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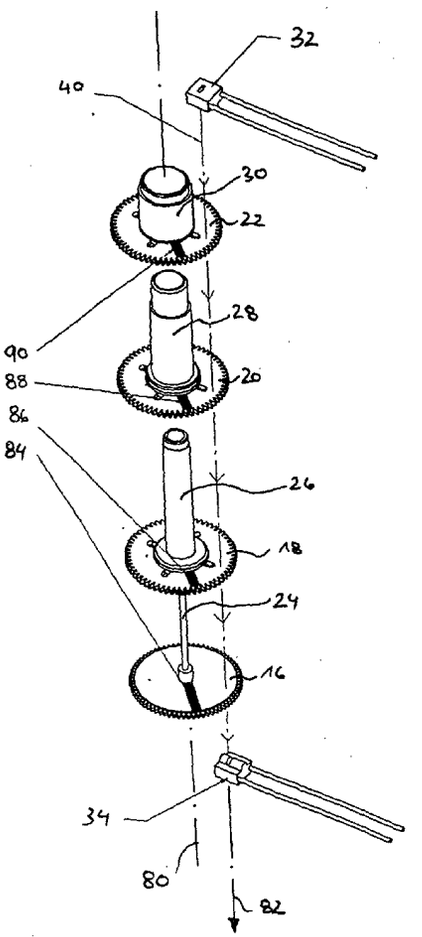
(54) Radio controllable clock

(57) The invention relates to a radio controllable clock comprising an analogue display having at least two hands each associated to a gear wheel (16, 18, 20, 22), optical means (32, 34) comprising elements for transmitting and receiving a light beam (40) for detecting a position of each hand by means for interrupting the beam path (42, 44, 82) with respect to the angular position of the gear wheels (16, 18, 20, 22), a driving unit (8, 10, 12, 14) for each gear wheel (16, 18, 20, 22) for adjusting the position of the hand in accordance with a received radio time or reset signal, and a micro-controller unit (2) for controlling the driving units (8, 10, 12, 14). The invention also relates to a method for adjusting the position of a radio controllable clock.

Fig. 2



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Description

[0001] The invention relates to a radio controllable clock comprising an analogue display having at least two hands each associated to a gear wheel, optical means comprising elements for transmitting and receiving a light beam for detecting a position of each hand by means for interrupting the beam path with respect to the angular position of the gear wheels, a driving unit for each gear wheel for adjusting the position of the hand in accordance with a received radio time or reset signal, and a micro-controller unit for controlling the driving units. The invention also relates to a method for adjusting the position of a radio controllable clock according to the invention.

[0002] Among conventional timepieces, there are radio controlled clocks capable of automatically adjusting the time after successfully receiving a radio time signal and decoding the signal to drive the hands of an associated analogue clock to an exact time position. For adjusting the hand shafts to the exact time position according to the received time signal, the second hand, minute hand, hour hand and optionally the alarm hand have to start at an absolute reference position whenever the system is reset, so that the micro-controller can calculate how many pulses must be generated for each shafts for a respective rotation. Thus, the reference position has to be determined before setting the time according to the time signal.

[0003] For detecting positions of the hands of an analogue display optical means are commonly used in radio controllable clocks. Such a clock having the above mentioned features is disclosed in the EP 0 180 880. This document shows the arrangement of the various elements of a timepiece with its respective drives, gear wheels, shafts and optical detection means.

[0004] An object of this invention is to provide a more simple timepiece that is easier and cheaper to manufacture.

[0005] This object is achieved, according to the invention, by a timepiece of the above-mentioned type having only a single light receiving element.

[0006] According to an embodiment of the invention transparent gear wheels are provided with non-transparent zones. The non-transparent zones may be integrated into the transparent gear wheels, e.g. by two-component-moulding of gear wheels made of any suitable plastic such as PC, PMMA or the like, or the non-transparent zones are provided on the surface of the transparent wheels, e.g. by providing separate painted or blackened patches that are attached to the wheels by adhesive means.

[0007] By means of the non-transparent zones, a light beam transmitted by a light transmitting element and received by a light receiving element can be blocked. Thus, by turning the gear wheel it can be moved from a position in which the light-beam is conducted through the transparent gear wheel to a position in which the light beam is blocked by the non-transparent zone. This position can thus be detected by the interruption of the reception of light at the light receiving element. By generating a predetermined number of pulses for driving the driving unit the gear wheel can then be moved to a predetermined reference position, in which the light beam is not blocked. By repeating the procedure for other gear wheels all hands can be turned into a reference position, from which the final setting of the time according to the received time signal can take place.

[0008] By providing a radio controllable clock with each of the hands being associated to a separate gear wheel and each of the gear wheels being driven by a seperate driving unit an independent control of all hands is possible.

[0009] To ensure a precise operation of the clock it is preferred that the driving units are stepper motors.

[0010] The invention also relates to a method for adjusting the position of a radio controllable clock according in which a position of one of the hands is detected in a first step by means for interrupting the beam path with respect to the angular position of the respective gear wheel, that the position of the hand is adjusted to a predetermined reference position in a second step, that the first and second steps are completed for one hand before proceeding with the first step for another hand and that the first and second steps are completed for all hands before the position of all hands is adjusted in accordance with a received radio time or reset signal in a final step.

[0011] This method and further details of the invention and its embodiments will be apparent from the following description of preferred embodiments with reference to the figures, in which

FIG. 1 is a schematic diagram showing the circuit design of the radio controllable clock;

FIG. 2 is an exploded view of an embodiment according to the invention.

[0012] Fig. 1 shows schematically a diagram illustrating the circuit design of the radio controllable clock. The circuit design comprises a micro-controller unit 2 which receives various signals via an antenna 4 and radio receiving means 6. The micro-controller unit 2 is connected with four stepper motors 8, 10, 12, 14 which serve as driving units for associated mechanical transmission means 16, 18, 20, 22 for driving shafts of the clock that are associated with hands of its analogue display. Upon respective digital pulse signals generated by the micro-controller unit 2 the respective stepper motors 8, 10, 12, 14 will be activated to drive the respective shafts and hands of the clock.

[0013] As an example and with reference to Fig. 1 and 2 the stepper motor 8 is connected with a gear wheel 16, which serves as a transmission means to drive a shaft 24 (which is connected to the second hand of the

clock, not shown in the drawing). The stepper motors 10, 12 and 14 are connected with respective gear wheels 18, 20 and 22. The gear wheels 18, 20 and 22 drive shafts 26, 28 and 30 which are connected to the minute hand, hour hand and alarm hand of the clock, respectively.

[0014] With further reference to Fig. 2 an embodiment according to the invention comprises an Infrared-transmitter 32 which serves as a light transmitting element, and an Infrared-receiver 34 which serves as a light receiving element. In this embodiment the IR-beam 40 is directed in a main downstream direction 82 parallel to the central axis 80 of the gear wheel. The gear wheels 16, 18, 20 and 22 are substantially made of transparent PC plastic material. The gear wheels are provided with integrated non-transparent zones 84, 86, 88 and 90 which are arranged to be apt to block in a particular angular position the downstream direction 82 of the IR-beam 40. The non-transparent zones 84, 86, 88 and 90 are constituted of black, light-blocking plastic material, which is embedded in the transparent PC material. Such a wheel can be manufactured by two-component moulding.

[0015] With the elements described above it is possible to detect and adjust the position of each hand in accordance with a received radio time or reset signal. After successfully receiving a radio time or reset signal via the antenna 4 and the radio receiving means 6 the micro-controller unit 2 generates pulse signals for the stepper motors 8, 10, 12 and 14 to drive the gear-wheels 16, 18, 20 and 22 to turn the shafts 24, 26, 28 and 30 associated with the second, minute, hour and alarm hand, respectively. However, the shafts 24, 26, 28 and 30 have to start at an absolute position whenever the clock is reset according to a received time signal, after replacement of a new battery or manual activating a reset pin.

[0016] The time detecting and adjusting procedure for the embodiment shown in Fig. 2 is as follows. By way of example, the gear wheel 16 is driven by the stepper motor 8 to rotate the second shaft 24. The gear wheel 16 is rotated until the IR-beam 40 transmitted by the IR-transmitter 32 is blocked by the non-transparent zone 84 provided in the gear wheel 16 and thus interrupting the reception of the IR-beam 40 by means of the IR-receiver 34. At this moment, the micro-controller unit 2 is eligible to determine the absolute position of the gear wheel 16 and thus of the shaft 24 and its associated second hand. Then the micro-controller unit 2 generates additional pre-determined steps to drive the gear wheel 16 and the shaft 24 to reach a definite reference position of the second hand which differs from the position in which the non-transparent zone 84 of the gear wheel 16 is aligned with the downstream direction 82 of the IR-beam 40.

[0017] In a following step the gear wheel 18 is driven by the stepper motor 10 to rotate the minute shaft 26. The gear wheel 18 is rotated until the IR-beam 40 transmitted by the IR-transmitter 32 is blocked by the non-transparent zone 86 provided in the gear wheel 18 and thus interrupting the reception of the IR-beam 40 by means of the IR-receiver 34. At this moment, the micro-controller unit 2 is eligible to determine the absolute position of the gear wheel 18 and thus of the shaft 26 and its associated minute hand. Then the micro-controller unit 2 generates additional pre-determined steps to drive the gear wheel 18 and the shaft 26 to reach a definite reference position of the minute hand which differs from the position in which the non-transparent zone 86 of the gear wheel 18 is aligned with the downstream direction 82 of the IR-beam 40.

[0018] The operation sequence described above is similar for the hour and alarm shafts and associated hands. Having set the hour and the alarm hands to their reference positions the time adjusting procedure is concluded in a final step in which all of the hands are moved into positions according to the received radio time signal. Accordingly the second shaft 24 is driven by its gear wheel 16 and stepper motor 8 after the micro-controller unit 2 has generated a number of pulse signals that corresponds to the angular rotation of the second hand and the second shaft 24 moving from its reference position to the position according to the received time signal. This time setting procedure is either repeated for the minute, hour and alarm shafts 26, 28 and 30 and respective hands or alternatively carried out simultaneously to the setting of the second hand.

Claims

1. Radio controllable clock comprising an analogue display having at least two hands each associated to a gear wheel (16, 18, 20, 22), optical means (32, 34) comprising elements for transmitting and receiving a light beam (40) for detecting a position of each hand by means for interrupting the beam path (82) with respect to the angular position of the gear wheels (16, 18, 20, 22), a driving unit (8, 10, 12, 14) for each gear wheel (16, 18, 20, 22) for adjusting the position of the hand in accordance with a received radio time or reset signal, and a micro-controller unit (2) for controlling the driving units (8, 10, 12, 14), **characterized in that** a single light receiving element (34) is provided.

2. Radio controllable clock according to claim 1, **characterized in that** transparent gear wheels (16, 18, 20, 22) are provided with non-transparent zones (84, 86, 88, 90).

3. Radio controllable clock according to claim 2, **characterized in that** the non-transparent zones (84, 86, 88, 90) are integrated into or provided on the surface of the transparent gear wheels (16, 18, 20, 22).

4. Radio controllable clock according to one of the preceding claims, **characterized in that** each of the hands is associated to a separate gear wheel and each of the gear wheels is driven by a seperate driving unit.

5. Radio controllable clock according to one of the preceding claims, **characterized in that** the driving units are stepper motors.

6. Method for adjusting the position of a radio controllable clock according to any of the preceding claims, **characterized in that** a position of one of the hands is detected in a first step by means for interrupting the beam path with respect to the angular position of the respective gear wheel (16, 18, 20, 22), that the position of the hand is adjusted to a predetermined reference position in a second step, that the first and second steps are completed for one hand before proceeding with the first step for another hand and that the first and second steps are completed for all hands before the position of all hands is adjusted in accordance with a received radio time or reset signal in a final step.

Fig. 1

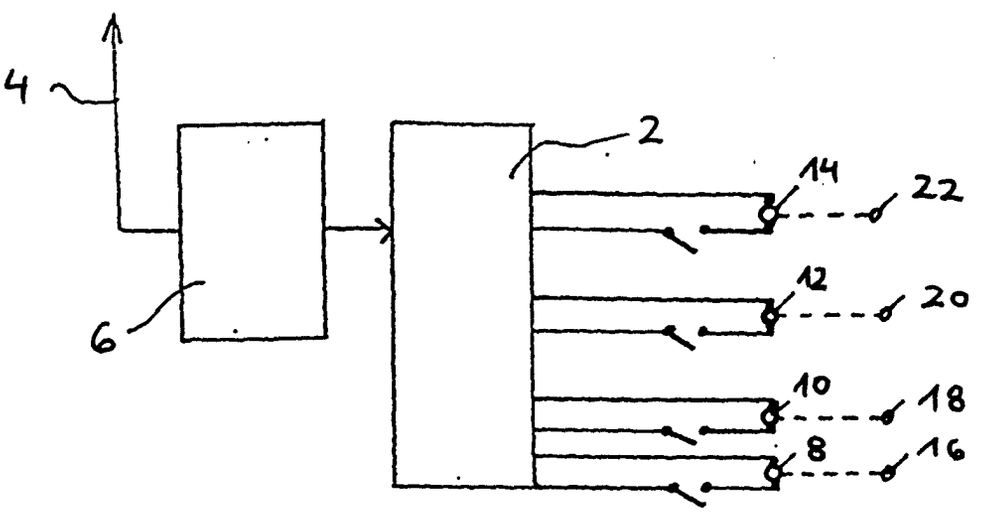
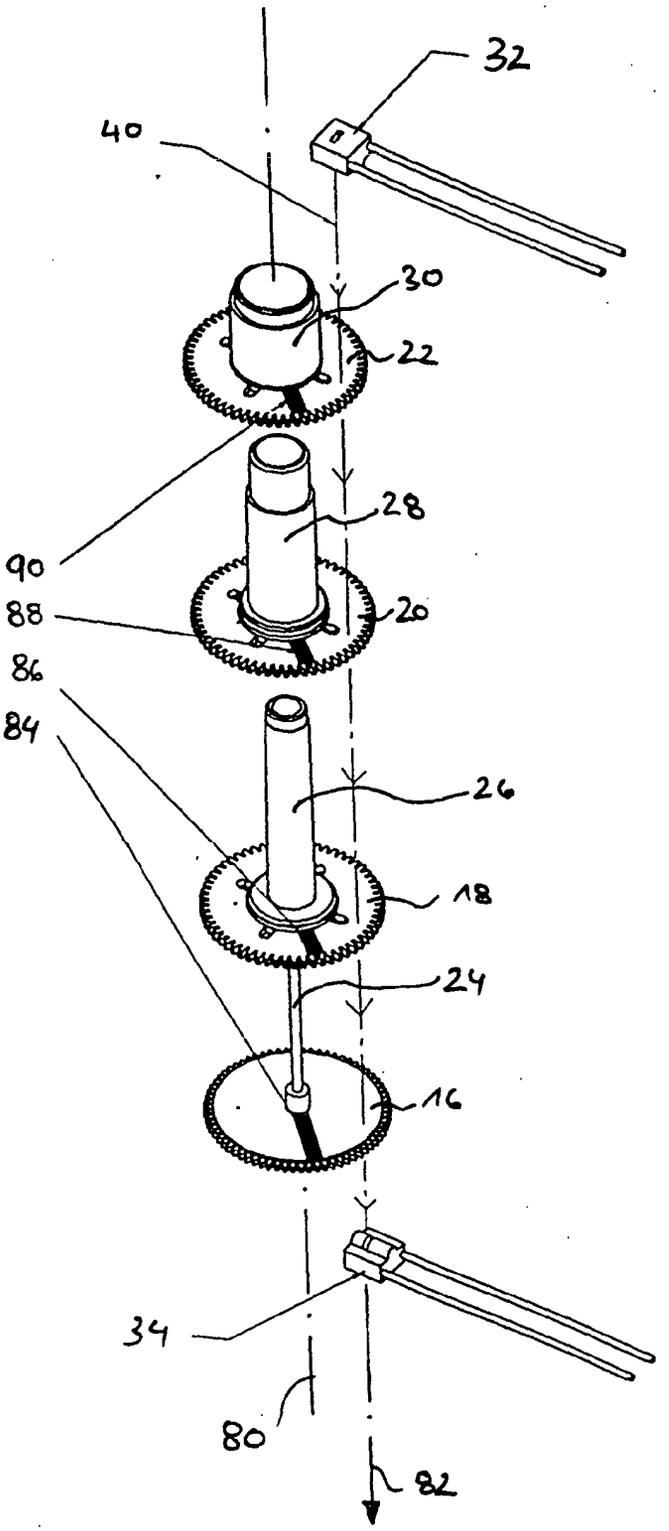


Fig. 2



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EUROPEAN SEARCH REPORT

Application Number
EP 02 01 3918

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X	DE 35 13 961 A (FORSCHUNGSGESELLSCHAFT FUER FEINGERAETE- MIKRO- UND UHRENTECHNIK E.V.) 23 October 1986 (1986-10-23) * page 4, line 23 - page 5, column 33; figure 1 *	1-6	G04C3/14 G04C13/02
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TECHNICAL FIELDS SEARCHED (Int.Cl.7)

G04C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	2 December 2002	Exelmans, U

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 02 01 3918

This annex lists the patent family membersrelating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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