United States Patent	12394610
Kind Code	B2
Date of Patent	August 19, 2025
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Magnetron target coupling and support device

Abstract

Disclosed herein are devices, methods, and systems related to a magnetron-target coupling that includes a target coupling flange, a shaft fixedly coupled to the target coupling flange on a face opposite the target coupling flange, and having a first linear bearing component on a face opposite the target coupling flange. The magnetron-target coupling also includes a communication interface having a first communication electrode and a second communication electrode that are electrically coupled to each other wherein the second communication electrode is fixedly attached to the target coupling flange on a side opposite the shaft, the target coupling flange being disposed between the first communication electrode and the second communication electrode. The first communication electrode is supported such that it may be moved toward and/or away from the second communication electrode.

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Appl. No.: **18/054560**

Filed: **November 11, 2022**

Prior Publication Data

Document Identifier	Publication Date
US 20230154733 A1	May. 18, 2023

Foreign Application Priority Data

DE	10 2021 129 533.5	Nov. 12, 2021

Publication Classification

Int. Cl.: **H01J37/34** (20060101)

U.S. Cl.:

CPC **H01J37/3435** (20130101); **H01J37/3405** (20130101);

Field of Classification Search

CPC: H01J (37/3435); H01J (37/3405); H01J (37/342); H01J (37/345); H01J (37/3455); H01J (37/347); C23C (14/35); C23C (14/3407)

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION(S)
(1) This application claims priority to German Patent Application No. 10 2021 129 533.5, filed on Nov. 12, 2021, the contents of which are fully incorporated herein by reference.
TECHNICAL FIELD
(2) Various embodiments relate to a magnetron-target coupling and a support/bearing device.
BACKGROUND
(3) In general, workpieces or substrates may be processed, e.g., machined, coated, heated, etched, and/or structurally modified. For example, one process for coating a substrate is cathode sputtering (referred to as sputtering), which is of the physical vapor deposition (PVD) type. By means of sputtering (i.e. by means of a sputtering process), for example, one layer or plurality of layers may be deposited on a substrate. For this purpose, a plasma-forming gas may be ionized by means of a cathode, and a material to be deposited (target material) may be sputtered by means of the plasma formed in the process. The atomized target material may then be brought to a substrate on which it may be deposited and form a layer.
(4) Modifications of cathode sputtering are sputtering by means of a magnetron, so-called magnetron sputtering, or so-called reactive magnetron sputtering. In this process, the formation of the plasma may be supported by means of a magnetic field. The magnetic field may be generated by a magnet system and penetrate the cathode (then also referred to as magnetron cathode), so that a toroidal plasma channel, a so-called racetrack, may be formed on the surface of the target material (target surface), in which plasma may form.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) In the drawings, like reference characters generally refer to the same parts throughout the different views. The drawings are not necessarily to scale, emphasis instead generally being placed upon illustrating the exemplary principles of the disclosure. In the following description, various exemplary aspects of the disclosure are described with reference to the following drawings, in which:
(2) FIGS. **1** and **2** each show a magnet system according to different embodiments in different views;
(3) FIG. **3**A shows a sputtering device according to different embodiments in various schematic views;
(4) FIG. **3**B shows a magnet system of the sputtering device;
(5) FIG. **4** shows a magnet system according to different embodiments in different views;
(6) FIG. **5** shows a sputtering device according to different embodiments in various schematic views;
(7) FIG. **6** shows a schematic cross-sectional view of a housing cover of a magnet system according to various embodiments;
(8) FIG. **7** shows a magnetron-target coupling according to various embodiments in different schematic views;
(9) FIG. **8** shows a communication assembly according to different embodiments in different schematic views;
(10) FIG. **9** shows a bearing device according to various embodiments in a schematic cross-sectional view;
(11) FIG. **10** shows a sputtering device according to different embodiments in various schematic

views;
(12) FIG. **11** shows a schematic perspective view of a pivot bearing of the bearing device according to various embodiments;
(13) FIG. **12** shows a magnetron-target coupling according to various embodiments in different schematic views; and
(14) FIG. **13** shows a communication assembly according to different embodiments in different schematic views.

DESCRIPTION

(15) The following detailed description refers to the accompanying drawings that show, by way of illustration, exemplary details and features.
(16) With respect to magnetic fields and sputtering, the spatial distribution of the plasma or the associated atomization rate depends very sensitively on the spatial distribution of the magnetic field. Therefore, the magnet system is of particular importance with respect to various process properties, such as process stability, reproducibility, target utilization and homogeneity. Against this background, there is a fundamental need to improve the magnet system, for example to simplify it and/or to reduce disturbing influences.
(17) One aspect of various embodiments may be illustratively seen in providing communication with an adjustable magnetic field. By means of adjusting the magnetic field, an atomization of the target material may be influenced, for example in such a way that an atomization and/or coating as uniform as possible may take place. In this respect, it was illustratively recognized that the components used for communication are subject to various disturbances, which makes communication with the magnetic system or adjustment of the magnetic field more difficult.
(18) According to various embodiments, a cohesive assembly is provided in the form of a magnetron-target coupling that includes an axially adjustable communication interface. The communication interface may provide a communicative coupling of the magnetron system with the bearing device so that the magnetron system may be controlled more reliably. Illustratively, the axially adjustable communication interface achieves that tolerances and thermal expansion are better compensated. This reduces interference with communication with the magnet system.
(19) The communication interface is optionally configured for contactless communication with the magnet system or with the bearing device, which reduces wearing or avoids moving sliding contacts.
(20) In the following, reference is made to the accompanying drawings which form part thereof and in which are shown, for illustrative purposes, specific embodiments in which the invention may be practiced. In this regard, directional terminology such as “top”, “bottom”, “front”, “rear”, “forward”, “rearward”, etc. is used with reference to the orientation of the figure(s) described. Since components of embodiments may be positioned in a number of different orientations, the directional terminology is for illustrative purposes and is not limiting in any way. It is understood that other embodiments may be used and structural or logical changes may be made without departing from the scope of protection. It is understood that the features of the various exemplary embodiments described herein may be combined, unless otherwise specifically indicated. Therefore, the following detailed description is not to be construed in a limiting sense, and the scope of protection is defined by the appended claims.
(21) In the context of this description, the terms “connected”, “attached” as well as “coupled” are used to describe both a direct and an indirect connection (e.g. ohmic and/or electrically conductive, e.g. an electrically conductive connection), a direct or indirect connection as well as a direct or indirect coupling. In the figures, identical or similar elements are given identical reference signs where appropriate.
(22) According to various embodiments, the term “coupled” or “coupling” may be understood in the sense of a (e.g. mechanical, hydrostatic, thermal and/or electrical), e.g. direct or indirect, connection and/or interaction. For example, a plurality of elements may be coupled together along

an interaction chain along which the interaction may be exchanged, e.g., a fluid (then also referred to as fluidically coupled). For example, two coupled elements may exchange an interaction with each other, e.g., a mechanical, hydrostatic, thermal, and/or electrical interaction. A coupling of a plurality of vacuum components (e.g., valves, pumps, chambers, etc.) to each other may have them fluidically coupled to each other. According to various embodiments, “coupled” may be understood in the sense of a mechanical (e.g., bodily or physical) coupling, e.g., by means of direct physical contact. A coupling may be configured to transmit a mechanical interaction (e.g., force, torque, etc.).

(23) The term “bearing device” as used herein means a device (for example comprising an assembly) configured for bearing (e.g. guided positioning and/or holding) one or more than one component. The bearing device may comprise, for example per component (which is supported by means thereof), one or more than one bearing for supporting (e.g. guided positioning and/or holding) the component. Each bearing of the bearing device may be configured to provide the component with one or more than one degree of freedom (for example, one or more than one translational degree of freedom and/or one or more than one rotational degree of freedom) according to which the component may be moved. Examples of a bearing have: Radial bearing, thrust bearing, radial-axial bearing, linear bearing (also referred to as linear guide).

(24) The term “sputtering” refers to the atomization of a material (also referred to as coating material or target material), which is provided as a so-called target, by means of a plasma. The atomized components of the target material are thus separated from each other and may be deposited elsewhere, for example to form a layer. Sputtering may be performed by means of a so-called sputtering device, which may have a magnet system (in which case the sputtering device is also referred to as a magnetron). For sputtering, the magnetron may be placed in a vacuum processing chamber so that sputtering may be performed in a vacuum. To this end, the environmental conditions (the process conditions) within the vacuum processing chamber (e.g., pressure, temperature, gas composition, etc.) may be adjusted or controlled during sputtering. For example, the vacuum processing chamber may be or may be configured to be air-tight, dust-tight, and/or vacuum-tight, such that a gas atmosphere having a predefined composition or pressure (e.g., according to a set point) may be provided within the vacuum processing chamber. For example, an ion-forming gas (process gas) or a gas mixture (e.g., of a process gas and a reactive gas) may be or be provided within the vacuum processing chamber. In a reactive magnetron sputtering process, for example, the atomized material may react with a reactive gas (e.g., comprising oxygen, nitrogen, and/or carbon) and the resulting reaction product (e.g., a dielectric) may be deposited.

(25) Sputtering may be performed by means of a so-called tubular magnetron, in which a tubular target (also referred to as a tube target or tubular cathode) containing the target material rotates axially around the magnet system. By adjusting the magnet system or by changing the magnetic field generated by it, the sputtering of the target material and thus the spatial distribution with which the target is ablated may be influenced.

(26) The tubular cathode and the magnet system may be supported by means of a bearing device (also referred to as a target bearing device) that rotatably supports the tubular cathode relative to the magnet system, for example. The bearing device may have, for example, one or more than one end block, each end block of the bearing device holding an end portion of the tubular cathode and magnet system, respectively. The bearing device (e.g., its one or more than one end block) may further provide a supply of electrical power, rotary motion, and/or cooling fluid to the tubular cathode.

(27) According to various embodiments, an end block (then also referred to as a drive end block) of the sputtering device may include a drive train for transmitting rotary motion to the tubular cathode, which may be coupled to a drive, for example. Alternatively or additionally, an end block (also referred to as a media end block) of the sputtering device may be configured to supply and discharge cooling fluid (e.g., a water-based mixture) that may be passed through the cathode.

(28) However, exactly one end block (also referred to as a compact end block) may be used, which has the drive train and fluid line and thus provides the functions of a drive end block and a media end block together. For example, the side of the tube target opposite the compact end block may be freely cantilevered (i.e., freely suspended), or supported by means of a bearing block, which is referred to as a cantilever configuration.
(29) The magnet system may be multipolar, i.e., have multiple magnetic poles. Of the plurality of magnetic poles, a first magnetic pole (also referred to as an outer pole) may extend along a self-contained path (also referred to as a circulatory path) and a second magnetic pole may be disposed within the area enclosed by the circulatory path (also referred to as an inner pole). The circulatory path may be oval-shaped, for example. Each magnetic pole may have a plurality of magnets lined up in series (then also referred to as a series of magnets or a series of magnets), each magnet being magnetized or having a magnetization. For example, each magnetic pole may have at least 10 (e.g., at least 100) magnets per meter. For example, two or more rows of magnets disposed between the end pieces of the magnet system may provide substantially the center region of the magnet system (illustratively, one row provides the inner pole, and one row of magnets on each side of the inner pole provides the outer pole). Generally, the outer pole and the inner pole may be spaced apart from each other and/or may differ from each other in their direction of magnetization and/or in their number of magnets.
(30) The magnet system, e.g. its so-called magnet bar, may optionally have several segments (also referred to as magnet system segment or as magnet system group) arranged one behind the other and/or spatially separated from each other (e.g. multipolar), of which two segments (also referred to as reversing segments or end pieces) are arranged at the end faces (illustratively at the magnet system end) of the magnet system and of which one or more than one optional segment (also referred to as middle piece) is arranged between the end pieces. Reference is made herein by way of example to a magnet system having a plurality of magnet system groups, wherein what is described with respect thereto may also apply to an unsegmented magnet system, or what is described with respect to one magnet system group may apply by analogy to a plurality of magnet system groups, and vice versa.
(31) According to various embodiments, the term “resilient” may be understood with reference to an object being deformable (also referred to as flexible) against a restoring force. The deformability may be or be provided by the resilient object comprising or being made of an elastic material, e.g., an elastomer. Alternatively or additionally, the deformability (e.g., extensibility) may be or be provided by the resilient object comprising or being made of a material having high strength (e.g., flexural strength), e.g., a steel spring. Deformability (e.g., ductility) refers to the ability of the object to deform from an initial state (e.g., initial shape) against the restoring force when subjected to a mechanical load and, when the load disappears, to return to the initial state (e.g., without damage). Starting from the initial state x (e.g., an extent x), the ratio F of the deformation Δx (e.g., a change in extent Δx) to the initial state (e.g., an initial extent), i.e., $\varepsilon=\Delta x/x$, also denotes the relative deformability (also referred to as elongation with respect to extent). According to various embodiments, the resilient object (e.g., the gas guiding structure) may be configured for a relative deformability greater than about 10%, e.g., about 25%, e.g., about 50%, e.g., about 75%.
(32) In the following, the functionality and structure of the magnet system and sputtering device are first explained to simplify the understanding of the magnetron-target coupling provided.
(33) Herein reference is made to a communication interface configured for length compensation, for example by having two electrically coupled communication electrodes whose distance from each other is configured to be variable (e.g. by means of a linear bearing), e.g. such that they may perform an axial relative movement to each other. This configuration is useful if the bearing electrode is fixedly (e.g., rigidly) coupled to the bearing frame (which it does not necessarily have to be). Alternatively or additionally, the distance of the bearing electrode from the bearing frame may be configured variably (e.g. by means of a linear bearing), e.g. in such a way that they may

perform an axial relative movement to each other. Then the two electrically coupled communication electrodes of the communication interface may (but do not necessarily have to) be fixedly (e.g., rigidly) coupled to each other.
(34) Thus, it may be understood that what is described herein with respect to the relative movement of the two electrically coupled communication electrodes may apply by analogy to the bearing electrode. More generally, the communication electrode (which is directly opposite the bearing electrode) and/or the bearing electrode may be supported such that a change in the separation distance thereof from each other when the magnetron-target coupling is moved a segment relative to the bearing frame is less than the segment. Similarly, length compensation may be implemented at the end of the target opposite the communication interface, for example, when no relative axial movement is possible between the four electrodes.
(35) FIG. **1** illustrates a magnet system **100** according to various embodiments in a schematic detailed view, e.g., looking at that direction **101** (also referred to as reference direction **101**) along which the magnet system **100** is elongated. For example, the magnet system may have a length (extent along the reference direction **101**) of more than about 0.5 m (meters) and/or less than about 6 m, e.g., in a range from 2 m about to about 5 m and/or more than 3 m.
(36) The magnet system **100** may include a plurality of magnets **104** and a carrier **160** configured to support the magnets **104** of the magnet system **100**. The support structure **160** may include at least one (i.e., one or more than one) carriers **102**, **202** (also referred to as magnet carriers or magnet holders), a first carrier **102** (also referred to as a first magnet carrier/holder or system carrier) of which is configured to support one or more than one magnet system group **150** of the magnet system **100** (e.g., magnets **104** thereof).
(37) For example, the magnet system **100** may include one or more than one magnet system group **150** per system support **102**, e.g., multiple magnet system groups **150** per system support **102**. Each magnet system group **150** may include multiple (e.g., three or more) magnets **104** and may optionally be configured to be adjustable. At least two magnets **104** per magnet system group **150** may differ in their direction of magnetization.
(38) Each adjustably configured magnet system group **150** may include an adjustment device **150***s* that is, for example, (e.g., partially) disposed between and/or couples the system support **102** and the magnet(s) **104** of the magnet system group **150**. The adjustment device **150***s* may be configured to change a spatial distribution of the magnetic field **120** generated by the magnet system group **150**, for example, by changing a spatial distribution (e.g., position and/or orientation) of the magnet(s) **104** of the magnet system group **150**. For example, the adjustment device **150***s* may be a component of the support structure **160** and configured to change the spatial position and/or orientation of at least one magnet of the magnet system **100**.
(39) Exemplary components of the adjustment device **150***s* include: a bearing device **116** (also referred to as a group bearing device) and/or an actuator **106**. The adjustment device **150***s* (e.g., its group bearing device **116** and/or actuator **106**) may couple the or each magnet **104** of the magnet system group **150** to the system support **102**. The group bearing device **116** may provide the magnets **104** with one or more than one translational degrees of freedom **111**, of which a first translational degree of freedom **111** may be along the reference direction **101** and/or one or more than one second translational degrees of freedom may be transverse to the reference direction **101**.
(40) Further, the support structure **160** may include, e.g., per magnet system group **150**, a second carrier **202** (also referred to as a second magnet carrier/holder or a group carrier) that couples the plurality of magnets **104** (see also FIG. **2**) to each other and/or to the adjustment device **150***s*. In that case, the or each group carrier **202** may be magnetic (then providing the so-called return carrier) and the system carrier **102** may be non-magnetic.
(41) The actuator **106** may be configured to mechanically move the magnets **104** according to one or more than one translational degrees of freedom **111** (also referred to as actuation). To this end, the actuator **106** may be coupled to the magnet **104** and/or the system support **102** such that when

the actuator **106** is actuated, a position (i.e., orientation and/or position) of the magnet **104** relative to the system support **102** may be changed, e.g., according to a desired state.

(42) To generate the motion, the actuator **106** may include an electromechanical transducer (e.g., an electric motor or piezoelectric actuator). The electromechanical transducer may be configured to generate translational motion (e.g., in the case of a linear electric motor) or to generate rotational motion (e.g., in the case of a rotary electric motor). To transmit motion to the magnets **104**, the actuator **106** may optionally include a gearbox (also referred to as an actuator).

(43) To supply electrical power (also referred to as supply power) to the actuator **106** and/or to supply a communication signal to the actuator **106**, the actuator **106** may be coupled to one or more than one electrical line **108**. In principle, the communication signal and the supply power may be supplied together via one line **108**, but need not be. They may also be supplied via separate lines **108**.

(44) FIG. **2** illustrates the magnet system **100** according to various embodiments **200** in a schematic perspective view, in which the magnet system **100**, e.g., each of its magnet system groups **150**, comprises a plurality of spatially separated magnet rows **204***a*, **204***i* mounted on (e.g., magnetically coupled to) a common group support **202**. Each of the magnet rows **204***a*, **204***i* may have a plurality of magnets of the same magnetization direction arranged in series one behind the other. At least the middle magnet row **204***i*, which is arranged between two magnets of the outer magnet row **204***a*, may be elongated in the reference direction **101**.

(45) FIG. **3**A illustrates a sputtering device **300** according to various embodiments in a schematic side view or cross-sectional view, and FIG. **3**B illustrates the magnet system **100** of the sputtering device **300** in a schematic detailed view **300***b*.

(46) The sputtering apparatus **300** may include a bearing device **350** (also referred to as a target bearing device) for rotatably supporting a tubular target **302** (also referred to as a tube target). The target bearing device **350** may include one or more than one end block **312***a*, **312***b* by means of which the tubular target **302** may be rotatably supported, e.g., about an axis of rotation **311**, and/or supplied. For this purpose, the target bearing device **350** (e.g., each end block **312***a*, **312***b*) may comprise one or more than one corresponding pivot bearing **950** (see also FIG. **9**).

(47) Per rotary bearing **950**, the target bearing device **350** may include, for example, a magnetron-target coupling **301** coupled to the rotary bearing **950**. The magnetron-target coupling **301** is configured to hold the target **302** and the magnet system **100**, such that the target **302** may be rotated around the magnet system **100**. For example, the magnetron-target coupling **301** may include a target connection flange **702** (cf. FIG. **7**) that is rotatably supported by means of the pivot bearing **950** and to which the tubular target **302** may be coupled. The axis of rotation **311** may be along reference direction **101** or along a shaft axis of the magnetron-target coupling **301**.

(48) A first end block **312***a* of the target storage device **350** may be configured as a drive end block **312***a*, i.e., having a drive train **302***a* for rotating the tubular target **302**. A second end block **312***b* of the target bearing device **350** or the first end block **312***a* may be configured as a media end block **312***b*, i.e., for supplying and discharging a cooling fluid (e.g., comprising water) and/or for supplying electrical power to the tubular cathode **302**. The cooling fluid may be directed through the tubular target **302**.

(49) The drive train **302***a* may be coupled to or include a drive device (e.g., a motor) disposed outside of the drive end block **312***a*. By means of the drive train **302***a*, torque may be coupled to the tubular target **302** for driving rotational movement of the tubular target **302**.

(50) Further, the sputtering device **300** may include the magnet system **100** held by the bearing device **350**, e.g., stationary and/or rotationally fixed relative to a gravitational direction. For example, the magnet system **100** may remain in a fixed orientation with respect to the direction of gravity when the tubular target **302** is rotated (around the magnet system **100**).

(51) The bearing device **350** may have a rotatably mounted target connection flange **702** (cf. FIG. **7**) per end block **312***a*, **312***b*, by means of which the tubular target **302** may be coupled, e.g. to the

drive train **302***a* and/or to the cooling fluid supply (e.g. having one or more than one fluid line). For example, the target connection flange **702** (cf. FIG. **7**) may be configured for releasable connection to the target **302**, such that assembly and disassembly of the tubular target **302** are possible. The target coupling **301**, e.g. its target connection flange **702**, may optionally be penetrated by a fixed bearing by means of which the magnet system **100** may be supported.

(52) Detail view **300***b* illustrates an exemplary pair of magnet system assemblies **150**, each magnet system assembly comprising an assembly support **202**; a plurality of magnets **104** coupled together (e.g., magnetically) by the assembly support **202**; and an electrical actuator **106** configured to adjust the position of the assembly supports **202** and/or the magnets **104** relative to the system support **102** and/or relative to each other in response to the electrical communication signal supplied to the actuator **106**. For example, the actuator **106** includes an electric motor **106***m* and an optional positioning gear **106***g*. The actuator **106***g* may couple the motor **106***m* to the group carrier **202**.

(53) Optionally, the magnet system **100** may include an electrical generator **308** configured to supply electrical power (also referred to as supply power) or a supply voltage to each of the actuators **106**. To this end, the line **108** may include one or more than one electrical supply lines **108***b* coupling the generator **308** to each of the actuators **106**.

(54) Further, the magnetron-target coupling **301** may include a communication interface **704** that electrically couples (e.g., galvanically decoupled and/or capacitively couples) at least one of the end blocks **312***a*, **312***b* to the line **108**, e.g., its communication line(s) **108***a*. For example, the communication interface **704** of the communication line **108***a* may be used to couple the communication signal from the end block.

(55) FIG. **4** illustrates the magnet system **100** according to various embodiments **400** in a schematic side view or cross-sectional view, in which the magnet system **100** comprises a (e.g., fluid-tight, e.g., vacuum-tight) chamber **406** (also referred to as a system chamber **406**) comprising a, e.g., tubular, housing **406***g* and one or more than one lid **406***d* (also referred to as a connector lid **406***d* or housing lid **406***d*). The or each housing cover **406***d* may be configured to close (e.g., fluid-tight, e.g., vacuum-tight) the housing **406***g* at the end face (e.g., out of or in the reference direction **101**). Optionally, at least one housing lid **406***d* of the system chamber **406** may be configured to supply the or each magnet system group **150** of the magnet system **100** (then also referred to as a supply lid), e.g., with the communication signal and/or with the supply power or supply voltage. For this purpose, the supply cover **406***d* may comprise, for example, a gear stage **804**, a generator **308**, a communication electrode **406***e*, and/or a rotary coupling (e.g., a rotor through-coupling or a rotary union), as will be described in more detail with respect to FIG. **6**.

(56) FIG. **5** illustrates the sputtering device **300** according to various embodiments **500** in a schematic circuit diagram. Here, six actuators **106** of the magnetic system **100** are illustrated as an example, although their number may also be greater than or less than six. Optionally, the sputtering device **300** may include a control device **806** (for example, for drive control) that generates the communication signal.

(57) It may be understood that communication between the control device **806** and an actuator **106** of the magnet system **100** may be performed by means of the communication signal, e.g., bidirectionally (i.e., back and forth) or unidirectionally (i.e., only from the control device **806** to the actuator **106**). In other words, the communication signal may be the carrier of an information transfer between the control device **806** and an actuator **106**.

(58) The communication signal may illustratively be an electrical signal by means of which information may be transmitted (also referred to as communication), for example instructions or control data, measurement data, requests and/or responses. The communication by means of the communication signal may be, on a physical level, by means of an exchange of electrical power. The physical level of communication may be by means of physical transmitters. The communication by means of the communication signal may take place, on a logical level, by means

of an exchange of information. The logical level of communication may take place by means of data processing, which may be implemented, for example, by means of a processor and/or a program and/or which controls the transmitters. The exchange of electrical power between the transmitters may, for example, be or become modulated according to the information to be transmitted.

(59) For example, the communication may be message-based (i.e., based on messages) according to a communication protocol (e.g., a network protocol). For example, a fieldbus network protocol may be used as the communication protocol. For example, a USB bus network protocol may be used as the communication protocol (Universal Serial Bus—USB). Of course, another communication protocol may also be used, which may be proprietary, for example.

(60) For example, information transmitted from the control device **806** to the actuator **106** may represent the desired state that the actuator **106** is to assume. Information transmitted from an actuator **106** to the control device **806** may, for example, represent the actual state of the actuator **106** or an acknowledgement of receipt.

(61) The communication line **108***a* may be coupled to the communication interface **704**. The communication interface **704** may be configured to exchange the communication signal between the control device **806** and one or more than one of the actuators **106**. In other words, the communication interface **704** may be configured to relay the communication signal. This may generally be accomplished using optical coupling, inductive coupling, and/or capacitive coupling. These achieve more reliable communication. Illustratively, optical, inductive, and/or capacitive relaying of the communication signal may provide galvanic isolation between the actuator **106** and the control device **806**. This galvanic isolation inhibits electrical interference during operation of the magnet system **100**.

(62) The communication interface **704** may be configured for contactless communication (e.g., transferring information) between stationary and moving parts across a plurality of media spaces and for simultaneous length compensation, as will be discussed in more detail later.

(63) Optionally, the communication interface **704** may be configured such that the one or more than one communication channel is interrupted (i.e., opened) and established (i.e., closed), e.g., alternately interrupted and established, in time with the rotational movement of the tubular target. This causes the communication to be clocked according to the rotational motion of the target (i.e., in time with the rotational motion). This clocking achieves more reliable communication. Illustratively, interference originating in the rotational motion of the tubular target **302** may thus be systematic, making it easier to filter out.

(64) It may be understood that this clocked communication may be implemented at the physical level of communication and/or at the logical level of communication. For example, the resistive, optical, inductive, and/or capacitive coupling may be physically interrupted (i.e., opened) and re-established (i.e., closed), e.g., alternately, in time with the rotational movement of the pipe target. Alternatively or additionally, the logical communication (e.g., sending and/or receiving data or entire messages) may be clocked so that this is interrupted and re-established.

(65) The generator **308** may be configured to generate the supply voltage during operation (for example, at the target rated speed) of the tubular target **302**. This supply voltage may be applied to all of the actuators **106** or, by means of a multiplexer, may be applied individually to only one of the actuators **106** at a time, which is actuated. When one of the actuators **106** is driven, the actuator **106** may receive corresponding electrical power from the generator **308**, which is applied to adjust the magnetic field.

(66) The magnet system **100** may optionally include one or more than one sensor **816** configured to capture the actual state (also referred to as the process state) of a sputtering process (e.g., coating process) provided by the sputtering device **300** and/or the magnetic field of the magnet system **100**. The control device **806** may be configured to control the actuators **106** based on the process state. For example, actuating the actuators **106** may be based on a predetermined target state, such as

such that a difference between the process state and the target state is reduced.
(67) Various exemplary implementations of the housing cover **406***g*, which facilitates the power supply and/or communication implementation described herein, are discussed below.
(68) FIG. **6** illustrates the housing cover **406***d* of the magnet system **100** according to various embodiments **600** in a schematic cross-sectional view. In general, the housing cover **406***d* has a (one-piece or multi-piece) mechanical carrier as the base body **802**, which carries the electronic communication and electrical power supply components.
(69) The electrical power supply components include a gear stage **804**, a generator **308**, and a rotary coupling **850** that couples the gear stage **804** (e.g., its generator gear **708**) to the generator **308**. The electronic communication components include the communication interface **704** and an electrical connector **862**, which are coupled together (e.g., electrically conductive).
(70) In an exemplary implementation of the base body **802**, the base body **802** may include a flange **802***p* and a (e.g., peg-shaped) support device **802***v* that extends away from the flange **802***p* and/or is electrically conductive. The support device **802***v* and the flange **802***p* may be, for example, fixedly (e.g., rigidly) and/or electrically conductively coupled to each other.
(71) The base body **802** (also referred to as the cover base body) is disposed at least partially (e.g., at least its flange **802***p*) between the gear stage **804** and the generator **308**. The rotary coupling **850** allows an exchange of a rotary motion through a through-hole of the base body **802** (e.g., its flange **802***p*).
(72) In an exemplary implementation of the electrical terminal **862**, it may have one or more than one connection terminal and/or be coupled to one or more than one electrical communication line **108***a*. Alternatively or additionally, the electrical terminal **862** may be electrically coupled, preferably ohmically, to the lid electrode **406***e*, e.g., by means of the base body **802** (e.g., its flange **802***p* and/or its support device **802***v*).
(73) The gear wheel **718** on the drive side may be supported on the base body **802**, e.g. its support device **802***v*, by means of a rotary bearing **851**. Alternatively or additionally, the rotary coupling **850** may have a shaft **850***w* which is supported by means of a pivot bearing **851** on the main body **802**, e.g. its flange **802***p*. If the gear stage is internally toothed, its drive-side gear wheel **718** has an internal ring gear **718***z* (see also FIG. **12**). The internal gear rim **718***z* illustratively provides a recess in which the generator gear **708** may be arranged. This saves installation space.
(74) The provided magnetron-target coupling **301** is explained below, and reference is made to exemplary implementations thereof. It may be understood that the magnetron-target coupling **301** may also be provided as a single assembly, for example, disassembled from the bearing device **350** and/or the magnet system **100**.
(75) FIG. **7** illustrates the magnetron-target coupling **301** according to various embodiments **700** in a schematic cross-sectional view.
(76) The magnetron-target coupling **301** includes the flange **702** (also referred to as the target connection flange **702**) and a communication interface **704**. The communication interface **704** comprises a first electrode **704***a* (also referred to as first communication electrode **704***a*) and a second electrode **704***b* (also referred to as second communication electrode **704***b*), which are electrically coupled to each other, e.g., by means of an electrical line **710** of the communication interface **704** and/or ohmically.
(77) The target coupling flange **702** may, for example, be penetrated (e.g., along the shaft axis **808***a*) by a through-hole **702***o* through which the electrical lead **710** extends. A seal **702***d* (for example, an O-ring seal) may be disposed in the through-hole **702***o*, for example, to abut the target coupling flange **702** and the electrical lead **710**.
(78) In an exemplary implementation, the or each communication electrode **704***a*, **704***b* (e.g., comprising an electrically conductive material, e.g., metal) is configured for capacitive communication. For example, the communication electrode **704***a*, **704***b* may be encapsulated (e.g., dielectrically), e.g., using a dielectric. This reduces the need to run a cable along the

communication path and/or to hardwire them together.
(79) In the or an exemplary implementation alternative thereto, the or each communication electrode **704***a*, **704***b* (e.g., comprising an electrically conductive material, e.g., metal) is disk-shaped and/or plate-shaped or configured as a plate electrode (e.g., a capacitor plate) for capacitive communication. For example, the first communication electrode **704***a* and/or the second communication electrode **704***b* may comprise or consist of a disk, ring, or segment thereof.
(80) The magnetron-target coupling **301** further includes a shaft **808** that is fixedly (e.g., rigidly) coupled to the target coupling flange **702**.
(81) The shaft **808** may extend along a shaft axis **808***a*, e.g., through the first communication electrode **704***a*. The shaft **808** may include a first linear bearing component **8081** (e.g., a rim) on a side opposite the target coupling flange **702**. The first linear bearing component **8081** may be configured to mate with a second linear bearing component **8181** (see FIG. **9**) to form a linear bearing **918** (also referred to as a shaft support bearing), such as a rotatably supported linear bearing.
(82) The first communication electrode **704***a* may be disposed between the linear bearing component **8081** and the target coupling flange **702**.
(83) The second communication electrode **704***b* may be fixedly (e.g., rigidly) mounted (e.g., on a side of the target coupling flange **702** opposite the shaft) to the target coupling flange **702** and/or the shaft **808**, for example at least partially recessed in the target coupling flange **702** or at least disposed in a recess of the target coupling flange **702**. This increases the compactness of the assembly.
(84) According to various embodiments, the first communication electrode **704***a* is supported by means of a bearing device **714** (also referred to as an electrode bearing device **714**). The electrode bearing device **714** may include at least one linear bearing that provides at least one translational degree of freedom to the first communication electrode **704***a*, for example, relative to the second communication electrode, the shaft **808**, and/or the target coupling flange **702**. The translational degree of freedom **714***t* may be, for example, along the shaft axis **808***a* of the shaft **808** or the reference direction **101**.
(85) Illustratively, the translational degree of freedom **714***t* achieves that the communication electrode **704***a* (e.g., rotatably mounted) is axially moveable to compensate for tolerances and thermal expansion. This mitigates interference with communication with the magnet system **100**.
(86) For example, the electrode bearing device **714** may be configured such that the first communication electrode **704***a* may be moved toward and/or away from the second communication electrode or target coupling flange **702**, for example, along a shaft axis **808***a* of the shaft **808**. Alternatively or additionally, the first communication electrode **704***a* is mounted such that it may be moved relative to the shaft **808**.
(87) The target coupling flange **702** may optionally include a sealing surface **706** distal to the first communication electrode **704***a*. The sealing surface **706** (e.g., having a groove for receiving a seal) may, for example, abut an elastomeric seal received in the groove, for example. The second communication electrode **704***b* may be circled by the sealing surface **706**, for example.
(88) Additional exemplary implementations of the components of the magnetron-target coupling **301** are discussed below.
(89) In an exemplary implementation of the electrical lead **710**, the electrical lead **710** may have or be formed of one or more than one pin **710***s* (also referred to as a contact pin) and a socket **710***b* (also referred to as a contact socket) in which the contact pin **710***s* is received, e.g., formed of a metal. The pin may be moveably supported relative to the first communication electrode **704***a* by means of a linear bearing, for example, and/or may be configured to be fixedly (e.g., rigidly) supported. This avoids the need for additional cables.
(90) In an exemplary implementation of the electrode bearing device **714**, the electrode bearing device **714** may include a resilient element **714***f* (e.g., a spring) that couples the first

communication electrode **704***a* and the second communication electrode **704***b*. When the resilient element **714***f* is deformed (e.g., stretched and/or compressed), the resilient element **714***f* may generate a restoring force that is directed in the opposite direction of the deformation. The restoring force (measured at constant deformation) may be greater the harder the resilient element **714***f* is, i.e., the greater its spring constant is.
(91) According to various embodiments, the resilient element **714***f* may comprise or consist of a resilient material, such as a plastic, such as an elastomer a polymer or a co-polymer, e.g., rubber, silicone, silicone rubber, fluorinated silicone rubber, natural rubber, or other suitable (e.g., soft and/or vacuum compatible) plastic. For example, the polymer or co-polymer may comprise silicon. According to various other embodiments, the resilient material may be metallic, such as steel (e.g., steel spring) or another metal, metal alloy, or intermetallic compound.
(92) In an exemplary implementation of the resilient element **714***f*, this may have multiple coils, e.g. in the form of a spiral spring or worm spring (see also FIG. **8** below). This is of low complexity and low cost. More generally, the resilient element **714***f* may have one or more than one spring (e.g., metal spring and/or plastic spring), e.g., in the form of a disc spring, torsion spring, torsion spring, leaf spring, or other spring form.
(93) The restoring force provided by means of the resilient element **710***s* may be directed against a movement (e.g., translation) of the first communication electrode **704***a* from an initial position and/or out along the translational degree of freedom **714***t*. In the initial position, the restoring force may be zero or the first communication electrode **704***a* may be pressed against a detent by the restoring force.
(94) In an exemplary implementation of the resilient element **710***f*, the resilient element **710***f* may be biased. Then, the restoring force may be configured to press the first communication electrode **704***a* against the detent. For example, the detent may be attached to the shaft **808** and/or be part of the encapsulation of the first communication electrode **704***a*.
(95) In an exemplary implementation of the linear bearing component **8081**, it provides a first segment **808***t* along which the shaft **808** may be moved. To this end, the linear bearing component **8081** may have an extent along the shaft axis **808***a* equal to or greater than the first segment **808***t*. For example, the first segment **808***t* may be about 1 centimeter (cm) or more, such as about 2 cm or more, such as about 4 cm or more, such as about 5 cm or more.
(96) In or an alternative exemplary implementation of the linear bearing component **8081**, the linear bearing component **8081** includes a torque arm. The torque support may be configured (e.g., when the linear bearing component **8081** provides the shaft support bearing) to inhibit rotation of the linear bearing component **8081**. For example, the torque restraint may be implemented using a contoured peripheral surface of the linear bearing component **8081**. Examples thereof include one or more than one torque support groove and/or one or more than one torque support tooth extending longitudinally along the shaft axis **808***a*, e.g., around the first segment **808***t* or more. For example, the linear bearing component **8081** may include a rim (e.g., spider) torque arm having an extent along the shaft axis **808***a* approximately equal to or longer than the first segment **808***t*, e.g., up to the target coupling flange **702**.
(97) In an exemplary implementation of the electrode storage device **714**, the electrode storage device **714** may provide the first communication electrode **704***a* with a second segment **714***t* by which the first communication electrode **704***a* may be moved (e.g., along the translational degree of freedom of **714***t*) relative to the shaft **808**. The second segment **714***t* may be at least 10% of the first segment **808***t*, e.g., at least 25% of the first segment **808***t*, e.g., at least 50% of the first segment **808***t*, e.g., at least 75% of the first segment **808***t*, e.g., at least 90% of the first segment **808***t*. For example, the second segment **714***t* and the first segment **808***t* may be the same size. The improves the handling of the magnetron-target coupling **301**.
(98) In an exemplary implementation of the communication interface **704**, it is separated from the target coupling flange **702** and/or the shaft **808**, e.g., galvanically separated and/or by means of a

dielectric. This improves the signal transmission.
(99) In the or an alternative exemplary implementation of the communication interface **704**, the first communication electrode **704***a* and/or the second communication electrode **704***b* are encapsulated, e.g., by means of a dielectric. This improves the galvanic isolation and/or the lifetime thereof.
(100) FIG. **8** illustrates a communication assembly **800** according to various embodiments in a schematic cross-sectional view, which includes magnetron-target coupling **301** and housing cover **406***d* mounted thereto, e.g., as part of sputtering device **300**.
(101) The shaft **808** may be rotatably mounted or have the shaft axis **808***a* about which it is rotatably mounted. Alternatively or additionally, the target coupling flange **702** may be rotatably supported relative to the housing cover **406***d*, e.g., its cover electrode **406***e*. To this end, the magnetron-target coupling **301** may include, for example, a mounting structure **814** (e.g., extending along the shaft axis **808***a* and/or disposed within the shaft **808**) that is rotatably mounted relative to and/or supported by the shaft **808**.
(102) The mounting structure **814** may be configured to match the housing cover **406***d* such that it may be attached to the mounting structure **814** (e.g., its base body **802**, e.g., its support device **802***v*).
(103) According to various embodiments, the cover **406***d* may include a fourth communication electrode **406***e* (also referred to as a cover electrode) that is electrically coupled, e.g., resistively, to the actuator **106** of the magnet system **100**.
(104) For example, the cover electrode **406***e* may be disposed proximate to the second communication electrode **704***b*, such as directly opposite thereto and/or at a distance **903** (also referred to as the second electrode-to-electrode distance) therefrom. For example, the second electrode-electrode distance **903** may be approximately equal to the first electrode-electrode distance **903**. Alternatively or additionally, the second electrode-electrode distance **903** may be smaller than approximately 1 cm, for example than approximately 0.5 cm, for example than approximately 0.25 cm. This improves communication.
(105) The cover electrode **406***e* and the second communication electrode **704***b* may be capacitively coupled to each other, such that they implement a communication path between the control device **806** and the magnet system **100** (e.g., its actuator **106**).
(106) According to various embodiments, the cover electrode **406***e* and/or the bearing electrode **904** may be fixedly (e.g., rigidly) mounted. Relative thereto, the communication interface **704** (e.g., its first communication electrode **704***a* and/or second communication electrode **704***b*) may be rotatably mounted, e.g., about the shaft axis **808***a* and/or concentric with the bearing electrode **904**.
(107) The first communication electrode **704***a* may have a distance **961** (also referred to as an electrode-flange distance) from the target coupling flange **702**. The electrode-flange distance may be greater than the first electrode-electrode distance **901** and/or than the second electrode-electrode distance **903**, e.g., their sum. The electrode-flange distance may be greater than the first segment **714***t*. Illustratively, the electrode-flange distance may serve to provide a free space for moving the first communication electrode **704***a*. Illustratively, the chamber of the electrode-flange spacing **961** serves as a clearance for tolerances and elongation.
(108) FIG. **9** illustrates the bearing device **350** according to various embodiments **900** in a schematic cross-sectional view, e.g., looking at an end block **312***a*, in which the bearing device **350**, e.g., its end block **312***a*, comprises a base frame **912** (also referred to as a bearing frame **912**). The base frame **912** may comprise or consist of, for example, an end block housing. Further, the bearing device **350** comprises the magnetron-target coupling **301**, which is only partially shown.
(109) The bearing device **350**, e.g., the end block **312***a* thereof, includes a joint **952** supported by the bearing frame **912**, the joint **952** including a pivot bearing **950** and a second linear bearing component **8181** rotatably supported by the pivot bearing **950**. The second linear bearing component **8181** may be configured to be mated (e.g., nested) with the first linear bearing

component **8081** to form the shaft support bearing **918**, such that the shaft support bearing **918** is a rotatably supported linear bearing. The shaft receiving bearing **918** may be rotatably supported about the shaft axis **808***a* by means of the rotary bearing **950**. The shaft support bearing **918** may provide the translational degree of freedom to the shaft **808** along the first segment **808***t*.

(110) Further, the bearing device **350** may include the bearing electrode **904** (also referred to as the third communication electrode **904**) that is fixedly coupled to (e.g., rigidly mounted to) the base frame **912**, for example, at least partially recessed within the base frame **912** or at least disposed within a recess of the base frame **912**. This increases the compactness of the assembly.

(111) For example, the bearing electrode **904** may be disposed near the first communication electrode **704***a*, e.g., directly opposite thereto and/or at a distance **901** (also referred to as the first electrode-to-electrode distance) therefrom. The first electrode-to-electrode distance **901** may be smaller than, for example, the first segment **808***t* and/or the second segment **714***t* (also referred to as the adjustment distance **714***t*). For example, the first electrode-to-electrode distance **901** may be smaller than about 1 cm, e.g., than about 0.5 cm, e.g., than about 0.25 cm. This improves the communication.

(112) For example, the first electrode-to-electrode distance **901** may be invariant to a displacement of the first communication electrode **704***a* along the of the shaft axis **808***a* and/or according to the translational degree of freedom, which improves communication. This may be achieved, for example, by means of a detent **962**, as will be described in more detail later.

(113) The bearing electrode **904** and the first communication electrode **704***a* may be capacitively coupled to each other, such that they implement a communication path between the control device **806** and the magnet system **100** (e.g., its actuator **106**).

(114) The bearing electrode **904** may be configured to be galvanically isolated from the communication electrode **704***a* and/or from the base frame **912**. For example, the bearing electrode **904** may be encapsulated (e.g., dielectrically), e.g., by means of a dielectric. This improves the galvanic separation and/or the lifetime thereof.

(115) FIG. **10** illustrates a sputtering device **300** according to various embodiments **1000** in a schematic detailed view, in which it comprises a plurality of cavities separated from each other.

(116) The base frame **912** may include a first cavity **10**A that has a first (e.g., atmospheric) pressure A during operation. A second cavity **10**B may be disposed between the first communication electrode **704***a* and the second communication electrode **704**, the second cavity **10**B having a vacuum (e.g., a pressure B) during operation.

(117) Pressure B may be less than pressure A and/or than 0.3 mbar, e.g., in a range from about 10 mbar to about 1 mbar (then also referred to as rough vacuum) or less, e.g., in a range from about 1 mbar to about 10-3 mbar (then also referred to as fine vacuum range) or less, e.g., in a range from about 10-3 mbar to about 10-7 mbar (then also referred to as high vacuum range) or less.

(118) A third cavity **10**C may be disposed within the target **302**, for example between the target **302** and the magnet system **100** and/or between the second communication electrode **704***b* and lid electrode **406***e*, and may include the cooling fluid and/or a pressure C during operation. The pressure C may be greater than pressure A, for example.

(119) Within the magnet system **100**, e.g., inside the housing **406***d* (also referred to as the housing interior), a fourth cavity **10**D may be arranged that has a fourth (e.g., atmospheric) pressure D during operation. Optionally, the fourth (e.g., atmospheric) pressure D and the first pressure A may differ from each other, i.e., they need not necessarily be identical.

(120) According to various embodiments, the bearing device **350** (e.g., its end block) may include a seal that separates the first cavity **10**A from the second cavity **10**B. Alternatively or additionally, the magnetron-target coupling **301** (e.g., the target coupling flange **702** thereof) may include the target seal **702***d* that separates the second cavity **10**B from the third cavity **10**C. Alternatively or additionally, the magnetron system **100** (e.g., its cover **406***d*) may include a seal that separates the third cavity **10**C from the fourth cavity **10**D.

(121) The communication path between the control device **806** and the magnet system **100** (e.g., to the actuator **106** thereof) may pass through the first cavity **10**A, the second cavity **10**B, the third cavity **10**C, and/or the fourth cavity **10**D, e.g., from atmosphere to vacuum to water to atmosphere.
(122) In an exemplary implementation of the target coupling flange **702**, the target coupling flange **702** may be multi-part, for example comprising a first flange component **702***a* (e.g., having a recess) and a second flange component **702***b*, between which an annular gap is formed. In the annular gap, the target may be received (e.g., clamped), e.g., frictionally and/or positively held. For example, the two flange components **702***a*, **702***b* may be joined together to form a clamping device (also referred to as a target clamp) for clamping the target **302**. Further, an additional target seal **712***d* may abut the sealing surface **706**, e.g., disposed in the annular gap and/or between the two flange components **702***a*, **702***b*.
(123) The second linear bearing component **8181** may include a fifth cavity **808***h* in which the first linear bearing component **8081** is received.
(124) FIG. **11** illustrates the bearing device **350** according to various embodiments **1100** in a schematic detailed view (looking at the bearing electrode **904**), in which the bearing electrode **904** is configured to be annular and/or disc-shaped, e.g., formed in the shape of a ring.
(125) FIG. **12** illustrates the magnetron-target coupling **301** according to various embodiments **1200** in a schematic perspective view (looking at the first communication electrode **704***a*), in which the first communication electrode **704***a* is configured in a segmented and/or disc-shaped manner, e.g., is configured in the form of a ring segment. Optionally, the first communication electrode **704***a* may be embedded in a dielectric.
(126) FIG. **13** illustrates a communication assembly **1300** according to various embodiments in a schematic cutaway perspective view comprising magnetron-target coupling **301**, housing cover **406***d*, and bearing electrode **904**, e.g., as part of sputtering device **300**.
(127) In an exemplary implementation, one or more (e.g., each) of the communication electrodes **704***a*, **704***b*, **904**, **406***d* is configured to form a circular surface element around the shaft axis **808***a* and is a full or partial surface of a ring (see also FIGS. **11** and **12**). Alternatively or additionally, each communication electrode **704***a*, **704***b*, **904** is galvanically separated from the components of the flange or base frame **912** adjacent thereto.
(128) The rotating second communication electrode **704***b* provides an electrical (e.g., capacitive) coupling by means of which the rotating moveable first communication electrode **704***a* is electrically coupled to the magnetic system **100**, e.g., its lid electrode **406***e*, wherein the electrical coupling is electrically isolated from the cooling fluid (e.g., water) and/or bridges the cooling fluid (e.g., without contact). The electrical coupling therebetween may be configured to be sealing, for example between vacuum and water.
(129) The electrical connection **862** of the cover **406***d* electrically coupled to the cover electrode **406***e* is electrically coupled to one or more than one actuator **106** of the magnet system **100**, for example, by means of the supply line **108***b*. The electrical coupling between the electrical connection **862** and the lid electrode **406***e* may be configured to be sealing, for example between the cooling fluid and the atmosphere.
(130) The components coupled to the target coupling flange **702** on the target side may have tolerances and longitudinal expansion. The axially moveable mounting of the first communication electrode **704***a* achieves that these tolerances and thermal expansion are better compensated. This reduces disturbances of the communication with the magnet system **100**.
(131) The restoring force provided or by means of the resilient element **714***f* (e.g., having one or more than one spring) may press the first communication electrode **704***a* against an optional detent **962**. This improves the stability of the first electrode-to-electrode distance **901**.
(132) The first communication electrode **704***a* and the second communication electrode **704***b* are electrically coupled to each other according to various embodiments. The electrical coupling therebetween may be configured to be maintained in any position of the first communication

electrode **704***a* and the second communication electrode **704***b* relative to each other. This mitigates interference with communication with the magnet system **100**. The electrical coupling therebetween may be further configured to seal the second cavity **10**B from the third cavity **10**B and/or exchange the communication signal between the second cavity **10**B and the third cavity **10**B. In an advantageous implementation, the electrical coupling therebetween may be provided by means of the contact socket **710***b* and the contact pin **710***s*.
(133) The contact pin **710***s* may move into or out of the contact socket **710***b*, for example. Optionally, an electrically conductive resilient element may also be arranged in the contact socket **710***b*, which presses against the contact pin **710***s* with its restoring force. This improves the electrical contact between contact pin **710***s* and contact socket **710***b*. Alternatively or additionally, the contact pin **710***s* may have a sliding surface with which it lies flat against the contact socket **710***b*.
(134) For example, the contact pin **710***s* and contact socket **710***b* may be electrically isolated from the target coupling flange **702**.
(135) Optionally, the target seal **702***d* may be disposed between the contact pin **710***s* and the target coupling flange **702**.
(136) The outer two communication electrodes (bearing electrode **904** and lid electrode **406***e*) may each be electrically coupled to electrical connection **862**. For example, a first electrical terminal **862** may be electrically coupled, preferably ohmically, to the lid electrode **406***e*, e.g., by means of the base body **802** (e.g., its flange **802***p* and/or its support device **802***v*). For example, a second electrical terminal **872** (see FIG. **9**) may be electrically coupled, preferably resistively, to the bearing electrode **904**.
(137) In the following, various examples are described that relate to what has been described above and what is shown in the figures.
(138) Example 1 is a magnetron-target coupling, comprising: a target coupling flange (e.g., for coupling a target, e.g., a tubular target); a shaft fixedly coupled (e.g., face-to-face) to the target coupling flange (e.g., extending along a shaft axis away from the target coupling flange and/or toward an end block side), and having, on a side opposite the target coupling flange, respectively on an end portion distal to the target coupling flange, a first linear bearing component (e.g. a rim); a communication interface, which comprises a first communication electrode (e.g. left inner disc), which is preferably arranged between the first linear bearing component and the target coupling flange, and a second communication electrode (e.g. right inner disc), which is electrically (e.g., resistively) connected to one another, wherein the second communication electrode (e.g. on a side distal to the shaft or at least the linear bearing component thereof) is fixedly coupled (e.g. fastened) to the target coupling flange, wherein the target coupling flange is arranged between the first communications electrode and the second communications electrode, wherein the first communications electrode preferably: in a manner (e.g., movable relative to shaft and/or rotatably secured to shaft) attached, such that the second communications electrode may be moved towards and/or away from this way (e.g. along a shaft axis of the shaft); or is fixedly coupled to the shaft and/or to the second communication electrode.
(139) Example 2 is the magnetron-target coupling of example 1, wherein the first communication electrode and/or the second communication electrode comprise a plate and/or are encapsulated.
(140) Example 3 is the magnetron-target coupling of example 1 or 2, further comprising: a resilient element (e.g., comprising one or more than one spring) coupling the first communication electrode and the second communication electrode such that the first communication electrode may be moved toward the second communication electrode against a restoring force of the resilient element.
(141) Example 4 is the magnetron-target coupling according to any one of examples 1 to 3, further comprising: a mechanical detent that limits a segment by which first communication electrode and the second communication electrode may move apart from each other; wherein the detent is

preferably fixedly coupled to the shaft or the first communication electrode; and/or wherein preferably the resilient element presses the first communication electrode against the detent or the detent against the bearing device.

(142) Example 5 is the magnetron-target coupling according to any one of examples 1 to 4, wherein a segment (e.g., along the shaft axis) by which the first communication electrode may be moved toward the second communication electrode is equal to greater than 50% of an extent of the linear bearing component parallel to the segment.

(143) Example 6 is the magnetron-target coupling according to any of examples 1 to 5, wherein the linear bearing component includes a torque arm.

(144) Example 7 is the magnetron-target coupling of example 6, wherein the torque arm is elongated toward the target coupling flange and/or includes a ring gear (e.g., external ring gear).

(145) Example 8 is the magnetron-target coupling according to any of examples 1 to 7, wherein the first communication electrode has a recess (e.g., through-hole) through which the shaft extends.

(146) Example 9 is the magnetron-target coupling according to any one of examples 1 to 8, further comprising: a linear bearing by means of which the first communication electrode is moveably supported.

(147) Example 10 is the magnetron-target coupling according to any of examples 1 to 9, wherein the flange includes one or more than one gasket that preferably encircles the second communication electrode.

(148) Example 11 is the magnetron-target coupling according to any one of examples 1 to 10, wherein the first communication electrode is disposed between the first linear bearing component and the target coupling flange.

(149) Example 12 is the magnetron-target coupling according to any of examples 1 to 11, wherein the communication interface is galvanically separated from the target coupling flange and/or the shaft.

(150) Example 13 is the magnetron-target coupling according to any of examples 1 to 12, wherein the first communication electrode or an encapsulation thereof has a through-hole through which the shaft extends.

(151) Example 14 is the magnetron-target coupling according to any one of examples 1 to 13, wherein the second communication electrode has a through-hole exposing a mounting structure (preferably for mounting a magnet system) which is preferably rotatably supported relative to the shaft.

(152) Example 15 is the magnetron-target coupling according to any one of examples 1 to 14, wherein the first communication electrode and/or the second communication electrode comprise or consist of a capacitor plate and/or a plate electrode.

(153) Example 16 is the magnetron-target coupling according to any one of examples 1 to 15, wherein the target coupling flange is multi-part, for example configured to be joined together to provide an annular gap for receiving the target.

(154) Example 17 is a bearing apparatus comprising: a base frame; a magnetron-target coupling according to any one of examples 1 to 16; a rotary bearing supported by the base frame; and a second linear bearing component rotatably supported by the rotary bearing and configured to form a linear bearing when assembled with the first linear bearing component of the magnetron-target coupling so as to provide the magnetron-target coupling with a degree of translational freedom along a rotational axis of the rotary bearing, respectively along the shaft axis; a third communication electrode arranged to face (e.g., capacitively communicate) with the first communication electrode of the magnetron-target coupling.(e.g. capacitively coupled thereto and/or galvanically separated therefrom) to the first communication electrode of the magnetron target coupling when the linear bearing is formed; wherein third communication electrode is preferably: fixedly coupled to the base frame (e.g. when the first communication electrode is preferably mounted such that it may be moved towards and/or away from the second communication

electrode) or mounted (e.g. by means of a linear bearing) such that it may be moved towards and/or away from the base frame (for example when the first communication electrode is fixedly coupled to the shaft and/or to the second communication electrode).

(155) Example 18 is a bearing apparatus (e.g., according to example 17), comprising: a base frame; a magnetron-target coupling (e.g., according to any one of examples 1 to 16), comprising: a target coupling flange (e.g., for coupling a target, e.g., a tubular target); a shaft which is rigidly coupled with the target coupling flange (e.g., face-to-face) (e.g., extending along a shaft axis away from the target coupling flange and/or toward an end block side), and has a first linear bearing component (e.g., a rim) on a side opposite to the target coupling flange or at an end portion distal to the target coupling flange; a communication interface comprising a first communication electrode (e.g. left inner disc) preferably arranged between the first linear bearing component and the target coupling flange, and preferably a second communication electrode (e.g. right inner disc) electrically (e.g. resistively) coupled to each other; wherein preferably the second communication electrode (e.g. on a side distal to the shaft or at least the linear bearing component thereof) is fixedly coupled (e.g. fastened) to the target coupling flange, wherein preferably the second communication electrode (e.g. on a side distal to the shaft or at least the linear bearing component thereof) is fixedly coupled (e.g. fastened) to the target coupling flange, preferably with the target coupling flange interposed between the first communication electrode and the second communication electrode; the bearing device further comprising: a rotary bearing supported by the base frame, and a second linear bearing component rotatably supported by the rotary bearing and configured to form a linear bearing assembled with the first linear bearing component of the magnetron-target coupling so as to provide the magnetron-target coupling with a degree of translational freedom along an axis of rotation of the rotary bearing and the first linear bearing component of the magnetron-target coupling, respectively along the shaft axis; a third communication electrode arranged to face the first communication electrode of the magnetron-target and/or is arranged at a separation distance therefrom (e.g. measured along the axis of rotation) when the linear bearing is formed; wherein the first communication electrode and/or the third communication electrode are preferably supported (at least by means of one or more than one translational bearing) such that a change in the separation distance when the magnetron-target coupling is moved according to the translational degree of freedom (e.g., by a segment) relative to the base frame is smaller than the segment (e.g., as 50% of the segment), e.g., is substantially constant, or is at least invariant to moving the magnetron-target coupling according to the translational degree of freedom.

(156) Example 19 is the bearing device of example 17 or 18, wherein the second linear bearing component includes a cavity configured to receive the first linear bearing component.

(157) Example 20 is a sputtering device comprising: a bearing device according to any of examples 17 to 19, preferably comprising one or more than one end block, for rotatably supporting a sputtering target by means of the magnetron-target coupling; an optional magnet system fixedly supported (e.g. relative thereto and/or relative to a gravitational direction) within the sputtering target by means of the bearing device.

(158) Example 21 is the sputtering device according to example 20, the bearing device further comprising: a fixed bearing which carries and/or is coupled to the magnet system through the magnetron-target coupling, e.g. through the shaft thereof.

(159) Example 22 is the sputtering device according to example 20 or 21, wherein the shaft has a through-hole into which the fixed bearing extends.

(160) Example 23 is the sputtering device according to any one of examples 20 to 22, the magnet system comprising: a (e.g. non-magnetic) housing having a housing interior; a (e.g. non-magnetic) magnet holder disposed in the housing interior and supported by the housing, preferably stationary with respect thereto; a (e.g. non-magnetic) housing cover, which forms a fluid-tight chamber when joined to the housing; wherein the housing cover has a fourth communication electrode directly opposite the second communication electrode (e.g. capacitively coupled thereto and/or galvanically

separated therefrom) and optionally has a gear stage, a generator and a rotary coupling, which couples the gear stage to the generator.

Claims

1. A magnetron-target coupling comprising: a target coupling flange for coupling a tubular target; a shaft that is fixedly coupled to the target coupling flange and has a first linear bearing component at an end portion distal from the target coupling flange; a communication interface comprising: a first communication electrode disposed between the first linear bearing component and the target coupling flange; and a second communication electrode electrically coupled to the first communication electrode, wherein the target coupling flange is fixedly coupled to the second communication electrode and disposed between the first communication electrode and the second communication electrode, wherein the first communication electrode is supported such that it may be moved towards and/or away from the second communication electrode.
2. The magnetron-target coupling of claim 1, wherein the first communication electrode or the second communication electrode comprise an encapsulated plate.
3. The magnetron-target coupling of claim 1, the magnetron-target coupling further comprising a resilient element coupling the first communication electrode and the second communication electrode to each other such that the first communication electrode may be moved toward the second communication electrode against a restoring force of the resilient element.
4. The magnetron-target coupling of claim 3, wherein the resilient element is a spring.
5. The magnetron-target coupling of claim 1, the magnetron-target coupling further comprising a mechanical detent that limits a segment by which the first communication electrode and the second communication electrode may move apart from each other.
6. The magnetron-target coupling of claim 5, wherein the detent is fixedly coupled to the shaft or the first communication electrode.
7. The magnetron-target coupling of claim 6, further comprising a resilient element coupling the first communication electrode and the second communication electrode to each other such that the first communication electrode may be moved toward the second communication electrode against a restoring force of the resilient element, wherein the resilient element, when engaged, presses the first communication electrode against the detent or presses the detent against the bearing device.
8. The magnetron-target coupling of claim 1, wherein a segment by which the first communication electrode may be moved toward the second communication electrode is at least 50% of an extent of the linear bearing component parallel to the segment.
9. The magnetron-target coupling of claim 1, wherein the linear bearing component comprises a torque arm.
10. The magnetron-target coupling of claim 9, wherein the torque arm is elongated toward the target coupling flange or includes a ring gear.
11. The magnetron-target coupling of claim 1, wherein the first communication electrode has a recess through which the shaft extends.
12. The magnetron-target coupling of claim 1, wherein the communication interface is galvanically separated from the target coupling flange and/or the shaft.
13. The magnetron-target coupling of claim 1, the magnetron-target coupling further comprising a second linear bearing that moveably supports the first communication electrode.
14. The magnetron-target coupling of claim 1, wherein the second communication electrode has a through-hole that exposes a mounting structure for rotatably supporting a magnet system relative to the shaft.
15. The magnetron-target coupling of claim 1, wherein the target coupling flange includes a gasket that encircles the second communication electrode.
16. A bearing device comprising: a magnetron-target coupling comprising: a target coupling flange

for coupling a tubular target; a shaft that is fixedly coupled to the target coupling flange and has a first linear bearing component at an end portion distal from the target coupling flange; a communication interface comprising: a first communication electrode disposed between the first linear bearing component and the target coupling flange; and a second communication electrode electrically coupled to the first communication electrode, wherein the target coupling flange is fixedly coupled to the second communication electrode and disposed between the first communication electrode and the second communication electrode, wherein the first communication electrode is supported such that it may be moved towards and/or away from the second communication electrode; a base frame; a rotary bearing supported by the base frame, and a second linear bearing component rotatably supported by the rotary bearing and configured to mate with the first linear bearing component of the magnetron-target coupling to form a linear bearing such that the magnetron-target coupling is provided a degree of translational freedom along an axis of rotation of the rotary bearing; and a third communication electrode arranged to face the first communication electrode of the magnetron-target coupling when the linear bearing is formed, the third communication electrode being fixedly coupled to the base frame.

17. The bearing device of claim 15, wherein the first communication electrode and/or the second communication electrode comprise a capacitor plate.

18. The bearing device of claim 15, wherein the target coupling flange comprises a plurality of flange parts that are joined together to form an annular gap for receiving the tubular target.

19. A bearing device comprising: a base frame; a magnetron-target coupling comprising: a target coupling flange for coupling a tubular target; a shaft that is fixedly coupled to the target coupling flange and has a first linear bearing component at an end portion distal from the target coupling flange; a rotary bearing supported by the base frame, and a second linear bearing component rotatably supported by the rotary bearing and configured to mate with the first linear bearing component of the magnetron-target coupling to form a linear bearing such that the magnetron-target coupling is provided a degree of translational freedom along an axis of rotation of the rotary bearing; and a communication interface comprising: a first communication electrode disposed between the first linear bearing component and the target coupling flange; and a second communication electrode electrically coupled to the first communication electrode, wherein the target coupling flange is fixedly coupled to the second communication electrode and disposed between the first communication electrode and the second communication electrode, wherein the first communication electrode is supported such that it may be moved towards and/or away from the second communication electrode; and an additional communication electrode arranged to face and be spaced from the first communication electrode of the magnetron-target coupling when the linear bearing is formed, wherein the first communication electrode or the additional communication electrode are supported such that a change in a separation distance when the magnetron-target coupling is moved by a segment relative to the base frame according to the translational degree of freedom is smaller than the segment.