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(54) Radio controlled analogue display clock with digital projection

(57) A radio controlled clock includes a primary micro-control unit receiving radio signals, a mechanical analogue time display controlled by the primary micro-control unit to display time, a secondary micro-control unit receiving pulse signals from the primary micro-control unit, and a digital time display controlled by the secondary micro-control unit to display time. The clock further comprises a light emitter and photo-coupler associated with the mechanical analogue time display and the primary micro-control unit to transmit a zero signal to the secondary micro-control unit.

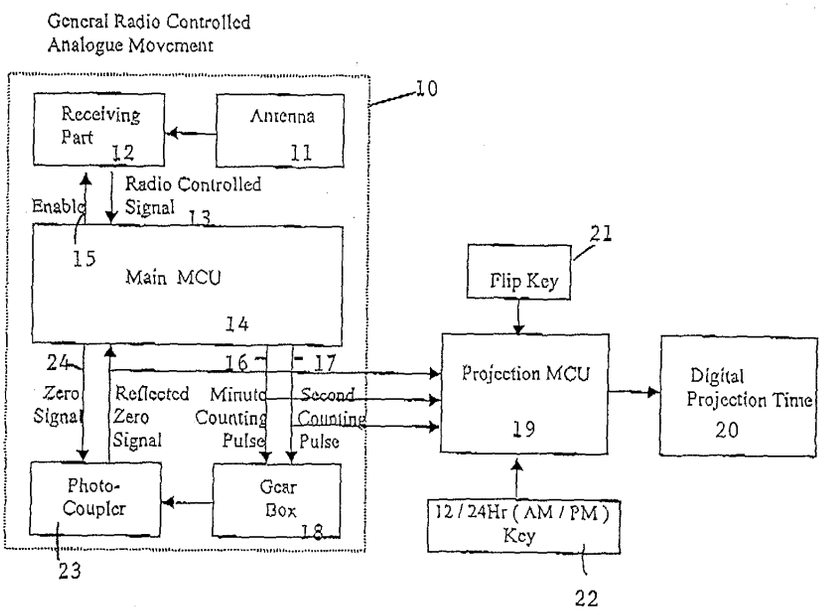

FIGURE 1

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Description

Background of the Invention

[0001] The present invention relates to a remotely controlled analogue display clock with digital projection of a time display. More particularly, although not exclusively, the invention relates to a digital clock having a primary micro-control unit receiving remote radio signals and sending pulses to a gearbox of an analogue time display as well as sending pulses to a secondary micro-control unit for displaying time digitally.

[0002] Micro-control units for radio controlled digital clocks are expensive. On the other hand, micro-control units for standard digital clocks are inexpensive.

[0003] It is known to project a digital time read-out onto a wall or ceiling. Radio controlled digital clocks having analogue time read-outs are also known. In proposing a radio controlled digital clock having an analogue display as well as a projected digital display, one is faced with the problem of duplicated costs in the expensive micro-control units.

Object of the Invention

[0004] It is an object of the present invention to overcome or substantially ameliorate the above disadvantage and/or more generally to provide a low-cost radio controlled analogue display clock with digital projection.

Disclosure of the Invention

[0005] There is disclosed herein a radio controlled clock comprising:

a primary micro-control unit receiving radio signals,
a mechanical analogue time display controlled by the primary micro-control unit to display time,
a secondary micro-control unit receiving pulse signals from the primary micro-control unit, and
a digital time display controlled by the secondary micro-control unit to display time.

[0006] Preferably the clock further comprises a light emitter and photo-coupler associated with the mechanical analogue time display and the primary micro-control unit to transmit a zero signal to the secondary micro-control unit at 12 o'clock.

[0007] Preferably the clock furt comprises a gearbox associated with the mechanical analogue time display and the primary micro-control unit, the gearbox adapted to transmit minute counting pulses to the secondary micro-control unit.

[0008] Preferably the gearbox is further adapted to transmit second counting pulses to the secondary micro-control unit.

[0009] Preferably the light emitter comprises an LED and the photo-coupler comprises a photo transistor adapted to receive light of the LED reflected from a minute hand of the mechanical analogue time display at a 12 o'clock position.

[0010] Preferably the mechanical analogue time display further comprises coaxial hour, minute and second gears wherein the hour and minute gears each comprise a slot at a 12 o'clock position and the second gear comprises a reflective mirror at a 12 o'clock position and wherein the slots and the reflective mirror are aligned with the light emitter and photo transistor at 12 o'clock.

[0011] Preferably the digital time display is projected onto a remote surface.

Brief Description of the Drawings

[0012] A preferred form of the present invention will now be described by way of example with reference to the accompanying drawings, wherein:

Figure 1 is a schematic block diagram showing functional specifications of a radio controlled analogue display clock with digital projection of

Figure 2 is a schematic flowchart showing operation of the clock,

Figure 3 is a schematic illustration of an analogue time display with its hour, minute and second-hands aligned at a 12 o'clock position,

Figure 4 is a schematic illustration showing an optical arrangement for determining alignment of the hour, minute and second-hands,

Figure 5 is a graph showing minute and second counting pulses (positive terminal),

Figure 6 is a graph showing minute and second counting pulses (negative terminal),

Figure 7 is a graph showing a zero signal,

Figure 8 is a graph showing a reflected zero signal at 12 o'clock,

Figure 9 is a schematic block diagram showing functional specifications of the clock,

Figure 10 is another schematic block diagram, and

Figure 11 is a schematic circuit diagram for the clock.

Description of the Preferred Embodiment

[0013] In Figure 1 of the accompanying drawings there is depicted schematically in block diagram form a general radio controlled analogue movement 10 com-

prising an antenna 11 and a receiver 12. The receiver 12 transmit a radio controlled signal 13 to a primary micro-control unit 14 after having received and enables signal 15. The primary micro-control unit transmits minute counting pulses 16 and second counting pulses 17 to a gearbox 18 and a secondary micro-control unit 19. The secondary micro-control unit 19 is an inexpensive off-the-shelf item as produced by many manufacturers.

[0014] The secondary micro-control unit 19 transmits signals to a digital time projector 20 for displaying the time on a bedroom ceiling or wall for example. There is a flip key 21 and a 12/24-hour key 22 associated with the secondary micro-control unit.

[0015] Associated with the primary micro-control unit 14 is a photo-coupler 23 to be described with reference to Figures 3 and 4. Suffice to say the time being that the photo coupler receives a zero signal from the primary micro-control unit and reflects that back to the primary micro-control unit and the secondary micro-control unit, only when the hour hand of the analogue display clock points to 12.

[0016] In Figure 2 there is illustrated the logic steps associated with the electronics of the clock. At the beginning, a battery is installed into the clock. The primary micro-control unit resets the hour, minute and second hands to 12 o'clock. The photo coupler produces a reflected zero signal to the primary micro-control unit. Concurrently, the secondary micro-control unit receives the zero signal and resets its display to "12:00".

[0017] The analogue movement begins receiving radio signals from a remote transmitter via its antenna 11. If a radio signal is received, the analogue movement will transmit counting pulses to the gearbox 18. The hour, minute and second hands will commence moving to display correct time. The secondary micro-control unit also receives counting pulses to calculate hours, minutes and seconds to be displayed. The analogue movement and the digital display both show the correct time synchronously.

[0018] After receiving the radio signals, the digital clock will aligned every 12 hours by using the zero signal from the analogue movement.

[0019] The 12/24 hour key 22 can be used to change the digital projection time in either 12 or 24-hour format. If it is held for three seconds say, the digitally projected time will include and "AM" or "PM" display.

[0020] The "flip key" 21 can be used to turn the projected time through 180 degrees for convenience of projection.

[0021] In Figure 3, there is shown an analogue mechanical clock face 30 having its hour, minute and second hands aligned at 12 o'clock. The gears of the analogue display clock and associated hardware are shown in Figure 4. There is a light emitting diode 31 that receives a zero signal 24 from the primary micro-control unit. The LED 31 emits a beam of light through a slot 32 in an hour gear 33 only when the hour hand is that the 12 o'clock position. The beam of light then passes through a slot 34 in a minute gear 35, but only when the minute gear is that the 12 o'clock position. The second gear 36 has a reflective mirror 37 at the 12 o'clock position. When all three gears are at the 12 o'clock position, the beam of light emitted by the LED 31 is reflected back through the slots 32 and 33 to a phototransistor 37. The phototransistor in turn relays a reflected zero signal 38 to the primary micro-control unit 14 and the secondary micro-control unit 19.

[0022] Figures 5, 6, 7 and 8 show pulse signals applicable on the various conditions as described above. When the primary micro-control unit receives radio signals via its antenna, it will transmit a number of minute and second counting pulses to the gearbox. The number of minute counting pulses = (3 x 60) + 15 = 195 minute counting pulses. The number of second counting pulses = 0 (no second counting pulses) so the secondary micro-control unit will capture the correct number of minute and second counting pulses to calculate what the time is and synchronised directly with the by Mary micro-control unit.

[0023] Then the secondary micro-control unit will be counting up for the seconds display passed to the gearbox e.g. "03:15:01". However, the secondary micro-control unit calculates its own seconds.

[0024] Every 60 seconds the primary micro-control unit transmits minute counting pulses to the gearbox for driving the minute step motor. The secondary micro-control unit can then use the minute counting pulses to check and synchronised the projected digital time with that of the primary micro-control unit.

[0025] The flowcharts of Figures 9 and 10 will not be described in detail. Suffice to say that the secondary micro-control unit captures reflected zero signals, minute counting pulses and second counting pulses as described. The reflected zero signal is used to resets all counters and register to 12:00:00. The minute counting pulses used to counter the minutes and hours. The second counting pulses used to counter the seconds only.

Claims

1. A radio controlled clock comprising:

   a primary micro-control unit receiving radio signals,
   a mechanical analogue time display controlled by the primary micro-control unit to display time,
   a secondary micro-control unit receiving pulse signals from the primary micro-control unit, and
   a digital time display controlled by the secondary micro-control unit to display time.

2. The clock of Claim 1 further comprising a light emitter and photo-coupler associated with the mechan-

ical analogue time display and the primary micro-control unit to transmit a zero signal to the secondary micro-control unit at 12 o'clock.

3. The clock of Claim 2 further comprising a gearbox associated with the mechanical analogue time display and the primary micro-control unit, the gearbox adapted to transmit minute counting pulses to the secondary micro-control unit.

4. The clock of Claim 3 wherein the gearbox is further adapted to transmit second counting pulses to the secondary micro-control unit.

5. The clock of Claim 2 wherein light emitter comprises an LED and the photo-coupler comprises a photo transistor adapted to receive light of the LED reflected from a minute hand of the mechanical analogue time display at a 12 o'clock position.

6. The clock of Claim 2 wherein the mechanical analogue time display further comprises coaxial hour, minute and second gears wherein the hour and minute gears each comprise a slot at a 12 o'clock position and the second gear comprises a reflective mirror at a 12 o'clock position and wherein the slots and the reflective mirror are aligned with the light emitter and photo transistor at 12 o'clock.

7. The clock of Claim 1 wherein the digital time display is projected onto a remote surface.

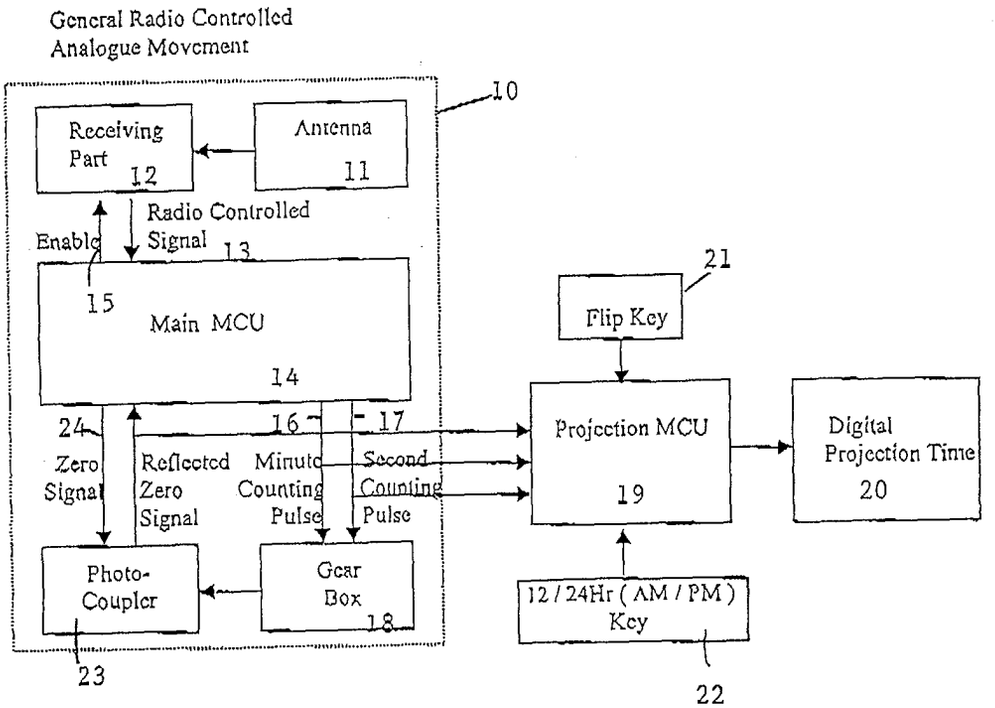
General Radio Controlled
Analogue Movement
10
Receiving Part
12
Antenna
11
Radio Controlled Signal
13
Enable
15
Main MCU
14
21
Flip Key
Projection MCU
19
Digital Projection Time
20
24
16
17
Zero Signal
Reflected Zero Signal
Minute Counting Pulse
Second Counting Pulse
Photo-Coupler
Gear Box
18
12 / 24Hr (AM / PM) Key
23
22

FIGURE 1

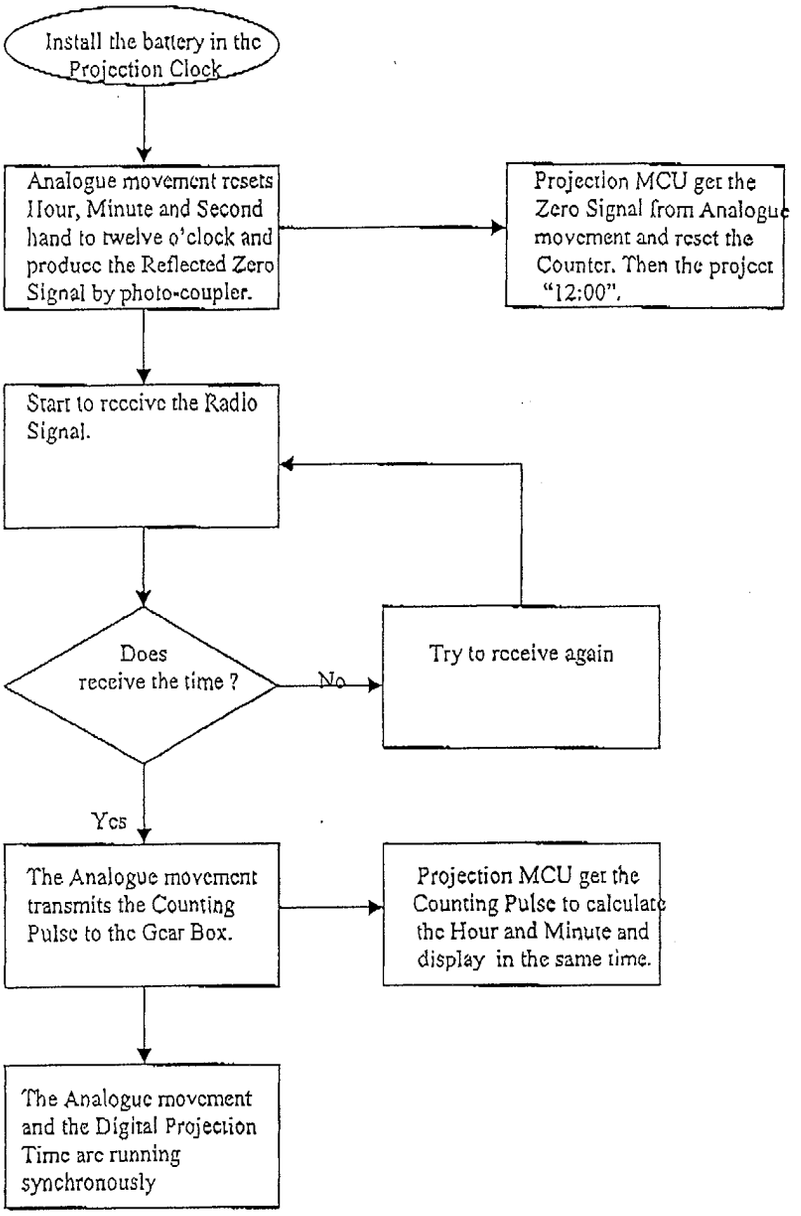
Install the battery in the Projection Clock
Analogue movement resets Hour, Minute and Second hand to twelve o'clock and produce the Reflected Zero Signal by photo-coupler.
Projection MCU get the Zero Signal from Analogue movement and reset the Counter. Then the project "12:00".
Start to receive the Radio Signal.
Does receive the time ?
No
Try to receive again
Yes
The Analogue movement transmits the Counting Pulse to the Gear Box.
Projection MCU get the Counting Pulse to calculate the Hour and Minute and display in the same time.
The Analogue movement and the Digital Projection Time are running synchronously

FIGURE 2

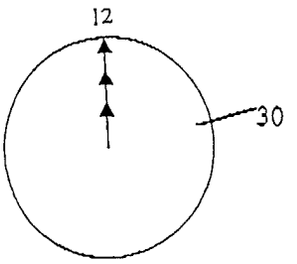

FIGURE 3

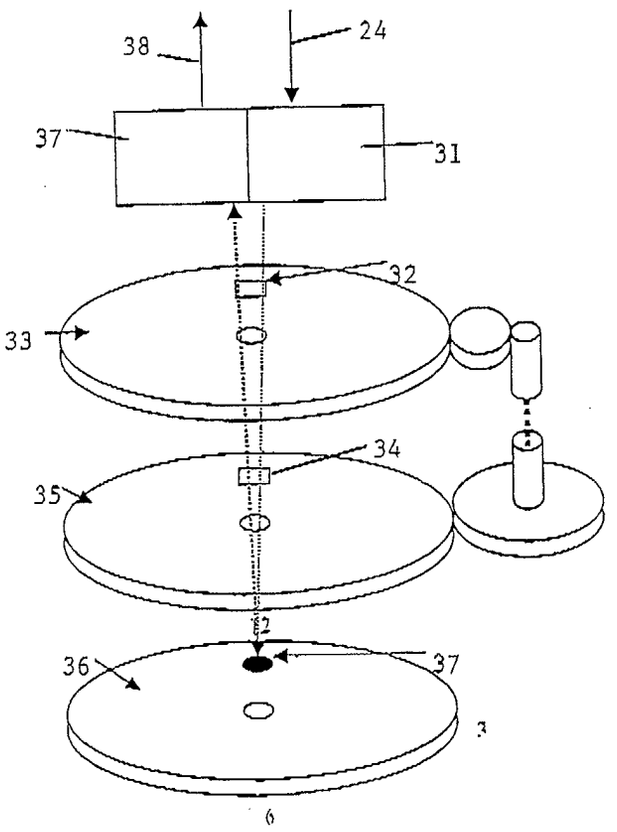

FIGURE 4

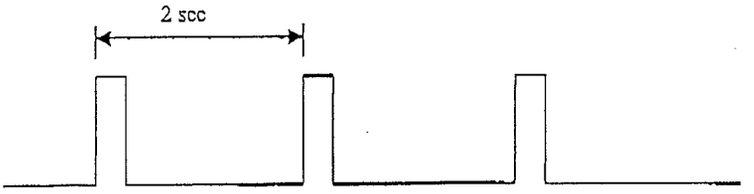

FIGURE 5

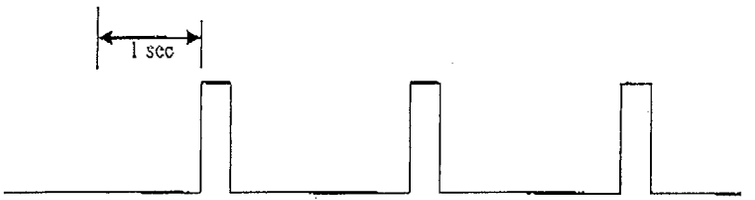

FIGURE 6

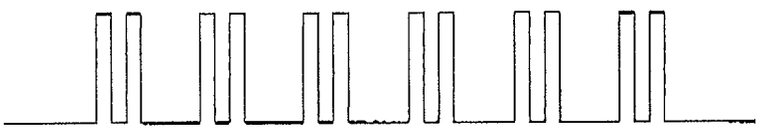

FIGURE 7

FIGURE 8

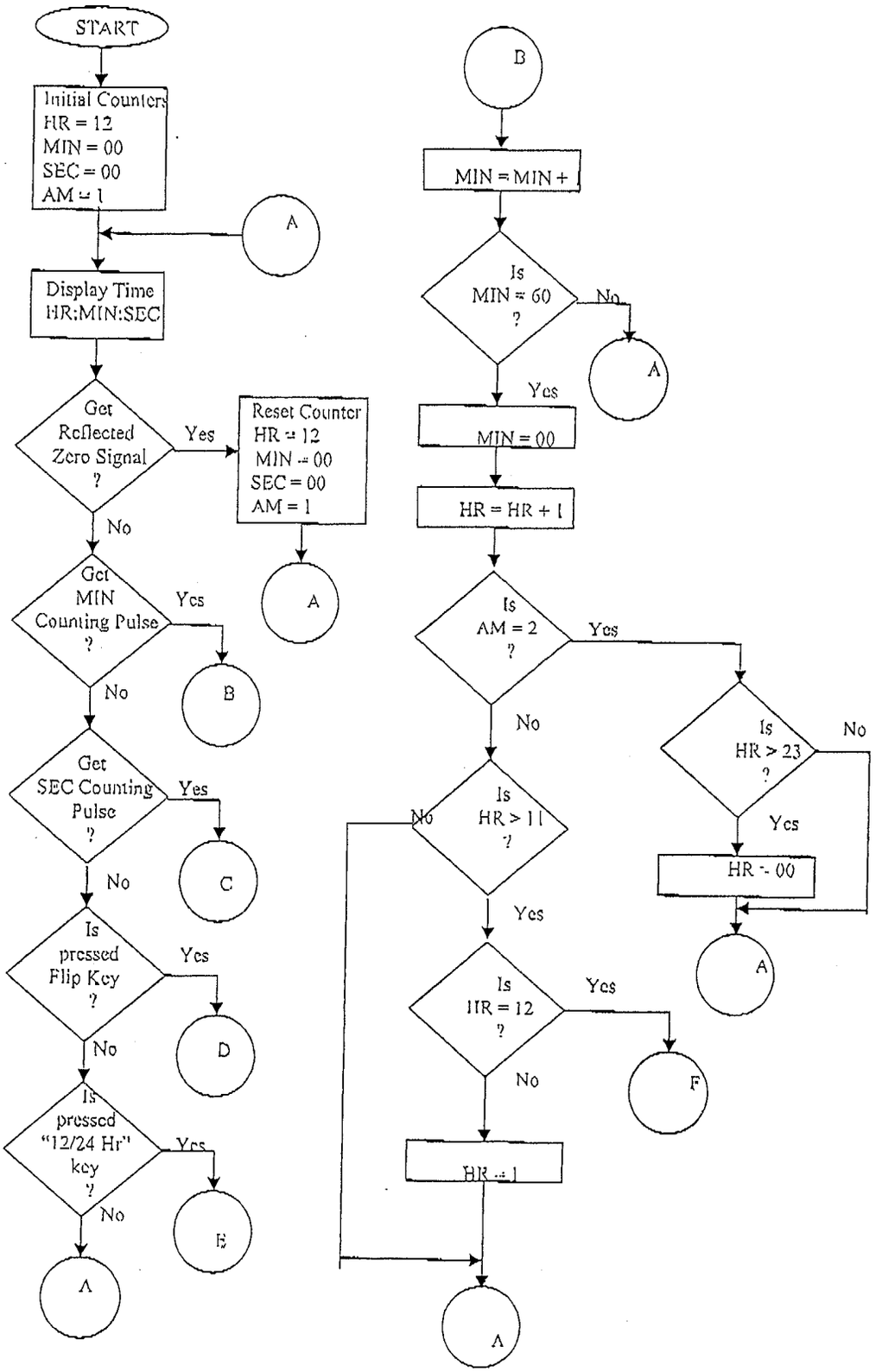
START
Initial Counters
HR = 12
MIN = 00
SEC = 00
AM = 1
A
Display Time
HR:MIN:SEC
Get Reflected Zero Signal ?
Yes
Reset Counter
HR = 12
MIN = 00
SEC = 00
AM = 1
A
No
Get MIN Counting Pulse ?
Yes
B
No
Get SEC Counting Pulse ?
Yes
C
No
Is pressed Flip Key ?
Yes
D
No
Is pressed "12/24 Hr" key ?
Yes
E
No
A
B
MIN = MIN + 1
Is MIN = 60 ?
No
A
Yes
MIN = 00
HR = HR + 1
Is AM = 2 ?
Yes
No
Is HR > 11 ?
No
Yes
Is HR = 12 ?
Yes
F
No
HR = 1
A
Is HR > 23 ?
No
Yes
HR = 00
A

FIGURE 9

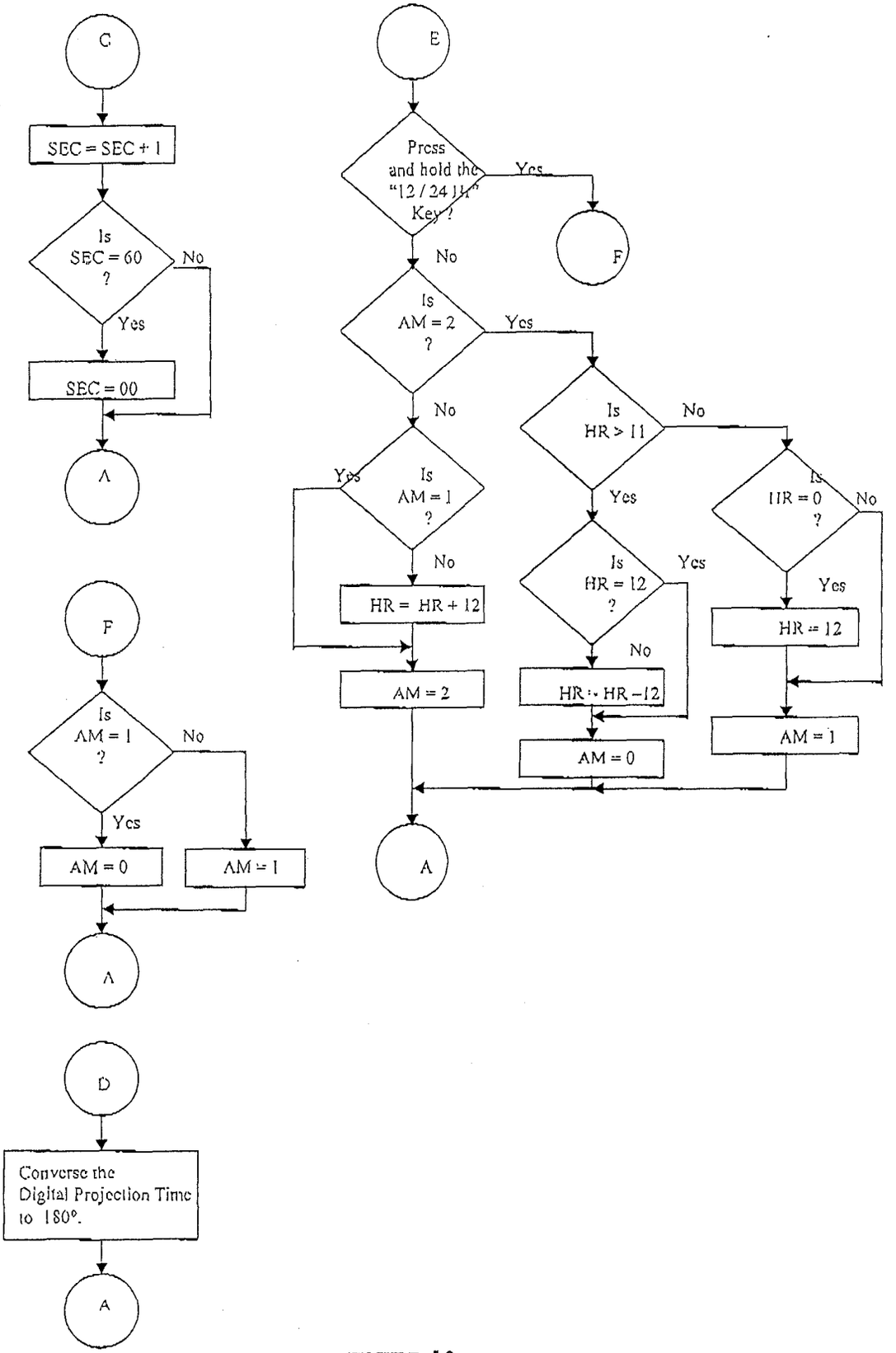
C
SEC = SEC + 1
Is SEC = 60 ?
No
Yes
SEC = 00
A
E
Press and hold the "12 / 24 H" Key ?
Yes
F
No
Is AM = 2 ?
Yes
No
Is HR > 11
No
Yes
Is AM = 1 ?
Yes
No
Is HR = 0 ?
No
Yes
HR = HR + 12
Is HR = 12 ?
Yes
No
HR = 12
AM = 2
HR = HR - 12
AM = 1
AM = 0
A
F
Is AM = 1 ?
No
Yes
AM = 0
AM = 1
A
D
Converse the Digital Projection Time to 180°.
A

FIGURE 10

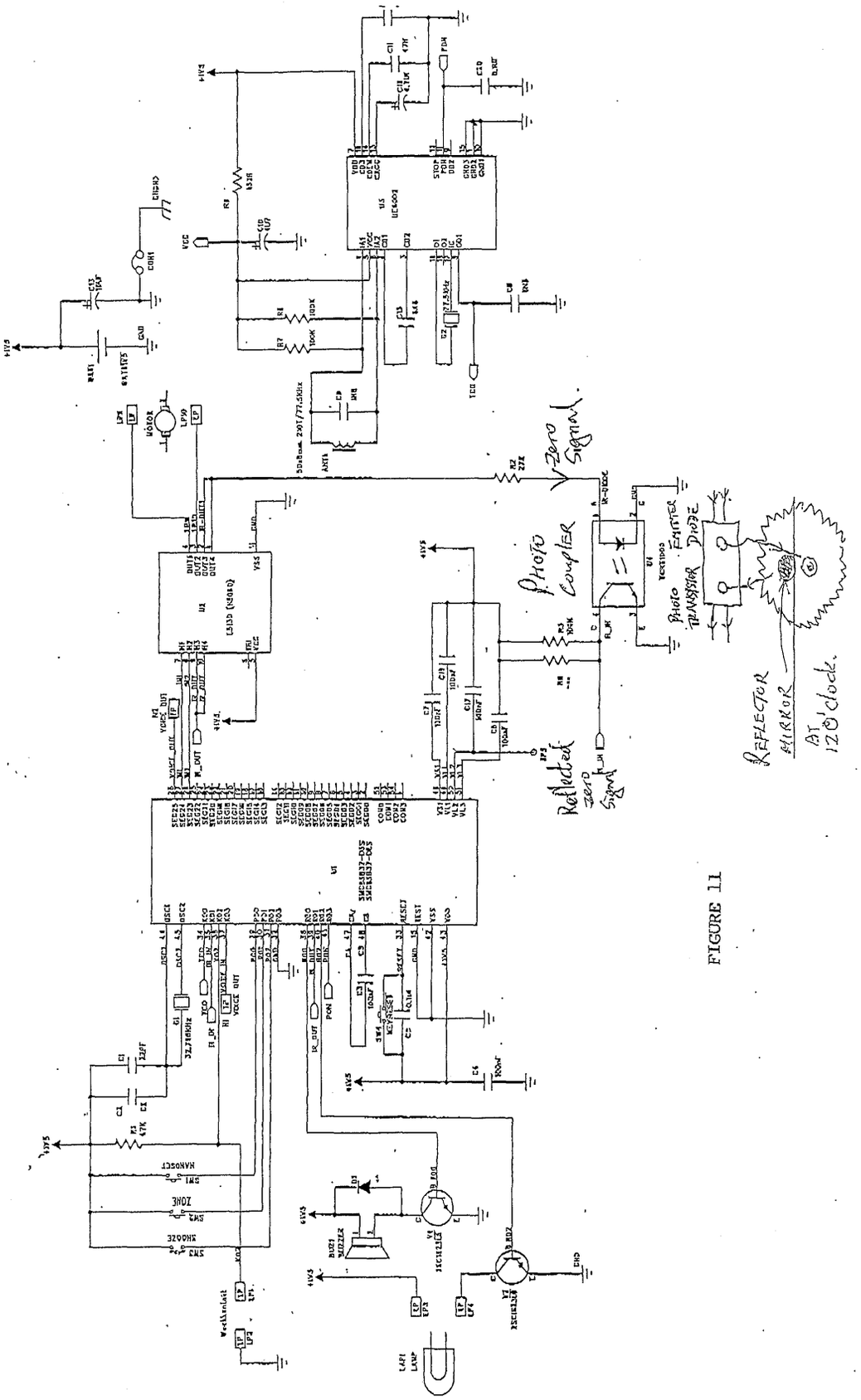
Zero Signal
Photo Coupler
Reflected Zero Signal
Photo Transistor
Photo Emitter
REFLECTOR
MIRROR
AT 12 O'clock.

FIGURE 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 03 25 2505

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 Y	US 6 343 050 B1 (KWOK JOSEPH TAK MING) 29 January 2002 (2002-01-29) * figures 1-3 * * column 4, line 22-27 *	1 2-7	G04C9/02 G04G5/00
Y	WO 94 23349 A (BRAUN AG ;BEERWERTH FRANK (DE); SCHIEBELHUTH HEINZ (DE)) 13 October 1994 (1994-10-13) * abstract * * figures 1-6 * * page 5, line 18-23 *	2,5	
Y	US 5 231 612 A (MAURER ROLAND ET AL) 27 July 1993 (1993-07-27) * abstract * * figures 1,2 * * column 5, line 23-25 * * claim 1 *	2,6	
Y	US 4 645 357 A (FLAIG HANS ET AL) 24 February 1987 (1987-02-24) * column 2, line 33-47 * * column 4, line 1-10 * * figures 1-4 * * abstract *	2-4	TECHNICAL FIELDS SEARCHED (Int.Cl.7) G04C G04G
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 March 2004	Burns, M

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
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D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 25 2505

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82