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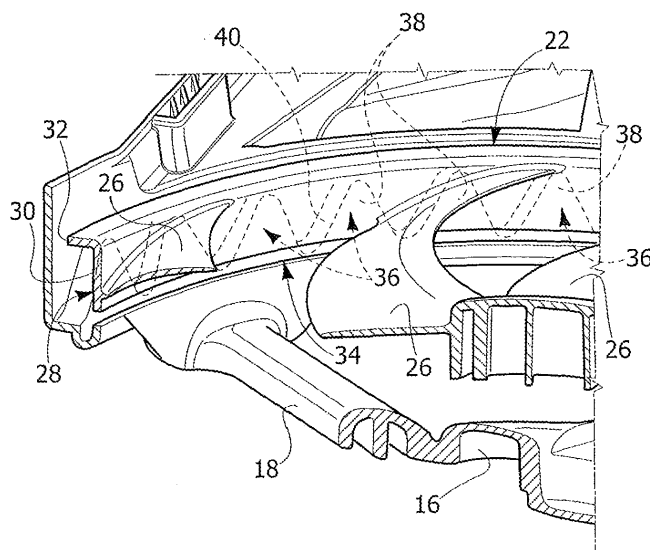
(54) **Fan assembly for vehicles**

(57) A fan assembly for cooling a radiator, a radiator-condenser assembly, or a radiator-condenser-intercooler assembly of a vehicle, comprising:

- a casing (12), having a through opening (14) and a support (16), which is located at the centre of said opening (14);
- a motor-fan assembly (20) carried by said support (16), which includes an axial fan (22) rotatable with respect to said support (16) about an axis of rotation (X); and

- a toothed ring (34), which is fixed with respect to the casing (12) and surrounds said fan (22) said toothed ring (34) having a plurality of teeth (36) that follow one another in a circumferential direction, wherein said toothed ring (34) has a front surface (38) sharing the axis of rotation (X) and a side wall (40) that forms sides of said teeth (36), where the distance in a direction parallel to the axis of rotation (X) between said side wall (40) and a plane orthogonal to the axis of rotation (X) varies periodically in a circumferential direction.

FIG. 3



Description

Field of the invention

[0001] The present invention relates to a fan assembly for cooling a radiator, a radiator-condenser assembly, or a radiator-condenser-intercooler assembly of a vehicle.

Description of the relevant art

[0002] A fan assembly for cooling a radiator or a radiator-condenser assembly of a vehicle comprises a casing, having a through opening, and a motor-fan assembly, carried by the casing and designed to generate a flow of air through said opening. The fan is generally of an axial type and comprises a hub, rotatable about an axis of rotation parallel to the direction of the flow, and a plurality of blades, which extend radially from said hub.

[0003] The documents Nos. US6863496 and US7481615 describe fan assemblies for vehicles in which the casing comprises a toothed ring that surrounds the fan. Said toothed ring has the purpose of reducing the vortices that are generated in the gap between the outer end of the fan and the casing. These documents describe solutions in which the toothed ring that surrounds the fan is provided with projections with sawtooth or undulated profile, which project towards the fan in a plane orthogonal to the axis of rotation of the fan.

Object and summary of the invention

[0004] The object of the present invention is to provide an improved geometry of the toothed ring surrounding the fan that, as compared to solutions of a known type, will reduce the tonal component of the noise generated by the fan without altering the efficiency of the system in terms of air-delivery capacity and head.

[0005] According to the present invention, the above purpose is achieved by a fan assembly having the characteristics forming the subject of Claim 1.

[0006] The claims form an integral part of the teaching provided herein in relation to the invention.

Brief description of the drawings

[0007] The present invention will now be described in detail with reference to the attached drawings, which are provided purely by way of non-limiting example and in which:

- Figure 1 is a perspective view of a fan assembly according to the present invention;
- Figure 2 is a perspective view of the casing indicated by the arrow II in Figure 1;
- Figure 3 is an enlarged detail of the part indicated by the arrow III in Figure 1;
- Figure 4 is a cross section according to the line IV-IV of Figure 1; and

- Figure 5 is a schematic cross section according to the line V-V of Figure 4.

[0008] With reference to Figure 1, designated by 10 is a fan assembly designed to perform cooling of a radiator, of a radiator-condenser assembly, or of a radiator-condenser-intercooler assembly of a vehicle. The fan assembly 10 comprises a casing 12 preferably made of injection-moulded plastic material having a shape designed to convey a flow of air through a radiator, a radiator-condenser assembly, or a radiator-condenser-intercooler assembly.

[0009] With reference in particular to Figure 2, the casing 12 has a through opening 14 and a support 16 located at the centre of the opening 14. The support 16 is connected to the edges of the opening 14 by means of radial arms 18. The support 16 carries a motor-fan assembly designated by 20 in Figure 1. The motor-fan assembly 20 comprises an axial fan 22 made of injection-moulded plastic material. The fan 22 comprises a hub 24, extending from which is a plurality of blades 26. The fan 22 is rotatable with respect to the support 16 about an axis of rotation designated by X in Figure 4.

[0010] As may be seen in particular in Figure 3, the fan 22 can be provided with an external ring 28 fixed with respect to the outer end of the blades 26. The external ring 28, if present, is constituted by a cylindrical wall 30 sharing the axis of rotation X and a radial wall 32 contained in a plane orthogonal with respect to the axis of rotation X.

[0011] The casing 12 comprises a toothed ring 34 fixed or else formed integrally with the casing and located along the edge of the opening 14. The toothed ring 34 surrounds the fan 22 and is provided with a plurality of teeth 36 that follow one another with a constant pitch in a circumferential direction. The teeth 36 can extend in a uniform way along a circumference or else can extend on arcs of circumference that are set at angular distances apart.

[0012] With reference to Figures 3 and 4, the toothed ring 34 has a front surface 38 that is cylindrical or shaped like a truncated cone, shares the axis of rotation X, and defines the walls of the teeth 36 facing the fan. The wall 38 is set at a constant or variable distance in the direction of the axis X from the outer end of the fan 22 or, if present, from the cylindrical wall 30 of the external ring 28.

[0013] The toothed ring 34 moreover has a side wall 40 that forms the sides of the teeth 36. The distance in a direction parallel to the axis of rotation X between the side wall 40 and a plane orthogonal to the axis of rotation X varies in a periodic way in the circumferential direction. In practice, the teeth 36 project in a direction parallel to the axis of rotation X with respect to a radial plane passing through the base of said teeth. The teeth 36 can have an undulated profile as illustrated in the figures or else can have a sawtooth shape or a shape of some other type.

[0014] With reference to Figure 5, the length L of an arc of a circle with centre on the axis of rotation X of the

fan 22 and passing through each tooth 36 remains constant for each radius comprised between the radii R1 and R2, where R1 and R2 are the internal radius and the external radius of the circumferential surfaces of the teeth 36.

[0015] The axial arrangement of the teeth 36 enables provision of a periodic sequence of cavities.

[0016] The purpose of the toothed ring 34 is to provide a circumferential coupling to the fan of a sequence of volumes designed to dissipate the radial component of the fluctuations of lift generated by the blades.

[0017] The irregularity of the coupled surface has two effects:

- 1) it favours effects of diffraction and diffusion of the pressure waves in a plane perpendicular to the axis of the fan (X) that render the spatial distribution of the waves of acoustic pressure random; this reduces the tonal component of the noise generated;
- 2) it induces formation of vortices within the compartments, which have the effect of reducing the cross section from the fluid-dynamic standpoint, thus preserving the fluid-dynamic performance (capacity/head).

Claims

1. A fan assembly for cooling a radiator, a radiator-condenser assembly, or a radiator-condenser-intercooler assembly of a vehicle, comprising:
 - a casing (12), having a through opening (14) and a support (16), which is located at the centre of said opening (14),
 - a motor-fan assembly (20) carried by said support (16), which includes an axial fan (22) rotatable with respect to said support (16) about an axis of rotation (X), and
 - a toothed ring (34), fixed with respect to the casing (12) and surrounding said fan (22), said toothed ring (34) having a plurality of teeth (36) that follow one another in a circumferential direction,
 said fan assembly being **characterized in that** said toothed ring (34) has a front surface (38) that is cylindrical or shaped like a truncated cone, sharing the axis of rotation (X) and set at a constant or variable distance in the direction of the axis of rotation (X) with respect to a radially outer end of said fan (22), and a side wall (40) that forms sides of said teeth (36), wherein the distance in a direction parallel to the axis of rotation (X) between said side wall (40) and a plane orthogonal to the axis of rotation (X) varies periodically in the circumferential direction.

2. The fan assembly according to Claim 1, **character-**

ized in that said side wall (40) has an undulated or a sawtooth profile.

3. The fan assembly according to Claim 1, **characterized in that** said fan (22) has an external circumferential collar (28) having a cylindrical wall (30), sharing said axis of rotation (X), and a radial wall (32), contained in a plane orthogonal to said axis of rotation (X), and **in that** the distance in a radial direction between the cylindrical wall (30) of the external circumferential collar (28) and said front wall (38) of said toothed ring (34) is constant and the distance in a direction parallel to the axis of rotation (X) between the radial wall (32) of the external circumferential collar (28) and said side wall (40) of said toothed ring (34) varies periodically in the circumferential direction.
4. The fan assembly according to Claim 1, **characterized in that** the width (L) of an arc of a circle centred on the axis of rotation (X) of the fan (22) and passing through each tooth (36) remains constant for each radius comprised between the radii (R1, R2) of the internal and external circumferential surfaces of the teeth (36).

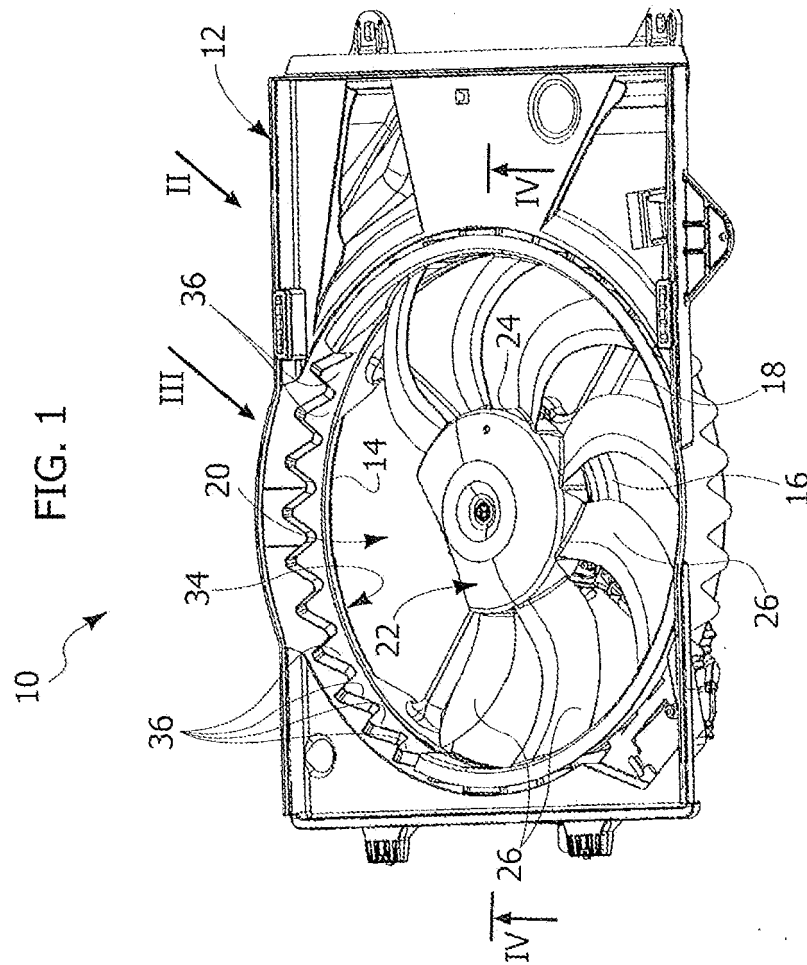


FIG. 2

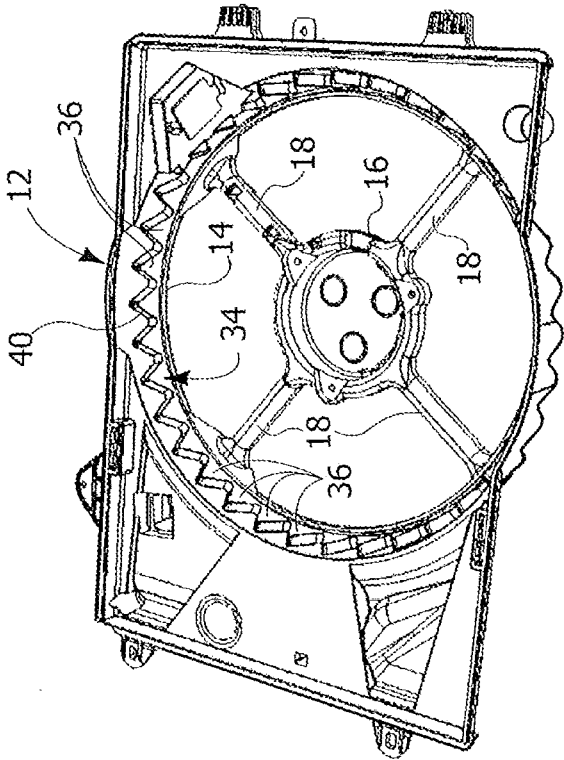


FIG. 3

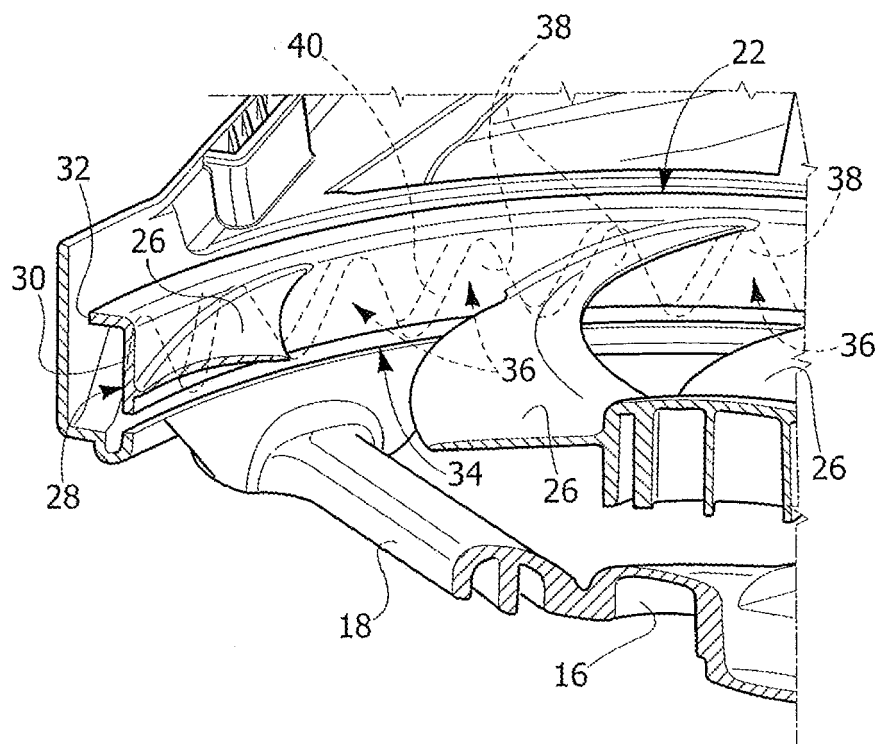


FIG. 4

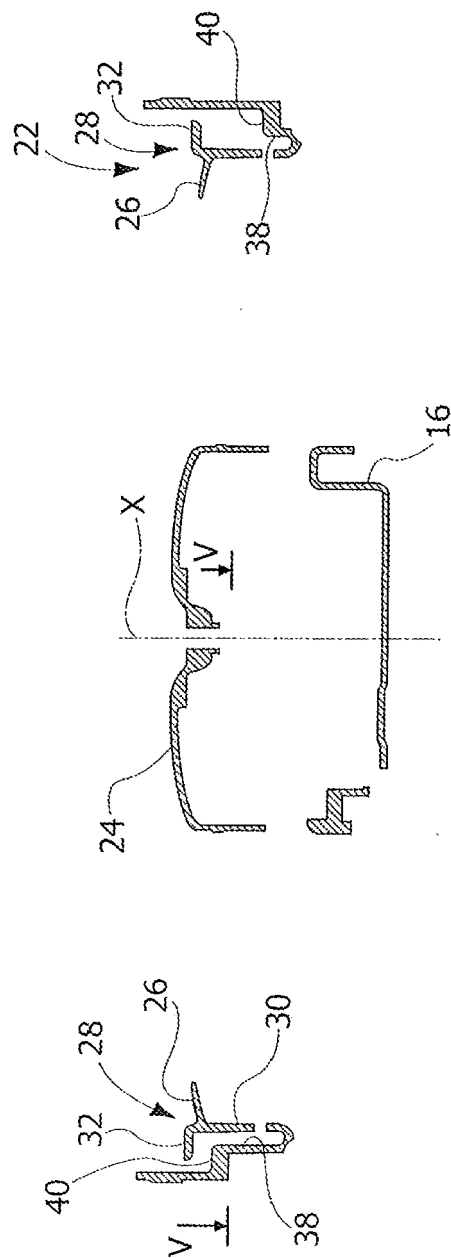
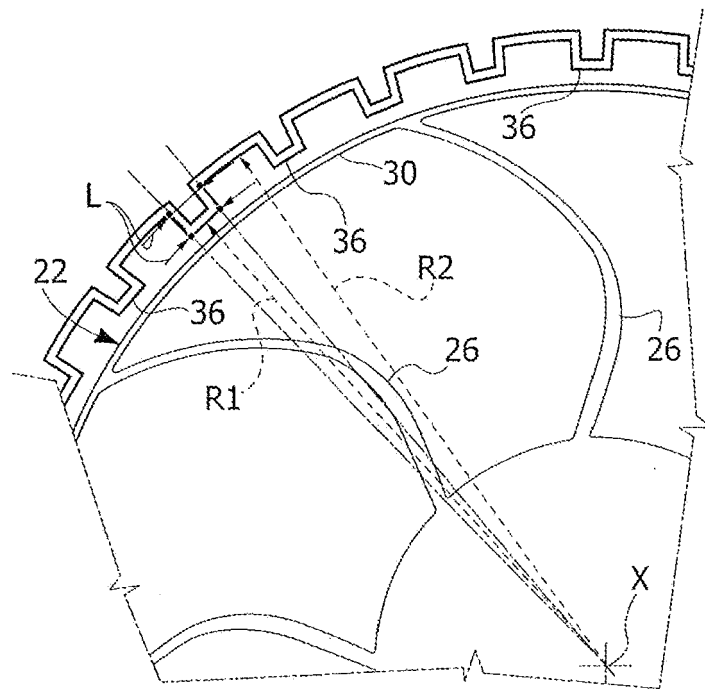


FIG. 5



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 6863496 B [0003]
- US 7481615 B [0003]