US 20090007552A1

(19) **United States**

(12) **Patent Application Publication**

Schmidt

(10) **Pub. No.: US 2009/0007552 A1**

(43) **Pub. Date: Jan. 8, 2009**

(54) **EXHAUST MANIFOLD HAVING IMPROVED NVH CHARACTERISTICS**

(76) Inventor: **Michael Paul Schmidt**, Howell, MI (US)

Correspondence Address:
MCDONALD HOPKINS LLC
600 Superior Avenue, East, Suite 2100
CLEVELAND, OH 44114-2653 (US)

(21) Appl. No.: **12/157,790**

(22) Filed: **Jun. 13, 2008**

Related U.S. Application Data

(60) Provisional application No. 60/934,376, filed on Jun. 13, 2007.

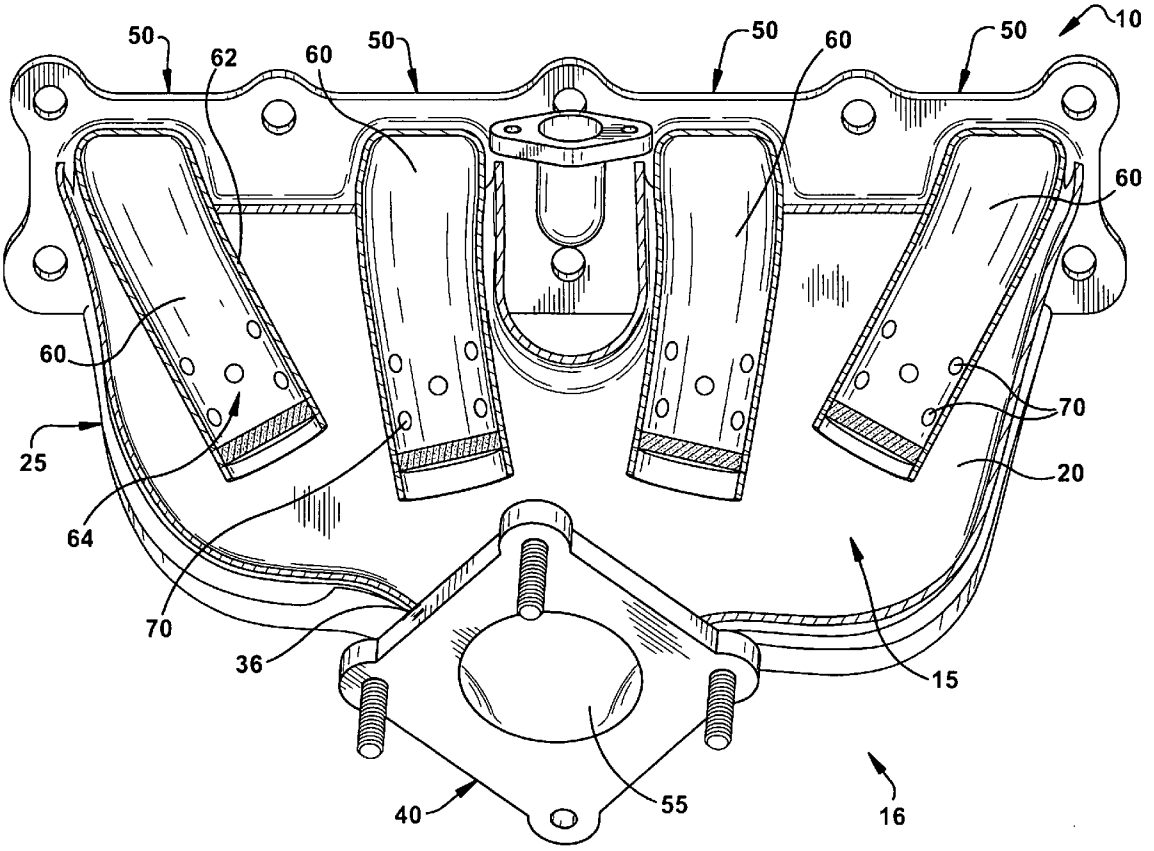
Publication Classification

(51) **Int. Cl.**
F01N 7/10 (2006.01)
B21D 51/16 (2006.01)

(52) **U.S. Cl.** **60/323**; 29/890.08

(57) **ABSTRACT**

An exhaust manifold and method of manufacturing the same is provided that includes at least one tube within shells of an exhaust manifold. The tube limits fluid communication from the tube into the shells of the exhaust manifold. An inlet flange is connectable to the exhaust manifold and is attachable to a cylinder head of a combustion engine. Exhaust gases expelled from the cylinder head are transmitted into the exhaust manifold. At least a portion of the exhaust gases pass through the tube. The exhaust manifold reduces NVH and cures emission control issues.



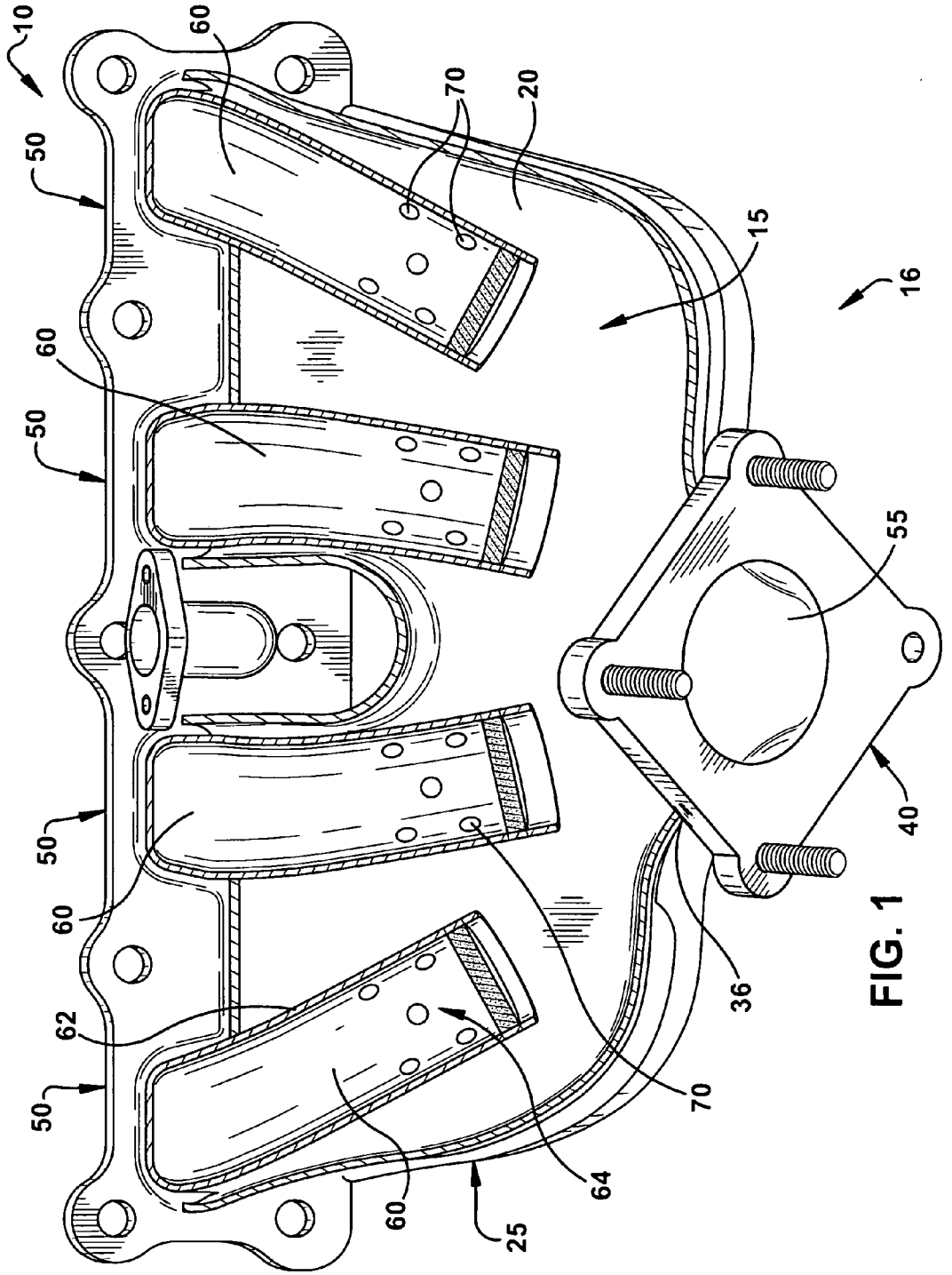


FIG. 1

EXHAUST MANIFOLD HAVING IMPROVED NVH CHARACTERISTICS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims benefit from U.S. Provisional Patent Application No. 60/934,376, entitled "Exhaust Manifold Having Improved NVH Characteristics," filed on Jun. 13, 2007, which is hereby incorporated in its entirety by reference.

FIELD OF THE INVENTION

[0002] This invention generally relates to an exhaust manifold that may be incorporated into an internal combustion engine, and more particularly to an exhaust manifold having exhaust tubes within an exhaust manifold housing that may improve noise, vibration and harness characteristics of the manifold housing.

BACKGROUND

[0003] In an internal combustion engine, a cylinder head is positioned atop an engine block having cylinders (or combustion chambers) extending therethrough. Upper portions of each combustion chamber extend through the cylinder head, where the upper portion of each combustion chamber corresponds with each cylinder of the engine block. The cylinder head may also house intake valves, exhaust valves, camshaft (s), rocker arms and pushrods, and numerous other mechanisms as is known in the art.

[0004] In addition, an intake manifold and an exhaust manifold are typically coupled to the cylinder head. The intake manifold is typically located between the carburetor and the cylinder head to supply an air-fuel mixture to each combustion chamber through internal intake ports in the cylinder head. In multi-port injected engines, for example, the intake manifold contains fuel injectors that supply an air-fuel mixture to each combustion chamber.

[0005] The exhaust manifold is typically coupled to the side of the cylinder head opposite the intake manifold (i.e. the "exhaust side"). The exhaust manifold collects exhaust gases exiting from each combustion chamber through internal exhaust ports in the cylinder head. The exhaust manifold then transfers the exhaust gases to an exhaust pipe of an exhaust system. Accordingly, the exhaust manifold is coupled to the cylinder head at the exhaust ports of the cylinder head such that the exhaust manifold collects exhaust gases exiting each combustion chamber within the manifold housing and transfers the exhaust gases to the exhaust pipe.

[0006] Traditionally, exhaust manifolds have been made from conventional cast iron for strength and durability. However, these manifolds are heavy, cumbersome, and therefore detract from the fuel efficiency of the vehicle. In addition, the cast iron manifolds are difficult to manufacture into compact shapes and other distinct shapes as may be required by the underhood packaging constraints of modern vehicles.

[0007] One solution to the problems presented by the traditional cast iron manifolds is to fabricate the exhaust manifolds from thin sheet metal, which is lightweight and more easily complies with underhood packaging constraints. However, these sheet metal manifolds present several disadvantages. In particular, since the sheet metal manifolds are thin and lighter in weight, the sheet metal manifolds provide noise, vibration, and harshness ("NVH") problems. For example, the NVH problems present objectionable noise and vibration from the exhaust pulses. Specifically, the NVH passes from the manifold housing into the engine compartment, and ultimately onto the passenger compartment. Furthermore, the sharing of exhaust pulses among cylinders via the exhaust manifold (i.e. "cross-talk") may compound the NVH problems and may result in further objectionable noise and vibration. The NVH transmitted and experienced by the passengers is bothersome and undesirable.

[0008] Consequently, there exists a significant need for an exhaust manifold that is durable, lightweight and capable of reducing NVH. In addition, a need exists for an exhaust manifold capable of being tuned to reduce and/or to dampen noise and vibrations of an exhaust system, such as noise and vibrations due to exhaust pulses from the internal combustion process.

SUMMARY OF THE INVENTION

[0009] An exhaust manifold assembly is provided. The exhaust manifold assembly may consist of an upper half shell secured to a lower half shell to form a housing. The upper half shell and/or the lower half shell may have one or more tubes extending within the interior of the housing. An inlet flange and an outlet flange may be attached to one of the shells. The inlet flange may be attached to a cylinder head to receive exhaust gases from the cylinder head. The exhaust gases may be received by the one or more tubes. Advantageously, the improved exhaust manifold assembly may reduce NVH.

BRIEF DESCRIPTION OF THE DRAWING

[0010] Objects and advantages together with the operation of the invention may be better understood by reference to the following detailed description taken in connection with the following illustration, wherein:

[0011] FIG. **1** is a cross-sectional view of an embodiment of an exhaust manifold in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Referring now to FIG. **1**, an exhaust manifold **10** is illustrated. The manifold **10** may include a lower half shell **20** and an upper half shell (not shown). The lower half shell **20** and the upper half shell may be integrally formed, attached, such as by welding or fastening, or otherwise joined together. The upper half shell and the lower half shell **20** may be joined to define a housing **25**.

[0013] The housing **25** may be defined between the upper half shell and the lower half shell **20**. The housing **25** may have an outlet flange **40** providing fluid communication between an interior **15** of the housing **25** and an exterior **16** of the housing **25**. The outlet flange **40** may have an opening **55** permitting fluid communication between the remainder of the exhaust system and the housing **25**. The outlet flange **40** may be sized and shaped for attachment to a remaining portion of the exhaust system (e.g. exhaust piping, turbocharger, etc.). The outlet flange **40** may be connected to the housing **25**, such as to the upper half shell and/or the lower half shell **20**. For example, the outlet flange **40** may be coupled to a first side **36** of the housing **25**. The outlet flange **40** may be integrally formed with the lower half shell **20** and/or the upper half shell. Alternatively, the outlet flange **40** may be a separate piece which is secured to one of or both of the half shells via, for example fasteners, a press-fit, welding, brazing, an adhesive or the like. In an embodiment, the upper half shell may have a portion of the outlet flange **40**, and the lower half shell **20** may have a corresponding portion of the outlet flange **40** such that joining the upper half shell and the lower half shell **20** results in formation of the outlet flange **40**.

[0014] An inlet flange **30** may be connected to the housing **25**. For example, the inlet flange **30** may be secured to one of or both of the upper half shell and the lower half shell **20** by way of fasteners, a press-fit, welding, brazing, an adhesive or in another manner that will be appreciated by a person of ordinary skill in the art. In an embodiment, the inlet flange **30** may be integrally formed with the upper half shell or the lower half shell **20** or may be separately connected to the housing **25**. The inlet flange **30** may be formed by the joining of the upper shell and the lower half shell **20**. For example the upper half shell may have a portion of the inlet flange **30** and the lower half shell **20** may have a corresponding portion of the inlet flange **30** such that joining the upper half shell and the lower half shell **20** results in formation of the inlet flange **30**.

[0015] The inlet flange **30** may be positioned adjacent to or at a second side **35** of the housing **25**, which may be adjacent to the manifold **10**. The second side **35** of the housing **25** may be opposite to the first side **36** of the housing **25** where the outlet flange **40** may be attached. In use, the inlet flange **20** may be secured to the exhaust side of a cylinder head, for example. The inlet flange **30** may comprise one or more openings **50** (or apertures). Each of the openings **50** may provide fluid communication between the interior **15** of the housing **25** and the exterior **16** of the housing **25**. The openings **50** may transmit exhaust gases from the cylinder head into the housing **25**. In an embodiment, the number of the openings **50** may correspond to the number of the exhaust ports in the cylinder head.

[0016] Alternatively, the number of the openings **50** may be greater than or less than the number of the exhaust ports in the cylinder head. In an embodiment, the inlet flange **30** may have at least one of the openings **50** receiving exhaust gases from two or more of the exhaust ports of the cylinder head. In another embodiment, the inlet flange **30** may have at least two of the openings **50** receiving exhaust gases from one of the exhaust ports of the cylinder head. A person of ordinary skill in the art should not be deemed as limited to any number of the openings **50**. The inlet flange **30** may have any number of the openings **50** and may attach to the cylinder head in any manner capable of transmitting exhaust gases from a cylinder head to the interior of the housing **25**.

[0017] One or more tubes (or pipes) **60** may be positioned within the housing **25**. The one or more tubes **60** are hereinafter referred to as "the tubes **60**" for simplicity and clarity purposes and not to limit the present invention to requiring two or more of the tubes **60**. It is clearly contemplated that "the tubes **60**" may consist of a single tube. The tubes **60** may be any shape capable of transmitting fluids, such as exhaust gases therethrough. For example, the tubes **60** may be cylindrical pipes for transmitting fluids through the housing **25**. The tubes **60** may be separated from one another such that NVH, such as noise and vibrations from one of the tubes **60** is not transmitted to another one of the tubes **60**. In addition, the tubes **60** may absorb the NVH and dampen the NVH felt or otherwise received by the upper half shell and the lower half shell **20**.

[0018] Each of the tubes **60** may be attached to the inlet flange **30**, the outlet flange **40**, and/or the housing **25**. The tubes **60** may be secured within the housing **25** via fasteners, a press-fit, welding, brazing, an adhesive or the like. The tubes **60** may be attached to or connected to the housing **25** to support the tubes, for example. Alternatively, the tubes **60** may simply rest on any suitable surface within the housing **25** or rest on mesh rings or pads **70** positioned between each tube **60** and any suitable surface within the housing **25**. The pads **70** may be attached to the upper half shell or the lower half shell **20** to support the tubes **60**.

[0019] In an embodiment, the tubes **60** may be attached at the openings **50** of the inlet flange **30**. For example, the tubes **60** may extend from the inlet flange **30** to the outlet flange **40**. In such an embodiment, the tubes **60** may be attached to the inlet flange **30** and the outlet flange **40**.

[0020] The tubes **60** may be die cast or formed by other methods and processes known to those skilled in the art. The upper half shell and the lower half shell **20** may be die cast or overmolded around the tubes **60**. In such an embodiment, the tubes **60** may be positioned within a mold at predetermined angles and lengths. The upper half shell and/or the lower half shell **20** may be cast with the tubes **60**. In such an embodiment, the tubes **60** may be integrally formed with the upper half shell and/or the lower half shell **20**.

[0021] In another embodiment, each of the tubes **60** is secured to the inlet flange **30** and terminates within the housing **25**, without attachment to the outlet flange **40**. For example, the tubes **60** may terminate a distance from the outlet flange **40**. In such an example, the distance may be sufficient for the exhaust gases to mix within the interior **15** of the housing **25** prior to exiting at the outlet flange **40**. Termination of the tubes **60** short of the opening **55** of the outlet flange **40** may permit the exhaust gases exiting the tubes **60** to mix within the housing **25** prior to passing through the opening **55** and onto other components of the exhaust assembly, such as a HEGO sensor and/or catalytic converter. Properly mixing the exhaust gases within the housing **25** prior to exiting at the outlet flange **40** may reduce inaccurate emission readings and limit problems with emissions controls.

[0022] In yet another embodiment, the tubes **60** may be attached to the outlet flange **40** without attachment to the inlet flange **30**. For example, the tubes **60** may extend from the outlet flange **40** towards the inlet flange **30** and terminate a distance from the inlet flange **30**. The tubes **60** may extend within the housing **25** without attachment to the inlet flange **30** and the outlet flange **40** in another embodiment of the present invention. In such an embodiment, the tubes **60** may terminate a first distance from the inlet flange **30** and a second distance from the outlet flange **40**. The first distance may be substantially similar to or different from the second distance.

[0023] The tubes **60** may combine embodiments herein described. For example, one of the tubes **60** may be attached to the inlet flange **30**, and another one of the tubes **60** may not be attached to the inlet flange **30** and the outlet flange **40**. To this end, the tubes **60** may have different lengths and dimensions.

[0024] The tubes **60** may have a wall structure **62** for preventing or at least limiting fluid communication from an interior **64** of the tubes **60** to the interior **15** of the housing **25**. To this end, the wall structure **62** of the tubes **60** may be metallic, plastic, or other material, preferably capable of transmitting relatively high temperature fluids therethrough. The wall structure **62** may have one or more layers separating an interior **64** of the tubes **60** from the interior **15** of the housing **25**.

[0025] In an embodiment, the wall structure **62** may have one or more apertures or perforations (not shown) for permitting fluid communication from the interior **64** of the tubes **60** into the interior **15** of the housing **25**. The perforations (or apertures) may provide limited fluid communication to the

interior **15** of the housing **25** such that a portion of the exhaust gases exit the tubes **60** into the interior **15** of the housing **25**.

[0026] The tubes **60** may be arranged such that exhaust gases flow through each of the tubes **60** towards the opening **55** of the outlet flange **40**. Advantageously, the tubes **60** may capture exhaust pulses exiting the cylinders thereby insulating the outer shell of manifold **10** from sound waves associated with these exhaust pulses leading to NVH improvement of the manifold **10** and vehicle as a whole. Furthermore, the tubes **60** may allow more flow separation of exhaust gases exiting each cylinder thereby significantly reducing, or even eliminating, NVH problems from cross-talk among cylinders. Additionally, the tubes **60** may also absorb thermal energy from the exhaust gases thereby reducing thermal energy transferred to and absorbed by other components of the manifold **10** thus improving overall durability of the manifold **10**.

[0027] In addition, the tubes **60** may be configured to provide additional NVH benefits, such as damping noise and vibration within the manifold **10** and/or tuning the manifold **10** to enhance the sound quality of the exhaust system and the entire vehicle. For example, some degree of tuning and/or damping may be possible by the appropriate selection of various physical characteristics of each tube **60**, such as length, cross-sectional shape, endform, wall structure, tube wall thickness, perforations or apertures in the wall structure of the tubes **60**, material composition, or the like.

[0028] Although the preferred embodiment of the present invention has been illustrated in the accompanying drawing and described in the foregoing detailed description, it is to be understood that the present invention is not to be limited to just the preferred embodiment disclosed, but that the invention described herein is capable of numerous rearrangements, modifications and substitutions without departing from the scope of the claims hereafter.

1. An exhaust manifold comprising:
an upper half shell;
a lower half shell secured to the upper half shell to define a housing; and
a tube positioned within an interior of the housing, the tube having a wall structure to substantially limit fluid communication between an interior of the tube and the interior of the housing.

2. The exhaust manifold of claim **1** further comprising:
an inlet flange attached to one of the lower half shell or the upper half shell, the inlet flange attachable to a cylinder head of a combustion engine.

3. The exhaust manifold of claim **2** wherein the tube is attached to the inlet flange.

4. The exhaust manifold of claim **3** further comprising:
an opening formed in the inlet flange, the openings providing fluid communication between an exterior of the housing and the interior of the housing.

5. The exhaust manifold of claim **3** further comprising:
an outlet flange attached to one of the lower half shell or the upper half shell, the outlet flange attached at an opposite side of the housing from the inlet flange.

6. The exhaust manifold of claim **5** wherein the tube extends from the inlet flange and terminates prior to the outlet flange.

7. The exhaust manifold of claim **6** wherein the tube is connected to the inlet flange at the opening of the inlet flange.

8. The exhaust manifold of claim **5** wherein the tube is connected to the inlet flange and the outlet flange.

9. The exhaust manifold of claim **5** wherein the tube extends from the outlet flange and terminates within the housing without connection to the inlet flange.

10. The exhaust manifold of claim **5** wherein the tube extends within the housing and terminates a first distance from the inlet flange and a second distance from the outlet flange.

11. An exhaust manifold comprising:
a housing including an upper half shell and a lower half shell, the housing attachable to a cylinder head of an internal combustion engine; and
a plurality of tubes positioned at least partially within the housing, the tubes having a wall structure to limit fluid communication between an interior of the tubes and the housing.

12. The exhaust manifold of claim **11** further comprising:
an inlet flange connected to the housing and securable to combustion chambers of an internal combustion engine.

13. The exhaust manifold of claim **12** wherein the inlet flange has a plurality of openings, and further wherein the tubes are equal in number to the openings in the flange.

14. The exhaust manifold of claim **12** wherein at least one of the plurality of tubes is connected to the inlet flange and extends within the housing.

15. The exhaust manifold of claim **12** wherein the plurality of tubes are within the housing without attachment to the inlet flange.

16. The exhaust manifold of claim **12** further comprising:
an outlet flange connected to the housing, the outlet flange connected at an opposite end of the housing from the inlet flange.

17. The exhaust manifold of claim **16** wherein at least one of the plurality of tubes extends from the inlet flange and terminates a distance from the outlet flange without attachment to the outlet flange.

18. A method for manufacturing an exhaust manifold assembly comprising:
forming a first half shell;
positioning a plurality of tubes within the first half shell;
connecting the first half shell to a second half shell to form a housing having an interior defined between the first half shell and the second half shell, the plurality of tubes positioned within the interior of the housing, wherein the plurality of tubes have a wall structure to limit fluid communication from the plurality of tubes into the housing along the length of each of the plurality of tubes;
connecting at least one of the shells to an inlet flange securable to a cylinder head of an engine; and
securing at least one of the tubes of the plurality of tubes to the inlet flange.

19. The method of claim **18** wherein the first half shell and the second half shell are molded over the plurality of tubes.

20. The method of claim **18** further comprising:
connecting an outlet flange to one of the shells opposite the inlet flange, wherein at least one of the tubes terminates without attachment to the outlet flange.

21. The exhaust manifold of claim **1** wherein the tube has one or more apertures providing fluid communication between the interior of the housing and the interior of the tube.

* * * * *