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(54) GRINDING TOOL

(57) A grinding tool, comprising: a motor having a rotating shaft, a motor housing accommodating the motor, a main shaft driven by the motor and extending in a direction intersecting the rotating shaft, a gear transmission mechanism which transmits rotation of the rotating shaft of the motor to the main shaft, a tip tool mounted on

the main shaft, and a gear box mounted in front of the motor housing and used to receive the gear transmission mechanism, the gear housing being formed of a metal insert overmoulded with a plastic material. The gear housing of the grinding tool of the present invention has reduced weight and good heat dissipation.

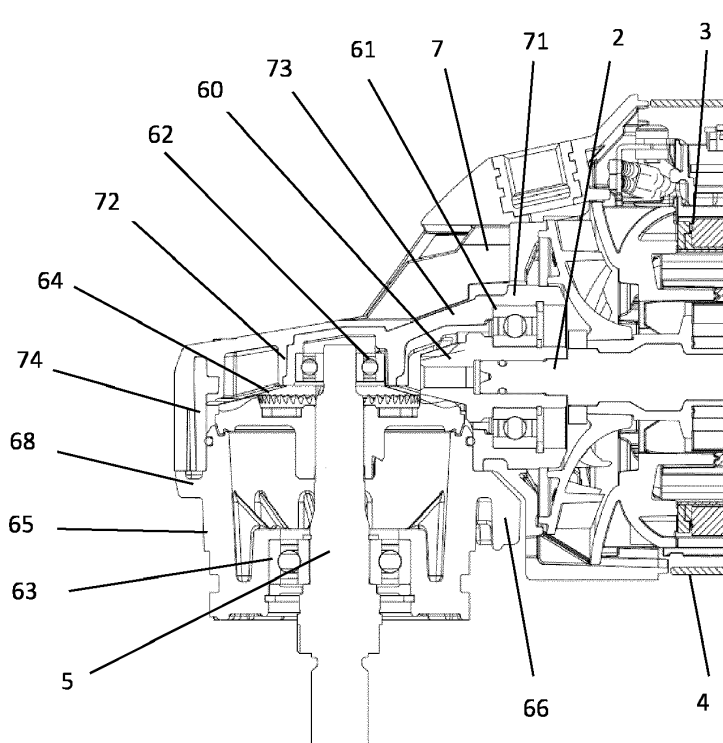


Fig.1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a grinding tool, in particular to a grinding tool for grinding a workpiece material, which grinds a workpiece by causing a tip tool to rotate.

BACKGROUND ART

[0002] For large hand-held grinding tools such as heavy-duty angle grinders, weight is a crucial consideration for giving users a good ergonomic experience. At present, the gear housing of such a grinding tool is usually made of a die-cast metal casing, such as aluminium alloy, to ensure that the gear housing has sufficient strength. However, when the size of the body of the grinding tool or the movable grinding wheel increases, the weight increases, resulting in increased load on the user's hands and arms, which thus become fatigued. In addition, a gear housing made of metal has high thermal conductivity and therefore transmits heat very easily, so the user's hands may experience discomfort. In addition, due to the ever-increasing price of metal raw materials, the manufacturing cost of grinding tools remains high.

SUMMARY OF THE INVENTION

[0003] It is an object of the present invention to provide a grinding tool in which the gear housing of the grinding tool has reduced weight and good heat dissipation.

[0004] The present invention provides a grinding tool comprising a motor having a rotating shaft, and a motor housing accommodating the motor. A main shaft is driven by the motor and extends in a direction intersecting the rotating shaft. A gear transmission mechanism transmits rotation of the rotating shaft of the motor to the main shaft. A tip tool is mounted on the main shaft, and a gear box is mounted in front of the motor housing and used to receive the gear transmission mechanism. The gear housing is formed of a metal insert overmoulded with a plastic material. According to the invention, the gear housing, traditionally formed of metal, is now formed of a metal insert overmoulded with plastic, thus reducing the weight of the grinding tool and reducing the load on the user's hands and arms, so that fatigue is reduced when operating the grinding tool. In addition, when the user's hand comes into contact with a gear box cover, the contacted part is made of a plastic or composite material with low thermal conductivity, so the temperature change of the gear box cover is very small and will not cause the user to be accidentally burned when operating the grinding tool.

[0005] According to an embodiment of the present invention, the gear transmission mechanism comprises a driving gear connected to the rotating shaft and at least one driven gear meshed with the driving gear. The driving gear is supported in the gear housing by means of a first

bearing. The main shaft passes through the centre of the driven gear and is supported in the gear housing by means of at least one second bearing. The metal insert comprises a first bearing seat for supporting the first bearing and a second bearing seat for supporting the second bearing. The metal insert forms the main functional parts of the gear housing, such as the bearing seats supporting the bearings. These functional parts often require high processing precision and good thermal conductivity. The fact that the metal insert forms the bearing seats supporting the bearings can ensure high dimensional precision and good thermal conductivity of interface components; for other non-interface parts, a plastic or composite material is used to overmould the metal insert, so there is no need for a subsequent process of fitting plastic parts to the metal insert. Thus, cumbersome process steps are reduced, and the strength is sufficient.

[0006] The metal insert further comprises an annular part surrounding the driven gear circumferentially. For grinding tools, the motor rotating shaft as the driving means drives the driving gear to rotate at high speed; the driving gear meshes with the driven gear to make the driven gear rotate around the centre of the main shaft. Therefore, there must be a certain gap between a circumferential surface of the driven gear and the gear housing, and at the same time, the driven gear must be protected from accidental damage. Moreover, heat is generated during the meshing and rotation of the driving gear and driven gear, and the bearings. Thus, the annular part of the metal insert can ensure very effectively the dimensional precision between the housing the driven gear, and the gear housing has sufficient rigidity and good heat dissipation.

[0007] The first bearing seat is arranged in the axial direction of the rotating shaft, and a front end thereof is joined to an outer peripheral face of the annular part. In this way, the metal insert essentially covers the parts of the driving gear and driven gear in the gear transmission mechanism for which it is most necessary to ensure processing precision and heat dissipation, while other parts are overmoulded from plastic or composite material, thereby ensuring the functionality of the gear housing while reducing the weight of the casing.

[0008] An upper edge of the annular part is provided with ribs extending towards the second bearing seat.

[0009] The gear transmission mechanism further comprises a flange cover arranged below the driven gear and connected to the bottom of the gear housing, the flange cover being substantially cylindrical with a hollow cavity, the driven gear being pre-fitted to the top of the flange cover, a main bearing being mounted in the cavity, and an upper part of the flange cover being at least partially in contact with the annular part. In the present invention, the main shaft of the grinding tool is actually jointly supported by the second bearing arranged at the upper end of the main shaft and the main bearing arranged below the driven gear. The second bearing is securely mounted in the gear housing, the main bearing is securely

mounted in the flange cover, and the flange cover is connected to the bottom of the gear housing, thereby ensuring the coaxiality of the second bearing and the main bearing, so as to ensure that the main shaft will not deviate from its central axis during operation. Moreover, the flange cover at least partially contacts a lower edge of the annular part, so the heat generated during operation of the gear transmission mechanism can be transmitted from the inside of the gear housing to the outside.

[0010] An outer peripheral face of the flange cover is at least partly provided with cooling fins. The cooling fins can be arranged on a side close to the motor housing. The side close to the motor housing is near an outlet for a cooling airflow of the grinding tool, so the cooling fins can be partially or completely exposed to the cooling airflow to maximize the cooling function.

[0011] The metal insert is integrally formed. In this way, the metal insert can be directly placed into the injection mould for overmoulding; this makes the gear housing forming process steps simple and convenient. The injection moulded part is ready when it exits the mould and may also be reprocessed to form a final product. Furthermore, the combination of the metal insert and overmoulded plastic makes it possible to reduce manufacturing costs compared to a light alloy gear housing.

[0012] According to another embodiment of the present invention, the gear housing further comprises at least one threaded seat; the threaded seat is also made of metal, and overmolded with plastic together with the metal insert. In addition to the part that serves as an interface with the gear transmission mechanism, the gear housing also comprises interfaces for connecting external components (e.g. a side handle, an auxiliary handle, etc.). Such an interface is usually a threaded seat, and the external component can be conveniently and stably connected to the gear housing by threaded connection. These threaded seats should also be formed of metal in advance, put into the injection mould together with the metal insert, and then overmoulded with plastic.

[0013] The threaded seat is arranged at the top and/or left and right sides of the gear housing, and used for connecting a side handle. Thus, the choice can be made to mount the side handle in a desired position according to the user's preference and the application scenario.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] A better understanding of the embodiments mentioned can be gained from the following detailed description with reference to the drawings. It is emphasized that various components are not necessarily drawn to scale. In fact, dimensions may be increased or decreased at will for the purpose of clear description. In the drawings, identical reference numerals denote identical elements.

Fig. 1 is a partial sectional view of the grinding tool of the present invention;

Fig. 2 is a schematic diagram of the gear housing of grinding tool of the present invention;

Fig. 3 is a schematic diagram of the metal insert and threaded seats of the gear housing of the grinding tool of the present invention;

Fig. 4 is a schematic diagram of the gear transmission mechanism and main shaft of the grinding tool of the present invention;

Fig. 5 is a bottom view of the gear transmission mechanism and main shaft shown in Fig. 4, when installed in the gear housing.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The grinding tool of the present invention is described below with reference to Figs. 1 - 5. The following description is merely exemplary and does not limit the disclosed content of the present application or the applications or uses of the present invention. The terms "front", "rear", "above...", "below...", "left" and "right" in the present invention are used throughout this Description to define various components of the grinding tool when arranged in an orientation in which it is desired to be used, such as the orientation shown in Fig. 1.

[0016] Fig. 1 shows a partial sectional view of a nose part of a grinding tool 1. The grinding tool 1 comprises a motor 3 having a rotating shaft 2; a motor housing 4 for accommodating the motor 3; a main shaft 5 driven by the motor 3 and extending in a direction intersecting the rotating shaft 2; a gear transmission mechanism 6, which transmits rotation of the rotating shaft 2 of the motor 3 to the main shaft 5; a tip tool (not shown) mounted on the main shaft 5; and a gear housing 7, which is mounted in front of the motor housing 4 and used to receive the gear transmission mechanism 6 and the main shaft 5. The rotating shaft 2 of the motor 3 extends substantially in the front-rear direction of the grinding tool 1, and when the motor 3 is activated, the rotating shaft 2 is driven to rotate at high speed around its axial extension direction.

[0017] The gear transmission mechanism 6 comprises a driving gear 60 directly or indirectly connected to the rotating shaft 2, at least one driven gear 64 meshed with the driving gear, and a flange cover 65 arranged below the driven gear 64 and connected to the bottom of the gear housing.

[0018] According to an embodiment of the present invention, the driving gear 60 is a conical pinion extending in the axial direction of the rotating shaft, and the driving gear 60 is press-fitted round the front end of the rotating shaft 2 in an interference fit. The driven gear 64 is arranged perpendicularly relative to the axial direction of the rotating shaft 2, i.e. the central axis of the driven gear extends in the vertical direction. A top face of the driven gear 64 has an oblique tooth part, meshed with bevel teeth of the driving gear 60. The driven gear can be a

bevel gear. The main shaft 5 passes through the centre of the driven gear, and there is an interference fit between the main shaft 5 and the driven gear 64. Furthermore, an upper end of the main shaft 5 is supported in the gear housing 7 by means of a second bearing 62.

[0019] The flange cover 65 is substantially cylindrical with a hollow cavity 67. The driven gear 64 is pre-fitted to the top of the flange cover 65, and the main bearing 63 is mounted in the cavity 67. The main shaft 5 is jointly supported by the second bearing 62 arranged at the upper end of the main shaft, and the main bearing 63 which is coaxial with the second bearing and arranged below the driven gear. The second bearing 62 is securely installed in the gear housing, the main bearing 63 is securely installed in the flange cover, and the flange cover 65 is fixedly connected to the gear housing 7, so that one end of the main shaft 5 is supported by the second bearing 62, and the other end of the main shaft 5 is supported by the main bearing 63, so as to ensure that the main shaft 5 will not deviate from its rotation centre during operation. Thus, the gear transmission mechanism 6 converts the high-speed rotational drive of the motor rotating shaft 2 in the front-rear direction into low-speed rotational output of the main shaft 5 in the vertical direction. In alternative embodiments, other angular transmission apparatuses 33 are also considered, e.g. a worm gear transmission apparatus or a spur gear transmission apparatus.

[0020] Fig. 2 shows the gear housing 7 in one embodiment of the present invention. The gear housing 7 of the present invention has substantially the same shape as a conventional metal housing, the difference being that the gear housing 7 of the present invention is formed of a metal insert 70 and a plastic part 75 overmoulded on the metal insert 70. The grinding tool of the present invention achieves a significant weight reduction by using plastic or any composite material instead of metal as much as possible. Especially for large grinding tools, the potential for gear housing weight reduction is in the range of about 50%, or between 150 g and 250 g, which is very significant for a tool with a total weight of 5 - 7 kg. In addition, when a user touches on an upper part of the gear housing with his palm, the part in contact with the palm is made of plastic with low thermal conductivity, so the exterior temperature of the gear housing changes very little during operation, and the user will not be burned or experience discomfort as a result of accidentally touching a gear housing with an excessively high temperature; thus, the grinding tool is safer to operate. In addition, the resin material of a gear cover makes it possible to reduce the production cost compared to a light alloy gear cover.

[0021] Referring to Figures 2 and 3, the metal insert 70 is an integrally formed finished part.

[0022] Preferably, the metal insert is made of a light alloy material such as aluminium alloy or magnesium alloy, so as to ensure that the metal insert has sufficient strength and a relatively light weight. The integrally formed metal insert 70 may be directly placed into an

injection mould, then a plastic or composite material is injected for overmoulding; this makes the gear housing forming process steps simple and convenient. The injection moulded part is ready when it exits the mould, and may also be reprocessed to form a final product. Through the use of a forming process in which an insert is overmoulded by injection, the present invention omits a process step of fitting together a metal component and a plastic component, thus greatly increasing the convenience of gear housing manufacturing. Moreover, the plastic used for overmoulding the metal insert may be selected to have different colours and properties, to give the product more character with regard to colour, and saves a downstream process like colouring or coating.

[0023] According to an embodiment of the present invention, the metal insert 70 comprises a first bearing seat 71 for supporting the first bearing 61, a second bearing seat 72 for supporting the second bearing 62, and an annular part 74 surrounding the driven gear 64 circumferentially. The first bearing seat 71 extends in the axial direction of the rotating shaft, and the front end thereof is joined to a outer peripheral face of the annular part 74. Preferably, an upper edge of the annular part 74 is provided with ribs 73 extending towards the second bearing seat 72. The outer peripheral face of the annular part may also be provided with screw fixation holes 76 for engaging with fasteners of the flange cover 65.

[0024] The metal insert 70 forms the main functional parts of the gear housing 7, for example the bearing seat supporting the bearing, because these functional parts often require high processing precision and good thermal conductivity. The metal insert 70 forms the main functional parts of the gear housing 7 to ensure sufficient rigidity, high dimensional precision and good thermal conductivity of components which serve as an interface with the gear transmission mechanism 6. For other non-interface parts, a plastic or composite material is used to overmould the metal insert, to reduce the weight of the gear housing 7.

[0025] In the grinding tool 1, the gear transmission mechanism 6 converts the high-speed rotational drive of the motor into the rotational output of the main shaft 5, thus driving the tip tool to rotate to perform a grinding operation. There must be a certain gap between a circumferential face of the driven gear 64 and an inner cavity of the gear housing, and at the same time, the driven gear must be protected from accidental damage; thus, as a component of the gear housing 7 that serves as an interface with the circumferential face of the driven gear, the annular part 74 of the metal insert of the present invention ensures dimensional precision between the gear housing and the driven gear 64, and gives the gear housing 7 sufficient rigidity.

[0026] As shown in Fig. 1, the front end of the driving gear 60 is a conical tooth part, and the rear end of the driving gear 60 is fitted round the front end of the rotating shaft 2 in an interference fit or form fit. The first bearing 61 is fitted round the shaft behind the conical tooth part of the

driving gear 60, and the first bearing 61 is installed in the first bearing seat 71 in an interference fit, so as to ensure that the driving gear 60 will not deviate from its centre of rotation when driven to rotate by the rotating shaft, and is able to apply sufficient driving torque to the driven gear to realize gear transmission.

[0027] The first bearing seat 71 extends in the axial direction of the rotating shaft 2, and the front end thereof is joined to the outer peripheral face of the annular part 74. In this way, the metal insert 70 essentially covers the parts of the driving gear and driven gear in the gear transmission mechanism for which it is most necessary to ensure processing precision and heat dissipation, while other parts are overmoulded from plastic or composite material, thereby ensuring the functionality of the gear housing while reducing the weight of the housing.

[0028] As mentioned above, there is an interference fit between the main shaft 5 and the driven gear 64, and the main shaft 5 is supported by coaxially arranging the second bearing 62 and main bearing 63. The second bearing 62 located at the upper end of the main shaft 5 is securely installed in the second bearing seat 72 of the gear housing 7. The main bearing 63 is disposed below the driven gear 64; referring to Figs. 1 and 4, when the flange cover 65 is connected to the gear housing 7 by the screw fixation holes 76 passing into the metal insert 70, the main bearing 63 and the second bearing 62 are coaxial. The second bearing seat 72 is made of metal, and has sufficiently high dimensional precision to ensure the coaxiality of the second bearing 62 and the main bearing 63.

[0029] The upper edge of the annular part 74 is provided with ribs 73 extending towards the second bearing seat 72; preferably, the ribs 73 are joined to a outer peripheral face of the second bearing seat 72, to further increase the rigidity of the gear housing. The ribs 73 are arranged at the upper edge of the annular part 74 uniformly in the circumferential direction, but must avoid the position of the driving gear.

[0030] With reference to Figs. 1 - 5, the periphery of the annular part 74 is provided with screw fixation holes 76, the periphery of the flange cover 65 is also provided with a mounting part 68 extending radially outwards, the mounting part 68 being provided with mounting holes 69, and fasteners are passed into the mounting holes 69 and the threaded holes 67 of the metal insert to connect the flange cover 65 to the bottom of the gear housing 7. At this time, an upper part of the flange cover 65 is at least partially in contact with the annular part 64, so that heat can be conducted from the inside and the plastic-covered metal insert to the outside. Preferably, the upper part of the flange cover extends into the inner peripheral side of the annular part, thereby fitting a lower peripheral edge of the annular part in the circumferential direction, so as to achieve a better heat dissipation effect.

[0031] The outer peripheral face of the flange cover 65 is at least partially provided with cooling fins 66. Preferably, the cooling fins 66 are disposed on a side close to

the motor housing 4. The side close to the motor housing 4 is near an outlet for a cooling airflow of the grinding tool, so the cooling fins 66 can be partially or completely exposed to the cooling airflow to maximize the cooling function.

[0032] According to another embodiment of the present invention, the gear housing 7 further comprises at least one threaded seat 8; the threaded seat 8 is also made of metal, and overmolded with plastic together with the metal insert 70. In addition to the part that serves as an interface with the gear transmission mechanism, the gear housing 7 also comprises interfaces for connecting external components, e.g. a side handle, an auxiliary handle, etc. Such an interface is usually a threaded seat, and the external component can be conveniently and stably connected to the gear housing by threaded connection. These threaded seats should also be formed of metal in advance, put into the injection mould together with the metal insert, and then overmoulded with plastic. It can be understood that these metal inserts can also be part of the main metal insert. According to a preferred embodiment of the present invention, the threaded seats 8 are three in number, respectively arranged at the left and right sides and the top of the gear housing. Thus, the choice can be made to mount external components at different positions according to user demands and application scenarios, resulting in more user-friendly operability. For example, the threaded seat 8 at the right side is used to receive a side handle, which is more suitable for users who customarily grip a main handle with their left hand.

[0033] According to the embodiments described above, the gear housing is formed from a lightweight metal insert overmoulded with a plastic or composite material, and this has the effect of reducing the weight of the grinding tool and reducing the load on the user's hands and arms. Since the outer surface of the gear housing is made of a plastic or composite material with low thermal conductivity, even if the user presses the upper part of the gear housing with his palm, the temperature change is very small, and this reduces the load on the hand, greatly improving comfort. Furthermore, a pre-processed or post-processed metal insert is used, ensuring the functionality and precision of geometric shape of all interfaces with adjacent parts (such as bearings), thus reducing weight while maintaining the relevant geometrical precision. In addition, the metal insert also helps to dissipate heat.

[0034] As described above, although exemplary embodiments of the present invention have been explained herein with reference to the drawings, the present invention is not limited to the specific embodiments described above, and may have many other embodiments. The scope of the present invention should be defined by the claims and their equivalents.

Claims

1. Grinding tool (1), comprising: a motor (3) having a rotating shaft (2), a motor housing (4) accommodat-
ing the motor (3), a main shaft (5) driven by the motor (3) and extending in a direction intersecting the
rotating shaft, a gear transmission mechanism (6) which transmits rotation of the rotating shaft (2) to the
main shaft (2), a tip tool mounted on the main shaft (5), and a gear housing (7) mounted in front of the
motor housing (4) and used to receive the gear transmission mechanism (6);
characterized in that
the gear housing (7) is formed of a metal insert (70) overmoulded with a plastic or composite material.
2. Grinding tool (1) according to Claim 1, **character-
ized in that** the gear transmission mechanism (6) comprises a driving gear (60) connected to the rotat-
ing shaft (2) and at least one driven gear (64) meshed with the driving gear (60), the driving gear (60) is
supported in the gear housing (7) by means of a first bearing (61), the main shaft (5) passes through the
centre of the driven gear (64) and is supported in the gear housing (7) by means of at least one second
bearing (62), and the metal insert (70) comprises a first bearing seat (71) for supporting the first bearing
(61) and a second bearing seat (72) for supporting the second bearing (62).
3. Grinding tool (1) according to Claim 2, **character-
ized in that** the metal insert (70) further comprises an annular part (74) surrounding the driven gear (64)
circumferentially.
4. Grinding tool (1) according to Claim 3, **character-
ized in that** the first bearing seat (71) is arranged in the axial direction of the rotating shaft (2), and joined
to an outer peripheral face of the annular part (74).
5. Grinding tool (1) according to Claim 4, **character-
ized in that** an upper edge of the annular part (74) is provided with ribs (73) extending towards the second
bearing seat (72).
6. Grinding tool (1) according to Claim 5, **character-
ized in that** the gear transmission mechanism (6) further comprises a flange cover (65) arranged be-
low the driven gear (64) and connected to the bottom of the gear housing (7), the flange cover (65) being
substantially cylindrical and having a hollow cavity (67), the driven gear (64) being pre-fitted to the top of
the flange cover (65), a main bearing (63) being mounted in the cavity (67), and an upper part of
the flange cover (65) being at least partially in contact with the annular part (64).
7. Grinding tool (1) according to Claim 6, **character-
ized in that** an outer peripheral face of the flange cover (65) is at least partly provided with cooling fins
(66), the cooling fins (66) preferably being arranged on a side close to the motor housing (4).
8. Grinding tool (1) according to any one of Claims 1 - 7, **characterized in that** the metal insert (70) is inte-
grally formed.
9. Grinding tool (1) according to Claim 8, **character-
ized in that** the gear housing further comprises at least one threaded seat (8); the threaded seat (8) is
also made of metal, and overmolded with a plastic or composite material together with the metal insert
(70).
10. Grinding tool (1) according to Claim 9, **character-
ized in that** the threaded seat is arranged at the top and/or left and right sides of the gear housing (7), and
used for connecting a side handle.

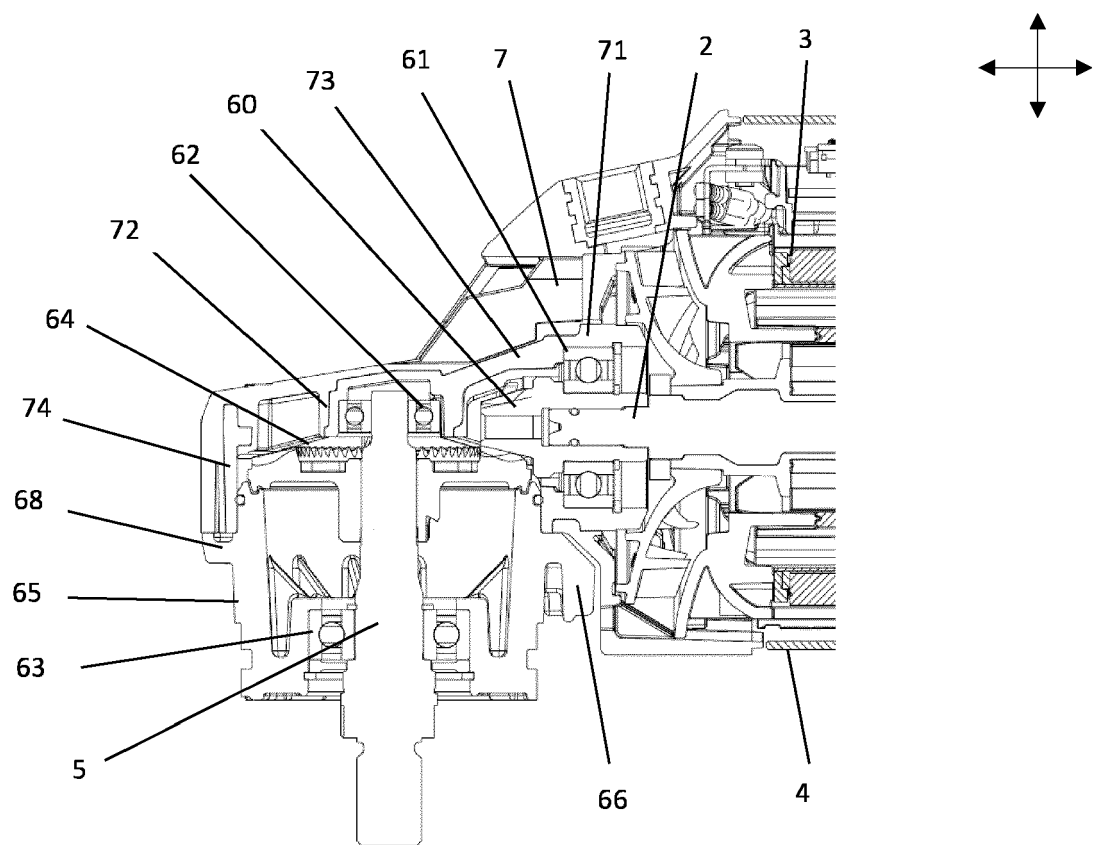


Fig.1

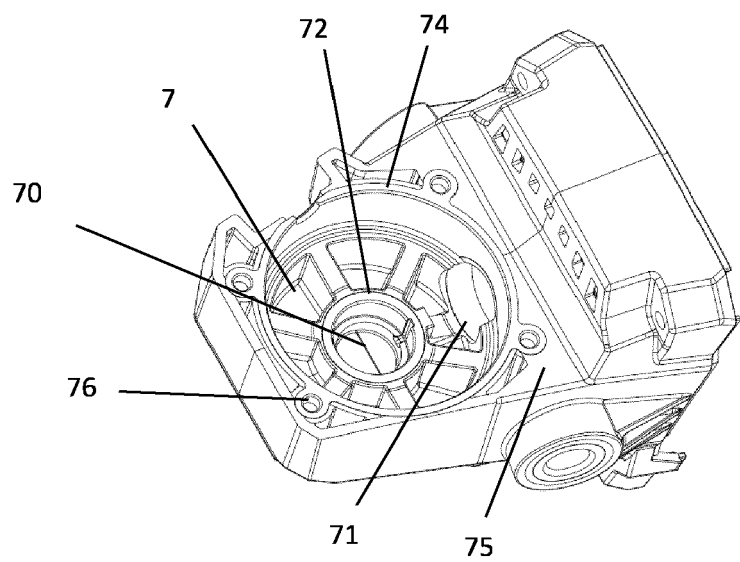


Fig.2

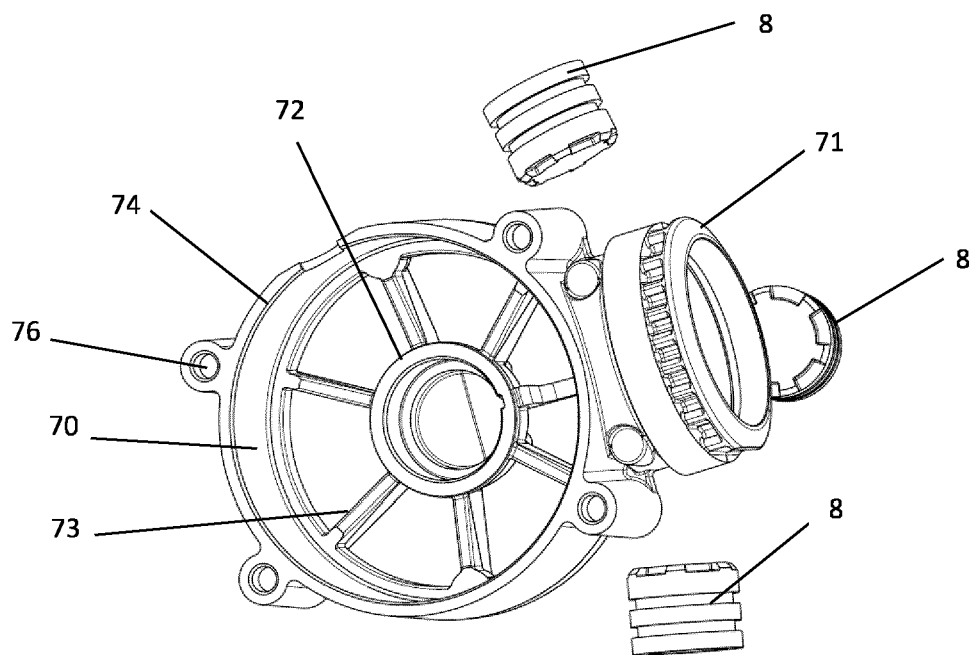


Fig. 3

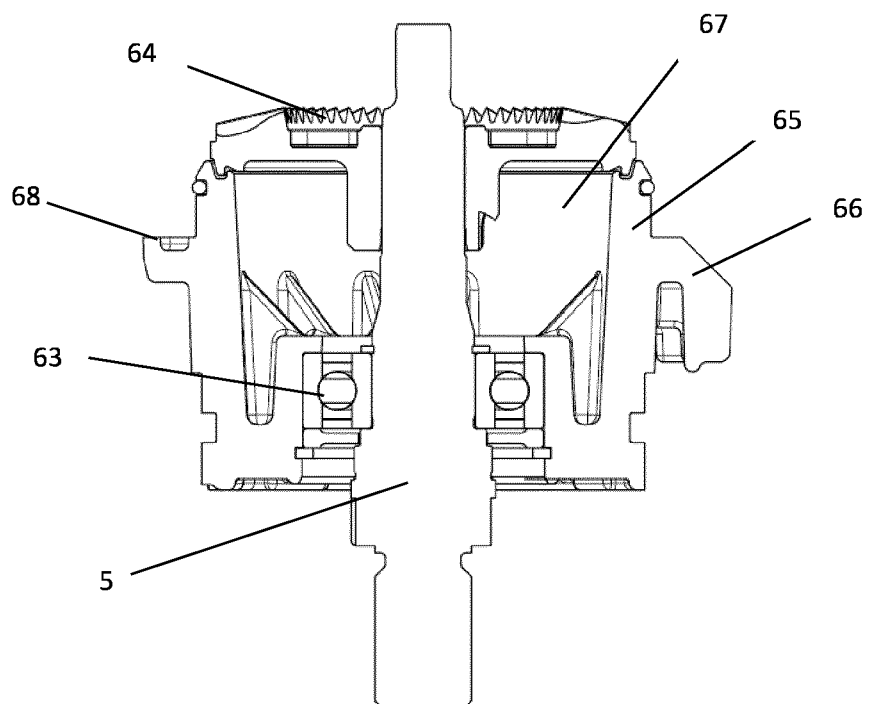


Fig.4

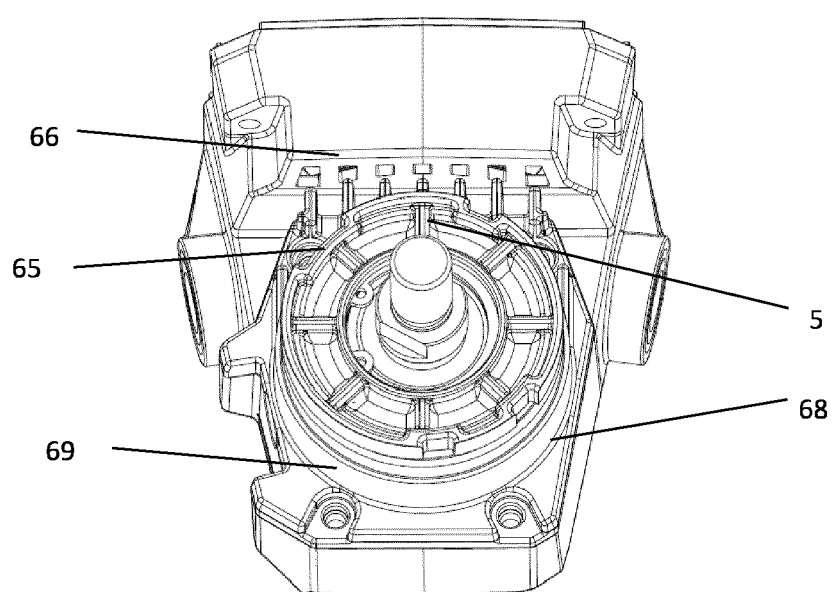


Fig. 5



EUROPEAN SEARCH REPORT

Application Number

EP 23 20 4852

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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The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		12 March 2024	Bermejo, Marco
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