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(54) **MOTOR/PUMP ASSEMBLY WITH IMPROVED SEALING**

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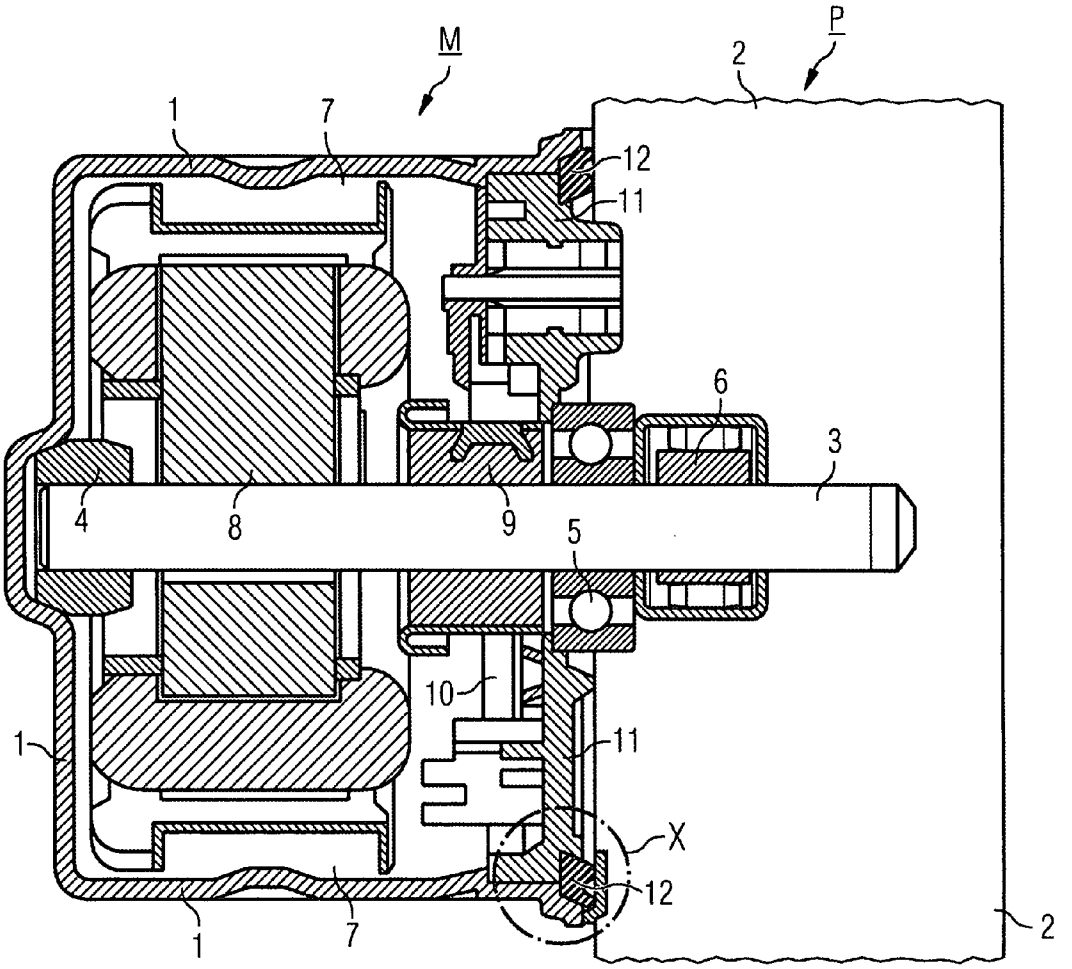
(57) **ABSTRACT**

A motor/pump assembly, in particular for a motor vehicle braking apparatus is fixed axially on an end face of the pump housing. The brush plate forms the termination face of the motor with respect to the pump housing. The boundary area of the motor housing which faces the pump housing and that area of the brush plate which is radially adjacent to the boundary area of the motor housing each have a seal-accommodating step, into which a seal is inserted which is compressed axially by the pump housing being fixed to the motor.



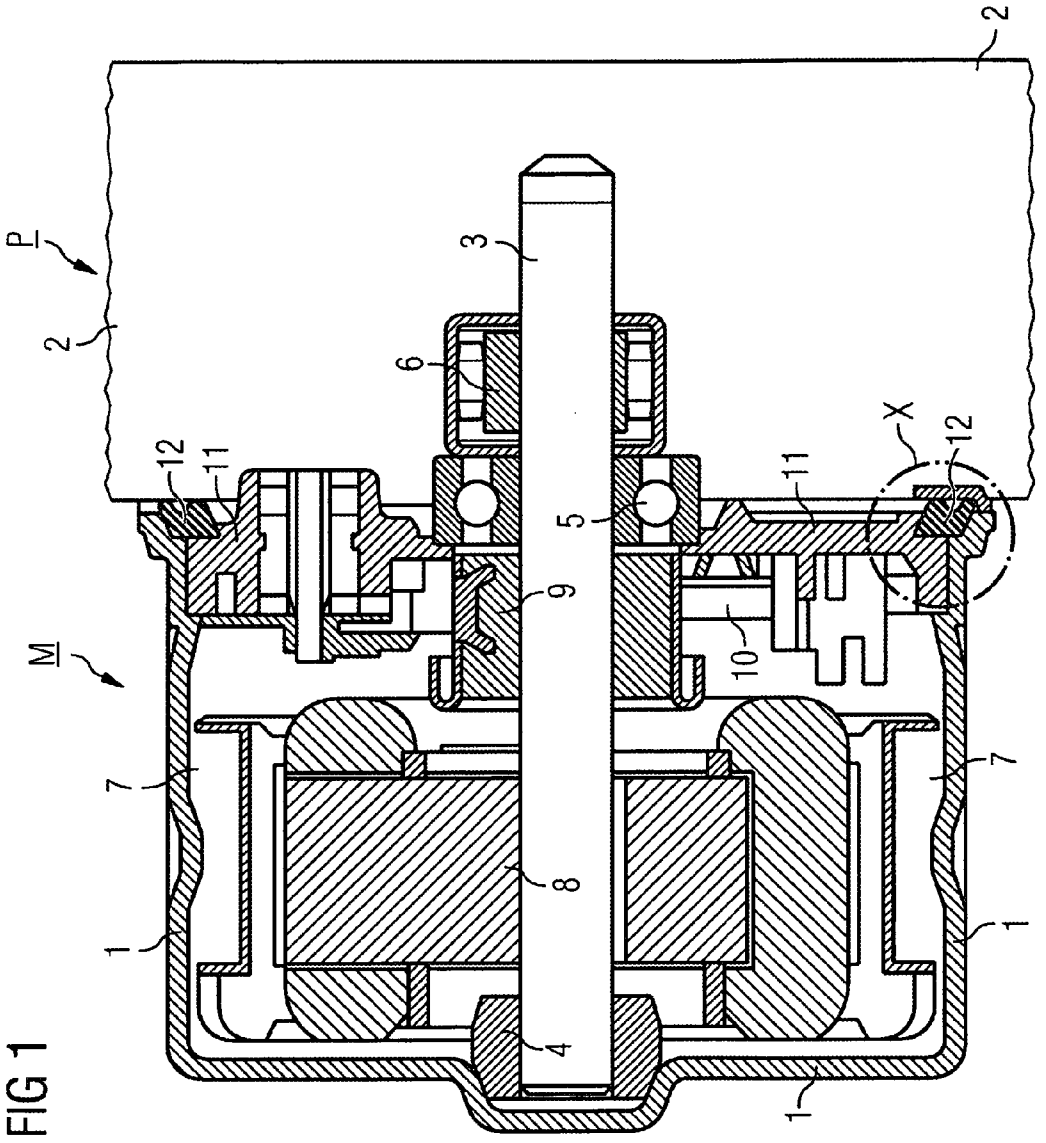



FIG 1

FIG 2

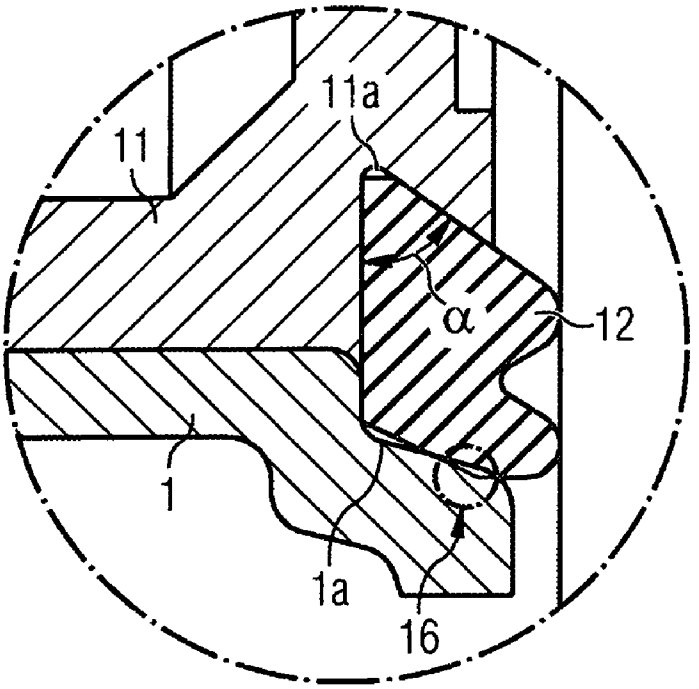
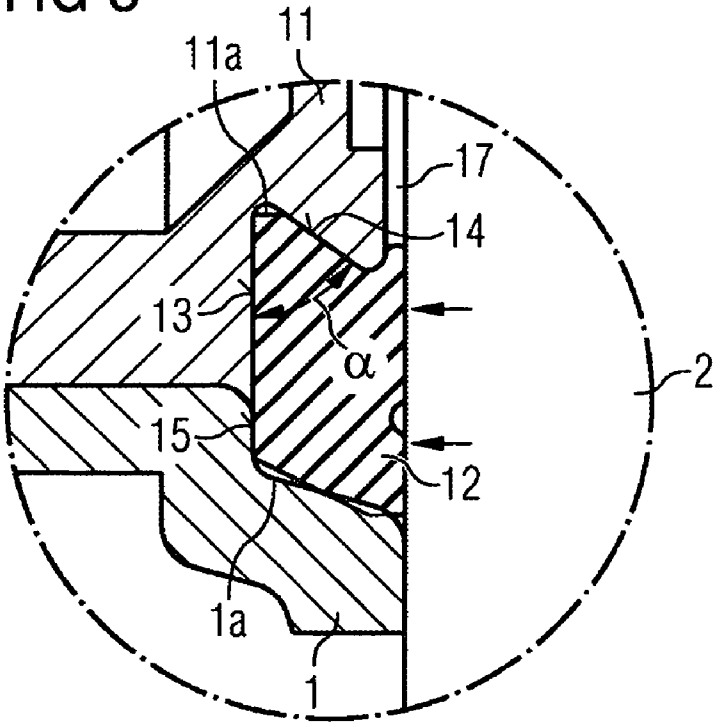



FIG 3



# MOTOR/PUMP ASSEMBLY WITH IMPROVED SEALING

## CROSS-REFERENCE TO RELATED APPLICATIONS

**[0001]** This application is a U.S. national stage application of International Application No. PCT/EP2006/067664 filed Oct. 23, 2006, which designates the United States of America, and claims priority to German Application Number 10 2005 056 082.2 filed Nov. 24, 2005, the contents of which are hereby incorporated by reference in their entirety.

## TECHNICAL FIELD

**[0002]** The invention relates to a motor/pump unit.

## BACKGROUND

**[0003]** Known from EP-B1-0 645 875 is a motor/pump unit that is in particular a motor vehicle anti-locking braking device. Said known unit contains a motor housing, a pump housing, and an electronics housing. The motor housing is located with one of its end faces in front of one of the pump housing's end faces. The electronics housing is located with one of its end faces in front of the pump housing's other end face. Connecting leads are ducted through the end faces situated one in front of the other and through the pump housing as electric power supply or control leads between in each case the interior of the motor housing on the one hand and that of the electronics housing on the other. The end faces situated one in front of the other are sealed one from the other, particularly radially outward, by means of circumferential seals situated between them. Said seals are generally produced by silicone rubber overmolding.

**[0004]** A further motor/pump unit is known from DE-C1-101 62 247. Said known unit is also a motor vehicle braking device. Said device contains a motor housing, a pump housing, and an electronics housing located axially one behind the other in a sandwich arrangement. At least two mutually electrically insulated plug-type power supply or control leads are ducted from the motor housing to the electronics housing. The plug-type power supply or control leads are fastened on the motor housing side in a base, in particular a brush plate, are embodied axially rigidly, and are free to move transversely to their longitudinal direction at least in terms of tolerance compensation. The plug-type power supply or control leads can with axial support with respect to the motor housing be plug-contacted with an electronics unit in the electronics housing. With the unit assembled, the brush plate can be supported by at least one supporting rib, located on the outer edge, on the motor housing's outer circumferential surface counter to the power supply and control leads' plug-in direction by means of a press fit taking all tolerances into account.

**[0005]** Known from EP-A1-1 341 290 is a further motor/pump unit that is in particular a motor vehicle braking device. Said known unit has an electric motor and a pump located axially behind it and driven thereby. Provided between the electric motor and pump is a drive link having a universal joint. The connection is made via a coupling part having a form-fitting plug-in receptacle for a rotor shaft end of the electric motor on the driven side and for a pump shaft end of the pump on the drive side. The plug-in receptacle is embodied axially conically. The rotor shaft end and pump shaft end are mutually axially pretensioned to insure rotational compliance that is free from play.

**[0006]** When the motor housing is in the known units sealed from the pump block and surroundings using silicone rubber overmolding, then highly complex tools as well as a highly complex process will be required for doing so. A high error rate will furthermore have to be accepted. The tool and handling costs will likewise be high.

**[0007]** It is furthermore already known how to use what are termed CIPG (cured in place gaskets) seals or wet seals which are injected onto the hydraulic block or motor while the motor is being assembled. Motor reworking is problematic when such seals are used because the motors can no longer be detached from the pump block and replaced without damaging the seal. The necessary scrapping entails high costs. The assembly process is also cost-intensive, complex, and prone to errors.

**[0008]** It is furthermore already known how to use a plurality of individual seals, for example O-rings or form rings, for sealing the motor housing from the pump housing and surroundings. A disadvantage associated therewith is that the individual seals are easily lost. That makes checking for the individual seals' presence unavoidable. The assembly process is more complex. The handling of parts is time-consuming. Using a plurality of individual seals increases overall costs.

## SUMMARY

**[0009]** According to an embodiment, a motor/pump unit may comprise a motor having a pot-shaped motor housing and a brush plate provided in the motor housing, and a pump having a pump housing, wherein the motor is secured axially to an end face of the pump housing, the brush plate forms the terminating face of the motor with respect to the pump housing, the edge region of the pot-shaped motor housing facing the pump housing has a seal-accommodating stage, the region of the brush plate radially adjacent to the edge region of the motor housing likewise has a seal-accommodating stage, and inserted into said seal-accommodating stages is a seal which is axially compressed through securing of the pump housing on the motor.

**[0010]** According to a further embodiment, the seal-accommodating stage of the brush plate can be slanted so that the seal-accommodating stage has sides that enclose an angle less than 90°.

**[0011]** According to a further embodiment, the seal-accommodating stage of the motor housing may have a slant on which is provided a monitoring area at which the presence of the seal is detected.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** Further advantageous characteristics of the invention will emerge from its exemplary elucidation with reference to the figures, in which:

**[0013]** FIG. **1** is a partial sectional representation of a motor/pump unit according to an embodiment,

**[0014]** FIG. **2** is an enlarged representation of detail X shown in FIG. **1** with the seal not yet in the compressed condition, and

**[0015]** FIG. **3** is another enlarged representation in which sealing is shown in the compressed condition.

## DETAILED DESCRIPTION

**[0016]** According to various embodiments, both the sealing function will be improved and the seal's service life extended because the seal's tensioned or compressed condition acts in one direction only. No silicone rubber overmolding is needed for insuring the sealing function. That function can be brought about simply and economically by inserting a seal into the motor housing's and brush plate's mutually adjacent seal-accommodating stages during assembly of the motor/pump unit, which seal will then be automatically compressed in the axial direction when the pump housing is secured to the motor. Sealing surfaces reliably preventing an ingress of brake fluid from the pump side will thereby be created where the seal makes contact with the brush plate's seal-accommodating stage. Sealing surfaces sealing the motor housing's interior from the surroundings will furthermore be created where the seal makes contact with the motor housing's seal-accommodating stage. A robust sealing effect will consequently be achieved with just one sealing component.

**[0017]** Using a single seal will reduce the number of components compared with known units where a plurality of seals is used.

**[0018]** A further advantage is that securing of the brush plate in the motor/pump unit will also be improved by the seal's axial compression.

**[0019]** A further advantage is increased overall system resistance to aging effects, for example in the case of storage at different temperatures. Undesired aging effects of the plastic end shield are particularly avoided. Coarser tolerances at the plastic end shield will also be possible as well as a reduction in the individual components' complexity. That will reduce costs.

**[0020]** More stringent customer requirements in terms of sealing functionality can furthermore be met by means of the various embodiments.

**[0021]** FIG. **1** is a partial sectional representation of a motor/pump unit according to an embodiment. An electric motor M and a pump P belong to said motor/pump unit. It can be used, for example, in a motor vehicle as an anti-locking braking device.

**[0022]** The motor M has a pot-shaped motor housing **1**. A rotor shaft **3** is supported therein in bearings **4** and **5**. Rotor laminations **8** are permanently connected to said shaft so that they turn with the rotor shaft during operation. Secured to the motor housing's interior sides are magnetic shells **7** serving when the motor is operating to energize the rotor winding belonging to the rotor laminations **8**. The rotor winding is connected to a commutator **9** that is likewise secured to the rotor shaft **3** and connected to brushes secured in a brush plate **11**. The brush plate **11** forms the terminating face of the motor M with respect to the pump housing **2**. The motor M is axially secured to an end face of the pump housing **2**, for example through a screw connection. The rotor shaft **3** of the motor M is ducted through the bearing **9** into the pump housing **2** and secured there in a bearing **6** on the pump side.

**[0023]** Provided between the motor housing **1** and pump housing **2** is a seal **12**, preferably a circumferential sealing washer. Said seal both seals the motor housing **1** from the surroundings and seals the motor housing **1** against an ingress of brake fluid discharging undesirably from the pump housing **2**.

**[0024]** FIG. **2** is an enlarged representation of detail X, shown in FIG. **1**, in which the seal **12** and associated accommodating elements are contained in the motor housing **1** and brush plate **11**.

**[0025]** It can be seen from said figure that the pot-shaped motor housing **1** has a seal-accommodating stage **1***a* in its edge region facing the pump housing **2**. The region of the brush plate **11** radially adjacent to the edge region of the motor housing **1** is, likewise, also provided with a seal-accommodating stage **11***a*.

**[0026]** The seal **12** is first inserted into the mutually adjacent seal-accommodating stages **1***a* and **11***a* during assembly of the motor housing **1** and pump housing **2**. It can be seen that the seal **12**, not yet being in the compressed condition, protrudes in the axial direction from the motor housing **1** after being inserted into the seal-accommodating stages.

**[0027]** The monitoring area **16** shown in FIG. **2** has an assisting function during the assembly process. Force monitoring can advantageously be performed to determine whether a seal is present or not. It can thereby be insured that the motor housing is not inadvertently permanently connected to the gear housing without a seal's first having been inserted into the seal-accommodating stages **1***a* and **11***a*.

**[0028]** The seal can in the region of the monitoring area **16** furthermore be slightly compressed in the radial direction when the seal **12** is inserted into the seal-accommodating stages **1***a* and **11***a* in order to fix the seal somewhat in position so that it cannot immediately drop out of the seal-accommodating stages **1***a*, **11***a* after being inserted. A sealing function in the radial direction, though, is not associated therewith.

**[0029]** FIG. **3** is another enlarged representation in which the seal **12** is shown in the compressed condition. Said compressed condition is brought about by pressing the pump housing **2** in the axial direction against the motor housing **1** then securing it in position thereon using, for example, screws. The seal **12** is compressed in the axial direction while being thus pressed, as illustrated in FIG. **3** by the small arrows. The seal **12** is pressed into the seal-accommodating stages **1***a* and **11***a* through being thus compressed in the axial direction. Sealing surfaces **13** and **14** are created between the pump housing **2** and brush plate **11** through the seal's being thus pressed in. Said surfaces will prevent an ingress of brake fluid undesirably discharged from the pump housing **2** and located in the groove **17** into the motor housing's interior. A sealing surface **15** is furthermore created through the seal's being thus axially pressed into the seal-accommodating stages. Said surface seals the motor housing **1** from its surroundings so that nothing from there can penetrate into the interior of the motor housing **1**.

**[0030]** The sides of the seal-accommodating stages **1***a* and **11***a* are slightly slanted to improve the sealing effect, particularly against an ingress of brake fluid into the interior of the motor housing **1**. The slant of the brush plate's seal-accommodating stage **11***a* is therein such that the seal-accommodating stage has sides enclosing an angle $\alpha$ that is less than 90° and preferably approximately in the 45° range.

**[0031]** Owing to the seal's being compressed exclusively in the axial direction a single-axis tensioned or compressed condition is insured that will have a more favorable impact on the seal's sealing function and service life than an overlaid tensioned or compressed condition where the seal is compressed in the axial and radial direction and in the case of

which the groove would fill to a higher level and increased relaxation of tension or, as the case may be, accelerated material aging hence result.

**[0032]** In contrast to known methods, sealing of the motor housing according to various embodiments will also fulfill enhanced specification requirements in terms of storage at different temperatures and temperature-change tests of the kind imposed of late.

**[0033]** A further major advantage is a simplified assembly process for the brush system. There is a robust brush system design. There is no need for silicone rubber overmolding as employed widely hitherto.

**1**. A motor/pump unit comprising:

a motor having a pot-shaped motor housing and a brush plate provided in the motor housing, and

a pump having a pump housing, wherein

the motor is secured axially to an end face of the pump housing,

the brush plate forms the terminating face of the motor with respect to the pump housing,

the edge region of the pot-shaped motor housing facing the pump housing has a seal-accommodating stage,

the region of the brush plate radially adjacent to the edge region of the motor housing likewise has a seal-accommodating stage, and

inserted into said seal-accommodating stages is a seal which is axially compressed through securing of the pump housing on the motor.

**2**. The motor/pump unit according to claim **1**, wherein

the seal-accommodating stage of the brush plate is slanted so that the seal-accommodating stage has sides that enclose an angle less than 90°.

**3**. The motor/pump unit according to claim **1**, wherein

the seal-accommodating stage of the motor housing has a slant on which is provided a monitoring area at which the presence of the seal is detected.

**4**. The motor/pump unit according to claim **1**, wherein the motor is secured axially to an end face of the pump housing by means of a screw connection.

**5**. The motor/pump unit according to claim **1**, wherein a rotor shaft of the motor is ducted through a bearing into the pump housing and secured to the pump housing in a bearing of the pump.

**6**. The motor/pump unit according to claim **2**, wherein the seal-accommodating stage has sides that enclose an angle of about 45°.

**7**. The motor/pump unit according to claim **1**, wherein the seal is circumferential sealing washer.

**8**. A method for sealing motor/pump unit comprising the steps of:

providing a motor having a pot-shaped motor housing and a brush plate provided in the motor housing, and

providing a pump having a pump housing, wherein the brush plate forms the terminating face of the motor with respect to the pump housing, the edge region of the pot-shaped motor housing facing the pump housing and the region of the brush plate radially adjacent to the edge region of the motor housing form a mutually adjacent seal-accommodating stage;

inserting a seal into the mutually adjacent seal-accommodating stage;

securing the motor axially to an end face of the pump housing.

**9**. The method according to claim **8**, wherein

the seal-accommodating stage of the brush plate is slanted so that the seal-accommodating stage has sides that enclose an angle less than 90°.

**10**. The method according to claim **8**, wherein

the seal-accommodating stage of the motor housing has a slant on which is provided a monitoring area at which the presence of the seal is detected.

**11**. The method according to claim **8**, wherein the motor is secured axially to an end face of the pump housing by means of a screw connection.

**12**. The method according to claim **8**, wherein a rotor shaft of the motor is ducted through a bearing into the pump housing and secured to the pump housing in a bearing of the pump.

**13**. The method according to claim **9**, wherein the seal-accommodating stage has sides that enclose an angle of about 45°.

**14**. The method according to claim **9**, wherein the seal is circumferential sealing washer.

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