

[54] **AUXILIARY AIR FUEL MIXTURE
CONTROL SYSTEM FOR REDUCING
AUTOMOTIVE EXHAUST EMISSIONS**

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19
[51] Int. Cl.F02m 7/24
[58] Field of Search261/41 D, 63, 64, 69 R, 78 R,
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B

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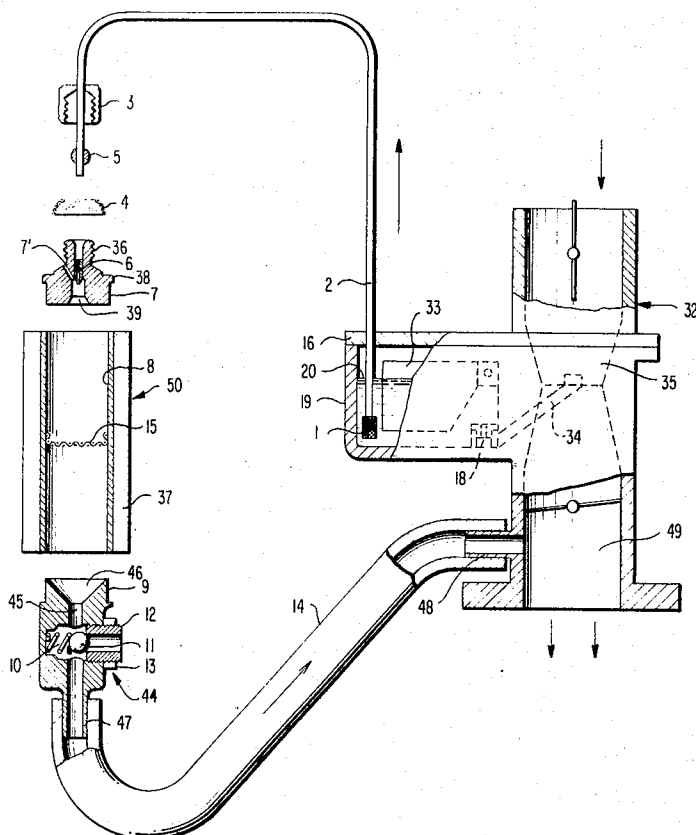
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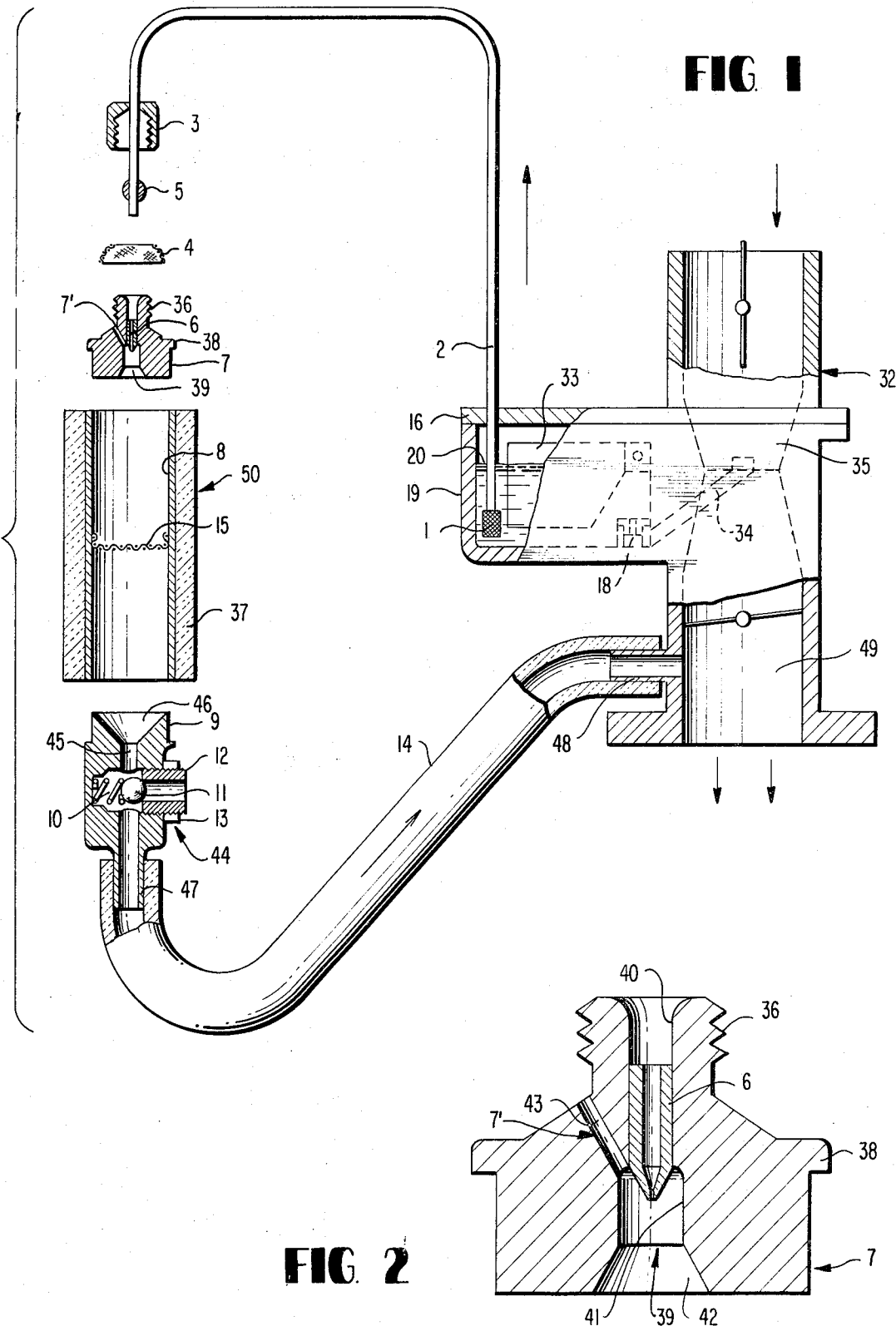
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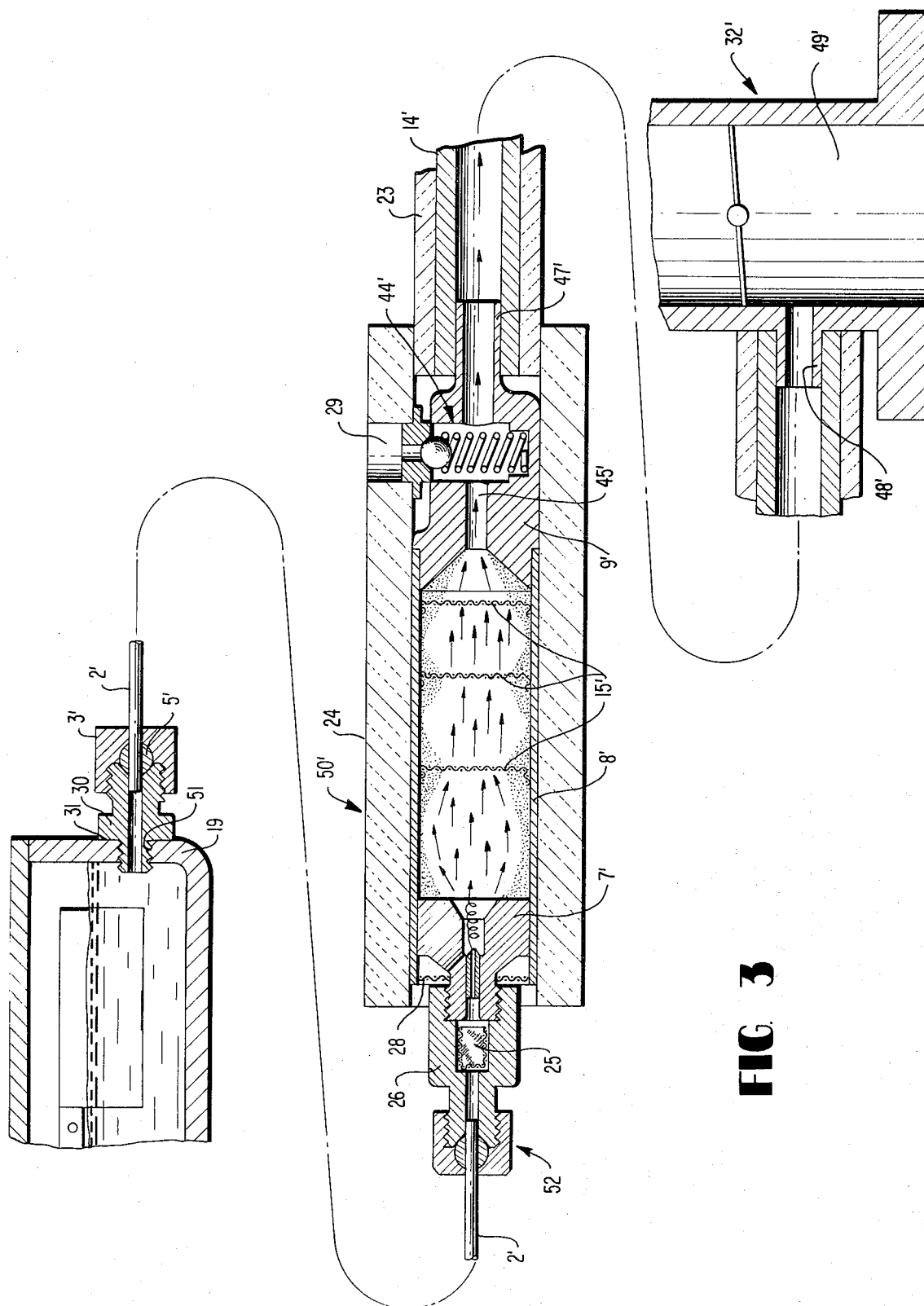
ABSTRACT

A generally sealed, thermally insulated diffusion chamber is coupled via a capillary tube to the fuel bowl of an automotive internal combustion engine with the capillary tube terminating at the upstream end of the diffusion chamber in a fuel jet nozzle which directs fuel into a venturi leading into the diffusion chamber. A plurality of small air inlet holes upstream of the venturi intersects the fuel leaving the jet nozzle to effect a low temperature thermally and molecularly changed air fuel mixture which is highly diffused and which is delivered by means of insulated tubing from the diffusion chamber to the intake manifold downstream of the carburetor under a delayed or partially retained action, greatly reducing exhaust emissions, especially during deceleration of the vehicle.

4 Claims, 3 Drawing Figures







AUXILIARY AIR FUEL MIXTURE CONTROL SYSTEM FOR REDUCING AUTOMOTIVE EXHAUST EMISSIONS

This application is a continuation-in-part application of application Ser. No. 17, 520, now abandoned, for "Exhaust Emission Control Device" filed in the U.S. Patent Office on Mar. 16, 1970.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

This invention relates to an auxiliary air fuel mixture control system for use in a conventional carburetor equipped automotive internal combustion engine for reducing exhaust emissions while increasing efficiency, engine performance and producing a cleaner burn, while reducing the need for engine maintenance.

SUMMARY OF THE INVENTION

The present invention is directed to an independent, auxiliary air-fuel diffusion chamber which under a time delay feature allows the air and fuel under vacuum application to have their molecular structure changed with maximum diffusion within each other, with the production of an ionic change and a primary catalytic action for fuel by-pass from the conventional carburetor of an automotive internal combustion engine prior to re-introduction of the diffused mixture at a different density, a lower temperature and a different flow angle into the main fuel air flow mixture discharging from the carburetor into the intake manifold. When ignited under timing adjustment recommendations, there is produced a more complete hydro-carbon burn resulting in a very substantial lowering of the exhaust emissions. The output horse power of the engine is increased by the use of the vacuum diffusion device of the present invention.

Specifically, the system is employed in an engine wherein the primary fuel jet or jets of the carburetor are replaced with jets having openings smaller than normal so that the by-pass fuel passing through the system of the present invention acts in conjunction with the fuel passing through the carburetor to maintain a generally normal amount of fuel being fed to the engine. A capillary tube providing a fuel feed path is coupled at one end to the carburetor fuel float bowl with the other end terminating at the upstream end of a generally sealed, thermally insulated diffusion chamber forming a principal element of the present invention. A fuel jet nozzle directs fuel into the upstream end of the vacuum diffusion chamber by means of a venturi just downstream of the end of the jet nozzle. A plurality of circumferentially spaced, inclined small diameter air bleed holes direct air under applied vacuum to the diffusion chamber along intersecting paths with respect to the fuel emanating from the jet nozzle, just upstream of the venturi. The resulting agitated swirling fuel and air mixture in passing through the diffusion chamber is further diffused and delayed by means of at least one screen extending transversely across the chamber. Thermally insulated conduit means are coupled at the downstream end of the diffusion chamber to the engine downstream of the carburetor, whereby the vacuum within the intake manifold insures that a highly diffused air fuel mixture taking place in the diffusion chamber, is fed at low temperature and under a primary catalytic and ionic change condition under vacuum conditions to the downstream end of the carburetor or the intake manifold where it mixes with the main flow of the lean air fuel mixture from the carburetor. Preferably, an air inlet valve in the form of a spring biased check valve set to open at 15 inches of vacuum couples the thermally insulated diffusion chamber to the thermally insulated conduit leading to the intake manifold to reduce the intake of the auxiliary fuel and air mixture from the diffusion chamber under vehicle deceleration conditions. In addition to the time delay caused by the diffusion chamber, the presence of one or more transversely extending, longitudinally spaced screens within the diffusion chamber, acts to delay delivery of the auxiliary air and fuel mixture which further reduces exhaust emissions.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an exploded view of the basic air-fuel vacuum diffusion system of the present invention as employed in conjunction with a modified carburetor fed internal combustion engine.

FIG. 2 is an enlarged sectional view of the entrance body at the upstream end of the diffusion chamber forming an important element of the system of FIG. 1.

FIG. 3 is an alternate embodiment of the auxiliary air-fuel vacuum diffusion system of the present invention with the diffusion chamber and float horizontally oriented in contrast to the vertical orientation of the system components of the embodiment of FIGS. 1 and 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Reference to FIG. 1 illustrates one embodiment of the auxiliary air-fuel vacuum diffusion system of the present invention as applied to a conventional downdraft carburetor 32 which is coupled at its lower end to an intake manifold (not shown) of a standard automotive internal combustion engine. The carburetor 32 is provided with a carburetor fuel bowl 19 of conventional construction and employs a float 33 to maintain a fuel level 20 above a primary jet 18 which by means of inclined passage 34 directs fuel in a conventional fashion to the venturi 35 of the carburetor 32. The only modification to the carburetor 32 required by the present invention is the replacement of the fuel jet 18 having a standard and relatively large opening, with a fuel jet having a slightly smaller opening, since it is the purpose of the present invention to by-pass the carburetor with a certain amount of the fuel which is to be mixed under the air-fuel vacuum diffusion system of the present invention.

In that respect, in the illustrated embodiment, a small hole, for instance 0.082 inches in diameter, is drilled into the carburetor bowl cover 16 permitting the insertion of a capillary tube 2 into the carburetor bowl, the end of the tube 2 within the bowl preferably being coupled to a fuel filter 1 to prevent clogging of the small diameter jet nozzle 6. It has been determined that a length of approximately 11 inches of 0.080 capillary tube, or the like, will provide a sufficient fuel transfer rate acting in conjunction with the other elements of the system for the desired purposes of the present invention. The capillary tube 2 terminates at its opposite end in a compression sleeve 5 which acts in conjunction with a compression nut 3 permitting coupling of that end of the capillary tube to the threaded end 36 of a cylindrical entrance body 7, which is best illustrated in FIG. 2. The entrance body 7, in turn, seals the upstream end of a cylindrical diffusion chamber 8 which is thermally insulated by means of insulation sleeve 37, body 7 being provided with a flange portion 38 which overlies the end of the diffusion chamber cylinder 8. In the illustrated embodiment, the diffusion chamber is approximately $\frac{1}{4}$ of an inch in diameter and is 4 inches long and is provided in this case with a single small mesh wire screen 15 which extends transversely across the chamber at the center of the same and downstream from a venturi area 38. Several screens or baffles with holes, slots, extrusions or a combination of the same may be employed, preferably at spaced longitudinal positions. In that respect, the entrance body 7 of the diffusion chamber is provided with a small diameter bore 40, a counterbore section 41 and terminating in an outwardly flaring passage portion 42, passages 41 and 42 defining the venturi area 39 downstream of an otherwise conventional fuel jet nozzle 6 which sealingly fits the small diameter bore 40. A plurality of angularly inclined small diameter air passages 43 are carried by the entrance body 7 entering counterbore 41 to the side of the fuel jet nozzle 6 and with the axis of the small diameter holes for passages 43 intersecting the axis of counterbore 41 just downstream of the fuel jet 6, the fuel and air entering the upstream end of the diffusion chamber in the vicinity of the venturi 39 and moving through the diffusion chamber under a swell path with the expansion of the fuel air mixture being such as to effect a low temperature diffusion which is maintained by the insulation 37 surrounding the chamber for the desired ionic and catalytic

actions taking place with respect to the fuel air mixture being diffused by means of the flow path there provided. At the downstream end of the diffusion chamber 8, there is provided a cylindrical exit body 9 formed of metal or a metal that produces a form of static electrical discharge under vacuum flow conditions which is coupled to the expansion chamber 8 in similar manner as the entrance body 7, the exit body being provided with an air inlet valve 44 consisting essentially of a cylindrical, threaded axially adjustable valve seat 12, a hard rubber or stainless steel ball valve 11 and a compression spring 10 tending to maintain the air inlet valve shut in the absence of applied vacuum below 15 inches of vacuum. The elements in contact with the fuel-air mixture in the vacuum diffusion chamber are preferable formed of hard rubber, plastics or exotic materials that will produce a static electrical discharge under vacuum flow conditions. In conjunction therewith, the exit body 9 is provided with a bore 45 passing axially therethrough and leading from a flared end 46 at the downstream end of the diffusion chamber, the exit body 9 being provided with a nipple 47 at its downstream end receiving a thermally insulative rubber tube or the like 14 which is coupled at its opposite end to a cylindrical fitting or nipple 48 carried at the downstream end of carburetor 32 and leading into the carburetor flow path 49 downstream of the carburetor venturi area 35. The bore 45 could be spirally threaded to cause further fuel-air mixture flow delay by means of air flow eddies caused by the threads. Alternatively, the hose or other insulative passage leading from the insulated diffusion chamber may be coupled directly to the intake manifold of the engine. An air screen or filter 4 is preferably overlying the small diameter holes 43 carried by the inlet body 7 to further prevent dirt particles from entering the fuel and air mixture. The fuel nozzle 6 should be positioned above the fuel level 20 of the carburetor to prevent syphoning of fuel into the diffusion chamber 8 absent applied vacuum.

In operation, the vacuum created by the engine draws fuel from the engine carburetor fuel bowl 19 through the capillary tube to fuel nozzle 6 in the entrance to the air-fuel vacuum diffusion chamber. Fuel and air under vacuum pressure and as a result of gas expansion in the venturi area 39 are highly diffused into each other and by expanding produce a very cold, air-fuel diffusion mixture in the process of traveling through the vacuum diffusion chamber 8. The presence of a screen or screens 15 produces a positive effect by further producing a time delay for maximum air-fuel diffusion prior to entering the main fuel stream of the downstream end 49 of the carburetor 32.

Within the air-fuel diffusion chamber 8, there is achieved a primary catalytic action with regards to the molecular structure of the fuel itself, the process producing an extremely cold mixture of air and fuel. It is well known that hot rod racers use carbon dioxide to produce cold mixtures and to increase the power and efficiency of their engines. The present invention is directed to an independent vacuum diffusing chamber which aids in the mixture of the fuel and air and which causes an air-fuel mixture in an auxiliary form which produces an unusual carburetion effect with improved results. Preferably, the air inlet valve is adjusted to 15 inches of vacuum at sea level on a special fixture prior to installation to dilute and decrease the fuel in the fuel-air mixture being drawn through the vacuum diffusion chamber at over 15 inches of vacuum such as during deceleration and to thereby effectively control exhaust emissions. As the cold air-fuel diffusion mixture leaves the outlet tube 14 and enters the main air-fuel mixture passing to the carburetor, which is leaned by the amount being by-passed through the diffusion chamber 8, a secondary catalytic action takes place. The result of the chemical and ionic phenomena which takes place, when using regular grade fuel, produces an air-fuel mixture which, when used in an internal combustion engine designed for premium fuel, gives a more complete burn within the engine, produces more horse power, better gas mileage, leading to greater engine efficiency and resulting in less exhaust pollution of the atmosphere. It is further desirable

to adjust the ignition system to optimize engine operation to the presence of the auxiliary vacuum diffused air-fuel control system of the present invention, which adjustment usually calls for retarding the spark to a point of lowest hydro-carbon output, while at the same time maintaining or even increasing engine performance. If necessary a distributor vacuum brake valve (not shown) may be used on engines that retard under high vacuum while decelerating.

The effectiveness of the system of the present invention applied to a conventional stock car may be seen from the following tests:

	Test No. 1	Hydro-carbons Idle 2500 rpm		Carbon monoxide Idle 2500 rpm	
15					
	Carburetor—stock Ignition —baseline 5° B.T.C.	(Parts Per Million)		(%)	
		210 ppm	100 ppm	2.7%	1.2%
20	Control—none	21=10%	10=10%	.27=10%	.12=10%
	Performance—normal	2.1=1%	1=1%	.027=1%	.012=1%
	Test No. 2				
	Carburetor—stock Ignition—retarded 3½°	50 ppm	50 ppm	1.6%	1.6%
	Control—none				
25	Performance—sluggish	(-76%)	(-50%)	(-40%)	(+33%)
	Test No. 3				
	Carburetor—Automotive Emission Control modified ignition—baseline 5° B.T.C.	80 ppm	20 ppm	1.7%	.4%
	Control —A.E.C. device				
	Performance—normal+	(-62%)	(180%)	(-37%)	(-166%)
30	Test No. 4				
	Carburetor—A.E.C. modified Ignition—retarded 3½° A.T.C.	20 ppm	0 ppm	1.7%	.3%
	Control—A.E.C. device				
	Performance—normal+	(-90%+)	(-100%)	(-37%)	(-75%)
35					

The above tests were employed in conjunction with a 1967 Cadillac No. 429 having been driven approximately 102, 000 miles, whose general condition was above average and with the motor in excellent condition. The test car performed beyond expectation using the same spark plugs for 30,000 miles with no cleaning or capping necessary.

Additional tests employed with the system of the present invention are given by the following result. In compliance with the State of California Air Resources Board Staff Statement on Exhaust Gas Devices for Older Cars, dated Jan. 21, 1970, A. B. 1056 (1969 Session), amended Section 39107 of the California Health and Safety Code to read:

"39107. In order for an exhaust emission device to be accredited by the Board pursuant to Article 5 (commencing with Section 39175) of this chapter, it shall not allow emissions exceeding any part of the following:

- 350 parts per million hydrocarbon;
- 2 percent carbon monoxide; and
- 300 parts per milligram nitrogen oxide."

The test results on various vehicles employing the system of the present invention are follows:

HEW MOTOR VEHICLE COMPLIANCE DIVISION
Abatement Branch, Division of Air Pollution
Building 2042, Willow Run Airport
Ypsilanti, Michigan 48197
March 8th 1967. 1964 Cadillac, with device attached to carburetor:

Hydrocarbon	Carbon Monoxide
261 PPM	.7%

NOTE: There were no facilities available for the testing of nitrogen oxides.

SCOTT RESEARCH LABORATORIES, INC.
2600 Cajon Blvd. P. O. Box 2416

San Bernardino, California 92406

Projects 2866 and 1870 (using 1963 Cadillac), inertia load 4,000 lbs.

February 16, 1970	HC	CO	NO
Baseline 5° BTC	332 PPM	2.55%	1259
With A.E.C. Device	321 PPM	2.31%	608

SCOTT RESEARCH LABORATORIES, INC.

2600 Cajon Blvd. P. O. Box 2416

San Bernardino, California 92406

May 22, 1970. Project 02897, 1967 Cadillac, with inertia load of 4,000 lbs.

	HC	CO	NO
Baseline 5° BTC	503 PPM	4.46%	664.8
With device TDC	334 PPM	1.91%	790
With device 3½° ATC	272	2.13%	590

CALIFORNIA AIR RESOURCES BOARD

Air Resources Laboratory

434 South San Pedro St.

Los Angeles, California 90013

November 4th, 1970. Project 0189, 1967 Cadillac. Inertia load 5,000 lbs.

	HC	CO	NO
Device without screen attached	306	1.52%	862
Device with screen inserted	284	1.8	470

From the above, the system of the present invention is not primarily intended to replace the usual carburetor idle system, but it could. Further, the idle system is not intended to be closed off, but it could be. The system as employed is in addition to the usual carburetor idle system with the air inlet valve 44 being set to open at 15 inches of vacuum at sea level such that fuel drawn through the capillary tube 2, under these conditions, would be at a high minimum and highly diluted under deceleration. The system does not unduly enrich the mixture fed by the normal carburetor since the primary jet hole sizes are reduced for the conventional carburetor to compensate for the amount of fuel being by-passed to the air-fuel vacuum diffusion system of the present invention. The system functions during acceleration a direct ratio to the carburetor itself and the valve 44 remains closed at all conditions under 15 inches of vacuum.

Turning to FIG. 3, there is illustrated another embodiment of the invention in which all of the components of the system are generally oriented horizontally especially the fuel and air mixture as it passes through the diffusion chamber 55. In this case, the carburetor bowl 19 is provided with a threaded opening 51 within the side of the same which receives a threaded end of nipple or adapter 30 which is bored to permit fuel to enter capillary tube 2' being coupled to the adapter 30 by means of a compression nut 3' which cooperates with a compression sleeve 5' in a conventional manner. A sealing gasket 31 insures against leakage by being positioned between the adapter 30 and the carburetor bowl 19. The opposite end of the capillary tube 2' is coupled by means of a similar fitting to a fuel filter body and air filter retainer 26 by threaded coupling assembly 52. In turn, the fuel filter body and air filter

retainer 26 is threadedly coupled to an entrance body 7 forming a part of the diffusion chamber defining the upper end of the diffusion chamber 50' and being received within a cylindrical metal body 8' with the exception of a felt screen, paper or equivalent material air filter 28 in annular form, and a wire mesh or similar fuel filter 25 in cylindrical form, the component carried by the entrance body 7', are identical to that of the embodiment of FIGS. 1 and 2. A cylindrical insulator sleeve 24 surrounds the thin metal cylinder 8' which defines in conjunction with the entrance body 7' and the exit body 9' of the diffusion chamber 50'. A plurality of longitudinally spaced small mesh wire screens 15 extend transversely across the flow path to intercept the fuel and air mixture passing through the same as indicated by the plurality of arrows, prior to exiting through the central bore 45' of the exit body 9'. An air inlet valve 44' similar in construction and operation to that of the first embodiment is provided within the outlet or exit body 9' and a cylindrical hold 29 is provided within the insulation jacket 24 to permit air to enter into the flow path exiting from the diffusion chamber. In that respect, the reduced diameter portion or nipple 47' at the downstream end of the exit body 9' carries in this case a metal tubing 14 which is surrounded by thermal insulation sleeve 23 and directs the ionically changed and catalytic treated fuel-air mixture to carburetor 32', tube 14 being coupled to nipple 48' at the downstream end of the carburetor for entrance into the passage 49' for mixing with the main air and fuel mixture passing through the carburetor. The operation of the illustrated embodiment in FIG. 3 is identical to that of FIG. 1 in all respects, although the structure is slightly modified.

What is claimed is:

1. An auxiliary air-fuel mixture control system for reducing automotive exhaust emissions for use with an internal combustion engine employing a carburetor whose primary fuel jets have openings smaller than normal, said system comprising:
 - a generally sealed, thermally insulated air-fuel mixture diffusion chamber external of said carburetor,
 - a capillary tube coupling said chamber to said carburetor float bowl,
 - means defining a venturi at the upstream end of said chamber,
 - a fuel jet nozzle coupled within said delay fuel feed path, upstream of said venturi, for injecting fuel into said chamber through said venturi,
 - at least one angularly inclined small diameter air inlet passage adjacent said fuel jet nozzle whose axis intersects the axis of the fuel jet nozzle upstream of said venturi, and thermally insulated outlet passage fluid connecting the downstream end of said chamber to said intake manifold downstream of said carburetor;
 whereby, fuel and air are vacuum induced into said diffusion chamber to effect a highly diffused, cold fuel-air mixture, introduced into the primary air-fuel mixture passing through the carburetor for increased engine efficiency and reduced emissions, particularly during vehicle deceleration.
2. The system as claimed in claim 1, further comprising an air inlet valve positioned intermediate of said chamber and said thermally insulated outlet passage to reduce the secondary air-fuel mixture under high engine vacuum conditions.
3. The system as claimed in claim 2, wherein said air inlet valve comprises a spring biased check valve set to open at approximately 15 inches vacuum sea level condition.
4. The system as claimed in claim 1, further comprising at least one fine mesh screen extending transversely across said chamber downstream of said venturi to retard the fuel and air mixture flowing to the intake manifold.

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