(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 726 020 A1

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
21.10.2020 Bulletin 2020/43

(51) Int Cl.:
F01P 11/12 *(2006.01)* ***F04D 29/32*** *(2006.01)*

(21) Application number: **20158256.6**

(22) Date of filing: **19.02.2020**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **26.03.2019 IN 201941011834**

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(54) **A COOLING SYSTEM**

(57) The present subject matter discloses a cooling system (300) for a heat exchanging device (302). The cooling system (300) comprises a shroud (320), a motor (303) and a cooling fan (304). The present invention discloses the cooling system (300) with a ring (305) in accordance with a predetermined ratio (b/a) between a ring height (b) and a blade height (a) for providing higher cooling rate, high durability, minimal noise and substantially optimum structural strength to the plurality of blades (304). Under the predetermined ratio (b/a) the ring height (b) is maintained smaller than the blade height (a) to minimize the obstruction coming in the out flow of the air while leaving the cooling fan (301). The proposed subject matter is simple in construction and easy to remove and mount giving rise to improved serviceability.

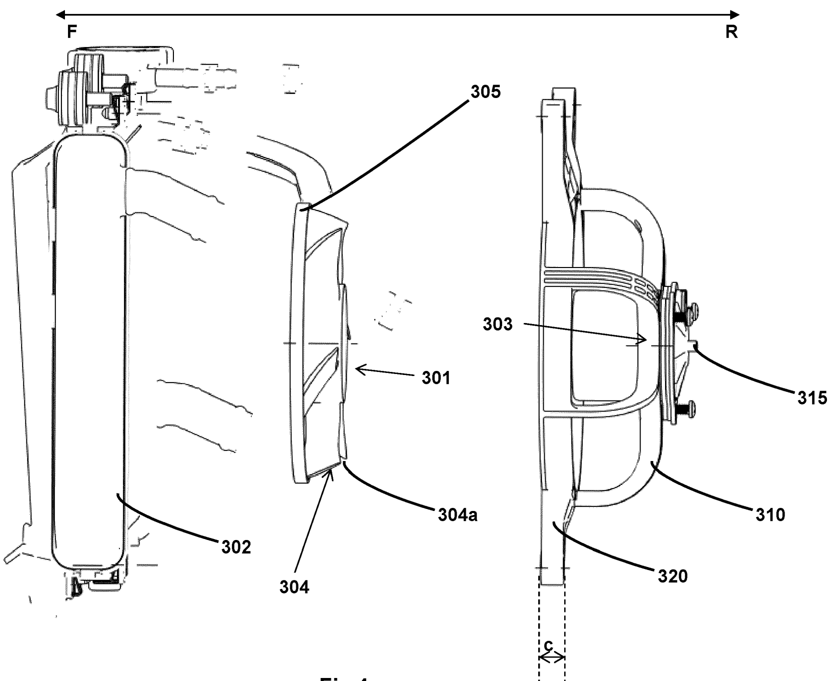

Fig.4

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Description

TECHNICAL FIELD

[0001] The present subject matter relates generally to a cooling system. More particularly but not specifically, the present invention relates to the cooling system for a vehicle.

BACKGROUND

[0002] In general, an automobile includes an engine block coupled with other components and suspended on a body frame with pair of wheels. Such automobile, often referred to as a two-wheeled vehicle or a three-wheeled vehicle or a multi-wheeled vehicle, may include a vehicle body cover which surrounds the engine to improve the outer appearance of the vehicle and protect the component elements of the vehicle. In order to make automobile appealing to diverse groups, various models of automobile designs have been developed.

[0003] Conventionally, these appealing automobiles has various multitude of components and parts fixed at various place on the vehicle which offers an unnecessary hurdle for heat dissipation from heat generating or heat releasing parts. Hence, the design and manufacturing of a cooling system plays a significant role for making appealing automobile at high pace with effective cooling and better safety. An effective cooling system enhances the engine efficiency and running efficiency of the automobile. Further, effective cooling can improve rider comfort by reducing un-desired noise produced by the cooling system as well as enhance performance & durability of the powertrain as whole.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] The detailed description is given with reference to the accompanying figures. The same numbers are used throughout the drawings to reference like features and components.

Fig. 1. illustrates the side view of a two-wheeled vehicle employing an embodiment of the present subject matter.

Fig. 2. illustrates the isometric view of the two-wheeled vehicle after the side panel and other style parts are removed according to the embodiment of present subject matter.

Fig. 3 illustrates a rear view of a cooling system with a heat exchanging device in accordance with the present subject matter.

Fig. 4 illustrates the exploded side view of the cooling system with the heat exchanging device in accordance with the present subject matter.

Fig. 5a illustrates a top view of a cooling fan in accordance with the present subject matter.

Fig. 5b illustrates a front view of the cooling fan in accordance with the present subject matter.

Fig. 5c illustrates a side view of the cooling fan in accordance with the present subject matter.

Fig. 6a depicts exemplary curve for cooling efficiency plotted against ratio, in accordance with another embodiment of the present subject matter.

Fig. 6b depicts exemplary curve for noise plotted against ratio, in accordance with another embodiment of the present subject matter.

DETAILED DESCRIPTION

[0005] Various features and embodiments of the present invention here will be discernible from the following further description thereof, set out hereunder. According to an embodiment, pair of wheels is described here to operate an automobile. The pair of wheels is installed in a step through type two wheeled vehicle colloquially called as scooter. It is pertinent to note that the pair of wheels may be mounted in two wheeled vehicles in different arrangements. However, in the ensuing description, such pair of wheels is disposed at extreme ends of the step through type two wheeled vehicle. It is contemplated that the concepts of the present invention may be applied to other types of vehicles and other types of casting methods within the spirit and scope of this invention. Further "front" and "rear", and "left" and "right" referred to in the ensuing description of the illustrated embodiment refer to front and rear, and left and right directions as seen from a rear portion of the vehicle and looking forward. The detailed explanation of the constitution of parts other than the present invention which constitutes an essential part has been omitted at suitable places.

[0006] During operation of an IC engine, the burning of fuel and air occurs inside an internal combustion (IC) engine generating mechanical energy which provides motive force for movement of an automobile. But, this operation generates lot of thermal energy in and around the IC engine which must be extracted out of the IC engine. Hence, it is necessary to cool the IC engine, and many saddle type two & three wheeled vehicles employ liquid cooling systems to cool the IC engine. In liquid cooling systems, a coolant is pumped under pressure and circulates to critical hot zones of the IC engine in passages. This helps to extract heat from various parts of the IC engine and maintains an optimum operating temperature for the IC engine to operate. A heat exchanging device is usually employed in such liquid cooling systems wherein the hot coolant is cooled and the cooled coolant is circulated back for the next cycle. Within the heat exchanging device, the coolant is made to pass through long circuitous passages and constant flow of air is passed through its core to extract the heat. The flow of air is obtained when the vehicle is moving by taking advantage of the impinging air flow from a front direction and assisted by a cooling system which helps draws in the air and direct the hot air out of the heat exchanging device after circulation especially when the vehicle is running at low speed, as at higher speed of the vehicle the natural air coming from the front is sufficient to cool the coolant circulating through the hat exchanging device. Generally, in two wheeled vehicles the heat exchanging device is disposed towards the front of the vehicle to take advantage of the incoming air from the front during motion. Behind the heat exchanging device, the cooling system is present to cool the coolant circulating through the heat exchanging device for controlling the IC engine temperature.

[0007] Further, with a view to incorporate look, and aesthetic value to the vehicle large side panels enclose the two sides of the vehicle in order to give a sporty look. The side panels enclose the heat exchanging device, the cooling system to form a substantial central region on the front to permit ingress of air and exits on either side behind on the rear of the side panels to permit hot air exit after passing through the heat exchanging device and the cooling system. However, due to the presence of the side panels and other aesthetic value parts there is a limited area present for the entry of the air to cool the IC engine. Hence, there is a requirement of high cooling rate from the cooling system to cool the IC engine and control the IC engine temperature. As the heat exchanging device is provided to cool the IC engine and the cooling system is provided to cool the heat exchanging device. So, for getting high cooling rate from the cooling system for the heat exchanging device, there is a need of developing an efficient cooling system without making any layout changes in the vehicle & having a cooling system of compact size and dimensions.

[0008] In general, the cooling system comprises a shroud, a motor and a cooling fan. The cooling fan operates at a certain operating speed and generates air flow for air suction coming out from the heat exchanging device. The cooling fan is having plurality of blades and the plurality of blades comprises a first end and a second end which is attached with a ring. The cooling system efficiency is directly proportional to the air flow coming out from the cooling fan. Because when more air flow comes out from the cooling fan then cooling of coolant circulating through the heat exchanging device takes place rapidly. Hence, in order to increase the cooling rate, it is recommended to have higher cooling fan air flow rate. Conventionally, the high cooling rate is achieved by increasing the cooling fan dimension. But due to the presence of the side panels and other aesthetic value parts there is a layout space constraint for increasing the cooling fan or the cooling system size and dimension.

[0009] Further, the cooling system operations are controlled by a controller. The controller in general considers coolant temperature as an input to control the cooling system operations. For example, if coolant temperature reaches to a predetermined temperature then the controller turns on the cooling system and the cooling system remains on until coolant temperature reaches up to another predetermined temperature. Now, in general the cooling system are having low cooling rate efficiency or low air flow rate then the life of the cooling system parts such as the shroud, the motor and the plurality of the blades of the cooling fan also comes down significantly.

[0010] In order to solve the above-mentioned problems and other problems, the present subject matter is providing a cooling system configured to provide higher cooling rate without increasing the cooling system size and dimension. As the present invention, discloses the cooling system with the cooling fan which comprises plurality of blades and the plurality of blades having a first end and a second end. The second end is partially connected with a ring in accordance with a predetermined ratio between a ring height and a blade height for increasing the cooling rate from the cooling system with minimal noise and substantially optimum structural strength to the blade.

[0011] Due to the cooling system disclosed in the present invention which is based on the predetermined ratio between a ring height and a blade height, the cooling fan throws out more air coming out from the heat exchanging device. As under the head of the predetermined ratio the ring height is maintained smaller than the blade height to minimize the obstruction coming in the out flow of the air while leaving the cooling fan. This results in a significant increase in the air flow coming out from the cooling fan. Since, cooling system efficiency is directly proportional to the air flow coming out from the cooling fan, Therefore, the cooling efficiency of the cooling system for the heat exchanging device is also increased significantly without making any change in the size and dimension of the cooling fan or the cooling system. Additionally, plurality of ribs joining the shroud and a motor box is also reduced for providing better cooling efficiency by removing obstruction coming in the air flow coming out from the cooling fan. Further, the predetermined ratio also helps the blade to obtain substantially optimum structural strength against the flow of the air through the ring. Furthermore, the cooling system is offering minimal resistance to the air going out from the cooling fan and this results in very minimal noise coming out from the cooling system. This ensures that sufficient cooling requirements are available all time around the internal combustion engine parts without causing any inconvenience to the rider.

[0012] With the above design of the cooling system, the cooling efficiency or the cooling fan flow rate is increased significantly with substantially optimum structural strength to the blade, and helps in maintaining cooling requirements around the internal combustion engine. The proposed subject matter is simple in construction and easy to remove and mount giving rise to improved serviceability.

[0013] It is an aspect of the present subject matter to provide efficient cooling system without making any change in the size and dimension of the cooling fan or the cooling system.

[0014] It is another aspect of the present subject matter to reduce the weight of the cooling system.

[0015] It is another aspect of the present subject matter to enhance the durability of the cooling system.

[0016] It is advantage of the present subject matter that the noise coming out from the cooling system is not inconvenient for the rider.

[0017] It is an effect of the present subject matter that the blade of the cooling fan is having substantially optimum structural strength to stand against the flow of the air.

[0018] The aforesaid and other advantages of the present subject matter would be described in greater detail in conjunction with the figures in the following description.

[0019] **Fig. 1** illustrates a side view of a two-wheeled straddle type vehicle **(100),** for example, a motorcycle **(100),** in accordance with an embodiment of the present subject matter. A frontward direction is indicated by an arrow **F,** and a rearward direction indicated by an arrow **R** provided in the top of the figure. The vehicle **(100)** is extending from the front direction to the rear direction along the vehicle longitudinal axis **(F-R).** In an embodiment; the two-wheeled vehicle **(100)** of the present subject matter comprises a frame assembly **(102).** All the portions of the frame assembly **(102)** are made of light weight metal alloy tubes joined together in a triangular form to reinforce and support the vehicular components. The two-wheeled vehicle **(100)** includes a front wheel **(104)** steered by a handlebar **(108)** and a rear wheel **(105)** supported by a swing arm **(113).** Steering assembly parts including the visor assembly **(131),** the handlebar **(108)** and the front wheel **(104)** are supported for pivotal steering operation on a head tube (**123**-shown in Fig.2) at the front end of the vehicle body frame **(102).** A rider seat **(109)** for a rider and a seat for a pillion rider **(110)** are placed rearward to a fuel tank **(114).** The IC engine **(101)** is disposed below the fuel tank **(114)** on the front portion of the two-wheeled vehicle. A front fender **(115)** is provided above the front wheel **(104)** to avoid the vehicle occupants from being splashed with mud. Likewise, a rear fender **(116)** is placed above the rear wheel **(105),** and to the outer side in the radial direction of rear wheel **(105).** The rear fender **(116)** inhibits rainwater or the like from being thrown up by rear wheel **(105).** The swing arm **(113)** along with a rear suspension assembly **(107)** is supported at a rear portion **(R)** thereof for pivotal motion by the frame assembly **(102).** A front suspension assembly **(106)** for providing better ride comfort to the rider. In general terms, both the front suspension **(106)** and rear suspension **(107)** act as shock absorbers and help cushion the vehicle on uneven roads. The two-wheeled vehicle **(100)** further comprises of a headlamp **(111),** a tail lamp assembly **(112)** and at least two turn signal lamps.

[0020] The two-wheeled vehicle **(100)** comprises two large side panels **(120)** (only one shown) disposed on either side enclosing the sides of the front portion **(F)** of the two-wheeled vehicle **(100).** The side panel **(120)** extends from the visor assembly **(131)** on the upper region till the IC engine **(101)** on the lower region almost enclosing the all components supported by the main frame portion **(103)** of the two-wheeled vehicle **(101).** Due to the presence of the side panel **(120)** and other style parts there is only a major way **(150)** is available for air to enter inside the vehicle **(100)** for cooling the IC engine **(101).** Through the major way **(150)** the air is drawn from a small inlet opening **(132)** below the headlamp assembly **(111)** and above the front fender **(115).**

[0021] **Fig. 2.** illustrates the isometric view of the two-wheeled vehicle **(100)** with a side panel **(120)** and other outer body members of the two-wheeled vehicle which are removed according to the embodiment of the present subject matter. In the present embodiment, the frame assembly **(102)** is the trellis type frame, and comprises the head tube **(123),** a main frame portion **(103),** a down frame portion **(124),** and a rear frame portion **(125).** The front suspension assembly **(106)** includes a pair of front forks (**106a** and **106b**). In an embodiment; a heat exchanging device **(302)** disposed in the front portion of the two-wheeled vehicle **(100)** when the side panel **(120)** is removed. The heat exchanging device **(302)** functions to exchange heat of flowing coolant with the flowing air and forms part of the engine coolant cooling system. A cooling system **(300)** is disposed towards the rear of the heat exchanging device **(302)** and on operation draws air from the atmosphere through the heat exchanging device **(302)** thus extracting heat from the engine coolant. The air is drawn from the small inlet opening **(132)** through the major way **(150)** below the headlamp assembly **(111)** and above the front fender **(115).** The air being drawn inside passes through the heat exchanging device **(302)** and flows downstream of the cooling system **(300)** wherein an air deflecting structure **(400)** is disposed. The heat exchanging device **(302)** is mounted to the frame assembly **(102)** with aid of bosses disposed on the upper part of the heat exchanging device **(302)** and the cooling system **(300)** is mounted on rear part of the heat exchanging device **(302).**

[0022] **Fig. 3** illustrates a rear view of the cooling system **(300)** with the heat exchanging device **(302)** in accordance with the present subject matter. Typically, the cooling system **(300)** is used in the automobile **(100)** to control the internal combustion engine **(101)** temperature. In present embodiment, the cooling system **(300)** is used in the two-wheeled vehicle **(100)** for cooling a coolant flowing through the heat exchanging device **(302).** Further, the heat exchanging device **(302)** is to cool and control the internal combustion engine **(101)** temperature. The cooling system **(300)** is located in the automobile **(300)** behind the heat exchanging device **(302)** which is also interchangeably termed as a radiator assembly **(302).** The heat exchanging device **(302)** receives the coolant from the internal combustion engine **(101).** The coolant is used in the internal combustion engine **(101)** to extract the heat generated inside the internal combustion engine **(101).** Once, the coolant is passed through the heat exchanging device **(302).** The heat exchanging device **(302)** is use to transfer the temperature of coolant to the atmospheric air through heat exchange process which includes forced cooling.

[0023] Conventionally, forced cooling occurs with the help of the cooling system **(300)** located behind the heat exchanging device **(302).** The cooling system **(300)** in general comprises a shroud **(320)** with plurality of ribs **(310),** a motor **(315)** and a cooling fan **(301)** with a ring **(305).** The cooling fan **(301)** is interchangeably termed as a radiator fan **(301).** The cooling fan **(301)** operates at a certain operating speed and generated air flow. The cooling system **(300)** efficiency is directly proportional to the air flow coming out from the cooling fan **(304).** In order to increase the cooling rate, it is recommended to have higher fan air flow rate.

[0024] **Fig. 4** illustrates the exploded side view of the cooling system **(300)** with the heat exchanging device **(302)** in accordance with the present subject matter. A frontward direction is indicated by an arrow **F,** and a rearward direction indicated by an arrow **R** provided in the top of the figure. The vehicle **(100)** is extending from the front direction to the rear direction along the vehicle longitudinal axis **(F-R).** The heat exchanging device **(302)** is in front of the vehicle ahead of the cooling system **(300).** The cooling fan **(301)** is having a hub **(333- shown in Fig. 5b)** and plurality of blades **(304).** The plurality of blades **(304)** comprises a first end **(304a)** and a second end **(304b).** The first end **(304a)** of plurality of blades **(304)** is disposed towards the shroud **(320)** and second end **(304b)** of plurality of blades **(304)** is disposed towards the heat exchanging device **(302).** The second end **(304b)** is in partial contact with the ring **(305)** in accordance with a predetermined ratio **(b/a**-shown in **Fig. 5a)** between a ring height **(b-** shown in **Fig. 5a)** and a blade height **(a--** shown in **Fig. 5a)** for increasing cooling rate from said cooling system **(300)** with minimal noise. The predetermined ratio **(b/a**-shown in **Fig. 5a)** between the ring height **(b)** and the blade height **(a)** ensures that minimal obstruction comes in the air flow coming out from the cooling fan **(301)** with substantially optimum structural strength to the plurality of blades **(304).** As the cooling system **(300)** is receiving hot air from the heat exchanging device **(302)** and taking hot air away from the heat exchanging device **(302)** majorly through the cooling fan **(301).** The hot air is coming out from the heat exchanging device **(302)** after taking heat from the coolant which is flowing through-out the heat exchanging device **(302).** Further, the cooling system **(300)** efficiency is directly proportional to the air flow coming out from the cooling fan **(301).** Because when more air flow comes out from the cooling fan **(301)** then cooling of coolant circulating through the heat exchanging device **(302)** takes place rapidly. Once coolant temperature is controlled effectively then the internal combustion (IC) engine **(101)** temperature is also remain in control. Hence, in order to increase the cooling rate, the present subject matter is providing higher cooling fan **(301)** air flow rate through the predetermined ratio **(b/a**-shown in **Fig. 5a)** between the ring height **(b-**shown in **Fig. 5a)** and the blade height **(a**-shown in **Fig. 5a)** without making any change in the size of the cooling system **(300).** Moreover, maintaining the size of the cooling system **(300)** is very much essential due to the presence of the side panels and other aesthetic value parts in the two-wheeled vehicle **(100).** As the presence of the side panels **(120)** and other aesthetic value parts creates a space constraint for increasing the cooling fan or the cooling system size and dimension. Further, in an embodiment, the ring height **(b)** is optimized for better flow rate with minimal noise and maximum mechanical strength to avoid blade distortion over a period of time. Furthermore, in one embodiment, the ring **(305)** is provided on a suction side edge of the plurality of blades **(304)** of the cooling fan **(301),** such that a minimum possible obstruction to the outflow from the fan is achieved.

[0025] The cooling system **(300)** disclosed in the present invention provides the cooling fan **(301)** for throwing out more air coming out from the heat exchanging device **(302).** As under the head of the predetermined ratio **(b/a-**shown in **Fig. 5a)** the ring height **(b**-shown in **Fig. 5a)** is smaller than the blade height **(a-**shown in **Fig. 5a)** to minimize the obstruction coming in the out flow of the air while leaving the cooling fan **(301).** This results in a significant increase in the air flow coming out from the cooling fan **(301).** Since, cooling system efficiency is directly proportional to the air flow coming out from the cooling fan **(301).** Therefore, the cooling efficiency of the cooling system for the heat exchanging device is also increased significantly without making any change in the size and dimension of the cooling fan or the cooling system **(300).**

[0026] Moreover, the plurality of ribs **(310)** joining the shroud **(320)** and a motor box **(315)** is also reduced for providing better cooling efficiency by removing obstruction coming in the air flow coming out from the cooling fan **(301).** Further, the predetermined ratio **(b/a**-shown in **Fig. 5a)** also helps the plurality of blades **(304)** to obtain substantially optimum structural strength against the flow of the air through the ring **(305).** Furthermore, the cooling system **(300)** is offering minimal resistance to the air going out from the cooling fan **(301)** and this result in very minimal noise coming out from the cooling system. This ensures that sufficient cooling requirements are available all time around the internal combustion engine parts without causing any inconvenience to the rider.

[0027] The cooling system **(300)** has the shroud **(320)** with a shroud height **(c).** In present embodiment, the shroud height **(c)** is equal or less than the ring height **(b-**shown in **Fig. 5a)** for offering no obstruction in the air flow coming out from the cooling fan **(301).** Further, the shroud height **(c)** is longitudinally extending only towards the heat exchanging device **(302)** and is restricted for extending in the other direction of the heat exchanging device **(302)** for offering no obstruction in the air flow coming out from the cooling fan **(301).** In present embodiment, the shroud height **(c)** is longitudinally extending only in the front direction **(F)** of the vehicle **(100).**

[0028] Further, operations of the cooling system **(300)** disclosed in present subject matter are controlled by a controller. The controller in general considers coolant temperature as an input to control the cooling system **(300)** operations. In present embodiment, the cooling system **(300)** the cooling fan **(301)** is based on the predetermined ratio **(b/a**-shown in **Fig. 5a)** to providing more air flow going out from the cooling fan **(301)** and this increases the air flow rate and the cooling efficiency. Due to the increased cooling efficiency, the cooling fan **(301)** is able to through-out more air with less rotation while maintaining controlling coolant temperature of the coolant flowing in the heat exchanging device **(302).** When the efficient cooling fan **(301)** is running less time, then the motor **(303)** is also running less for controlling coolant temperature. When parts of the cooling system **(300)** are running less time for controlling the coolant temperature than the life & durability of the cooling system **(300)** and the cooling system parts **(300)** such as the shroud **(320),** the motor **(303)** and the plurality of the blades **(304)** of the cooling fan **(301)** increases significantly.

[0029] **Fig. 5a, 5b, and 5c** illustrates a top view, a front view and a side view of the cooling fan **(301)** in accordance with the present subject matter. The cooling fan **(301)** is having the hub **(333)** and plurality of blades **(304).** The plurality of blades **(304)** comprises the first end **(304a)** and the second end **(304b).** The first end **(304a)** of plurality of blades **(304)** is in contact with the hub **(333).** The second end **(304b)** is in partial contact with the ring **(305)** in accordance with the predetermined ratio **(b/a)** between the ring height **(b)** and the blade height **(a)** for increasing cooling rate from said cooling system **(300)** with minimal noise. The predetermined ratio **(b/a)** between the ring height **(b)** and the blade height **(a)** ensures that minimal obstruction comes in the air flow coming out from the cooling fan **(301)** with substantially optimum structural strength to the plurality of blades **(304).** In present embodiment, the predetermined ratio **(b/a)** value is less than or equal to **0.80**

[0030] **Fig. 6a** depicts exemplary curve for cooling efficiency plotted against ratio between ring height **(b)** and blade height **(a),** in accordance with another embodiment of the present subject matter. In present embodiment, when the ratio between ring height **(b)** and blade height **(a)** lies in the range of the predetermined ratio **(b/a)** which is less than or equal to **0.80** then the air coming out from the cooling system **(300)** increases significantly because under the head of the predetermined ratio **(b/a)** the ring height **(b)** is smaller than the blade height **(a)** to provide more space to the air while leaving the cooling fan **(301)** with substantially optimum structural strength to the plurality of blades **(304)** against the flow of the air through the ring **(305).** Additionally, less number of the plurality of ribs **(310)** is also for providing better cooling efficiency by removing obstruction coming in the air flow coming out from the cooling fan **(301).** Further, under the head of the predetermined ratio **(b/a)** the cooling efficiency of the cooling system **(300)** for the heat exchanging device **(302)** increases significantly without increasing the size of the cooling system **(300)** or the cooling fan **(301).**

[0031] **Fig. 6b** depicts exemplary curve for noise level plotted against ratio between ring height **(b)** and blade height **(a),** in accordance with another embodiment of the present subject matter. In present embodiment, when the ratio between ring height **(b)** and blade height **(a)** lies in the range of the predetermined ratio **(b/a)** which is less than or equal to **0.80** then the noise level coming out from the cooling system **(300)** reduces significantly because under the head of the predetermined ratio **(b/a)** the ring height **(b)** is smaller than the blade height **(a)** to minimize the obstruction coming in the out flow of the air while leaving the cooling fan **(301).** Additionally, the presence of less number of the plurality of ribs **(310)** is providing less obstruction to the air flow coming out from the cooling fan **(301).** Further, the predetermined ratio **(b/a)** value which is less than or equal to **0.80** provides the plurality of blades **(304)** substantially optimum structural strength against the flow of the air through the ring **(305).** This ensures that sufficient cooling requirements are available all time around the internal combustion engine parts without causing any noise related inconvenience to the rider.

[0032] While preferred embodiments of the present subject matter have been described above, it is to be understood that variations and modifications will be apparent to those skilled in the art without departing the scope and spirit of the present subject matter.

Claims

1. A cooling system (300) for a heat exchanging device (302) comprising:

a motor (303);
a ring (305); and
a cooling fan (301) to discharge fluid, said cooling fan (301) having plurality of blades (304); said plurality of blades (304) comprises a first end (304a) and a second end (304b), said first end (304a) is disposed towards a shroud (320) and said second end (304b) is disposed towards said heat exchanging device (302);
wherein,
said second end (304b) of the plurality of blades (304) is in partial contact with said ring (305) in accordance with a predetermined ratio (b/a) between a ring height (b) and a blade height (a) for increasing cooling rate from said cooling system (300) with minimal noise.

2. The cooling system (300) for the heat exchanging device (302) as claimed in claim 1, wherein the predetermined ratio (b/a) of the ring height (b) to the blade height (a) is less than 0.80.

3. The cooling system (300) for the heat exchanging device (302) as claimed in claim 1, wherein plurality of ribs (310) are connecting with motor (303).

4. The cooling system (300) for the heat exchanging device (302) as claimed in claim 1, wherein said motor (303) is operationally connected to and driving the cooling fan (300).

5. The cooling system (300) for the heat exchanging device (302) as claimed in claim 1, wherein a shroud (320) is integrally connected with a motor box (315).

6. The cooling system (300) for the heat exchanging device (302) as claimed in claim 1 or claim 5, wherein a shroud height (c) extends only towards the heat exchanging device (302).

7. The cooling system (300) for the heat exchanging device (302) as claimed in claim 6, wherein the shroud height (c) extends longitudinally extending in a front direction (F) of the vehicle (100).

8. A cooling fan (301) comprising:

plurality of blades (304); said plurality of blades (304) comprises a first end (304a) and a second end (304b),
wherein,
said second end (304b) of the plurality of blades (304) is in partial contact with a ring (305) in accordance with a predetermined ratio (b/a) between a ring height (b) and a blade height (a) for increasing fluid flow rate from cooling fan (301) with minimal noise.

9. The cooling fan (301) as claimed in claim 8, wherein the ring (305) is provided on a suction side edge of the plurality of blades (304) of the cooling fan (301) for minimizing the obstruction of outflow from said cooling fan (301).

10. A vehicle (100) comprising:

a frame assembly (102), extending from a front portion (F) to a rear portion (R) along a longitudinal axis (F-R);
a heat exchanging device (302) disposed on the front portion (F);
an internal combustion (IC) engine (101) mounted to the front portion (F) of the frame assembly (102) rearward of the heat exchanging device (302);
a cooling system (300) interposed between the heat exchanging device (302) and the IC engine (101), said cooling system (301) configured to draw cooling air through the heat exchanging device (302), the cooling system (300) comprising a motor (303); a ring (305); and an apparatus (301) having plurality of blades (304) to discharge fluid;
a side body panel (120) disposed on the left-hand and right-hand side of the vehicle (100) and covering the heat exchanging device (302), the cooling system (300) and at least a portion of the IC engine (101);
wherein,
said plurality of blades (304) comprises a first end (304a) and a second end (304b), said first end (304a) is connected to said motor (303) and said second end (304b) is connected to said ring (305);
wherein,
said second end (304b) of the plurality of blades (304) is in partial contact with said ring (305) in accordance with a predetermined ratio (b/a) between a ring height (b) and blade height (a) for increasing cooling rate from said cooling system (300) with minimal noise.

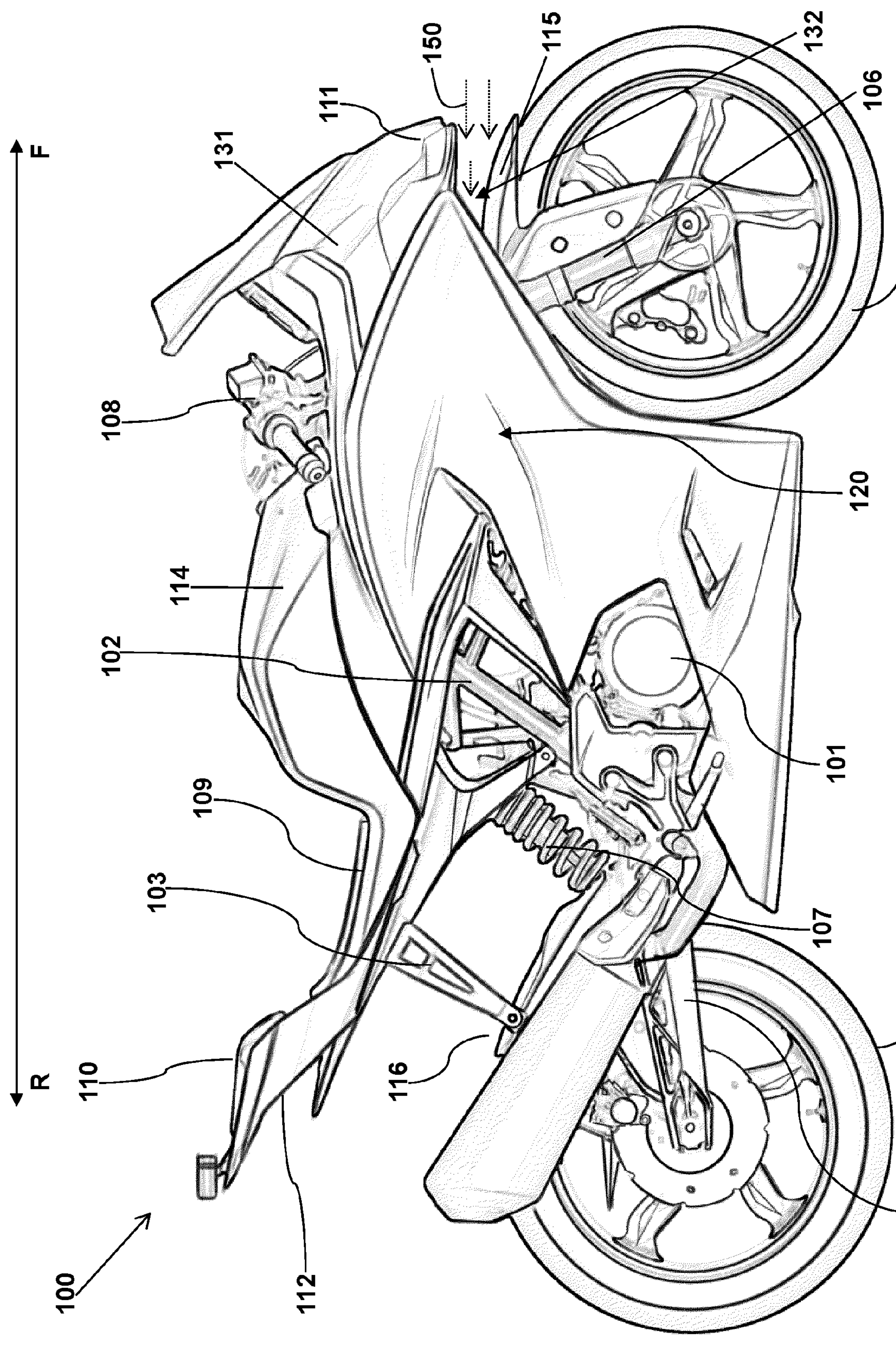
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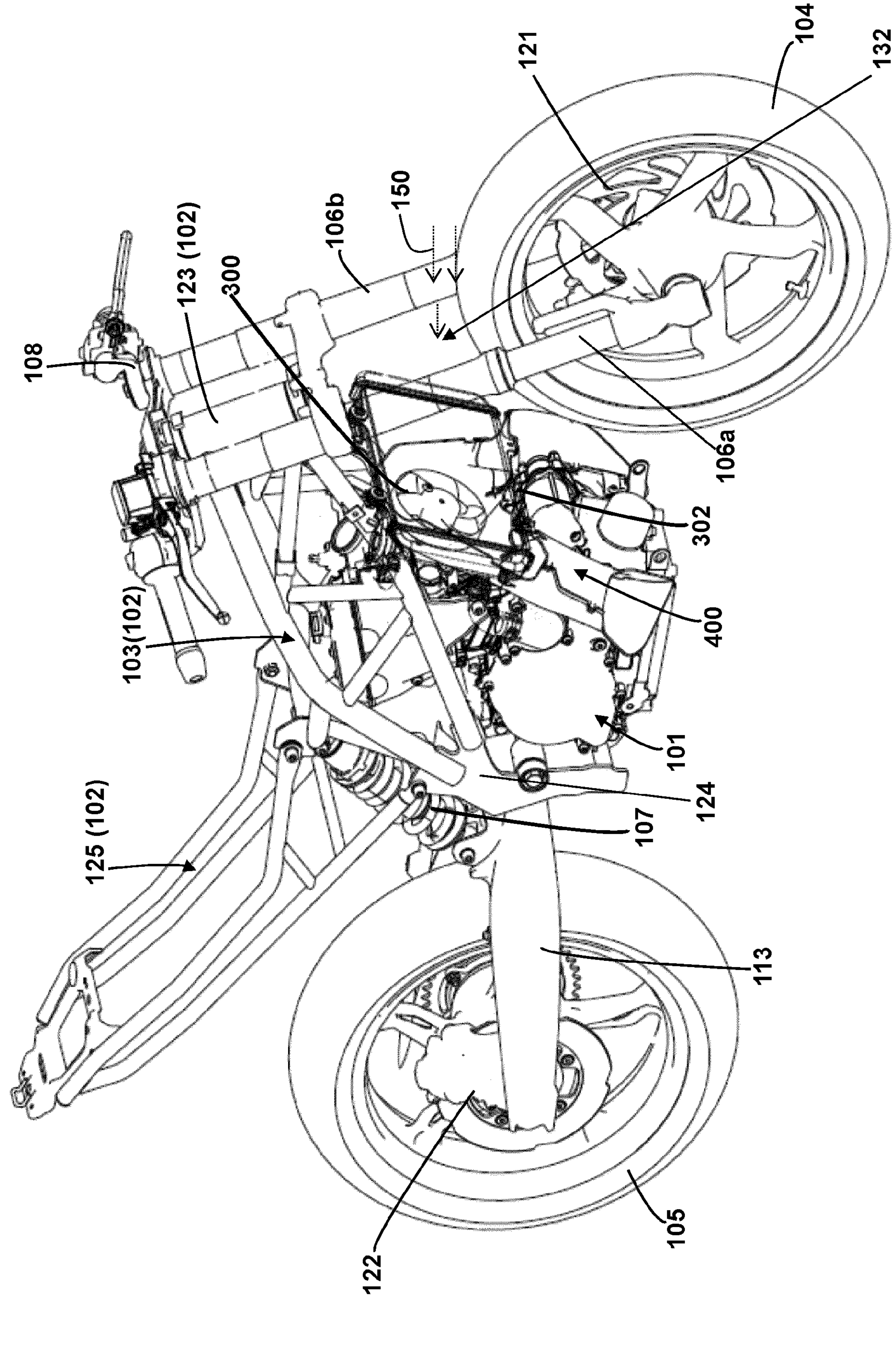
Fig.1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101
124
107
125 (102)
113
105
122

Fig.2

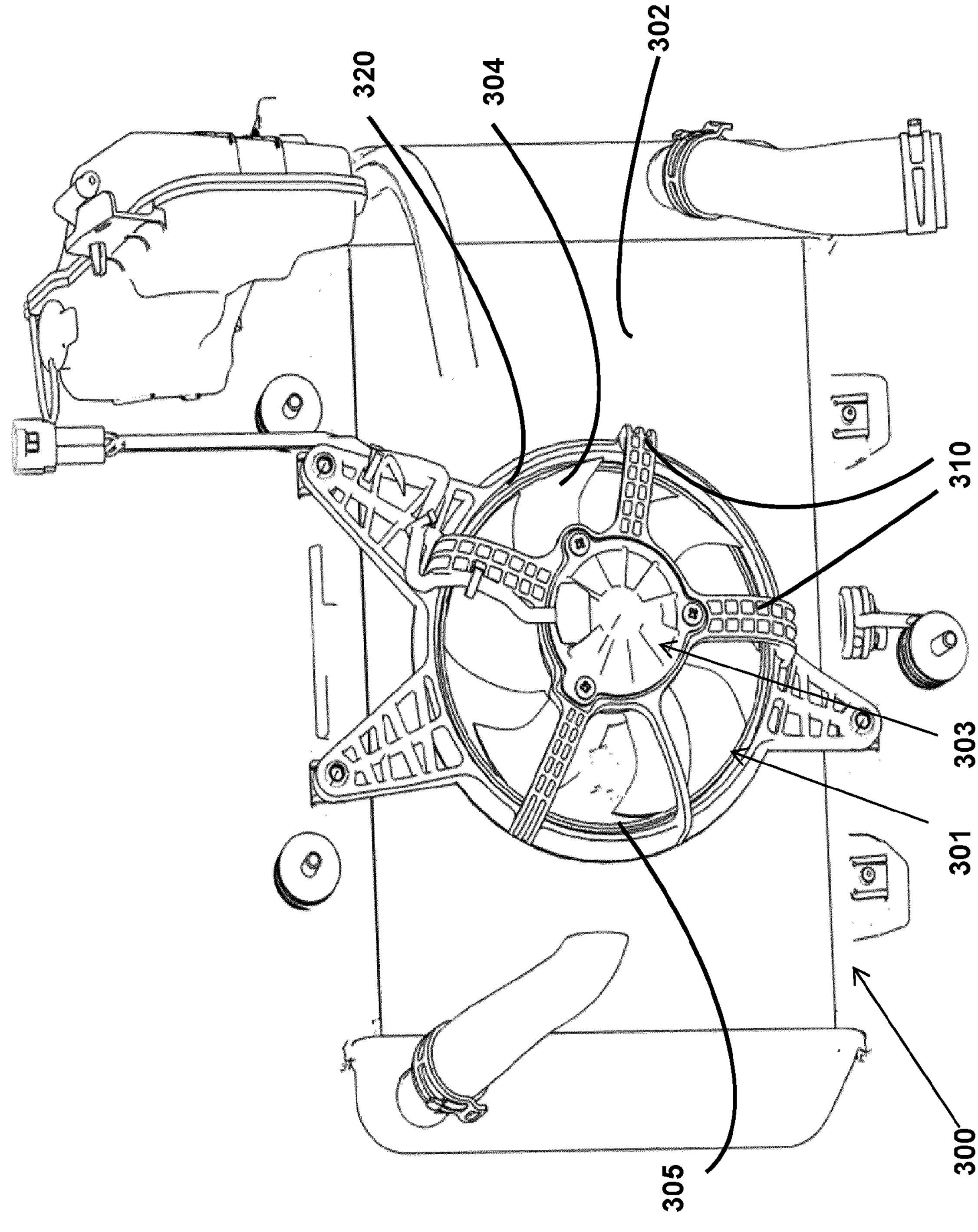

Fig. 3

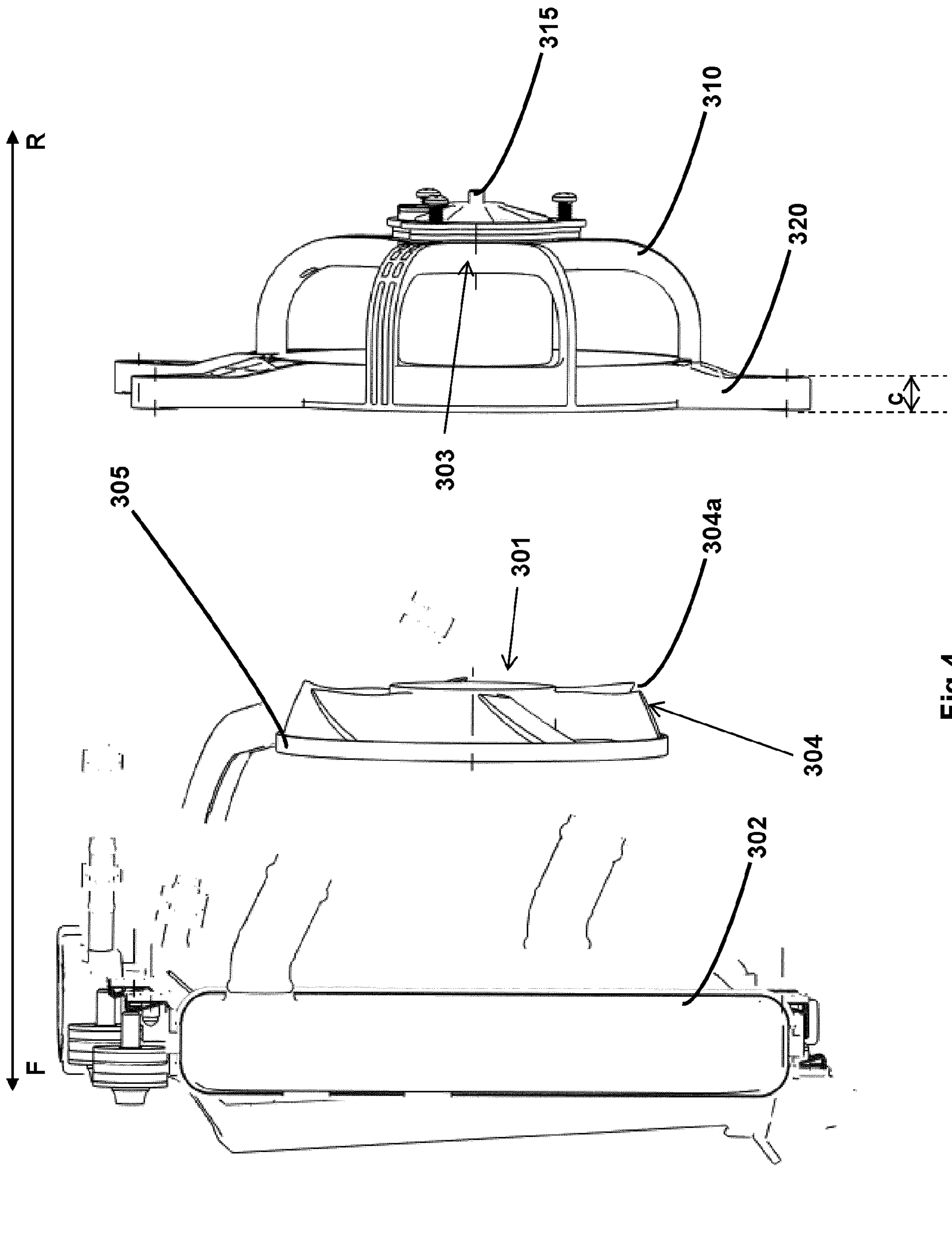

Fig.4

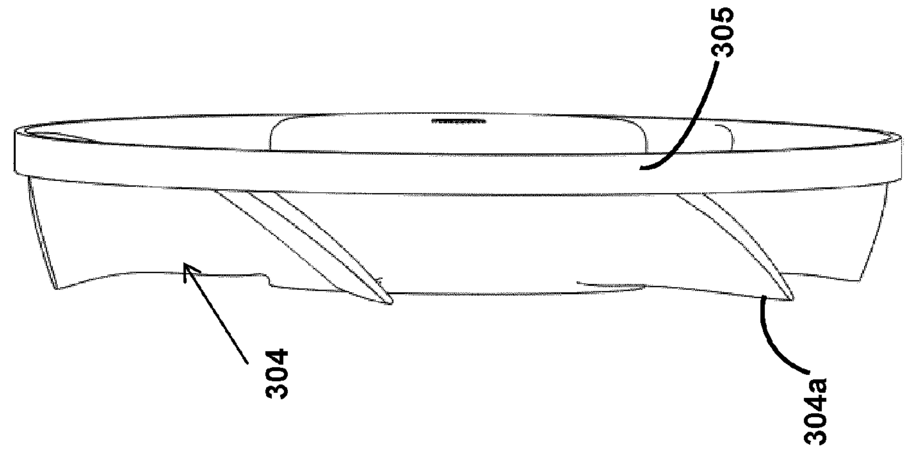

Fig.5c

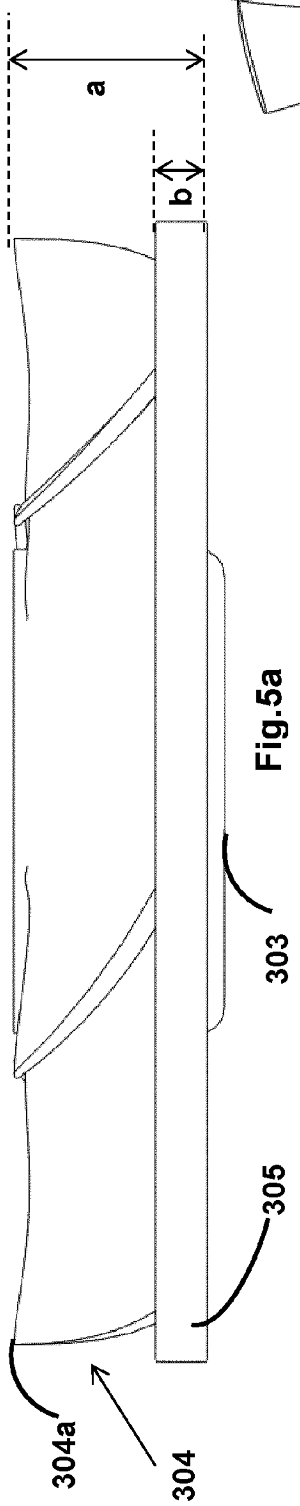

Fig.5a

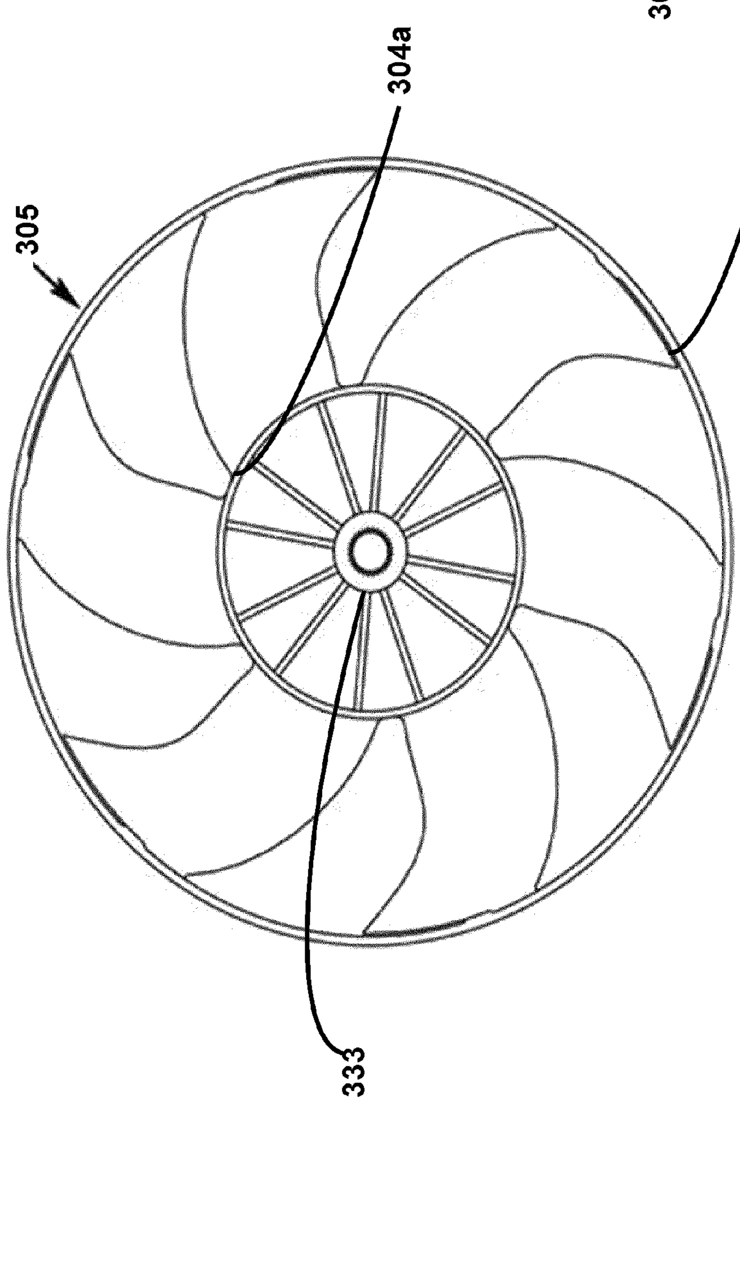

Fig.5b

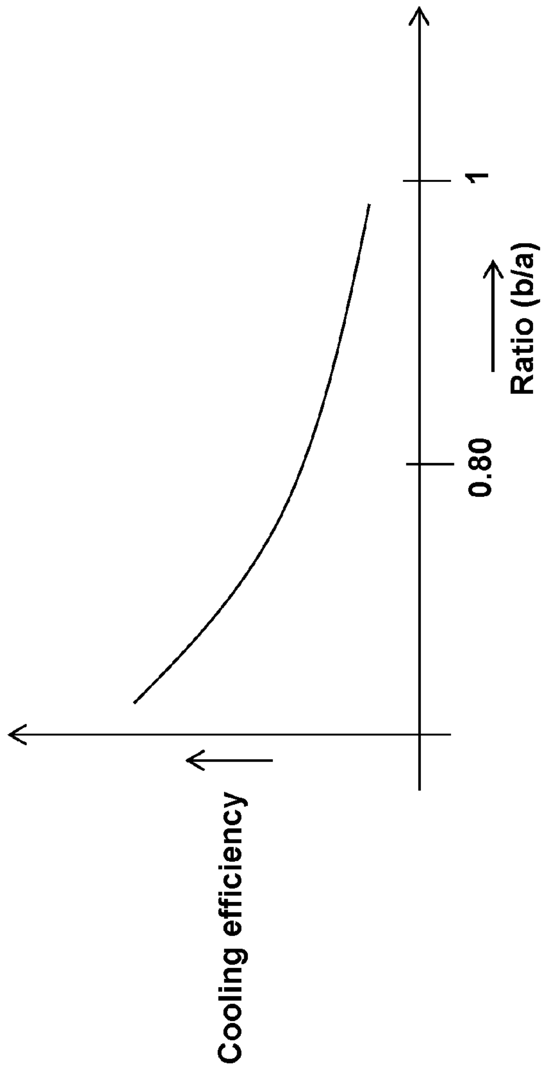

Fig.6a

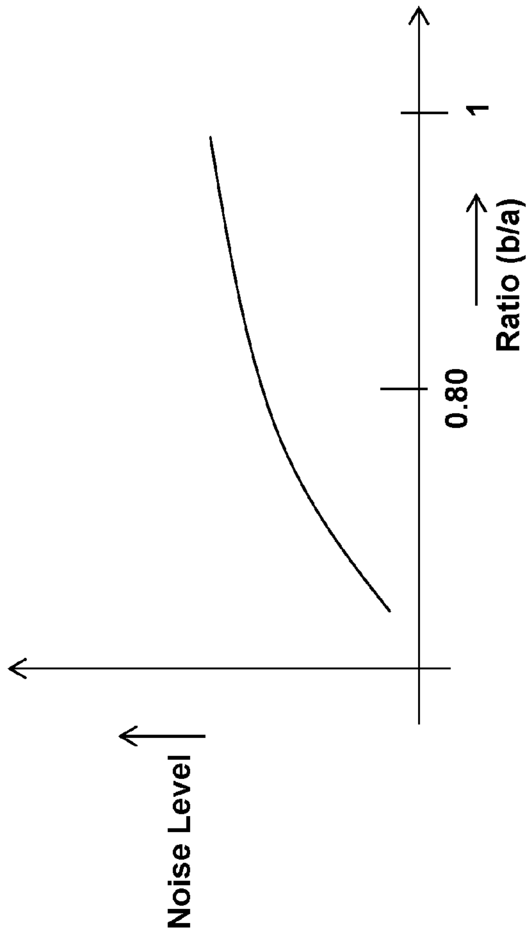

Fig.6b

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EUROPEAN SEARCH REPORT

Application Number
EP 20 15 8256

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 Y	US 4 329 946 A (LONGHOUSE RICHARD E) 18 May 1982 (1982-05-18) * column 3, lines 27-57; figures 1-6 * * column 3, line 58 - column 4, line 50 * * column 4, lines 26-46 * * column 5, lines 15-56 *	1-9 10	INV. F01P11/12 F04D29/32
Y	US 9 581 073 B2 (HONDA MOTOR CO LTD [JP]) 28 February 2017 (2017-02-28) * column 3, lines 34-42 * * column 4, lines 16-25; figures 1,3,5 *	10	
A	JP 2002 201944 A (TOYO RADIATOR CO LTD) 19 July 2002 (2002-07-19) * abstract; figure 3 *	1-9	
A	JP H05 33797 A (NIPPON DENSO CO) 9 February 1993 (1993-02-09) * abstract; figures 2,3 *	1-9	

TECHNICAL FIELDS SEARCHED (IPC)
F01P F04D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	15 September 2020	Luta, Dragos

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15-09-2020

Patent document cited in search report		Publication date	Patent family member(s)			Publication date
US 4329946	A	18-05-1982	AU	535984	B2	12-04-1984
			EP	0026997	A1	15-04-1981
			ES	8107358	A1	01-10-1981
			JP	S5656926	A	19-05-1981
			JP	S6315453	B2	05-04-1988
			US	4329946	A	18-05-1982
US 9581073	B2	28-02-2017	JP	6270321	B2	31-01-2018
			JP	2014162437	A	08-09-2014
			US	2014238635	A1	28-08-2014
JP 2002201944	A	19-07-2002	NONE			
JP H0533797	A	09-02-1993	JP	2819873	B2	05-11-1998
			JP	H0533797	A	09-02-1993

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