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(54) MOON PHASE DISPLAY WATCH

(57) A moon phase display watch of the present disclosure includes a first member configured to make one rotation per day, a second member configured to rotate coaxially with the first member and to make M-1 rotations every M days, the M days being a period of a synodic month, a moon phase indicating part provided at one of the first member and the second member, the moon phase indicating part being configured to indicate a moon phase, and a moon phase pointing part provided at the other of the first member and the second member, the moon phase pointing part being configured to point to the moon phase indicating part.

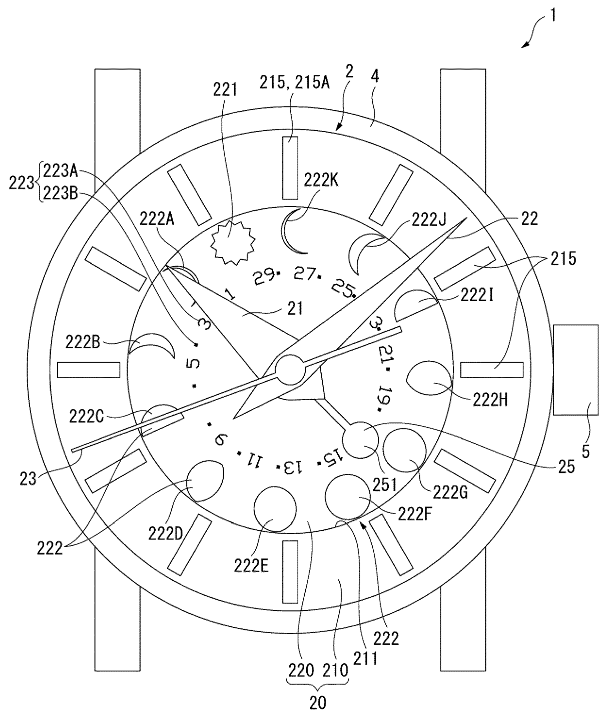

FIG. 1

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Description

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a moon phase display watch that displays the moon phase by displaying positions of the sun and the moon.

2. Related Art

[0002] JP-A-2009-229069 discloses a watch including a mechanism for displaying the moon position and the moon phase. The watch includes a constellation plate on which the ecliptic and the numbers representing, on the ecliptic, the positions of the sun in each day of each month are provided, and a moon plate on which marks of the moon positions and the moon phases are provided. The constellation plate rotates in synchronization with the stellar diurnal motion, and the moon plate rotates at a predetermined rotational ratio with respect to the constellation plate. The user can determine the moon phase by estimating the position of the today's sun on the basis of the numbers on the ecliptic, by connecting the position of the sun and the center of the moon plate with a virtual straight line, and then by checking a moon phase indicator through which the straight line passes, on the moon plate.

[0003] With the above-described watch, the user has to read the moon phase indicator by estimating the position of the sun by his or her self, and as such the user may recognize a wrong moon phase.

SUMMARY

[0004] A moon phase display watch of the present disclosure include a first member configured to make one rotation per day, a second member configured to rotate coaxially with the first member and to make M-1 rotations every M days, the M days being a period of a synodic month, a moon phase indicating part provided at one of the first member and the second member, the moon phase indicating part being configured to indicate a moon phase, and a moon phase pointing part provided at the other of the first member and the second member, the moon phase pointing part being configured to point to the moon phase indicating part.

[0005] In the moon phase display watch of the present disclosure, the moon phase indicating part may indicate the moon phase in a form of a number of the moon phase or a shape of a moon, and the moon phase pointing part may display the moon phase by pointing to the number of the moon phase or the shape of the moon.

[0006] In the moon phase display watch of the present disclosure, the first member may be a sun plate having a disc shape, the second member may be a moon hand having a hand shape, the moon phase indicating part may be provided at the sun plate, and the moon phase pointing part may be provided at the moon hand.

[0007] In the moon phase display watch of the present disclosure, the first member may be a sun hand having a hand shape, the second member may be a moon plate having a disc shape, the moon phase indicating part may be provided at the moon plate, and the moon phase pointing part may be provided at the sun hand.

[0008] The moon phase display watch of the present disclosure may further include a synodic plate disposed on a side opposite to the sun hand with the moon plate disposed between the synodic plate and the sun hand, and a planetary gear mechanism configured to drive the synodic plate in conjunction with a rotation of the sun hand and in conjunction with a rotation of the moon plate. The moon plate may include an aperture having a circular shape, and the synodic plate may include a light region and a dark region that are visually recognized through the aperture in accordance with the rotations of the sun hand and the moon plate in plan view in a direction perpendicular to the moon plate.

[0009] The moon phase display watch of the present disclosure may further include a first wheel to which the first member is fixed, the first wheel being configured to make one rotation per day, the first wheel including a first gear, a second wheel to which the second member is fixed, the second wheel being configured to make M-1 rotations every M days, the second wheel including a second gear, and an intermediate wheel including a first intermediate gear configured to engage with the first gear and a second intermediate gear configured to engage with the second gear, in which a = 59, b = 103, c = 74, and d = 85 hold, where a is a number of teeth of the first gear, d is a number of teeth of the second gear, c is a number of teeth of the first intermediate gear, and b is a number of teeth of the second intermediate gear.

[0010] The moon phase display watch of the present disclosure may further include an hour hand, an hour wheel configured to fix the hour hand, a second wheel to which the second member is fixed, the second wheel being configured to make M-1 rotations every M days, the second wheel including a second gear, and an intermediate wheel including an hour intermediate gear configured to engage with the hour wheel and a second intermediate gear configured to engage with the second gear, in which e = 59, f = 148, g = 103, and h = 85 hold, where e is a number of teeth of the hour wheel, f is a number of teeth of the hour intermediate gear, g is a number of teeth of the second intermediate gear, and h is a number of teeth of the second gear.

[0011] In the moon phase display watch of the present disclosure, the M may be 29.53059.

[0012] A moon phase display watch of the present disclosure includes a sun wheel configured to make one rotation per day, a moon wheel configured to make M-1 rotations every M days, the M days being a period of a synodic month, a moon plate having a disc shape and fixed to the moon wheel, the moon plate including an aperture having a circular shape, a synodic wheel configured to be rotated coaxially with the moon wheel, a synodic plate fixed to the synodic wheel, the synodic plate including a light region and a dark region that are visually recognized through the aperture of the moon plate, and a planetary gear mechanism including a synodic feed gear configured to be driven in conjunction with a rotation of the sun wheel and in conjunction with a rotation of the moon wheel to rotate the synodic wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013]

FIG. 1 is a front view illustrating a moon phase display watch of a first embodiment.
FIG. 2 is a cross-sectional view illustrating a main portion of a movement of the moon phase display watch.
FIG. 3 is a plan view illustrating a main portion of the movement of the moon phase display watch.
FIG. 4 is a cross-sectional view illustrating a main part of a correction mechanism of the moon phase display watch.
FIG. 5 is a diagram illustrating combinations of the numbers of teeth of a moon wheel, a sun wheel, and a sun moon intermediate wheel of the moon phase display watch.
FIG. 6 is a diagram illustrating combinations of the numbers of teeth of the moon wheel, an hour wheel, and the sun moon intermediate wheel of the moon phase display watch.
FIG. 7 is a front view illustrating a moon phase display watch of a second embodiment.
FIG. 8 is a plan view illustrating a synodic plate of the moon phase display watch.
FIG. 9 is a cross-sectional view illustrating a main portion of a movement of the moon phase display watch.
FIG. 10 is a plan view illustrating a main portion of the movement of the moon phase display watch.
FIG. 11 is a diagram illustrating an example of a moon phase display with movement of a moon plate and a synodic plate of the moon phase display watch.

DESCRIPTION OF EXEMPLARY EMBODIMENTS

First Embodiment

[0014] A moon phase display watch 1 of a first embodiment will be described with reference to FIGS. 1 to 6.

[0015] As illustrated in FIG. 1, the moon phase display watch 1 is a watch with hands, and includes a case 4 that houses a display unit 2 and a movement 3, and a crown 5. The case 4 is a common watch case including a case body, a cover glass, and a case back.

[0016] The display unit 2 includes a dial 20, an hour hand 21, a minute hand 22, a second hand 23, and a moon hand 25 having a hand shape.

[0017] The dial 20 includes a fixed dial 210 and a sun plate 220. The fixed dial 210 is composed of a circular plate having a circular aperture 211 at a planar center. In other words, the fixed dial 210 is formed in an annular shape and is disposed on the outer perimeter side of the sun plate 220. Indexes 215 are provided on the fixed dial 210 at an interval of 30 degrees. The index 215 is also referred to as an hour mark, and is an indicator disposed to indicate a time. As such, an index 215A is an indicator that indicates 12 o'clock.

[0018] The sun plate 220 is composed of a circular plate that can be visually recognized through the aperture 211 of the fixed dial 210. The sun plate 220 is configured to be rotatable together with a sun wheel 52 described later and makes one rotation every 24 hours.

[0019] Note that the rotation axis of the sun plate 220, i.e., the rotation axis of the sun wheel 52, is aligned with the rotation axes of the hour hand 21, the minute hand 22, the second hand 23, and the moon hand 25, and is provided at a planar center position of the dial 20.

[0020] A sun mark 221 mimicking a sun shape, a plurality of moon marks 222 mimicking moon shapes, and moon phase marks 223 representing moon phases are printed on the sun plate 220. The sun mark 221 and the moon marks 222 are displayed along the outer perimeter of the sun plate 220.

[0021] The moon phase marks 223 are printed on the inner circumference side of the sun mark 221 and the moon marks 222. In addition, the moon phase marks 223 are provided as moon phase numbers 223A and dots 223B. The moon phase numbers 223A represent odd numbered moon phases, and the dots 223B represent even numbered moon phases. Note that in the moon phase marks 223, even numbered moon phases may be represented by numbers and odd numbered moon phases may be represented by dots, or all moon phases may be provided as numbers.

[0022] The moon shape and the moon phase depend on the positional relationship between the sun and the moon. The moon phase 0 corresponding to a new moon is indicated when the positions match each other, and the moon phase 15 corresponding to a full moon is indicated when the positions are shifted from each other by 180 degrees. In the sun plate 220, the sun mark 221 is printed at the position of the new moon, and the moon marks 222 are printed such that moon marks 222A to 222K having shapes corresponding to the waxing and waning of the moon are printed at positions substantially corresponding to the moon marks 223. The moon mark 222F is a mark that represents a full moon of a moon phase 15, and is printed at a position opposite to the sun mark 221 with respect to the rotation axis of the sun plate 220, i.e., at a position rotated 180 degrees from the sun mark 221.

[0023] The moon hand 25 includes a pointing part 251 that points to the sun mark 221, the moon mark 222, and the moon phase mark 223 of the sun plate 220.

[0024] The hour hand 21 is attached at the 12 o'clock position where it points to the index 215A in the state where the sun mark 221 of the sun plate 220 is aligned with the index 215A representing the 12 o'clock position, i.e., the state where the planar center point of the sun mark 215A is located on a virtual line connecting between the rotation axis of the sun plate 220 and the index 215A. The sun plate 220 makes one rotation every 24 hours, and therefore the sun mark 221 serves the same function as a 24-hour hand of a watch. Thus, when the 12 o'clock position of the moon phase display watch 1 is directed toward the north, the sun mark 221 points to the actual sun direction.

[0025] With respect to the earth, the sun makes one rotation per day and the moon makes one rotation approximately every 24 hours 50 minutes. Accordingly, the moon falls behind the sun by one rotation every M days, which is the period of the synodic month, i.e., approximately 29.53059 days. In other words, it makes 28.53059 rotations every 29.53059 days.

[0026] The moon hand 25 is fixed to a moon wheel 51 described later, and makes approximately 28.53059 rotations every synodic month, i.e., M days = approximately 29.53059 days as with the actual moon. Thus, once the moon hand 25 is set at the position of moon phase 0, i.e., the position where it points to the sun mark 221 at the time of a new moon, the pointing part 251 of the moon hand 25 points to the actual moon direction when the 12 o'clock position of the moon phase display watch 1 is directed toward the north.

Movement

[0027] The movement 3 of the moon phase display watch 1 will now be described with reference to FIGS. 2 and 3.

[0028] The movement 3 is the movement 3 of a mechanical watch that is driven by a mainspring, and as illustrated in FIG. 2, includes a main plate 11, a center wheel bridge 12, a train wheel bridge 13, a barrel (not illustrated) that contains a mainspring, a train wheel that is rotated by the barrel, and a speed governing mechanism that governs the rotational speed of the train wheel. The speed governing mechanism may be a common speed governing mechanism of a mechanical watch including an escape wheel, a pallet fork and the like, or may be a speed governing mechanism of an electronic mechanical watch including a generator including a rotor that is rotated by a train wheel, and a brake control circuit that is driven by the power generated by the generator to control the rotation of the rotor.

[0029] Further, the moon phase display watch 1 may be achieved as a quartz watch that drives hands with a motor. In other words, it suffices that the moon phase display watch 1 is a watch including hands, and the driving method for the hands is not limited.

[0030] The train wheel that is rotated by the barrel includes a center wheel 41, a third wheel (not illustrated), and a fourth wheel 42. In this embodiment, the center wheel 41 is rotatably supported by the main plate 11 and the center wheel bridge 12, and the fourth wheel 42 is rotatably supported by the center wheel 41 and the train wheel bridge 13.

[0031] The second hand 23 is attached to a pivot 421 of the fourth wheel 42, and the minute hand 22 is attached to a cannon pinion 45 fitted with the pivot of the center wheel 41. The hour hand 21 is attached to an hour wheel 46 that is rotated through a minute wheel 43 that engages with the cannon pinion 45. Note that the minute wheel 43 is not illustrated in FIG. 2 and is illustrated in FIG. 3.

[0032] The moon wheel 51 is rotatably attached at a pivotal outer perimeter portion of the hour wheel 46, and the sun wheel 52 is rotatably mounted to a pivotal outer perimeter portion of the moon wheel 51.

[0033] The moon wheel 51 includes a pivot portion 511, a gear 512, and a pinion 513. The pivot portion 511 is formed in a cylindrical shape and is rotatably supported by the hour wheel 46 disposed therein. The gear 512 is continuously formed on the end portion of the pivot portion 511 on the main plate 11 side, and engages with a moon intermediate gear 63 of a sun moon intermediate wheel 60 (described later). The pinion 513 is press-fitted to the pivot portion 511 so as to rotate together with the pivot portion 511 and the gear 512, and to engage with a fifth moon phase correction transmission wheel 86 (described later).

[0034] The moon hand 25 is attached to the pivot portion 511 of the moon wheel 51. As also illustrated in FIG. 1, the moon hand 25 includes at its tip a disc-shaped pointing part 251 mimicking a full moon, and indicates the moon phase by the positional relationship of the sun mark 221 and the moon mark 222 located in the vicinity of the pointing part 251 and the moon phase mark 223 overlapping the pointing part 251. Note that the shape of the pointing part 251 of the moon hand 25 is not limited to a disc shape, and may be a half-moon shape, a crescent shape, or the like. The moon hand 25 may also be formed in the same manner as a typical hand, but may be colored or shortened so as to be distinguishable from the hour hand 21, the minute hand 22, and the second hand 23.

[0035] The sun wheel 52 includes a pivot portion 521 and a gear 522. The pivot portion 521 is formed in a rectangular prism shape having a square shape in plan view, and a through-hole to which the pivot portion 511 of the moon wheel 51 is inserted is formed in a center portion thereof. The pivot portion 521 is rotatably supported by the pivot portion 511.

[0036] The sun plate 220 is attached to the pivot portion 521 of the sun wheel 52 such that the sun plate 220 is rotatable together with the sun wheel 52. Specifically, a rectangular hole having a square shape in plan view is formed at the planar center of the sun plate 220, and the sun plate 220 rotates together with the sun wheel 52 by inserting the pivot portion 521 of the sun wheel 52 to the rectangular hole.

[0037] The outer circumference edge of the sun plate 220 overlaps the inner circumference edge of the fixed dial 210 along the aperture 211 in plan view, and the fixed dial 210 restrains the movement, to the cover glass side, of the sun plate 220 located on the main plate 11 side relative to the fixed dial 210. Note that, in this embodiment, viewing in the direction perpendicular to the dial 20 is referred to as a plan view.

[0038] The moon wheel 51 and the sun wheel 52 are rotated by the sun moon intermediate wheel 60 that transmits the rotation of the hour wheel 46. The sun moon intermediate wheel 60 is composed of four members, namely, a pivot 61, an hour intermediate gear 62, the moon intermediate gear 63, and a sun intermediate gear 64.

[0039] The pivot 61 is press-fitted to the main plate 11. The hour intermediate gear 62 is axially rotatably supported by the pivot 61 and engages with a pinion 461 that rotates together with the hour wheel 46. Here, the number of teeth of the pinion 461 of the hour wheel 46 is 59 and the number of teeth of the hour intermediate gear 62 is 148, and accordingly, the hour intermediate gear 62 reduces the rotational speed of the hour wheel 46 by a gear ratio of 59:148.

[0040] The sun intermediate gear 64 is press-fitted to the pivot portion of the hour intermediate gear 62 and engages with the gear 522 of the sun wheel 52. Here, the number of teeth of the sun intermediate gear 64 is 74, and the number of teeth of the gear 522 of the sun wheel 52 is 59, and accordingly, the sun intermediate gear 64 increases the rotational speed of the sun moon intermediate wheel 60 by a gear ratio of 74:59. Thus, the rotational speed of the hour wheel 46 is reduced in half and transmitted to the sun wheel 52 and the sun plate 220, and they make one rotation every 24 hours.

[0041] The moon intermediate gear 63 is press-fitted to the pivot portion of the hour intermediate gear 62 such that the moon intermediate gear 63 can slip, and the moon intermediate gear 63 engages with the gear 512 of the moon wheel 51. Here, the number of teeth of the moon intermediate gear 63 is 103 and the number of teeth of the gear 512 of the moon wheel 51 is 85. Accordingly, the moon intermediate gear 63 increases the rotational speed of the sun moon intermediate wheel 60 by a gear ratio of 103:85, and reduces the rotational speed of the hour wheel 46 to approximately 1/2.07, and, transmits it to the moon wheel 51 is 85. More specifically, this deceleration ratio is 1/2.070100378, and when the hour wheel 46 makes 29.53059 x 2 rotations, the moon wheel 51 makes approximately 28.53058752 rotations. In other words, in the case where the sun wheel 52 and the sun plate 220, which make two rotations per day, make 29.53059 rotations through the hour wheel 46, which makes two rotations per day, the moon wheel 51 and the moon hand 25 make approximately 28.53058752 rotations. Here, the moon wheel 51 causes an error of 0.00000248 days every 29.53059 days, i.e., an error of one day in approximately 1100 years.

[0042] In this embodiment, a first wheel that makes one rotation per day is the sun wheel 52, and a first gear of the first wheel is the gear 522 of the sun wheel 52. A first member fixed to the first wheel is the sun plate 220.

[0043] In the case where the period of the synodic month is M days, i.e., 29.53059 days, a second wheel that makes M-1 rotations every M days is the moon wheel 51, and a second gear of the second wheel is the gear 512 of the moon wheel 51. A second member that rotates coaxially with the sun plate 220 serving as the first member and is fixed to the second wheel is the moon hand 25.

[0044] Thus, a moon phase indicating part is composed of the sun mark 221, the moon mark 222, and the moon phase mark 223 provided on the sun plate 220 serving as the first member, and a moon phase pointing part is composed of the pointing part 251 provided on the moon hand 25 serving as the second member.

[0045] A first intermediate gear that engages with the gear 522 serving as the first gear is the sun intermediate gear 64, and a second intermediate gear that engages with the gear 512 serving as the second gear is the moon intermediate gear 63. The sun moon intermediate wheel 60 is an intermediate wheel including the sun intermediate gear 64 serving as the first intermediate gear, and the moon intermediate gear 63 serving as the second intermediate gear, and is also an intermediate wheel including the hour intermediate gear 62 that engages with the hour wheel 46, and the moon intermediate gear 63 serving also as the second intermediate gear.

Correction Mechanism of Moon Wheel

[0046] The moon intermediate gear 63 has a slip structure and can rotate the moon wheel 51 with respect to the hour wheel 46 and the sun wheel 52. A correction mechanism 70 of the moon wheel 51 is described below.

[0047] As illustrated in FIGS. 3 and 4, the correction mechanism 70 includes a winding stem 71, a winding pinion 72, a clutch wheel 73, a setting lever 74, a yoke 75, a yoke holder 76, a setting wheel lever 77, a setting wheel 78, and a moon wheel correction train wheel 80.

[0048] The winding stem 71 can be pulled out to three positions, namely, a zeroth position, a first position, and a second position.

[0049] The moon wheel correction train wheel 80 includes a moon phase correction wheel 81, a first moon phase correction transmission wheel 82, a second moon phase correction transmission wheel 83, a third moon phase correction transmission wheel 84, a fourth moon phase correction transmission wheel 85, and a fifth moon phase correction transmission wheel 86 as described below.

[0050] The moon phase correction wheel 81 is axially supported by the setting wheel lever 77 such that the moon phase correction wheel 81 is rotatable together with the setting wheel 78, and the setting wheel lever 77 is moved by the setting lever 74 such that the moon phase correction wheel 81 engages with the first moon phase correction transmission wheel 82 when the winding stem 71 is set at the first position whereas the moon phase correction wheel 81 does not engage with the first moon phase correction transmission wheel 82 when the winding stem 71 is set at the zeroth position or the second position. The setting lever 74 rotates in conjunction with a pulling operation of the winding stem 71.

[0051] The fifth moon phase correction transmission wheel 86 is engaged with the pinion 513 of the moon wheel 51 as illustrated in FIG. 2.

[0052] Although not illustrated in the drawings, at the zeroth position of the winding stem 71, the mainspring can be wound up, and when the winding pinion 72 and the clutch wheel 73 engage with each other through the action of the setting lever 74 and the yoke 75 and the winding stem 71 is rotated, the clutch wheel 73 that rotates together with the winding stem 71 rotates, and the winding pinion 72 that engages with the clutch wheel 73 rotates, and also, the round hole wheel 79 that engages with the winding pinion 72 rotates. The rotation of the round hole wheel 79 is transmitted to a rectangular hole wheel (not illustrated), and thus the mainspring is wound up.

[0053] As illustrated in FIGS. 3 and 4, at the first position of the winding stem 71, the moon wheel 51 can be corrected. Specifically, when the winding stem 71 is moved to the first position, the clutch wheel 73 engages with the setting wheel 78 through the action of the setting lever 74, the yoke 75, and the setting wheel lever 77, and the moon phase correction wheel 81 that rotates coaxially together with the setting wheel 78 engages with the first moon phase correction transmission wheel 82. Thus, the rotation operation of the winding stem 71 is transmitted to the moon phase correction wheel 81 through the clutch wheel 73 and the setting wheel 78, and is further transmitted to the moon wheel 51 through the moon phase correction transmission wheels 82 to 86 from the moon phase correction wheel 81. Since the moon intermediate gear 63 that engages with the moon wheel 51 has the slip structure, the moon hand 25 can be moved by rotating the moon wheel 51 with respect to the hour wheel 46 and the sun wheel 52 through the operation of the winding stem 71 at the first position.

[0054] At the second position of the winding stem 71, the setting wheel 78 is moved by the setting lever 74 and the setting wheel lever 77 to a position where the setting wheel 78 engages with the minute wheel 43, and the clutch wheel 73 is moved by the setting lever 74 and the yoke 75 to a position where the clutch wheel 73 engages with the setting wheel 78. Thus, when the winding stem 71 is operated, the cannon pinion 45 and the hour wheel 46 are rotated through the clutch wheel 73, the setting wheel 78, and the minute wheel 43, and the hour hand 21 and the minute hand 22 are corrected.

[0055] When assembling the moon phase display watch 1, the hour hand 21, the minute hand 22, and the second hand 23 are attached at a position of 00:00:00 (12:00:00) with the sun mark 221 of the sun plate 220 being located at the 12 o'clock position of the fixed plate 210.

[0056] The moon hand 25 can be corrected by pulling the winding stem 71 to the first position, and is therefore moved to the current moon phase position. In this manner, the positions of the sun mark 221 and the moon hand 25 can be set in accordance with the positions of the sun and the moon with respect to the earth.

[0057] Then, when the winding stem 71 is pulled out to the second position and the hour hand 21 and the minute hand 22 are corrected to the current time, the sun plate 220 and the moon hand 25 also move to the position corresponding to the current time through the sun moon intermediate wheel 60.

[0058] After the above initialization has been performed, the rotation of the moon hand 25 with respect to the rotation of the sun mark 221 can be aligned to the actual relationship of the sun and the moon, and its accuracy can be kept to an error of approximately one day in approximately 1000 years.

Effects of First Embodiment

[0059] According to the moon phase display watch 1 according to this embodiment, which includes the sun moon intermediate wheel 60 that transmits the rotation of the hour wheel 46 to the moon wheel 51 and the sun wheel with a predetermined deceleration ratio, the moon wheel 51 can be set to fall behind by approximately one rotation when the sun wheel 52 and the sun plate 220, which make one rotation per day, make 29.53059 rotations. Thus, the moon wheel 51 and the moon hand 25 make approximately 28.53059 rotations in the M-day period of the synodic month = 29.53059 days as with the actual moon and thus can accurately indicate the moon phase.

[0060] It suffices for the movement 3 to add the moon wheel 51, the sun wheel 52, and the sun moon intermediate wheel 60 to a movement that drives the hour hand 21, the minute hand 22, the second hand 23, and therefore the moon phase display watch 1 can perform a moon phase display with almost no error with a relatively simple structure.

[0061] With the correction mechanism 70 of the moon wheel 51, the user can readily correct the moon phase pointing. While the moon phase display watch 1 is very accurate with an error of one day in approximately 1000 years, the pointing accuracy can be further increased since the user can periodically correct the pointing position of the moon hand 25.

[0062] Since the sun mark 221 and the moon hand 25 move in association with the movements of the sun and the moon with respect to the earth, i.e., the user, the user can identify the current positions of the sun and the moon. As such, when the sun mark 221 is directed toward the sun, the index 215A representing 12 o'clock of the fixed dial 210 indicates the north, and the directions of 3 o'clock, 6 o'clock, and 9 o'clock indicate the east, south, and west, respectively as with a 24-hour hand, and thus the user can readily determine the direction. Further, the direction can be determined even at night by directing the moon hand 25 toward the moon. Thus, the means for determining the direction is increased, and the direction can be conveniently confirmed using the moon phase display watch 1 even at night when the position of the sun cannot be confirmed.

[0063] The moon wheel 51 and the sun wheel 52 are configured to move in conjunction with each other through one sun moon intermediate wheel 60, and the numbers of the teeth of the sun wheel 52 serving as the first gear, the moon wheel 51 serving as the second gear, the sun intermediate gear 64 serving as the first intermediate gear, and the moon intermediate gear 63 serving as the second intermediate gear are set to a = 59, b = 103, c = 74, and d = 85, respectively, and thus, a structure that causes only a small error can be achieved with small gears.

[0064] Specifically, in the case where the moon wheel 51 and the sun wheel 52 are rotated with one sun moon intermediate wheel 60, it is possible to set a plurality of combinations of the number of teeth of the gears for achieving a deceleration ratio with which the moon wheel 51 falls behind by approximately one rotation when the sun wheel 52 makes 29.53059 rotations as illustrated in FIG. 5. Among them, the time period until the pointing error of the moon wheel 51 becomes one day is longest in the example of the number 12 in FIG. 5, i.e., the example of this embodiment. Therefore, by setting the number of teeth as in this embodiment, a highly accurate moon phase display can be achieved even in comparison with the combinations of other numbers of teeth.

[0065] The moon wheel 51 and the hour wheel 46 are configured to move in conjunction with each other through one sun moon intermediate wheel 60, and the numbers of teeth of the hour wheel 46, the hour intermediate gear 62, the moon intermediate gear 63 serving as the second intermediate gear, and the moon wheel 51 serving as the second gear are set to e = 59, f = 148, g = 103, and h = 85, respectively, and thus, a structure that causes only a small error can be achieved with small gears.

[0066] Specifically, in the case where the moon wheel 51 and the hour wheel 46 are rotated with one sun moon intermediate wheel 60, it is possible to set a plurality of combinations of the number of teeth of the gears for achieving a deceleration ratio with which the moon wheel 51 falls behind by approximately one rotation when the sun wheel 52 makes 29.53059 rotations, as illustrated in FIG. 6. Among them, the time period until the pointing error of the moon wheel 51 becomes one day is longest in the example of the number 9 in FIG. 6, i.e., the example of this embodiment. Therefore, by setting the number of teeth as in this embodiment, a highly accurate moon phase display can be achieved even in comparison with the combinations of other numbers of teeth.

[0067] The sun moon intermediate wheel 60 includes the hour intermediate gear 62, the moon intermediate gear 63, and the sun intermediate gear 64 that engage with the hour wheel 46, the moon wheel 51, and the sun wheel 52, respectively, and the most accurate numbers of teeth illustrated in FIGS. 5 and 6 are set. Thus, it is not necessary to use two intermediate wheels, and the number of parts can be reduced while achieving highly accurate moon phase display.

[0068] When the number of teeth of each gear is not greater than 150, the size of the gears can be reduced and the frictional load is also small, and therefore, the excessive reduction in the duration can be prevented. In other words, it is difficult to ensure the tooth shape accuracy in manufacture of gears having 150 or more teeth. In addition, a tooth shape of a module of 0.05mm or smaller is prone to problems with strength. Further, a gear having with 150 or more teeth whose module is 0.05mm has a pitch diameter of 7.5mm or greater, and consequently the frictional load due to the weight is large. In contrast, in the combinations of the number of teeth illustrated in FIGS. 5 and 6, the number of teeth of each gear is not greater than 150, and thus the tooth shape accuracy and the strength of the gear can be ensured while reducing the frictional load.

Second Embodiment

[0069] Next, a second embodiment of the present disclosure will be described with reference to FIGS. 7 to 11.

[0070] A moon phase display watch 1B of the second embodiment includes the case 4 and the crown 5 as illustrated in FIG. 7. The case 4 houses a display unit 2B and a movement 3B as in the first embodiment.

[0071] The display unit 2B includes the hour hand 21, the minute hand 22, and the second hand 23 as with the first embodiment. The display unit 2B also includes a sun hand 26 having a hand shape instead of the moon hand 25 of the first embodiment, a dial 20B instead of the dial 20, and further, a synodic plate 241 disposed between the dial 20B and the movement 3B.

[0072] The dial 20B includes a fixed dial 210B and a moon plate 230. As with the fixed dial 210, the fixed dial 210B is formed in an annular shape, and an index 215B that indicates a time and a direction mark 216B that indicates a direction are printed on the fixed dial 210B. The direction mark 216B is N, S, E, and W of the alphabet representing the north, south, east, and west.

[0073] The moon plate 230 is composed of a circular plate that can be visually recognized through the aperture 211 of the fixed dial 210B. The moon plate 230 is configured to be rotatable together with a moon wheel 51B described later, and makes approximately 28.53059 rotations in the M-day period of the synodic month=29.53059 days as with the moon hand 25 of the first embodiment. In the moon plate 230, a round hole 231, which is a circular aperture that represents a moon position, is formed, and moon phase numbers 232, which represent the moon phase, are provided along the outer perimeter of the moon plate 230.

[0074] The synodic plate 241 is configured to be rotatable together with a synodic wheel 240 described later, and is used to display mimicking the state of the waxing and waning of the moon when viewed through the round hole 231 of the moon plate 230. As illustrated in FIG. 8, in the synodic plate 241, a white colored light region 242 and a black colored dark region 243 are alternately arranged.

[0075] The light region 242 is provided with a first light region 242A, a second light region 242B, and a third light region 242C provided at an interval of 120 degrees.

[0076] The dark region 243 includes a first dark region 243A, a second dark region 243B, and a third dark region 243C provided at an interval of 120 degrees.

[0077] The synodic plate 241 rotates in conjunction with the phase difference between a sun wheel 52B and the moon wheel 51B. The synodic plate 241 is displayed through the round hole 231 of the moon plate 230, and provides a display mimicking the moon shape in combination with the round hole 231.

[0078] The sun hand 26 makes one rotation every 24 hours as with a 24-hour hand, and indicates the current time in the form of a 24-hour display. The sun hand 26 includes at its tip a pointing part 261 having a shape mimicking the sun, and indicates the moon phase by the moon phase number 232 of the moon plate 230 overlapping the pointing part 261.

[0079] Thus, in the moon phase display watch 1B, the moon phase pointing part is composed of the pointing part 261 of the sun hand 26, and the moon phase display part is composed of the moon phase numbers 232 of the moon plate 230.

[0080] Note that the shape of the pointing part 261 of the sun hand 26 is not limited to that illustrated in FIG. 7 as long as the shape can be distinguished from the hour hand 21, the minute hand 22, and the second hand 23, and the user can understand the indication of the position of the sun.

[0081] From the main plate 11 of the movement 3B, the synodic plate 241, the moon plate 230, the sun hand 26, the hour hand 21, the minute hand 22, and the second hand 23 are disposed in this order.

[0082] The waxing and waning of the moon depend on the positional relationship, i.e., the phase difference, between the moon and the sun with respect to the earth. For example, a new moon appears when the moon and the sun are located at the same position with respect to the earth, and a full moon appears when the moon and the sun are shifted from each other by 180 degrees. Therefore, it suffices that the sun hand 26 makes one rotation every 24 hours in accordance with the position of the sun, that the moon plate 230 makes approximately 28.53059 rotations in the period of the synodic month, 29.53059 days, in accordance with the position of the moon, and that the synodic plate 241 makes rotations in accordance with the phase difference between the moon and the sun.

[0083] Thus, after the sun hand 26 is attached at the 12 o'clock position with the round hole 231 of the moon plate 230 being located at the 12 o'clock position, and the round hole 231 that indicates the position of the moon and the sun hand 26 that indicates the position of the sun are attached to a position corresponding to the moon phase 0, the moon shape is determined in accordance with the phase difference between the moon and the sun. Thus, once the user of the moon phase display watch 1B has aligned the position of the sun hand 26 to the current moon phase number after setting the time, the user does not need to correct the moon phase for approximately 1000 years as long as the moon phase display watch 1B is not stopped. In addition, even if the moon phase display watch 1B is stopped, correction can be readily performed by simply aligning the sun hand 26 to the moon phase after setting the time.

Movement

[0084] The movement 3B of the moon phase display watch 1B will now be described with reference to FIGS. 9 and 10.

[0085] As with the movement 3 of the first embodiment, the movement 3B is the movement 3 of a mechanical watch that is driven by a mainspring. Here, since the mechanisms for driving the hour hand 21, the minute hand 22, and the second hand 23 are the same as those of the first embodiment, the same reference signs are attached thereto and descriptions thereof are omitted.

[0086] The sun wheel 52B is rotatably attached at a pivotal outer perimeter portion of the hour wheel 46, the moon wheel 51B is rotatably attached at a pivotal outer perimeter portion of the sun wheel 52B, and the synodic wheel 240 is rotatably attached at a pivotal outer perimeter portion of the moon wheel 51B.

[0087] The sun wheel 52B includes a pivot portion 521B and a gear 522B. The pivot portion 521B is formed in a cylindrical shape and is rotatably supported by the hour wheel 46 disposed therein. The gear 522B is continuously formed on the end portion of the pivot portion 521B on the main plate 11 side and engages with a sun intermediate gear 64B (described later).

[0088] The sun hand 26 is attached to the pivot portion 521B of the sun wheel 52B.

[0089] The moon wheel 51B includes a pivot portion 511B and a gear 512B. The pivot portion 511B is formed in a cylindrical shape and is rotatably supported by the pivot portion 521B of the sun wheel 52B disposed therein. In addition, the outer perimeter surface of the pivot portion 511B rotatably supports the synodic wheel 240. Further, the end portion of the pivot portion 511B on the cover glass side is shaped such that a rectangular hole formed in the moon plate 230 can be inserted and the moon wheel 51B and the moon plate 230 can rotate together.

[0090] In addition, the outer circumference edge of the moon plate 230 overlaps the inner circumference edge of the fixed dial 210 along the aperture 211 in plan view in the direction perpendicular to the moon plate 230, and the fixed dial 210 restrains the movement, to the cover glass side, of the moon plate 230 located on the main plate 11 side relative to the fixed dial 210. The synodic plate 241 is fixed to the synodic wheel 240.

[0091] The moon wheel 51B and the sun wheel 52B are rotated by a sun moon intermediate wheel 60B that transmits the rotation of the hour wheel 46. As with the sun moon intermediate wheel 60 of the first embodiment, the sun moon intermediate wheel 60B includes a pivot 61B, an hour intermediate gear 62B, a moon intermediate gear 63B, and the sun intermediate gear 64B. Note that, the positional relationship between the moon wheel 51B and the sun wheel 52B is opposite to that of the first embodiment, and accordingly the positional relationship between the moon intermediate gear 63B and the sun intermediate gear 64B is also opposite. Specifically, the sun moon intermediate wheel 60B is disposed such that the hour intermediate gear 62B, the sun intermediate gear 64B, and the moon intermediate gear 63B are disposed in this order from the main plate 11 side to overlap each other. Note that the gear ratio of the sun moon intermediate wheel 60B, the moon wheel 51B, the sun wheel 52B, and the hour wheel 46 is the same as that of the first embodiment.

[0092] The moon intermediate gear 63B is press-fitted to the sun intermediate gear 64B such that the moon intermediate gear 63B can slip, and the correction mechanism 70 that corrects the positions of the moon wheel 51B and the moon plate 230 by pulling and operating the winding stem 71 to the first position is provided. As illustrated in FIG. 10, since the correction mechanism 70 is the same as that of the first embodiment, the same reference signs are attached thereto and descriptions thereof are omitted.

[0093] The movement 3B includes a synodic feed wheel 90 that rotates the synodic plate 241 in conjunction with the phase difference between the moon wheel 51B and the sun wheel 52B.

[0094] As illustrated in FIG. 9, the synodic feed wheel 90 includes a synodic sun pivot 91, a synodic planetary intermediate gear 92, a second synodic sun gear 93, a second synodic sun pinion 94, a synodic planetary wheel 95, a synodic sun gear 96, a synodic feed gear 97, a synodic feed wheel spacer 98, and a synodic feed wheel support 99. That is, the synodic feed wheel 90 is a planetary gear mechanism.

[0095] The synodic sun pivot 91 is rotatably supported in a hole in the main plate 11.

[0096] The synodic planetary intermediate gear 92 is axially rotatably supported by the synodic sun pivot 91 and engages with the sun wheel 52B. The sun wheel 52B and the synodic planetary intermediate gear 92 are gears having the same tooth shape, and both have 59 teeth.

[0097] The second synodic sun gear 93 is a gear that is axially rotatably supported by the synodic sun pivot 91 through the second synodic sun pinion 94. The second synodic sun gear 93 engages with the moon wheel 51B and has the same tooth shape as the moon wheel 51B. The moon wheel 51B and the second synodic sun gear 93 both have 85 teeth.

[0098] The second synodic sun pinion 94 is press-fitted to the second synodic sun gear 93. The number of teeth of the second synodic sun pinion 94 is 16.

[0099] The synodic planetary wheel 95 is inserted to a pin 921 erected on the synodic planetary intermediate gear 92 such that the synodic planetary wheel 95 is axially rotatably supported. The synodic planetary wheel 95 includes a synodic planetary pinion 951 that engages with the second synodic sun pinion 94 and a synodic planetary gear 952 that engages with the synodic sun gear 96.

[0100] The number of teeth of the synodic planetary pinion 951 is 12 and the number of teeth of the synodic planetary gear 952 is 15.

[0101] The synodic sun gear 96 is fixed to the synodic sun pivot 91 and rotates together with the synodic sun pivot 91. The number of teeth of the synodic sun gear 96 is 15.

[0102] The synodic feed gear 97 is press-fitted to the synodic sun pivot 91 and engages with the synodic wheel 240 to which the synodic plate 241 is fixed. The synodic feed gear 97 and the synodic wheel 240 have the same tooth shape as the sun wheel 52B, and have the same number of teeth, i.e., 59 teeth.

[0103] The synodic feed wheel spacer 98 is press-fitted to the synodic sun pivot 91. This restrains the axial movement of the synodic planetary intermediate gear 92, the second synodic sun gear 93, the second synodic sun pinion 94, the synodic planetary wheel 95, and the synodic sun gear 96 that are disposed between the flange of the synodic sun pivot 91 and the synodic feed wheel spacer 98, and the synodic feed wheel 90 can serve as a unit.

[0104] The synodic feed wheel support 99 is interspersed between the second synodic sun gear 93 and the synodic feed gear 97 with backlash in the axial direction of the synodic sun pivot 91 and in the direction orthogonal to the axial direction. The synodic feed wheel support 99 is fixed to the main plate 11 with a screw (not illustrated), and the synodic feed wheel 90 is fixed with backlash in the axial direction of the synodic sun pivot 91.

[0105] The synodic feed wheel support 99 is disposed between the moon wheel 51B and the synodic wheel 240, and, in plan view as illustrated in FIG. 10, covers the upper side of the sun moon intermediate wheel 60B such that the moon intermediate gear 63B and the second synodic sun gear 93 and the synodic wheel 240 do not engage with each other in cross section.

Description of Operation

[0106] As illustrated in FIG. 11, when the moon wheel 51B, i.e., the moon plate 230, is rotated 360 degrees counterclockwise with respect to the sun wheel 52B, the synodic wheel 240, i.e., the synodic plate 241, is 85/85 x 16/12 x 15 x 15 x 59/59 = 4/3 from the above-mentioned gear ratio, and rotates 480 degrees counterclockwise.

[0107] Conversely, when the sun wheel 52B is rotated 360 degrees clockwise with respect to the moon wheel 51B, the synodic wheel 240 is 59/59 x (1-15/15 x 16/12) x 59/59 = - 1/3, and rotates 120 degrees counterclockwise. Since the synodic feed wheel 90 is set such that the moon plate 230 and the synodic wheel 240 relatively rotate as described above, the moon shape can be set in accordance with the phase difference between the moon and the sun by attaching the sun hand 26 at the 12 o'clock position with the round hole 231 of the moon plate 230 being aligned with the 12 o'clock position at moon phase 0. Thus, once the user of the moon phase display watch 1B has aligned the position of the sun hand 26 to the current moon phase number after setting the time, the user does not need to correct the moon phase for approximately 1000 years as long as the moon phase display watch 1B is not stopped, and even if the moon phase display watch 1B is stopped, the moon phase can be readily aligned next time since the correction can be performed with the winding stem 71.

[0108] In FIG. 11, display states 301 to 313 represent the waxing and waning of the moon associated with the relative rotation of the moon plate 230 and the synodic plate 241 when the pointing part 261 of the sun hand 26 is located at the 12 o'clock position. The display state 301 is a new moon, the display state 304 is a waxing moon, the display state 307 is a full moon, the display state 310 is a waning moon, and the display state 313 is a new moon. The other display states represent respective intermediate moon phases. In this manner, by moving the moon plate 230 and the synodic plate 241, the display in accordance with the moon shape can be achieved.

Effects of Second Embodiment

[0109] The moon phase display watch 1B of the second embodiment can also provide operational effects similar to those of the first embodiment.

[0110] Specifically, with the sun moon intermediate wheel 60B having the same gear ratio as the sun moon intermediate wheel 60 of the first embodiment, the moon wheel 51 and the moon plate 230 can be set to fall behind by approximately one rotation when the sun wheel 52 and the sun hand 26, which make one rotation per day, make rotations for M days, i.e., 29.53059 rotations. As a result, with the moon wheel 51B, the sun wheel 52B, and the sun moon intermediate wheel 60B, it is possible to achieve the same operational effects as the first embodiment, such as accurate indication of the moon phase with the sun hand 26 pointing to the moon phase number 232 of the moon plate 230.

[0111] In addition, the user can intuitively identify the moon phase, and improved convenience can be provided since the synodic feed wheel 90 is provided and the synodic plate 241 that rotates with a phase difference between the moon wheel 51B and the sun wheel 52B such that a display mimicking the waxing and waning of the actual moon can be achieved with the light region 242 and the dark region 243 of the synodic plate 241 and the round hole 231 of the moon plate 230.

[0112] In particular, the round hole 231 of the moon wheel 51B also indicates the position of the moon, and can indicate the position and the waxing and waning of the moon at the same time, and thus, the convenience can be improved.

[0113] Since the synodic feed wheel 90 uses a planetary gear mechanism, compactness can be achieved with a relatively simple configuration. Thus, it can be readily incorporated in the moon phase display watch 1B utilized as a watch.

Other Embodiments

[0114] Note that the present disclosure is not limited to the above-described embodiments.

[0115] For example, while the hour intermediate gears 62 and 62B, the moon intermediate gears 63 and 63B, and the sun intermediate gears 64 and 64B are integrally composed in the sun moon intermediate wheels 60 and 60B, they may be composed of two members. For example, it is possible to provide two intermediate wheels including an intermediate wheel that rotates the hour wheel 46 and the moon wheel 51 in conjunction with each other and an intermediate wheel that rotates the hour wheel 46 and the sun wheel 52 in conjunction with each other. It is also possible to provide two intermediate wheels including an intermediate wheel that rotates the hour wheel 46 and the moon wheel 51 or the sun wheel 52 in conjunction with each other, and an intermediate wheel that rotates the moon wheel 51 and the sun wheel 52 in conjunction with each other.

[0116] While the moon mark 222 mimicking the moon shape and the moon phase mark 223 representing the moon phase are displayed as the moon phase display in the first embodiment, only one of them may be displayed.

[0117] While the combination of the pointing to the moon phase with the sun hand 26 and the display of the waxing and waning of the moon with the round hole 231 and the synodic plate 241 are used in the second embodiment, only one of them may be provided.

[0118] Specifically, it is possible to adopt a moon phase display watch in which the moon plate 230 including the moon phase number 232 serving as the moon phase indicating part and the sun hand 26 including the pointing part 261 serving as the moon phase pointing part are provided, and the round hole 231 and/or the synodic plate 241, i.e., the display of the waxing and waning of the moon, is not provided.

[0119] In addition, it is also possible to adopt a moon phase display watch in which the moon plate 230 including only the round hole 231, and the synodic plate 241 are provided, and the numbers representing the moon phase that are pointed to by the sun hand 26 or the sun hand 26 are not provided. In other words, it is also possible to adopt a moon phase display watch that displays the moon phase only by means of the display of the waxing and waning of the moon.

[0120] The light region 242 and the dark region 243 of the synodic plate 241 are not limited to the configuration divided into three sections at intervals of 120 degrees, and the region may be divided into four or more sections. In this case, it suffices to appropriately set the number of teeth of the synodic planetary wheel 95 of the synodic feed wheel 90 and the like in accordance with the number of the sections.

[0121] While the period of the synodic month is set to M = 29.53059 in the embodiments, the period may be set to a value of M = 29, M = 29.53, or the like, for example. Specifically, while it is preferable to set the value to M = 29.5305 in view of improving the accuracy, M may be an approximate value with a small number of significant digits, and is not limited as long as the value can be set as the period of the synodic month.

Claims

1. A moon phase display watch comprising:

a first member configured to make one rotation per day;
a second member configured to rotate coaxially with the first member and to make M-1 rotations every M days, the M days being a period of a synodic month;
a moon phase indicating part provided at one of the first member and the second member, the moon phase indicating part being configured to indicate a moon phase; and
a moon phase pointing part provided at the other of the first member and the second member, the moon phase pointing part being configured to point to the moon phase indicating part.

2. The moon phase display watch according to claim 1, wherein
the moon phase indicating part indicates the moon phase in a form of a number of the moon phase or a shape of a moon; and
the moon phase pointing part displays the moon phase by pointing to the number of the moon phase or the shape of the moon.

3. The moon phase display watch according to claim 1 or 2, wherein
the first member is a sun plate having a disc shape;
the second member is a moon hand having a hand shape;
the moon phase indicating part is provided at the sun plate; and
the moon phase pointing part is provided at the moon hand.

4. The moon phase display watch according to claim 1 or 2, wherein
the first member is a sun hand having a hand shape;
the second member is a moon plate having a disc shape;
the moon phase indicating part is provided at the moon plate; and
the moon phase pointing part is provided at the sun hand.

5. The moon phase display watch according to claim 4, comprising:

a synodic plate disposed on an opposite side of the moon plate from the sun hand; and
a planetary gear mechanism configured to drive the synodic plate in conjunction with a rotation of the sun hand and in conjunction with a rotation of the moon plate; wherein
the moon plate includes an aperture having a circular shape; and
the synodic plate includes a light region and a dark region that are visually recognized through the aperture in accordance with the rotations of the sun hand and the moon plate in plan view seen from a direction perpendicular to the moon plate.

6. The moon phase display watch according to any one of claims 1 to 5, comprising:

a first wheel to which the first member is fixed, the first wheel being configured to make one rotation per day, the first wheel including a first gear;
a second wheel to which the second member is fixed, the second wheel being configured to make M-1 rotations every M days, the second wheel including a second gear; and
an intermediate wheel including a first intermediate gear configured to engage with the first gear and a second intermediate gear configured to engage with the second gear; wherein
a = 59, b = 103, c = 74, and d = 85,
where a is a number of teeth of the first gear, d is a number of teeth of the second gear, c is a number of teeth of the first intermediate gear, and b is a number of teeth of the second intermediate gear.

7. The moon phase display watch according to any one of claims 1 to 6, comprising:

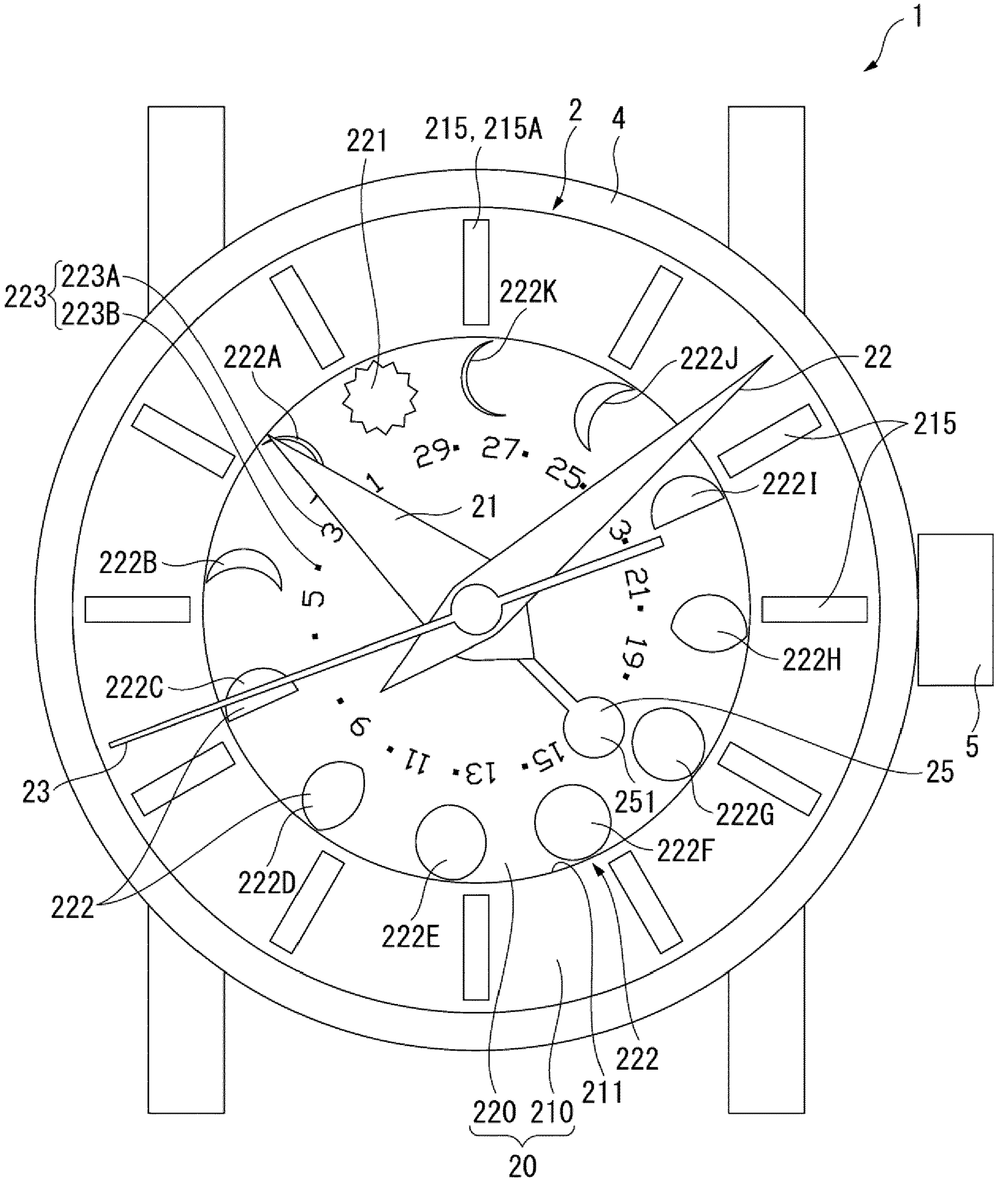
an hour hand;
an hour wheel configured to fix the hour hand;
a second wheel to which the second member is fixed, the second wheel being configured to make M-1 rotations every M days, the second

wheel including a second gear; and
an intermediate wheel including an hour intermediate gear configured to engage with the hour wheel and a second intermediate gear configured to engage with the second gear; wherein
e = 59, f = 148, g = 103, and h = 85,
where e is a number of teeth of the hour wheel, f is a number of teeth of the hour intermediate gear, g is a number of teeth of the second intermediate gear, and h is a number of teeth of the second gear.

8. The moon phase display watch according to any one of claims 1 to 7, wherein the M is 29.53059.

9. A moon phase display watch comprising:

a sun wheel configured to make one rotation per day;
a moon wheel configured to make M-1 rotations every M days, the M days being a period of a synodic month;
a moon plate having a disc shape and fixed to the moon wheel, the moon plate including an aperture having a circular shape;
a synodic wheel configured to be rotated coaxially with the moon wheel;
a synodic plate fixed to the synodic wheel, the synodic plate including a light region and a dark region that are visually recognized through the aperture of the moon plate; and
a planetary gear mechanism including a synodic feed gear configured to be driven in conjunction with a rotation of the sun wheel and in conjunction with a rotation of the moon wheel to rotate the synodic wheel.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222A
222J
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215
222I
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222B
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222C
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23
222G
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222F
222D
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222E
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220 210
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5
29 27 25
1 3 5 7 9 11 13 15 19 21 3

FIG. 1

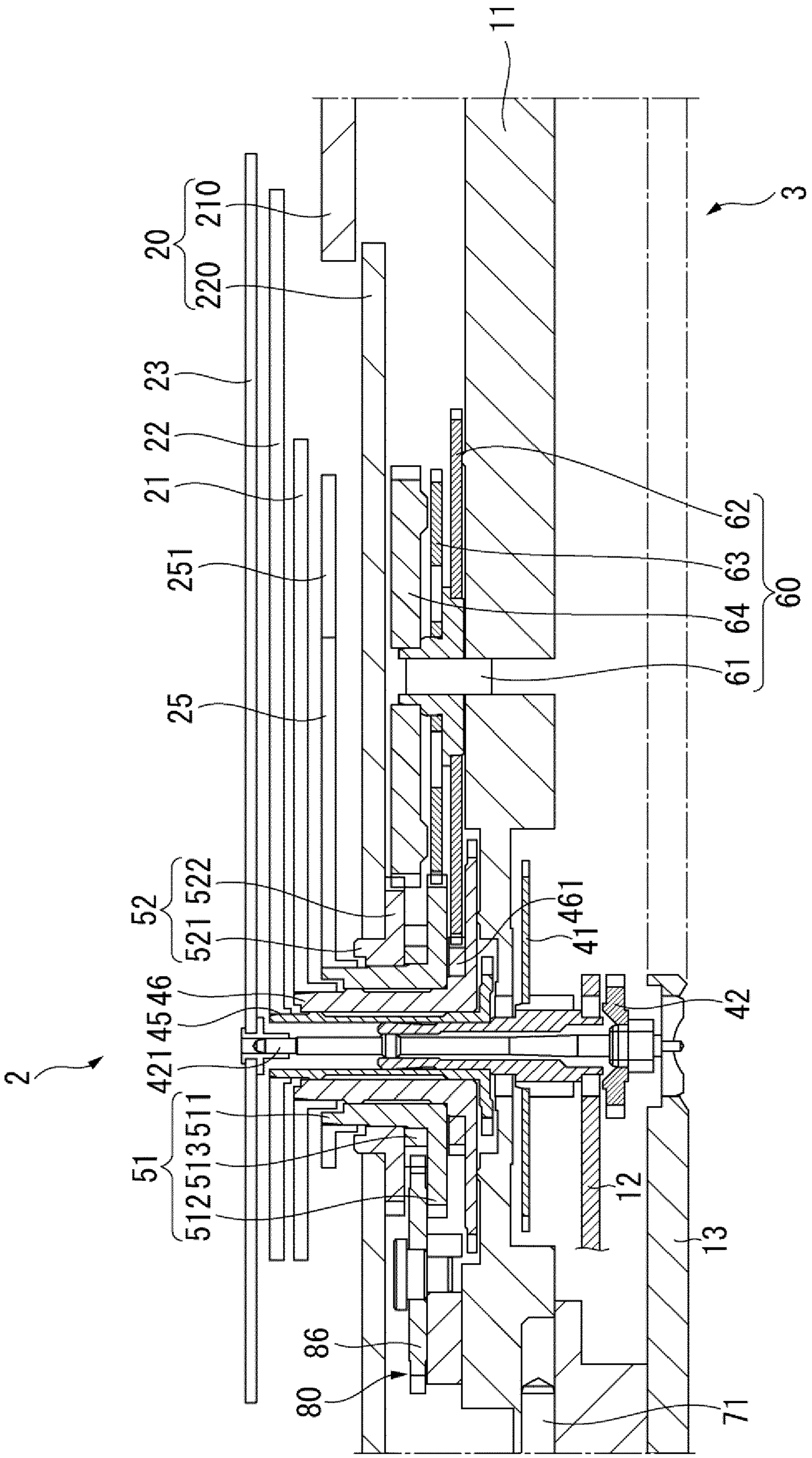
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FIG. 2

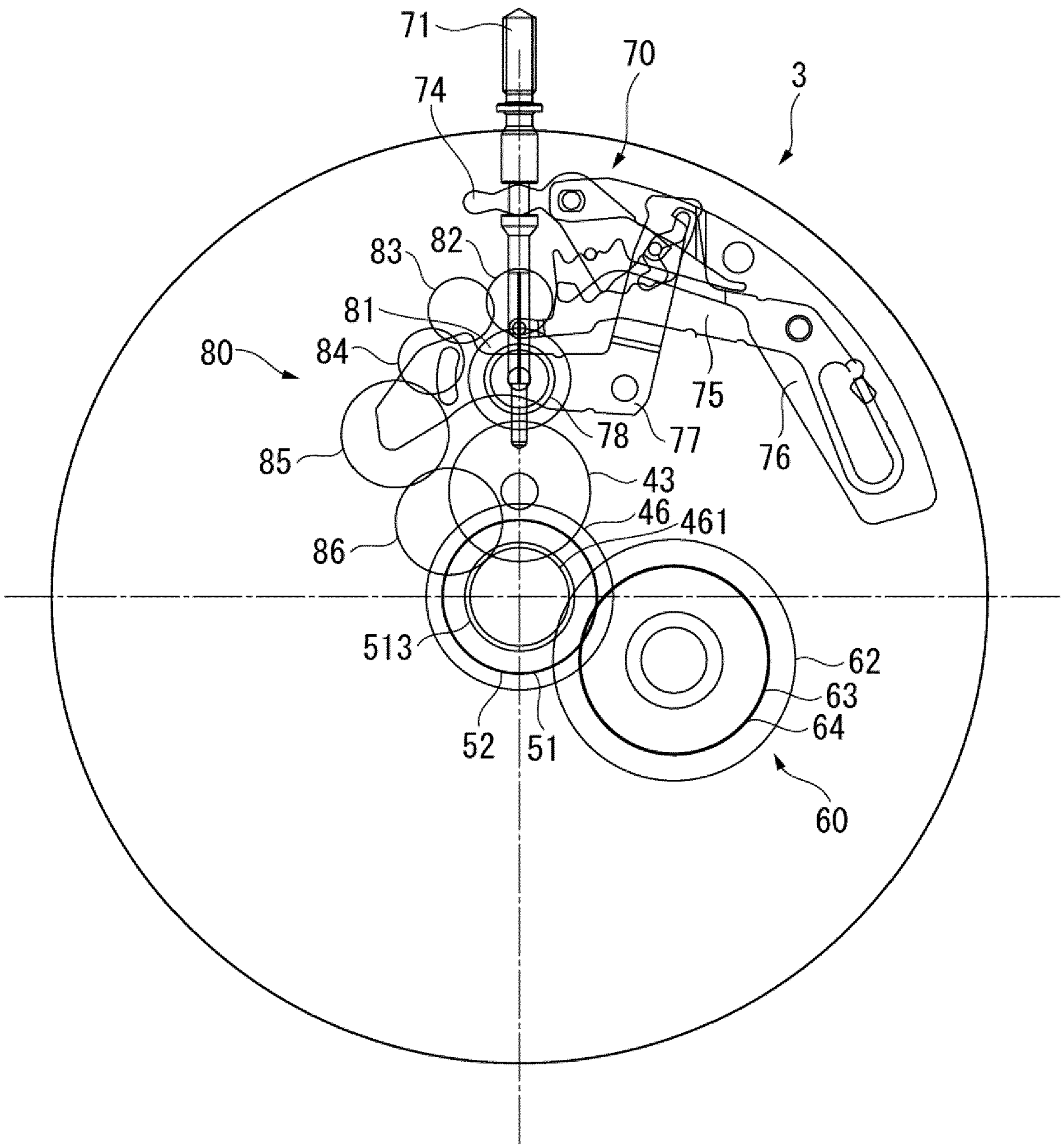
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FIG. 3

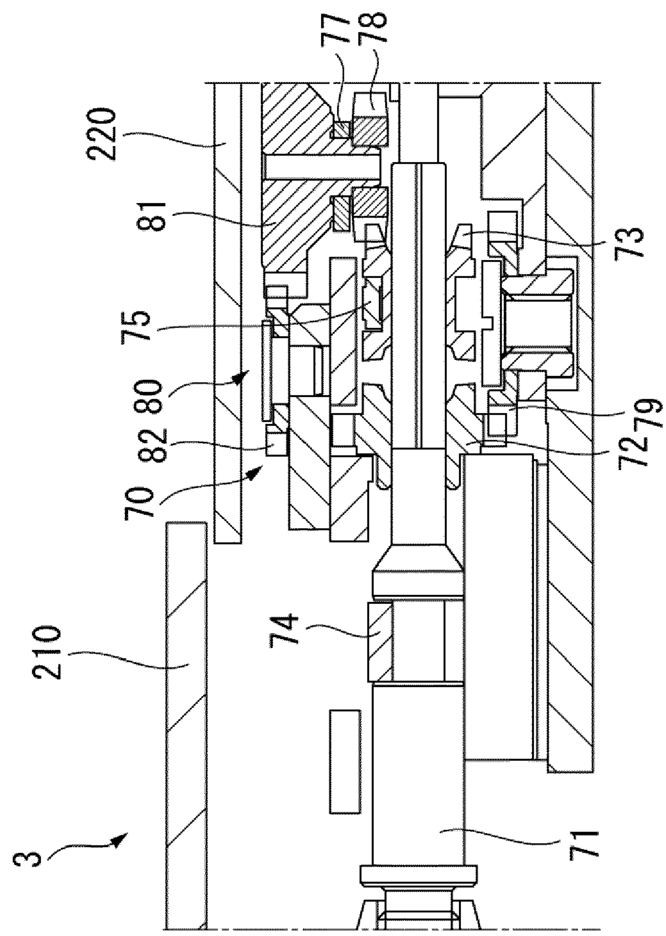


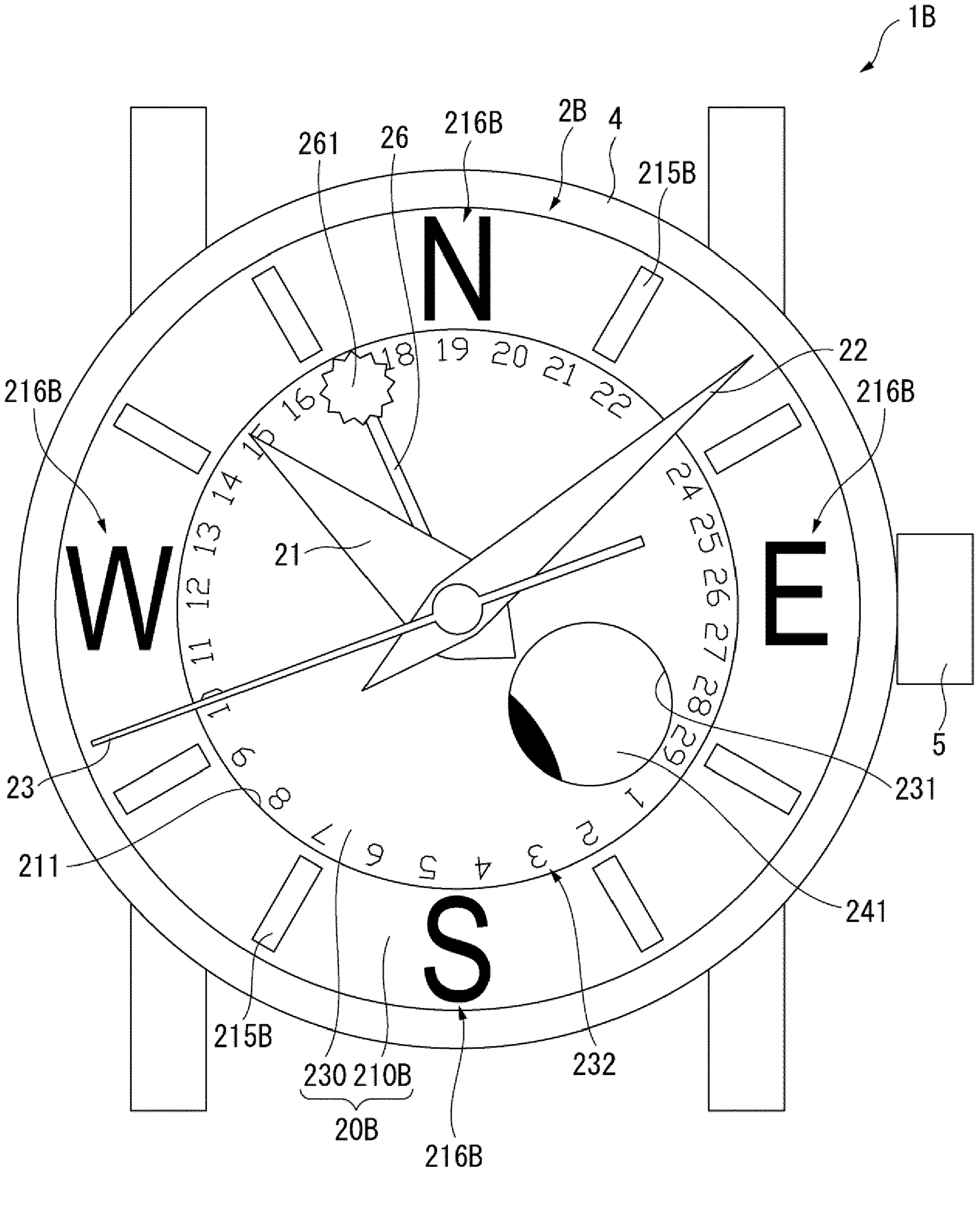
FIG. 4

	c,d		a,b		(c×d)/(a×b)	ERROR PER DAY (YEAR)	c×d	a×b
1	73	125	76	116	1.0350499093	521	9125	8816
2	95	106	69	141	1.0350498510	399	10070	9729
3	67	93	43	140	1.0350498339	373	6231	6020
4	47	71	26	124	1.0350496278	210	3337	3224
5	83	132	73	145	1.0350495985	198	10956	10585
6	107	146	117	129	1.0350493606	134	15622	15093
7	7	135	11	83	1.0350492881	122	945	913
8	68	109	77	93	1.0350509705	−114	7412	7161
9	19	129	16	148	1.0350506757	−173	2451	2368
10	40	110	39	109	1.0350505763	−209	4400	4251
11	79	117	94	95	1.0350503919	−341	9243	8930
12	74	85	59	103	1.0350501892	−1115	6290	6077

FIG. 5

	f, h		e, g		DECELERATION RATIO	CORRECTION YEARS	f×h	e×g
1	73	125	38	116	2.0700998	521	9125	4408
2	67	93	35	86	2.0700997	373	6231	3010
3	47	71	13	124	2.0700993	210	3337	1612
4	14	135	11	83	2.0700986	122	1890	913
5	109	136	93	77	2.0701019	−114	14824	7161
6	19	129	8	148	2.0701014	−173	2451	1184
7	80	110	39	109	2.0701012	−209	8800	4251
8	117	79	95	47	2.0701008	−341	9243	4465
9	85	148	59	103	2.0701004	−1115	12580	6077

FIG. 6


1B
261
26
216B
2B
4
215B
22
216B
216B
N
W
E
S
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232
215B
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210B
20B
216B

FIG. 7

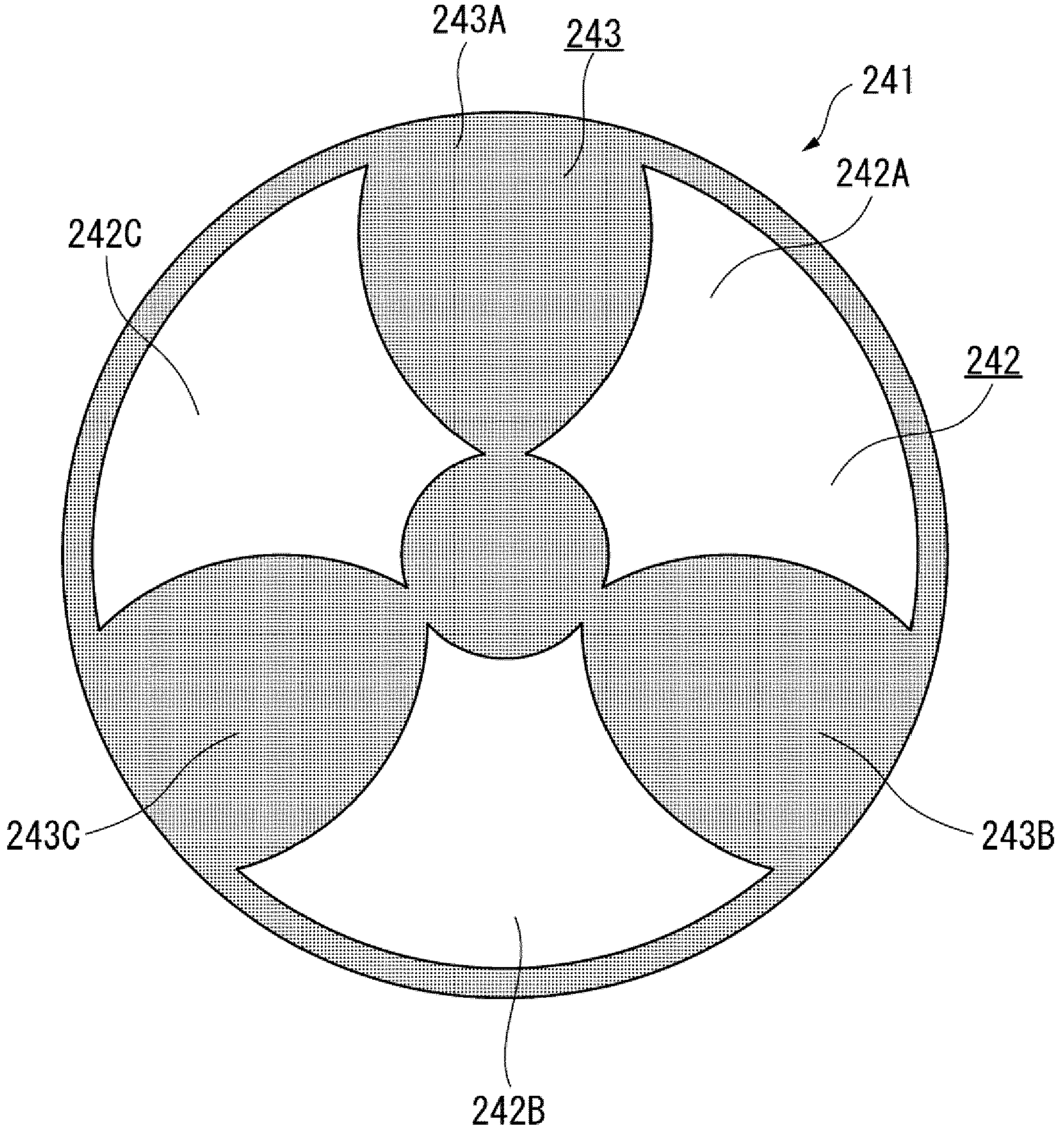
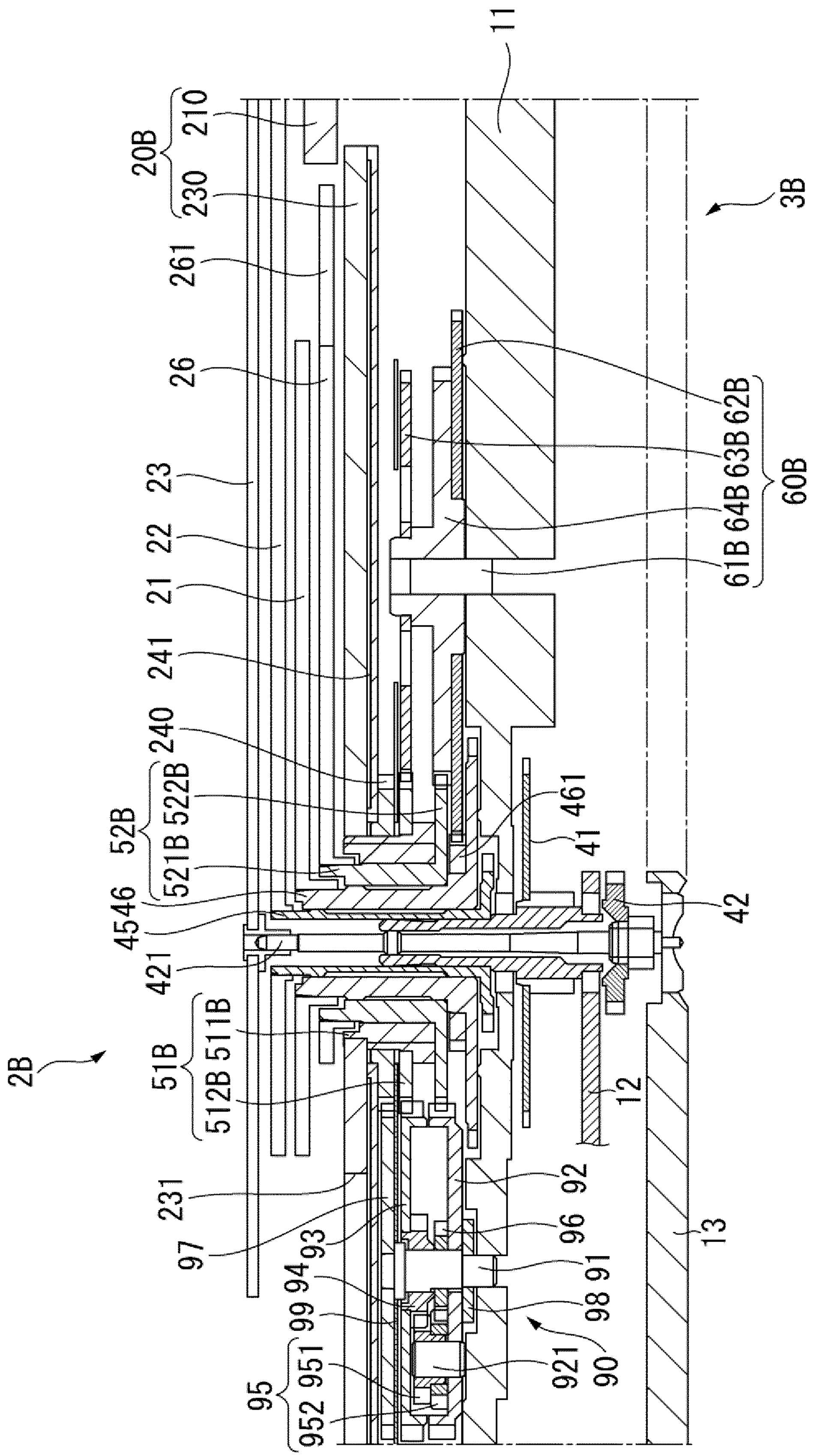


FIG. 8


11
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20B
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3B
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62B
63B
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64B
61B
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52B
522B
521B
461
41
4546
42
421
51B
511B
2B
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FIG. 9

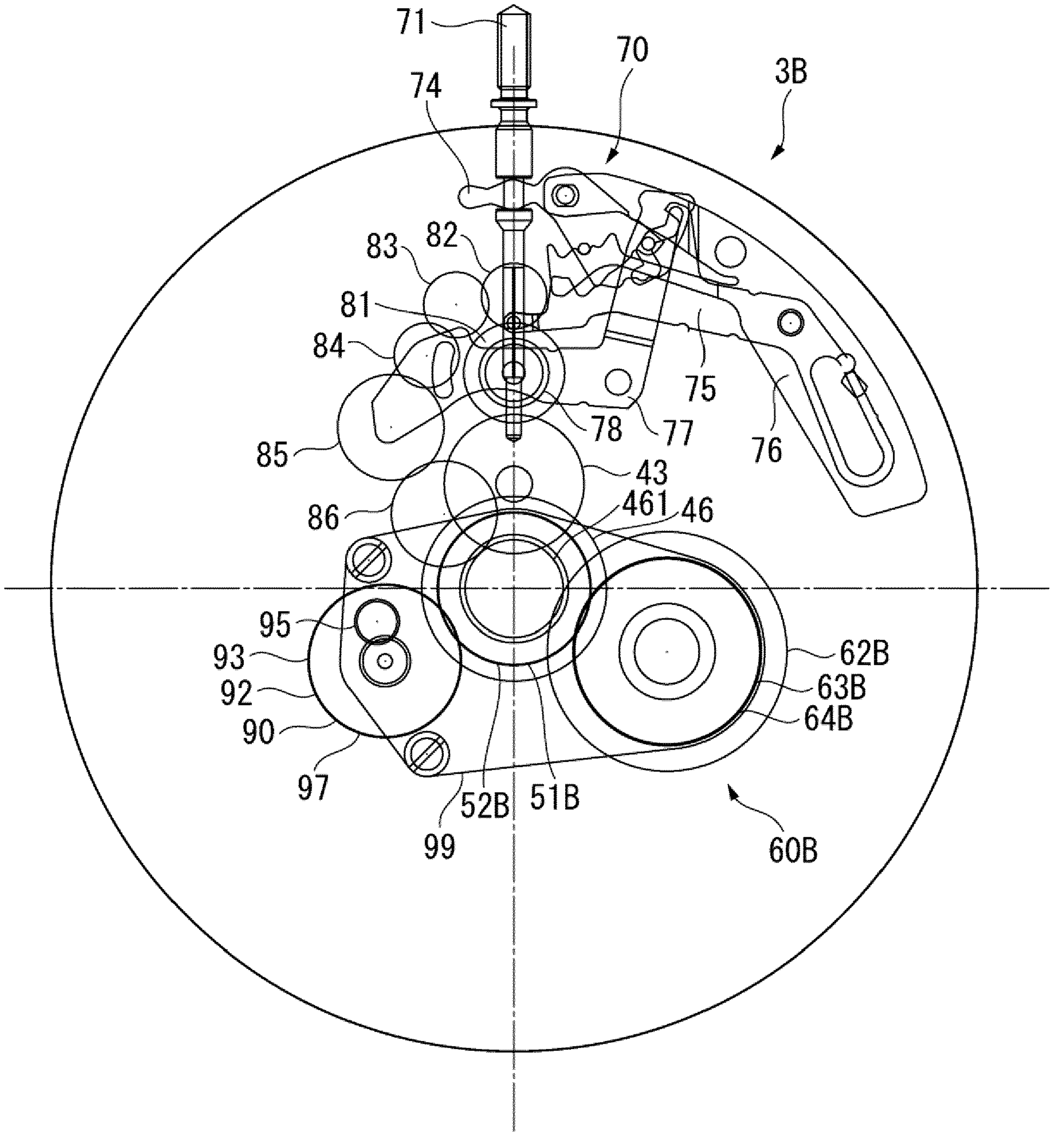
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FIG. 10

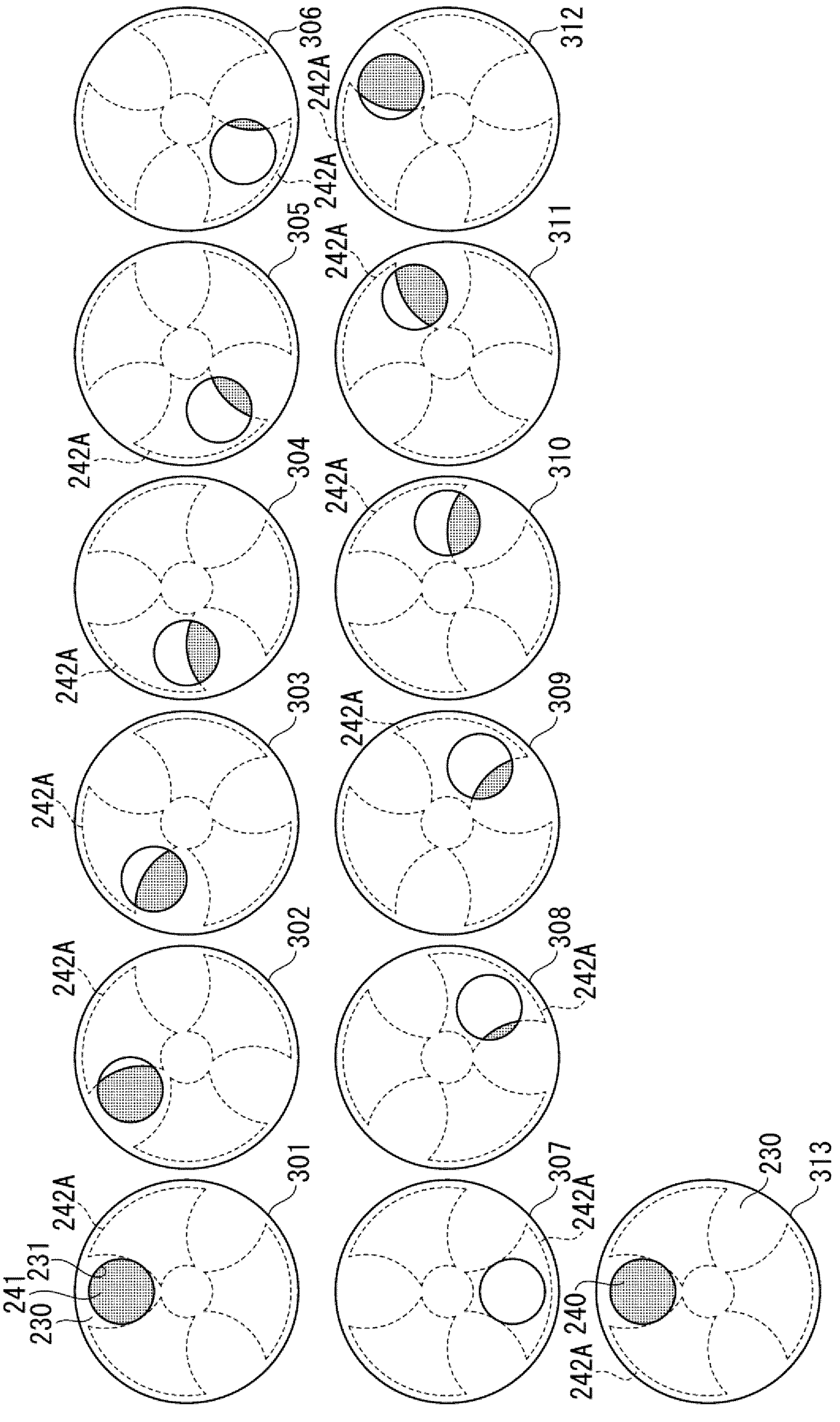
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FIG. 11

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European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 6724

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 A	EP 3 267 267 A1 (BLANCPAIN SA [CH]) 10 January 2018 (2018-01-10) * paragraphs [0032] - [0035]; figure 2 *	1-4,9 5-8	INV. G04B19/26
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Place of search	Date of completion of the search	Examiner
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