# United States Patent [19]

**Kashio**

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[54] **ELECTRONIC CLOCK DEVICES**


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[51] **Int. Cl.** ..... **G04b 19/24**; G04b 19/30
[58] **Field of Search** ..... 58/4 A, 50 R, 58, 52 R; 40/107



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*Primary Examiner*—Edith Simmons Jackmon
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[57] **ABSTRACT**

An electronic clock device comprises time measuring means for counting hours to produce a carry signal at each 24 hours, seven-step counter means stepped by the carry signal for counting seven days of the week, and seven display elements for displaying the days of the week in accordance with the content of the seven-step counter means.


**5 Claims, 4 Drawing Figures**

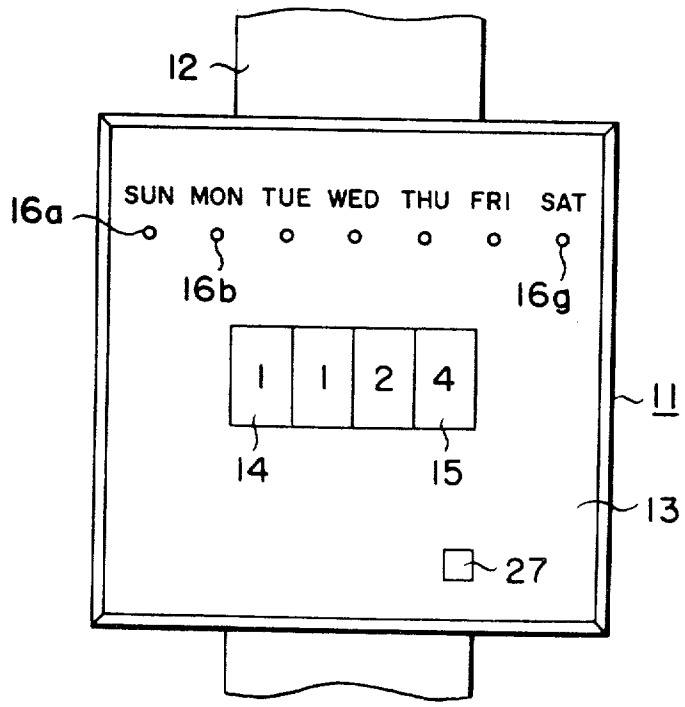


FIG. 1

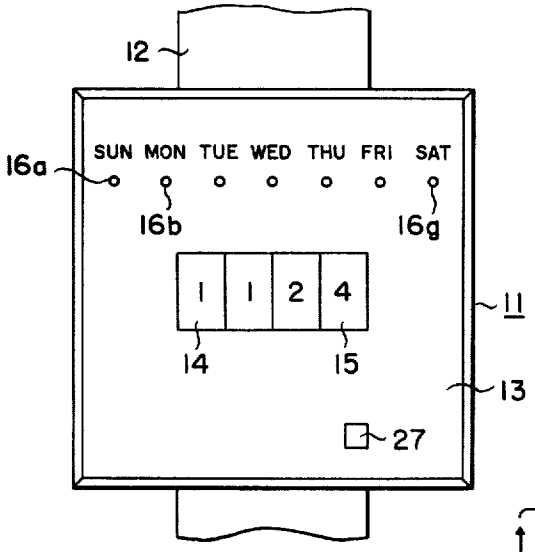
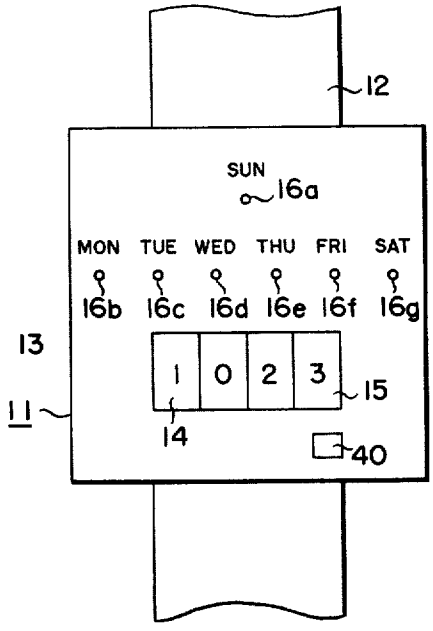

12
SUN MON TUE WED THU FRI SAT
16a
16b
16g
1 1 2 4
14
15
11
13
27

FIG. 2


16a
16g
34
DRIVER
33
DECODER
32
COUNTER
14
DRIVER
17
DECODER
26
25b
25a
24b
24a
24c
31b
31a
28
15
DRIVER
18
DECODER
22
COUNTER
21
COUNTER
23
COUNTER
30
29
COUNTER
COUNTER
1HZ
20
CLOCK SIGNAL GENERATOR
19
27
DATA BUTTON

FIG. 3


12
SUN
16a
MON
TUE
WED
THU
FRI
SAT
16b
16c
16d
16e
16f
16g
13
1
0
2
3
15
11
14
40

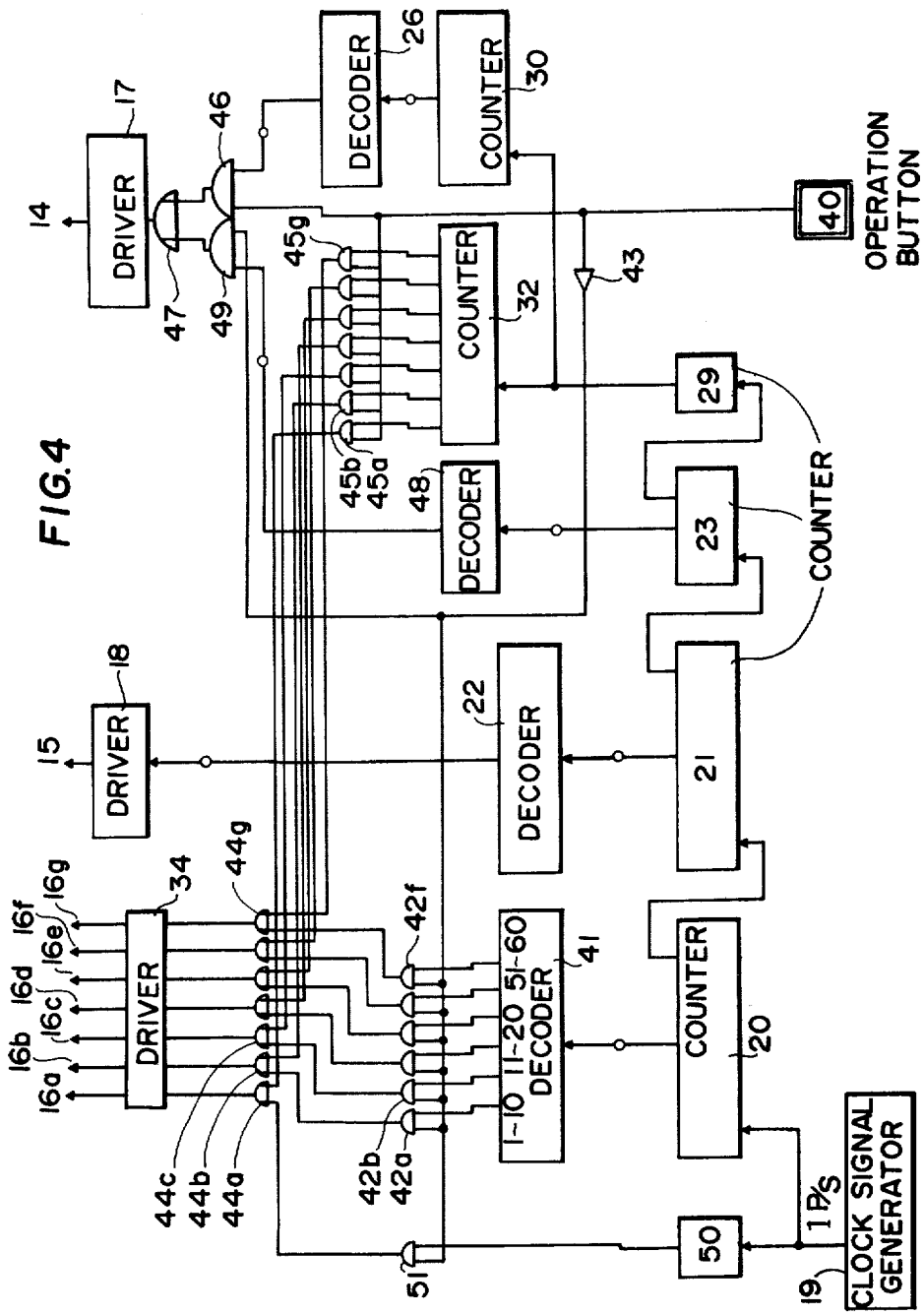

DRIVER
17
14
46
47
49
DECODER
26
COUNTER
30
45g
COUNTER
32
43
40
OPERATION BUTTON
45b
45a
48
DECODER
29
23
COUNTER
DRIVER
18
15
22
DECODER
21
DRIVER
34
44g
16f
16g
16e
16d
16c
16b
16a
42f
1-10 11-20 51-60 DECODER
41
COUNTER
20
44c
44b
44a
42b
42a
51
50
1 P/S
CLOCK SIGNAL GENERATOR
19

FIG.4

# ELECTRONIC CLOCK DEVICES

This invention relates to a clock device, and more particularly to an improved digital clock device capable of efficiently displaying dates and the days of the week.

The display of time in a clock is usually accomplished by means of a long hand indicating minutes and a short hand indicating hours. Recently, a digital clock has been developed in which the time is displayed digitally. In such a digital clock it is necessary to use as large a display as possible for displaying digits for facilitating the reading of the displayed time.

For this reason, when applying the digital display to a clock of small size, for example a wrist watch, it is necessary to use the large area of the dial plate for digital display. Where dates and days of the week are also to be displayed in such a small digital clock, sufficient space is not available for displaying the dates and the days of the week. Also sufficient space is not available for displaying seconds. For this reason, the display on the dial plate is simple which does not give an attractive appearance, and which does not call the attention of the user because the state of the display is not dynamic.

Accordingly, it is an object of this invention to provide an improved clock device capable of efficiently displaying the dates and the days of the week without using any dial plate other than that for displaying hours and minutes.

Another object of this invention is to provide an improved clock device capable of efficiently displaying minutes, hours, dates and the days of the week as well as dynamically displaying seconds in a limited space available for display in the clock device.

## SUMMARY OF THE INVENTION

According to one aspect of this invention there is provided an electronic clock device of the type including electronic counter means for counting the time and time display means for displaying the content of the electronic counter means, characterized in that there are provided seven step counter means operated stepwisely by a carry signal generated by the electronic counter means at each **24** hours for counting 7 days of the week, and seven display means providing unique displays to indicate the 7 days of the week, the displays; corresponding to the contents of the seven step counter means.

According to another aspect of this invention there is provided an electronic clock device of the type including counter means for counting hours and minutes and display means for displaying the content of the counter means, characterized in that there are provided second counter means for counting six values at an interval of 10 seconds, six display means corresponding to the six values, days of the week counter means for counting seven values representing the 7 days of the week, display switching means operated by an operator for switching the six display means for displaying six output values of the days of the week counter means, and means for flickering at each second one display means which corresponds to the particular one value representing a day of the week.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** shows a plan view of a clock device embodying this invention;



FIG. **2** shows a block diagram of a control circuit for driving the clock device shown in FIG. **1**;

FIG. **3** shows a plan view of another embodiment of this invention; and

FIG. **4** shows a block diagram of a control circuit for driving the clock device shown in FIG. **3.**

## DETAILED DESCRIPTION OF ILLUSTRATED EMBODIMENTS

The digital wrist watch shown in FIG. **1** comprises a body **11** which is fastened to the wrist of the user by two bands **12.** The dial plate **13** contained in the body **11** is provided with an hour display section **14** and a minute display section **15,** each section displaying two letters or displaying digits. Above these display sections **14** and **15** are arranged seven display elements, for example, luminous elements **16***a*, **16***b*, **16***c*, **16***d*, **16***e*, **16***f* and **16***g* which are arranged along a straight line. If desired, words, Sunday, Monday, etc. which represent the days of the week may be labelled to these luminous elements **16***a* to **16***g* as shown in FIG. **1.** However, since usually the days of the week begin from Sunday, it is not always necessary to label such words to the luminous elements **16***a* to **16***g*.

Turning now to FIG. **2,** the hour display section **14** and the minute display section **15** are composed of liquid crystal display members, respectively, which are driven by the outputs from first and second drivers **17** and **18,** respectively. If the space available in the body **11** permits, the liquid crystal displaying elements may be replaced by digit display tubes of well known construction.

In the circuit shown in FIG. **2** the clock or second signals, which are the basic units of the time are generated by a clock signal generator **19,** for example, a crystal oscillator having frequency dividers, which generates one pulse per second. The output second signals generated by the clock signal generator **19** are applied to a sixty step counter **20** which operates to generate one carry signal for each sixty second pulses or one minute. The carry signals from the counter **20** are applied to a second sixty step counter **21** which functions to supply minute display signals to a decoder **22** and carry signals to twelve-step counter **23.** In response to the minute display signals, the decoder **22** functions to convert these signals into other forms of minute display signals suitable for digitally displaying minutes on the liquid crystal displaying members of the section **15** via a driver **18.**

The counter **23** receives carry signals from counter **21** at a rate of one signal per hour, and the contents of counter **23** are applied to one input terminal of each of the AND gate circuits **24***a*, **24***b*, **24***c* . . . . The outputs of these AND gate circuits **24***a*, **24***b*, **24***c* . . . are applied to a decoder **26** via OR gate circuits **25***a*, **25***b*, **25***c*, . . . , and are converted into hour display signals suitable to display digits representing hours by the liquid crystal displaying members. These converted signals are sent to the hour display section **14** through a driver **17** for displaying hours. The output from a date display button **27** is impressed upon the other inputs of AND gate circuits **24***a*, **24***b*, **24***c* . . . via an inverter **28** so that AND gate circuits **24***a*, **24***b*, **24***c* . . . are enabled only when the date button **27** does not produce any output and the display of hours by the hour display section **14** is performed.

The carry signal produced by twelve-step counter **23** at a rate of one signal per 12 hours is applied to a binary counter **29.** Consequently, the counter **29** produces a carry signal at a rate of one signal per day and the output carry signal thereof is applied to thirty-one-step counter **30** and to a seven-step counter **32.** The content of counter **30** which corresponds to the counted number of days is applied to the inputs of AND gate circuits **31***a*, **31***b* . . . , together with the outputs from the date button **27.** Thus, in the presence of the output from the date button **27,** AND gate circuits **24***a*, **24***b*, . . . are enabled to send date display signals from AND gate circuits **31***a*, **31***b* . . . to driver **17** via OR gate circuits **25***a*, **25***b* . . . and decoder **26,** thereby displaying the dates on hour display section **14** instead of hours.

The contents of the seven-step counter **32** which correspond to the number of the counted days of the week are converted into the days of the week signals corresponding to Sunday, Monday . . . Saturday, respectively, by a decoder **33** and the outputs from decoder **33** are applied to seven displaying elements **16***a*, **16***b* . . . **16***g* shown in FIG. **1** via a driver **34.** As the displaying elements **16***a* to **16***g*, may be used electric lamps, liquid crystal displaying members which luminously display when they are applied with voltage, etc, for example.

According to this embodiment, hours and minutes are displayed digitally and upon depression of the date button **27,** the hour display is switched to the date display. In addition, the day of the week is displayed by the operation of one of seven display members. In this manner, by using digital display sections which display hours and minutes and very small seven display elements it is possible to display hours, minutes, dates and the days of a week. Thus the invention is especially advantageous for clocks or watches of small size.

When a days of a week display button is used for the purpose of displaying the days of a week at any desired time, it is possible to lengthen the useful life of a battery contained in the clock. However, continuous operation of the display elements not only improves the appearance but also gives a dynamic feeling. Such construction is particularly advantageous for wrist watches.

A modified embodiment will be described with reference to FIGS. **3** and **4** in which elements corresponding to those shown in FIGS. **1** and **2** are designated by the same reference numerals. In this embodiment, six display elements **16***b* to **16***g* corresponding to from Monday to Saturday, respectively, are arranged at a suitable spacing along a straight line above an hours and dates display section **13,** and a display element **16***a* displaying a Sunday is disposed above the straight line of elements **16***b* to **16***g*. Again, the days of a week are labelled, but on Sunday a single display element **16***a* is operated and on Monday to Saturday display elements **16***b* to **16***g* aligned on a line are operated sequentially so that even though the days of a week are not displayed by letters, what day of the week can be readily determined. Furthermore, the body **11** of the watch is provided with a display switching member in the form of a push button **40,** for instance.

With reference to FIG. **4,** the second display output from sixty-step counter **20** which counts the second signal produced by clock signal generator **19** is applied to a decoder **41** which functions to send sequentially an output signal to AND gate circuits **42***a*, **42***b*, **42***c*, **42***d*, **42***e* and **42***f* at a rate of one signal per ten counts or 10 seconds. More specifically, when the content of counter **20** equals one to nine, for each ten seconds, the output of the counter **20** is sent to AND gate circuit **42***a*, when the count equals to eleven to twenty, the output signal is sent to AND gate circuit **42***b*, and when the count equals to twenty-one to thirty the output signal is sent to AND gate circuit **42***c* and so on. The other inputs of AND gate circuits **42***a* to **42***f* are connected to a push button **40** via an inverter **43,** so that AND gate circuits **42***a* to **42***f* operate only when there is no information from push button **40** to energize display elements **16***b* to **16***g* through OR gate circuits **44***b* to **44***g* and driver **34** for displaying the days of a week. In this manner, in the absence of the output from push button **40** for displaying the days of a week, six display elements **16***b* to **16***g* are sequentially and cyclically energized at an interval of 10 seconds. For example, when element **16***d*, that is the third element from left is operating at a given instant, this means that seconds from **21** to **30** are being displayed.

The date stepping signal generated by binary counter **29** at a rate of one carry signal per day is counted by a seven-step counter **32** and the contents thereof corresponding to the days of a week are applied to one input terminal of each of the AND gate circuits **45***a* to **45***g* corresponding to Sunday through Saturday, respectively. The other inputs of these AND gate circuits are connected to receive the output from push button **40** so that when push button **40** is operated, AND gate circuits **42***a* to **42***f* are disabled and the outputs of AND gate circuits **45***a* to **45***g* are supplied to driver **34** via OR gate circuits **44***a* to **44***g*. Thus, either one of the display elements **16***a* to **16***g* is operated by the output of one of OR gate circuits **44***a* to **44***g* thus displaying a particular day of the week.

As in the foregoing embodiment, the carry signal from counter **29** is sent to a thirty-one-step counter **30** and the content thereof for displaying the date of a month is sent to one input of an AND gate circuit **46** via decoder **26** whereas the content is sent to driver **17** through AND gate **46** and an OR gate **47** when the push button **40** is operated thereby displaying a date on the hour display section **14.** Since the other input of OR gate **47** is connected to receive the content of twelve-step counter **23** which displays hours through decoder **48** and AND gate circuit **49,** where the push button **40** is not operated the AND gate circuit **49** is enabled by the output of inverter **43** thus displaying hours on the hours display section **14.**

The output from clock pulse generator **19** is applied to a binary counter **50,** the output thereof being applied to one input of an AND gate circuit **51.** The other input of this AND gate circuit **51** is connected to receive the output of inverter **43** and the output of AND gate circuit **51** is applied to the other input of OR gate circuit **44***a*. With this connection, when the push button or an actuator **40** is not operated, AND gate circuit **51** is enabled by the output of inverter **43** whereby the output from binary counter **50** operates a particular display element **16***a* at each second via OR gate circuit **44***a*.

In the modified clock device described above, when the push button **40** is not operated, the minutes display section **15** is operated by the output from driver **18** and the hours display section **14** is operated by the output from driver **17.** At the same time a particular display element **16***a* is caused to be energized at each second by the output of binary counter **50** for displaying seconds. Further, six display elements **16***b* to **16***g* are

caused to operate sequentially and cyclically at an interval of 10 seconds. Thus, the operation of display elements **16***a* to **16***g* also displays seconds.

Upon operation of the push button **40**, the output from inverter **43** disappears whereby the display of the seconds is interrupted. Concurrently therewith, the output of driver **17** causes the hours display section to display dates and the output from counter **32** operates one of the display elements **16***a* to **16***g* through driver **34** whereby a particular day of a week is displayed.

As above described, according to this modification, the display of the seconds is effected efficiently and dynamically by the operation of display elements **16***a* to **16***g*, and when desired, the date is also displayed. Thus, the displays of dates, hours, minutes, days of a week are performed by the operations of hours and minutes display sections **14** and **15** and of the display elements **16***a* to **16***g*, thereby making it possible to use efficiently the dial plate of the limited area of the clock device.

Although, in the above described embodiments, the hours display section **14** is switched to also display the dates, it should be understood that the minutes display section **15** can also be switched to display the dates.

Further, it will be understood that the invention is also applicable to analogue display type clock devices. In this case, when the days of a week are displayed by the display elements and by displaying the seconds by the second hand as well as by the flickering of the display elements it is possible to provide a more dynamic display effect.

What is claimed is:

**1.** An electronic clock device comprising:

a clock signal generator for generating a clock signal having a highly stable frequency;

first counter means responsive to said clock signals for counting the six values of units of ten-seconds obtained from the clock signal of said clock signal generator at an interval of ten seconds, for generating outputs corresponding to said six values and for generating a stepping output every 60 seconds;

second counter means for counting units of minutes which is operated stepwisely by the stepping output of said first counter means and for generating a stepping output every 60 minutes;

third counter means for counting units of hours which is operated stepwisely by the stepping output of said second counter means and for generating a stepping output every 24 hours;

fourth counter means for counting the seven valves of the days of a week which is operated stepwisely by the stepping output of said third counter means and for generating seven output values which correspond to the respective 7 days of the week;

first display means coupled to and displaying the contents of said second and third counter means;

second to eighth display means coupled to said fourth counter means providing respective unique displays corresponding to the seven output values of the output of said fourth counter means; and

display switching means for displaying the six values of the output of said first counter means by using six display means of said second to eighth display means.

**2.** An electronic clock device according to claim **1** further comprising means for flickering one of said second to eighth display means upon receipt of the output signal of said clock signal generator when the remaining of said second to eighth display means are displaying said six values of the output of said first counter means under the control of said display switching means.

**3.** An electronic clock device according to claim **1** wherein said clock signal generator includes a standard high frequency signal source and a frequency divider for dividing said standard high frequency signal into a predetermined frequency signal, said first to fourth counter means being responsive to said predetermined frequency signal.

**4.** An electronic clock device comprising:

a clock signal generator for generating a clock signal having a highly stable frequency;

first counter means responsive to said clock signals for counting the six values of units of ten-seconds obtained from the clock signal of said clock signal generator at an interval of ten seconds, for generating outputs corresponding to said six values and for generating a stepping output every 60 seconds;

second counter means for counting units of minutes which is operated stepwisely by the stepping output of said first counter means and for generating a stepping output every 60 minutes;

third counter means for counting units of hours which is operated stepwisely by the stepping output of said second counter means and for generating a stepping output every 24 hours;

fourth counter means for counting the seven values of the days of a week which is operated stepwisely by the stepping output of said third counter means and for generating seven output values which correspond to the respective 7 days of the week;

first display means for displaying the contents of said second and third counter means;

second display means, having six display sections, for displaying all the seven output values from said fourth counting means except a particular output value; and

display-switching means coupled to said second display means to cause said second display means to display the six output values from said first counting means.

**5.** An electronic clock device according to claim **4** further comprising third display means for displaying said particular output value from said fourth counting means.

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