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(71) Applicant: **Valeo Autosystemy SP. Z.O.O.**
32-050 Skawina (PL)

(72) Inventors:
- **GODZINA, Radoslaw**
  32-050 SKAWINA (PL)
- **HYPTA, Michal**
  32-050 SKAWINA (PL)
- **JURKIEWICZ, Damian**
  32-050 SKAWINA (PL)
- **SUSLIK, Marek**
  32-050 SKAWINA (PL)
- **KRAJEWSKI, Krzysztof**
  32-050 SKAWINA (PL)

(74) Representative: **Bialkowski, Adam**
Valeo Systèmes Thermiques
Industrial Property Department
ZA L'Agiot
8 rue Louis Lormand
CS 80517 LA VERRIERE
78322 Le Mesnil Saint Denis Cedex (FR)

(54) COOLING SYSTEM WITH A SHROUD ASSEMBLY

(57) A cooling system for a vehicle is provided. The cooling system includes a heat exchanger and a shroud. The shroud is mounted to the heat exchanger at a posterior position with respect to the heat exchanger. The shroud further includes a frame, a fan socket, and a plurality of arms. The frame is provided at a first plane of the shroud to mount the shroud to the heat exchanger. The fan socket is provided at a second plane of the shroud to receive a motor of a fan, where the first plane and the second plane are parallelly spaced apart from each other. The plurality of arms is adapted to be coupled in between the frame and the fan socket to provide rigid support to the fan and minimize displacement of the fan.

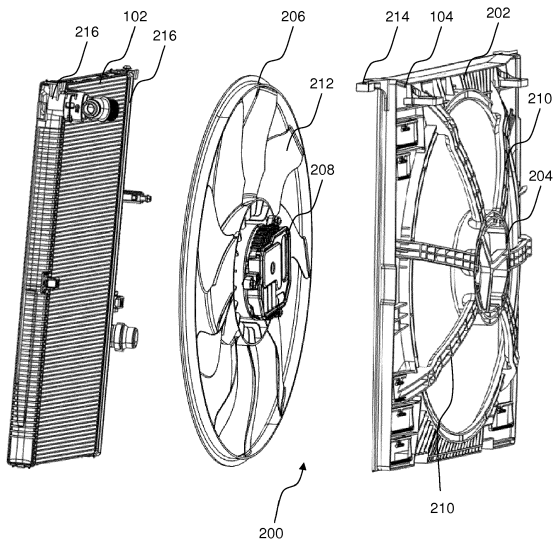

FIG. 2B

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Description

[0001] The present invention generally relates to a cooling system, and in particularly, to a shroud assembly to accommodate and support a fan of a cooling system.

[0002] Generally, cooling systems are provided in a vehicle to maintain the temperature of an engine and a passenger cabin of the vehicle at an optimum level. The cooling systems may be a part of Heating Ventilation and Air Conditioning (HVAC) system. Ideally, the cooling systems may include a radiator to exchange heat generated in the engine with the ambient air or the cooling system may include a condenser to reject heat extracted from the vehicle cabin to the ambient air. For example, the radiator is connected with the engine through conduits, the conduits supply heat exchange fluid to the engine to carry away the heat from the engine, the heat exchange fluid getting heated in the process. Further, a fan (e.g., a blower) is provided upstream of the radiator to enable flow of ambient air on the radiator to enable heat exchange between the heat exchange fluid and the ambient air to cool the heat exchange fluid that is heated after extracting heat from the engine. The fan may be provided in a shroud assembly and tightly packed with the radiator core as shown in Fig. 1, due to space constraints in the vehicle and to provide optimum ambient air to the radiator. Fig. 1 is a cross-sectional view of a radiator 10 provided with a conventional shroud assembly 12 having a fan 14. The shroud assembly 12 is mounted on the radiator 10 in a posterior position with respect to the radiator 10, and the fan 14 is provided in the shroud assembly 12. The shroud assembly 12 having arms coupled to a fan socket to provide rigid support to the fan 14. As the fan 14 is tightly mounted on the radiator 10, blades of the fan 14 may collide with the radiator 10 during vibration test of vehicle or when the vehicle is moving on an uneven terrain. Further, collision between the blades of the fan 14 and the radiator 10 may cause considerable damages to the blades of the fan 14 as well as the radiator 10. As the arms of the shroud assembly 12 do not distribute the pressure generated by a load applied on the fan 14, collision between the blades of the fan 14 and the radiator 10 is unavoidable.

[0003] Conventionally, the shroud assembly 12 is made of lighter and cheaper materials to meet market and customer requirements. In order to be cost effective and lighter cooling system, the shroud assembly 12 is made of not so robust materials which may get damaged in high temperature and reduction young's modulus of the shroud assembly 12. However, such shroud assembly 12 tends to bend while during vibration test or any force applied thereon due to use of non-robust material, which leads to damage of the fan and the radiator.

[0004] Accordingly, there is a need for a cooling system that provides optimum efficiency and enhanced life span. Further, there is a need for a shroud assembly that withstands high pressure and force applied thereon. Further, there is need for a shroud assembly that is capable of avoiding collision between blades of a fan and radiator.

[0005] 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.

[0006] In view of the foregoing, an embodiment of the invention herein provides a cooling system for a vehicle. The cooling system includes a heat exchanger and a shroud. The shroud is mounted to the heat exchanger at a posterior position with respect to the heat exchanger. The shroud further includes a frame, a fan socket, and a plurality of arms. The frame is provided at a first plane of the shroud to mount the shroud to the heat exchanger. The fan socket is provided at a second plane of the shroud to receive a motor of a fan, where the first plane and the second plane are parallelly spaced apart from each other. The plurality of arms is adapted to be coupled in between the frame and the fan socket to provide rigid support to the fan and minimize displacement of the fan.

[0007] In one embodiment, the plurality of arms coupled between the frame and the fan socket forms a dome shape to accommodate blades of the fan. In another embodiment, at least one arm of the plurality of arms is bent to form an arc shape. In yet another embodiment, the at least one arm of the plurality of arms is inclined at an angle to form a connection between the fan socket and the frame.

[0008] Generally, the plurality of arms of the shroud is of plastic composites.

[0009] In one embodiment, the plurality of arms is adapted to distribute force, applied on the fan socket in a lateral axis, along a longitudinal axis of the plurality of arms.

[0010] In another embodiment, the fan is provided in between the shroud and the heat exchanger, and heat exchanger is a radiator of the vehicle.

[0011] In yet another embodiment, the frame further includes at least one locking element adapted to engage with at least one complementary groove provided on side walls of the heat exchanger.

[0012] According to another aspect, a shroud assembly for a heat exchanger is provided. The shroud assembly includes a frame, a fan, and a fan socket. The frame is provided at a first plane of the shroud assembly and facilities mounting of the shroud assembly to the heat exchanger, where the frame is at a posterior position with respect to the heat exchanger. The fan having a motor is provided in between the frame and the heat exchanger. The fan socket is provided at a second plane of the shroud assembly to receive the motor of the fan, where the first plane and the second plane are parallelly spaced apart from each other. The plurality of arms is adapted to couple the frame and the fan socket to provide rigid support

to the fan and minimize displacement of the fan.

[0013] In one embodiment, the plurality of arms coupled between the frame and the fan socket forms a dome shape to accommodate blades of the fan.

[0014] In another embodiment, the at least one arm of the plurality of arms is bent to form an arc shape.

[0015] In yet another embodiment, the at least one arm of the plurality of arms is inclined at an angle to form an connection between the fan socket and the frame. Further, the shroud assembly is coupled to an upstream side of the heat exchanger

[0016] 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. 1 illustrates a schematic view of a conventional shroud assembly, showing an embodiment of a prior art;

Fig. 2A illustrates a schematic view of a cooling system, in accordance with an embodiment of the present invention;

Fig. 2B illustrates an exploded view of the cooling system of Fig. 2A;

Fig. 3 illustrates a side view of a shroud of the cooling system of Fig. 2A;

Fig. 4A illustrates a schematic view of the shroud having a plurality of arms, in accordance to an embodiment of the present invention;

Fig. 4B illustrates another schematic view of the shroud having the plurality of arms, in accordance to another embodiment of the present invention;

Fig. 5A illustrates a perspective view of the shroud of the cooling system of Fig. 2A;

Fig. 5B illustrates a thermal image of displacement of a fan provided in the conventional shroud assembly of Fig. 1; and

Fig. 5C a thermal image of displacement of a fan provided in the shroud assembly of the present invention.

[0017] It must be noted that the figures disclose the invention in a detailed enough way to be implemented, the figures helping to better define the invention if needs be. The invention should however not be limited to the embodiment disclosed in the description.

[0018] The present invention relates to a cooling system for maintaining optimum temperature in a vehicle or for engine cooling. For example, the cooling system can be integrated to a Heating Ventilation and Air-conditioning (HVAC) system to condition air inside a passenger cabin of the vehicle. In another example, the cooling system is adapted to extract heat generated in an engine and reject the same to the environment. The cooling system may include a heat exchanger, preferably a radiator, and a shroud assembly. The cooling system may further include other elements known to the persons skilled in the art. The shroud assembly is mounted on the heat exchanger at a posterior position with respect to the heat exchanger. The shroud assembly may include a frame mounted on the radiator and a fan socket provided in parallel planes spaced apart from each other. Further, the fan socket and the frame are connected by a plurality of arms, which forms a dome shape. As the plurality of arms forms a dome shape, displacement of a fan received in the fan socket towards the radiator is reduced even when the shroud assembly is subjected to any vibration or load. The plurality arms distribute the load or pressure to the frame of the shroud assembly, thereby preventing substantial movement of the fan. Therefore, collision between blades of the fan and the heat exchanger is avoided.

[0019] While aspects relating to a shroud assembly having a plurality of arms to avoid collision between a fan and a heating exchanger as described above and henceforth the plurality of arms can be implemented in any angled shape, the embodiments are described in the context of the following system(s).

[0020] Figs. 2A and 2B illustrate schematic views of a cooling system 200 for a vehicle, in accordance with an embodiment of the present invention. In one example, Fig. 2A illustrates a schematic view of the cooling system 200, and Fig. 2B illustrates an exploded view of the cooling system 200. The cooling system 200 may include a heat exchanger 102, and a shroud assembly 104, hereinafter referred to as shroud 104. Further, the cooling system 200 may include other elements (not shown in Figs) required to perform cooling operation, as known to the persons skilled in the art. The heat exchanger 102 may be a radiator provided at an anterior portion of the vehicle. The heat exchanger 102 may be connected to an engine or evaporator of a HVAC system through conduits to receive heat exchange fluid. In one example, the heat exchange fluid received from the engine or the evaporator extracts heat generated in the engine or passenger cabin of the vehicle. The heat exchanger 102 enables heat exchange between the heat exchange fluid and the ambient air flowing thereon. The shroud 104 can be mounted on the heat exchanger 102 at a posterior position with the respect to the heat exchanger 102. In one embodiment, the shroud 104 can be positioned at an anterior position or the posterior position with respect to the heat exchanger 102 based on the type of fan used in the cooling system 200. For example, if the cooling

system 200 is blowing air type, the shroud 104 can be positioned at the anterior position with respect to the heat exchanger 102. The shroud 104 further includes a frame 202, a fan socket 204, and a plurality of arms 210. The frame 202 is provided at a first plane of the shroud 104, and the fan socket 204 is provided at a second plane of the shroud 104. The first plane of the frame 202 and second plane of the fan socket 204 will be explained in the forthcoming figures. The first plane and the second plane are parallelly spaced apart from each other.

[0021] The cooling system 200 further includes a fan 206, preferably a blower, provided in the fan socket 204 to enable airflow on the heat exchanger 102. In one embodiment, the fan 206 may receive ambient air from the environment and facilitate passing of the air through the heat exchanger 102, in case the shroud 104 is provided in the posterior position with respect to the heat exchanger 102. In another embodiment, the fan 206 may blow the ambient air on the heat exchanger 102, in case the shroud 104 is provided in the anterior position with respect to the heat exchanger 102. The fan 206 includes a motor 208 provided with blades 212 to enable ambient airflow on the heat exchanger 102. The fan socket 204 is adapted to receive the motor 208 and the blades 212 of the fan 206 are accommodated adjacent to the plurality of arms 210. The fan 206 is provided in the fan socket 204 in such a way that the fan 206 is posterior to the heat exchanger 102 and anterior to the shroud 104. In other words, the fan 206 is provided in between the shroud 104 and the heat exchanger 102.

[0022] The plurality of arms 210 forms a connection between the frame 202 and the fan socket 204 to provide rigid support to the fan 206 and minimize displacement of the fan 206 when any force or load is applied on the shroud 104. As the frame 202 is in the first plane and the fan socket 204 is in the second plane, the plurality of arms 210 forms an angled connection when connecting the plurality of arms 210 between the frame 202 and the fan socket 204. As the plurality of arms 210 is connected between the frame 202 and the fan socket 204 at an angle, the plurality of arms 210 distributes the force/pressure acting on the fan socket 204 to the edges of the frame 202, thereby minimizing displacement of the fan 206 towards the heat exchanger 102. By minimizing displacement of the fan 206, collision between the blades 212 of the fan 206 and a core of the heat exchanger 102 is avoided, thereby eliminating damages of the blades 212 of the fan 206 and the heat exchanger 102. The frame 202 further includes one or more locking elements 214 to mount the shroud 104 on the heat exchanger 102. The heat exchanger 102 may include one or more complementary grooves provided in side walls 216 of the heat exchanger 102. The one or more complementary grooves receive the one or more locking elements 214 to enable a connection between the shroud 104 and the heat exchanger 102.

[0023] Fig. 3 illustrates a side view of the shroud 104 of the cooling system 200 of Fig. 2A. As shown in Fig. 3, the frame 202 of the shroud 104 is in the first plane 302, and the fan socket 204 is in the second plane 304. The first plane 302 is parallelly spaced from the second plane 304. In other words, the first plane 302 is laterally spaced from the second plane 304 of the shroud 104. The plurality of arms 210 is adapted to connect the fan socket 204 with the frame 202 to distribute the stress/load acting on the fan socket 204 to the frame 202. In one embodiment, at least one arm of the plurality of arms 210 is bent to form an arc shape. In another embodiment, the plurality of arms 210 coupled in between the frame 202 and the fan socket 204 forms a dome shape to accommodate the blades 212 of the fan 206.

[0024] Figs 4A and 4B illustrate different views of the shroud 104 of the cooling system 200 of Fig. 1. In one example, Fig. 4A illustrates a schematic view of the shroud 104 having the plurality of arms 210, in accordance to an embodiment of the present invention. In this embodiment, the plurality of arms 210 is formed as dome shaped to accommodate the blades 212 of the fan 206. When any force F acting on the fan socket 204 in a lateral axis 402 of the fan socket 204, the plurality of arms 210 dissipates or distributes the force along longitudinal axis 404 of the plurality of arms 210, the force is ultimately transmitted to the frame 202. According to this embodiment, the plurality of arms 210 is formed as an arc shape and forms a connection between the fan socket 204 and the frame 202. In another example, Fig. 4B illustrates another schematic view of the shroud 104 having the plurality of arms 210, in accordance to another embodiment of the present invention. According to the present embodiment, the plurality of arms 210 is angled arms to form a connection between the frame 202 and the fan socket 204 at an angle "a" marked as 406. The plurality of arms 210 is inclined at the angle 406 to form a connection between the fan socket 204 and the frame 202. As the frame 202 and the fan socket 204 are in different planes, the plurality of arms 210 connected between the frame 202 and the fan socket 204 forms an angle with respect to the frame 202.

[0025] Fig. 5A illustrates a perspective view of the shroud 104 of the cooling system 200 of Fig. 2A. The frame 202 of the shroud 104 can be rectangular frame having an aperture 502 to provide space for receiving the fan socket 204 and rotating blades of the fan. In one embodiment, the fan socket 204 is of circular shape centrally disposed in the aperture 502 of the frame 202. The plurality of arms 210 is of plastic composites, such as for example Polypropylene with 40% Glass Fiber Filler, PA6 composite. In one embodiment, the plurality of arms 210 may include 2-20 arms, and at least one arm amongst the plurality of arms 210 is bent. During vibration or strong shock or impact acting on the fan socket 204 in the lateral direction 504 of the fan socket 204, tension created in the plurality of arms 210 is transmitted along the longitudinal axis 506 of the plurality of arms 210 and distributed within the plurality of arms 210 to minimize the displacement of the fan 206.

[0026] Figs. 5B and 5C are comparison of displacement of the conventional shroud assembly 12 and the shroud 104 according to the present invention. In one example, Fig. 5B illustrates a thermal image of displacement of the fan provided in the conventional shroud assembly 12, and Fig. 5C illustrates a thermal image of displacement of the fan 206 provided in the shroud 104 of the present invention. When the load of 200N (Newton) is applied on both the conventional shroud assembly 12 and the shroud 104 of the present invention, the fan socket of the conventional shroud assembly 12 displaces 5,34mm from its original position as depicted in 508 in Fig. 5B, whereas the fan socket 204 of the shroud 104 of the present invention displaces 3,69mm from its original position as depicted in 510 in Fig. 5C. Therefore, the plurality of arms 210 in the shroud 104 of the present invention reduces displacement of the fan socket 204, thereby eliminating collision of the fan 206 with the heat exchanger 102. Further, stiffness of the shroud 104 of the present invention is more than the stiffness of the conventional shroud assembly 12, due to the present design of the plurality of arms 210. Furthermore, the shroud 104 of the present invention having stiffness of 5420 N/mm when the load 200N applied on the shroud 104, whereas the conventional shroud assembly 12 has 3745 N/mm. Therefore, the cooling system 200 of the present invention efficiently performs even when the vehicle moves in the uneven terrain and avoids damages of any elements in the cooling system 200 during vibration tests of the vehicle.

[0027] Obviously, numerous modifications and variations of the present invention are possible in light of the above teachings. It is therefore to be understood that the invention may be practiced otherwise than as specifically described herein.

[0028] 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. A cooling system (200) for a vehicle, comprising:

a heat exchanger (102); and
a shroud (104) mounted to the heat exchanger (102), wherein the shroud (104) further comprising:

a frame (202) provided at a first plane (302) of the shroud (104) to mount the shroud (104) to the heat exchanger (102);
a fan socket (204) provided at a second plane (304) of the shroud (104) to receive a motor (208) of a fan (206), wherein the first plane (302) and the second plane (304) are parallelly spaced apart from each other; and
a plurality of arms (210) adapted to be coupled in between the frame (202) and the fan socket (204) to provide rigid support to the fan (206) and minimize displacement of the fan (206).

2. The cooling system (200) as claimed in claim 1, wherein the plurality of arms (210) coupled between the frame (202) and the fan socket (204) forms a dome shape to accommodate blades (212) of the fan (206).

3. The cooling system (200) as claimed in claim 1, wherein at least one arm of the plurality of arms (210) is bent to form an arc shape.

4. The cooling system (200) as claimed in claim 1, wherein at least one arm of the plurality of arms (210) is inclined at an angle (406) to connect in between the fan socket (204) and the frame (202).

5. The cooling system (200) as claimed in any of preceding claims, wherein the plurality of arms (210) of the shroud (104) is of plastic composites.

6. The cooling system (200) as claimed in any of preceding claims, wherein the plurality of arms (210) is adapted to distribute force, applied on the fan socket (204) in a lateral axis (402), along a longitudinal axis (404) of the plurality of arms (210).

7. The cooling system (200) as claimed in any of preceding claims, wherein the fan (206) is provided in between the shroud (104) and the heat exchanger (102).

8. The cooling system (200) as claimed in any of preceding claims, the heat exchanger (102) is a radiator of the vehicle.

9. The cooling system (200) as claimed in claim 1, wherein the frame (202) further includes at least one locking element (214) adapted to engage with at least one complementary groove provided in side walls (216) of the heat exchanger (102).

10. The cooling system (200) as claimed in any of preceding claims, wherein the shroud (104) is mounted on the heat exchanger (102) at a posterior position with respect to the heat exchanger (102).

11. A shroud assembly (104) for a heat exchanger (102), comprising:

a frame (202) provided at a first plane (302) of the shroud assembly (104) to mount the shroud

assembly (104) to the heat exchanger (102), wherein the frame (202) is at a posterior position with respect to the heat exchanger (102);
a fan (206) having a motor (208) provided in between the frame (202) and the heat exchanger (102);
a fan socket (204) provided at a second plane (304) of the shroud assembly (104) to receive the motor (208) of the fan (206), wherein the first plane (302) and the second plane (304) are parallelly spaced apart from each other; and
a plurality of arms (210) adapted to be coupled in between the frame (202) and the fan socket (204) to provide rigid support to the fan (206) and minimize displacement of the fan (206).

12. The shroud assembly (104) as claimed in claim 11, wherein the plurality of arms (210) coupled between the frame (202) and the fan socket (204) forms a dome shape to accommodate blades (212) of the fan (206).

13. The shroud assembly (104) as claimed in claim 11, wherein at least one arm of the plurality of arms (210) is bent to form an arc shape.

14. The shroud assembly (104) as claimed in claim 11, wherein at least one arm of the plurality of arms (210) is inclined at an angle (406) to connect in between the fan socket (204) and the frame (202).

15. The shroud assembly (104) as claimed in claim 11, wherein the shroud assembly (104) is coupled to an upstream side of the heat exchanger (102).

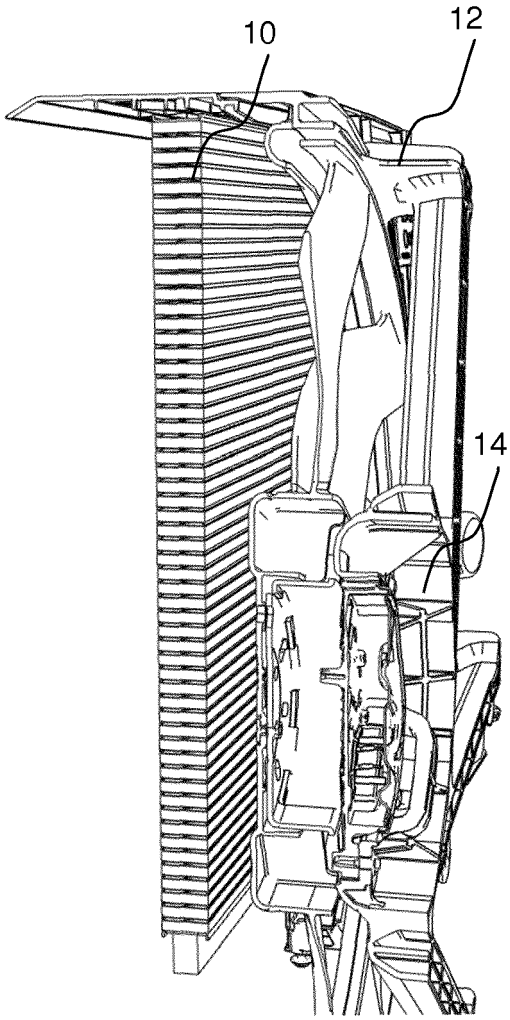


FIG. 1 (Prior Art)

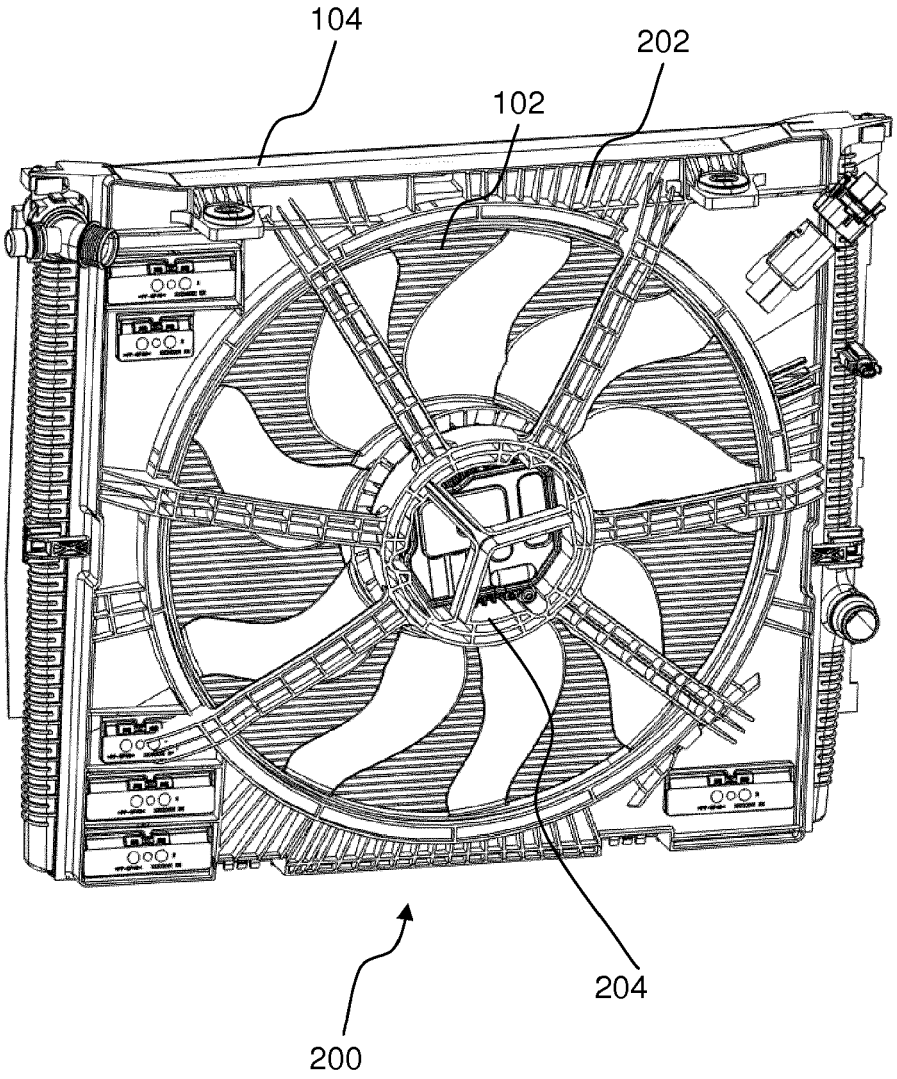


FIG. 2A

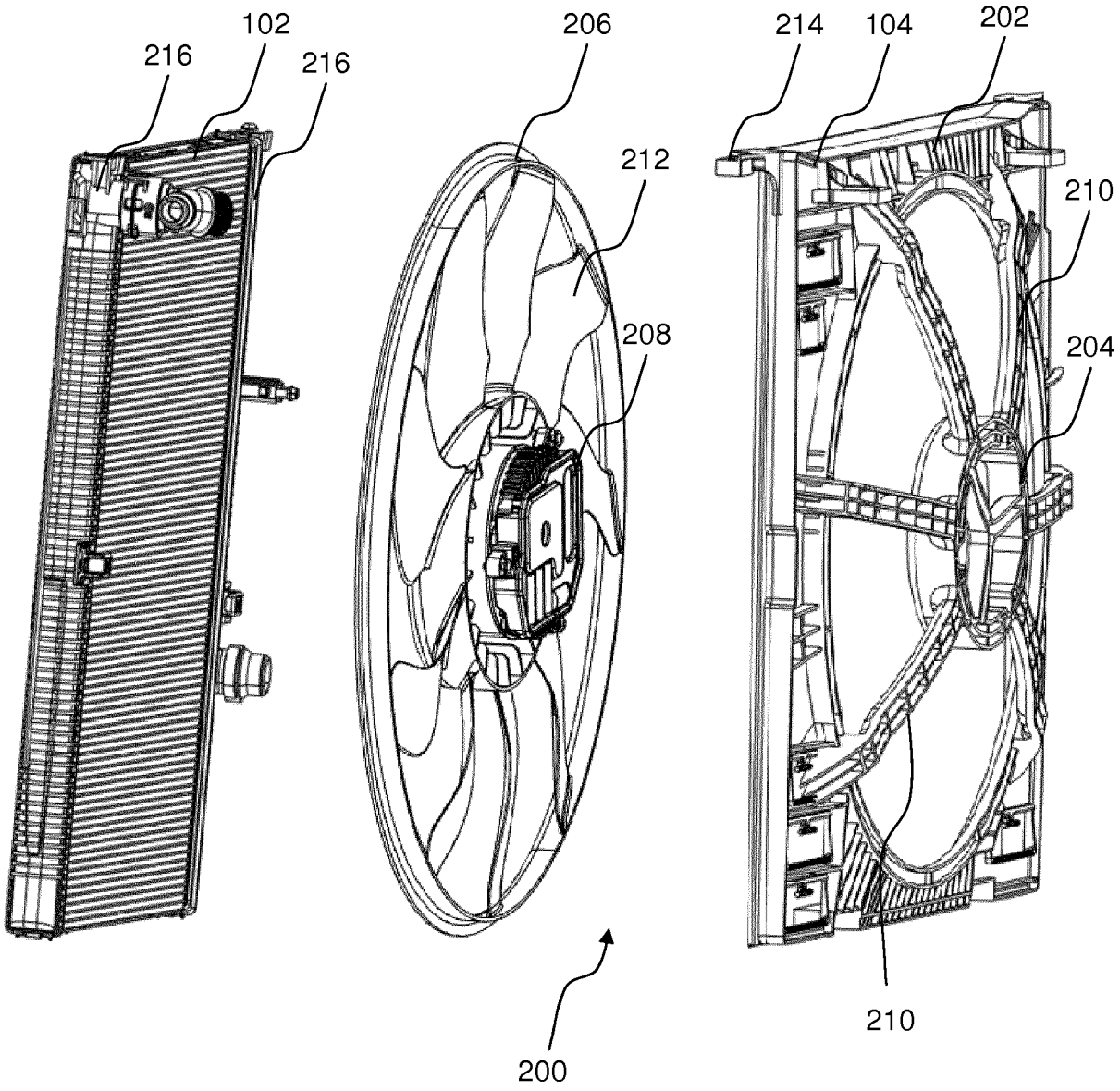


FIG. 2B

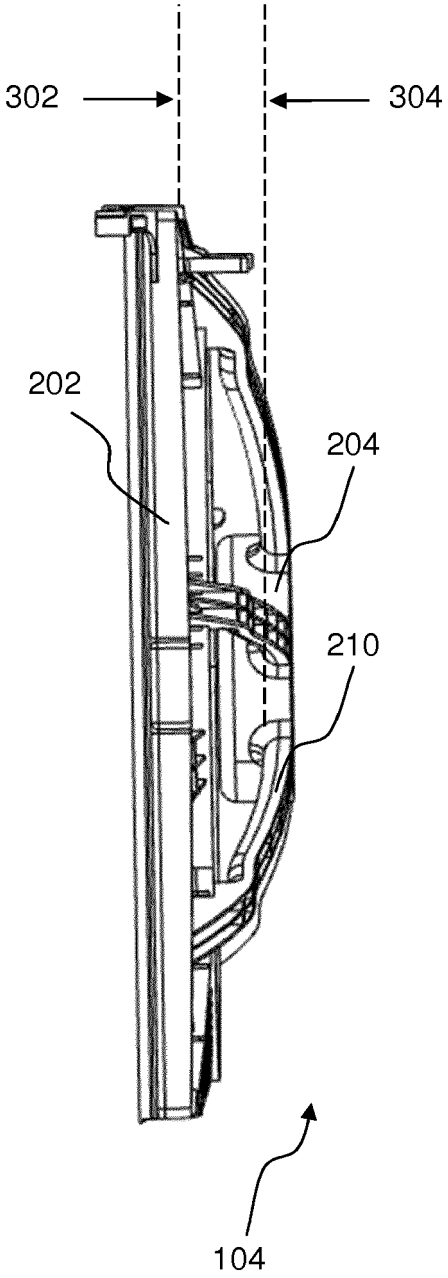


FIG. 3

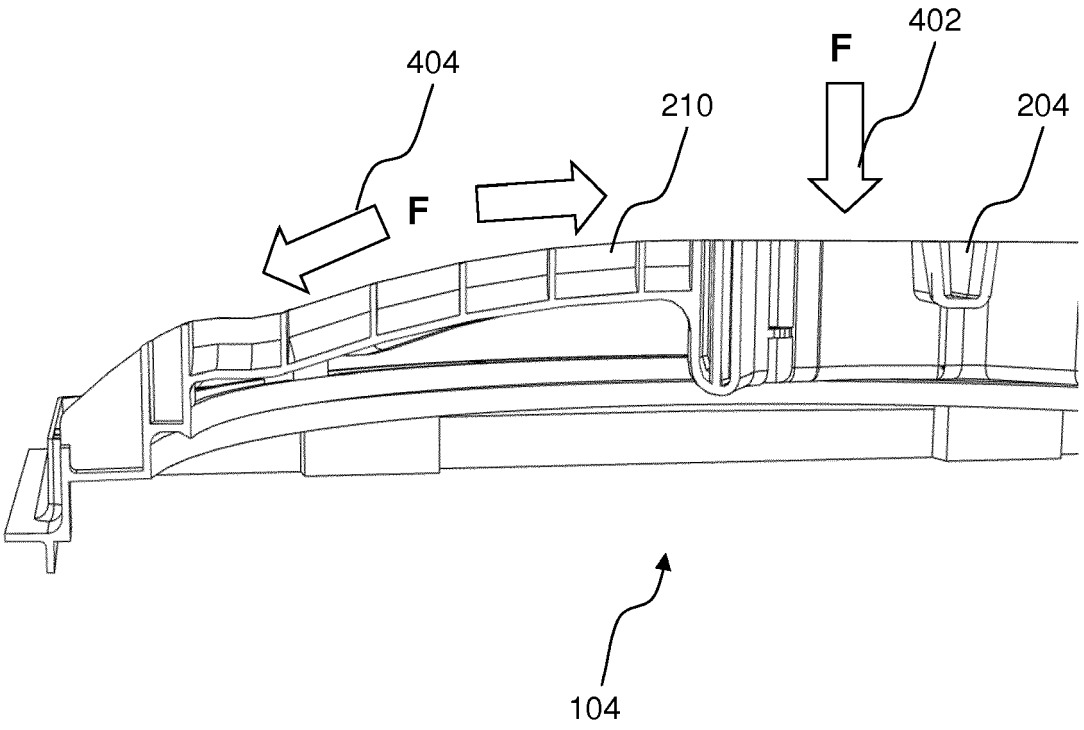


FIG. 4A

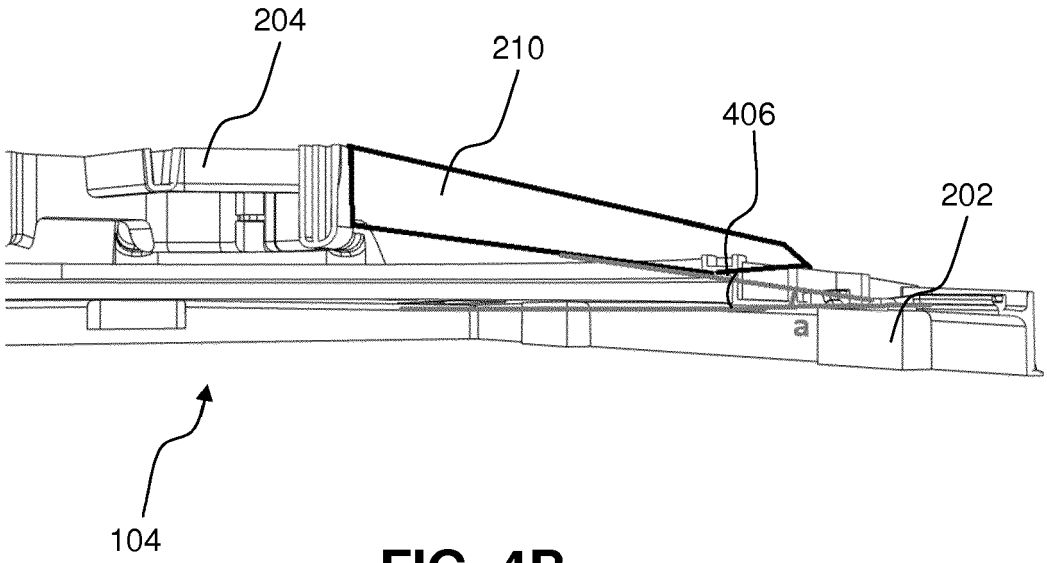


FIG. 4B

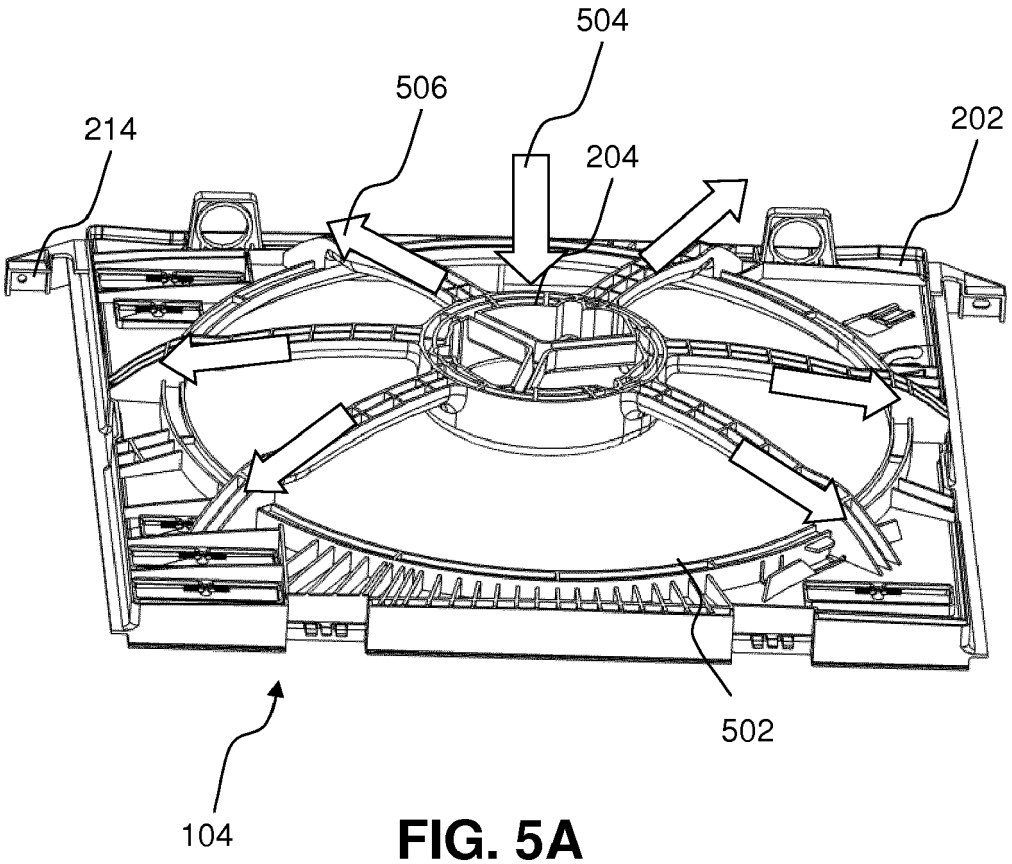
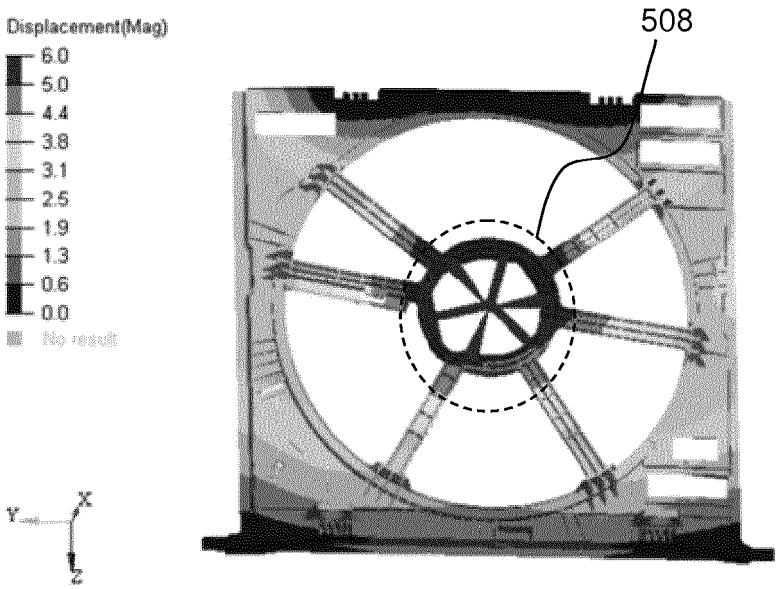


FIG. 5A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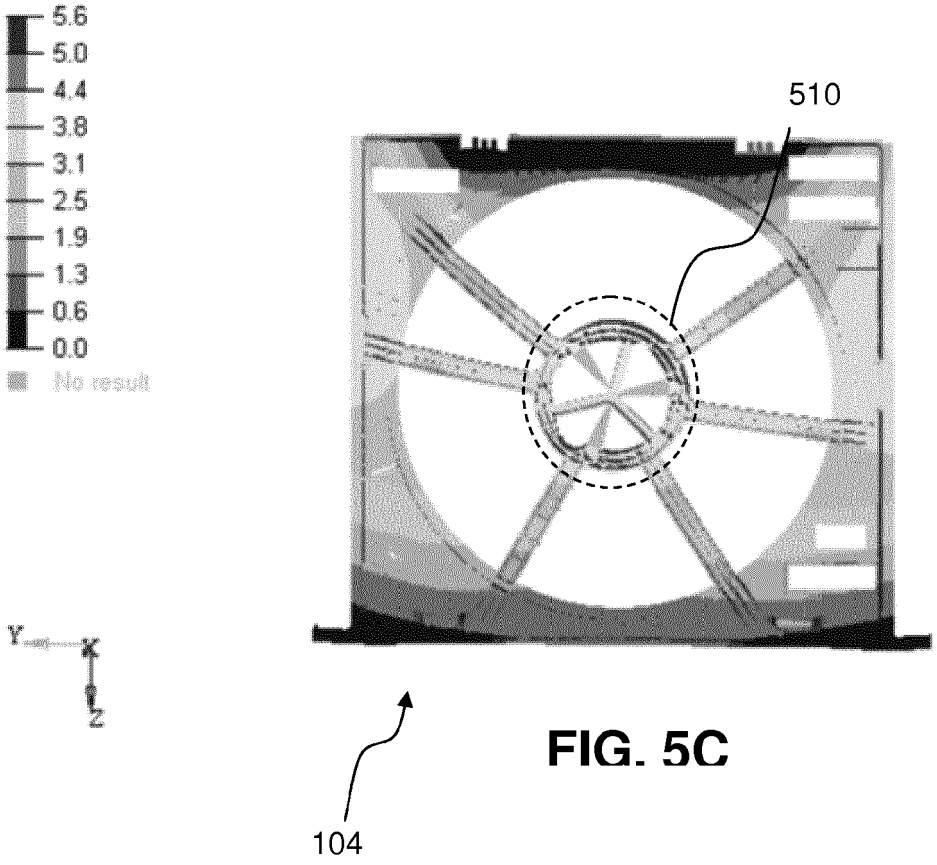
12

FIG. 5B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104

FIG. 5C

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EUROPEAN SEARCH REPORT

Application Number
EP 19 46 1540

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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A	* column 2, line 40 - column 4, line 19; figures 3-6 *	11	

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Y	EP 1 452 820 A2 (MODINE MFG CO [US]) 1 September 2004 (2004-09-01)	9	
A	* column 4, lines 7-56; figures 1-4 *	1-8, 10-15	
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			F01P

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 June 2019	Luta, Dragos

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

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