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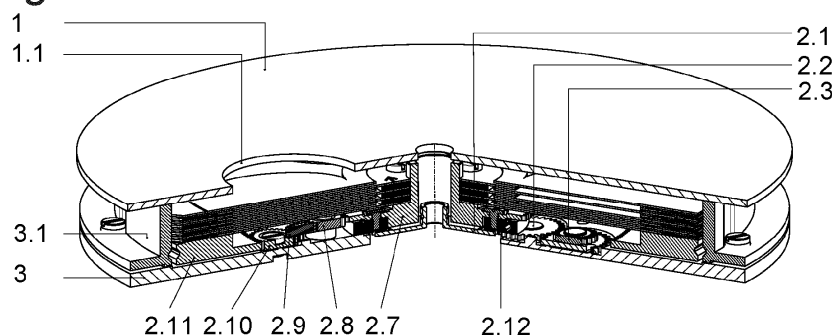
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(54) MECHANISM FOR INDICATION OF THE LUNAR PHASES FOR INTEGRATION INTO A WATCH

(57) The present invention concerns a mechanism for indication of the lunar phases, in particular for integration into a watch, comprising a dial (1) having an aperture (1.1), a moon indicator element (M1), at least two shade elements (S1, S2), and a gear train (2) adapted to rotatably drive said moon indicator element (M1) and/or said at least two shade elements (S1, S2) in a manner allowing to display at least part of said moon indicator element (M1) and/or at least part of said at least two shade elements (S1, S2) through said aperture (1.1), said moon indicator element (M1) being at least partly shaded by at least part of said at least two shade elements (S1, S2) for displaying certain lunar phases, such as to indicate the lunar phases in said aperture (1.1). The mechanism distinguishes by comprising a plurality of moon indicator elements (M1, M2, ...) and a plurality of

shade elements (S1, S2, ...) arranged in a vertical stack underneath said dial (1), at least part of said plurality of moon indicator elements (M1, M2, ...) and/or at least part of said plurality of shade elements (S1, S2, ...) being adapted to be driven rotatably by said gear train (2), at least one lunar phase being at least partially indicated by all or part of at least a first moon indicator element (M1, M2, ...) of said plurality of moon indicator elements (M1, M2, ...) and at least another lunar phase being at least partially indicated by all or part of at least a second, different moon indicator element (M1, M2, ...) of said plurality of moon indicator elements (M1, M2, ...), such that the lunar phases and the lunar terminator indicated through the aperture (1.1) of the dial (1) substantially correspond during the entire lunation to the appearance of the moon as visible from earth.

Fig.4d



EP 4 818 820 A1

Description

Field of the invention

[0001] The present invention pertains to a mechanism for indication of the lunar phases, in particular for integration into a watch, comprising a dial having an aperture, a moon indicator element, at least two shade elements, and a gear train adapted to rotatably drive said moon indicator element and/or said at least two shade elements in a manner allowing to display at least part of said moon indicator element and/or at least part of said at least two shade elements through said aperture, said moon indicator element being at least partly shaded by at least part of said at least two shade elements for displaying certain lunar phases, such as to indicate the lunar phases in said aperture.

Background of the invention and state of the art

[0002] In general, the present invention is situated in the context of moon phase display devices adapted for integration into watches. In particular, watches having mechanical movements often are equipped with various kinds of so-called complications, such as chronographs, date displays, calendar displays, display devices of astronomical data, and so on. Traditional moon phase display devices for watches form a specific kind of display devices of astronomical data and are known to a person skilled in the art of watchmaking for a long time. Such traditional moon phase display devices are very simple, basically only allowing to display the moon phases visible on earth in rough and symbolic manner on the dial of the watch.

[0003] Therefore, several attempts have been made in the past to realize moon phase display devices allowing to display the moon phases visible on earth in more realistic manner. For example, the prior art document DE 20 206 629 U1 describes a watch comprising a liquid crystal display (LCD) allowing to display the moon phases visible on earth more realistically. However, such device is not adapted to be integrated into watches having a mechanical movement or, more generally, into watches belonging to the segment of "Haute Horlogerie".

[0004] The prior art document EP 4 016 197 discloses a moon phase display device comprising several display elements arranged in the same plane, each of the display elements being rotatable around its longitudinal axis. However, the resulting indication of the moon phases is not very realistic, in particular in terms of the lunar terminator indicated by this device. For a person skilled in the art, the lunar terminator is defined as the line delimiting the illuminated and the shaded parts of the moon as visible from earth, it being noted that the shape of the lunar terminator continuously changes throughout the lunar cycle which has a duration of about 29.5 days. Moreover, due to the fact that driving the display elements of this device is complicated and that these elements

have a non-negligible height, such device is not quite adapted for integration into watches having a mechanical movement, either.

[0005] A moon phase display device which is adapted to be integrated into watches having a mechanical movement is described in prior art document EP 2 392 976. In an embodiment, the device comprises, next to a dial having a substantially semi-circular aperture, one moon disk and two or three occultation disks as well as a gear train adapted to rotatably drive said moon disk and said occultation disks in such a way that the indications inscribed on the moon disk are obscured, at least in part, during specific phases of operation of the device, such that the indications appearing through the substantially semi-circular aperture of this device indicate the moon phases visible on earth in more realistic manner as compared to the above mentioned traditional moon phase display devices for watches. However, although this device forms an improvement as compared to traditional moon phase display devices, it still only allows to display the moon phases visible on earth in symbolic manner on the dial of the watch, in particular by means of eight different symbolic shapes of the moon phases such as shown in figures 2a to 2h of prior art document EP 2 392 976. In reality, the moon phases and, in particular, the lunar terminator visible from earth during the lunar cycle take much more varying shapes.

[0006] In view of the above, it is clear that the above mentioned devices according to prior art comprise several problems and inconveniences, either as not being adapted for integration into watches having a mechanical movement or as not allowing to display the moon phases visible from earth during the entire lunar cycle in sufficient and desirable detail.

Objectives of the invention

[0007] It is the object of the present invention to overcome the above mentioned difficulties and to realize a mechanism for indication of the lunar phases which, in particular, is adapted for integration into a watch having a mechanical movement and which is adapted to provide a more realistic representation of the moon phases as well as, preferably, also of the lunar terminator visible from earth during the entire lunar cycle. At the same time, the mechanism and, in particular, its driving means should remain comparatively simple in terms of technical complexity. Moreover, both the space occupied by the mechanism within the corresponding watch movement and the cost for realizing the mechanism should remain within acceptable limits.

Solution according to the invention

[0008] To this effect, the present invention proposes a mechanism for indication of the lunar phases which is characterized by the features enumerated in claim 1 and which allows to achieve the objectives identified above.

[0009] In particular, the mechanism for indication of the lunar phases according to the present invention comprises a plurality of moon indicator elements and a plurality of shade elements arranged in a vertical stack underneath said dial, at least part of said plurality of moon indicator elements and/or at least part of said plurality of shade elements being adapted to be driven rotatably by said gear train, at least one lunar phase being at least partially indicated by all or part of at least a first moon indicator element of said plurality of moon indicator elements and at least another lunar phase being at least partially indicated by all or part of at least a second, different moon indicator element of said plurality of moon indicator elements, such that the lunar phases and the lunar terminator indicated through the aperture of the dial substantially correspond during the entire lunation to the appearance of the moon as visible from earth.

[0010] In preferred embodiments of such a mechanism for indication of the lunar phases, the moon indicator elements, optionally except the moon indicator element arranged at the bottom of said vertical stack underneath said dial, and the shade elements each comprise a number of cycles of apertures and shapes. The number of cycles of apertures and shapes in the moon indicator elements preferably are different from the number of cycles of apertures and shapes in the shade elements, both numbers of cycles of apertures and shapes preferably being chosen from the group comprising the numbers 1 to 6. Furthermore, the number of moon indicator elements and/or the number of shade elements arranged in said vertical stack underneath said dial preferably is chosen from the group comprising the numbers 2 to 8. Said vertical stack arranged underneath said dial may comprise an equal number of moon indicator elements and of shade elements.

[0011] Typically, during each cycle of displaying the lunar phases in a mechanism for indication of the lunar phases according to the present invention, at least one element of the plurality of moon indicator elements or of the plurality of shade elements is driven in rotation, either continuously or intermittently. Preferably at least one element of both of the plurality of moon indicator elements and of the plurality of shade elements is driven in rotation during at least certain steps of displaying the lunar phases. In preferred embodiments of such a mechanism, the plurality of moon indicator elements, optionally except the moon indicator element arranged at the bottom of said vertical stack underneath said dial, forms a set of moon indicator elements and the plurality of shade elements forms a set of shade elements. Rotation of all elements within a given set preferably is performed about a concentrically arranged axis of rotation. The axis of rotation of said set of moon indicator elements and the axis of rotation of said set of shade elements may be arranged concentrically or non-concentrically. In most embodiments, at least part of the moon indicator elements and of the shade elements are driven rotatably in different direction, preferably at different speeds of rota-

tion.

[0012] A mechanism for indication of the lunar phases according to the present invention may indicate the lunar phases and the lunar terminator through said opening of the dial in a manner substantially corresponding, during the entire lunation, to the appearance of the moon as visible from a given hemisphere of the earth, i. e. from the northern hemisphere or the southern hemisphere, or may indicate the lunar phases and the lunar terminator through two openings of the dial simultaneously for both the northern hemisphere and the southern hemisphere.

[0013] Other features and advantages of the present invention are mentioned in the dependent claims as well as in the description disclosing in the following, with reference to the figures, the invention in more detail.

Brief description of the figures

[0014] The attached figures exemplarily and schematically illustrate the principles as well as several embodiments of the present invention.

Figure 1a is a plan view from above of a plurality of moon indicator elements used in a first embodiment of the mechanism for indication of the lunar phases according to the present invention; figure 1b is an exploded view of the plurality of moon indicator elements of figure 1a, schematically illustrating how these elements are supposed to be assembled; figures 1c and 1d are perspective views from above, respectively from below, showing the plurality of moon indicator elements of figure 1b in the assembled state; figure 1e is a plan view from above of the plurality of moon indicator elements of figure 1b in the assembled state; figure 1f is a cross-sectional view of the plurality of moon indicator elements along the line I-I figuring in figure 1e.

Figure 2a is a plan view from above of a plurality of shade elements used in said first embodiment of the mechanism for indication of the lunar phases according to the present invention; figure 2b is an exploded view of the plurality of shade elements of figure 2a, schematically illustrating how these elements are supposed to be assembled; figures 2c and 2d are perspective views from above, respectively from below, showing the plurality of shade elements of figure 2b in the assembled state; figure 2e is a plan view from above of the plurality of shade elements of figure 2b in the assembled state; figure 2f is a cross-sectional view of the plurality of shade elements along the line II-II figuring in figure 2e.

Figure 3 schematically illustrates, for each day of lunation during the entire cycle of lunation, the result obtained by the first embodiment of the mechanism for indication of the lunar phases according to the present invention in terms of the lunar phases and

the lunar terminator indicated, the day of lunation being indicated in the left column, the parts of the corresponding moon indicator elements and shade elements being visible on a given day of lunation through the aperture of the dial being shown in the middle column, and the resulting display visible on a given day of lunation on the dial being shown in the right column.

Figures 4a and 4b are perspective views from above, respectively from below, showing a moon phase indicator module corresponding to the first embodiment of the mechanism for indication of the lunar phases according to the present invention, said moon phase indicator module comprising a dial, the plurality of moon indicator elements of figure 1a, the plurality of shade elements of figure 2a, a gear train and a module bridge; figure 4c is a plan view from above of said moon phase indicator module; figure 4d is a perspective view from above showing the moon phase indicator module of figure 4a, with a cross-sectional cut in said moon phase indicator module along the line III-III figuring in figure 4c; figures 4e and 4f are cross-sectional views of said moon phase indicator module along the lines IV-IV, respectively V-V, figuring in figure 4c; figures 4g, 4h and 4i are a perspective view, a plan view from above and a perspective view with a cross-sectional cut along the line III-III figuring in figure 4c, each showing the moon phase indicator module of figure 4a from above without the dial; figures 4j, 4k and 4l are a perspective view, a plan view and a perspective view with a cross-sectional cut along the line VI-VI figuring in figure 4k, each showing the moon phase indicator module of figure 4a from above without the dial as well as without both the plurality of moon indicator elements and the plurality of shade elements; figure 4m is a plan view from above of the gear train of said moon phase indicator module, with some parts being shown in transparent manner for ease of comprehension of its structure and functioning; figure 4n is an exploded view of the plurality of moon indicator elements of figure 1b as well as of the gear train and the module bridge of the moon phase indicator module of figure 4l, schematically illustrating how these elements are supposed to be assembled, figure 4n not showing the plurality of shade elements for reasons of comprehension; figure 4o is an exploded view of the plurality of shade elements of figure 2b as well as of the gear train and the module bridge of the moon phase indicator module of figure 4l, schematically illustrating how these elements are supposed to be assembled, figure 4o not showing the plurality of moon indicator elements for reasons of comprehension; figure 4p is an exploded view of the plurality of moon indicator elements of figure 1b and of the plurality of shade elements of figure 2b arranged in a vertical stack underneath the dial as well

as of the gear train and the module bridge of the moon phase indicator module of figure 4l, schematically illustrating how these elements are supposed to be assembled.

Figures 5a and 5b schematically illustrate, by an exploded view and a perspective view with a cross-sectional cut as well as with enlarged views of parts of said cut, a first embodiment of arranging the plurality of moon indicator elements and the plurality of shade elements in a vertical stack underneath the dial by use of both circumferential rings and spacer rings, both the moon indicator and the shade elements being illustrated only in symbolic and schematic manner, for ease of comprehension, without the apertures and shapes formed in these elements; figures 5c and 5d schematically illustrate, by an exploded view and a perspective view with a cross-sectional cut as well as with enlarged views of parts of said cut, a second embodiment of arranging the plurality of moon indicator elements and the plurality of shade elements in a vertical stack underneath the dial by use only of circumferential rings, the moon indicator and the shade elements again being illustrated only in symbolic and schematic manner without the apertures and shapes formed in these elements.

Figure 6a is a plan view from above of a plurality of moon indicator elements used in a second embodiment of the mechanism for indication of the lunar phases according to the present invention; figure 6b is a plan view from above of a plurality of shade elements used in said second embodiment of the mechanism for indication of the lunar phases according to the present invention; figure 6c is an exploded view of the plurality of moon indicator elements of figure 6a and of the plurality of shade elements of figure 6b, schematically illustrating how these elements are supposed to be arranged in a vertical stack underneath the dial of said second embodiment of the mechanism for indication of the lunar phases according to the present invention; figures 6d and 6e are a plan views from above, respectively from below, showing the plurality of moon indicator elements and the plurality of shade elements of figure 6c in the assembled state; figure 6f is a side view schematically showing the plurality of moon indicator elements and the plurality of shade elements of figure 6c in the assembled state.

Detailed description of the invention

[0015] In the following, the invention shall be described in detail with reference to the above mentioned figures. In particular, the basic principle, the structure and the functioning of a mechanism according to the present invention shall be described by referring to a first embodiment

of a mechanism for indication of the lunar phases according to the present invention. Further embodiments, including additional embodiments not shown in the figures, and further possible modifications of the mechanism will be described below, too.

Basic principle and structure

[0016] A mechanism for indication of the lunar phases according to the present invention typically is adapted for integration into a bracelet watch and allows to display the lunar phases and the lunar terminator through an aperture of a dial of the mechanism in a manner substantially corresponding, during the entire lunation, to the appearance of the moon such as visible from earth. Preferably, but not necessarily, the source of energy of the corresponding watch is mechanical, typically by use of a mainspring inside a barrel, it being understood that the source of energy may also be electrical, for example by use of batteries or solar cells. In case of integration of the mechanism into a bracelet watch, the movement of the watch is used to transmit energy required for driving the mechanism for indication of the lunar phases from the source of energy of the corresponding watch to said mechanism. This movement is preferably, but not necessarily either, a mechanical watch movement, but may for example also consist of a quartz movement or of a movement comprising another type of regulating organ. In general, a mechanism for indication of the lunar phases according to the present invention is adapted not only for integration into a watch, but for integration into any kind of device which shall be equipped with a display of the lunar phases. Although the mechanism for indication of the lunar phases according to the present invention will be described in the following mainly by referring to the case of integration of the mechanism into a bracelet watch, this does not limit the scope and the application of the invention.

[0017] The mechanism for indication of the lunar phases according to the present invention comprises, like devices of the type of prior art mentioned above, a dial 1 having an aperture 1.1, a moon indicator element M1, at least two shade elements S1, S2, and a gear train 2 adapted to rotatably drive said moon indicator element M1 and/or said at least two shade elements S1, S2 in a manner allowing to display at least part of said moon indicator element M1 and/or at least part of said at least two shade elements S1, S2 through said aperture 1.1. For displaying certain lunar phases, said moon indicator element M1 is at least partly shaded by at least part of said at least two shade elements S1, S2, such as to indicate the lunar phases in said aperture 1.1 in more realistic manner. Said dial 1 of the mechanism in practice corresponds to or is part of the watch dial.

[0018] In contrast to devices of prior art, the mechanism according to the present invention comprises a plurality of moon indicator elements M1, M2, ... and a plurality of shade elements S1, S2, ... arranged in a vertical stack

underneath said dial 1, at least part of said plurality of moon indicator elements M1, M2, ... and/or at least part of said plurality of shade elements S1, S2, ... being adapted to be driven rotatably by said gear train 2. The series of figure 1a to 1f and 2a to 2f schematically illustrate a plurality of moon indicator elements M1, M2, M3, M4 and a plurality of shade elements S1, S2, S3, S4 used in a first embodiment of a mechanism for indication of the lunar phases according to the present invention. In said first embodiment, both the plurality of moon indicator elements M1, M2, ... and the plurality of shade elements S1, S2, ... are driven rotatably by said gear train 2, although this in general isn't required in a mechanism for indication of the lunar phases according to the present invention. Figures 1a and 1b, respectively 2a and 2b, schematically show said plurality of moon indicator elements, respectively of shade elements, in plan views from above and corresponding exploded views, and figures 1c to 1f, respectively 2c to 2f, schematically illustrate the first embodiment of the plurality of moon indicator elements M1, M2, M3, M4 and of the plurality of shade elements S1, S2, S3, S4 in the assembled state, by corresponding perspective views from above, respectively from below, plan views from above and cross-sectional views along the line I-I figuring in figure 1e, respectively along the line II-II figuring in figure 2e. By rotatably driving said plurality of moon indicator elements M1, M2, M3, M4 and said plurality of shade elements S1, S2, S3, S4 by means of the above mentioned gear train 2, which will be described in detail in a corresponding section below, the first embodiment of a mechanism according to the present invention allows that at least one lunar phase is indicated by at least two different moon indicator elements M1, M2, M3, M4. Preferably, at least one lunar phase is also indicated by at least two different shade elements S1, S2, S3, S4. However, in general, this isn't required in a mechanism for indication of the lunar phases according to the present invention, either. Instead, the fact that, in the first embodiment of a mechanism according to the present invention, some lunar phases are indicated by multiple, i. e. at least two different, moon indicator elements M1, M2, M3, M4 and possibly also by multiple, i. e. at least two different, shade elements S1, S2, S3, S4 is a consequence of the specific construction of said first embodiment, in particular a consequence of the simultaneous driving in rotation by said gear train 2 of both the plurality of moon indicator elements M1, M2, ... and the plurality of shade elements S1, S2, ... realized in said first embodiment. In the general configuration of a mechanism for indication of the lunar phases according to the present invention, at least one lunar phase is at least partially indicated by all or part of at least a first moon indicator element M1, M2, ... of said plurality of moon indicator elements M1, M2, ... and at least another lunar phase is at least partially indicated by all or part of at least a second, different moon indicator element M1, M2, ... of said plurality of moon indicator elements M1, M2, ... For example, this may be achieved

by arranging the moon indicator elements M1, M2, ... and/or the shade elements S1, S2, ... such as to jump between discrete lunar phases, none of which is displayed by multiple moon indicator elements M1, M2, ... or even by multiple shade elements S1, S2, ... In any of these configurations, this allows that both the lunar phases and the lunar terminator are indicated through the aperture 1.1 of the dial 1 in a manner substantially corresponding, during the entire lunation, to the appearance of the moon as visible from earth. Indication of the lunar phases and, in particular, of the lunar terminator therefore is much more realistic as compared to the moon phase indication achieved by prior art devices.

[0019] This is easily comprehensible by taking note of the display of the lunar phases and of the lunar terminator realized by first embodiment of a mechanism for indication of the lunar phases according to the present invention on each day of lunation, such as schematically and exemplarily illustrated by figure 3. In this figure, the day of lunation is indicated in the left column, the parts of the corresponding moon indicator elements M1, M2, M3, M4 and shade elements S1, S2, S3, S4 being visible on a given day of lunation through the aperture 1.1 of the dial 1 are shown in the middle column, and the resulting display visible on a given day of lunation on the dial 1 of the mechanism, respectively of a corresponding watch, is shown in the right column. As can be seen, for example, this embodiment of a mechanism for indication of the lunar phases according to the present invention indicates the lunar phase corresponding to days of lunation 8, 9, 21 and 22, respectively to days of lunation 10, 11, 18 and 19, by use of the moon indicator elements M2, M3 and of the shade elements S1, S2, S3, respectively by use of the moon indicator elements M3, M4 and of the shade elements S1, S2, S3, S4, similar applying to other days of lunation. In sum, this results in a very realistic display of the lunar phases and, in particular, of the lunar terminator during the entire lunation having, such as known to a person skilled in the art of watchmaking, a duration of about 29.5 days.

[0020] To further elaborate on the structure of the first embodiment of a mechanism for indication of the lunar phases according to the present invention, it is visible in figures 1a and 1b, respectively in figures 2a and 2b, that the moon indicator elements M1, M2, M3 and the shade elements S1, S2, S3, S4 each comprise a number of cycles of apertures and shapes. The moon indicator element M4 arranged at the bottom of said vertical stack underneath said dial 1 of the first embodiment of the mechanism doesn't comprise such apertures and shapes, but optionally may comprise such apertures and shapes in other embodiments. In general, the number of cycles of apertures and shapes in the moon indicator elements M1, M2, M3, M4 preferably is different from the number of cycles of apertures and shapes in the shade elements S1, S2, S3, S4. In the first embodiment of a mechanism for indication of the lunar phases according to the present invention, the moon indicator elements M1,

M2, M3 each comprise one cycle of apertures and shapes and the shade elements S1, S2, S3, S4 each comprise three cycles of apertures and shapes, such as visible in figures 1a and 1b, respectively in figures 2a and 2b. In general, both the number of cycles of apertures and shapes in the moon indicator elements M1, M2, M3, M4 and in the shade elements S1, S2, S3, S4 preferably is chosen from the group of numbers comprising the numbers 1 to 6.

[0021] In the preferred, first embodiment of a mechanism for indication of the lunar phases according to the present invention, the moon indicator elements M1, M2, M3, M4 and the shade elements S1, S2, S3, S4 are realized as moon indicator discs, respectively as shade discs. However, in general, neither the moon indicator elements M1, M2, ... nor the shade elements S1, S2, ... need to be realized as discs, but may take another form, for example the form of a triangular plate, as will become clear further below. To revert to the first embodiment of the mechanism, as visible for example in figure 1a, the moon indicator discs M1, M2, M3, M4 have a central opening of preferably circular shape with a flat side on part of its circumference, in order to allow fixing of the moon indicator discs M1, M2, M3, M4 onto its physical axis of rotation and, for example, in order to allow housing of tubes forming the axis of rotation of hands of the corresponding watch through this opening, an inner first ring-like section surrounding said central opening, a middle second ring-like section comprising (except disc M4) the above mentioned one cycle of apertures and shapes formed within the moon indicator discs M1, M2, M3, with said middle second ring-like section extending on a radial distance sensibly corresponding to the width, respectively the diameter, of the aperture 1.1 in the dial 1 and being arranged in the mechanism such that during the entire rotation of a given disc M1, M2, M3, M4 an angular range of the corresponding second ring-like section lies underneath said aperture 1.1, and an optional, outer third ring-like section of small width surrounding said middle second ring-like section and serving mainly for guaranteeing stability of the discs as well as that no other parts than the discs M1, M2, M3, M4, S1, S2, S3, S4 are visible through the outer edge of the aperture 1.1 of the dial 1. Likewise, as visible for example in figure 2a, the shade discs S1, S2, S3, S4 have a central opening of preferably circular shape, in order to allow housing of the axis of rotation of the moon indicator discs M1, M2, M3, M4 through this opening as well as also in order to allow housing of said tubes forming the axis of rotation of hands of the corresponding watch through this opening, an optional inner first ring-like section surrounding said central opening, a middle second ring-like section comprising the above mentioned three cycles of apertures and shapes formed within the shade discs S1, S2, S3, S4, with said middle second ring-like section of the shade discs also extending on a radial distance corresponding to the width, respectively the diameter, of the aperture 1.1 in the dial 1 and being arranged in the mechanism such

that during the entire rotation of a given disc S1, S2, S3, S4 an angular range of the corresponding second ring-like section lies underneath said aperture 1.1, and an outer third ring-like section of small, but as compared to the width of the third ring-like section of the moon indicator discs somewhat larger, width surrounding said middle second ring-like section of the shade discs S1, S2, S3, S4, said third ring-like section of the shade discs S1, S2, S3, S4 preferably, but not necessarily, being used for fixing of the shade discs S1, S2, S3, S4 onto its physical axis of rotation.

[0022] Furthermore, concerning said apertures in the discs, the middle, second ring-like sections of the moon indicator discs M1, M2, M3 (except disc M4) comprise, in the preferred, first embodiment of a mechanism for indication of the lunar phases according to the present invention, an aperture angularly extending sensibly on three quarters in the second ring-like section of disc M1, an aperture of a sensibly semi-ring shape in the second ring-like section of disc M2, respectively an aperture angularly extending sensibly on one quarter in the second ring-like section of disc M3, thus forming in each of the moon indicator discs M1, M2, M3 the above mentioned one cycle of apertures and shapes. Likewise, the middle, second ring-like sections of the shade discs S1, S2, S3, S4 each comprise, in the first embodiment of the mechanism according to the present invention, three apertures each angularly extending sensibly on about a sixth of the second ring-like sections of discs M1, M2, M3, M4 and being separated from each other by an angular distance also of about a sixth of the second ring-like sections, thus forming in each of the shade discs S1, S2, S3, S4 the above mentioned three cycles of apertures and shapes. Concerning said shapes in the discs, the lateral ends of the apertures in the middle, second ring-like sections of the moon indicator discs M1, M2, M3 have, in the preferred, first embodiment of a mechanism for indication of the lunar phases according to the present invention, for disc M1, a convex, for disc M2, a straight line, and for disc M3, a concave shape. Likewise, the lateral ends of the apertures in the middle, second ring-like sections of the shade discs S1, S2, S3, S4 have, in the first embodiment of the mechanism, for discs S1, S2, a more pronounced concave, respectively a less pronounced concave shape, and, for discs S3, S4, a less pronounced convex, respectively a more pronounced convex shape.

[0023] In general, said apertures and shapes of at least part of the moon indicator elements M1, M2, M3, M4 and/or of at least part of the shade elements S1, S2, S3, S4 preferably are delimited, on said lateral ends of the apertures in the middle, second ring-like sections of the moon indicator elements M1, M2, M3, M4 and/or of the shade elements S1, S2, S3, S4, by parts of the circumference of ellipses having a major axis length corresponding to the size of said aperture 1.1 of the dial 1, with the minor axis length of these ellipses being chosen depending on several parameters, amongst others on

the number of moon indicator/shade elements used and on the number of cycles of apertures and shapes in these elements. The moon indicator elements M1, M2, M3, M4 preferably have shapes of light colour, like white, yellow or golden colours, representing illuminated parts of the moon, at least in the shapes formed within the corresponding second ring-like sections. The shade elements S1, S2, S3, S4 preferably have shapes of dark colour, like black, brown or blue colours, representing shaded parts of the moon, again at least in the shapes formed within the corresponding second ring-like sections. Depending on the design chosen for a particular moon phase display, respectively for a given watch supposed to house the mechanism according to the present invention, this may also be done vice versa, i. e. a dark colour representing illuminated parts of the moon and a light colour representing shaded parts of the moon. Furthermore, again depending on the design chosen for a particular moon phase display, respectively for a corresponding watch, it is also possible to adapt the mechanism such that the moon indicator elements M1, M2, M3, M4 have shapes of dark colour, like black, brown or blue colours, representing shaded parts of the moon, at least in the shapes formed within the corresponding second ring-like sections. In this case, the shade elements S1, S2, S3, S4 have shapes of light colour, like white, yellow or golden colours, representing illuminated parts of the moon, again at least in the shapes formed within the corresponding second ring-like sections.

[0024] The exploded view of figure 1b and the cross-sectional view of figure 1f show that, in case of the preferred, first embodiment of a mechanism for indication of the lunar phases according to the present invention, a spacer disk SD is arranged between each two moon indicator elements M1, M2, M3, M4. The three spacer disks SD used in this embodiment have, like the moon indicator discs M1, M2, M3, M4, a central opening of preferably circular shape optionally with a flat side on part of its circumference, in order to allow fixing of the moon indicator discs M1, M2, M3, M4 onto its physical axis of rotation and, for example, in order to allow housing of tubes forming the axis of rotation of hands of the corresponding watch through this opening. Moreover, these spacer disks SD have an outer diameter somewhat smaller than the diameter of the inner, first ring-like section of the moon indicator disks M1, M2, M3 and a height allowing to arrange, between two moon indicator discs M1, M2, M3, M4, one of the shade discs S2, S3, S4. In other terms, the spacer disks SD ensure the distance required at each instance between two of the moon indicator disks M1, M2, M3 such that the one of the shade discs S2, S3, S4 arranged between them can safely rotate. In this manner, the plurality of moon indicator elements M1, M2, M3, M4 forms a set of moon indicator elements, meaning in case of the first embodiment of the mechanism that the moon indicator discs M1, M2, M3, M4, in this specific case by including the spacer disks SD, form a set by being fixed to each another, for example by

corresponding screws or equivalent fixing means known to a person skilled in the art of watchmaking. Generally speaking, the wording "forming a set of elements" such as used in the present description, as compared to the wording "forming a plurality of elements" also used herein, may - instead of referring to a plurality of elements fixed to each other like in the first embodiment of the mechanism - also mean that all or part of the plurality of elements in addition to or instead of being fixed to each other has another common attribute, for example that each or part of the plurality of elements has the same direction of rotation, in order to be qualified as forming a set of elements. Furthermore, in the general case of a mechanism for indication of the lunar phases according to the present invention, the moon indicator element arranged at the bottom of said vertical stack underneath said dial 1 doesn't need to form a set with the other members of the plurality of moon indicator elements M1, M2, ..., because its rotation is optional. For the case of the first embodiment of the mechanism for indication of the lunar phases according to the present invention, the set of moon indicator elements M1, M2, M3, M4 is schematically illustrated by the views of figures 1c, 1d, and 1e in its assembled state.

[0025] Similarly, the exploded view of figure 2b and the cross-sectional view of figure 2f show that, in case of the preferred, first embodiment of a mechanism for indication of the lunar phases according to the present invention, spacer rings SR and therebetween a circumferential ring CR are arranged between each two shade elements S1, S2, S3, S4 as well as a spacer ring SR and a circumferential ring CR underneath the shade element S4. Both the spacer rings SR and the circumferential rings CR used in this embodiment have an outer diameter sensibly identical to the outer diameter of the shade discs S1, S2, S3, S4. The circumferential rings CR have an inner diameter slightly larger than the outer diameter of the moon indicator discs M1, M2, M3, M4, such as to allow arranging each of the moon indicator discs M1, M2, M3, M4 at the same height within the mechanism inside a corresponding circumferential ring CR. The spacer rings SR have an inner diameter slightly smaller than the outer diameter of the moon indicator discs M1, M2, M3, M4, such as to avoid in all circumstances that one of the moon indicator discs M1, M2, M3, M4 comes into contact with one of shade discs S1, S2, S3, S4, for example in the event of an impact on the mechanism. Of course, the spacer rings SR and, in particular, the circumferential rings CR have a height allowing to arrange, between two shade discs S1, S2, S3 as well as underneath the shade disc S4, one of the moon indicator discs M1, M2, M3, M4. In other terms, the circumferential rings CR ensure the distance required at each instance between two of the shade discs S1, S2, S3, S4 such that the one of the moon indicator discs M1, M2, M3, M4 arranged between them can safely rotate and the spacer rings SR ensure the distance between a shade disc S1, S2, S3, S4 and a moon indicator disc M1, M2, M3, M4 arranged next to it

such as to avoid contact between such neighbouring disks, simultaneously serving for a better guidance of the moon disks on its outer circumference. In this manner, the plurality of shade elements S1, S2, S3, S4 forms a set of shade elements, meaning in case of the first embodiment of the mechanism that the shade discs S1, S2, S3, S4, in this specific case including the spacer rings SR and the circumferential rings CR, form a set by being fixed to each another, again for example by corresponding screws or equivalent fixing means. For the case of the first embodiment of the mechanism according to the present invention, the set of shade elements S1, S2, S3, S4 is schematically illustrated by the views of figures 2c, 2d, and 2e in its assembled state.

[0026] Therefore, given that, on the one hand, the plurality of moon indicator discs M1, M2, M3, M4 forms a set of moon indicator elements and the plurality of shade discs S1, S2, S3, S4 forms a set of shade elements, with the discs inside a set being fixed one to another, as well as that, on the other hand, the moon indicator discs M1, M2, M3, M4 are arranged axially between, respectively underneath, and radially inside the shade discs S1, S2, S3, S4, one may note that, in the first embodiment of the mechanism for indication of the lunar phases according to the present invention, (a) rotation of all discs/elements within a given set is performed about a concentrically arranged axis of rotation and (b) the axis of rotation of said set of moon indicator discs/elements M1, M2, ... and the axis of rotation of said set of shade discs/elements S1, S2, ... are arranged concentrically. As will become clear further below, both features (a) and (b) are preferred and therefore realized in the first embodiment of the mechanism, but generally don't need to be present in a mechanism for indication of the lunar phases according to the present invention.

[0027] The first embodiment of a mechanism for indication of the lunar phases according to the present invention realizes some other preferred, but only optional features, too. In particular, it is clear from the above description as well as visible for example in figure 4p, which schematically illustrates the entire vertical stack arranged underneath said dial 1 comprising the plurality of moon indicator elements M1, M2, ... and the plurality of shade elements S1, S2, ..., that the first embodiment of the mechanism also realizes feature (c) that the moon indicator elements M1, M2, ... and the shade elements S1, S2, ... are arranged in an alternating manner within said vertical stack. It also realizes feature (d) that the vertical stack arranged underneath said dial 1 comprises an equal number of moon indicator elements M1, M2, ... and of shade elements S1, S2, ... The choice for the first embodiment of the mechanism that both the number of moon indicator elements M1, M2, M3, M4 and the number of shade elements S1, S2, S3, S4 arranged in said vertical stack underneath said dial 1 is chosen to be 4 is optional, as will become clear further below, too. In general, the number of moon indicator elements M1, M2, ... and/or the number of shade elements S1, S2, ... arranged

in said vertical stack underneath said dial 1 preferably is chosen from the group of numbers comprising the numbers 2 to 8, this however not being required, either.

[0028] Turning to the structure of the gear train 2 used in the first embodiment of a mechanism for indication of the lunar phases according to the present invention, one may note at the outset of describing the gear train that, in this first embodiment, the above mentioned plurality of moon indicator discs M1, M2, M3, M4 forming a set of moon indicator elements and the above mentioned plurality of shade discs S1, S2, S3, S4 forming a set of shade elements, with the discs inside each set being fixed one to another, together with the dial 1, the gear train 2 of the mechanism and a module bridge 3 advantageously form a moon phase indicator module. For the purpose of describing the gear train 2, figures 4a, 4b, 4c, 4d, 4e and 4f show said moon phase indicator module by perspective views from above, respectively from below, by a plan view from above, by a perspective view from above with a cross-sectional cut in said moon phase indicator module along the line III-III figuring in figure 4c, and by cross-sectional views of said moon phase indicator module along the lines IV-IV, respectively V-V, figuring in figure 4c. For ease of comprehension, figures 4g, 4h and 4i show said moon phase indicator module, without the dial 1, by a perspective view from above, a plan view from above and a perspective view from above with a cross-sectional cut along the line III-III figuring in figure 4c, the shade discs being marked in figures 4g and 4h by hatching. Similarly, figures 4j, 4k and 4l show said moon phase indicator module, without the dial 1 as well as without both the plurality of moon indicator elements M1, M2, M3, M4 and the plurality of shade elements S1, S2, S3, S4, by a perspective view from above, a plan view from above and a perspective view from above with a cross-sectional cut along the line VI-VI figuring in figure 4k. Figure 4m is a plan view from above of the gear train 2 of said moon phase indicator module, with some parts being shown in transparent manner and without showing the module bridge 3. The aperture 1.1 in the dial 1 of the moon phase indicator module typically is placed such that it is in the 12 o'clock position of the corresponding watch.

[0029] As visible in particular in figures 4e, 4f, 4i, 4j, 4k and 4m, the gear train 2 used in the first embodiment of the mechanism comprises an hour wheel 2.1 arranged rotatably and concentrically with the axis of rotation of said set of moon indicator discs M1, M2, M3, M4 and the axis of rotation of said set of shade discs S1, S2, S3, S4. The hour wheel 2.1 is driven by the above mentioned source of energy of the corresponding bracelet watch by means of the watch movement, respectively in general by the source of energy of the corresponding device which shall be equipped with a display of the lunar phases, and in turn drives a first intermediate wheel 2.2 which is in engagement with an intermediate wheel mobile 2.3 driving a second intermediate wheel 2.4. The latter drives a finger wheel 2.5 driving a star wheel 2.6 having a star

wheel mobile being in engagement with a moon disks wheel 2.7. The latter also engages with a first change wheel 2.8 which is in engagement with a change wheel mobile 2.9 driving a second change wheel 2.10 which on its turn rotatably drives a shade disks wheel 2.11 by engaging with a toothing arranged on the inner circumference of said shade disks wheel 2.11 which in fact forms a ring. In the first embodiment of the mechanism, the hour wheel 2.1 preferably is driven rotatably in clockwise direction, such that the wheels and mobiles 2.2 to 2.10 having an odd numbering are driven rotatably in clockwise direction, too, whilst the wheels and mobiles 2.2 to 2.10 having an even numbering as well as the shade disks wheel 2.11 are driven rotatably in counterclockwise direction.

[0030] The moon disks wheel 2.7 simultaneously serves as a first supporting plate for the above described set of moon indicator discs/elements M1, M2, M3, M4 which is fixed thereto, including the spacer disks SD, for example by the above mentioned screws or equivalent fixing means. In particular, the moon disks wheel 2.7 preferably has a central opening of preferably tubular shape, in order to allow housing of the above mentioned tubes forming the axis of rotation of hands of the corresponding watch through this opening. The moon disks wheel 2.7 preferably also has an upwards extending cylindrical prolongation surrounding its central opening and having a flat side wall on part of its circumference, such as to receive the set of moon indicator elements M1, M2, M3, M4 including the spacer disks SD, given that both of these parts have a central opening of preferably circular shape with a flat side on part of its circumference in order to allow for easily fixing these parts together whilst automatically guaranteeing its correct relative orientation. The ring-shaped shade disks wheel 2.11 likewise simultaneously serves as a second supporting plate for the above described set of shade discs/elements S1, S2, S3, S4 which is fixed thereto, including the corresponding circumferential rings CR and the spacer rings SR, for example by the above mentioned screws or equivalent fixing means. The latter and corresponding, pre-formed holes in the shade discs S1, S2, S3, S4, in the circumferential rings CR and the spacer rings SR as well as in the shade disks wheel 2.11 preferably guarantee correct orientation of these parts relative to each other.

[0031] One finally should note that the wheels and mobiles 2.1 to 2.6 and 2.8 to 2.10 are rotatably mounted on said module bridge 3 of the moon phase indicator module, for example by means commonly known to a person skilled in the art of watchmaking. The moon disks wheel 2.7 is rotatably mounted on the module bridge 3 by being fixed on the inner ring of an annular bearing 2.12, the outer ring of which is fixed onto the module bridge 3. The shade disks wheel 2.11 is rotatably mounted at its outer circumference on the inner circumference of a module bridge ring 3.1 which forms a kind of annular bearing with the shade disks wheel 2.11 and which is fixed on its lower end onto the module bridge 3, with the

dial 1 being fixed on the upper end of said module bridge ring 3.1, like visible for example in figures 4d, 4i and 4l. This allows, on the one hand, to space apart the module bridge 3 and the dial 1 at a desired distance depending on the entire height of the gear train 2 and the vertical stack of discs arranged underneath said dial 1 as well as, on the other hand, to safely house the plurality of moon indicator elements M1, M2, ... and the plurality of shade elements S1, S2, ... within the housing formed by the module bridge 3, the module bridge ring 3.1 and the dial 1. For ease of comprehension, figure 4n shows in an exploded view the plurality of moon indicator elements of figure 1b as well as the above described gear train 2 together with the module bridge 3 and the module bridge ring 3.1 of the moon phase indicator module according to the first embodiment of the mechanism. Figure 4n schematically illustrates how these elements are supposed to be assembled, but doesn't show the plurality of shade elements. Similarly, figure 4o shows in an exploded view the plurality of shade elements of figure 2b as well as the gear train 2 together with the module bridge 3 and the module bridge ring 3.1 of the moon phase indicator module of the first embodiment of the mechanism. Figure 4o schematically illustrates how these elements are supposed to be assembled, but doesn't show the plurality of moon indicator elements. In turn, figure 4p schematically illustrates by an exploded view the entire vertical stack of discs arranged underneath said dial 1 of the first embodiment of the mechanism, showing the plurality of moon indicator elements of figure 1b and the plurality of shade elements of figure 2b arranged in a vertical stack underneath the dial 1 as well as the gear train 2, the module bridge 3, and the module bridge ring 3.1 of the moon phase indicator module, schematically illustrating how these elements are supposed to be assembled. The shade discs/elements S1, S2, S3, S4 are marked by hashing in figures 4o and 4p for ease of comprehension.

Functioning

[0032] In view of the above description of the structure of the first embodiment of a mechanism for indication of the lunar phases according to the present invention, it is clear that the moon indicator disks M1, M2, M3, M4 in this preferred embodiment are driven together in clockwise direction at a speed of one rotation per moon cycle, i. e. one rotation in approximately 29.53 days. Since there are three cycles of apertures and shade shapes on the shade disks S1, S2, S3, S4, these are driven together in counterclockwise direction at a speed of one rotation per 88.59 days, i. e. 3 times slower. The direction of rotation of the moon disks and of the shade disks in the first embodiment of the mechanism is symbolically indicated in figures 1a, 1b and 2a, 2b by arrows. The moon indicator disks M1, M2, M3, M4 and/or the shade disks S1, S2, S3, S4 or parts thereof therefore appear through the aperture 1.1 of the dial 1 and disappear therefrom during operation of the mechanism, such as schematically shown for each day of

lunation in the middle column of figure 3. Due to the careful design of the apertures and shapes in the different moon indicator elements M1, M2, M3, M4 and shade elements S1, S2, S3, S4, including the contours of the apertures formed within those elements, the elements M1, M2, M3, M4, S1, S2, S3, S4 selectively show or hide parts of the elements beneath them, with the displayed lunar phase resulting from a combination of all the moon indicator elements M1, M2, M3, M4 and shade elements S1, S2, S3, S4 that are visible within the aperture 1.1 of the dial 1. The resulting display of the lunar phases and of the lunar terminator realized by the first embodiment of a mechanism for indication of the lunar phases according to the present invention on each day of lunation is schematically and exemplarily illustrated in figure 3 and has been described above in the context of figure 3.

[0033] In general, in a mechanism for indication of the lunar phases according to the present invention, during each cycle of displaying the lunar phases, at least one element M1, M2, ..., S1, S2, ... of the plurality of moon indicator elements M1, M2, ... and/or of the plurality of shade elements S1, S2, ... is driven in rotation, either continuously or intermittently. Driving these elements in continuous or intermittent manner is clear to a person skilled in the art in view of the above technical teaching, in particular with respect to continuously or intermittently driving the hour wheel 2.1 of the above described moon phase indicator module according to the first embodiment of the mechanism, such that this aspect won't be described in more detail in the following. Preferably, at least one element M1, M2, ..., S1, S2, ... of both of the plurality of moon indicator elements M1, M2, ... and of the plurality of shade elements S1, S2, ... is driven in rotation during at least certain steps of displaying the lunar phases, such as realized in the above described first embodiment of the mechanism. Furthermore, preferably at least part of the moon indicator elements M1, M2, ... and of the shade elements S1, S2, ... are driven rotatably in different direction, preferably at different speed of rotation, with the latter depending on the number of cycles of apertures and shapes in the moon indicator elements M1, M2, ... and the number of cycles of apertures and shapes in the shade elements S1, S2, ..., these optional features being realized in the first embodiment of the mechanism, too.

Further embodiments and alternatives

[0034] Next to the modifications, options, and alternative solutions already mentioned in the above description of the first embodiment of the mechanism for indication of the lunar phases according to the present invention, there are a number of further alternatives available for realizing a mechanism according to this invention.

[0035] For example, this concerns the manner of arranging the plurality of moon indicator elements M1, M2, ... and the plurality of shade elements S1, S2, ... in a vertical stack underneath the dial 1 of the mechanism,

respectively the manner of mounting these elements M1, M2, ..., S1, S2, ... in corresponding sets, in an effort to achieve a minimal height of the entire stack whilst ensuring safe operation of the mechanism. In this context, figures 5a and 5b schematically illustrate, by an exploded view and a perspective view with a cross-sectional cut as well as with enlarged views of parts of said cut, a second embodiment of arranging the plurality of moon indicator disks M1, M2, M3, M4 and the plurality of shade disks S1, S2, S3, S4 in a vertical stack underneath the dial 1. This second embodiment in principle is similar to the first embodiment of arranging the disks M1, M2, M3, M4, S1, S2, S3, S4 used in the first embodiment of the mechanism having already been described above, i. e. it uses both circumferential rings CR and spacer rings SR in the set of shade disks S1, S2, S3, S4 as well as spacer disks SD in the set of moon indicator disks M1, M2, M3, M4. However, whilst in the above described first embodiment there are only somewhat thicker spacer disks SD arranged between the moon indicator elements M1, M2, ..., the second embodiment of arranging the disks M1, M2, M3, M4, S1, S2, S3, S4 shown in figures 5a and 5b uses both somewhat thinner spacer disks SD, ensuring the distance required at each instance between two of the moon indicator disks M1, M2, M3 such that the one of the shade discs S2, S3, S4 arranged between them can safely rotate, and distancing disks DD arranged on both sides of each spacer disks SD, ensuring the distance between a moon indicator disc M1, M2, M3, M4 and a shade disc S1, S2, S3, S4 arranged next to it such as to avoid contact between such neighbouring disks. Both the moon indicator and the shade elements are illustrated only in symbolic and schematical manner in figure 5a, without the apertures and shapes formed in these elements, given that this schematical illustration only concerns arranging, respectively mounting, the disks. Using the first or the second embodiment of arranging the disks M1, M2, M3, M4, S1, S2, S3, S4 in a vertical stack underneath the dial 1, it is possible, for the example of the first embodiment of the mechanism, to achieve a height of the entire stack of about 0,7 mm to 1,6 mm. Similarly, figures 5c and 5d schematically illustrate, by an exploded view and a perspective view with a cross-sectional cut as well as with enlarged views of parts of said cut, a third embodiment of arranging the plurality of moon indicator disks M1, M2, M3, M4 and the plurality of shade disks S1, S2, S3, S4 in a vertical stack underneath the dial 1. In the third embodiment, only circumferential rings CR and spacer disks SD are used, the moon indicator and the shade elements again being illustrated in figure 5c only in symbolic and schematical manner without the apertures and shapes in these elements. With this manner of arranging the disks M1, M2, M3, M4, S1, S2, S3, S4 in a vertical stack underneath the dial 1, it is possible, again for the example of the first embodiment of the mechanism, to achieve a height of the entire stack of about 0,4 mm to 0,9 mm. In general, the height of the mechanism for indication of the lunar phases according to the present

invention, of course, mainly depends on the number of the moon indicator and shade elements arranged in the vertical stack underneath the dial of the mechanism.

[0036] A second embodiment of a mechanism for indication of the lunar phases according to the present invention is illustrated schematically and exemplarily in figures 6a to 6f. Figures 6a and 6b show, by corresponding plan views from above, a plurality of moon indicator elements M1, M2, M3, M4, M5, M6, respectively a plurality of shade elements S1, S2, S3, S4, S5, S6 used in said second embodiment of the mechanism, whilst figure 6c shows the plurality of moon indicator elements of figure 6a and of the plurality of shade elements of figure 6b in an exploded view, schematically illustrating how these elements are supposed to be arranged in a vertical stack underneath the dial 1 of said second embodiment of the mechanism. Figures 6d and 6e are a plan views from above, respectively from below, showing the plurality of moon indicator elements M1, M2, M3, M4, M5, M6 and the plurality of shade elements S1, S2, S3, S4, S5, S6 of figure 6c in the assembled state and figure 6f shows a schematical side view of the plurality of moon indicator elements and the plurality of shade elements of figure 6c in the assembled state. As visible namely in figures 6a, 6c and 6e, the moon indicator elements M1, M2, M3, M4, M5, M6 of the second embodiment of the mechanism aren't realized as discs, but have the form of a triangular plate. In other embodiments, this could be applied to the shade elements S1, S2, ..., too. In the second embodiment of the mechanism, the plurality of moon indicator elements realized by six plates M1, M2, M3, M4, M5, M6, and the plurality of shade elements realized by six disks S1, S2, S3, S4, S5, S6, are each forming a set of moon indicator elements M1, M2, ..., respectively a set of shade elements S1, S2, ..., too, and are arranged in alternating manner underneath the dial, both features being similar to what has been described above regarding the first embodiment of the mechanism. However, as another major difference - next to the shape of the moon indicator elements - as compared to the above described first embodiment of the mechanism, the axis of rotation of said set of moon indicator elements M1, M2, ... and the axis of rotation of said set of shade elements S1, S2, ... are different and are arranged non-concentrically in the second embodiment of the mechanism according to the present invention. As a further difference, driving in rotation of the plurality of moon indicator elements M1, M2, ..., respectively of the set of moon indicator elements M1, M2, ..., in this embodiment isn't performed by a rotational movement directed always in the same direction, irrespective of whether the rotational movement was continuous or intermittent, like in the first embodiment of the mechanism. Instead, driving in rotation of the set of moon indicator elements M1, M2, ... in this embodiment is performed by a pivoting movement, i. e. that the set of moon indicator elements M1, M2, M3, M4, M5, M6 can take two stationary positions and is pivoted from one stationary position to another depending on the state

of operation of the mechanism. More particularly, given that each of the moon indicator elements realized by plates M1, M2, M3, M4, M5, M6 and of the shade elements realized by disks S1, S2, S3, S4, S5, S6 comprises two cycles of apertures and shapes, the shade disks S1, S2, S3, S4, S5, S6 are driven together in rotation at a speed of one rotation per two moon cycles, i. e. one rotation in about 59 days. During said rotation of the shade disks, the position of the moon indicator plates M1, M2, M3, M4, M5, M6 remains fixed for each half moon display cycle, while pivoting by a certain angle - of about 45 ° in this embodiment - after each such half cycle. Alternatively, this arrangement could be inverted, such that the moon indicator elements M1, M2, M3, M4, M5, M6 rotate and the shade elements S1, S2, S3, S4, S5, S6 pivot every half cycle by a certain angle.

[0037] Reverting to alternative solutions and modifications generally applying to both of the above described first and second embodiments of a mechanism for indication of the lunar phases according to the present invention as well as to its modified versions already mentioned above, it should be noted that the directions of rotation of the moon indicator elements M1, M2, ... and of the shade elements S1, S2, ... in general may be switched, which however might require adapting correspondingly the colours, apertures and shapes in the moon indicator elements M1, M2, ... and in the shade elements S1, S2, ..., depending on the form of said apertures and shapes as well as on the shape of the dial 1. In this context, it should be noted that the direction of rotation of the shade elements sets the direction in which the lunar terminator moves across the aperture of the dial. The importance of this feature will become clear in the following when describing the options with respect to the aperture in the dial.

[0038] Furthermore, in both the first and second embodiments of the mechanism, the moon indicator elements M1, M2, ... within said set of moon indicator elements are fixed to each other and the shade elements S1, S2, ... within said set of shade elements are fixed to each other, such that in these cases each set may be driven rotatably in independent manner, i. e. for example at different speed or in any case by using at least partly separate gear trains.

[0039] Moreover, concerning alternative solutions in terms of driving in rotation the moon indicator elements M1, M2, ... and the shade elements S1, S2, ..., it should be noted, too, that driving in rotation these elements M1, M2, ..., S1, S2, ... alternatively may be done by use of physical axis of rotation realized as tubes, such as perfectly known to a person skilled in the art of horology in the context of watch hands. In corresponding alternative embodiments of a mechanism for indication of the lunar phases according to the present invention, the moon indicator elements M1, M2, ... and the shade elements S1, S2, ..., preferably realized as discs or as plates of triangular or another adequate shape, are fixed to a number of tubular axis of rotation having diameters al-

lowing that these tubular axis of rotation may be stacked one inside another, with the innermost tubular axis of rotation (which doesn't need to be tubular in case it's not required to house the axis of watch hands) supporting the upper shade element S1 and the outermost tubular axis of rotation supporting the lowermost moon indicator element Mx, the other moon indicator elements M1, M2, ... and shade elements S2, ... being arranged on the tubular axis of rotation situated between said innermost tubular axis of rotation and said outermost tubular axis of rotation. Whilst such embodiments are not preferred in case of use of many moon indicator elements M1, M2, ... and many shade elements S1, S2, ..., such embodiments are conceivable for example in case the number of moon indicator elements M1, M2, ... and/or the number of shade elements S1, S2, ... arranged in said vertical stack underneath said dial 1 is chosen, for example, amongst the numbers 2, 3, or 4. Such embodiments are particularly conceivable in case the axis of rotation of said set of moon indicator elements M1, M2, ... and the axis of rotation of said set of shade elements S1, S2, ... are different and are arranged non-concentrically, especially in case both of these axis of rotation are arranged non-concentrically as compared to the axis of rotation of the watch hands.

[0040] Such embodiments allow at least partially individual driving, i. e. that at least part of the plurality of moon indicator elements M1, M2, ... and/or of the plurality of shade elements S1, S2, ... may be driven in rotation individually by adapting the gear train 2 correspondingly, this being easily feasible for a person skilled in horology in view of the above technical instruction. In such embodiments, at least one element M1, M2, ..., S1, S2, ... of the plurality of moon indicator elements M1, M2, ... and/or of the plurality of shade elements S1, S2, ... may be driven in rotation independently of the other elements M1, M2, ... of the plurality of moon indicator elements M1, M2, ..., respectively of the other elements S1, S2, ... of the plurality of shade elements S1, S2, ... This underlines that the above mentioned features (a), (b), (c) and (d) are only optional and may not be present in certain embodiments of a mechanism according to the present invention. For example, the above mentioned feature that (a) rotation of all elements within a given set is performed about a concentrically arranged axis of rotation isn't present in an embodiment of a mechanism according to the present invention wherein all axis of rotation of the moon indicator elements M1, M2, ... and of the shade elements S1, S2, ... are realized as tubular axis of rotation and are at least partly arranged non-concentrically, for example by use of two stacks of non-concentrically arranged tubular axis of rotation, each stack comprising individually driven moon indicator elements and shade elements. In such case, the lowermost moon indicator element Mx may advantageously remain stationary, i. e. not be driven in rotation, as far as it doesn't comprise any apertures like in the above described first embodiment and given that driving energy in such mechanisms typi-

cally is kept at the lowest possible level. Of course, in this embodiment of a mechanism according to the present invention, the above mentioned feature that (b) the axis of rotation of said set of moon indicator elements M1, M2, ... and the axis of rotation of said set of shade elements S1, S2, ... are arranged concentrically isn't present, too, which is also the case for the second embodiment of a mechanism according to the present invention. It is also clear that the above mentioned features that (c) the moon indicator elements M1, M2, ... and the shade elements S1, S2, ... are arranged in an alternating manner within said vertical stack and that (d) the vertical stack arranged underneath said dial 1 comprises an equal number of moon indicator elements M1, M2, ... and of shade elements S1, S2, ... aren't present in the embodiment of a mechanism according to the present invention briefly described above and using two stacks of non-concentrically arranged tubular axis of rotation, each stack comprising individually driven moon indicator elements and shade elements, for example if one stack comprises three individually driven elements and the other stack comprises two individually driven elements.

[0041] It should be noted that embodiments of a mechanism according to the present invention using a combination of the principles set out above, i. e. using sets of moon indicator elements M1, M2, ... and/or of shade elements S1, S2, ... with the elements within a set being (fixed to one another and) driven together as well as using individually driven moon indicator elements M1, M2, ... and/or shade elements S1, S2, ... by use of at least one corresponding tubular axis of rotation or at least one stack of such tubular axis of rotation, are conceivable as well. Due to this fact, conception of a mechanism according to the present invention is very flexible, such that it isn't possible to describe at this place all theoretically conceivable embodiments.

[0042] Furthermore, other alternative solutions in terms of the aperture 1.1 in the dial 1 are conceivable, too. In fact, the above described first and second embodiments of a mechanism according to the present invention refer to an aperture 1.1 in the dial 1 at the 12 o'clock position of a watch allowing for indication of the lunar phases in the northern hemisphere of earth, such as depicted in schematical manner in figure 3 as well as, for example, in figures 4a and 4c. Alternatively, the aperture 1.1 in the dial 1 may be situated at the 6 o'clock position of a watch, allowing for indication of the lunar phases in the southern hemisphere of earth. The latter may be achieved in the above described first embodiment of a mechanism according to the present invention by simply replacing the aperture 1.1 in the dial 1 at the 12 o'clock position by an aperture 1.1 in the dial 1 situated at the 6 o'clock position of a watch. In both of these cases, the aperture of the dial 1 preferably is realized by a circular opening 1.1, but depending on the form and/or design chosen for the apertures and shapes in the moon indicator elements M1, M2, ... and/or in the shade elements S1, S2, ..., the aperture of the dial 1 may be

realized by an opening having another shape, for example a kind of semi-ring-like opening as used in conventional moon phase display devices.

[0043] A particularly preferred alternative embodiment of a mechanism for indication of the lunar phases according to the present invention comprises an aperture realized by two openings 1.1, 1.2 in the dial 1 of the moon phase indicator module, one opening 1.1 being situated at the 6 o'clock position and another opening 1.2 being situated at the 12 o'clock position of the corresponding watch, said two openings 1.1, 1.2 in the dial 1 in even more preferred manner being circular openings, in order to allow for indication of the lunar phases in both the southern hemisphere and in the northern hemisphere of earth. Typically, these two circular openings 1.1, 1.2 are arranged symmetrically with respect to the axis of rotation of said moon indicator elements M1, M2, ... and/or the axis of rotation of said shade elements S1, S2, ..., preferably with respect to the concentrically arranged axis of rotation of said moon indicator elements M1, M2, ... and of said shade elements S1, S2, ... By applying such modification, for example, to the above described first embodiment of a mechanism according to the present invention, the sets of moon indicator elements M1, M2, ... and/or shade elements S1, S2, ... need to be adapted as well, for example by providing two (or four) cycles of apertures and shapes in the moon indicator elements M1, M2, ... (instead of just one cycle as described above) and two or four cycles of apertures and shapes in the shade elements S1, S2, ... (instead of three cycles as described above). The same or a similar result may be obtained by adapting the number of moon indicator elements M1, M2, ... and/or of shade elements S1, S2, ..., their direction and/or speed of rotation, and/or, of course, not only the number of cycles of apertures and shapes, but the apertures and shapes itself. In this context, one may add as a general note that the lunar phases visible for an observer on earth have an appearance that differs depending on his position on the globe, in particular on the latitude of his position. The part of the lunar surface that is illuminated by the sun and can be seen by an observer on earth depends in fact on the relative positions of the sun, earth and moon, and the effective view that the observer has of this visible part moreover depends on the observer's position on the globe. For instance, an observer in the northern hemisphere perceives the illuminated part of the waxing moon - depending on the latitude of his exact location and on the season of the year - approximately on the right-hand side of the lunar surface, while for an observer in the southern hemisphere this part appears to the left, since he observes the same situation as it were upside down. For the waning moon, this is exactly the inverse. In principle, a vertical (waxing) crescent seen to the left or right corresponds - as a function of the seasons - to observer locations at the North and South Pole of the earth, respectively, but to observers in latitudes between the poles the waxing or waning crescent has an inclined appearance between

said extremes, and at the equator, for instance, it appears in a horizontal position. Traditional lunar phase displays usually disregard these differences, whilst at least some embodiments of the present invention, though not allowing to reflect the different perception of the lunar phases caused by different latitudes of the observer's positions, take into account the major difference of perception of the lunar phases in the southern and in the northern hemisphere of earth.

[0044] Furthermore, other alternative embodiments of a mechanism for indication of the lunar phases according to the present invention in terms of the dial 1 are conceivable, too. In fact, the dial 1 comprising an aperture 1.1 like described above in the context of the first and second embodiments of a mechanism according to the present invention may simply be formed by a ring-like structure placed above the vertical stack of moon indicator elements M1, M2, ... and of shade elements S1, S2, ... Such ring-like structure may for example physically consist in a ring placed above said vertical stack and symbolising a dial 1 which, physically, isn't present or may be formed by a ring drawn on a sapphire glass placed above said vertical stack and symbolising an aperture 1.1 of a dial 1 which, physically, isn't present. Some embodiments of a mechanism for indication of the lunar phases according to the present invention may even completely lack a physical implementation of said dial 1 and its aperture 1.1, the dial 1 and its aperture 1.1 in such embodiments being represented, for example, by the outer circumference of the moon indicator elements M1, M2, ... and/or of the shade elements S1, S2, ... and/or by the upper end of the module bridge ring 3.1 which is visible through the crystal of a corresponding watch and which may have a specific design in order to allow for representing the dial 1 and its aperture 1.1 in such embodiments. Of course, the same applies analogously to embodiments of a mechanism according to the present invention wherein the aperture in the dial has a different shape. Such embodiments are particularly preferred in case of integration of the mechanism into so-called skeleton watches having a watch case with an openworked dial or possibly with virtually no dial, because this allows to make visible for the user of the watch the components of the mechanism with its stack of discs. For this reason, the term "dial" and wordings like "dial having an aperture", "aperture in the dial", "underneath said dial", "through/in said aperture", or the like are used in the present text in a manner such as to include all of the above mentioned options and must neither be interpreted in a manner such as to be limited to a physically represented dial necessarily having a cut-out aperture formed therein nor such as to limit the scope of protection and the range of application of the invention to one of the above mentioned options, but rather such as to include all of these options.

[0045] Further alternative embodiments of a mechanism according to the present invention are also available by varying the new and full moon dwell periods so that each lasts for one or more days. To achieve this, it is for

example possible to adapt the apertures and shapes in the moon indicator elements M1, M2, ... and in the shade elements S1, S2, ..., in particular the apertures and shapes in the uppermost moon indicator element M1, and/or their speed of rotation.

[0046] Finally, it should be noted that the present invention is also related to a watch movement, in particular a mechanical watch movement, comprising a mechanism as described above as well as to a watch, in particular a mechanical watch, comprising such a watch movement or such a mechanism. Preferably, a mechanism as described above may also be integrated into bracelet watches and other types of timepieces like mechanical clocks, especially desk clocks or wall clocks.

Material, manufacturing and applications

[0047] The moon indicator elements M1, M2, ... and the shade elements S1, S2, ... are preferably made of stainless steel, in particular of 301/1.4310 stainless steel. This has two advantages: (1) Steel has a high modulus and yield stress, so the discs/plates realizing the moon indicator elements M1, M2, ... and the shade elements S1, S2, ... tend not to bend and hit each other and (2) this alloy is available as shim stock in many different and precise thicknesses under tight tolerances. Tight thickness tolerances are important when stacking so many elements and avoiding interference between stacks. A choice of thicknesses allows to make compromises between thick rigid discs/plates for robustness and thin discs/plates to keep the height of the watch complication small. It may also be noted in this context that many commercially available treatments to colour the discs/plates result in an unacceptable thickness increase, such that a layer coating produced by Physical Vapor Deposition (PVD) has been used for the shade elements S1, S2, ..., respectively for the shade discs/plates, as forming an extremely thin coating (Nitron Black). This coating has been applied to the corresponding discs/plates, and also to the SD spacer discs, such that any thickness increase occurs in both stacks equally. PVD can be used to apply a range of decorative colours. Alternatively, layer coatings produced by Atomic Layer Deposition (ALD) could be used as well, given that ALD provides even thinner coloured coatings. In alternative embodiments, the moon indicator elements M1, M2, ... and the shade elements S1, S2, ... may be made of ceramics, e. g. aluminium oxide, silica, zirconia, or zirconia toughened alumina. Such ceramics can be accurately laser cut and have the advantage that it is possible to colour them without use of a coating. Techniques adapted to accurately cut the apertures in the moon indicator elements M1, M2, ... and in the shade elements S1, S2, ... include chemical (photo) etching, laser cutting, stamping, wire electrical discharge machining (EDM), water jet cutting, and electroforming. The wheels and mobiles of the gear train 2 are preferably made of material and manufactured by techniques known by a person skilled in the art, such that this will

not be described in the following.

[0048] Like mentioned above, a mechanism for indication of the lunar phases according to the present invention preferably is integrated into a watch, in particular into a bracelet watch. Advantageously, such mechanism is integrated into a watch having a mechanical source of energy and a mechanical watch movement, and the dial 1 of the mechanism corresponds to the watch dial.

Advantages

[0049] In light of the above description of the structure and of the operating mode of a mechanism for indication of the lunar phases according to the present invention, its advantages are clear. Most importantly, such mechanism allows to display the lunar phases and the lunar terminator through the aperture 1.1 of the dial 1 in a manner substantially corresponding, during the entire lunation, to the appearance of the moon as visible from earth. The display of the lunar phases and, in particular, of the lunar terminator realized by such mechanism is much more realistic as compared to prior art devices. Furthermore, a mechanism for indication of the lunar phases according to the present invention is flexible and may be adapted to several needs, for example by choosing the number of elements used in the vertical stack arranged underneath the dial or by adapting the height of said vertical stack underneath said dial by other means. The moon phase indicator module according to the first, preferred embodiment of the mechanism includes all components inside a housing formed by the module bridge, the module bridge ring and the dial, such that integration of such module is simple, because the module forms a single block ready for use simply by connecting the hour wheel of the module to adequate driving means.

List of reference signs

[0050]

Nr.	Element	
1	Dial	
1.1	Aperture/opening in the dial	
1.1	Aperture/opening in the dial	
M1, M2, ...	Moon indicator element	
S1, S2, ...	Shade element	
SD	Spacer disk	
DD	Distancing disk	
CR	Circumferential ring	
SR	Spacer ring	
2	Gear train	
2.1	Hour wheel	

(continued)

Nr.	Element	
2.2	First intermediate wheel	
2.3	Intermediate wheel mobile	
2.4	Second intermediate wheel	
2.5	Finger wheel	
2.6	Star wheel	
2.7	Moon disks wheel	
2.8	First change wheel	
2.9	Change wheel mobile	
2.10	Second change wheel	
2.11	Shade disks wheel	
2.12	Annular bearing	
3	Module bridge	
3.1	Module bridge ring	

Claims

1. Mechanism for indication of the lunar phases, in particular for integration into a watch, comprising a dial (1) having an aperture (1.1), a moon indicator element (M1), at least two shade elements (S1, S2), and a gear train (2) adapted to rotatably drive said moon indicator element (M1) and/or said at least two shade elements (S1, S2) in a manner allowing to display at least part of said moon indicator element (M1) and/or at least part of said at least two shade elements (S1, S2) through said aperture (1.1), said moon indicator element (M1) being at least partly shaded by at least part of said at least two shade elements (S1, S2) for displaying certain lunar phases, such as to indicate the lunar phases in said aperture (1.1), **characterised by the fact that** the mechanism comprises a plurality of moon indicator elements (M1, M2, ...) and a plurality of shade elements (S1, S2, ...) arranged in a vertical stack underneath said dial (1), at least part of said plurality of moon indicator elements (M1, M2, ...) and/or at least part of said plurality of shade elements (S1, S2, ...) being adapted to be driven rotatably by said gear train (2), **and by the fact that** at least one lunar phase is at least partially indicated by all or part of at least a first moon indicator element (M1, M2, ...) of said plurality of moon indicator elements (M1, M2, ...) and at least another lunar phase is at least partially indicated by all or part of at least a second, different moon indicator element (M1, M2, ...) of said plurality of moon indicator elements (M1, M2, ...), such that

the lunar phases and the lunar terminator indicated through the aperture (1.1) of the dial (1) substantially correspond during the entire lunation to the appearance of the moon as visible from earth.

2. Mechanism according to the preceding claim, **characterised by the fact that**, within said vertical stack arranged underneath said dial (1) comprising the plurality of moon indicator elements (M1, M2, ...) and the plurality of shade elements (S1, S2, ...), the moon indicator elements (M1, M2, ...) and the shade elements (S1, S2, ...) are arranged in an alternating manner.
3. Mechanism according to one of the preceding claims, **characterised by the fact that** said vertical stack arranged underneath said dial (1) comprises an equal number of moon indicator elements (M1, M2, ...) and of shade elements (S1, S2, ...).
4. Mechanism according to one of the preceding claims, **characterised by the fact that** the number of moon indicator elements (M1, M2, ...) and/or the number of shade elements (S1, S2, ...) arranged in said vertical stack underneath said dial (1) is chosen from the group comprising the numbers 2 to 8.
5. Mechanism according to one of the preceding claims, **characterised by the fact that** the moon indicator elements (M1, M2, ...), optionally except the moon indicator element arranged at the bottom of said vertical stack underneath said dial (1), and the shade elements (S1, S2, ...) each comprise a number of cycles of apertures and shapes, the number of cycles of apertures and shapes in the moon indicator elements (M1, M2, ...) preferably being different from the number of cycles of apertures and shapes in the shade elements (S1, S2, ...), both numbers of cycles of apertures and shapes preferably being chosen from the group comprising the numbers 1 to 6.
6. Mechanism according to the preceding claim, **characterised by the fact that** said apertures and shapes of at least part of the moon indicator elements (M1, M2, ...) and/or of at least part of the shade elements (S1, S2, ...) are delimited by parts of the circumference of ellipses having a major axis length corresponding to the size of said aperture (1.1) of the dial (1).
7. Mechanism according to one of the preceding claims, **characterised by the fact that** the moon indicator elements (M1, M2, ...) and/or the shade elements (S1, S2, ...) are realized as moon indicator discs, respectively as shade discs, the moon indicator discs preferably having shapes of light colour representing illuminated parts of the moon and the shade discs preferably having shapes of dark colour

representing shaded parts of the moon, or vice versa.

8. Mechanism according to one of the preceding claims, **characterised by the fact that**, during each cycle of displaying the lunar phases, at least one element (M1, M2, ..., S1, S2, ...) of the plurality of moon indicator elements (M1, M2, ...) or of the plurality of shade elements (S1, S2, ...) is driven in rotation, either continuously or intermittently, preferably at least one element (M1, M2, ..., S1, S2, ...) of both of the plurality of moon indicator elements (M1, M2, ...) and of the plurality of shade elements (S1, S2, ...) being driven in rotation during at least certain steps of displaying the lunar phases.
9. Mechanism according to one of the preceding claims, **characterised by the fact that** the plurality of moon indicator elements (M1, M2, ...), optionally except the moon indicator element arranged at the bottom of said vertical stack underneath said dial (1), forms a set of moon indicator elements (M1, M2, ...) and the plurality of shade elements (S1, S2, ...) forms a set of shade elements (S1, S2, ...), rotation of all elements within a given set occurring about a concentrically arranged axis of rotation.
10. Mechanism according to the preceding claim 9, **characterised by the fact that** the axis of rotation of said set of moon indicator elements (M1, M2, ...) and the axis of rotation of said set of shade elements (S1, S2, ...) are arranged concentrically.
11. Mechanism according to the preceding claim 9, **characterised by the fact that** the axis of rotation of said set of moon indicator elements (M1, M2, ...) and the axis of rotation of said set of shade elements (S1, S2, ...) are arranged non-concentrically.
12. Mechanism according to one of the preceding claims 9 to 11, **characterised by the fact that** the moon indicator elements (M1, M2, ...) within said set of moon indicator elements (M1, M2, ...) are fixed to each other and the shade elements (S1, S2, ...) within said set of shade elements (S1, S2, ...) are fixed to each other, each set being driven rotatably in an independent manner.
13. Mechanism according to one of the preceding claims 1 to 11, **characterised by the fact that** at least one element (M1, M2, ..., S1, S2, ...) of the plurality of moon indicator elements (M1, M2, ...) and/or of the plurality of shade elements (S1, S2, ...) is driven in rotation independently of the other elements (M1, M2, ...) of the plurality of moon indicator elements (M1, M2, ...), respectively of the other elements (S1, S2, ...) of the plurality of shade elements (S1, S2, ...).

14. Mechanism according to one of the preceding claims, **characterised by the fact that** at least part of the moon indicator elements (M1, M2, ...) and at least part of the shade elements (S1, S2, ...) are driven rotatably in a different direction, preferably at a different speed of rotation. 5
15. Mechanism according to one of the preceding claims, **characterised by the fact that** driving in rotation of at least one element (M1, M2, ..., S1, S2, ...) of the plurality of moon indicator elements (M1, M2, ...) and/or of the plurality of shade elements (S1, S2, ...) is performed by a pivoting movement. 10
16. Mechanism according to one of the preceding claims, **characterised by the fact that** the aperture of the dial (1) is realized by a circular opening (1.1), such that the mechanism allows to indicate the lunar phases and the lunar terminator through said opening (1.1) of the dial (1) in a manner substantially corresponding during the entire lunation to the appearance of the moon as visible from a given hemisphere of the earth. 15 20
17. Mechanism according to one of the preceding claims 1 to 15, **characterised by the fact that** the aperture of the dial (1) is realized by two circular openings (1.1, 1.2) arranged symmetrically with respect to the axis of rotation of said moon indicator elements (M1, M2, ...) and/or the axis of rotation of said shade elements (S1, S2, ...), preferably with respect to the concentrically arranged axis of rotation of said moon indicator elements (M1, M2, ...) and of said shade elements (S1, S2, ...), such that the mechanism allows to indicate the lunar phases and the lunar terminator through said openings (1.1, 1.2) of the dial (1) in a manner substantially corresponding during the entire lunation to the appearance of the moon as visible from both hemispheres of the earth. 25 30 35 40

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Fig.1a

Fig.1b

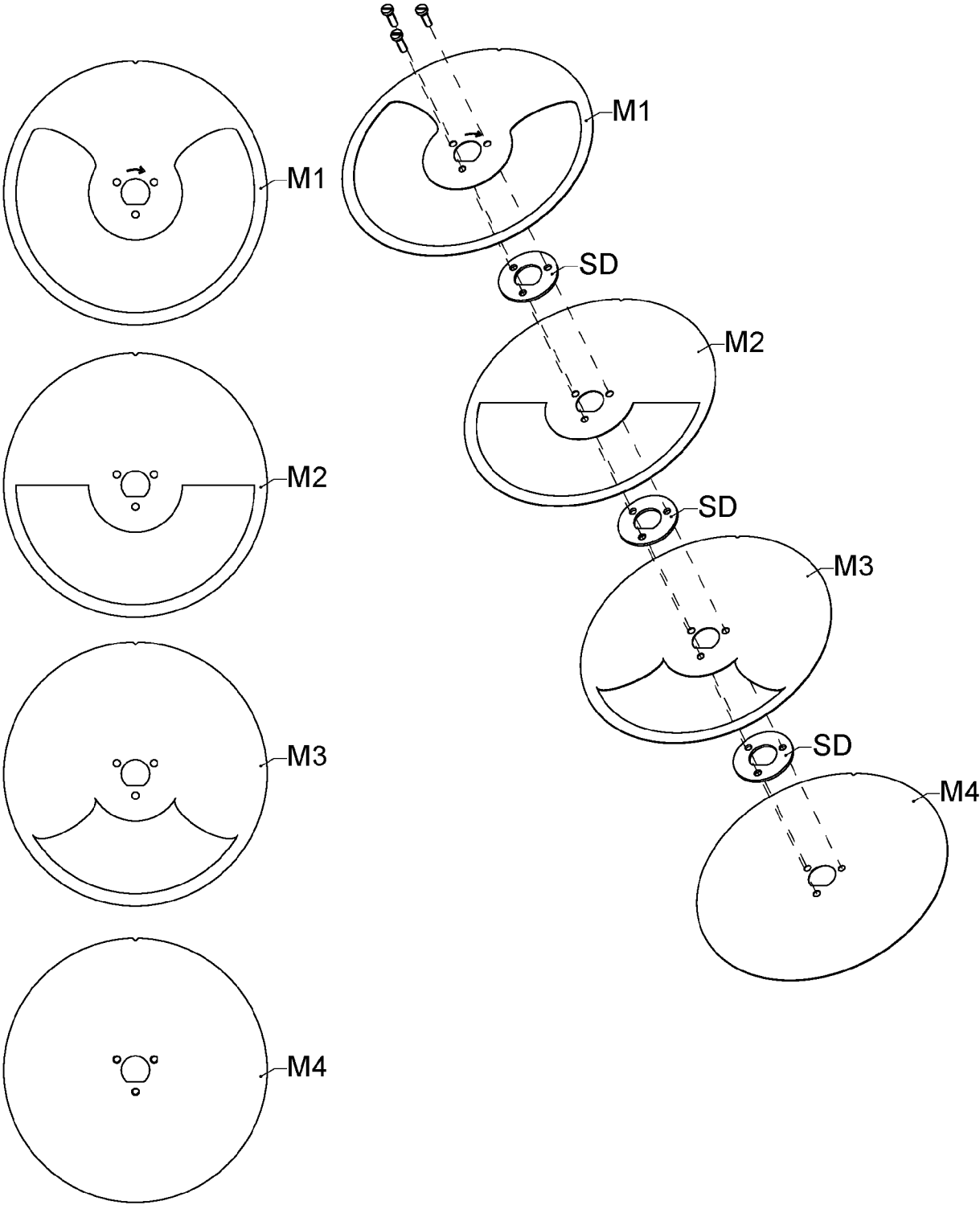


Fig.1c

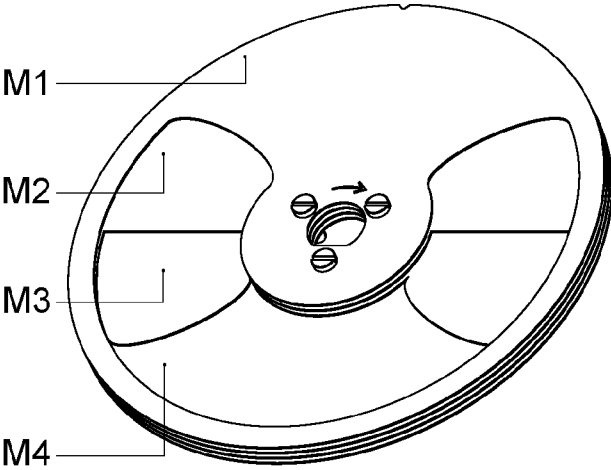


Fig.1d

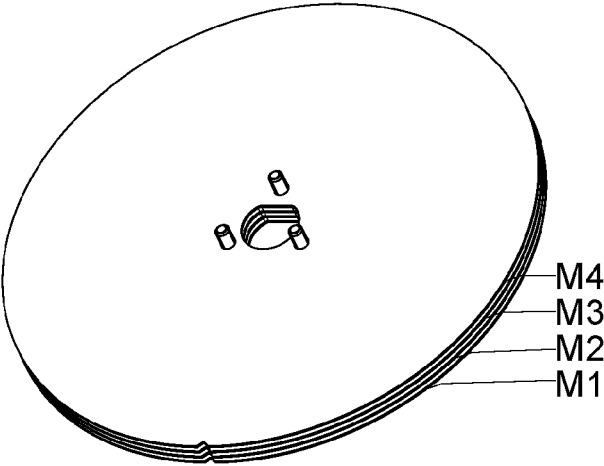


Fig.1e

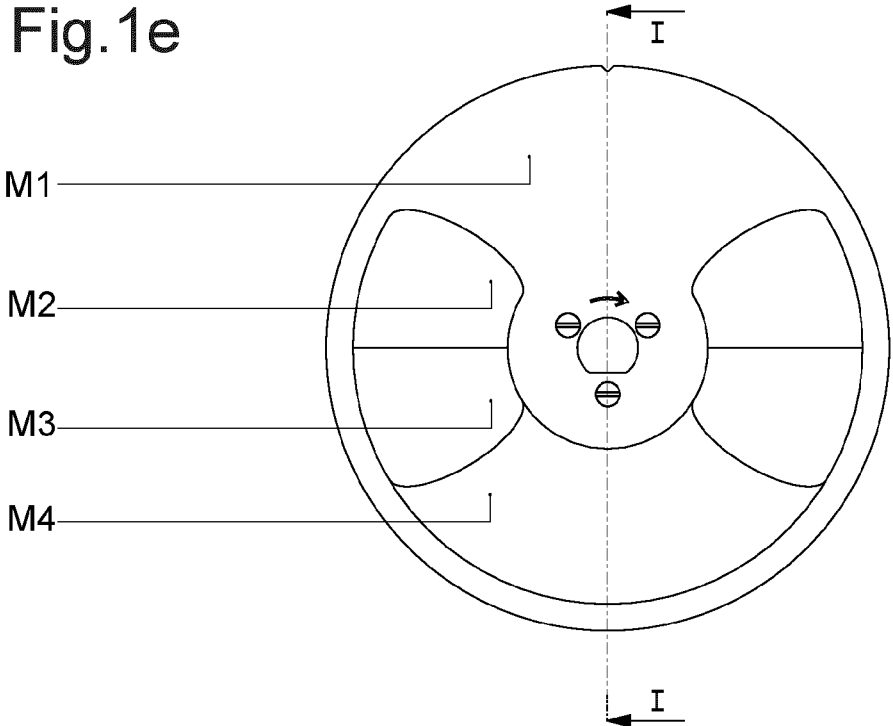


Fig.1f

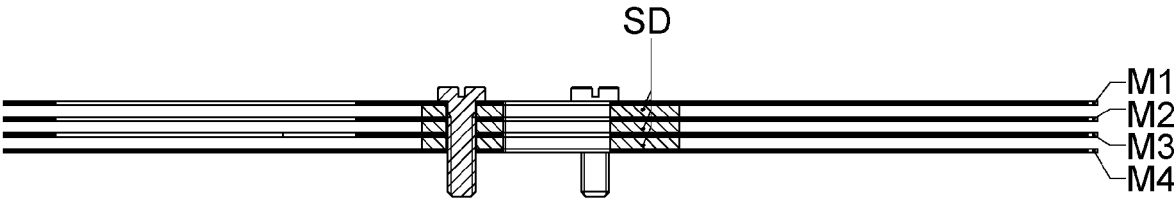


Fig.2a

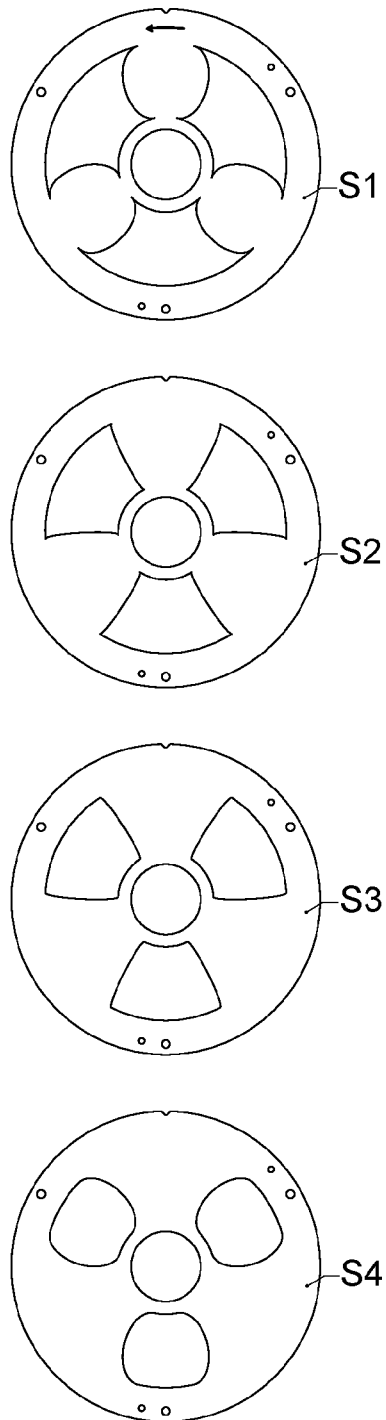


Fig.2b

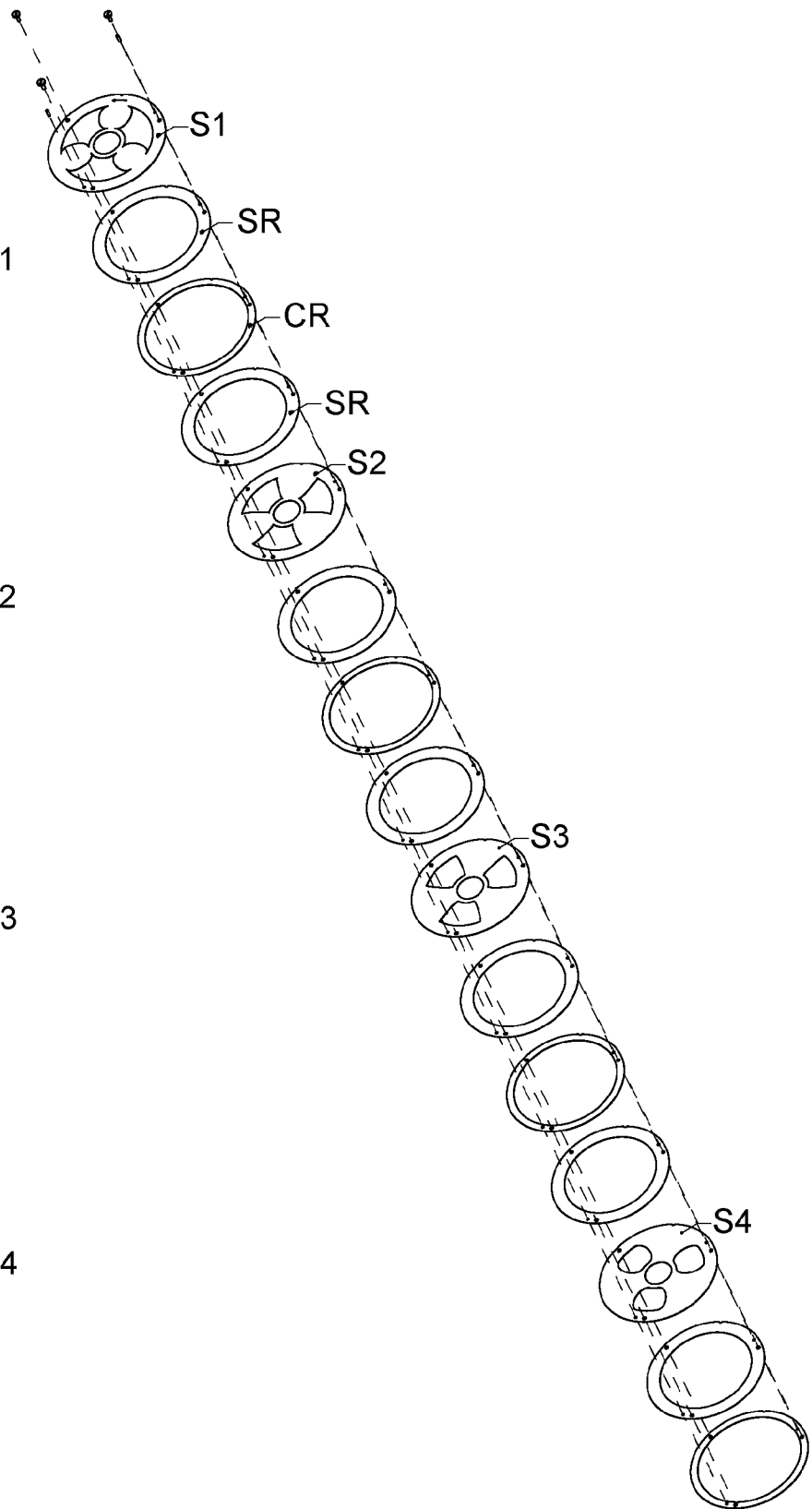


Fig.2c

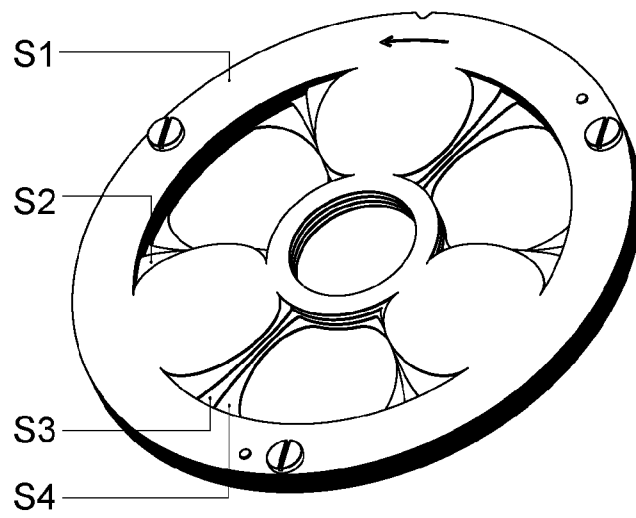


Fig.2d

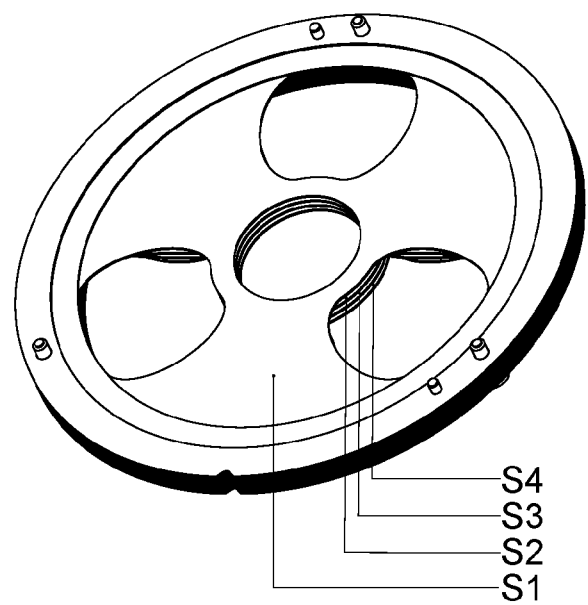


Fig.2e

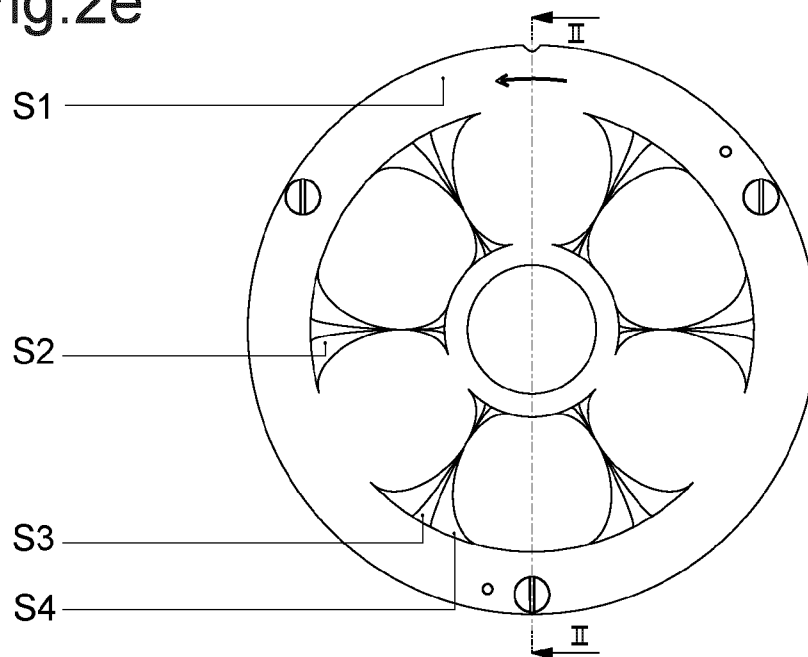
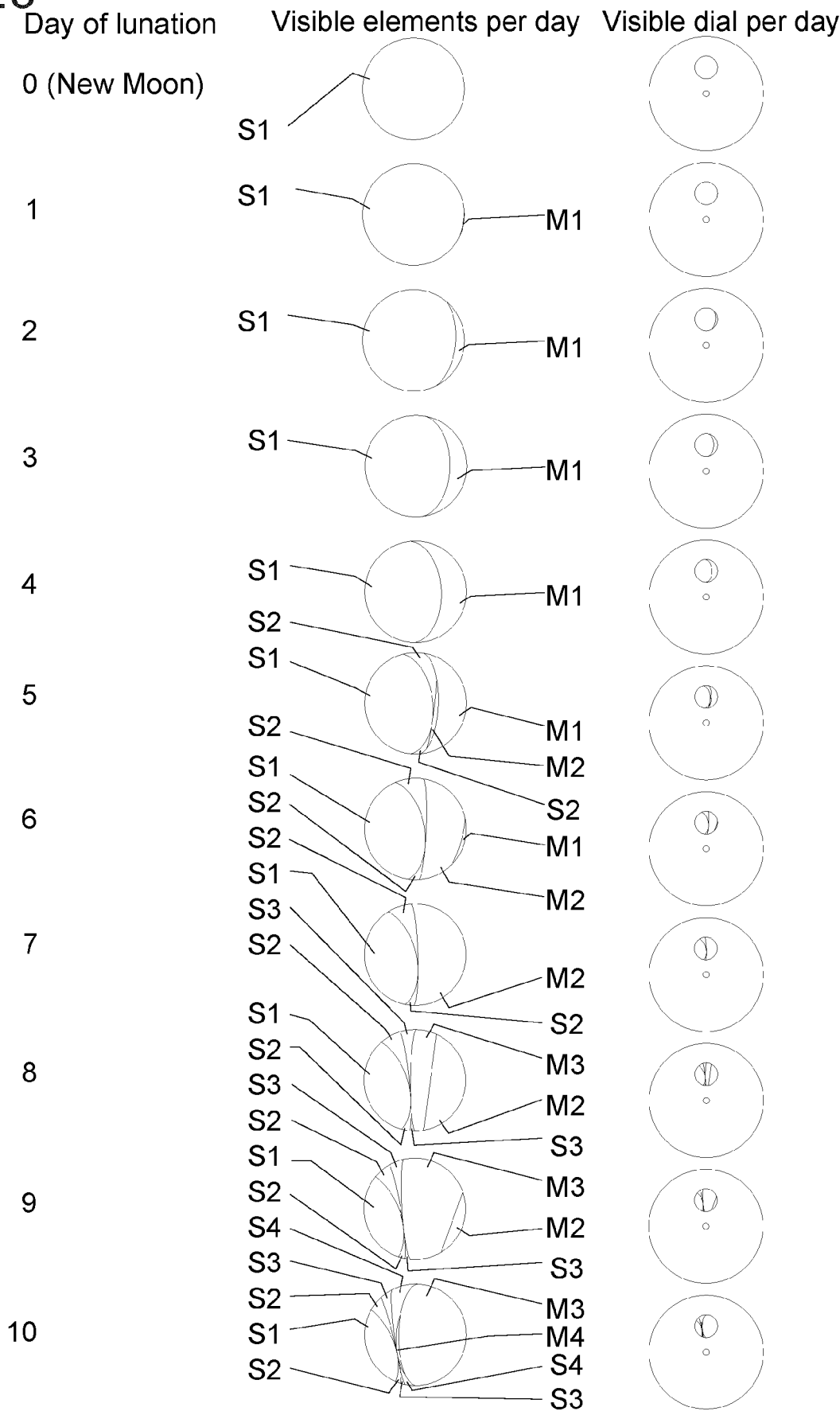
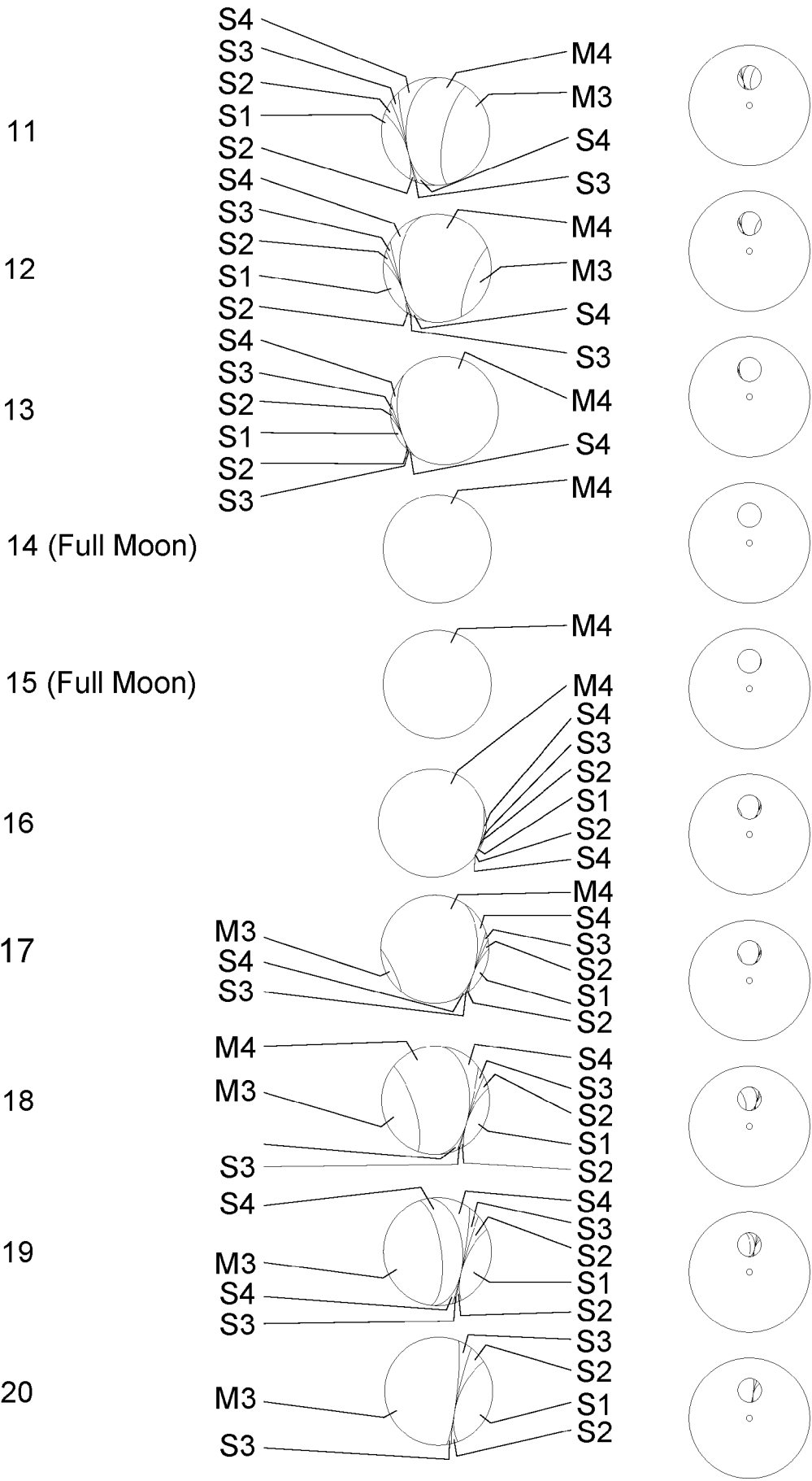


Fig.2f



Fig.3





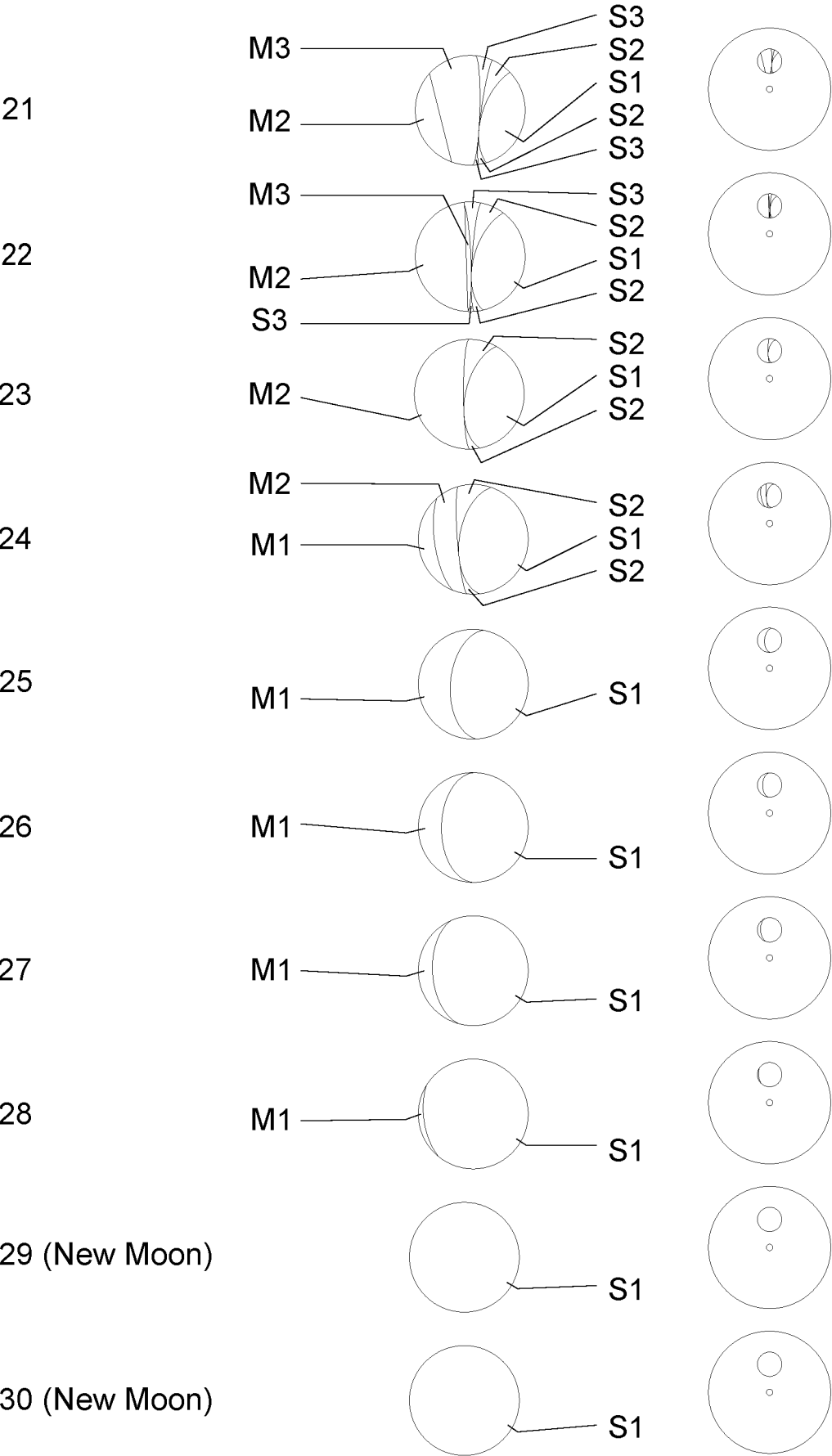


Fig.4a

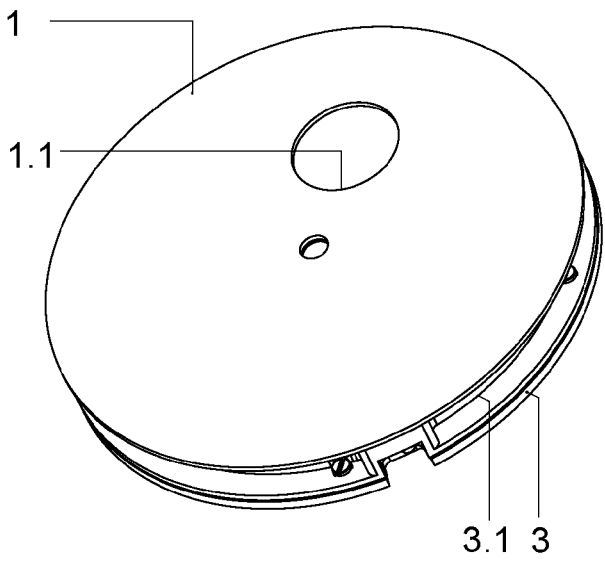


Fig.4b

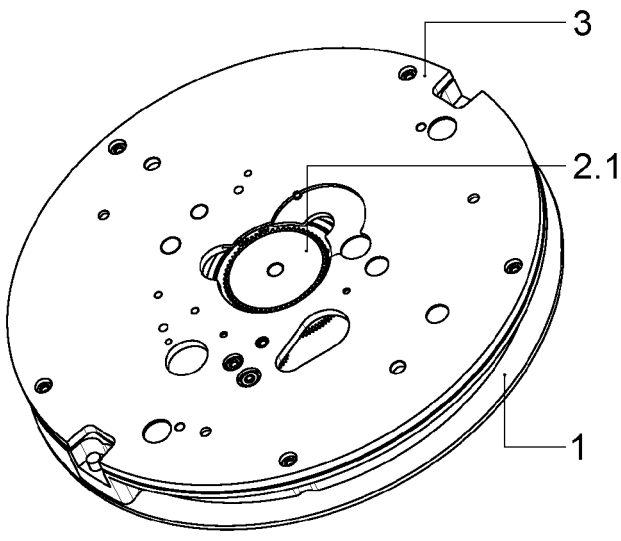


Fig.4c

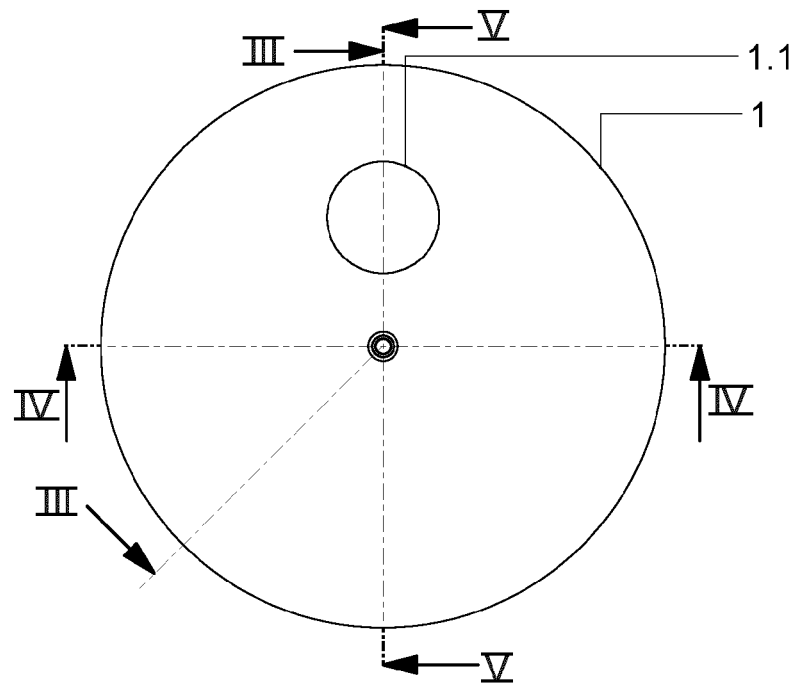


Fig.4d

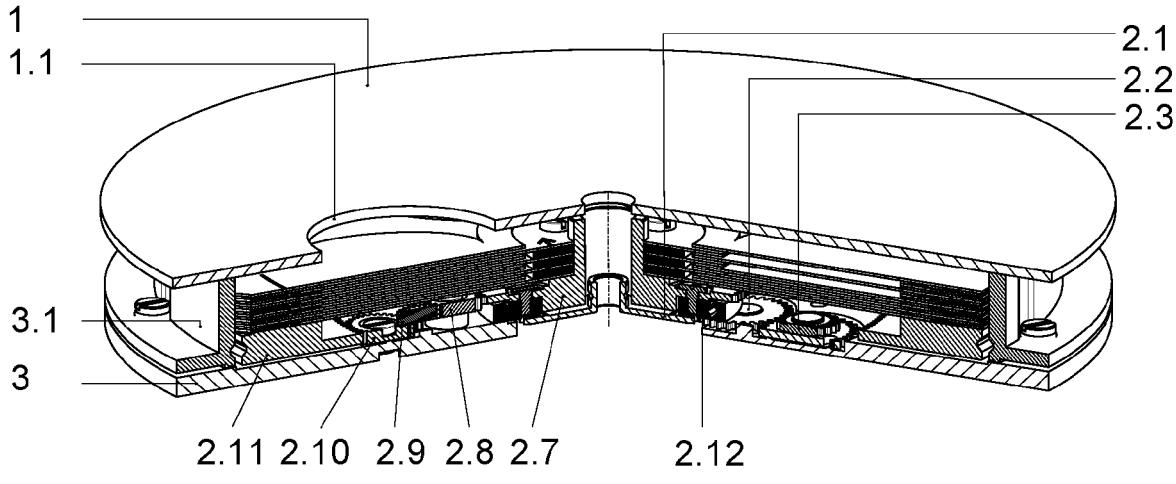


Fig.4e

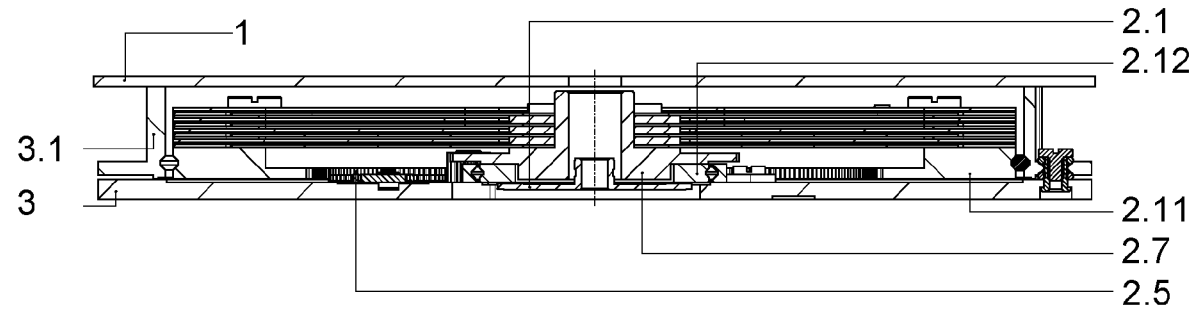


Fig.4f

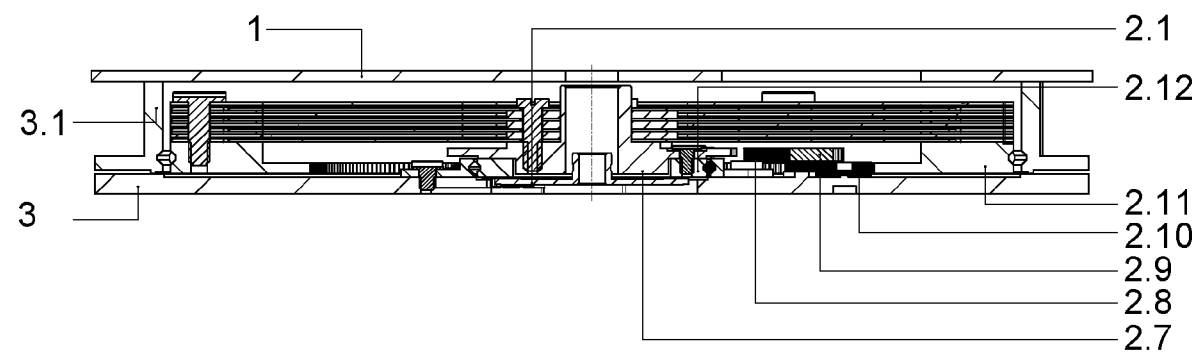


Fig.4g

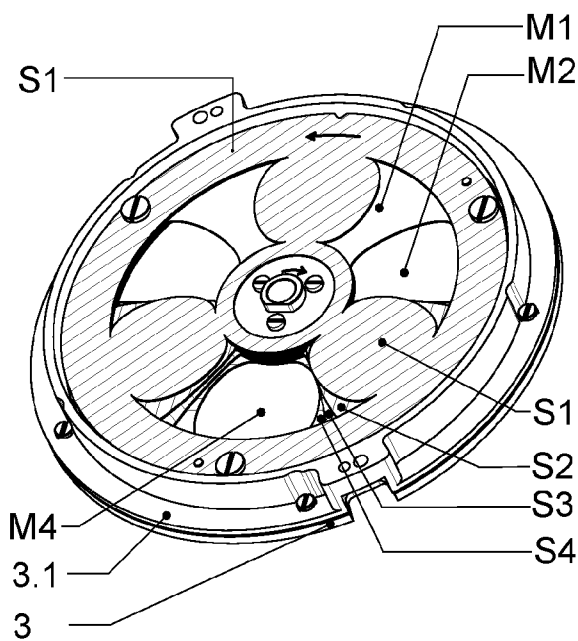


Fig.4h

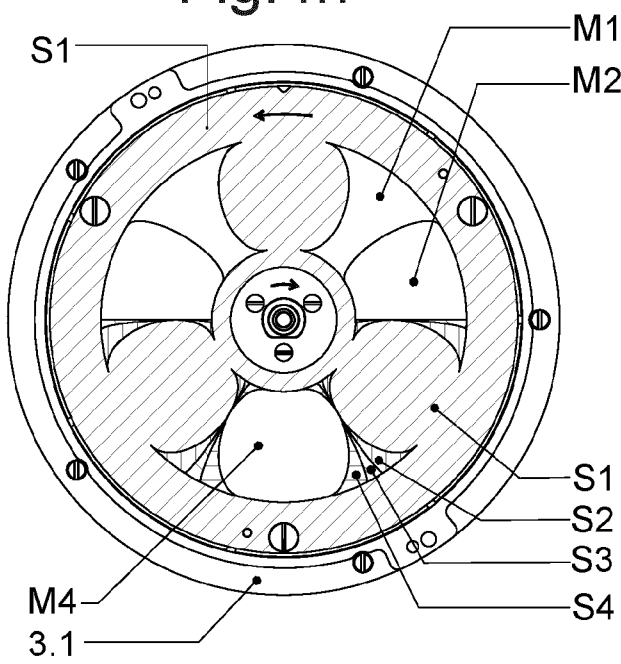


Fig.4i

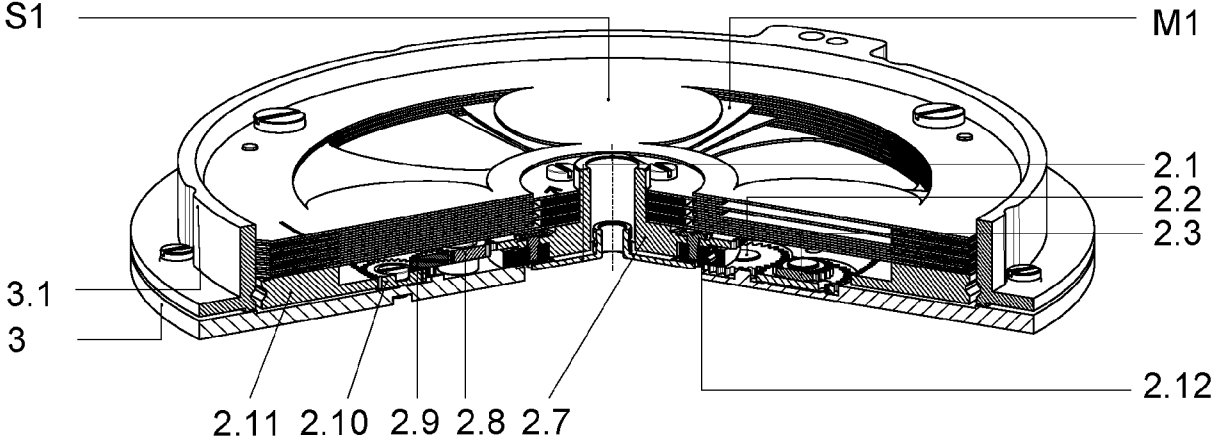


Fig.4j

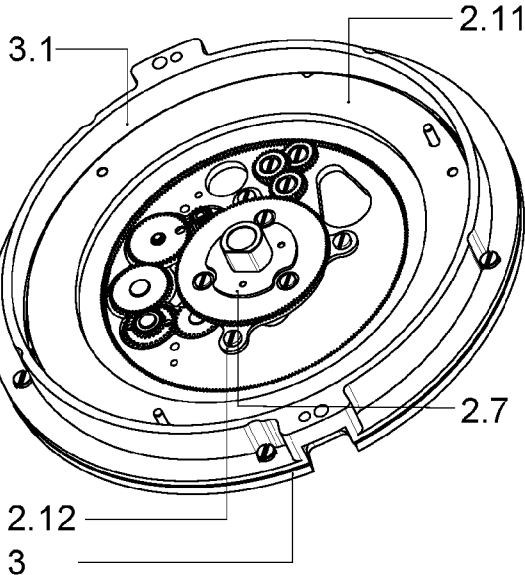


Fig.4k

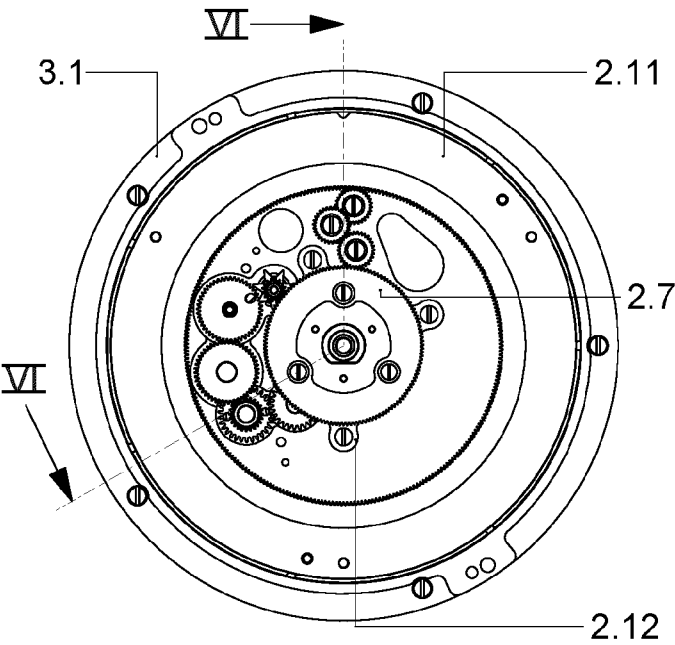


Fig.4l

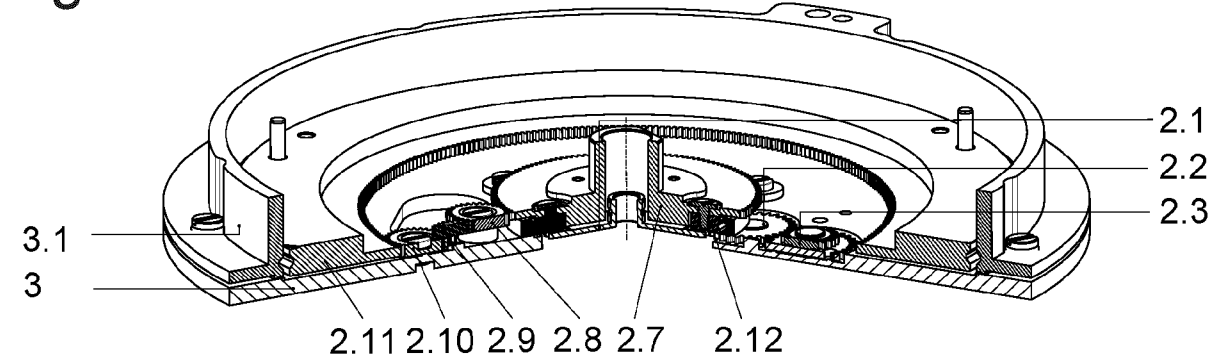


Fig.4n

Fig.4m

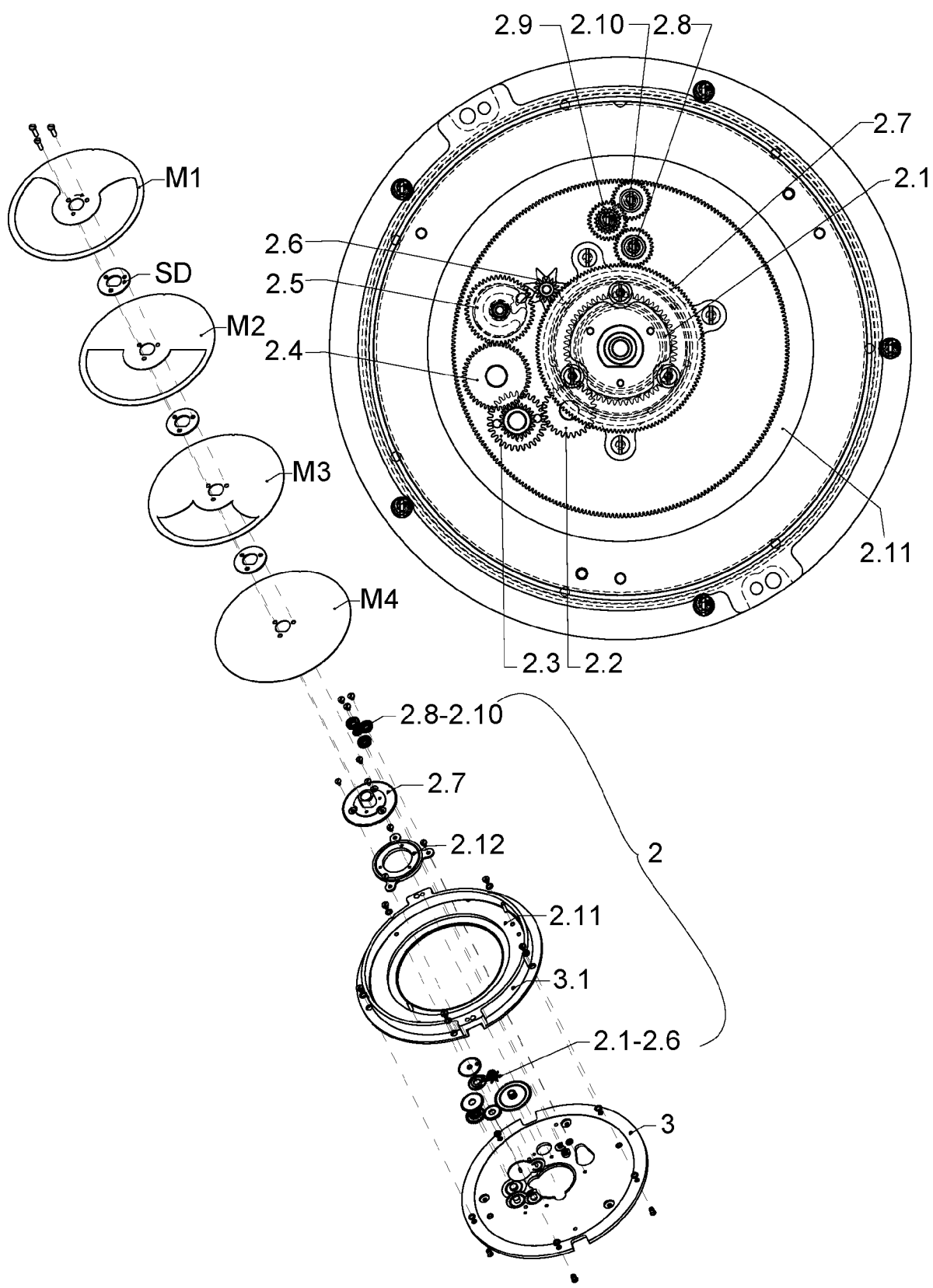


Fig.4o

Fig.4p

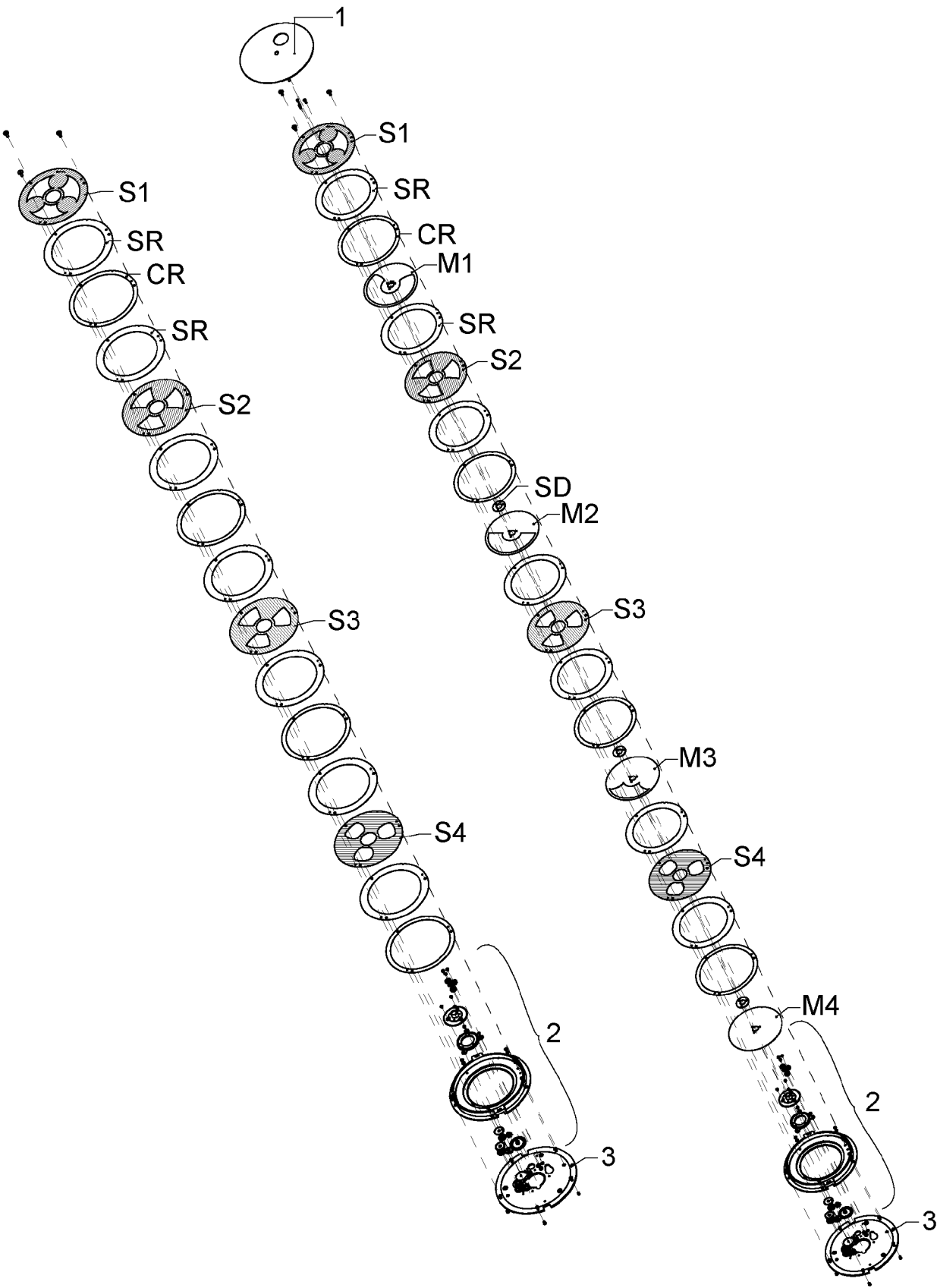


Fig.5a

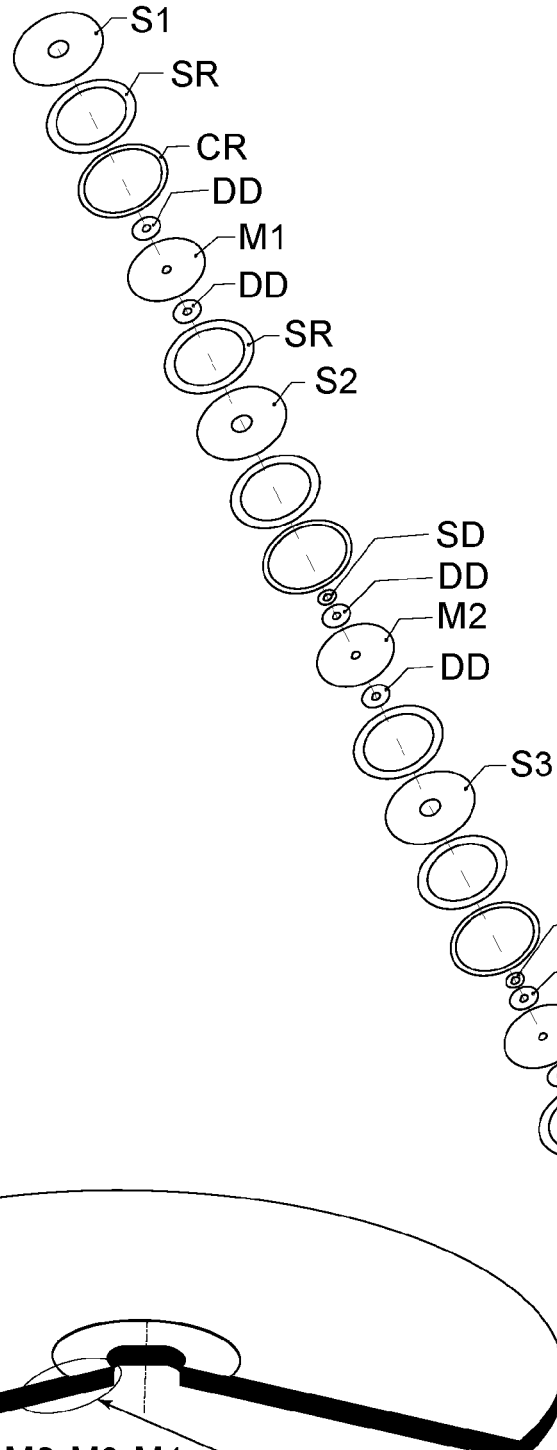


Fig.5b

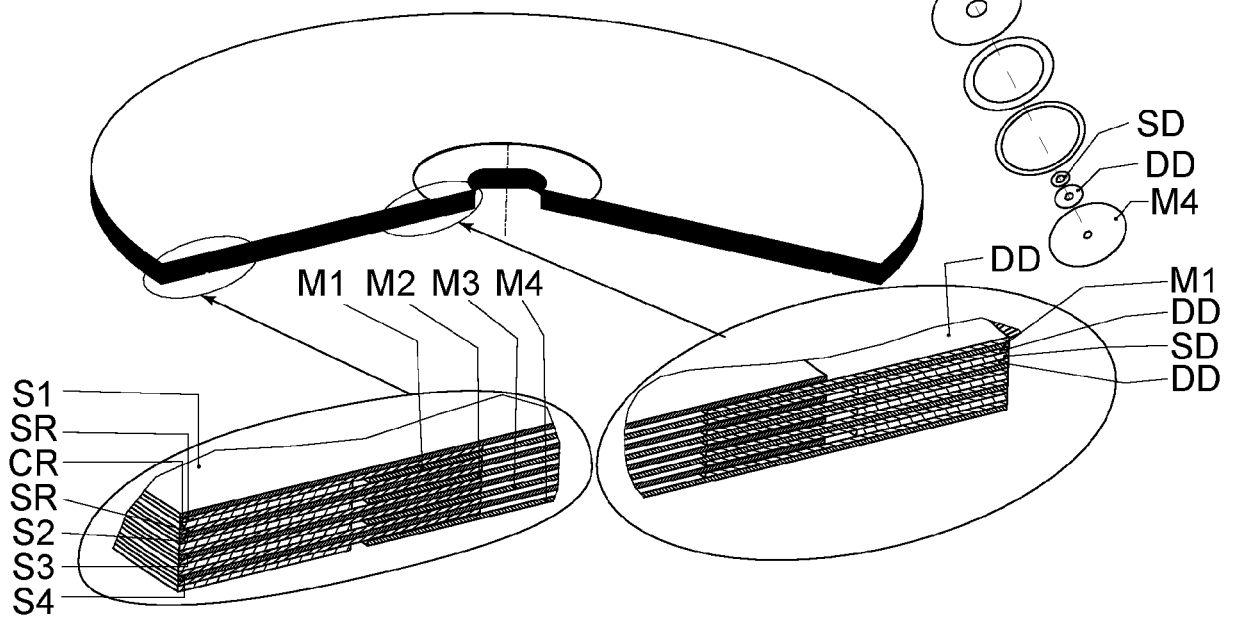


Fig.5c

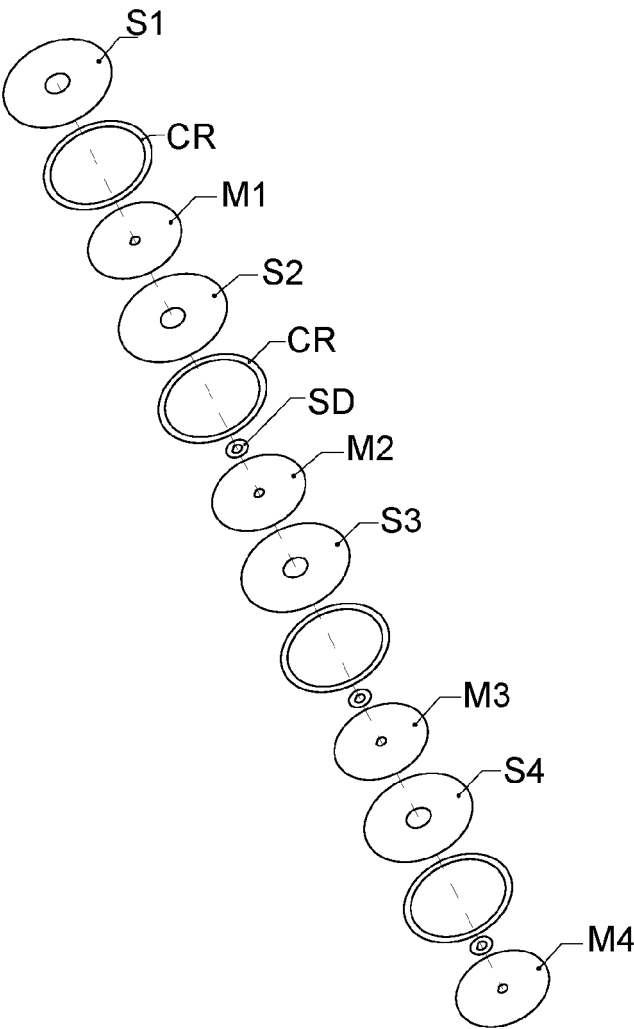


Fig.5d

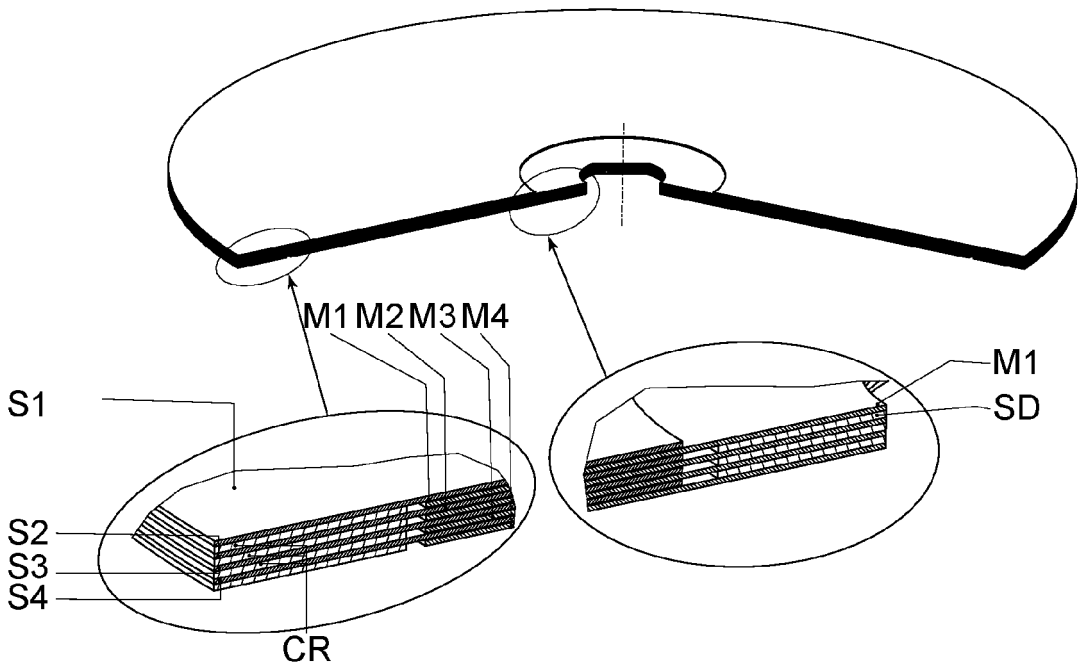


Fig.6a

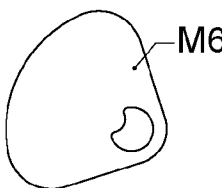
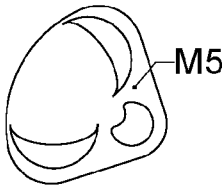
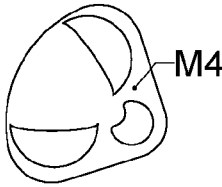
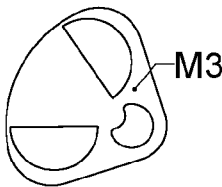
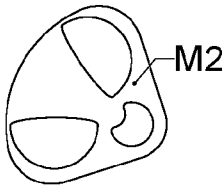
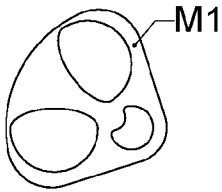


Fig.6b

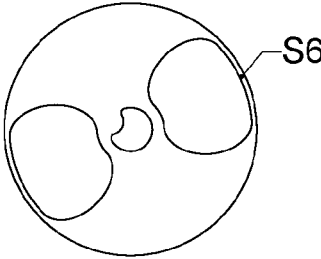
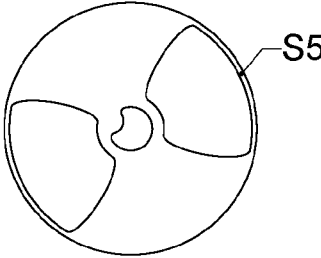
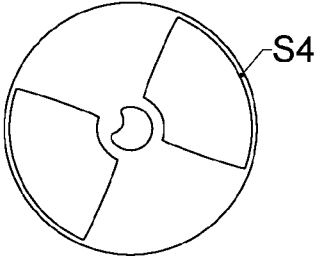
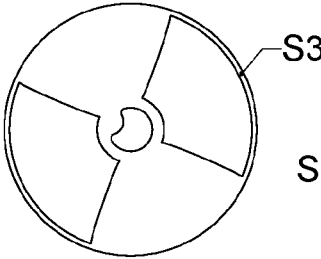
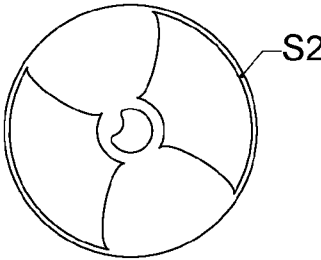
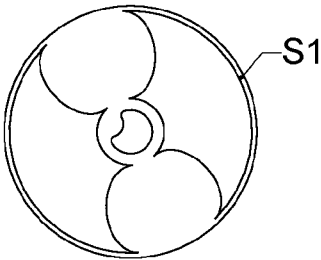


Fig.6c

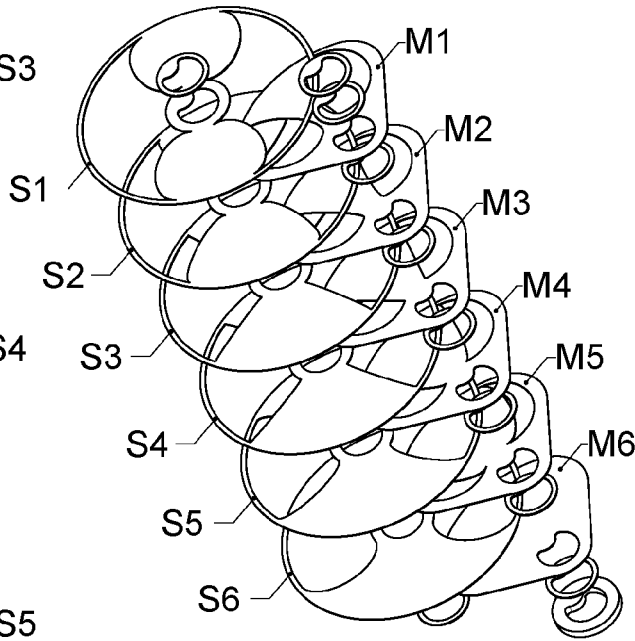


Fig.6d

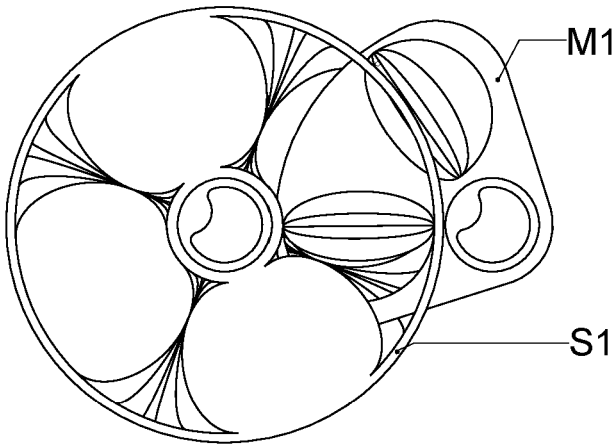


Fig.6e

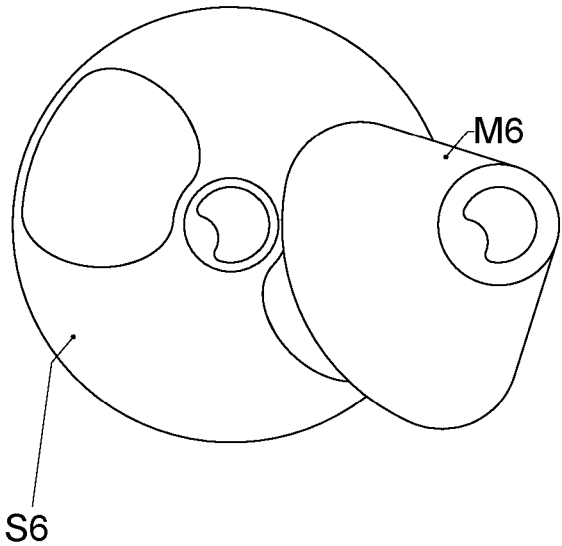
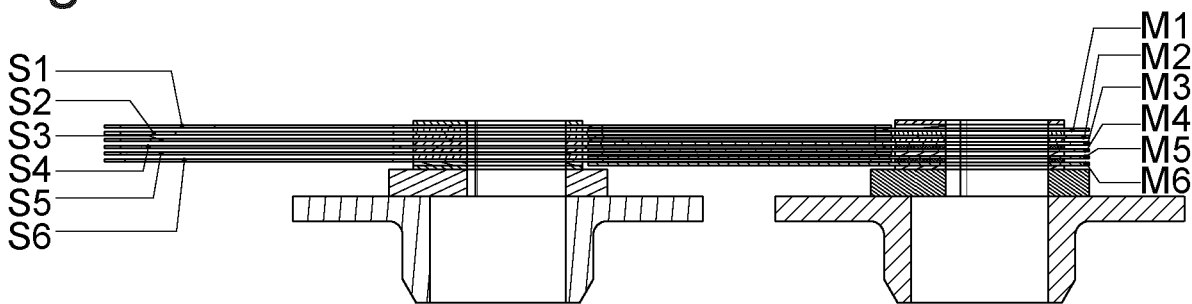


Fig.6f





EUROPEAN SEARCH REPORT

Application Number

EP 25 16 8104

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A	US 8 498 179 B2 (MONTET JOHAN [CH]; DESCHANEL FABRICE [FR]; FIGUET & CO HORLOGERIE [CH]) 30 July 2013 (2013-07-30) * column 3, line 19 - line 28; figures 3a, 8a-c * * column 10, line 28 - line 67 * * column 11, line 1 - line 33 * -----	1-17	INV. G04B19/26
A	US 2022/171340 A1 (REY-MERMET GILLES [CH]) 2 June 2022 (2022-06-02) * paragraph [0035] - paragraph [0043]; figures 1-4 * -----	1-17	
			TECHNICAL FIELDS SEARCHED (IPC)
			G04B G04F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		17 September 2025	Decaix, François
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