetor functions in the manner set out above. FIG. 5 shows the temperature control bleed valve mounted in the air cleaner. This is a convenient and preferred position for this element. The bimetal control means, however, can be mounted anywhere that it can sense and respond to the engine operating temperature.

FIG. 6 schematically illustrates a preferred engine system using a three-barrel carburetor of the present invention. The basic system is described in U.S. Pat. No. 3,577,727, to F. Marsee and J. A. Warren; and the system has been and is herein referred to as the lean reactor system. The carburetor 29 is of the three-barrel type illustrated in FIG. 2. It is conventionally mounted on the intake manifold 30. Air/fuel mixture is fed through the carburetor 29 into the intake manifold 30 which in turn supplies the air/fuel mixture through intake port 31 to the combustion chamber 32. On being ignited, the air/fuel mixture provides energy and forms exhaust products, or simply, exhaust. This exhaust passes through the exhaust port 33 into the exhaust manifold 34, then into the exhaust pipe 35 and finally out into the atmosphere. The exhaust port 33 is insulated by means of a metal liner 36 which forms an insulating air space 37. The exhaust manifold 34 is also insulated by means of a metal shroud 38 which defines an insulating air space 39. This air space 39, if desired, can contain other insulating material, e.g., asbestos, metal foam, fiberglass insulation and the like. A portion of the exhaust is recycled via conduit 40 to a point 41 in the intake manifold 30 just below the primary barrel 1 of carburetor 29. It is preferred to obtain the exhaust for recycle at a point in the exhaust system beyond the exhaust manifold 34. However, exhaust for recycle can be obtained at any other desired point in the exhaust portion of the system. The quantity of exhaust which is recycled is controlled by valve means 42. Although this valve means 41 may be controlled mechanically or electrically, valve means responsive to a manifold vacuum signal is preferred. A most preferred exhaust recycle control system is described in my concurrently filed application herewith. By recycling exhaust in this manner, a substantial reduction in total nitrogen oxides in the exit exhaust is achieved. A heat exchange means 43 is also provided to cool the recycle exhaust before it is introduced into the intake manifold 30. Any suitable heat exchange device or construction can be used. Although not shown in FIG. 6, a catalytic converter and/or a back pressure control valve may also be provided in the engine exhaust system if desired.

The multistage, multibarrel carburetor of the present invention can be used with a conventional internal combustion engine having a conventional induction system and exhaust system. Use of the carburetor in such a system will effect improved air/fuel mixture uniformity, especially with lean mixtures, that is, mixtures in which the amount of air is greater than the stoichiometric amount of air required for complete combustion of the fuel (e.g., air:fuel ratios of 16:1 and greater), and distribution of this air/fuel mixture uniformly to all the cylinders in a multicylinder engine will be facilitated. Because of the improved air/fuel blending, the combustion efficiency of the engine is improved and unburned hydrocarbons and carbon monoxide emitted in the exhaust are reduced. Although other multibarrel carburetors and especially three-barrel carburetors, will provide good lean air/fuel mixtures (see U.S. Pat. No. 3,310,045, to E. Bartholomew), the present carburetor, especially the preferred three-barrel embodiment, significantly improves the driveability of an automobile powered by an engine which uses the present carburetor.

The carburetor of the present invention can also be used in a system of the type described in U.S. Pat. No. 3,577,727. This patent describes a system for reducing exhaust emissions from an internal combustion engine which comprises combination of (1) a fuel induction system to provide a lean air/fuel mixture, (2) means of conserving the exhaust heat, and (3) a back pressure control valve. Use of a three-barrel carburetor of the present type, in the fuel induction portion of the combination described above, either with or without the back pressure element (3) enhances the overall efficiency of the aforesaid system; and substantially improves the driveability of an automobile which utilizes such an engine system. To illustrate the effectiveness of this latter combination (that is, without the back pressure control valve) in maintaining low hydrocarbon, carbon monoxide emissions, the following emission ranges can be maintained by a standard V8 engine equipped with (a) the present three-barrel carburetor (as illustrated in FIGS. 1-6) intake manifold induction system and (b) some of the elements for conserving exhaust heat described in U.S. Pat. No. 3,577,727 (and illustrated in FIG. 6).

Test Method	Hydrocarbons	Exhaust Emissions	
		Carbon Monoxide	Nitrogen Oxides
California 7-Mode Cycle Test	<30 ppm	<.4%	<300 ppm
Federal Vehicle Exhaust Test Procedure, Subpart H (1)	0.6-1 gram/mile	6-10 gram/mile	1-2 gram/mile

(1) Described in Federal Register, Volume 35, No. 219, November 10, 1970

More importantly, the driveability of a standard automobile equipped with such an engine system is excellent. This has been verified by extensive road testing and rating of such an automobile by qualified personnel. By standard automobile is meant a current model of a regular production automobile.

Still another embodiment, is the three-barrel carburetor illustrated in FIG. 1 being provided with a means for enriching the fuel/air mixture in the primary con-

ventional, fixed venturi barrel during engine accelerations. This embodiment is illustrated in FIGS. 7-9A. This embodiment may be used with lean reactor system, as well as with systems which add air to the exhaust system at the exhaust port or beyond. This embodiment will be better understood by considering the illustrations of FIGS. 7-9A.

FIG. 7 illustrates in partial section the primary barrel venturi portion of the FIG. 1 carburetor. For convenience, the drawing has been reversed. Also, the fuel intake orifice 6a in fuel supply conduit 6 is shown turned one-quarter.

FIG. 8 is an illustration in partial section view of a portion of said primary barrel of FIG. 7 with means for increasing fuel flow (and thereby enriching the air/fuel mixture) during engine acceleration. The means comprises an acceleration sensor 44 connected to a solenoid means 52 which controls movement of a flow control means (needle) 53 in the main jet 6a. The acceleration sensor 44 is responsive to manifold vacuum. This sensor has two chambers 46 and 47 separated by a flexible diaphragm 48. The diaphragm 48 is provided with a valve means 49 having a ball check 49a, ball retaining means 49b, and a bleed port 49c in the portion of the valve means 49 which extends into chamber 47. Chamber 46 has an opening 46a through which manifold vacuum signal is received.

Chamber 47 has a contact element 50 which extends through in insulator element 50a, in leak-free opening 47a. A spring 47b in said chamber 47 surrounds said element 50 and seats against the valve means 49 at one end and around said insulator 50a against said grounded chamber enclosure 47b at the other end.

The contact element 50 is connected via lead 51 to solenoid means 52. Solenoid 52 controls movement of needle means 53 into and out of main jet 6a. Solenoid 52 also has a spring 52a which acts on needle 53. The needle 53 never closes main jet 6a.

In operation, this system functions as follows. During engine operating modes other than acceleration, the pressure (or vacuum) in both chambers 46 and 47 of sensor 44 is equal. Under this condition, the rod element 50 stands away from valve means 49 — the circuit to the solenoid is thereby open. When the solenoid is inactive, the spring 52a in the solenoid maintains the needle 53 in main jet 6a in its normal position allowing normal fuel flow into the primary barrel venturi. On acceleration, manifold vacuum is reduced. This causes a pressure increase in chamber 46 which forces diaphragm 48 downward (shown in phantom). This downward movement causes valve means 49 to contact element 50. This closes the circuit and activates solenoid 52 which causes needle 53 to be withdrawn from main jet 6a thus permitting more fuel to flow into the primary barrel venturi causing instantaneous fuel/air mixture enrichment. When acceleration is discontinued, the pressure (or vacuum) in both chambers 46 and 47 again equalizes causing the diaphragm, assisted by spring 47b to return to its balanced position thereby opening the solenoid circuit. The solenoid is thereby deactivated and the spring 52a in the solenoid 52 causes the needle 53 to move back into its normal position in main jet 6a. Thus, the resultant enrichment of the fuel/air mixture in the primary barrel venturi occurs only during engine acceleration.

The acceleration sensor can also be made electrically or mechanically responsive. A convenient accelerator

sensor is one which would be responsive to movement of the throttle means during acceleration. Movement of the throttle means could then be arranged by a suitable mechanical device to activate the solenoid means 52 by contacting contact means 50 as illustrated in FIG. 8. Thus, the function of the throttle responsive acceleration sensor would be substantially the same as that described for the vacuum responsive sensor of FIG. 8.

FIGS. 9 and 9A illustrate a throttle responsive sensor means. In FIG. 9 a lever means 54 is connected via attachment means 54a to element 55 which runs to the throttle control (not shown). The lever means 54 is combined with a disk element 56 having an arm 56a extending therefrom. A friction disk 57 (shown in FIG. 9A) is positioned between said disk element 56 and said lever 54. These elements 54, 56 and 57 are mounted on an axle 58. They are secured by means 58a and 58b so that the elements can rotate on said axle 58 — and the entire assembly is then mounted on the engine block (not shown) by bracket means 58c (shown in FIG. 9A). The assembly is mounted so that arm 56a is positioned to make contact with switch means 51 when the throttle control is moved (in the direction shown by the arrow) during acceleration. A stop element 59 is provided to limit the return of the arm 56a when contact with 50 is broken. This contact activates the solenoid circuit as described for the system of FIG. 8. The lever 54 is also connected by element 60 to a spring 60a which is attached via means 60b to the engine block (not shown). This spring 60a functions to pull the lever 54 in a direction opposite the acceleration movement direction and with it the arm 56a moves away from the contact means 50, when there is a slight letup on the throttle control. At this time, the solenoid 52 is deactivated and fuel flow through jet 6a is returned to normal. Thus, using such a mechanical (throttle) responsive device to sense acceleration, enrichment of the fuel/air mixture in the primary barrel venturi is achieved during acceleration in the same manner as that described for the FIG. 8 system. Unlike the vacuum responsive sensor of FIG. 8, however, there must be a slight letup on the throttle control in order to ensure deactivation of the solenoid 52 and a return to normal fuel feed in the primary fixed venturi barrel.

The means for enriching air/fuel mixture during all accelerations is described as used in combination with the primary conventional venturi section of the three-barrel carburetor of FIG. 1. Basically, this means controls the amount of fuel flow into the main jet of the carburetor barrel, increasing the fuel flow during all engine accelerations. However, this means for enriching the air/fuel mixture during acceleration is not limited to use with just the primary barrel as described and illustrated. This means can be used to the same effect with any carburetor barrel construction including the variable venturi type. Also, the acceleration limited enriching means can be used on a single barrel carburetor, on only one barrel of a multibarrel carburetor or on more than one as well as all barrels of a multibarrel carburetor. Thus, the means for enriching air/fuel mixture in a carburetor barrel during all accelerations — and specifically where the means is an acceleration sensor which actuates valve means to increase fuel flow through the carburetor barrel main jet during all engine accelerations — are other embodiments of this invention.

The present invention is embodied in (a) a multistage, multibarrel carburetor which comprises a high velocity primary section and an essentially constant and high velocity, variable venturi secondary section; (b) air/fuel mixture enrichment means in the secondary section for improved fuel control; (c) said carburetor provided with means for enriching the air/fuel mixture to its primary section during acceleration; (d) means for enriching air/fuel mixture in a carburetor barrel during all accelerations; and (e) a combination using the present carburetor (as illustrated in FIGS. 1-6) with elements of an exhaust emission reducing system (described in U.S. Pat. No. 3,577,727) which improves driveability of an automobile. These embodiments have been described in detail and illustrated in the drawings.

Claims to the invention follow.

I claim:

1. A multibarrel, multistage carburetor for a spark ignition internal combustion engine which comprises
 - a. at least one primary barrel which includes
 1. a first mixing conduit having a venturi,
 2. a fuel nozzle situated in said venturi to deliver fuel to said first conduit,
 3. a first throttle means mounted in said conduit downstream of said fuel nozzle, said throttle means being manually moveable between opened and closed position,
 4. choke means situated in said first conduit upstream of said nozzle, said choke means being mounted in said conduit to permit manual movement between closed and opened positions,
 5. a vacuum modulated throttle by-pass which provides required enrichment of fuel/air mixture during engine deceleration, and
 - b. at least one secondary barrel, having no choke means, which includes
 6. a second mixing conduit having a cross-sectional area larger than said first mixing conduit,
 7. a second throttle means rotatably mounted in said second conduit to permit manual movement between closed and opened positions, said second throttle means being directly linked to said first throttle means so that said second throttle means begins to open when said first throttle means reaches a pre-determined open position,
 8. slidably adjustable means situated above said second throttle means, and being positioned to move across the short axis of and into said second conduit, said slidably adjustable means having a needle axially attached to the end which enters said conduit and being attached to a vacuum

operator at the opposite end, said vacuum operator being responsive to a vacuum signal obtained at a point in said second conduit just above said second throttle means,

9. a fuel orifice for providing fuel to said second conduit, situated in said second conduit upstream of said second throttle means and opposite said slidably adjustable means, the extent of said fuel orifice opening being controlled by the movement of said needle into and out of said orifice as said slidably adjustable means responds to said vacuum operator,
10. a fuel/air mixture enrichment means which comprises a vane situated in and substantially parallel to the long axis of said second conduit, said vane being responsive to manifold vacuum and acting to reduce the cross-section area of said second conduit in the region of the slidably adjustable means at high engine loads,
- c. means for enriching the air/fuel mixture in at least said primary barrel during acceleration, said primary barrel providing fuel/air mixture to said engine at idle and relatively low engine loads and combining with said second barrel to provide fuel/air mixture to said engine at higher engine load.
2. The carburetor of claim 1 wherein said means for enriching air/fuel mixture during acceleration comprises an acceleration sensor operatively connected to activate a solenoid circuit, said circuit having a solenoid which controls a valve means for admitting additional fuel to at least said primary barrel.
3. The carburetor of claim 2 wherein said sensor is manifold vacuum responsive.
4. The carburetor of claim 2 wherein said sensor is throttle movement responsive.
5. The carburetor of claim 1 additionally having means which cause enrichment of the air/fuel mixture in said primary barrel and in at least one secondary barrel during acceleration.
6. The carburetor of claim 2 wherein said valve means are operable with a main jet, which supplies fuel to at least the primary barrel of the carburetor, to control the amount of fuel flow through said jet.
7. The enriching means of claim 6 which comprises an acceleration sensor which actuates valve means to increase fuel flow through said main jet.
8. The enrichment means of claim 7 wherein said sensor is manifold vacuum responsive.
9. The enrichment means of claim 7 wherein said sensor is throttle movement responsive.

* * * * *

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

PATENT NO. :3,885,004

DATED May:20, 1975

INVENTOR(Σ) : Frederick J. Marsee

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Page one - insert:

(*) Notice: The portion of the term of this patent subsequent to Oct. 30, 1990, has been disclaimed.

[SEAL]

Signed and Sealed this
seventh Day of October 1975

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks