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ASPIRATOR FOR USE IN A FLOWING GAS STREAM

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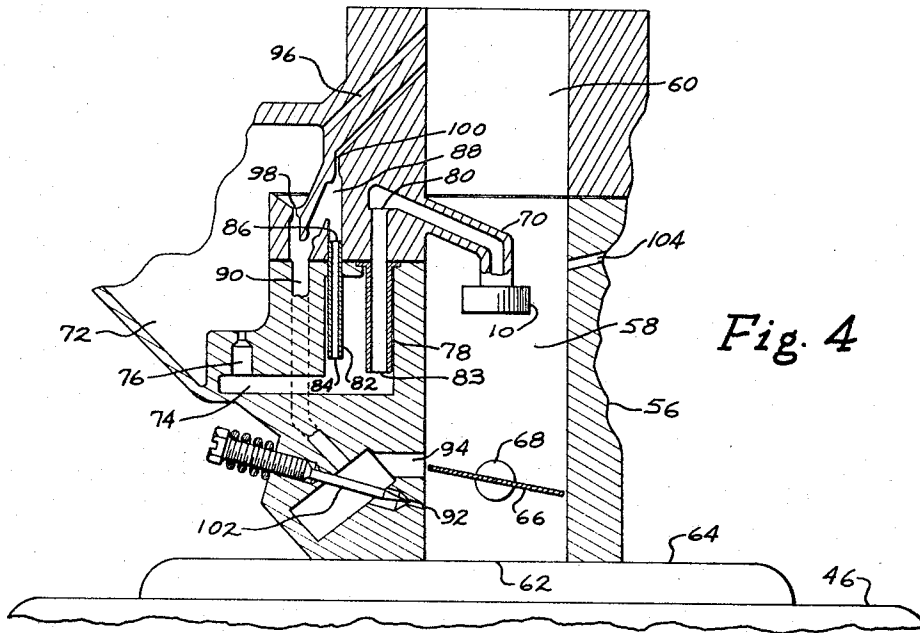


Fig. 4

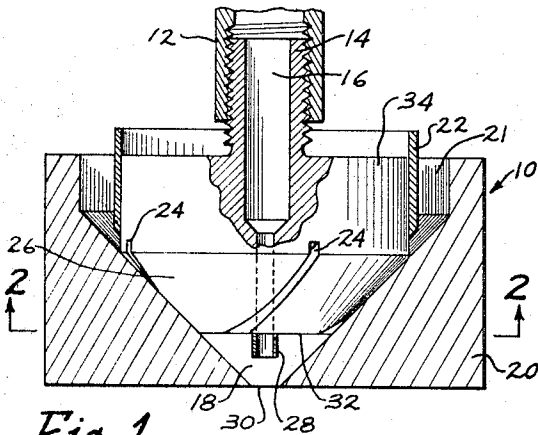


Fig. 1

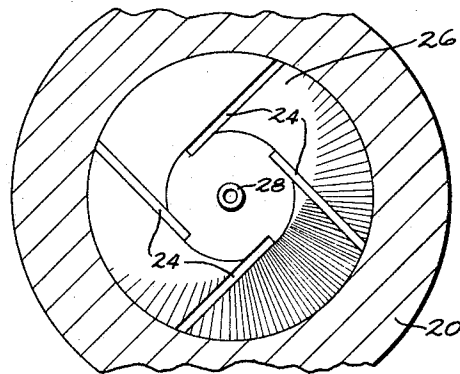


Fig. 2

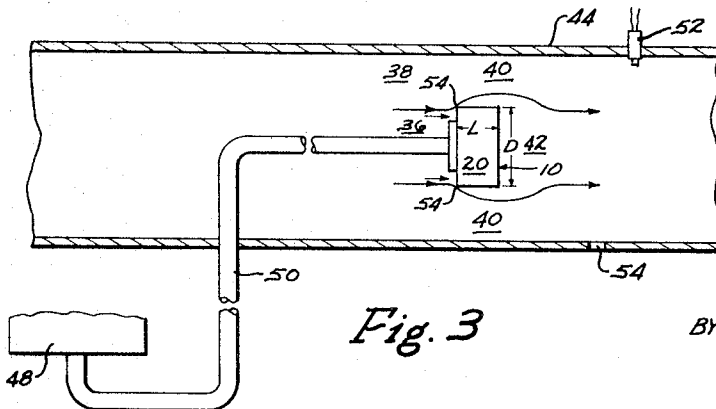


Fig. 3

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ASPIRATOR FOR USE IN A FLOWING GAS STREAM

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ABSTRACT OF THE DISCLOSURE

An aspirator is disposed coaxially within a pipe through which a gaseous stream is flowing. The aspirator is provided with an exterior casing defining a peripheral sharp edge at its widest diameter and the length from the sharp edge to the downstream end of the aspirator is no greater than said diameter. The sharp edge induces an annular vena contracta in the flowing gas stream which in turn induces a reduction in the pressure of the flowing gas stream in the region immediately downstream of the aspirator. The vena contracta assists the flow of gas through the aspirator which in turn aspirates fluid from a reservoir to the aspirator where it is mixed with gas and discharged as a gas-fluid mixture.

This application is a continuation-in-part of Ser. No. 160,208, filed Dec. 18, 1961, now U.S. 3,223,394.

This invention relates to process and apparatus utilizing improved aspirators adapted to be disposed coaxially within a conduit through which a gaseous stream is flowing. This invention also relates to the combination of said aspirators with the gaseous fluid flow systems in which they are advantageously disposed, such as carburetors and exhaust pipes of internal combustion engines.

The aspirator of this invention is disposed coaxially within a conduit having means for inducing flow of a gas therethrough. The aspirator is adapted so that a portion of the flowing gaseous stream enters the aspirator through passageway means in the rear thereof and flows through the aspirator wherein it aspirates another fluid, preferably a liquid, from a source outside the system. A mixture of the aspirating gas and aspirated liquid is sprayed from the aspirator into the conduit with the liquid in a highly atomized condition.

The aspirator of this invention possesses an exterior configuration which advantageously induces a reduction in the pressure of a flowing gas stream in the region immediately downstream of the aspirator. When the aspirator is disposed in a flowing gas stream, a reduced pressure in the region immediately downstream of the aspirator assists in inducing a substantial flow of gas through the aspirator to produce a substantial amount of aspiration therein. The fact that the aspirator itself produces the region of reduced pressure permits the aspirator to be disposed at any longitudinal position within the surrounding conduit and establishes a high degree of interdependence between the aspirator and the system having a flowing gas stream in which it is disposed.

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The relatively low pressure which is produced in front of the aspirator is sufficiently lower than the pressure at the rear of the aspirator so that the portion of the gas stream passing through the aspirator can undergo a sufficient pressure drop to be capable of performing an aspirating function. Therefore, the aspirator of this invention is provided with tangential slots to cause swirling of the aspirating gas which in turn causes swirling of the aspirated liquid. Swirling of the aspirated liquid is highly advantageous since the centrifugal effect of swirling creates a thin swirling film of said liquid within the aspirator which, when sprayed from the aspirator, diverges and disintegrates into a highly atomized state. The aspirator of this invention is capable of not only a high degree of aspiration but also of atomizing the aspirated liquid into a fog-like mist.

The invention will be more clearly understood by reference to the drawings in which:

FIGURE 1 is an interior view of an aspirator of this invention,

FIGURE 2 is a view of a cross section taken through the plane 2—2 of FIGURE 1,

FIGURE 3 is a view of the aspirator of FIGURE 1 operatively disposed within the exhaust pipe of an internal combustion engine, and

FIGURE 4 is a view of the aspirator of FIGURE 1 operatively disposed within the carburetor of an internal combustion engine.

FIGURES 1 and 2 show internal details of an aspirator 10. Aspirator 10 can be attached at its rear by means of threaded stud 14 to a liquid supply conduit 12, which can be a fuel supply conduit extending from a gasoline tank. Stud 14 is provided with an axial bore 16 through which fuel is passed to swirl chamber 18. Swirl chamber 18 is shown as being conical in longitudinal cross section but could also be cylindrical in longitudinal cross section. Nozzle 10 is provided with a funnel-like enlargement at its rear, such as annular funnel-shaped zone 21, adapted for entrapping a substantial portion of a flowing gas stream, such as an air stream, in which aspirator 10 is disposed. From zone 21 the air enters swirl chamber 18 through a plurality of slots 24 on a frusto-conical swirl stem 26. Slots 24 enter the rear of swirl chamber 18 in a forwardly and tangential direction with respect to the wall surface of swirl chamber 18, as is clearly shown in FIGURES 1 and 2. The frusto-conical surface of swirl stem 26 containing the slots 24 abuts in sealing engagement against a complementary interior surface of casing 20. Air entering swirl chamber 18, after passing through tangential slots 24, has a swirling motion imparted to it causing it to swirl in the swirl chamber and to establish an axial vortex which is under a vacuum. The fuel is exposed to this axial vortex by means of cylindrical tube 28, causing it to be drawn into the swirl chamber. A swirling mixture of air and fuel is discharged through swirl chamber discharge orifice 30.

The flat surface 32 of swirl stem 26 extending between cylindrical tube 28 and the conical wall surface of swirl chamber 18 constitutes rear enclosure means for swirl chamber 18. Slots 24 extend through only a minor portion of surface 32 in only the region thereof which is at

the conical wall surface of swirl chamber 18 and laterally remote from cylindrical tube 28. The small size of slots 24 permits only a limited quantity of swirling air to enter swirl chamber 18 and the forwardly direction of slots 24 permits the swirling air to quickly traverse the swirl chamber and be discharged therefrom, thereby preventing flooding of swirl chamber 18 with aspirating air and allowing an axial evacuated vortex to be formed therein.

Axial tube 28 whose outer periphery is cylindrical in shape extends into swirl chamber 18 to an intermediate axial position therein. The reason cylindrical tube 28 is present in the aspirator of FIGURE 1 is that the fluid being aspirated should be exposed to the swirl chamber in a region in which the swirling gas has created an evacuated central vortex. Air moving in a helical pattern develops a central vortex which is under a vacuum into which aspiration of fuel can proceed. Utilization of an axial oil inlet tube 28 extending to an intermediate position along the length of the swirl chamber permits exposure of the fuel to the aspirating air stream in a zone wherein a central vortex has developed. In this manner effective aspiration of liquid into the vortex of a swirling air stream is accomplished and no external pressure need be applied to the liquid entering the aspirator.

It was further found by tests that the exterior surface of axial fuel inlet port 28 should be cylindrical, i.e., it should extend longitudinally parallel to the axis of the aspirator. It was found that in an aspirator utilized as an oil burner if the exterior of axial inlet duct 28 constitutes a cone with its broad base coincident with the rear wall 32 of the swirl chamber, it is not possible to aspirate sufficient fuel to discharge a combustible mixture from the aspirator. It was also found that if the exterior of the axial inlet duct is hemispherical in shape with the base of the hemisphere coincident with rear wall 32 of the swirl chamber it is not possible to aspirate sufficient fuel to discharge a combustible mixture from the aspirator. In contrast, when an axial duct whose exterior surface had a cylindrical shape was employed highly satisfactory aspiration was achieved. The reason evidently is that in the cases of the conical and hemispherical axial ducts a portion of the swirling air stream was directed past the fuel opening in a direction at least partially transverse to the opening, thereby blocking the opening. On the other hand, with a cylindrical axial duct the air traveling past the opening moves completely parallel to the opening thereby preventing back pressure against the opening and allowing most effective aspiration to proceed. With an axial duct whose outer periphery is cylindrical in shape the only axial component of movement of the swirling air stream in the region surrounding the opening of the axial duct is parallel to the opening, rather than transverse to it.

The quantity of fuel aspirated is advantageously adjustable in accordance with this invention. The quantity of fuel aspirated can be adjusted by regulating the amount of air permitted to enter aspirator 10. This is accomplished by axial adjustment of sleeve 22 which fits snugly around the base 34 of swirl stem 26, thereby permitting at least partial obstruction of the entrance to air slots 24. The regulation of fuel flow through the aspirator indirectly by means of regulation of air flow through the aspirator is a significant advantage of this invention. If fuel flow rate adjustment is performed by the direct method of restriction of fuel passages, the presence of unavoidable insoluble particles in the fuel could plug the aspirator and render it inoperative, thereby greatly increasing aspirator maintenance problems. However, by means of partial restriction of air flow through an aspirator in accordance with this invention the fuel flow rate can be adjusted without restriction of fuel passages, thereby allowing any solid particles to freely pass through the aspirator without causing plugging.

When the aspirator of this invention is disposed axially within a conduit through which a gas is flowing, it causes the gas stream to be divided into two unequal portions.

The first and relatively larger portion continues its flow through the conduit, bypassing the aspirator and flowing through the annular space between the exterior of the aspirator and the conduit. The second and relatively smaller portion flows through the aspirator, traveling through narrow tangential slots 24, swirl chamber 18 and discharge orifice 30. It is evident that the total resistance to the flow of the second and smaller portion of gas flowing through the aspirator is much higher than the total resistance to the flow of the first portion of gas flowing the same axial distance in the annular space surrounding the exterior of the nozzle. Because a flowing stream tends to follow the path of least resistance, flow around the exterior of the aspirator will be great but flow through the aspirator will be minimal.

Referring to FIGURE 3, if the aspirator is to be operative, the relatively small resistance to flow around the exterior of the aspirator must be prevented from unduly diminishing flow through the aspirator. In many applications disposing the nozzle at the throat of a venturi restriction will induce a substantial resistance in the fluid stream flowing along the exterior of the aspirator, thereby increasing flow through the aspirator. However, the ordinarily high effectiveness of a venturi is diminished in applications wherein the total length of an aspirator is extremely small. For example, the aspirator employed in obtaining the results of the carburetor tests reported in the table below had an exterior casing length of only 1/4 inch. It is evident that the pressure drop that can be induced by a venturi along an axial length of only 1/4 inch will be very small. Therefore, if the aspirator is to be highly effective it is necessary to employ a means which will induce a pressure drop in the stream flowing along the exterior of the nozzle which is appreciable over a small axial distance and which is localized precisely between the upstream end and the downstream end of the aspirator.

In accordance with this invention, a highly advantageous means for inducing a pressure drop precisely at the aspirator is provided. The pressure drop means of this invention can be utilized alone or can be utilized in cooperation with a venturi by disposing an aspirator of this invention at the throat of a venturi. The pressure drop means of this invention is adapted to provide a pressure drop adequate to induce a high rate of flow through the aspirator. The pressure drop means is adapted to induce a significant pressure drop along only the relatively short axial length of the aspirator. Furthermore, the pressure drop means of this invention is operative at whatever longitudinal position the aspirator is disposed within its surrounding conduit and does not require that the aspirator be disposed at a precise or particular longitudinal position along the axis of its surrounding conduit, for example, at the throat of a venturi.

The pressure drop means of this invention is illustrated in FIGURE 3. FIGURE 3 shows aspirator 10 which is illustrated in detail in FIGURES 1 and 2, disposed axially within a conduit 44, which is advantageously the exhaust pipe of internal combustion engine 46, shown in FIGURE 4. Conduit 44 is connected at its upstream end to engine 46 and is open to the atmosphere at its downstream end. Aspirator 10 is connected to gasoline tank 48 of engine 46 by means of tube 50 which extends from the rear of aspirator 10 to the bottom of gasoline tank 48. Gasoline tank 48 is under atmospheric pressure. Any suitable ignitor means, such as spark plug 52, is disposed in the wall of exhaust pipe 44.

The configuration of the exterior casing of aspirator 10 illustrates the improved structure of an aspirator of this invention. Referring to FIGURE 3, exterior casing 20 of aspirator 10 is substantially cylindrical and defines a substantially circular relatively sharp edged corner 54 at the rearward or upstream end thereof. Sharp edge 54 is located at the widest diameter of the casing and aspirator 10 is substantially free of any lateral extension wider

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than sharp edge 54 of casing 20. Exterior casing 20 has a ratio of length, measured axially from sharp edge periphery 54 to the front or downstream end of the aspirator, denoted as L, to diameter at sharp edge 54, denoted as D, which is substantially no greater than about 1, preferably no greater than about 0.75, and most preferably no greater than about 0.4. A portion of the gas stream is deflected outwardly by peripheral sharp edge 54 forming an annular vena contracta in the annular zone 40, thereby inducing a zone of reduced pressure 42 directly in front of aspirator 10. The zone of reduced pressure 42 assists flow of a portion of the gas stream through aspirator 10, whereby aspirator 10 operates to aspirate gasoline from tank 48.

The aspirator casing can have a conical, hemispherical, cylindrical, or any other configuration as long as its widest lateral extension defines a continuous sharp edge. If the casing is conical the sharp edge is at the base of the cone and the casing converges in a downstream direction. If the casing is hemispherical, its flat base defines a substantially circular sharp edge at its upstream end.

If desired, the apparatus shown in FIGURE 3 can be modified by disposing a conventional orifice plate slightly upstream from the aspirator. The conventional orifice plate will induce an axial vena contracta in the gas stream flowing therethrough tending to direct the gas stream in the direction of aspirator 10.

It is seen that when aspirator 10 is disposed axially within exhaust pipe 44 having a stream of engine exhaust gases flowing therethrough, the exterior configuration of the aspirator is highly critical to aspirator operation. The reduced pressure effect of sharp edge 54 induces a pressure drop over only a limited axial distance downstream from sharp edge 54 equal to about the diameter of the casing at the sharp edge, and is more effective to induce aspiration for an axial distance downstream from sharp edge 54 equal to only about 0.75D. Therefore, the circumferential sharp edge 54 at the rear of cylindrical casing 20 and the critical length to diameter ratio of casing 20 represent a high degree of interdependence when aspirator 10 is disposed axially within conduit 44 having means, such as engine 46, for inducing flow of a gas therethrough.

When engine 46 is not in operation, no exhaust gases flow through exhaust pipe 44 whereby aspirator 10 is not in operation and does not aspirate gasoline from tank 48, disposed on a lower level than aspirator 10. Spark plug 52 is connected to the ignition system of engine 46 and therefore when engine 46 is not operating spark plug 52 is also not operating. As soon as engine 46 starts to operate, incompletely burned exhaust gases flow through exhaust pipe 44 at an adequate velocity to form an annular vena contracta at zone 40 which creates a zone of reduced pressure 42 in front of aspirator 10. The zone of reduced pressure 42 induces a portion of the exhaust gases to flow through aspirator 10. Slots 24, shown in FIGURES 1 and 2, cause the gases flowing through the aspirator to swirl within swirl chamber 18 prior to discharge through discharge orifice 30. The vacuum created at the vortex of the swirling gas stream in swirl chamber 18 induces aspiration of gasoline from tank 48, through tubing 50, passageway 16 and tubular duct 28, whence it enters swirl chamber 18. Upon entering swirl chamber 18, the gasoline becomes involved with the swirling gas stream and is flung under centrifugal force against the wall of swirl chamber 18 where it swirls as a thin film prior to discharge through orifice 30. Upon discharge through orifice 30, the thin film of gasoline is released from the confinement of the wall of swirl chamber 18 and disintegrates into a very highly atomized divergent spray of gasoline droplets intermixed with incompletely burned exhaust gases. Atmospheric air is drawn into exhaust pipe 44 through one or more air passages 54 in the wall thereof and the mixture of incompletely burned exhaust gases, spray atomized gasoline and air is ignited by means of spark plug 52. The combustion of this mixture within

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exhaust pipe 44 greatly reduces the amount of smoke and noxious fumes that is discharged to the atmosphere in the exhaust gases. Aspirator 10 automatically and continuously regulates the amount of gasoline aspirated into the exhaust pipe so that the amount of gasoline aspirated is at all times proportional to the rate of exhaust flow.

FIGURE 4 shows aspirator 10 in combination with a carburetor. Referring to FIGURE 4, 56 indicates generally a carburetor having an air passageway 58 in which upper opening 60 is relatively close to the atmosphere and lower opening 62 is relatively close to the intake manifold 64 of internal combustion engine 46. The flow of air from the top to the bottom of air passageway 58 is regulated by a butterfly valve 66 fixedly attached to a rotatable shaft 68 which is actuated by a throttle. Aspirator 10 is disposed in air passageway 58 wherein it is secured to the terminus of a gasoline inlet duct 70.

Gasoline is stored in the bottom portion of a relatively large reservoir 72 to which it is supplied by means of a fuel pump, not shown. The fuel in reservoir 72 has access to a smaller reservoir 74 through passageway 76. A well 78 having a top opening 80 and a bottom opening 83 extends down into fuel reservoir 74. During operation of the engine above idling speeds, fuel is drawn from reservoir 74, through opening 83 into well 78, out of wall 78 through opening 80, through fuel pipe 70 and finally through aspirator 10 from which it is sprayed into air passageway 58 in admixture with air.

Also extending down into fuel reservoir 74 is an idle tube 82 having a bottom opening 84 and a top opening 86. Idle tube 82 is provided with access to the air passageway 58 through upper opening 86, chamber 88, bore 90 in the body of the carburetor, a primary idle port 92 and a secondary idle port 94. A restricted passageway 96 is provided to vent the main fuel reservoir 72, while restricted passageways 98 and 100 are provided to vent the idling fuel system. A needle valve 102 is provided to adjust the opening of primary idle port 92.

A port 104 also extends into air passageway 58 for providing occasional heavy surges of fuel, if required, from an auxiliary fuel pump, not shown. A heavy surge of fuel might be required during startup of a cold engine.

In operating the engine at speeds above idling speeds, rotation of shaft 68 adjusts butterfly valve 66 into an open position allowing air to flow from the atmosphere downwardly through air passageway 58 to the engine manifold 64. A portion of the air flowing in air passageway 58 enters aspirator 10. Aspirator 10 is illustrated in detail in FIGURES 1, 2 and 3. The flow of air around the exterior of aspirator 10 induces flow of air through the interior of aspirator 10 which in turn induces an aspirational effect drawing gasoline from fuel reservoir 74, through opening 83, well 78, opening 80 and fuel inlet duct 70 to aspirator 10 wherein it is admixed with air and discharged as an air-fuel spray.

Closure of the throttle to the position shown in FIGURE 4 results in butterfly valve 66 obstructing air flow through air passageway 58. The obstruction of air flow reduces the aspirational effect in the aspirator 10 and results in actuation of the carburetor idling system whereby fuel flows into the bottom of air passageway 58 at a position below the butterfly valve 66 to provide the engine with sufficient fuel to prevent stalling. Fuel is drawn from secondary fuel reservoir 74 into idling tube 82 through bottom opening 84 and passes upwardly through idle tube top opening 86, through chamber 88, bore 90, and outwardly through primary idle port 92 and secondary idle port 94. Adjustment of the opening of primary idling port 92 can be accomplished by rotation of needle valve 102.

Tests were made on a gasoline burning automobile engine equipped with a standard carburetor of the general type illustrated in FIGURE 4 except that the standard carburetor was not modified by the addition of an aspirator. The results of these tests are shown in the following

table. Thereupon, further tests were made with the same engine by modifying the carburetor to include an aspirator having a cylindrical outer casing measuring $\frac{1}{4}$ inch in length and $\frac{1}{2}$ inch in diameter and defining a peripheral sharp edge at its upstream end, as shown in FIGURE 4. The results of these tests are also shown in the following table.

the improvement comprising said aspirator having swirling means therein, open passageway means extending into said aspirator from the rear thereof providing passage to said swirling means, second passageway means extending into said aspirator from the rear thereof for supplying said other fluid, said aspirator having an exterior casing defining a circular sharp edge means at its widest diam-

COMPARISON OF PERFORMANCE OF AN 8.0:1 COMBUSTION RATIO 6 CYLINDER AUTOMOBILE ENGINE WHEN EMPLOYING A STANDARD CARBURETOR AND WHEN EMPLOYING THE SAME CARBURETOR WITH AN ASPIRATOR

Engine Crank Shaft Speed (R.P.M.)	Throttle Position	Crank Shaft Brake Torque (Ft.-Lb.)	Brake Horse Power	Fuel Consumption (Lb./Hr.)	Brake Specific Fuel Consumption (Lb./BHP-Hr.)	Average Air: Fuel Ratio (Lb.: Lb.)	Corrected ¹ Brake Torque (Ft.-Lb.)	Corrected ¹ Brake Horse Power
Standard Carburetor								
800	Wide Open	79	12.0	8.475	0.704	12.2	82.4	12.6
1,200	do	86	19.7	13.636	0.694	12.3	89.7	20.5
1,600	do	94	28.6	18.237	0.637	12.2	98.0	29.9
2,000	do	97	36.9	22.489	0.609	12.3	101.2	38.5
2,400	do	98	44.8	27.125	0.606	12.3	102.2	46.7
2,800	do	96	51.2	31.414	0.614	12.4	100.1	53.4
3,200	do	90	54.8	35.672	0.650	12.0	93.9	57.2
Carburetor Modified With Aspirator								
800	Wide Open	83	12.6	8.721	0.690	12.2	85.7	13.1
1,200	do	91	20.8	13.272	0.638	12.1	93.9	21.5
1,600	do	97	29.6	18.927	0.641	11.7	100.1	30.5
2,000	do	100	38.1	22.371	0.587	12.2	103.2	39.3
2,400	do	101	46.2	27.248	0.590	12.1	104.2	47.6
2,800	do	100	53.3	32.468	0.609	11.8	103.2	55.0
3,200	do	92	56.1	36.991	0.660	11.4	94.9	57.9

¹ Corrected to standard dry air pressure of 29.92 inches Hg and standard temperature of 60° F.

The results of the tests tabulated in the above table show that the aspirator modified carburetor produced superior performance as compared to the standard carburetor. For example, at any given engine crankshaft speed both the corrected and uncorrected brake torque and brake horsepower are higher in the case of the aspirator modified carburetor. Also, at most engine speeds the brake specific fuel consumption is advantageously generally lower when employing the aspirator modified carburetor as compared to the standard carburetor. It is also seen from the table that at a uniform air-fuel ratio such as substantially obtained, as shown by the data, during the 2000 r.p.m. engine speed test with both the standard and aspirator modified carburetor, the aspirator modified carburetor advantageously produced a lower brake specific fuel consumption and advantageously produced higher corrected and uncorrected brake torque and brake horsepower as compared to the standard carburetor.

The aspirator of this invention can be utilized in many diversified applications. For example, it can be used as a humidifier for spray atomizing water into an air duct of an air conditioning system. Also, it can be used as a lubricator for spray atomizing lubricating oil into the air duct leading to an air compressor. Another application is spray atomization of combustion improver additives into a carburetor.

I claim:

1. In an aspirator adapted so that the passage of a gas therethrough aspirates and spray atomizes another fluid, the improvement comprising said aspirator having first opening means at the rear thereof for receiving said gas and second opening means at the rear thereof for receiving said other fluid, said aspirator defining a peripheral sharp edge at its widest diameter and the length of said aspirator from said sharp edge to the downstream end thereof being no greater than said diameter.

2. The aspirator of claim 1 wherein said first opening means comprises funnel-like enlargement means for the entrapment of a substantial portion of a flowing gas stream in which the aspirator is disposed.

3. In an aspirator adapted so that the passage of a gas therethrough aspirates and spray atomizes another fluid

eter for inducing an annular vena contracta, and the length from said sharp edge to the downstream end of the aspirator being no greater than said diameter.

4. In combination, a pipe, means for inducing flow of a gaseous stream through said pipe, aspirator means disposed coaxially within said pipe, conduit means connected to said aspirator means for supplying a liquid thereto, open passageway means at the rear of said aspirator means for receiving a portion of said gas stream and passing said portion of said gaseous stream therethrough to aspirate and spray atomize said liquid, said aspirator means defining peripheral sharp edge means at its widest diameter for inducing an annular vena contracta in said gas stream, and the length from said sharp edge to the downstream end of the aspirator means being no greater than said diameter.

5. The combination of claim 4 wherein said open passageway means comprises funnel-like enlargement means at the rear of said aspirator means for the entrapment of a portion of said gaseous stream.

6. In combination, a pipe, means for inducing flow of a gaseous stream through said pipe, aspirator means disposed coaxially within said pipe, said aspirator means having swirling means therein, first passageway means open to said pipe extending from the rear of said aspirator means to said swirling means, second passageway means closed to said pipe extending from the exterior of said pipe into said aspirator means through the rear thereof for supplying liquid under atmospheric pressure to be aspirated, said aspirator means passing a portion of said gaseous stream through said first passageway means to aspirate and spray atomize said liquid, said aspirator means having an exterior casing defining peripheral sharp edge means at its widest diameter for inducing an annular vena contracta in said gaseous stream, and the length from said sharp edge means to the downstream end of the aspirator means being no greater than said diameter.

7. The combination of claim 6 wherein said exterior casing has a cylindrical configuration and defines said peripheral sharp edge means at its upstream end.

8. In combination, an exhaust pipe connected at its upstream end to an internal combustion engine and open

to the atmosphere at its downstream end, aspirator means disposed coaxially within said exhaust pipe, conduit means connected to said aspirator means at the rear thereof for supplying liquid fuel thereto, open passageway means at the rear of said aspirator means for receiving a portion of the exhaust gases flowing through said exhaust pipe, said aspirator means for passing a portion of said exhaust gases therethrough and aspirating and spray atomizing said liquid fuel, said aspirator means defining peripheral sharp edge means at its widest diameter for inducing an annular vena contracta in said gas stream, and the length of said aspirator means from said sharp edge means to the downstream end thereof being no greater than the diameter at said sharp edge means.

9. The combination of claim 8 wherein said open passageway means comprises a funnel-like enlargement at the rear of said aspirator means.

10. In combination, an exhaust pipe connected at its upstream end to an internal combustion engine and open to the atmosphere at its downstream end, aspirator means disposed coaxially within said exhaust pipe, conduit means connected to said aspirator means at the rear thereof for supplying liquid fuel thereto, open passageway means at the rear of said aspirator means for receiving a portion of the exhaust gases flowing through said exhaust pipe and passing said portion of said exhaust gases therethrough to aspirate and spray atomize said liquid fuel, said aspirator means having an exterior casing of substantially cylindrical configuration, the rearward end of said casing defining circular peripheral sharp edge means for inducing an annular vena contracta in said gas stream, the length to diameter ratio of said casing being no greater than 1, means for supplying air to said exhaust pipe in the region of said aspirator means, and ignitor means in said exhaust pipe in the region of said aspirator means, said aspirator means operating only when said internal combustion engine is in operation.

11. In combination, an exhaust pipe connected at its upstream end to an internal combustion engine and open to the atmosphere at its downstream end, aspirator means disposed coaxially within said exhaust pipe, said aspirator means having swirling means therein, first passageway means open to said exhaust pipe extending from the rear of said aspirator means to said swirling means, second passageway means closed to said exhaust pipe extending from the exterior of said pipe into said aspirator means through the rear thereof for supplying liquid fuel to be aspirated, said aspirator means passing a portion of the exhaust gas stream through said first passageway means to aspirate and spray atomize said liquid, said aspirator means defining peripheral sharp edge means at its widest diameter for inducing an annular vena contracta in said gas stream, and the length of said aspirator means from said sharp edge means to the downstream end thereof being no greater than the diameter at said sharp edge means.

12. In combination, a carburetor having an air duct, aspirator means disposed coaxially within said air duct, conduit means connected to said aspirator means at the rear thereof for supplying liquid fuel thereto, open passageway means at the rear of said aspirator means for receiving a portion of the air flowing through said air duct, said aspirator means passing a portion of the carburetor air stream therethrough to aspirate and spray atomize said liquid fuel, said aspirator means defining peripheral sharp edge means at its widest diameter for inducing an annular vena contracta in said air stream, and the length of said aspirator means from said sharp edge means to the downstream end thereof being no greater than the diameter at said sharp edge means.

13. The combination of claim 12 wherein said open passageway means comprises a funnel-like enlargement at the rear of said aspirator means.

14. In combination, a carburetor having an air duct, aspirator means disposed coaxially within said air duct, said aspirator means having swirling means therein, first passageway means open to the air stream in said carburetor air duct extending from the rear of said aspirator means to said swirling means, conduit means closed to said air duct connected to said aspirator means at the rear thereof for supplying liquid fuel thereto, said aspirator means passing a portion of the carburetor air stream through said first passageway means to aspirate and spray atomize said liquid fuel, said aspirator means defining peripheral sharp edge means at its widest diameter for inducing an annular vena contracta in said air stream, and the length of said aspirator means from said sharp edge means to the downstream end thereof being no greater than the diameter at said sharp edge means.

15. A process comprising passing a gaseous stream through a conduit having an aspirator disposed coaxially therein so that a first portion of said gas stream passes around the exterior of said aspirator and a second portion of said gas stream passes through said aspirator, exposing a fluid under atmospheric pressure to the interior of said aspirator, inducing an annular vena contracta in said first gas stream portion, said vena contracta extending to the front of said aspirator, said vena contracta assisting flow of said second gas stream portion through said aspirator, the flow of said second gas stream portion through said aspirator aspirating and spraying said fluid.

16. The process of claim 15 wherein said vena contracta is induced by the exterior casing of said aspirator.

17. A process comprising passing a gaseous stream through a conduit having an aspirator disposed coaxially therein so that a first portion of said gas stream passes around the exterior of said aspirator and a second portion of said gas stream passes through said aspirator, exposing a fluid under atmospheric pressure to the interior of said aspirator, inducing an annular vena contracta in said first gas stream portion, said vena contracta extending to the front of said aspirator, said vena contracta assisting flow of said second gas stream portion through said aspirator, inducing swirling of said second gas stream portion within said aspirator, aspirating said fluid into said swirling second gas stream portion, and spray atomizing said fluid from said aspirator.

18. The process of claim 17 wherein said vena contracta is induced by the exterior casing of said aspirator.

19. A process comprising passing a gaseous stream through a conduit having an aspirator disposed coaxially therein so that a first portion of said gas stream passes around the exterior of said aspirator and a second portion of said gas stream passes through passageway opening means at the rear of said aspirator, exposing a fluid under atmospheric pressure to the interior of said aspirator, inducing an annular vena contracta in said first gas stream portion, said vena contracta extending to the front of said aspirator, said vena contracta assisting flow of said second gas stream portion through said aspirator, the flow of said second gas stream portion through said aspirator aspirating and spraying said fluid, adjusting the quantity of said fluid which is aspirated by adjusting the size of said second gas stream portion passageway opening means at the rear of said aspirator.

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