

[54] **BURNER MODULE FOR APPLICATION TO AN AIR INTAKE MANIFOLD OR OTHER GAS FLOW CONDUIT**

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[51] Int. Cl. **F23d 13/00**

[58] Field of Search..... 432/62, 63, 222;
123/142.5 R, 27; 60/39.6

[56] **References Cited**

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Primary Examiner—John J. Camby

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[57] **ABSTRACT**

A burner module having particular application to an engine intake manifold, applicable to any gas flow conduit for gas or air heating purposes, comprising a

shell-like housing mounting means to intercept a portion of the air moving through the manifold or conduit and to channel said portion into and through a supplementary flow path defined in the housing. This flow path is arranged to exit to the manifold or conduit downstream of the intercepting means. This supplementary flow path is so formed as to swirl the intercepted air about a fuel nozzle. Atomized fuel which issues from the nozzle is externally ignited to produce a flame which is formed in a small tight configuration within a flame retention head defining the exit from said flow path. A portion of the air moving through the flow path is diverted to pass directly through the fuel nozzle to assist in aspirating and atomizing the fuel which is passed therethrough. The major portion of the intercepted air is directed about the flame in a supporting and a shielding relation thereto whereby to provide a gas envelope separating the flame from the surrounding surface of the flame retention head. The latter together with the intercepting means functions to create a relatively non-turbulent environment for the flame which is quietly exposed so as to maintain a relatively uniform temperature of the supporting and shielding gas or air, which it heats in passage thereby in the course of its exit to the manifold or conduit. Further, the flame uniformly adds heat to the main stream of the gas flowing through the related manifold or conduit.

20 Claims, 7 Drawing Figures

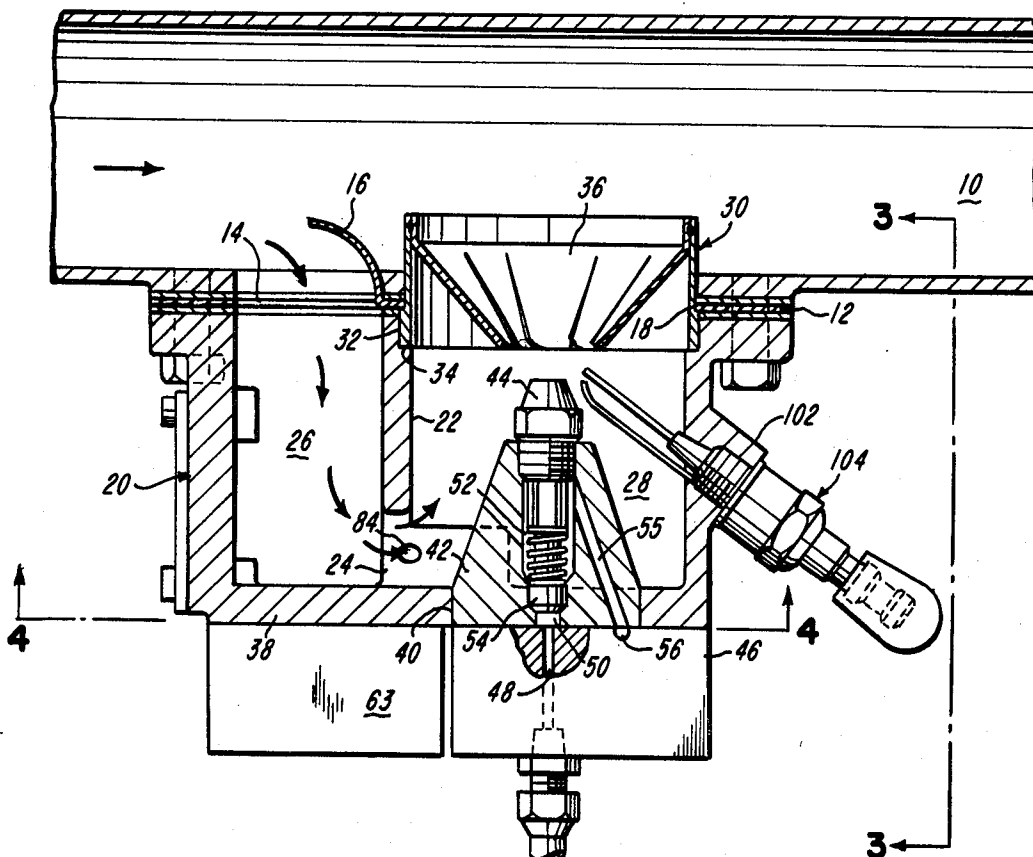


FIG-1

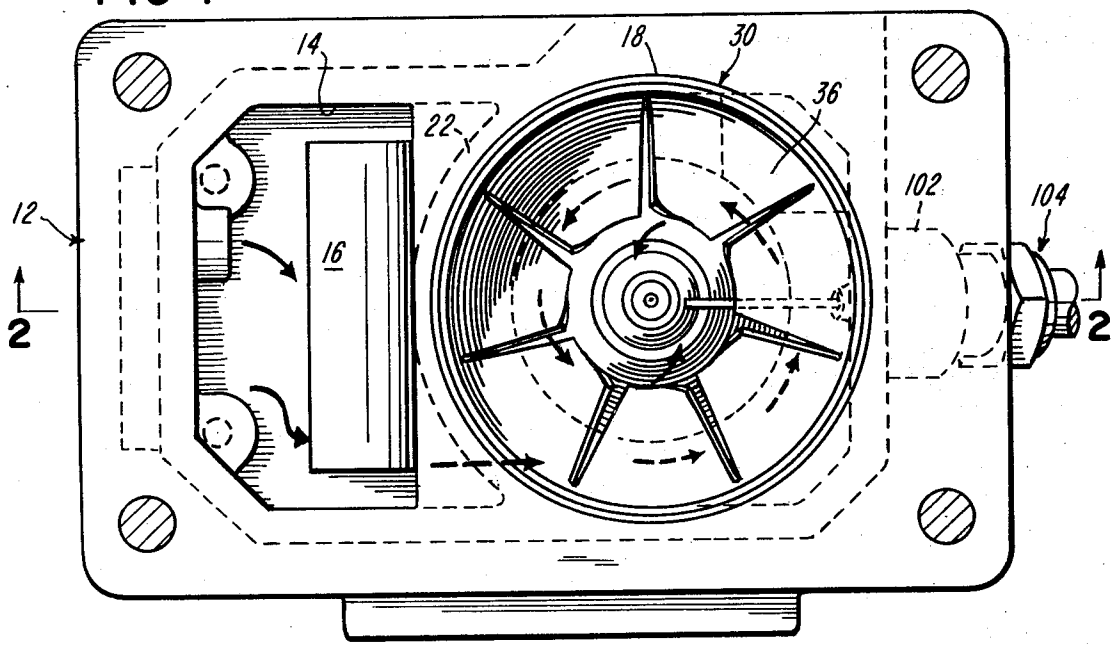
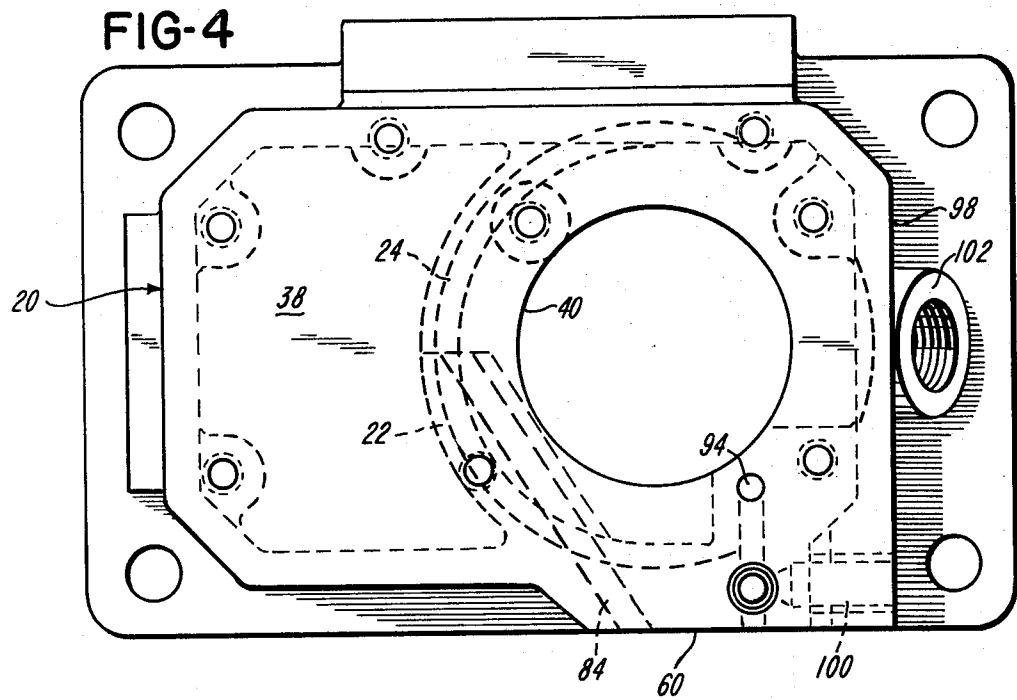


FIG-4



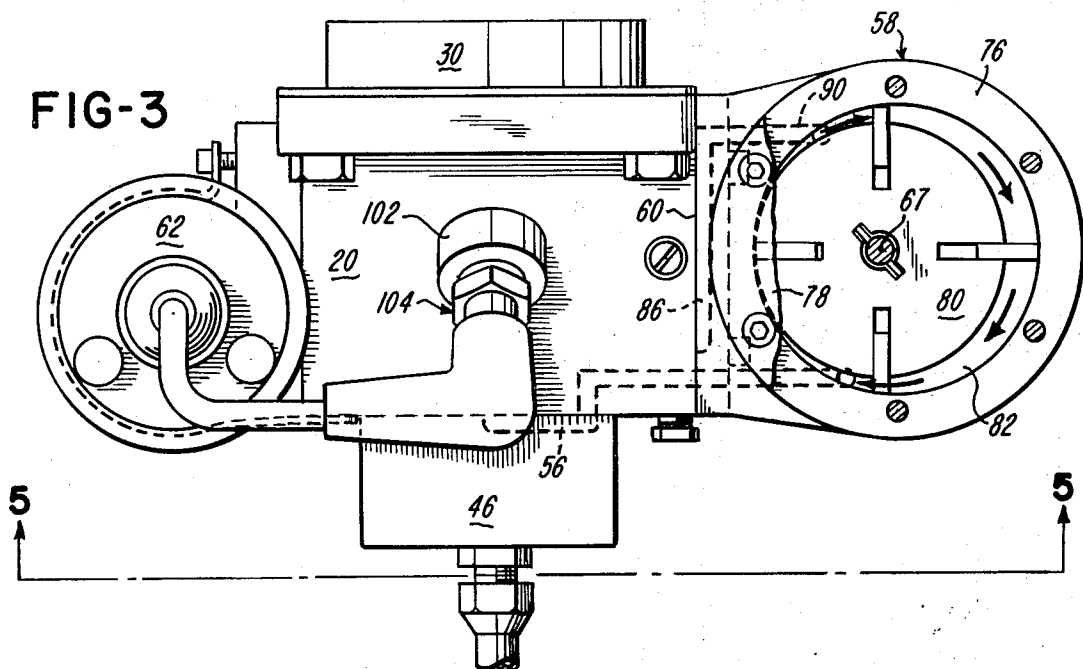
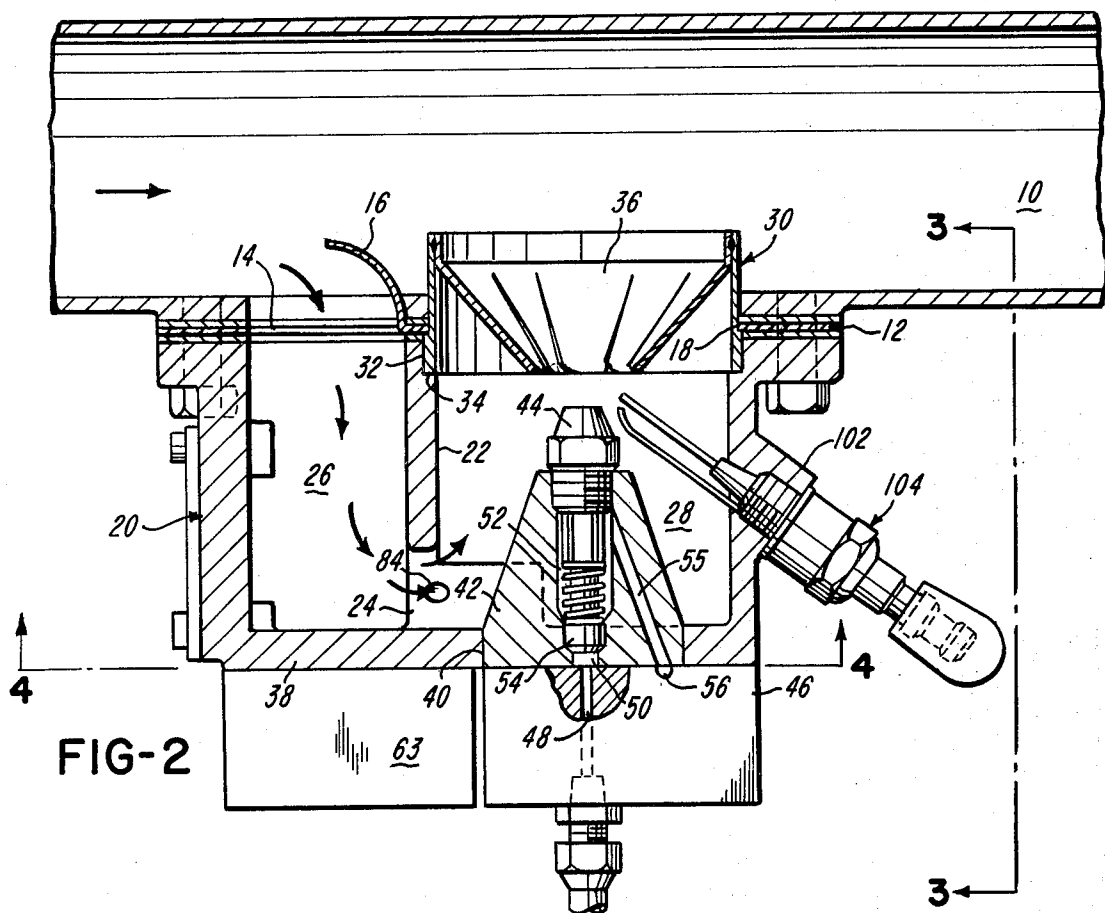


FIG-5

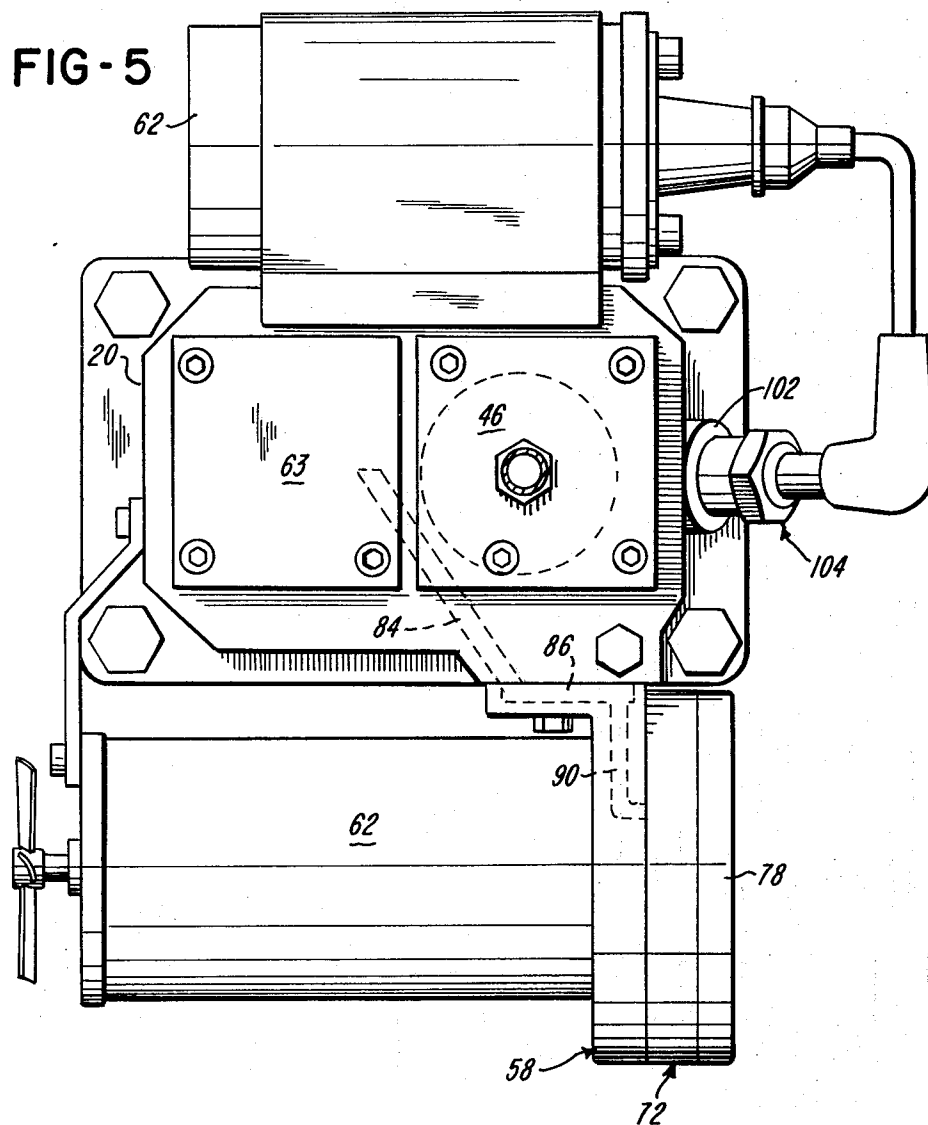


FIG-6

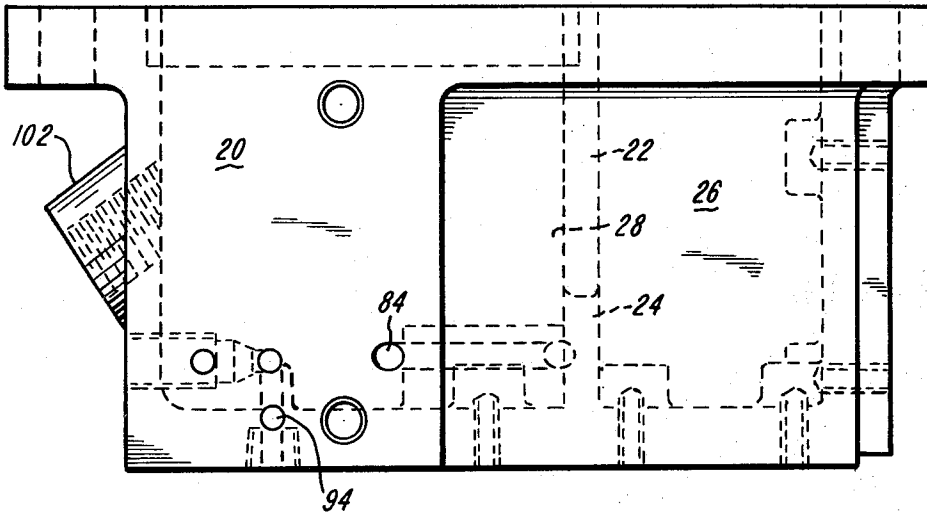
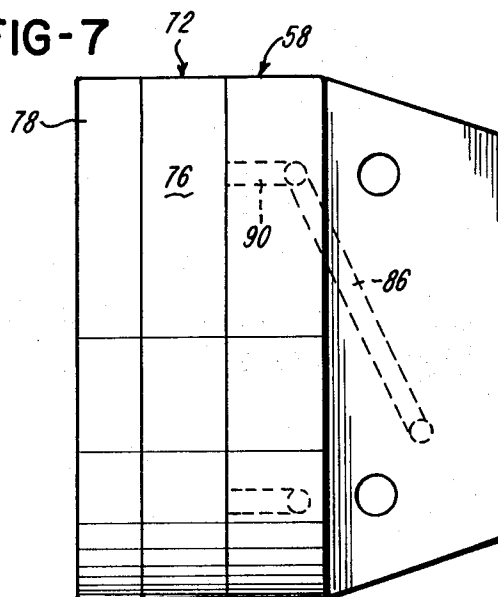


FIG-7



BURNER MODULE FOR APPLICATION TO AN AIR INTAKE MANIFOLD OR OTHER GAS FLOW CONDUIT

BACKGROUND OF THE INVENTION

The invention in its preferred embodiment and application provides an anti-pollution device which enables a low emission engine. Its nature is such that it reduces and substantially eliminates the problems of white or black smoke and reduces nitrous oxide, carbon monoxide and unburned hydrocarbon emissions such as will normally occur in the use of an internal combustion engine during cold starts, extending idling periods, light load conditions and engine speed-up after down hill braking. Such problems are particularly existent in use of the engines applied to trucks. The invention in its structural embodiment provides a compact burner module which will provide, on a simple application thereof to a gas flow conduit or air intake manifold of an engine, a quick heating of the air and a raising of its temperature to an essentially uniform desired level, before it enters the combustion section of an engine, for example. In application to an internal combustion engine it provides the added benefit of a derivative increase in the engine horse power. Invention embodiments are such as to enable an engine to be easily started under below zero conditions.

The problems which the engine solves have been contemplated in prior art proposals to be solved as by structure such as shown in the U.S. Pat. No. 3,093,126 of D. C. Baker, which issued June 11, 1963. However, the teachings of the prior art provide neither the construction nor concept of the present invention, merely being directed to providing means for exposing a flame to an air stream moving through a conduit.

SUMMARY OF THE INVENTION

The present invention provides a burner or heating module which can be quickly inserted to bridge an opening in any ducting portion of an air or gas supply system wherein a fluid flow is directed for use in support of a combustion system. Invention embodiments provide for a compact package so constructed to intercept a portion of the gas or air moving through a conduit and diverting it through a supplementary flow path in a controlled fashion. Exposed in said flow path and opening to the related conduit downstream of the intercepting means is a fuel delivery nozzle and positioned externally thereof an igniter. A portion of the air moving through the supplementary flow path is directed through the module per se to serve to assist in aspirating fuel to and from the nozzle and to atomize the fuel in the process. The major portion of the air directed through the supplementary flow path is caused to move in a swirling pattern about the nozzle and on ignition of fuel issuing from the nozzle causes it to be supported as a tight clean burning flame. A retention head is provided which projects into the related conduit downstream and to the rear of the intercepting means. The air swirling about the nozzle and out from the retention head not only supports the flame and contours the same but shields it from direct contact with the retention head. As this occurs there is a layer of air exiting to the conduit which is uniformly heated in passage. Simultaneously, the flame contained in the retention head is exposed to the main stream passing through the

conduit to lend a substantially constant temperature increasing heat thereto. In this manner there is immediate general uniformity in the pre-heating of the air moving through the conduit, the whole being achieved with a relatively non-turbulent movement of air, with optimal results in function of the related equipment.

A primary object of the invention is to provide an improved burner module having particular advantage in application to a gas flow conduit for pre-heating the air and other gas that might pass therethrough, which module is economical to fabricate, most efficient and satisfactory in use and unlikely to cause malfunction.

Another object of the invention is to provide an improved means and method of pre-heating air moving through the air intake manifold of an internal combustion engine.

An additional object of the invention is to provide an antipollution device of a nature to enable a low emission engine.

Another object of the invention is to provide a burner module in a compact packaged form which may be applied to the opening of a gas flow conduit leading to the combustion section of an internal combustion engine, of a nature to insure immediate starting thereof and to inhibit the creation thereby of air polluting emissions.

A further object of the invention is to provide an air burner module possessing the advantageous features, the inherent meritorious characteristics and the means and mode of use herein described.

With the above and other incidental objects in view as will more fully appear in the specification, the invention intended to be protected by Letters Patent consists of the features of construction, the parts and combinations thereof, and the mode of operation as hereinafter described or illustrated in the accompanying drawings, or their equivalents.

Referring to the drawings wherein one but not necessarily the only form of embodiment of the invention is shown,

FIG. 1 is a planned view of the burner module of the invention, of the side thereof to be applied to a gas flow conduit in a manner such as illustrated in FIG. 2;

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1;

FIG. 3 is an end view of the burner module taken in a direction indicated by the line 3—3 of FIG. 2;

FIG. 4 is a view taken on line 4—4 of FIG. 2 with parts being eliminated for clarity of disclosure;

FIG. 5 is a view taken on line 5—5 of FIG. 3;

FIG. 6 is a view of the burner module assembly taken from a side thereof opposite that shown in FIG. 1; and

FIG. 7 is a detailed view of the motor mount in connection with the burner module housing, showing the compressor unit in connection therewith.

Like parts are indicated by similar characters of reference throughout the several views.

DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT OF THE INVENTION REFERENCED TO THE ACCOMPANYING DRAWINGS

As seen in FIG. 2 there is diagrammatically illustrated an air or gas intake manifold or conduit 10 provided with a side wall opening, which opening is capped by a burner module in accordance with the invention.

The module comprises, in immediate bridging relation to the manifold opening, a suitably secured control plate 12. At its upstream end the plate 12 has a rectangular opening 14 at the downstream edge of which is an arcuately curved offset plate extension 16. As seen in FIG. 2, the extension 16 is initially projected generally perpendicular to the plate 12 to position inwardly of the manifold 10 and to cup in a direction to oppose the flow through the manifold. The plate extension will substantially bridge the manifold to intercept a portion of the air moving therethrough and to smoothly divert the same into a supplementary flow path which is arranged by the burner module to be exterior to the manifold per se. The downstream end of the plate 12, immediately following the opening 14, is provided with a circular aperture 18 the purpose of which will be further described. A suitably apertured gasket will be applied to either face of the plate 12 for sealing purposes. Abutting and fixed to the plate 12 exterior to the manifold 10 is a shell-like housing 20 in which is defined the aforementioned supplementary flow path. Intermediate the ends thereof the housing 20 has in bridging relation thereto a partition 22 which is arcuate in a transverse sense and includes therein, to one side thereof and in the end thereof remote from the plate 12, a small window or aperture 24. The partition 22 divides the shell-like housing 20 into an area constituting an inlet chamber 26 and a second area constituting an outlet chamber 28. In the side thereof adjacent the control plate 12 the housing 20 has an opening to the inlet chamber 26 aligning with the plate opening 14. Similarly, downstream the housing 20 has an opening from the chamber 28 in alignment with the opening 18 in the control plate 12. The aforementioned supplementary flow path is thus defined by the opening 14 and the intercepting plate extension 16 of the control plate 12, the contour of the inlet chamber 26, partition opening 24, the contour of the chamber 28 and the included structure, and the means included in the area of the aperture 18 (to be further described) in the plate 12.

Mounted to project through the aperture 18 and into the manifold 10 immediately downstream of the interceptor plate extension 16 is a burner tube 30 the inner end of which is externally enlarged by a mounting ring 32. The extremities of this mounting ring respectively abut shoulder portions 34 formed in the wall of the chamber 28 and the retainer plate 12. As will be seen, in assembly the burner tube 30 will be seated at one end to the shoulder portions 34 and the control plate 12 will be superposed to contain the burner tube in the position shown in FIG. 2. Of course, the aperture 18 will be dimensioned to be compatible to the peripheral dimension of the tube 30. Welded within the interior of the tube 30 is a flame retention head 36 of truncated conical shape the smallest diameter of which is positioned substantially in the plane defined by the inner limit of the tube 30. Note that the retention head has longitudinally extending slits in the wall thereof and one edge portion of each slit is uniformly angled inwardly thereof to function in a manner to be further described.

In the wall 38 of the housing 20, directly opposite and centered in line with the burner tube 30, is an opening 40 through which is projected an adapter 42 mounting in projected relation thereto the head of an atomizing nozzle 44.

The adapter 42 has a generally conical configuration in the portion thereof which projects interiorly of the chamber 28 while the base thereof which positions in and projects outwardly from the aperture 40 in the housing wall 38 has a cylindrical configuration. This adapter base is suitably connected, as diagrammatically shown, with a fuel metering structure 46 which connects the nozzle 44 with a source of fuel. The details of the fuel metering structure are not per se essential to an understanding of the invention and the same will be described only in reference to those features required for the practice of the invention by way of the embodiment illustrated. For purposes of this discussion, the path of flow through the metering structure 46 is merely identified by a passage 48 identifying the fuel exit path in moving to an aligned passage 50 in the adapter 42 communicating the fuel within a fuel passage defined by a central bore on the longitudinal axis of the nozzle 44.

As may be seen, the passage 50 in the adapter 42 is counterbored at the end thereof remote from the adapter base to receive the body of nozzle 44. Within the counterbore the cross section of the nozzle body is reduced to define thereabout an air chamber 52. The innermost end of the nozzle is provided with a seal means to separate the air in the chamber 52 from fuel which is passed to and through the nozzle. Grooves in the nozzle body and connecting small bore passages in its head (not shown) communicate air in the chamber 52 with the nozzle fuel passage. The small bore passages are arranged in a conventional manner so that air exiting therefrom will induce an aspirating effect in the nozzle bore and cause fuel to exit from the nozzle in an atomized condition. Such nozzle construction is known and has been here described only to the extent necessary for an understanding of the present invention. The important point in this instance is that adapter 42 has a small bore air passage 55, shown in FIG. 2 of the drawings, which opens at its discharge end to the chamber 52 and communicates to its inlet end with a slot 56 at the adapter base. In this instance the slot 56 is shown to be formed in the abutted face of the fuel passing and metering device 46.

FIG. 2 of the drawing shows that a motor mount 58 is mounted to project from and perpendicular to one side 60 of the housing 20. An ignition coil 62 is suitably secured to the opposite side of the housing. Fixed to project perpendicular to one face of the motor 58 is a D.C. motor unit 64. The motor 64 is arranged to be immediately adjacent and to have a length coextensive with that of the housing 20. The projected extremity of the motor is supported by and in connection with the housing 20 through the medium of a suitably secured retention bracket 66. The motor drive shaft 67 projects from the end of the motor supported by the bracket 66 to mount a fan 70. This fan will serve to distribute air over the exterior surface portion of the related structure to maintain a reduced temperature thereof in a manner believed obvious.

As may be seen from the drawings, the motor mount has an aperture of circular outline and secured to the face thereof remote from the motor is the cylindrically formed housing of a relatively flat compact compressor unit 72. The housing of the compressor unit consists of a cup-shaped part 76 the flat base of which bridges the abutted face of the mount 58 and has a central aperture which accommodates the projection therethrough of

the motor drive shaft 67. The cup-shaped portion of the compressor housing is capped by a cover plate 78. Within the chamber defined by the compressor housing the motor drive shaft mounts in eccentric position therein a conventional vaned rotor 80. The eccentric position of the disc shaped rotor 80 forms and defines a compression chamber 82 about a portion of its periphery.

Referring now to the housing 20, formed in its wall structure and opening at one end to the aperture 24 in partition 22 is a small bore passage 84 the opposite end of which opens through the side 60 into one end of a groove 86 formed in the base of the motor mount 58. This groove leads to a passage 90 in the body of the motor mount, an angled portion of which passage opens from the face of the motor mount remote from the motor 64 to align with an aperture in the compressor housing communicating with the entrance end of the chamber 82. As shown in the drawings, chamber 82 is of conventional arcuate configuration, gradually expanding from the inlet end of the chamber to a point midway in its length, beyond which point it uniformly reduces to its outlet end from which opens an exit aperture for delivering compressed air from the chamber 82. This exit aperture opens to a passage formed in the motor mount 58 and directed therein to the motor mount base to open therefrom to a flow passage 94 in the wall structure of the housing 20. This passage 94 exits from the housing 20 at the face thereof abutted by the housing of the fuel metering apparatus generally indicated by the number 46 and into a slot 56 formed in the abutted face thereof. The slot 56 communicates at its remote end with the air flow passage 55. Further mounted in the housing 20 to communicate with the passage 94 is a pressure regulator 100 through the medium of which air may be relieved from the passage 94 and suitably directed back to the manifold 10.

As seen in the drawings the one housing end wall 98 mounts a boss 102 which accommodates the projection therethrough of a sparking device 104 the operative tip of which is positioned immediately adjacent the discharge end of the nozzle 44, to one side thereof. It is thereby positioned immediately adjacent and within the perimeter of the opening to the retainer head portion 36.

The ignition coil 62 and an exciter 63 will be coupled with the device 104 for suitable control of ignition in a manner well known to those versed in the art. This can be accomplished in various ways, and the same is therefore not further described.

As indicated previously, the conduit or manifold 10 may be of any suitable nature to channel air or other gaseous fluid to a required location to serve its intended purpose. The module of the invention will in the process function as follows. The description, for expediency, will consider the conduit 10 as the air intake manifold of an internal combustion engine.

As air moves towards the combustion chamber of the engine there will be an interception of a peripheral portion of its inflow by the plate extension 16. The arcuate curve of the latter will cause the portion of the air intercepted to be smoothly diverted into the chamber 26 and induce a swirling pattern of the air as it moves interiorly of the chamber to the small window or aperture 24 of the partition 22. In movement of air through the aperture 24 there will be a momentary acceleration of its flow. During this period a portion of the air will be

diverted into the small bore passage 84 and directed through the body 20 of the module and to and through the motor mount by way of passages 86 and 90 to exit to the inlet of the compression chamber 82. As the vaned compressor rotor is turned by the motor 64, this air will be conventionally compressed and delivered from the compressor chamber and through the motor mount back to the housing 20. The compressed air will pass through the passage 94 and by way of the groove 56 to the small bore passage 55 in the nozzle adapter 42. It must be here noted that where the support for the groove 56 communicating the compressed air with the small bore passage 55 may be suitably embodied in the nozzle adapter structure per se. In any event, it will be seen that a portion of the air flow moving from the inlet chamber 26 to the exit chamber 28 will be picked up and moved in a fully contained path to supply the air necessary for assisting in the aspiration and atomizing of the fuel carried to and through the nozzle 44. Within the exit chamber 28, as the fuel issuing from the nozzle is ignited immediately adjacent the retainer head, the air moving in accelerated fashion through the aperture 24 and partition 22 will be induced to swirl about the nozzle and its adapter and around the walls of the chamber 28 to move in supporting and shielding relation to the flame produced by ignition. A portion of the air will pass into and through the retainer head portion 36 which defines an opening from the housing 20 back to the manifold 10 immediately downstream of the deflector or interceptor 16. The swirling air will both form a shield separating the flame from the physical structure of the retainer head and cause the contouring of the flame to a compact form assuming the configuration of a creamy extended ball configuration. Of course, part of the air goes to support combustion while the remainder is heated in passage by the flame, in a generally uniform manner.

It is to be particularly noted that the extension of the retainer head to the interior of the manifold 10 and immediately downstream of the curved deflector 16 places the flame in a relatively non-turbulent zone. This contributes to the control of the flame and in an unexpected manner produces an even heating of the passing air. It is to be kept in mind that not only is there thus provided a particularly controlled supplementary flow path for the air but the nature of the path is such as to create a temperature control and to lend rapid heating to the air flow in the manifold 10. The flame is of course exposed to the main air stream and lends heat thereto as well as to the air flowing thereabout.

Thus, the invention contributes substantially to the art in question by providing an easily applied unit for inducing heat to raise the temperature of a passing gaseous fluid. It achieves its result by affording a diversion of a portion of the fluid flow to and through a supplementary flow path in the process of which to utilize a portion thereof for atomizing and aspirating purposes and another portion thereof to support and shield the flame which lends a uniform heat to the flow and which is exposed to the main stream in a manner to achieve a heating of the fluid flow which may be uniformly distributed at relatively uniform temperatures. The unobvious results obtained are illustrated by a fact that with the use of the invention embodiment, internal combustion engines of the diesel type have been to start at 10° below zero within a period of eight seconds. The use of

the invention has also unobviously increased the productive horse power to a significant degree.

A main advantage of the invention application to use with internal combustion engines is the clean burning it enables regardless of the engine operating conditions. The supplementary flow path as provided by the invention structure has resulted also in a swirling of heated air in a uniform manner which assists and enhances the continuous air flow in the related manifold and maintains it relatively uniform, again regardless of engine operating conditions.

Particular attention is directed to the fact that in the illustrated embodiment the module provided eliminates the need for external connectors and avoids the necessity for flame divertors and the complications of the manifold design which was necessary to accomplish uniform pre-heating of an engine such as described in accordance with the teachings of the prior art.

It should be understood that the basic aspects of the invention which have been noted as fine features are important and definitive. Of course, it will be understood that there can be various modifications of the conventional aspects of the structure required while retaining the basic concepts of the invention. Such is considered to lie within the scope of the appended claims.

The package concept of the unit is unique and facilitates its use for a wide and diversified application. It features per se a highly advantageous integration of an exciter and ignition coil coupled with a sparking device and means providing for flow of a gaseous fluid from a flow path supplementary to the main flow in a conduit and for directing the same through means producing a uniformly pressured flow of the gaseous fluid to enhance the discharge of the fuel delivery means. By the invention, the uniformly pressured flow of gaseous fluid will be maintained regardless of pressure conditions in the related manifold.

From the above description it will be apparent that there is thus provided a device of the character described possessing the particular features of advantage before enumerated as desirable, but which obviously is susceptible of modification in its form, proportions, detail construction and arrangement of parts without departing from the principle involved or sacrificing any of its advantages.

While in order to comply with the statute the invention has been described in language more or less specific as to structural features, it is to be understood that the invention is not limited to the specific features shown, but that the means and construction herein disclosed comprise but one of several modes of putting the invention into effect and the invention is therefore claimed in any of its forms or modifications within the legitimate and valid scope of the appended claims.

Having thus described our invention we claim:

1. A burner module for application to a manifold or conduit passing a stream of gaseous fluid in a main flow path comprising a housing having an inlet thereto, an outlet therefrom and means defining a passage therebetween, means for intercepting and diverting a portion of the gaseous fluid from said main flow path to a supplementary flow path defined by said passage extending between said inlet and outlet of said housing, fuel delivery means in connection with said housing the discharge end of which positions in said supplementary flow path adjacent said outlet, means for igniting the

delivered fuel to produce a flame at said housing outlet, means projecting from said housing at said outlet to contain the flame, and said supplementary flow path being defined by means for inducing the intercepted air to move in a swirling flow and to exit from said housing in a containing and supporting relation to the flame, the air from the supplementary flow path being heated in passage back to the main flow path by way of said housing outlet and said flame being exposed to said main flow path at said outlet, said intercepting means being characterized by a form to smoothly divert gaseous fluid from said main flow path so as to maintain a non-turbulent flow of the gaseous fluid, said intercepting means positioning immediately up stream of said housing outlet and said means projecting from said outlet constituting a flame retention head projecting similarly to said intercepting means and arranged to induce a controlled shaping of the flame produced at said outlet.

2. A burner module for application to a manifold or conduit passing a stream of gaseous fluid in a main flow path comprising a housing having an inlet thereto, an outlet therefrom and means defining a passage therebetween, means for intercepting and diverting a portion of the gaseous fluid from said main flow path to a supplementary flow path defined by said passage extending between said inlet and outlet of said housing, fuel delivery means in connection with said housing the discharge end of which positions in said supplementary flow path adjacent said outlet, means for igniting the delivered fuel to produce a flame at said housing outlet, means projecting from said housing at said outlet to contain the flame, and said supplementary flow path being defined by means for inducing the intercepted air to move in a swirling flow and to exit from said housing in a containing and supporting relation to the flame, the air from the supplementary flow path being heated in passage back to the main flow path by way of said housing outlet and said flame being exposed to said main flow path at said outlet, and means defining a further small bore flow passage communicating said supplementary flow path with said fuel delivery means.

3. A burner module as in claim 2 characterized by means in connected relation to said housing to intercept fluid moving through said small bore passage and to deliver it under pressure to said fuel delivery means.

4. Apparatus for application to a structure such as a manifold or other conduit feeding primary air to an internal combustion engine and defining a primary flow path for a stream of gaseous fluid, including a housing segment having an inlet thereto, an outlet therefrom and a flow passage between said inlet and said outlet, said housing segment including, in association therewith, means to directly couple the same to said structure to directly communicate said inlet with one location in said flow path and said outlet with a second location in said path spaced longitudinally of and downstream from said first location, said inlet providing means for directing a portion of said gaseous fluid moving past said first location to said housing flow passage, means in association with said housing arranged to discharge and ignite fuel within said flow passage to produce a flame therein, said housing flow passage being formed to direct at least a portion of the gaseous fluid received from said first location in said primary flow path to move therethrough in a swirling flow and in a

containing supporting relation to said flame and to exit from said outlet and back to said primary flow path at an elevated temperature, raising the temperature of said gaseous fluid moving through said primary flow path as it moves downstream of said first location, and said housing segment further having a small bore flow passage one end of which is arranged to communicate with and divert from said housing flow passage a portion of the gaseous fluid moving therethrough and another end of which is directed to provide for delivery of said diverted portion of the gaseous fluid to said fuel discharge means to induce the discharge of fuel therefrom for ignition in said flow passage.

5. Apparatus for application to a structure such as a manifold or other conduit feeding primary air to an internal combustion engine and defining a primary flow path for a stream of gaseous fluid, including a housing segment having an inlet thereto, an outlet therefrom and a flow passage therebetween, said housing segment including, in association therewith, means to directly couple the same to said structure to directly communicate said inlet with one location in said flow path and said outlet with a second location in said path spaced longitudinally of and downstream from said first location, said inlet providing means for directing a portion of said gaseous fluid moving past said first location to said housing flow passage, means in association with said housing arranged to discharge and ignite the fuel within said flow passage to produce a flame therein, said housing flow passage being formed to direct at least a portion of the gaseous fluid received from said first location in said primary flow path to move therethrough in a swirling flow in a containing supporting relation to said flame and to exit from said outlet and back to said primary flow path at an elevated temperature, raising the temperature of said gaseous fluid moving through said primary flow path as it moves downstream of said first location, and said housing segment mounting in connected relation thereto a motor, a compressor and means for energizing said fuel ignition means and said housing segment and mounting means for said motor providing means for passage of gaseous fluid from said housing flow passage in a contained relation to direct the same to atomize fuel delivered by said fuel discharge means.

6. Apparatus for application to a structure such as a manifold or other conduit feeding primary air to an internal combustion engine defining a primary flow path for a stream of gaseous fluid, including a housing segment having an inlet thereto, an outlet therefrom and a flow passage therebetween, said housing segment including, in association therewith, means to directly couple the same to said structure to directly communicate said inlet with one location in said flow path and said outlet with a second location in said path spaced longitudinally of and downstream from said first location, said inlet providing means for directing a portion of said gaseous fluid moving past said first location to said housing flow passage, means in association with said housing arranged to discharge and ignite the fuel within said flow passage to produce a flame therein, said housing flow passage being formed to direct at least a portion of the gaseous fluid received from said first location in said primary flow path to move therethrough in a swirling flow in a containing supporting relation to said flame and to exit from said outlet and back to said primary flow path at an elevated tempera-

ture, raising the temperature of said gaseous fluid moving through said primary flow path as it moves downstream of said first location, and compressor means integrally connected with said housing segment and means providing for a diversion of gaseous fluid from said housing flow passage directly to said compressor means which is arranged and connected to produce a uniformly pressured flow of the diverted gaseous fluid to said fuel discharge means, regardless of pressure conditions in said primary flow path.

7. In a manifold heater for an internal combustion engine having a duct for delivering a supply of combustion air thereto, the improvement comprising means defining a passage arranged with a portion thereof in operatively parallel relationship to and spaced from said duct and including an inlet, an outlet and means for inducing swirling of combustion air flowing in said passage, said inlet and outlet communicating with said duct whereby a portion only of the combustion air in the duct flows through said inlet into said passage and re-enters said duct from said outlet, means for producing a heating flame in said passage to heat said portion of combustion air flowing therethrough, whereby said portion of combustion air effects heating of the supply of combustion air upon re-entering said duct, said flame producing means including fuel delivery means, and a second passage communicating with said first mentioned passage for supplying primary combustion air into said fuel delivery means.

8. Apparatus for application to a structure such as a manifold or other conduit defining a primary flow path for a stream of gaseous fluid directed to an internal combustion engine or like power unit including a housing adapted to seat to an exterior surface portion of said structure, said housing having an inlet thereto, an outlet therefrom and means defining a flow passage connecting said inlet with said outlet, means in connection with said housing to provide for a communication of said inlet with one location in said flow path and said outlet with a second location in said flow path which is downstream from said first location, including means for smoothly directing a peripheral portion of said stream of gaseous fluid moving past said first location to move to and through said inlet and said housing flow passage, heat transfer means in communication with said housing flow passage in the vicinity of said housing outlet, said housing flow passage being formed to direct at least a portion of the gaseous fluid received from said first location in said primary flow path to move therethrough in a swirling flow and past said heat transfer means in the area of said outlet, the arrangement providing a direct and immediate exposure of said heat transfer means to said outlet and a heating thereby of the gaseous fluid moving back to said conduit by way of said outlet immediately of the main stream of the flow of gaseous fluid moving downstream from said first location in said conduit structure.

9. Apparatus as in claim 8 characterized by said heat transfer means comprising means in association with said housing arranged to discharge and ignite fuel within said flow passage to produce a flame therein within the vicinity of said outlet and said gaseous fluid in said housing flow passage moving therethrough in a swirling flow and in a containing and supporting relation to said flame in the area of outlet, the arrangement providing a direct exposure of said flame to said outlet

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and an exiting of gaseous fluid about the flame in the vicinity of said outlet.

10. Apparatus as in claim 9 wherein said fuel discharge and igniting means are located to produce a flame in said housing flow passage at said outlet.

11. Apparatus as set forth in claim 9 wherein means project from said outlet to produce a controlled shaping and projecting of the flame at said outlet and a non-turbulent return of gaseous fluid to said primary flow path.

12. Apparatus as in claim 9 characterized by means projecting at said outlet forming a flame retention head and said flame retention head and said housing flow passage having a form to provide that the swirling of the gaseous fluid in said housing passage is continued about the fuel discharge means and in surface contacting relation to the flame retention head to hold the flame created from direct contact with said housing segment and its connected structure whereby to maintain an essentially uniform transmittal of heat to gaseous fluid moving to and through said primary flow path.

13. Apparatus as in claim 9 characterized by said housing including means defining a small bore passage for diverting a portion of the gaseous fluid moving through said housing flow passage and channeling the same for delivery to and through said fuel discharge means to mix with the fuel and control its discharge to said housing flow passage.

14. Apparatus as in claim 9 constituting an air preheater package characterized by said housing having a side portion formed to seat to said conduit structure and position said outlet in direct communication with said stream of gaseous fluid by way of an opening in the wall of said conduit, said fuel discharge means including a fuel nozzle mounted on an interior wall portion of said housing to position its discharge end relatively adjacent to and in direct alignment with said outlet, and means positioning within said outlet and immediately beyond the discharge end of said fuel nozzle to influence the produced flame to assume a compact form, in which form it is immediately exposed to the main stream of gaseous fluid within said conduit and to the flow of gaseous fluid moving from said housing flow passage and back to said conduit by way of said outlet.

15. An air preheater package as in claim 14 charac-

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terized by means for diverting a portion of the gaseous fluid entering said housing for delivery thereof to the interior of said nozzle to mix with and atomize the fuel moving through and from said nozzle.

16. Apparatus as in claim 8 characterized by said housing having a side portion adapted to seat to said conduit, which side portion includes both said inlet and said outlet and said housing including a partitioned cavity forming therein a plurality of chambers including an inlet chamber the entrance to which is provided by said inlet and an outlet chamber the exit from which is provided by said outlet and said chambers providing portions of said housing flow path.

17. Apparatus as in claim 16 characterized by said housing cavity being partitioned by a single partition means defining two chambers one of which is said inlet chamber and the other said outlet chamber.

18. Apparatus as in claim 16 wherein the partition means in said cavity provide passage therethrough to communicate said inlet and outlet chambers, said apparatus being further characterized in that said heat transfer means includes a nozzle for directing an ignitable fuel mixture into said flow path and means for igniting the fuel mixture in said outlet chamber and said housing includes in association therewith means for directing a portion of the fluid passing through said housing flow path to said nozzle to produce said ignitable fuel mixture.

19. Apparatus as in claim 8 wherein said heat transfer means includes a burner nozzle for discharging an ignitable fuel mixture and means for igniting said fuel mixture and producing a flame in proximity to said outlet, about which flame the gaseous fluid in said housing flow passage will swirl and exit therefrom, and a tube-like structure mounted within and projected outwardly of said housing at said outlet to contain said flame and direct the fluid exiting from said housing flow passage to a central position of the associated conduit to be picked up by the main body of the gaseous fluid moving through said conduit in a non-turbulent manner.

20. Apparatus as in claim 8 characterized by means forming an extension of said inlet having a form to cause said peripheral portion of said gaseous fluid to be smoothly diverted from said primary flow path so as to maintain a non-turbulent flow of the gaseous fluid in said conduit.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,829,281 Dated August 13, 1974

Inventor(s) Eugene C. Briggs, William C. Wellbaum

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

Column 3, line 22, "bridging" is corrected to read -- bridging --;

Column 5, line 24, "form" is corrected to read -- from --;

Column 6, line 66, -- enabled -- is inserted following "been"; and

Column 9, line 21, "strcture" is corrected to read -- structure --.

Signed and sealed this 29th day of October 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents