(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
12 August 2004 (12.08.2004)

PCT

(10) International Publication Number
WO 2004/067072 A1

(51) International Patent Classification[7]: A61M 21/00, A61B 19/00

(21) International Application Number: PCT/US2003/001928

(22) International Filing Date: 23 January 2003 (23.01.2003)

(25) Filing Language: English

(26) Publication Language: English

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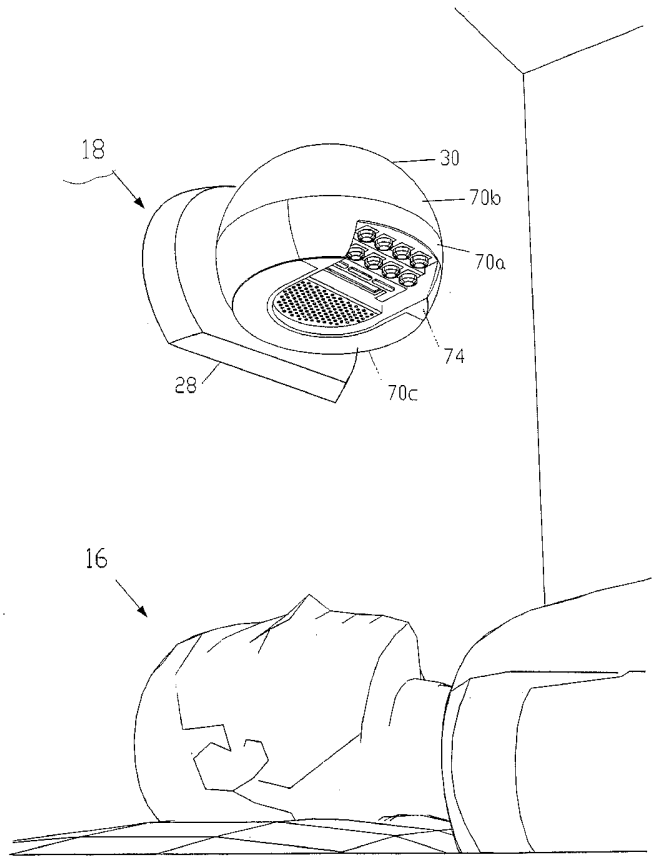
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, ZA, ZM, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: APPARATUS FOR FACILITATING ANALYSIS OF DREAM ACTIVITY



(57) Abstract: A programmable dream analyzer apparatus (18) for assisting the user in recording his or her dreams, including a microcontroller (60) for receiving input defining the user's sleep period, predicting the time and of each REM event and playing an alert for each predicted REM event during the user's sleep, such that it is sufficient to wake the user during a REM event, but not during non-REM sleep. The dream analyzer (18) further incorporates a voice activated recording device (66) to allow the user to record a description of his or her dream upon awaking from a REM event without moving.

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APPARATUS FOR FACILITATING ANALYSIS OF DREAM ACTIVITY

FIELD OF THE INVENTION

The present invention provides a method and apparatus enabling a user to investigate his or her nightly dream activity with little or no loss in the restorative process of a good night's sleep.

BACKGROUND OF THE INVENTION

The use of dreams as an anecdotal source of inspiration and prophecy is so common as to be recognizable across cultures, both current and through the ages. Mythological references to dreams and their effects abound. More recently, dreams have been made the basis of mental health inquiries through psychoanalysis. Individuals discussing their dreams with family and friends is an experience shared by all. Many inventors, scientists and artists have reported dream activity as the basis of many of their creative accomplishments.

A few devices have been developed over the years to analyze dreams and enhance the dreamer's memory of his or her dreams. However, the prior art has mainly focused on one notable aspect of dream activity: the so-called "Lucid Dream". The lucid dream is a dream in which the dreamer is aware of dreaming while remaining in the dream state. This arcane condition is often the focus of sleep labs and research institutes. Such facilities have developed devices to sense a sleeper's dreaming or non-dreaming state.

In general, these devices are worn by the test subject in order to sense the dream state. When a dream state is detected some form of feedback is provided to alert the patient that a dream is occurring. If all works out well, a lucid dream will ensue. The prior art all require some form of device that is physically attached to the sleeper. Wearing such an attachment is not a normal part of the sleeper's habits and can interfere with the test subject's usual night's sleeping process and may itself become the focus of the subject's dream activity.

For example, LaBerge et al. U.S. Patent 5,507,716 discloses a mask, similar to sunglasses or goggles, which is additionally wired for sound. Such devices may be suitable for investigating sleep patterns in a lab context, but are not likely to find widespread nightly usage among the general populous. Additionally, the devices described by Laberge et al. are expensive, further limiting their appeal to individuals who may desire to investigate their dreams on their own.

Many experiments have been performed to awaken test subjects during the so-called REM (Rapid Eye Movement) periods of sleep. It has been determined that these periods usually correspond with dream activity. When a test subject is awakened during a REM event, the subject is usually able to remember the dream which was occurring at the time he or she was awakened. If the test subject is not awakened, the dream is more likely to be forgotten during the intervening periods of deeper, dreamless sleep. Thus, for those individuals who are interested in investigating the subjects of their dreams it is desirable that they occasionally be woken up either during or shortly after a REM event. With most subjects, the first REM event usually occurs about sixty minutes after the subject falls asleep. Thereafter, periods of deep sleep with little dream activity are punctuated by periods of heightened dream activity during REM events which occur approximately every 90 minutes.

Most persons experience a cycle of 4, 5 or 6 REM events per night.. These cycles are usually consistent for a given individual but vary from one person to another. In a substantial percentage of the population the rhythms are so strong and consistent that many people have no need for an alarm clock. Their own "internal clocks" are so accurate that they wake up at the same time each morning on their own. This indicates that for many individuals it is not necessary to provide sensors and or physical hookups to the individual to determine when REM events are taking place since the REM events will take place at substantially the same time each night.

For those persons having a sufficiently regular sleeping rhythm, a remote device could be programmed to awaken the individual at the appropriate time at the end of or just after the conclusion of a REM event. Such a device could be configured to wake the dreaming individual by issuing an "alert" in the form of flashing lights, playing sounds at certain frequencies, playing music, and so forth. As REM sleep is much closer to the waking state than non-REM sleep, the strength of the alert would be set at a level which would only awaken the user during a REM event. Such a device would ideally allow for variable time settings in order to individually synchronize the occurrence of dream alerts with an individual's nightly rhythms. Dream alerts could be set to occur, for example, at the end of the individual's REM events or shortly thereafter.

Such synchronization could be effected through repeated use and fine tuning of the dream alert settings. Reliable timing will proceed from the daily stored and updated values of the alert variables. By fine tuning the synchronization between the dream alerts and the

occurrence of REM events, the dream alerts may be provided by a remote device with no physical connections to the user. The user would then experience a more natural sleep environment while still benefiting from being awakened during and usually near the end of REM events so that dreams are more fully remembered. An additional desirable feature of such a device would be to include a dictation system so that the user could record the subject matter of his or her dreams before returning to sleep. Further, the user's normal sleep patterns such as the time the individual normally goes to bed and gets up should be storable so that the user need not go through a tedious set up procedure each night before retiring. The nature of the dream alerts should also be selectable to allow for a wide range of wake up options. For example, device settings should allow for minimal intrusion during the REM cycle. This will help to prevent waking the user during non-REM periods, as well allowing the user to complete dreams before the user awakens in response to the alert event.

SUMMARY OF THE INVENTION

These needs and other needs are satisfied by the present invention comprising a programmable dream analyzer apparatus containing a programmable microcontroller, at least one input device operatively connected to the microcontroller, and an alert device or alert enunciator connected to the microprocessor. The microcontroller is adapted to receive user input consisting of a start time corresponding to a time when the user goes to sleep, and an end time corresponding to a time when the user expects to wake up. Alternatively, the user may input his or her total sleep time instead of the wake up time.

The microcontroller then calculates and programs the times for an alert that are associated with the occurrence of a REM event that the user is expected to experience in the time period between the start time and end time. The microcontroller then activates an alert device or alert enunciator at the programmed alert times, such as flashing LEDs or playing a melody or tone through a speaker.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of the inventive dream analyzer apparatus shown in relation to the user.

FIGURES 2A and 2B illustrate a timeline showing the periodicity of dream intervals with six REM events within an eight hour and six hour period, respectively.

FIGURES 3A and 3B illustrate a timeline showing the periodicity of dream intervals with five REM events within an eight hour and six hour period, respectively.

FIGURES 4A and 4B illustrate a timeline showing the periodicity of dream intervals with four REM events within an eight hour and six hour period, respectively.

FIGURE 5 is a top perspective view of the dream analyzer apparatus of Fig. 1 seen from behind, showing the assembly of the electronic unit on the wall mounting plate.

FIGURE 6 is a top perspective view of the dream analyzer apparatus of Fig. 5 seen from the front.

FIGURE 7 is an inverted bottom perspective view of the dream analyzer apparatus of Fig. 1 seen from behind, showing the assembly of the electronic unit on the wall mounting plate.

FIGURE 8 is an inverted, bottom perspective view of the dream analyzer apparatus of Fig 7 seen from the front.

FIGURE 9 is an inverted, exploded bottom perspective view of the dream analyzer apparatus of Fig. 1 seen from the front.

FIGURE 10 is an exploded top perspective view of the dream analyzer apparatus of Fig. 9 seen from the front.

FIGURES 11a and 11b together are an operational flowchart illustrating the Program Interface as the user sets the times and alert variables for the inventive dream analyzer apparatus.

FIGURE 12 is a schematic electrical circuit diagram of the inventive dream analyzer apparatus.

FIGURE 13 is a perspective view of an alternative embodiment of the inventive dream analyzer apparatus, shown in relation to the user.

DETAILED DESCRIPTION OF INVENTION

In accordance with the present invention, a dream analyzer apparatus is described, which operates to wake a sleeping individual at predetermined times corresponding to the individual's pattern of nightly REM event cycles. In general, dreams that occur during REM events are usually forgotten during the next non-REM interval. Thus, an individual is more likely to remember the details of a dream or dreams that occurred during the REM event if he or she awakes at or near the end of an REM event, than if the individual remained sleeping.

The inventive dream analyzer includes a voice activated recording system whereby, upon waking up during or shortly after a dream, an individual may dictate a description of the dream to the apparatus. The dream analyzer records the individual's spoken message for later playback when the individual is awake. In this way, an individual may preserve many vivid details of the dreams that are normally forgotten when the individual returns from REM to non-REM sleep.

Figure 1 shows the inventive dream analyzer apparatus **18** mounted to a wall or the head board of a bed above a sleeping individual **16**. Dream analyzer **18** operates by playing a series of alert event devices to wake individual **16** at predetermined times corresponding to the individual's nightly pattern of REM event cycles. The time and nature of each alert is fully programmable, so that individual **16** can customize dream analyzer **18** to his or her individualized sleeping patterns and habits. Optimal results are achieved when the individual using dream analyzer **18** has regular sleep habits, such as going to bed at or near the same time each evening and rising at substantially the same time each morning. Under these conditions, REM events are most likely to occur at or near predictable times each night.

In order to fully appreciate the operation of the inventive dream analyzer apparatus, it is first necessary to review the sleeping patterns common to most people. The sleep period for most individuals ranges from 6 to 10 hours, and usually varies with the age of the user. Older children and younger adults may require up to 10 hours of sleep, while the elderly require, on average, 6 or even fewer hours of sleep a night. Thus, dream analyzer **18** provides for up to a 12-hour sleep period, with the actual time settings typically determined by the age of the user.

Most individuals experience 4, 5 or 6 REM event cycles during each sleep period. The first and last REM events typically occur at the same relative time, regardless of the length of the sleep period or the number of REM events. The first REM event occurs approximately 60 minutes after the individual falls asleep and usually lasts about 10 minutes. The last REM event of the night occurs approximately 30 minutes before the end of the sleep period and typically ends when the individual wakes up. In general, the remaining REM events are evenly spaced between first and last REM events, and increase in length as the sleep period progresses.

For example, Figs. 2A and 2B, 3A and 3B, and 4A and 4B respectively depict the REM event cycles of individuals having 4, 5 or 6 REM events per night. Figures 2A, 3A and

4A depict the REM event cycles of individuals over an 8-hour sleep period, while Figs. 2B, 3B, and 4B depict the REM event cycles over a 6-hour sleep period. In general, individuals who have a sleep period in the 6-hour range will experience 4 REM event cycles per night (Fig. 4B), while those in the 8-hour range will experience 5 or 6 REM event cycles per night (Figs. 2A, 3A). A 10-hour sleep period is not shown but would be proportional to the sleep periods shown Figs. 2A and 2B, 3A and 3B, and 4A and 4B.

Each such figure depicts a graph of an individual's sleep period, with time extending along the horizontal axis. The longer, lower shaded portions represent intervals of deep sleep **22**, while the upper shaded portions represent REM events **20**. The series of numbers above REM events **20** represent the duration of each REM event in minutes. Line **24** shows the REM event cycles, with the series of numbers above line **24** indicating the amount of time for each cycle, as measured between the midpoints of adjacent REM events **20**. Similarly, line **25** shows the amount of time for each interval of deep sleep **22** between REM events **20**. Finally, line **26** shows the total amount of time for the sleep period.

As can be seen in Figs. 2A and 2B, 3A and 3B, and 4A and 4B, the duration of the REM events **20** increases as the night wears on, while the duration of the intervals of deep sleep **22** remains substantially constant. For example, Fig. 4B shows an individual who experiences 4 REM event cycles in a 6-hour (360 minute) sleep period. The duration of the REM events **20** increases in time from 10 minutes for the initial REM event to 16, 23 and 30 minutes for subsequent REM events. The REM events are evenly spaced between 74 minute intervals of deep sleep **22**. Thus, if that individual desired to be awakened for each REM event, dream analyzer **18** would be programmed to play a series of alerts at the midpoint of each REM event **20**, approximately 64, 150, 244 and 345 minutes after first falling asleep.

Dream analyzer **18** may be programmed to wake the user at appropriate times by simply inputting the time for going to bed at night and getting up in the morning, to define the total amount of time for the sleep period. Dream analyzer **18** will then calculate and set the time for a series of alerts based on the 4, 5 and 6 REM event cycles. The user may further program dream analyzer **18** by individually rescheduling each alert.

Dream analyzer **18** is also programmable in the sense that the user may adjust the strength of each alert with respect to several variables to fit his or her own preferences. In particular, the strength of the alert may be adjusted so that it is sufficient to wake the user during a REM event when the user is closest to the waking state, but not during non-REM,

deep sleep. In one embodiment of the invention, the dream analyzer **18** is provided with an alert device or alert enunciator, such as flashing Light Emitting Diodes (LEDs) **54a**, **56a** and **58a** directed toward the sleeping user, as best shown in Figs. 9 and 10. Alert LEDs **54a**, **56a** and **58a** are arranged in a plurality of triads of red **54a**, green **56a** and blue **58a** diodes. The user may adjust the color emitted by alert LEDs **54a**, **56a** and **58a** by programming dream analyzer **18** to flash either one or a combination of red, green and blue diodes in each triad. The user may also adjust the overall intensity of alert LEDs **54a**, **56a** and **58a**, as well as the number, duration and length of time between flashes.

The required alert strength varies not only between individuals, but also at different times of the night for the same individual. Thus, if a user is particularly interested in dreams that occur in early REM events, he or she may program dream analyzer **18** to increase the strength for alerts that occur early in the night, and reduce the strength for later alerts. The user may further program a ramp function wherein the intensity of flashing alert LEDs **54a**, **56a** and **58a** gradually decreases and increases over the course of an alert. The least intensity that will awaken the user will also usually awaken the user latest in the REM event and, thus, offer most of the dreaming sequence for vocal notation.

The alert device may also play an accompanying sound which is selectable by the user, such as a melody, tone, or other alert sounds that are well known in the art. Dream analyzer **18** may be programmed such that the early, middle and late alerts may each have their own alert sound. Silence also may be selected and the alert sound volume is adjustable. As the entire program fills approximately only 60% of the memory capacity of a microcontroller, such as the PIC16F876 chip (Microchip Technology Inc. - Itasca, IL), space for two dozen songs is available.

Dream analyzer **18** will now be described with regard to Figs. 1, and 5-10. Figure 1 shows dream analyzer **18** properly positioned for use by a sleeping individual **16**. Dream analyzer **18** comprises an electronic unit **30** rotatably mounted on a mounting plate **28**, that is attached to a vertical support above the head of a sleeping individual **16**, such as a wall or headboard of a bed, by screws, adhesive or other means well known in the art (not shown).

Electronic unit **30** comprises a bottom casing **70a**, an upper casing **70b**, and a transparent lens **70c**. As best seen in Figs. 5-10, electronic unit **30** is assembled on mounting plate **28** by means of a tab **27b**, which projects from the rear of bottom casing **70a**. A slotted opening **27a** is formed in the center of the mounting plate **28**, and is configured to rotatably

receive tab **27b**. Electronic unit **30** is assembled on mounting plate **28** by inserting tab **27b** into slotted opening **27a** and rotating 90 degrees to lock tab **27b** in place within slot **27a** and fix electronic unit **30** in its proper position on mounting plate **28**.

The power for the unit electronic **30** is primarily provided by a 600 mA/6 V wall outlet transformer with appropriate cord and plug (not shown), as is well known in the art. To accommodate the transformer plug, a recessed power jack **27d** is formed in tab **27b**, which accepts a complementary projection plug **27c** cast within the slot **27a** of mounting plate **28**.

Upper casing **70b** is removably attached to lower casing **70a** by means of complementary threads **70d**, **70f**, respectively formed in lower casing **70a** and upper casing **70b**. As shown in Figs. 9 and 10, threads **70d** and **70f** accommodate a 90 degree rotation. The removable upper casing **70b** provides convenient access to the battery carriage **70e**, which is integrally formed within upper casing **70b**. Battery carriage **70e** is configured to hold 6 AA-type batteries **73**, which provide backup power when the electronic unit **30** is removed from mounting plate **28** and is disconnected from the wall outlet transformer.

Lens **70c** is permanently attached to lower casing **70a** by welding, gluing or other means well known in the art.

The instrumentation and display for operating dream analyzer **18** is mounted on underside **74** of electronic unit **30**, so as to face the user sleeping below. A single row, 16-character Liquid Crystal Display (LCD) screen **42a** with an integral backlight **43** (shown in Fig 12), such as an Optrex DMC 16105NY-LY produced by Optrex America, Inc. (Plymouth, MI), is mounted in an opening **42b** in bottom casing **70a**. A speaker **44a**, such as a LabTech SS-11 (Andover, MA) is mounted within a housing **42b** formed in bottom casing **70a**, and concealed behind a screen **44c**. A series of indicator LEDs **57a**, **59a** and **61a** are mounted within complementary slots **57b**, **59b** and **61b** in bottom casing **70a**, and provide visual confirmation of the status of the recording system as described below.

As best shown in Figs. 8 and 9, a plurality of momentary pushbutton operators **36a**, **38a**, **40a**, **47a**, **53a** and **55a**, such as Mountain Switch momentary, 107 DS-622, and latching operators **48a** and **52a**, such as Mountain Switch on-off switch, also 107 DS 622, (Mouser, Mansfield, TX) and a one megaohm potentiometer **49a**, such as Digi-Key CT2271-ND (Thief River Falls, MN) are positioned on the underside **74** of the electronic unit **30**, mounted within complementary slots **36b**, **38b**, **40b**, **47b**, **48b**, **49b**, **52b**, **53b** and **55b** in bottom

casing **70a**. The pushbuttons include a device on/off button **48a**, a playback/record button **52a**, a voice chip reset button **53a**, a voice chip start/pause button **55a** and a device reset button **47a**. In addition, electronic unit **30** is provided with a quartet of device programming pushbuttons comprising left, middle and right pushbuttons **36a**, **38a**, and **40a**, and a rotatable alert sound volume button **49a**. Buttons **36a**, **38a** and **40a** have varying functionality in the input of user information and programming of dream analyzer **18**, as described below.

In alternative embodiments, other input devices may be utilized as well as the pushbutton operators **36a**, **38a**, **40a**, **47a**, **48a**, **49a**, **52a**, **53a** and **55a**, such as an infrared remote control device, as is well known in the art. In yet another embodiment, dream analyzer **18** is provided with an input/output jack and direct reprogramming of microcontroller **60** is enabled, as is well known in the art, to permit downloading of alert presets, songs, tones or other information stored in a computer or similar device, or from an Internet web site.

A pair of electret microphones **50a**, **50b** and a series of alert LEDs **54a**, **56a** and **58a** are concealed behind lens **70c**. As shown in Figs. 9 and 10, a printed circuit board **80** is mounted within bottom casing **70a**, behind lens **70c**. LEDs Microphones **50a**, **50b** are installed in sound mounts **50c** attached to circuit board **80** and positioned above openings **50d** in lens **70c**. A plurality of alert LEDs **54a**, **56a** and **58a** are also connected to circuit board **80** behind lens **70c**, arranged in a series of triads encircling LCD **42a**, each triad comprising a red **54a**, green **56a** and blue **58a** alert LED. Alert LEDs **54a**, **56a**, and **58a**, are preferably 10 mm narrow view diodes having at least 8000 mll luminosity, such as those provided by Marktech Optoelectronics (Menands, NY), but other comparable LEDs or lamps may be used. As alert LEDs **54a**, **56a** and **58a** have a 10 year life expectancy, the lens **70c** is permanently mounted to lower casing **70a**.

As shown in the diagram of Fig. 12, printed circuit board **80** includes a microcontroller **60**, a voice recording/playback chip **66** and a voice activated switch **64**. In a preferred embodiment, microcontroller **60** is a PIC16F876 chip, voice recording/playback chip **66** is an ISD25120 chip (WINBOND/ISD, Inc. - San Jose, CA), although those skilled in the art will appreciated that other chips with similar functions may be used. If a PIC16F876 chip is used, the following chip fuses should be programmed along with the hex code supplied.

Oscillator:	XT
Watchdog Timer	Off
Power Up Timer	On
Code Protect	Off
Brown Out Detect	Off
Low Voltage Program	Off
Flash Program Write	Off
Background Debug	Disabled

Voice activated switch **64** is an Rk 990-0085 switch (Electronic Rainbow Inc. - Indianapolis, IN). The circuit diagram for voice switch **64** indicates a one megaohm pot may be used as an alternate for a supplied resistor to tune the sensitivity of the switch, as is well known in the art. Operating power for the components mounted on circuit board **80** is provided by wall outlet transformer or by batteries **73** through a +5 volt voltage regulator with suitably sized and mounted heat sink **63,** as shown in Fig 12.

Figure 12 shows the connections between voice recording/playback chip **66**, speaker **44a**, and one of the microphones **50a**. The second microphone **50b** is connected to voice activated switch **64**, which, in turn, is input to the RB0 interrupt line of microcontroller **60**. The output from voice activated switch **64** controls the record function of voice recording/playback chip **66**, as modified by the programming output of microcontroller **60**.

During a programmed alert, dream analyzer **18** enables voice activated switch **64** and turns on LCD screen backlight **43** in preparation for receiving the dictated description of the user's dream. The sound of the user's voice activates switch **64**, which, in turn, signals microcontroller **60** to activate voice recording/playback chip **66** and record the user's dictation. Voice recording/playback chip **66** further activates indicator LED **61a** to provide visual confirmation that the recording system is activated. As the recording device is a solid state voice recording/playback chip **66** rather than tape, a syllable may be slightly clipped, but beginning words are usually not completely lost or unintelligible.

Because the brain represses physical movements during dreaming, a dream will usually be forgotten if a dreamer initially moves after waking without first mentally reviewing the dream. For this reason, the combination of voice-activated switch **64** and voice recording/playback chip **66** allows the user to record a description of his or her dream without

requiring the user to move. In addition, not moving permits the user to quickly fall back into non-REM slumber after the record of the dream is made. On arising the following morning, the user may playback the dream recorded during the night by pressing playback/record button **52a** in conjunction with voice chip start/pause button **55a**, as indicated by step **200**, allowing the user to remember the dream that would otherwise probably have been forgotten.

Voice recording/playback chip **66** has a two minute record time, which may be extended by cascading additional chips **66**, as is well known in the art. To conserve recording capacity, pauses in dictation or short silences of approximately two seconds will temporarily turn off voice recording/playback chip **66** and indicator LED **61a**, until the sound of the user's voice once again activates switch **64**.

For each programmed alert, microcontroller **60** resets an internal pointer to the beginning of voice recording/playback chip **66**'s message storage. Thus, if voice activated switch **64** is activated during more than one alert, the recording made during the last alert will partly or wholly overwrite the earlier recordings. In addition, the user may manually reset voice recording/playback chip **66**'s internal message pointer to the beginning by pressing reset button **53a** or by pressing playback/record button **52a**. In an alternative embodiment, dream analyzer **18** is able to save multiple recordings made during different alerts. Increased storage for multiple messages may be obtained by cascading additional recording/playback chips **66** and providing the appropriate code for microcontroller 60, as is well known in the art.

To provide visual confirmation and ensure that dream analyzer **18** is not inadvertently left in manual playback mode, which would prevent voice activated recording during alerts, LCD screen backlight **43** is on during the play mode for voice recording/playback chip **66**, but is other wise off except for programming and alert event times.

The playback function is controlled by the play/record pushbutton **52a**, the voice chip reset by button **53a** and the start/pause function by button **55a**, all of which are connected as shown in Fig 12. Various biasing, filtering and voltage regulating components are also connected as shown in Fig 12.

Microcontroller **60** is further connected to a 4 MHz oscillator **62a** through OSC1 input at pin 9, to provide the clock input for operation of microcontroller **60**. A 32 kHz oscillator **62b**, commonly known as a watch crystal, is connected to microcontroller **60** at pins RC1 and RC2, to provide a very accurate clock time for user inspection at any time

during nominal operation of dream analyzer **18**. Device programming pushbuttons **36a**, **38a**, and **40a** are connected to microcontroller **60** through inputs RB2, 3, and 4 at pins 23, 24, and 25, respectively. Microcontroller **60** drives alert LEDs **54a**, **56a** and **58a** through outputs RA1, RA2 and RA3, pins **3**, **4**, and **5**. Microcontroller **60** in combination with voice recording/playback chip **66** also drives backlight **43** for LCD screen **42a** through output RB7, pin 28; RB5, pin 26 or playback/record button **52a**. Microcontroller **60** also plays the programmed melody or other alert sound at the beginning of an alert through the RA0 pin, which is connected to the auxiliary pin 12 in voice recording/playback chip **66**. Various biasing resistors and operating voltages are connected to the microcontroller **60**, voice recording/playback chip **66** and voice activated switch **64**, as shown.

Microcontroller **60** automatically turns on backlight **43** for LCD screen **42** during an alert, the programming of electronic unit **30** or during a test of the programmed alerts. Backlight **43** turns off to conserve power after the alert, programming or test is complete. However, except during an alert or device programming, the user may manually activate voice recording/playback chip **66** and backlight **43** at any time by pressing latching playback/record button **52a** to initiate Playback or Record mode and then pressing momentary reset button **53a** and then the momentary chip enable button **55a**.

Dream Analyzer **18** operates by playing an alert, such as flashing alert LEDs **54a**, **56a** and **58a**, for each REM event during the user's sleep period. In a preferred embodiment, dream analyzer **18** does not require the user to determine in advance the number of REM events cycles he or she will experience, but calculates an alert for every REM event predicted to occur during a 4, 5 and 6 REM event cycle. Although the 4, 5 and 6 REM event cycles total 15 REM events (4 + 5 + 6), the first and last REM events in each cycle take place at the same time. Thus, dream analyzer **18** calculates and programs a total 11 separate alerts, any or all of which may be enabled or reset by the user.

The user inputs the start time and end time of his or her sleep period using device programming buttons **36a**, **38a** and **40a**. Dream analyzer **18** automatically calculates the time and programs an alert for each REM event predicted to occur during the user's input sleep period, according to the proportionate ratios shown in Figs. 2A, 2B, 3A, 3B, 4A and 4B. The user may then reprogram dream analyzer **18** to reschedule, set or clear any of the 11 automatically calculated alerts, as illustrated by the flowchart of the steps of programming and operation of dream analyzer **18** shown in Figs. 11a, 11b and Appendix A. The flowchart

is generally divided into three levels of programming steps **82a**, **82b** and **82c**, each successive level providing more detailed control of the functions of dream analyzer **18**. Appendix A shows the software program for a PIC16F876 microcontroller chip in hexadecimal code, enabling the operation of dream analyzer **18** as described by the flowchart of Figs. 11a and 11b.

The software program running the microcontroller **60** is initialized by pressing on/off button **48a** in conjunction with reset button **47a**. The sequence of boxes **84**, **86**, **87a**, **87b**, **88**, **90**, **92**, **94**, **96**, **98** and **99** in Figures 11a and 11b show the display of LCD screen **42a** at each programming step. LCD screens **84**, **86**, **87a** or **87b** represent the steps of entering the user's sleep period information, which dream analyzer **18** uses to calculate the times of the alerts. The user begins the process of programming dream analyzer **18** by inputting the start time and length of his or her sleep period. Initial LCD screen **84** displays the current time "XX:XX", where "X" represents the decimal value that appears on LCD screen **42a** as the result of user input or the operation of dream analyzer **18**. The current time may be adjusted up **148** in one minute increments by pressing button **146** ("R"), which corresponds to right button **40a** as shown in Figs. 7 and 8. Similarly, the time may be adjusted down **150** in one minute increments. by pressing button **144** ("M"), which corresponds to middle button **38a**. The user then enters the time displayed on LCD screen **84** by pressing button **142** ("L"), which corresponds to left button **36a**. These same buttons **146** (**40a**), **144** (**38a**) and **142** (**36a**) are also used to select between the options presented in each subsequent programming step, as indicated in Figs. 11a and 11b.

Once the current time is set, microcontroller **60** displays LCD screen **86** showing the previously stored BEDTIME value, which corresponds to the user's time for going to bed. The user may either accept or set a new BEDTIME value by pressing buttons **146** (**40a**), **144** (**38a**) and **142** (**36a**) as described above for setting the current time. Microcontroller **60** compares the entered BEDTIME value with the previous BEDTIME value. If the user accepts the previous BEDTIME value, microcontroller **60** displays LCD screen **87a** showing the previously stored TOTAL SLEEP time, which corresponds to the total length of the user's sleep period. The user may then accept or set a new value for the TOTAL SLEEP time by pushing buttons **146** (**40a**), **144** (**38a**) and **142** (**36a**) as before.

If the user accepts the previous TOTAL SLEEP time displayed on LCD screen **87a**, the program proceeds to review the number of events set for each alert event cycle by

automatically displaying the sequence of LCD screens **88, 90, 92, 94, 96** and **98**, as indicated by diamond shaped automatic sequencing blocks **152**. LCD screen **88**, 4 DREAM CYCLE, indicates that the number of alerts set for a sleep period having 4 REM events will be reviewed. Microcontroller **60** then automatically displays LCD screen **90**, which shows the current number of programmed alerts SET for a 4 REM event cycle sleep period. The user may interrupt the automatic sequence of the program and reschedule any of the 4 REM event cycle alert times by pressing left button **142 (36a)** in response to LCD screen **90**.

The user may accept the previously programmed 4 REM event cycle alert times by allowing the automatic sequence of LCD screens to proceed uninterrupted. Microcontroller **60** then displays LCD screens **92** and **94**, which allow the user to review and reschedule the previously programmed times for each of the alerts SET corresponding to a 5 REM event cycle sleep period, in the same manner as screens **88, 90**. If the user does not interrupt LCD screen **94**, microcontroller **60** automatically proceeds to display LCD screens **96** and **98**, which similarly allows the user to review and reschedule the previously programmed times for each of the alerts SET corresponding to a 6 REM event cycle sleep period.

If the user accepts the previously programmed BEDTIME value shown on LCD screen **86**, but enters a new TOTAL SLEEP time in response to LCD screen **87a**, microcontroller **60** automatically recalculates, without setting or clearing their alert status, the predicted times for each of the 11 alerts based on the new TOTAL SLEEP time, and then proceeds to display the automatic sequence of LCD screens **88, 90, 92, 94, 96** and **98**, as described above.

If the user enters a new BEDTIME value in response to LCD screen **86**, the previously stored TOTAL SLEEP time is displayed on LCD screen **87b**. As before, the user may accept or enter a new value for the TOTAL SLEEP time. If the user accepts the previous TOTAL SLEEP time, microcontroller **60** then displays LCD screen **91**, which provides the user with the option to SHIFT ALL or REVISE ALL of the programmed times for each alert. The user selects the SHIFT ALL or REVISE ALL options by pressing middle button **144 (38a)** or right button **146 (40a)**, respectively, and then entering the selected option by pressing left button **142 (36a)**.

If the user selects and enters the SHIFT ALL option, microcontroller **60** shifts all of the programmed alert times by an amount equal to the change in BEDTIME value. The SHIFT ALL option allows the user to change the BEDTIME value and preserve previous

alert settings, without rescheduling each alert. Thus, the SHIFT ALL option is useful where the user has developed individualized alert settings found to be particularly effective based on previous experience and merely wishes to accommodate a change in BEDTIME.

If the user selects and enters the REVISE ALL option in response to LCD screen **91**, microcontroller **60** recalculates, without setting or clearing their alert status, the predicted times for each of the 11 alerts based on the new BEDTIME value. Similarly, if the user enters a new BEDTIME value and a new TOTAL SLEEP time in response to LCD screens **86** and **87b**, then microcontroller **60** recalculates, without setting or clearing their alert status, the predicted times for each of the 11 alerts based on the combination of the new TOTAL SLEEP time and the new BEDTIME values.

It will be readily apparent to one skilled in the art that microcontroller **60** can be used to calculate the TOTAL SLEEP value if the user's time to wake up is known. Thus, in an alternative embodiment, the user may input his or her "WAKE UP" time, instead of the TOTAL SLEEP time.

Once the alert times are calculated and stored, microcontroller **60** automatically sequentially displays LCD screens **88**, **90**, **92**, **94**, **96** and **98**, as described above. LCD screens **88**, **92** and **96** show the location of the user in the program step of reviewing the 4, 5 or 6 REM event DREAM CYCLE. LCD screens **90**, **94** and **98** respectively display the number of alerts programmed for the 4, 5 and 6 DREAM CYCLE. The user may choose to allow the program to automatically sequence through LCD screens **90** to **98** without interruption, thereby accepting the settings of previous use as the settings of the present use. Microcontroller **60** then completes the programming process by automatically displaying LCD screen **99** NOMINAL DISPLAY, and then LCD screen **191** TIME'S NOW XX:XX, which displays the current time in minutes until a programmed alert occurs. This will be the usual mode as users empirically arrive at their individual settings with the use of the dream analyzer **18** over a period of time.

Should the user desire to review and/or reset the time of the alerts, he or she may interrupt the automatic sequence of LCD screens **88**, **90**, **92**, **94**, **96** and **98**, and send the program to the second level of LCD screens **82b** through paths **154a**, **154b** and **154c**. The second level **82b** comprises the sequence of LCD screens **100**, **104**, **106**, **108**, **110** and **112**, which allow the user to review and change the status of each alert. Pressing left button **142a (36a)** in response to LCD screens **90**, **94** or **98** causes microcontroller **60** to display LCD

screen **100**, showing the time of the first alert in the appropriate DREAM CYCLE and whether it is SET ("S") **174** or CLEAR ("C") **176**. At LCD screens **100**, **104**, **106**, **108**, **110** and **112**, pressing the right button **146** (**40a**) will SET **174** an alert at the time shown, and pressing the middle button **144** (**38a**) will CLEAR **176** an alert so that the alert will not occur at the time shown. Pressing the left button **142** (**36**) enters the selected SET or CLEAR option and continues the programming sequence.

If the SET option is selected and entered, each LCD screen **100**, **104**, **106**, **108**, **110** and **112** respectively proceeds to LCD screens **102a**, **102b**, **102c**, **102d**, **102e** and **102f**, which provide the user with the option to CONTINUE CYCLE and review the time programmed for the next alert in the DREAM CYCLE, or RESET and reschedule the programmed alert variables. Continuing to press the left button **142** (**36a**) in response to LCD screens **102a**, **102b**, **102c**, **102d**, **102e** and **102f** will accept the default screen CONTINUE CYCLE and display the next LCD screen in the sequence. If the CLEAR option is selected and entered in response to LCD screens **100**, **104**, **106**, **108**, **110** and **112**, the program skips the corresponding LCD screen **102a**, **102b**, **102c**, **102d**, **102e** or **102f** and proceeds to the next LCD screen in the previous sequence. This review/reset sequence will continue until the last alert in the DREAM CYCLE is displayed on either LCD screen **102d** (4 DREAM CYCLE), **102e** (5 DREAM CYCLE) or **102f** (6 DREAM CYCLE). Pressing left button **142** (**36a**) at this point accepts the current alert settings and sends the program to the next step of the first level of screens **82a** through paths **162a**, **164a** and **166a**.

For example, pressing left button **142a** (**36a**) in response to LCD screen **90** sends the program to the second level of screens **82b** through path **154a**, and causes microcontroller **60** to display LCD screen **100**, showing the time of the first alert in the 4 DREAM CYCLE and whether it is SET **174** or CLEAR **176**. The user may select the SET **174** or CLEAR **176** options by pressing either right button **146** (**40a**) or middle button **144** (**38a**), respectively, and then entering the selection by pressing left button **142a** (**36a**). If the SET **174** option is selected, microcontroller **60** displays screen **102a**, which provides the user with the option to CONTINUE CYCLE and review the subsequent alert settings or RESET ALERTS and reschedule the current alert and its variables. The CONTINUE CYCLE or RESET ALERTS options are selected by pressing either middle button **144** (**38a**) or right button **146** (**40a**), respectively, and then entered by pressing left button **142a** (**36a**).

If the user selects the CONTINUE CYCLE option in response to LCD screen **102a** or selects the CLR **176** option in response to LCD screen **100**, microcontroller **60** displays LCD screen **104** showing the time of the second alert in the 4 DREAM CYCLE and whether it is SET **174** or CLEAR **176**. The user may choose to SET **174** or CLEAR **176** the displayed alert time and then CONTINUE CYCLE or RESET ALERTS as before. Each of the alert times programmed in the 4 DREAM CYCLE may be sequentially reviewed and reset by proceeding through LCD screens **100**, **102a**, **104**, **102b**, **106**, **102c**, **108** and **102d** in this manner. Pressing left button **142a** (**36a**) in response to LCD screen **102d** returns the program to the first level of screens **82b** at LCD screen **92** through path **162a**.

Similarly, pressing left button **142** (**36a**) at the last LCD screen **102e** for the 5 DREAM CYCLE, returns the program to LCD screen **96** through path **164a**. Pressing left button **142** (**36a**) at the last LCD screen **102f** for the 6 DREAM CYCLE, returns the program to LCD screen **99** NOMINAL DISPLAY, through path **166a**.

Selecting and entering the RESET ALERTS option in response to LCD screens **102a**, **102b**, **102c**, **102d**, **102e**, or **102f**, sends the program through path **180** to the third level **82c**, comprising the sequence of LCD screens **130, 131, 132, 133, 134, 135, 136** and **137,** which allow the user to reschedule each of the alert variables. For example, LCD screen **130** displays the time set for the alert. LCD screen **131** displays the FLASHES/EVENT value, which represents the number of times alert LEDs **54a**, **56a** and **58a** are flashed during an alert and ranges from 0 to 29. LCD screen **132** displays the INTENSITY value, which represents the intensity of the flashes. LCD screen **133** displays the LED ON value, which represents the length of time the alert LEDs **54a**, **56a** and **58a** are on during a flash. LCD screen **134** displays the LED OFF value, which represents the length of time between flashes. LCD screen **135** displays the PULSE CONTROL value, which represents the ramping up and down of the intensity of alert LEDs **54a**, **56a** and **58a** during a series of flashes. The values of LCD screens **132**, **133**, **134** and **135** arbitrarily range from 0-9. In alternative embodiments, dream analyzer **18** may be reprogrammed to provide a larger or smaller number of intervals over the range for these variables.

LCD screens **136** and **137** have non-numerical values. LCD screen **136** displays the COLOR CHOICE value, which represents the color of the flash. By using different combinations of red **54a**, green **56a** and blue **58a** alert LEDs, dream analyzer **18** may produce

flashes that are White, Red, Yellow, Green, Blue, Blue-Green or Magenta in color. LCD screen **137** displays the SELECT SONG value, which represents the melody or other alert sound that is played during an alert. A microcontroller, such as the PIC16F876 chip, has sufficient memory space to program a dozen or more melodies, as the user may desire.

The numerical values for each alert variable displayed by LCD screens **130, 131, 132, 133, 134** and **135** may be adjusted up **190** by pressing right button **146** (**40a**) or down **192** by pressing middle button **144** (**38a**). Pressing right and middle buttons **146** (**40a**), **144** (**38a**) in response to LCD screens **136** and **137**, cycles through the various COLOR CHOICE and SELECT SONG values. Once the appropriate value is selected, pressing left button **142** (**36a**) enters the displayed value and causes microcontroller **60** to display the next LCD screen in the sequence.

The programmed values of the alert variables are shared between certain alerts according to their relative time of occurrence during the user's sleep period. Alerts are divided into early, middle and late categories. In the 4 REM event cycle, the first two REM events are classified as early, the third is classified as middle, and the last is classified as late. In the 5 REM event cycle, the first two REM events are early, the third is middle, and the last two are late. Finally, in the 6 REM event cycle, the first two REM events are early, the second two are middle, and the last two are late.

Alerts in each category share the same alert variables, except the alert time. Thus, setting an alert variable for any early alert, other than the alert time, will set that alert variable for all early alerts in the 4, 5 and 6 DREAM CYCLEs. Similarly, except for the alert time, all alerts in the middle category share the same alert variables and all late alerts share the same alert variables. This arrangement of alert variables allows the user to store variable settings for the alerts for the early, middle or last part of the sleeping period and provides greater control over awakenings by cutting alert values to the barely noticeable during one part of the sleep period, while holding other alert values constant as a control group in dream awakening experimentation.

Although it is possible to program an alert at a time that is earlier or later than the time calculated by microcontroller **60**, the alert will retain its original early, middle or late classification. For example, the time of the first alert in the 4 DREAM CYCLE may be rescheduled for the end of the sleep period, but will still retain the early alert variables.

Once all of the alert variables are programmed for the alert, pressing left button **142** (**36a**) in response to LCD screen **137** causes microcontroller **60** to display LCD screen **138**, which allows the user to TEST the program by reviewing the sequence of alert variables and the overall effect of the sounds and lights programmed for each alert. Pressing right and middle buttons **146** (**40a**), **144** (**38a**) in response to LCD screen **138**, respectively selects between the default CLR TEST option to skip the test, and the SET TEST option to run the TEST. If the user makes no selection, the default value is CLR TEST. The selection is then entered by pressing left button **142** (**36a**). A selection of SET TEST or CLR TEST is operative unless changed later in the programming or unless the device program is reset which reestablishes the default setting of CLR TEST.

If the SET TEST option is chosen, dream analyzer **18** will display LCD screen **191**, but will pass time at the rate of 4 minutes per second until a programmed alert occurs. The TEST will then play the flashing LEDs and alert sounds comprising the programmed alert variables at the normal rate of time. Once the alert is completed, dream analyzer **18** resumes passing the time at the accelerated rate. The TEST proceeds through a 12-hour period in this fashion, playing each programmed alert until device reset button **47a** is pressed to clear the TEST and reset the program.

Dream analyzer **18** does not store the time displayed during a TEST. After the TEST is completed and the user resets the device, the program returns to LCD screen **84** which shows the actual current time. The user may then proceed from the LCD screen **84** to LCD screen **191** by pressing the left button **142a** (**36a**) to progress through LCD screens **84**, **86** and **87a** without changing any of the input values, and then allowing the program to automatically proceed through the remaining steps without further button press, as described above.

If the user accepts the default CLR TEST option, the program returns to the next sequential program step in the first level of screens **82a** along path **178a** to **178b** or the second level of screens **82b** along path **178a** to**178c** or if at the end of the 6 EVENT CYCLE proceeds to the final user input screen 99, NOMINAL DISPLAY .

All user data in the microcontroller is stored in a separate bank called EEPROM (Electrically Erasable Programmable Memory) (not shown), which will retain all user data even when the device is without power. However, the stored user data may become corrupted in conditions of low power or static discharge. This condition may be resolved by

pressing right button **146** (**40a**) at LCD screen **99** NOMINAL DISPLAY, which allows the user to return the program to the LCD screen **84** to reconfigure the user data. The use of the right button **146** (**40a**) to reprogram the user data at LCD screen **99**, rather than the usual left button **142** (**36a**), which is used to interrupt the automatic sequencing of screens, helps to prevent accidental reset by the user.

Pressing right button **146** (**40a**) at LCD screen **99** NOMINAL DISPLAY, causes microcontroller to display LCD screen **102g**, which provides the user with the option to CORRECT ERRORS and reprogram the user data, or to enter NO CORRECTIONS. Pressing right button **146** (**40a**) at LCD screen **102g** selects the CORRECT ERRORS option and causes the EEPROM memory bank to be cleared via path **155b**. A blank LCD screen is then displayed to indicate that the reprogramming has taken place and that the device must be reinitialized and programmed with all new entries made by the user beginning at LCD screen **84**, as previously described. Pressing either middle button **144** (**38a**) or left button **142** (**36a**) returns the program to its normal progression and displays LCD screen **191**, showing the current time. If the user does not press either right, middle or left buttons **146** (**40a**), **144** (**38a**) or **142** (**36a**), the program will proceed automatically from LCD screen **102g** to LCD screen **191**.

In addition, pressing the device on-off button **48a** and then the device reset button **47a** at any time will also restart the program at LCD screen **84**, as indicated by operational step **202**.

Once the user has input his or her sleep period information and completes the programming of dream analyzer **18**, microcontroller **60** displays the current time on LCD screen **191** and proceeds with operational steps **193**, **194**, **196** and **198**. As previously mentioned, oscillator **62b** is used as a watch crystal, which provides input to the timer function of microcontroller **60**. In the case of a PIC16F876 chip, the Timer 1 function is a 16 bit register which counts up until it rolls over at zero and sets an interrupt bit. The timer is two seconds long with the default loading, but in the preferred embodiment is loaded halfway to produce a rollover each second. The PIC16F876 chip is ordered to sleep each second and only reawakens with the Timer 1 interrupt. It then will increase that minute's seconds, increase the display by one minute when required, store the new time as each minute is increased, check whether an alert has been programmed for that time **193**, play an alert if

appropriate, and then returns to sleep. The oscillator **62b** thereby provides electronic unit **30** with an accuracy of within a few seconds per day. The timing interrupt is continuous through user programming, running the alert sequences and keeping clock time. If electronic unit **30** loses power or is otherwise reset, it will, when restarted, display the stored value when power down occurred.

If it is determined in step **193** that an alert has been programmed for the current time, then microcontroller **60** will play the alert **194** if the alert has been set or bypass the alert if cleared. As indicated by step **196**, during an alert LCD screen backlight **43** is turned on and voice activated switch **64** is enabled for a period of approximately 15 minutes after the end of the flashing light and/or sound alert. During this 15 minute period, voice recording/playback chip **66** will record the user's spoken description of his or her dream, as shown by step **198**. Alert LED **61a** is turned on only while recording is actually taking place. If the user is not awakened, voice recording/playback chip **66** will not record and, after the 15 minute period, LCD screen backlight **43** and voice activated switch **64** are turned off until the next set alert. In the morning, the user may playback any recordings made during the previous night, which will be a continuous message.

Voice recording/playback chip **66** automatically resets for the next alert and begins a continuous record over any notes made previously. The user may also manually playback or record by pressing playback/record button **52a** in conjunction with voice chip reset button **53a** and chip enable button **55a**. Accordingly, the user may manually enable the recording and playback modes at any time other than the programmed alert times enabled by the microcontroller **60**.

Fig 13 shows an alternative embodiment **318** of the present invention, which is housed in a one-piece casing **370**. Dream analyzer **318** provides the same features shown in the preferred embodiment, described above. Red **354a**, green **356a** and blue **358a** LEDs are shown in the same orientation as in the preferred embodiment. However, the speaker **344a**, the electret microphones **350a** and **350b**, the LCD screen **342a**, the left, middle and right pushbuttons **336a**, **338a** and **340a**, the device reset button **347a**, the device on/off button **348a**, the alert sound volume button **349a**, the Sound Playback button **352a** are all at right angles to the orientation of the preferred embodiment.

All features and operations of the preferred embodiment are the same as those of the alternative embodiment. The significant differences between the two are the removable

electronic unit **330** of the preferred embodiment shown in Fig. 7. This is smaller than the assembly **318** of Fig. 13 and is easy to remove from its normal placement and its orientation is both more accessible and readable than the alternative embodiment.

Dream analyzer **318** may have the advantage of lower cost through the use of less casing, tooling and material. In addition, dream analyzer **318** may have an aesthetic advantage in that it is similar to a picture mounted to the wall and, therefore, may be more familiar to the user.

In a further embodiment of the present invention, the dream analyzer apparatus includes an input/output plug or jack for connection to a computer port or sound card, as is well known in the art. The user's oral recordings can then be converted and stored as text, using commercially available software such as "Naturally Speaking 5.0" by Dragon Systems, Inc. In addition, the computer can be used to transmit the user's oral or text records via the Internet, to facilitate analysis or share information with others on a web site. Conversely, be enabling direct reprogramming of microcontroller **60**, the computer may be used to download material to dream analyzer **18** from the Internet, computers or similar devices, such as alert variable settings, program upgrades or additional alert sounds.

While my above descriptions contain many specificities, those should not be construed as limitations on the scope of the invention, but rather as exemplification of one preferred embodiment thereof. Many other variations are possible. For example: cell phone, personal digital assistant and hand-held electronic game operations could also easily adopt the means herein disclosed. Accordingly, the scope of the invention should be determined not by the embodiments illustrated, but by the appended claims and their legal equivalents.

Appendix A

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What is claimed is:

1. An apparatus for facilitating the investigation of the subject matter of a user's dreams during a REM event, the apparatus comprising:

a microcontroller;

an input device connected to the microcontroller;

an alert enunciator connected to the microcontroller; and

wherein said microcontroller receives a start time and an end time from said input device, said start time corresponding to a time when the user goes to sleep and said end time corresponding to a time when the user expects to rise, calculates an alert setting temporally associated with the occurrence of a REM event which the user is expected to experience in the time period between the start time and end time, and activates said alert enunciator at a time corresponding to said alert setting.

2. The apparatus of claim 1 wherein said enunciator comprises an aural alert to wake the user during REM sleep.

3. The apparatus of claim 1 wherein said enunciator comprises a visual alert to wake the user during REM sleep.

4. The apparatus of claim 3 wherein said visual alert comprises a flashing light directed toward the user.

5. The apparatus of claim 4, wherein said flashing light comprises a plurality of differently colored LEDs

6. The apparatus of claim 4 wherein said flashing light has a pulse frequency, a pulse length and a pulse intensity adjustable by said user.

7. The apparatus of claim 1 wherein said microcontroller calculates a plurality of alert settings, each alert setting being temporally associated with a different REM event calculated to occur between the start time and end time.

8. The apparatus of claim 1, further comprising a voice activated dictation system for the user to record statements upon being awakened by said alert enunciator.

9. An apparatus for facilitating the remembrance of a user's dreams during a REM event in the user's sleep period comprising:

means for inputting data relating to the start time and end time of the user's sleep period;

electronic controller means responsive to said means for inputting data to calculate the time of said REM event based on said start time and said end time of the user's sleep period;

means for waking the user associated with said electronic controller means; and

means for recording a description of the user's dreams associated with said electronic controller means;

said means for waking the user and said means for recording activated by said electronic controller means to wake said user and record said description of the user's dreams at said calculated time.

10. The apparatus of claim 9 wherein the means for recording comprises a microphone and a speaker associated with a record/playback chip, for recording an oral description of the user's dreams on said record/playback chip through said microphone and played back over said speaker.

11. The apparatus of claim 9 wherein said electronic controller means is a microcontroller and said means for inputting data is a switch associated with said microcontroller.

12. The apparatus of claim 11 further comprising a display means associated with said microcontroller to display a visual prompt for said user to input said data relating to the start time and end time of the user's sleep period.

13. The apparatus of claim 9 wherein said electronic controller means is a microcontroller and said means for waking the user is a flashing LED activated by said microcontroller at said calculated time.

14. The apparatus of claim 13 wherein the flash frequency of said flashing LED is adjustable.

15. The apparatus of claim 13 wherein the flash duration of said flashing LED is adjustable.

16. The apparatus of claim 13 wherein the length of time between flashes of said flashing LED is adjustable.

17. The apparatus of claim 13 wherein the color of said flashing LED is adjustable.

18. The apparatus of claim 13 wherein said microcontroller is programmable by said user to calculate a selectable number of REM event times.

19. An apparatus for facilitating the remembrance of a user's dreams during a REM event in the user's sleep period comprising:

means for inputting data relating to the start time and end time of the user's sleep period;

electronic controller means remote from said user, said electronic controller means responsive to said means for inputting data to calculate the time of said REM event based on said start time and said end time of the user's sleep period;

means for waking the user associated with said electronic controller means; and

means for recording a description of the user's dreams associated with said electronic controller means;

said means for waking the user and said means for recording activated by said

electronic controller means to wake said user and record said description of the user's dreams at said calculated time.

20. An apparatus for waking a user during a REM event in the user's sleep period, comprising:

a microcontroller;

an alert device responsive to said microcontroller for waking said user;

a user input device associated with said microcontroller for inputting the start time and length of said user's sleep period to program said microcontroller to calculate the time of said REM event and activate said alert device at said calculated time.

21. The apparatus of claim 20 further comprising a recording device connected to said microcontroller, wherein said microcontroller is further programmed to activate said recording device during said REM event.

22. The apparatus of claim 21 wherein said recording device is voice activated.

23. The apparatus of claim 20 wherein the strength of said alert device is adjustable to wake said user during a REM event, but not during non-REM sleep.

24. The apparatus of claim 23 wherein said alert device is a flashing light.

25. The apparatus of claim 24 wherein the strength of said flashing light is adjustable with respect to one or more variables selected from the group consisting of flash intensity, flash frequency, flash duration and flash color.

26. The apparatus of claim 23 wherein said alert device is a speaker for playing an alert sound.

27. The apparatus of claim 26 wherein said alert sound is a melody.

28. The apparatus of claim 20 wherein said microcontroller is programmed to

calculate the times of each REM event in a sleep period having 4 REM events and activate said alert device at said calculated times.

29. The apparatus of claim 20, wherein said microcontroller is programmed to calculate the times of each REM event in a sleep period having 5 REM events and activate said alert at said calculated times.

30. The apparatus of claim 20, wherein said microcontroller is programmed to calculate the times of each REM event in a sleep period having 6 REM events and activate said alert at said calculated times.

31. An apparatus for assisting the user in recording his or her dreams during a REM event in said user's sleep period, comprising:

a microcontroller;

a recording device responsive to said microcontroller;

an alert device responsive to said microcontroller to wake said user during a REM event, but not during non-REM sleep;

an input device associated with said microcontroller for inputting the start time and length of said user's sleep period; and

said microcontroller programmable to calculate the time of said REM event during said sleep period, and activate said alert device and said recording device during said REM event.

32. The apparatus of claim 31 wherein said recording device is voice activated.

33. The apparatus of claim 31 wherein said alert device is a flashing light and the strength of said flashing light adjustable with respect to at least one variable selected from the group consisting of flash intensity, flash frequency, flash duration and flash color.

34. The apparatus of claim 31, wherein said alert device is a speaker for playing an alert sound.

35. The apparatus of claim 31, wherein said microcontroller is programmable to calculate the times of each REM event during said sleep period having 4 REM events, and activate said alert device and said recording device at said calculated times.

36. The apparatus of claim 31, wherein said microcontroller is programmable to calculate the times of each REM event during said sleep period having 5 REM events, and activate said alert device and said recording device at said calculated times.

37. The apparatus of claim 31, wherein said microcontroller is programmable to calculate the times of each REM event during said sleep period having 6 REM events, and activate said alert device and said recording device at said calculated times.

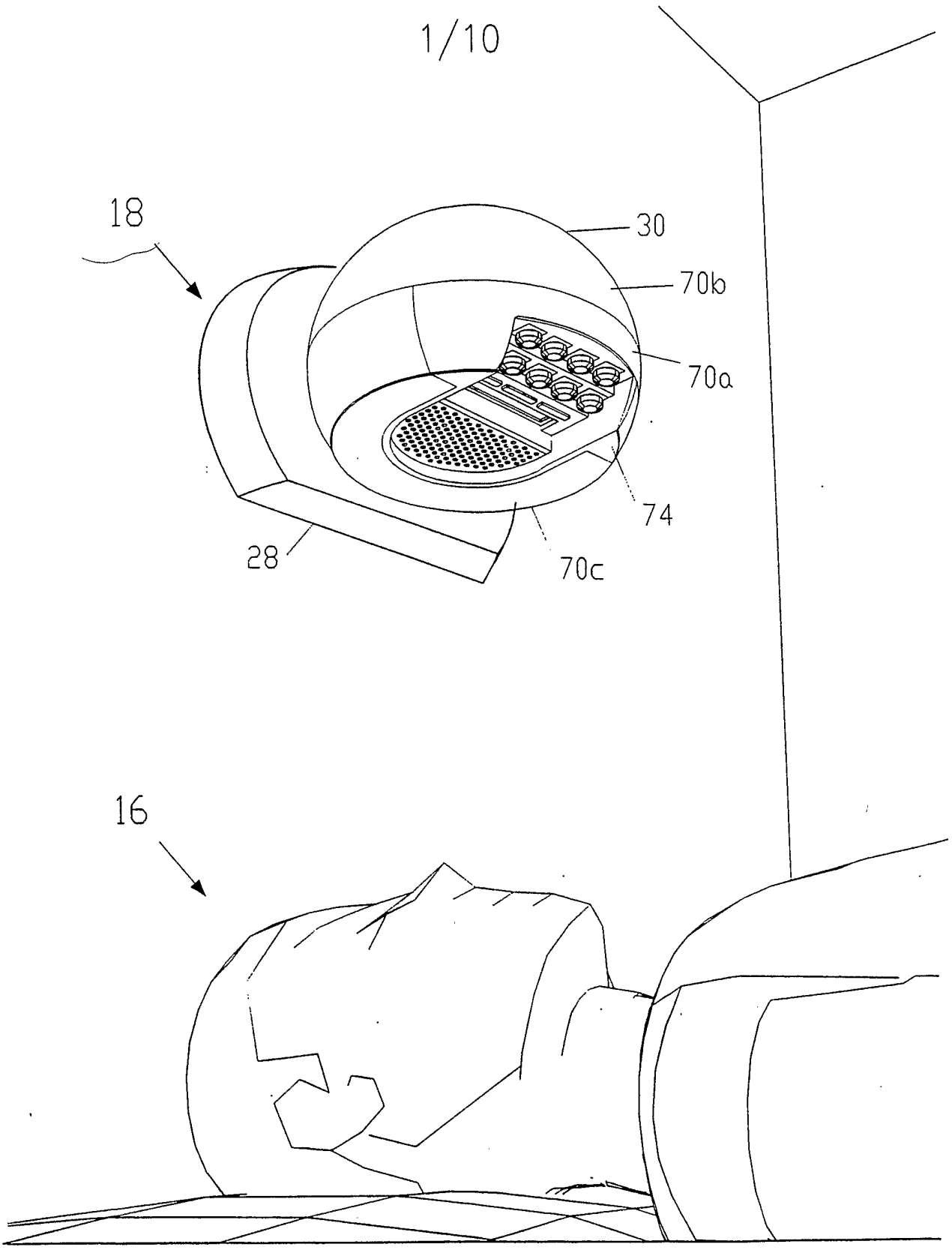


FIG 1

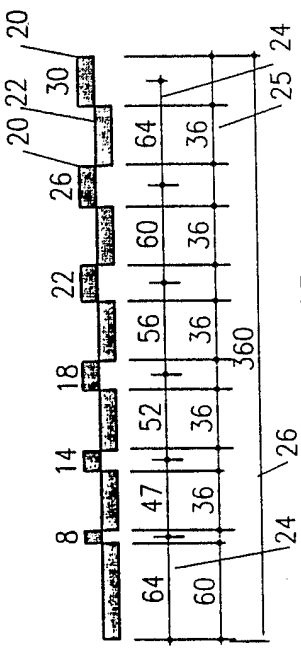


FIG 2B

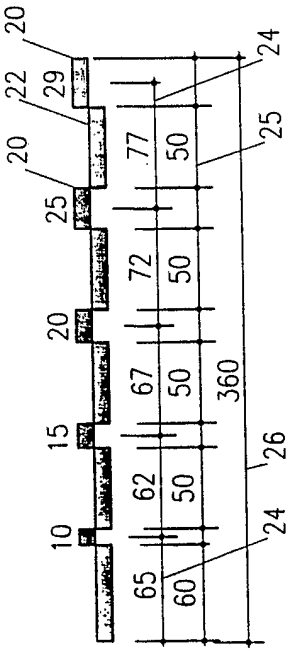


FIG 3B

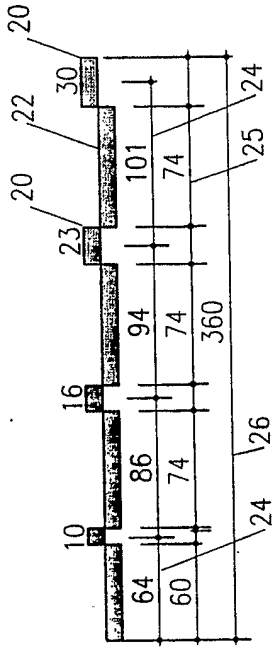


FIG 4B

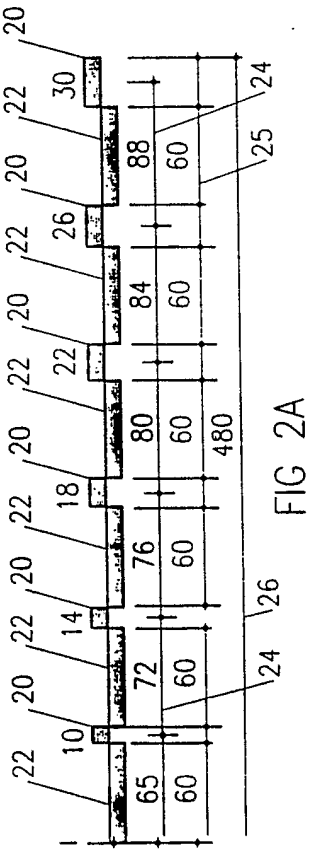


FIG 2A

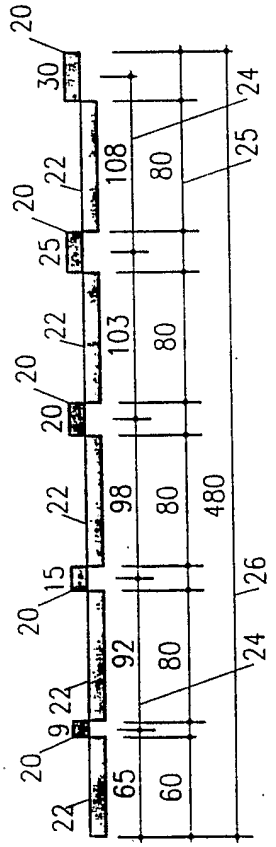


FIG 3A

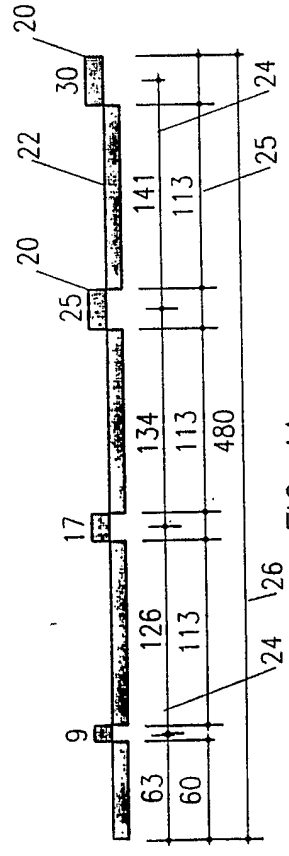


FIG 4A

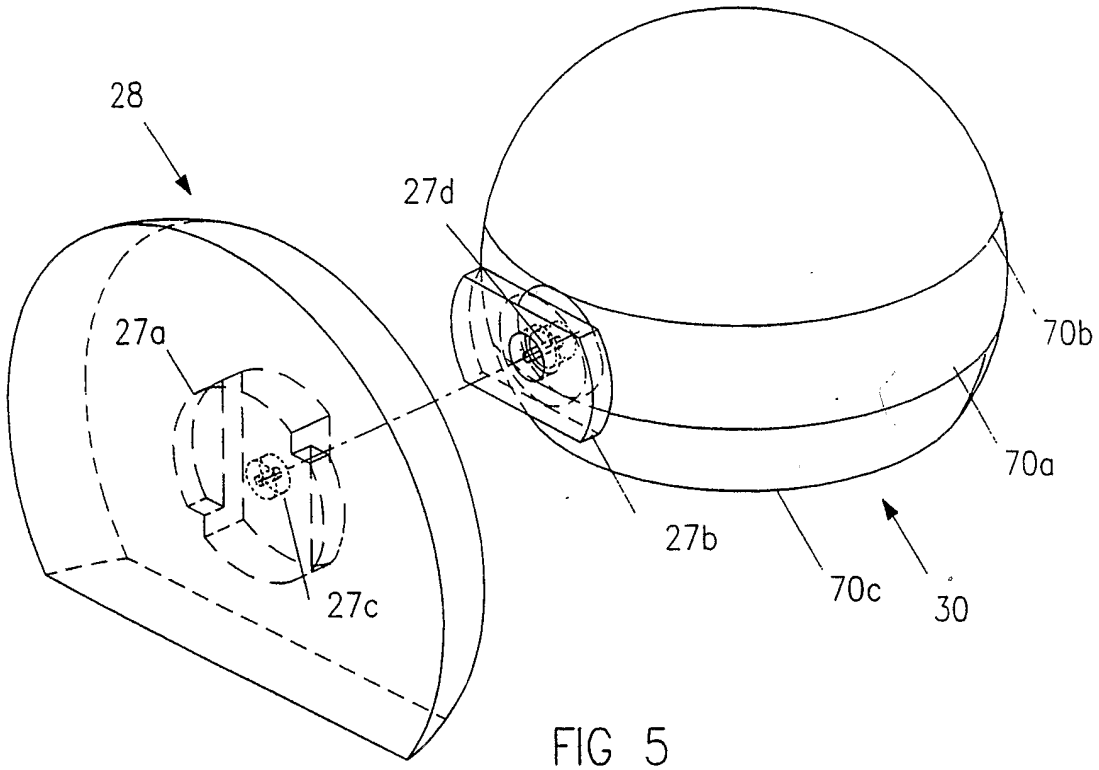


FIG 5

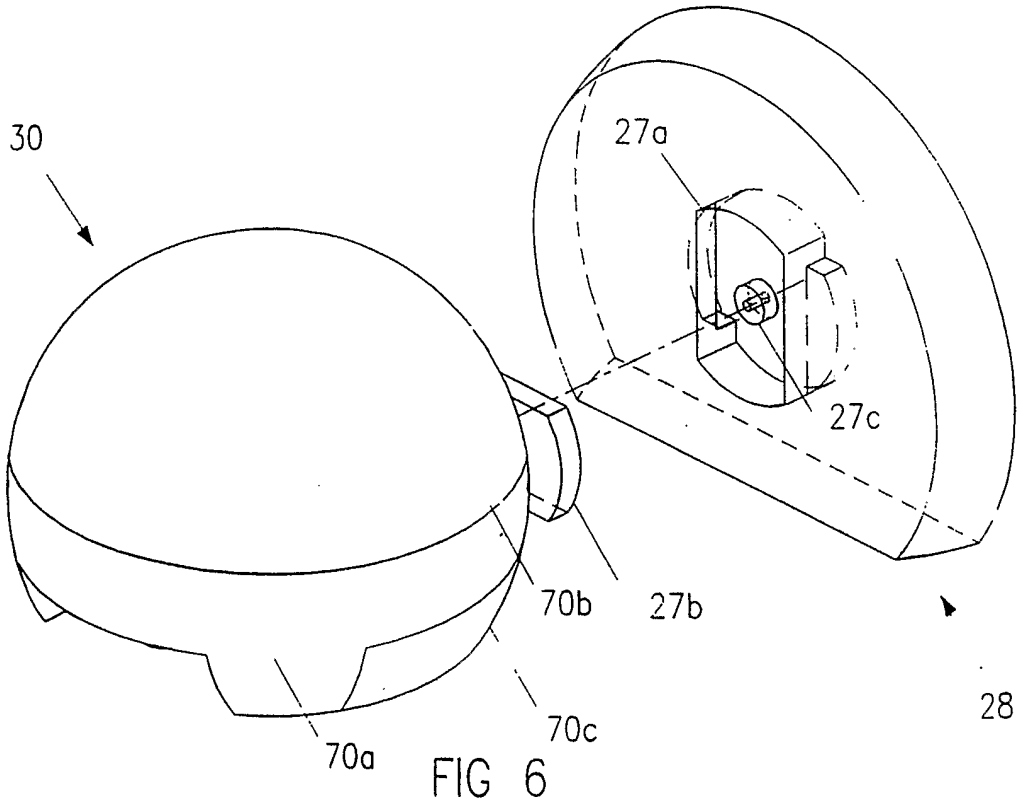
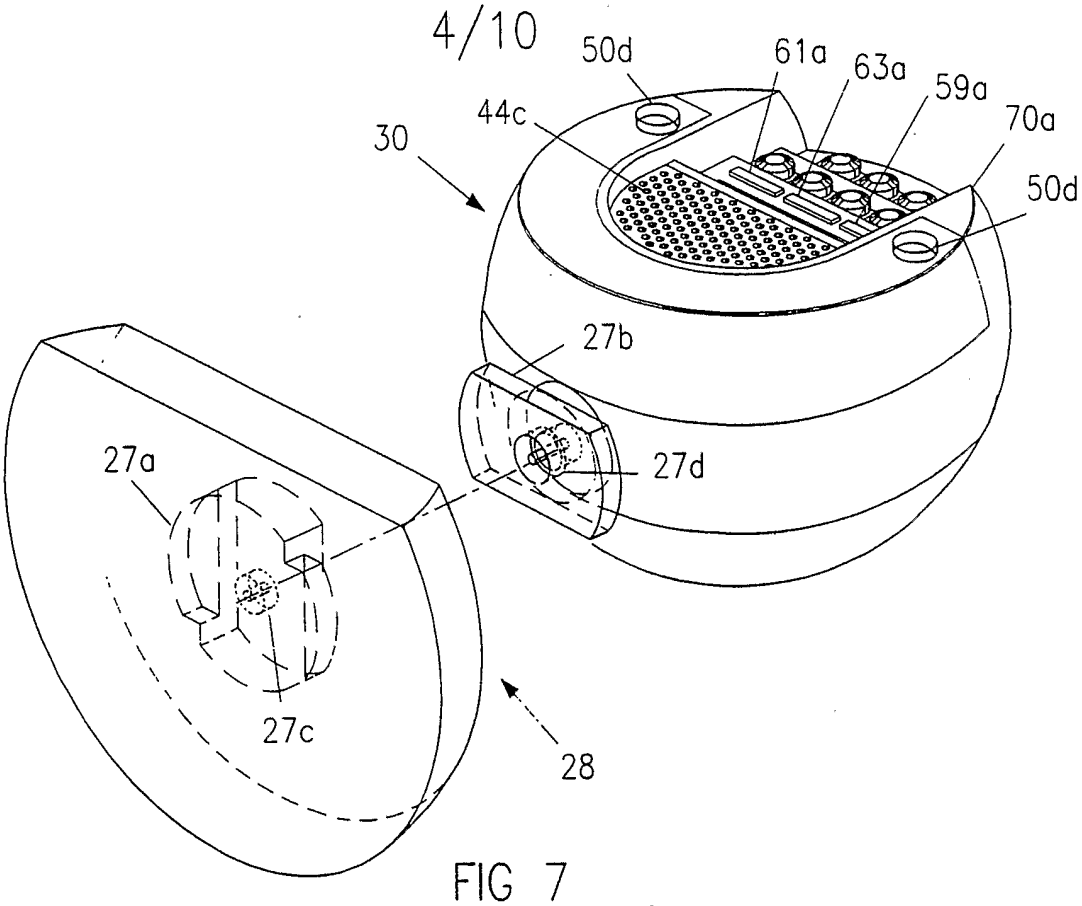


FIG 6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30
50d
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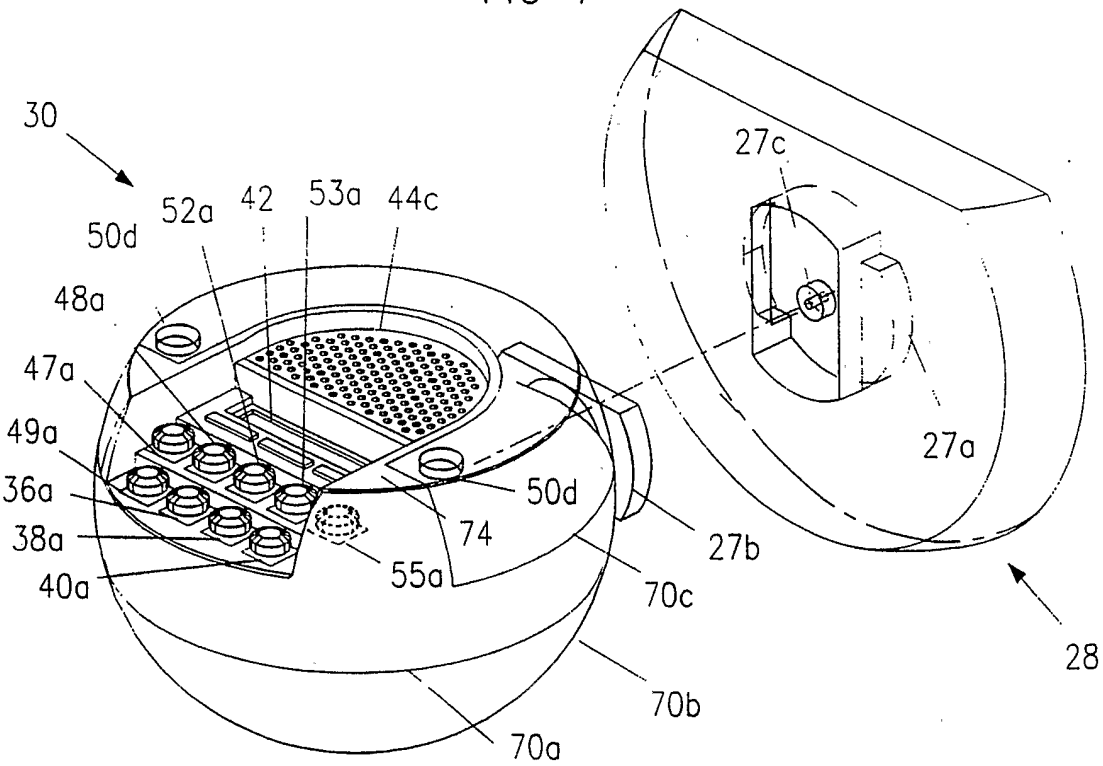
27a
27d
27c
28

FIG 7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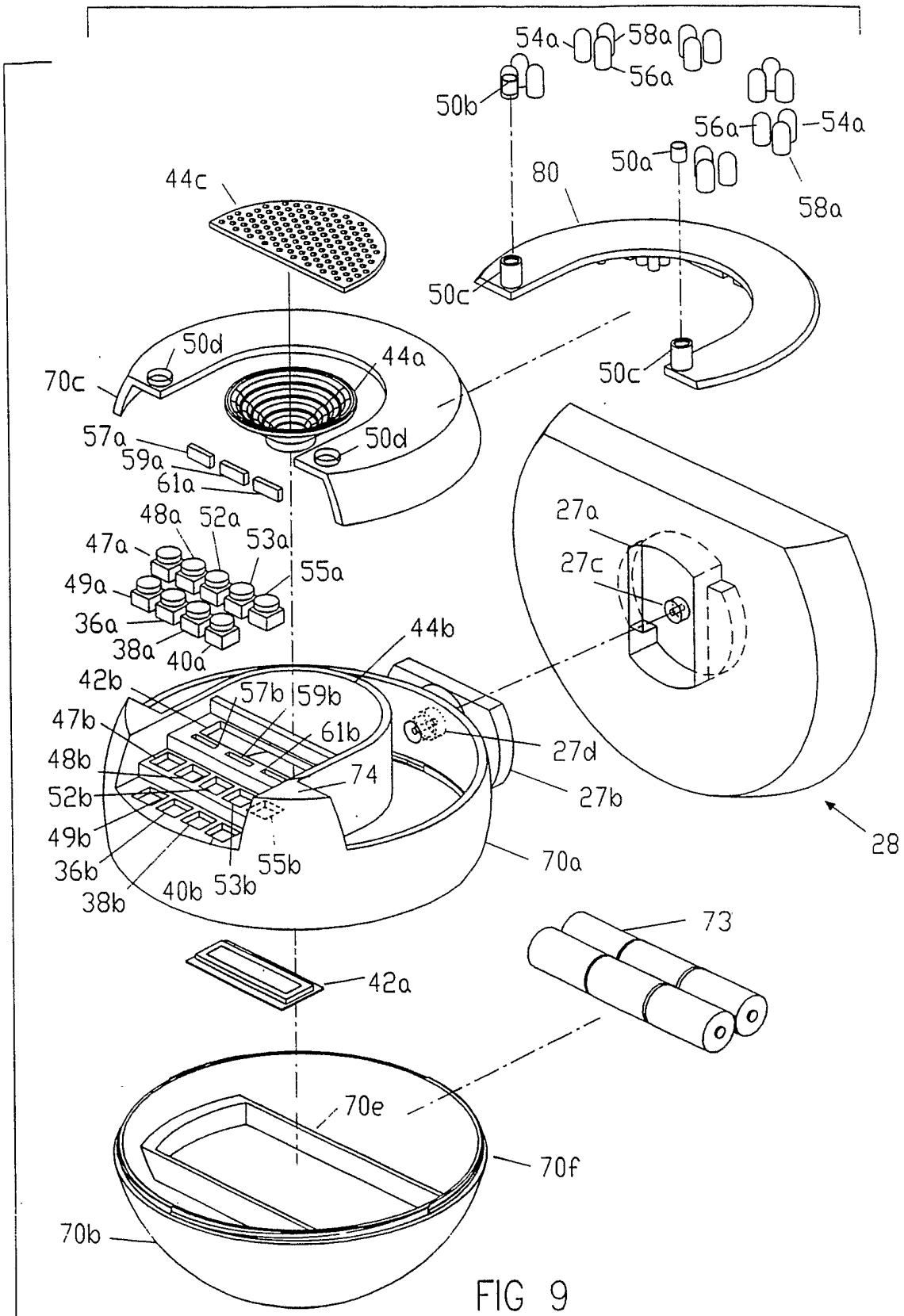
50d
27b
27a
70c
28
70b
70a

FIG 8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50d
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27c
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27d
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74
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FIG 9

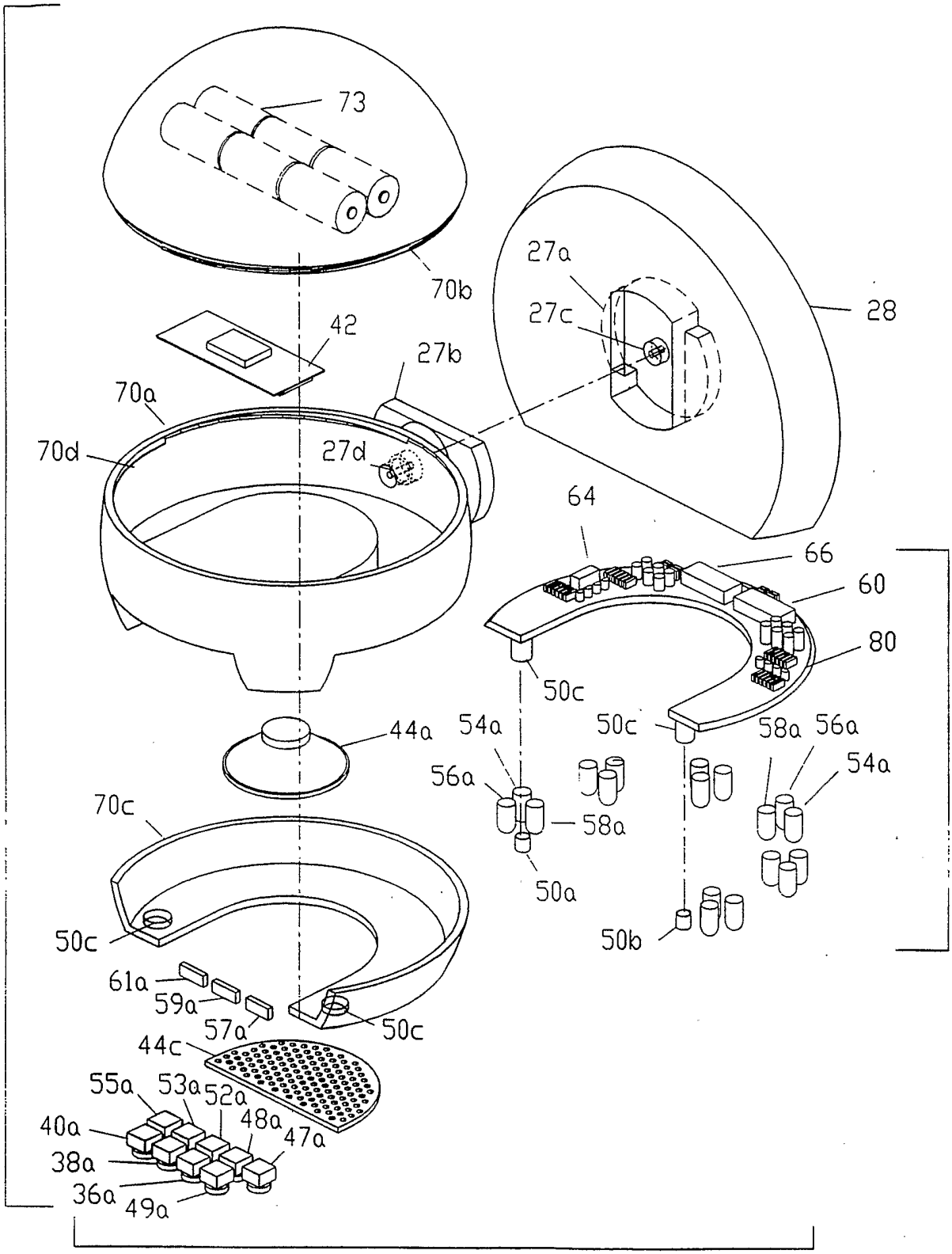
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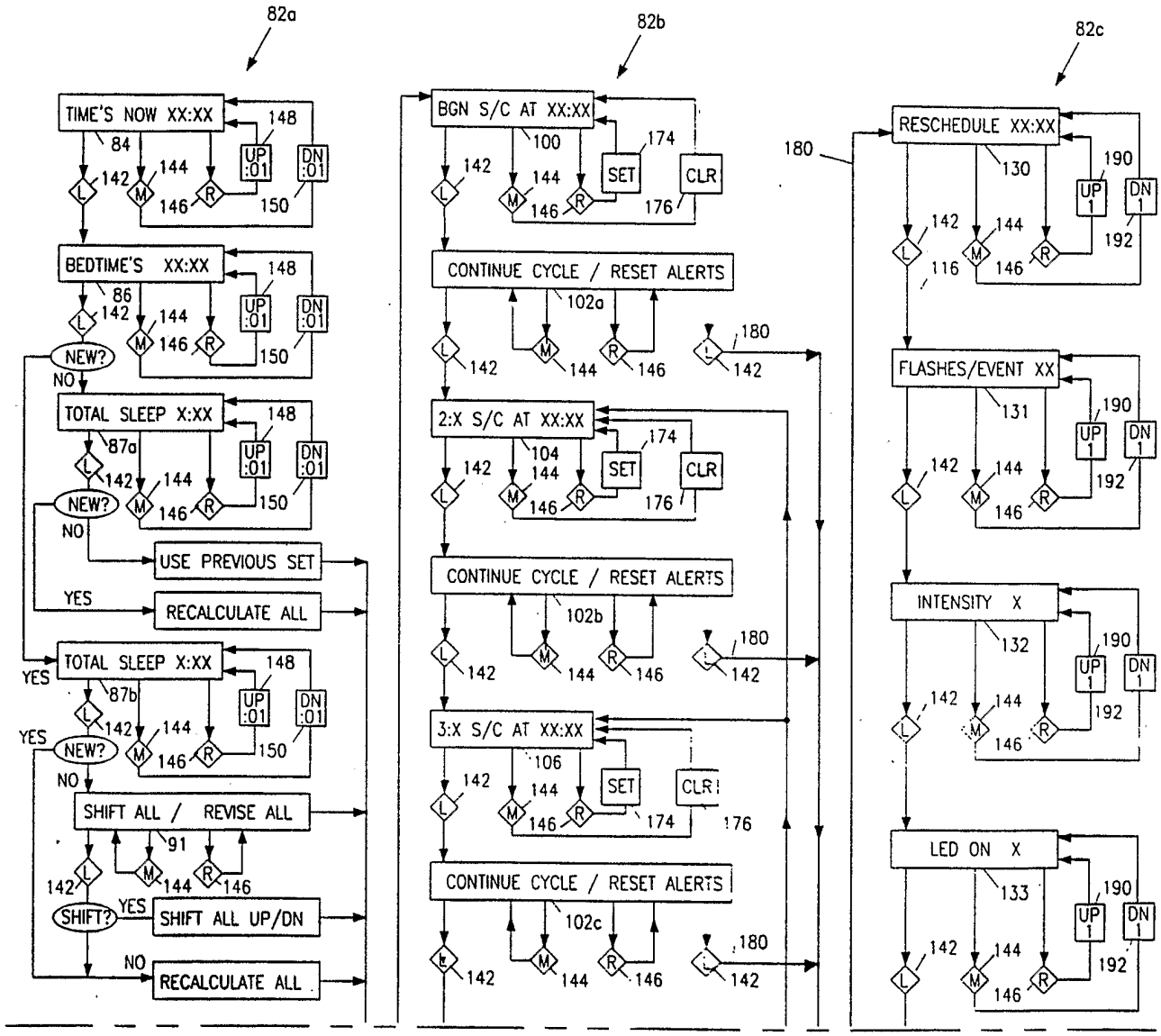
FIG 10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NEW?
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TOTAL SLEEP X:XX
YES
USE PREVIOUS SET
RECALCULATE ALL
SHIFT ALL / REVISE ALL
SHIFT?
SHIFT ALL UP/DN
BGN S/C AT XX:XX
CONTINUE CYCLE / RESET ALERTS
2:X S/C AT XX:XX
3:X S/C AT XX:XX
SET
CLR
RESCHEDULE XX:XX
FLASHES/EVENT XX
INTENSITY X
LED ON X
UP :01
DN :01
UP 1
DN 1
L
M
R

FIG 11a

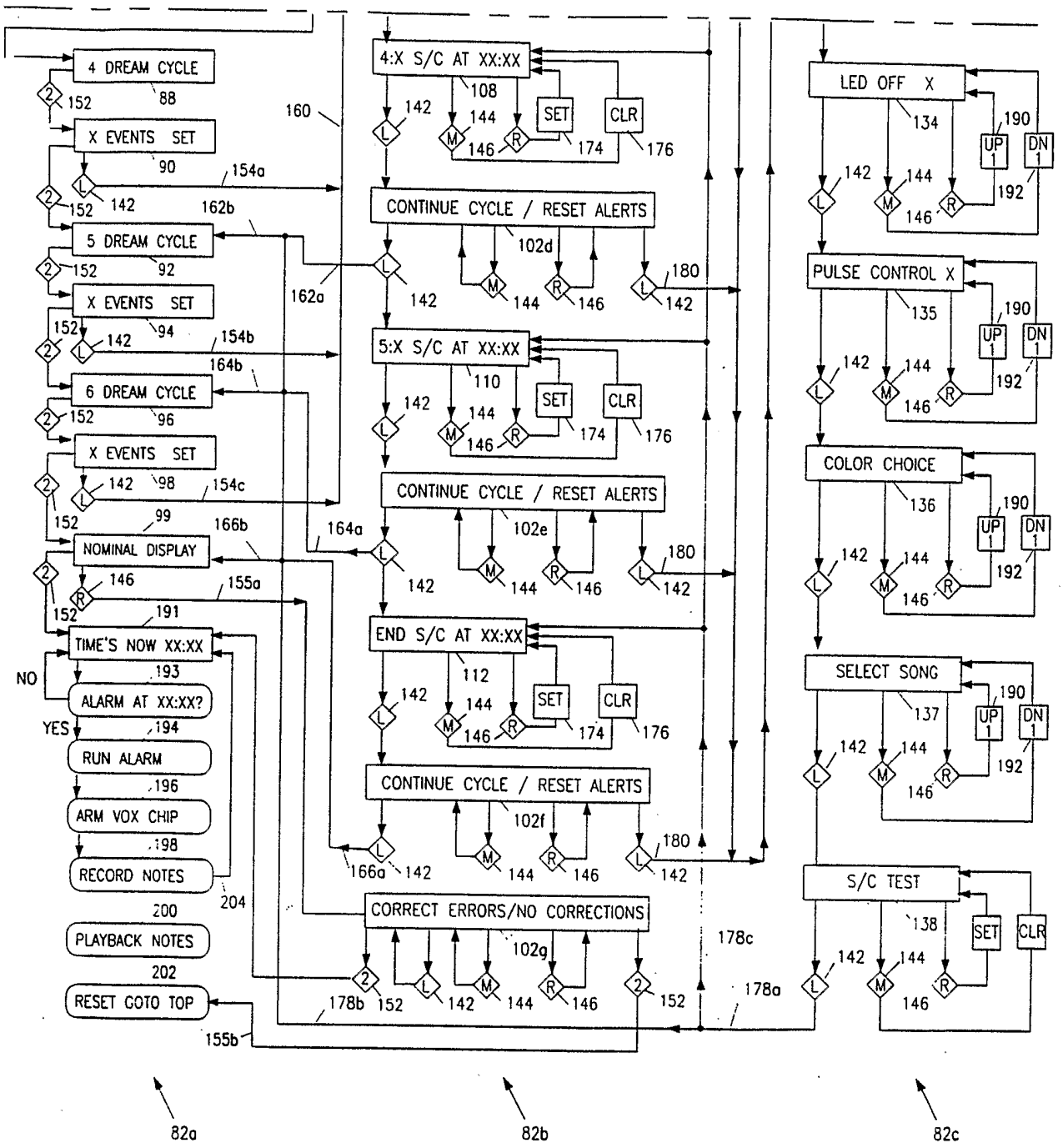
4 DREAM CYCLE
88
X EVENTS SET
90
5 DREAM CYCLE
92
X EVENTS SET
94
6 DREAM CYCLE
96
X EVENTS SET
98
NOMINAL DISPLAY
99
TIME'S NOW XX:XX
191
ALARM AT XX:XX?
193
NO
YES
RUN ALARM
194
ARM VOX CHIP
196
RECORD NOTES
198
PLAYBACK NOTES
200
RESET GOTO TOP
202
204
4:X S/C AT XX:XX
108
CONTINUE CYCLE / RESET ALERTS
102d
5:X S/C AT XX:XX
110
CONTINUE CYCLE / RESET ALERTS
102e
END S/C AT XX:XX
112
CONTINUE CYCLE / RESET ALERTS
102f
CORRECT ERRORS/NO CORRECTIONS
102g
SET
CLR
174
176
LED OFF X
134
PULSE CONTROL X
135
COLOR CHOICE
136
SELECT SONG
137
S/C TEST
138
UP 1
DN 1
190
192
L
M
R
142
144
146
152
160
154a
154b
154c
155a
155b
162a
162b
164a
164b
166a
166b
178a
178b
178c
180
82a
82b
82c

FIG 11b

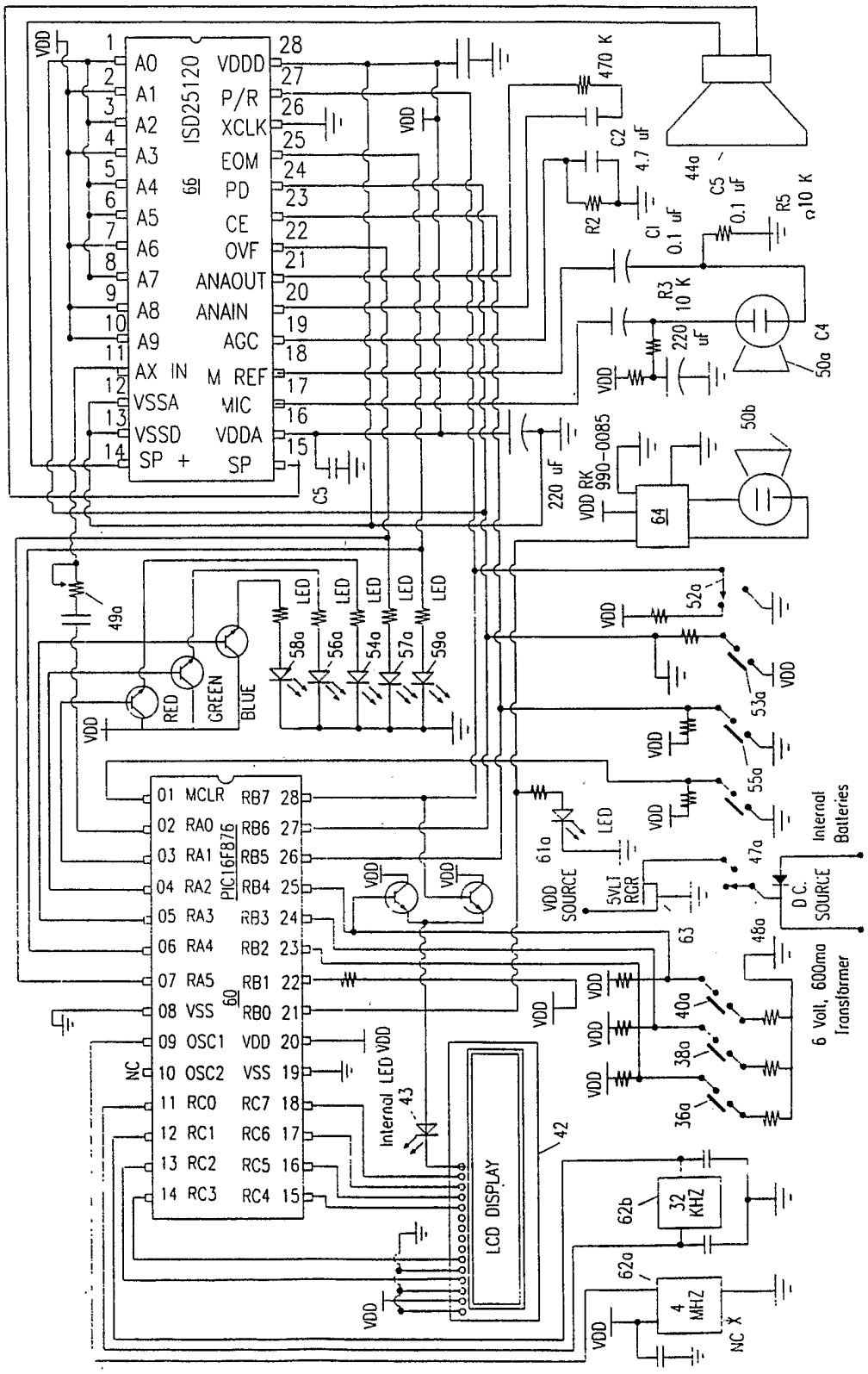
ISD25120
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
AX IN
VSSA
VSSD
SP +
VDDD
P/R
XCLK
EOM
PD
CE
OVF
ANAOUT
ANAIN
AGC
M REF
MIC
VDDA
SP
66
VDD
470 K
C2
4.7 uF
C1
0.1 uF
C5
0.1 uF
R5
10 K
R2
R3
10 K
220 uF
C4
50a
50b
C5
220 uF
VDD RK 990-0085
64
49a
LED
58a
56a
54a
57a
59a
RED
GREEN
BLUE
52a
53a
55a
61a
VDD SOURCE
5VLT REGR
47a
Internal Batteries
D.C. SOURCE
48a
6 Volt, 600ma Transformer
63
40a
38a
36a
PIC16F876
60
01 MCLR
02 RA0
03 RA1
04 RA2
05 RA3
06 RA4
07 RA5
08 VSS
09 OSC1
10 OSC2
11 RC0
12 RC1
13 RC2
14 RC3
RB7 28
RB6 27
RB5 26
RB4 25
RB3 24
RB2 23
RB1 22
RB0 21
VDD 20
VSS 19
RC7 18
RC6 17
RC5 16
RC4 15
NC
Internal LED VDD
43
LCD DISPLAY
42
62b
32 KHZ
62a
4 MHZ
NC X

FIG 12

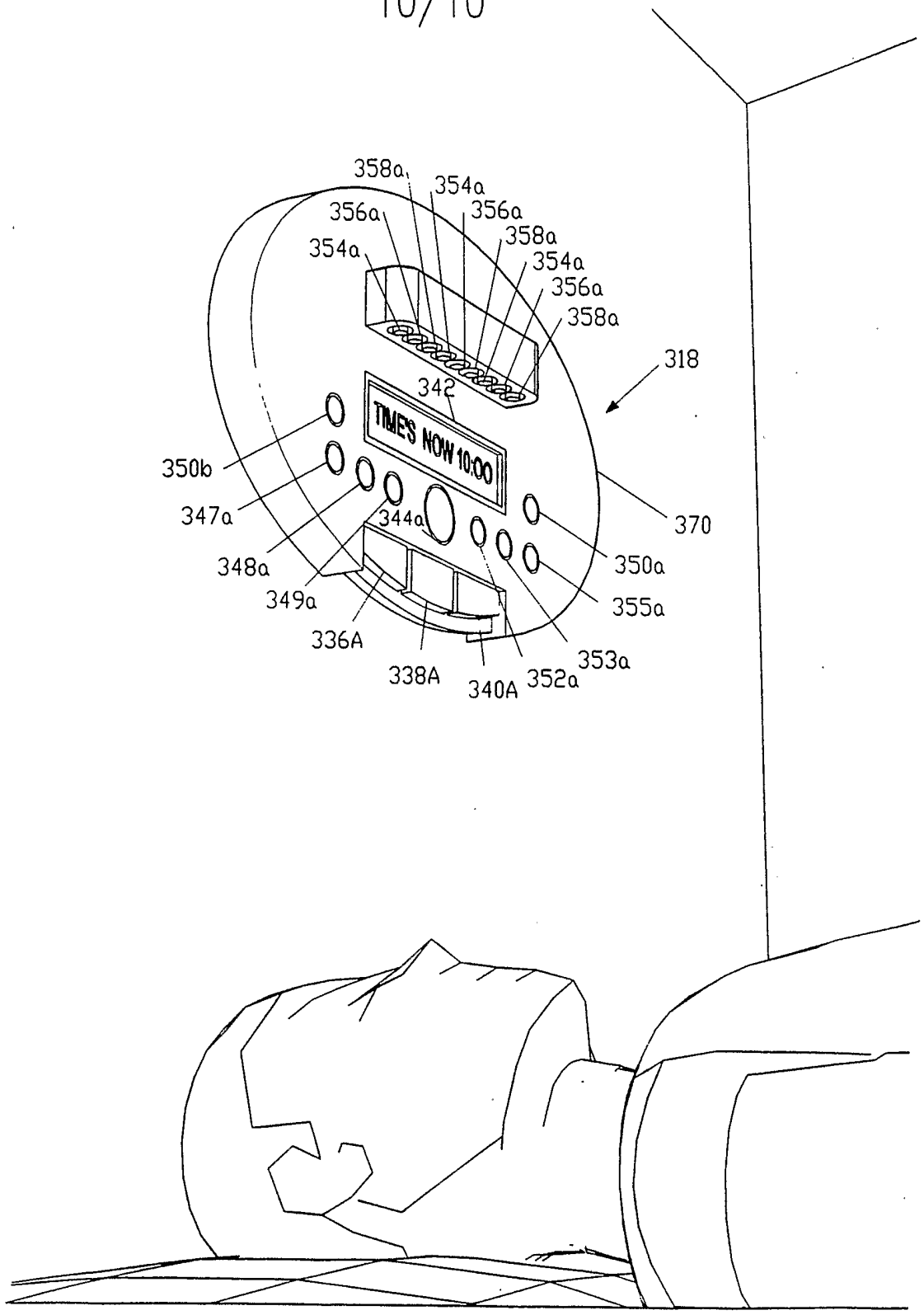
358a
354a
356a
356a
358a
354a
354a
356a
358a
318
342
TIMES NOW 10:00
350b
347a
344a
370
348a
350a
349a
355a
336A
353a
338A
340A
352a

FIG 13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US03/01928

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) : A61M 21/00; A61B 19/00
US CL : 600/27,28 128/898

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. : 600/27,28 128/897, 898; 368/246, 815, 967, 239, 231, 244, 588

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EAST

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,E	US 6,540,664 A (BLAIR) 01 April 2003. See entire document.	1-37
A	US 4,228,806 A (LIDOW) 21 October 1980. See entire document.	1-37
A	US 5,551,879 A (RAYNIE ET AL) 03 September 1996. See entire document.	1-37
A	US 2002/0080035 A (YOUDENKO) 27 June 2002. See entire document.	1-37

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

* Special categories of cited documents:

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"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
17 May 2003 (17.05.2003)

Date of mailing of the international search report
02 JUL 2003

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Form PCT/ISA/210 (second sheet) (July 1998)