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(54) **INTEGRATED INTAKE MANIFOLD AND
HEAT EXCHANGER**

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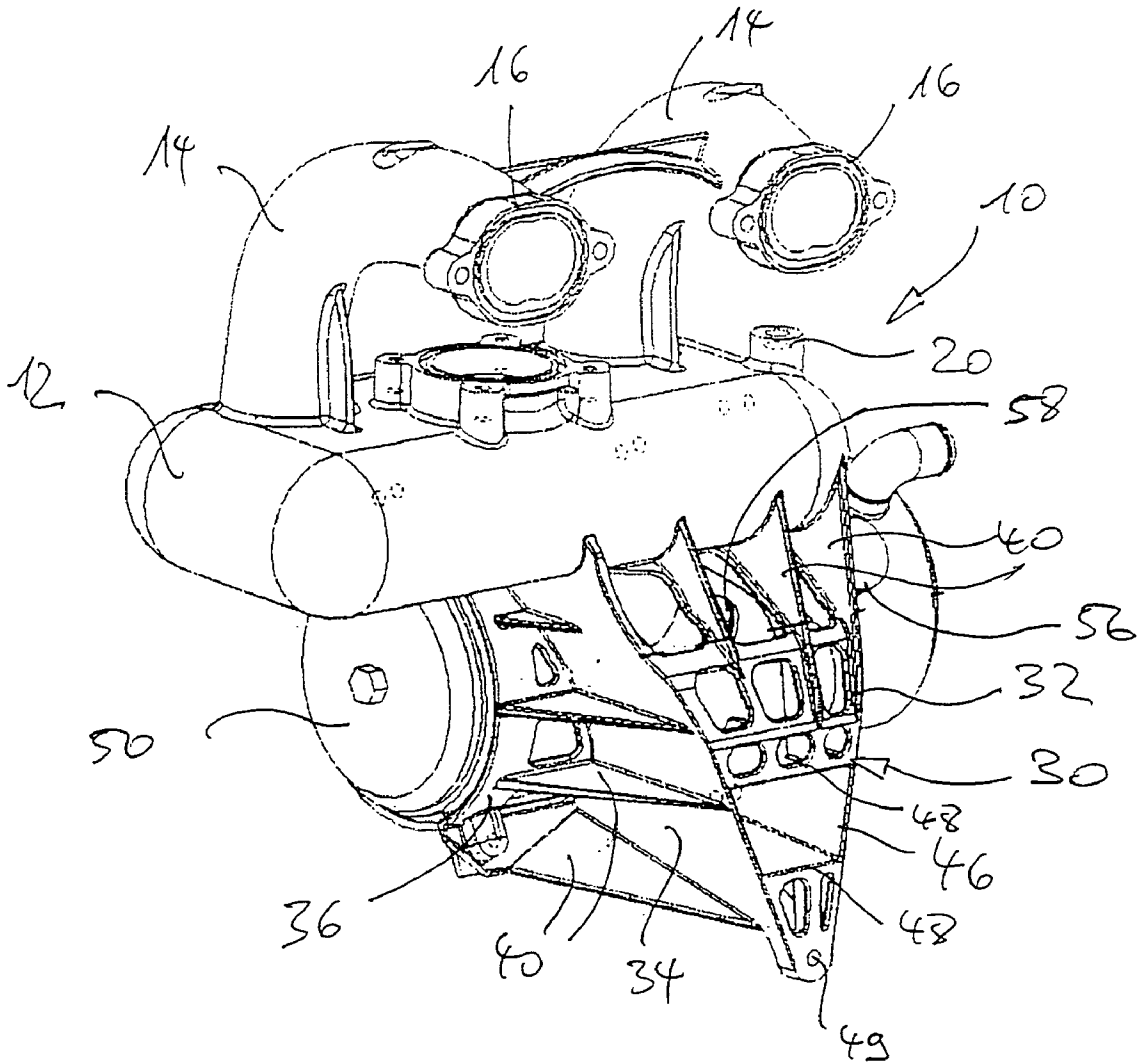
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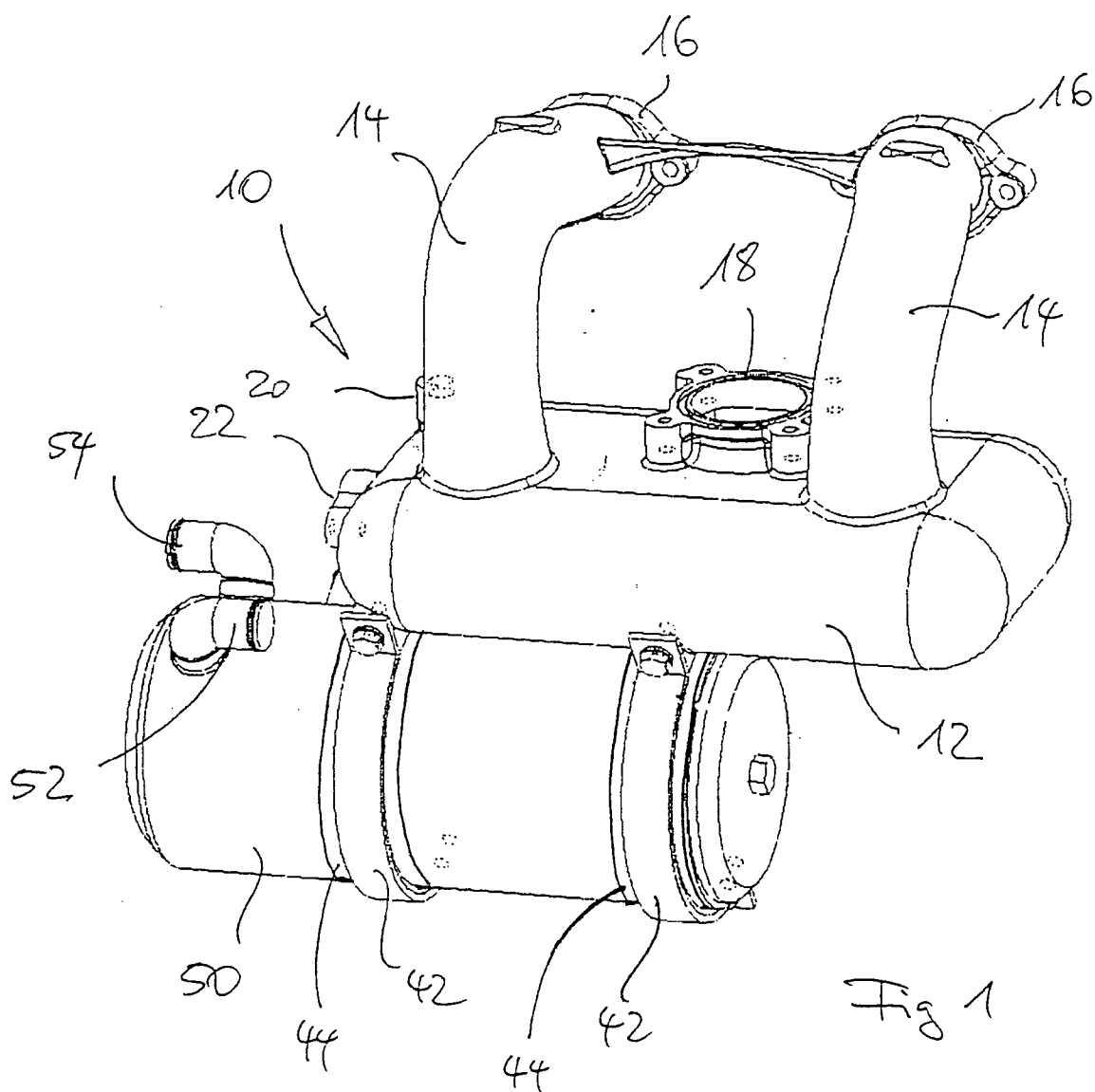
(57) **ABSTRACT**

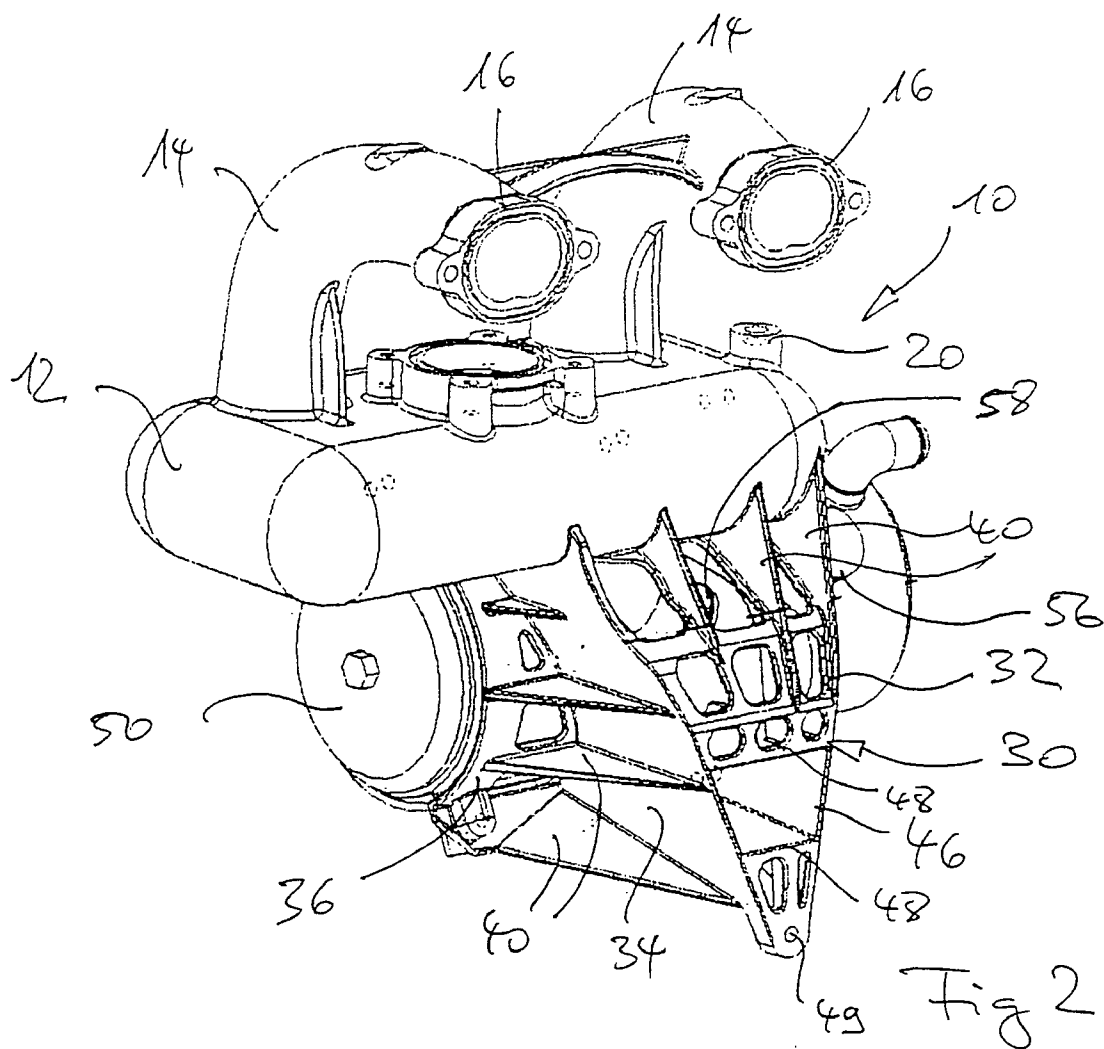
Intake manifold for an internal combustion engine with a heat exchanger fastened to the intake manifold. An internal combustion engine characterized by a heat exchanger fastened to the intake manifold.

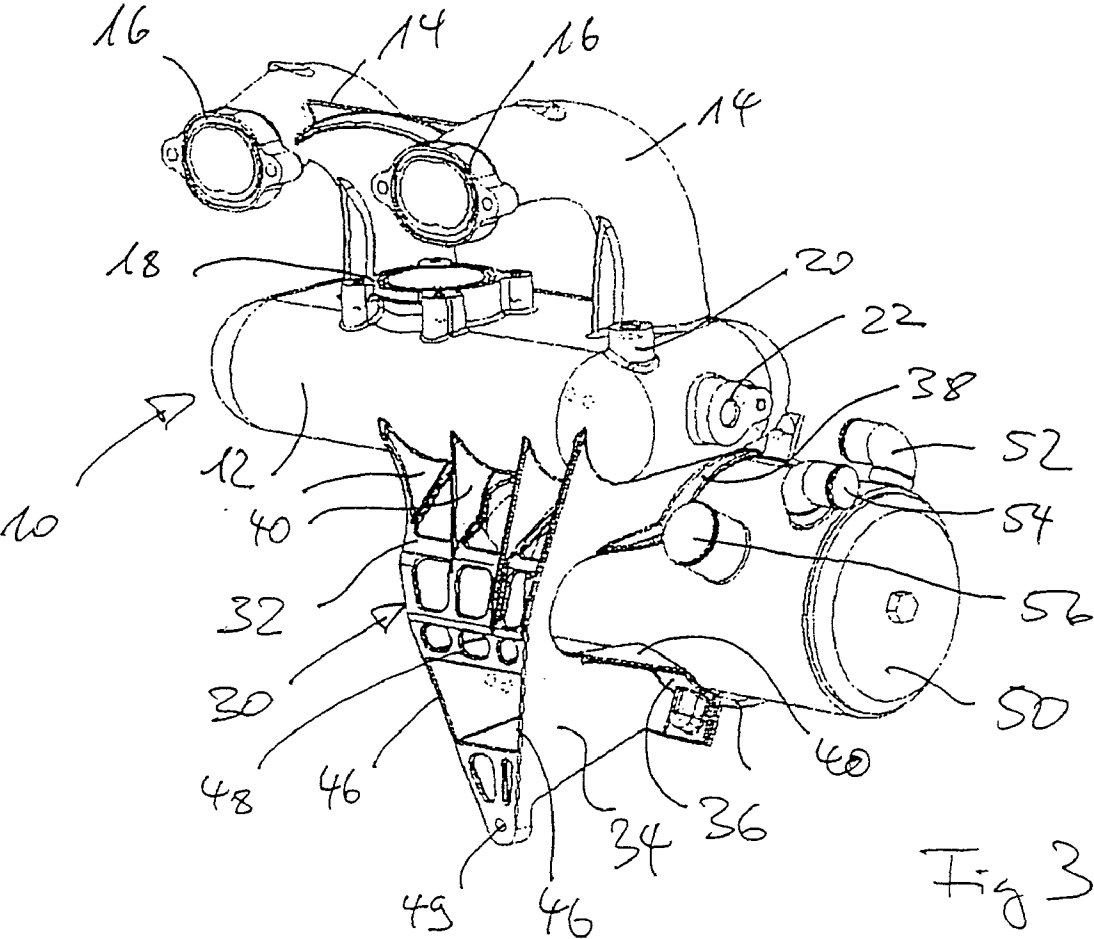
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INTEGRATED INTAKE MANIFOLD AND HEAT EXCHANGER

RELATED APPLICATIONS

[0001] This application is related to and claims priority to U.S. Provisional Patent Application No. 60/450,103, filed on Feb. 25, 2003, the entire disclosure of which is hereby incorporated by reference.

[0002] This application is also related to and claims priority to German Patent Application No. 102 35 190.2, filed on Jul. 26, 2002, the entire disclosure of which is hereby incorporated by reference.

FIELD OF THE INVENTION

[0003] The present invention relates generally to integrating a heat exchanger with an intake manifold. More particularly, the present invention relates to an intake manifold connected to a heat exchanger for an internal combustion engine for marine applications.

BACKGROUND OF THE INVENTION

[0004] With internal combustion engines, the waste heat developed in the engine must be reliably transferred to the surroundings under all conditions via suitable cooling means. With internal combustion engines for marine applications, especially internal combustion engines for watercraft, boats or recreational sporting equipment such as personal watercraft, cooling takes place either directly through the ocean/lake water in an open-loop cooling circuit, or through a closed-loop cooling circuit with a cooling agent/ocean water heat exchanger. For known internal combustion engines with closed loop cooling circuits, the heat exchanger is mounted to the chassis or hull.

SUMMARY OF THE INVENTION

[0005] According to the invention, the heat exchanger is no longer tightly attached to the boat, but to the engine. For this design, the invention provides for a holding fixture useful for supporting a heat exchanger attached to, or integrated with, an intake manifold of an internal combustion engine.

[0006] Thus, according to the invention, the heat exchanger is attached directly to the air intake manifold of the internal combustion engine. This is advantageous because previously required additional holders are no longer necessary and an additional interface between engine and boat, with costly hosing and line arrangement, is avoided.

[0007] By preference, the intake manifold subject to the invention has a holding device to support the heat exchanger. This design allows the holding device to be formed as a single piece with the intake manifold, minimizing the assembly effort.

[0008] To achieve best possible seating of the heat exchanger in the holding device of the intake manifold, the holding device, in accordance with the design of the invention, has a support with its form adapted to that of the heat exchanger for positive-locking of the heat exchanger in the holding device. To reduce vibrations, vibration-damping elements can be included in the holding device.

[0009] As a further particular design advantage of the invention, the holding device of the intake manifold subject to the invention is, at the same time, also shaped as a support element to support the intake manifold on an engine block of the internal combustion engine. Thus, the holding device fulfills the additional purpose of a support for the intake manifold against the engine block. This design increases the stability of the engine layout and suppresses vibrations. As a design advantage, the holding device is fitted with reinforcement fins.

DESCRIPTION OF THE DRAWINGS

[0010] **FIG. 1** is a perspective view of the intake manifold and heat exchanger emphasizing the capacity buffer and heat exchanger.

[0011] **FIG. 2** is a perspective view of the intake manifold and heat exchanger emphasizing the holding device.

[0012] **FIG. 3** is a different perspective view of the intake manifold and heat exchanger emphasizing the holding device.

DETAILED DESCRIPTION

[0013] The invention provides for an intake manifold **10** for an internal combustion engine, characterized by a heat exchanger **50** that is connected to the intake manifold **10**, and an internal combustion engine for marine applications with the heat exchanger **50** connected to the intake manifold **10**. The intake manifold **10** of an internal combustion engine may be characterized by a holding fixture **30** to support the heat exchanger **50**. The holding fixture **30** may be formed as a single piece with the intake manifold **10**. In order to achieve a form-fit support of the heat exchanger **50** in the holding fixture **30**, the contours of the holding fixture **36, 38** may be adapted to the shape of the heat exchanger **50**. Concurrently, the holding fixture **30** may be formed as a supporting element **46** for support of the intake manifold **10** to an engine block of the internal combustion engine.

[0014] As an example version of the invention, **FIG. 1** schematically represents the intake manifold **10** with a capacity buffer **12**, from which two curved suction arms **14** project upwards as shown in **FIG. 1**. On the ends facing away from the intake plenum or capacity buffer **12**, the intake runners or passages **14** are fitted with flanges **16** for connection of the intake manifold **10** to an engine (not shown). Located on the capacity buffer **12** between the two suction arms **14** is an opening with a flange **18** used for connection of a (not shown) throttle unit. Further provided on the capacity buffer **12**, are openings and flanges **20, 22**, which are intended for a pressure connection and the connection of a temperature sensor.

[0015] Below the capacity buffer **12** of the intake manifold **10**, the holding device **30** subject to the invention projects off of the capacity buffer **12**, which is preferably shaped as a single unit with the intake manifold **10**, as shown in **FIG. 2**.

[0016] The base corpus **32** of the holding device **30** consists primarily of two side walls **34** that face downward from the capacity buffer **12** and generally have a C-shaped base surface. In the upper and lower section of the C-shape on the side walls **34** are concave surfaces that form the seat **36, 38** for a primarily cylinder-shaped heat exchanger **50**.

The concave surfaces within the area from the C-ends of the holding device **30** can be formed separately as in **FIG. 3**, or connected with each other as in **FIG. 2**. Additionally, the holding device **30** is fitted with several reinforcement fins **40** to increase stability.

[0017] For attachment of the heat exchanger **50** in the seat **36, 38** of the holding fixture **30**, straps as well as clamps **42** are provided for as shown in **FIG. 1**. In order to reduce vibrations, rubber matting or rubber straps **44** can be placed under the attachment clamps **42** as indicated in **FIG. 1**. In the same manner, the concave surfaces of the seat **36, 38** can be laid out with rubber linings.

[0018] On the side facing away from the heat exchanger **50**, the holding device **30**, according to the invention, is designed to be supported against an engine block of the (not shown) internal combustion engine. For this purpose, the edges **46** from the side walls **34** of the holding device **30** pointing away from the heat exchanger **50** as well as the struts **48** arranged in between are adapted in their form so that a positive form-fit is achieved. At its lowest point, the holding device **30** is fitted with a bore **49**, which is used to bolt it together with the engine block.

[0019] The heat exchanger **50** has similar connections **52, 54** for intake and outlet of ocean/lake water, as well as connections **56, 58** for intake and outlet of cooling agent.

What is claimed is:

1. An assembly comprising:
 - an engine; and
 - a holding fixture coupled to the engine, the holding fixture having a surface for mounting a heat exchanger thereto.
2. The assembly according to claim 1 wherein the mounting surface of the holding fixture has a C shape.
3. The assembly according to claim 1 wherein the holding fixture is fitted with reinforcement fins.
4. The assembly according to claim 1 further comprising a pair of straps for securing the heat exchanger to the holding fixture.
5. The assembly according to claim 4 further comprising vibration dampening elements located between the heat exchanger and the straps.
6. The assembly according to claim 5 wherein the vibration dampening elements are rubber strips.
7. The assembly according to claim 1 wherein the holding fixture is directly coupled to an input manifold of the engine.
8. The assembly according to claim 7 wherein the holding fixture is integral with the intake manifold.

9. The assembly according to claim 7 wherein the holding fixture is separate from the intake manifold.

10. The assembly according to claim 1 wherein the surface for mounting the heat exchanger is complementary to the shape of the heat exchanger.

11. An assembly comprising:

a heat exchanger mounting bracket coupled to an engine, the heat exchanger mounting bracket comprising:

a seat section configured to accommodate an exterior surface of the heat exchanger, the seat section located on a side of the engine.

12. The assembly according to claim 11 wherein the seat section has a C shape.

13. The assembly according to claim 11 wherein the mounting bracket is fitted with reinforcement fins.

14. The assembly according to claim 13 further comprising a pair of straps for securing the heat exchanger to the mounting bracket.

15. The assembly according to claim 14 further comprising vibration dampening elements located between the heat exchanger and the straps.

16. The assembly according to claim 15 wherein the vibration dampening elements are rubber strips.

17. The assembly according to claim 11 wherein the mounting bracket is directly coupled to an input manifold of the engine.

18. The according to claim 17 wherein the mounting bracket is integral with the intake manifold.

19. The assembly according to claim 17 wherein the mounting bracket is separate from the intake manifold.

20. The assembly according to claim 11 wherein the surface for mounting the heat exchanger is complementary to the shape of the heat exchanger.

21. A watercraft comprising:

a hull;

a deck located I the hull;

a propulsion device carried by the hull for propelling the watercraft;

an engine positioned within the hull, the engine driving the propulsion device; and

a heat exchanger mounting bracket coupled to the engine, the heat exchanger mounting bracket having a seat section configured to accommodate an exterior surface of the heat exchanger, the seat section located on a side of the engine.

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