Feb. 16, 1965 L. I. BENJAMEN 3,169,365

APPARATUS FOR COOLING AN EXHAUST MANIFOLD

Filed March 29, 1961 2 Sheets-Sheet 1

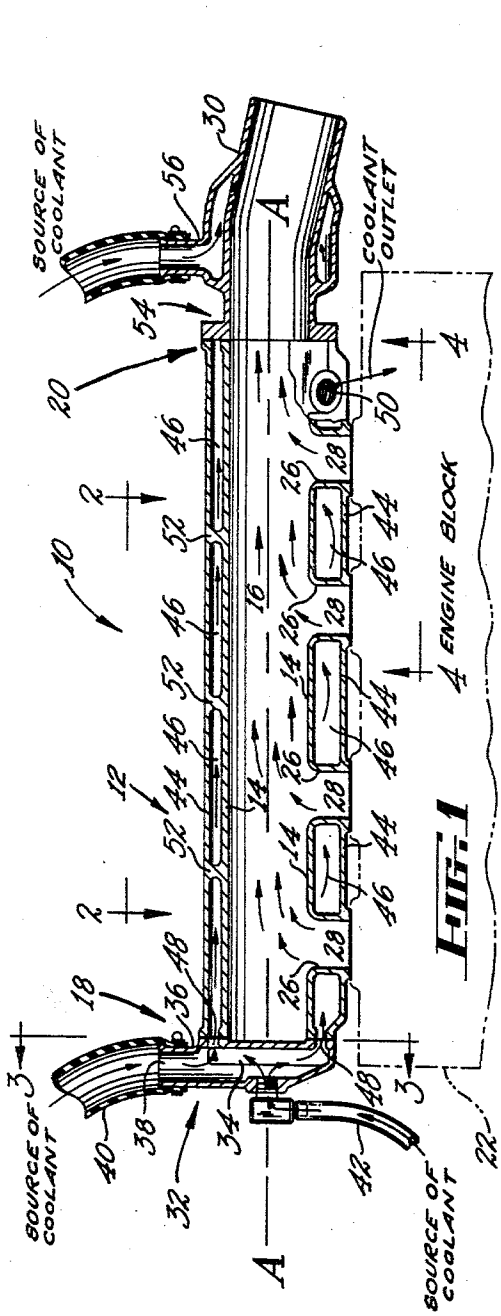

FIG. 1

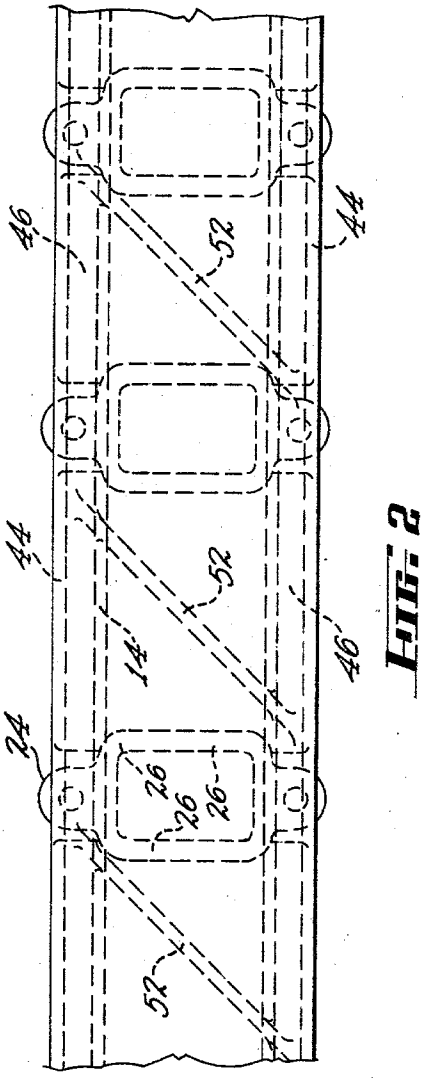

FIG. 2

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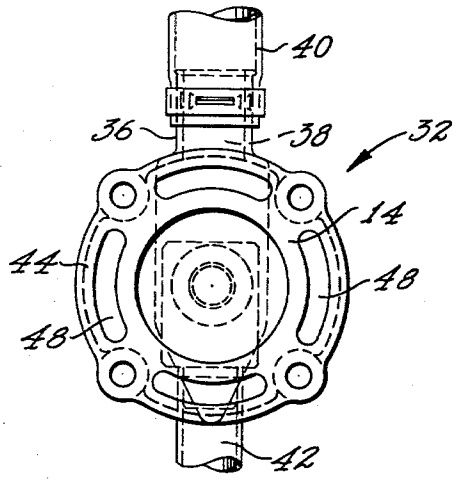

FIG. 3

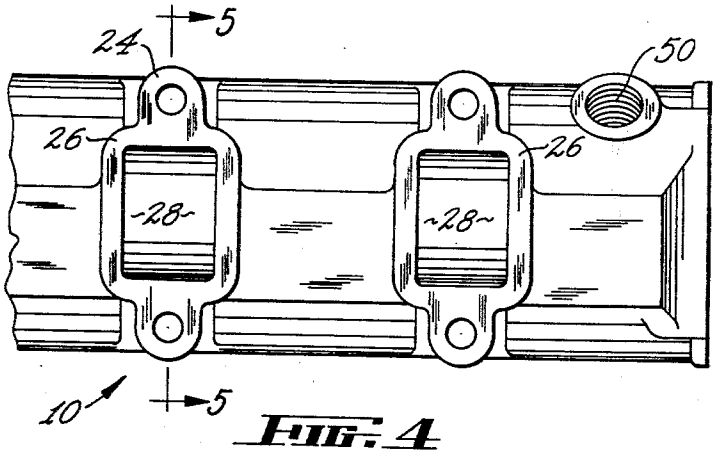

FIG. 4

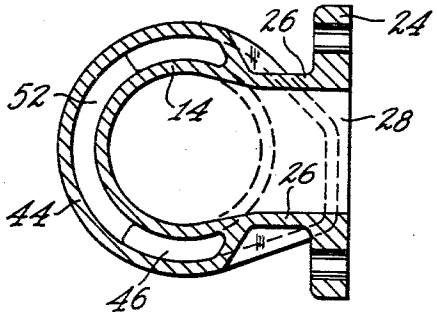

FIG. 5

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APPARATUS FOR COOLING AN EXHAUST MANIFOLD

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10 Claims. (Cl. 60—31)

This invention relates to improved apparatus for cooling an exhaust manifold, and more particularly, relates to an apparatus for cooling aluminum cast exhaust manifold by effectively dissipating the heat created therein by the exhaust gases which are passing therethrough in a manner to prevent the creation of localized hot spots, corrosive disintegration, differential heating, overheating and cracking thereof.

In exhaust manifolds wherein the exhaust gases from a combustion cylinder of an engine block are passed through a passageway in the exhaust manifold, there has long been a problem in being able to prevent localized overheating, corrosive disintegration, differential heating, hot spots and cracking of the exhaust manifold and, more particularly, the localized overheating, corrosive disintegration, differential heating, hot spots and cracking of the exhaust manifolds are greater and more prevalent when the exhaust manifolds are manufactured of a cast aluminum, or some other similar type of material.

One of the solutions in the prevention of such localized overheating, corrosive disintegration, differential heating, hot spots and cracking of exhaust manifolds has been to provide the exhaust manifold with a fluid coolant jacket and to employ water as a cooling fluid. However, when such a fluid coolant jacket is employed, it will normally take the form of a coolant chamber which is disposed about and around the passageway through which the exhaust gases pass through the exhaust manifold with the coolant chamber generally being defined by spaced apart substantially concentrically disposed wall portions. In this type of exhaust manifold, it is then necessary to provide inlet ports which convey the exhaust gases from the combustion chambers of the engine block into the exhaust gas passageway of the exhaust manifold and these exhaust gas inlet ports extend into, close off and obstruct areas of the coolant chamber so that the flow of liquid coolant therethrough is obstructed, impaired and otherwise fails to cool the inlet ports in the downstream side of the liquid coolant flow together with the parts of the exhaust manifold which are immediately adjacent thereto. In this way, the coolant fluid is not effective to cool the downstream inlet ports and the regional areas of the exhaust manifold that are adjacent thereto and does not effectively eliminate or prevent the localized overheating, corrosive disintegration, differential heating, hot spots or cracking of the exhaust manifold, since the fluid coolant is more effective on the upstream side, immediately adjacent to the obstruction created by the exhaust gas inlet ports which extend through the coolant chamber, and less effective on the downstream side thereof.

Accordingly, it is an object of this invention to provide apparatus for dissipating heat created in an exhaust manifold which will effectively prevent localized overheating, corrosive disintegration, differential heating, hot spots and cracking of the manifold.

It is also an object of this invention to provide apparatus for an exhaust manifold which enables a fluid coolant to pass in a generally helical path or swirling manner around the exhaust manifold.

It is a further object of this invention to provide apparatus for an exhaust manifold having an exhaust gas passageway and inlet ports which comprises a fluid coolant conveying chamber disposed about the exhaust gas passageway and the inlet ports in the exhaust manifold and means within the confines of the conveying chamber which induces a fluid coolant to pass therethrough in a swirling substantially helical path relative to the exhaust gas passageway.

It is also a further object of this invention to provide apparatus for dissipating heat in an exhaust manifold formed from cast aluminum, aluminum alloy, or other similar material.

An additional object of this invention is to provide an exhaust manifold with apparatus that will enable a coolant fluid to flow in a substantially continuous unobstructed helical path or swirling manner throughout the substantial length and over the substantial entire area of the exhaust manifold.

It is also an additional object of this invention to provide an exhaust manifold having a plurality of exhaust gas inlet ports disposed at longitudinal space intervals therealong with apparatus which enables a coolant fluid to flow in a swirling manner relative to the exhaust manifold and thereby substantially dissipate heat created in and adjacent the downstream inlet ports by the exhaust gases which pass through the inlet ports and the exhaust manifold in a manner which will prevent any localized overheating, corrosive disintegration, differential heating, hot spots and cracking to occur in the inlet ports and the exhaust manifold.

In order to overcome the disadvantages which exist to the known types of apparatus and methods of cooling exhaust manifolds now being employed and to accomplish the objects, as stated above, this invention provides an exhaust manifold having an exhaust gas passageway and a plurality of substantially longitudinally aligned exhaust gas inlet ports disposed at longitudinal space intervals therealong with apparatus in the form of a fluid coolant conveying chamber or jacket which substantially surrounds the exhaust gas passageway in the exhaust manifold and the inlet ports therein with the fluid coolant conveying chamber being provided with a passageway defined by baffle or web-like means disposed within the confines of the fluid coolant conveying chamber which enables the fluid coolant to pass from one end, the upstream end portion, of the exhaust manifold to the other end, the downstream end portion thereof, in a substantially continuous helical flow path or in swirling manner relative to the longitudinal axis of the exhaust manifold so that the fluid coolant will be effective to dissipate heat from the surface area of the exhaust manifold and the exhaust gas inlet ports, and particularly to both the upstream and downstream sides of the exhaust gas inlet ports which are normally defined by wall portions that extend through the fluid coolant conveying chamber and which will normally amount to and create an obstruction, impediment or hindrance to the flow of the fluid coolant through the fluid coolant conveying chamber. The provision of the baffle or web-like structure which creates the liquid coolant helical flow path or induces the liquid coolant to flow in a swirling manner through the fluid coolant conveying chamber not only enables the fluid coolant to dissipate heat from both the upstream and downstream exhaust gas inlet ports, but also enables the coolant fluid to dissipate heat throughout the longitudinal extent of the exhaust manifold and particularly, the parts thereof which are adjacent to the downstream side of the exhaust gas inlet ports so that the fluid coolant is effective in the dissipation of the heat created by the exhaust gases which pass first through the exhaust gas inlet ports and then through the exhaust gas passageway in the exhaust manifold in a manner which prevents any localized overheating, corrosive disintegration, differential heating, hot spots and cracking in the exhaust manifold and the exhaust gas inlet ports therein.

Other objects, advantages and important features of the invention will be apparent from the study of the specification following, taken with the drawing, which together describe, disclose and illustrate the preferred embodiment of the invention and what is now considered and believed to be the best mode of practicing the principals thereof. Still other embodiments, arrangements or modifications may be suggested to those having the benefit of the teachings therein, and such other embodiments, arrangements or modifications are intended to be reserved especially as they fall within the scope and breadth of the sub-joined claims.

In the drawing:

FIGURE 1 is a longitudinal sectional plan view of an exhaust manifold having apparatus, according to this invention, incorporated therewith for dissipating heat throughout the extent of the exhaust manifold in a manner which will prevent localized overheating, corrosive disintegration, differential heating, hot spots and cracking therein;

FIGURE 2 is an enlarged partial side longitudinal elevational view taken along the line 2—2 of FIGURE 1 looking in the direction of the arrows.

view of the upstream side of the exhaust manifold and

FIGURE 3 is an enlarged and elevational sectional view of the upstream side of the exhaust manifold and apparatus as illustrated in FIGURE 1, taken along the line 3—3 and looking in the direction of the arrows therein;

FIGURE 4 is an enlarged partial isometric side longitudinal elevational view of the exhaust manifold and apparatus as illustrated in FIGURE 1 taken along the line 4—4 looking to the direction of the arrows therein, and

FIGURE 5 is an end elevational sectional view of the downstream side of the exhaust manifold and apparatus of the invention, taken along the line 5—5 of FIGURE 4 looking in the direction of the arrows.

Attention is now directed to FIGURE 1 of the drawing wherein there is illustrated an elongated substantially cylindrical exhaust manifold **10** and apparatus **12** for cooling the exhaust manifold **10**, as will be explained in more detail hereinafter.

The exhaust manifold **10** is preferably formed of cast aluminum, or some other like material, wherein the exhaust gases which pass therethrough will normally, in the absence of the apparatus **12**, create localized overheating, corrosive disintegration, differential heating throughout the extent of the exhaust manifold, hot spots, etc. or the like, with the result being that the exhaust manifold **10** will fail to properly function by reason of cracks and/or holes being created therein.

A wall portion **14** defines a substantially cylindrical elongated unobstructed open ended exhaust gas passageway **16** which may extend throughout the full longitudinal extent of the exhaust manifold **10** from one end portion **18** to the other end portion **20**, hereinafter referred to as the upstream and the downstream sides of the exhaust manifold **10**, respectively.

The exhaust manifold **10** and the apparatus **12** are removably secured to an engine block **22**, shown schematically, by suitable securing means **24**, which may be in the form of lug portions that are integral with the wall portion **14**, as illustrated in FIGURES 2 and 5 of the drawing.

It is to be noted that the wall portion **14** has that part thereof which is away from the engine block **22** formed substantially continuous and unobstructed while that part of the wall portion **14** which is closest to the engine block **22** is provided with a plurality of outwardly extending wall portions **26** which define a plurality or series of longitudinally aligned exhaust gas inlet ports **28** which are disposed at longitudinal space intervals therealong and which place the combustion chambers of the engine block **22** in communication with the exhaust gas passageway **16** in the exhaust manifold **10** through which

the exhaust gases pass to an exhaust pipe **30**. It is to be noted that in the passage of the exhaust gases from the combustion chamber of the engine block **22** to the exhaust pipe **30**, as indicated by the arrows in FIGURE 1 of the drawing, that after the exhaust gases leave the inlet ports **28** there is an abrupt change in the direction in the flow of the exhaust gases with such change being substantially 90 degrees from the flow of the exhaust gases through the inlet ports **28** and it is this abrupt change in the flow of the exhaust gases which normally creates and maintains a heat differential, corrosive disintegration, localized overheating and hot spots in the exhaust manifold **10** in the regional areas of the inlet ports **28**.

In order to dissipate, eliminate and otherwise prevent the localized overheating, corrosive disintegration, differential heating and hot spots in the wall portion **14** of the exhaust manifold **10** and in the wall portions **26** of the inlet ports **28**, the apparatus **12** is provided to effectively cool the surface of the wall portion **14** of the exhaust manifold **10** throughout substantially the entire surface extent thereof and particularly the wall portions **26** of the inlet ports **28** and the regional areas of the wall portion **14** which are adjacent to the wall portions **26**.

The apparatus **12** comprises a header device **32** which closes off the upstream side **18** of the exhaust gas passageway **16** of the exhaust manifold **10**. The header device **32** is provided with a chamber **34** and a neck portion **36** having an opening **38** therein to which there may be connected a conduit **40** for placing the chamber **34** in communication with a source of fluid coolant, as indicated by the legend in FIG. 1 of the drawing. The header device **32** may also be provided with a centrally disposed opening which may be connected to conduit **42**, in a somewhat conventional manner, to introduce additional coolant as required by thermal system considerations.

The apparatus **12** further comprises an outer wall portion **44** which is disposed in outwardly spaced relationship relative to the wall portion **14** of the exhaust gas passageway **16** of the exhaust manifold **10** and defines with the wall portion **14** a cooling jacket having a fluid coolant conveying chamber **46** which is in communication through openings **48** with the chamber **34** of the header device **32**.

It is to be noted that the wall portions **26** which define the inlet ports **28** extended between the spaced apart wall portions **14** and **44** and through the fluid coolant chamber **46** and in effect constitute and create obstructions, impediments and obstacles to a flow of fluid coolant from the upstream side **18** (the left side of FIGURE 1) to the downstream side **20** (the right side of FIGURE 1) of the exhaust manifold **10** so that in absence of other structure, a flow of fluid coolant from the chamber **34** of the header device **32** through the openings **48** into the fluid coolant chamber **46** and then to an outlet **50** would be impaired, obstructed and otherwise fail to sufficiently cool the downstream inlet ports **28**, the downstream side of the wall portions **26** of the inlet ports **28** together with the regional areas of the wall portion **14** which are adjacent thereto so that the fluid coolant would not be effective in cooling the exhaust manifold **10**.

In order that the downstream inlet ports **28**, the downstream wall portions **26** of the inlet ports **28** and the regional areas of the wall portion **14** of the exhaust manifold **10** which are immediately adjacent thereto may be effectively cooled, there is provided baffle or web-like means **52** which as illustrated in FIGURES 1 and 5 of the drawing, preferably comprises elongate structure such as a series or arrangement of a plurality of substantially straight members disposed within the confines of the fluid conveying chamber **46** and extending generally longitudinally therethrough in substantially parallel relationship to each other and generally circumferentially about the exhaust gas passageway **16** at locations along the chamber **46** which may be laterally opposed to and intermediate of adjacent ones of the exhaust gas inlet ports

28 with the structure 52 being in circumferentially offset relationship relative to the inlet ports 28, note FIG. 5 of the drawing. The baffle-like or web-like structure 52, in effect, extends from adjacent the upstream side 18 to adjacent the downstream side 20 of the exhaust manifold 10 and will induce or create a substantially continuous helical flow path or flow in a swirling action for the fluid coolant relative to the longitudinal axis A—A of the exhaust manifold 10 with the helical flow path or swirling action of the coolant fluid being effective to sufficiently cool not only the surface area of the wall portion 14 of the exhaust manifold 10, but also highly effective in cooling the downstream inlet ports 28, the upstream and the downstream sides of the wall portions 26 of the inlet ports 28 and the regional areas of the wall portion 14 of the exhaust manifold 10 which are adjacent thereto in a manner which will eliminate and prevent localized overheating, differential heating, hot spots and cracking of the wall portion 14 of the exhaust manifold 10 and wall portions 26 of the inlet ports 28.

In actual practice, it has been found most desirable and the best results have been acquired when the series or arrangement of baffle like or web-like means 52 is disposed at an inclined angle of approximately 45 degrees from the longitudinal axis A—A. However, it is to be understood that the series or arrangement of the baffle-like or web-like means 52 may be disposed or inclined relative to the axis A—A at other angles than that of approximately 45 degrees, longitudinally positioned at other locations which may be laterally opposed to or in other ways circumferentially offset relative to the inlet ports 28 and, if desired, being symmetrically curved or helically shaped or in non-parallel or curved relationship relative to each other so long as the series or arrangement of the baffle-like or web-like means 52 will be sufficiently inclined, disposed and positioned to induce or create the desired substantially continuous helical flow path or swirling action in the fluid coolant from the upstream side 18 to the downstream side 20 of the exhaust manifold 10 as the fluid coolant passes through the fluid coolant conveying chamber 46.

It is to be noted that the wall portion 44 of the apparatus 12 is spaced from the wall portion 14 of the exhaust manifold 10 a greater distance adjacent to the wall portions 26 of the inlet ports 28 than the spacing between the wall portions 44 and 14 along the part of the exhaust manifold 10 which is laterally opposed thereto so that the cross-sectional area of the fluid coolant passageway in the fluid coolant conveying chamber 46 is substantially equal throughout the full extent thereof.

As illustrated, a connector 54 may be provided at the downstream side 20 of the exhaust manifold 10 for connecting the exhaust pipe 30 thereto and, if desired, suitable fluid coolant structure 56 may be provided for cooling the exhaust pipe 30 adjacent to the connector 54.

Also, as illustrated, and in the preferred embodiment of the invention, the exhaust manifold 10 and the apparatus 12 are formed integral as a unitary structure with the wall portion 14, the wall portions 26, the wall portion 44, the baffle-like structure 52, the securing means 24, the outlet 50 etc., all being preferably cast from aluminum, or some other like material.

From the above description and disclosure, it is believed that the apparatus 12 enables the fluid coolant to pass about the wall portion 14 of the exhaust manifold 10 and the wall portions 26 of the inlet ports 28 in a substantially continuous helical flow path or swirling action that will assure the cooling of the surface area of the wall portion 14 of the exhaust manifold 10 together with the downstream inlet ports 28 as well as the upstream and downstream sides of the wall portions 26 of the inlet ports 28 and the regional areas of the wall portion 14 of the exhaust manifold 10 that are immediately adjacent thereto in a manner which will effectively dissipate the heat therefrom so that localized overheating, corrosive disintegration, differential heating and hot spots will be eliminated and prevented.

While the invention has been described and disclosed in terms as of the preferred embodiment, which it has assumed in practice, the scope of the invention should not be deemed to be limited to the precise embodiment herein shown, illustrated, described and disclosed, and it is to be understood that other such embodiments, arrangements or modifications are intended to be reserved especially as they fall within the scope of the claims herein subjoined.

I claim:

1. In an exhaust manifold having an exhaust gas passageway, a fluid coolant conveying chamber and an exhaust gas inlet port extending from said exhaust gas passageway through the fluid coolant conveying chamber to create an obstruction therein to the flow of fluid coolant therethrough, the improvement comprising, in combination with said fluid coolant conveying chamber, apparatus for inducing a fluid coolant to flow with swirling action through the fluid coolant conveying chamber, said apparatus comprising baffle-like means disposed within the fluid coolant conveying chamber and extending therethrough and terminating at locations therein which are circumferentially offset relative to the exhaust gas inlet port.

2. In combination with an exhaust manifold having an exhaust gas passageway and a plurality of exhaust gas inlet ports, apparatus for cooling the inlet ports as well as the exhaust manifold, said apparatus comprising a fluid coolant conveying chamber substantially surrounding the inlet ports and the exhaust gas passageway, a device for placing a source of fluid coolant in communication with said fluid coolant conveying chamber, and means disposed within the confines of the fluid coolant conveying chamber for inducing fluid coolant to flow in a substantially swirling manner relative to the exhaust gas passageway from one end portion to the other end portion of the fluid coolant conveying chamber, said baffle-like means comprising an arrangement of elongate members disposed in spaced apart relationship relative to each other and in circumferentially offset relationship relative to the inlet ports which are adjacent thereto.

3. In combination with an exhaust manifold having a plurality of longitudinally aligned spaced apart exhaust gas inlet ports and an exhaust gas passageway therethrough, apparatus for cooling the inlet ports as well as the exhaust manifold, said apparatus comprising a fluid coolant conveying chamber disposed about the inlet ports and the exhaust gas passageway, a device for placing a source of fluid coolant in communication with said fluid coolant conveying chamber, and structure within the confines of the fluid coolant conveying chamber for inducing fluid coolant to flow from one end portion to the other end portion thereof with swirling action relative to the exhaust gas passageway to effectively cool the inlet ports which may be positioned to the downstream side of the exhaust manifold, said structure comprising a plurality of spaced apart elongate members each being disposed in circumferentially offset relationship relative to the inlet ports which are adjacent thereto.

4. An exhaust manifold comprising elongate substantially cylindrical inner and outer spaced apart wall portions, said inner wall portion defining an exhaust gas passageway, said inner and outer wall portions defining a fluid coolant chamber disposed about said exhaust gas passageway, a plurality of longitudinally aligned spaced apart exhaust gas inlet ports for placing the exhaust gas passageway in communication with combustion chambers of an engine, said exhaust gas inlet ports each being defined by a wall portion extending through the fluid coolant chamber, a device disposed adjacent one end portion of the exhaust manifold for placing fluid coolant in communication with the fluid coolant chamber, and apparatus for inducing swirling action in the flow of said

fluid coolant through said fluid coolant chamber, said apparatus comprising a plurality of spaced apart baffle-like structures, each of said structures being disposed within the confines of the fluid coolant chamber at a location therein which is circumferentially offset relative to the exhaust gas inlet ports that are adjacent thereto.

5. Apparatus for effectively cooling an exhaust manifold having an exhaust gas inlet port and an exhaust gas passageway, said apparatus comprising a fluid coolant conveying chamber disposed about the passageway and the inlet port, and an arrangement of a series of elongate spaced apart baffle-like structures disposed within the confines of the fluid coolant conveying chamber in offset relationship relative to the inlet port for inducing a fluid coolant passing therethrough to flow in a swirling manner relative to the exhaust gas passageway and about the exhaust gas inlet port.

6. In an exhaust manifold having an exhaust gas passageway, a fluid coolant conveying chamber disposed about said exhaust gas passageway and an exhaust gas inlet port which creates an obstruction to the flow of fluid coolant disposed within the confines of the fluid coolant conveying chamber, the improvement comprising, in combination with said fluid coolant conveying chamber,

apparatus for inducing fluid coolant to flow with a swirling action through the fluid coolant conveying chamber relative to the exhaust gas passageway and about the obstruction in the fluid coolant conveying chamber,

said apparatus comprising

an elongate baffle-like structure disposed within the confines of the fluid coolant conveying chamber and extending therethrough at a location therein which is circumferentially offset relative to the obstruction created by the exhaust gas inlet port.

7. In combination with an exhaust manifold having an exhaust gas inlet port and an exhaust gas passageway therethrough,

apparatus for cooling the inlet port as well as the exhaust manifold, said apparatus comprising

a fluid coolant conveying chamber extending about the exhaust gas inlet port and the exhaust gas passageway,

said fluid coolant conveying chamber having a cross-sectional area which is substantially equal throughout the extent thereof and a cross-sectional configuration which varies at location therealong, and

structure for inducing fluid coolant to flow with a swirling action through the fluid coolant conveying chamber,

said structure comprising

an arrangement of baffle-like means disposed within the confines of the fluid coolant conveying chamber in circumferentially offset relationship relative to the exhaust gas inlet port.

8. In combination with an exhaust manifold having exhaust gas inlet ports and an exhaust gas passageway therethrough,

apparatus for cooling the inlet ports as well as the exhaust manifold, said apparatus comprising

a fluid coolant conveying chamber extending about the exhaust gas inlet ports and the exhaust gas passageway,

said fluid coolant conveying chamber having a cross-sectional area which is substantially equal throughout the extent thereof and a cross-sectional configuration which varies therealong, and

structure for inducing a fluid coolant to flow through the fluid coolant conveying chamber with a swirling action relative to the exhaust gas passageway and about the inlet ports,

said structure comprising

a plurality of elongate members disposed within the confines of the fluid coolant conveying chamber in spaced relationship relative to each other and in circumferentially offset relationship relative to the inlet ports which are adjacent thereto.

9. In an exhaust manifold having an exhaust gas passageway, a fluid coolant conveying chamber disposed about the exhaust gas passageway and a plurality of exhaust gas inlet ports extending from said exhaust gas passageway through the fluid coolant conveying chamber, the improvement comprising, in combination with said fluid coolant conveying chamber, apparatus for inducing fluid coolant to flow through the fluid coolant conveying chamber in a substantially swirling manner relative to the exhaust gas passageway and about said inlet ports, said apparatus comprising a series of elongate baffle-like structures disposed within the fluid coolant conveying chamber and extending therethrough from adjacent one end portion of the exhaust gas passageway to adjacent the other end portion thereof, said structures being positioned in circumferentially offset relationship relative to the inlet ports and in spaced relationship relative to each other.

10. An exhaust manifold comprising inner and outer spaced apart wall portions, said inner wall portion defining an exhaust gas passageway, said inner and outer wall portions defining a fluid coolant chamber, an inlet port extending through said fluid coolant chamber for placing the exhaust gas passageway in communication with a combustion chamber of an engine, a device for placing fluid coolant in communication with the fluid coolant chamber, and apparatus for inducing a fluid coolant to flow through said fluid coolant chamber in a swirling manner relative to the exhaust gas passageway and about the inlet port, said apparatus comprising an arrangement of baffle-like means disposed within the confines of the fluid coolant chamber in circumferentially offset relationship relative to the inlet port.

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