United States Patent

Miwa

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[54] DIGITAL DISPLAY WORLD CLOCK

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[30] **Foreign Application Priority Data**

Aug. 20, 1969 Japan.....44/65555

[52] **U.S. Cl.**.....**58/42.5,** 58/4

[51] **Int. Cl.**.....**G04b 19/22,** G04b 19/24

[58] **Field of Search** 58/4–6, 42.5–44, 58/58, 152

[56] **References Cited**

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[57] **ABSTRACT**

A portable world clock which displays day, hour, minute and second corresponding to each city of the world by selecting a pushbutton. Adder means of an electronic computer and a quartz crystal clock are combined in this world clock, and a counter means is driven in synchronization with the time of Greenwich standard time minus 12 hours.

6 Claims, 6 Drawing Figures

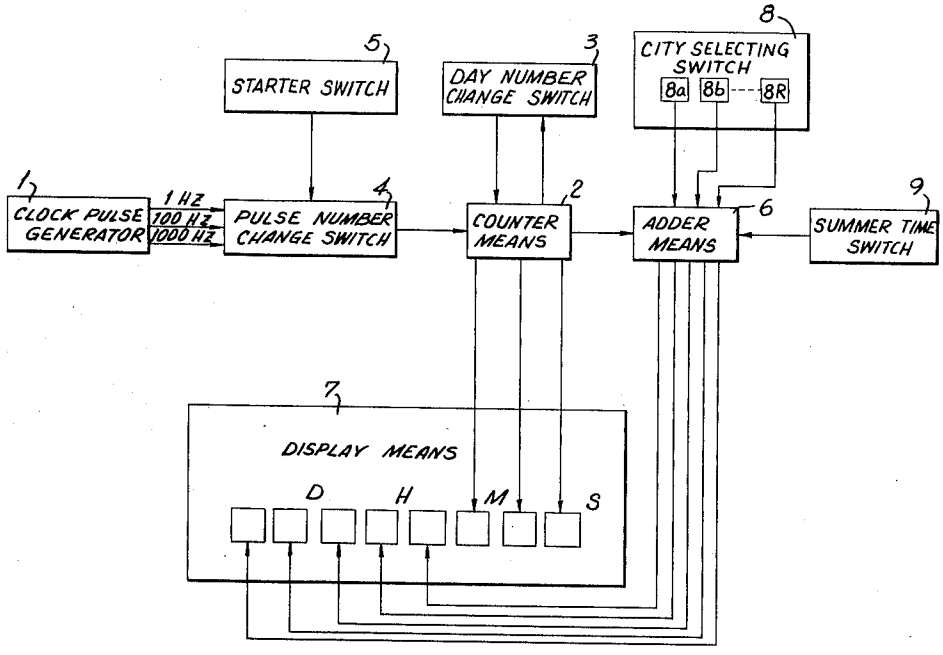


FIG. 1

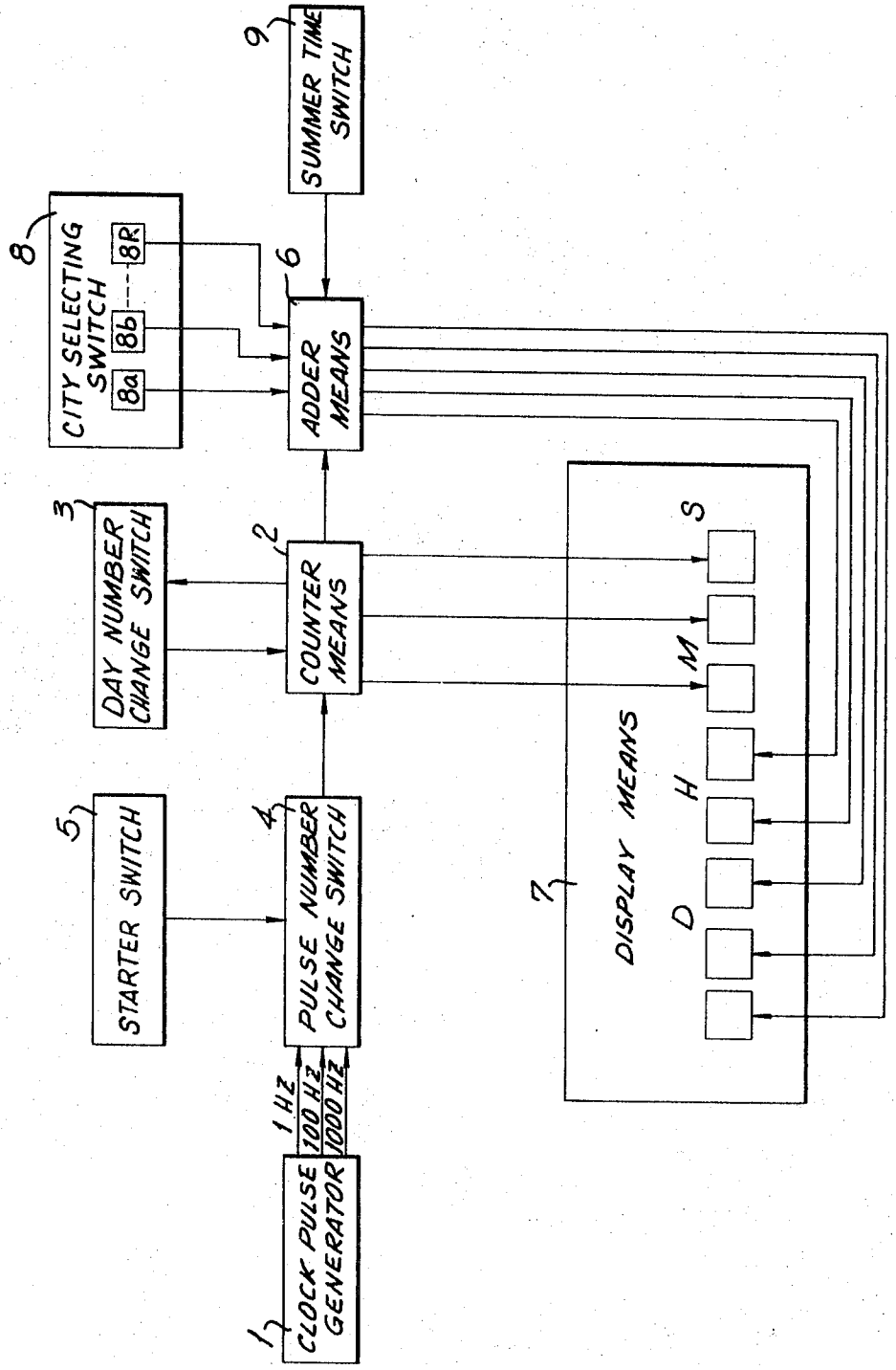

CLOCK PULSE GENERATOR
1 Hz
100 Hz
1000 Hz
PULSE NUMBER CHANGE SWITCH
STARTER SWITCH
DAY NUMBER CHANGE SWITCH
COUNTER MEANS
ADDER MEANS
CITY SELECTING SWITCH
8a
8b
8R
SUMMER TIME SWITCH
DISPLAY MEANS
S
M
H
D
1
2
3
4
5
6
7
8
9

FIG. 2

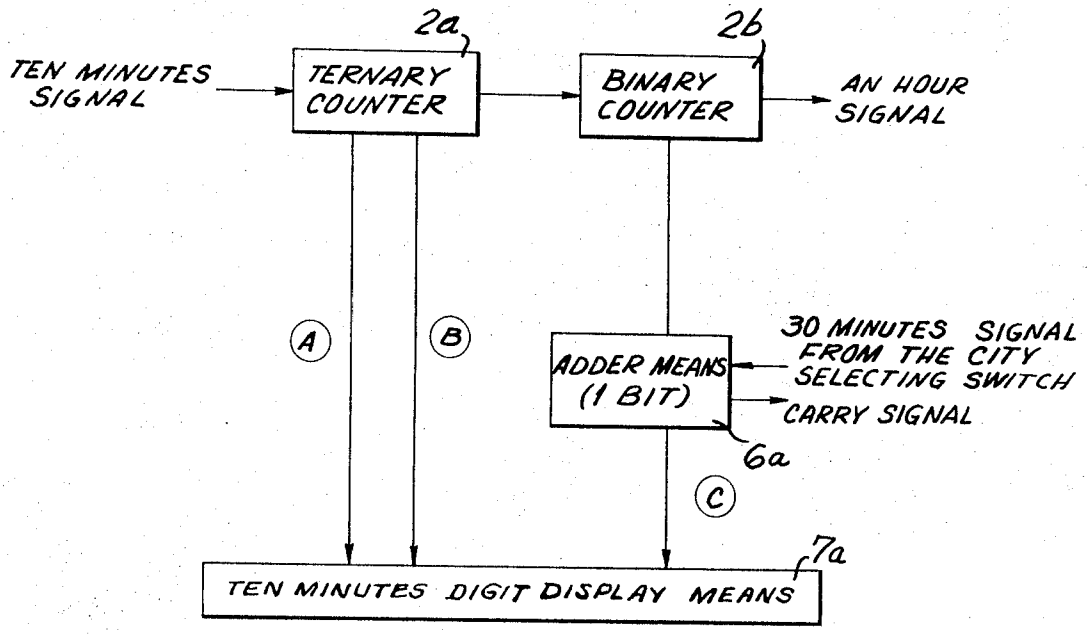


FIG. 3

NUMBER	C	B	A
0	0	0	0
1	0	0	1
2	0	1	0
3	1	0	0
4	1	0	1
5	1	1	0

FIG. 4

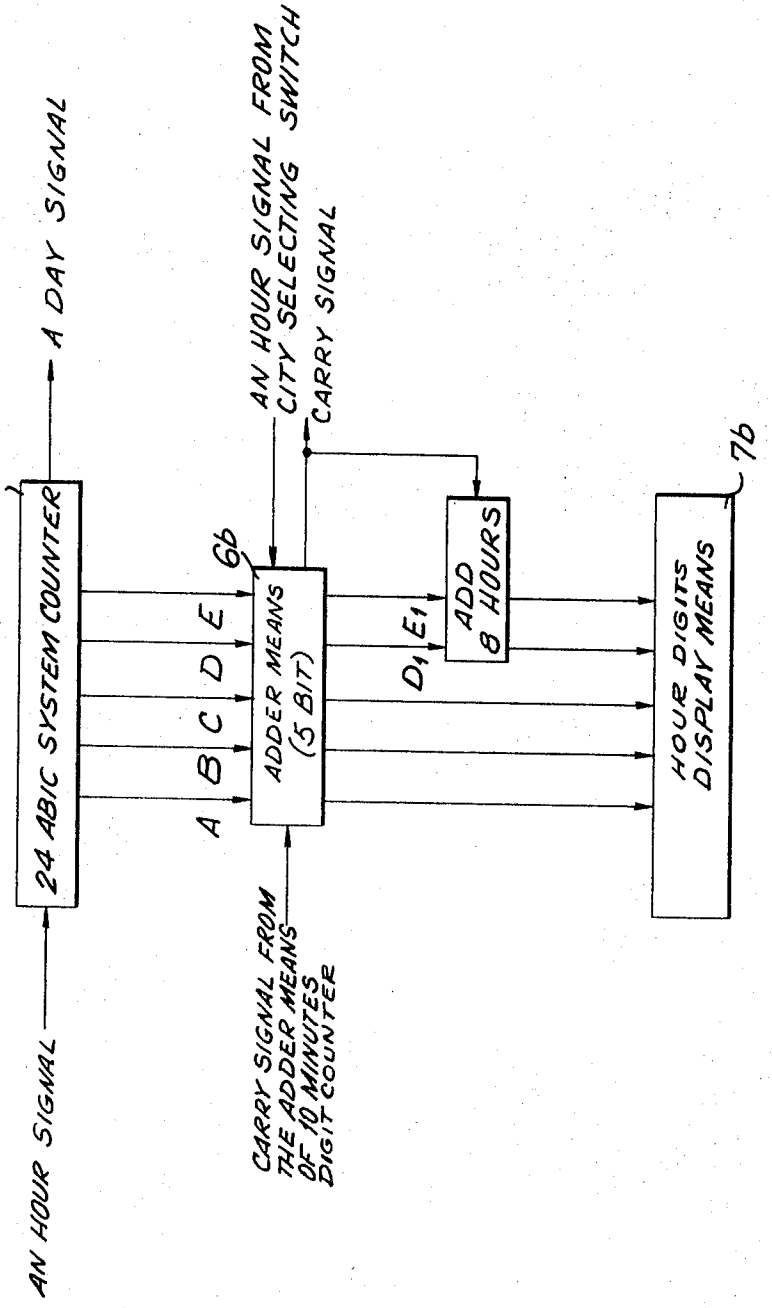
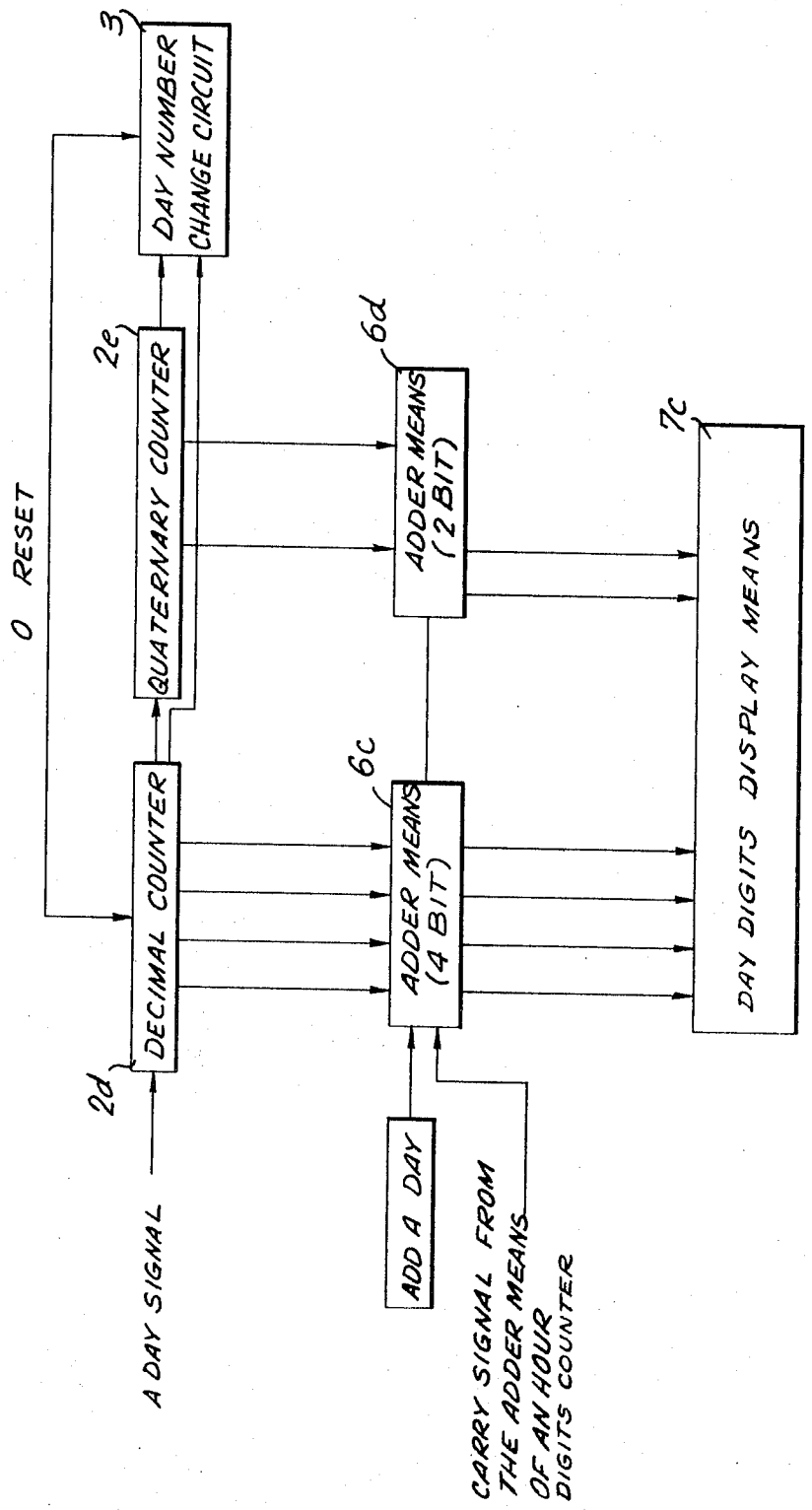

A DAY SIGNAL
AN HOUR SIGNAL FROM CITY SELECTING SWITCH
CARRY SIGNAL
2c
24 ABIC SYSTEM COUNTER
6b
ADDER MEANS (5 BIT)
A
B
C
D
E
D1
E1
ADD 8 HOURS
7b
HOUR DIGITS DISPLAY MEANS
AN HOUR SIGNAL
CARRY SIGNAL FROM THE ADDER MEANS OF 10 MINUTES DIGIT COUNTER

FIG. 5

NUMBER	E	D	C	B	A
0	0	0	0	0	0
1	0	0	0	0	1
2	0	0	0	1	0
3	0	0	0	1	1
4	0	0	1	0	0
5	0	0	1	0	1
6	0	0	1	1	0
7	0	0	1	1	1
8	0	1	0	0	0
9	0	1	0	0	1
10	0	1	0	1	0
11	0	1	0	1	1
12	0	1	1	0	0
13	0	1	1	0	1
14	0	1	1	1	0
15	0	1	1	1	1
16	1	0	0	0	0
17	1	0	0	0	1
18	1	0	0	1	0
19	1	0	0	1	1
20	1	0	1	0	0
21	1	0	1	0	1
22	1	0	1	1	0
23	1	0	1	1	1
24	1	1	0	0	0

FIG. 6


3
DAY NUMBER CHANGE CIRCUIT
2e
QUATERNARY COUNTER
6d
ADDER MEANS (2 BIT)
7c
DAY DIGITS DISPLAY MEANS
0 RESET
DECIMAL COUNTER
6c
ADDER MEANS (4 BIT)
2d
A DAY SIGNAL
ADD A DAY
CARRY SIGNAL FROM THE ADDER MEANS OF AN HOUR DIGITS COUNTER

DIGITAL DISPLAY WORLD CLOCK

BACKGROUND OF THE INVENTION

The present invention relates to a digital display world clock, more particularly to a digital display world clock which displays day, hour, minute and second corresponding to each city of the world by selecting a push-button.

The object of the present invention is to provide a digital world clock which displays local time of each city of the world by pushing the push-ubtton corresponding to that city.

Another object of the present invention is to provide a small size, lightweight and portable world clock, which is suitable to be set in the guest rooms of a hotel, the office rooms of a trading firm, etc., and to be employed on modern aircraft, ships and the like.

A further object of the present invention is to provide a world clock which is enabled to display summer (daylight) time, in the event that summer (daylight) time is effective in the city selected.

A still further object of the present invention is to provide a world clock comprising a day number change switch. By setting said switch to the day number of the previous month, this clock automatically shows the first day of the next month after having shown the last day of the preceding month.

Among conventional world clocks there are none which indicate "day". Therefore, users are required to estimate whether the day is "the day before", "the same day", or "the next day" in such city selected to ascertain the correct time.

Further, if the selected city has been on summer (daylight) time, users, by adding 1 hour to the time indicated by the clock, may be enabled to know the exact time.

Still further, clocks of this type are so large in size and heavy in weight which makes it difficult to transport or carry and once set down become difficult to move.

SUMMARY OF THE INVENTION

The present invention is characterized by the fact that a quartz crystal clock and adder means of an electronic computer are combined in one set and a clock pulse generator which is controlled by a quartz crystal oscillator, counter means which are driven in synchronization to the time of Greenwich standard time minus 12 hours, adder means which add signals from the city selecting switch and signals from said counter means, and display means which display time and day of the present city or time and day of another selected city are incorporated therein.

The nature, principle and details of the invention will be more fully understood by reference to the following description in conjunction with the accompanying drawings in which like parts are designated by like reference numerals.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram showing one embodiment of the present invention;

FIG. 2 is a block diagram of the part of the adder means for producing the 10 minutes digit;

FIG. 3 is the code list of the 10 minutes digit;

FIG. 4 is a block diagram of the part adder means for producing the hour digits;

FIG. 5 is the code list of the hour digits; and

FIG. 6 is a block-diagram of the part of the adder means for producing the day digits.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following is an explanation of the structure of one embodiment of the present invention:

In the block diagram of FIG. 1, 1 shows a clock pulse generator which is constituted of a quartz crystal oscillator circuit and a divider circuit and which generates stabilized 1 Hz., 100 Hz. and 1,000 Hz. pulses. 2 shows counter means which contains the counters for the second digit (4 bit, decimal), the counter for the 10 seconds digit (3 bit, hexanary), the counter for the hour digits (5 bit, 24 abic system) and the counter for the day digits (the unit digit; 4 bit, decimal; the 10th digit; 2 bit, quaternary). The output signals of each digit of said counter means are binary code signals, the number of which corresponds to the number of the bit indicated in the parenthesis. Said counter means is usually driven in synchronization to the time of the Greenwich standard time minus 12 hours. 3 shows a day number change switch which generates a reset signal according to any one of the scales of 28–31 by previously setting it to the day number of the month (any of 28, 29, 30 and 31) manually. 4 shows a pulse number change switch which changes the number of the pulses transmitted from the clock pulse generator 1 to the counter means 2. Usually it is set at the start position and connected as 1 Hz. pulses are transmitted from the clock pulse generator to the counter means 2. The counter means 2 indicates day and time at random when it is connected to the power source. Accordingly, to drive said counter means 2 in synchronization with the time of Greenwich standard time minus 12 hours, the counter means 2 is quickly fed by changing the pulse number changing switch 4 to 1,000 Hz., 100 Hz. or 1 Hz. as occasion demands. For example, we will consider the case that the counter means 2 indicates 25th day, 14 hours, 59 minutes and 30 seconds, and we want to correct it to 24th day, 23 hours, 42 minutes and 00 seconds. Because the day number change switch 3 is so constructed to work according to 31 abic system, when the pulse number change switch 4 is transferred from start position to any one of the 1,000 Hz., 100 Hz. or 1 Hz. position, it is necessary to quickly feed the counter means 2, 30 days, 8 hours, 42 minutes and 30 seconds. Further, when the pulse number change switch 4 is transferred from the start position to any of the 1,000 Hz., 100 Hz. and 1 Hz. positions, the 1 second digit counter and 10 seconds digit counter of counter means 2 are reset to zero. Accordingly, the counter means 2 indicates 25th day, 14 hours, 59 minutes and 00 second. As a result, it is necessary to quickly feed the counter means 2, 30 days, 8 hours, 43 minutes and 00 second. The device is so constructed that the signals of 1,000 Hz., 100 Hz. and 1 Hz. are added to the 1 minute digit counter. In the event the counter means 2 is fed corresponding to 30 days, 8 hours, 43 minutes, 00 second using only 1 Hz. signals, it consumes much time, namely 43,723 seconds. By adding 1,000 Hz., 100 Hz. and 1 Hz. signals properly to the 1 minute digit counter of the counter means 2, much time is saved for setting the counter means 2.

As soon as the time which the counter means 2 indicates corresponds to the time of Greenwich standard time minus 12 hours, the pulse number change switch 4 is transferred to the START position and starter switch 5 is pushed. 1 Hz. pulses are transmitted from the clock pulse generator 1 to the scale of 1 second of the counter means 2.

6 shows adder means which adds day and time counted by the counter means 2 (time of Greenwich standard time minus 12 hours) and time corresponding to the difference in time between the place and a certain city in parallel. Its operation is based on the same principle as adder circuits of the electronic computer.

As the smallest unit for setting of time difference of the device is 30 minutes, addition is done on the 10 minutes digit counter, hour digits counter and day digits counter in the adder means 6. Addition is done here with the binary scale code signals. Counter means 2 and adder means 6 will be explained more fully later.

As the signals on the 1 second, 10 seconds and 1 minute digit counters of the counter means 2 have no connection with the addition of time corresponding to time difference between cities, they are connected directly to the display means 7. Further, the signals on the 10 minutes digit counter, hour digits counter and day digits counter, after being added, time correspond to time difference between cities on the adder means 6, also connected to the display means 7 and displayed digitally. This display means 7 uses numeric display tubes, display tubes with semi-conductor or the like.

The display means **7** can also be placed at as many places as desired at the same time.

8 shows a city selecting switch to allow the counter means **2** to indicate time at the major cities of the world, and is provided with several 10s of push-buttons **8***a* , **8***b* , . . . **8***n* corresponding to the number of cities required.

To clarify the explanation of the function of the counter means **2** at its 10 minutes, hour and day digit counters, the adder means **6** and the city selecting switch **8**, the following examples are shown:

1. Addition at the 10 minutes digit counter:

As the smallest unit for setting of time difference of the device is 30 minutes, the 10 minutes digit counter consists of a ternary counter **2***a* and a binary counter **2***b* (ternary multiplied by binary) as shown in FIG. **2**.

Their codes are shown in FIG. **3**. Addition of 30 minutes is done on the adder means **6***a* (1 bit) which is connected to the binary counter **2***b*. For example, in case the 10 minutes digit counter indicates 20 minutes, and 30 minutes corresponding to difference in time is to be added, the formula of this addition is as follows:

0 1 0	(40 minutes)
+ 1 0 0	(30 minutes)
1 1 0	(50 minutes)

Further, in case the 10 minutes digit counter indicates 40 minutes, and 30 minutes corresponding to the difference in time is added, the formula of addition becomes as follows:

1 0 1	(40 minutes)
+ 1 0 0	(30 minutes)
1 0 0 1	(10 minutes)

1 is a carry signal to the hour. The result of addition is displayed on the 10 minutes of the display means **7**.

2. Addition at the hour digits counter in FIG. **4**:

Addition at the hour digits counter is done on the adder means **6***b* (5 bit) which is connected to the 24 abic system counter **2***c*.

For example, in the event that the 24 abic system counter **2***c* indicates 20 hours and that 21 hours corresponding to the difference in time are added, according to the codes in FIG. **5**, the formula of addition is as follows:

1 0 1 0 0	(20 hours)
+ 1 0 1 0 1	(21 hours)
1 0 1 0 0 1	(9 hours)

1 becomes a carry signal to the day digits counter. As 5 bit adder means **6***b* works on binary coded 32 abic system, the result of addition becomes 1 day plus 9 hours as shown above. However, as the actual time is 17 o'clock, there is a difference of 8 hours. This difference of 8 hours does not, however, occur at all times, occuring only in case the result of addition is more than 24 hours (11000). To eliminate this inconvenience, 8 hours must be added to the result of addition and becomes as follows:

1 0 1 0 0 1	(9 hours)
+ 0 1 0 0 0	(8 hours)
1 1 0 0 0 1	(17 hours)

The discrimination of whether the result of addition is more than 24 hours or not is done automatically, whether there is a carry signal or not and whether the signals shown in FIG. **4** have become 1 or not.

The result of addition of the hour digits is indicated on the hour digits display **7***b* of the display means **7**.

3. Addition at the day digits counter in FIG. **6**:

Addition at the day digits counter is done using a binary coded decimal counter **2***d* for the unit digit, and a binary coded quaternary counter **2***e* for the 10th digit which constitute 28–31 abic system counter together with the day number change circuit **3**.

The adder means **6***c* (4 bit) is connected to the decimal counter **2***d* and the adder means **6***d* (2 bit) is connected to the quaternary counter **2***e*.

Addition at the day digits counter is done in the same way as that of the 10 minutes and hour digit counters.

As the numerical values of the 28–31 abic system counter are 0 → 27–30, if they are displayed directly on the day digits display means **7***c* the displayed digit is subtracted 1 from the number of the actual date. To eliminate this inconvenience, 1 is added to the numerical value of the adder means **6***c* (4 bit) and the date shown corresponding to the actual date.

According to the device of the present invention, the correction of difference in time between cities is effected in the adder means **6** by parallel addition of time corresponding to difference in time between the present place and the city to the day and time counted by the counter **2** which works continuously, and therefore no error occurs in correcting the difference in time caused by contact of the city selecting switch **8**.

Correction is effectuated instantly. Further, no error is caused by pushing the city selecting switch **8** during the carry action of the counter means **2**.

While a preferred embodiment of the invention has been shown and described, it will be understood that many modifications and changes can be made within the true spirit and scope of the invention.

What is claimed is:

1. A world clock comprising a clock pulse generator, counter means working in synchronization with the time of Greenwich standard time minus 12 hours in response to signals from said generator, a city selecting switch providing a signal, means adding the signals from said counter means and those from said city selecting switch to provide an output signal representing the time in the selected city and display means for displaying the time in the selected city.

2. A world clock comprising a clock pulse generator controlled by an oscillator, counter means working in synchronization with the time of Greenwich standard time minus 12 hours in response to signals from said generator, a city selecting switch providing a signal, means adding the signals from said counter means and those from said city selecting switch to provide an output signal representing the time in the selected city and display means showing digitally date and time in the selected city.

3. A world clock according to claim **2**, comprising a summer (daylight) time switch adding a summer (daylight) time signal.

4. A world clock according to claim **3**, wherein the clock pulse generator generates stabilized different frequency pulses and transmits such pulses to the pulse number change switch, and a pulse number change switch for transmitting the lowest frequency pulses to the counter means at ordinary state, and transmitting other frequency pulses, as the case may be, to said counter means at correction of display.

5. In a world clock according to claim **4**, a day number change switch for generating a reset signal according to any of the scales of 28 to 31 by initially setting it to the day number of the month.

6. A world clock according to claim **5**, wherein said city selecting switch has a plurality of push-buttons each associated with a respective city each of said push-buttons transmits pulse numbers corresponding to the difference in time of its city.

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