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(71) Applicant *(for all designated States except US)*: **HIDEKI ELECTRONICS, INC. (USA)**; 7865 SW Mohawk Street, Tualatin, OR 97062 (US).

(71) Applicants and
(72) Inventors: **TAM, Ho Chuen (Thomas)** [AU/CN]; Flat C 21/F, Tower 7, Park Avenue, Mongkok, Hong Kong (CN). **BOYLE, James** [US/US]; 1331 Troon Drive, West Lynn, OR 97068 (US).

(74) Agent: **HAAS, Peter, A.**; 1929 SW 13th Ave., Portland, OR 97201 (US).

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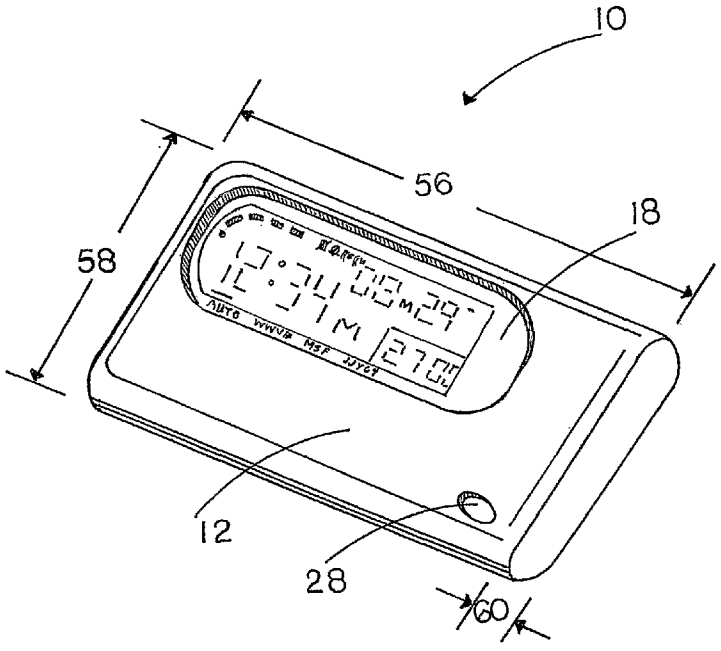
(54) Title: MULTI-BAND RADIO-CONTROLLED CLOCK



(57) Abstract: The present invention relates to a compact travel alarm clock with automatic selection of a particular radio-frequency corresponding to the standard time broadcast of the region where the clock currently operates. More specifically the present invention relates to a compact design, digital-time travel alarm clock with temperature measurement capability and an automatically selectable tuner for automatically receiving a plurality of national time broadcasts, automatically selecting the appropriate broadcast based on signal strength, and displaying the current local time based on the automatic selection of the broadcast.

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TITLE OF THE INVENTION

Multi-band Radio-controlled Clock.

INVENTORS

Tam, Ho Chuen and Boyle, James

BACKGROUND

[01] The present invention relates to a clock that automatically selects one signal from a set of radio frequencies corresponding to a remotely transmitted, standard-time broadcast for a given geographic location. More specifically the present invention relates to a compact design, digital-time travel alarm clock with temperature measurement capability.

[02] As global commerce and international trade increase so does the amount of international travel of both business-persons and tourists. The demands of international travel present unique problems for such travelers. One problem, the availability of a time-piece that can accurately and reliably determine and display the local time, commonly alludes most travelers.

[03] Another challenge for manufacturers of travel alarm clocks, the ability to present a clock with compact dimensions and an aesthetically pleasing design, results in many existing clocks that are expensive to manufacture or are aesthetically unattractive to consumers and are overly cumbersome in size.

[04] Further problems of existing time-pieces include a high purchase price, a high demand on power - which results in overly large and cumbersome batteries, unpleasing aesthetics, dated materials that are out

of fashion with consumer trends, a lack of a suitable alarm function, and small display areas for presenting the time-related information.

[05] Moreover, many existing time-pieces do not adapt to the local time unless manually adjusted by the user. This requires knowledge by the user of the current local time. However, as often in the case, the precise and accurate local time is unknown.

[06] To overcome this problem, some time-pieces include means for receiving a radio frequency transmitting standardized national time. For example, in the United States the National Institute for Standards and Technology (NIST) operates radio station WWVB near Fort Collins, Colorado. The WWVB broadcasts are used by millions of people throughout North America to synchronize consumer electronic products. WWVB continuously broadcasts time and frequency signals at 60 kHz and a time code is synchronized with the 60 kHz carrier and broadcast continuously at a rate of 1 bit per second using pulse width modulation. The carrier power is reduced and restored to produce the time code bits. The carrier power is reduced 10 dB at the start of each second, so that the leading edge of every negative going pulse is on time. Full power is restored 0.2 s later for a binary "0", 0.5 s later for a binary "1", or 0.8 s later to convey a position marker. The binary coded decimal (BCD) format is used so that binary digits are combined to represent decimal numbers. The time code contains the year, day of year, hour, minute, second, and flags that indicate the status of Daylight Saving Time, leap years, and leap seconds. WWVB identifies itself by advancing its carrier phase 45° at 10 minutes after the hour and returning to normal phase at 15 minutes after the hour.

[07] Similarly, in Germany time telemetry is transmitted by the Mainflingen radio station, DCF, at a frequency of 77.5 kHz. The carrier amplitude is reduced to 25% at the beginning of each second for 100ms

(binary zero) or 200ms (binary one) duration excepting the 59th second. The time code format consists of 1 minute time frames. No modulation at the beginning of the 59th second serves to recognize the switch-over to the next 1 minute time frame. A time frame contains BCD-coded information of minutes, hours, calendar day, day of the week, month and year between the 20th second and the 58th second of the time frame, including the start bit S (200ms) and the parity bits P1, P2 and P3. Further there are 4 additional bits R(transmission by reserve antenna), A (announcement of change-over to daylight savings time), Z1 (during daylight savings time 200ms, otherwise 100ms) and Z2(during standard time 200ms, otherwise 100ms) transmitted between the 15th second and the 18th second of the time frame.

[08] Likewise, the United Kingdom broadcasts a national time standard from station MSF from the city of Rugby by the National Physical Laboratory (NPL). Transmission is 24 hours a day, and the carrier frequency is maintained at 60 kHz to within 2 parts in 1012. The signal is generated at Rugby using the atomic clocks and time code equipment provided by NPL.

[09] Europe hosts yet another national standard time broadcaster, the radio station HBG, located in Prangins near Geneva Switzerland, broadcasts at 75 kHZ. In Japan time is continually broadcast on 40 kHz and 60 kHz (JJY40 and JJY60, respectively).

[010] Despite the prevalence of such time-related data telemetry, few existing time-pieces utilize this signal to control the time displayed and fewer still have the ability to adapt to one frequency from a set of multiple frequencies. For example, most radio-controlled clocks can only receive telemetry from one specific frequency. Thus, such time-pieces can only be used in one country and cannot provide radio-controlled time when

traveling outside that specific country. For example, a radio-controlled clocks sold to U.S.-based customers can only receive and manipulate the 60 kHz frequency and U.S.-specific encoded data and are unable to receive or process any other national time broadcasts.

[011] Presently, one time-piece can receive three separate national radio broadcast time telemetry data. However, it must be manually adjusted to receive the correct radio frequency. This method is disadvantageous, as it requires the user to know the correct frequency and to "tune" the clock.

[012] Accordingly, one significant limitation of existing time-pieces, the inability to receive and interpret time broadcast frequencies, makes them ill-suited for international travelers. In addition to being limited to a single national radio frequency, existing radio controlled time-pieces are bulky and overly large. Further, existing time-pieces, to receive time telemetry broadcasts, consist of a radio-frequency inert shell, such as plastic, to house the internal components. The plastic shell, while performing its task adequately, does not suit the styling tastes of many consumers. Finally, no existing time-pieces combine multiple radio frequency reception with an automatic selection of the frequency with the strongest signal.

[013] Therefore, there exists a need for a small, compact radio-frequency time piece that can receive multiple radio frequencies based on several separate national time telemetry broadcasts. Such a time-piece should include an attractive shell or housing made from the latest, consumer-accepted materials such as aluminum. There is a need for a time-piece that automatically selects – based on signal strength – the appropriate national time broadcast. Such a time-piece, moreover, should be economical to produce in mass quantities, and be easy to use.

SUMMARY OF THE INVENTION

[014] The present invention addresses and overcomes the shortcomings of existing time-pieces. The present invention, in one embodiment, comprises a compact, radio-controlled travel alarm clock with internal temperature gauge with a combination of advantageous features.

[015] Advantages of the present invention include:

- A Multi-band radio receiver adapted to receive a plurality of radio frequencies for example, WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60;
- A single antenna configured to receive a plurality of radio frequencies broadcasting time telemetry;
- Automatic scanning to locate the appropriate frequency based on the current physical location of the unit;
- Sensing and display of the indoor temperature;
- Providing a visual display of signal strength;
- Displaying day, date, and time;
- Alarm and snooze functions;
- Compact dimensions of about 96 mm x 19 mm x 6 mm;
- An external housing comprising substantially aluminum, stainless steel or similar metal;
- An LCD with EL backlight;
- A low battery indicator;
- Multi-language display; and
- A crescendo-type alarm.

[016] A further objective of the present invention is the ability to operate in several nations and utilize the time telemetry broadcast by each such nation. Accordingly, the invention includes means for receive time telemetry from national broadcasts in Japan, Germany, USA, Switzerland, and the United Kingdom, for example.

[017] Accordingly, in one embodiment the present invention comprises a radio-controlled clock device having an antenna adapted to receive multiple frequencies; the antenna communicating data signals to a

processor; the processor enabled to determine signal strength to select one frequency from the multiple frequencies; the processor further adapted to determine local time based on time-telemetry received from the one frequency; and the processor further communicating to means for displaying the local time.

[018] The device further comprises a multi-band radio receiver adapted to receive a plurality of radio frequencies, at least one frequency being selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

[019] In a separate embodiment the device comprises a multi-band radio receiver adapted to receive a plurality of radio frequencies, at least two frequencies being selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

[020] The device includes a substantially metallic housing for encapsulating the processor and means for displaying local time. And, the means for displaying the local time comprises a LCD panel. The LCD panel further comprises means for displaying battery charge and means for displaying signal strength.

[021] In another embodiment the present invention comprises a radio-controlled clock device comprising a compact housing encapsulating a single antenna, the antenna adapted to receive a plurality of radio frequencies; a processor linked to the antenna and adapted to automatically select a single frequency based on signal strength and further enabled to determine a current local time based on time-telemetry received via the single frequency; and a display enabled to output the current local time.

[022] The device further comprises means for automatic scanning to locate the appropriate frequency based on the current physical location of

the unit and wherein the plurality of radio frequencies being selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

[023] The device further comprises means for sensing and displaying an indoor temperature, means for providing a visual display of signal strength, and means for displaying day, date, and time.

BRIEF DESCRIPTION OF THE DRAWINGS

[024] 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 perspective view of the top of one embodiment of the present invention.

Figure 2 is a top view of the embodiment of Figure 1.

Figure 3 is a front view of the embodiment of Figure 1.

Figure 4 is a bottom view of the embodiment of Figure 1.

Figure 5 is a detail view of a portion of the top of Figure 2 highlighting display output.

Figure 6 is a back view of the embodiment of Figure 1.

Figure 7 is a perspective view of an alternative embodiment of the present invention.

Figure 8 is a graph illustrating alarm frequency of one mode of operation of the present invention.

Figure 9 is a side view of the embodiment of Figure 1.

Figure 10 is a schematic view of internal components according to one possible embodiment of the present invention.

Figure 11 is a circuit diagram of one possible embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[025] Representative embodiments of the present invention are illustrated in the drawing consisting of Figures 1 through 10, as described above. Similar features share a common reference numeral throughout each of the several figures.

[026] COMPACT DIMENSIONS

[027] In one particular embodiment as illustrated in Figures 1 and 7, for example, the present invention 10 includes a housing 12 consisting primarily of aluminum, stainless steel, or other similar metal and having compact dimensions. For example, the embodiment illustrated in Figure 7 includes an external housing 12 comprising aluminum and including an overall length 56 of about 96.0 mm, an overall width 58 of about 53.0 mm and an overall height 60 (or thickness) of about 6.0 mm.

[028] As depicted in Figure 9, the device 10 includes a cabinet stand 62 to facilitate orientation of the device on a tabletop or other such surface. The cabinet stand 62 selectively pivots with relation to the back housing 16. In one position, the cabinet stand 62 mounts substantially flush to the back housing. In a second position, the cabinet stand 62 mounts substantially perpendicular to the back housing. In one embodiment (not pictured in the drawing), the cabinet stand 62 comprises a pair of pivotable elements located on the lower, facing corners of the back housing.

[029] Despite a substantially metallic external housing, this embodiment, nevertheless, maintains excellent radio frequency reception due - in part - from it unique antenna array located at the interface of the front and back housings. In other embodiments a portion of the front housing, back housing, or both comprises a substance that is inert to radio waves, such

as plastic. Moreover, this single antenna array enables reception over multiple frequencies.

[030] As illustrated, for example, in Figure 11, the present invention achieves its compact dimensions by integrating a compact circuit design. In one contemplated embodiment an integrated circuit (IC) connects to the single antenna to receive frequencies of 77.5 kHz, 75 kHz, 60 kHz, and 40 kHz. Accordingly, requisite transistors (T2, T3, T4) placed in series enable user-selected or automatic selection of the appropriate frequency to determine the current local time.

[031] DISPLAY SCREEN

[032] A large, easy-to-read, LCD (liquid crystal display) panel screen 18 presents information including present time, date, day, temperature, battery life, signal strength, and transmitting antenna received. In other modes the screen 18 adapts to display the alarm setting and other functional information as will be explained later.

[033] The screen 18, occupying a large portion of the front panel 14, is shown in Figures 1, 2, and 7, for example. Figure 5 details a possible layout of the screen 18 including useful information including the current local time 50. A series of power status bars 38 indicate the battery charge of the device 10 – a full charge on the battery illuminates all the bars and, as the battery drains, lesser and lesser of the bars are highlighted. For example, four indicated bars represents a full battery charge, two bars indicates a half-empty battery and no bars indicates only reserve power remains. An icon 40 resembling a battery cell with a hash mark through it indicates a dead or extremely low battery condition. Other icons, such as alarm status indicator 44 of Figure 5, for example, can indicate the status of a user-programmed alarm for the weekend or during the week for a dual-alarm enable device.

[034] The display screen 18 further includes a portion for displaying the date 48 in day and month format, with the day of the week (Monday, Tuesday, Wednesday, etc.) indicated by a letter corresponding to that day in any one of several pre-programmed languages. For example, in English Monday would be indicated by the letter "M", but in French, Monday is indicated by the letter "L" corresponding to Lundi, the French equivalent.

[035] A temperature field 48 includes sufficient characters to display double-digit temperature with a decimal point and tenths of degrees. Based on user input, the temperature is presented in either degrees Celsius or Fahrenheit. The screen 18 further includes a transmitting antenna icon set 52, which indicates the source of the time signal received by the device 10.

[036] CONTROL BUTTONS

[037] Several control buttons, located advantageously on the housing 12 and illustrated in Figures 1 through 7, enable the user to manipulate the device according to any one of several pre-programmed functions. In one embodiment for example, the device 10 includes an alarm control button 28, a mode button 30, a key-lock slide 32, a temperature select button 34, a snooze button 22, an increment key 24, and a decrement key 26.

[038] MODE OF OPERATION

[039] In one embodiment the device 10 includes an indoor temperature sensor enabling measurement of the current indoor temperature in the vicinity of the device. The temperature sensor, linked to a processor, enables display of the current indoor temperature in the temperature display zone 48 on the screen 18. The range of operation for the temperature sensor operates from about - 5.0 C to about + 50.0 C and display zone 48 can indicate temperatures from about - 9.9 C to about + 60.0 C. When the sensor operates from about + 5.0 C to about + 40.0 C,

the temperature resolution is about 0.1 C with an accuracy of about +/- 1.0 C. When the sensed temperature is above or below this range, the accuracy drops to about +/- 2.0 C. By manipulating the temperature display button 34, the user selectively controls the display of current indoor sensed temperature in either degrees C or F.

[040] CLOCK AND ALARM FUNCTION

[041] The device features both current time and dual-alarm modes. The user programs current time by manipulating the mode button 30 and holding it in the depressed position for at least about two seconds and, thus, entering the time/date programming mode. By manipulating the mode button 30 in conjunction with the increment button 24 and decrement button 26, the user can program the current time, date, date/month format, weekday language, time zone, and 12-hour or 24-hour format. Supported languages include, for example, English, German, French, Italian, Spanish, or Dutch. Other languages in addition or in lieu of these exemplary languages can easily be substituted, as would be understood in the art.

[042] Based on user-inputted information the time is displayed on the screen 18 in either a HH:MM:ss format or a HH:MM:ww format – "HH" representing a 2-position hour field, "MM" indicating a 2-position minute field, "ss" indicating a 2-position seconds field, and "ww" indicating a 2-position day of the week field on the screen 18 and generally referenced by number 50. Also, the user may select a 12-hour or 24-hour clock format for the display output. The time heuristic can automatically adjust for daylight savings time related alterations in the present or current local time.

[043] The device 10 may selectively enter an automatic time mode based on user inputs. In this mode, automatic reception of the time signal

broadcast by the previously successful broadcast frequency, for example WWVB-60, is initiated by the device two times each day. The user may force immediate reception of the broadcast time signal by depressing and holding the increment button 24, for example.

[044] The device 10 includes a calendar function, which user input controls. The calendar selectively displays either DD:MM or MM:DD, wherein "DD" represents a 2-position day field and "MM" represents a 2-position month – the month represented by a numeral corresponding to its sequence in a standard western calendar-year (for example, January equates to 01, February to 02, and so on).

[045] A second clock heuristic enables the device to automatically adjust for the current local time as broadcast by the nearest transmitter and adjusted by the device using the time-zone heuristic. For example, in the United States, station WWVB broadcasts time on a frequency of 60kHz. At that frequency there isn't enough room on the signal (bandwidth) to carry a voice or any type of audio information. Instead, all that is sent is a code, which consists of a series of binary digits, or bits, which have only two possible values (0 or 1). These bits are generated at WWVB by raising and lowering the power of the signal. They are sent at a very slow rate of 1 bit per second, and it takes a full minute to send a complete time code, or a message that tells the clock the current date and time. Once the device 10 decodes the signal, it synchronizes its own clock to the message received by radio and applies a time zone correction, based on the time zone setting inputted by the user. The time broadcast by WWVB is Coordinated Universal Time (UTC), or the time kept at the Prime Meridian that passes through Greenwich, England. To display local time, the device corrects its output by the appropriate number of hours. For example, if the user programs the device for local time in Portland, Oregon

(Pacific Time Zone in the USA), the device 10 subtracts 8 hours during standard time (7 hours during savings time) from the UTC signal. Thus, a UTC signal of 11:00 am results in a display of 03:00 am in Portland for this example.

[046] Referring specifically to Figure 10, in one embodiment the present invention comprises a device 10 including a main central processing unit (CPU) 72 for enabling functioning, calculation, and communication between modules. An antenna 68 receives a radio broadcast representing local time from any one of several national radio towers as represented by the signal R. The antenna relays the time telemetry to a signal receiving module 70, which is in bi-directional communication with the CPU 72. An optional temperature sensing module 76 gathers environmental temperature T from the vicinity of the device 10 and relays a signal representing the temperature to the CPU. A user input module 74 enables a user to program selectable features, such as 12/24-hour format, alarm function, etc. Finally, a display module 78 enables a user to view output O generated by the CPU. Such output may include temperature, time, date, day, and battery status. Not shown in this diagram is a power source, such as a removable power cell.

[047] The device 10 is configured to receive a plurality of standard time-telemetry broadcasts from multiple nations. Accordingly, auto-synchronization by radio signal on WWVB-60, MSF-60, DCF-77.5, HBG-75, JJY40, and JJY60 enables the device to display accurate local time. To activate auto-synchronization, the user depresses and holds the increment button 24 for at least about two-seconds. To de-activate reception, the user depresses and holds in the depressed position the decrement button 26 for at least about two seconds.

[048] PROGRAMMING MODE

[049] The alarm-programming mode activates when the user depresses and holds in the depressed position the alarm button 28. In this mode the desired alarm ringing time is set by manipulating the increment button 24 and decrement button 26, as needed. When the alarm is in the "on" position an indicator icon 42 becomes visible. The alarm includes an audible alert programmed to crescendo with increasing frequency and intensity when activated for a ring duration of about two minutes. Figure 8 depicts one possible crescendo-type alarm function on a repeating 2-second period for a duration of 120 second cycle.

[050] Figure 8 illustrates a two-second cycle for the ring duration over a period of two minutes. In the first 20 seconds of the cycle an alarm alert tone sounds every two seconds. In the last minute (from 60 to 120 seconds) the alarm tone sounds repeatedly in the two second cycle, or about eight tones per 2-seconds.

[051] Located on the top panel 20, the snooze button 22 includes a first function enabling illumination of a back light for the display screen 18. When the snooze button 22 is depressed for about 5 seconds or less, the back light illuminates. In a second mode, the snooze button 22 triggers an alarm reset loop. In this mode, a ringing alarm (set by the user to alert at a particular time) is temporary silenced and a five-minute delay loop initiates. At the expiration of this delay loop, the alarm re-alerts. This loop may continue indefinitely by repeated subsequent operations of the snooze button, or until the user turns off the alarm by depressing the alarm button 28.

[052] SAFE MODE

[053] Utilizing the present invention as a travel alarm clock and time-piece particularly exploits the advantages of this device's 10 compact size and radio-controlled time features. As such, it includes a safe mode where by

the various control buttons are inactivated, when a user selectively slides the key-lock slide 32 preventing accidental programming or enabling the alarm function, for example.

[054] The terms and expressions utilized in this specification are intended as terms of description - not limitation - and do not, therefore, exclude equivalents of the features shown and described or portions of them.

CLAIMS

[055] We claim:

1. A radio-controlled clock device comprising:
a substantially metallic housing encapsulating a single antenna, the antenna adapted to receive a plurality of radio frequencies related to time-telemetry broadcast by a plurality of national time broadcasts.

2. The clock of claim 1further comprising a means for enabling display of a current local time.

3. The clock of claim 1 wherein the plurality of radio frequencies comprises at least one of the following: 60 kHz, 77.5kHz, JJY40, JJY60, and 75 kHz.

4. The clock of claim 1 further comprising means for automatically selecting one frequency from the plurality of radio frequencies and means for displaying a current local time based on the one frequency.

5. The clock of claim 1 further comprising means for enabling a user programmable alarm function mode.

6. The clock of claim 1 further comprising means for enabling a display of current local indoor temperature.

7. The clock of claim 1 further comprising means for enabling display of date information in at least one of a plurality of selectable languages.

8. A radio-controlled clock device comprising:

an antenna adapted to receive multiple frequencies;

the antenna communicating data signals to a processor;

the processor enabled to determine signal strength to select one frequency from the multiple frequencies;

the processor further adapted to determine local time based on time-telemetry received from the one frequency; and

the processor further communicating to means for displaying the local time.

9. The device of claim 8 further comprising a multi-band radio receiver adapted to receive a plurality of radio frequencies, at least one frequency being selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

10. The device of claim 8 further comprising a multi-band radio receiver adapted to receive a plurality of radio frequencies, at least two frequencies being selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

11. The device of claim 8 further comprising a substantially metallic housing for encapsulating the processor and means for displaying local time.

12. The device of claim 8 wherein the means for displaying the local time comprises a LCD panel.

13. The device of claim 12 wherein the LCD panel further comprises means for displaying battery charge.

14. The device of claim 12 wherein the LCD panel further comprises means for displaying signal strength.

15.A radio-controlled clock device comprising:

a compact housing encapsulating a single antenna, the antenna adapted to receive a plurality of radio frequencies;

a processor linked to the antenna and adapted to automatically select a single frequency based on signal strength and further enabled to determine a current local time based on time-telemetry received via the single frequency; and

a display enabled to output the current local time.

16. The device of claim 15 further comprising means for automatic scanning to locate the appropriate frequency based on the current physical location of the unit and wherein the plurality of radio frequencies being selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

17. The device of claim 15 further comprising means for automatic scanning to locate the appropriate frequency based on the current physical location of the unit and wherein the plurality of radio frequencies consists of at least two frequencies selected from the group consisting of WWVB at 60 kHz, DCF at 77.5 kHz, MSF at 60 kHz, HBG at 75 kHz, JJY40, and JJY60.

18.The device of claim 15 further comprising means for sensing and displaying an indoor temperature.

19. The device of claim 15 further comprising means for providing a visual display of signal strength.

20. The device of claim 15 further comprising means for displaying day, date, and time.

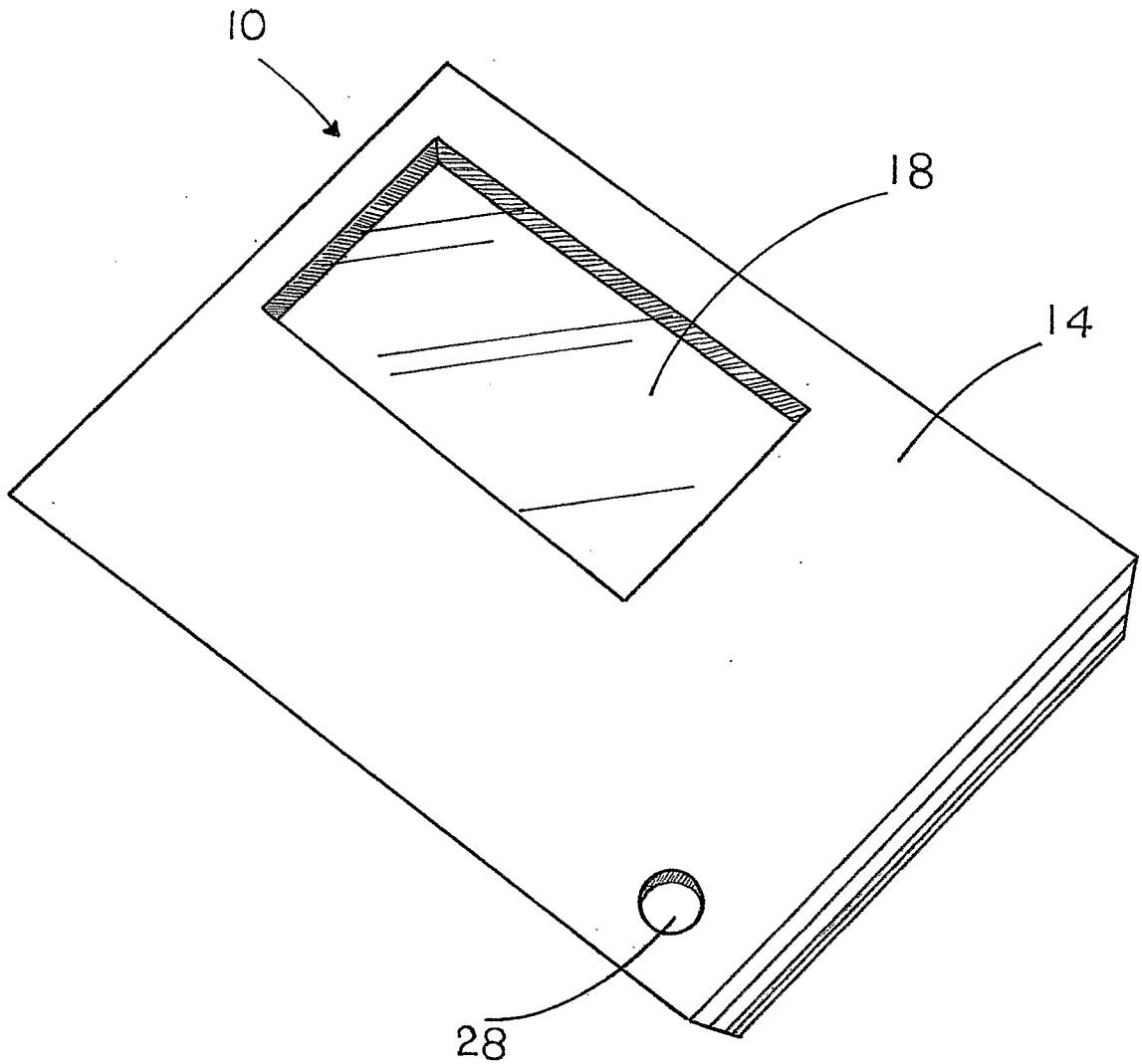


FIG. 1

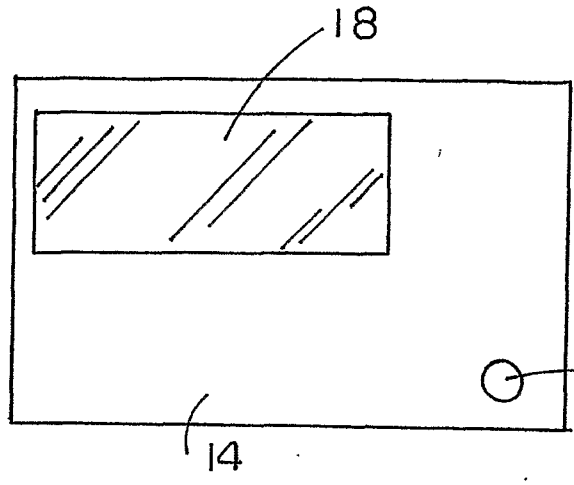


FIG. 2

FIG. 3

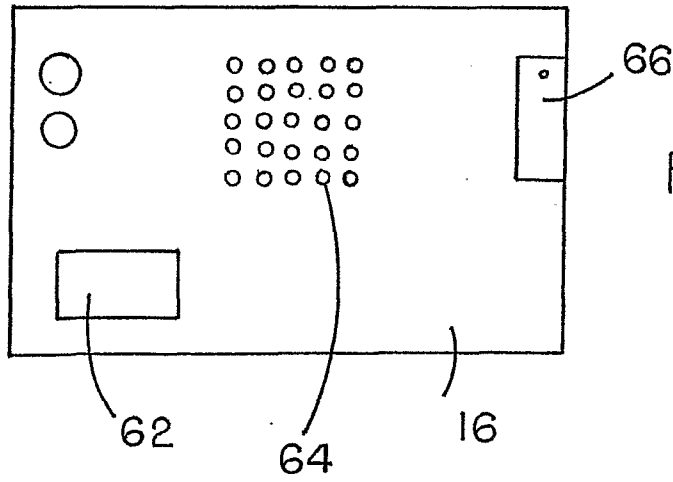


FIG. 4

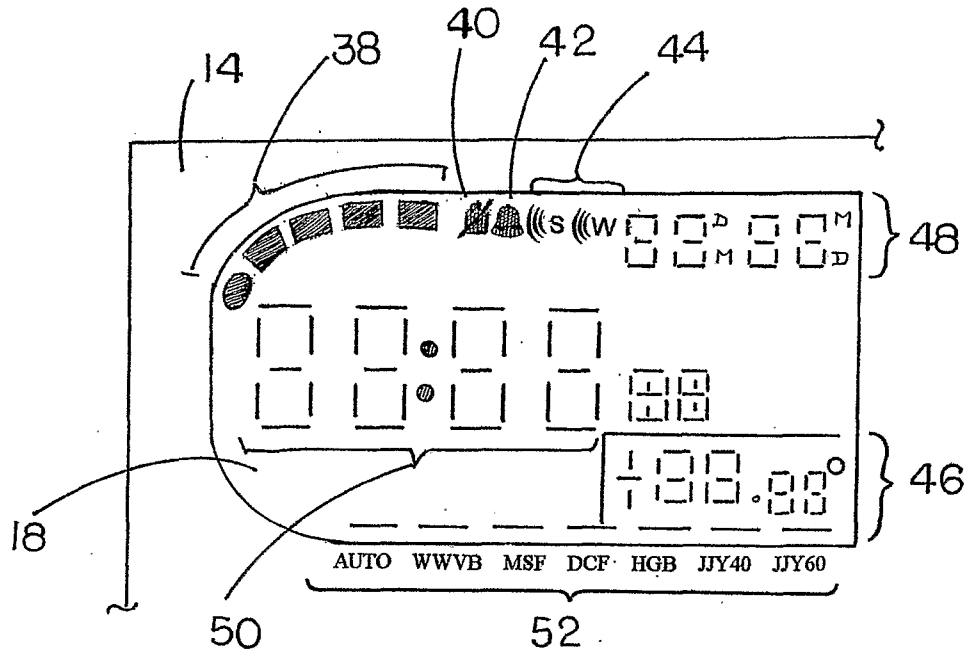
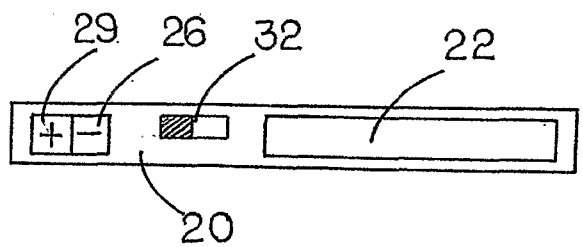

14
38
40
42
44
48
46
18
50
52
AUTO WWVB MSF DCF HGB JJY40 JJY60

FIG. 5


29
26
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20

FIG. 6

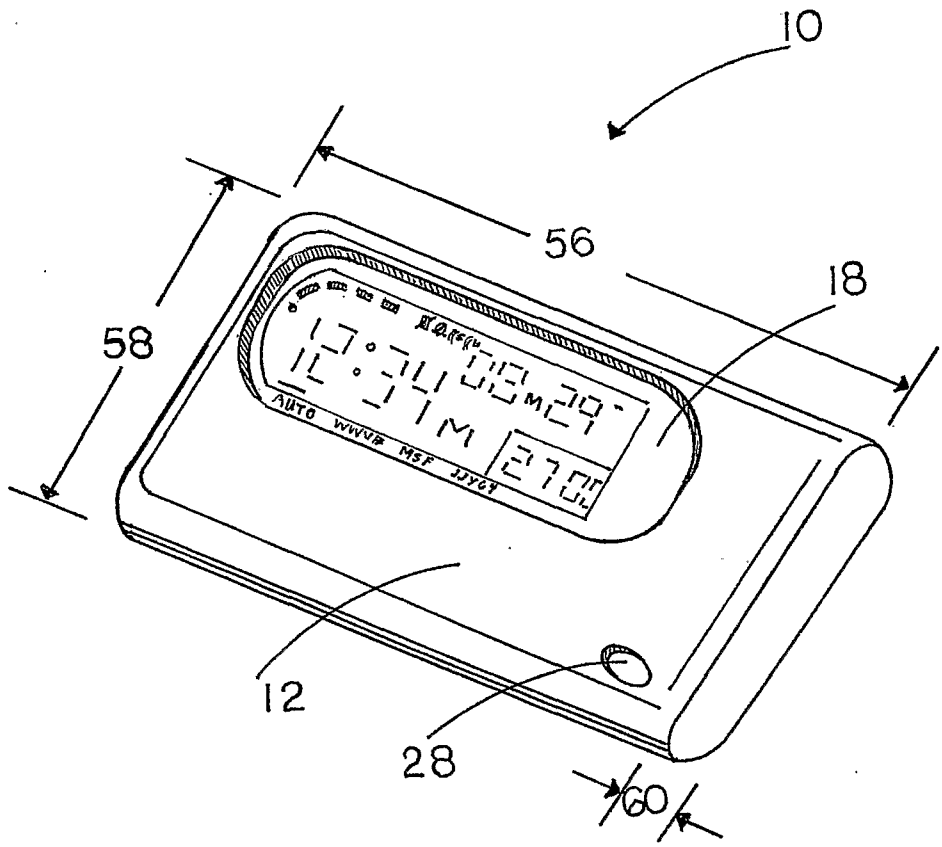

FIG. 7

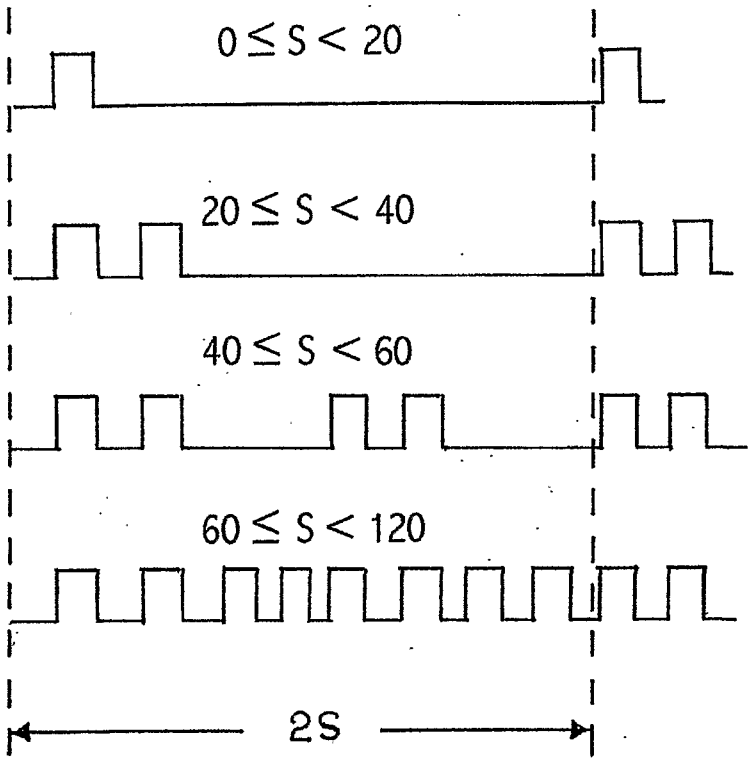

FIG. 8

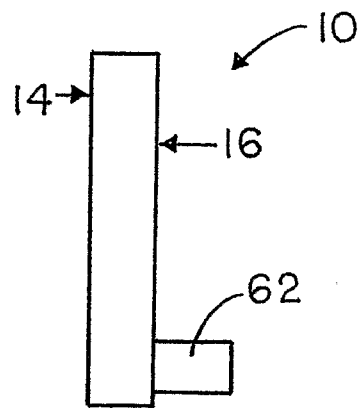

FIG. 9

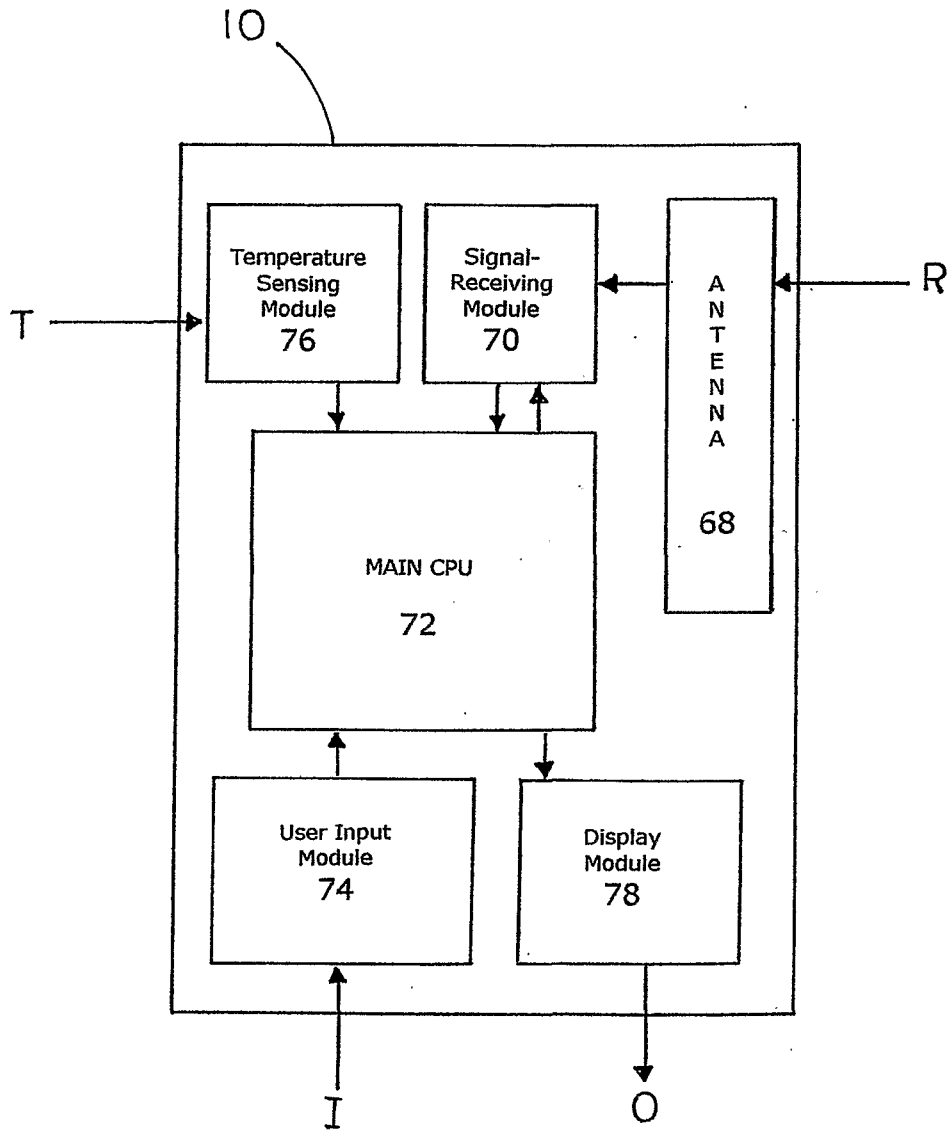
10
Temperature Sensing Module 76
Signal-Receiving Module 70
ANTENNA 68
T
R
MAIN CPU 72
User Input Module 74
Display Module 78
I
O

FIG. 10

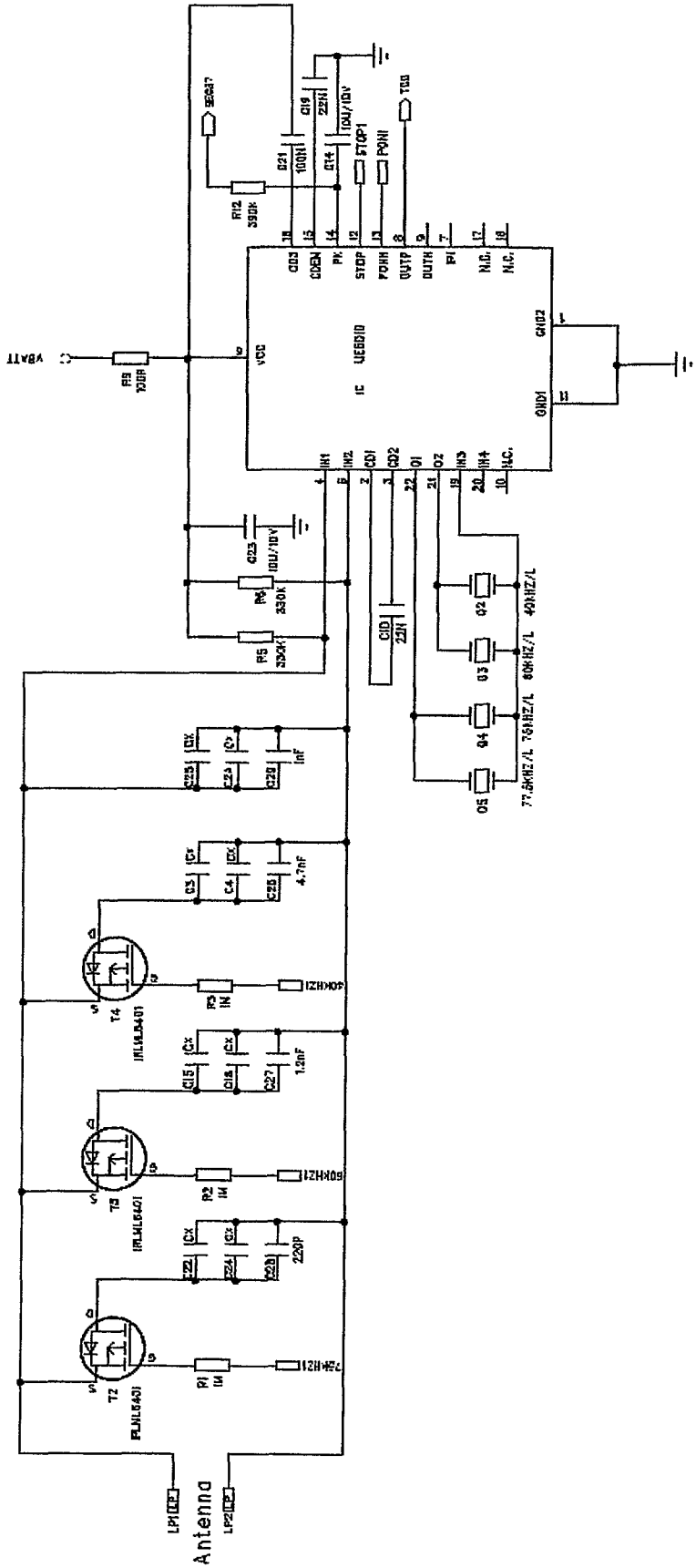
VBATT
R9 330R
VCC
IC UE8010
GND2
GND1
IN1
IN2
CD1
CD2
O1
O2
IN3
IN4
N.C.
R12 390K
C19 220N1
C21 100N1
C14
STOP1
PON1
R6 330K
R5 330K
C23 100U/10V
C10 22N1
Q2 40KHZ/L
Q3 60KHZ/L
Q4 76KHZ/L
Q5 77.5KHZ/L
C25 1nF
C3 4.7nF
C4
C26
T4 IRLML6401
R3 1M
40KHZ1
C15 1.2nF
C16
C27
T3 IRLML6401
R2 1M
60KHZ1
C21 220P
C24
C28
T2 IRLML6401
R1 1M
76KHZ1
LP1
LP2
Antenna

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/28684

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **G04C 11/02**(2006.01);**H04B 1/18**(2006.01)

USPC: 368/47;455/161.3,181.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
U.S. : 368/47; 455/161.3, 181.1

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
East search: "radio and clock and frequencies and tun$ and time"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2005/0018543 A1(FUJISAWA) 27 January 2005 (27.01.2005), see entire document.	1-4,6,8-12,15-18,20
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Y		5,7,13,14,19
A	US 5,375,018 A (KLAUSNER et al) 20 December 1994 (20.12.1994), see entire patent.	1-20

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 July 2006 (24.07.2006)	15 AUG 2006
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450 Alexandria, Virginia 22313-1450 Facsimile No. (571) 273-3201	Authorized officer V. Miska Telephone No. 571-272-2108

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