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(54) **Device for Ventilating a Room**

(57) The device (1) comprises a fastening and movement device (2) comprising a fastening portion (3), a stator (4), a rotor (5) turnably engaged to the stator and rotated by the latter, a blade-carrying rotor (50) having a hub (51) mechanically connected to the rotor and a supporting structure (60) fastened to the hub, and a plurality of blades (80) individually fastened to the supporting structure, wherein the fastening and movement device supports and rotates the blade-carrying rotor for moving an air volume of the room, wherein the supporting structure (60) comprises an upper flange (61) and a lower flange (62) arranged on opposite sides of the hub and integral therewith, and a plurality of blade-carrying elements (70), each carrying a respective blade, interposed circumferentially between the flanges and fastened thereto, each blade-carrying element comprising, fastened one another, an upper support (71), a lower support (72) and an anti-vibration element (73) interposed in contact between the upper and the lower supports.

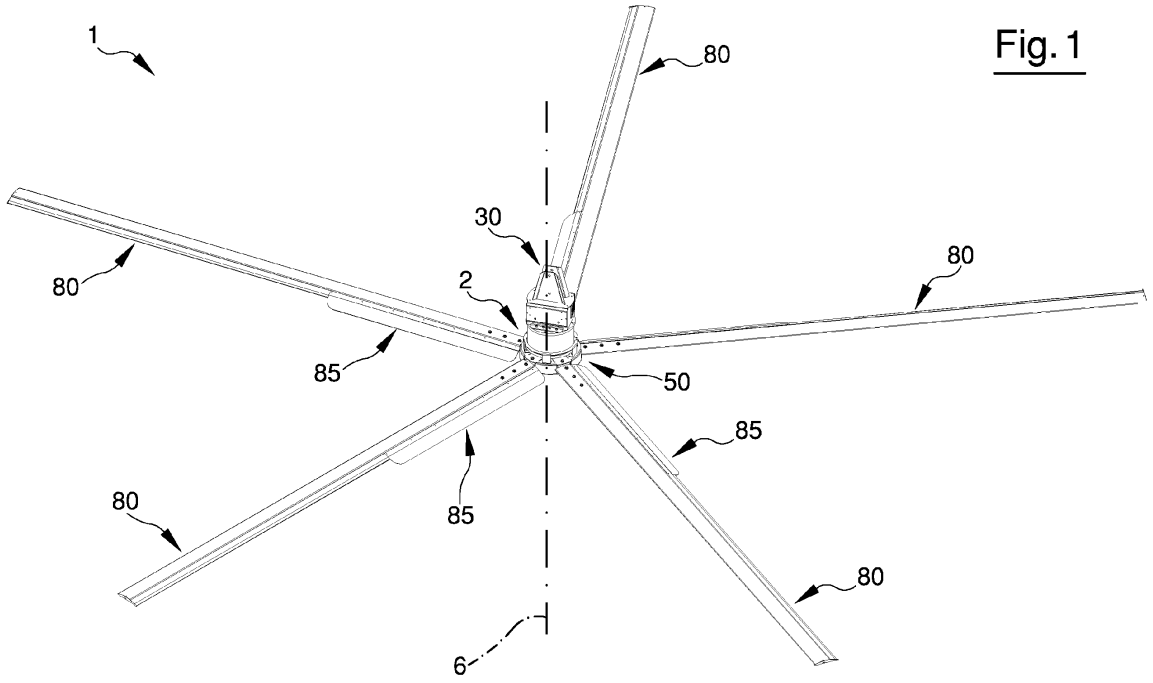

Fig. 1

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Description

[0001] The present invention relates to a device for ventilating a room. In further detail, the invention relates to a device for ventilating large-size rooms by means of large-size blades rotating at low speeds.

[0002] Several places, such as e.g. industrial or commercial buildings, warehouses, rearing farms, etc., are typically subjected to an unwanted temperature increase and/or air stratification and/or accumulation of substances generated by the activities performed in such places, which can be polluting, harmful and/or unpleasant. These phenomena make such places uncomfortable and unsuitable for people and/or animals to stay therein. In order to obviate these problems, an artificial ventilation is typically created, i.e. air is moved continuously inside the place so as to generate an air circulation enabling to obtain an exchange with outside air and/or to mix the various layers of air inside the place.

[0003] In order to obtain this ventilation, usually special, large-size fans are used, since small fans are unsuitable due to their limited power (which prevents them e.g. from moving large air masses) and to the need to use a large number thereof.

[0004] Typically, fans for large-size rooms are provided with large-size blades, e.g. from one to a few meters, which are continuously rotated at low speeds. As a matter of fact, what enables to effectively move air in the room is not the rotational speed but mainly blade size. In order to generate the desired air circulation and ensure at the same time the safety of the device without creating unpleasant and/or harmful air draughts and/or excessive noise, blades are rotated continuously and uniformly at low speed (typically below 200 rpm).

[0005] It is known about ventilation devices, such as e.g. the device described in patent document EP1588024, having a hooking plate fastened to the room ceiling, a fixed frame fastened below to the hooking plate, which houses a rotary motor, e.g. an asynchronous motor, below which a related reduction gearbox is mounted. The gearbox is connected and transmits motion to a rotor carrying a plurality of blades moving air and generating the circulation thereof in the room.

[0006] The Applicant has found that current devices for ventilating large rooms are not without drawbacks and can be improved under various aspects.

[0007] In particular, the Applicant has found that known devices are characterized by an extremely complex structure, comprising e.g. the fixed frame, the motor and the reduction gearbox, distinct from one another. This structure, designed for the support of the large-size blades and for the rotation thereof at a low speed, is quite heavy and has a large axial size. The high weight represents a drawback since e.g. the device installed on the building structure (e.g. a beam or a slab) can create structural problems to the building itself (the more when several ventilation devices are installed in the building). Moreover, the high weight results in larger overall dimensions of the elements of the device, since these must bear such weight. The overall dimensions of known devices represent a drawback since they limit the applicability of devices to rooms with a high ground clearance, so that it is sufficient for installation under safety conditions and/or without reducing useful space.

[0008] Moreover, the complexity of the mechanical structure as well as the high weight and large overall dimensions make assembly, installation and/or maintenance more complicated and/or can jeopardize operators' safety.

[0009] Another drawback of known devices is their high cost, due e.g. to the complexity of the mechanical structure.

[0010] Another drawback found by the Applicant consists in the high energy consumptions of known devices, due e.g. to the low energy efficiency (e.g. of the motor and/or of the reduction gearbox) and to the complexity of the mechanical structure.

[0011] Another drawback found by the Applicant consists in the presence in known devices of vibrational phenomena, e.g. in the fixed frame and/or in the rotating blades.

[0012] Another drawback found by the Applicant consists in the generation by known devices of a noise level which can be harmful and/or unpleasant for people and/or animals in the room.

[0013] Furthermore, the aforesaid drawbacks can results in a lower reliability of the system and/or a higher susceptibility to faults.

[0014] Another drawback of known devices consists in the low efficiency (e.g. in terms of air volume moved as a function of the energy supplied to the rotor) of the blades.

[0015] Another drawback found by the Applicant consists in the difficulty of known devices, e.g. due to their structure, to integrate other devices or systems required for the activities performed in such room.

[0016] Another drawback found by the Applicant consists in the low versatility of known devices, characterized by a little versatile mechanical structure that does not allow to alter the operation thereof (e.g. to vary the rotational speed of the blades) as a function of the different operating conditions and/or installation configurations and/or characteristics of the installation environment, without making complex changes in the structure of such devices, which require long times and/or high costs.

[0017] Another drawback consists in the difficulty to alter blade configuration (e.g. blade type, blade inclination around their longitudinal axis, wing area) as a function of the desired type of installation and of the intended room.

[0018] Under these circumstances, the aim underlying the present invention in its various aspects and/or embodiments is to provide a device for ventilating a room, which is able to obviate one or more of the drawbacks mentioned above.

[0019] This aim and others, if any, that will be more

apparent in the following description are substantially achieved by a device for ventilating according to one or more of the appended claims, each of them being considered alone (without its related dependent claims) or in any combination with other claims, and according to the following aspects and/or embodiments, variously combined, also with the aforesaid claims.

[0020] In one aspect, the invention relates to a device for ventilating a room comprising:

- a fastening and movement device comprising a fastening portion intended to be connected in high position and in a stable manner to a fixed structure of the room, a stator firmly fastened in lower position to said fastening portion, and a rotor turnably engaged to said stator, said stator being apt to rotate said rotor around an axis of rotation;
- a blade-carrying rotor having a hub mechanically connected to said rotor and a supporting structure fastened to said hub, said fastening and movement device being apt to support said blade-carrying rotor and to rotate it around said axis of rotation for moving an air volume of said room and generating a forced air circulation in said room;
- a plurality of blades individually fastened to said supporting structure,

wherein the blade-carrying rotor is rotationally integral with the rotor so that, during rotation, the rotational speed of the blade-carrying rotor is the same as the rotational speed of the rotor.

[0021] The Applicant thinks that the combination of the aforesaid technical features, in particular the fact that the blade-carrying rotor is rotationally integral with the rotor so as to rotate integrally with the latter, e.g. thanks to the fact that no speed variator (e.g. reduction gearbox) is installed, makes the mechanical structure of the device both simple and rational (e.g. with reduced weight and/or small axial overall dimensions and/or low costs and/or low consumptions).

[0022] The term "rotationally integral" refers to the absence of the (relative) degree of rotational freedom around the axis of rotation. It should be noted that the present invention can encompass the case in which the blade-carrying rotor has at least one degree of freedom with respect to the rotor which is different from the aforesaid degree of rotational freedom, e.g. in order to orient the blade-carrying rotor in space. However, during the operation of the device, the rotation of the rotor and of the blade-carrying rotor occurs simultaneously. In one preferred aspect, the blade-carrying rotor is completely integral with the rotor, e.g. without any relative degree of freedom.

[0023] In one aspect, said fastening portion comprises a fastening plate having an upper surface and a lower surface to which said stator is firmly fastened.

[0024] In one aspect, said rotor is turnably engaged inside to said stator, so as to be at least partially surrounded by the stator, and has on the opposite side with respect to said fastening portion an end portion for fastening the hub.

[0025] In one aspect, said rotor comprises one or more pairs of permanent magnets, and said stator comprises one or more pairs of windings, said stator and rotor forming a brushless motor. As an alternative, the rotor may comprise said windings and the stator said permanent magnets.

[0026] In one aspect, the stator comprises a first ring provided with the aforesaid windings.

[0027] In one aspect, the first ring is closed on its ends by an upper plate and a lower plate, said plates being provided each with a respective first seat for housing a bearing.

[0028] In one preferred aspect, said upper plate coincides with the aforesaid fastening plate. Thus the structure is even simpler and more compact.

[0029] In one aspect, the rotor comprises a second ring, e.g. of ferromagnetic material, provided with the aforesaid magnets fastened thereto and closed on its ends by an upper cap and a lower cap, said caps being provided each with a respective second seat for housing a bearing.

[0030] In one alternative aspect, said rotor is turnably engaged outside to said stator, so as to surround the stator and have on the opposite side with respect to said fastening portion said end portion, said second ring having in this case such an inner diameter as to contain said first ring.

[0031] In one aspect, said first and second ring have a respective axial size, along a respective central axis, defining the torque generated by said rotor. Preferably, the ratio of the axial size to a radial size (orthogonal to said central axis) of said first ring is selected from 0.1, preferably 0.25, to 2, preferably 1.5, more preferably 1. It is thus possible to obtain the aforesaid low rotational speed keeping a high torque, without using a reduction gearbox between motor and blade-carrying rotor.

[0032] In one aspect, said stator comprises one or more first additional rings having the same technical features as said first ring and mounted piled up one onto the other so as to form an assembly stator ring, and said rotor comprises one or more second additional rings having the same technical features as said second ring and mounted piled up one onto the other so as to form an assembly rotor ring, said axial size of said assembly stator and said assembly rotor being a multiple integer of said predefined basic size. Thus, the motor obtained by the coupling stator-rotor is modular and can be configured as a function of the torque required by the application (e.g. as a function of blade diameter) by adding a suitable number of first and second additional rings (thus varying the axial size of the stator and of the rotor) and leaving the remaining parts of the device unchanged. The ventilation device can thus be configured as far as torque is concerned, leaving blade rotational speed unchanged. Preferably, the first and second additional rings are iden-

tical to said first and second ring, respectively. Preferably, the number of first additional rings coincides with the number of second additional rings.

[0033] In one aspect, the fastening and movement device comprises a mounting bracket fastened to the fastening portion on the opposite side with respect to the stator and provided with at least one anchoring portion to the fixed structure of the room for firmly connecting the fastening and movement device to the fixed structure.

[0034] In one aspect, said fastening and movement device comprises an electronic actuating central unit programmed to supply and manage the operation of the ventilation device.

[0035] In one aspect, the electronic central unit is programmed to enable a continuous adjustment of the rotational speed of the rotor.

[0036] In one aspect, the electronic central unit is programmed to detect the absolute or relative angular position of the rotor. Thus, the fastening and movement device does not require any sensor (e.g. encoder or resolver) and can be simpler, more reliable and less expensive.

[0037] In another aspect, the invention relates to a device for ventilating a room comprising:

- a fastening and movement device (preferably as described above) comprising a fastening portion intended to be connected (e.g. in high position) in a stable manner to a fixed structure of the room, a stator firmly fastened (e.g. in low position) to said fastening portion, and a rotor turnably engaged to said stator, said stator being apt to rotate said rotor around an axis of rotation;
- a blade-carrying rotor (preferably as described above) having a hub mechanically connected to said rotor and a supporting structure fastened to said hub, said fastening and movement device being apt to support said blade-carrying rotor and to rotate it around said axis of rotation for moving an air volume of said room;
- a plurality of blades individually fastened to said supporting structure, wherein the supporting structure of the blade-carrying rotor comprises an upper flange and a lower flange arranged on opposite sides of the hub and integral therewith, and a plurality of blade-carrying elements, each carrying a respective blade, interposed between said upper and lower flanges and fastened thereto, the blade-carrying elements being distributed along a circumference centered on the hub axis.

[0038] In one aspect, the hub of the blade-carrying rotor has an upper end and a lower end opposite, along an axis of the hub, the upper end, and the upper flange is fastened in central position to the upper end of the hub, and the lower flange is fastened in central position to the lower end of the hub.

[0039] In one aspect, each blade-carrying element comprises an upper support fastened in upper position to the upper flange, a lower support fastened in lower position to the lower flange, and an anti-vibration element interposed in contact between said upper and lower supports, the upper and lower supports and the anti-vibration element being fastened to one another. This structure can advantageously damp the vibrations of the ventilation device (e.g. of the blades, of the blade-carrying rotor and/or of the fastening and movement device) during its operation.

[0040] In one aspect, the upper support and the lower support comprise each a respective first portion configured for being mounted to the upper and lower flange, respectively, and for being housed in a space between said upper and lower flanges, and a respective second portion radially opposite said first portion and intended to be fastened to a proximal end of a blade.

[0041] In one aspect, the upper and/or lower support is made as a substantially planar plate, the respective first portion having a pair of wings projecting from the main lying plane of the plate in the same half-space with respect to the aforesaid lying plane and defining each a respective height. These wings can contribute to the vibration damping action.

[0042] In one aspect, the anti-vibration element is a plate, typically planar, and has a respective thickness. In one aspect, the upper and lower flanges are parallel to one another and at a certain distance corresponding to the sum of the heights of the wings of the upper and lower supports and of the thickness of the anti-vibration element. This distance corresponds to the axial length of the hub.

[0043] In one aspect, the two wings of the upper support have the same height and the two wings of the lower support have the same height, preferably corresponding to the height of the wings of the upper support. In one alternative aspect, the two wings of the upper support have different heights from one another and the two wings of the lower support have the same heights as, and inverted with respect to, the two wings of the upper support. Thus, the aforesaid lying plane (and therefore the anti-vibration element and the respective blade) of the upper and lower supports is inclined with respect to a horizontal plane (preferably perpendicular to said axis of rotation). It is thus possible to mount the blades with a desired inclination with respect to the horizontal plane (i.e. an inclination obtained by rotation around a respective axis of longitudinal development of the blade) and the inclination of the blades can be easily obtained by selecting the adequate height of the wings of the upper and lower supports only. Therefore, in one aspect, the present invention relates to an assembly comprising the device of the present invention, with the two wings of the upper and lower supports having the same height, and further at least one additional set (preferably two additional sets) of additional upper and lower supports, corresponding to the number of blades, as in the last aspect above.

[0044] In one aspect, the upper and/or lower flanges

have a pair of notches (preferably parallel to one another and/or passing through the respective flange) for each blade-carrying element and the wings of the upper and/or lower support have each a joint portion configured for being inserted, during assembly, into the respective notch provided on the respective flange. It is thus possible to make mounting operations easier and to obtain a more stable assembly.

[0045] In one aspect, said stator and said rotor are provided with a respective through hole coaxial with one another (preferably lying on the aforesaid axis of rotation), the combination of the through hole of the stator and of the rotor forming an inner channel passing from said fastening portion to said end portion of the rotor. It should be observed that in known devices the aforesaid inner channel cannot be obtained due to the presence of the reduction gearbox axially placed between the motor and the blade-carrying rotor.

[0046] In one aspect, said hub is provided with a respective hole, typically coaxial with its axis, passing from the upper end to the lower end, forming a respective inner channel.

[0047] In one aspect, the inner channel of the fastening and movement device and the inner channel of the hub form an assembly inner channel for enabling the passage of a duct or of an electric and/or optic cable or of a bearing element.

[0048] In one aspect, the device includes a diffuser system (e.g. by atomization) for substances in the room (e.g. sanitizing substances, insecticide, deodorant) comprising a duct integral with the fastening portion and getting through said assembly inner channel so as to get with a nozzle out of the through hole of the hub, in correspondence of the lower end thereof. Thus, substances are effectively dispersed into the room because they are diffused (e.g. atomized) just below the blades and effectively moved by the rotation of the latter.

[0049] In one aspect, the device includes an auxiliary system comprising a bearing element (e.g. a bar or a tube and/or an electric or optic cable, preferably inserted into the tube) integral with the fastening portion and getting through said assembly inner channel so as to get with an end portion out of the through hole of the hub, in correspondence of the lower end thereof, and comprising one or more accessories, e.g. light sources (e.g. night, safety, directional lamps) or a camera for a video surveillance system, fastened to said lower end of the bearing element and apt to perform certain functions in the room. Thus, the ventilation device advantageously integrates auxiliary systems which can perform given functions related to the activity performed in the room where the device is installed.

[0050] In one aspect, the blades have a longitudinal length, along an axis of longitudinal development, greater than or equal to 1 m and preferably lower than or equal to 5 m.

[0051] In one aspect, each blade is provided with a front longitudinal edge pointing in the sense of rotation of the blades around said axis of rotation (in practice, the edge cleaving the air), and with a rear longitudinal edge opposite the first one.

[0052] In another aspect, the invention relates to a device for ventilating a room comprising:

- a fastening and movement device (preferably as described above) comprising a fastening portion intended to be connected in a stable manner to a fixed structure of the room, a stator firmly fastened to said fastening portion, and a rotor turnably engaged to said stator, said stator being apt to rotate said rotor around an axis of rotation;
- a blade-carrying rotor (preferably as described above) having a hub mechanically connected to said rotor and a supporting structure fastened to said hub, said fastening and movement device being apt to support said blade-carrying rotor and to rotate it around said axis of rotation for moving an air volume of said room;
- a plurality of blades individually fastened to said supporting structure, wherein each blade comprises an additional wing profile fastened to the blade in correspondence of the proximal end fastened to the blade-carrying element and developing from the rear longitudinal edge parallel to the aforesaid axis of longitudinal development of the blade for a smaller length than the longitudinal length of the blade. Preferably, the additional wing profile has a concave plate-like shape with its concavity pointing downwards. One or more of the aforesaid solutions enables to enlarge the total wing surface of the blade where tangential rotational speeds are smaller (in proximal position) and to increase the global efficiency of air movement of the blade.

[0053] Further characteristics and advantages will be more evident from the detailed description of some exemplary though not exclusive embodiments, among which also a preferred embodiment, of a device for ventilating a room according to the present invention. This description will be disclosed below with reference to the accompanying drawings, provided to a merely indicative and therefore non-limiting purpose, in which:

- Figure 1 is a perspective view of a device for ventilating a room according to the present invention;
- Figure 2 is partial perspective view, partially exploded, of the device of Figure 1;
- Figure 3 is a sectioned view of the fastening and movement device belonging to the device for ventilating of Figure 1, sectioned along an axial plane;
- Figure 4 is a perspective exploded view of a blade-carrying rotor belonging to the device for ventilating of Figure 1;
- Figure 5 is a partial perspective view of a blade belonging to the device of Figure 1;
- Figure 6 is a partial view of the device of Figure 1,

partially sectioned along two perpendicular axial planes.

[0054] With reference to the accompanying figures, a device for ventilating a room according to the present invention is globally referred to with the numeral 1. In general, the same numeral is used for identical or similar elements, if necessary in their variants of execution.

[0055] The device 1 is a ventilation device intended to be installed in a large-size room such as e.g. an industrial or commercial building (e.g. workshop, foundry, manufacturing plant in general, warehouse, shopping center), a rearing farm or other environment (e.g. airport, station, gym, etc.). The device described in the present invention enables to obtain a ventilation of such room by moving a plurality of large-size blades, which rotate at low speeds.

[0056] The device 1 comprises a fastening and movement device 2 comprising a fastening portion 3 intended to be connected in high position and in a stable manner to a fixed structure (not shown) of the room, a stator 4 firmly fastened in low position to the fastening portion 3, and a rotor 5 turnably engaged to the stator. The stator 4 rotates the rotor 5 around an axis of rotation 6. The device 1 comprises a blade-carrying rotor 50 having a hub 51 mechanically connected to the rotor 5, and a supporting structure 60 fastened to the hub 51. The device 1 further comprises a plurality of blades 80 (preferably 2 or more and 10 or less, by way of example 5 blades) individually fastened to the supporting structure 60 of the blade-carrying rotor. The fastening and movement device 2 supports and rotates the blade-carrying rotor 50 around the axis of rotation 6 for moving an air volume of the room and generating therein a forced air circulation. Moreover, the blade-carrying rotor is rotationally integral with the rotor so that during rotation the rotational speed of the blade-carrying rotor is the same as the rotational speed of the rotor. Preferably, the hub is fastened directly to the rotor, e.g. by means of a system of screws and threaded holes.

[0057] Preferably, the fastening and movement device 2 is structured for rotating the rotor at a speed greater than or equal to 50 rpm, preferably grater than or equal to 100 rpm, and/or lower than or equal to of 400 rpm, preferably lower than or equal to 300 rpm, by way of example of about 200 rpm.

[0058] Preferably, the fastening portion 3 comprises a fastening plate 7 having an upper surface 7a and a lower surface 7b, to which fastening plate 7 the stator 4 is firmly fastened (by way of example the stator is fastened to the lower surface).

[0059] Preferably, as in the exemplary embodiment shown in the figures, the rotor 5 is turnably engaged inside to the stator 4, so as to be at least partially surrounded by the stator itself, and has on the opposite side with respect to the fastening portion 3 an end portion 5a for fastening the hub 51.

[0060] Preferably, the rotor 5 comprises one or more pairs of permanent magnets (not shown, e.g. of known type), and the stator 4 comprises one or more pairs of windings (schematically shown, e.g. of known type). Preferably, the stator 4 and the rotor 5 thus form a brushless motor.

[0061] Preferably, the stator 4 comprises a first ring 11, made e.g. of ferromagnetic material, provided with the aforesaid windings. Preferably, the first ring 11 is closed at its ends by an upper plate 12 and by a lower plate 13, each provided with a respective first seat for housing a bearing (sliding or rolling bearing). Preferably, the plates 12 and 13 close the first ring 11 by means of threaded couplings 14 (e.g. screws screwed into respective threaded holes of the first ring). As an alternative, the first ring and the upper and/or lower plates can be made as one piece, e.g. by melting or machining.

[0062] In one preferred aspect, as in the embodiment in the figure, the upper plate 12 coincides with the aforesaid fastening plate 7, so as to rationalize the fastening and movement device and make the structure simple and compact.

[0063] Preferably, the lower plate 13 is provided with a through hole 15 (by way of example an axial hole) enabling to fasten the end portion of the rotor to the hub. This fastening operation occurs e.g. by means of threaded couplings or other connecting elements (e.g. a key or a tongue).

[0064] Preferably, the rotor 5 comprises a second ring 21, made e.g. of ferromagnetic material, provided with the aforesaid magnets fastened thereto (e.g. by means of resin or glue) and closed at its ends by an upper cap 22 and by a lower cap 23, each provided with a respective second seat for housing a bearing (sliding or rolling bearing). Preferably, the caps 22 and 23 close the second ring 21 by means of threaded couplings 24 (e.g. screws screwed into respective threaded holes of the second ring). As an alternative, the second ring and the upper and/or lower caps can be made as one piece, e.g. by melting or machining. Preferably, the first ring 11 has a minimum inner diameter which is greater than the maximum diameter of the second ring 21, so as to contain the latter.

[0065] Preferably, the first seats of the upper and lower plates correspond to the second seats of the upper and lower caps, respectively.

[0066] Preferably, the fastening and movement device 2 comprises a first and a second bearing 16, 26 (sliding or rolling bearing), wherein the first bearing 16 is housed in the first seat and in the corresponding second seat, and the second bearing 26 is housed in the first seat and in the corresponding second seat. These bearings, interposed between stator and rotor, support the rotor and enable a correct (e.g. aligned and low-friction) rotation thereof with respect to the stator.

[0067] In one alternative aspect (not shown), the rotor is turnably engaged outside to the stator, so as to surround the latter and have, on the opposite side with respect to the fastening portion, the end portion. In this

case the second ring has such an inner diameter as to contain the first ring.

[0068] Preferably, the first and the second ring have a respective axial size, along a respective central axis, defining the torque generated by the rotor. Preferably, the ratio of the axial size to a radial size (orthogonal to the aforesaid central axis) of the first ring 11 is selected from 0.1, preferably 0.25, to 2, preferably 1.5, more preferably 1. Preferably, the aforesaid axial size corresponds to a predefined basic size (e.g. from 25 mm to 300 mm, typically of about 150 mm).

[0069] Preferably, the fastening and movement device 2 comprises a mounting bracket 30 fastened (e.g. by means of a suitable threaded connection) to the fastening portion 3 on the opposite side with respect to the stator 4 (e.g. fastened to the upper surface 7a of the fastening plate 7) and provided with at least one anchoring portion 31 to the fixed structure of the room (e.g. a beam or a slab of the building delimiting the room) for firmly connecting the fastening and movement device 2 to the fixed structure. As an alternative, in an embodiment not shown, the fastening bracket is made as one piece with the fastening portion 3 (e.g. with the aforesaid fastening plate 7).

[0070] Preferably, the fastening and movement device 2 comprises an electronic actuating central unit 35 programmed to supply and manage the operation of the device 1. Preferably, the electronic central unit is programmed to enable a continuous adjustment of the rotational speed of the rotor 5.

[0071] Preferably, the mounting bracket 30 comprises a housing seat 36 in which the electronic central unit is firmly housed and fastened (e.g. by means of a suitable threaded connection).

[0072] As an alternative (not shown), the electronic central unit 35 is fastened to the fastening portion 3 of the fastening and movement device 2 (e.g. to the upper surface 7a of the fastening plate 7).

[0073] Preferably, the electronic central unit is programmed to detect the absolute (e.g. with respect to a reference position) or relative (e.g. with respect to the stator) angular position of the rotor.

[0074] In one preferred aspect, as in the embodiment shown in the figures, the supporting structure of the blade-carrying rotor comprises an upper flange 61 and a lower flange 62 arranged on opposite sides of the hub and integral therewith, and a plurality of blade-carrying elements 70, each carrying a respective blade 80, interposed between the upper and lower flanges and fastened thereto, the blade-carrying elements being distributed along a circumference centered on the hub axis.

[0075] Preferably, the hub 51 of the blade-carrying rotor 50 has an upper end 52 and a lower end 53 opposite, along an axis 54 of the hub 51, at the upper end. Preferably, the upper flange is fastened in central position to the upper end 52 of the hub, and the lower flange is fastened in central position to the lower end 53 of the hub (e.g. by means of the same fastening elements for the hub to the rotor 5 and/or additional fastening elements 77). As an alternative, the hub 51 can be made as one piece with the upper and/or lower flange. The blade-carrying elements 70 preferably lie at the same angular distance around the axis 54 of the hub 51. Preferably, the blade-carrying elements are identical one with the other. Typically, the number of the blade-carrying elements is the same as the number of blades.

[0076] Preferably, each blade-carrying element 70 comprises an upper support 71 fastened in a upper position to the upper flange 61, a lower support 72 fastened in the lower position to the lower flange 62, and an anti-vibration element 73 placed in contact between the upper and lower supports, the upper and lower supports and the anti-vibration element being fastened to one another.

[0077] Preferably, the upper and lower supports comprise each a respective first portion 71a, 72a mounted to the upper and lower flange, respectively, and housed in a space between the upper and lower flanges, and a respective second portion 71 b, 72b radially opposite the first portion and intended to be fastened to a proximal end of a blade.

[0078] Preferably, the upper and lower supports are made as a basically planar plate, the respective first portion having a pair of wings 75 projecting from the main lying plane of the plate (typically orthogonal thereto) in the same half-space with respect to the aforesaid lying plane and defining each a respective height. (also including the thickness of the support). Preferably, the wings 75 are parallel to each other. Preferably, the lower support 72 has the same technical features as the upper support 71, more preferably it is specular thereto.

[0079] Preferably, the anti-vibration element 73 is a plate, typically a planar plate, and has a respective thickness. The anti-vibration element can be made of plastic, rubber, metal or other suitable material. Preferably, the anti-vibration element is interposed in its whole length between the upper 71 and lower 72 supports, and preferably for the whole length of the latter, preferably so that the supports are not in contact with one another.

[0080] Preferably, the upper 61 and lower 62 flanges are parallel to each other (preferably perpendicular to the axis of rotation 6 and 54) and at a distance corresponding to the sum of the heights of the wings 75 of the upper and lower supports and of the thickness of the anti-vibration element. This distance typically corresponds to the axial length of the hub.

[0081] Preferably, the two wings of the upper support have the same height and the two wings of the lower support have the same height, preferably the same as the one of the wings of the upper support.

[0082] In one alternative embodiment (not shown), the two wings 75 of the upper support 71 have different heights from one another and the two wings of the lower support 72 have the same heights as and inverted with respect to the two wings of the upper support. Preferably, the device according to the present invention is associated to a plurality (typically two or three) of additional sets of additional upper and lower supports (the number of

the additional supports corresponding to the number of blades), wherein each additional set can be selected in order to obtain a respective predefined inclination of the blades. Preferably, all the wings of the additional supports of one of these sets have the same height. Preferably, a wing of the additional supports of an additional set has a height corresponding to a predefined first height, and the other wing has a height corresponding to a predefined third height. Preferably, a wing of the supports of another additional set has a height corresponding to a predefined second height, different from the first one, and the other wing has a height corresponding to a predefined fourth height, different from the third one. Preferably, the first and third height and the second and fourth height have such a value as to define, when the respective blade-carrying element is assembled to the supporting structure of the blade-carrying rotor, a total height of the blade-carrying element, in an axial direction perpendicular to the horizontal plane, corresponding to the axial size of the hub. By way of example, the supports of the set in which the wings have the first and third height define a first inclination of the blade with respect to the aforesaid horizontal plane, whereas the supports of the set in which the wings have the second and fourth height define a second inclination of the blade with respect to the aforesaid horizontal plane. It is thus possible to have sets of upper and lower supports that can be used in a modular fashion for each blade-carrying element, once the desired inclination for the respective blade has been defined.

[0083] Preferably, the upper 61 and/or lower 62 flanges have a pair of notches 66 parallel to one another (preferably passing through the respective flange) for each blade-carrying element 70, and the wings 75 of the upper and/or lower support have each a joining portion 76 configured for being inserted during assembly into the respective notch 66 provided on the respective flange 61 or 62. It should be noted that the clamping portion does not contribute to define the aforesaid height of the wing of the support. Preferably, the blade-carrying element 70 is made so that the second portions 71 b and 72b of the upper 71 and lower 72 supports and the anti-vibration element 73 form a polygonal, e.g. rectangular, section. Preferably, the first portions 71 a and 72a of the upper and lower supports are fastened to the upper and lower flanges and the proximal end 80a of a blade 80 is fastened to the second portions 71 b and 72b of the upper and lower supports by means of respective coupling elements 77, e.g. threaded couplings, screws, bolts or weldings. Preferably, as shown by way of example in Figures 4 and 6, the coupling elements 77 enabling to fasten the supports to the flanges enable at the same time the assembly of the blade-carrying element 70 (thanks to suitable holes getting through the main elements), thus fixing the mutual position of the upper and lower supports and of the anti-vibration element, and also contribute to the assembly of the flanges and of the hub. It is thus possible to make assembly operations easier.

[0084] If the upper and lower supports are provided with wings having different heights one from the other, the coupling elements are preferably configured accordingly for enabling an inclined assembly of the respective blade (e.g. the aforesaid through holes in the upper and lower support and in the anti-vibration element are inclined accordingly). In addition, the top portions of the wings are preferably shaped so as to contact with a flat surface the respective upper or lower flange.

[0085] Preferably, the stator 4 and the rotor 5 are provided with a respective through hole 8 and 9 coaxial with one another (preferably lying on the aforesaid axis of rotation 6), and the combination of the through holes 8 and 9, of the stator 4 and of the rotor 5, respectively, form an inner channel 10 passing from the fastening portion 3 to the end portion 5a of the rotor 5.

[0086] Preferably, the first and the second ring 11 and 21, the upper and lower plates 12 and 13, the upper and lower caps 22 and 23 and/or the fastening plate 7 are provided each with a respective through (preferably central) hole. Preferably, all the aforesaid holes are coaxial with one another, preferably they are centered on the aforesaid axis of rotation 6 and form the aforesaid inner channel 10.

[0087] Preferably, the hub 51 is provided with a respective through hole 55, typically coaxial with its axis 54, from the upper end 52 to the lower end 53 and forming a respective inner channel.

[0088] Preferably, the inner channel 10 of the fastening and movement device 2 and the inner channel of the hub 51 form an assembly inner channel 20 enabling the passage of a duct or of a electric and/or optic cable or of a bearing element. Preferably, the inner channel 10 of the fastening and movement device and the inner channel of the hub are coaxial and communicating.

[0089] Preferably, as shown by way of example in Figure 6, the device 1 includes a diffuser system 90 (e.g. by atomization) for substances in the room (e.g. sanitizing substances, insecticide, deodorant) comprising a duct 91 integral with the fastening portion 3 and getting through the assembly inner channel 20 so as to get with a nozzle 92 out of the through hole 55 of the hub 51, in correspondence of the lower end 53 thereof.

[0090] Preferably, in one embodiment not shown, the device includes an auxiliary system comprising a bearing element integral with the fastening portion and getting through the assembly inner channel so as to get with an end portion out of the through hole of the hub, in correspondence of the lower end thereof, and comprising one or more accessories, e.g. light sources (e.g. night, safety, directional lamps) or a camera for a video surveillance system, fastened to the lower end of the bearing element and apt to perform certain functions in the room. The bearing element can be e.g. a stiff bar or a tube and/or an electric or optic cable, preferably inserted into the tube. As an alternative, the bearing element is the electric or optic cable itself, provided that it is able to support alone the aforesaid accessory.

[0091] Preferably, the blades 80 have a longitudinal length, along an axis of longitudinal development, greater than or equal to 1 m and, preferably, lower than or equal to 5 m, and are arranged with their respective axis of longitudinal development parallel or inclined with respect to a horizontal plane (preferably perpendicular to the axis of rotation 6).

[0092] Preferably, each blade 80 is provided with a front longitudinal edge 81 pointing in the sense of rotation of the blades around the axis of rotation 6 (in practice, the edge cleaving the air), and with a rear longitudinal edge 82 opposite the first one. Preferably, each blade 80 comprises an additional wing profile 85 fastened to the blade in correspondence of the proximal end fastened to the blade-carrying element and developing from the rear longitudinal edge parallel to the aforesaid axis of longitudinal development of the blade.

[0093] Preferably, the additional wing profile is fastened (e.g. with screws or rivets) to an upper face 83 of the blade on the rear longitudinal edge 82 of the blade, Preferably, the additional wing profile has a concave plate-like shape with its concavity pointing downwards.

[0094] Preferably, the additional wing profile has a length lower than or equal to about 3/4 of the longitudinal length of the blade, preferably lower than or equal to about half the longitudinal length of the blade, e.g. of about 1/3 of the longitudinal length of the blade.

[0095] In a possible embodiment, the device 1 can advantageously comprise a remote control device, not shown, connected (e.g. by means of a communication cable or in wireless fashion) to the electronic control unit 35, placed in a point of the room (where the device 1 is installed) that can be reached by a user, and configured for enabling this user to manage remotely the operation of the device, e.g. by setting torque values and/or rotor speed. Preferably, the remote control device can be configured to control the aforesaid diffuser system and/or auxiliary system.

Claims

1. A device (1) for ventilating a room comprising:

- a fastening and movement device (2) comprising a fastening portion (3) intended to be connected in a stable manner to a fixed structure of the room, a stator (4) firmly fastened to said fastening portion, and a rotor (5) turnably engaged to said stator, said stator being apt to rotate said rotor around an axis of rotation (6);
- a blade-carrying rotor (50) having a hub (51) mechanically connected to said rotor and a supporting structure (60) fastened to said hub, said fastening and movement device being apt to support said blade-carrying rotor and to rotate it around said axis of rotation for moving an air volume of said room;
- a plurality of blades (80) individually fastened to said supporting structure,

wherein the supporting structure of the blade-carrying rotor comprises an upper flange (61) and a lower flange (62) arranged on opposite sides of the hub and integral therewith, and a plurality of blade-carrying elements (70), each carrying a respective blade, interposed between said upper and lower flanges and fastened thereto, the blade-carrying elements being distributed along a circumference centered on the hub axis, each blade-carrying element comprising an upper support (71), fastened in upper position to the upper flange, a lower support (72), fastened in lower position to the lower flange, and an anti-vibration element (73) interposed in contact between said upper and lower supports, the upper and lower supports and the anti-vibration element being fastened to one another.

2. The device (1) according to claim 1, wherein the upper support (71) and the lower support (72) comprise each a respective first portion (71a, 72a) configured for being mounted to the upper and lower flange, respectively, and for being housed in a space between said upper and lower flanges, and a respective second portion (71 b, 72b) radially opposite said first portion and intended to be fastened to a proximal end (80a) of a blade.

3. The device (1) according to claim 1 or 2, wherein the anti-vibration element (73) is a plate, typically planar, and has a respective thickness.

4. The device (1) according to any one of the preceding claims, wherein the anti-vibration element is interposed between the upper (71) and lower (72) supports for the whole length of the latter.

5. The device (1) according to any one of the preceding claims, wherein the upper and/or lower support is made as a substantially planar plate, the respective first portion having a pair of wings (75) projecting from the main lying plane of the plate in the same half-space with respect to said lying plane and defining each a respective height.

6. The device (1) according to claim 5, wherein the two wings (75) of the upper support (71) have the same height and the two wings (75) of the lower support (72) have the same height, preferably corresponding to the height of the wings of the upper support, the upper (61) and lower (62) flanges being parallel to one another and at a certain distance corresponding to the sum of the heights of the wings of the upper and lower supports and of the thickness of the anti-vibration element (73).

7. The device (1) according to claim 5, wherein the two wings (75) of the upper support (71) have different heights from one another and the two wings (75) of the lower support (72) have the same heights as, and inverted with respect to, the two wings of the upper support.

8. The device (1) according to any one of the claims from 5 to 7, wherein said upper and/or lower flanges have a pair of notches (66) for each blade-carrying element (70) and the wings (75) of the upper and/or lower support have each a joint portion (76) configured for being inserted, during assembly, into the respective notch (66) provided on the respective flange.

9. The device (1) according to any one of the preceding claims, wherein each blade (80) is provided with a front longitudinal edge (81) pointing in the sense of rotation of the blades around said axis of rotation, and with a rear longitudinal edge (82) opposite the first one, and comprises an additional wing profile (85) fastened to the blade in correspondence of the proximal end (80a) fastened to the blade-carrying element (70) and developing from the rear longitudinal edge parallel to the aforesaid axis of longitudinal development of the blade for a smaller length than the longitudinal length of the blade.

10. Assembly comprising the device (1) according to claim 6, further comprising at least one additional set of additional upper and lower supports, corresponding to the number of blades, wherein the two respective wings (75) of the additional upper supports (71) have different heights from one another and the two respective wings (75) of the additional lower supports (72) have the same heights as, and inverted with respect to, the two respective wings of the upper supports.

Fig. 1

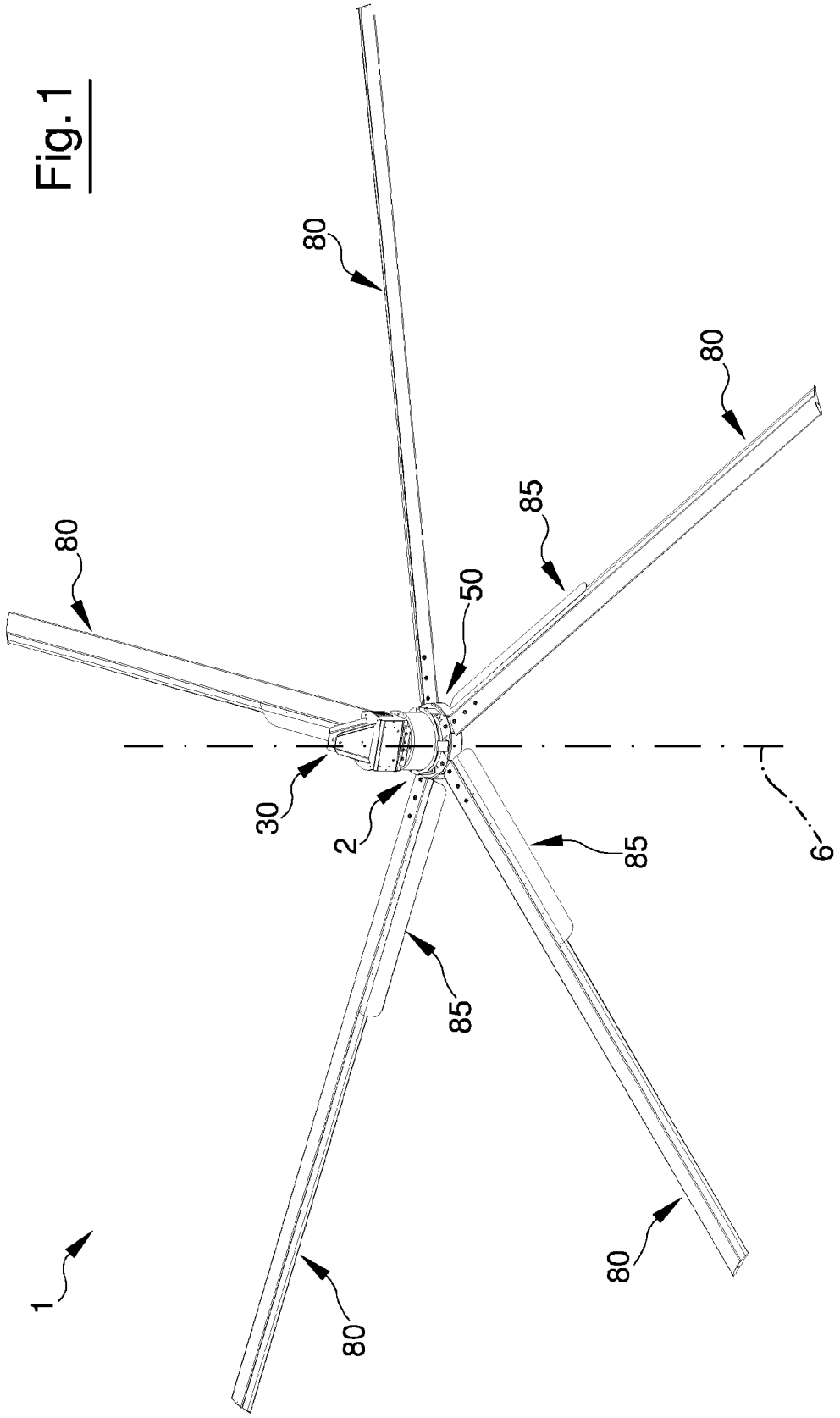

Fig. 2

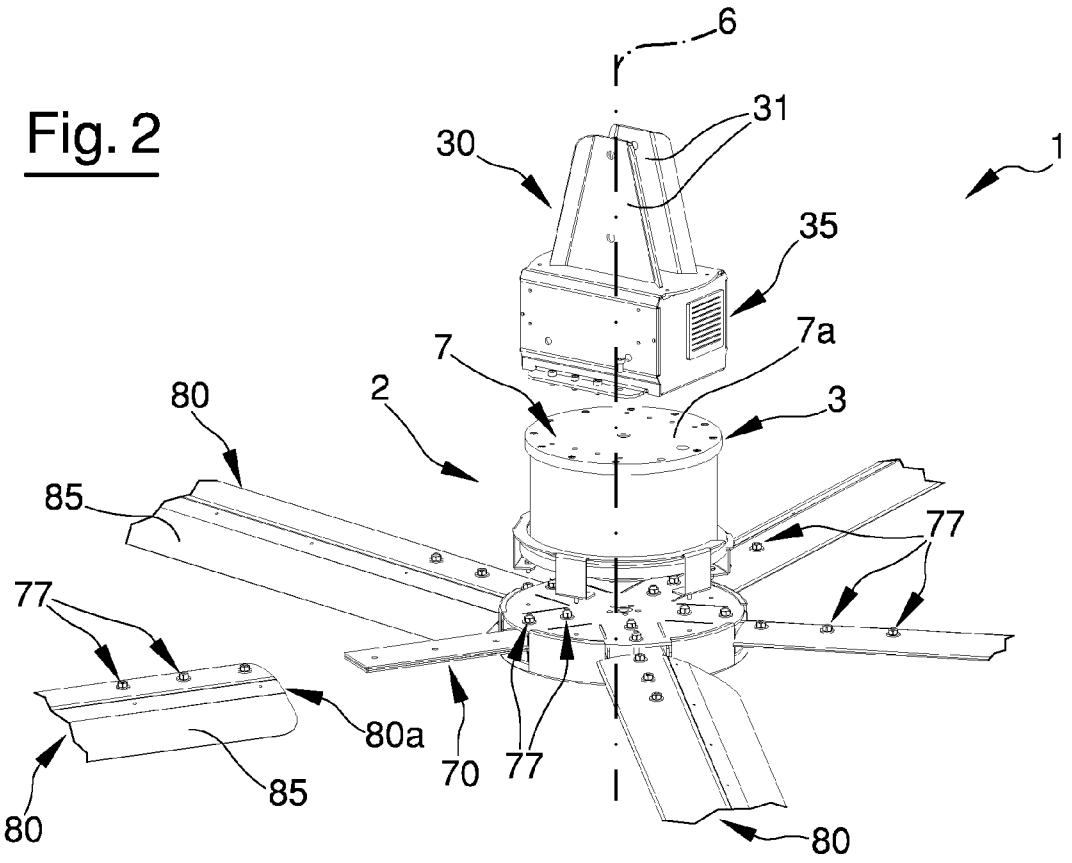
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Fig. 3

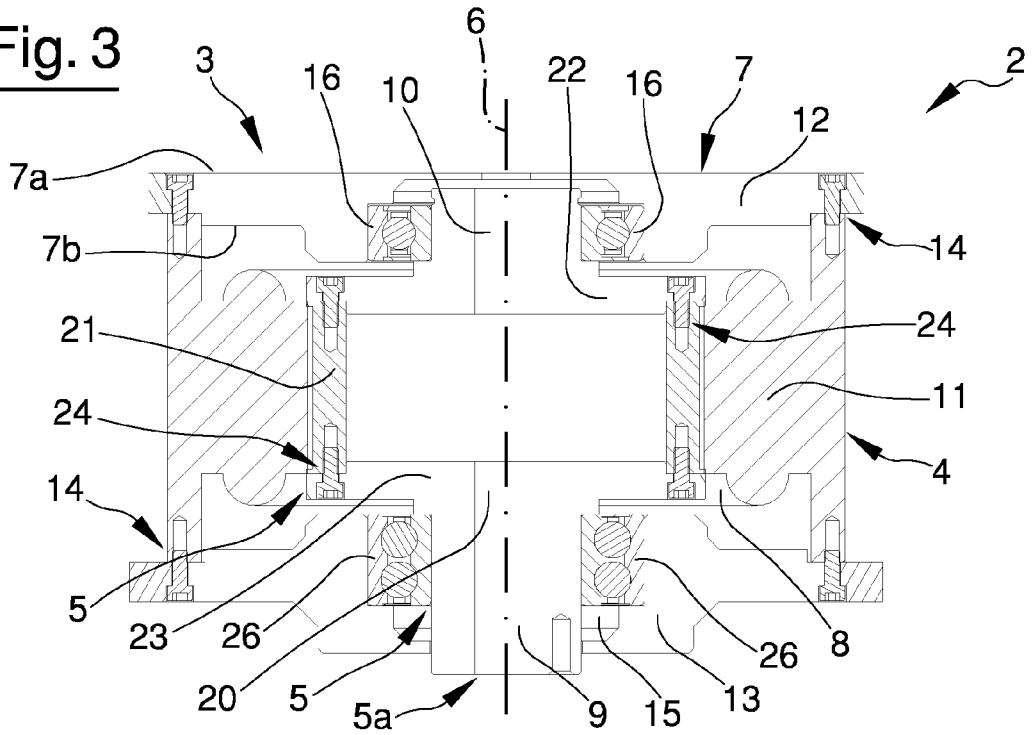
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Fig. 4

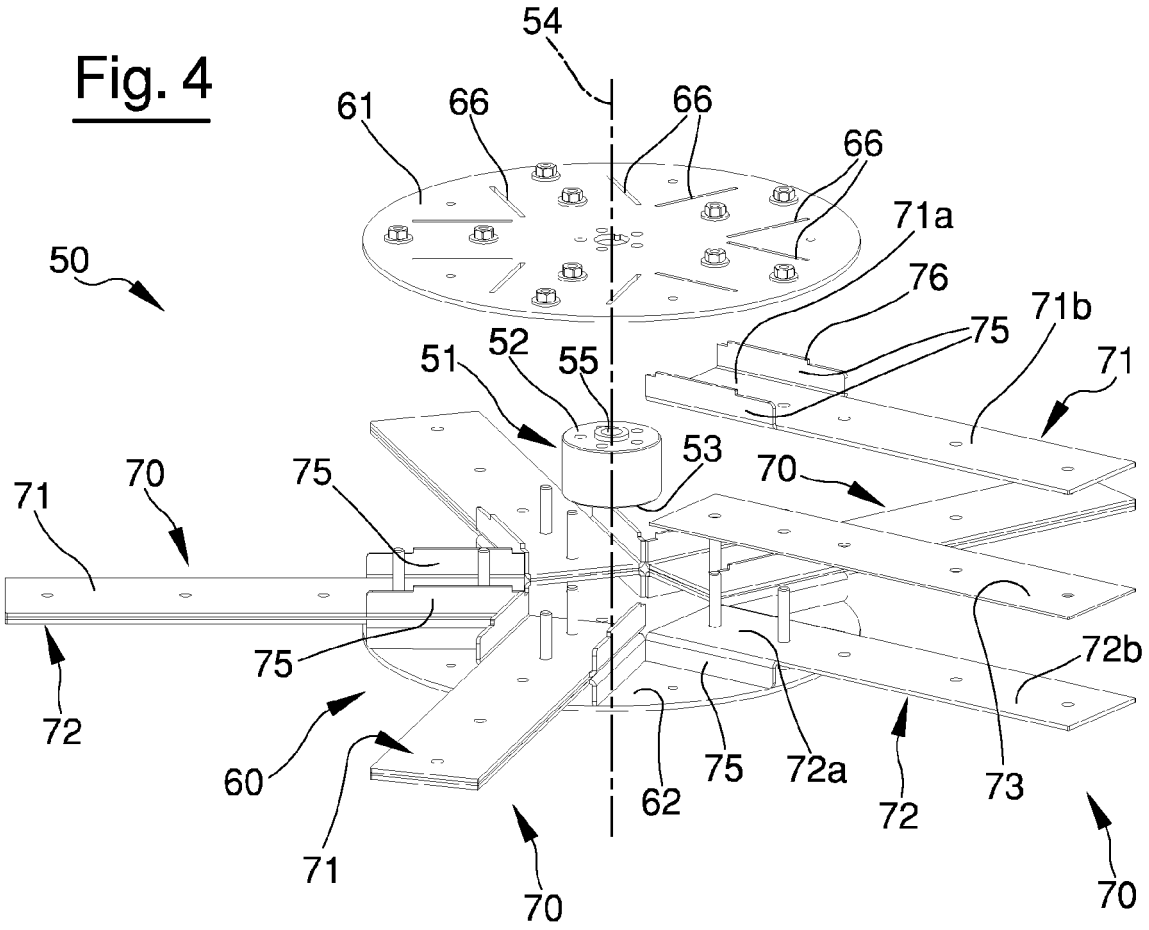
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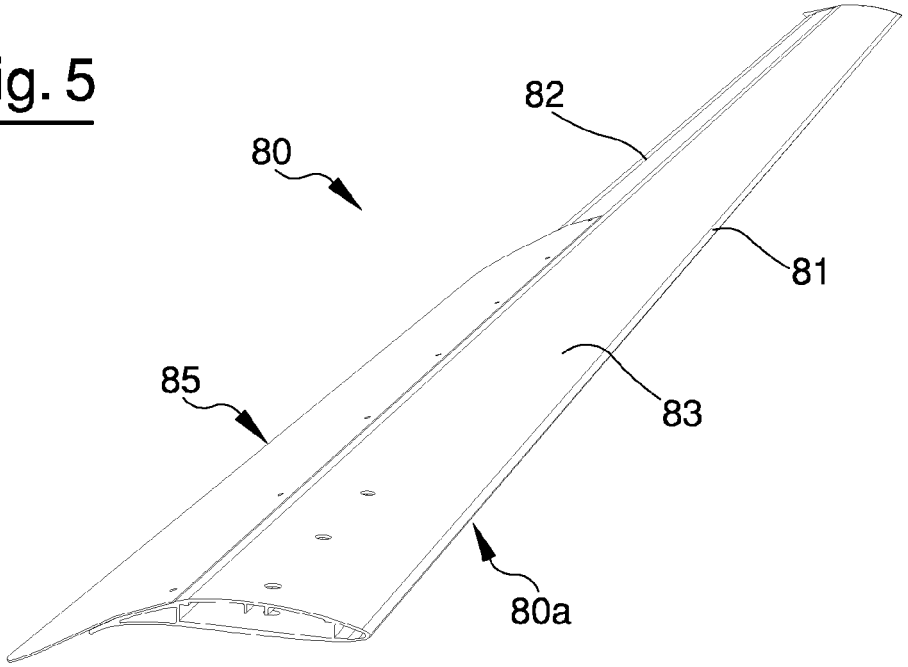
Fig. 5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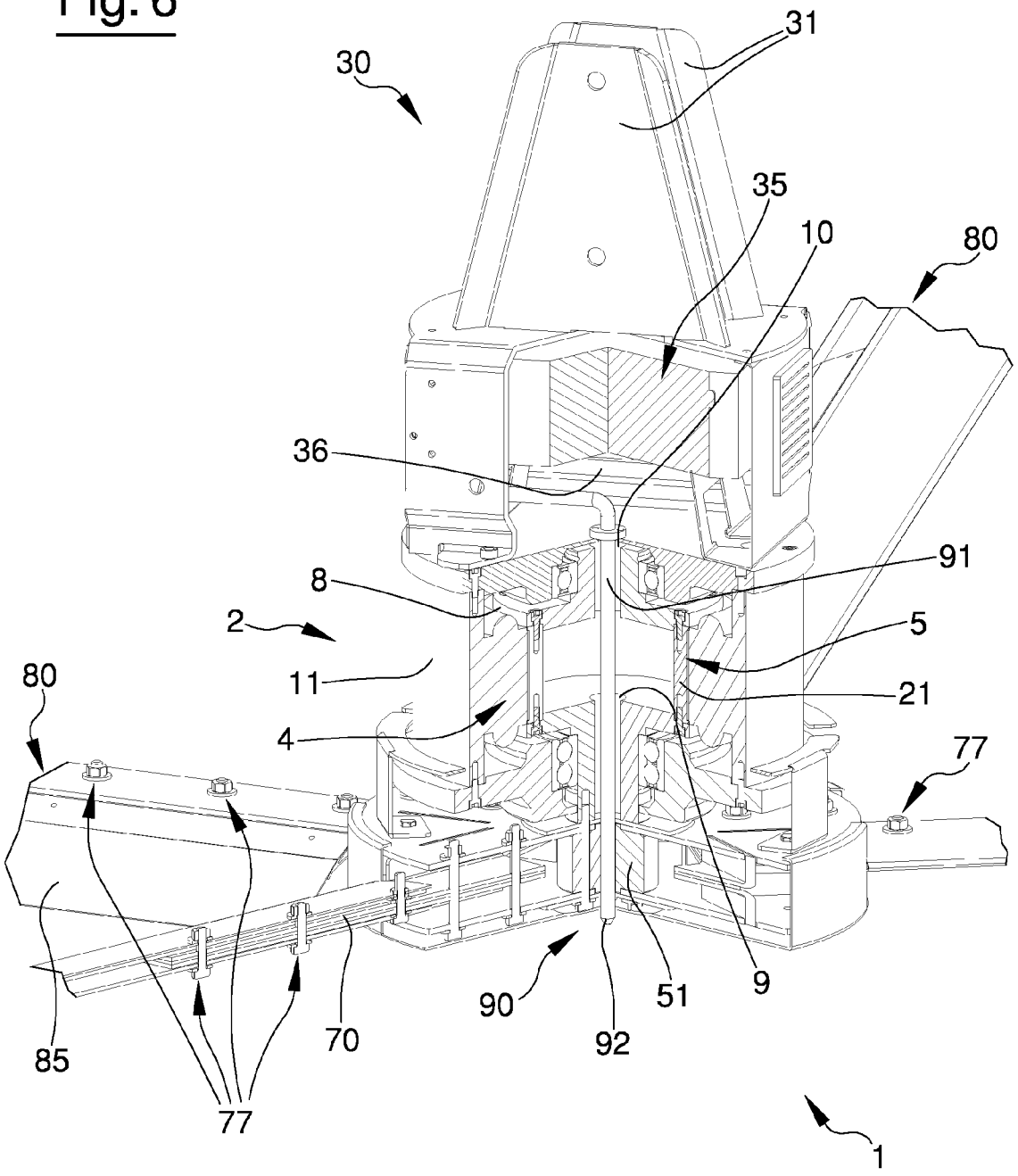
80a

Fig. 6



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Application Number
EP 11 17 0490

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The present search report has been drawn up for all claims

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