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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : **H04Q 7/02** | **A1**

(11) International Publication Number: **WO 96/27993**

(43) International Publication Date: 12 September 1996 (12.09.96)

(21) International Application Number: PCT/US96/03150

(22) International Filing Date: 8 March 1996 (08.03.96)

(30) Priority Data:
112,939 8 March 1995 (08.03.95) IL

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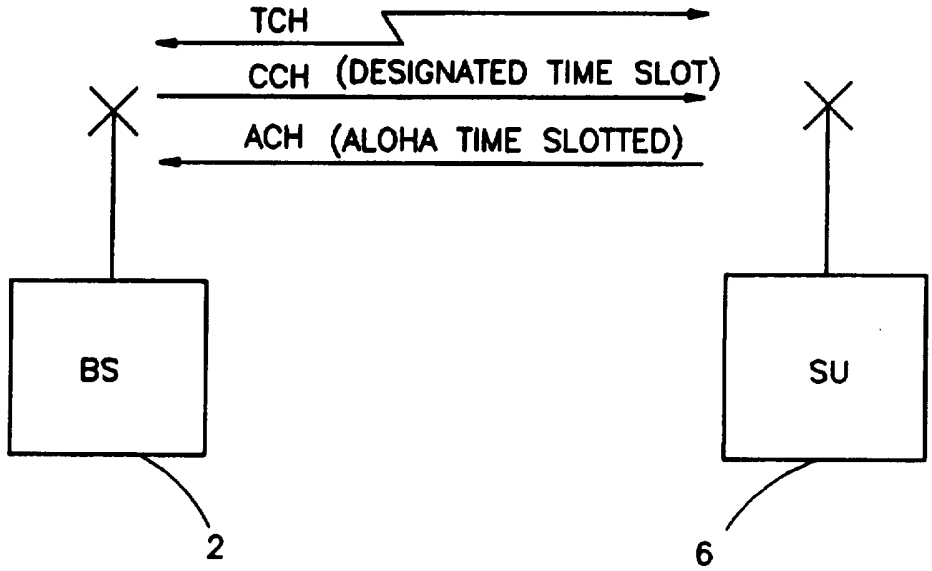
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: A SUBSCRIBER UNIT HAVING A SLEEP MODE AND A DORMANT MODE



(57) Abstract

A method for providing communication services between a base station (2) and a subscriber unit (6), including the steps of placing the subscriber unit in a dormant mode wherein the subscriber unit consumes limited power, transmitting communication signals from the base station when the subscriber unit is in the dormant mode, at the base station, determining that the subscriber unit is not responsive to the transmitted communication signals and storing the communication and the identity of the subscriber unit to which the communication was directed in a buffer at the base station, after a predetermined time, taking the subscriber unit out of the dormant mode and causing the subscriber unit to communicate with the base station to inquire about communications messages, and if there are buffered communications for the subscriber unit, transmitting the buffered communications from the base station to the subscriber unit.

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A SUBSCRIBER UNIT HAVING A SLEEP MODE AND A DORMANT MODE

Background of the Invention

The present invention relates to wireless communication systems. More specifically, it relates to the subscriber units used by subscribers to the wireless communication systems.

Wireless communication systems are used to provide communications capabilities to businesses having fleets of vehicles operating in the field -- for example, taxi companies or limousine companies. Typically, wireless communication systems include a base station, one or more dispatch stations and a plurality of subscriber units. All communications are routed through the base station. The subscriber units are mounted in the vehicles operating in the field to provide communication capabilities to the vehicle's occupants. The dispatch stations allow a dispatcher to send dispatch communications to one or more of the subscriber units through the base station.

Today's dispatch communication systems, however, provide limited communication capabilities. For example, deliverymen working the eight-to-five shift turn their subscriber units off at 5:00 P.M. The next day, when they start their new workshift, they turn their subscriber units on a short time before 8:00 A.M. Communications from the dispatch station are not transmitted until the subscriber units are turned on. If too many subscriber

units are turned on at the same time, the communication system can be overloaded, thereby creating delays in the transmissions of messages.

In view of these and other limitations, new systems and methods that provide improved communications between a dispatch station and a fleet of subscriber units are needed.

Summary of the Invention

The present invention provides apparatus and method of providing dispatch communications in a system that includes a base station, a dispatch station and one or more subscriber units. In accordance one aspect of the present invention, the subscriber unit has four modes of operation that consume various amounts of power. The modes include a sleep mode, a dormant mode, a power off mode and a power on mode. In the sleep mode, limited power is consumed while the subscriber unit listens for communications from the base station. In the dormant mode, the subscriber unit is essentially shut down and, therefore, consumes minimal power. During the dormant mode, communication signals transmitted to the subscriber unit, including dispatches from a dispatch station, are stored in a buffer at the base station. After a predetermined time, which is preset by the dispatch station or by the subscriber, an internal alarm clock in the subscriber unit causes the subscriber unit to come out of the dormant mode to initiate a call to the base station to inquire about messages which were directed to the subscriber unit during the time it was in the dormant mode.

If there are buffered communications for the subscriber unit, the base station transmits the buffered communications from the base station to the subscriber unit. The subscriber unit then returns to the dormant mode.

The invention will now be described in connection with certain illustrated embodiments; however, it should be clear to those skilled in the art that various modifications, additions and subtractions can be made without departing from the spirit and scope of the claims.

Description of the Drawings

FIG. 1 illustrates a communication system;

FIG. 2 illustrates a common air interface for providing communications between the various components of the communication system of FIG. 1;

FIG. 3 illustrates a base station in the communication system;

FIGS. 4 and 5 illustrate a subscriber unit in the communication system;

FIG. 6 illustrates a dispatch station in the communication system;

FIG. 7 illustrates a billing station in the communication system;

FIG. 8 illustrates the on/off power control of the subscriber unit;

FIG. 9 illustrates the power control of the subscriber unit during the sleep mode;

FIGS. 10 and 11 illustrate the steps taken by the subscriber unit in the dormant mode; and

FIGS. 12 and 13 illustrate the organization of memory in the base

station which is used to buffer messages to dormant subscriber units.

Description of the Preferred Embodiment

Referring to FIG. 1, a communication system 1 is illustrated. The system 1 includes a base station 2, a dispatch station 4 and a plurality of subscriber units 6. A billing station, not shown in FIG. 1, is preferably also provided to process billing information from a plurality of communication systems 1.

The communication system 1 may be a frequency hopping system which is divided into sectors 8 to 10 wherein sets of frequencies are reused in each sector to provide wireless communications. Note, however, that the present invention may be used on other types of communication systems, including TDMA systems, CDMA systems and even analog based systems.

The base station 2 includes the communication equipment necessary to provide the multiple access communications for the plurality of subscribers units 6 and for the dispatch station 4. The base station 2 also includes the communication equipment needed to provide communications through the Public Switched Telephone Network (PSTN).

The dispatch station 4 includes equipment necessary to dispatch communications from the dispatch station 4 to a number of subscriber units 6, commonly referred to as point-to-multipoint communications. It also includes equipment needed to communicate with individual subscriber units. The subscriber units 6 generally consist of mobile or portable equipment

necessary to transmit, receive and process communication signals.

Referring to FIG. 2, the communication links between the base station 2, the dispatch station 4 and the subscriber units 6 -- referred to as the common air interface -- are illustrated. The communication channels in FIG. 2 include a plurality of traffic channels (TCHs), at least one control channel (CCH) and at least one access channel (ACH). In the communication system 1 of FIG. 1, all of these channels are present in each sector 8 to 10. The TCHs operate in the uplink (transmissions from subscriber units 6 to the base station 2) and in the downlink (transmissions from the base station 2 to the subscriber units 6). The CCH and the ACH, however, operate only in one direction -- the CCH in the downlink and the ACH in the uplink.

In the illustrated embodiment of FIGS. 1 and 2, ten 25 kHz frequency channels are used to define ten uplink channels and ten 25 kHz frequency channels are used to define ten downlink channels. In each sector 8 to 10, nine of the frequency channels are used to implement nine uplink TCHs and nine of the frequency channels are used to implement nine downlink TCHs. In each sector 8 to 10, the remaining frequency channels are used to transmit one ACH and one CCH. Voice information, data information and inband overhead control signals between the base station 2 and the subscriber units 6 are transmitted over the TCHs, preferably using frequency hopping and time hopping communication methodology. Timing and control signals from the base station 2 to the subscriber unit 6 are transmitted on

the CCH. Status and operational requests from the subscriber unit 6 to the base station 2 are transmitted on the ACH. Transmissions between the base station 2 and the dispatch station 4 are treated in the same fashion as transmissions between the base station 2 and the subscriber units 6. Note that this description is illustrative of one communication method and one air interface that can be used in connection with the present invention -- many others are possible.

Referring to FIG. 3, the base station 2 is illustrated. The base station 2 includes a first sector unit 16, a second sector unit 17, a third sector unit 18, a microsector unit 20, a redundant sector 21, a PABX 22, a voice mail unit 24, a central frequency source unit 26, an administration computer 28, a central controller 30, a database server 32, a local administrative computer 34 a terminal server 36, a local area network 38, a power supply 39, data computers 40 and a modem pool 41. The base station 2 may also include a billing station, but where the communication system 1 is part of a regional or national system having numerous base stations, it is preferred to provide a central billing system that serves all of the base stations. The base station 2 of FIG. 3 does not include a billing station.

The sector units 16 to 18 establish the communication channels illustrated in FIG. 2 in the sectors 8 to 10, respectively. The microsector unit 20 establishes communications with additional communication equipment in trouble spots in the communication system 1. The redundant

sector 21 provides redundant communication channels for the sector units 16 to 18. The base station 2 provides communications with the PSTN via the PABX 22. The PABX 22 also provides three way conferencing, routing, least cost routing of long distance calls, voice mail interfacing, dispatch bridging, user services support and metering functions.

The voice mail unit 24 provides voice mail capability to the communication system 1. The central frequency source unit 26 provides timing references throughout the system. The administrative computer 28 tracks subscriber unit 6 configurations, tracks administrative activities, performs network management, performs built-in-test management and performs system initialization. The central controller 30 provides various functions, including call management, dispatch management, control of the PABX 22, voice mail interfacing, operational mode management, subscriber management, call management, supplies billing information, and generates reports. The data base server 32 stores user data concerning user rights, status, calls and airtime. It also provides basic data base management and services to all data base clients, such as the local operator, fleet administrators and remote operators. The local administration computer 34 provides maintenance and operational control of the base station 2. The local area network 38 enables communications between the various components connected to the network.

Two pieces of equipment form a subscriber unit -- a subscriber

terminal 14 illustrated in FIG. 4 and a radio unit 12 illustrated in FIG. 5. In general, the radio unit 12 provides the equipment needed to transmit, receive and process signals over the common air interface of FIG. 2 while the subscriber terminal 14 provides an interface to a subscriber.

Referring to FIG. 4, the subscriber terminal 14 includes a microprocessor 50, an oscillator circuit 52, a power supply circuit 54, a serial interface circuit 56, a display driver circuit 58, a memory circuit 60, a keyboard interface circuit 62, an I/O decoder circuit 64, a LED driver 66 and an interface circuit 68. The subscriber terminal 14 can also include a real time clock 70 or, alternatively, the base station 2 can distribute real time clock information to each of the subscriber units 6.

The memory circuit 60 includes a decoder circuit 76, an address latch 78. a boot ROM 80, a flash memory 82 and a static RAM 84. The boot ROM 80 stores the code necessary to initialize the microprocessor 50 and the circuitry of the subscriber terminal 14 as well as code necessary to download future software versions for the subscriber terminal 14. The flash memory 82 is non-volatile re-writable memory which is utilized to store information which must be maintained even during a loss of power. The static RAM 84 is utilized as a working memory as needed.

The display driver circuit 58 includes the LCD display 24, a power supply 86, a LCD controller 88, a memory circuit 90 and an address controller 92. The display driver circuit 58 is accessed by the

microcontroller 50 via the I/O decoder 64. The information to be displayed is downloaded from the microprocessor 50 to the memory circuit 90. The display of the information on the display 24 is then controlled in a conventional manner by the LCD controller 88.

The microprocessor 50 is responsive to the selection of the keys 30 to 34 and 36 to 43, as well as to the selection of the keys on the handset 28. When the keys are selected, selection signals are processed through the keyboard interface circuit 62 to the microprocessor 50. The microprocessor 50 also controls the LEDs 44 through the LED driver circuit 66. The RS-232 interface 94 provides communications between the subscriber terminal 14 and external devices, such as notebook computers, magnetic swipe devices used to read magnetic strips, printers, bar code readers and serial keyboards. The RS-485 interface 96 and the interface circuitry 68 provides communications between the subscriber terminal 14 and the receiver and transmitter circuitry of the radio unit 12 (shown in FIG. 5).

In FIG. 5, the circuitry of the radio unit 12 is illustrated. The radio unit 12 includes antennas 102 and 104, a radio board 106, a baseband unit 108, a service board 110, and a GPS interface 111. The radio unit circuitry illustrated in FIG. 5, except the antennas 102 and 104, is preferably housed separately from the subscriber terminal 14, for example, inside the trunk of an automobile. The antennas 102 and 104 are preferably mounted externally on the automobile.

The radio board 106 includes transmitter and receiver circuitry. More particularly, it includes a transmitter 112, two receiver channels 114 and 116, a duplexer 118, a frequency synthesizer 120, gain and frequency control circuitry 122 and transmitter gain control circuitry 124. As previously described, the circuitry of the radio board 106 preferably provides communication via frequency hopping, that is, a communication signal is transmitted and received by hopping the signal over several different frequency channels.

The radio board 106 is interfaced with the baseband unit 108. The baseband unit 108 includes a modem 126, a controller 128, a voice processing package 130 and an interface circuit 132 to the subscriber terminal's 14 circuitry. This baseband unit 108 receives the signals to be transmitted to the base station 2 from the subscriber terminal 14 processes those signals and then sends the signals to the transmitter 112 in the radio board 106 for transmission. This baseband unit 108 also receives the signals that the radio board 106 receives from the base station 2, processes the received signals and sends them to the subscriber terminal 14 through the interface 132.

Referring to FIG. 6, the dispatch station 4 is illustrated. The dispatch station 4 includes a personal computer 150, a modem 152, a radio unit 12, a microphone 154, a speaker 156 and an antenna 158. When the base station transmits to the dispatch station 4, the communication signals are

received on the antenna 158, processed by the radio unit 12 and sent to the computer 150 through a serial port 160. The computer 150 determines whether the communication is voice or data communications. If the communication is a voice communication, then the signals are sent to a sound card in the computer 150 for voice processing. The voice signals are eventually sent to the speaker 156 through a port 162 on the sound card so that they can be heard by a dispatcher. If the communication is a data communication, then the computer 150 processes the data so that it can be presented to the dispatcher in a desired format.

When the dispatcher sends a voice or data communication signal from the dispatch station 4 to the base station 2, the signal is generated from the microphone 154, in the case of voice signals, or from a data file in the computer 150, in the case of data signals. The voice signals are preferably processed through the sound card in the computer 150. Then, the voice or data signals are sent through the port 160 to the radio unit 12 for transmission by the antenna 158.

In addition to voice and data, the dispatcher can send fleet administration information to the subscriber units in the dispatcher's fleet to control the configuration and capabilities of those subscriber units. To do this, the dispatcher accesses the computer 150 to set the desired fleet administration information. The fleet administration information, once configured by the dispatcher, is then sent through a port 164 to the modem

152. The modem 152 transmits the fleet administration information to either a central billing station or to the base station 2 over a land line. Alternatively, the fleet administration information is transmitted over-the-air to the base station 2 through the dispatch station radio unit 12. The fleet administration information can then be forwarded to the billing station, whether the billing station is part of the base station 2 or off-site in a central location.

Referring to FIG. 7, a central billing station 170 is illustrated. The billing station 170 includes a server 172, a gateway 174, a local area network 176 and a router 178 to a wide area network. The server 172 has a database that keeps track of information concerning all users of the communication system 1, including all of the dispatchers and all of the subscribers. The information tracked includes the services that the users have signed up to use, the payment histories of the users, the configurations of the users of the system 1 and current billing information. The gateway 174 is a switch that provides a signal path to and from the local area network 176. A router 178 then routes these signals to a wide area network for distribution to and from the local area network 38 of the base station 2.

In accordance with the present invention, the subscriber unit 6 preferably has four different modes of operation, each of which consume differing amounts of power. In the first mode, power off, all components in

the subscriber unit 6 are turned off and no power is consumed. In the second mode of operation, power on, all components in the subscriber unit 6 are turned on and maximum power is consumed. In the third mode, the dormant mode, all components except those responsible for "waking up" the subscriber unit 6 at a preset time are turned off. The subscriber unit 6 wakes up at a preselected time to query the base station 2 for messages. Once in the dormant mode, however, the subscriber unit 6 will not resume normal operation until the unit is turned on by the subscriber. In the fourth mode, the sleep mode, subscriber unit 6 turns power off to all components except those necessary to receive signals from the base station 2. Then, when signals are received, the subscriber unit 6 again wakes up to process those signals. The subscriber unit 6 exits the sleep mode whenever any key on the keypad 24 is touched.

These modes of operation are illustrated in FIGS. 8 to 11. Referring to FIG. 8, the steps taken by the subscriber unit 6 when turning power on and off are illustrated. In step 200, the microprocessor 50 in the subscriber terminal 14 determines that the power control key on the subscriber terminal 14 has been selected. If the power is being turned on, then in steps 202 and 204, the controller 128 and the microprocessor 50 cause the power to the radio unit 12 and to the subscriber terminal 14, respectively, to be turned on. If the power is being turned off, then in steps 206 and 208, the controller 128 and the microprocessor 50 cause the power to the radio unit

12 and to the subscriber terminal 14, respectively, to be turned off.

Referring to FIG. 9, the steps taken by the subscriber unit 6 in the sleep mode are illustrated. In step 220, the microprocessor 50 receives an instruction from a subscriber that causes the subscriber unit 6 to enter the sleep mode. In step 222, the microprocessor 50 sends an instruction to the controller 128 in the radio unit 12 that tells the radio unit 12 to enter the sleep mode. Then, in step 224, the processor 50 causes power to the subscriber terminal 14 to be turned off. In step 226, the controller 128 causes power to be turned off to selected components but allows power to supplied to other components. The controller 128 turns power off to all components not needed to receive communication signals from the base station 2. Therefore, in the radio unit 12 (FIG. 5), the receivers 114 and 116, the synthesizer 120, the frequency and gain control circuit 122, the modem 126 and the controller 128 remain powered during the sleep mode. Thus, the subscriber unit 6 can receive signals when in the sleep mode. When signals are received or when a subscriber touches a key on the keypad 26, the subscriber unit 6 returns to normal operation and processes any received or transmitted communications.

Referring to FIG. 10, the steps taken to enter the dormant mode are illustrated. In step 300, the subscriber depresses keys on the keyboard 26 on the subscriber terminal 14 to instruct the subscriber unit 6 to enter a dormant mode of operation. The microprocessor 50 reads the depressed

keys, interprets the dormant mode instructions and notifies the controller 128 in the radio unit 12 that the subscriber unit 6 has been instructed to enter the dormant mode of operation.

Then, in step 302, in one embodiment of the present invention, the controller 128 causes a communication signal to be sent by the subscriber unit's transmitter 112 to the base station 2. The communication signal is preferably sent on the ACH, but may also be sent on the uplink TCH as well. It is received and processed by the appropriate sector unit 16 to 18 or 20. The sector unit 16 to 18 or 20 processes the signal by examining a control field in the communication signal to determine what type of communication was received. In this case, the control field indicates that the communication signal is from a particular subscriber unit that is entering the dormant mode.

The sector unit 16 to 18 or 20, from the received communication signals, determines which subscriber unit is entering the dormant mode. This information is transmitted to the database 32 and the administrative computer 28 under the control of the central controller 30. The information concerning the status of the subscriber unit 6 in the database 32 and the administrative computer 28 is updated to reflect the dormant status. Thus, the base station 2 knows which subscriber units 6 are in the dormant state.

In an alternate embodiment of the present invention, step 302 is skipped. Then, the base station 2 is not notified that the subscriber unit 6 is

entering the dormant mode of operation. Thus, upon attempting a communication with a dormant subscriber unit 6, the base station 2 will only know that the subscriber unit 6 is not receiving the communication.

In response to the dormancy message, the base station 2 can send a message to the subscriber unit 6 instructing the subscriber unit 6 to stay awake for a preselected or an instructed period of time. The base station 2 can issue this instruction if it wants to broadcast a message to many subscriber units 6 or for any other reason.

In step 304, the subscriber unit 6 checks its controller 128 memory to determine how long the subscriber unit 6 should enter the dormant mode. In one embodiment, the length of time is set in the controller 128 memory so that every subscriber unit 6 enters the dormant mode for the same length of time. In an alternate embodiment, the subscriber can enter the length of time that the subscriber unit 6 should stay in the dormant mode through the keyboard 26 on the subscriber terminal 14. In this case, the microprocessor 50 reads this information (the length of time) from the keyboard and transmits it to the controller 128, where it is stored in memory.

In another embodiment, however, the length of time that a subscriber unit 6 stays in the dormant mode is programmable by a dispatcher at the dispatch station 4. To do this, the dispatcher accesses the computer 150. One of the options the computer 150 offers as part of a fleet administration package is to allow the dispatcher to select the length of time the subscriber

unit remains dormant once the subscriber places the unit in the dormant mode. When the dispatcher selects this option, the computer 150 prompts the dispatcher to enter the length of time. Once the dispatcher enters the length of time, the computer 150 stores this parameter in its memory.

When the dispatcher completes the entry, the dispatcher enters an instruction that causes the computer 150 to send this information to the base station 2. This information is preferably sent to the base station with the other dispatcher controlled fleet administration information that configures and controls the subscriber units 6. Examples of the information that can be controlled include groupings of subscriber units, PSTN assignments to subscriber units, and subscriber unit telephony configurations and quick dial lists.

Referring to FIG. 6, when the dispatcher instructs the computer 150 to send the fleet administration information, including the dormancy time in accordance with the present invention, the computer 150 sends the information through a port 164 to a modem 152 in the dispatch station 4. The modem 152 preferably transmits the fleet administration information over a land line to the modem pool 41 in the base station 2. Alternatively, the computer 150 can route the fleet administration information through the radio unit 12 so that the transmission is over-the-air, via the TCH or the ACH, to one of the sectors 16 to 18 in the base station 2.

Once the length of dormancy has been determined, in step 306, a

power off timer is set. The timer determines the time that the subscriber unit 6 spends in the dormant mode and in waking up from the dormant mode. Then, in step 308, the power to the components in the subscriber terminal 14 and the radio unit 12 are turned off, except power is supplied to the microprocessor 50 in the subscriber terminal 14 and to the controller 128 in the radio unit 12. This allows the subscriber unit to "wake up" at a later time and then, in turn, to wake up other components needed to receive messages. It also allows the controller 128 to maintain the power off timer.

Referring now to FIG. 11, during the dormancy time, the controller 128, in step 310, keeps checking to see whether the dormancy time has elapsed. During this time, the base station 2 can be attempting to transmit communication signals to the subscriber unit 6 while it is in the dormant state. If step 302 has been skipped, the base station 2 attempts to communicate with the dormant subscriber unit 6 and determines that the subscriber unit 6 is not responding. If step 302 is performed, the base station 2 will know that the subscriber unit 6 is in the dormant mode by checking its database.

When the base station 2 determines that the subscriber unit 6 to which the communication is directed is not available, either by attempting to communicate or by checking the database or both, the base station 2 buffers the message in the communication signal. FIGS. 12 and 13, illustrate the buffering of these messages. In FIG. 12, the database 32 maintains a table

of subscriber unit identification numbers, an indication of whether there are buffered messages and the locations of those buffered messages. Whenever a message cannot be delivered by the base station 2 to the subscriber unit 6, the table of FIG. 12 is updated to indicate that the subscriber unit has a buffered message and the location of the message. In FIG. 13, the buffering of the message is indicated. For example, in FIG. 12, the database indicates that subscriber unit having identification number SU002 has a buffered message starting at memory location 0000. Referring to memory location 0000, in FIG. 13, the buffered message is found. In this case, the buffered message is the next days itinerary.

Referring now back to FIG. 11, once the dormancy time has elapsed, the controller 128 checks the power off timer. The power off timer keeps track of how long the subscriber unit 6 has been in the dormant mode, including the times that the subscriber unit 6 wakes up and then returns to the dormant mode. If the power off timer is less than a predetermined amount, preferably fourteen (14) hours, in step 312, the microprocessor 50 and the controller 128 cause power to be turned on to the subscriber terminal 14 and to the radio unit 12, respectively. If the power off timer exceeds the predetermined amount, then the subscriber unit 6 does not wake up. Thus, the power off timer stops the subscriber unit 6 from repeatedly waking up from the dormant mode, thereby preventing the draining of the battery of the vehicle in which the subscriber unit 6 is

installed.

Once awake, in step 314, the controller 128 causes a communication signal to be transmitted to the base station 2 indicating that the subscriber unit 6 is no longer in the dormant mode. Then the base station 2 accesses its memory as illustrated in FIGS. 12 and 13 to determine whether there are buffered messages. If any are found, the base station 2, in step 316, transmits these messages to the subscriber unit 6.

Any message which has been directed to the dormant subscriber unit 6 can be buffered and then transmitted. The present invention, however, is particularly useful in transmitting the next day's work orders to a subscriber, to transmit new user databases and to download new software versions to subscriber units.

Once all of the buffered messages have been transmitted, the subscriber unit 6 returns to the dormant mode. The subscriber unit 6 is removed from the dormant mode by power being turned on or, in an alternative embodiment, by the selection of one of the keys on the keypad 24.

It is understood that changes may be made in the above description without departing from the scope of the invention. It is accordingly intended that all matter contained in the above description and in the drawings be interpreted as illustrative rather than limiting.

We claim:

1. A method of providing communication services between a base station and a subscriber unit, comprising the steps of:

placing the subscriber unit in a dormant mode wherein the subscriber unit consumes limited power;

transmitting communication signals from the base station when the subscriber unit is in the dormant mode;

at the base station, determining that the subscriber unit is not responsive to the transmitted communication signals and storing the communication and the identity of the subscriber unit to which the communication was directed in a buffer at the base station;

after a predetermined time, taking the subscriber unit out of the dormant mode and causing the subscriber unit to communicate with the base station to inquire about communications messages; and

if there are buffered communications for the subscriber unit, transmitting the buffered communications from the base station to the subscriber unit.

2. The method of claim 1, further comprising the step of:

from the dispatch station, transmitting a communication to the subscriber unit containing the length of the dormant mode.

3. The method of claim 2, further comprising the step of:

transmitting a communication containing the length of the dormant mode from the dispatch station to the base station and then to the subscriber unit.

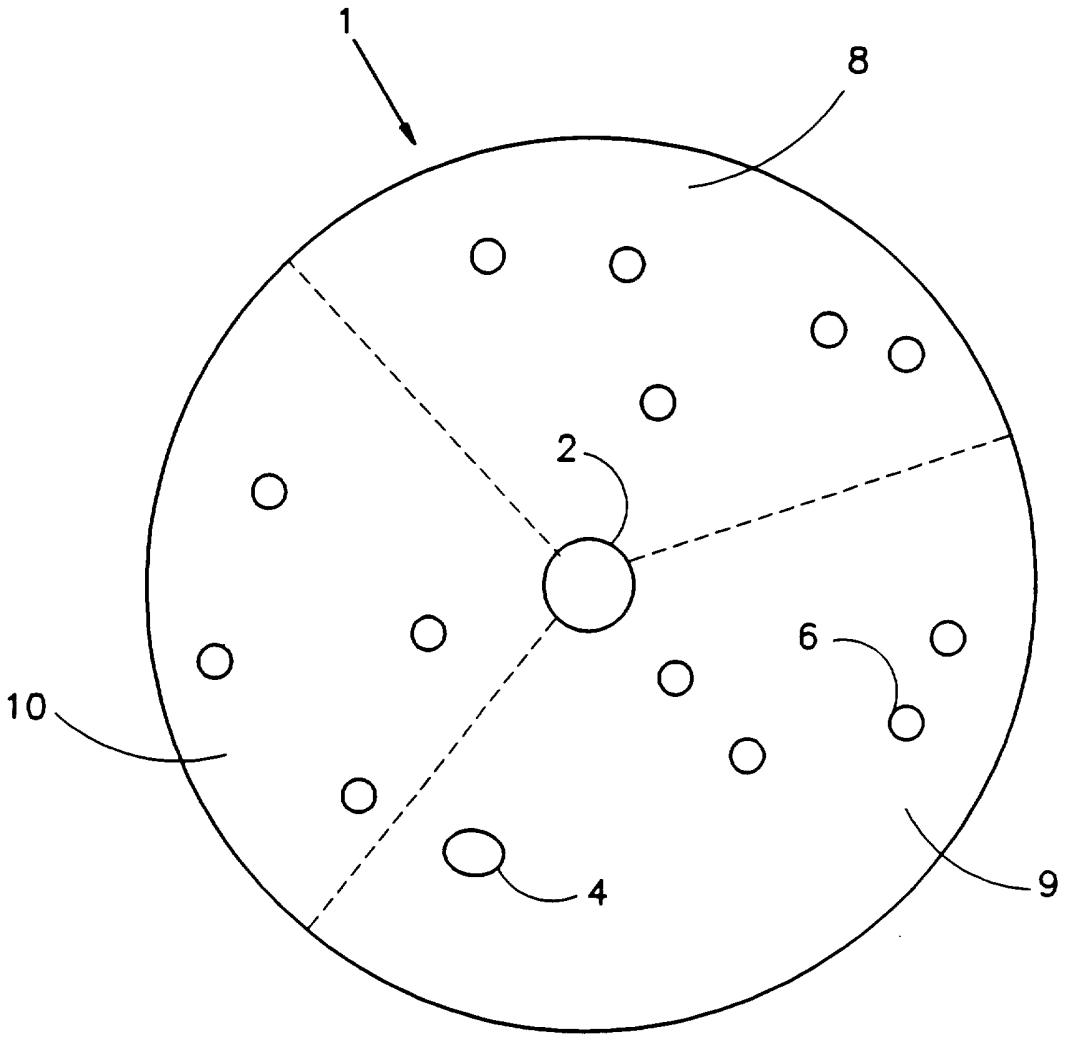


FIG. 1

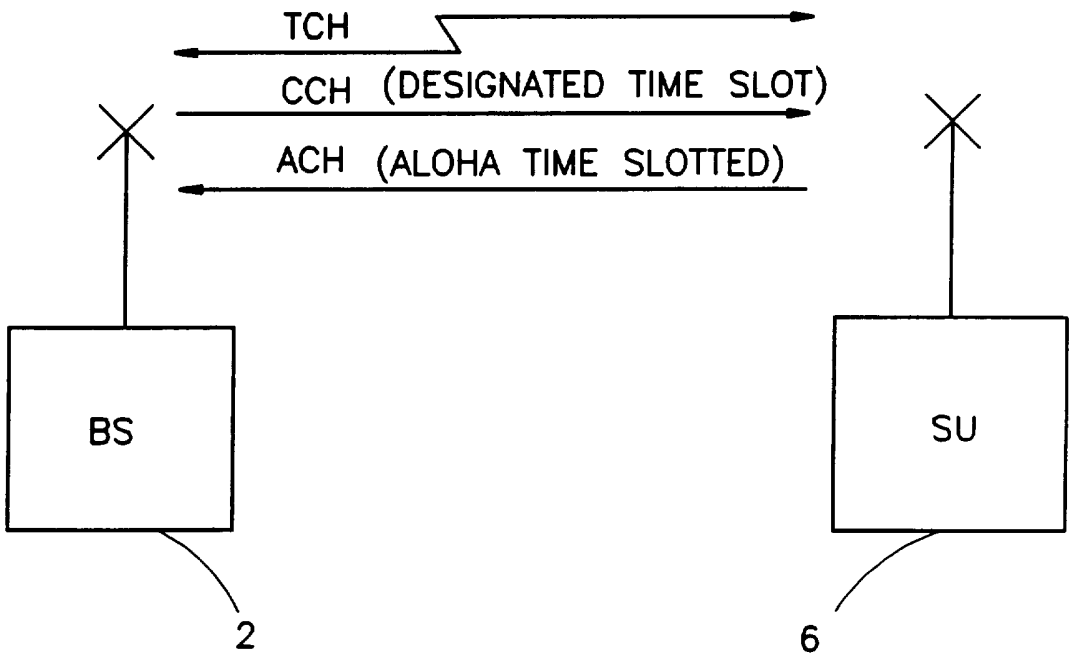
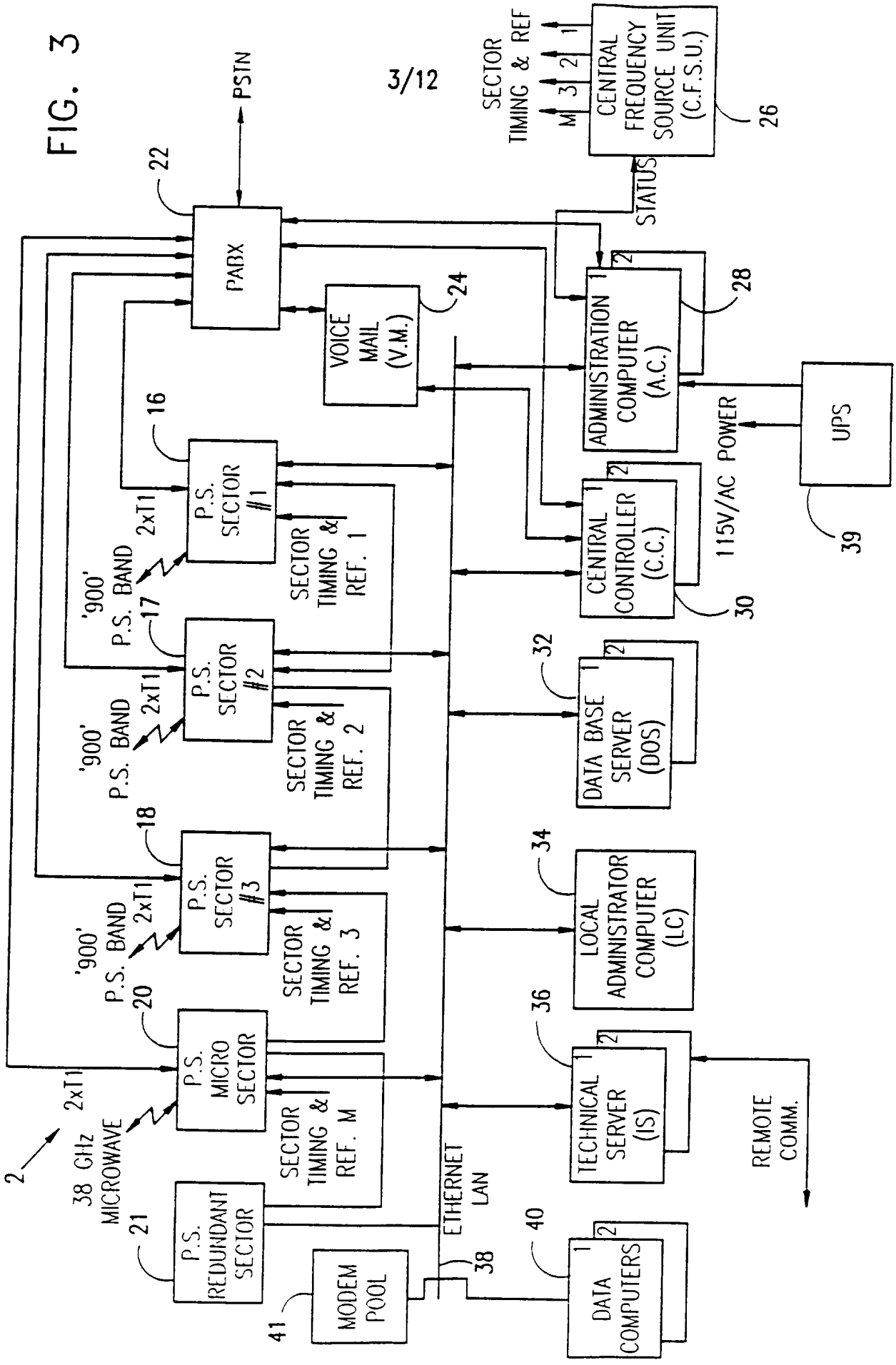


FIG. 2

FIG. 3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SECTOR TIMING & REF
M 3 2 1
CENTRAL FREQUENCY SOURCE UNIT (C.F.S.U.)
26
STATUS
VOICE MAIL (V.M.)
24
ADMINISTRATION COMPUTER (A.C.)
28
16
P.S. SECTOR #1
2xT1
'900' P.S. BAND
17
P.S. SECTOR #2
2xT1
'900' P.S. BAND
18
P.S. SECTOR #3
2xT1
'900' P.S. BAND
20
P.S. MICRO SECTOR
2xT1
38 GHz MICROWAVE
2
21
P.S. REDUNDANT SECTOR
SECTOR TIMING & REF. 1
SECTOR TIMING & REF. 2
SECTOR TIMING & REF. 3
SECTOR TIMING & REF. M
CENTRAL CONTROLLER (C.C.)
30
115V/AC POWER
UPS
39
32
DATA BASE SERVER (DOS)
34
LOCAL ADMINISTRATOR COMPUTER (LC)
36
TECHNICAL SERVER (IS)
REMOTE COMM.
ETHERNET LAN
38
40
DATA COMPUTERS
41
MODEM POOL

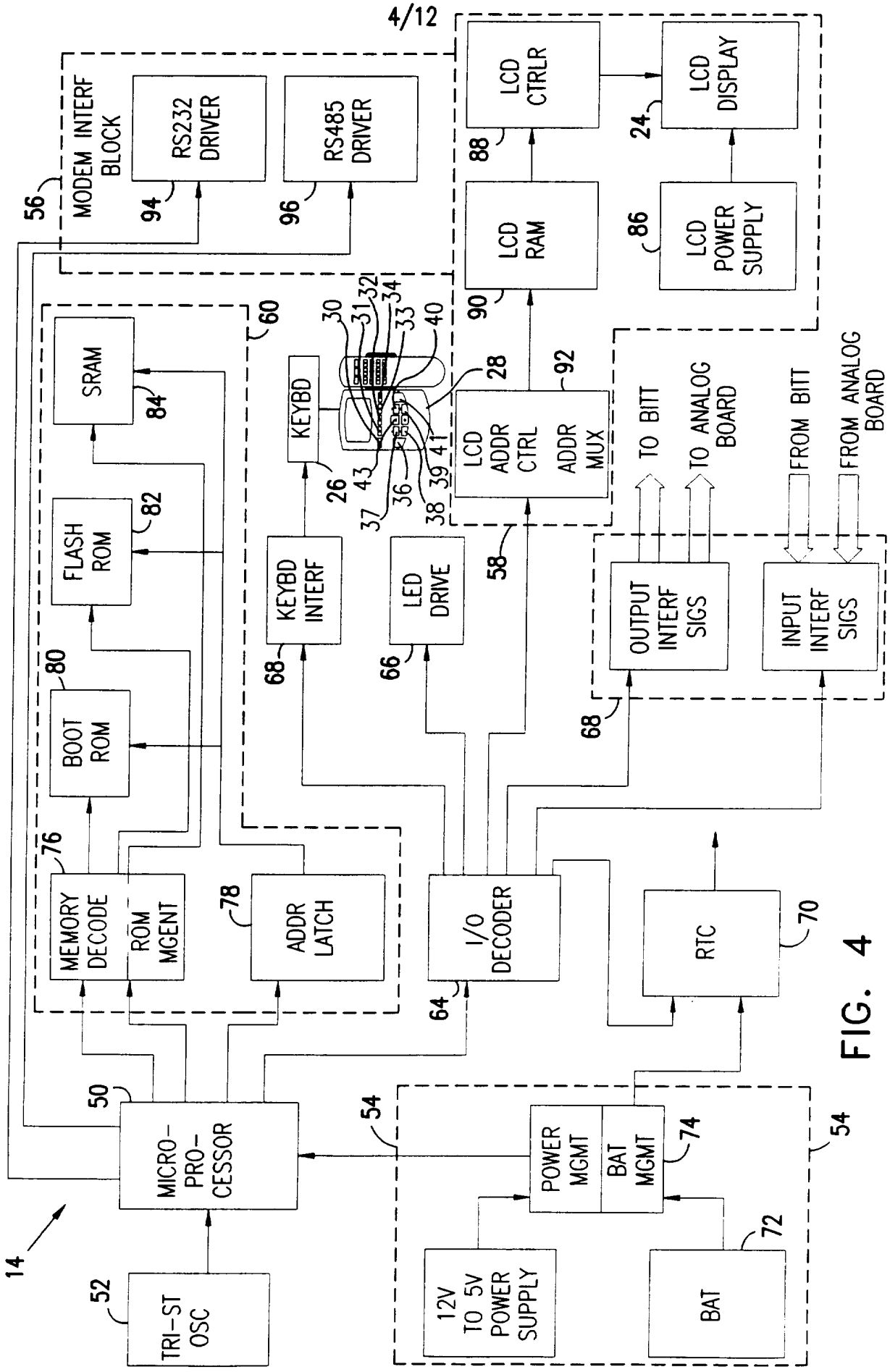

MODEM INTERF BLOCK
56
RS232 DRIVER
94
RS485 DRIVER
96
LCD CTRLR
88
LCD DISPLAY
24
LCD RAM
90
LCD POWER SUPPLY
86
60
SRAM
84
FLASH ROM
82
BOOT ROM
80
KEYBD
26
KEYBD INTERF
68
LED DRIVE
66
LCD ADDR CTRL
ADDR MUX
92
28
58
TO BITT
TO ANALOG BOARD
FROM BITT
FROM ANALOG BOARD
OUTPUT INTERF SIGS
INPUT INTERF SIGS
68
MEMORY DECODE
ROM MGENT
76
ADDR LATCH
78
I/O DECODER
64
RTC
70
MICRO-PRO-CESSOR
50
14
TRI-ST OSC
52
54
POWER MGMT
BAT MGMT
74
12V TO 5V POWER SUPPLY
BAT
72
30
31
32
34
33
40
43
36
39
41
37
38

FIG. 4

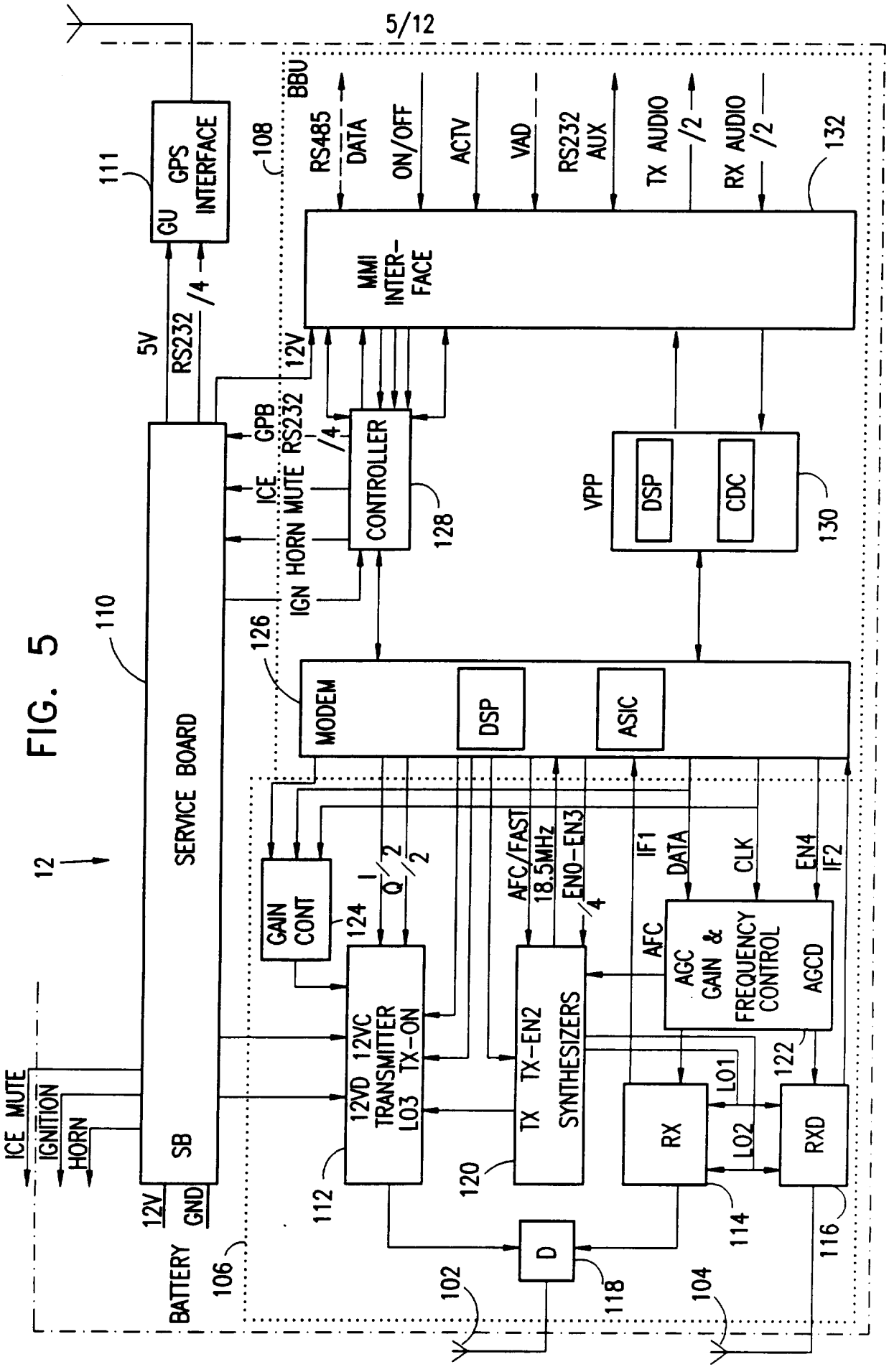
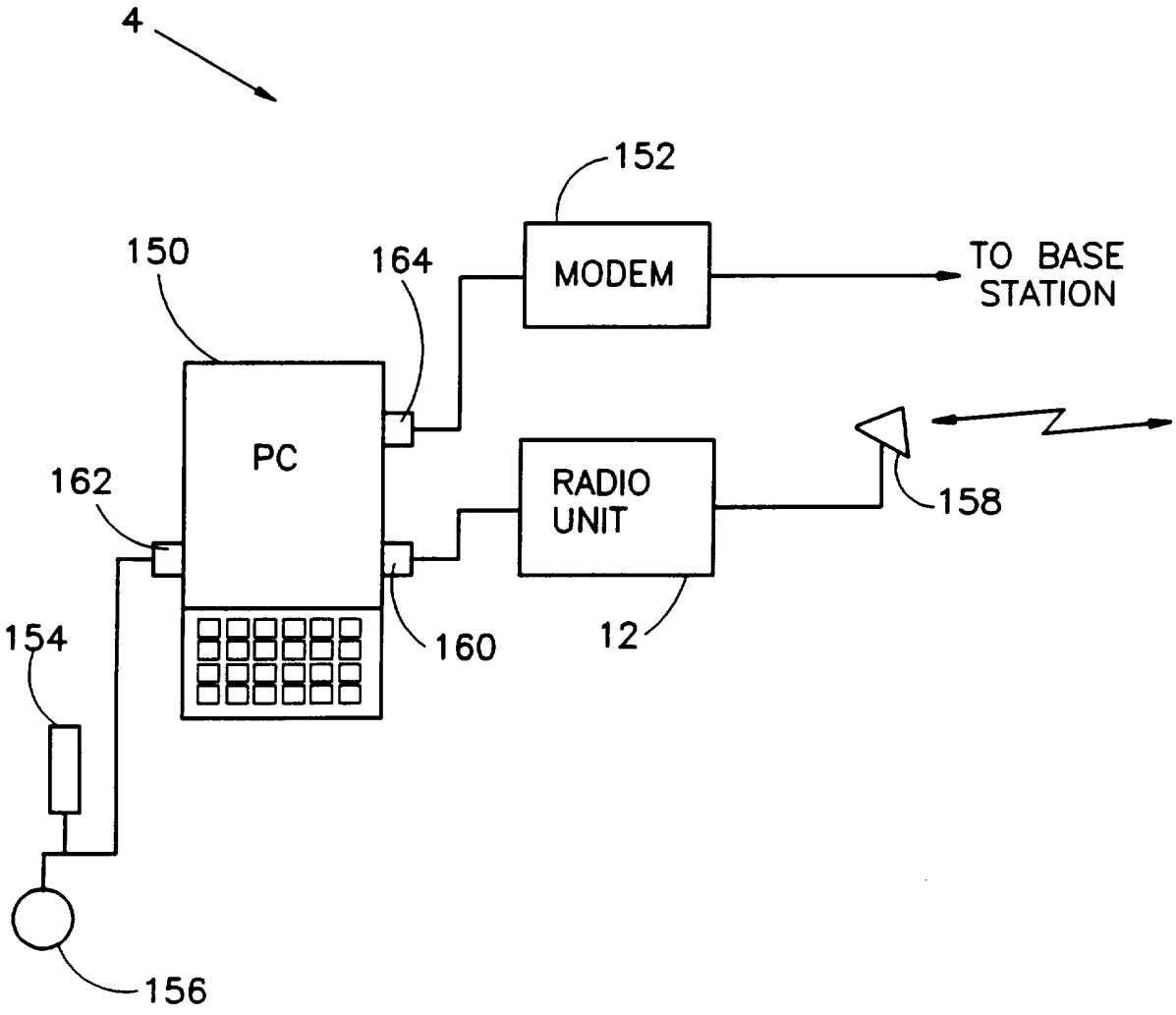

5/12
BBU
RS485 DATA
ON/OFF
ACTV
VAD
RS232 AUX
TX AUDIO /2
RX AUDIO /2
132
111
GU GPS INTERFACE
108
MMI INTER-FACE
5V
RS232 /4
12V
GPB RS232 /4
ICE
MUTE
IGN
HORN
CONTROLLER
128
VPP
DSP
CDC
130
110
126
MODEM
DSP
ASIC
12
SERVICE BOARD
GAIN CONT
124
I
Q
/2
/2
AFC/FAST
18.5MHz
EN0-EN3
/4
IF1 DATA
CLK
EN4 IF2
AFC
AGC GAIN & FREQUENCY CONTROL
AGCD
122
ICE MUTE
IGNITION
HORN
SB
12V
GND
BATTERY
106
12VD 12VC TRANSMITTER LO3 TX-ON
112
TX TX-EN2 SYNTHESIZERS
120
RX
LO1
LO2
RXD
114
116
D
118
102
104

FIG. 5

FIG. 6


4
152
150
164
MODEM
TO BASE STATION
PC
RADIO UNIT
158
162
154
160
12
156

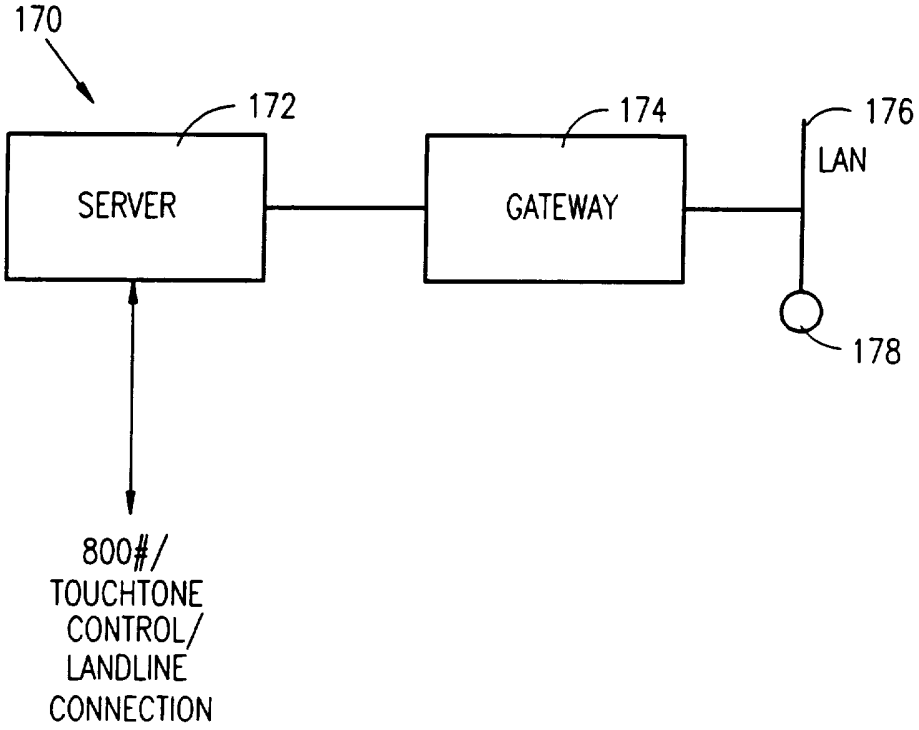

170
172
174
176
LAN
SERVER
GATEWAY
178
800#/
TOUCHTONE
CONTROL/
LANDLINE
CONNECTION

FIG. 7

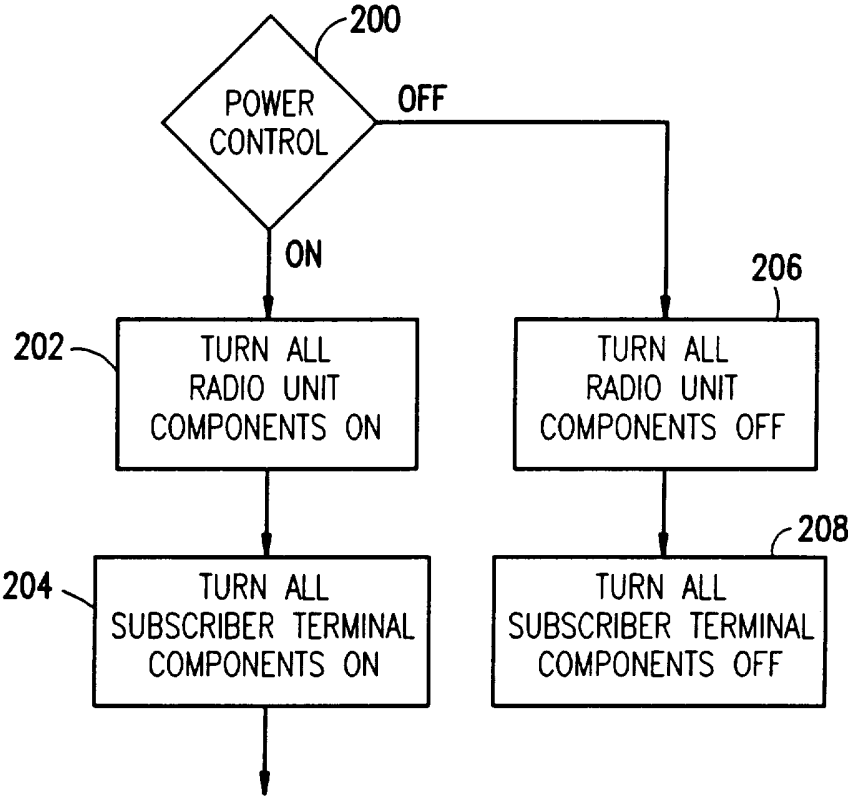

200
POWER CONTROL
OFF
ON
206
202
TURN ALL RADIO UNIT COMPONENTS ON
TURN ALL RADIO UNIT COMPONENTS OFF
208
204
TURN ALL SUBSCRIBER TERMINAL COMPONENTS ON
TURN ALL SUBSCRIBER TERMINAL COMPONENTS OFF

FIG. 8

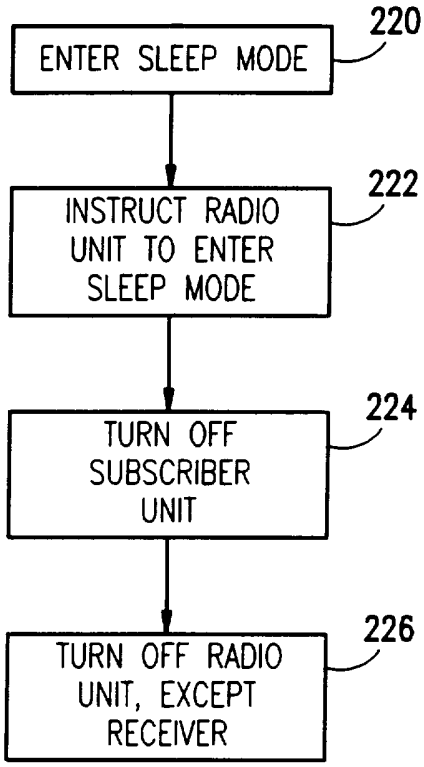

ENTER SLEEP MODE
220
INSTRUCT RADIO UNIT TO ENTER SLEEP MODE
222
TURN OFF SUBSCRIBER UNIT
224
TURN OFF RADIO UNIT, EXCEPT RECEIVER
226

FIG. 9

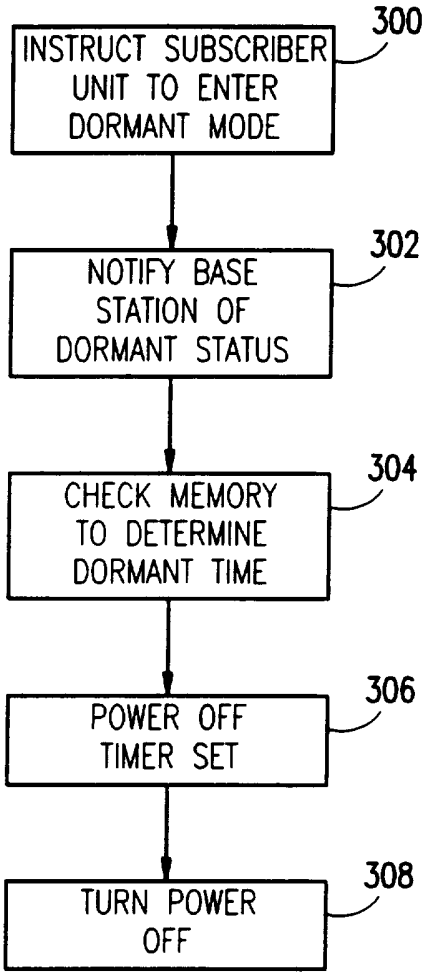

INSTRUCT SUBSCRIBER UNIT TO ENTER DORMANT MODE
300
NOTIFY BASE STATION OF DORMANT STATUS
302
CHECK MEMORY TO DETERMINE DORMANT TIME
304
POWER OFF TIMER SET
306
TURN POWER OFF
308

FIG. 10

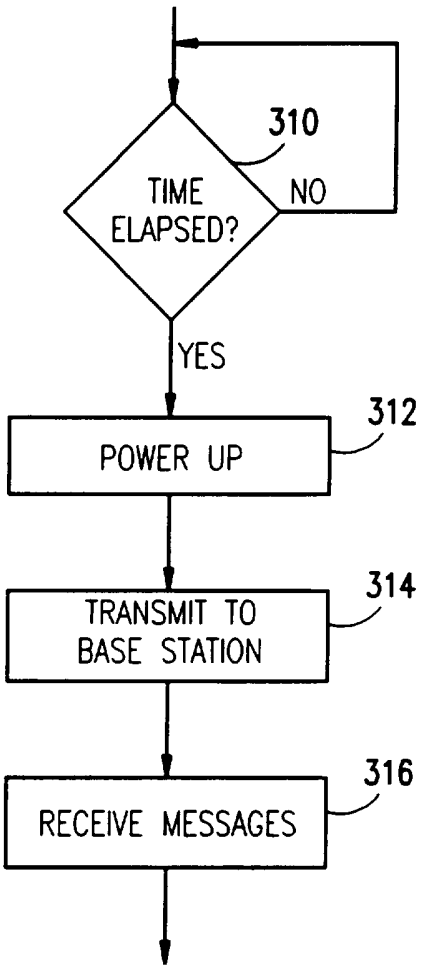

310
TIME ELAPSED?
NO
YES
312
POWER UP
314
TRANSMIT TO BASE STATION
316
RECEIVE MESSAGES

FIG. 11

FIG. 12

SUID	INFO	BUFFERED MESSAGES	LOCATION
SU001	INFO	NO	
SU002	INFO	YES	0000
⋮		⋮	
SU150	INFO	YES	0037
SU151	INFO	YES	0038

FIG. 13

LOCATION	SUID	MESSAGE
0000	SU002	TOMORROW'S ITINERARY IS ...
⋮		⋮
0037	SU150	STOP BY THE OFFICE FIRST THING TOMORROW
0038	SU151	TOMORROW'S ITINERARY IS ...

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/03150

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04Q 7/02
US CL :455/54.1

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. : 455/54.1, 38.1, 38.2,. 38.3. 54.2, 56.1, 343, 228; 340/825.44, 825.54

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)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US, A, 4,868,560 (OLIWA et al) 19 September, 1989, figures 6a-d, col 2, lines 28-63,col 14, lines 18-65.	1 --- 2,3
Y	US, A, 5,175,870 (MABEY et al) 29 December 1992, figure 1, col 1, lines 37-48	2,3
A	US, A, 5,382,949 (MOCK et al) 17 January 1995, figure 4, col2, lines 4-59	1-3
A	US, A, 5,077,830 (MALLIA) 31 December 1991, col 6, lines 12-40.	1-3

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

*	Special categories of cited documents:	"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
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"E"	earlier document published on or after the international filing date	"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
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"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 26 MAY 1996	Date of mailing of the international search report 12 JUN 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Philip J. Sobutka Telephone No. (703) 305-4825

Form PCT/ISA/210 (second sheet)(July 1992)*