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(54) **Axial electric fan unit using a centrifugal regulator device for opening and closing a shutter**

(57) Electric fan unit including a casing (2) defining a passage for an air flow and comprising a central support (10); a fan (26) mounted rotatably on the central support; a shutter comprising a system of slats (12) movable between a configuration in which the passage is completely open and a configuration in which it is completely closed, and a centrifugal regulator (44) having a base element (46) connected in rotation to the fan (26); an axially movable actuating member (56) connected for operation to the system of slats in order to move them towards their maximum opening configuration when the fan is activated; at least two articulated arms connecting the actuator member (56) to the base element (46) and movable by

centrifugal force in such a way as to cause the axial advance of the actuating member; and a slidable coupling (84, 86) for guiding the axial translational movement of the actuating member relative to the base element. The fan is mounted rotatably on axle (20) connected fixedly to the central support; the axle defines the axis of rotation (z) of the fan (26) and has a through cavity (91) within which a rotating shaft (93) is coaxially housed, a front end of this shaft being connected fixedly to said fan, while a rear end of the shaft is connected integrally to the base element of the centrifugal regulator. The base element is mounted rotatably on the axle (20), on the opposite side of the central support (10) from the fan.

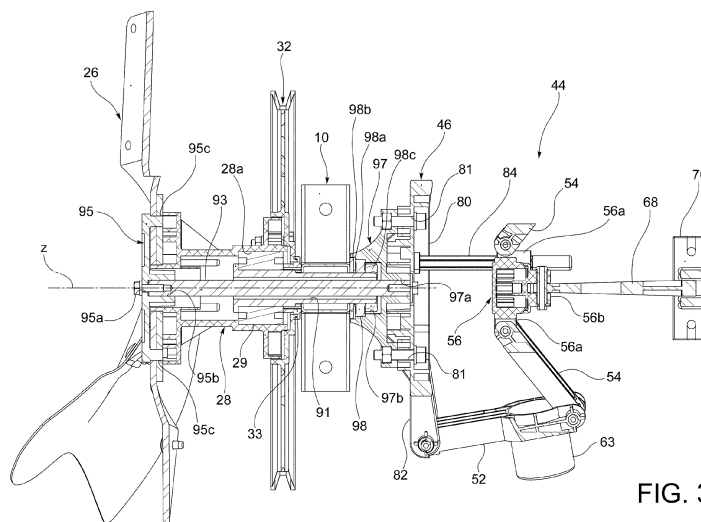


FIG. 3

## Description

**[0001]** The present invention relates to axial electric fan units provided with a shutter which intercepts the flow of fluid in the conduit of the electric fan, and with a centrifugal regulator device capable of causing the opening and closing of the aforesaid shutter.

**[0002]** More specifically, the invention relates to an electric fan unit comprising:

a casing defining a passage for the air flow, having an inlet and an outlet, and comprising a central support positioned between said inlet and outlet, a fan mounted on said central support and rotatable about its own axis of rotation, a shutter comprising a system of slats movable between a configuration in which the passage is completely open and a configuration in which it is completely closed, and a centrifugal regulator having

- a base element connected rotationally to the fan,
- an axially movable actuator member connected for operation to the system of slats in order to move them toward their maximum opening configuration when the fan is activated,
- at least two articulated arms connecting the actuator member to the base element, each of said articulated arms including a centrifugal weight and being movable by centrifugal force in such a way as to cause the axial advance or retraction of said actuating member, and
- a slidable coupling to guide the axial translational movement of the actuating member relative to the base element.

**[0003]** According to the prior art described in patent EP 0 563 875, the base element of the centrifugal regulator is connected integrally and directly to a hub of the fan. This arrangement is advantageous in an installation configuration in which the shutter is positioned at the outlet of the air flow passage; on the other hand, if the shutter is positioned on the inlet side of the air flow passage, the provision of a connection between the actuating member of the centrifugal regulator and the system of slats of the shutter requires considerable modification of some components of the unit, as well as the introduction of additional elements. In particular, an electric fan unit with a centrifugal regulator normally configured for operation by a pushing action must be modified for operation by a pulling action, since the centrifugal regulator and the shutter are positioned on opposite sides of the central support, that is to say on the outlet side and the inlet side respectively. For this purpose, a cavity must be formed inside the regulator device, and also inside the hub and the spindle supporting the fan and pulley, to allow the passage of an actuating rod which connects the actuating member of the centrifugal regulator to the system of slats

of the shutter; furthermore, the actuating member must be connected to the system of slats by means of a flexible pulling element (such as a chain), making it necessary to use support members (such as sprocket wheels) for the pulling element.

**[0004]** The aforesaid solution is therefore relatively complicated and costly, and relatively unsatisfactory in its operation, since it requires the use of a flexible pulling element and corresponding supports.

**[0005]** One object of the present invention is to provide an electric fan unit in which the centrifugal regulator can operate by a pushing action even if the shutter is positioned on the inlet side. Another object of the present invention is to provide an electric fan unit in which the fewest possible modifications and additional components are introduced with respect to the known solution in order to adapt this solution to the case in which the shutter is positioned on the inlet side.

**[0006]** These objects are achieved according to the invention by an electric fan unit of the type defined in the introductory part of this description, in which the unit comprises an axle connected integrally to said central support, on which said fan is mounted rotatably, said axle defining the axis of rotation of the fan and having a through cavity within which a rotating shaft is coaxially housed, a front end of this shaft being connected integrally to said fan, while a rear end of the shaft is connected integrally to said base element of the centrifugal regulator, said base element being mounted rotatably on the axle, on the opposite side of the central support from said fan.

**[0007]** With an arrangement of this kind, only a few components of the unit, in other words those forming the axle, are modified in order to provide the cavity in which the rotating shaft is housed. The additional elements present, apart from the rotating shaft, are the components required to fasten the fan hub to one end of the rotating shaft and to fasten the base element of the centrifugal regulator to the other end, and the bearings by means of which this base element is supported by the axle. On the other hand, the solution according to the invention requires no modifications for the adaptation of the centrifugal regulator, and allows the latter to operate by a pushing action even when the shutter is positioned on the air flow inlet side.

**[0008]** Preferred embodiments of the invention are defined in the dependent claims, which are to be considered as an integral part of the present description.

**[0009]** Further characteristics and advantages of the fan unit according to the invention will be made clearer by the following detailed description of an embodiment of the invention, given with reference to the attached drawings which are provided purely as non-limiting illustrations, in which:

- Figure 1 is a view in longitudinal section of an electric fan unit according to the prior art;
- Figure 2 is a partial perspective view of an electric

fan unit according to the invention;

- Figure 3 is a view in longitudinal section of the electric fan unit of Figure 2; and
- Figure 4 is an exploded view of some components of the electric fan unit of Figure 2.

**[0010]** Figure 1 shows an electric fan unit as described in EP 0 563 875, the description of which is incorporated herein by reference. With reference to this figure, the electric fan unit comprises a casing 2 formed by a hollow parallelepipedal body defining a passage 4 for the flow of air. Two opposing walls of the casing 2 have openings which form an inlet and an outlet, respectively, for the air flow. Figure 1 shows only the outlet opening, indicated by 8. The inlet opening, indicated by 6, is visible in Figure 2. The casing 2 comprises a central support 10 which is positioned between the inlet and outlet of the electric fan unit, and which, for example, is formed by one or more beams extending between opposite walls of the casing and supported thereby. The central support 10 is conventionally capable of supporting the internal components of the electric fan unit.

**[0011]** The outlet 8 is provided with a louvred shutter including a system of oscillating slats 12 which can be operated simultaneously. Each slat is supported oscillatably at the ends by two opposing walls of the casing 2 and is also provided at one of its ends with a link (not shown) which has one end fastened to the slat and the other end connected in an articulated way to a vertical connecting bar (not shown). All the slats are therefore interconnected by means of the aforesaid bar, and it is therefore possible to move only one of the slats and thereby cause a movement of all the slats 12. One of the aforesaid links is connected to one end of a spring (not shown). The other end of the spring is fastened to a wall of the casing 2 in such a way that the connecting bar is pushed upwards and all the slats 12 are kept in a configuration of complete closure of the outlet 8.

**[0012]** An axle 20 is connected integrally to the central support 10. A fan 26 is mounted on the central support 10 by means of the axle 20. The fan 26 is connected integrally to a hub 28 mounted rotatably on the axle 20, which thus defines an axis of rotation z for the fan. For this purpose, a bearing 29 is interposed radially between the axle 20 and a bearing seat 28a formed centrally inside the hub 28. A pulley 32 is also fastened to the hub 28 and is connected by means of a belt 34 to an electric drive motor (not shown) positioned inside the casing 2. An axial retaining element 33 (visible in Figure 4 in particular) is mounted on the axle 20 to retain the hub 28 and the pulley 32 in a predetermined axial position on the axle 20.

**[0013]** A centrifugal regulator device 44 is fastened directly to the end of the hub 28 which is opposite the pulley 32. For the description of this device, reference should be made additionally to Figure 2. The regulator 44 comprises a base element 46 formed by a disc 80 having holes 81 for the engagement of screws for fastening to

the fan, and by two opposing spokes 82. Two arms 52 are connected in an articulated way to the ends of the spokes 82. Two centrifugal weights 63 are fastened to the articulated arms 52. The ends of the arms 52 located opposite the spokes 82 are connected by two articulated bars 54 to two lateral portions 56a of an actuating member 56. The disc 80 is connected integrally to two guide bars 84 which are positioned parallel to and at a distance from the axis of rotation z of the fan, and which extend in the opposite direction to the fan. Two appendages 86, connected integrally to the actuating member 56, have two respective holes for slidable mounting on the guide bars 84. The actuating member 56 has a forked part 56b to which one end of an actuating bar 68 is connected in an articulated way. The other end of the actuating bar 68 is connected in an articulated way to a fork 70 connected to one of the slats 12.

**[0014]** In the aforesaid known device, the actuating member 56 is movable between a position adjacent to the base element 46, corresponding to the inactive condition of the fan, and a position of maximum separation from the base element 46, corresponding to the operating condition of the fan. The actuating member 56 therefore moves axially from the position adjacent to the hub to the position of maximum separation as a result of the centrifugal action of the weights 63 caused by the rotation of the fan. This axial movement causes a corresponding movement of the slats 12 from the completely closed configuration to the completely open configuration. The regulator device in question operates by a pushing action; in other words, the centrifugal force acting on the weights 63 when the electric fan is in motion causes the actuating member 56 to move towards the slats 12 in such a way that the actuating bar 68 pushes the fork 70 towards the outside of the electric fan, thus causing the slats 12 to open.

**[0015]** Figures 2 to 4 show an electric fan unit according to the invention. In these figures, the parts corresponding to those of Figure 1 are indicated by the same reference numerals.

**[0016]** In the case of Figures 2 to 4, the louvred shutter including the system of simultaneously operable oscillating slats 12 is positioned at the inlet opening 6, and the centrifugal regulator 44 is positioned on the opposite side of the central support 10 from the fan 26. In other words, whereas the fan 26 is positioned between the central support 10 and the outlet of the electric fan unit, the centrifugal regulator 44 is positioned between the central support 10 and the inlet 6 of the electric fan unit.

**[0017]** The fixed axle 20 has a through cavity 91 in which a rotating shaft 93 with a polygonal cross section is housed coaxially. A front end of the rotating shaft 93 is connected integrally to the fan 26, by means of a front flange 95 which has a central hole 95a for the engagement of a screw for fastening to the rotating shaft 93. The front end of the rotating shaft 93 is fitted by means of a prismatic coupling into a housing hole 95b formed centrally in the front flange 95; the rotating shaft 93 is there-

fore fixed to the front flange 95 with respect to rotation. The fan 26 is axially interposed between this flange 95 and the hub 28. The front flange 95 is fixed to the fan 26 and to the hub 28 with respect to rotation by means of one or more drive pins 95c formed eccentrically on the flange 95, which engage in corresponding holes formed in the central part of the fan 26 (these are holes which are normally already provided for fastening the base element 46 of the centrifugal regulator). A rear end of the rotating shaft 93 is connected integrally to the base element 46 of the centrifugal regulator 44, by means of a rear flange 97 which has a central housing hole 97a into which the rear end of the rotating shaft 93 is fitted by means of a prismatic coupling; the rotating shaft 93 is therefore fixed to the rear flange 97 with respect to rotation. The rear flange is fastened axially to the rotating shaft 93 by means of a screw and a washer interposed between the screw and the rear flange. The rear flange 97 is mounted rotatably on the axle 20 by means of a bearing 98 interposed radially between the rear end of the axle 20 and a bearing seat 97b formed centrally in the rear flange 97. Between the bearing 98 and the central support 10 there are interposed a spacing washer 98a and a tapered spring washer 98; these elements are retained axially on the axle 20 by means of a nut 98c screwed on to the axle 20. The rear flange 97 is axially interposed between the axle 20 and the base element 46 of the centrifugal regulator. The base element 46 of the centrifugal regulator is fixed to the rear flange 97 with respect to rotation by means of screws for fastening to this flange, which engage in the holes 81 formed in the base element 46 of the centrifugal regulator (these are the holes which are normally already provided for fastening to the hub 28). As a result of this arrangement, the base element 46 and therefore the centrifugal regulator 44 are mounted rotatably on the axle 20.

**[0018]** In an alternative embodiment (not shown), the arrangement of the components at the rear end of the axle is radially inverted with respect to that described above; in this alternative embodiment, the rear flange is mounted rotatably on the axle by means of a bearing interposed radially between a front end of the rear flange and a bearing seat formed centrally on a rear end of the axle. This configuration can be provided with axles having a sufficiently large diameter.

**[0019]** To summarize, although in the known configuration of Figure 1 the centrifugal regulator 44 is directly connected to the hub 28, in the configuration according to the invention of Figures 2 to 3 the centrifugal regulator 44 is connected indirectly to the hub 28 by means of the rotating shaft 93 and the front and rear flanges 95 and 97. This enables the motion to be transmitted from the pulley/hub/fan unit to the centrifugal regulator, even though they are positioned on opposite sides of the central support. Furthermore, the number of modifications and additional components in the configuration of Figures 2-4 by comparison with the configuration of Figure 1 is very small, and essentially relates only to the axle (a mod-

ified component), the rotating shaft and the front and rear flanges (additional components).

**[0020]** Clearly, provided that the principle of the invention is retained, the details of construction and the forms of embodiment can be varied widely from what has been described and illustrated purely by way of example, without thereby departing from the scope of the invention.

## 10 Claims

### 1. Electric fan unit comprising:

a casing (2) defining a passage for an air flow, having an inlet (6) and an outlet (8), and comprising a central support (10) positioned between said inlet and outlet,  
a fan (26) mounted on said central support and rotatable about its own axis of rotation (z),  
a shutter comprising a system of slats (12) movable between a configuration in which the passage is completely open and a configuration in which it is completely closed, and  
a centrifugal regulator (44) having

- a base element (46) connected rotationally to the fan (26),
- an axially movable actuator member (56) connected for operation to the system of slats in order to move them towards their maximum opening configuration when the fan is activated,
- at least two articulated arms (52, 54) connecting the actuator member (56) to the base element (46), each of said articulated arms including a centrifugal weight (63) and being movable by centrifugal force in such a way as to cause the axial advance or retraction of said actuating member, and
- a slidable coupling (84, 86) to guide the axial translational movement of the actuating member relative to the base element;

said electric fan unit being **characterized in that** it comprises

an axle (20) connected fixedly to said central support, on which said fan is mounted rotatably, said axle defining the axis of rotation (z) of the fan (26) and having a through cavity (91) within which a rotating shaft (93) is coaxially housed, a front end of this shaft being connected fixedly to said fan, while a rear end of the shaft is connected fixedly to said base element of the centrifugal regulator, said base element being mounted rotatably on the axle (20), on the opposite side of the central support (10) from said fan.

2. Unit according to Claim 1, in which said slidable coupling comprises at least one guide bar (84) integral with the base element (46) and extending parallel to and at a distance from the axis of rotation (z) of the fan (26) towards the actuating member (56), and at least one corresponding appendage (86), integral with the actuating member (56) and having a shaped opening coupled slidably to the corresponding guide bar.
 

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3. Unit according to Claim 1 or 2, in which a front end of the rotating shaft (93) is connected integrally to the fan (26) by means of a front flange (95) fastened to the rotating shaft (93), said fan being axially interposed between said front flange and a hub (28) of the fan.
 

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4. Unit according to Claim 3, in which the front end of the rotating shaft (93) is fitted by means of a prismatic coupling in a housing hole (95b) formed centrally in the front flange (95), said front flange being additionally fixed to the fan (26) and to the hub (28) with respect to rotation by means of at least one drive pin (95c) formed eccentrically on the front flange (95) and engaging in a corresponding hole formed in a central part of the fan (26).
 

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5. Unit according to any of the preceding claims, in which a rear end of the rotating shaft (93) is connected fixedly to the base element (46) of the centrifugal regulator (44) by means of a rear flange (97) fastened to the rotating shaft (93), said rear flange being axially interposed between the axle (20) and the base element (46) of the centrifugal regulator.
 

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6. Unit according to Claim 5, in which said rear flange has a central housing hole (97a) into which the rear end of the rotating shaft (93) is fitted by means of a prismatic coupling.
 

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7. Unit according to Claim 5 or 6, in which said rear flange is mounted rotatably on the axle (20) by means of a bearing (98) interposed radially between a rear end of the axle (20) and a bearing seat (97b) formed centrally in the rear flange (97).
 

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8. Unit according to Claim 5 or 6, in which said rear flange is mounted rotatably on the axle by means of a bearing interposed radially between a front end of the rear flange and a bearing seat formed centrally in a rear end of the axle.
 

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9. Unit according to any of the preceding claims, in which said fan is connected integrally to a hub (28) which is mounted rotatably on the axle (20), and which is also connected integrally to a pulley (32) connected by means of a belt (34) to an electric drive motor.
 

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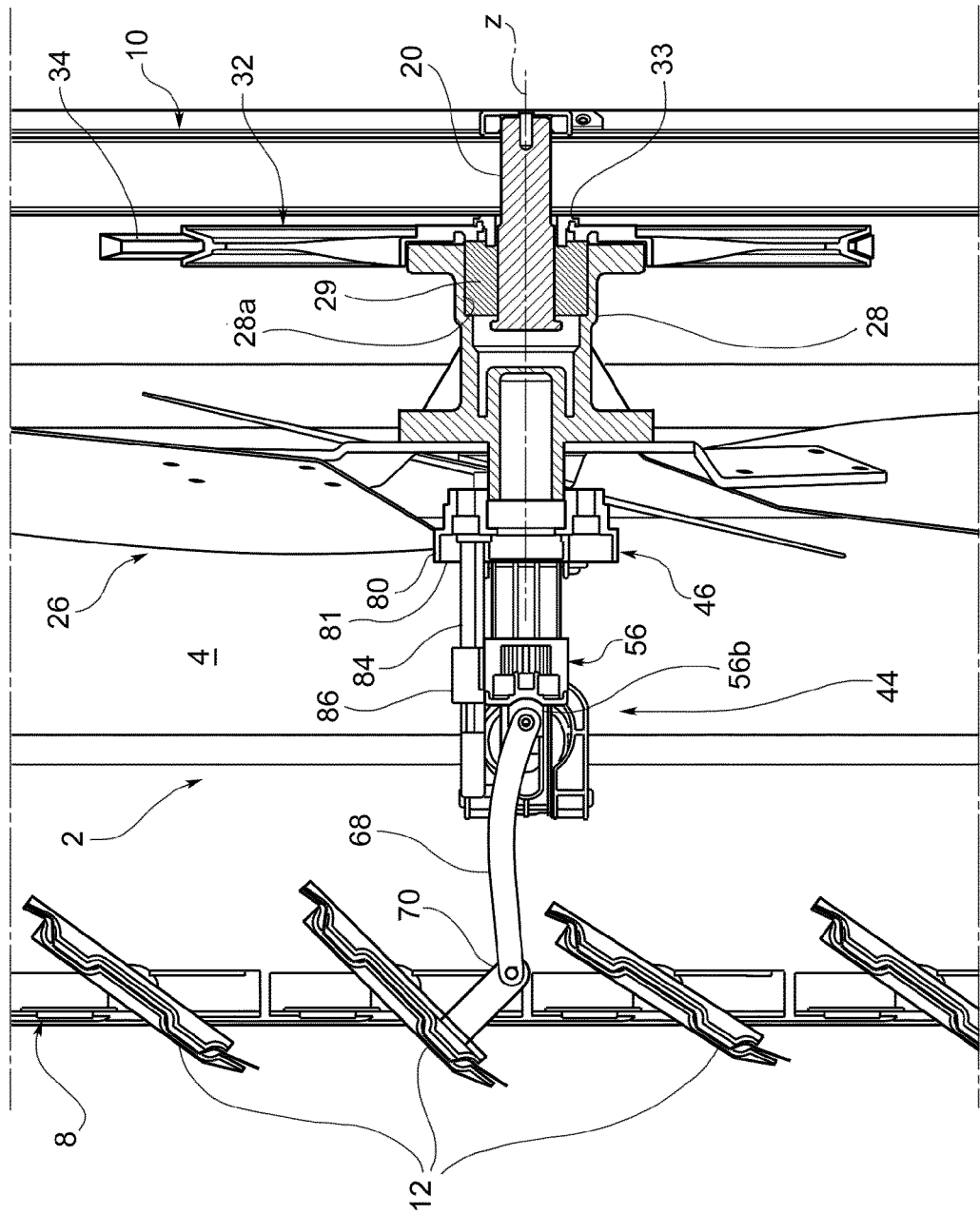


FIG. 1

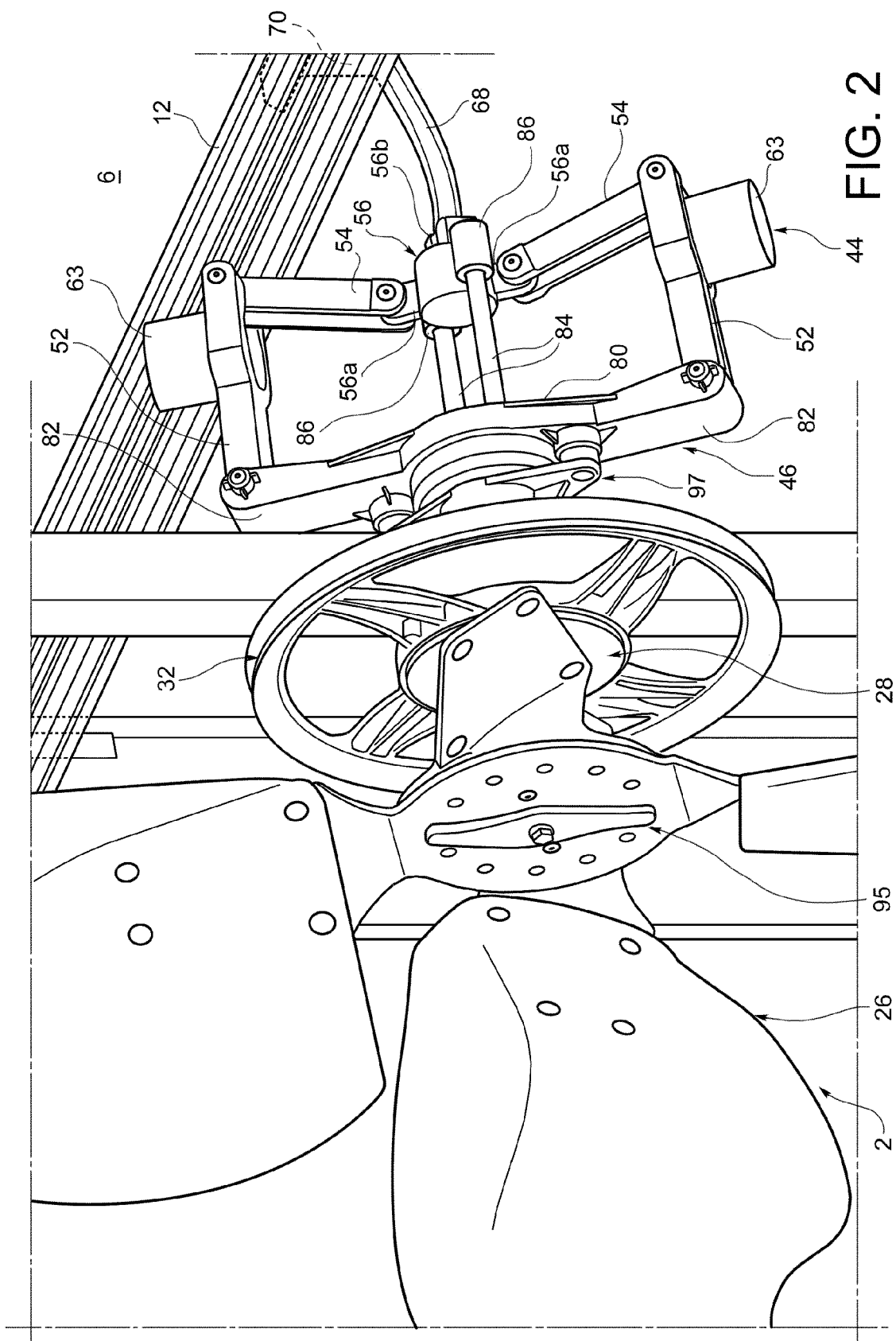


FIG. 2

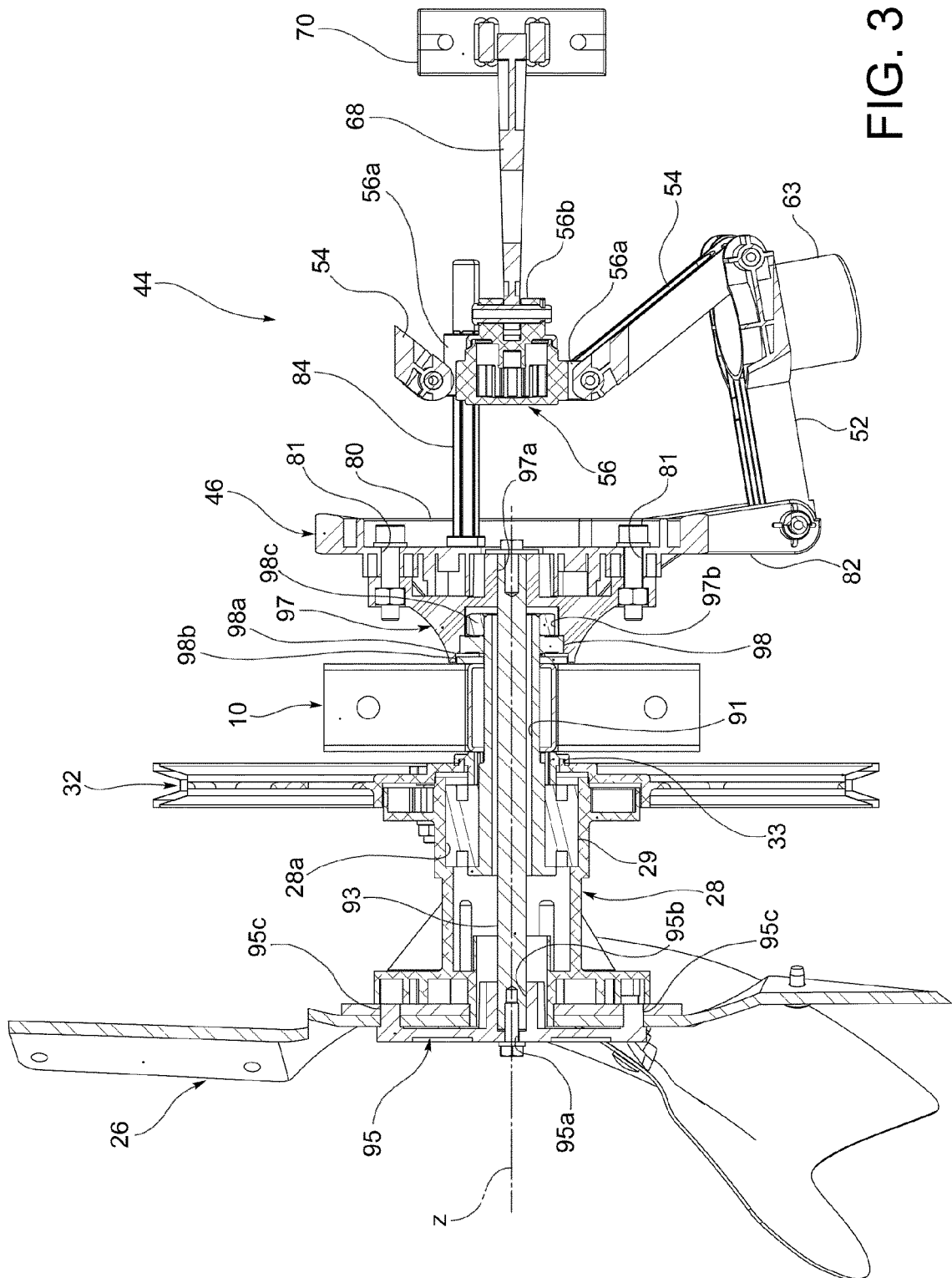


FIG. 3



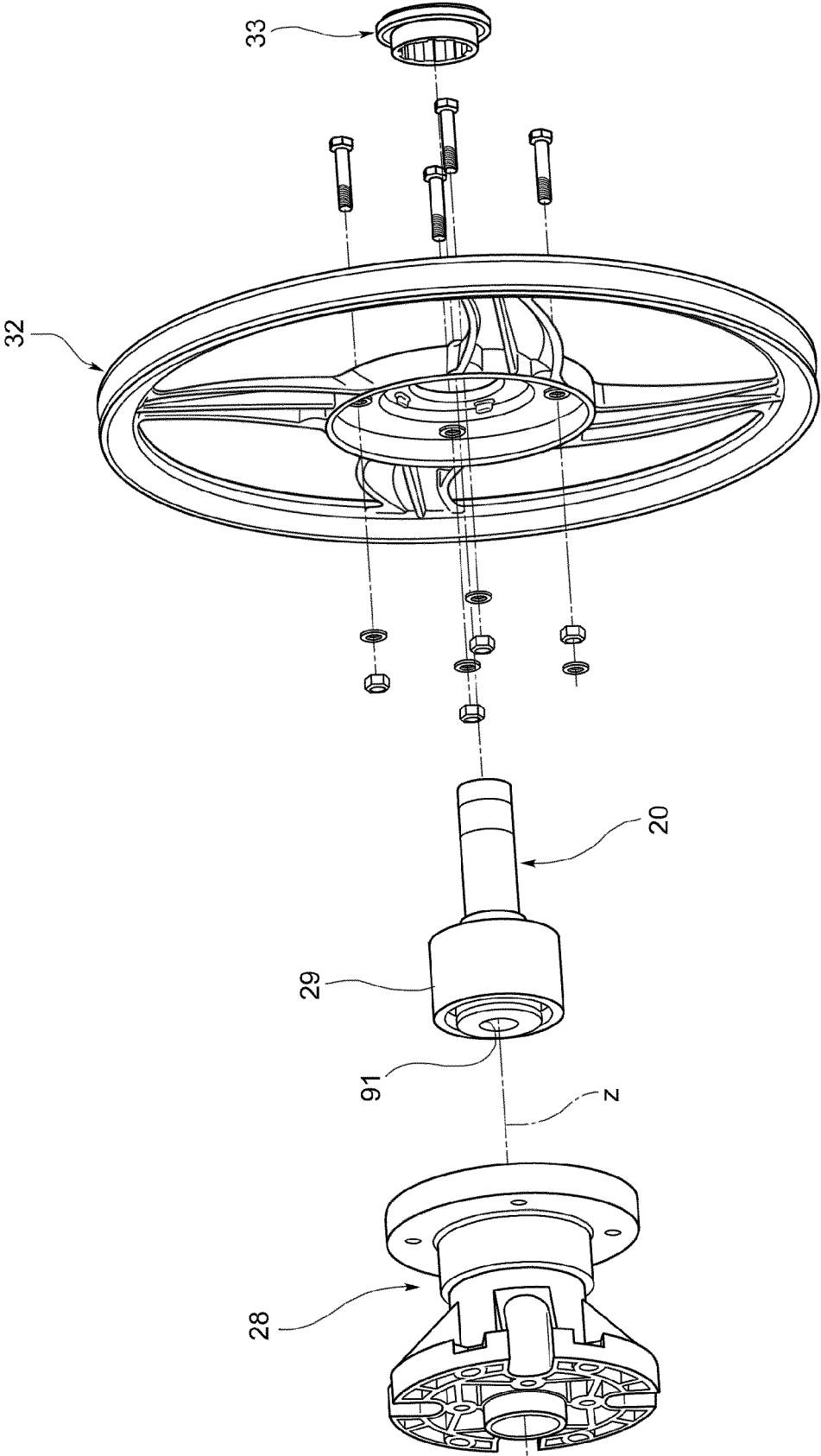


FIG. 4



## EUROPEAN SEARCH REPORT

Application Number  
EP 12 42 5133

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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			TECHNICAL FIELDS SEARCHED (IPC)
			F04D
The present search report has been drawn up for all claims			
Place of search <b>The Hague</b>		Date of completion of the search <b>21 January 2013</b>	Examiner <b>Ingelbrecht, Peter</b>
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons &amp; : member of the same patent family, corresponding document</p>			

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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 42 5133

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.  
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**REFERENCES CITED IN THE DESCRIPTION**

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