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(54) **Automotive electrical coolant pump with crimped housing**

Elektrische Kraftfahrzeugkühlmittelpumpe mit gebördeltem Gehäuse

Pompe à liquide de refroidissement électrique d'automobile avec carter serti

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(56) References cited:
EP-A1- 1 635 064
DE-A1- 19 646 617
DE-A1-102006 039 712
US-A- 4 961 018

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Description

[0001] The Invention refers to an automotive electrical coolant pump for pumping a coolant in a coolant circuit of a car, for example for cooling the cars combustion engine.

[0002] The coolant pump is provided with a pump section comprising a pump wheel and with a motor section comprising a motor rotor and a motor stator. The producers of automotive coolant pumps generally provide cooling pumps for many different car manufacturers or engine manufacturers. The standard coolant pump type is the Impeller pump which is provided with an axial coolant Inlet and a tangential coolant outlet. The size of the coolant pump and the rotational angle of the tangential coolant outlet with respect to the fixation means of the coolant pump can vary from customer to customer. As a consequence, the producer of automotive coolant pumps must provide different variations of one coolant pump model with different rotational angles of the tangential coolant outlet.

[0003] EP 2 469 1 02 A1 discloses a coolant pump with a pump section housing separate from the motor section housing, wherein the two section housings are fixed to each other by a snap-mechanism. The rotational position of the pump section housing can be varied with relatively little constructional efforts. However, the construction of the snap mechanism is somehow complex and expensive.

[0004] EP 1 635 064 A1 discloses a coolant pump with a clamping fixation of the pump section housing and the motor section housing.

[0005] It is an object of the present invention to provide an automotive coolant pump with a simple and inexpensive construction for providing the coolant pump with different rotational angles of the tangential coolant outlet.

[0006] This object is solved with a coolant pump with the features of claim 1.

[0007] The coolant pump comprises a pump section with a pump wheel and a motor section with a motor rotor and a motor stator. The pump housing comprises at least two separate section housings, i.e. the pump section housing and a separate motor section housing which is directly fixed to the pump section housing. The pump section housing comprises a central axial coolant inlet and a tangential coolant outlet. The tangential coolant outlet needn't be strictly tangential but continues the outlet volute which is typical for an impeller liquid pump.

[0008] The fixation of the pump section housing at the motor section housing is provided by a bordering arrangement. The bordering arrangement is defined by a circular fixation bulge at the axial end of one section housing and a corresponding circular bordering ring at the axial end of the other section housing. The bordering ring embraces and engages behind the fixation bulge so that the bordering ring and the fixation bulge define a strong axial fixation of the pump section housing at the motor section housing. The bordering arrangement generally allows to freely choose the rotational position of the pump section housing with respect to the motor section housing.

[0009] The fixation bulge is provided with at least one chamfer depression and the bordering ring is provided with a corresponding bordering tongue which is projecting into the chamfer depression at the fixation bulge. This chamfer/tongue arrangement defines a strong rotational fixation of the pump section housing at the motor section housing. The bordering arrangement is relatively simple and can be provided before assembling with relatively large mechanical tolerances because the bordering arrangement is assembled and fixed to each other by a cold forming process step.

[0010] For varying the rotational angle of the pump section housing with respect to the motor section housing, the pump section housing has only to be preassembled, before bordering, to the motor section housing in the desired rotational angle. The motor section housing can always be placed in the same rotational position in the bordering tool, no matter in which rotational angle the pump section housing is finally assembled. After the pump section housing is pre-assembled, a first positioning tool presses the part of the bordering tongue which is corresponding to and axially in-line with the chamfer depression into the chamfer depression. After this positioning step, the rotational position of the pump section housing with respect to the motor section housing is fixed and can not be changed anymore. In the following bordering step, the bordering ring is bended around the fixation bulge over the entire circumference so that, in cross section, the bordering ring axially engages behind the fixation bulge. Alternatively, these two fixation steps can also be provided in one single mechanical fixation step.

[0011] With the present concept of a bordering arrangement a strong axial and rotational fixation of the pump section housing at the motor section housing can be provided, whereby production and preparation of the bordering elements as well as of the bordering tools are simple and cost-effective. Also the final fixation step is simple, reliable and can be provided with the same machines and tools for different tangential fixation angles of the pump section housing with respect to the motor section housing and its mounting flanges.

[0012] A separate sealing arrangement is provided to provide a liquid tight sealing of the gap between the two section housings. The sealing arrangement is axially not overlapping with the bordering arrangement. In other words, the sealing arrangement and the bordering arrangement have no radial plane in common. The axial separation of the sealing arrangement from the bordering arrangement avoids negative mechanical impacts on the sealing arrangement caused by the bordering process. Therefore, the liquid-tight sealing of the joint between the motor section housing and the pump section housing can be guaranteed even after the bordering process.

[0013] According to a preferred embodiment of the invention, the proximal end of the pump section housing

is provided with the fixation bulge and the distal end of the motor section housing is provided with the bordering ring.

[0014] According to another preferred embodiment of the invention, two or more chamfer depressions are provided at the fixation bulge. Two or more chamfer depressions in connection with the corresponding bordering tongues provide an increased rotational fixation.

[0015] Preferably, the chamfer depression is provided at the axial end of the fixation bulge which means that the chamfer depression is provided at the position of high radial thickness of the bulge so that the total thickness of the bulge at the depression is not less than the housing wall thickness. The housing is not weakened by the depression.

[0016] According to a preferred embodiment, a motor control section is provided which comprises a separate control section housing which is fixed to the motor section housing by a second bordering arrangement which can be designed similar or identical to the bordering arrangement between the motor section housing and the pump section housing.

[0017] One embodiment of the invention is described with reference to the enclosed drawings, wherein

figure 1 shows a longitudinal section of an electrical automotive coolant pump with a motor section housing and a pump section housing which are fixed to each other by a bordering arrangement,

figure 2 shows a side view of the coolant pump of figure 1,

figure 3 shows a front view of the pump and of the coolant section housing of figure 1,

figure 4a shows an enlarged cross section of the bordering arrangement of the coolant pump of figure 1, and

figure 4b shows the bordering arrangement of figure 4A including a bordering tongues projecting into a corresponding chamfer depression.

[0018] The figures show an automotive electrical coolant pump 10 for pumping a liquid coolant, for example water, to an internal combustion engine of an automotive vehicle. The pump 10 is driven by an electric motor which is electronically commutated.

[0019] The pump 10 comprises, seen in axial direction, three lengthwise sections: a pump section 12 with a pump wheel 40, a motor section 14 with a motor rotor 52 and with a motor stator 50, and a control section 16 comprising an electronic motor control board 48 in a separate control electronics chamber 64. The three sections 12, 14, 16 are provided with separate section housings, respectively: a control section housing 46 defining the control electronics chamber 62a, the motor section housing 44 surrounding a ring-like stator cavity 45 with several motor stators 50, and a pump section housing 42 with an axial coolant inlet 24 and a tangential coolant outlet 26. The motor section housing 44 and the control section housing 46 are made of metal, for example of aluminum or of steel. The pump section housing 42 is preferably made of plastics.

[0020] The coolant flows through the coolant inlet 24 into the axial pump wheel inlet 22 and is forced by the rotating pump wheel 40 radially outwardly into an outlet volute 28 from where the coolant leaves the pump 10 through the tangential coolant outlet 26. The pump wheel 40 is supported by a rotatably rotor shaft 62 which also supports the permanent magnetic motor rotor 52.

[0021] The axial proximal end of the pump section housing 42 is fixed at the motor section housing 44 by a bordering arrangement 20 which is shown in detail in figures 4a and 4b. The bordering arrangement 20 is generally circular and is defined by a circular fixation bulge 36 at the radial outside surface of a cylindrical end section 47 of the pump section housing 42 and by a circular bordering ring 34 embracing - seen in cross section - the fixation bulge 36. The bordering ring 34 is provided at the axial end of the motor section housing 44 but not necessarily at the edge of the housing opening.

[0022] The bordering arrangement 20 is provided with three chamfer fixations 21 positioned in a rotational angle of 120° to each other. The chamfer fixations 21 are defined by a chamfer depression 37 at the root of the fixation bulge 36 and by a corresponding bordering tongue 38 of the bordering ring 34. The bordering tongues 38 are projecting into the corresponding chamfer depression 37, respectively.

[0023] The circular cylindrical end section 47 of the pump section housing 42 surrounds the corresponding circular cylindrical end section 47 of the motor section housing 44. The corresponding circular cylindrical end section 49 of the motor section housing 44 has an axial length x of at least 20 mm. The axial length y of the bordering arrangement 20 is less than half of the axial length x of the cylindrical end section of the motor section housing 44. In the bordering-free axial section of the cylindrical end section 47 of the pump section housing 42 a sealing arrangement 31 is provided defined by a circular sealing groove 33 in the end section 49 of the motor section housing 44 and a circular flexible sealing ring 32 within the sealing groove 33. Seen in axial direction, the sealing arrangement 31 is not overlapping with the bordering arrangement 20.

[0024] The control section housing 46 is fixed at the motor section housing 44 by a bordering arrangement 18 similar or substantially identical to the bordering arrangement 20 between the pump section housing 42 and the motor section housing 44.

[0025] The bordering arrangement 20 is assembled by axially shifting the pump section housing 42 onto the corresponding axial end 49 of the motor section housing 44. After that, a fixation tool forces the corresponding parts

of the open bordering ring 34 into the corresponding chamfer depressions 37 to define three bordering tongues 38 projecting into the corresponding chamfer depressions 37. Finally the bordering ring is completely bordered around the fixation bulge 36 over the entire circumference.

Claims

1. An automotive electrical coolant pump (10) comprising a pump section (12) with a pump wheel (40) and a motor section (14) with a motor rotor (52) and a motor stator (50), wherein
a pump housing comprises a pump section housing (42) and a separate motor section housing (44) which is fixed to the pump section housing (42),
the pump section housing (42) comprises an axial coolant inlet (24) and a tangential coolant outlet (26),
the fixation of the pump section housing (42) with the motor section housing (44) is provided by a bordering arrangement (20),
the bordering arrangement (20) is defined by a circular fixation bulge (36) at the radial outside surface of an axial end section (47) of one section housing (42, 44) and a circular bordering ring (34) at the axial end of the other section housing (44, 42),
the bordering ring (34) embraces the fixation bulge (36),
the fixation bulge (36) is provided with at least one chamfer depression (37),
a bordering tongue (38) of the bordering ring (34) is projecting into the chamfer depression (37),
the end section (47) of the one section housing (42, 44) surrounds a corresponding circular end section (49) of the other section housing (44, 42), and
a separate sealing arrangement (31) is provided, defined between the end section (47) of the one section housing (42, 44) and the end section (49) of the other section housing (44, 42), to provide a liquid-tight sealing and
the sealing arrangement (31) is axially not overlapping with the bordering arrangement (20).

2. The automotive electrical coolant pump (10) of claim 1, wherein the proximal end of the pump section housing (42) is provided with the fixation bulge (36) and the distal end of the motor section housing (44) is provided with the bordering ring (34).

3. The automotive electrical coolant pump (10) of one of the preceding claims, wherein two or more chamfer depressions (37) and corresponding bordering tongues (38) are provided.

4. The automotive electrical coolant pump (10) of one of the preceding claims, wherein a motor control section (16) is provided which comprises a separate control section housing (46) which is fixed to the motor section housing (44) by another bordering arrangement (18).

Patentansprüche

1. Elektrische Kraftfahrzeugkühlmittelpumpe (10) mit einem Pumpenabschnitt (12), der ein Pumpenrad (40) aufweist, und einem Motorabschnitt (14), der einen Motorrotor (52) und einen Motorstator (50) aufweist, bei welcher
ein Pumpengehäuse ein Pumpenabschnittsgehäuse (42) und ein separates Motorabschnittsgehäuse (44) aufweist, das an dem Pumpenabschnittsgehäuse (42) angebracht ist,
das Pumpenabschnittsgehäuse (42) einen axialen Kühlmitteleinlass (24) und einen tangentialen Kühlmittelauslass (26) aufweist,
die Befestigung des Pumpenabschnittsgehäuses (42) mit dem Motorabschnittsgehäuse (44) durch eine Bördelanordnung (20) gebildet ist,
die Bördelanordnung (20) durch einen kreisrunden Befestigungswulst (36) an der radial äußeren Fläche eines axialen Endabschnitts (47) eines Abschnittsgehäuses (42, 44) und einen kreisrunden Bördelring (34) am axialen Ende des anderen Abschnittsgehäuses (44, 42) definiert ist,
der Bördelring (34) den Befestigungswulst (36) umschließt,
der Befestigungswulst (36) mit mindestens einer schrägen Vertiefung (37) versehen ist,
eine Bördelzunge (38) des Bördelrings (34) in die schräge Vertiefung (37) ragt,
der Endabschnitt (47) des einen Abschnittsgehäuses (42, 44) einen entsprechenden kreisförmigen Endabschnitt (49) des anderen Abschnittsgehäuses (44, 42) umgibt, und
eine separate Dichtanordnung (31) vorgesehen ist, welche zwischen dem Endabschnitt (47) des einen Abschnittsgehäuses (42, 44) und dem Endabschnitt (49) des anderen Abschnittsgehäuses (44, 42) definiert ist, um eine flüssigkeitsdichte Abdichtung zu bewirken, und
die Dichtanordnung (31) nicht axial mit der Bördelanordnung (20) überlappt.

2. Elektrische Kraftfahrzeugkühlmittelpumpe (10) nach Anspruch 1, bei welcher das proximale Ende des Pumpenabschnittsgehäuses (42) mit dem Befestigungswulst (36) versehen ist, und das distale Ende des Motorabschnittsgehäuses (44) mit dem Bördelring (34) versehen ist.

3. Elektrische Kraftfahrzeugkühlmittelpumpe (10) nach einem der vorhergehenden Ansprüche, bei welcher zwei oder mehr schräge Vertiefungen (37) und entsprechende Bördelzungen (38) vorgesehen sind.

4. Elektrische Kraftfahrzeugkühlmittelpumpe (10) nach einem der vorhergehenden Ansprüche, bei welcher ein Motorsteuerabschnitt (16) vorgesehen ist, der ein separates Steuerabschnittsgehäuse (46) aufweist, das an dem Motorabschnittsgehäuse (44) mittels einer anderen Bördelanordnung (18) befestigt ist.

Revendications

1. Pompe à liquide de refroidissement électrique d'automobile (10) avec une section de pompe (12), comprenant une roue de pompe (40), et une section de moteur (14), comprenant un rotor de moteur (52) et un stator de moteur (50), dans laquelle
un carter de pompe comprend un carter de la section de pompe (42) et un carter de la section de moteur (44) séparé, qui est fixé au carter de la section de pompe (42),
le carter de la section de pompe (42) comprend une entrée de liquide de refroidissement (24) axiale et une sortie de liquide de refroidissement (26) tangentielle,
la fixation du carter de la section de pompe (42) au carter de la section de moteur (44) est effectuée par un ensemble de sertissage (20),
l'ensemble de sertissage (20) est défini par un renflement de fixation (36) circulaire sur la surface radialement extérieure d'une section d'extrémité (47) axiale d'un des carters de section (42, 44) et un anneau de sertissage (34) circulaire à l'extrémité axiale de l'autre des carters de section (44, 42),
l'anneau de sertissage (34) embrasse le renflement de fixation (36),
le renflement de fixation (36) est prévu d'au moins une dépression chanfreinée (37),
une languette de sertissage (38) dudit anneau de sertissage (34) saille dans la dépression chanfreinée (37),
la section d'extrémité (47) d'un des carters de section (42, 44) entoure une section d'extrémité (49) circulaire correspondante de l'autre des carters de section (44, 42), et
un ensemble de scellement (31) séparé est prévu, l'ensemble étant défini entre la section d'extrémité (47) d'un des carters de section (42, 44) et la section d'extrémité (49) de l'autre des carters de section (44, 42), afin d'obtenir un scellement étanche à liquide, et ledit ensemble de scellement (31) n'est pas en chevauchement axial avec l'ensemble de sertissage (20).

2. Pompe à liquide de refroidissement électrique d'automobile (10) selon la revendication 1, dans laquelle l'extrémité proximale du carter de la section de pompe (42) est munie du renflement de fixation (36) et l'extrémité distale du carter de la section de moteur (44) est munie de l'anneau de sertissage (34).

3. Pompe à liquide de refroidissement électrique d'automobile (10) selon l'une quelconque des revendications précédentes, dans laquelle deux ou plusieurs dépressions chanfreinées (37) et languettes de sertissage (38) correspondantes sont prévues.

4. Pompe à liquide de refroidissement électrique d'automobile (10) selon l'une quelconque des revendications précédentes, dans laquelle une section de commande du moteur (16) est prévue, qui comprend un carter de la section de commande (46) séparé, qui est fixé au carter de la section de moteur (44) par un autre ensemble de sertissage (18).

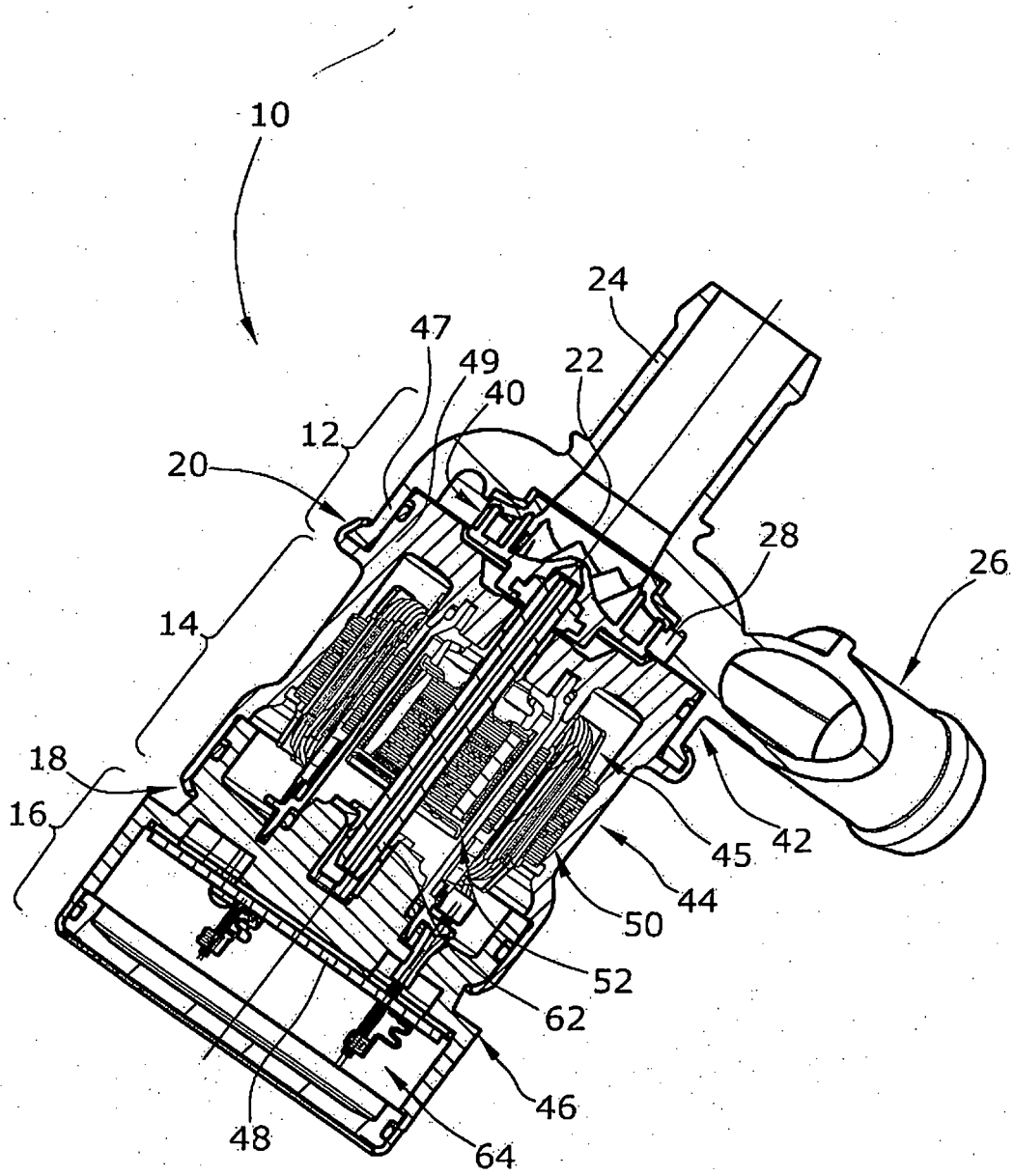


Fig.1

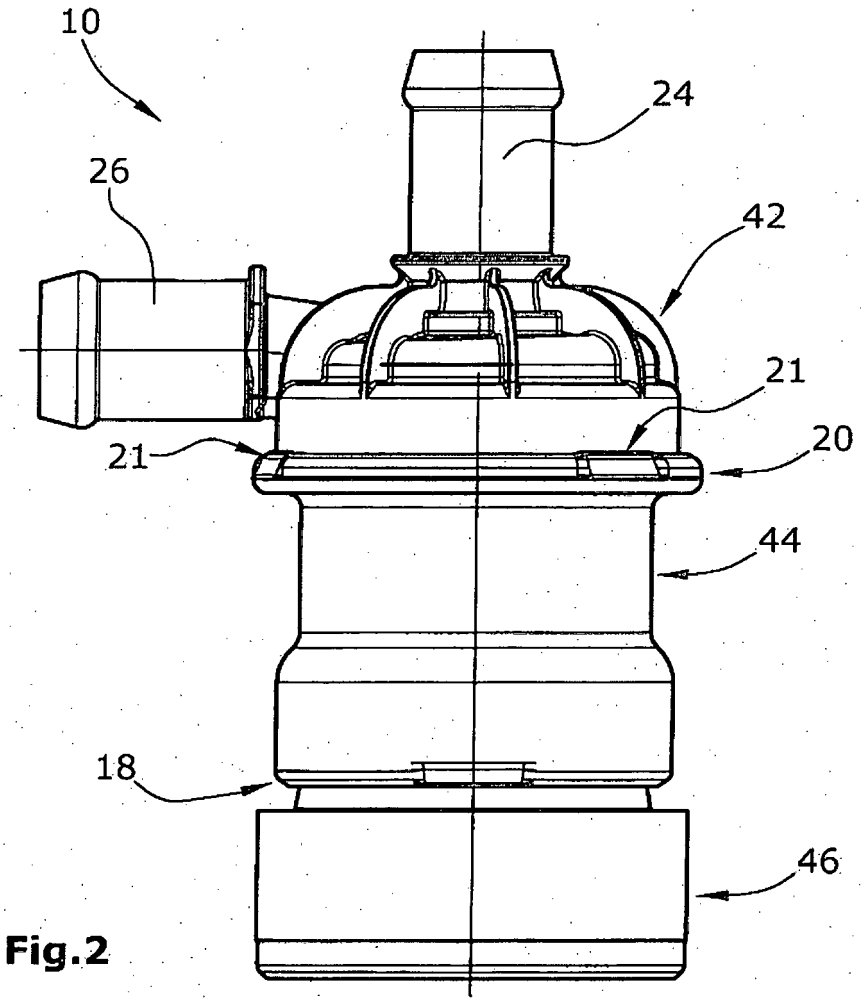


Fig.2

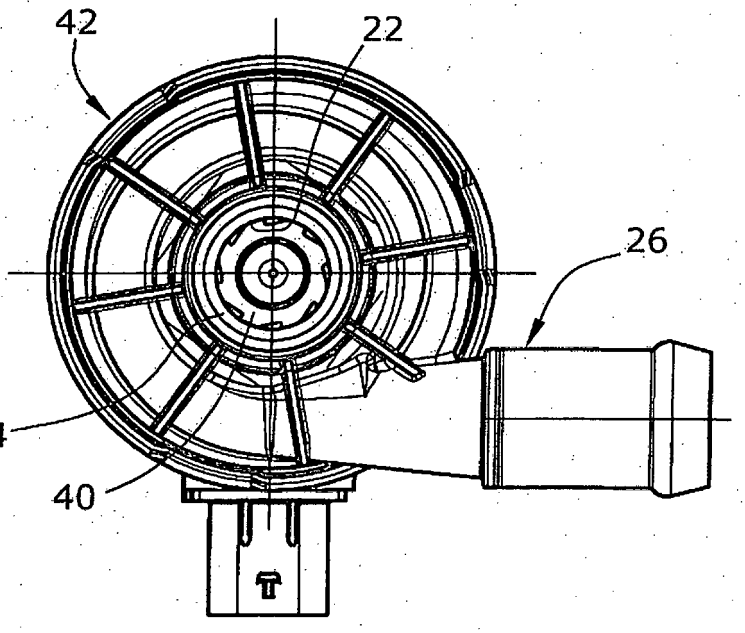


Fig.3

Fig.4a

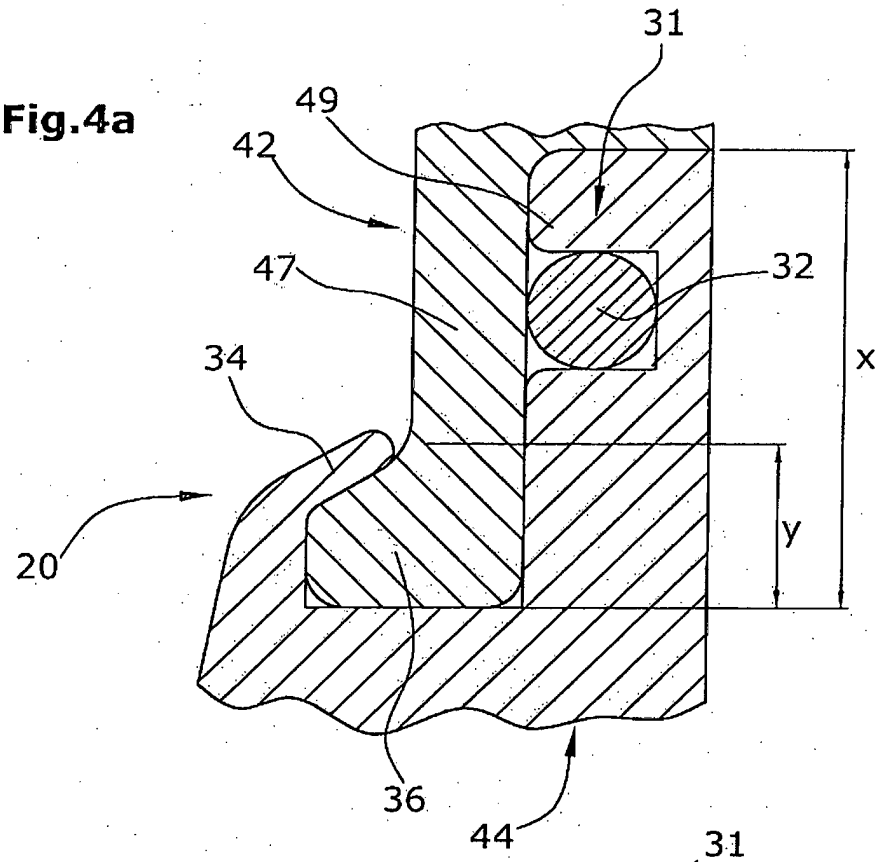
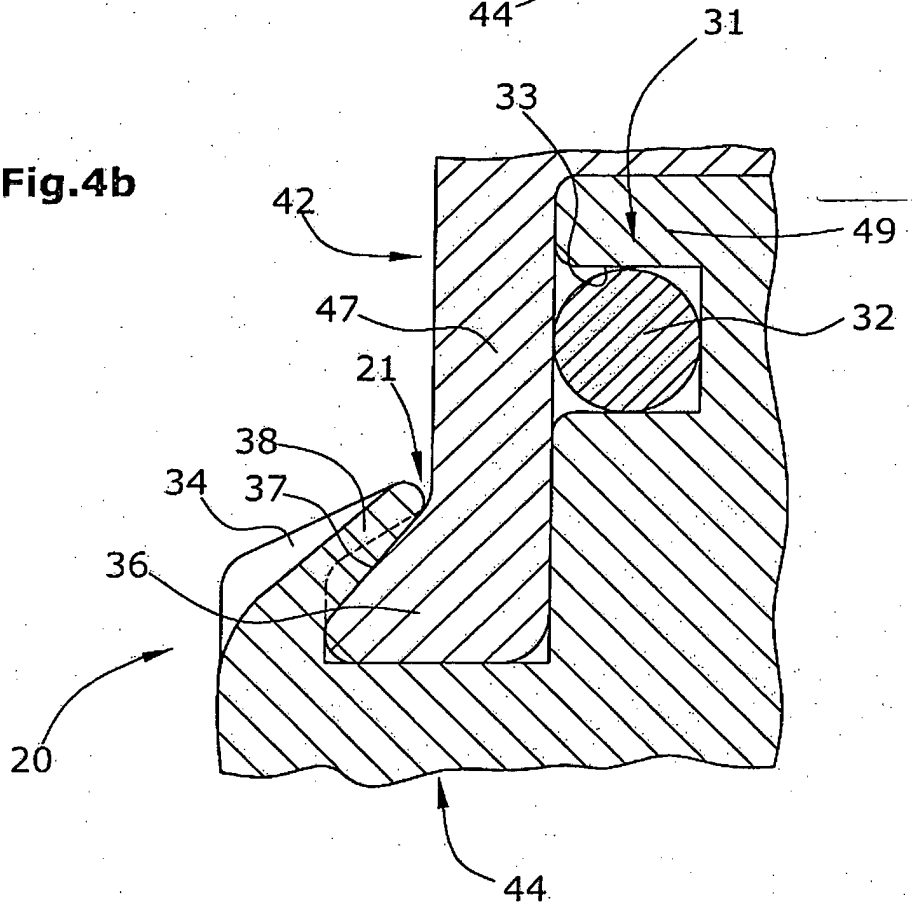


Fig.4b



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 2469102 A1 **[0003]**
- EP 1635064 A1 **[0004]**