

PATENT SPECIFICATION

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DRAWINGS ATTACHED

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(54) WATCH BALANCE WHEEL ASSEMBLY

- (71) We, TIMEX CORPORATION, a Corporation organised under the laws of the State of Delaware, United States of America, of Waterbury 20, Connecticut, United States of America, 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:—
- 10 The present invention relates to horology and more particularly to the construction of a balance wheel assembly for a watch.
- The timekeeping ability of a horological instrument is dependent upon the accuracy of its frequency regulating element, which in the case of a watch is its balance wheel. The balance wheel must satisfy many requirements. As small watches are thought desirable, the balance wheel should be as small as possible consistent with good timekeeping. The balance wheel must be shaped so that it can be poised, i.e., exactly balanced, for example, by removal of metal. The balance wheel should not greatly add to the cost of the watch and should not be influenced by magnetic fields and by changes in temperature.
- 25 The problem of constructing a satisfactory balance wheel is particularly acute in electronic or electric watches in which a small electric coil is carried by the balance wheel. In such a watch the coil is used, in effect, as the moving member of a motor and converts the electrical energy from a battery cell into oscillatory motion used to drive the gear train and hands of the watch. The coil interacts with the field, or fields, of one or more permanent magnets, or electromagnets, fixed on a plate of the watch. The interaction of the coil and the magnetic field maintains the oscillation, i.e. it forms the drive of the balance wheel. A suitable magnetic arrangement and electronic circuit is described in United States Patent No. 3,046,460. An electric watch generally utilizes a spring which makes contact with a pin on the balance wheel to bring current to the coil. The other contact of the coil is made through the hairsprings to conduct current to and from the coil.
- 50 It has been found advantageous to utilize only one coil carried by the balance wheel, instead of two or more coils. One coil is less costly to wind than a plurality of coils, and requires fewer magnets. However, the single coil may present a difficult problem in regard to the construction of the balance wheel assembly. If the coil is held by metal arms, eddy currents may be induced in the arms by the magnets. Eddy currents are electric currents induced in metal when it passes through a magnetic field. The current establishes a field opposed to the field of the magnet. Eddy currents act as a drag on the balance wheel and are wasteful of power, which is precious in battery driven watches. The use of a single coil on the balance wheel causes an appreciable amount of mass to be concentrated on the side of the balance wheel carrying the coil. The weight of the balance wheel must be evenly distributed, so that a counter-weight or other means must be used to balance the coil. Such a counter-weight may give rise to eddy current or to problems of manufacture.
- 75 It is an objective of the present invention to provide a balance wheel assembly useful for an electric or electronic watch, which reduces undesirable eddy current effects, which may be readily poised and which may be mass-produced at relatively low cost.
- 80 In accordance with the present invention, there is provided a balance wheel assembly for an electric or an electronic watch, comprising a balance wheel of metal consisting of a rim having a widened portion and a spoke fixed to or integral with said widened portion and directed inwardly of said rim, a plastics carrier member fixed to said spoke inwardly of said rim, and an electric coil fixed to and carried by carrier member, said spoke and said carrier member having a hole therethrough suitable to receive a balance wheel staff and said coil and said widened portion of said rim being respectively on opposite sides of said hole.

[Price 25p]

The balance wheel assembly of the present invention may be utilised in either a contact electric watch or in an electronic watch, for example, utilizing a solid-state circuit. In one convenient form, the balance wheel assembly is constructed with a metal or plastics staff and with a solid metal, non-magnetic wheel rim. The metal rim provides desirable counter-balancing mass at the furthest point from the staff. Preferably only a single spoke of metal is used, which reduces undesirable eddy currents and which provides some protection against the effect of shocks. A flat coil, wound of fine wire, preferably in a round annular shape when viewed in top plan view, is carried on the plastics carrier member. The plastics carrier member is light in weight, which is desirably near the staff, and does not exhibit eddy current effects. The plastics carrier member may also act, in effect, as another spoke to steady the rim.

Features of the present invention will be more fully apparent from the following detailed description, given by way of example, of preferred embodiments thereof and made with reference to the accompanying drawings, in which:—

Fig. 1 is a perspective exploded view of the balance wheel assembly of a first embodiment of the present invention, showing the wheel rim partly broken away;

Fig. 2 is a top plan view of a second embodiment of a balance wheel assembly according to the present invention;

Fig. 3 is a side view taken along line 2—2 of Fig. 2 in the direction of the arrows;

Fig. 4 is a cross-sectioned enlarged perspective view of a portion of the assembly of Fig. 3;

Fig. 5 is a top plan view of a third embodiment of the balance wheel assembly of the present invention;

Fig. 6 is a side view taken along line 5—5 of Fig. 5; and

Fig. 7 is a top plan view of a fourth embodiment of the present invention.

The balance wheel assembly of Fig. 1 includes a balance wheel having an annular rim 10 formed of a non-magnetic metal such as brass. A widened portion 11 of the rim, which is integral with it, is provided to counter-balance the coil and poise the balance wheel. The portion 11 provides an area from which metal may be removed, for example, by forming small drilled cavities, in order to poise the balance wheel. A wheel spoke 12 is integral with the widened portion 11 and directed from it toward the centre of the wheel. The spoke 12, near its free end, has a hole 13 adapted to receive the balance wheel staff (not shown). The balance wheel rim 10, with its widened portion 11 and spoke 12, is stamped from a sheet of non-magnetizable metal, such as brass.

A plastics member 14 is secured on the

free end of the spoke 12, for example, by an epoxy adhesive or by injecting the plastics about the end of the spoke. The plastics member is preferably moulded from a plastic which: (1) may be precisely moulded otherwise formed, (2) is not adversely affected by moisture, (3) is dimensionally stable under temperature changes, (4) may be cast in thin-wall constructions, (5) is not adversely affected by aging, and (6) may be adhered using available adhesives such as epoxy formulations. A suitable plastic resin is "Duroplast", which is formed by both injection moulding or press pressure. "Duroplast" is a thermo-setting plastic; other suitable plastics are for example "Bakelite", Buton or Epoxy Resin (Alfane-Epiphen). (The word 'Bakelite' is a registered Trade Mark).

The plastics member 14 is an integral, one-piece member and is comprised of a body portion 15, a left arm 16, a right arm 17, and a web 18 joining the left and right arms; a ring 22 is secured to the web 18 in a precisely predetermined position. A drop 19 of epoxy resin is placed on web 18 and a coil 23 is pressed on the adhesive. The ring 22 fits within a hole 23a in the coil 23. A non-conductive D-shaped jewel 20 is press-fitted in the body portion 15 and a metal contact pin 21 is press-fitted in the body portion 15 next to a jewel 20. The diameter of the hole 23a is held to a close and exact tolerance. Consequently, the plastics ring 22, which may be exactly formed, locates the coil with precision, in regard to the balance wheel assembly. The ring 22 permits the positioning of the coil to be accomplished without the use of a jig.

The second embodiment of the present invention is shown in Figs. 2, 3 and 4. The balance wheel 25 includes a rim 26 of non-magnetic metal, such as brass. The rim has an integral widened portion 27 having an integral spoke 28. A plastics member 29 is secured to the free end of the spoke 28. As in conventional electric watches, a hair-spring 30a is secured at its inner end to a hub 30 fixed on the balance wheel staff 31. A round annular coil 32, carried by the plastics member 29, is positioned so that it swings between a fixed magnet 33 adapted to be secured to the frame plate (not shown) of the watch, and a magnetic shunt 34.

The plastics carrier member 29 is shown in detail in Fig. 4. It is an integral member and comprises a body web portion 35 having two ends, a tubular portion 36 positioned on one end and adapted to be inserted in the central hole of the coil 32, and a holding portion 37 for the spoke 28, at the opposite end of the web. The holding portion 37 comprises a first disk 39 having a hole 40 for the balance wheel staff 31, a connecting web 37a and a second disk 41 having a hole 42 for the staff 31.

The embodiments of Figs. 5 to 7 have many parts in common with the embodiment Figs. 2—4. They utilize the balance wheel 2 with its rim 26 and integral widened portion 27 and spoke 28 and the coil 32 with its cooperating magnet 33 and shunt 34.

The balance wheel assembly of Figs. 5 and 6 utilizes an integral plastics coil carrier member 45 having two parallel portions 46 and 47 which encompass and firmly hold the free end of the spoke 28. The parallel portions 46 and 47 have holes 48 and 49 respectively, for the balance wheel staff (not shown), and a connecting web portion 50. The plastics member also has a left arm 51 having extending fingers 52 and 53 and a right arm 54 with similar extending fingers 55 and 56. The coil 32 is adhered, for example, by epoxy adhesive, to the extending fingers which may be only on one side of the coil. Alternatively the fingers may consist of opposite clamping members, that is, each finger would have an opposite finger to clamp the coil between them. The coil is held at its outside periphery. The outer diameter of the coil is less closely controlled as to tolerance than is its inner diameter. Consequently, the plastics arms 51 and 54 are slightly elastic (springy) to encompass coils of slightly different outer diameters.

In the embodiment shown in Fig. 7, the outer fingers 53 and 56 are extended away from the coil to form rim-holding portions 57 and 58 respectively. As shown, the rim may be adhered to the portions 57 and 58, which overlay the rim, by an adhesive such as epoxy adhesive, or the portions 57 and 58 may each consist of opposed fingers which clamp the rim between them.

The contact pin and "D" shaped insulating jewel are not shown in Figs. 2—7, for the purpose of simplicity of illustration, but would be present in these balance wheel assemblies.

The material forming the plastics coil carrier member is not subjected to eddy currents. It permits a desirable reduction in mass near the centre of the balance wheel, the ratio of the weight of plastics to brass being about 7 to 1. However, the strength of plastics may be less than the strength of metal, requiring a thicker balance wheel assembly. Such a thicker balance wheel may be accommodated in a watch, for example, by reduction of the thickness of the magnet or by special shaping of the shunt.

WHAT WE CLAIM IS:—

1. A balance wheel assembly of an electric or an electronic watch, comprising a balance wheel of metal consisting of a rim having

a widened portion and a spoke fixed to or integral with said widened portion and directed inwardly of said rim, a plastics carrier member fixed to said spoke inwardly of said rim, and an electric coil fixed to and carried by said carrier member, said spoke and said carrier member having a hole therethrough suitable to receive a balance wheel staff and said coil and said widened portion of said rim being respectively on opposite sides of said hole.

2. A balance wheel assembly as claimed in claim 1, wherein said plastics carrier member has a body portion with said hole therethrough and two arm portions, and said coil is carried between the two arm portions.

3. A balance wheel assembly as claimed in claim 1, wherein said plastics carrier member has an integral tubular portion and said coil has a hole which fits around said tubular portion.

4. A balance wheel assembly as claimed in claim 1, wherein the balance wheel is of a non-magnetic metal.

5. A balance wheel assembly as claimed in claim 2, wherein the plastics carrier member has an integral plastics web connecting its arms and a plastics ring fixed to the web, and wherein the coil has a hole which fits over the exterior surface of said ring.

6. A balance wheel assembly as claimed in claim 5, wherein the coil is adhered to the web.

7. A balance wheel assembly as claimed in claim 2, wherein the plastics arms have integral extending fingers which are fixed to the outer portion of the coil.

8. A balance wheel assembly as claimed in claim 7, wherein each arm has an additional extending member fixed to the balance wheel rim.

9. A balance wheel assembly as claimed in claim 7, wherein the coil is clamped between clamp members which are formed by the said fingers.

10. A balance wheel assembly as claimed in any one of the preceding claims including a balance wheel staff.

11. A balance wheel assembly substantially as hereinbefore described with reference to Fig. 1, Figs. 2 to 4, Figs. 5 and 6 or Fig. 7 of the accompanying drawings.

12. A watch which incorporates the balance wheel assembly as claimed in any one of the preceding claims.

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The balance wheel assembly of Figs. 5 and 6 utilizes an integral plastics coil carrier member 45 having two parallel portions 46 and 47 which encompass and firmly hold the free end of the spoke 28. The parallel portions 46 and 47 have holes 48 and 49 respectively, for the balance wheel staff (not shown), and a connecting web portion 50. The plastics member also has a left arm 51 having extending fingers 52 and 53 and a right arm 54 with similar extending fingers 55 and 56. The coil 32 is adhered, for example, by epoxy adhesive, to the extending fingers which may be only on one side of the coil. Alternatively the fingers may consist of opposite clamping members, that is, each finger would have an opposite finger to clamp the coil between them. The coil is held at its outside periphery. The outer diameter of the coil is less closely controlled as to tolerance than is its inner diameter. Consequently, the plastics arms 51 and 54 are slightly elastic (springy) to encompass coils of slightly different outer diameters.

In the embodiment shown in Fig. 7, the outer fingers 53 and 56 are extended away from the coil to form rim-holding portions 57 and 58 respectively. As shown, the rim may be adhered to the portions 57 and 58, which overlay the rim, by an adhesive such as epoxy adhesive, or the portions 57 and 58 may each consist of opposed fingers which clamp the rim between them.

The contact pin and "D" shaped insulating jewel are not shown in Figs. 2—7, for the purpose of simplicity of illustration, but would be present in these balance wheel assemblies.

The material forming the plastics coil carrier member is not subjected to eddy currents. It permits a desirable reduction in mass near the centre of the balance wheel, the ratio of the weight of plastics to brass being about 7 to 1. However, the strength of plastics may be less than the strength of metal, requiring a thicker balance wheel assembly. Such a thicker balance wheel may be accommodated in a watch, for example, by reduction of the thickness of the magnet or by special shaping of the shunt.

WHAT WE CLAIM IS:—

1. A balance wheel assembly of an electric or an electronic watch, comprising a balance wheel of metal consisting of a rim having

a widened portion and a spoke fixed to or integral with said widened portion and directed inwardly of said rim, a plastics carrier member fixed to said spoke inwardly of said rim, and an electric coil fixed to and carried by said carrier member, said spoke and said carrier member having a hole therethrough suitable to receive a balance wheel staff and said coil and said widened portion of said rim being respectively on opposite sides of said hole.

2. A balance wheel assembly as claimed in claim 1, wherein said plastics carrier member has a body portion with said hole therethrough and two arm portions, and said coil is carried between the two arm portions.

3. A balance wheel assembly as claimed in claim 1, wherein said plastics carrier member has an integral tubular portion and said coil has a hole which fits around said tubular portion.

4. A balance wheel assembly as claimed in claim 1, wherein the balance wheel is of a non-magnetic metal.

5. A balance wheel assembly as claimed in claim 2, wherein the plastics carrier member has an integral plastics web connecting its arms and a plastics ring fixed to the web, and wherein the coil has a hole which fits over the exterior surface of said ring.

6. A balance wheel assembly as claimed in claim 5, wherein the coil is adhered to the web.

7. A balance wheel assembly as claimed in claim 2, wherein the plastics arms have integral extending fingers which are fixed to the outer portion of the coil.

8. A balance wheel assembly as claimed in claim 7, wherein each arm has an additional extending member fixed to the balance wheel rim.

9. A balance wheel assembly as claimed in claim 7, wherein the coil is clamped between clamp members which are formed by the said fingers.

10. A balance wheel assembly as claimed in any one of the preceding claims including a balance wheel staff.

11. A balance wheel assembly substantially as hereinbefore described with reference to Fig. 1, Figs. 2 to 4, Figs. 5 and 6 or Fig. 7 of the accompanying drawings.

12. A watch which incorporates the balance wheel assembly as claimed in any one of the preceding claims.

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