

PATENT SPECIFICATION

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(54) BEARING ARRANGEMENT

(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, respectively, 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 bearing arrangement and, although the invention is not so restricted, it is more particularly concerned with a bearing arrangement for use in a timepiece.

The accurate mounting of a shaft in a bearing has previously required considerable skill and could not be readily performed automatically.

According to the present invention, there is provided a bearing arrangement comprising a case, and a shaft which is disposed within the case and which is perpendicular to a wall of the case, one end of the shaft being rotatably mounted in an integrally formed bearing portion of said wall, the wall having an integrally formed guide part for guiding the said one end of the shaft into the bearing portion during assembly of the shaft in the bearing portion, the guide part projecting from said wall and inwardly of the case.

The guide part may be tubular and may surround a part of said shaft so that, when the said one end of the shaft has been introduced into the bearing portion and the shaft is otherwise unsupported, the tubular guide part limits tilting of the shaft with respect to the wall.

Preferably, the first-mentioned wall is disposed parallel to a second wall of the case which is provided with a bearing portion in which the opposite end of the shaft is rotatably mounted.

The said second wall may have a projecting guide part for guiding the said opposite end of the shaft into the last-mentioned bearing portion during assembly of the shaft in the latter.

The last-mentioned guide part may be constituted by a tapered recess in the said second wall, the said tapered recess leading to the said bearing portion of the second wall.

In addition to the first-mentioned shaft there may be at least one further shaft which is rotatably mounted in a said bearing portion or portions, the or each wall having a respective guide part for each said bearing portion.

The shaft, or one of the shafts, may be a rotor shaft of an electric motor. Thus the electric motor may drive a gear train at least one of the gears of which is carried by a said shaft. Moreover, the gear train may drive time-indicating means.

The invention also comprises a timepiece provided with a bearing arrangement as set forth above.

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

Figure 1 is a plan view of a timepiece provided with a bearing arrangement according to the present invention with a wall thereof removed, and

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

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 provided with a bearing arrangement according to the present invention has parallel, spaced apart walls 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 part of the timepiece movement. The walls 1, 2 are U-shaped in cross-section and are

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respectively provided at their sides with integral mutually engaging resilient parts 3a, 3b of a joint 3 such that the walls 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 walls 1, 2 are joined together. The walls 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 walls 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 centre plate for the timepiece movement, the said centre plate being disposed parallel to the walls 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 shown in the drawings, it may be made from separate laminated members of the same configuration. 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 walls 1, 2 whereby the ends of the bobbin 5 also serve as spacers between the walls 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 part 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.

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 the intermediate wheel 10 and the resilient

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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 walls 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 walls 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 walls 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 wall 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 wall 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 wall 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 an "oil-less" metal, i.e. a metal containing particles of lubricant. 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 wall 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 wall 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 wall 2. The intermediate wheel 12 is secured against removal by the lower end face of the stator 6 once the latter has been set in its position. The stem-like support portion 29 also serves for positioning the stator 6.

A support portion 30 of the wall 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 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 before the wall 1 is mounted in position.

When the wall 1 is set in place, the hand setting pinion 18 has a shaft portion 17a thereof supported in an apertured portion 31 of the wall 1, the apertured portion 31 forming a curved recess.

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 wall 2 projects into a hole 36 formed in the 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 walls 1 and 2. The support posts 35 and 37, however, function both as fixing means for the stator 6 and also as spacers between the walls 1 and 2.

The wall 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 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 part and welded at its end to a power supply terminal on the support plate 5a.

The distance *l* between the upper side of the wall 1 and the lower side of the wall 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 embodiment by virtue of the fact that the walls 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.

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 are turned so as to effect turning of the minute wheel 11, but the resilient projecting portions 10d of the intermediate gear 10c 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.

Thus, in the arrangement shown in the drawings the rotor shaft 7a is supported substantially perpendicularly to the walls 1, 2, the provision of the guide parts 19b, 20b ensuring that, even if the rotor shaft 7a should be slightly tilted when being assembled, it can be properly and smoothly guided to fit accurately into the respective bearing portions 19a, 20a. This arrangement is extremely useful in the automatic assembly of timepieces, and permits such assembly to be effected with ease and high reliability.

Attention is directed to the claims of our co-pending British Patent Application No. 20887/76 (Serial No. 1,528,535) and of our co-pending British Patent Application No. 20888/76 (Serial No. 1,528,536).

WHAT WE CLAIM IS:—

1. A bearing arrangement comprising a case, and a shaft which is disposed within the case and which is perpendicular to a wall of the case, one end of the shaft being rotatably mounted in an integrally formed bearing portion of said wall, the wall having an integrally formed guide part for guiding the said one end of the shaft into the bearing portion during assembly of the shaft in the bearing portion, the guide part projecting from said wall and inwardly of the case.

2. A bearing arrangement as claimed in Claim 1 in which the guide part is tubular and surrounds a part of said shaft so that, when the said one end of the shaft has been introduced into the bearing portion and the shaft is otherwise unsupported, the tubular guide part limits tilting of the shaft with respect to the wall.

3. A bearing arrangement as claimed in Claim 1 or 2 in which the first-mentioned wall is disposed parallel to a second wall of the case which is provided with a bearing portion in which the opposite end of the shaft is rotatably mounted.

4. A bearing arrangement as claimed in Claim 3 in which the said second wall has a projecting guide part for guiding the said

When the wall 1 is set in place, the hand setting pinion 18 has a shaft portion 17a thereof supported in an apertured portion 31 of the wall 1, the apertured portion 31 forming a curved recess.

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 wall 2 projects into a hole 36 formed in the 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 walls 1 and 2. The support posts 35 and 37, however, function both as fixing means for the stator 6 and also as spacers between the walls 1 and 2.

The wall 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 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 part and welded at its end to a power supply terminal on the support plate 5a.

The distance *l* between the upper side of the wall 1 and the lower side of the wall 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 embodiment by virtue of the fact that the walls 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.

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 are turned so as to effect turning of the minute wheel 11, but the resilient projecting portions 10d of the intermediate gear 10c 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.

Thus, in the arrangement shown in the drawings the rotor shaft 7a is supported substantially perpendicularly to the walls 1, 2, the provision of the guide parts 19b, 20b ensuring that, even if the rotor shaft 7a should be slightly tilted when being assembled, it can be properly and smoothly guided to fit accurately into the respective bearing portions 19a, 20a. This arrangement is extremely useful in the automatic assembly of timepieces, and permits such assembly to be effected with ease and high reliability.

Attention is directed to the claims of our co-pending British Patent Application No. 20887/76 (Serial No. 1,528,535) and of our co-pending British Patent Application No. 20888/76 (Serial No. 1,528,536).

WHAT WE CLAIM IS:—

1. A bearing arrangement comprising a case, and a shaft which is disposed within the case and which is perpendicular to a wall of the case, one end of the shaft being rotatably mounted in an integrally formed bearing portion of said wall, the wall having an integrally formed guide part for guiding the said one end of the shaft into the bearing portion during assembly of the shaft in the bearing portion, the guide part projecting from said wall and inwardly of the case.

2. A bearing arrangement as claimed in Claim 1 in which the guide part is tubular and surrounds a part of said shaft so that, when the said one end of the shaft has been introduced into the bearing portion and the shaft is otherwise unsupported, the tubular guide part limits tilting of the shaft with respect to the wall.

3. A bearing arrangement as claimed in Claim 1 or 2 in which the first-mentioned wall is disposed parallel to a second wall of the case which is provided with a bearing portion in which the opposite end of the shaft is rotatably mounted.

4. A bearing arrangement as claimed in Claim 3 in which the said second wall has a projecting guide part for guiding the said



opposite end of the shaft into the last-mentioned bearing portion during assembly of the shaft in the latter.

8. A bearing arrangement as claimed in Claim 7 in which the electric motor drives a gear train at least one of the gears of which is carried by a said shaft.

9. A bearing arrangement as claimed in Claim 8 in which the gear train drives a time-indicating means.

10. A bearing arrangement as claimed in Claim 1 and substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

11. A timepiece provided with a bearing arrangement as claimed in any preceding claim.

5 5. A bearing arrangement as claimed in Claim 4 in which the last-mentioned guide part is constituted by a tapered recess in the said second wall, the said tapered recess leading to the said bearing portion of the second wall.

10 6. A bearing arrangement as claimed in any preceding claim in which, in addition to the first-mentioned shaft, there is at least one further shaft which is rotatably mounted in a said bearing portion or portions, the or each wall having a respective guide part for each said bearing portion.

15 7. A bearing arrangement as claimed in any preceding claim in which the shaft, or one of the shafts, is the rotor shaft of an electric motor.

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

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