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(54) **Arrangement to control coolant flow in an engine**

(57) An arrangement (10) to control coolant flow in an engine comprising a coolant cavity (14) having a coolant inlet (34) and a coolant outlet 36 for flow of a coolant; an oil cooler matrix (16) positioned in the coolant cavity (14) and having a channel (46a, 46b) for circulation of oil; and at least one baffle (18) arranged in the coolant cavity (14) to direct the flow of the coolant (14) through the coolant cavity. A method of controlling coolant flow in an engine comprising circulating a coolant through a coolant cavity (14), the coolant cavity (14) having an oil cooler matrix (16); and directing flow of the coolant through the coolant cavity (14) by a baffle (18) arranged in the coolant cavity (14).

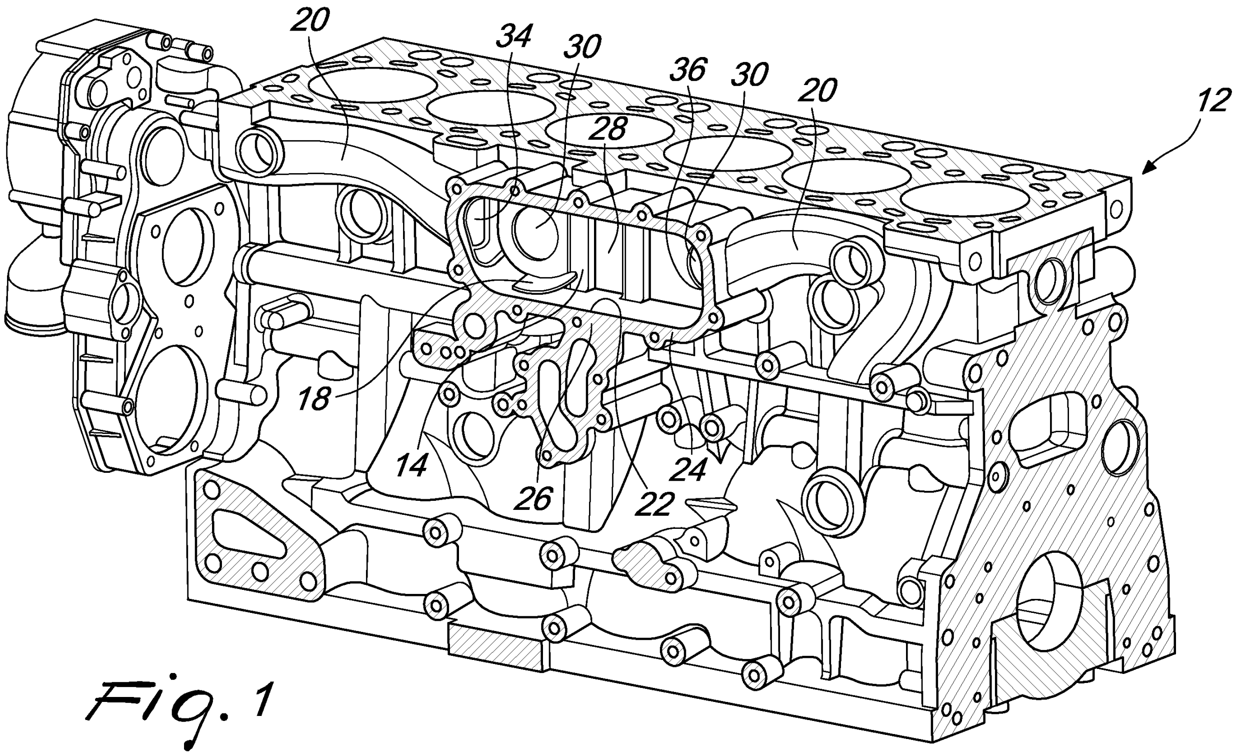

Fig. 1

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Description

Technical Field

[0001] This disclosure relates generally to engines of vehicles and machines, for instance generators. This disclosure relates particularly to coolant flow in engines of vehicles.

Background

[0002] Cooling of an internal combustion engine may be needed due to high temperatures which may be generated in the engine. Some of the heat generated in the combustion engine may be transferred to the walls of the engine. The high temperatures may damage parts of the engine or the materials within the engine.

[0003] During operation of an engine, the engine may be kept in operative mode by using a coolant. The coolant may transport the heat away from a heat source in order to prevent overheating of the engine. Some engines may have an oil cooler to cool the engine oil. Heat from the engine oil may be transferred to the coolant for dissipation of heat through a radiator.

[0004] An internal combustion engine may include an engine block. An engine block may be machine cast and are usually made from cast iron or, in modern engines, aluminium and magnesium. The engine block may contain cylindrically bored holes to accommodate the pistons of a multi-cylinder combustion engine. The engine block may comprise points of attachments or recesses for the attachment of engine components for instance the cylinder head, crankcase, engine mounts, drive housing, engine ancillaries and the oil cooler. The engine block may also comprise passages for coolants and lubricants and may have a cast pocket to receive the oil cooler.

[0005] Generally the size and shape of the points of attachments and recesses within the engine block may not be easily changed, as machining facilities would require extensive modification. Hence, an oil cooler and the cast pocket in the engine block may be produced with assembly clearances to prevent the oil cooler from fouling on the cast pocket during assembly of the engine block. However, the assembly clearance permits an easy flow of coolant away from the oil cooler in an assembled engine and the transfer of heat from the oil cooler to the coolant may not be optimal.

[0006] The present disclosure is directed, at least in part, to improving or overcoming one or more aspects of the prior art system.

Brief Summary of the Invention

[0007] In a first aspect, the present disclosure describes an arrangement to control a flow in an engine comprising a coolant cavity having a coolant inlet and a coolant outlet for flow of a coolant; an oil cooler matrix positioned in the coolant cavity and having a channel for circulation of oil; and at least one baffle arranged in the coolant cavity to direct the flow of the coolant through the coolant cavity.

[0008] In a second aspect, the present disclosure describes a method of controlling coolant flow in an engine comprising circulating a coolant through a coolant cavity, the coolant cavity having an oil cooler matrix; and directing flow of the coolant through the coolant cavity by a baffle arranged in the coolant cavity.

[0009] Other features and advantages of the present disclosure will be apparent from the following description of various embodiments, when read together with the accompanying drawings.

Brief Description of the Drawings

[0010] The foregoing and other features and advantages of the present disclosure will be more fully understood from the following description of various embodiments, when read together with the accompanying drawings, in which:

Fig. 1 is a schematic representation of an engine block according to the present disclosure;
Fig. 2 is a isometric view of an oil cooler matrix according to the present disclosure;
Fig. 3 is a first embodiment of a baffle according to the present disclosure;
Fig. 4 is a second embodiment of a baffle according to the present disclosure;
Fig. 5 is schematic representation of a first embodiment of a baffle arrangement in the coolant cavity;
Fig. 6 is schematic representation of a second embodiment of a baffle arrangement in the coolant cavity;
Fig. 7 is schematic representation of a third embodiment of a baffle arrangement in the coolant cavity; and
Fig. 8 is schematic representation of a fourth embodiment of a baffle arrangement in the coolant cavity.

Detailed Description

[0011] This disclosure generally relates to an arrangement to control coolant flow in an engine.

[0012] An arrangement **10** of the present disclosure may comprise a coolant cavity **14**, an oil cooler matrix **16** and a baffle **18.**

[0013] Fig. 1 illustrates an engine block **12**. Engine block **12** may be machined cast and may have portions to receive engine components. The engine block **12** may be assembled with the engine components. The assembled engine block **12** may be used to assemble an engine, for instance a vehicle engine. Engine block **12** may have the coolant cavity **14** machined thereon and may include a coolant rail **20** for passage of coolant fluid.

[0014] Coolant cavity **14** may be formed, for instance through machine casting, according to predetermined requirements. Coolant cavity **14** may be of a suitable size and shape to accommodate the oil cooler matrix **16**. Coolant cavity **14** may be substantially rectangular and may have a longitudinal axis. The coolant cavity **14** may have an opening **22** to receive the oil cooler matrix **16**. The periphery of the opening **22** may be a contact portion **24** which may include holes **26** for locating and mounting the oil cooler matrix **16** to the engine block **12**.

[0015] Opposite the opening **22**, the coolant cavity **14** may have a side wall **28**. The side wall **28** may have recesses **30** to accommodate protrusions from the oil cooler matrix **16**. Circumventing the side wall **28** may be a enclosure wall **32**. In an assembled engine block **12** the oil cooler matrix **16** may be spaced from the side wall **28** and the enclosure wall **32.** A gap may be formed between the oil cooler matrix **16** and the enclosure wall **32.** In an assembled engine, the coolant may flow through the gap.

[0016] Coolant rail **20** may be formed, for instance through machine casting, according to predetermined requirements. Coolant rail **20** may be a part of continuous coolant circuit. A portion of the coolant rail **20** may lead from the coolant cavity **14** to a radiator and another portion of the coolant rail **20** may lead from the radiator to the coolant cavity.

[0017] In an assembled engine, the coolant rail **20** may carry the coolant to and away from the coolant cavity **14**. Coolant may be heated in the coolant cavity and coolant rail **20** may carry the heated coolant to a radiator for dissipation of the heat. Coolant rail **20** may return the cooled coolant to the coolant cavity **14**. A pump may be connected to the coolant circuit and may propel the flow of coolant through the coolant rail **20** and coolant cavity **14**.

[0018] Coolant rail **20** may be connected to the opposite ends of the coolant cavity **14**. At an end of the coolant cavity **14** the coolant rail **20** may form a coolant inlet **34** at enclosure wall **32**. At an opposite end of the coolant cavity **14** the coolant rail **20** may form a coolant outlet **36** at enclosure wall **32**. In an assembled engine coolant may enter the coolant cavity **14** through the coolant inlet 34 flow through the coolant cavity **14** and may exit through the coolant outlet **36.**

[0019] Coolant inlet **34** and coolant outlet **36** may be formed, for instance through machine casting, according to predetermined requirements. Coolant inlet **34** and coolant outlet **36** may be located along the longitudinal axis of the coolant cavity **14**.

[0020] Fig. 2 illustrates an oil cooler matrix **16**. Oil cooler matrix **16** may be supported on a frame **38**. Frame **38** may include a reciprocal contact portion **40** to abut the contact portion **24** at the periphery of opening **22**. The reciprocal contact portion **40** may be formed in the same shape and size as the contact portion **24**. The reciprocal contact portion **40** may have reciprocal holes **42** that may correspond to holes **26** on the contact portion **24**. Frame **38** may include locating fasteners **44**. Locating fasteners **44** may assist in placement of frame **38** onto engine block **12**. In an assembled engine block **12** the reciprocal contact portion **40** and the contact portion **24** may form a seal to prevent leakage of coolant and oil.

[0021] Oil cooler matrix **16** may include internally disposed channels **46a** and **46b** for flow of engine oil to and from the oil cooler matrix **16**. In an assembled engine block **12**, channels **46a** and **46b** may lead from the oil cooler matrix 16 into the engine block **12**.

[0022] In an assembled engine, oil may be carried to the oil cooler matrix **16** for dissipation of heat to the coolant in the coolant cavity **14**. Channel **46a** may carry heated oil into the oil cooler matrix **16** and channel **46b** may return the cooled oiled from the oil cooler matrix **16**.

[0023] Oil cooler matrix **16** may comprise a series of hollow plates **48**. Each plate **48** may be substantially rectangular with a linear side edges **50** and rounded terminal edges **52** and may have a thickness of some millimeters, for instance 3 mm. In an assembled engine, block **12** the longitudinal axis of the oil cooler matrix **16** may be aligned with the longitudinal axis of the coolant cavity **14**. Terminal edges **52** may face coolant inlet **34** and coolant outlet **36** at enclosure wall **32**.

[0024] Channels **46a** and **46b** may connect plates **48**. Each plate **48** may be spaced from one another and may communicate be positioned at terminal edges **52**. Channel **46a** may be positioned at a terminal edge **52** and the channel **46b** may be positioned at opposite terminal edge **52**. Oil may flow through plates comprised in oil cooler matrix **16** may vary according to requirements. In one embodiment, the number of plates may be between 9 and **13** plates.

[0025] In an assembled engine, coolant flow through the coolant cavity **14** may be directed at the oil cooler matrix **16**. The coolant may be directed through the oil cooler matrix **16** between plates **48.**

[0026] In another embodiment, oil cooler matrix **16** may comprise of a solid body internally segmented by plates or channels.

[0027] In a further embodiment, oil cooler matrix **16** may comprise of a solid body having clefts or recesses on the body.

[0028] Baffle **18** may be positioned in the coolant cavity **14**. The baffle **18** may be positioned along the enclosure wall **32** in the cavity. Baffle **18** may be mounted to a position along the enclosure wall **32.** In another embodiment the baffle may be mounted to the side wall **28.**

[0029] In another embodiment baffle **18** may be mounted to the oil cooler matrix **16**. Baffle **18** may be mounted to a position along the side edges **50** or the terminal edges **52** of the oil cooler matrix **16**.

[0030] Baffle **18** may be mounted mechanically for instance by rivets or mechanical coupling. Baffle **18** may be mounted chemically, for instance by adhesives. Baffle **18** may be composed of suitable heat resistant material and may be composed of resilient material for instance, rubber.

[0031] In an embodiment, baffle **18** may be flexible. A flexible baffle **18** may facilitate mounting thereof to the coolant cavity **14** or the oil cooler matrix **16**. The flexible baffle **18** may be again composed of rubber, or plastic. During assembly of the engine block **12**, a flexible baffle **18** may deform and thereby allow an efficient assembly.

[0032] In the assembled engine block **12**, baffle **18** may be located between the oil cooler matrix **16** and the walls of coolant cavity **14**. Baffle **18** may be located between a side edge **50** or a terminal edge **52** of the oil cooler matrix **16** and the enclosure wall **32**.

[0033] In the assembled engine, baffle **18** may direct the flow of the coolant through the coolant cavity. Baffle **18** may direct the flow of the coolant at the oil cooler matrix **16**.

[0034] Fig. 3 illustrates a first embodiment of baffle **18**. Baffle **18** may comprise an arcuate portion 54 and a base portion **56**. Arcuate portion **54** may have a support end **58** and tapered end **60**. Support end **58** may connect the arcuate portion **54** to the base portion **56**. Width of tapered end **60** may substantially equal to the height of the oil cooler matrix **16**.

[0035] Baffle **18** may be mounted to the coolant cavity **14** through the base portion **56**. Base portion **56** may comprise rivet holes **62** and a mounting plate **64** for mechanical attachment to the coolant cavity **14**. In an embodiment base portion **56** may be bonded to the coolant cavity **14**.

[0036] In an assembled engine block **12**, base portion **56** may be mounted to enclosure wall **32** of the coolant cavity **14** and tapered end **60** of arcuate portion **54** may abut the oil cooler matrix **16**.

[0037] In another embodiment, tapered end **60** of arcuate portion **54** may be mounted to the oil cooler matrix **16**, for instance by adhesive or mechanical coupling, and base portion **56** may abut enclosure wall **32**.

[0038] In an assembled engine, arcuate portion **54** may direct the flow of coolant. Coolant flowing through coolant cavity **14** may impact the arcuate portion **54** and the flow may be diverted towards oil cooler matrix **16**.

[0039] Fig. 4 illustrates a second embodiment of baffle **18.** Baffle **18** may comprise a guide portion **66**, a link portion **68** and a base portion **70**. Link portion **68** may connect the guide portion **66** to the base portion **70.** Width of guide portion **66** may be substantially greater than the width of the link portion **68**. Width of guide portion **66** may substantially equal to the height of the oil cooler matrix **16**.

[0040] Baffle **18** may be mounted to the coolant cavity **14** through the base portion **70**. Base portion **70** may be mechanically or chemically attached to the coolant cavity **14**.

[0041] In an assembled engine block **12**, base portion **70** may be mounted to enclosure wall **32** of the coolant cavity **14** and guide portion **66** may abut the oil cooler matrix **16**.

[0042] In another embodiment, guide portion **66** may be mounted to the oil cooler matrix **16**, for instance by adhesive or mechanical coupling, and base portion **70** may abut enclosure wall **32**.

[0043] Link portion **68** may be supported from enclosure wall **32**, for instance a projection from the enclosure wall **32** or from the link portion **68**.

[0044] In an assembled engine, guide portion **66** may direct the flow of coolant. Coolant flowing through coolant cavity **14** may abut the guide portion **66** and the flow may be diverted towards oil cooler matrix **16**.

[0045] In a further embodiment, baffle **18** may be a flat panel which may be mounted to the side wall **28**, enclosure wall **32** or oil cooler matrix **16**. In an assembled engine, the flat panel may direct the flow of coolant. Coolant flowing through coolant cavity **14** may abut the flat panel and the flow may be diverted towards oil cooler matrix **16**.

[0046] The baffle **18** may be suitably arranged to direct the flow of coolant through the coolant cavity **14** in an assembled engine. In further embodiments, more than one baffle may be provide to direct the flow of coolant through the coolant cavity **14**.

[0047] Baffles **18** may be suitably provided. Baffles **18** may be positioned to direct the flow of coolant at the oil cooler matrix **16**. Baffles **18** may be mounted to the oil cooler matrix **16** or to the coolant cavity **14** as described in the foregoing paragraphs.

[0048] Fig. 5 illustrates a first embodiment of a baffle arrangement in an assembled engine. A first baffle **18** and a second baffle **18** may be positioned between side edge **50** of the oil cooler matrix **16** and the enclosure wall **32** of coolant cavity **14**. The baffles **18** may be located proximate to the coolant inlet **34**. The baffles **18** may be located proximate to a terminal edge **52** facing the coolant inlet **34**.

[0049] Coolant flowing from the coolant inlet **34** may flow towards the oil cooler matrix **16** and into gaps in the coolant cavity **14** between the oil cooler matrix **16** and the enclosure wall **32**.

[0050] Baffles **18** located between the oil cooler matrix **16** and the enclosure wall **32** may direct the coolant flow from the gaps to the oil cooler matrix **16**. Coolant may be directed by the baffles to flow through the oil cooler matrix **16** comprising a series of plates **48**. Coolant may be directed to flow between plates **48**.

[0051] Fig. 6 illustrates a second embodiment of a baffle arrangement in an assembled engine. A first baffle **18** and a second baffle **18** may be positioned between terminal edge **52** of the oil cooler matrix **16** and the enclosure wall **32** of coolant cavity **14**. The baffles **18** may be located proximate to the coolant inlet **34**. The baffles **18** may be located between terminal edge **52** and the coolant inlet **34**.

[0052] Coolant flowing from the coolant inlet **34** may flow towards baffles **18**. Baffles **18** may direct the coolant flow at the oil cooler matrix **16**. Coolant may be directed by the baffles to flow through the oil cooler matrix **16** comprising a series of plates **48**. Coolant may be directed to flow between plates **48**.

[0053] Fig. 7 illustrates a third embodiment of a baffle arrangement in an assembled engine. A first baffle **18** and a second baffle **18** may be positioned between side edge **50** of the oil cooler matrix **16** and the enclosure wall **32** of coolant cavity **14**. The baffles **18** may be located proximate to the coolant inlet **34**. The baffles **18** may be located proximate to a terminal edge **52** facing the coolant inlet **34**. Baffles **18** may extend along side edges **50** towards the opposite terminal edge **52**. The opposite terminal edge **34** may face coolant outlet **36**.

[0054] Coolant flowing from the coolant inlet **34** may flow towards the oil cooler matrix **16** and into gaps in the coolant cavity **14** between the oil cooler matrix **16** and the enclosure wall **32**.

[0055] Baffles **18** located between the oil cooler matrix **16** and the enclosure wall **32** direct the coolant flow from the gaps to the oil cooler matrix **16**. Coolant may be directed by the baffles to flow through the oil cooler matrix **16** comprising a series of plates **48**. Coolant may be directed to flow between plates **48**. Coolant flow between the plates **48** may be maintained by the extended baffles **18.**

[0056] Fig. 8 illustrates a fourth embodiment of a baffle arrangement in an assembled engine. A first baffle **18** and a second baffle **18** may be positioned between side edge **50** of the oil cooler matrix **16** and the enclosure wall **32** of coolant cavity **14**. The first and second baffles **18** may be located proximate to the coolant inlet **34.** The first and second baffles **18** may be located proximate to a terminal edge **52** facing the coolant inlet **34**.

[0057] A third and fourth baffles **18a** may be positioned between side edge **50** of the oil cooler matrix **16** and the enclosure wall **32** of coolant cavity **14**. The third and fourth baffles **18a** may be located proximate to the coolant outlet **36**. The third and fourth baffles **18a** may be located proximate to a terminal edge **52** facing the coolant outlet **36**.

[0058] Coolant flowing from the coolant inlet **34** may flow towards the oil cooler matrix **16** and into gaps in the coolant cavity **14** between the oil cooler matrix **16** and the enclosure wall **32**.

[0059] First and second baffles **18** located between the oil cooler matrix **16** and the enclosure wall **32** direct the coolant flow from the gaps to the oil cooler matrix **16**. Coolant may be directed by the first and second baffles **18** to flow through the oil cooler matrix **16** comprising a series of plates **48.** Coolant may be directed to flow between plates **48**.

[0060] Coolant may flow through the plates **48** and may flow towards the gaps in the coolant cavity **14** between the oil cooler matrix **16** and the enclosure wall **32**. Coolant flow may be diverted by the third and fourth baffles **18a** to the oil cooler matrix **16.**

Industrial Applicability

[0061] This disclosure describes at least one baffle **18** for control of coolant flow through a coolant cavity **14**.

[0062] Heat transfer from oil in the oil cooler matrix **16** may depend on the flow rate and flow path of the coolant. A greater heat transfer may occur with an increased flow rate at the oil cooler matrix **16**. A greater heat transfer may occur with a coolant flowing through the oil cooler matrix **16** between plates **48**. Further heat transfer may be achieved with an increased coolant flow rate between the plates 48.

[0063] The arrangement of baffle **18** and oil cooler matrix **16** in a coolant cavity may be used in engines of vehicles to achieve increased heat transfer rates for the engine oil to the coolant.

[0064] Tests have shown that the volume of coolant flowing between the plates may be increased by baffles. A baseline cooler has shown slow moving flow over much of the surface, with some areas of higher velocity flow near to the edges of the plates. The addition of baffles has shown jets of higher velocity flow extending over much of the plates. Results have been compared indicating a noticeable increase of flow rate. Particularly, a baseline model showed a low flow rate at the entry to the cooler, which reduced gradually along the cooler length. A model with baffles according to the disclosure has shown greatly increased flow at the upstream end of the cooler, which decreases as the flow redistributes and enters the gaps around the cooler.

[0065] Additionally, a baseline cooler generally shows fairly uniform Heat Transfer Coefficient (HTC) on plates of the oil cooler matrix over the surfaces of the plates. The HTCs are raised near the front of the cooler and along the edges, as high velocity coolant enters the cooler. The jets of high velocity fluid generated by the baffles create regions with very high HTC values. The jets dissipate as they pass through the cooler, significantly increasing the HTCs over the rear part of the cooler.

[0066] The industrial applicability of the baffle arrangement for control of coolant flow through a coolant cavity 14 as described herein will have been readily appreciated from the foregoing discussion.

[0067] Accordingly, this disclosure includes all modifications and equivalents of the subject matter recited in the claims in any claim are followed by references signs, the reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, neither the reference signs nor their absence have any limiting effect on the technical features as described above or on the scope of any claim elements.

[0068] One skilled in the art will realise the disclosure may be embodied in other specific forms without departing from the disclosure or essential characteristics thereof. The foregoing embodiments are therefore to be considered in all respects illustrative rather than limiting of the disclosure described herein. Scope of the invention is thus indicated by the appended claims, rather than the foregoing description, and all changes that come within the meaning and range of equivalence of the claims are therefore intended to be embraced therein.

Claims

1. An arrangement (10) to control coolant flow in an engine comprising:

    a coolant cavity (14) having a coolant inlet (34) and a coolant outlet 36 for flow of a coolant;
    an oil cooler matrix (16) positioned in the coolant cavity (14) and having a channel (46a, 46b) for circulation of oil; and

    at least one baffle (18) arranged in the coolant cavity (14) to direct the flow of the coolant (14) through the coolant cavity.

2. The arrangement (10) according to claim 1 wherein the baffles are arranged to direct the flow of the coolant at the oil cooler matrix (16).

3. The arrangement (10) according to claims 1 or 2 wherein oil cooler matrix (16) comprises a series of plates (48).

4. The arrangement (10) according to claim 3 wherein the baffles are arranged to direct the flow of the coolant through the plates (48).

5. The arrangement (10) according to any of the preceding claims wherein the at least one baffle (18) is mounted to at least one of the oil cooler matrix (16) or the coolant cavity (14).

6. The arrangement (10) according to claim 5 wherein at least one baffle (18) is mechanically or chemically mounted.

7. The arrangement (10) according to any of the preceding claims wherein at least a first baffle (18) is located proximate to the coolant inlet (34).

8. The arrangement (10) according to claim 7 further comprising a second baffle (18) located proximate to the coolant inlet (34).

9. The arrangement (10) according to claim 8 wherein the first and second baffles (18) are located along opposite side edges (50) of the oil cooler matrix (16).

10. The arrangement (10) according to claim 9 wherein the first and second baffles (18) extend along the side edges (50) towards the coolant outlet (36).

11. The arrangement (10) according to claim 9 further comprising a third and a fourth baffle (18a) located along the side edges (50) of the oil cooler matrix (16) spaced from the first and the second baffles (18) and proximate to the coolant outlet (36).

12. The arrangement (10) according to any of the preceding claims wherein the baffle is flexible.

13. The arrangement (10) according to claim 12 wherein the baffle is composed of rubber or plastic.

14. A vehicle comprising the arrangement (10) according to any one of the preceding claims.

15. A method of controlling coolant flow in an engine comprising:

    circulating a coolant through a coolant cavity (14), the coolant cavity (14) having an oil cooler matrix (16); and
    directing flow of the coolant through the coolant cavity (14) by at least one baffle (18) arranged in the coolant cavity (14).

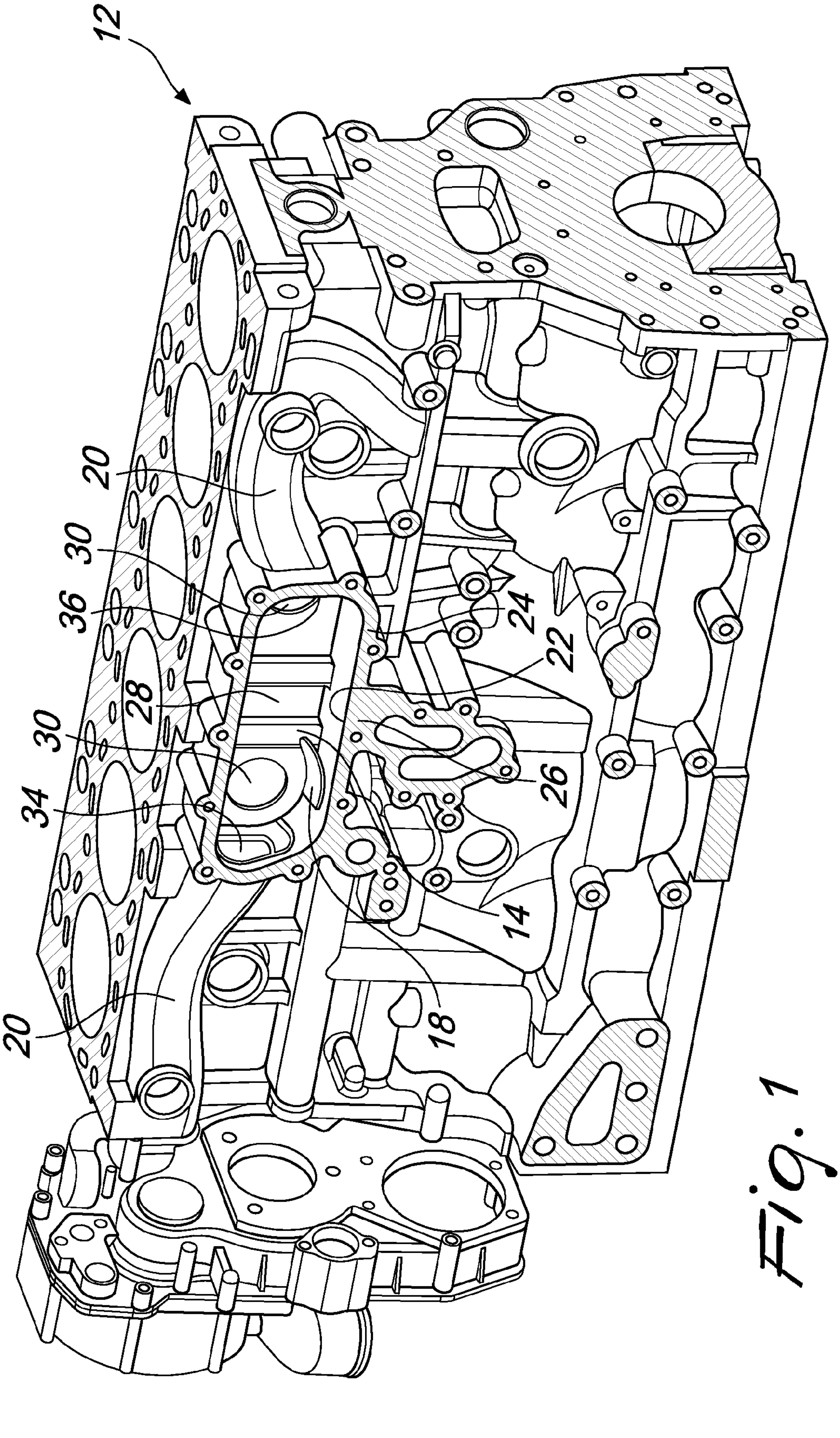

Fig. 1

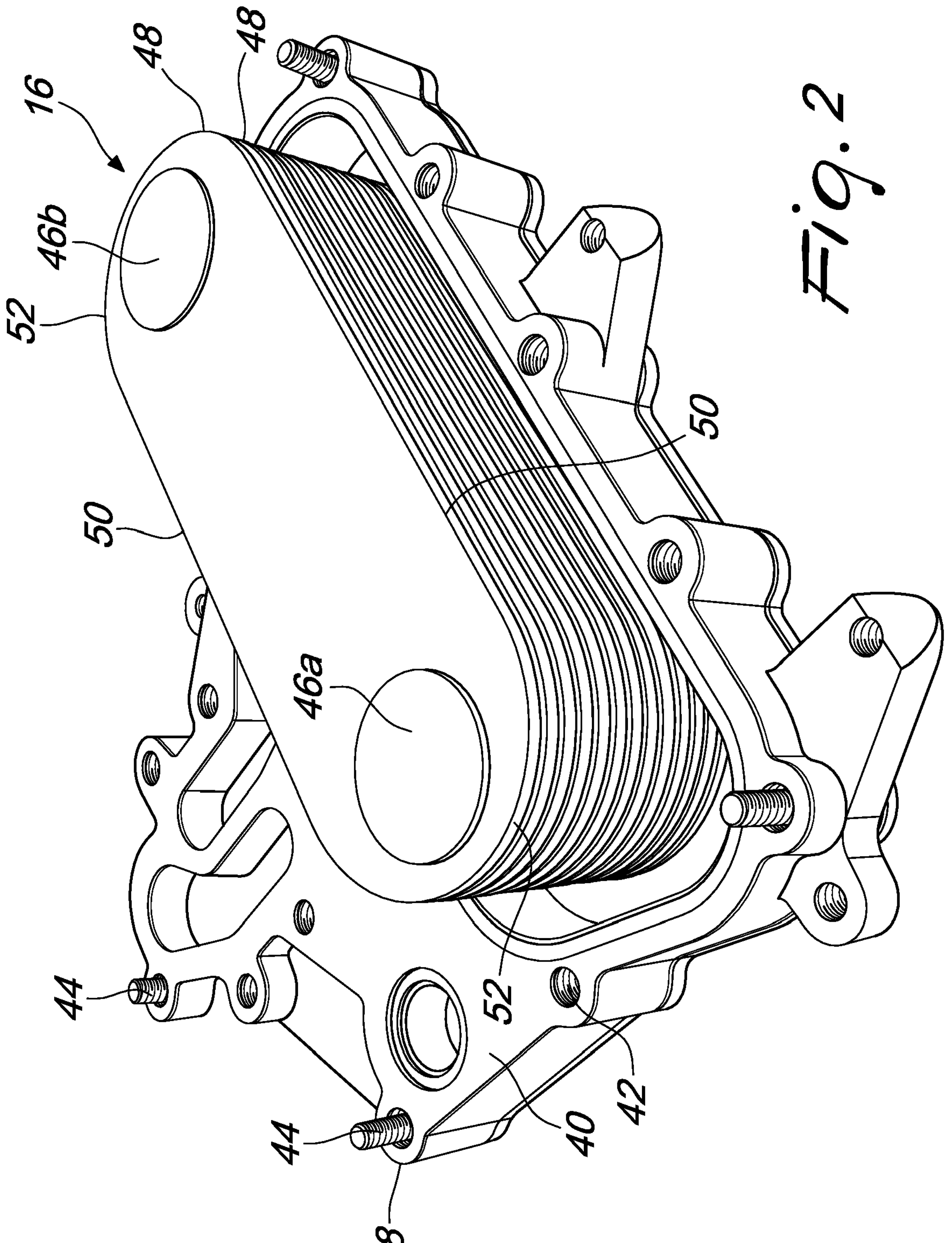

Fig. 2

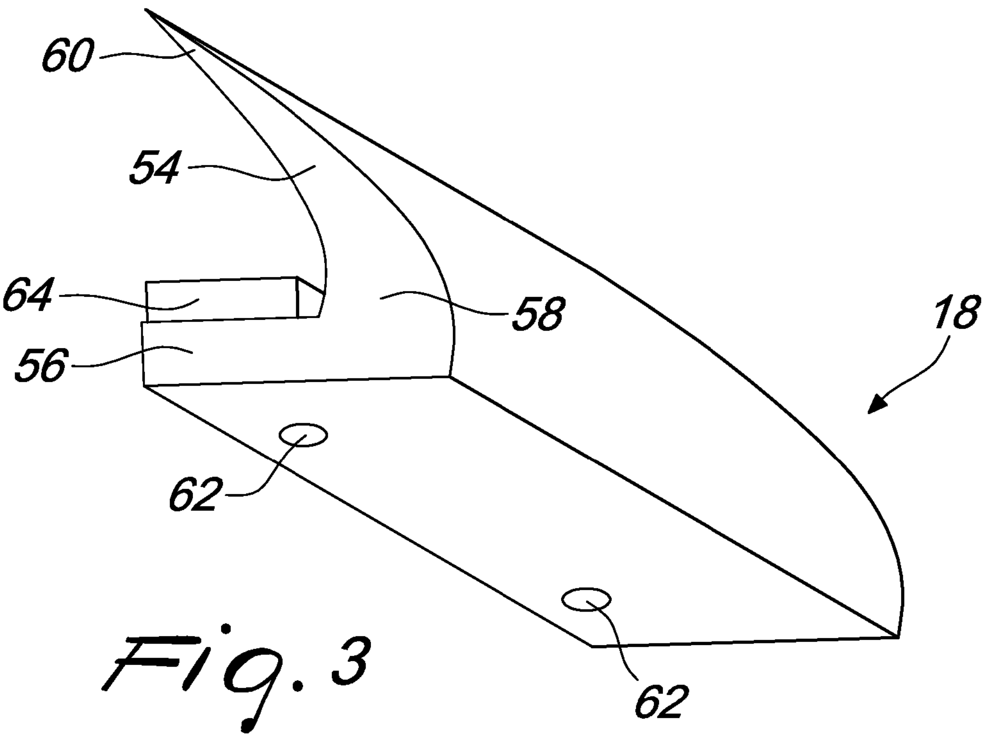

Fig. 3

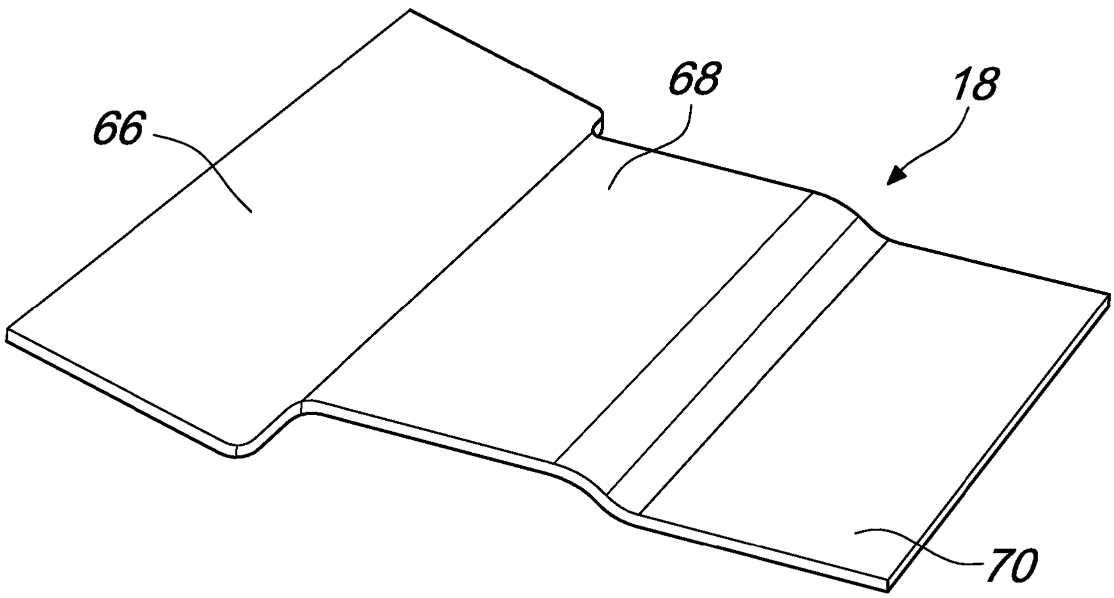

Fig. 4

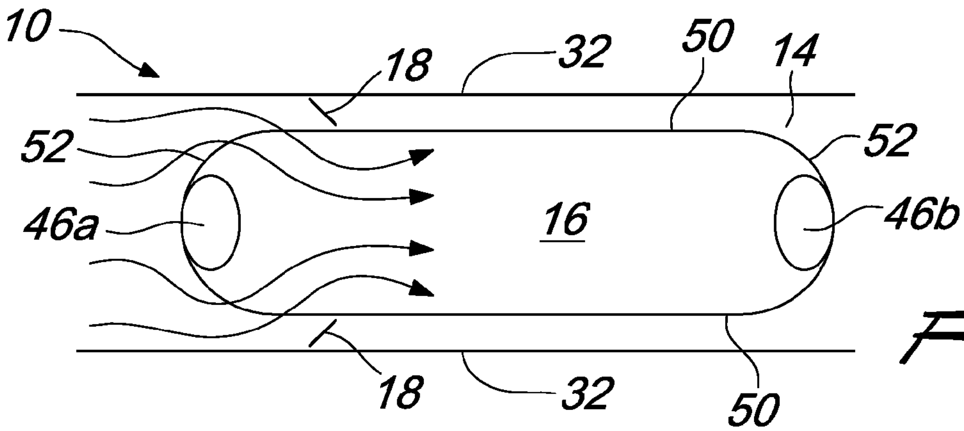

Fig. 5

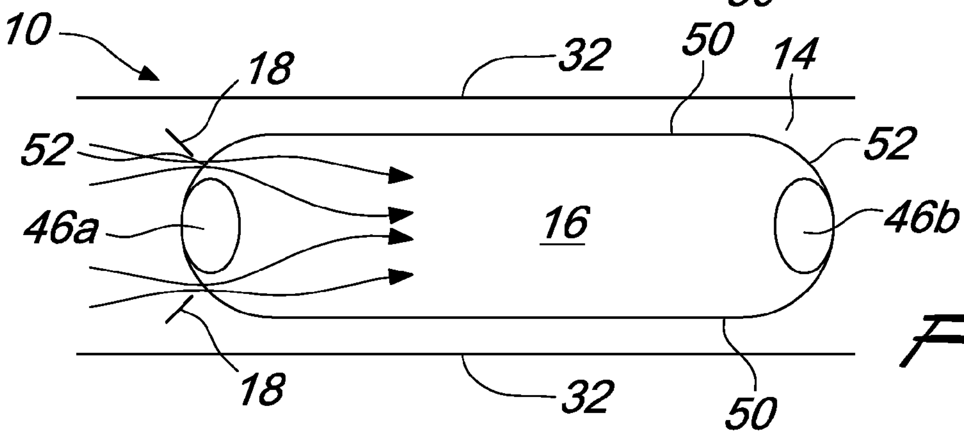

Fig. 6

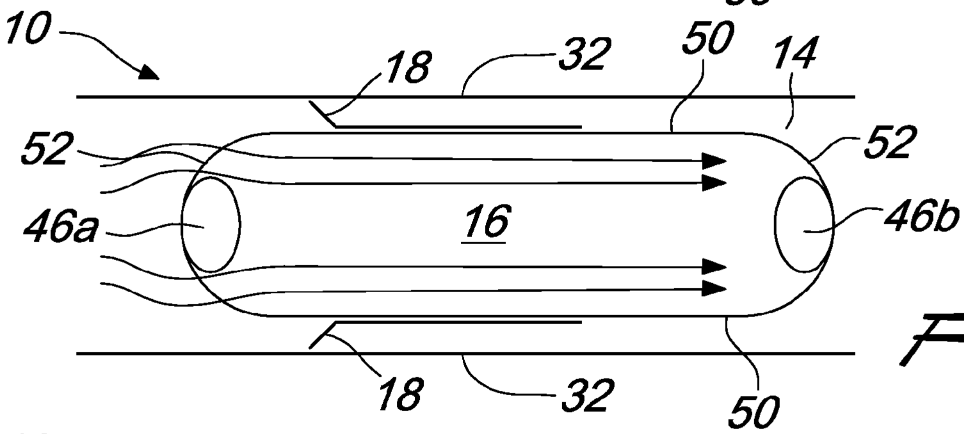

Fig. 7

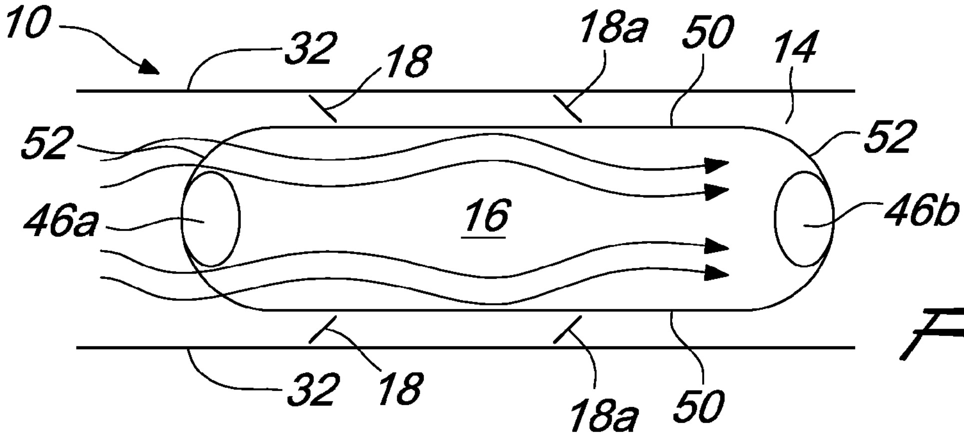

Fig. 8

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 08 16 7309

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 341 649 B1 (JOSHI SHRIKANT MUKUND [US] ET AL) 29 January 2002 (2002-01-29) * column 4, line 17 - line 28; claim 9 *	1-15	INV. F01P11/08
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X Y	DE 10 27 012 B (MOTOREN WERKE MANNHEIM AG) 27 March 1958 (1958-03-27) * column 4, line 8 - line 12 *	1-4, 14-15 5-13	
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