EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the grant of the patent: 29.06.2011 Bulletin 2011/26

(21) Application number: 10158544.6

(22) Date of filing: 28.08.2002

(54) Electronic timepiece with a contactless data communication function, and a contactless data communication system

Elektronische Uhr und System mit Kontaktloskommunikationsfunktion
Montre électronique et système capables de communiquer sans contact

(84) Designated Contracting States: CH DE FR GB LI


(43) Date of publication of application: 30.06.2010 Bulletin 2010/26

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC: 02760778.7 / 1 424 611

(73) Proprietor: Seiko Epson Corporation
Shinjuku-ku
Tokyo (JP)

(72) Inventors:
• FUJISAWA, Teruhiko
Suwa-shi Nagano 392-8502 (JP)
• WASHIZAWA, Akira
Suwa-shi Nagano 392-8502 (JP)

(74) Representative: Cloughley, Peter Andrew
Miller Sturt Kenyon
9 John Street
London WC1N 2ES (GB)

(56) References cited:
DE-A1- 19 926 271

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).
TECHNICAL FIELD

[0001] The present invention relates to an electronic timepiece having a contactless data communication function and to a contactless data communication system.

RELATED ART

[0002] Magnetic cards are widely used today for many different applications, including telephone cards, various kinds of credit cards, frequent shopper cards issued by retail stores, and prepaid toll cards. That such cards can be easily forged, however, is a problem for society. IC cards are therefore starting to be used to prevent forgery, maintain confidential personal information, and for increased storage capacity.

[0003] However, even IC cards must contact a card reader/writer in order to exchange data, and during a transaction, that is, when reading/writing data to an IC card, the IC card must be handed to another person or passed through the reader/writer, and IC cards can thus not be considered completely safe with respect to forgery and maintaining confidentiality.

[0004] The more recently introduced contactless IC cards, on the other hand, can contactlessly communicate data with the reader/writer and thus offer improved safety and convenience when reading and writing the card, but because they are cards there is the danger of accidental loss, must be removed from a pocket when used, and thus also have drawbacks.

[0005] For these reasons products having this contactless IC card function built in to the kind of wristwatch that is normally worn by the user have also been recently developed. This wristwatch is a wristwatch with the communication structure built in to a contactless IC card, that is, an antenna and a transceiver means for contactless data communication with an external device via the antenna, contained in the watch case.

[0006] However, the case must be made from an insulating material because an antenna is disposed inside the case in a conventional wristwatch with an internal contactless IC card function, and because metal material and other such conductive material that are frequently used as the case material for conventional wristwatches cannot be used, great limitations are imposed on the exterior design, and a particular problem is that a cheap image lacking in a sense of high quality cannot be eliminated.

[0007] Furthermore, even if an insulating material is used for the case, if a conductive member is affixed on the inside and outside of the case, an eddy current (loop current) can be produced in the conductive member by externally emitted radio waves or radio waves emitted by the wristwatch itself, and energy loss from this eddy current leads to degraded communication characteristics (such as a drop in the communication distance). As a result, a further problem is that an annular electrically conductive member cannot be used for the rotating bezel or decorative edge affixed externally to the case, or the dial or spacer provided inside the case.

[0008] DE 19926271 discloses an electronic watch with a contactless data communication function in which a nonconducting ring is disposed within a multi-part electrically conducting case body.

[0009] The present invention is therefore directed to solving the above problems, and an object of the invention is to provide an electronic timepiece having a contactless data communication function whereby a drop in communication capabilities can be suppressed without degrading the performance required for a normal watch even when an annular electrically conductive member is used for the case or other parts. A further object is to improve the reliability of an electronic timepiece having a contactless data communication function by improving case strength or improving the water resistance or seal of the case.

SUMMARY OF THE INVENTION

[0010] To achieve the above object an electronic watch with a contactless data communication function according to the present invention comprises:

- a contactless communication unit for contactless data communication with an external transceiver device;
- a conductive member formed effectively in a ring;
- a clock means;
- a time information display unit; and
- a case housing the clock means, said case comprising a conductive case part and a non-conductive case part, wherein said conductive case part has a dial-side opening, wherein said non-conductive part is disposed between said conductive case part and a back cover whereby said conductive case part and said back cover are insulated, wherein said contactless communication unit comprises an antenna for producing a magnetic field, and a transceiver means for contactless data communication via the antenna, and wherein the open ends of said antenna face an inner surface of said non-conductive case part.

[0011] Preferably, the case is substantially annular, the time information display unit being located on one side of the axial direction of the case, and at least part formed from an insulator.

[0012] Preferably, a loop axis of said antenna is arranged in the direction orthogonal to the axis of said information time display unit.

[0013] Preferably, said antenna has a core and a coil.
BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The present invention further provides a contactless data communication system characterized by comprising an electronic watch with a contactless data communication function as defined above, and an external transceiver device for contactless data communication with the electronic watch.

Description of the Preferred Embodiments

[0016] Preferred examples and embodiments of an electronic watch having a contactless data communication function according to the present invention is described next with reference to the accompanying figures. Each of the embodiments described below shows the specific configuration (wristwatch) of an electronic watch having a contactless data communication function. The present invention shall not, however, be limited to a wristwatch, and can be applied to a pocketwatch or other type of electronic watch.

[First example not forming part of the invention]
eral low power RF communication using a 13.56 [MHz]
or 125 [kHz] carrier wave (carrier signal) and limiting
transmission output from both devices to a low level.
Therefore, because the communication range is a range
of several centimeters from the external transceiver 510,
the user must pass the electronic watch 100 near the
antenna of the external transceiver 510 before passing
the gate G to enable two-way communication.

(Configuration of the external transceiver)

[0019] Fig. 2 is a block diagram showing the configur-
ation of the external transceiver 510 assembled into the
wicket machine 500. In this external transceiver 510 a
control device 511 provides overall control of the external
transceiver 510. A transmission circuit 512 generates
and outputs a transmission control signal as controlled
by control device 511. Receiver circuit 513 receives a
reception signal captured by antenna 515 through high
frequency circuit 514, demodulates the received data
from this reception signal, and outputs to control device
511. Based on the transmission control signal the high
frequency circuit 514 generates and sends a transmis-
sion signal via antenna 515 to electronic watch 100, and
outputs reception signals received from the electronic
watch 100 by antenna 515 to receiver circuit 513.

[0020] It should be noted that electronic watch 200 ac-
ccording to a second example is shown in Fig. 2 together
with electronic watch 100, and this electronic watch 200
is further described below.

(Configuration of the contactless communication unit)

[0021] Fig. 3 is a block diagram showing the configur-
ation of the contactless communication unit 110 having
the contactless data communication function of the elec-
tronic watch 100. The contactless communication unit 110
of this electronic watch 100 has an antenna 111 and
a transceiver means 110RF for communicating by way
of this antenna 111. The antenna 111 is formed as a
circumferential loop with loop axis 111a oriented in a spe-
cific direction. This contactless communication unit 110
can be configured using, for example, a contactless IC
card standard such as ISO 14443.
[0022] The transceiver means 110RF has a tuning ca-
capitor 112 connected to both ends of the antenna 111,
and part of an integrated circuit (IC) or other communi-
cation module 110IC (transceiver circuit part).

[0023] The communication module 110IC is connect-
ed to rectifying circuit 113 connected to the antenna 111;
a reception circuit 114 connected to the antenna 111 for
demodulating the reception signal received by the anten-
na 111 and outputting the received data; a transmission
circuit 115 connected to the antenna 111 for modulating
the transmission data to generate and output a transmis-
sion signal to the antenna 111; a reference signal gen-
erating circuit 116 for generating a specific reference sig-

(Configuration of the time information display processing function part)

[0025] Fig. 4 is a basic block diagram showing a struc-
ture (the time information display processor including
a clock means and time information display part) for
achieving the main function of the electronic watch 100.
The electronic watch 100 can comprise only a contactless
data communication function such as described
above, but in this preferred embodiment of the invention
also has the time information display function of a typical
electronic watch. The configuration achieving this func-
tion includes a watch CPU 14 and hands driving unit 18.

[0026] The watch CPU 14 provides overall control of
the clock function (time information display function),
such as drive control over the hands or other time infor-
mation display means, display format according to oper-
ation of the stem or other external operating means de-
scribed further below, and internal time control.

[0027] The hands driving unit 18 includes drive circuit
18A and drive mechanism 18B. The drive mechanism
18B has a stepping motor 310 consisting of a drive coil
311 for producing magnetic force by means of the drive
pulses supplied from drive circuit 18A, a stator 312 ex-
cited by this drive coil 311, and a rotor 313 that turns as
a result of the magnetic field excited inside the stator 312.
A magnetic saturation part 317 is disposed to the stator
312 to produce magnetic poles that differ according to the magnetic force produced by the drive coil 311 in opposing parts 315, 316 around rotor 313. An internal switch 318 is disposed at appropriate positions to the inside circumference of the stator 312 in order to regulate the direction of rotor 313 rotation. When the stator 312 is excited by the drive coil 311 in this configuration, cogging torque is produced in the rotor 313 and the rotor 313 stops at an appropriate position. Rotation of the rotor 313 of stepping motor 310 is transferred to the hands by a gear train 350 consisting of fifth wheel 351 engaging the rotor 313, fourth wheel 352, third wheel 353, second wheel 354, day wheel 355, and center wheel 356.

[0028] The second hand 361 is connected to the shaft of the fourth wheel 352, the minute hand 362 is connected to the second wheel 354, and the hour hand 363 is connected to center wheel 356 so that the time (time information) is displayed by these hands in conjunction with rotation of the rotor 313.

[0029] The drive circuit 18A is a circuit for supplying drive pulses of various waveforms to the stepping motor 310 according to drive commands from the watch CPU 14. This drive circuit 18A has a bridge circuit consisting of p-channel MOS transistor 333a, n-channel MOS transistor 332a, p-channel MOS transistor 333b, and n-channel MOS transistor 332b. The drive coil 311 of stepping motor 310 is inserted between the node between p-channel MOS transistor 333a and n-channel MOS transistor 332a, and the node between p-channel MOS transistor 333b and n-channel MOS transistor 332b. A drive pulse is supplied to drive coil 311 and the rotor 313 is thus driven by applying a control pulse from watch CPU 14 to the gate electrodes of these MOS transistors 332a, 332b, 333a, and 333b.

(Structure of an electronic watch)

[0030] As shown in Fig. 5 and Fig. 6 an exemplar electronic watch 100 has a case 101, a crystal 102 mounted in dial-side opening 101A of this case 101, a back cover 103 mounted in back-side opening 101B of case 101, a movement (time information display processor) 104 disposed inside the case 101, a crown (external operating member) 106 mounted on the outside end of stem 105, dial 107 disposed inside the crystal 102, and annular substrate 108 fixed to the back side of dial 107. The crystal 102 is see-through construction made from a material that is transparent and electrically insulating. Sapphire or polycarbonate, for example, can be used for this material. Eddy current generation can thus be prevented.

[0031] The watch CPU 14, drive circuit 18A, and drive mechanism 18B described above with reference to Fig. 4 are built in to the movement (time information display processor including a clock means) 104. A battery, high capacity capacitor, or other power source may be built in to the movement 104 as necessary. A display unit is also formed by the crystal 102, dial 107, and hands such as the second hand 361, minute hand 362, and hour hand 363. Substrate 108 is a printed circuit board made of epoxy resin or phenol resin reinforced with glass fiber or glass cloth as necessary, or a flexible printed circuit board made from polyimide resin, for example. An antenna 111 with a loop shape is formed on both top and bottom sides of the substrate 108 (in the shown example the antenna winds two revolutions on both top and bottom sides). In the shown example the antenna 111 is formed from a conductive pattern of copper foil, for example, bonded to the substrate 108.

[0033] It will be further noted that while the antenna 111 is shown in the figure formed in a loop winding plural revolutions, the number of turns and shape of the loop antenna can be determined as desired. More specifically, if the frequency of the carrier wave is 13.56 [MHz], a loop antenna with 2 to 3 loops is sufficient, and if the frequency is 125 [kHz] several hundred turns are needed.

[0034] Because gain improves as the aperture area of the loop antenna increases, antenna 111 is preferably formed along the inside circumference part of the case 101 (adjacent to the inside circumference part). In this example substrate 108 is formed as a circle along the inside surface of the case 101, and the loop of antenna 111 is formed on the outside circumference side on substrate 108. The movement 104 is disposed on the inside of the opening formed on the inside of the annular shape of substrate 108.

[0035] The above-noted communication module 110IC is mounted on the substrate 108 and is connected to both ends of antenna 111. It should be noted that the tuning capacitor 112 connected to antenna 111 is also mounted on substrate 108 but is not shown in this figure.

[0036] As also shown schematically in Fig. 8, case 101 of this example is made from a conductive member such as metal (stainless steel, brass, titanium, or other) formed substantially as a ring with dial-side opening 101A and back-side opening 101B. A gap 101G configured to completely interrupt the case at one part in the circumferential direction is further disposed to the case 101 as an insulating part for insulating the case in the circumferential direction as seen in the direction encircling the circumference of openings 101A and 101B. That is, the case 101 is C-shaped when seen in plan view due to gap 101G. Because the width (thickness) of gap 101G in the circumferential direction of case 101 only needs to be sufficient to prevent or reduce the occurrence of eddy current described below, it can be quite slight, less than 1 mm, and on the order of 0.1 mm to 1.0 mm, for example. We have confirmed that if a 13.56 [MHz] carrier wave is used a gap of 0.5 mm or more assures sufficient insulation and is thus preferable.

[0037] An insulation material 109 that is a non-conductive member made from a synthetic resin or other insulator is disposed inside this gap 101G. The insulation material 109 shown here is an inverted T-shape when seen from the side of case 101, and is fastened to the case 101 by mounting screws 109a when fit to the gap.
To communicate it first sends data for mutual verification and detects the polling signal, it starts communicating. The electronic transceiver 510 recognizes the expiration date and data type, such as a boarding pass or prepaid card, from the received data, and determines if the content can be accepted or not (step S107).

Evaluation period T03 follows after the memory data from electronic watch 100 is thus received by external transceiver 510. In this evaluation period T03 external transceiver 510 recognizes the expiration date and data type, such as a boarding pass or prepaid card, from the received data, and determines if the content can be accepted or not (step S107).

The external transceiver 510 enters write period T04 when this evaluation is completed, and returns data indicating a detected boarding pass or payment amount to the electronic watch 100 (step S108). In response electronic watch 100 returns reply data indicating that this data was received to the external transceiver 510 (step S109).

When communication according to this procedure ends electronic watch 100 enters internal processing period T05. In this period T05 the data content sent in step S108 is written to a corresponding storage address in memory 110M to record (a boarding record) or update (remaining balance information) the necessary items. Also in this period T05 external transceiver 510 confirms the reply data sent from electronic watch 100 in step S109, and then prepares for the next polling process (step S110).

It should be noted that if display 110DP is disposed as indicated by the double-dot dash line in Fig. 6, for example, the communication status, communication process step, or communication process content (such as boarding pass recording or other recording step, or remaining balance or payment amount data) may be displayed on this display 110DP in the mutual verification period T01, read period T02, evaluation period T03, write period T04, and internal processing period T05. Furthermore, if as in the below-described second embodiment the liquid crystal display or other display is configured to also display time information, displaying the time information can be temporarily stopped in mutual processing period T10. In this case the above-noted communication status, communication process step, or communication process content, for example, could be displayed instead of the time information.

In the example described above a gap 101G that is an insulation part is disposed in part of the ring-
shaped case 101, which is a conductor, as shown in Fig. 8. This prevents the eddy current (loop current) that occurs when the magnetic field fluctuates in the direction the magnetic flux extends along the annularly shaped axis 101a of case 101 and suppresses a drop in the transmission strength and reception sensitivity of contactless data communication.

[0048] That is, because magnetic flux passing the opening in case 101 changes when ring-shaped case 101 is made from a conductor and does not have a gap such as described above, and field H fluctuates periodically in the neighborhood of case 101 due to external radio waves or radio waves produced by antenna 111, eddy current (loop current) I results from electromagnetic induction. Because this eddy current I consumes energy in the radio waves, it reduces the reception sensitivity of the antenna 111 disposed inside case 101 and reduces the strength of radio waves transmitted from antenna 111. The effect of this eddy current I is particularly great when the axis 101a of case 101 shown in Fig. 8 and the loop axis 111a of antenna 111 shown in Fig. 3 are substantially parallel.

[0049] However, this eddy current I does not occur in the case of the present example because gap 101G, which is an insulator, is disposed to case 101 as shown in Fig. 10, radio wave energy loss is therefore also reduced, and a drop in transmission strength and reception sensitivity during communication can also be suppressed. Furthermore, because the annularly shaped axis of case 101 and the loop axis of antenna 111 are substantially aligned, or more specifically because the loop of antenna 111 is inside the annularly shaped case 101, case 101 acts as a shield for antenna 111, and thus functions as a shielded loop antenna known from the literature as taught, for example, in Japanese Patent Laid-Open Publication (kokai) S56-27509.

[0050] Moreover, when the frequency band used for contactless data communication in the present embodiment is in the range of approximately 40 [kHz] to 600 [MHz], it is possible to reduce the size of the electronic watch by configuring the antenna 111 as a loop antenna.

[Second example not forming part of the invention]

[0051] An electronic watch 200 is described next referring to Fig. 11. This example is also configured for contactless data communication with an external transceiver 510 as shown in Fig. 1 and Fig. 2, and description of the configuration of external transceiver 510 is therefore omitted.

[0052] This electronic watch 200 has a case 201 made from a metal or other conductive material, crystal 202 mounted in a dial-side opening in case 201, back cover 203 made from an insulator mounted on the back-side opening in case 201, and a circuit board 204 disposed inside case 201. Mounted on this circuit board 204 are a clock IC 205, liquid crystal display panel or other display 206, quartz oscillator 207 for clock generation, and storage battery 208 such as a chemical secondary cell or capacitor. In other words, this electronic watch 200 is a digital watch with a digital display 206.

[0053] A loop-shaped antenna 211 is formed on the surface of circuit board 204, and a communication module 210IC identical to that in the first embodiment is mounted on the back of circuit board 204.

[0054] This example has part of the annular case 201 cut out with an insulator 209 made from a synthetic resin, for example, fixed in the resulting gap. Therefore, even if the case 201 is made from a conductive material, for the same reasons described in the above first embodiment, the effects on transmission and reception by the antenna 211 disposed inside the case 201 are reduced.

[Variation 1]

[0055] A first variation of the preceding examples is described next with reference to Fig. 12. Fig. 12 is an exploded oblique view schematically showing the structure of the external members in a variation of the electronic watch 100. It should be noted that parts other than those shown in the figure are identical to those in the first example.

[0056] This first variation has an annular case 101' with a dial-side opening 101A' and back-side opening 101B', and a crystal 102 and back cover 103 as in the first example. This variation is configured so that a bezel 101R can be mounted on the outside on the dial side of case 101'. This bezel 101R is made from a ring shaped conductive material such as a metal in a configuration having a part of the ring cut away and an insulation material 101S made from an insulator such as ceramic or shell placed and fixed inside the gap.

[0057] In this first variation the bezel 101R is made from a conductive material but because part of it is cut away and insulated occurrence of an eddy current in bezel 101R can be prevented and the effects of the antenna disposed inside case 101' on contactless data communication can be reduced. It is also possible to leave the gap in bezel 101R as a gap without disposing insulation material 101S therein.

[0058] Insulation material 109' is also disposed to the case 101', and insulation material 109' has an annular frame 109a' formed in a ring shape inside the case and an insulation fitting 109b' formed integrally with this annular frame 109a' and positioned inside the gap in case 101'. By thus disposing an annular frame 109a' configured in a ring inside case 101' to insulation material 109', the seal between case 101' and insulation material 109' can be improved and water resistance can be improved. Particularly because a bonding surface between the case and insulation material is not exposed inside the case as a result of configuring the annular frame 109' so that it completely covers the inside surface of case 101', the seal, water resistance, and shock resistance can be further improved. It should be noted that in this case the case can be a one-piece configuration with an integrally
formed bottom equivalent to the back cover. In this case the annular frame 109a' can be configured with a cover so as to completely cover the bottom inside surface of the one-piece case.

[0059] The insulation material 109' of this variation also engages the case 101' in the axial direction (circumferential axis) of the case 101'. Furthermore, because this insulation material 109' has an annular frame 109a' engaging the inside surface of the case 101', it is also engaged in the radial direction (radial to the circumference) of the case 101'. Therefore, when the insulation material 109' is fit to the case 101', the insulation material 109' is positioned in both the axial direction and radial direction to the case 101'.

[0060] It should be noted that an insulation member is disposed to the bezel mounted to the case in this example, but the same configuration can be applied to other outside member other than the bezel or inside member (such as the spacer) housed inside the case that is likewise made from an annular conductive material.

[Variation 2]

[0061] A second variation of the above examples is described next referring to Fig. 13. In this variation gaps are formed at two locations in an annular case 131 having a dial-side opening 131A and a back-side opening 131B, and insulator fittings 138b of an insulation material 138 are disposed and fixed in these gaps. In the shown example an annular frame 138a is affixed to the back side of the case 131, and the insulator fittings 138b formed integrally to this annular frame 138a are disposed in the gaps of the case 131 between the lugs. Because the case 131 is thus configured from plural case parts 131C, 131D as a result of forming gaps at plural locations, parts processing is easier. It should be noted that the crystal 102 mounted to the dial-side opening 131A of this case 131 is the same as in the first embodiment.

[0062] In this second variation the back cover 133 has an annular cover frame part 133F made from metal or other conductive material, and a cap part 133T for closing the opening in this cover frame part 133F. A gap is disposed at one place in the circumferential direction of the cover frame part 133F, and an insulation material 139 made from synthetic resin or other insulator is fixably disposed in this gap. The cap part 133T is made from an insulator such as synthetic resin, glass, ceramic, or shell material. By making the cap part 133T from glass or other transparent material, a see-through construction enabling the inside of the case 131 to be seen can be achieved.

[0063] The cover frame part 133F of the back cover 133 in this second variation is made from a conductive material, but because the circumferential direction is insulated by the gap and the insulation material 139 disposed thereinside, the occurrence of eddy current can be prevented and its effects on contactless data communication can be reduced as described above.

[0064] Furthermore, because the insulation material 138 engages the case 131 in the axial direction (axial to the circumference) in this variation, fitting the insulation material 138 to the case 131 positions the insulation material 138 in the axial direction to the case 131.

[Variation 3]

[0065] A further variation of the above examples is described next with reference to Fig. 14. Fig. 14 is an enlarged exploded oblique view showing the structure for fitting a non-conductive member to a conductive member in a third variation. A gap 141G is formed in the substantially annular conductive member 141 forming the case, for example. An engaging channel 141T is also formed in the conductive member 141 in a part proximal to the gap 141G.

[0066] A non-conductive member 148 made from synthetic resin or other insulator is fit in this gap 141G. An insulation part 148A fit into gap 141G and an engagement flange 148B fit into engaging channel 141T are disposed to this non-conductive member 148. In the example shown in the figure a through-hole 148a is formed in the non-conductive member 148. As in the preceding examples, this through-hole 148a is for passing a part such as the stem of the external operating member.

[0067] The conductive member 141 and non-conductive member 148 are engaged in the radial direction (radial to the circumference) of the conductive member 141 by this structure of fitting engaging channel 141T to engagement flange 148B. The non-conductive member 148 is thus positioned in the radial direction to the conductive member 141 by simply fitting it to conductive member 141.

[0068] Furthermore, because the non-conductive member 148 is engaged so as to connect the ends of the conductive member 141 overlooking the gap 141G, when the conductive member 141 and non-conductive member 148 are bonded with adhesive, for example, so that non-conductive member 148 acts to inhibit stresses causing the gap 141G of conductive member 141 to widen, it becomes difficult for stress to be applied to the bonded surfaces, and removal or separation of the non-conductive member 148 from the conductive member 141 can be prevented. Moreover, because conductive member 141 fully engages the non-conductive member 148 in the circumferential direction, the rigidity of the conductive member 141 can be increased.

[0069] The structure of this third variation for fitting the conductive member and on-conductive member together can be applied to all examples and variations thereof.

[Third example not forming part of the invention]

[0070] A third example is described next with reference to Fig. 15. This example forms an inside case 151 for housing the movement, for example, therein from a synthetic resin or other insulator. A housing part 151C and
lugs 151K protruding from both sides of the housing part 151C for connecting a band not shown in the figures are disposed to this inside case 151.

[0071] An annular outside case 152 is fit to the outside surface of the above inside case 151, which is made from an insulator, so as to cover the housing part 151C. The outside case 152 is an annular frame with an L-shape in section. Multiple openings are disposed in the outside case 152 so that it does not contact the crown or other external operating members or the lugs 151K projecting to the outside from housing part 151C of inside case 151.

[0072] The outside case 152 has a ring part 152R that is a conductive member made from metal, for example. This ring part 152R is substantially annular with gaps provided in parts. A synthetic resin or other insulation material 152S is fit into these gaps.

[0073] By housing the movement including a clock means and contactless communication part inside an inside case 151 made from an insulator in this example, electrical shorts and communication problems can be prevented, and greater freedom can be achieved in the exterior design by covering this inside case 151 with an outside case 152 made from a conductive material. For example, a sense of high quality can be improved by using a metal outside case 152.

[Fourth example not forming part of the invention]

[0074] A fourth example is described next with reference to Fig. 16. An electronic watch according to this example has a substantially annular frame 161 and an insulated case 163 made of synthetic resin inside of which is housed the watch movement (including a time information display processing part and contactless communication part). The electronic watch is assembled by fitting the insulated case 163 into the annular frame 161. The insulated case 163 and annular frame 161 are therefore disposed around the antenna of the contactless communication part.

[0075] The annular frame 161 has a pair of lug 165A that are projections made from a metal (stainless steel, brass, or titanium, for example) or other conductive member for attaching a band, inter-lug parts 165B (connecting parts) that are the connecting parts between the pairs of lugs 165A, and a main frame part 167 disposed contiguously to the inter-lug parts 165B in the circumferential direction of the annular frame 161.

[0076] One pair of lugs 165A and inter-lug part 165B are disposed at each end of the annular frame 161 (that is, at the 12 o’clock and 6 o’clock sides). A pivot hole 168 is formed to the mutually opposing inside surfaces of each pair of lugs 165A. These pivot holes 168 are for engaging the ends of metal or other spring pins (not shown in the figure), i.e., connecting members, and a strap (not shown in the figure) is attached to each pair of lugs 165A by these spring pins.

[0077] The main frame part 167 is formed between the above two inter-lug parts 165B. An insulation part 167A having a gap is formed in this main frame part 167. The main frame part 167 is thus interrupted in the circumferential direction by the gap in this insulation part 167A. The insulation part 167A in this embodiment is formed at the 3 o’clock position of the annular frame 161. It should be noted that the insulation part 167A can be formed by cutting after forming the annular frame 161 into a closed ring, or can be preformed in the annular frame 161.

[0078] The insulated case 163 is a hollow cylindrical shape (disk shape) having a bottom formed on the back side of the insulated case 163 and an opening on the face side of the insulated case 163. A crystal 162 made of glass or other non-conductive material is attached to the face side of the insulated case 163 so as to cover the opening. The bottom of the insulated case 163 and the crystal 162 are covers mounted in the opening 164 of the annular frame 161. The contactless communication part inside the insulated case 163 is enclosed by the annular frame 161 and these covers.

[0079] A crown (external operating member) 166 attached to the stem connected to the movement not shown in the figure protrudes from the side of insulated case 163. Hands 169a, 169b, 169c are disposed to the dial (not shown in the figure) attached to the top of the movement inside crystal 162. A protrusion 163A located inside the insulation part 167A of annular frame 161 is disposed to the side of insulated case 163. This protrusion 163A is formed where the crown 166 projects.

[0080] Because insulation part 167A is formed to the substantially annular frame 161 in this embodiment, the eddy current (loop current) that occurs when the magnetic field fluctuates in the direction the magnetic flux extends along the annularly shaped axis of frame 161 can be prevented and a drop in the transmission strength and reception sensitivity of contactless communication can be suppressed.

[0081] Furthermore, because it is not necessary to assure the strength, seal, or water resistance of the frame 161, which is a conductive member, if case strength, seal, or water resistance are assured in the insulated case 163, for example, by providing an insulated case 163 housing the movement, the insulation part 167A can be formed more easily and the freedom of design can be improved for the annular frame 161 with the present example. The reliability of the electronic watch can also be increased by improving the case strength, seal, or water resistance.

[Fifth example not forming part of the invention]

[0082] A fifth example is described next with reference to Fig. 17 and Fig. 19. A case 171 made from metal or other conductive material is provided in this embodiment as shown in Fig. 17. This case 171 is substantially annular with a gap 171G formed in part.

[0083] A frame member 172 with a glass edge, for example, is attached to the front of case 171. This frame member 172 is made from synthetic resin or other insu-
A crystal 173 made of glass, for example, is mounted to the frame member 172. The case 171 and frame member 172 are connected by an appropriate method such as press fitting, adhesion, set screws, or screwing. A back cover 174 is mounted to the back side of case 171. The back cover 174 is preferably made completely from an insulation material.

In this example a fitting member 178 that is a non-conductive member made from synthetic resin or other insulator is fit into the gap 171G in case 171 with packing 179 made from synthetic rubber or other insulator mounted to the fitting member 178. In the example shown in the figure the fitting member 178 is fit into gap 171G from either the top or bottom of the case 171, and the frame member 172 and back cover 174 are then attached to the case 171 to form the outside case of the wristwatch.

A horizontal section view near the insulator part of the above case structure is shown in Fig. 18, and a longitudinal section view of the above case structure is shown in Fig. 19. As shown in these figures fitting member 178 is sealed with case 171, frame member 172, and back cover 174 by means of packing 179, thereby assuring water resistance.

It should be noted that a through-hole can be passed therethrough.

In this example a fitting member 178 is fit and fixed inside gap 171G in case 171. This fitting member 178 has a metal core 178C located inside an insulator having the same external shape as the fitting member 178 of the fifth example. This fitting member 178C and metal core 178C can be manufactured by insertion molding or other integrated molding process, or metal core 178C can be pressed into a hole opened inside to outside through fitting member 178 can be disposed so that the stem and other external operating members can pass through.

A horizontal section view near the insulator part of the above case structure is shown in Fig. 18, and a longitudinal section view of the above case structure is shown in Fig. 19. As shown in these figures fitting member 178 is sealed with case 171, frame member 172, and back cover 174 by means of packing 179, thereby assuring water resistance.

It should be noted that a through-hole passing external operating member (crown) 186 and movement 185 passes through this through-hole 188a.

Because the internal spacer 187 of this example is a conductive member a gap is formed in the internal spacer 187 so that eddy current does not occur, and insulator 188 is fit into this gap.

It should be noted that the internal spacer 187 in this example has both a movement positioning function and a function as a magnetic shield, but could be configured as a member with only either one of these functions.

An electronic watch 300 according to the present invention is described last with reference to Fig. 24. This embodiment differs from each of the above examples in that the case consists of a metal or other conductive case part 371X and a synthetic resin or other insulating case part 371Y. Crystal 372 is attached to the dial-side opening 371A of case part 371X, and parts such as movement 374 and antenna 381 are housed inside the housing part 371B of case part 371Y. The stem, internal spacer, circuit board, and other parts are omitted in the figure. Back cover 373 is attached to the back of case part 371Y. The back cover 373 could be an insulator or a conductor.

The antenna 381 has a core 381C made of ferrite or other magnetic body, and a coil 381R wound to this core 381C. The loop axis 381A of this antenna 381 is oriented substantially orthogonally to the axis of the display face, opening 371A, and housing part 371B, and is disposed sideways to this axis. The open ends of this antenna 381 face the walls of the case part 371Y, which is an insulator. This configuration therefore does not have.
a conductor that would create interference at the open ends of the antenna 381. Because this antenna 381 has numerous turns, it is suitable for communication using a relatively low carrier frequency, such as 125 [kHz].

[0099] Because metal or other conductive material can be used for the case part 371X and back cover 373 in this embodiment, exterior design freedom is improved and case strength can be increased.

[0100] Furthermore, between the back cover 373 and the dial-side case part 371X is insulated by disposing an insulating case part 371Y between the conductive case part 371X and back cover 373 (that is, in the gap therebetween) in this embodiment, and a closed conductive path is not formed around the loop axis 381a of antenna 381 in at least the case. An eddy current therefore cannot arise in the case during contactless data communication, and a drop in communication sensitivity and transmission strength can be suppressed.

[0101] It should be noted that an electronic watch having a contactless data communication function according to the present invention shall not be limited to the above embodiment shown in figure 24, and can obviously be varied in many ways without departing from the intended scope of the present invention as set forth in the claims. For example, the case, bezel, and cover frame part described as annular conductive members are round in shape, but this annular shape shall not be limited to round and could be rectangular or other suitable plane figure that overall describes a substantially circumferential shape. Furthermore, the conductive members are made from a conductive material such as metal, but a ceramic or plastic member with the surface thereof metallized by a dry film plating process, for example, could be used instead of these conductive members.

FIELD OF APPLICATION IN INDUSTRY

[0102] With the present invention as described above a metal or other conductive member can be used in an electronic watch having a contactless data communication function while maintaining communication quality and achieving a sense of high quality without sacrificing the performance required for a normal watch. In particular, by improving case strength or improving the water resistance or seal of the case, the reliability of an electronic watch having a contactless data communication function can be improved.

Claims

1. An electronic watch (300) with a contactless data communication function, comprising:

   a contactless communication unit (110) for contactless data communication with an external transceiver device (510);

   a conductive member (371) formed effectively in a ring;

   a clock means;

   a time information display unit (102, 107, 361, 362, 363); and

   a case housing the clock means, said case comprising a conductive case part (371X) and a non-conductive case part (371Y), wherein said conductive case part (371X) has a dial-side opening (371A), wherein said non-conductive part (371Y) is disposed between said conductive case part (371X) and a back cover (373) whereby said conductive case part (371X) and said back cover (373) are insulated, wherein said contactless communication unit (110) comprises an antenna (381) for producing a magnetic field, and a transceiver means (110RF) for contactless data communication via the antenna (381), and wherein the open ends of said antenna (381) face an inner surface of said non-conductive case part (371Y).

2. An electronic watch with a contactless data communication function as defined in claim 1, wherein the case is substantially annular, the time information display unit (102, 107, 361, 362, 363) being located on one side of the axial direction of the case, and at least part formed from an insulator.

3. An electronic watch with a contactless data communication function as defined in any one of the preceding claims, wherein a loop axis (381A) of said antenna (381) is arranged in the direction orthogonal to the axis of said information time display unit (102, 107, 361, 362, 363).

4. An electronic watch with a contactless data communication function as defined in any one of the preceding claims wherein said antenna (381) has a core (381C) and a coil (381R).

5. A contactless data communication system characterized by comprising an electronic watch with a contactless data communication function as defined in any one of claims 1 to 4, and an external transceiver device (510) for contactless data communication with the electronic watch.
ein leitfähiges Element (371), das effektiv in einem Ring gebildet ist;
eine Zeitanzeigeeinheit (102, 107, 361, 362, 363); und
ein Gehäuse, in dem das Uhrmittel untergebracht ist, wobei das Gehäuse ein leitendes Gehäuseteil (371X) und ein nicht leitendes Gehäuseteil (371Y) umfasst;
wobei das leitende Gehäuseteil (371X) eine Öffnung (371A) an der Ziffernblattseite aufweist;
wobei das nicht leitende Teil (371Y) zwischen dem leitenden Gehäuseteil (371X) und einer Rückabdeckung (373) isoliert sind;
wobei die kontaktlose Kommunikationseinheit (110) eine Antenne (381) zur Erzeugung eines Magnetfeldes und ein Sender-Empfänger-Mittel (110RF) für die kontaktlose Datenkommunikation über die Antenne (381) aufweist;
wobei die offenen Enden der Antenne (381) einer Innenfläche des nicht leitenden Gehäuseteils (371Y) zugewandt sind.

2. Elektronische Uhr mit einer kontaktlosen Datenkommunikationsfunktion nach Anspruch 1, wobei das Gehäuse im Wesentlichen ringförmig ist, die Zeitinformationsanzeigeeinheit (102, 107, 361, 362, 363) an einer Seite der axialen Richtung des Gehäuses angeordnet ist, und wenigstens eine Partie aus einem Isolator gebildet ist.

3. Elektronische Uhr mit einer kontaktlosen Datenkommunikationsfunktion nach einem der vorangehenden Ansprüche, wobei eine Schleifenachse (381A) der Antenne (381) in die Richtung orthogonal zu der Achse der Zeitanzeigeeinheit (102, 107, 361, 362, 363) angeordnet ist.

4. Elektronische Uhr mit einer kontaktlosen Datenkommunikationsfunktion nach einem der vorangehenden Ansprüche, wobei die Antenne (381) einen Kern (381C) und eine Spule (381R) aufweist.

5. Kontaktloses Datenkommunikationssystem, dadurch gekennzeichnet, dass es eine elektronische Uhr mit einer kontaktlosen Datenkommunikationsfunktion nach einem der Ansprüche 1 bis 4 umfasst, und eine externe Sender-Empfänger-Vorrichtung (510) für die kontaktlose Datenkommunikation mit der elektronischen Uhr.

Revendications

1. Montre électronique (300) avec une fonction de communication sans contact, comprenant :
eine unité de communication sans contact (110) pour la communication de données sans contact avec un dispositif émetteur/récepteur externe (510) ;
ungenommen conducteur (371) formé de manière efficace dans un anneau ;
un moyen d’horloge ;
eine unité d’affichage d’informations de temps (102, 107, 361, 362, 363) ; et
un boîtier logeant le moyen d’horloge, ledit boîtier comprenant une partie de boîtier conductrice (371X) et une partie de boîtier non-conductrice (371Y),
do laquelle ladite partie de boîtier conductrice (371X) possède une ouverture de face cadran (371A),
do laquelle ladite partie non-conductrice (371Y) est disposée entre ladite partie de boîtier conductrice (371X) et un couvercle arrière (373) moyennant quoi ladite partie de boîtier conductrice (371X) et ledit couvercle arrière (373) sont isolés,
do laquelle ladite unité de communication sans contact (110) comprend une antenne (381) pour produire un champ magnétique, et un moyen émetteur/récepteur (110RF) pour la communication de données sans contact via l’antenne (381),
e dans laquelle les extrémités ouvertes de ladite antenne (381) font face à une surface interne de ladite partie de boîtier non-conductrice (371Y).

2. Montre électronique avec une fonction de communication de données sans contact telle que définie dans la revendication 1, dans laquelle le boîtier est essentiellement annulaire, l’unité d’affichage d’informations de temps (102, 107, 361, 362, 363) se situant d’un côté de la direction axiale du boîtier, et au moins une partie étant formée par un isolateur.

3. Montre électronique avec une fonction de communication de données sans contact telle que définie par l’une quelconque des revendications précédentes, dans laquelle un axe de boucle (381A) de ladite antenne (381) est disposé dans la direction orthogonale à l’axe de ladite unité d’affichage d’informations de temps (102, 107, 361, 362, 363).

4. Montre électronique avec une fonction de communication de données sans contact telle que définie par l’une quelconque des revendications précédentes, dans laquelle ladite antenne (381) possède une partie centrale (381C) et une bobine (381R).

5. Système de communication de données sans con-
tact caractérisé en ce qu’il comprenne une montre électronique avec une fonction de communication de données sans contact telle que définie par l’une quelconque des revendications 1 à 4, et un dispositif émetteur/récepteur externe (510) pour la communication de données sans contact avec la montre électronique.
FIG. 7

510

EXTERNAL TRANSCEIVER

100

WRISTWATCH TYPE ELECTRONIC DEVICE

S101

POLLING SIGNAL

S102

S103

S104

S105

S106

S107

S108

S109

S110

POLLING SIGNAL

MUTUAL VERIFICATION PERIOD T01

READ PERIOD T02

EVALUATION PERIOD T03

WRITE PERIOD T04

INTERNAL PROCESSING PERIOD T05
REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader’s convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- DE 19926271 [0008]
- JP S5627509 B [0049]