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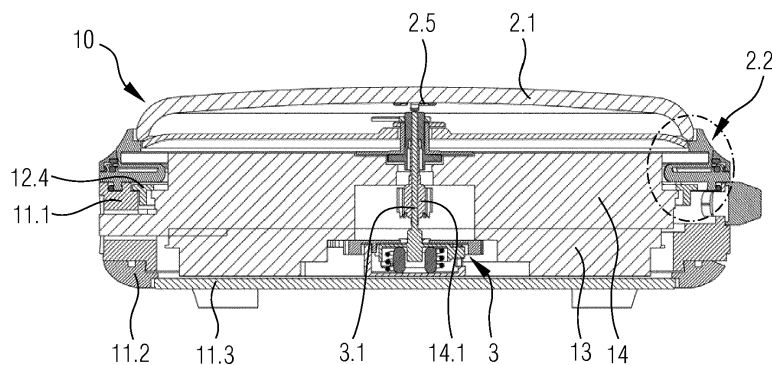
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(54) **CHIMING MECHANISM WITH HAMMER STRIKING THE WATCH CRYSTAL**

(57) The present invention concerns a chiming mechanism (1) for producing a sound at specific moments in time and adapted for integration into a timepiece (10) which is equipped with a timepiece movement (14), preferably into a timepiece equipped with a mechanical watch movement, and which has a case (11) with at least one opening, said opening being closed by a crystal (2.1), the chiming mechanism (1) comprising a gong element (2) adapted to vibrate in order to produce a sound as well as an actuating element (3) adapted to strike onto the gong element (2) in order to produce vibrations of said gong element. The chiming mechanism distinguishes

from prior art due to the fact that its gong element (2) of the chiming mechanism (1) consists in said crystal (2.1) and due to the fact said actuating element (3) comprises a striking part (3.1) adapted to move, if actuated, at least partially in a direction essentially perpendicular to a plane defined by the crystal (2.1) and to strike an inner surface of the crystal (2.1) running essentially parallel to a plane defined by said movement (14). The present invention also concerns a timepiece (10) comprising a timepiece movement (14) as well as a striking work (13) like an hour strike and/or minute repeater and/or an alarm as well as such a chiming mechanism (1).

Fig.3a



Description

Field of the invention

[0001] The present invention pertains to a chiming mechanism for producing a sound at specific moments in time and adapted for integration into a timepiece which is equipped with a timepiece movement, in particular into a timepiece equipped with a watch movement, and which has a case with at least one opening, said opening being closed by a crystal, the chiming mechanism comprising a gong element adapted to vibrate in order to produce a sound as well as an actuating element adapted to strike the gong element in order to produce vibrations of said gong element.

Background of the invention and state of the art

[0002] In general, the present invention is situated in the context of timepieces, in particular of timepieces such as wrist watches and pocket watches equipped with a mechanical watch movement, comprising a chiming mechanism for producing a sound at specific times, e.g. each full hour and eventually also at other times like each half or quarter hours or minutes, or at an alarm time. Such mechanisms are also referred to as gong mechanisms and are typically used as sound generators in watches comprising a so-called hour and/or minute repeater function and/or an alarm function. There exist different types of such chiming mechanisms, the most common type being equipped with a hammer mounted pivotably such as to be adapted to strike at specific times on an arc-shaped wire gong surrounding the movement. The vibrations of the gong are then transmitted directly or indirectly to a component of the watch case - such as the case middle, case back or watch crystal - whose vibrations produce an audible sound. However, given that both the hammer and the gong are housed within the watch case, the resulting sound often isn't sufficiently audible outside the watch case, due to the production of the initial vibrations entirely inside the watch case and their corresponding attenuation as they propagate inside the watch case, respectively due to limited transmission of the vibrations, depending on the specific configuration of the mechanism, through the watch case onto the outside of the watch.

[0003] Mostly for this reason, it is also known in the prior art that some such mechanisms have a separate gong element which is connected through the movement or the watch case to a watch crystal which most often is mounted on the case via an elastic bezel or an elastic membrane in a manner that the crystal may vibrate and emit a sound. These prior art approaches are directed to enable production of sound waves directly by the watch crystal, i.e. at the outside border of the watch case, in an effort to avoid losses due to the above mentioned absorption inside the watch case, respectively due to limited transmission through the watch case.

[0004] Such prior art approaches may be classified, next to other criteria, with respect to the type of connection between the separate gong element and the watch crystal. In this sense, a first type of such prior art approaches uses watch crystals which are adapted to vibrate by being connected directly to a gong element made of glass, the watch crystal in this case generally being fixedly mounted on the watch case. For example, the document WO 2015/039883 discloses a timepiece comprising a case closed by a crystal and a chiming mechanism having at least one gong integral, at one end, with a stud itself integral with the crystal. The connection of the gong to the crystal is realized solely and directly via the stud, the gong and the crystal being made of the same material.

[0005] Another example of this approach is disclosed in document DE 20102939U which describes an alarm watch comprising a watch case that is closed by a bottom having a fixedly mounted glass portion of sapphire crystal provided centrally therein. A clockwork, preferably a manually wound movement with an alarm clock, is arranged inside the watch case. The alarm clock has a hammer which, when activated at high frequency, strikes a cylindrical glass gong which has the form of a pin and is connected to an end face on the glass bottom by means of a transparent adhesive.

[0006] A second type of such prior art approaches uses watch crystals which are adapted to vibrate whilst not being directly connected to a gong element, the watch crystal in this case generally being mounted elastically on the watch case. For example, the documents EP 503 132 and EP 503 133 disclose a minute repeater watch with gongs mounted on the plate of the movement and comprising an elastic internal bezel made of three parts, namely a first solid part attached to the middle part of the watch case, a second solid part carrying the watch crystal and a third thin elastic part connecting the first and second parts such that the second part and the crystal can vibrate. According to EP 503 132, the vibrations of a stud of the gongs are transmitted by a pin to said second part of the bezel such as to produce vibrations of the watch crystal, whilst according to EP 503 133, the vibrations of the gongs are transmitted to the watch crystal by the air located between the gongs and the crystal, inside the watch case.

[0007] Another example of this approach is disclosed in documents CH 630 220 and CH 632 387 which describe an elastic lever or gong that vibrates when it is actuated by electromagnetic means. One end of the lever is fixed by a screw to the frame of the movement whilst, near its other end, the lever can be actuated by vibration by electromagnetic means. At this other end of the lever, a rod adjustable in length is mounted perpendicular to the plane of the lever in order to transmit the vibrations of the lever to the watch crystal. An annular piece of elastic metal ensures the watertight connection between the crystal and a bezel mounted on the middle of the watch case. Due to its elongated shape and to the presence of

a gasket acting as elastic member, the crystal can vibrate freely in the direction perpendicular to its plane and reproduces the vibrations of the lever transmitted by said rod. This disclosure thus, in substance, corresponds to the one of document EP 503 132, the gong or lever, however, being actuated by electromagnetic means instead of mechanically by a hammer.

[0008] The document CH 698 742 also describes a flexible membrane interposed between the watch crystal and the stud, or rather a screw of the stud, fixing a gong on part of the movement of the timepiece, similar to document CH 632 387. For transmission of the vibration of the gong to the crystal, the inner peripheral edge of the flexible membrane is connected to the crystal and the end of the screw by welding, gluing or mechanical fixing. By means of the flexible membrane, the crystal is mounted floating on the watch case and is subjected to vibrations of the stud of the gong which are transmitted to it by said screw and the inner edge of the flexible membrane.

[0009] The document CH 708 111 discloses a sound device comprising a percussion element and a vibrating member. The vibrating member comprises a longitudinal portion comprising an element which extends in a direction substantially perpendicular to the plane of the longitudinal portion. An elastic membrane in contact with the longitudinal part receives the vibrations of the latter. The vibrating member can be fixed on the crystal of the watch by means of a stud and of the membrane. Alternatively, the vibration components of the vibrating member can be retransmitted to the crystal by the membrane and a bezel of the watch, it being possible to manufacture the bezel integrally with the membrane.

[0010] The document CH 698 533 discloses a striking work with at least one gong integral at one of its ends with a stud, the gong and the stud being both of a material having a velocity of sound less than that of the watch crystal, such as steel, all of this gong and stud being fixed, in the assembled position of the timepiece, only on the crystal to the exclusion of any other part of the timepiece, such that the vibrations of the gong are transmitted directly to the crystal. The attachment of the stud may be realized by means of a crystal holder.

[0011] The document EP 3 002 639 describes a watch bezel for a musical watch having at least one gong, said bezel being arranged to directly carry at least one gong or forming itself a gong. The crystal is driven, glued or welded in the bezel and the latter is screwed to the case middle by means of at least one lug of said bezel. The fastening provided by the lugs allows to lower the eigenfrequencies of the solidarized mechanical sub-assembly crystal-bezel and to select almost monopolar vibration modes. The number of the lugs, their thicknesses as well as their lengths and the constituent materials are parameters that allow to modify the effective radiation frequency band of the system.

[0012] The document DE 10 2014 114 969 discloses a clock having a housing including an annular centre part

and an annular bezel, an opening on an observer side in the bezel being sealed by a cover glass. At least one gong having a gong foot for fixation is disposed such as to extend in the housing. The gong can be struck by a striking hammer and the gong foot is firmly disposed on the bezel.

[0013] The document CH 686 600 is another example of the second approach and discloses a timepiece comprising an electro-acoustic transducer, its crystal forming the movable element. In this case, a piezoelectric device, having a first attachment area attached to said crystal and a second attachment area attached to a mechanical assembly, has a first face located in a plane and being arranged to undergo, in response to an excitation signal, a deformation causing displacement of said crystal relative to said mechanical assembly in a direction substantially perpendicular to said plane. A gasket is attached to the periphery of the crystal and the middle of the case and is shaped so that the crystal can move relative to the case.

[0014] The documents EP 2 409 200 and EP 2 738 625 disclose a watch case comprising a case middle of which at least one opening is closed by a bezel and/or a crystal, or by a bottom, and wherein at least one of the closing elements of the opening is connected to the middle by a resilient metal member in the form of a ring or endless frame and of recessed straight section defined by the profile of a non-rectilinear wall whose ends are integral with the periphery of said closure element, respectively of the middle, the profile of said non-rectilinear wall forming at least one annular fold oriented parallel to the plane of said opening. According to EP 2 409 200, the fold is formed around a plane parallel to said plane of said opening and is generated by a curvature whose arc describes an angle between greater than 90 ° and 180 °, to provide said closing element with freedom of movement relative to the plane of the opening. According to EP 2 738 625, said resilient metal member forms a bellows comprising at least said annular fold generated by a curvature whose arc describes an angle of between greater than 90 ° and 180 °, to provide said closing element with freedom of movement relative to the plane of the opening, adapted to a movement in a direction perpendicular to the opening.

[0015] Therefore, in sum, the above mentioned prior art documents either disclose gong elements formed integrally with or fixedly mounted on the watch crystal or disclose means for transmitting vibration from a separate gong element to the watch crystal. Some of these documents primarily concern the manner of elastically mounting a watch crystal on a watch case to allow for improved vibration of the crystal.

[0016] However, even the high number of such prior art documents is an indication that the devices disclosed therein still comprise several inconveniences, in particular in terms of the absolute loudness or audibility of the sound produced, but also in terms of other criteria like e.g. the quality of sound on the level of the harmonics

produced, i.e. such as perceived by humans, or the efficiency on the level of the energy consumption of the mechanism as compared to the loudness of the sound produced, i.e. in other words the efficiency after transmission losses. Other parameters like the bulkiness, the complexity and/or the energy source used in the prior art device also do form inconveniences that may prevent use of some of these devices in specific applications, in particular in the framework of timepieces having a mechanical watch movement.

Objectives of the invention

[0017] Therefore, it is an objective of the present invention to overcome the above mentioned inconveniences and to realize a chiming mechanism which allows to produce a sound sufficiently audible outside the watch case and which is particularly suitable for integration into a timepiece equipped with a mechanical watch movement. Furthermore, other objectives of the present invention consist in that the chiming mechanism is preferably adapted for use in timepieces having a modular construction, and may be adapted for use in combination with many different kinds of watch movements and/or watch cases without requiring multiple modifications of the latter. Furthermore, the chiming mechanism of the present invention should be of relatively simple construction and correspondingly of relatively low production cost, while simultaneously providing, on the level of the notes produced, a quality of sound which is perceived by users as being pleasant.

Solution according to the invention

[0018] To this effect, the present invention proposes a chiming mechanism which is characterized by the features enumerated in claim 1 and which allows to achieve the objectives identified above.

[0019] In particular, the chiming mechanism according to the present invention distinguishes by the fact that the crystal acts as the gong element of the chiming mechanism, the actuating element comprising a striking part adapted to move, when actuated, at least partially in a direction essentially perpendicular to a plane generally defined by the crystal and to strike an inner surface of the crystal running essentially parallel to a plane defined by said movement.

[0020] Advantageously, this avoids both gong elements formed integrally with or fixedly mounted on the watch crystal as well as means for transmitting vibration from a separate gong element to the watch crystal, allowing instead the use of the crystal directly as a gong. Therefore, any losses both in terms of energy required for production of a sound of given loudness as well as in terms of transmission of vibration may be avoided or at least reduced, by direct actuation of the crystal, thus allowing the crystal to produce a sound well audible outside the watch case.

[0021] 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.

Short description of the figures

[0022] The attached figures exemplarily and schematically illustrate the principles as well as several embodiments of the present invention.

[0023] Figure 1a represents an exploded perspective view of a timepiece comprising a first embodiment of a chiming mechanism according to the present invention, the movement and further parts of the timepiece not being illustrated for simplification; figure 1b is a perspective view, partially in sectional representation, schematically illustrating the timepiece of figure 1a in assembled state, the movement and further parts of the timepiece not being illustrated for simplification, either.

[0024] Figure 2a is a perspective view, partially in sectional representation, schematically illustrating the first embodiment of a chiming mechanism according to the present invention; figure 2b is a sectional view of the chiming mechanism of figure 2a; figure 2c is an enlarged view of part of figure 2b and shows a cross section of the crystal and the holding bezel comprising a flexible membrane.

[0025] Figure 3a represents a sectional view of a timepiece comprising a second embodiment of a chiming mechanism according to the present invention, the movement and further parts of the timepiece only being indicated symbolically for simplification; figure 3b is an enlarged view of the lateral part of figure 3a and shows a cross section of part of the crystal as well as of the holding bezel comprising at least three separate spring elements; figure 3c is an enlarged view of the central part of figure 3a and shows a cross section of the actuating element of a chiming mechanism according to the present invention, assembled into a timepiece; figure 3d is a perspective view of the holding bezel allowing elastic mounting of the crystal of the chiming mechanism shown in figure 3a and comprising at least three separate spring elements.

[0026] Figures 4a and 4b represent exploded perspective views, from the top, respectively from the bottom, of the actuating element of a chiming mechanism according to the present invention; figures 4c and 4d are perspective views, partially in sectional representation, schematically illustrating the actuating element of figures 4a and 4b in assembled state, in its charged condition, respectively in its released condition.

Detailed description of the invention

[0027] In the following, the invention shall be described in detail with reference to the above mentioned figures.

[0028] The present invention relates to a chiming mechanism 1 for producing a sound at specific moments

in time and adapted for integration into a timepiece 10 which is equipped with a movement 14. In general, the chiming mechanism 1 is adapted to be used in combination with any kind of timepiece 10 requiring a sound generator, independently of the source of energy of its movement 14, which may in particular consist of a mechanical or of a quartz movement, and of the size of the timepiece, which may, in principle, range from small bracelet or pocket watches to large clocks. However, a chiming mechanism according to the present invention is, advantageously, integrated into a wrist watch equipped with a mechanical watch movement. For this reason, the term "timepiece" will in the following mostly be used synonymously with the term "watch", without however limiting the invention to watches only. In any case, the timepiece, respectively the watch, has, such as schematically shown in figures 1a and 1b, a case 11 with at least one opening situated at the top side of the watch, said opening being closed by a crystal 2.1. The latter is also called by the person skilled in the art watch crystal, watch glass or simply glass. The watch case typically comprises a case middle 11.1 and a bottom 11.2 which may, as schematically shown in figures 1a and 1b, also comprise an opening closed by a bottom crystal 11.3, but may simply consist in a disc-like bottom formed of one piece without further opening.

[0029] A timepiece supposed for housing of a chiming mechanism according to the present invention also comprises a striking work 13 such as an hour strike and/or minute repeater and/or an alarm, these parts being known to the person skilled in the art and thus won't be described here. For the same reason and for reasons of simplicity, the watch movement 14 as well as the striking work 13 formed by an hour strike and/or minute repeater and/or an alarm aren't represented in figures 1a and 1b and are only indicated symbolically in figures 3a and 3c. The cooperation of the chiming mechanism 1 with said striking work 13, which determines the specific moments in time when a sound is produced by the chiming mechanism, also is fully known to the person skilled in the art and, except some details following here below, won't be described further, for conciseness of the present description.

[0030] The chiming mechanism according to the present invention, in general, comprises a gong element 2 adapted to vibrate in order to produce a sound as well as an actuating element 3 adapted to strike the gong element in order to produce vibrations of said gong element. For example, figures 1a and 1b show a timepiece comprising a first embodiment of a chiming mechanism according to the present invention, the actuating element 3 being mounted inside the watch case 11 by means of a bridge 12 comprising a main bridge 12.1 of generally annular shape fixed on the inner periphery of the case middle 11.1. A support plate 12.2 disposed parallel to the plane of the watch movement 14 and separating the volume inside the watch case 11 noticeably into two parts is fixed on the main bridge 12.1 by means of a mounting

ring 12.3. The watch movement 14 is housed on the top side of the support plate 12.2, i.e. between the support plate 12.2 and the crystal 2.1, and the striking work 13 is housed on the bottom side of the support plate 12.2, i.e. between the support plate 12.2 and the bottom 11.2 with its bottom crystal 11.3. In the example shown in figures 1a and 1b, the actuating element 3 is mounted on top of the support plate 12.2, i.e. in a corresponding opening on the lower side of the watch movement 14, and faces the watch crystal 2.1.

[0031] Figures 2a, 2b and 2c show in more detail the first embodiment of a chiming mechanism according to the present invention with the help of a perspective view, partially in sectional representation, of the chiming mechanism, a corresponding sectional view, and an enlarged cross section showing details of the pieces holding the crystal 2.1. It is clearly visible in these figures that the chiming mechanism according to the present invention distinguishes from prior art devices such as mentioned in the introduction due to the fact that the crystal 2.1 acts directly as said gong element 2, i.e. that there isn't any other separate gong element like in prior art. Furthermore, the actuating element 3 comprises a striking part 3.1 adapted to move, when actuated, at least partially in a direction essentially perpendicular to a plane generally defined by the crystal 2.1 and to strike an inner surface of the crystal 2.1 running essentially parallel to a plane defined by the watch movement 14. In this manner, the inner surface of the crystal 2.1 is struck at an angle by said striking part 3.1. Preferably, said striking part 3.1 of the actuating element 3 has a longitudinal axis oriented in a direction essentially perpendicular to said plane defined by the crystal 2.1 so that the inner surface of the crystal 2.1 is struck at approximately a 90° angle. As will become clearer below, the striking part 3.1 preferably traverses the centre of the movement 14 and may simply consist of a hammer realized by a hammer stem.

[0032] The crystal 2.1 may be circular as shown in the figures, but more generally it may have various shapes depending on the shape of the watch case of the timepiece in the plane of the movement 14, for example its shape may also be oval, rectangular, polygonal or of any other desired geometrical shape. In addition, the crystal 2.1 may be domed and not strictly flat, in a cross section perpendicular to the plane of the movement 14. Nevertheless, it is understood that the crystal, in closing the top and/or bottom of the watch case, still defines a plane which generally lies parallel to the watch movement. The crystal 2.1 may be realized by any known material, preferably by sapphire, as well as by any production method available to the person skilled in the art.

[0033] In a chiming mechanism according to the present invention, the crystal 2.1, i.e. the gong element 2, is preferably mounted elastically on the case 11 of the corresponding timepiece 10. The elastic mounting of the crystal 2.1 on the watch case 11 may be realized such as disclosed in the documents EP 503 132 and EP 503 133 originating from the same applicant as the present

invention. In short, the crystal 2.1 is mounted on the case middle 11.1 of the case 11 by using an elastic holding bezel 2.2 comprising three parts, namely a first solid part 2.2.1 adapted to be attached to the middle 11.1 of the watch case 11, a second solid part 2.2.3 carrying the watch crystal 2.1 and a third elastic part, for example a flexible membrane 2.2.2, connecting the first and second parts 2.2.1, 2.2.3 such that the second part 2.2.3 and the crystal 2.1 can vibrate. For conciseness of the present description, the disclosure of the documents EP 503 132 and EP 503 133 is herewith included by reference into this description. Furthermore, in the first embodiment of the chiming mechanism shown schematically in figures 1a and 1b as well as figures 2a to 2c, the elastic mounting of the crystal 2.1 on the watch case 11 substantially corresponds to the mounting disclosed in EP 503 132 and EP 503 133 and therefore won't be described in all detail, reference being made to the disclosure of these documents for further information. It shall only be mentioned that the elastic holding bezel 2.2 of the first embodiment of the chiming mechanism shown in figures 1a and 1b as well as figures 2a to 2c also comprises said three parts 2.2.1, 2.2.2, 2.2.3, in particular the flexible membrane 2.2.2. The latter is symbolically indicated in these figures as being of flat annular shape, but may have any other configuration required for mounting the crystal elastically. In particular, instead of being flat, it may have a bellows-like form and, instead of being annular, its shape may also be oval, rectangular, polygonal or of any other desired geometrical shape, depending on the cross section of the case middle 11.1 of the timepiece in the plane of the movement 14, but the flexible membrane 2.2.2 in this embodiment extends throughout the entire periphery of the watch crystal 2.1. The elastic holding bezel 2.2 may be realized as well by any known material, preferably by steel, as well as by any production method available to the person skilled in the art, for example by conventional machining or by 3D printing. Concerning the fixing of the crystal 2.1 inside the second solid part 2.2.3 and the mounting of the first solid part 2.2.1 on the middle 11.1 of the watch case 11, both may be realized by any means known to the person skilled in the art, e.g. by gluing or driving in, in particular by use of corresponding sealing rings 11.4.

[0034] A second embodiment of a chiming mechanism according to the present invention is shown in figures 3a to 3c, in a state assembled inside a corresponding timepiece. Like in the first example described above, the striking work 13 such as an hour strike and/or minute repeater and/or an alarm is housed on the bottom 11.2 with its bottom crystal 11.3 and the watch movement 14 is housed on top of it, however in this case without any support plate 12.2, the watch movement 14 being held by a fixing ring 12.4 mounted on the inner periphery of the case middle 11.1 and resting on a corresponding shoulder of the movement 14. Furthermore, in the second example shown in figures 3a to 3c, the actuating element 3 is mounted in a corresponding opening on the lower

side of the striking work 13, and also faces the watch crystal 2.1. As compared to the first embodiment of the chiming mechanism, the hammer stem realizing said striking part 3.1 is extended correspondingly and also traverses the centre of the watch movement 14.

[0035] In the second embodiment of a chiming mechanism according to the present invention shown in figures 3a to 3c, the elastic mounting of the crystal 2.1 on the watch case 11 is also realized by using an elastic holding bezel 2.2 comprising three parts, namely a first solid part 2.2.1 adapted to be attached to the middle 11.1 of the watch case 11, preferably by use of a corresponding sealing ring 11.4 such as shown in figure 3b, a second solid part 2.2.3 carrying the watch crystal 2.1 and a third elastic part 2.2.4, connecting the first and second parts 2.2.1, 2.2.3 such that the second part 2.2.3 and the crystal 2.1 can vibrate. Instead of using a flexible membrane 2.2.2 or bellows extending throughout the entire periphery of the watch crystal 2.1 like in the first embodiment, the third elastic part of the elastic holding bezel 2.2 of the second embodiment of the chiming mechanism comprises at least three discrete, spaced apart spring elements 2.2.4 which connect the first and second parts 2.2.1, 2.2.3 such that the second part 2.2.3 and the crystal 2.1 can vibrate.

In this embodiment of the chiming mechanism, the first solid part 2.2.1 adapted to be attached to the middle 11.1 of the watch case 11 and the second solid part 2.2.3 carrying the watch crystal 2.1 are separated by a gap in each of the areas situated between said discrete, spaced apart spring elements 2.2.4. Such configuration allows to increase the freedom in motion of the second solid part 2.2.3 carrying the watch crystal 2.1, respectively of the watch crystal 2.1, thus facilitating the production of sound by its vibration. Furthermore, said discrete, spaced apart spring elements 2.2.4, separated by gaps, between the first and second parts 2.2.1, 2.2.3 may have different strengths in order to provide these elements with different spring constants, for producing vibration modes better suited to generate individual musical notes out of chords.

In the example illustrated by the perspective view of figure 3d, the holding bezel 2.2 allowing elastic mounting of the crystal 2.1 of the chiming mechanism 1 comprises four discrete, spaced apart spring elements 2.2.4 of different strengths. Alternatively, in order to achieve different spring constants of said discrete, spaced apart spring elements 2.2.4, these may also be realized by different materials. In order to close said gap in the areas situated between said discrete, spaced apart spring elements 2.2.4 and to render the watch 10 watertight as well as to provide for additional shock protection, the second embodiment of a chiming mechanism according to the present invention further comprises, such as visible in particular in figure 3b, a water seal 2.3 and an outer protecting bezel 2.4 both extending throughout the entire periphery of the first and second parts 2.2.1, 2.2.3. The water seal 2.3 noticeably has an I-shaped profile and is captured between the protecting bezel 2.4 and the spring elements 2.2.4 on the top face and its bottom surface is

mounted on the first part 2.2.1 of the holding bezel 2.2. Preferably, the bottom surface of the water seal 2.3 is glued into a corresponding groove on the upper surface of the first part 2.2.1 of the holding bezel 2.2. Furthermore, the first part 2.2.1 of the holding bezel 2.2 preferably has interlocking elements 2.2.1.1 acting like flexible hooks for mounting the protecting bezel 2.4, which has a corresponding holding groove on its internal periphery, onto said first part 2.2.1 of the holding bezel 2.2.

[0036] The exemplary actuating element 3 used in both embodiments of the chiming mechanism according to the present invention is schematically illustrated in more detail in figures 4a and 4b which are exploded perspective views, from the top, respectively from the bottom, of the actuating element 3 and in figures 4c and 4d which are perspective views, partially in sectional representation, of the actuating element, once assembled, in its charged condition, respectively in its released condition. As visible most clearly from figures 4a and 4b, the actuating element 3 in general consists of two sub-entities, namely a first sub-entity comprising the striking part 3.1, an actuating spring 3.2, a hammer housing 3.3, trigger wheels 3.4.1, 3.4.2 and a hammer bearing 3.5 as well as a second sub-entity comprising a recoil absorber 3.6.

[0037] The striking part 3.1 preferably consists of a hammer comprising a hammer stem 3.1.1 adapted to be housed within the central hand shaft 14.1 of the watch movement 14, such as visible in particular from figure 3c, and a loading wheel 3.1.2. In an unmodified mechanical watch movement 14 of conventional type, the shaft 14.1 typically is about 0.4 mm in diameter, which is sufficient to house in its interior the hammer stem 3.1.1 which is supported along most of its length and hence is unlikely to be prone to buckling. However, if required for mechanical stability of the hammer stem 3.1.1, it is comparatively simple to modify a conventional watch movement in a manner to increase the diameter of its central shaft 14.1 such as to be in the range of about 0,8 mm to 1,2 mm, in order to facilitate housing the hammer stem 3.1.1 within the central shaft 14.1 of the watch movement 14. In any case, the free end of the hammer stem 3.1.1 is adapted to strike on the watch crystal 2.1 in order to produce vibration of the crystal, whilst its other end is fixed to or, preferably, formed in one piece with a loading wheel 3.1.2 acting simultaneously as hammer weight. The loading wheel 3.1.2 has at its periphery at least one but preferably three or more, sloped (i.e. bevelled) loading teeth 3.1.2.1 and preferably comprises at its lower side an annular groove adapted to house the actuating spring 3.2 and the recoil absorber 3.6. In turn, the loading wheel 3.1.2 is housed, together with the actuating spring 3.2 and the recoil absorber 3.6, inside a cylindrical opening provided at the upper side of the hammer housing 3.3. The peripheral wall of the hammer housing 3.3 furthermore comprises a number of vertical cut-outs 3.3.1 corresponding to the number of sloped loading teeth 3.1.2.1 provided on the loading wheel 3.1.2. In the assembled state of the chiming mechanism, the sloped loading teeth 3.1.2.1 of

the loading wheel 3.1.2 are housed in the vertical cut-outs 3.3.1 of the hammer housing 3.3, such that the entire striking part 3.1, comprising the hammer stem 3.1.1 and the loading wheel 3.1.2, is adapted to move up and down.

[0038] For this purpose, the first trigger wheel 3.4.1 comprises on its bottom side an annular toothing 3.4.1.1 with saw-tooth profile, the teeth of which engage with said sloped loading teeth 3.1.2.1 provided on the loading wheel 3.1.2. The slowly rising part of the annular saw toothing 3.4.1.1 on the trigger wheel 3.4.1 is used to drive by its cooperation with the correspondingly sloped loading teeth 3.1.2.1 of the loading wheel 3.1.2 the striking part 3.1 downward, which simultaneously loads the actuating spring 3.2, whilst the vertical part of the annular saw toothing 3.4.1.1 on the trigger wheel 3.4.1 allows the striking part 3.1 to rapidly move in the direction of the watch crystal 2.1, by the action of the instant discharge of the actuating spring 3.2 once the vertical part of the annular saw toothing 3.4.1.1 on the trigger wheel 3.4.1 passes the vertical part of the loading teeth 3.1.2.1 of the loading wheel 3.1.2. Due to the annular saw toothing 3.4.1.1 on the first trigger wheel 3.4.1, preferably three sloped loading teeth 3.1.2.1 are used on the loading wheel 3.1.2 in order to ensure that the striking part 3.1 is driven down evenly in a plane during loading of the actuating spring 3.2, while avoiding tolerance requirements associated with using more loading teeth 3.1.2.1. The first trigger wheel 3.4.1 further comprises on its periphery a lateral toothing 3.4.1.2 which engages with the toothing of the second, intermediate trigger wheel 3.4.2. The latter either directly or by means of further intermediate wheels cooperates in known manner with, or forms part of the striking work 13 which as mentioned may be an hour strike and/or a minute repeater and/or an alarm, such that this cooperation doesn't need further description. Preferably, the lateral toothing 3.4.1.2 of the first trigger wheel 3.4.1 is sufficiently high to form an annular slot between its inner periphery and the outer periphery of the annular saw toothing 3.4.1.1, said annular slot being conformed to house the peripheral wall of the hammer housing 3.3. At its centre, the first trigger wheel 3.4.1 has an opening by which passes the hammer stem 3.1.1 of the striking part 3.1, said opening preferably being equipped with said hammer bearing 3.5, for example a jewelled bearing. The recoil absorber 3.6, housed together with the actuating spring 3.2 inside the cylindrical opening between the loading wheel 3.1.2 and the hammer housing 3.3, preferably consists of a viscoelastic material and is energised simultaneously with the actuating spring 3.2. It isn't attached to the striking part 3.1 of the actuating element 3, but held loosely between the loading wheel 3.1.2 and the hammer housing 3.3. When the striking part 3.1 is released, the recoil absorber 3.6 relaxes and recovers its original shape comparatively slowly, thereby absorbing some of the striking part's energy of rebound from the crystal 2.1. As a result, it does not impede the instant movement of the striking part 3.1 towards the crystal 2.1, however, by the time the striking part 3.1 rebounds

and returns, the recoil absorber 3.6 has recovered enough to engage the striking part 3.1 and dampen its movement backwards to avoid a significant second strike on the crystal 2.1.

[0039] Finally, one may note that the crystal 2.1 may be equipped, at its inner surface near the point of interaction with the striking part 3.1 of the actuating element 3, with a seating spring 2.5 cooperating with the striking part 3.1 for load distribution, seating and contact resonance, such as symbolically indicated e.g. in figures 3a and 3c.

[0040] In view of the above description of the structure of a chiming mechanism according to the present invention, its functioning may easily be understood. In fact, the first trigger wheel 3.4.1 is driven, by means of its lateral tothing 3.4.1.2, directly or by means of the second trigger wheel 3.4.2 by the striking work 13 of the corresponding timepiece 10. This simultaneously energises the actuating spring 3.2 and the recoil absorber 3.6, by cooperation of the annular tothing 3.4.1.1 with saw-tooth profile on the bottom side of first trigger wheel 3.4.1 with the sloped loading teeth 3.1.2.1 on the loading wheel 3.1.2. Once the vertical part of the annular saw tothing 3.4.1.1 on the trigger wheel 3.4.1 passes the vertical part of the loading teeth 3.1.2.1 of the loading wheel 3.1.2, both the actuating spring 3.2 and the striking part 3.1 are released and the instant discharge of the actuating spring 3.2 results in the hammer stem 3.1.1 of the striking part 3.1 to strike the inner surface of the crystal 2.1 running essentially parallel to the plane defined by the watch movement 14. The viscoelastic recoil absorber 3.6, energised simultaneously with the actuating spring 3.2, recovers its original shape more slowly as compared to the movement of the striking part 3.1 and thus absorbs some of the energy of rebound of the striking part 3.1 from the crystal 2.1, thereby serving to avoid a significant further strike on the crystal 2.1. Further driving of the first trigger wheel 3.4.1 then prepares the striking part 3.1 for the next strike on the crystal, i.e. prepares the chiming mechanism for production of the next sound.

[0041] Finally, it is to be noted that the present invention is also related to a timepiece 10 comprising a timepiece movement 14, a striking work 13 such as an hour strike and/or minute repeater and/or an alarm, as well as a chiming mechanism 1 such as described above, the chiming mechanism 1 cooperating with said striking work 13 to determine the specific moments in time when a sound is produced by the chiming mechanism. In particular, the timepiece 10 may be equipped with a mechanical watch movement 14 and with a watch case 11, wherein said watch case is adapted to house or is formed in one piece with the elastic holding bezel 2.2 housing the crystal 2.1 which forms the gong element 2 of the chiming mechanism 1. The timepiece 10 preferably is a wrist watch or a pocket watch.

[0042] In light of the above description of the structure and of the functioning of the present invention, its advantages are clear. Primarily, a chiming mechanism accord-

ing to the present invention is able to produce a sound well audible outside the watch case, given that any transmission of vibration from a separate gong element to the watch crystal is eliminated. For the same reason, the efficiency in terms of energy required for production of a sound of given loudness is comparatively high, given that transmission losses are minimised. Furthermore, the chiming mechanism according to the present invention is particularly adapted for integration into a timepiece equipped with a mechanical watch movement and may very advantageously be used in timepieces having a modular construction, for example a module for the watch movement and another module for the striking work 13. Moreover, the chiming mechanism is adapted for use in combination with many different kinds of watch movements and/or watch cases without requiring complicated modifications of the latter. Also, it is of relatively simple construction, which corresponds to relatively low production cost of such a chiming mechanism.

Claims

1. Chiming mechanism (1) for producing a sound at specific moments in time and adapted for integration into a timepiece (10) which is equipped with a timepiece movement (14), preferably into a bracelet watch or a pocket watch equipped with a mechanical watch movement, and which has a case (11) with at least one opening, said opening being closed by a crystal (2.1), the chiming mechanism (1) comprising a gong element (2) adapted to vibrate in order to produce a sound as well as an actuating element (3) adapted to strike the gong element (2) in order to produce vibrations of said gong element, **characterised by the fact that** said actuating element (3) comprises a striking part (3.1) adapted to move, when actuated, at least partially in a direction essentially perpendicular to a plane generally defined by the crystal (2.1) in order to strike, at an angle, an inner surface of the crystal (2.1) running essentially parallel to a plane defined by said movement (14), said crystal (2.1) thereby acting directly as the gong element (2).
2. Chiming mechanism according to the preceding claim, **characterised by the fact that** said striking part (3.1) of the actuating element (3) moves along a longitudinal axis oriented in a direction essentially perpendicular to said plane defined by the crystal (2.1) and traversing the centre of the movement (14).
3. Chiming mechanism according to one of the preceding claims, **characterised by the fact that** the striking part (3.1) comprises a hammer stem (3.1.1) adapted to be housed within the central shaft (14.1) of the movement (14) of the timepiece (10), the free end of the hammer stem (3.1.1) being adapted to

- strike the watch crystal (2.1) in order to produce vibrations of the crystal, whilst the other end of the hammer stem (3.1.1) is fixed to or, preferably, is formed in one piece with a loading wheel (3.1.2).
4. Chiming mechanism according to one of the preceding claims, **characterised by the fact that** said actuating element (3) further comprises an actuating spring (3.2), a hammer housing (3.3) as well as at least a first trigger wheel (3.4.1, 3.4.2).
 5. Chiming mechanism according to the preceding claims 3 and 4, **characterised by the fact that** the loading wheel (3.1.2) has at its periphery at least one sloped loading teeth (3.1.2.1), in that the hammer housing 3.3 comprises on its peripheral wall a number of vertical cut-outs (3.3.1) corresponding to the number of sloped loading teeth (3.1.2.1) provided on the loading wheel (3.1.2), such that the entire striking part (3.1) with the hammer stem (3.1.1) and the loading wheel (3.1.2) is adapted to move up and down.
 6. Chiming mechanism according to the preceding claim, **characterised by the fact that** the first trigger wheel (3.4.1) comprises on its bottom side an annular toothing (3.4.1.1) with saw-tooth profile cooperating with said sloped loading teeth (3.1.2.1) provided on the loading wheel (3.1.2), said cooperation allowing, on the one hand, the first trigger wheel (3.4.1) to drive down the striking part (3.1) and to simultaneously load the actuating spring (3.2) and, on the one hand, the striking part (3.1) to instantly move in the direction of the watch crystal (2.1), by the action of the instant discharge of the actuating spring (3.2).
 7. Chiming mechanism according to one of the preceding claims 5 or 6, **characterised by the fact that** the first trigger wheel (3.4.1) comprises on its periphery a lateral toothing (3.4.1.2) which directly or by means of further trigger wheels (3.4.2) cooperates with a striking work (13) of the timepiece (10).
 8. Chiming mechanism according to the preceding claim 4, **characterised by the fact that** said actuating element (3) further comprises a recoil absorber (3.6) which is housed together with the actuating spring (3.2) inside a cylindrical opening between the loading wheel (3.1.2) and the hammer housing (3.3), which is energised simultaneously with the actuating spring (3.2) and which consists of a viscoelastic material recovering its original shape comparatively slowly, such that the recoil absorber (3.6) absorbs some of the energy of rebound of the striking part (3.1) from the crystal (2.1) in order to avoid a significant further strike on the crystal (2.1).
 9. Chiming mechanism according to one of the preceding claims, **characterised by the fact that** the crystal (2.1) is equipped, at the inner surface of the crystal (2.1) near the point of interaction with the striking part (3.1) of the actuating element (3), with a seating spring (2.5) cooperating with the striking part (3.1) for load distribution, seating and contact resonance.
 10. Chiming mechanism according to one of the preceding claims, **characterised by the fact that** the crystal (2.1) is mounted elastically on the case (11) of the corresponding timepiece (10) by means of a holding bezel (2.2) comprising a first solid part (2.2.1) adapted to be attached to a middle (11.1) of the watch case (11), a second solid part (2.2.3) carrying the watch crystal (2.1) and a third elastic part (2.2.2, 2.2.4) connecting the first and second parts (2.2.1, 2.2.3) such that the second part (2.2.3) and the crystal (2.1) can vibrate.
 11. Chiming mechanism according to the preceding claim, **characterised by the fact that** the third elastic part of the holding bezel (2.2) comprises a flexible membrane (2.2.2) extending throughout the entire periphery of the watch crystal (2.1).
 12. Chiming mechanism according to the preceding claim 10, **characterised by the fact that** the third elastic part of the holding bezel (2.2) comprises at least three discrete, spaced apart spring elements (2.2.4), the first solid part (2.2.1) adapted to be attached to a middle (11.1) of the watch case (11) and the second solid part (2.2.3) carrying the watch crystal (2.1) being separated by a gap in each of the areas situated between said discrete, spaced apart spring elements (2.2.4).
 13. Chiming mechanism according to the preceding claim, **characterised by the fact that** said discrete, spaced apart spring elements (2.2.4), separated by gaps, between the first solid part (2.2.1) and the second solid part (2.2.3) have different spring constants for producing vibration modes better suited to generate individual musical notes out of chords.
 14. Chiming mechanism according to one of the preceding claims 12 or 13, **characterised by the fact that** the holding bezel (2.2) further comprises a water seal (2.3) and a protecting bezel (2.4) both extending throughout the entire periphery of the first and second solid parts (2.2.1, 2.2.3) of the holding bezel (2.2) in order to close said gap in each of the areas situated between said discrete, spaced apart spring elements (2.2.4) and to render the timepiece (10) watertight as well as to provide for additional shock protection.
 15. Timepiece (10) comprising a timepiece movement (14) as well as a striking work (13) preferably com-

prising an hour strike and/or a minute repeater and/or an alarm, **characterised by the fact that** the timepiece (10) comprises a chiming mechanism (1) according to one of the preceding claims, the chiming mechanism (1) cooperating with said striking work (13) to determine the specific moments in time when a sound is produced by the chiming mechanism. 5

16. Timepiece according to the preceding claim, **characterised by the fact that** the timepiece comprises a mechanical watch movement (14) and a watch case (11), said watch case being adapted to house or being formed in one piece with the elastic holding bezel (2.2) supporting the crystal (2.1). 10

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Fig.1a

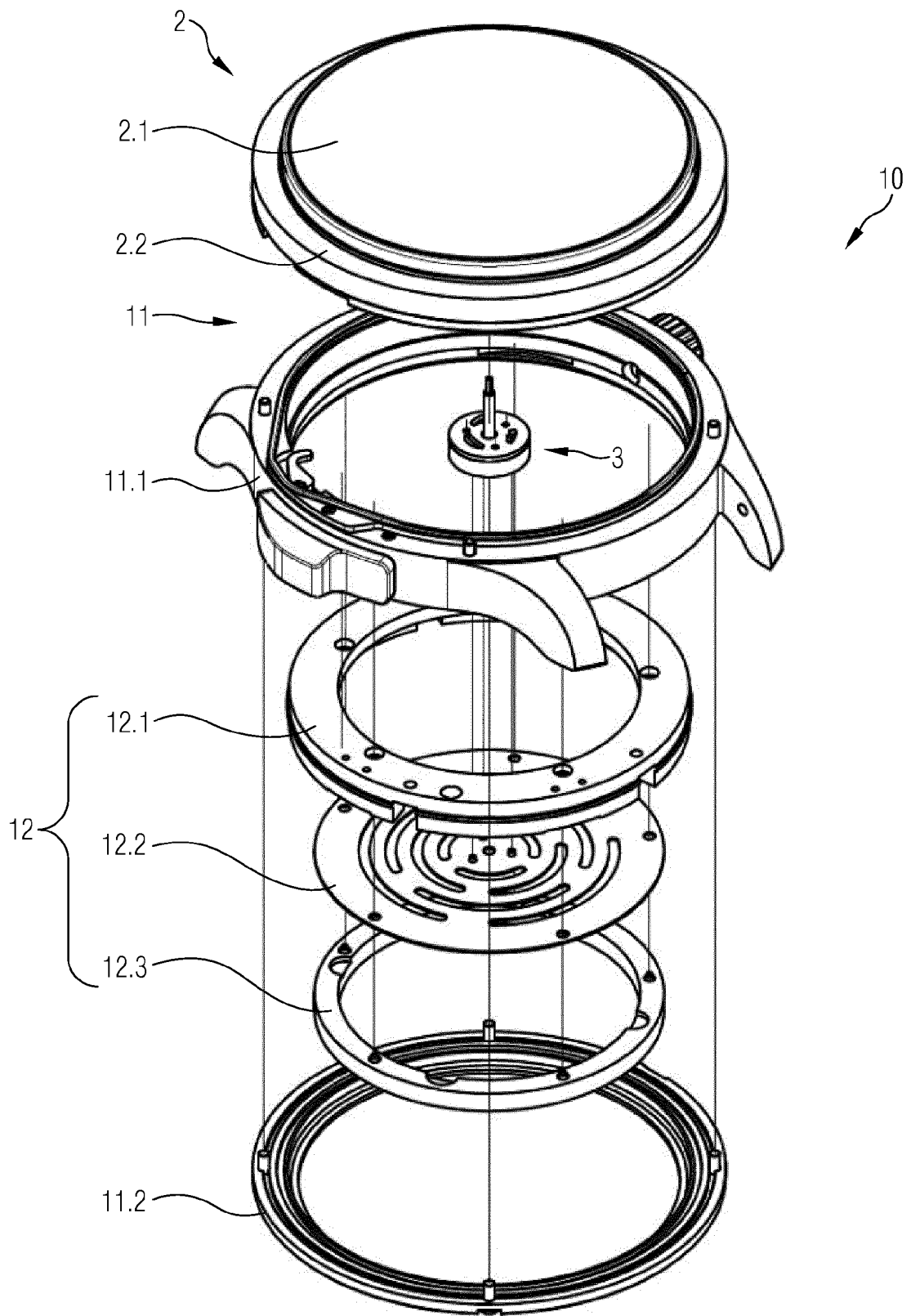


Fig.1b

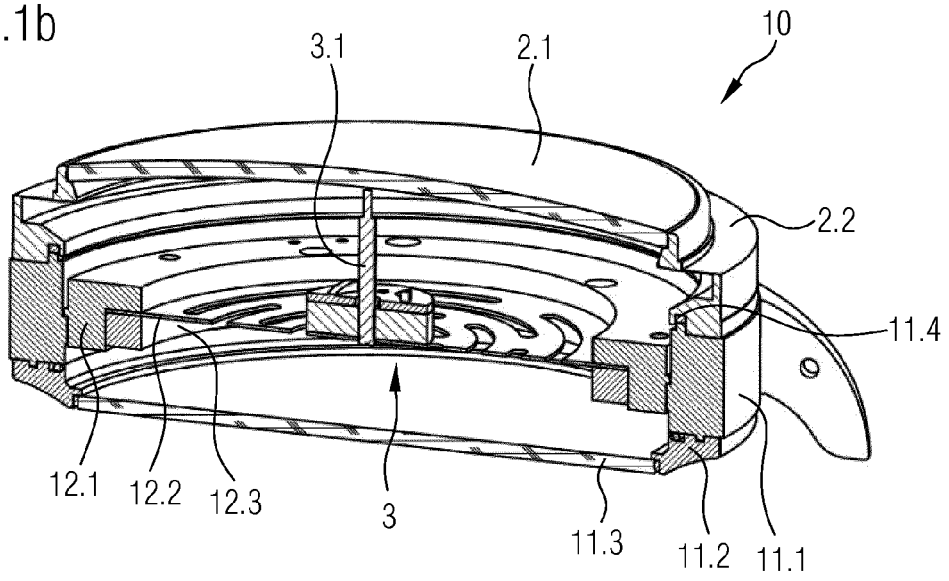


Fig.2a

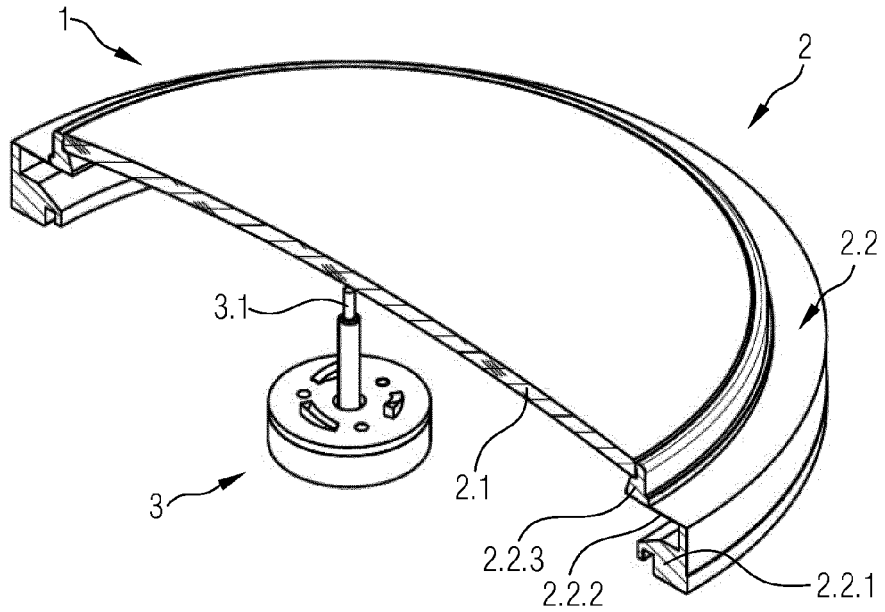


Fig.2b

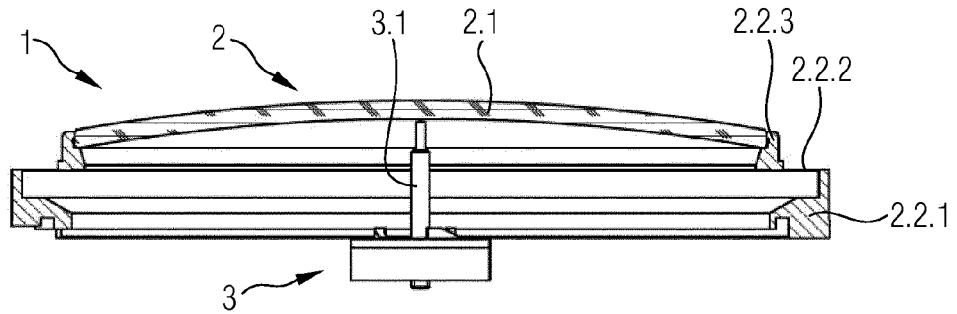


Fig.2c

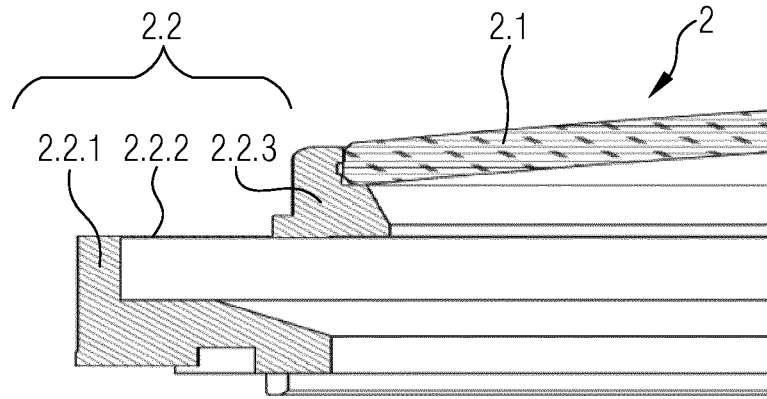


Fig.3a

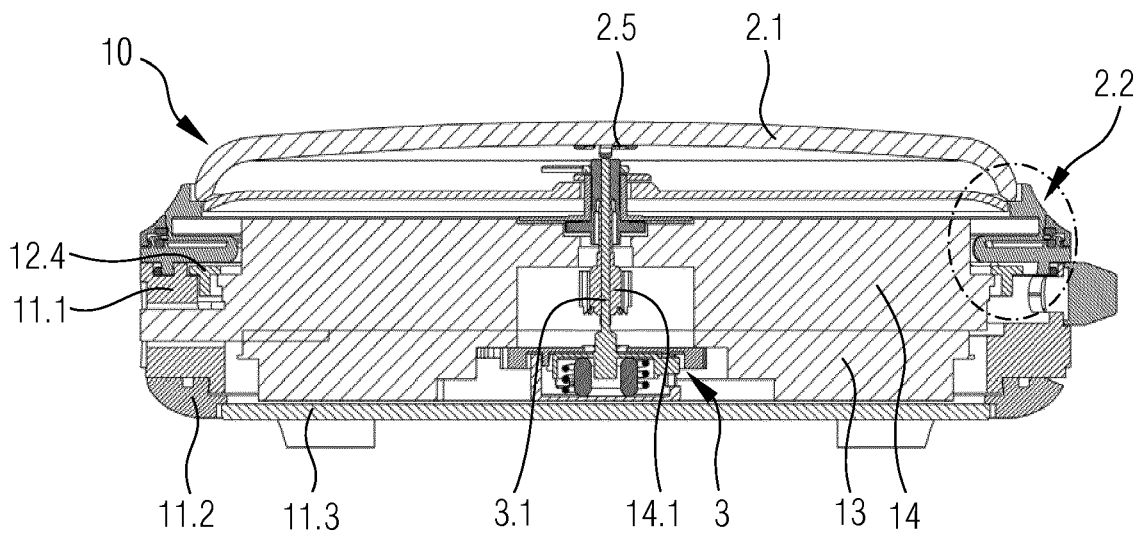


Fig.3b

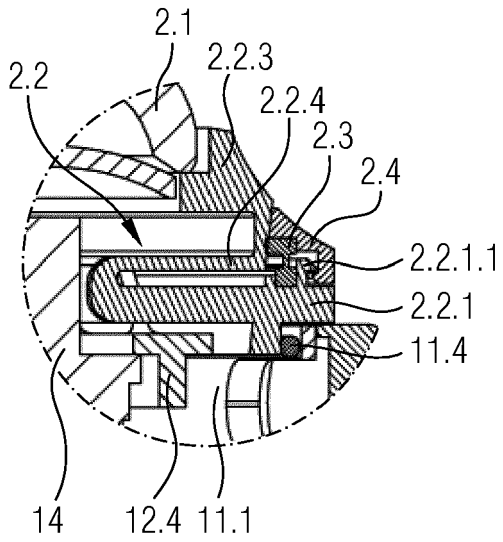


Fig.3c

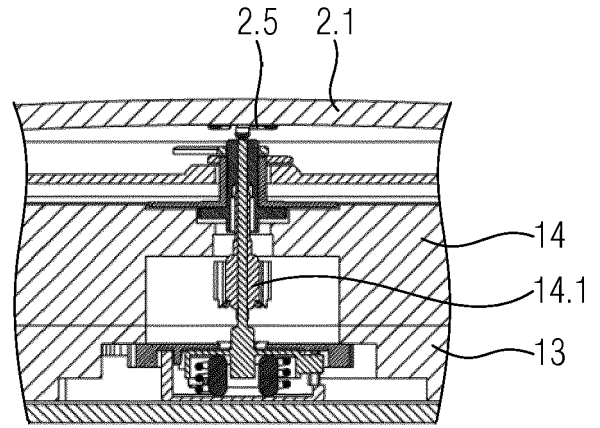


Fig.3d

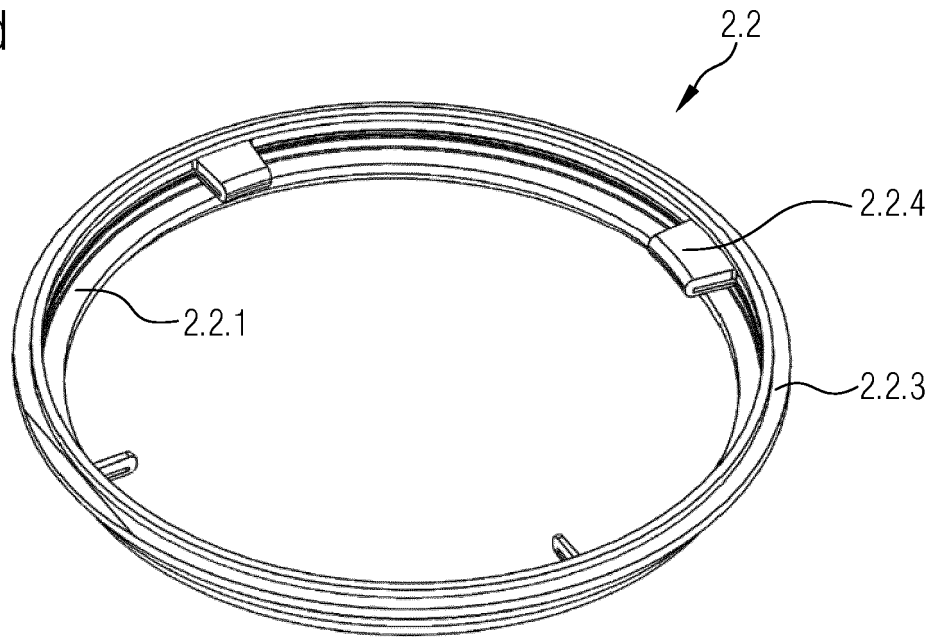


Fig.4a

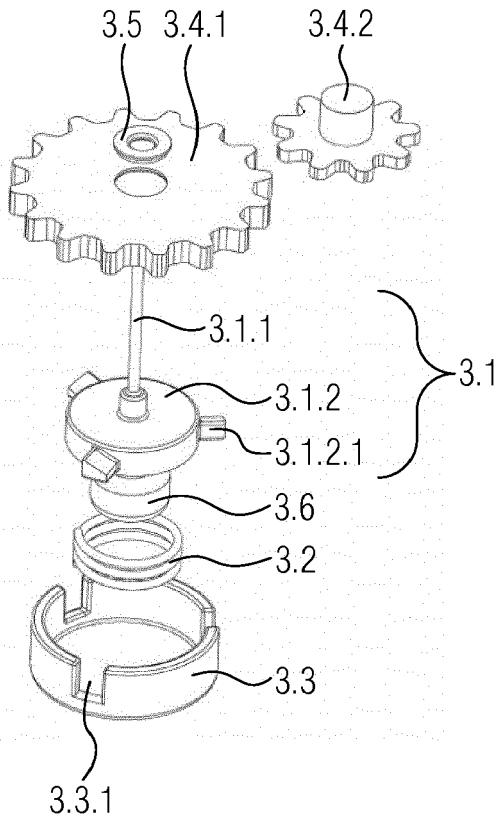


Fig.4b

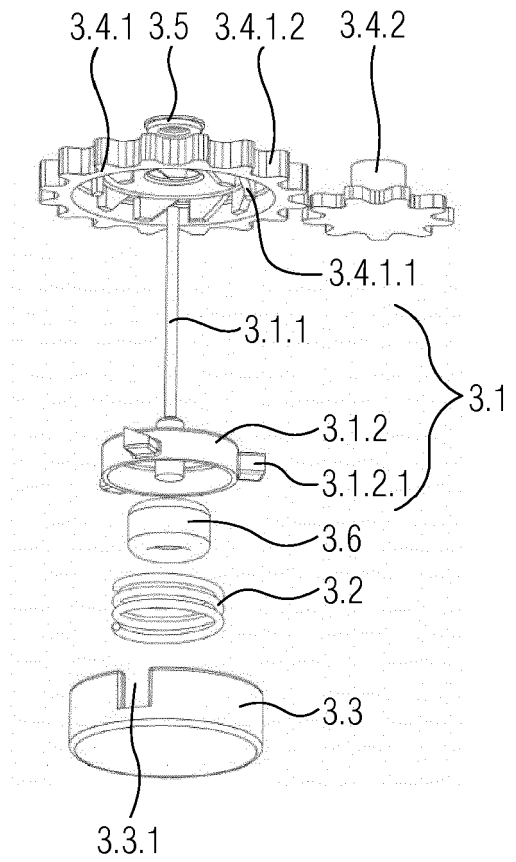


Fig.4c

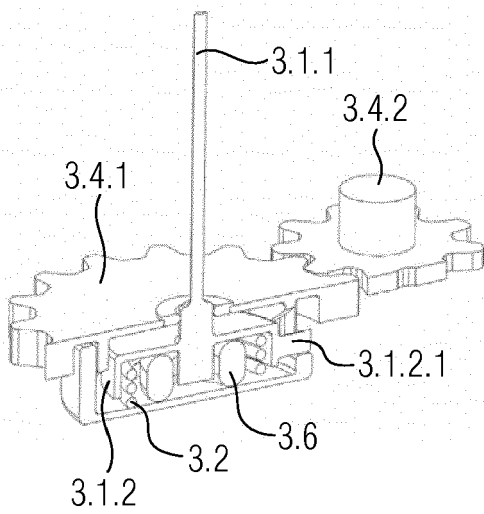
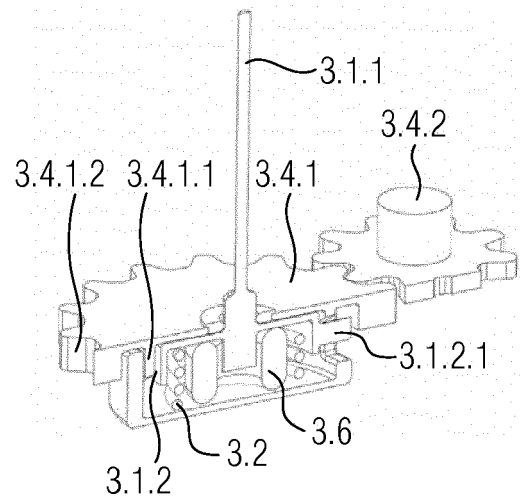


Fig.4d





EUROPEAN SEARCH REPORT

Application Number
EP 18 19 4193

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D A	CH 632 387 A3 (EBAUCHES SA [CH]) 15 October 1982 (1982-10-15) * page 3, column 1, line 64 - page 3, column 2, line 24; figure 1 * * page 3, column 2, line 56 - page 4, column 2, line 28 *	1,9,15 2-8	INV. G04B21/06 G04B21/08 G04B21/02 G04B23/02
X A	US 3 225 535 A (ANDRE DELADERRIERE) 28 December 1965 (1965-12-28) * column 1, lines 37-45,59-64; claims 1-4; figure 1 * * column 2, lines 3-7,26-41 *	1,2,15 3-8	
A	CH 520 357 A (SPADINI PAOLO [CH]) 29 October 1971 (1971-10-29) * column 2, line 5 - column 3, line 22; claims 1-7; figures 1-2 *	1-9,15	
A	EP 3 070 541 A1 (MONTRES BREGUET SA [CH]) 21 September 2016 (2016-09-21) * abstract; figures 1-3 * * paragraphs [0005], [0008] - [0017] *	1-9,15	
			TECHNICAL FIELDS SEARCHED (IPC)
			G04C G04B
-The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 12 July 2019	Examiner Laeremans, Bart
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)



Application Number

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CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing claims for which payment was due.

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Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due and for those claims for which claims fees have been paid, namely claim(s):

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No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for those claims for which no payment was due.

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LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

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see sheet B

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All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

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As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.

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Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

1-8(completely); 9, 15(partially)

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None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:

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The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).

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**LACK OF UNITY OF INVENTION
SHEET B**

Application Number

EP 18 19 4193

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1, 2(completely); 9, 15(partially)

Chiming mechanism for producing a sound at specific moments in time and adapted for integration into a timepiece which is equipped with a timepiece movement and which has a case with at least one opening, said opening being closed by a crystal, the chiming mechanism comprising a gong element adapted to vibrate in order to produce a sound as well as an actuating element adapted to strike the gong element in order to produce vibrations of said gong element, wherein said actuating element comprises a striking part adapted to move, when actuated, at least partially in a direction essentially perpendicular to a plane generally defined by the crystal in order to strike, at an angle, an inner surface of the crystal running essentially parallel to a plane defined by said movement, said crystal thereby acting directly as the gong element.

1.1. claims: 2(completely); 9, 15(partially)

Chiming mechanism according to the claim 1, wherein said striking part of the actuating element moves along a longitudinal axis oriented in a direction essentially perpendicular to said plane defined by the crystal and traversing the centre of the movement.

2. claims: 3-8(completely); 9, 15(partially)

Claim 3: Chiming mechanism according to one of the preceding claims, wherein the striking part comprises a hammer stem adapted to be housed within the central shaft of the movement of the timepiece, the free end of the hammer stem being adapted to strike the watch crystal in order to produce vibrations of the crystal, whilst the other end of the hammer stem is fixed to or, preferably, is formed in one piece with a loading wheel.

Claim 4: Chiming mechanism according to one of the preceding claims, wherein said actuating element further comprises an actuating spring, a hammer housing as well as at least a first trigger wheel.

3. claims: 10-14, 16(completely); 15(partially)

Chiming mechanism according to claim 1, wherein the crystal is mounted elastically on the case of the corresponding timepiece by means of a holding bezel comprising a first solid part adapted to be attached to a middle of the watch case, a second solid part carrying the watch crystal and a third elastic part connecting the first and second parts



**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 18 19 4193

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The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

such that the second part and the crystal can vibrate.

Please note that all inventions mentioned under item 1, although not necessarily linked by a common inventive concept, could be searched without effort justifying an additional fee.

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 18 19 4193

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

12-07-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CH 632387 A3	15-10-1982	-----	-----
US 3225535 A	28-12-1965	DE 1902489 U	15-10-1964
		FR 1387204 A	29-01-1965
		US 3225535 A	28-12-1965
CH 520357 A	29-10-1971	CH 520357 A	29-10-1971
		CH 825266 A4	29-10-1971
EP 3070541 A1	21-09-2016	NONE	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2015039883 A [0004]
- DE 20102939 U [0005]
- EP 503132 A [0006] [0007] [0033]
- EP 503133 A [0006] [0033]
- CH 630220 [0007]
- CH 632387 [0007] [0008]
- CH 698742 [0008]
- CH 708111 [0009]
- CH 698533 [0010]
- EP 3002639 A [0011]
- DE 102014114969 [0012]
- CH 686600 [0013]
- EP 2409200 A [0014]
- EP 2738625 A [0014]