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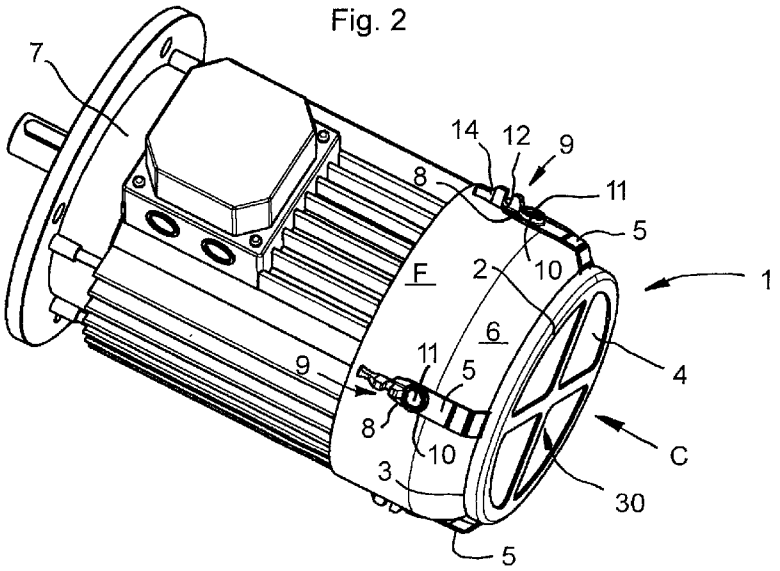
(54) Title: AIR FILTER FOR COOLING AN ELECTRIC MOTOR AND APPROPRIATE MOUNTING SUPPORT

Fig. 2



(57) Abstract: A cooling air filter for an electric motor, comprises a filter (4, 24) with a planar shape and minimum dimension so as to cover the area of the slits of a covering casing (6) of a fan for an electric motor (7) for which it is intended; and wherein said filter is housed in a support (1) which is fixed in a steady and removable way on the surface of the casing; the support having a frame-like structure (2) from which at least two arms (5, 25) extend, which are diametrically opposite in the frame-like structure, and which are provided at their end with fixing and gripping means (9) of the arms on the casing itself; the fixing means being configured for the fast detachment from and hooking onto said casing (6).

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AIR FILTER FOR COOLING AN ELECTRIC MOTOR AND APPROPRIATE MOUNTING SUPPORT

Field of the invention

The present invention relates to a cooling air filter for an electric motor and related mounting support, that is to say, to a passive device that, when it is inserted in the cooling airflow of an electric motor, filters its air and allows the latter to be purified from fine dust and droplets of sprayed liquids present in it as a suspension.

Prior art

The prior art already includes the custom of using filters to purify the cooling air moved by the fan of an electric motor. That is to say, it is known to apply to the case of the electric motor, in such a way as to cover the casing of the cooling fan, a coating of filtering material that prevents the sucked air from directly reaching the fan, having first to cross said filtering material. Moreover, the coating is fully made of filtering material, typically a layer of non-woven fabric, in such a way as to use a large amount of filtering material even if only a small part of said coating is crossed by the sucked airflow.

In use, considering that the employment of these filters in electric motors is constant, after a prearranged time period they must be replaced to have a new filtering surface which is not clogged by the fine dust and/or by the sprayed liquids it holds. Therefore, with said coating the amount of filtering material is very large in proportion to the surface actually used to filter the air.

Efforts were made to solve these drawbacks, as described in the prior art document JP2004108602, using a layer of filtering material that is stuck, by means of a double-sided adhesive element, on the slits on the outside of the protection casing of the cooling fan of the electric motor.

The main limit of this embodiment lies in the inconvenience of keeping the adhesion efficient, that is to say, enabling the detachment of the filtering material from the protection casing of the fan or even its destruction at the moment of detachment if the adhesive is strong to prevent its detachment. Furthermore,

considering the frequency of replacement of the filtering material, it is necessary to put a new filtering material every week and, on average, the operation of replacement is frequent and must be fast, to avoid unnecessary delays for a maintenance operator who has to intervene on all the installations of the machines in operation, which are often many in a workshop.

A filter applicable on the outside of a retaining casing of an electrical alternator for a motor vehicle, which is demountable and replaceable in the filtering part, is known in the art from document GB1292186. The filter has a frame provided with four hooking members, in a direction perpendicular to the positioning plane of the filter, within a seat specifically shaped in the casing of the alternator for the housing of the filter. In the body of the filter there is a tongue, parallel to the hooking members, which closes the electrical circuit of operation of the alternator when inserted. The fan is axially opposite to the body of the alternator itself so as to be in opposition to the casing and to the related housing seat of the body of the filter, which has a specific shape, also considering the desired effect of interruption of the electrical circuit.

Such an arrangement of parts, as set forth in said document, does not help overcome the problem of realizing a supporting frame for a filter that can be applied in a fast and versatile way on generic casings of electric motors built according to the standardization regulations and which are used in the motorization of workshop machineries, that is to say, in a field of art which is completely different from the endothermic engines for land vehicles.

Finally, in the systematic use of the filtering of the cooling air of the electric motors of machine tools the large number of motors that a machine can have and that, notoriously, have a standard shape according to the construction norms of electric motors, requires the possibility for a fast maintenance intervention with the replacement of the filtering material, to make the operation inexpensive, also in the case of electric motors with different dimensional and physical characteristics that are all provided by the specific construction norms.

Said prior art is subject to significant improvements with reference to the possibility of realizing a cooling air filter for an electric motor and related mounting support, which overcomes the above-mentioned limits of the prior art,

introducing a new way of mounting, use and management of the cooling air filters in the electric motors of workshop machines.

Therefore, the technical problem, which is at the basis of the present invention, is to realize a cooling air filter for an electric motor and related mounting support, which is practical, inexpensive and fast in the mounting and maintenance with the replacement of the filtering material housed in it and which is suitable for the various configurations provided by the dimensional construction norms of electric motors.

An inherent aim in the previous technical problem consists in making steady, but easily decomposable, the grip of the mounting support of the cooling air filter.

An additional aim of the present invention is to allow, according to user requirements, to use the mounting support of the cooling air filter of an electric motor, when one wants to replace the electric motor and the new motor has different physical or dimensional characteristics of the protection casing of the cooling fan.

Finally, an additional part of the technical problem and of completion of what has been outlined above is to make the frequent replacement of the filtering material easy and simple allowing the support to be dismounted from and re-mounted onto the electric motor without damaging the filter or the support itself.

Summary of the invention

This problem is solved, according to the present invention, by a cooling air filter for an electric motor, comprising a filter with a planar shape and minimum size so as to cover the area of the slits of a covering casing of a fan, operating in suction for the cooling of the electric motor for which it is intended; characterised in that said filter is housed in a support that is fixed, in a steady and removable way, on the external surface of said casing; the support has a frame-like structure from which at least two arms extend, diametrically opposite in the frame structure, provided with gripping and fixing means of the arms on the casing itself; the steady and removable fixing means are configured for the fast detachment from and

hooking onto said casing.

In an additional embodiment said steady and removable fixing means comprise said arms provided with a fabric with fabric gripping microhooks that engages in a portion of fabric glued in a fixed way on the surface of said casing for the cooling fan of the electric motor.

Furthermore, in a specific embodiment said steady and removable fixing means comprise said arms provided with a seat for a permanent magnet within which a permanent magnet is housed, in such a way as to realize the magnetic grip on a casing of ferromagnetic material for the cooling fan of the electric motor.

Moreover, in an additional embodiment said steady and removable fixing means comprise said arms, which are foldable on the surface of the side of the casing and have a sufficient length for the grip of the gripping means applied on the cylindrical surface of the casing.

Furthermore, in a specific, improved embodiment said steady and removable fixing means comprise the elastic extension made on an elastic element applied at the end of one arm, which in itself does not have elasticity in extension; said elastic element is provided with a hook at the end, which engages on the edge of the casing of the electric motor.

Moreover, in a specific embodiment said arms are foldable on the surface of the side of the casing and are kept on the side of the casing by means of a ring-shaped elastic element, which engages in grooves present in the end of the single arm.

Moreover, in an additional embodiment said arms, besides being foldable, are also extensible, that is to say, they are provided with an elastic extension and a hook at the end, which engages on the edge of the casing of the electric motor.

Furthermore, in a specific embodiment at least two different gripping means are present simultaneously in the body or ends of each of the arms for steady and removable positioning, in such a way as to allow the user to select the use of one of said gripping means.

Moreover, in an additional and specific embodiment at least the frame-

like support and the related edge are made of transparent material.

Finally, in a very advantageous embodiment the ends of the arms have a tapered shape to facilitate grasping by the user's fingers.

Further features and the advantages of the present invention, in the realization of a cooling air filter for an electric motor and related mounting support, will appear from the following description of some embodiments given as an indicative and non-exhaustive example, with reference to the five drawing tables enclosed.

Short description of the drawings

Figure 1 shows a schematic perspective view of a filter support according to the invention before being mounted on the casing that covers the cooling fan in an electric motor;

Figure 2 shows a schematic perspective view of the support of Figure 1, here mounted on the metal casing of a generic electric motor in which the positioning of the ends of the arms occurs by a magnetic action;

Figure 3 shows a schematic plan view of a filter support used in the previous Figures;

Figure 4 shows a schematic sectional view taken along the line IV-IV of Figure 3;

Figure 5 shows a schematic enlarged view of the portion V of the section of Figure 4;

Figure 6 shows a schematic enlarged view of the portion of Figure 3;

Figure 7 represents a schematic enlarged view in a limited perspective in the direction VII of Figure 1;

Figure 8 shows a schematic view in lower perspective, that is to say, the casing side of the electric motor, of the filter support of Figure 1;

Figure 9 shows a schematic side view of a filter support, according to the invention, of a specific embodiment with elastic grip of the edge of a casing for an electric motor;

Figure 10 shows a schematic perspective view of a cooling air filter for

an electric motor with its support, according to the embodiment of Figure 9;

Figure 11 shows a schematic perspective view of a cooling air filter of an electric motor according to the embodiment of Figures 1-8, with its support and an elastic element for fixing the arms of the support;

Figure 12 shows a schematic perspective view of the support of Figures 1-8, here mounted on the metal casing of a generic electric motor in which the positioning of the end of the arms occurs by the action of a ring-shaped elastic element, which keeps the arms of the support in position;

Figure 13 shows a schematic perspective view of a cooling air filter of an electric motor according to the embodiment of Figures 1-8, with its support and added extensible elastic fixing elements provided with an end hook, one for each arm of the support;

Figure 14 shows a schematic perspective view of the support of Figures 1-8, here mounted on the casing of a generic electric motor in which the fixing of the arms occurs at the ends of the arms by the action of an elastic element, each arm being provided with a hook, which hooks the arm on the edge of the protection casing of the fan of the electric motor.

Detailed description of preferred embodiments

In Figures 1 to 7 a support 1 for an air filter comprises a frame-like support 2, advantageously ring-shaped, provided with a centering edge 3 of a filter 4, advantageously disc-shaped; from said edge 3 at least two arms 5 extend in radial opposition, foldable and opposite to each other, to follow the shape of the covering casing 6 of the fan of an electric motor 7, the ring-shaped support 2 is centred on the front C of the casing in correspondence of the air suction slits of the cooling fan, the fan and slits not being shown; each foldable arm comprises at its end 8 gripping means 9 for the positioning of said end on the side F of the casing 6 of the electric motor 7. The gripping means 9 of the arm consist of an interlocking seat 10 for a permanent magnet 11, a groove 12 for receiving an annular fixing means 13, advantageously an elastic ring, visible in Figures 11 and 12, which is inserted in said grooves and keeps the ends of the foldable arms 5 against the casing 6. To complete the end 8 there is a tapered shape 14, to

facilitate grasping by the fingers of a maintenance-operator to allow him/her to position the end of the foldable arm correctly.

In Figures 4, 5 and 8 one can also see a connection hole 15 for an elastic element 16, visible in Figures 13 and 14, as a further element and mounting variant of the gripping means of a foldable arm 5 on a casing 6 and in the absence of a permanent magnet 11, or if the casing is not ferromagnetic, in the absence of an annular means 13, or elastic ring. Said elastic element 16 being made up of a male element 17, intended for the coupling in the hole 15 and of a body 18, for joining said male element with a hook 19, connected with a rubber band 20 to said body 18. The hook 19 grips on the terminal edge 21 of the casing 6, in such a way as to keep the foldable arm 5 in position and, as a consequence, also the ring-shaped frame-like support 2, with the filter 4.

In Figures 9 and 10, of a specific embodiment, a frame-like support 22, advantageously ring-shaped, has a retaining edge 23 of a filter 24, advantageously disc-shaped, and is provided with foldable and elastic arms 25 ending with a hook 26, bent for the grip of an edge 21 of a casing 6 of an electric motor, similarly to what is shown in Figure 14. Each foldable and elastic arm 25 has a bellows configuration 27, in such a way as to obtain the extension elasticity of the hook 26, for the elastic extension by deflection of the material of which it is made, with respect to the frame-like support 22 and grip on said edge 21 of the casing 6. Moreover, in the absence of a hook 26 or in replacement of the latter at the end 28 of one arm 25, or even in coupling with an end 8 of one arm 5, one can apply a fabric with fabric gripping microhooks (trade name Velcro®) which engages in a portion of fabric glued in a firm way on the surface of a casing 6 of a cooling fan for an electric motor (embodiment not shown).

The frame-like support 2 or 22 and the retaining edge of the filter 4 or 24 is advantageously made of transparent material, to be able to see the progressive clogging of the filter with the fine dust and with the spraying of liquids: a greater clogging is detectable from the greater penetration, and consequent blackening of the material of the filter, in the thickness of the filter itself. In this way the user can decide whether to continue to use the filter or replace it.

The use of the support for the cooling air filter for an electric motor is

clear from the enclosed figures. The filter support is thus a new and practical means for positioning a filter 4 or 24, which is disc-shaped only to imitate the ventilation slits of a casing 6, but which can also be square, rectangular, triangular, hexagonal or of another shape, and by the use of the support according to the present invention it is easily mounted on a casing 6 of a generic electric motor 7. The mounting on an electric motor is made on any constructive form of motors, with the only necessary limit that the size of the filter 4 or 24 is not much greater than the size of the slits of the protection casing of the cooling fan of the electric motor. Obviously the size of the filter should be equal to the width of the slits in the casing as well as the openings 30 in the support 2 or 22.

By the proposed embodiments of the foldable arms of the support the grip is performed in any efficient way: with magnetic means, that is to say, with the permanent magnet 11 housed in the seat 10, which holds the magnet in the end 8 of the arm 5, and, when drawn close to the ferromagnetic external surface of a casing 6, is able to fix the position of the end 8 of the foldable arm 5. Similarly, the presence of a groove 12 in the end of the arm allows to house in it an annular means 13, which can consist of a flexible and extensible elastic ring, or of a broken and flexible metal ring, made of material for springs, in such a way that it behaves like an elastic ring, which holds the ends 8 where it is inserted against a casing 6, when the latter is not ferromagnetic or does not have the permanent magnets.

Thus, in the embodiment with the hook 19 or 26, the end of one arm 5 or 25 is fixed to the edge 21 of a casing 6 of an electric motor, slightly tensioning the elastic part of the arm: be it the bellows part 27 or the rubber band part 20 to hook said hook to the edge 21 of the casing after tensioning said elastic part.

The advantages in the use of a cooling air filter for an electric motor can be summarized in the practicality of mounting and following maintenance of each of the described embodiments, either by magnetic fastening, or by fastening with an annular elastic means or with a tensioned elastic means. Last but not least, also the embodiment with the microhooks gripping element (trade name Velcro®) is advantageous, in the specific need to apply and detach several times, in the

expected life of the filter support, and replace the filter 4 or 24 itself.

The realization of said fixing means can occur individually on a filter support, that is to say, the support being provided during construction with only one of said fixing means, but more advantageously two or more of said fixing means are combined during construction on one single support 1, as depicted, in such a way as to leave the user free to select which of the fixing means to use in the application of the cooling air filter for electric motor he/she wants to carry out.

Obviously, to the above-described cooling air filter for an electric motor and related mounting supports a person skilled in the art, in order to meet specific and contingents needs, can make several changes, which will all be included within the scope of protection of the present invention as defined by the following claims. Obviously, although less advantageously, a support for a cooling air filter can be applied to electric motors whose shape is not necessarily cylindrical, it being possible, as stated in the text, to shape the frame-like support with a perimeter having a varied shape and at least two radially opposite arms 5. Moreover, the length of the arms 5 being able to be limited and the gripping means 9 gripping directly on the front C of the casing 6 of an electric motor, optionally with a permanent magnet, if the casing is ferromagnetic, or even with a fabric having fabric gripping microhooks (trade name Velcro®) which engages in a portion of fabric glued in a steady way on the surface of the casing. In both the embodiments, which have just been described, there always remaining the steady and removable fixing of the frame-like support, when required, for the replacement of the filtering material constituting the filter.

CLAIMS

1. A cooling air filter for an electric motor, comprising a filter (4, 24) with a planar shape and minimum dimension so as to cover the area of the slits of a covering casing (6) of a fan, operating in suction for the cooling of the electric motor (7) for which the filter is intended; characterised in that said filter is housed in a support (1) which is fixed in a steady and removable way on the external surface of the casing; the support having a frame-like structure (2) from which at least two arms (5, 25) extend, which are diametrically opposite in the frame-like structure, and which are provided with fixing and gripping means (9) of the arms on the casing itself; the steady and removable fixing means being configured for the fast detachment from and hooking onto said casing (6).

2. A cooling air filter, according to claim 1, wherein said steady and removable fixing means comprise said arms which are provided with a fabric with fabric gripping microhooks which engages in a portion of fabric glued in a fixed way on the surface of the casing for the cooling fan of an electric motor (7).

3. A cooling air filter, according to claim 1, wherein said steady and removable fixing means comprise said arms (5) which are provided with a seat (10) for a permanent magnet within which a permanent magnet (11) is housed, in such a way as to perform the grip by magnetic attraction on a casing (6) of ferromagnetic material, for the cooling fan of the electric motor (7).

4. A cooling air filter, according to claim 1, wherein said steady and removable fixing means comprise said arms (5) which are foldable on the surface of the side (F) of the casing (6) and have a sufficient length for the grip of the gripping means applied on the cylindrical surface of the casing.

5. A cooling air filter, according to claim 4, wherein said steady and removable fixing means comprise the elastic extension made on an elastic element (16), applied at the end of one arm (5), which in itself does not have

elasticity in extension; said elastic element being provided with a hook (19) at the end engaging on the edge (21) of the casing (6) of the electric motor.

6. A cooling air filter, according to claim 4, wherein said arms are foldable on the surface of the side (F) of the casing (6) and are kept on the side of the casing by a ring-shaped elastic element (13) which engages in grooves (12) which are present in the end (8) of the single arm (5).

7. A cooling air filter, according to claim 4, wherein said arms (25), besides being foldable, are also extensible, that is to say, they are provided with an elastic extension (27) and a hook (26) at the end engaging on the edge (21) of the casing of the electric motor.

8. A cooling air filter, according to the previous claims 1 to 7, wherein at least two different gripping means (9, 19, 26) are present simultaneously in the body or end of each of the arms for steady and removable positioning, in such a way as to allow the user to select which of said gripping means to use.

9. A cooling air filter, according to the previous claims, wherein at least the frame-like support (2, 22) and the related edge (3, 23) are made of transparent material.

10. A cooling air filter, according to the previous claims, wherein the ends of the arms (5, 25) have a tapered shape (14) to facilitate grasping by the user's fingers.

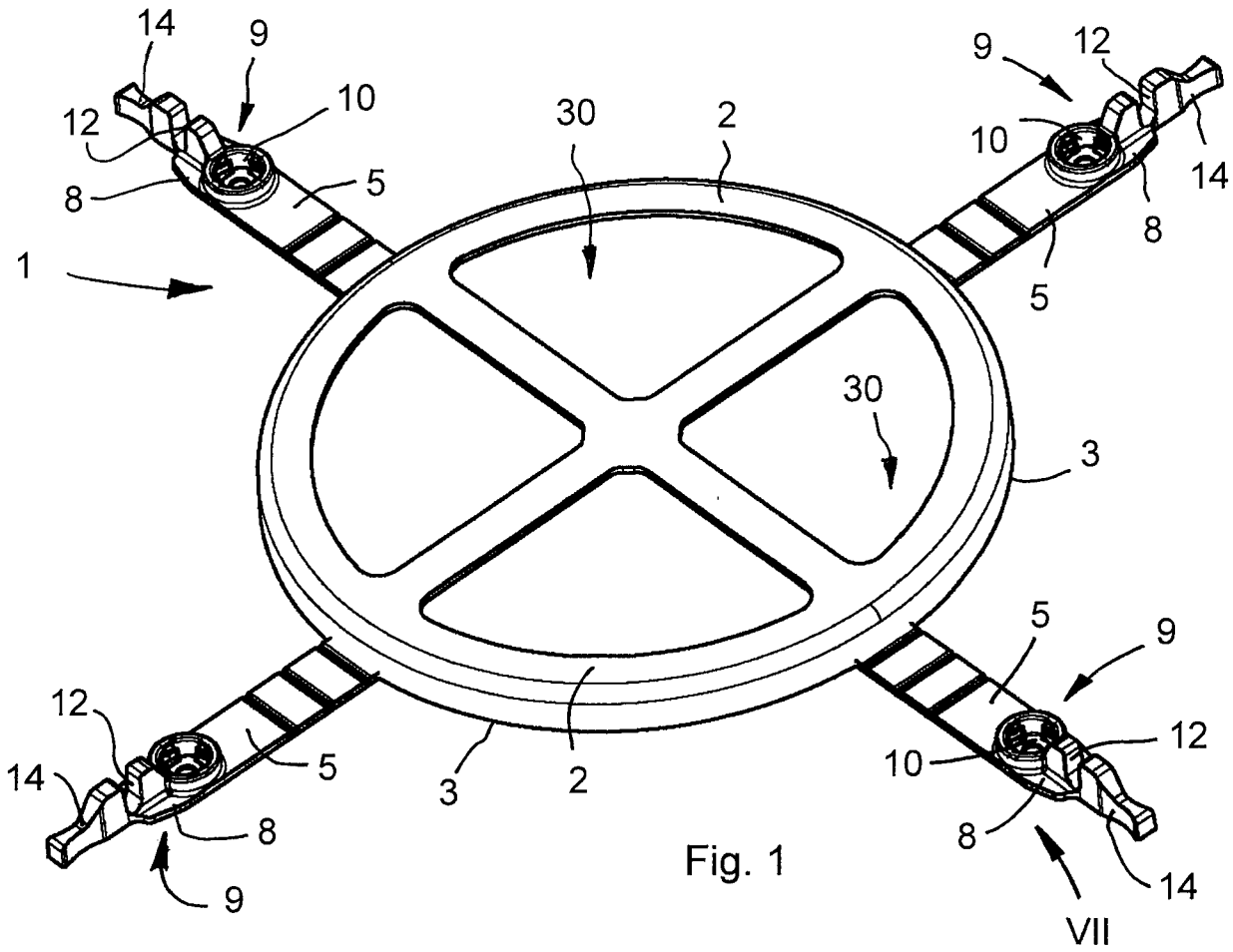
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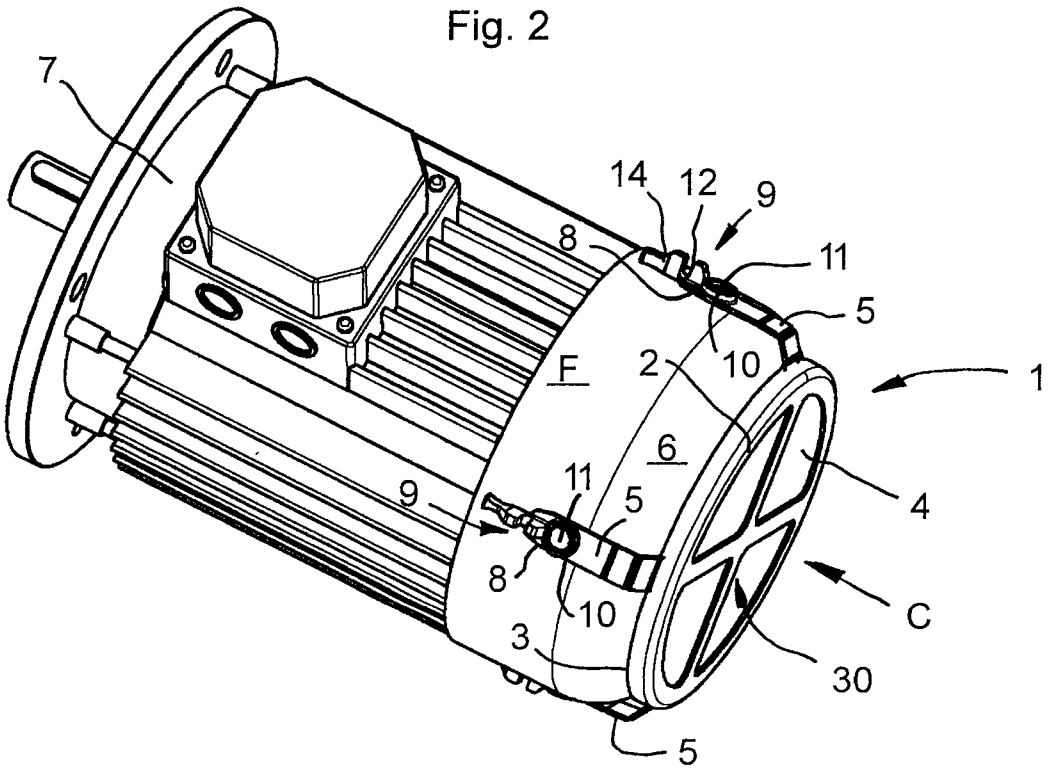
Fig. 1

Fig. 2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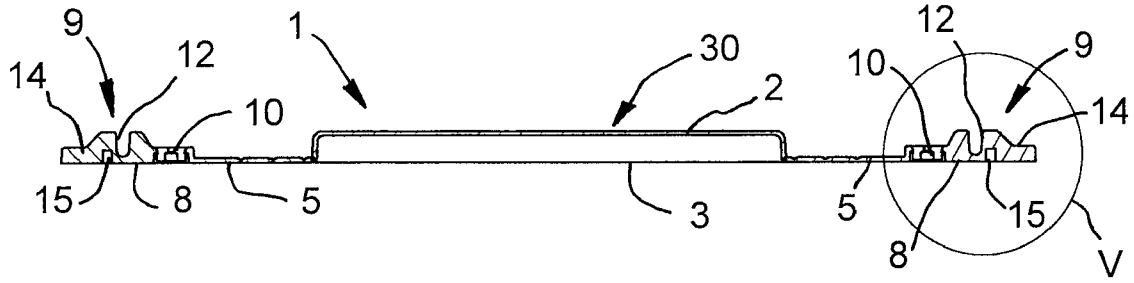

Fig. 4

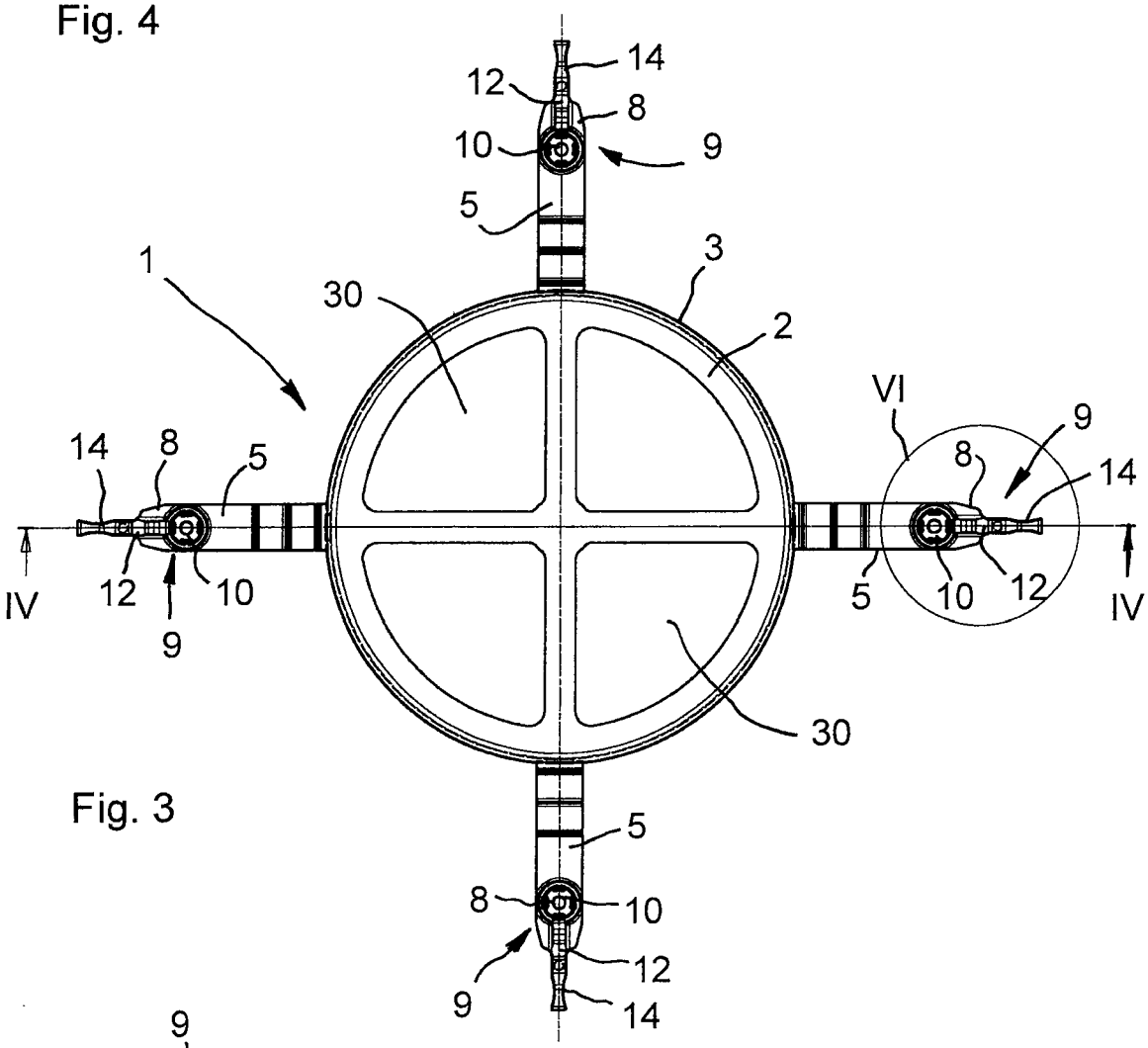

Fig. 3

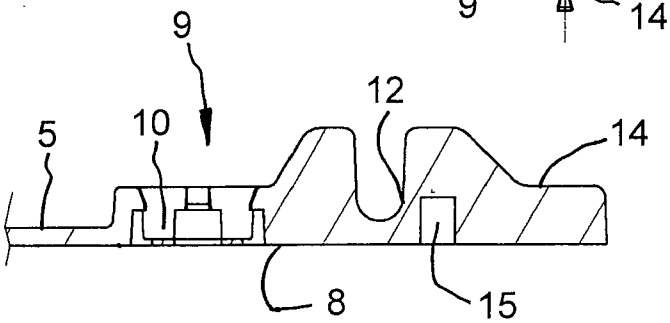

Fig. 5

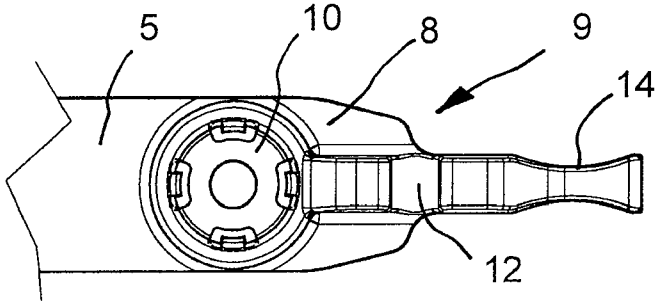

Fig. 6

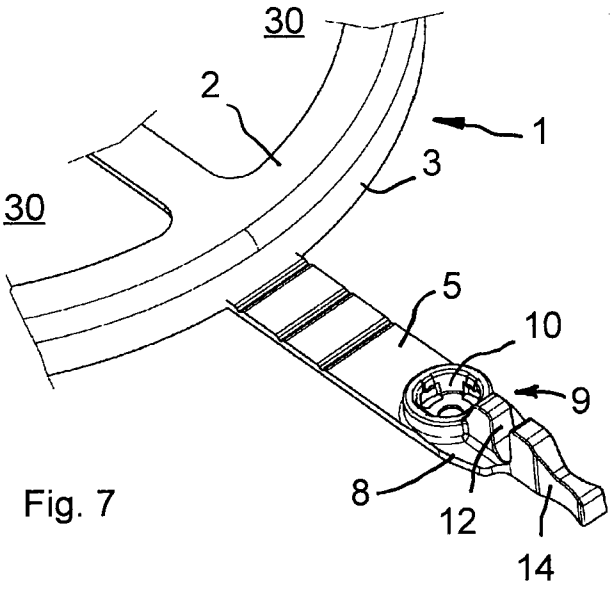

Fig. 7

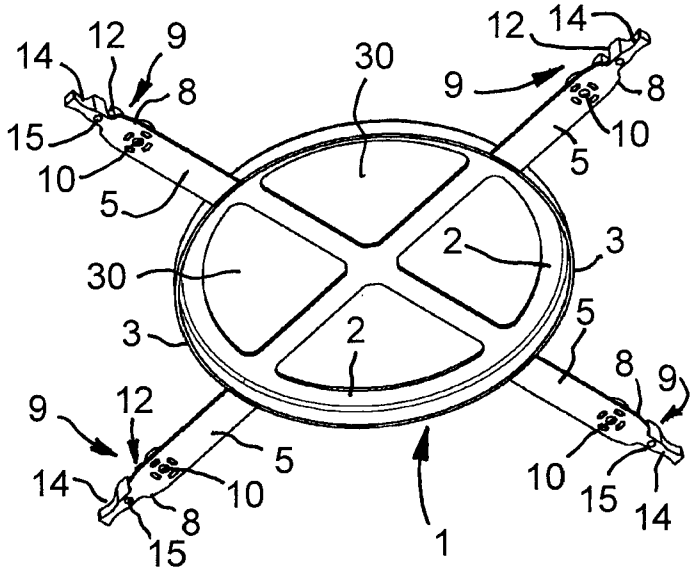

Fig. 8

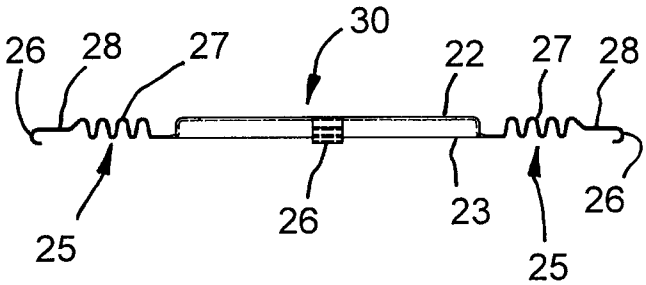

Fig. 9

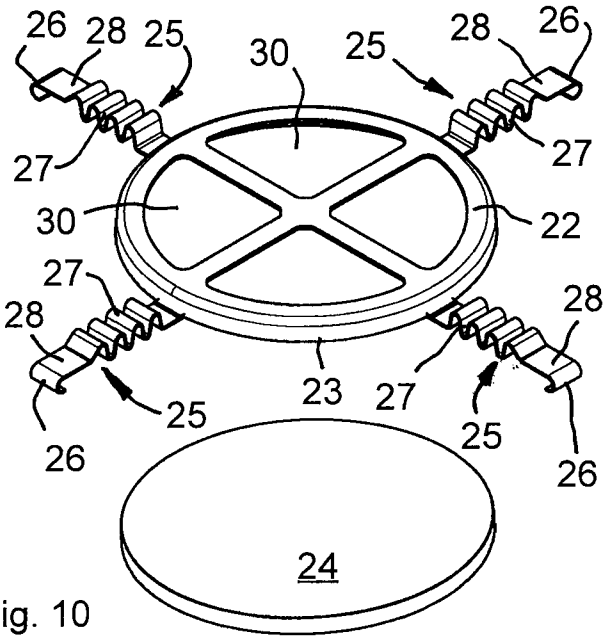

Fig. 10

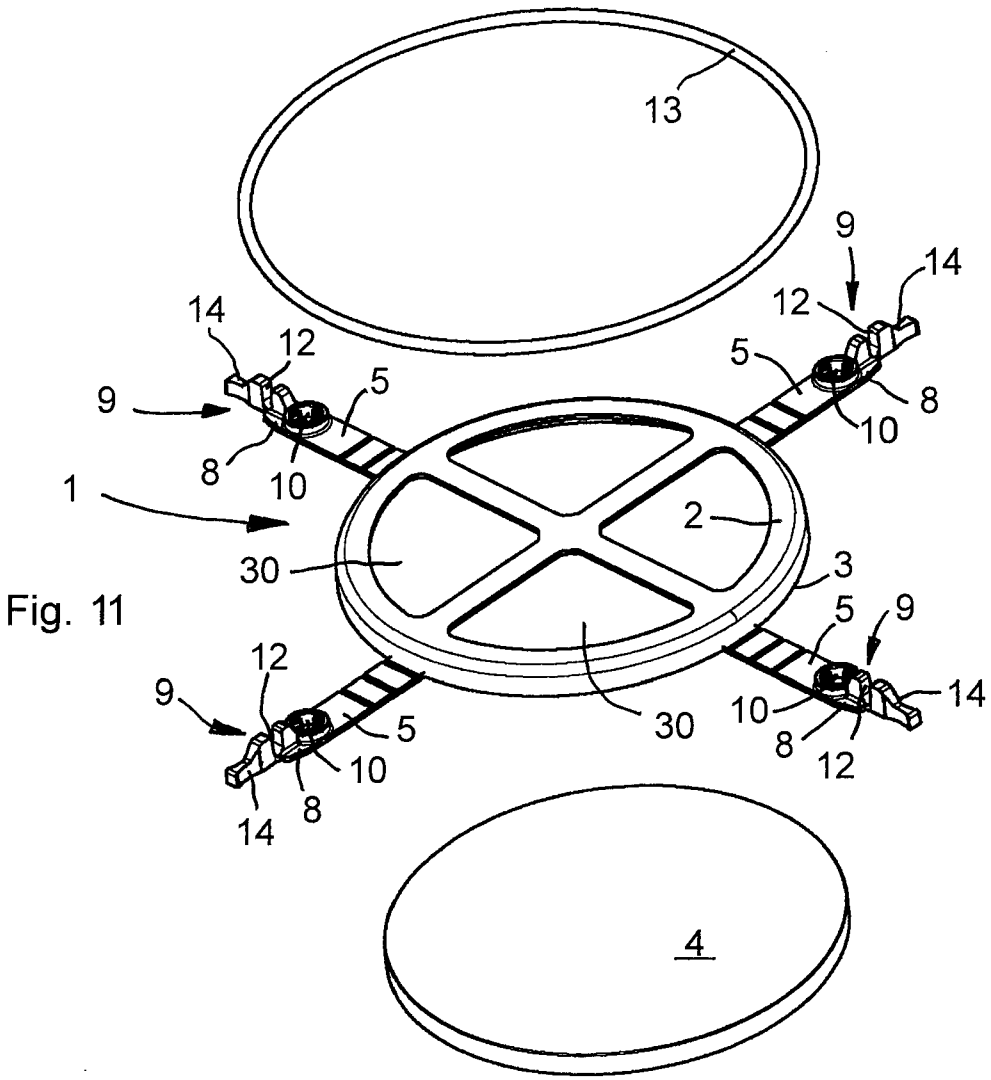

Fig. 11

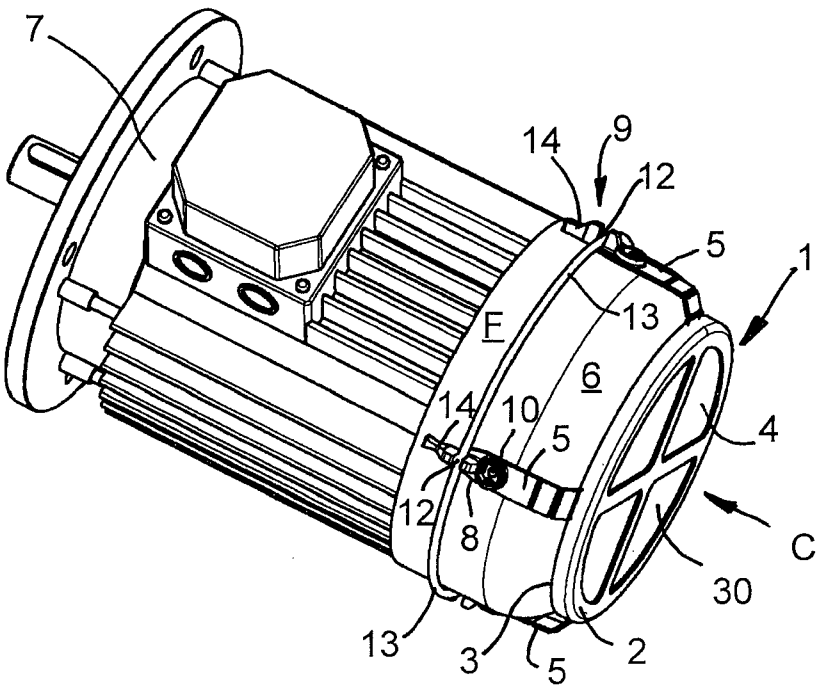

Fig. 12

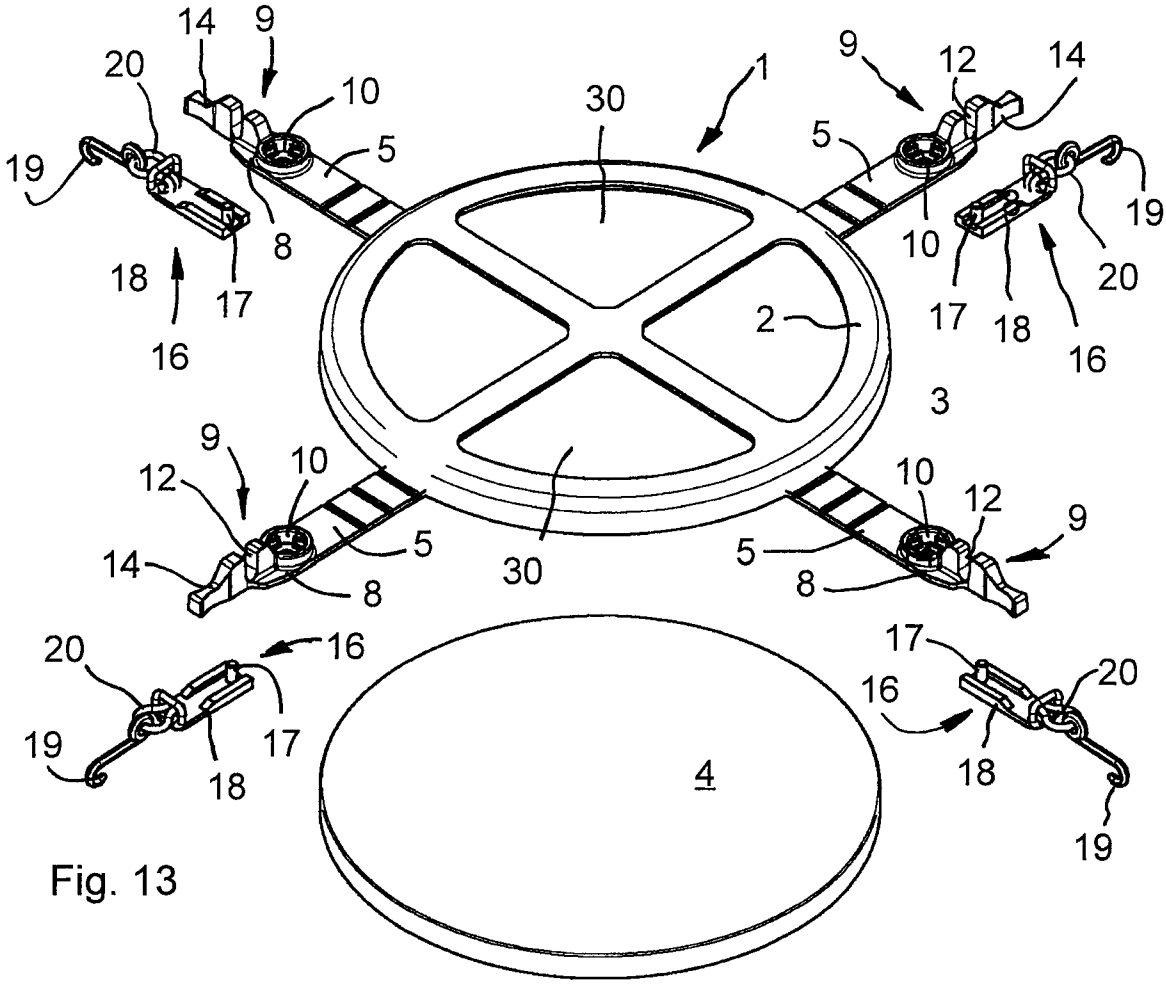
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Fig. 13

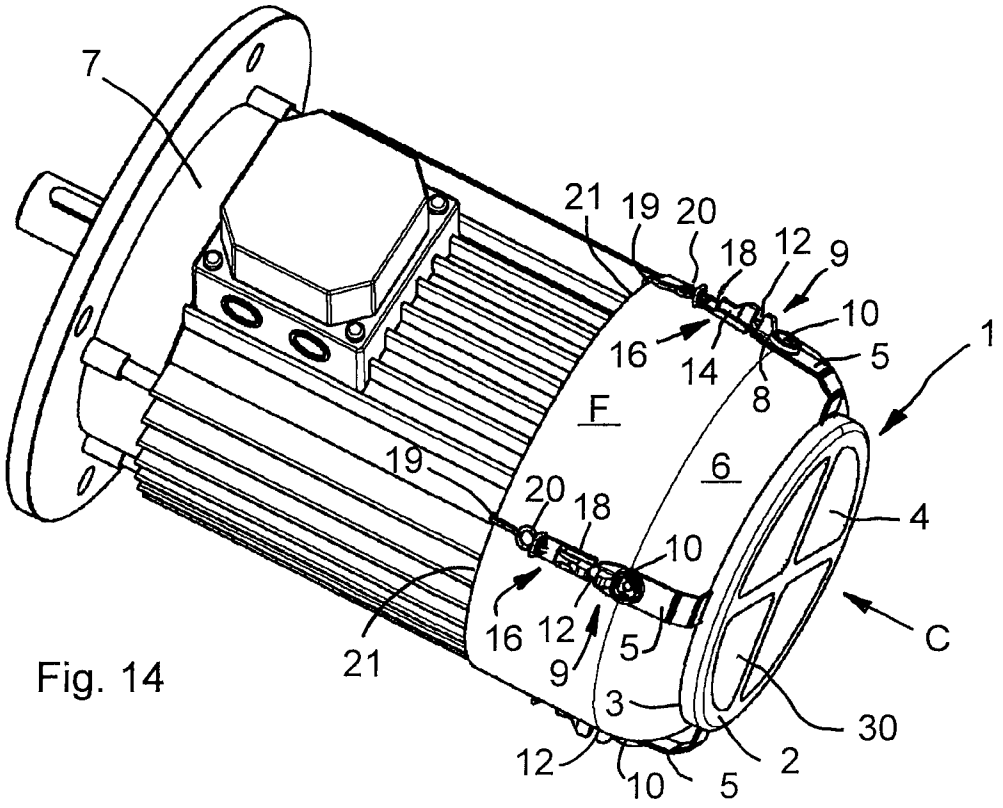
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Fig. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2016/000303

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02K9/14 H02K9/26 B01D46/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02K B01D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1 292 186 A (SEV MARCHAL [FR]; S E V MOTOROLA S A [FR]) 11 October 1972 (1972-10-11)	1,8-10
Y	page 2, line 63 - page 3, line 10; figures 1,2	2-7
Y	US 5 493 160 A (BOTTEN THOMAS J [US]) 20 February 1996 (1996-02-20) column 3, lines 29-38; figure 2	2
Y	US 4 826 512 A (FULLER CARMEL U [US]) 2 May 1989 (1989-05-02) column 4, line 63 - column 5, line 5	3
Y	US 2012/240540 A1 (METZGER MICHAEL [DE] ET AL) 27 September 2012 (2012-09-27) paragraphs [0048], [0049]	4-7

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 May 2017	29/05/2017

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IT2016/000303

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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