

Description

The invention relates to a radio-controlled clock according to the preamble to Claim 1.

Such a radio-controlled clock is known from DE-A-30 43 867. The problem of detecting an item of time information in the poorly received radio signal should be improved there in that the current, most likely known items of partial information are given by hand, so that only with regard to the data which changes more quickly and therefore is not immediately available is a deduction necessary from the demodulated and decoded item of radio information, which aids the correlation comparison of the items of time information. The uncritical range of information always includes the year, since the user of the clock is usually familiar with the year in which he is actually living. Also the current month and the present date together with the day of the week should be familiar and are therefore put into the clock by hand. What the actual hour is, or indeed the actual minute, may well be less certain and in any case the actual precise second must be obtained from the radio information for continuous operation of the clock. If the manual data could then also be confirmed by way of radio (and corrected as necessary), then the possibility of manual intervention in the actual time representation is blocked and only released again when, following an interruption in operation, the radio-controlled clock has to start again under unfavourable receiving conditions. The differing items of time information transmitted via radio, i.e. particularly for operating the clock in adjacent time zones, are not considered in that publication.

Therefore a radio-controlled clock is not to be interpreted for instance as a receiver (which can for example also be worn on the wrist) for the broadcasting of radio or television programmes or for personal-call systems which can also be fitted with a clock; rather with a radio-controlled clock of the generic type it is a

question of a receiver, which is positively tuned for periodical reception of coded absolute items of time information to at least one transmitter (always in the long-wave range) in order to determine a time display from the decoded information. With an autonomous radio-controlled clock, an internal timekeeping circuit is also provided to step on the time display when - the battery-operated radio-controlled clock being for instance switched off to save energy or by reason of interference in radio transmissions - no valid time information is received.

The function of the clock known from JP-A-53 003 870 (according to Patent Abstracts of Japan, Vol. 2, No. 40 (E-78, 16.03.1978)) actually differs from this ordinary radio-controlled clock insofar as there it is really only a matter of a traditional electronic clock; with the special feature that, for checking and possibly correcting the current time display, the user can briefly switch by hand to a transmitter for reception and decoding of absolute items of time information broadcast by radio. Of course this gives him the wrong time information if the particular transmitter is not coded for that time zone in which the clock is presently working. Also with DE-A-25 30 985, it is not so much a matter of a generic radio-controlled clock in the stricter sense, when the clock built into a computer only produces a time display when the receiver is expressly switched on for that purpose and actually receives a useful item of time information. When the computer is switched off, all time information is also cleared again.

A radio-controlled clock basically does not need any operating component whatsoever, since, with provision of the operating power, the receiver is switched on in order to set the display of the internal autonomous timekeeping and correct it from time to time as necessary, as is for instance explained with reference to the time-telegram in the circuit specification U. Berger "DCF-77 Timepiece with Microprocessor" in FUNKSCHAU Vol. 50 No. 12 dated June 1978, Pages 579 to 582. If EP-A-0 308 881 is nonetheless fitted with manually operable key switches then

their purpose is not to influence the time display controlled by radio but only to give an alarm time and to switch off a signal triggered when this time is reached.

In accordance with JP-A-61 144 588 according to Patent Abstracts of Japan, Vol. 10 No. 341 (P-517)(2397), 18.11.1986, an electronic clock can for instance, on its delivery from the factory until its sale to the end customer, be put into an inactive state to preserve the battery, in that the predetermined rhythm of a manual key operation is sensed for a time evaluation.

However, the invention is based on the objective of improving a radio-controlled clock of the generic type as to its end purpose in that, as a functionally efficient small portable clock, for instance in the form of a travelling alarm clock or a wristwatch, it overcomes the basic user problems which inevitably occur with its operation outside of that geographical time zone for which the particular received time-telegram transmitter is operated.

This objective is achieved according to the invention by a radio-controlled clock with the features of Patent Claim 1.

This invention allows a switching over to a time display of equal accuracy but in adjacent time zones and finally also the operation as well as even the starting-up of the clock itself far outside of the transmitter-related time zone without any fear that, due to accidental or playful switching-on of the receiver, an item of time information which is not really useful falsifies the previously still accurate time display. At the same time the switching device provided for this time zone switch-over allows the clock, in a way known in itself, to be put into its highly energy-saving inactive state by manual operation of a key, from which state it can then be returned, by simply pressing a key, to the normal operating state with automatic tuning in to the received actual standard time.

Further alternatives and developments as well as further features of the invention are made clear, also bearing in mind the statements in the summary, from the following description of a preferred embodiment of the invention as represented in the drawing, this being reduced and limited to the essential points; and, for easier understanding, the assembly connections themselves are not mentioned in the description of the drawing, only in each case the signals entering or leaving.

The single illustration shows, in a symbolically simplified way, a small, autonomous radio-controlled clock 11, for instance taking the form of a wristwatch, with receiver 12 positively tuned - and if necessary retunable - to a time-telegram transmitter. This is supplied from an aerial 13, in which respect it can be a matter of a magnetic aerial 13 with aerial coil on a flexible core, stored in a watchstrap (not shown) connected to the casing 20. The absolute time information 14 given out by the receiver 12, after demodulation of the signal received by radio, is delivered into a register 15, which is then stepped on from an internal, autonomous timekeeping circuit 16, in order periodically to supply control signals 17 for the clock time display device 18. This can be designed as electro-optical display or as electromechanical display device for the presentation of analogue or digital information. In the case of an electromechanical display device 18, this supplies a repeating signal 19 as to the present display position (that is for instance the present angular position of hands or the positioning of digit drops) in order, in the event of a deviation from the time information currently contained in the time store 35, to trigger a correction of the display by means of the register 15, such as is known with generic radio-controlled clocks.

Moreover the radio-controlled clock casing 20 is equipped with a manually accessible and operable multi-function switching device 21 which preferably comprises three separately operable push-buttons 22. Their actual operation combination is decoded in a decoder 23 and serves to activate the previously mentioned functional elements of the radio-controlled clock 11.

Thus a test cycle can be carried out by way of this switching device 21, possibly in the course of the quality control on completion of manufacture, this test being of particular interest when using an electro-optical display device 18. For this purpose the decoder 23 delivers a test signal 24, when two push-buttons 22 (possibly the top one and the bottom one) are pressed simultaneously and at the same time the remaining third push-button 22.2 is also briefly pressed - hence an operation of the switching device 21 takes place, which can in no circumstances happen accidentally and, by reason of the flush-mounted push-button 22, is best carried out by means of an appropriate multiple-die tool (not shown). The test signal 24 results in a counting signal 24' which counts through all display elements of the electro-optical display device.

After successful testing on completion of production, in order to minimize the power consumption of such a battery-operated clock 11, its entire circuit arrangement is put into an "inactive" mode, in that by simultaneously operating two push-buttons, for instance 22.2 and 22.3, an economy signal 25 is given out by the decoder 23. This results in the function of the radio-controlled clock being switched off. On the display device 18, however, a corresponding item of information appears in order to make it clear that the clock or its display device 18 are not defective. Returning to the operational state is simple in that any one of push-buttons 22 is briefly operated.

In order to ensure a definite operational start-up, the entire evaluating circuit is then usefully first set in a definite initial state; which likewise should not take place inadvertently, for which reason only a multi-button operation of for instance push-buttons 22.1 and 22.2 gives rise to the so-called system reset 26. In this way not only are all stores cleared, but in particular a processor, by means of which the register 15 and the decoder 23 are controlled, is set in a definite programme starting state for faultless starting in the programme sequence.

When starting up (from the economizing inactive mode or for instance as a result of a battery replacement for the operation of the clock 11), a switch-on signal 27 is delivered to the receiver 12 and a flashing display 28 signalling the receiving operation is activated. In this way the internal timekeeping circuit 16 also starts up so that an internal item of time information is counted up on the display device 18 (particularly its seconds display). However, as soon as the receiver 12 delivers a useful item of time information 14, the display device 18 switches over to a special region 29 (such as for example the calendar display) for its presentation, in order thus to indicate that an item of time information 14 received by radio has indeed been presented - but not as yet an absolutely reliable item of time information 14. Only when a current absolute item of time information 14 appears, confirmed by means of a comparison with successive items of time information, is this complete information presented henceforth in the normal time-displaying region 30 of the display device 18, i.e. in the case of an electro-optical digital display by digital representations of the hours, minutes and seconds. Consequently the receiver switch-on signal 27 disappears again but the internal timekeeping circuit 16, once started, continues to function. When the receiver 12 is switched off, the receiving display 28 also disappears, and the presentation of information on the normal display region 30 is now stepped on from the internal timekeeping circuit 16. However, at specific times predetermined in the register 15, such as for instance each day at 2 a.m., a new switch-on signal 27 is given, in order to correct as necessary the current time presentation in the normal region 30 of the display device 18 if it should deviate from the absolute time ascertained by radio.

The reception range of the receiver/aerial combination 12/13 typically extends not only over the time zone in which the time-telegram transmitter (such as for instance the transmitter DCF 77) is installed and to which the receiver 12 is tuned, but also even far into the adjacent geographical time zones on either side.

In order with the time display to leave the geographical time zone, to whose time-telegram transmitter the receiver 12 is tuned, only the currently indicated hours - with unaffected stepping-on of the presentations of minutes and seconds - need be counted up or down in hourly stages. This can take place by means of correspondingly frequent operation of the push-buttons 12.3 or 12.1, which switch corresponding hour-addition or subtraction signals 31, 32 by way of the register 15 to the time store 35 for the display device 18.

When staying in an adjacent time zone as regards the transmitter, with each newly received item of time information 14, it switches back to the hour time display according to the original time zone, which then if necessary has to be manually corrected as described by operating a push-button 22.3 or 22.1. However, on the other side of the time zones which are adjacent on either side, the probability is minimal that the receiver 12 can still supply useful items of time information 14. In order to eliminate erroneous displays or display misinterpretations or even unnecessary display interruptions during attempts at reception which are probably useless, a blocking signal 33 is therefore delivered to the receiver 12, which puts this out of operation as long as the manually adjusted hour display deviates by more than one hour from that which would be correct according to the time information 14 in the locality of the transmitter.

This blocking of the receiver 12 in the power-saving switched-off position can be cancelled in that either the manual adjustment of the hour display is reversed again by way of push-buttons 22.1 or 22.3; or the time store 35 containing this hour adjustment in the register 15 is reset in its initial zero state in that a restart is effected corresponding to the start-up described above (by inserting the battery or by terminating the inactive mode). However this resetting of the time store 35, with clearing of the display 18, can also always be achieved in that one of the push-buttons 22.2 is kept

pressed in over a specific minimum period of time, which can be sensed by a time switch-point 34 in the decoder 23. In this event, this delivers a reset signal 36 to the time store 35, by means of which at the same time the blocking signal 33 can be cancelled. When the push-button 22.2, operated over the relevant minimum period of time, is released, the presentation in the normal display region 30, controlled from the internal timekeeping circuit 16, begins to count up. Subsequently only the current hour display still has to be set up by means of the manually produced addition or subtraction signals 31, 32. Thus, on acoustic pick-up of an hour time marker transmitted for example by way of a programme radio network, the start of the minute and second display for the full hour can be manually started, precise as to the second, if at the time of starting up the clock there is no contact with the appropriate transmitter by reason of temporarily unfavourable receiving conditions. However the switched-on receiver 12 endeavours to replace this manual-start display as soon as possible with a confirmed absolute item of time information 14.

If, on the other hand, during normal operation of the radio-controlled clock 11, this reset push-button 22.2 is only briefly operated, the time switch-point 34 delivers instead a switch-on signal 27' acting on the receiver 12. This so-called "transmitter call" does clear the presentation in the normal region 30 of the display device 11, but the time store 35 is not reset but stepped on from the autonomous timekeeping circuit 16. If the receiver 12, now switched on, delivers an item of time information 14, which is plausible when compared with the updated time information in the store 35 or when compared with an item of time information 14 previously received, this is accepted in the time store 35 for display. Otherwise, the internally stepped-on item of time information is again passed from the store 35 to the display device 18 if, over a certain predetermined receiving period, the receiver 12 is unable to deliver a plausible item of time information 14 by reason of for example radio transmission conditions. Thus the absolute accuracy of the item of time information then displayed

again has not of course been confirmed by radio, but is nevertheless given with a sufficiently high degree of probability, since it involves information from the earlier, internally continuing time display; without the time presentation being definitely interrupted (until the receiver 12, being periodically switched on, once again delivers a correct item of time information 14). This display reset function, which is triggered by way of the "transmitter call" key 22.2, is however usefully forestalled with manual hour adjustment on the other side of the adjacent time zones by means of a blocking signal 38 since, as mentioned, a sufficiently reliable reception of radio time-telegrams is no longer to be expected there anyway.

The display device 18 usefully also has a control display 37, on which there appears as applicable a numerical indication, from the register, of the period (for example the number of days) during which the automatic brief switching-on of the receiver 12, which takes place periodically at night by means of a switch-on signal 27", does not lead to the decoding of a useful current item of time information 14. However this control display 37 is also counted up by one unit each time the receiver 12 is set in operation by the so-called "transmitter call key" - the push-button 22.2 - by way of the manual switch-on signal 27'; the receiver 12 is then however switched off again without obtaining a real item of time information 14 after a certain period of operation in order to save power. If the display volume of the control display 37 is fully counted up with one-place digital display, i.e. after nine useless switchings-on of the receiver, the highest display remains. It is reset at zero when the automatic or manual switching-on of the receiver again leads to the acquisition of a useful item of time information 14.

The control display 37 can be structurally combined with the receiving display 28, in that the control numbers are allowed to flash if and as long as the clock 11 is receiving. In order to avoid possible confusion, it is expedient for the control display 37 to be also subsequently completely switched off, when it would indicate "zero", since the current time display was able to be confirmed during a former switching-on of the receiver.



Patent Claims

1. A small-size autonomous radio-controlled clock (11), in particular in the form of a small travel alarm or wrist-watch, with a receiver (12) for coded items of time information (14) for controlling a display device (18) which, with the receiver (12) switched off, is stepped on from an internal timekeeping circuit (16), and with pushbuttons (22) for manually influencing the content of the display device (18), characterized in that a manual hours-display adjustment is provided and, in the event of more than one hour's deviation from the items of time information (14) received by radio, an otherwise automatically recurring switching-on of the receiver (12) is blocked.
2. A radio-controlled clock according to Claim 1, characterized in that, upon manual adjustment of the hours display by more than one hour's deviation from the items of time information (14) received by radio, only a complete manual system reset (restart) is possible but not a manual switching on of the receiver with internal continuation of the time register (transmitter call).
3. A radio-controlled clock according to Claim 2, characterized in that associated with a reset pushbutton (22.2) is a time switch-point (34) for the discrimination of the exceeding or falling below of a specific actuation period of time which, in the event of not more than one hour's deviation from the items of time information (14) received by radio, in response to brief pushbutton actuation, only temporarily clears the display device (18), but not its time store (35) stepped on from the internal timekeeping circuit (16), but in response to lengthy pushbutton actuation gives rise to a complete system reset (26) into the operational initial position of the entire circuit system including its processor programme for the time evaluation.



4. A radio-controlled clock according to Claim 3, characterized in that it is equipped with a multi-function switching device (21) with several push-buttons (22), one of which is the reset pushbutton (22.2), by way of which the clock (11) can also be switched into a current-saving storage state and back out of this again for the start-up of the clock (11).
5. A radio-controlled clock according to Claim 4, characterized in that, when it starts up, the items of time information stepped on from the internal timekeeping circuit (16) are initially displayed in the display device (18), whereupon the display (18) switches over to a special region (29) for the presentation of the first items of time information (14) ascertained by radio, upon confirmation of which by subsequent items of time information (14) ascertained by radio the time display is transferred into the region of the display device (18) provided for this.