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(54) **MODULAR COOLING SYSTEM**

(57) The invention relates to a heat sink (200) for a cooling system for an air-cooled combustion engine, wherein the heat sink (200) comprises a plurality of fins (201a, 201b, 201c, 201d, 201e, 201f) and is adapted to be interchangeably mounted to the housing (101) of the combustion chamber (105) of an air-cooled combustion engine.

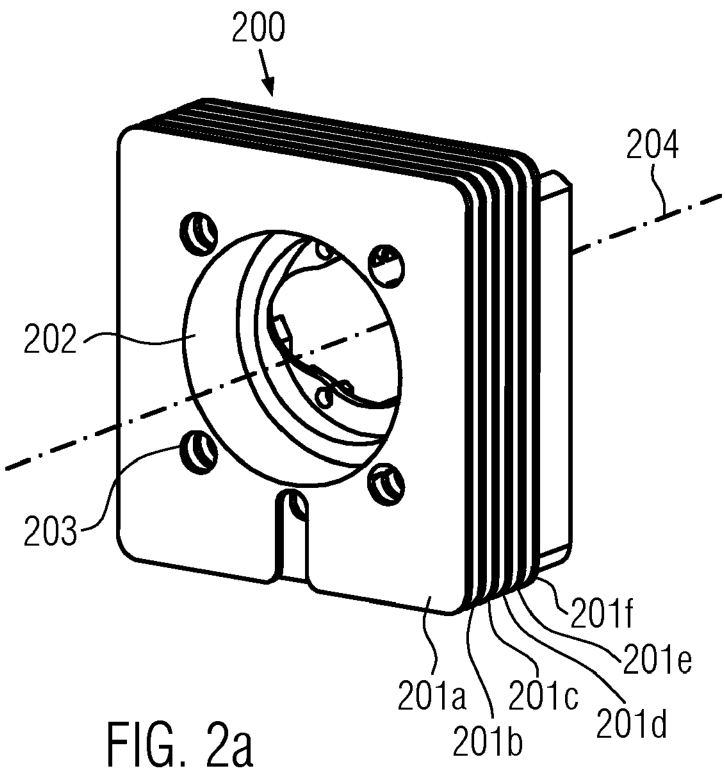

FIG. 2a

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Description

Background

[0001] In reciprocating or combustion engines a significant fraction of the energy and power they generate is not transformed into movement or power output, but into heat that needs to be dissipated into the engine environment, e.g. the atmosphere, such that an overheating of the engine can be avoided.

[0002] The amount of heat to be dissipated into the atmosphere can be approximated as more or less the same as the power produced which is normally around 25 or 30% of the fuel power for current engines used inter alia in the field of aviation or aerospace.

[0003] Independently of the fact that the energy to be dissipated is more or less the same or very well defined within the power envelope of the engine, there are many other variables that will influence the amount of heat that is dissipated to the surrounding environment, e.g. the atmosphere.

[0004] One important variable influencing the amount of dissipating heat is the ambient temperature, i.e. the temperature of the engine's environment, since the equation that defines the heat dissipation is directly proportional to the temperature gradient between the engine temperature and the temperature of the environment medium, e.g. air or a liquid such as water, used to cool the engine.

[0005] Thus the engine cooling system needs to be sized for a specific range of temperatures.

[0006] Operating engines at temperatures that are outside of the designed engine envelope of the capabilities of the engine's cooling system can lead to overheating or running the engine under temperature with associated problems such us reliability or lifetime reduction or even engine failures.

[0007] It is currently a challenge to provide cooling systems for engines, in particular for air-cooled engines in the motorcycle or car or aviation or aerospace industry, that allow the engines to operate at optimal performance for a large range of operating temperatures.

Problem

[0008] It is therefore the object of the present invention to provide means for improving the cooling of engines.

[0009] In particular, it is an object of the present invention to provide improved means for the cooling of air-cooled engines in the car or aviation or aerospace industry.

[0010] In particular, it is an object of the present invention to provide more flexible and more efficient means for the cooling of air-cooled engines such that the engines can operate at optimal performance across an enlarged range of operating temperatures and for a large variety of different operation modes and operation scenarios.

Solution

[0011] According to the present invention, this object is achieved by the subject-matter of the independent claims.

[0012] Advantageous embodiments and further developments are the subject-matter of the dependent claims.

[0013] The invention in particular provides a heat sink for a cooling system for an air-cooled combustion engine, wherein the heat sink can comprise a plurality of fins, e.g. and can be adapted to be interchangeably mounted to a/the housing of a/the combustion chamber of an air-cooled combustion engine.

[0014] Said fins can serve as heat exchangers for dissipating heat generated by the combustion engine and can also be referred to as heat transfer fins.

[0015] Stated differently, the present invention provides a modular approach to the challenge of cooling an air-cooled combustion engine, wherein the engine's cooling capabilities can be changed by exchanging a current heat sink with another heat sink that is more suitable to current operation conditions or operation scenarios.

[0016] Examples for different operation conditions or different operation scenarios may inter alia refer to different climates such as tropical, desert, continental, ocean or sea climates in which the engine should/is planned to operate.

[0017] For example, if the air-cooled combustion engine is to operate in a comparable warmer climate, e.g. in a desert region, a heat sink with enlarged fins, i.e. with an enlarged surface area of the fins, could be mounted to the housing of the combustion chamber in order to increase the available heat dissipation area of the fins.

[0018] Also, if the operating parameters, e.g. power output and/or allowed operating temperatures, of the air-cooled combustion engine are modified, a heat sink could be mounted to the housing of the combustion chamber, wherein the heat sink comprises fins with surface areas adapted or optimized for cooling of the modified air-cooled combustion engine.

[0019] In other words, the modularity of the herein described heat sinks allows an optimal cooling of an/the air-cooled combustion engine over a wide range of engine operating parameters, e.g. a wide range of engine operating temperatures, and for a large variety of different operation modes and operation scenarios for the engine.

[0020] For example, the herein described heat sink(s) can provide an optimal cooling of an air-cooled combustion engine for engine operating temperatures of up to several hundred degrees Celsius, e.g. 100 to 200°C, or higher. Specifically, the herein described heat sink(s) can ensure that operating temperatures of an air-cooled combustion engine do not exceed temperatures of beyond 200 or 250°C.

[0021] The housing of the combustion chamber of an air-cooled combustion engine to which the herein exemplary described heat sink may be adapted to be interchangeably mounted to/mountable, can have a shape that is rotationally symmetric with respect to a/the longitudinal axis of the housing of the combustion chamber.

[0022] For example, the housing of the combustion chamber of an air-cooled combustion engine to which the herein exemplary described heat sink may be adapted to be interchangeably mounted to/mountable, can have a cylindrical shape.

[0023] More specifically, at least the part of the housing of the combustion chamber to which the heat sink is adapted to be connected/mounted can have a cylindrical shape,

[0024] The rotationally symmetric shape or the cylindrical shape of the housing of the combustion chamber or the rotationally symmetric shape or the cylindrical shape of the part of the housing of the combustion chamber to which the heat sink is adapted to be connected can inter alia facilitate the connection mechanism between the heat sink and the housing of the combustion chamber.

[0025] Furthermore, said possible rotationally symmetric shape or cylindrical shape of the housing of the combustion chamber or of a/said part of the housing can inter alia facilitate the heat transfer of heat from the combustion chamber towards the herein exemplary described heat sink and its heat transfer fins.

[0026] The mounting mechanism or coupling mechanism or connection mechanism between the heat sink and the housing of the combustion chamber can be configured so as to allow a practically endless number of release/removal and connect/mount operations between the heat sink and the housing of the combustion chamber, i.e. the mounting mechanism or coupling mechanism or connection mechanism can be configured to allow an arbitrary number of exchanges/interchanges of the heat sink. In other words the connection between the heat sink and the housing of the combustion chamber can be released and re-established repeatedly and reproducibly.

[0027] Stated differently, the mounting mechanism or coupling mechanism or connection mechanism between the heat sink and the housing of the combustion chamber allows to connect and/or remove the heat sink from the housing of the combustion chamber an arbitrary number of times, without significant wear or tear or degradation of the stability of the connection between the heat sink and the housing of the combustion chamber.

[0028] For example, the heat sink can be configured as a female connector that can be adapted to receive a male part of the housing of the combustion chamber to form or to establish a connection with the housing of the combustion chamber.

[0029] Such a connection can provide a suitable stable connection between the heat sink and the housing of the combustion chamber.

[0030] For example, the heat sink may comprise an internal thread, e.g. a female thread, and a part of the housing of the combustion chamber may comprise an external thread, e.g. a male thread, in order to establish a connection between the heat sink and the housing of the combustion chamber.

[0031] More specifically, the heat sink can be adapted to be interchangeably mounted to a housing of the combustion chamber of an air-cooled combustion engine via at least one of the following connection mechanisms: a form-fit connection, a friction-type connection, a force-locked connection, a welding connection, and via any combination of the aforementioned connection mechanisms.

[0032] Said exemplary connection mechanisms may also involve the use of fastening means such as bolts or screws.

[0033] Furthermore, said exemplary connection mechanisms may involve the use of a thermal conductive paste or compound that can be applied to the respective contact surface(s) of the heat sink and the housing of the combustion chamber. This can also improve the efficiency of transferring heat from the combustion chamber to the heat sink.

[0034] An exemplary suitable thermal conductive paste may have a thermal conductivity of several watts per meter-kelvin, e.g. 5-20 W/(m K), or higher.

[0035] Furthermore, an exemplary suitable thermal conductive paste may comprise a polymerizable liquid matrix, e.g. epoxies, silicones, urethanes, or acrylates, and large volume fractions of electrically insulating, but thermally conductive filler material, e.g. aluminum oxide, boron nitride, zinc oxide, or aluminum nitride.

[0036] Said fins or heat transfer fins of the heat sink can have a variety of shapes.

[0037] For example, the outer contour of the cross section of the fins can have a polygonal shape, e.g. a rectangular shape, or a rotationally symmetric shape, e.g. a circular shape.

[0038] A polygonal shape, such as a rectangular shape, of the fins can facilitate making optimal use of available space in and around the air-cooled combustion engine.

[0039] All fins or heat transfer fins of the plurality of fins of the heat sink may have the same shape or may have different shapes or at least one fin of the plurality of fins may have a different shape than other fins of the plurality of fins.

[0040] Again, this can improve tailoring the heat dissipation properties or the heat dissipation area(s) of the fins of the heat sink to specific engine operating parameters and/or specific operation modes and/or operation scenarios for the engine.

[0041] The surface area provided by the fins of the heat sink, e.g. the surface area provided by the fins that can come into contact with the environment, e.g. air, can be larger than the surface area of the housing of the combustion chamber.

[0042] For example, the surface area provided by the fins of the heat sink can be at least 10 to 20 times larger than the surface area of the housing of the combustion chamber.

[0043] For example, for a housing of the combustion chamber having a surface area of 50 cm^2, the surface area provided by the fins of the heat sink could be 10 to 20 times larger, e.g. could be around 500 to 1000 cm^2.

[0044] However, said possible surface areas are exemplary only, i.e. other sizes, e.g. smaller or larger, are conceivable too.

[0045] The heat sink may comprise/may be manufactured from a material having a thermal expansion rate that matches the thermal expansion rate of the housing of the combustion chamber to which the heat sink is adapted to be interchangeably mounted.

[0046] Herein, the term matching may be understood as referring to being the same or being substantially the same or substantially similar. For example, the thermal expansion rate of said heat sink material can be equal to the thermal expansion rate of the housing of the combustion chamber within a predetermined tolerance, e.g. within +/-10% or less.

[0047] This can inter alia ensure that during operation of the engine with the heat sink being mounted, the connection between the heat sink and the housing of the combustion chamber remains stable and functioning during operation of the engine.

[0048] An exemplary range of a possible thermal expansion rate, for example provided as a range of a linear temperature expansion coefficient α may lie between 20 - 24 micron per meter per Celsius degree or specifying the linear temperature expansion coefficient α in SI units, it may lie between (20 - 24) 10^{-6} K^{-1}.

[0049] For example, assuming a linear temperature expansion coefficient α of 23 for the heat sink material, a 10 cm long piece of the heat sink would expand by approximately 0.23 mm when the temperature increases by 100 Kelvin, when adopting a linear approximation for the expansion.

[0050] A possible material of the heat sink, i.e. a possible material for manufacturing the heat sink, may comprise aluminium.

[0051] However, other heat sink materials may be conceivable as well.

[0052] The herein exemplary described heat sinks may, for example, be manufactured via 3D printing and/or by casting techniques.

[0053] To make full use of the modularity of the herein described heat sink, a set of a plurality of heat sinks can be provided, wherein the set can comprise heat sinks of different sizes and/or with different geometries and/or with a different number of fins and/or with different sized fins and/or with different shaped fins.

[0054] Albeit being of different sizes and/or being of different geometries and/or despite having different numbers of fins and/or having fins with different sized fins and/or having different shaped fins, each heat sink of said set of heat sinks may be adapted to be interchangeably mounted to same type of combustion chamber housing, in particular to the same housing of the combustion chamber.

[0055] In other words, all heat sinks from said plurality of heat sinks may have the same connection mechanism that allows each of the heat sinks to be interchangeably mounted to the same housing of the combustion chamber.

[0056] It is also conceivable that said heat sinks from said plurality of heat sinks may have a different connection mechanism, but that said different connection mechanism nevertheless allows each of the heat sinks to be interchangeably mounted to the same housing of the combustion chamber.

[0057] This way the flexibility of an air-cooled combustion engine can be improved, since for each specific engine setup and/or for each specific engine operating mode and/or for each specific operation scenario for the engine, the optimum/most suitable, heat sink may be selected from said plurality of heat sinks to be mounted to the housing of the combustion chamber of the engine.

[0058] An exemplary air-cooled combustion engine can therefore comprise a combustion chamber and a heat sink that is/can be interchangeably mounted to the housing of the combustion chamber, and wherein said heat sink can comprise any, some or all of the above and herein described features.

[0059] As previously indicated the housing of the combustion chamber may have a cylindrical shape.

[0060] The cylindrical shape of the housing of the combustion chamber can inter alia facilitate the heat transfer from the combustion chamber to the fins of the heat sink.

[0061] Said exemplary air-cooled combustion engine may be part of/may be used as the/an engine for an aerial vehicle or a ground or a surface vehicle or a sea vehicle or a space vehicle. Said vehicle may be remotely controlled, e.g. an unmanned drone.

[0062] Stated differently, a herein described vehicle may comprise an air-cooled combustion engine having a combustion chamber and a heat sink that is/can be interchangeably mounted to the housing of the combustion chamber, and wherein said heat sink can comprise any, some or all of the above and herein described features.

[0063] Said exemplary air-cooled combustion engine may further be an exemplary two-stroke engine or a four-stroke engine or another type of combustion engine.

[0064] A further advantage of the herein exemplary described heat sink is that the existing air-cooled combustion engine can be easily re-fitted with the herein exemplary described heat sink due to its modular design.

[0065] For example, a method for refitting an air-cooled combustion engine with a herein exemplary described heat sink or a method for installing a heat sink on an air-cooled combustion engine may comprise one, some or all of the following steps:

- machining at least the part of the housing of the combustion chamber of an/the air-cooled combustion engine that is to be connected to the/ a herein exemplary described heat sink, and

- mounting the heat sink to the machined part of the housing of the combustion chamber using any of the above exemplary described connection mechanisms.

[0066] The exemplary step of machining may comprise removing any previously present fins on the housing of the combustion chamber or may comprise removing any previously present fins on the part of the housing of the combustion chamber of an/the air-cooled combustion engine that can be connected to said heat sink.

[0067] For completeness, it is noted that it is possible that in addition to the fins of the herein described exemplary heat sink, the housing of the combustion chamber may comprise additional fins, which however are not removable/interchangeable, but that are fixedly mounted to or integrated into the housing of the combustion chamber of the air-cooled combustion engine.

[0068] The following figures illustrate exemplary:

Fig. 1a: Exemplary perspective view of an exemplary housing of a combustion chamber
Fig. 1b: Exemplary side view of combustion chamber housing
Fig. 1c: Exemplary cross section perspective of combustion chamber housing
Fig. 2a: Exemplary perspective view of an exemplary heat sink
Fig. 2b: Exemplary side view of heat sink
Fig. 2c: Exemplary second cross section perspective of heat sink
Fig. 3: Exemplary heat sink mounted to an exemplary housing of a combustion chamber The figures serve to illustrate certain technical aspects of some features of the invention.

[0069] **Fig.1a** exemplary shows a perspective view of an exemplary housing 100 of an exemplary combustion chamber of an exemplary air-cooled combustion engine, e.g. a two-stroke combustion engine.

[0070] The housing has an exemplary first end 101 and an exemplary second end 102, wherein the exemplary first end 101 is the part of the housing 101 to which an exemplary heat sink (not shown here, but could, for example, be the exemplary heat sink 200 shown in Fig. 2a) could be interchangeably mounted/attached.

[0071] Reference numeral 103 exemplary denotes a possible bulge-shaped part of the housing accommodating a transfer port of the engine, e.g. a two-stroke combustion engine. However said exemplary bulge-shaped part of the housing is just optional and other air-cooled combustion engines to which a herein described exemplary heat sink could be interchangeably mounted/attached, such as for example a four-stroke engine, may not have such a bulge-shaped part of the housing at all.

[0072] The exemplary housing 100 has a rotationally symmetric shape with respect to its longitudinal axis 106. More specifically, the exemplary housing 100 has overall a cylindrical shape.

[0073] The exemplary second end 102 of the housing can be connected to/can be attached to/can be mounted to a further exemplary part of the engine, e.g. to the engine block (not shown), where, for example, a/the crankcase (not shown) can be located.

[0074] The exemplary housing 100 may further comprise exemplary fins or heat transfer fins 104 that are fixed to/integrated into the housing 100, i.e. they cannot be removed.

[0075] In other words said exemplary fins 104 cannot be exchanged or interchanged with other fins.

[0076] In the present illustrated example the housing comprises exemplary five fins, wherein the exemplary fin 104 located closest to the first end 101 is larger, i.e. has a larger surface area, than the other fins of the housing 100.

[0077] However, it is possible that the housing comprises different numbers of fins and fins of various other sizes.

[0078] Moreover, it is possible that the housing 100 comprises no fins at all and that fins for heat dissipation of the engine's heat generated inside the engine's combustion chamber 105 are provided only via the fins of the above and herein described modular heat sink, such as, for example, the heat transfer fins of the heat sink illustrated in Fig. 2a, Fig. 2b, Fig. 2c and Fig. 3.

[0079] **Fig. 1b** shows an exemplary side view perspective along the side of the exemplary housing 100 of an exemplary combustion chamber of an exemplary air-cooled combustion engine shown in Fig. 1a, i.e. same reference signs in Fig. 1a and Fig. 1b denote the same components.

[0080] More specifically, Fig. 1b shows an exemplary side view perspective along an axis parallel to the longitudinal axis 106 of the housing 100 of Fig. 1a.

[0081] Furthermore, Fig. 1b exemplary shows possible exemplary bores or through holes 107 provided at the exemplary first end 101, e.g. the male part, of the housing 101 that can receive possible fastening means, e.g. bolts and/or screws, when an exemplary heat sink (not shown here, but could, for example, be the exemplary heat sink 200 shown in Fig. 2a) is interchangeably mounted/attached to the housing 101.

[0082] **Fig. 1c** shows an exemplary cross section perspective along the side of the exemplary housing 100 of an exemplary combustion chamber of an exemplary air-cooled combustion engine shown in Fig. 1a, i.e. same reference signs in Fig. 1a, Fig. 1b and Fig. 1c denote again the same components.

[0083] More specifically, Fig. 1c shows an exemplary cross section perspective along the longitudinal axis 106 of the housing 100 of Fig. 1a.

[0084] Fig. 1c inter alia allows a view into the combustion chamber 105 of the exemplary air-cooled combustion engine and also provides a more simplified view of the cross section of the exemplary part/first end 101 of the housing 101 to which an exemplary heat sink (not shown here, but could, for example, be the exemplary heat sink shown in Fig.2a) could be interchangeably mounted/attached.

[0085] The reference numerals 108a, 108b denote exemplary areas or regions of the housing 101 that heat up the most during operation of the engine, i.e. where the main heat transfer is taking place and where the heat sink is to be interchangeably mounted/attached. Said areas of regions 108a, 108b are exemplary located at the first end 101 of the housing 101.

[0086] **Fig. 2a** shows an exemplary perspective view of an exemplary heat sink 200.

[0087] The exemplary heat sink 200 has an exemplary number of five fins or heat transfer fins 201a, 201b, 201c, 201d, 201e, 201f. However, this number is exemplary only and the heat sink may be provided also with other numbers of fins.

[0088] The fins are also arranged such that adjacent fins have the same distance or separation from each other along the exemplary longitudinal axis 204.

[0089] The exemplary fins or heat transfer fins 201a, 201b, 201c, 201d, 201e, 201f also exemplary have the same shape, e.g. a rectangular or quadratic shape.

[0090] Again, the illustrated shapes are exemplary only. It is possible that the heat sink 200 may be provided with different sized fins and/or with different shaped fins.

[0091] The exemplary heat sink 200 has an exemplary central opening 203 that forms an exemplary central tube across the heat sink 200 and its fins 201a, 201b, 201c, 201d, 201e, 201f.

[0092] This can facilitate mounting or attaching or connecting the heat sink 200 to a housing of an exemplary combustion chamber of an exemplary air-cooled combustion engine, such as the housing 100 illustrated in Fig. 1a, Fig. 1b and Fig. 1c.

[0093] In addition, the heat sink 200 exemplary is provided with four openings or bores or through holes that can receive fastening means, such as bolts or screws, to further support mounting or attaching or connecting the heat sink 200 to a housing of an exemplary combustion chamber of an exemplary air-cooled combustion engine, such as the housing 100 illustrated in Fig. 1a, Fig. 1b, Fig. 1c and Fig. 3.

[0094] **Fig. 2b** shows an exemplary side view perspective along the longitudinal axis 204 of the heat sink 200 depicted in Fig. 2a, i.e. same reference signs in Fig. 2a and Fig. 2b denote the same components.

[0095] Fig. 2b exemplary illustrates the equidistant arrangement of adjacent fins of the plurality of fins 201a, 201b, 201c, 201d, 201e, 201f along the longitudinal axis 204 and further illustrates the tube 202 or central opening along the longitudinal axis 204 of the heat sink 200 of Fig. 2a.

[0096] **Fig. 2c** shows an exemplary cross section perspective along the longitudinal axis 204 of the heat sink 200 depicted in Fig. 2a, i.e. same reference signs in Fig. 2a, Fig. 2b and Fig. 2c denote the same components.

[0097] Fig. 2c provides an exemplary view inside the opening or tube 202 across the heat sink 200 and which can facilitate the mounting or attaching or connecting the heat sink 200 to a housing of an exemplary combustion chamber of an exemplary air-cooled combustion engine, such as the housing 100 illustrated in Fig. 1a, Fig. 1b, Fig. 1c and Fig. 3.

[0098] **Fig. 3** exemplary shows the heat sink 200 of Fig. 2a, Fig. 2b and Fig. 2c being interchangeably mounted or connected or attached to the housing 100 of the combustion chamber 105 of an air-cooled combustion engine from Fig. 1a, Fig. 1b and Fig. 1c. For completeness it is noted that the same reference signs in Fig. 1a, Fig. 1b, Fig. 1c, Fig. 2a, Fig. 2b, Fig. 2c and Fig. 3 denote the same components.

[0099] Fig. 3 illustrates that the heat sink 200 is exemplary configured as a female connector that is adapted for receiving a male part 101 of the housing 100 of the combustion chamber 105 to form or to establish a connection with the housing 100 of the combustion chamber 105, and wherein said connection can be released and re-established repeatedly and reproducibly.

[0100] The illustrated exemplary connection between the heat sink 200 and the housing 100 of the combustion chamber 105 is an example of a possible form-fit connection.

[0101] Said exemplary connection can inter alia be further supported by fastening means, e.g. bolts and/or screws that inter alia can make use of bores or through holes 203 in the heat sink 200 and corresponding bores or through holes 107 in the male 101 of the housing 100 of the combustion chamber 105.

[0102] However, the connection mechanism shown in Fig. 3 is exemplary only. Other types of connection mechanism could also be used to connect or mount or attach the exemplary heat sink 200 to the exemplary housing 101 of the combustion chamber 105 of an/the exemplary air-cooled combustion engine.

[0103] For example, as indicated previously, further possible connection mechanisms may include friction-type connections and/or force-locked connections, and/or welding connections and/or soldering connections, and any possible combination of the herein mentioned connection mechanisms.

[0104] The reference numeral 300 denotes an exemplary engine block that, for example, may comprise the crankcase of the engine and wherein the second end 102 of the housing of the combustion chamber 105 is mounted or connected or attached to said exemplary engine block.

[0105] Followed by Figures Fig. 1a, Fig. 1b, Fig. 1c, Fig. 2a, Fig. 2b, Fig. 2c, and Fig. 3, wherein the reference numerals identify the following components:

100 Exemplary housing of an exemplary combustion chamber of an exemplary air-cooled combustion engine

101 Exemplary first end of housing, exemplary male part
102 Exemplary second end of housing
103 Exemplary transfer port of the engine
104 Exemplary fin(s)
105 Exemplary combustion chamber
106 Exemplary longitudinal axis
107 Exemplary opening or bore or through hole
108a Exemplary region where main heat transfer is taking place
108b Exemplary region where main heat transfer is taking place
200 Exemplary heat sink
201a, 201b, 201c, 201d, 201e, 201f Exemplary fins, exemplary heat transfer fins
202 Exemplary central opening or recess or tube
203 Exemplary opening or bore or through hole
204 Exemplary longitudinal axis
300 Exemplary engine block of exemplary air-cooled combustion engine

Claims

1. Heat sink (200) for a cooling system for an air-cooled combustion engine,
wherein the heat sink (200) comprises a plurality of fins (201a, 201b, 201c, 201d, 201e, 201f) and is adapted to be interchangeably mounted to the housing (101) of the combustion chamber (105) of an air-cooled combustion engine.

2. Heat sink (200) according to the preceding claim, wherein the heat sink is adapted to be interchangeably mounted to a housing of the combustion chamber of an air-cooled combustion engine and wherein the housing of the combustion chamber has a cylindrical shape.

3. Heat sink (200) according to one of the preceding claims, wherein the heat sink is configured as a female connector and is adapted to receive a male part (101) of a/the housing (100) of the combustion chamber (105) to form a connection with a/the housing (101) of the combustion chamber (105).

4. Heat sink (200) according to one of the preceding claims, wherein the heat sink (200) is adapted to be interchangeably mounted to a housing (100) of the combustion chamber (105) of an air-cooled combustion engine via at least one of the following connection mechanisms: a form-fit connection, a friction-type connection, a force-locked connection, a welding connection, and via any combination of the aforementioned connection mechanisms.

5. Heat sink (200) according to one of the preceding claims, wherein the outer contour of the cross section of the fins (201a, 201b, 201c, 201d, 201e, 201f) has a polygonal shape, e.g. a rectangular shape, or a rotationally symmetric shape, e.g. a circular shape.

6. Heat sink (200) according to one of the preceding claims, wherein the heat sink material comprises a material having a thermal expansion rate that matches the thermal expansion rate of the housing (100) of the combustion chamber (105) to which the heat sink is adapted to be interchangeably mounted.

7. Heat sink (200) according to one of the preceding claims, wherein the heat sink material comprises aluminium.

8. Heat sink (200) according to one of the preceding claims, wherein the surface area provided by the fins of the heat sink is larger than the surface area of the housing of the combustion chamber.

9. Set of a plurality of heat sinks (200) according to one of the preceding claims, wherein
the set comprises heat sinks of different sizes and/or with different geometries and/or with different number of fins and/or with different sized fins and/or with different shaped fins.

10. Air-cooled combustion engine comprising:

a combustion chamber (105);
a heat sink (200) according to one of the previous claims and wherein the heat sink is interchangeably mounted to the housing (101) of the combustion chamber (105).

11. Air-cooled combustion engine according to the preceding claim,
wherein the housing (100) of the combustion chamber (105) has a cylindrical shape.

12. Vehicle comprising an air-cooled combustion engine according to one of the preceding air-cooled combustion engine claims.

13. Vehicle according to the preceding claims, wherein the vehicle is a remotely controlled aerial vehicle, e.g. an unmanned drone.

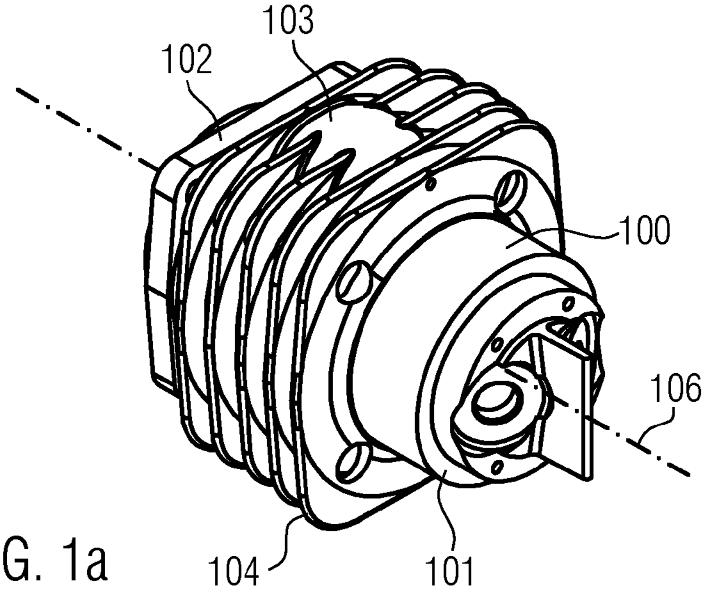

FIG. 1a

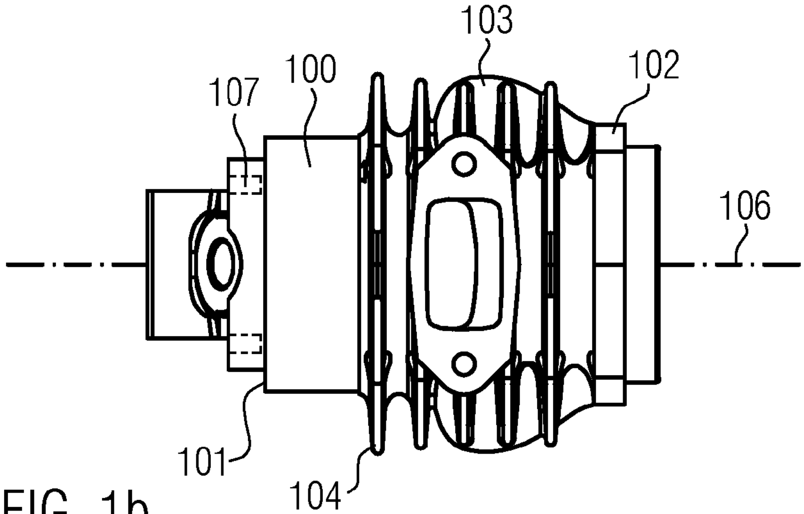

FIG. 1b

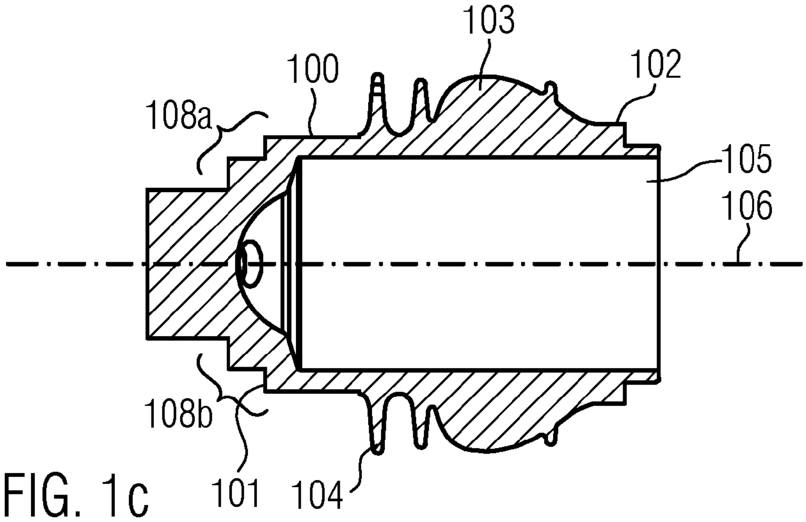

FIG. 1c

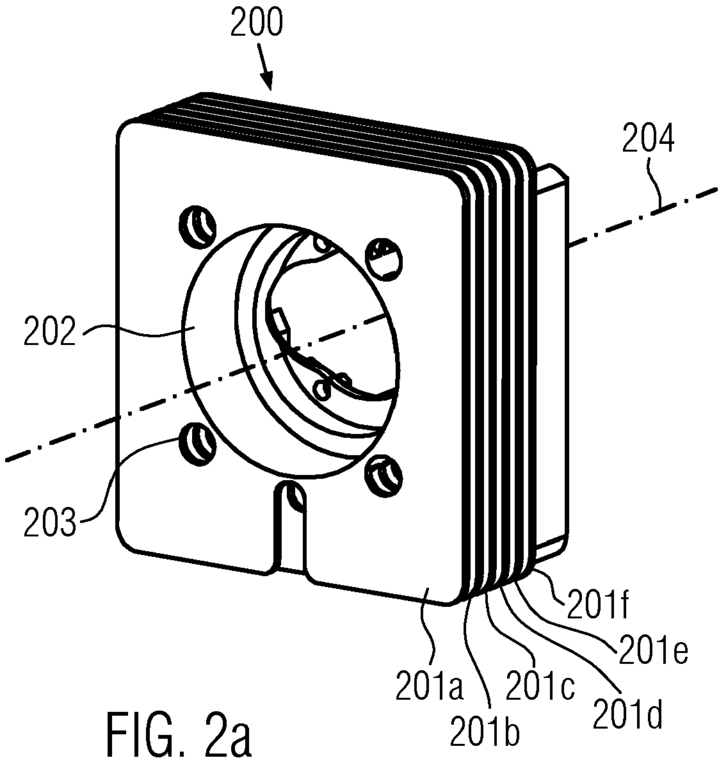

FIG. 2a

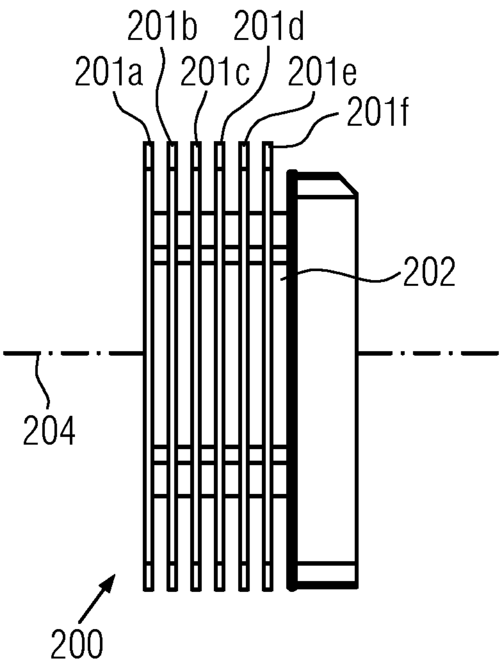

FIG. 2b

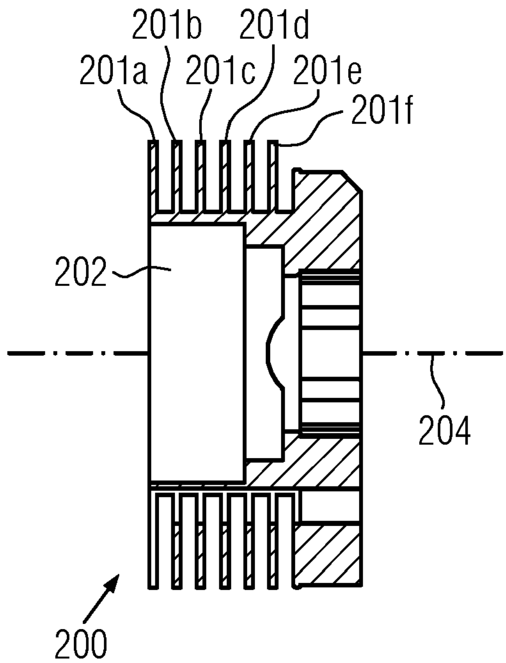

FIG. 2c

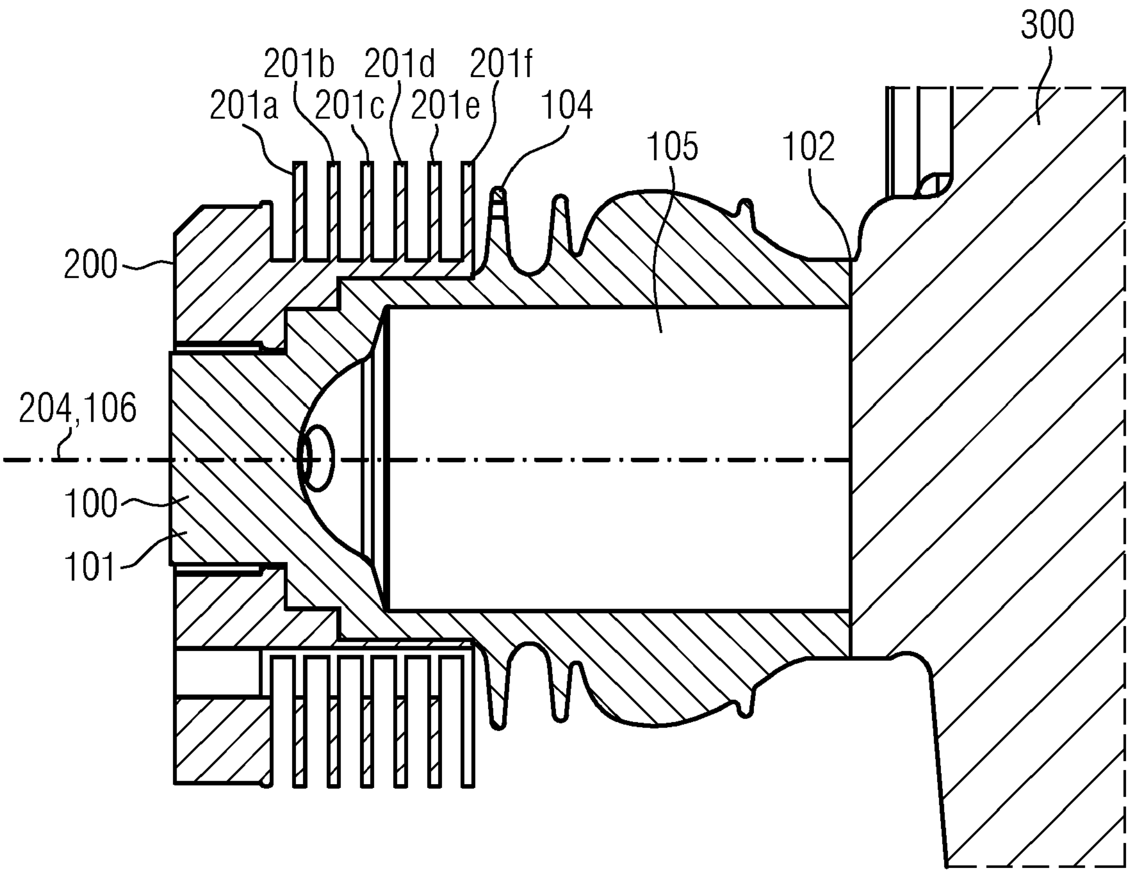
300
201b
201d
201f
201a
201c
201e
104
105
102
200
204,106
100
101

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 23 38 2464

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	Anonymous: "Novarossi Plus.21-4 Bttwc/a 4 Port", , 31 December 2012 (2012-12-31), pages 1-24, XP093088884, Retrieved from the Internet: URL:https://www.autorcnewsmodelisme.fr/content/4173-novarossi-plus-21-4-bttwc-a-4-port.html [retrieved on 2023-10-05] * pages 12-13 * -----	1-13	INV. F01P1/02 B64C39/02 F02B75/34
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TECHNICAL FIELDS SEARCHED (IPC)
F01P
F02B
B64C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	5 October 2023	Schwaller, Vincent

CATEGORY OF CITED DOCUMENTS

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