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ACTUATOR

Abstract

An actuating drive including a housing, which comprises a housing trough and a housing cover, an electric motor arranged in the housing, a gear unit arranged in the housing that has an output gear, and a position detection unit arranged in the housing for detecting a rotational angle position of the output gear, which detection unit comprises a magnet arranged on a rotary axle of the output gear, and a magnetic field sensor unit having a magnetic field sensor designed to detect a magnetic field of the magnet. It is proposed that he housing trough of the housing has a receiving region in which the magnetic field sensor unit is arranged such that the rotary axle of the output gear extends through the magnetic field sensor of the magnetic field sensor unit.

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Background/Summary

FIELD

[0001] The invention relates to an actuating drive.

BACKGROUND

[0002] DE 10 2020 108 860 A1 already discloses an actuating drive having a housing comprising a housing trough and a housing cover. The housing of the actuating drive contains an electric motor, a spur gear with an output gear and a position detection unit for detecting the rotational angle position of the output gear. The position detection unit comprises a magnet arranged on a rotary axle of the output gear and a magnetic field sensor configured to detect a magnetic field of the magnet. The magnetic field sensor of the position detection unit is arranged on a rigid circuit board together with actuating drive control electronics. In order to arrange the magnetic field sensor in the rotary axle of the output gear, the circuit board has a complex geometry. In addition, the arrangement of the magnetic field sensor on the one rigid circuit board makes it difficult to accurately position the magnetic field sensor in the rotary axle of the output gear.

[0003] A corresponding actuating drive is also already known from DE 10 2020 120 241.

[0004] This disclosure provides an actuating drive, which has advantageous properties, in particular with regard to positioning the magnetic field sensor in the rotary axle of the output gear, and/or a compact design.

SUMMARY

[0005] This disclosure provides an actuating drive having a housing, which comprises a housing trough and a housing cover, an electric motor arranged in the housing, a gear unit arranged in the housing that comprises an output gear, and a position detection unit arranged in the housing for detecting a rotational angle position of the output gear, which unit comprises a magnet arranged on a rotary axle of the output gear, and a magnetic field sensor unit comprising a magnetic field sensor designed to detect a magnetic field of the magnet.

[0006] It is proposed that the housing trough of the housing has a receiving region in which the magnetic field sensor unit is arranged such that the rotary axle of the output gear extends through the magnetic field sensor of the magnetic field sensor unit.

[0007] The actuating drive can be used in particular in the automotive sector and/or in automation technology, for example as a flap actuating drive and/or valve actuating drive, for example for needle valves.

[0008] The housing of the actuating drive is designed in particular as a two-part housing. The housing comprises a housing trough and a housing cover, which is fixed to the housing trough when the actuating drive is mounted and at least largely seals the trough against dirt and/or liquid. Preferably, both the housing trough and the housing cover are made of plastics. In particular, the housing trough and the housing cover are injection-molded plastics parts. The housing cover can be connected to the housing trough, for example, by gluing, screwing or, preferably, by laser welding. The electric motor of the actuating drive arranged in the housing trough is designed in particular as a brushless DC motor. The electric motor is designed in particular as an internal rotor motor, which comprises a stator and a rotor rotatably arranged within the stator. The rotor has a pinion which transmits a rotary motion of the rotor to a gear unit of the actuating drive which is also arranged in the housing trough.

[0009] The gear unit is designed in particular as a multi-stage spur gear, wherein an output gear forms the last gear wheel of the gear unit. The gear unit is preferably designed as a reduction gear. The output gear is mechanically coupled to the pinion of the rotor of the electric motor via the further gear wheels of the gear unit so that a rotary motion of the rotor of the electric motor causes a rotary motion of the output gear via the further gear wheels of the gear unit. The output gear is in particular designed to be mechanically coupled to an actuator, for example to cause the actuator to move as a result of a rotary motion of the output gear. The output gear has in particular an output shaft with a suitable driving profile, wherein the output shaft can in particular be designed as a hollow shaft and the driving profile can in particular be arranged on an inner and/or outer circumference of the output shaft. The housing cover comprises a circular recess via which an end of the output shaft that comprises the driving profile is guided out of the housing of the actuating drive or via which an end of the output shaft that comprises the driving profile is accessible for connection to an actuator to be driven by means of the actuating drive. The end of the output shaft that comprises the driving profile is rotatably mounted in the recess in the housing cover, in particular by means of a plain bearing. In addition, a shaft sealing ring is arranged in the recess in the housing cover and is designed to seal the housing of the actuating drive at the output shaft guided out thereof.

[0010] In addition to the electric motor and the gear unit comprising the output gear, a position detection unit is also arranged in the housing trough and is designed to detect a rotational angle position of the output gear during operation of the actuating drive. The position detection unit comprises a magnet arranged on a rotary axle of the output gear. The magnet is arranged on a side of the output gear facing toward the bottom of the housing trough of the actuating drive. In particular, the magnet is fastened to the side of the output gear facing the bottom of the housing trough for conjoint rotation therewith and is arranged on a rotary axle of the output gear. The rotary axle of the output gear extends through a body of the magnet. The rotary axle runs through the magnet body itself, i.e., not through an opening in the magnet body, as is the case with ring-shaped position magnets, for example. In particular, the output gear has a receptacle for the magnet extending toward the bottom of the housing trough. In particular, the magnet is fixed in the receptacle of the output gear by means of a form fit, a force fit and/or an integral bond. The magnet is preferably magnetized in a plane that is perpendicular to the rotary axle of the output gear. The magnet can, for example, be a two-pole magnet having a north pole and a south pole or a multi-pole magnet having more than two poles, e.g., a quadrupole magnet. When the output gear rotates, the magnet moves together with the output gear, which changes the magnetic field generated by the magnet. This change can be detected by means of a magnetic field sensor of the position detection unit, which sensor is arranged in the rotary axle of the output gear such that it cannot move relative to the magnet, and the rotational angle position of the gear wheel can be determined therefrom.

[0011] The magnetic field sensor is in particular designed to detect the strength and/or direction of a magnetic field of the magnet of the position detection unit arranged on the output gear. The magnetic field sensor can be, for example, an inductive magnetic field sensor or a Hall-effect sensor, e.g., a one-dimensional, two-dimensional or three-dimensional Hall-effect sensor, which is designed to measure the strength of the magnetic field in one, two or three spatial directions, respectively. If the output gear is moved, the magnetic field changes at the location of the magnetic field sensor. The rotational angle position of the output gear can thus be determined using the magnetic field measured. To actuate the electric motor, the measured values recorded by the magnetic field sensor are transmitted to a control unit that is also arranged within the housing trough and is designed to actuate the electric motor on the basis of these measured values or to determine the rotational angle position of the output gear on the basis of these measured values in order to allow precise actuation of the electric motor. The magnetic field sensor unit is immovably arranged on the bottom of the housing trough of the actuating drive housing. In particular, the magnetic field sensor unit can be rigidly connected to the bottom of the housing trough in order to at least largely prevent the magnetic field sensor unit from moving. The housing trough has at its bottom a receiving region, which is delimited in particular by a circumferential wall, within which the magnetic field sensor unit is arranged such that the rotary axle of the output gear extends through the magnetic field sensor of the magnetic field sensor unit. The circumferential wall can be designed in particular to at least largely eliminate any axial play of the output gear.

[0012] By means of such a configuration, it is possible to provide an actuating drive of the type in question having advantageous properties, in particular with regard to positioning the magnetic field sensor of the magnetic field sensor unit relative to the magnet of the position detection unit. In particular, by arranging and fixing the magnetic field sensor unit on a bottom of the housing trough, the magnetic field sensor is immovably positioned relative to the magnet arranged on the output gear. Positioning can also be simplified and/or improved by providing a dedicated receiving region in the housing trough for the arrangement of the magnetic field sensor unit.
[0013] It is further proposed that the receiving region is delimited by an annular wall which extends from a bottom of the housing trough and into an interior of the housing and runs concentrically around the rotary axle of the output gear. This makes it possible to achieve precise positioning of the magnetic sensor of the magnetic field sensor unit in relation to the magnet of the magnetic field sensor unit that is arranged on the output gear. The circular wall is integrally formed in particular on the bottom of the housing trough. Preferably, the circular wall is produced during manufacture of the housing trough. This can easily be done by manufacturing the housing trough using plastics injection molding. The circular wall extends from the bottom of the housing trough toward the output gear. The wall encloses the receiving region in the circumferential direction, resulting in a circular base surface for the receiving region. Since the wall runs concentrically around the rotary axle of the output gear, the rotary axle runs vertically through the center of the receiving region. When mounted, the magnetic field sensor unit is arranged in the receiving region such that the magnetic field sensor of the magnetic field sensor unit is located in the center of the receiving region, and therefore the rotary axle of the output gear passes through the magnetic field sensor. In particular, additional alignment elements, such as pins, can be arranged in the receiving region and can make it even easier to precisely position the magnetic field sensor unit. The circular wall of the receiving region can also be used to mount the output gear. For this purpose, the output gear protrudes into the receiving region enclosed by the circular wall, the circular wall forming a plain bearing the output gear.
[0014] It is also proposed that the magnetic field sensor unit comprises a circular rigid circuit board in the center of which the magnetic field sensor is arranged. The circular rigid circuit board allows simple, in particular fully automatic, fitting of the magnetic field sensor. In addition, the circular rigid circuit board allows for precise positioning of the magnetic field sensor unit in the receiving region of the housing trough. The circular rigid circuit board is preferably made of FR4 material. The magnetic field sensor is arranged in particular in the center of the circular circuit board. In particular, the circuit board can have at least two circular through-recesses. The through-recesses are in particular designed to interact with an equal number of alignment elements of the receiving region of the housing trough. At least two cylindrical pins can in particular be arranged in the receiving region of the housing trough as alignment elements, which are designed to be inserted into the circular through-recesses in the circular rigid circuit board when the circular rigid circuit board is inserted into the receiving region of the housing trough. Due to the interaction between the at least two cylindrical pins of the receiving region of the housing trough and the at least two through-recesses in the circular rigid circuit board of the magnetic field sensor unit, the magnetic field sensor unit can be accurately positioned within the receiving region of the housing trough, it thus being possible for the magnetic field sensor of the magnetic field sensor unit to be precisely arranged in the rotary axle of the output gear. It is also conceivable that an outer circumference of the circuit board of the magnetic field sensor unit rests against an inner circumference of the wall of the receiving region when the magnetic field sensor unit is mounted, as a result of which the circular rigid circuit board of the magnetic field sensor unit can also be accurately oriented in the receiving region of the housing trough. Preferably, the circular rigid circuit board of the magnetic field sensor unit is fixed in the receiving region of the housing trough by means of at least one heat-staking connection on the bottom of the housing trough. This can allow the circular rigid circuit board of the magnetic field sensor unit to be reliably and/or simply fixed in the receiving region of

the housing trough. In particular, this fixing can be done via at least two alignment elements of the receiving region of the housing trough, which are designed as cylindrical pins and which pass through at least two corresponding through-recesses in the circular rigid circuit board of the magnetic field sensor unit arranged in the receiving region of the housing trough. For this purpose, free ends of the cylindrical pins protruding from the through-recesses in the circular rigid circuit board of the magnetic field sensor unit are thermally deformed in such a way that mushroom heads are formed that interlockingly fix the circular rigid circuit board of the magnetic field unit at least in the axial direction.

[0015] Furthermore, it is proposed that the actuating drive comprises a control unit which comprises a rigid circuit board arranged in the housing trough above the electric motor when viewed from the bottom of the housing trough. The control unit comprises in particular control electronics for actuating the electric motor, in particular also on the basis of measured values recorded by the magnetic field sensor unit and transmitted to the control unit. The control unit comprises a rigid circuit board on which the control electronics are arranged and which is in particular placed directly on the electric motor, as a result of which stator coils of the electric motor can be directly connected to the rigid circuit board of the control unit. To transmit the measured values from the magnetic field sensor unit to the control unit, the control unit is connected to the magnetic field sensor unit via a plurality of electrical lines. Preferably, the actuating drive comprises a flexible circuit board which electrically connects the rigid circuit board of the control unit to the circular rigid circuit board of the magnetic field sensor unit. This allows the electrical connection between the control unit and the magnetic field sensor unit to be flexible with minimum space requirements. In particular, a height difference between the rigid circuit board of the control unit and the circular rigid circuit board of the magnetic field sensor unit can also be easily bridged. In order to bridge the height difference, the flexible circuit board is preferably guided from the rigid circuit board of the control unit to the bottom of the housing trough and along the bottom of the housing trough to the circular rigid circuit board of the magnetic field sensor unit. The flexible circuit board is formed in particular from a carrier film, for example a polyimide film, to which a plurality of conductor tracks, in particular copper conductor tracks, is applied. The conductor tracks of the flexible circuit board are electrically conductively connected to both the rigid circuit board of the control unit and the circular rigid circuit board of the magnetic field sensor unit.

[0016] In an example, it is proposed that the rigid circuit board of the control unit, the circular rigid circuit board of the magnetic field sensor unit and the flexible circuit board are integrally formed as a rigid-flex circuit board. Rigid-flex circuit boards are hybrids that consist of a combination of at least one conventional rigid circuit board and at least one flexible circuit board. In particular, rigid-flex circuit boards can consist of a plurality of rigid parts that are seamlessly connected to one another by means of a flexible circuit board. Rigid-flex circuit boards therefore form a mechanical and electrical unit. By using a rigid-flex circuit board, polarity and/or contact reliability can be achieved with regard to the electrical conductivity between the control unit and the magnetic field sensor unit. In addition, plug and/or line components can be eliminated.

[0017] In addition, it is proposed that the flexible circuit board is fixed in a region between the rigid circuit board of the control unit and the circular rigid circuit board of the magnetic field sensor unit by means of at least one heat-staking connection on the bottom of the housing trough. This allows the flexible circuit board to be fixed in position in the housing trough. In particular, at least one tab is formed on the carrier film of the flexible circuit board, which has a through-recess. Preferably, a plurality of tabs is formed on the carrier film of the flexible circuit board, each tab having a through-recess. In particular, formed on the bottom of the housing trough is a number of cylindrical pins that corresponds to the number of tabs of the carrier film of the flexible circuit board, which pins are designed to extend through the through-recesses in the tabs of the flexible circuit board arranged on the bottom of the housing trough. Mushroom heads are formed by thermal deformation of the free ends of the cylindrical pins, which mushroom heads fix the flexible circuit board in a form-fitting manner to the bottom of the housing trough, at least in the axial direction.

[0018] The output gear can be directly slidingly and rotatably mounted by means of the circular wall, which limits the receiving region of the housing trough. Alternatively, however, it is conceivable that the actuating drive has an annular plain bearing element for mounting the output gear such that it rotates about the rotary axle, which gear is arranged in the receiving region of the housing trough. The plain bearing element can in particular consist of a plastics material with good sliding properties. The plain bearing element has in particular an outer diameter which substantially corresponds to an inner diameter of the circular wall of the receiving region of the housing trough such that the plain bearing element rests in an assembled state with its outer circumference on the inner circumference of the circular wall of the receiving region of the housing trough, at least substantially without any play. In particular, the circular wall of the receiving region of the housing trough can have a step on which the sliding bearing element rests in an assembled state such that the sliding bearing element is axially spaced apart from the bottom of the housing trough and the circular rigid circuit board of the magnetic field sensor unit arranged on the bottom of the housing trough in the receiving region.

[0019] The actuating drive is not intended to be limited to the application and examples described above. In particular, the actuating drive can have a number of individual elements, components and units that differs from the number mentioned herein in order to fulfill a function described herein.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] Further advantages can be found in the following description of the drawings. The drawings show an example of the actuating drive of this disclosure. The drawings, the description and the claims contain numerous features in combination. Those skilled in the art will also expediently consider the features on their own and combine them into further meaningful combinations.

[0021] In the drawings:

[0022] FIG. **1** is an exploded view of an actuating drive;

[0023] FIG. **2** is a sectional view of the actuating drive in FIG. **1**

[0024] FIG. **3** is a perspective plan view of the actuating drive from FIG. **1** shown without the housing cover and gear unit; and

[0025] FIG. **4** is a sectional view of an output gear of the actuating drive from FIG. **1**.

DETAILED DESCRIPTION

[0026] FIG. **1** is an exploded view of an actuating drive **10**. FIG. **2** shows the actuating drive **10** in a sectional view. The actuating drive **10** has a two-part housing **12**, which comprises a housing trough **14** and a housing cover **16**. The housing trough **14** and the housing cover **16** of the housing **12** are preferably designed as injection molded plastics parts. In an assembled state of the actuating drive **10**, the housing trough **14** is closed by means of the housing cover **16**. In particular, the housing cover **12** can be glued or welded to the housing trough **14**.

[0027] The actuating drive **10** further comprises an electric motor **18**, which is arranged in the housing trough **14** of the housing **12**. The electric motor **18** is preferably designed as a brushless DC motor. The actuating drive **10** has a control unit **44** with a rigid circuit board **46**. In particular, control electronics for actuating the electric motor **18** are arranged on the rigid circuit board **46** of the control unit **44**. The rigid circuit board **46** of the control unit is placed directly on the electric motor **18**. Viewed from a bottom **38** of the housing trough **14** of the housing **12**, the rigid circuit board **46** of the control unit **44** is arranged above the electric motor **18**.

[0028] The electric motor **18** comprises a stator **56** and a rotor **58** that is rotatably mounted within the stator **56**. The rotor **58** is rotatably mounted on a stationary axle **60** and rotates about this stationary axle **60** during operation of the electric motor **18**. The rotor **58** has a pinion **62** which is designed to transmit a rotary motion of the rotor **58** to a gear unit **20** of the actuating drive **10**. The gear unit **20** of the actuating drive **10**, as well as the electric motor **18**, is arranged in the housing trough **14** of the housing **12**. The gear unit **20** is designed as a multi-stage spur gear with a plurality of gear wheels, wherein an output gear **22** forms the last gear wheel of the gear unit **20**. The output gear **22** is coupled to the pinion **62** of the rotor **58** of the electric motor **18** via the other gear wheels of the gear unit so that a rotary motion of the rotor **58** is transmitted to the output gear **22** via the gear wheels arranged between the pinion **62** and the output gear **22**.

[0029] The output gear **22** is designed to be mechanically coupled to an actuator (not shown here), for example to transform a rotary motion of the output gear **22** into a movement of the actuator. The output gear **22** comprises an output shaft **64** designed as a hollow shaft, which has a driving profile **72** for mechanically coupling to an actuator to be driven. The housing cover **16** has a circular recess **74** in which the output shaft **64** of the output gear **22** is mounted so as to rotate about a rotary axle **28** by means of a plain bearing **68**. In the recess **74** in the housing cover **16**, there is also arranged a shaft sealing ring **70**, which is designed to seal the housing **12** of the actuating drive **10** at the output shaft **64** of the output gear **22** guided out thereof.

[0030] To detect a rotational angle position of the output gear **22**, the actuating drive **10** comprises a position detection unit **24**, which is also arranged in the housing trough **14** of the housing **12**. The position detection unit **24** has a magnet **26** which is arranged on the rotary axle **28** of the output gear **22**. The magnet **26** is arranged on a side of the output gear **22** facing the direction of the bottom **38** of the housing trough **14** of the housing **12**. In order to arrange the magnet **26** in the rotary axle **28** of the output gear **22**, the output gear **22** has a receptacle **76** for the magnet **26** that extends in the direction of the bottom **38** of the housing trough **14** of the housing **12**. The magnet **26** is arranged within the receptacle **76** of the output gear **22** for conjoint rotation. The magnet **26** can in particular be fixed in the receptacle **76** of the output gear **22** by means of a form fit, force fit and/or integral bond. For example, the magnet **26** can be pressed into and/or glued in the receptacle **76**. Alternatively, however, it is also conceivable that the magnet **26** is fixed in the receptacle, as shown in FIG. **4**, by the deformation, in particular thermal deformation, of a wall **78** of the receptacle **76**. The magnet **26** is arranged in the receptacle **76** such that the rotary axle **28** of the output gear **22** extends through a body of the magnet **26**. The magnet **26** is preferably magnetized in a plane perpendicular to the rotary axle **28** of the output gear **22**. The magnet **26** can, for example, be a two-pole magnet with a north pole and a south pole or a multi-pole magnet with more than two poles, e.g., a quadrupole magnet.

[0031] In addition to the magnet **26**, the position detection unit **24** has a magnetic field sensor unit **30** with a magnetic field sensor **32**. The magnetic field sensor **32** of the magnetic field sensor unit **30** is configured to detect a magnetic field of the magnet **26**. The housing trough **14** of the housing **12** has a receiving region **34** in which the magnetic field sensor unit **30** is arranged such that the rotary axle **28** of the output gear **22** extends through the magnetic field sensor **32** of the magnetic field sensor unit **30**. When the output gear **22** rotates, the magnet **26** also rotates relative to the magnetic field sensor **32** of the magnetic field sensor unit **30**. This changes the magnetic field at the location of the magnetic field sensor **32** of the magnetic field sensor unit **30**. The rotational angle position of the output gear **22** can be determined using the measured magnetic field.

[0032] The receiving region **34** for receiving the magnetic field sensor unit **30** is delimited by an annular wall **36**. The wall of the receiving region **34** extends from the bottom **38** of the housing trough **14** of the housing **12** into an interior of the housing **12** and thus in the direction of the output gear **22**. The wall **34** of the receiving region **34** runs concentrically about the rotary axle **28** of the output gear **22**. The receiving region **34** thus has a circular base surface, wherein the rotary axle **28** of the output gear **22** runs perpendicularly through the center of the circular base surface of the receiving region **34** (cf. FIG. **3**).

[0033] The magnetic field sensor unit **30** has a circular, rigid circuit board **40** in the middle of which the magnetic field sensor **32** is arranged. The circular rigid circuit board **40** of the magnetic field sensor unit **30** is arranged in the receiving region **34** such that the magnetic field sensor **32** is located at the center of the circular base surface of the receiving region **34**. The magnetic field sensor **32** of the magnetic field sensor unit **30** is arranged such that the rotary axle **28** of the output gear **22** extends through the magnetic field sensor **32** of the magnetic field sensor unit **30**. The circular, rigid circuit board **40** of the magnetic field sensor unit **30** is fixed in the receiving region **34** of the housing trough **14** by means of two heat-staking connections **42** on the bottom **38** of the housing trough **14** of the housing **12**. To produce the heat-staking connections **42**, the circular, rigid circuit board **40** of the magnetic field sensor unit **30** has two through-recesses **90**. Two cylindrical pins (not shown here) are formed on the bottom **38** of the housing trough **14** in the receiving region **34** and are designed to extend through the through-recesses **90** in the circular rigid circuit board **40** of the magnetic field sensor unit **30** arranged on the bottom **38** of the housing trough **14**. Through thermal deformation of free ends of the cylindrical pins, mushroom heads **92** are formed which fix the circular rigid circuit board **40** of the magnetic field sensor unit **30** in the receiving region **34** on the bottom **38** of the housing trough **14** (cf. FIG. **3**).

[0034] To connect the circular rigid circuit board **40** of the magnetic field sensor unit **30** to the rigid circuit board **46** of the control unit **44**, the actuating drive **10** has a flexible circuit board **48**. The flexible circuit board **48** consists in particular of a carrier film to which a plurality of conductor tracks is applied. In order to bridge the height difference between the rigid circuit board **46** of the control unit **44** and the circular rigid circuit board **40** of the magnetic field sensor unit **30**, the flexible circuit board **48** is guided from the rigid circuit board **46** of the control unit to the bottom **38** of the housing trough **14** and along the bottom **38** of the housing trough **14** of the housing **12** to the circular rigid circuit board **40** of the magnetic field sensor unit **30** (cf. FIG. **3**). Here, the flexible circuit board **48** is deflected twice, each time at an angle of at least substantially 90°. In order to guide the flexible circuit board **48** along the bottom **38** of the housing trough **14** of the housing **12** into the receiving region **34** for the magnetic field sensor unit **30**, the circular wall **36** of the receiving region **34** has a recess **80** facing the direction of the electric motor **18**, through which recess the flexible circuit board **48** is guided. Preferably, the rigid circuit board **46** of the control unit **44**, the circular rigid circuit board **40** of the magnetic field sensor unit **30** and the flexible circuit board **48** are integrally formed as a rigid-flex circuit board **50**. In this case, in particular, the use of additional plug connectors can be dispensed with in order to electrically connect the flexible circuit board **48** to the rigid circuit board **46** of the control unit **44** and the circular rigid circuit board **40** of the magnetic field sensor unit **30**. In a region between the rigid circuit board **46** of the control unit **44** and the circular rigid circuit board **40** of the magnetic field sensor unit **30**, the flexible circuit board **48** is fixed to the bottom **38** of the housing trough **14** by means of two heat-staking connections **52**. To produce the heat-staking connections **52**, the flexible circuit board **48** has two tabs **84**, with a through-recess **86** formed in each tab **84**. Two cylindrical pins (not shown here) are formed on the bottom **38** of the housing trough **14** and are designed to extend through the through-recesses **86** in the tabs **84** of the flexible circuit board **48** arranged on the bottom **38** of the housing trough **14**. By thermal deformation of free ends of the cylindrical pins, mushroom heads **88** are formed which fix the flexible circuit board **48** to the bottom **38** of the housing trough **14** (cf. FIG. **3**).

[0035] In order to also mount the output gear **22** on a side opposite the output shaft **64** so that it can rotate about the rotary axle **28**, the actuating drive **10** has an annular plain bearing element **54** which is arranged in the receiving region **34** of the housing trough **14**. The sliding bearing element **54** is preferably made of a plastics material with good sliding properties. An outer diameter of the plain bearing element **54** corresponds at least substantially to an inner diameter of the circular wall **36** of the receiving region **34** of the housing trough **14**. In an assembled state, the outer circumference of the plain bearing element **54** rests against the inner circumference of the circular wall of the receiving region **34** of the housing trough **14**. The circular wall **36** of the receiving

region **34** of the housing trough **14** has a step **82** on which the sliding bearing element **54** rests in an assembled state such that the sliding bearing element **54** is arranged axially spaced apart from the bottom **38** of the housing trough **14**. This allows the flexible circuit board **48** to be guided under the plain bearing element **54** into the receiving region **34** of the housing trough **14**.
TABLE-US-00001 List of reference numerals 10 actuating drive 12 housing 14 housing trough 16 housing cover 18 electric motor 20 gear unit 22 output gear 24 position detection unit 26 magnet 28 rotary axle 30 magnetic field sensor unit 32 magnetic field sensor 34 receiving region 36 receiving region wall 38 bottom 40 circular circuit board 42 heat-staking connection 44 control unit 46 circuit board control unit 48 flexible circuit board 50 rigid-flex circuit board 52 heat-staking connection 54 plain bearing element 56 stator 58 rotor 60 axle 62 pinion 64 output shaft 68 plain bearing 70 shaft sealing ring 72 driving profile 74 cover recess 76 receptacle 78 receptacle wall 80 recess 82 step 84 tab 86 through-recess 88 mushroom head 90 through-recess 92 mushroom head

Claims

1. An actuating drive comprising a housing, which comprises a housing trough and a housing cover, an electric motor arranged in the housing, a gear unit arranged in the housing that has an output gear and a position detection unit arranged in the housing for detecting a rotational angle position of the output gear, which detection unit comprises a magnet arranged on a rotary axle of the output gear and a magnetic field sensor unit having a magnetic field sensor which is designed to detect a magnetic field of the magnet, wherein the housing trough of the housing has a receiving region in which the magnetic field sensor unit is arranged such that the rotary axle of the output gear extends through the magnetic field sensor of the magnetic field sensor unit.
2. The actuating drive according to claim 1, wherein the receiving region is delimited by an annular wall which extends from the bottom of the housing trough and into the interior of the housing and runs concentrically around the rotary axle of the output gear.
3. The actuating drive according to claim 1, wherein the magnetic field sensor unit comprises a circular, rigid circuit board in the center of which the magnetic field sensor is arranged.
4. The actuating drive according to claim 3, wherein the circular rigid circuit board of the magnetic field sensor unit is fixed in the receiving region of the housing trough by means of at least one heat-staking connection on the bottom of the housing trough.
5. The actuating drive according to claim 3, further comprising a control unit which comprises a rigid circuit board which is arranged in the housing trough above the electric motor when viewed from the bottom of the housing trough.
6. The actuating drive according to claim 5, further comprising a flexible circuit board which electrically connects the rigid circuit board of the control unit to the circular rigid circuit board of the magnetic field sensor unit.
7. The actuating drive according to claim 6, wherein the flexible circuit board is guided from the rigid circuit board of the control unit to the bottom of the housing trough and along the bottom of the housing trough to the circular rigid circuit board of the magnetic field sensor unit.
8. The actuating drive according to claim 6, wherein the rigid circuit board of the control unit, the circular rigid circuit board of the magnetic field sensor unit and the flexible circuit board are integrally formed as a rigid-flex circuit board.
9. The actuating drive according to claim 6, wherein the flexible circuit board is fixed in position in a region between the rigid circuit board of the control unit and the circular rigid circuit board of the magnetic field sensor unit by means of at least one heat-staking connection on the bottom of the housing trough.
10. The actuating drive according to claim 1, further comprising an annular plain bearing element

for mounting the output gear such that it can rotate about the rotary axle, which bearing element is arranged in the receiving region of the housing trough.