

PATENT SPECIFICATION

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(54) TIMEPIECE

(71) We, KABUSHIKI KAISHA SEIKOSHA, SEIKO KOKI KABUSHIKI KAISHA and KABUSHIKI KAISHA SUWA SEIKOSHA, all Japanese Companies of 5,2-chome, Kyobashi, Chuo-ku, Tokyo, Japan; 3-1, 4-chome, Ginza, Chuo-ku, Tokyo, Japan and 3-4, 4-chome, Ginza, Chuo-ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention concerns a timepiece.

In conventional timepieces, the case for protecting the internal mechanism or timepiece movement of the timepiece and places for housing and supporting parts of the timepiece movement were constituted by separate members which inevitably made the size of the timepiece unnecessarily large and increased the number of parts employed.

According to the present invention there is provided a timepiece comprising two plate members which are joined together to form a case, and a timepiece movement which is mounted within the case, each of the plate members having integral support portions which face each other and which act as bearings for a rotatable part or parts of the timepiece movement.

The present invention thus provides a timepiece in which the said plates both serve as a case, which is their primary function, and also support parts of the movement, thereby reducing the number of parts, and so permitting simplification of the movement and a reduction in size, and particularly a reduction in thickness of the timepiece as a whole.

Preferably, the plate members are U-shaped in cross-section and respectively have mutually engaged resilient integral parts. Thus the mutually engaged resilient integral parts may be tapered to take up looseness therebetween.

Preferably, at least one part of the timepiece movement is held in position by

support portions of said plate members and said part spaces the plate members apart. 50

The timepiece movement may be provided with an electric motor. Thus the last-mentioned part may be a bobbin on which is wound a coil of the electric motor. 55

The electric motor may drive timepiece hands by way of a gear train, manually operable means being provided for adjusting the timepiece hands, the gear train comprising frictionally engaging parts which transmit the drive of the electric motor to the timepiece hands but which do not transmit drive from the manually operable means back to the electric motor. Preferably, the frictionally engaging parts comprise a shaft of a gear of the gear train, and resilient projecting members which project from said gear and are disposed on opposite sides of said shaft. 60

One of the support portions may have a tubular portion which surrounds and is disposed adjacent to a rotor shaft of the electric motor to limit tilting of the latter with respect to the respective plate member. 65

The invention is illustrated, merely by way of example, in the accompanying drawings, in which:— 75

Figure 1 is a plan view of a first embodiment of a timepiece according to the present invention with a plate thereof removed. 80

Figure 2 is a sectional view of the structure shown in Figure 1, 85

Figure 3 is an enlarged perspective view of a part of the structure shown in Figure 2, 90

Figure 4 is a broken-away sectional view of part of a second embodiment of a timepiece according to the present invention, 95

Figure 5 is a sectional view of a case forming part of a third embodiment of a timepiece according to the present invention, 100

Figure 6 is a broken-away sectional view on a larger scale of a part of the structure shown in Figure 5, and 105

Figure 7 is a diagrammatic drawing

showing a modified stator which may be used in a timepiece according to the present invention.

Terms such as "upper" and "lower" as used in the description below, are to be understood to refer to directions as seen in the accompanying drawings.

Referring first to Figures 1 and 2 of the drawings, a timepiece according to the present invention has plates 1, 2 which have integrally moulded therewith support portions which, as more fully described below, are adapted to act as bearings for the gear train and other parts of the timepiece movement. The plates 1, 2 are U-shaped in cross-section and are respectively provided at their sides with integral mutually engaging resilient parts 3a, 3b of a joint 3 such that the plates 1, 2 together constitute a case. The mutually engaging resilient parts 3a, and 3b are formed with tapered portions which take up looseness at the joint 3 when the plates 1, 2 are joined together. The plates 1, 2 may be made of a synthetic resin material, such for example as a polycarbonate resin, e.g. a fluorine-containing polycarbonate resin, a glass fibre-reinforced polyester resin, or a denatured polyphenylene oxide resin, or may be made of a metal material such as for example diecast aluminium. However these materials may be substituted by any other material which can provide sufficient mechanical strength for use as the plates 1, 2 and which can provide satisfactory friction and wear resistance when used as bearings.

A coil 4 of an electric motor is wound on a bobbin 5 which is mounted on a stator 6 of the electric motor. The stator 6 may be formed integrally by press-cutting a plate of a magnetic material, such as a silicone steel plate, into a U-shaped element. The stator 6 is designed not only to act as the stator of the electric motor, which is its primary function, but also to serve as a middle plate for the timepiece movement, the said middle plate being disposed parallel to the plates 1, 2. The bobbin 5 is inserted from an end of the stator 6 against projections 6a formed on the stator 6. As shown in Figure 2, one end of the bobbin 5 is secured in place by the projections 6a. Although the stator 6 is formed from a single sheet of plate in the embodiment of Figures 1 and 2, it may be made from separate laminated member S₁, S₂ as shown in Figure 7. As shown in Figure 2, opposite ends of the bobbin 5 are held in position by inwardly projecting support portions a formed integrally on the plates 1, 2 whereby the ends of the bobbin 5 also serve as spacers between the plates 1, 2.

A support plate 5a, which extends outwardly integrally from one end of the

bobbin 5, is formed with a printed or other circuit carrying various circuit parts such as a quartz oscillator, an integrated circuit, and a trimmer condenser. In order to provide such a circuit on the support plate 5a, a printed circuit board, already provided with the necessary circuit parts, may be bonded to the support plate 5a.

The electric motor has a rotor 7 which drives a centre wheel 8 which itself drives a second wheel 9, the latter driving a minute wheel 11 by way of intermediate wheel 10. The minute wheel 11 drives an hour wheel 13 via an intermediate wheel 12. The second wheel 9, of the gear train constituted by the parts 8-13, is fixed on a shaft or arbor 14. The second wheel arbor 14 is mounted concentrically within a tubular member 15 which is formed integrally with the minute wheel 11. The tubular member 15 is mounted concentrically within a tubular member 16 which is formed integrally with the hour wheel 13. A manually operable hand setting knob 17 is formed integrally with a hand setting pinion 18 which meshes with the intermediate wheel 12. In this embodiment, all the parts of the mechanism, except for the electric motor, the electrical parts and the second wheel arbor 14, are made of a synthetic resin material.

The arrangement of the intermediate wheel 10 of the said gear train is now described in further detail with particular reference to Figure 3. The intermediate wheel 10 is provided with a shaft 10b on which an intermediate pinion 10a is formed integrally, the intermediate wheel 10 also being provided with an intermediate gear 10c. The pinion 10a meshes with the minute wheel 11. On the back side of the intermediate gear 10c there are symmetrically provided a pair of resilient bridge-like projecting members 10d, 10d. The resilient projecting members 10d, 10d are spaced from each other by a distance which is slightly smaller than the outer diameter of the intermediate wheel shaft 10b so that the sides of the resilient projecting members 10d, 10d which face each other are pressed elastically against the corresponding sides of the shaft 10b at a predetermined slip torque. Accordingly, during the normal hand movement produced by the electric motor, the intermediate gear 10c and the shaft 10b are turned in unison by the frictional force developed therebetween with the result that drive is transmitted from the second wheel 9 to the minute wheel 11, and thus is transmitted from the electric motor to the timepiece hands. However, when the hands are turned manually by the hand setting knob 17, the transmission between the gear 10c and the shaft 10b is cut off so that no

drive is transmitted from the minute wheel 11 back to the second wheel 9 to the electric motor. The portions of the resilient projecting members 10d which contact the shaft 10b may be arcuate. The slip torque is determined by the size (length, thickness and width) of each said resilient projecting member 10d, the outer diameter of the shaft 10b, and the distance between the adjacent sides of the resilient projecting members 10d which face each other, and hence the configurations of these parts are designed in accordance with the manner in which they are intended to operate. At the top end of the shaft 10b, there is formed an enlarged portion 10e which engages between intermediate wheel 10 and the resilient projecting members 10d to prevent accidental removal of the shaft 10b.

The gears of the gear train 8—13 are supported, directly or indirectly by the plates 1, 2 or by a part of the stator 6. The said gears are provided with washers (not shown) which permit the gears to be easily introduced into position, for example, by using an automatic assembling device, but which thereafter prevent the gears from becoming displaced.

The plates 1, 2 are formed integrally with support portions 19, 20 which support the shaft 7a of the rotor 7 so that the shaft 7a is perpendicular to the plates 1, 2. The support portion 20 is provided with a bearing portion 20a in which is rotatably mounted the lower end portion of the rotor shaft 7a, and with an outwardly extending tubular guide part 20b which is integral with the bearing portion 20a and which is axially spaced from the latter. The tubular guide part 20b surrounds and is disposed adjacent to the shaft 7a of the rotor 7 so that, when the lower end of the rotor shaft 7a has been introduced into the bearing portion 20a and the rotor shaft 7a is otherwise unsupported, the tubular guide part 20b limits tilting of the rotor shaft 7a with respect to the plate 2. Thus the tubular portion 20b is so designed that it can hold the rotor 7 in a substantially fixed position by its inner peripheral edge even when the plate 1 is not yet fixed in position. It also acts to keep the rotor 7 apart from the stator 6 when the rotor 7 has tilted to the limit permitted by the tubular portion 20b. Moreover, the tubular guide part 20b is provided internally with a tapered portion 20c which guides the lower end of the rotor shaft 7a into the bearing portion 20a during assembly thereof. This arrangement permits the plate 1 to be easily fitted into position, since the tubular portion 20b maintains a certain posture of the rotor after the latter has been mounted in the support portion 20 and right up to the time that the plate 1 is fully fixed in position as a result of the automatic assembling

operation. The other support portion 19 is provided with a bearing portion 19a, in which the upper end of the rotor shaft 7a is rotatably mounted; and with a convex outwardly extending guide part 19b moulded integrally therewith, the guide part 19b being constituted by a tapered recess which leads to the bearing portion 19a. The guide part 19b is designed to guide the upper end of the rotor shaft 7a smoothly into the bearing portion 19a during assembly even if the rotor shaft 7a should be slightly tilted during mounting of the plate 1.

The plate 1 is also provided with integral support portions 21, 22 and 23 for rotatably supporting one end of the shaft of the centre wheel 8, one end of the second wheel arbor 14 and one end of the shaft 10b of the intermediate wheel 10 respectively. The support portions 21—23 are substantially of the same construction as the support portion 19, and each of the support portions 21—23 respectively comprises a bearing portion 21a, 22a, 23a and a guide part 21b, 22b, 23b, which are all identical with those already described. The other end of the shaft of the centre wheel 8 is supported by a synthetic resin bearing bush 24 which is press-fitted into the stator 6.

The shaft of the centre wheel 8 may be supported directly by the stator 6 without the medium of the bearing bush 24, although, in the latter case, it is desirable, for obtaining better lubricating properties, to form an oil groove (not shown) in the stator 6 or to make the stator from a metal impregnated with oil. The lower end face of the second wheel 9 is supported by a spring washer 25, and the second wheel arbor 14 is resiliently pressed against the support portion 22 with appropriate pressure by the resilient force of the spring washer 25 to prevent oscillation of the seconds hand (not shown). The upper end of the minute wheel 11 is supported in an aperture 26 formed in the stator 6.

A support portion 27 of the plate 2, which supports the lower end of the shaft 10b of the intermediate wheel 10, is substantially of the same construction as the support portion 23, but the shaft 10b of the intermediate wheel 10 extends through an aperture 28 of the stator 6 so as to be supported against tilting after it has been mounted in the support portion 27 and at a time when the plate 1 has not yet been set in place.

The intermediate wheel 12 is rotatably supported by a stem-like support portion 29 formed integral with and projecting from the plate 2. The intermediate wheel 12 is secured against removal by the lower end face of the stator 6 once the latter has been

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set in its position. The stem-like support portion 29 also serves for positioning the stator 6.

5 A support portion 30 of the plate 2 is provided for rotatably supporting the hand setting pinion 18. The support portion 30 comprises a bearing portion 30a adapted to support the shaft 18a of the pinion 18, an open guide part 30b formed integrally with
10 the bearing portion 30a, and a protuberance 30c having a flat top surface. The underside of the hand setting pinion 18 is adapted to be supported by the flat top surface of the protuberance 30c so that the hand setting pinion 18 will not topple over
15 before the plate 1 is mounted in position. When the plate 1 is set in place, the hand setting pinion 18 has a shaft portion 17a thereof supported in an aperture portion 31 of the plate 1, the apertured portion 31 forming a curved recess.

20 The stator 6 is supported by support members 32, 33 and 34 (Figure 1) and by the stem-like support portion 29. The support members 32 and 33 are of the same construction, and as shown in Figure 2, a small projection 35a from a frusto-conical support post 35 formed integral with the plate 2 projects into a hole 36 formed in the
25 stator 6 and into a hole 37a formed in another frusto-conical support post 37 projecting from the plate 1. The stator 6 is thus supported vertically by the support posts 35 and 37, which are disposed on opposite sides of it. The support member 34 is merely formed by support posts (not shown) projecting from the plates 1 and 2. The support posts 35 and 37, however,
30 function both as fixing means for the stator 6 and also as spacers between the plates 1 and 2.

35 The plate 2 has also formed integrally therewith a housing 39 for a battery 38, a positive (+) connection terminal 40 and a negative (-) connection terminal 41 being provided at opposite ends of the battery 38. Extending from an end of the positive connection terminal 40 is a strip-shaped bent tongue 40a which is welded at its end
40 remote from the terminal 40 to a power supply terminal of the circuit pattern on the support plate 5a. On the other hand, an end portion 41a of the negative connection terminal 41 extends along the external wall of the housing 39 and is bent at a suitable
45 part and welded at its end to a power supply terminal on the support plate 5a.

50 The distance between the upper side of the plate 1 and the lower side of the plate 2, in one example of the present invention, is 17 mm. This represents an extremely small thickness for a timepiece including a case. Such a small thickness is achieved in the case of the present invention by virtue of
55 the fact that the plates 1, 2 serve as a case

and by virtue of the stator 6 also acting as a plate.

In operation, when the rotor 7 is driven by the driving output of the quartz oscillator, the second wheel 9 is turned, through the medium of the centre wheel 8, so as to make one full rotation in one minute, while the minute wheel 11 is turned, through the medium of the intermediate wheel 10, so as to make one full rotation in one hour. Similarly, the hour wheel 13 is turned through the medium of the intermediate wheel 12, to make one full rotation in 12 hours.

70 When it is desired to correct the position of the hands, the hand setting knob 17 is merely turned manually, whereby the intermediate wheel 12 is turned through the medium of the setting pinion 18. This causes corresponding rotation of the minute wheel 11 and hour wheel 13 to effect the desired correction of the hands. In this case, the intermediate pinion 10a and the integral intermediate wheel shaft 10b, which are shown in Figure 3, are turned so as to effect turning of the minute wheel 11, but the resilient projecting portions 10d of the intermediate gear 10 and the shaft 10b slip relative to each other at their frictional contact faces and hence the hand turning motion is not transmitted to the other part of the gear train.

80 As shown in Figure 4, a small annular protruberance 37b may be formed on support post 37 at the end of hole 37a for holding and fixing the stator 6, a corresponding annular recess 35b being formed in the corresponding support post 35 such that the annular protruberance 37b fits into the corresponding recess 35b. This arrangement can prevent the plates 1, 2 from moving away from one another, thus reducing the risk that gears of the said gear train may be forced out of engagement with the associated support portions by shock or other external impact.

85 Figures 5 and 6 show another means of joining the plates 1 and 2 together. In the construction of Figures 5 and 6, posts 42 are provided at suitable locations on one of the plates, for example the plate 2 as shown, so that said posts reach the underside of the other plate, e.g. the plate 1 as shown. Each of the posts 42 is formed at its top end with a protruberance 45 having a hook portion 43. Each protruberance 45 is deformable diametrically by reason of being split by a groove 44, and each said protruberance 45 is fitted in a corresponding hole 46 formed in the base plate 1 so as to join the two plates 1 and 2 together. This method permits secure joining of the two plates 1, 2 while preventing their moving away from one another.

Thus, according to the present invention, as the plates 1, 2 are adapted not only to perform their primary function of supporting the parts of the movement but also to serve as a case, it is possible to decrease the number of parts employed, to simplify the mechanism, and to reduce the thickness *l* (Figure 2) of the timepiece. In order to obtain a dust-proof effect, it is desirable to arrange that the support portions which act as bearings have openings which extend only towards the other plate.

If the stator and other parts are held in place by the support posts which face each other and are disposed on the inner sides of the two plates, it is possible to fix the stator and the other parts and to vertically position the plates at the same time. If the distance between the two plates is regulated by at least one of the parts of the movement, it is possible to maintain the space between the plates constant without any need to provide any extra spacer means. Moreover, since there is a certain amount of tolerance in the inter-engaging parts of the plates 1, 2 it may be arranged that means are used to prevent any looseness between the joined plates 1, 2 in the direction of their thickness whereby secure support of the gear train is provided.

Attention is directed to the claims of our co-pending British Patent Application No. 20888/76, (Serial no. 1,528,536) and of our co-pending British Patent Application No. 21180/76, (Serial No. 1,528,537).

WHAT WE CLAIM IS:—

1. A timepiece comprising two plate members which are joined together to form a case, and a timepiece movement which is mounted within the case, each of the plate members having integral support portions which face each other and which act as bearings for a rotatable part or parts of the timepiece movement.

2. A timepiece as claimed in Claim 1 in which the plate members are U-shaped in cross-section and respectively have mutually engaged resilient integral parts.

3. A timepiece as claimed in Claim 2 in which the mutually engaged resilient

integral parts are tapered to take up looseness therebetween.

4. A timepiece as claimed in any preceding Claim in which at least one part of the timepiece movement is held in position by support portions of said plate members and said part spaces the plate members apart.

5. A timepiece as claimed in any preceding Claim in which the timepiece movement is provided with an electric motor.

6. A timepiece as claimed in Claim 4 and in Claim 5 in which the last-mentioned part is a bobbin on which is wound a coil of the electric motor.

7. A timepiece as claimed in any of Claims 5 and 6 in which the electric motor drives timepiece hands by way of a gear train, manually operable means being provided for adjusting the timepiece hands, the gear train comprising frictionally engaging parts which transmit the drive of the electric motor to the timepiece hands but which do not transmit drive from the manually operable means back to the electric motor.

8. A timepiece as claimed in Claim 7 in which the frictionally engaging parts comprise a shaft of a gear of the gear train, and resilient projecting members which project from said gear and are disposed on opposite sides of said shaft.

9. A timepiece as claimed in any of Claims 5 to 8 in which one of the support portions has a tubular portion which surrounds and is disposed adjacent to a rotor shaft of the electric motor to limit tilting of the latter with respect to the respective plate member.

10. A timepiece as claimed in Claim 1 and substantially as hereinbefore described with reference to and as shown in Figures 1 to 3 or in Figure 4, or in Figures 5 and 6 of the accompanying drawings.

J. MILLER & CO.,
Agents for the Applicants,
Chartered Patent Agents,
Lincoln House,
296—302, High Holborn,
London, WC1V 7JH.

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Thus, according to the present invention, as the plates 1, 2 are adapted not only to perform their primary function of supporting the parts of the movement but also to serve as a case, it is possible to decrease the number of parts employed, to simplify the mechanism, and to reduce the thickness 1 (Figure 2) of the timepiece. In order to obtain a dust-proof effect, it is desirable to arrange that the support portions which act as bearings have openings which extend only towards the other plate.

If the stator and other parts are held in place by the support posts which face each other and are disposed on the inner sides of the two plates, it is possible to fix the stator and the other parts and to vertically position the plates at the same time. If the distance between the two plates is regulated by at least one of the parts of the movement, it is possible to maintain the space between the plates constant without any need to provide any extra spacer means. Moreover, since there is a certain amount of tolerance in the inter-engaging parts of the plates 1, 2 it may be arranged that means are used to prevent any looseness between the joined plates 1, 2 in the direction of their thickness whereby secure support of the gear train is provided.

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J. MILLER & CO.,
Agents for the Applicants,
Chartered Patent Agents,
Lincoln House,
296—302, High Holborn,
London, WC1V 7JH.



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