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(54) **AN ELECTRIC FLUID HEATER**

(57) An electrical fluid heater (100) includes a housing (10), heater coils (20), an inlet nozzle (12) and an outlet nozzle (14). The housing (10) is formed with a channel (10a). The heater coils (20) is received within the channel (10a) in spaced apart relation with respect to each other and with respect to inner walls (10b) of the channel (10a). The inlet nozzle (12) is for ingress of fluid inside the housing (10) surrounding the heater coils (20). The outlet (14) is for egress of heated fluid from the housing (10). The heater coils (20) include respective main portions arranged along respective parallel, planes and adjacent to each other with spacing between adjacent heater coils (20) being at least 3 mm.

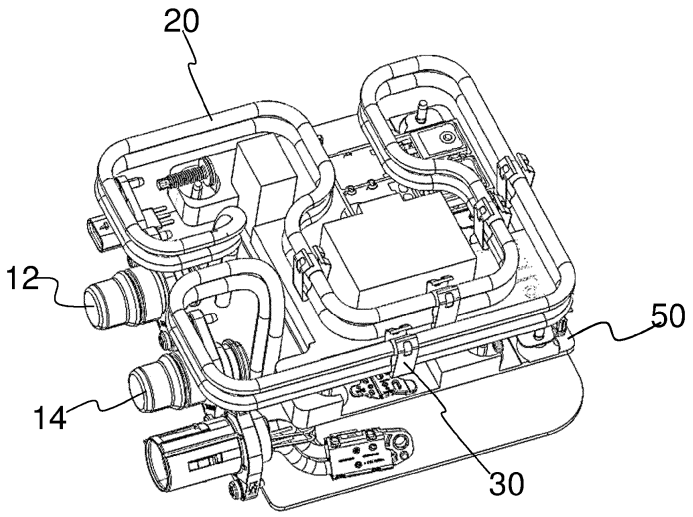

FIG. 4

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Description

[0001] The present invention relates to an electrical fluid heater, more specifically, the present invention relates to an electrical fluid heater for a vehicle.

[0002] FIG. 1a and FIG. 1b illustrate isometric views of a conventional electrical heater 1. The conventional electrical heater 1 includes a housing 2, a heater coil 6 and a Printed Circuit Board (PCB) 8. The housing 2 includes side walls 2a, 2b, 2c and 2d and a cover 2e and a base 2f. The housing 2 further includes a channel 4 formed thereon for receiving electrical heater coil 6. The channel 4 is formed on one side accessible by removing the cover 2e. One end of the heater coil 6 acts as positive terminal whereas other end of the heater coil 6 acts as negative terminal to cause current to flow through the heater coil 6 for heating of the heater coil 6. The power supply to the heater coil 6 is controlled by the PCB 8 received in the housing 2. The housing 2 further includes inlet port 3a and outlet port 3b for ingress and egress of fluid. The fluid entering inside the housing 2 flows around the heater coil 6 received in the channel 4 to extract heat from the heater coil 6 and egresses out of the housing 2 after undergoing heat exchange and extracting heat from the heater coil 6.

[0003] The channel 4 generally receives a single heater coil 6, however, the heating capacity of electrical fluid heater 1 using a single heater coil 6 is insufficient for heating the fluid. The heating capacity of the electrical fluid heater 1 is directly proportional to surface area of the heater coils 6 that depends on the length of the heater coils 6 and the number of the heater coils 6. In order to increase the length of the heater coil 6 within limited packaging space, the channel 4 and the heater coil 6 received in the channel 4 follows a torturous path with number of turns. To further increase the surface area of the heat coils 6, few prior art suggests use of multiple heater coils 6 in limited space inside the channel 4, however, packaging and routing of the multiple heater coils 6 in limited space inside the channel 4 is a problem. Further, in case multiple heater coils 6 are packaged in limited space within the channel 4, the heater coils 6 are required to be maintained spaced apart from each other and spaced from the inside walls of the channel to prevent short circuiting.

[0004] Accordingly, there is a need for an electrical heater with multiple heater coils that can be arranged in limited space inside the channel without danger of short-circuiting. Further, there is a need for an electrical heater that addresses packaging and routing issues associated with multiple heater coils arranged in limited space inside the channel.

[0005] An object of the present invention to obviate drawbacks associated with conventional electrical heaters, particularly, routing and packaging issues associated with packaging of multiple heater coils in limited space inside the channel.

[0006] Another object of the present invention is to provide an electrical heater that ensures thermal insulation between multiple heater coils and thermal insulation between the heater coils and the channel.

[0007] Still another object of the present invention is to provide an electrical heater that exhibits comparatively more service life and requires comparatively less maintenance than conventional electrical heaters.

[0008] In the present description, some elements or parameters may be indexed, such as a first element and a second element. In this case, unless stated otherwise, this indexation is only meant to differentiate and name elements which are similar but not identical. No idea of priority should be inferred from such indexation, as these terms may be switched without betraying the invention. Additionally, this indexation does not imply any order in mounting or use of the elements of the invention.

[0009] An electrical fluid heater is disclosed in accordance with an embodiment of the present invention. The electrical fluid heater includes a housing, a plurality of heater coils, an inlet nozzle and an outlet nozzle. The housing is formed with a channel. The heater coils are received within the channel in spaced apart relation with respect to each other and with respect to inner walls of the channel. The inlet is for ingress of fluid inside the housing and surrounding the heater coils. The outlet is for egress of fluid from the housing after the fluid had extracted heat from the heater coils. The heater coils having respective main portions arranged along respective parallel, planes and adjacent to each other with spacing between adjacent heater coils being at least 3 mm.

[0010] Generally, each channel follows a torturous path.

[0011] Specifically, a depth "d" of each channel is at least 2.5 times diameter of the heater coil.

[0012] Particularly, a width "w" of each channel at least 1.5 times diameter of the heater coil.

[0013] Specifically, the heater coils are disposed centrally with respect to a width "w" of the channel.

[0014] Particularly, the heater coils are uniformly spaced with respect to each other along the length thereof.

[0015] More specifically, each of the heater coils are on opposite sides of the center of a depth "d" of the channel.

[0016] Further, the electrical heater includes at least one holding clip for holding the heater coils inside the channel.

[0017] Furthermore, the electrical heater includes sleeves of insulating material disposed between the heater coil and the corresponding holding clips.

[0018] Particularly, the sleeve is of ceramic material.

[0019] Generally, each heater coil includes the main portion and a connection portion orthogonal to the main portion.

[0020] More specifically, the main portion is at least 80 percent, particularly, 90 percent of the total length of the corresponding heater coil.

[0021] Further, the connection portions are extending

parallel to each other.

[0022] Other characteristics, details and advantages of the invention can be inferred from the description of the invention hereunder. A more complete appreciation of the invention and many of the attendant advantages thereof will be readily obtained as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying figures, wherein:

FIG. 1a illustrates an isometric view of a conventional electrical fluid heater without a cover for depicting internal details thereof, wherein the conventional fluid heater includes a single heater coil;

FIG. 1b illustrates another isometric view of the conventional electrical fluid heater of FIG. 1a without the side walls;

FIG. 2 illustrates an isometric view of an electrical fluid heater in accordance with an embodiment of the present invention;

FIG. 3 illustrates an isometric view of the electrical fluid heater of FIG. 2 without a cover for depicting internal details, such as channel formed on one side of a housing of the electrical fluid heater;

FIG. 4 illustrates an isometric view of the electrical fluid heater of FIG. 2 without the side-walls and the cover; and

FIG. 5 illustrates a sectional view of the electric fluid heater of FIG. 2 depicting the heater coils held inside a respective channel by means of a holding clip.

[0023] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, said figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

[0024] Although the present invention is explained with an example of electrical fluid heater for use in vehicle, however, the present invention is also applicable for any vehicular or non-vehicular applications, wherein current carrying heater coils are required to be packaged and routed in a limited space of a channel without danger of short circuit.

[0025] FIG. 2 illustrates an isometric view of an electrical fluid heater 100 in accordance with an embodiment of the present invention. FIG. 3 illustrates an isometric view of the electrical fluid heater 100 without a cover 10h for depicting internal details, such as a channel 10a formed on one side of the housing 10 of the electrical fluid heater 100. FIG. 4 illustrates an isometric view of the electrical fluid heater 100 without the side-walls and the cover 10g. The electrical fluid heater 100 includes a housing 10, a plurality of heater coils 20, an inlet nozzle 12 and an outlet nozzle 14.

[0026] Referring to the FIG.2, the housing 10 includes a pair of opposite front and rear walls 10c and 10d, a pair of opposite sidewalls 10e and 10f and a pair of opposite top cover 10g and bottom cover 10h. The walls and the covers together define an enclosure for receiving a PCB 50, the channel 10a and the fluid to be heated around the channel 10a. The top and bottom covers 10g and 10h are removable to access an interior of the housing 10 for inspection and maintenance. The housing 10 is formed with the channel 10a. The channel 10a is preferably formed on one side thereof. However, the present invention is not limited any particular configuration of the housing 10 as far as the housing 10 defines an enclosure for receiving the PCB 50, the channel 10a and the fluid to be heated around the channel 10a receiving the heater coils 20. The PCB 50 controls the heating of the heater coils 20 by controlling the current supplied to the heater coils 20. Also, the channel 10a can be formed on any one side or extend to multiple sides of the housing 10. The channel 10a is having a rectangular cross section. However, the present invention is not limited to any particular configuration, placement and number of the channels formed on the housing 10 as far as the channel receive and securely hold the heater coils 20 therein to enable heat exchange between the fluid flowing around the channel 10a with the heater coil 20 received inside the channel 10a. The inlet nozzle 12 and the outlet nozzle 14 are formed on one of the sides of the housing, preferably the sidewall 10e of the housing 10. The side wall 10d further includes at least one electrical connector 16a and 16b for supplying electrical power to the heater coils 20 via the PCB 50 after being regulated by the PCB 50. More specifically, the electric power is transmitted from the electrical connector 16a and 16b to the PCB 50 and thereafter to the resistance inside the heater coils 20 after being regulated by the PCB 50. The inlet nozzle 12 is for ingress of fluid inside the housing 10, particularly, the inlet nozzle 12 supplies fluid to the fluid flow passages inside the housing 10 around the heater coils 20 received inside the channel 10a to extract heat from the heater coils 20 received in the channel 10a. More specifically, the fluid entering the hosing 10 via the inlet nozzle 12 is supplied to the annular space between the heater coils 20 and the inner walls 10b of the channel 10a. The outlet nozzle 14 is for the egress of the fluid from the electrical fluid heater 100 after the fluid had undergone heat exchange and extracted heat from the heater coils 20. However, the present invention is not limited to the number and placement of the inlet nozzle 12, the outlet nozzle 14 and the electrical connectors 16a and 16b.

[0027] The heater coils 20 has one end connected to positive terminal and another end connected to negative terminal to allow current flow there through to cause heating of the heater coils 20. Preferably, each of the heating coil 20 includes a main portion 20a and a connection portion 20b orthogonal to the main portion 20a. Generally, the main portion 20a is at least 80 percent, particu-

larly, 90 percent of the total length of the corresponding heater coil 20. The connection portions 20b are extending parallel to each other. Preferably, the main portions 20a are received in channel 10a.

[0028] Referring to the FIG.4, the heater coils 20 are having respective main portions arranged along respective parallel, planes and adjacent to each other with spacing between adjacent heater coils being at least 3 mm. With such configuration, the heater coils 20 are received within the channel 10a in spaced apart relation with respect to each other and with respect to inner walls 10b of the channel 10a. The heating coils 20 reject heat to the fluid received in the channel 10a and around the heating coils 20. The heating capacity of the electrical fluid heater 100 is directly proportional to surface area of the heater coils 20 that depends on the length of the heater coils 20 and the number of the heater coils 20. In order to increase the length of the heater coils 20 received within limited packaging space of the channel 10a, the channel 10a and the heater coil 20 received in the channel 10a follows a torturous path with number of turns. To further increase the surface area of the heat coils, more number of the heater coils 20 are disposed within limited space of the channel 10a. In order to achieve sufficient spacing and address packaging and routing issues, the heater coils 20 are arranged adjacent to each other with spacing between adjacent heater coils being at least 3 mm. The main portions of the respective heater coils 20 are disposed one above the other inside the channel 10a.

[0029] Particularly, at least one holding clip 30 is disposed within the channel 10a to hold the heater coils 20 inside the channel 10a. More specifically, referring to the FIG.5, the holding clip 30 maintains the heater coils 20 at desired spacing with respect to the inner walls 10b of the channel 10a. In a preferred embodiment, multiple holding clips 30 are disposed inside the channel 10a to hold multiple heater coils 20 spaced away from each other and from inside walls 10b of the channel 10a. However, the present invention is not limited to number and placement of the holding clips 30 as far as the holding clips 30 are capable of holding the heater coils 20 spaced away from each other and from inside walls 10c of the channel 10a when received in the channel 10a. The channel 10a is of such configuration that depth "d" of each channel 10a is at least 2.5 times diameter of the heater coil 20 in case two heater coils 20 are disposed one underneath the other adjacent to each other inside the channel 10a. Specifically, a depth of the channel 10a is based on the number of the heater coils 20 arranged one above the other adjacent to each other within the channel 10a. Further, the channel 10a is of such configuration, that a width "w" of each channel 10a at least 1.5 times diameter of the heater coil 20. With such configuration, the heater coils 20 are uniformly spaced with respect to each other along the length thereof and the heater coils 20 are spaced from the inner walls 10b of the channel 10a. Referring to the FIG. 5, the heater coils 20 are disposed centrally with respect to a width "w" of the channel 10a. Each of the heater coils 20 are on opposite sides of the center of a depth "d" of the channel 10a. With such configuration of the channel 10a receiving the heater coil 20, the heater coils 20 are sufficiently spaced apart from each other and inside walls of the channel 10a. The electrical fluid heater 100 further includes arrangement for electrically insulating the heater coils 20 with respect to each other and the inside 10b walls of the channel 10a. The arrangement includes sleeves 40 of insulating material disposed between the heater coil 20 and the corresponding holding clips 30. Generally, the sleeve 40 is of ceramic material. In accordance with one embodiment either one of inside walls of the holding clips 30 or outside walls of the heater coil 20 held in the holding clips 30 is formed with a lining of ceramic material. However, the present invention is not limited to any particular arrangement for insulating the heater coils 20 with respect to the inner walls 10b of the channel 10a.

[0030] In any case, the invention cannot and should not be limited to the embodiments specifically described in this document, as other embodiments might exist. The invention shall spread to any equivalent means and any technically operating combination of means.

Claims

1. An electrical fluid heater (100) comprising:

   • a housing (10) formed with a channel (10a);
   • a plurality of heater coils (20) adapted to be received within the channel (10a) in spaced apart relation with respect to each other and inner walls (10b) of the channel (10a);
   • an inlet nozzle (12) for ingress of fluid inside the housing (10) and surrounding the heater coils (20); and
   • an outlet nozzle (14) for egress of fluid from the housing (10) after the fluid had extracted heat from the heater coils (20),

   characterized in that the heater coils (20) are having respective main portions arranged along respective parallel, planes and adjacent to each other with spacing between adjacent heater coils (20) being at least 3 mm.

2. The electrical fluid heater (100) as claimed in any of the previous claim, wherein each channel (10a) follows a torturous path.

3. The electrical fluid heater (100) as claimed in any of the preceding claims, wherein a depth "d" of each channel (10a) is at least 2.5 times diameter of the heater coil (20).

4. The electrical fluid heater (100) as claimed in any of the preceding claims, wherein a width "w" of each channel (10a) at least 1.5 times diameter of the heat-

er coil (20).

5. The electrical fluid heater (100) as claimed in any of the preceding claims, wherein the heater coils (20) are disposed centrally with respect to a width "w" of the channel (10a).

6. The electrical fluid heater (100) as claimed in any of the preceding claims, wherein the heater coils (20) are uniformly spaced with respect to each other along the length thereof.

7. The electrical fluid heater (100) as claimed in any of the preceding claims, wherein each of the heater coils (20) are on opposite sides of the center of a depth "d" of the channel (10a).

8. The electrical fluid heater (100) as claimed in any of the preceding claims, further comprises at least one holding clip (30), adapted to hold the heater coils (20) inside the channel (10a).

9. The electrical fluid heater (100) as claimed in the previous claim further comprises sleeves (40) of insulating material disposed between the heater coil (20) and the corresponding holding clip (30).

10. The electrical fluid heater (100) as claimed in the previous claim, wherein the sleeve (40) is of ceramic material.

11. The electrical fluid heater (100) as claimed in any of the preceding claims, wherein each heater coil (20) comprises the main portion (20a) and a connection portion (20b) orthogonal to the main portion (20a).

12. The electrical fluid heater (100) as claimed in previous claim, wherein the main portion (20a) is at least 80 percent, particularly, 90 percent of the total length of the corresponding heater coil (20).

13. The electrical fluid heater (100) as claimed in claim 11, wherein the connection portions (20b) are extending parallel to each other.

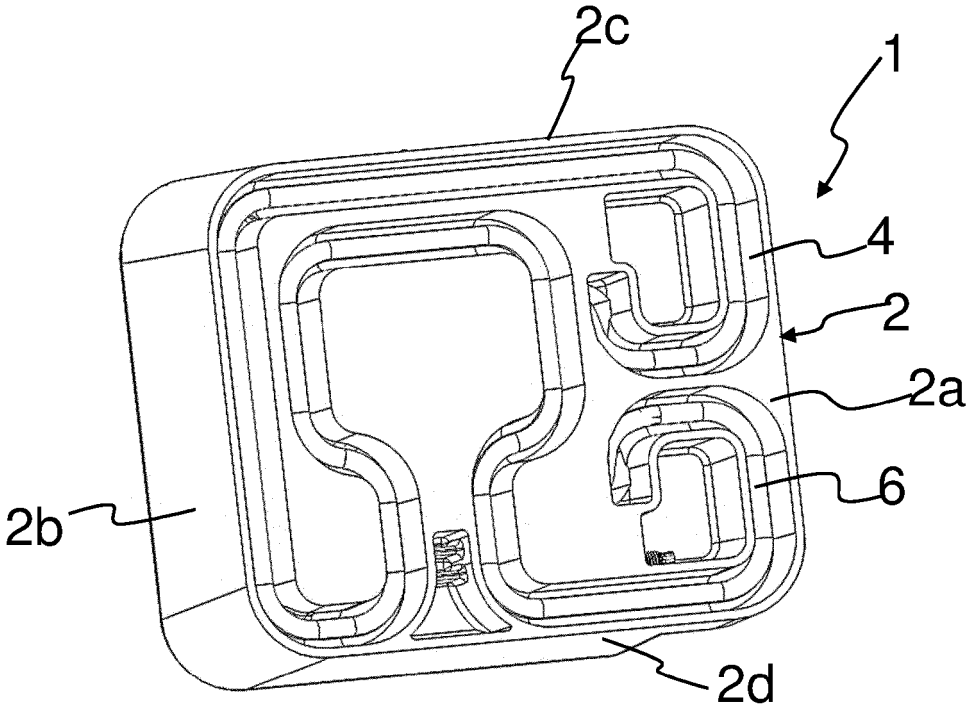

FIG. 1a

(PRIOR ART)

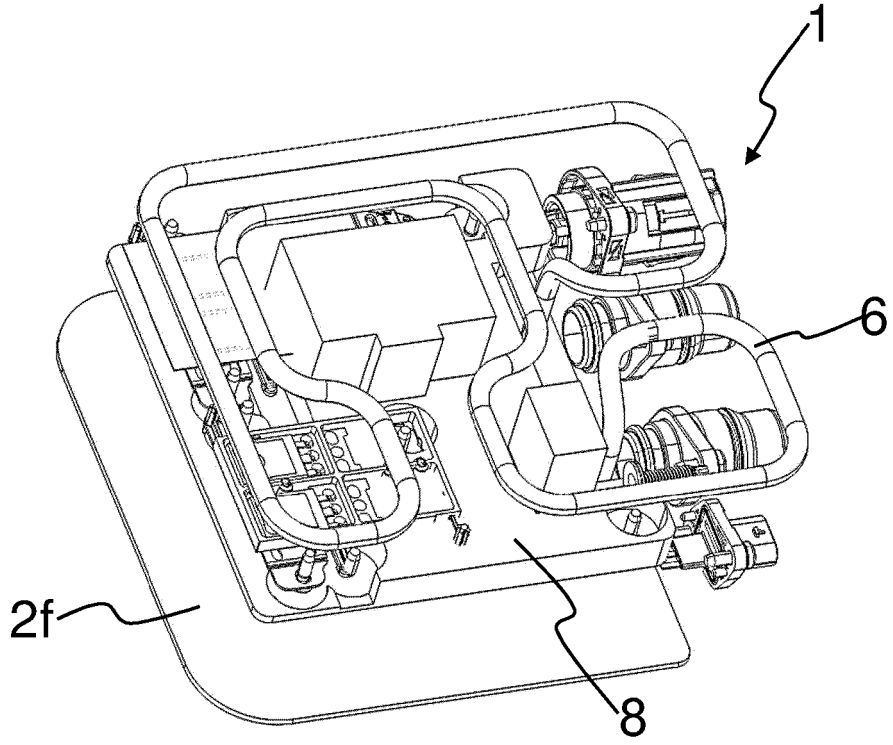

FIG. 1b

(PRIOR ART)

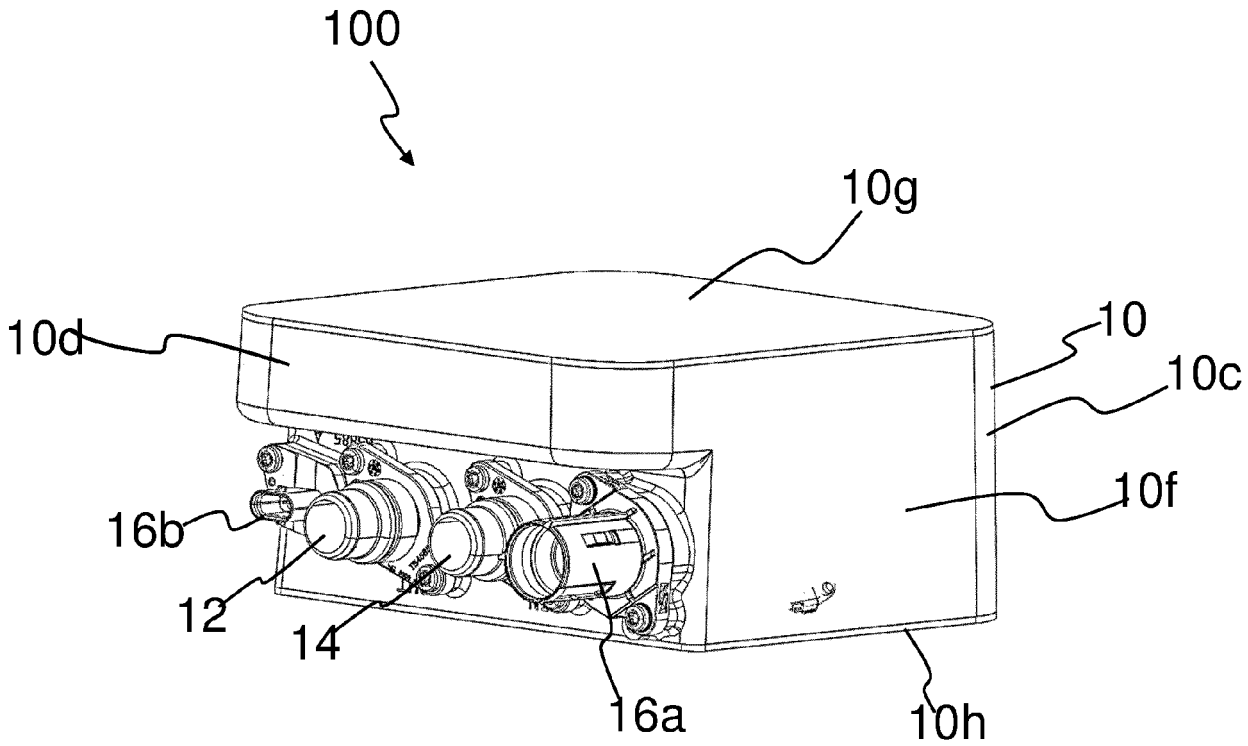

FIG. 2

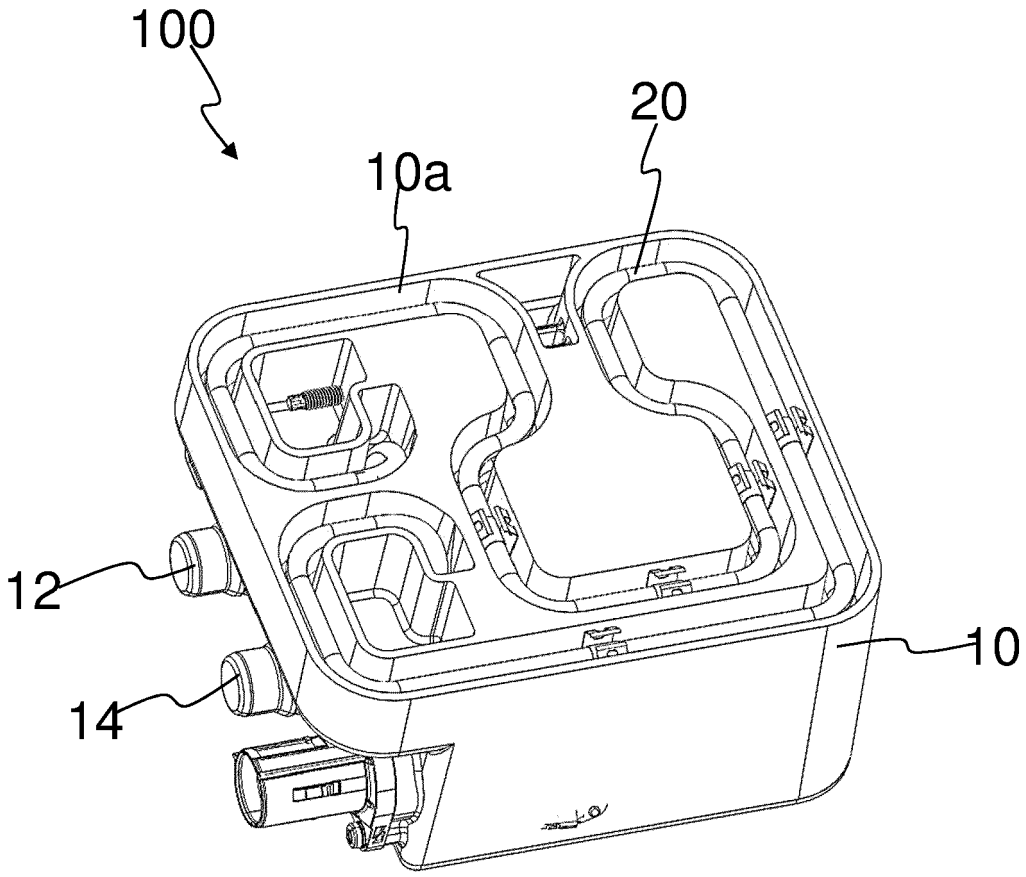

FIG. 3

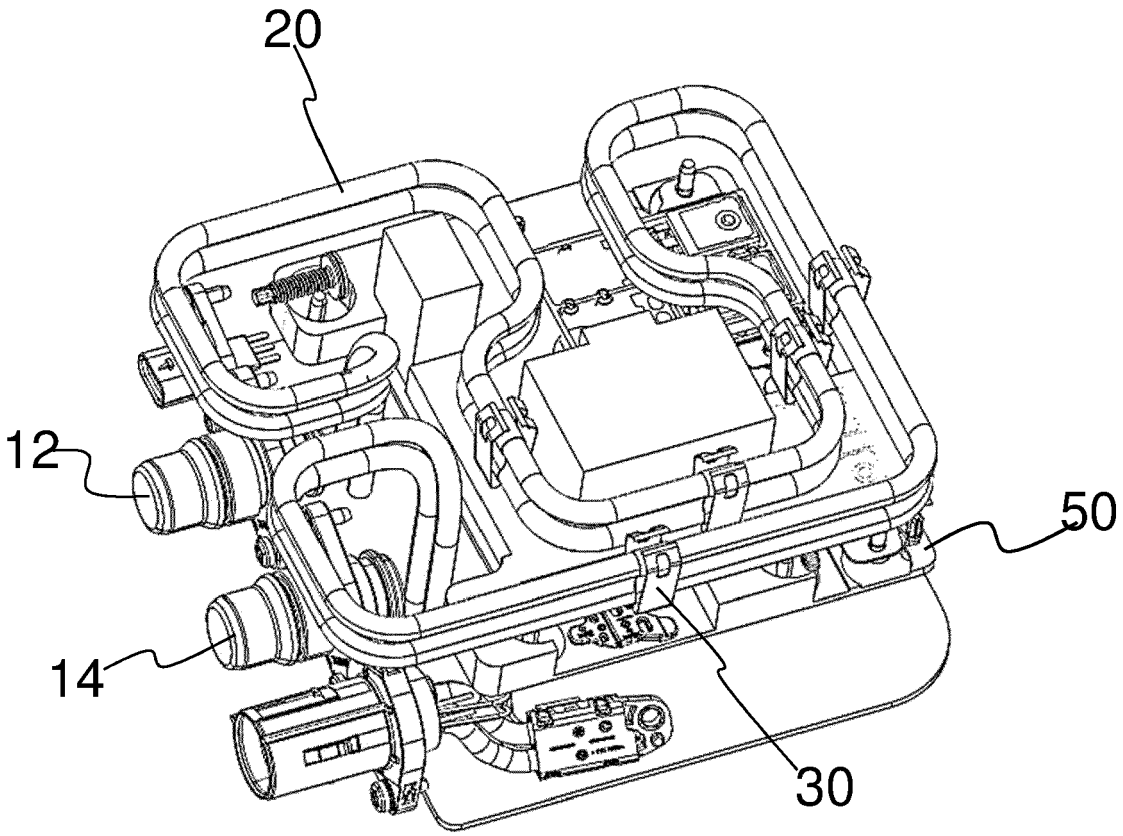

FIG. 4

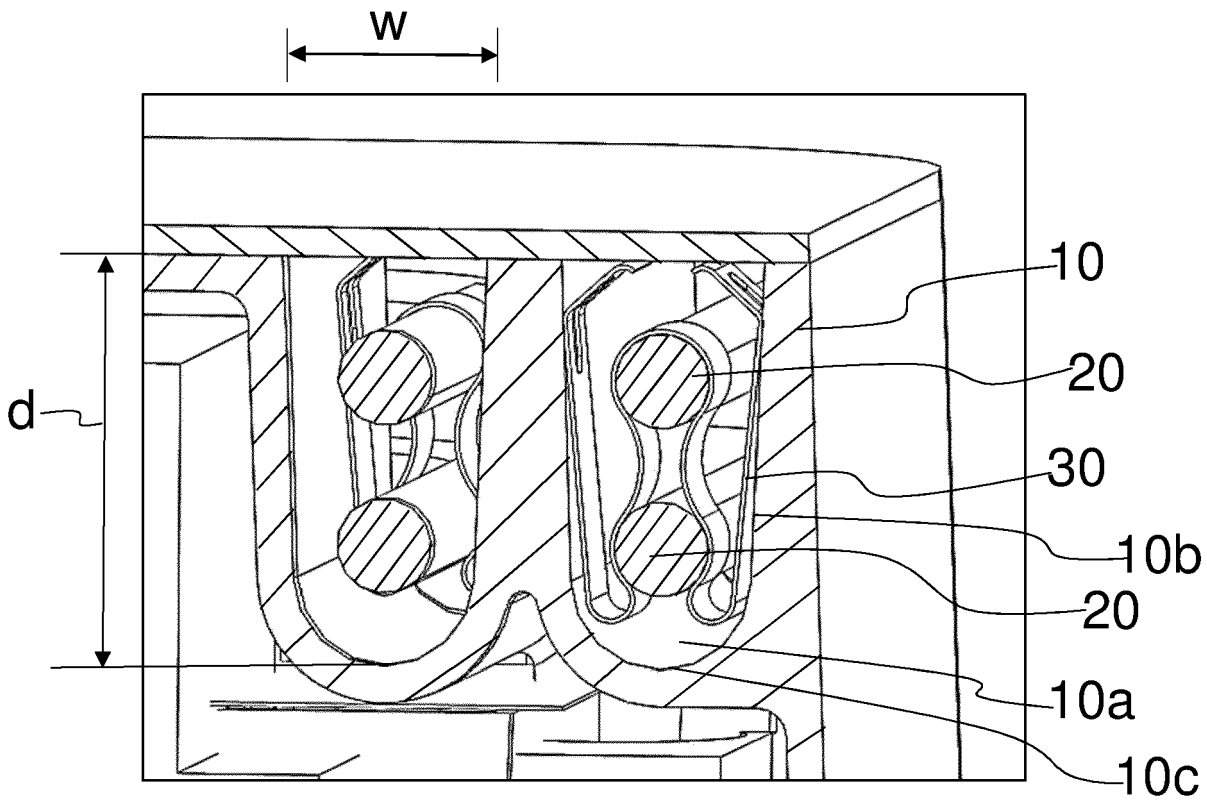

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 5572

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 5 892 888 A (ROMERO FRANCIS [FR]) 6 April 1999 (1999-04-06)	1,3-13	INV. H05B3/80
Y	* figures 1,3 * * column 2, line 45 - column 3, line 19 * * column 3, line 45 - column 4, line 13 * * column 4, lines 30-36 * * column 5, lines 20-23 * -----	2	H05B3/06 F24H1/20 F24H9/1818
Y	DE 10 2018 119041 A1 (WEBASTO SE [DE]) 6 February 2020 (2020-02-06) * paragraphs [0068] - [0070], [0072], [0075]; figures 1-5 * -----	2	

TECHNICAL FIELDS SEARCHED (IPC)

H05B
F24H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	15 December 2022	Aubry, Sandrine

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 22 18 5572

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15-12-2022

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DE 102018119041 A1	06-02-2020	DE 102018119041 A1	06-02-2020
		WO 2020030506 A1	13-02-2020

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82