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(54)

ELECTRIC PUMP

- (57)

Electric pump (1) comprising a pump body (2) and a motor body (3), the motor body (3) comprising an enclosure (4) by means of which it is coupled to the pump body (2), a rotatable impeller (5), and an electric motor (20), the impeller (5) is arranged on one side of the enclosure (4) whereas the motor (20) is arranged on the other side, the electric motor (20) comprises a stator (6), at least one stator coil (6a) and a rotor (7) comprising a

shaft (7a) cooperating with the impeller (5), the electric pump (1) moreover comprises a cover (8) attached to the enclosure (4) such that a leak-tight chamber (9) is formed therein, the stator (6) and the stator coil/coils (6a) being arranged inside said leak-tight chamber (9), where- in the chamber (9) is filled with a thermally conductive material.

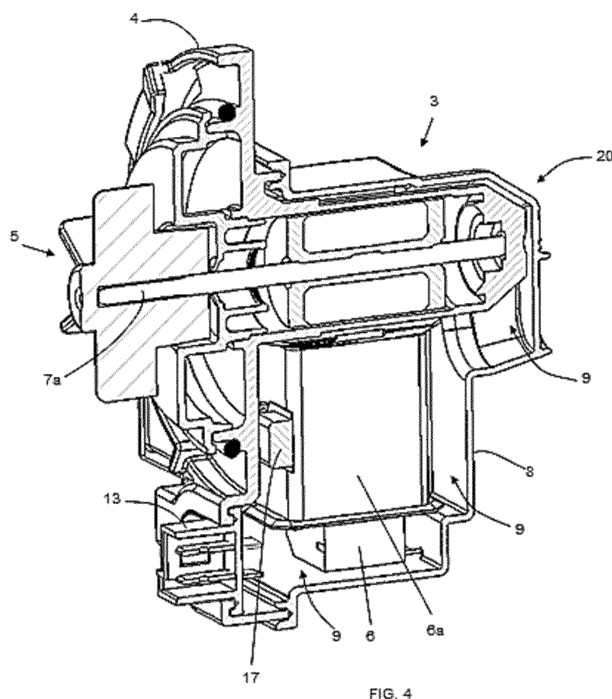


FIG. 4

Description

TECHNICAL FIELD

[0001] The present invention relates to electric pumps, and more specifically to pumps comprising a motor with at least one coil.

PRIOR ART

[0002] Using electric pumps to drive a fluid, usually water, is known. Such pumps are used in washing machines or dishwashers, for example, to drain, at the end of a washing cycle, the water contained in the washing drum or tub out or towards a recirculation conduit that introduces said water back in again for that it is treated again. In such pumps there are clearly two functional parts, the first refers to the part where the fluid is prepared so that it can be expelled through an expulsion element or impeller, and the second refers to the part where said element is made to rotate in order to allow driving said fluid.

[0003] Synchronous, preferably brushless, motors are normally used in such pumps, although asynchronous motors can also be used. A synchronous motor is a type of AC (alternate current) motor in which the rotation of the shaft of the rotor that moves the impeller is synchronized with the frequency of the supply current. The magnetic field required to make the shaft of the rotor rotate is generated by circulating an electric current through a coil arranged around the stator.

[0004] In that sense, ES1101080 U discloses a drain pump comprising a pump body, in connection with the hydraulic part, and a motor body, in connection with the motorized part of the pump. The motor body comprises an enclosure coupled to the pump body to close the pump at one end, an impeller arranged on one side of the enclosure and a synchronous motor arranged on the other side of the enclosure. The synchronous motor comprises a stator with a winding and a rotor with a shaft which is coupled to the impeller.

DISCLOSURE OF THE INVENTION

[0005] The object of the invention is to provide an electric pump, as defined in the claims.

[0006] The electric pump of the invention comprises a pump body and a motor body. The motor body comprises an enclosure by means of which it is coupled to the pump body, a rotatable impeller, and an electric motor, preferably synchronous one. The impeller is arranged on one side of the enclosure whereas the motor is arranged on the other side. The electric motor comprises a stator, at least one stator coil and a rotor comprising a shaft cooperating with the impeller.

[0007] The pump also comprises a cover attached to the enclosure such that a leak-tight chamber is formed therein. The stator and coil/coils are arranged inside the leak-tight chamber, and said chamber is filled with a ther-

mally conductive material.

[0008] The pump of the invention helps to improve thermal dissipation of heat losses of the electric motor such that the performance of the motor itself is improved because the reduction of the temperature of the winding as well as of other parts of the motor is optimized, making it possible to reduce the size of the electric motor, being able to save in materials.

[0009] The noise generated by the electric motor is also advantageously reduced as a result of the vibrations being dampened by the conductive material.

[0010] These and other advantages and features of the invention will become evident in view of the drawings and detailed description of the invention.

DESCRIPTION OF THE DRAWINGS

[0011]

Figure 1 shows a perspective view of a first embodiment of the electric pump according to the invention, with the pump body and the motor body uncoupled from one another.

Figure 2 shows a perspective view of the motor body of the pump of Figure 1.

Figure 3 shows a perspective view of the enclosure of the motor body of Figure 2.

Figure 4 is a sectional view of the motor body of Figure 2.

Figure 5 is a detail of the motor body of Figure 2.

Figure 6A is a sectional view of a motor body of an electric pump according to the invention comprising one embodiment of the bushing.

Figure 6B is another sectional view of a motor body of an electric pump according to the invention comprising another embodiment of the bushing.

Figure 7 shows a perspective view of a second embodiment of the motor body.

DETAILED DISCLOSURE OF THE INVENTION

[0012] The electric pump 1 according to a first embodiment of the invention comprises a pump body 2, in connection with the hydraulic part of the pump 1, and a motor body 3, in connection with the motorized part of the pump 1. The motor body 3 comprises an enclosure 4 by means of which said motor body 3 is coupled at one end of the pump body 2, enabling the closure thereof at said end. The other end of the pump body 2 is closed with a filter 2a which is arranged inside the pump body 2, as seen in Figure 1. The pump 1 also comprises an impeller 5 and

an electric motor, preferably a synchronous one. The impeller 5 is arranged on one side of the enclosure 4 whereas the electric motor is arranged on the other side, as shown in Figures 1 and 2. The motor of the invention, which is either single-phase or polyphase, comprises at least one assembly formed by a stator 6 and at least one stator coil 6a, and a rotor 7 comprising a shaft 7a cooperating with the impeller 5.

[0013] The pump 1 also comprises a cover 8 attached to the enclosure 4 in a leak-tight manner such that a leak-tight chamber 9 is formed therein. The stator 6 and the stator coil 6a are arranged inside the leak-tight chamber 9 and said chamber 9 is filled with a thermally conductive material, such that the heat generated in said motor, which is usually generated by the passage of an electric current, is quickly evacuated as it is transferred primarily by conduction to another point, usually into the atmosphere, thereby preventing the motor from overheating. This allows the stator coil 6a of the motor to work in a smaller temperature range, fully assuring compliance with the corresponding safety regulation.

[0014] On the other side, however, if working in the same temperature range is desirable, the pump 1 according to this first embodiment allows reducing the volume of the conductor of the stator coil 6a, i.e., less material in the stator coil 6a, reducing the material of the stator 6 (for example by designing a stator 6 that is less thick, etc.) also being possible, such that significant savings in material costs and a weight reduction can be achieved.

[0015] The current circulating through the stator coil 6a is inversely proportional to the impedance opposing the stator coil 6a itself, i.e., the wire of the stator coil 6a, the longer the length of the winding the more it opposes the passage of electric current, so current intensity is lower. Similarly, the shorter the length of the winding the less it opposes the passage of electric current, so current intensity is greater, but since the pump 1 of the invention dissipates heat losses quickly and efficiently, the motor is prevented from overheating, allowing the stator coil 6a to continue working in the same temperature range.

[0016] The pump 1 according to the first embodiment of the invention comprises a single coil 6a. Optionally, the pump 1 can also comprise several coils.

[0017] The electric motor 20 of the invention also operates quieter as a result of the conductive material dampening vibrations generated within the motor 20.

[0018] The thermally conductive material that is arranged in the leak-tight chamber 9 can be a fluid, preferably a liquid, gel or solid. Out of all the fluids used, use of air is not advised because the heat transfer due to convection provided by air is very slow.

[0019] In the preferred embodiment of the invention, the thermally conductive material is an oil which provides faster cooling (by convection and conduction) than the cooling produced exclusively by convection.

[0020] The stator coil 6a is arranged inside the leak-tight chamber 9 which is filled with oil, providing a cham-

ber 9 with lack of oxygen. Since there is a lack of oxygen, the galvanic corrosion of the wire of the stator coil 6a is avoided as well as the corrosion of any component disposed inside the leak-tight chamber 9. Indeed, in the hypothetical case that the motor 20 overheats, propagation of a possible flame would be avoided because this lack of oxygen.

[0021] Furthermore, in the preferred embodiment of the invention said thermally conductive material is a dielectric material which avoids having to isolate elements such as the stator coil 6a, the stator 6, etc.

[0022] In the preferred embodiment, the pump 1 of the invention further comprises a thermal protector 17, for example a bimetal switch, connected in series with the coil 6a and the power source of the electric motor 20 in a known manner. Said thermal protector 17 is configured to interrupt the current circulating through the coil 6a in case of overheating.

[0023] In the preferred embodiment, the thermal protector 17 is disposed inside the leak-tight chamber 9 as can be seen in Figure 4, and therefore it is in contact with the thermally conductive material. Advantageously, the thermal protector 17, since it is in contact with the thermally conductive material, is more sensitive to the temperature variations of the coil 6a and therefore is able to react faster to cut power to the motor 20 in an overheating event.

[0024] To ensure the leak-tight closure between the enclosure 4 and the cover 8, the enclosure 4 comprises a closure profile 4a, such as that shown in Figure 3, axially projecting from the side where the electric motor is arranged, and the cover 8 comprises in the contour of the free end an engagement profile 8a cooperating with the closure profile 4a of the enclosure 4, as shown in the detail of Figure 5.

[0025] In this embodiment of the invention, said engagement profile 8a comprises a U shape, such that the closure profile 4a of the enclosure 4 is introduced by means of form fitting, thereby being housed therein. However, to ensure leak-tightness in the entire attachment joint once the closure profile 4a has been fixed in the engagement profile 8a, in this first embodiment a sealing operation is carried out, for example by means of laser, welding, ultrasound, hot-ironing, gluing, siliconizing, etc. A leak-tight attachment is thereby ensured without having to use elastic joints.

[0026] Optionally, in a variant of this embodiment not shown in the drawings, between the closure profile 4a of the enclosure 4 and the engagement profile 8a of the cover 8 there is arranged an elastic joint assuring the leak-tight attachment between said closure profile 4a and said engagement profile 8a. The sealing process described in the preceding paragraph is thereby avoided.

[0027] As is known, an electric motor comprises terminals 12 enabling the connection of said motor to an external power source. In the preferred embodiment, the terminals 12 of the pump 1 of the invention are at least partly disposed inside the leak-tight chamber 9, prefera-

bly at least the part that is connected with the coil 6a and are therefore in contact with the thermally conductive material. In this way, in the event of a short circuit where a local overheat can be generated near the connection area of the terminals 12 and the coil 6a, the conductive material more readily dissipates the heat to reduce the likelihood of plastic deformation of surrounding plastic components and the occurrence of flame.

[0028] The enclosure 4 comprises, preferably in the front or rear lower part, an opening 11 that allows the passage of said terminals 12. In this embodiment of the invention, however, it is necessary to also seal said opening 11 so that the chamber 9 is actually leak-tight.

[0029] To that end, the pump 1 of the first embodiment of the invention comprises a bushing 13 arranged in said opening 11 in a leak-tight manner, as shown in Figure 4. In the preferred embodiment said bushing 13 is made of plastic, preferably rigid, which is attached to the enclosure 4 by carrying out a subsequent sealing operation around the periphery of the opening 11 as can be seen in more detail in figure 6A, for example by welding or gluing.

[0030] In order to seal the terminals 12, after sealing the bushing 13 and the opening 11 of the enclosure 4 in a leak-tight manner, the terminals 12 are assembled and then a resin is applied over the bushing 13 and the terminals 12, so that an elastic sealing 16 is formed and therefore the terminals 12 are sealed in a leak-tight manner.

[0031] Alternatively, in another embodiment of the invention in which a subsequent sealing operation is not necessary, the bushing 13, which is also arranged in said opening 11 in a leak-tight manner, comprises an elastic part, referred to as sealing bushing 13', which is arranged at the end of the bushing 13 that is arranged close to the electric motor 20, as shown in the detail of Figure 6B. Said sealing bushing 13' comprises an elastic area cooperating with the opening 11. In this embodiment of the invention, said elastic area is in contact with the inner face of the opening 11, as seen in Figure 6B. To ensure the leak-tight closure with the opening 11 of the enclosure 4, the elastic area cooperating with the edge of the opening 11 of the bushing 13 comprises close to the end an elastic profile 15 having a larger section in the entire area of contact with the opening 11. When the bushing 13 is introduced in the opening 11, the elastic profile 15 is deformed and applies pressure against the inner face of the opening 11. For the sake of clarity, the elastic profile 15 is shown arranged in the opening 11 of the enclosure 4, but without deforming so that the initial shape of said elastic profile 15 can be seen better. Optionally, an elastic joint can also be arranged between the bushing 13 and the opening 11.

[0032] The sealing bushing 13' of this alternative embodiment also comprises a constricted and elastic area 14 for each terminal 12, depicted in Figure 6B, cooperating with the corresponding terminal 12 in a manner that the terminals 12 pass through therein. The side 21

through which the corresponding terminal 12 must be introduced is the wider side so as to make guiding the terminal 12 easier. The opposite side, i.e. the side through which the terminal 12 exits, is sized so that it is able to close up around the corresponding terminals 12. In the non-limiting example of the invention, said opposite side closes up, forming a thin membrane 22 that breaks when the corresponding terminal 12 is introduced, such that when the terminal 12 is introduced the narrowest area of said constricted area 14 comes into contact with said terminal 12, also applying pressure against the terminal 12.

[0033] In any of the embodiments, the bushing 13 is interchangeable, therefore it can be adapted to different types and positions of the terminals 12, allowing greater versatility of the pump 1, because it is adaptable to different types of electrical connections.

[0034] In a preferred embodiment of the invention, the cover 8 is formed by a single part but it is not ruled out that the cover 8 can comprise several parts attached to one another in a leak-tight manner to form the cover 8, or that it even comprises a single part but with different materials. This latter variant can be useful, for example, in obtaining a cover 8 with different materials and geometries that help to direct and optimize outward heat transfer.

[0035] The cover 8 of the pump 1 of the invention is preferably made of the same material as the enclosure 4, being made of plastic, preferably polypropylene, in the non-limiting example of the embodiment of the invention. As already mentioned in the preceding paragraph, is it not ruled out that the cover 8 may comprise more than one material either.

[0036] In another embodiment of the invention in which the invention differs from the first embodiment only with respect to the external configuration of the cover 8, said cover 8 comprises in its outer contour a plurality of fins 10 projecting in perpendicular, as shown in Figure 7, such that the surface of contact, usually with the atmosphere, increases. This configuration allows further accelerating cooling, i.e., heat transfer, of the electric motor of the pump 1 of the invention because on one hand, heat is quickly evacuated from the motor by conduction as a result of the conductive material arranged in the leak-tight chamber 9, and on the other hand the evacuation of said heat is optimized by convection into the atmosphere.

[0037] Such pumps, like the one described for the invention, are used for moving or driving a fluid, preferably water, and are normally used in dry environments. An application of this type can be, for example, in drain pumps or recirculation pumps in home appliances, such as a washing machine or a dishwasher, or in driers.

[0038] However, since in the pump 1 of the invention the chamber 9 in which the stator 6 and the stator coil 6a are housed is leak-tight, use of the pump 1 in another type of environments is enabled, such as in environments with a high level of humidity, it also being possible for the

pump 1 of the invention to work immersed in a liquid. Therefore, the pump 1 of the invention is also suitable for being used in fish tanks, aquariums or similar devices.

Claims

1. Electric pump comprising a pump body (2) and a motor body (3), said motor body (3) comprising an enclosure (4) whereby it is coupled to the pump body (2), a rotatable impeller (5) arranged on one side of said enclosure (4), and an electric motor (20) arranged on the other side of the enclosure (4) comprising a stator (6), at least one stator coil (6a) and a rotor (7), said rotor (7) comprising a shaft (7a) cooperating with the impeller (5), **characterized in that** it also comprises a cover (8) attached to the enclosure (4) so that a leak-tight chamber (9) is formed therein, the stator (6) and the coil (6a) being arranged inside said leak-tight chamber (9), and said leak-tight chamber (9) being filled with a thermally conductive material.
2. Electric pump according to claim 1, wherein said thermally conductive material is a fluid, preferably a liquid, gel or solid.
3. Electric pump according to claim 2, wherein said material is an oil, preferably vegetable oil.
4. Electric pump according to any of the preceding claims, wherein said material is dielectric material.
5. Electric pump according to any of the preceding claims, wherein said thermally conductive material is in contact with the stator coil (6a).
6. Electric pump according to any of the preceding claims, wherein the enclosure (4) comprises a closure profile (4a) axially projecting from the side where the electric motor (20) is arranged, the cover (8) comprising in the contour of the free end an engagement profile (8a) cooperating with the closure profile (4a) of the enclosure (4).
7. Electric pump according to claim 6, wherein the engagement profile (8a) of the cover (8) comprises a U shape for housing the closure profile (4a) therein.
8. Electric pump according to claim 6 or 7, wherein the closure profile (4a) of the enclosure (4) and the engagement profile (8a) of the cover (8) are fixed by pressure and attached to one another in a leak-tight manner after carrying out a subsequent sealing operation.
9. Electric pump according to claims 6 or 7, wherein an elastic joint is arranged between the closure profile (4a) of the enclosure (4) and the engagement profile (8a) of the cover (8), ensuring a leak-tight attachment between said closure profile (4a) and said engagement profile (8a).
10. Electric pump according to any of the preceding claims, wherein the enclosure (4) comprises an opening (11), preferably in the front or rear lower part, to allow the passage of the terminals (12) of the electric motor (20), a bushing (13) being housed in said opening (11) in a leak-tight manner, also sealing the terminals (12) in a leak-tight manner.
11. Electric pump according to claim 10, wherein said bushing (13) comprises a sealing bushing (13') comprising an elastic area cooperating with the edge of the opening (11) and a constricted and elastic area (14) for each terminal (12) cooperating with the corresponding terminal (12).
12. Electric pump according to claim 11, wherein the elastic area cooperating with the edge of the opening (11) of the bushing (13) comprises close to the end an elastic profile (15) having a larger section in the entire area of contact with the opening (11) for sealing said opening (11) in a leak-tight manner.
13. Electric pump according to claims 10 to 12, wherein a bushing (13) is housed in said opening (11) in a leak-tight manner after being carried out a subsequent sealing operation as for example by welding or gluing, the bushing (13) comprising an elastic sealing (16) being formed by applying a resin over the bushing (13) and the terminals (12), wherein said elastic sealing (16) cooperates with the terminals (12) such that the terminals (12) are sealed in a leak-tight manner.
14. Electric pump according to any of claims 10 to 13, wherein at least part of each terminal (12) is disposed inside the leak-tight chamber (9), preferably at least the part that is connected with the coil (6a), being therefore in contact with the thermally conductive material.
15. Electric pump according to any of the preceding claims, wherein the cover (8) comprises in its outer contour a plurality of fins (10) projecting perpendicularly.
16. Electric pump according to any of the preceding claims, wherein the cover (8) is made of plastic, preferably polypropylene, and/or of the same material as the enclosure (4).
17. Electric pump according to any of the preceding claims, further comprising a thermal protector (17) connected with the coil (6a), said thermal protector

(17) being disposed inside the leak-tight chamber
(9) and therefore being in contact with the thermally
conductive material.

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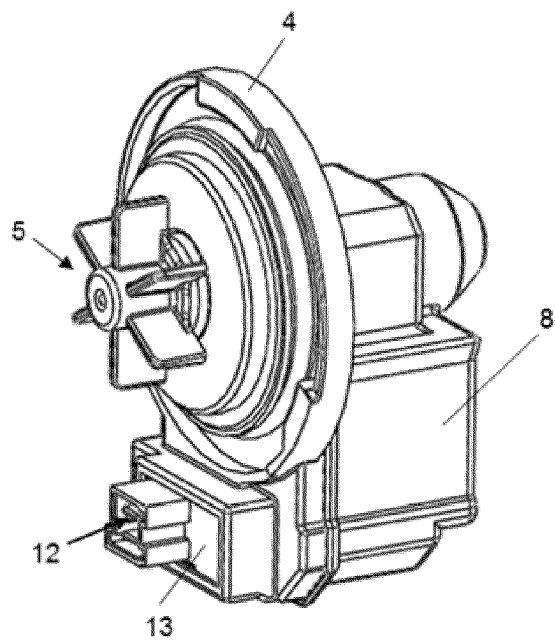
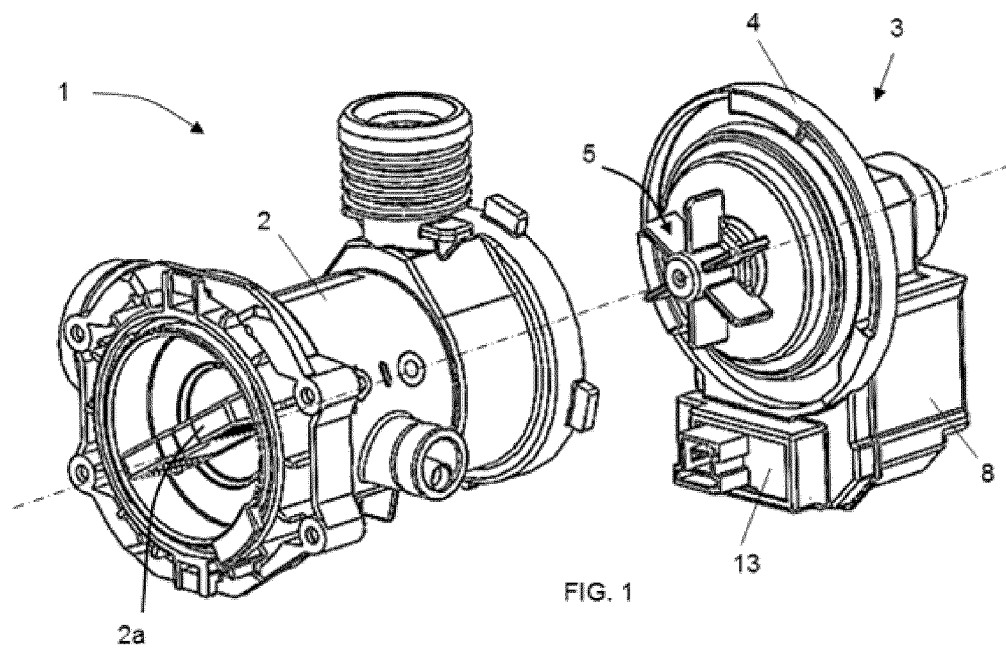
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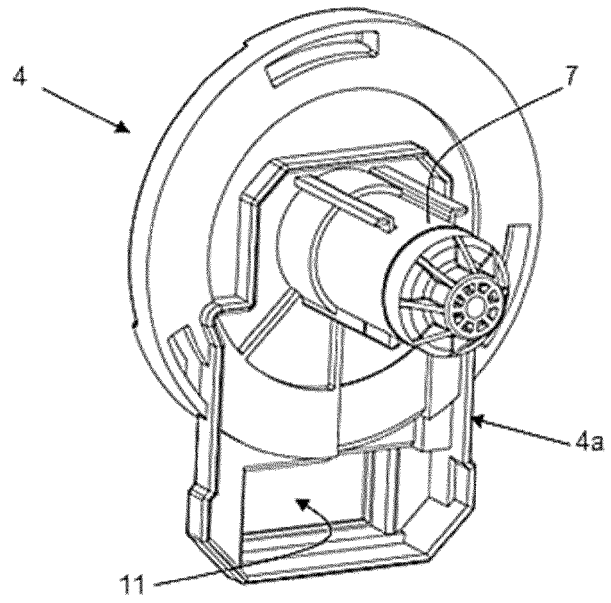


FIG. 3

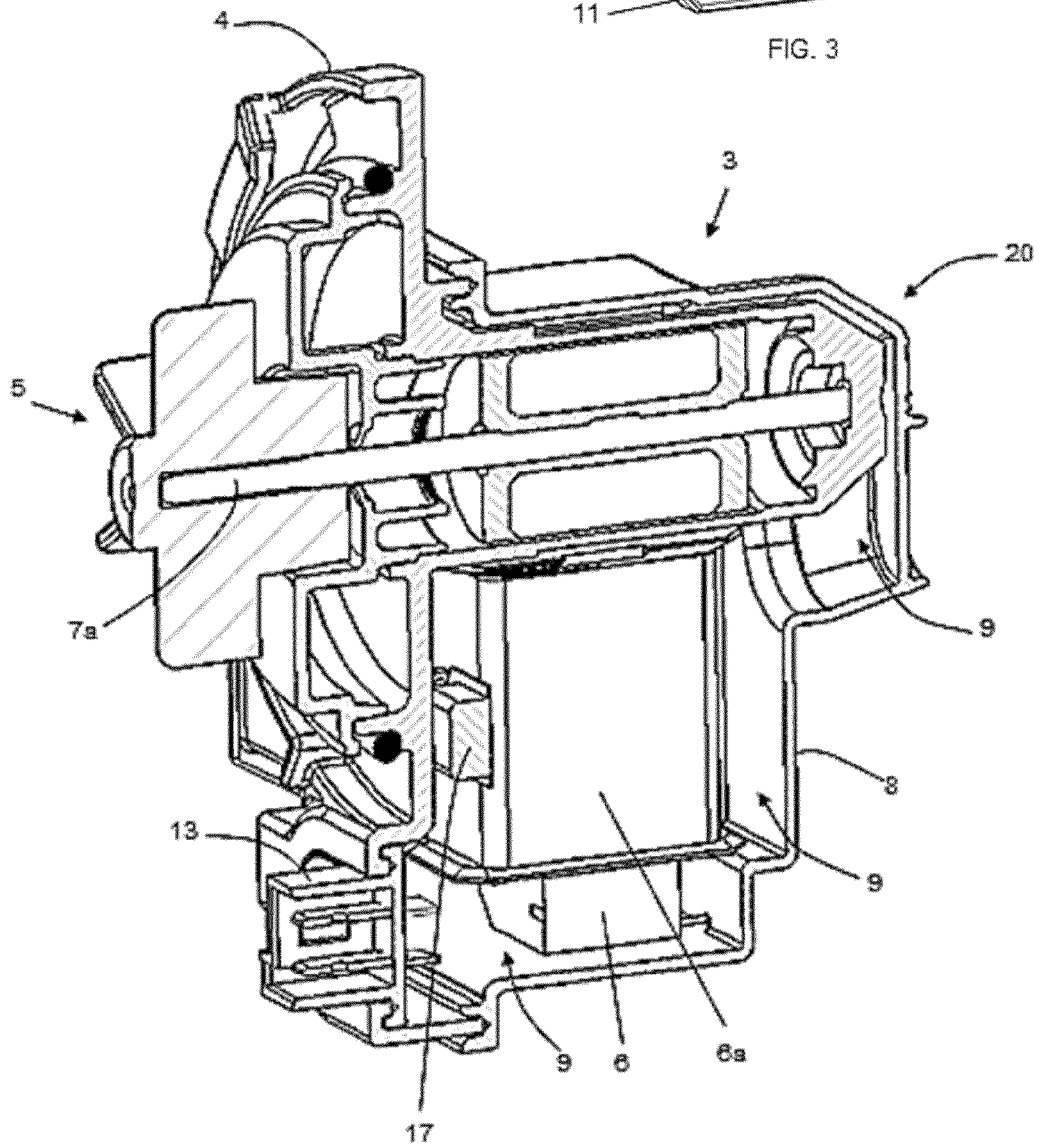


FIG. 4

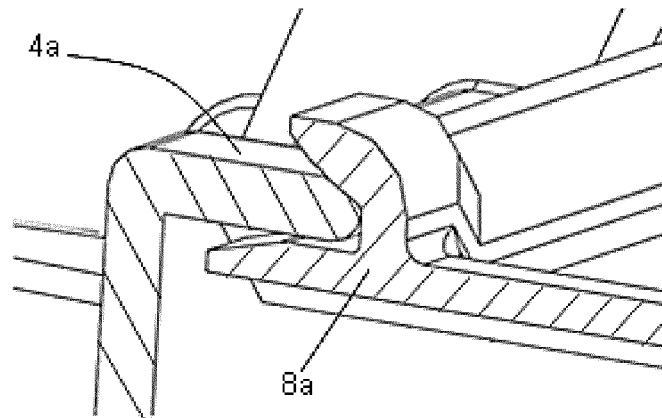


FIG. 5

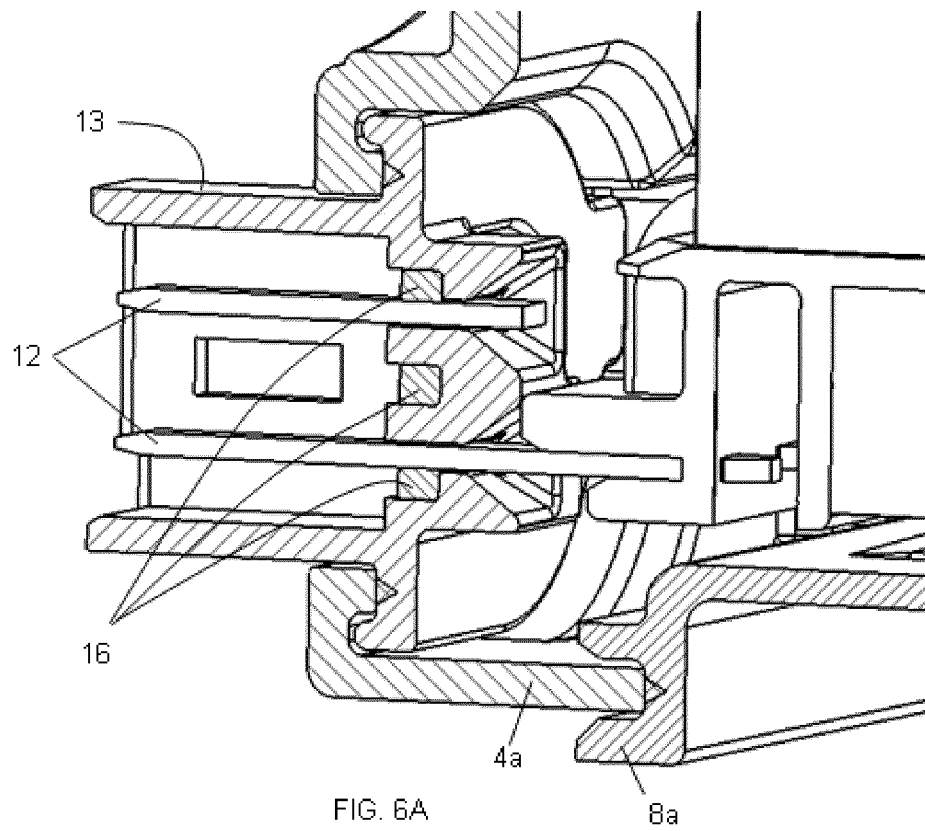


FIG. 6A

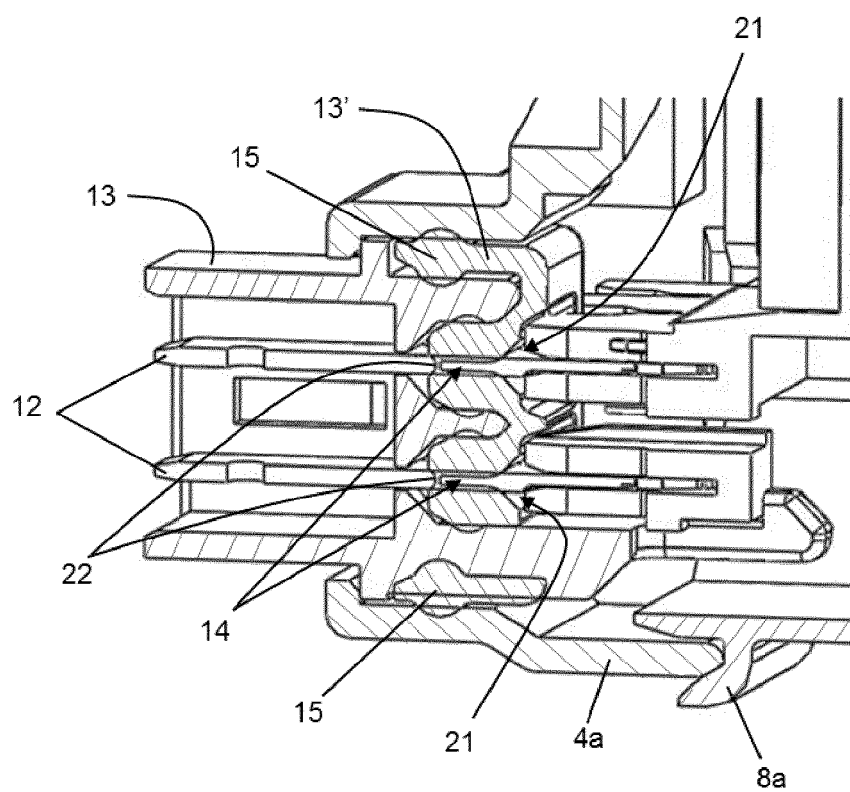


FIG. 6B

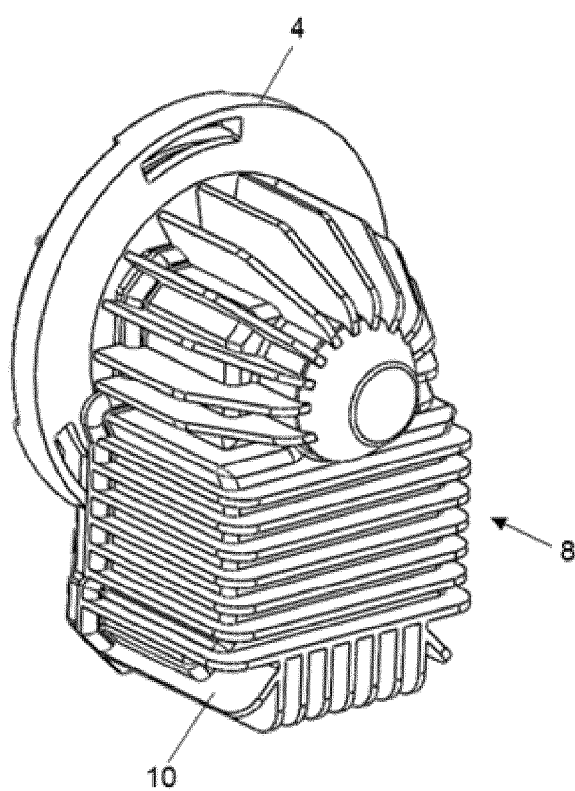


FIG. 7



EUROPEAN SEARCH REPORT

Application Number
EP 16 15 1193

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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 4 May 2016	Examiner Clivio, Eugenio
CATEGORY OF CITED DOCUMENTS 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 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 & : member of the same patent family, corresponding document			

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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