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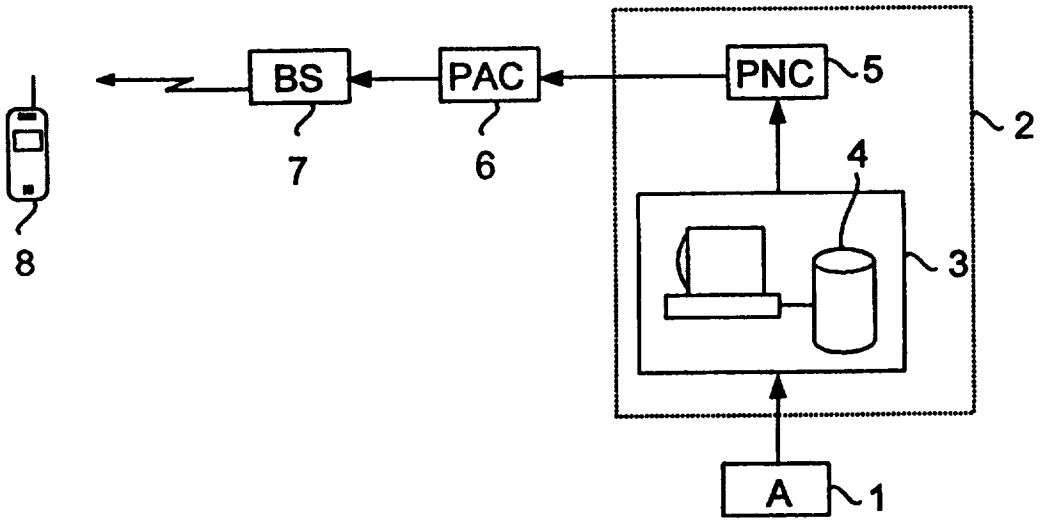
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(57) Abstract

The present invention relates to eliminating a call delay caused by a sleep mode in a paging system, which operates at a service centre and in which a pager can be set to a sleep mode, in which a power saving mode and a receiving mode alternate. The delay caused by the sleep mode is avoided by selecting a first pager set, to which at least one pager (8) to be selected later on belongs, on the basis of a received call according to a predefined criterion before analysing the contents of the call, and a signal for interrupting the sleep mode is sent to said first pager set. The selection criterion for the first pager set may be e.g. information on the number of subscriber A (1) stored in the system or a reference stored in the system and based on information on the caller's location to at least one pager, the sleep mode of which will be interrupted on the basis of a call from said location.

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ELIMINATING RECEPTION DELAY IN PAGING SYSTEM

FIELD OF THE INVENTION

The invention relates to a method for eliminating a call delay caused by a sleep mode in a paging system, in which the pager can be in alarm mode, continuous receiving mode or in sleep mode, in which a power saving mode and a receiving mode alternate, the method comprising the steps of receiving a call in a service centre comprising a paging system, analysing the contents of the call, selecting at least one pager on the basis of the contents of the call and sending a call to said at least one pager.

BACKGROUND OF THE INVENTION

Effective utilization of the resources provided by any organization is based on mobility and swift accessibility of persons. The use of advanced paging systems based on radio connection has reduced the need for maintaining overlapping resources, since they allow rapid activation of the operations of the organization and mobilisation of the persons involved.

A mobile communication system is a telecommunication system consisting of a mobile communication network and mobile stations. In a paging system communication is unidirectional, i.e. the pager functions only as a receiver. Paging is initiated by a call to the exchange of the paging network. A signal is sent to pagers by paging transmitters, which are controlled by a paging network controller through paging area controllers. If a person is within the coverage area of the paging system and his/her pager is on, he/she receives a paging message.

The paging message can be indicated in several ways. The simplest way is to indicate the paging message by a sound signal, light signal or by vibration of the device. Furthermore, in addition to the paging message, a number sequence (e.g. a number to which a person should call) or an alphanumeric message can be provided on the display of the pager.

In order to provide reliable operation of the paging system, the pager needs to be small and light, whereby the user can easily carry it with him/her. The operating time of the device has to be long so that the reliability of the system will not suffer. Hence, as regards the performance of the system, it is particularly important to optimize the use of the power source of the pager.

Several solutions to reducing the power consumption of a pager have been disclosed. The most common prior art arrangement is the use of a sleep mode (e.g. EP 483246, EP 607037 and EP 597308). In the sleep mode the pager visits the power-consuming receiving mode only at intervals and at other times it operates in power saving mode. This arrangement known as SLEEP MODE increases the operation time of the power source, since the power is consumed only in short bursts and not continuously. The longer the power saving mode can be defined to be, the longer the power source will last.

Since in the power saving mode of the sleep mode the pager does not receive a call, the use of the sleep mode causes an inconvenient delay in the paging system. When the pager has been set to the sleep mode, the exchange can send a paging message only when the pager is known to be in receiving mode. At most the delay can be as long as the power saving period, but on the average it is half of the duration of the power saving mode.

BRIEF DESCRIPTION OF THE INVENTION

An object of this invention is to provide an arrangement for eliminating the delay between the decision to call and indication of the call caused by the sleep mode of a pager in situations where a paging message can be anticipated.

This object is achieved with the method, system and pager of the invention described in independent claims 1, 6 and 13. The invention is based on the idea that the pager is often used in such environments in which it is possible to define the pager or pagers already in advance for which a call from a given number will probably cause a call. Such an environment typically is a service centre which allocates resources under its control on the basis of the calls that have entered the centre. Such include, for example, a public emergency centre, main control room of a large production process, hospital exchange or the like. The invention does not provide any substantial advantage in such a paging system in which a paging message is automatically sent to a certain pager when the paging centre receives a call to the number of this particular pager.

In the service centre there preferably is a person on duty, who receives a call and on the basis of its contents selects the pager or pagers which will be activated on the basis of the call. The operations of the service centre are often such that it is possible to anticipate that calls from a certain group will cause a call for certain pagers. Storing the anticipated information in

a data base as references from certain numbers to certain pagers allows to retrieve the pager set related to the number of subscriber A and to send a signal for interrupting the sleep mode to the pagers of the set as soon as a call enters the service centre. Identification of the subscriber A of the call and carrying out the related retrieval operations of a data base in the call set-up or switching phase is conventional technology, and thus obvious to one skilled in the art.

Having received a signal for interrupting the sleep mode, the pagers switch to a continuous receiving mode and the actual paging message can be sent immediately after the decision to page has been made, and in the paging phase the system does not need to wait for a moment when the pager is known to be in receiving mode next time. As soon as the person on duty has analysed the contents of the call and sent a paging message to the selected devices, the call causes an alarm and there will be no additional delay between the decision to page and indication of the paging message.

The signal for interrupting the sleep mode is substantially sent to all pagers to which the call will probably be sent. This group of pagers will be hereafter referred to as a first pager set. The first pager set can include e.g. pagers of a certain area, group or of a combination of these, depending on the application.

The person on duty at the service centre sends a paging message to those pagers the resources of which will be needed according to his/her estimation. This group of pagers will hereafter be referred to as a second pager set. The second pager set preferably is part of the first pager set.

The invention allows to eliminate the delay caused by the power saving mode, since an alarm can be sent off immediately after the decision to page has been made, and thus it is not necessary to wait for the moment when the pager is in receiving mode again. After the delay has been eliminated, increasing the duration of the power saving mode does not substantially slower realization of the call, which clearly helps to optimize the use of the battery.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention will be described in greater detail with reference to the accompanying drawings, in which

Figure 1 illustrates a first preferred embodiment of the system of the invention,

Figure 2 illustrates implementation of a sleep mode in a pager functioning on a radio path in a paging system,

Figure 3 illustrates benefits provided by the method of the invention in a pager functioning on a radio path in a paging system, and

Figure 4 illustrates a functional flow chart of a series of the operations of the invention.

DETAILED DESCRIPTION OF THE INVENTION

The benefits provided by the invention will be viewed in the following in connection with a first preferred embodiment of the invention, illustrated by a block diagram in Figure 1. The example shows a service centre 2, which allocates resources under its control on the basis of the calls to the centre. The service centre 2 preferably comprises an application system 3, which provides adequate data processing and display means for the person on duty so that he/she can control and update paging operations. The service centre 2 also comprises a paging network controller 5, which performs paging operations on the basis of the commands given by the application system 3. The application system 3 and the paging network controller 5 may be separate units, as illustrated in Figure 1, or they can form a larger part of a paging facility operating under a mobile communication network or a paging network. Examples of such mobile communication networks and paging networks are e.g. TETRA (Trans-European Trunked Radio) and ERMES (European Radio Message System). The paging system in Figure 1 is, where applicable, based on the ERMES paging system, of which only one paging area controller PAC 6, base station BS 7 and pager 8 are shown for the sake of clarity. In practice, the number of pagers 8 and base stations 7 is large.

Pagers of the system can be set to the sleep mode by sending a sleep mode signal to a pager at the command of the application system. Correspondingly, it is possible to interrupt the sleep mode of selected pagers by sending them a signal for interrupting the sleep mode. Depending on the application, the pager can in some cases also be a mobile station used in bidirectional traffic.

A caller 1 can contact the service centre 2 via any network, e.g. from an integrated services digital network ISDN, public switched telephone network PSTN or public land mobile network PLMN. When a call enters the service centre, the application system 3 identifies the number of subscriber A and retrieves information on the first pager set attached to the number of

subscriber A from a data base 4. The application system 3 gives a command to the paging network controller 5 to send a signal for interrupting the sleep mode to the pagers of the first pager set. The paging network controller sends a message to the base station 7 via paging area controllers 6, and the base station sends a signal to a pager 8 of the first pager set.

As the call proceeds, the person on duty at the centre analyses the contents of the call, on the basis of which he/she selects a second pager set to which a paging message is sent. Since the second pager set typically is a subset of the first pager set, the pagers are already in receiving mode and a paging message can be sent immediately.

The sleep mode of the pager comprises two modes: a power saving mode and a receiving mode. The receiving mode is the normal operation mode of the device, in which the pager can continuously receive signals sent by the base station. In the power saving mode the device is on, but operationally in a passive state. In that case the reception functions consuming power most are switched off and the device maintains such a level of readiness that it can quickly switch to the receiving mode.

The system sets a pager to a sleep mode by sending a sleep mode signal to it. Having received the signal the pager first switches to a power saving mode. After a certain predefined period the timer of the pager sets the pager to a receiving mode for a short predefined period, after which the pager switches back to the power saving mode. After this the pager switches to the power saving mode and receiving mode at intervals, synchronized by internal timing of the device.

Figure 2 illustrates the operation modes of a pager operating on a radio path. The paging network controller 5 operating under the service centre 2 sets the pager 8 to a sleep mode at moment T_1. In the sleep mode the pager 8 alternates between a power saving mode and a receiving mode. At moment T_2 a call enters the service centre 2. The person on duty at the service centre decides to send a paging message to the pager 8 at moment T_4. Since the pager is in power saving mode, the paging network controller 5 cannot send the call, but it must wait until the pager is in receiving mode again. When the pager 8 switches to the receiving mode, the paging controller 5 sends a paging message, and the device gives an alarm at moment T_5. The delay caused by the power saving mode of the pager 8 between the decision to page and the paging message is $DT = T_5 - T_4$.

Figure 3 illustrates the advantage achieved with the method of the invention in a paging system. When a call enters the service centre 2 at moment T_2, the application system 3 defines a first pager set according to the criteria stored in the data base 4 of the application system in advance on the basis of the number of the subscriber A. Having completed this, the application system 3 gives a command to the paging network controller 5 to send a signal for interrupting the sleep mode to the pagers of the first pager set, and the paging network controller sends the signal at moment T_3. The interrupt signal sets the pager to a continuous receiving mode immediately after the current power saving mode has ended. When the paging network controller 5 sends a paging message to the pager 8 at moment T_4, the device immediately starts to alarm at moment T_4.

Figure 4 illustrates a functional flow chart of the series of operations of Figure 3 in a system according to the first embodiment. At the beginning, the paging network controller 5 has sent a sleep mode signal to the pager 8 concerned. In the sleep mode the pager is in an operationally passive state (power saving mode) for most of the time, but switches to the receiving mode at intervals, whereby it can receive signals sent by the base station 7 (step 10). When an emergency call enters the service centre 2 (step 11), the application system 3 finds out the number of subscriber A and retrieves definitions of the pagers attached to said number A from the data base 4 of the system (step 12). These pagers form the first pager set to which the application system 3 commands a signal for interrupting the sleep mode to be sent (step 13). As the call proceeds, the person on duty analyses the contents of the call and decides whether the call causes an alarm, or whether the situation in question is harmless and does not require the use of the resources of the service centre (step 14). If the telephone call does not cause a call, the application system commands that a sleep mode signal is to be sent to the devices of the first pager set (step 16). If a decision is made to send a paging message on the basis of the contents of the call, the application system 3 defines a second pager set (step 17) to the pagers of which a paging message that switches them to an alarm mode is sent (step 18). After the paging message has been sent, the system defines those pagers of the first pager set which do not belong to the second pager set (step 19) and a sleep mode signal is sent to them (step 20).

In several cases it is important to quickly alarm the resources nearest to the caller. In a second embodiment of the invention the first pager set is defined on the basis of the caller's location during the call. Location of a call from the fixed network can be retrieved directly from the subscriber register of the number of caller A, and a call from a mobile station can also be located quickly at least with an accuracy of a cell. Determining the location of a call on an application-specific basis when a call enters from a different network is conventional technology, and thus obvious to one skilled in the art. When a call causing a paging message enters the service centre, the system locates subscriber A and on the basis of the location the sleep mode of a selected pager set is interrupted.

In the above embodiments of the invention the signal for interrupting the sleep mode is sent as soon as the system 3 has defined the first pager set on the basis of the number of subscriber A. The command to interrupt the sleep mode can also be delayed so as to avoid unnecessary interruptions of the sleep mode caused by erroneous calls, malicious calls and other unnecessary calls. If such interruptions occur often, they may decrease the duration of the power source compared with an uninterrupted sleep mode. When a call enters the service centre 2, the system 3 defines the first pager set according to the first embodiment of the invention, but does not send a signal for interrupting the sleep mode immediately. The signal for interrupting the sleep mode can be delayed automatically by a preselected period, which preferably is the estimated duration of a call during which erroneous or malicious calls are usually interrupted. Sending of the signal for interrupting the sleep mode can also be arranged in such a manner that the person on duty manually sends it off after he/she is certain that the call in question really requires the use of the resources of the service centre.

In one preferred embodiment of the invention means are provided for the person on duty for defining the first pager set manually. The system may provide some helpful proposals or shortcut menus for the user from which he/she makes a choice while listening to the contents of the call. This allows the person on duty to quickly adapt the need for interrupting the sleep mode to correspond e.g. to the estimated need for resources on the basis of the call.

Defining selection criteria for the first pager set is a system-specific solution determined by the operation of the service centre. A selection criterion may also be a combination of the embodiments described above. It is

essential that the selection criterion comprises as good an estimate as possible of the pager for which a call to the service centre 2 probably causes a paging message.

In step 19 of Figure 4 the system determines the pagers of the first pager set to which no message was sent and in step 20 a sleep mode signal is sent to said pagers. These operations can be replaced with a feature of the pager 8 according to which switching back to the sleep mode occurs on the basis of internal time supervision of the pager. If the pager 8 does not receive a paging message from the paging network controller 5 within a certain predefined period after sending the signal for interrupting the sleep mode, the pager 8 automatically switches to the sleep mode.

The drawings and the related description are, where applicable, based on the structure of the ERMES paging system. It is, however, important to note that they are only intended for illustrating the inventive concept. The invention is not limited to any individual paging system, but may be applied to any paging system operating according to the definitions of the description and independent claims. The details of interruption of the sleep mode according to the invention may vary within the scope of the appended claims.

CLAIMS

1. A method for eliminating a call delay caused by a sleep mode in a paging system, in which a pager can be in alarm mode, continuous receiving mode or in sleep mode, in which a power saving mode and a receiving mode alternate, the method comprising the steps of

receiving a call in a service centre (2) comprising the paging system,

analysing the contents of the call,

selecting at least one pager (8) on the basis of the contents of the call,

sending a call to said at least one pager,

characterized in that the method also comprises the steps of

selecting a first pager set, to which at least one pager (8) to be selected later on probably belongs, on the basis of the received call according to a predefined criterion before analysing the contents of the call,

sending a signal for interrupting the sleep mode to said first pager set, the signal setting the pagers to a continuous receiving mode.

2. A method as claimed in claim 1, **characterized** in that the selection criterion for the first pager set is a reference, related to the number of subscriber A (1) and stored in the system, to at least one pager the sleep mode of which is interrupted on the basis of a call from said number.

3. A method as claimed in claim 1, **characterized** in that the selection criterion for the first pager set is a reference, based on the information on the caller's location and stored in the system, to at least one pager the sleep mode of which is interrupted on the basis of a call from said number.

4. A method as claimed in claim 1, **characterized** in that a signal for interrupting the sleep mode is sent to the first pager set in advance after a predefined period since the call entered the centre, the period preferably being the estimated period during which erroneous or malicious calls are usually interrupted.

5. A method as claimed in claim 1, **characterized** by the steps of

determining those pagers of the first pager set to which no paging message was sent after sending the paging message, and

sending a sleep mode signal to said pagers, whereby they switch to the sleep mode.

6. A paging system comprising

at least one service centre (2), which allocates resources under the control of the centre on the basis of the calls to the service centre,

one or more pagers (8), which may be in alarm mode, continuous receiving mode or in sleep mode, in which a power saving mode and a receiving mode alternate,

means (4, 5, 6, 7) for enabling a transmission between the service centre (2) and the pager (8),

means (4, 5, 6, 7) for sending a paging message to the pagers selected at the service centre, and

means (4, 5, 6, 7) for sending a paging message to at least one pager (8) selected on the basis of the contents of a call to the service centre,

characterized in that the system also comprises

means (3) for selecting the first pager set on the basis of the contents of the call according to a predefined criterion before analysing the contents of the call, whereby at least one of the pagers to be selected later on probably belongs to the first pager set, and

means (4, 5, 6, 7) for sending a signal for interrupting the sleep mode to the first pager set in order to switch the pagers to a continuous receiving mode.

7. A paging system as claimed in claim 6, **characterized** in that the selection criterion for the first pager set is a reference, related to the subscriber A's number and stored in the system, to at least one pager the sleep mode of which is interrupted on the basis of a call from said number.

8. A paging system as claimed in claim 6, **characterized** in that the selection criterion for the first pager set is a reference, based on the information on the caller's location and stored in the system, to at least one pager the sleep mode of which is interrupted on the basis of a call from said number.

9. A paging system as claimed in claim 7 or 8, **characterized** in that the system comprises means for delaying a signal for interrupting the sleep mode by a preselected period after a call has entered the centre, the period being preferably the duration during which erroneous or malicious calls to the centre are usually interrupted.

10. A paging system as claimed in claim 7 or 8, **characterized** in that the system also comprises

means for making one or more proposals for the composition of the first pager set,

means for displaying the proposals to the person on duty at the centre, and

means with which the person on duty defines the first pager set completely independently or preferably on the basis of the proposals provided by the system.

11. A paging system as claimed in claim 7 or 8, **characterized** in that the system also comprises

means for determining those pagers of the first pager set to which no paging message was sent, and

means for sending a sleep mode signal to said pagers.

12. A paging system as claimed in claim 7 or 8, **characterized** in that the pager switches back to the sleep mode if the pager does not receive the paging message within a predefined period after receiving the signal for interrupting the sleep mode.

13. A pager of a paging system, which can be in alarm mode, continuous receiving mode or in sleep mode, in which a power saving mode and a receiving mode alternate, **characterized** in that the pager is arranged to receive a signal for interrupting the sleep mode, whereby the sleep mode of the pager is interrupted and the pager switches to a continuous receiving mode.

14. A pager as claimed in claim 13, **characterized** in that the pager switches back to the sleep mode if the pager does not receive a paging message signal within a predefined period after receiving the signal for interrupting the sleep mode.

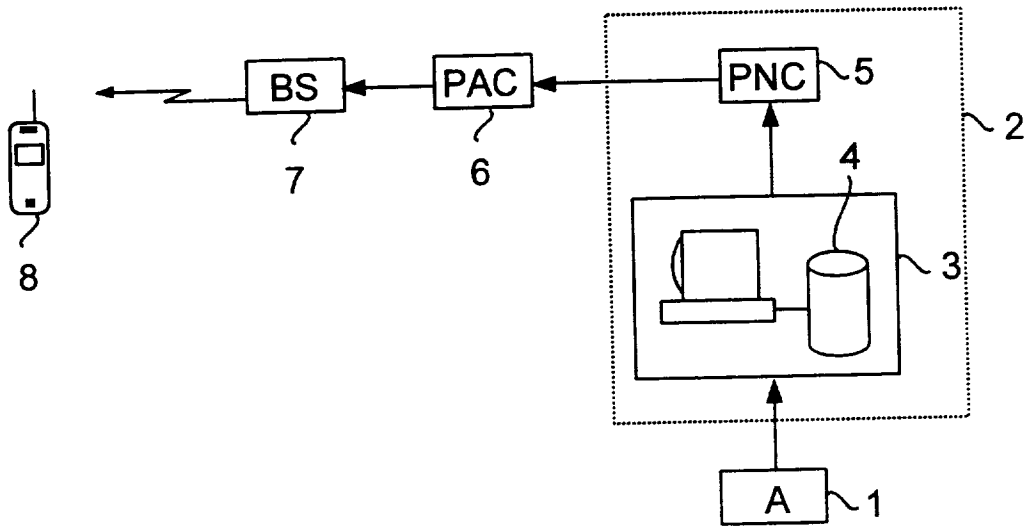


FIG. 1

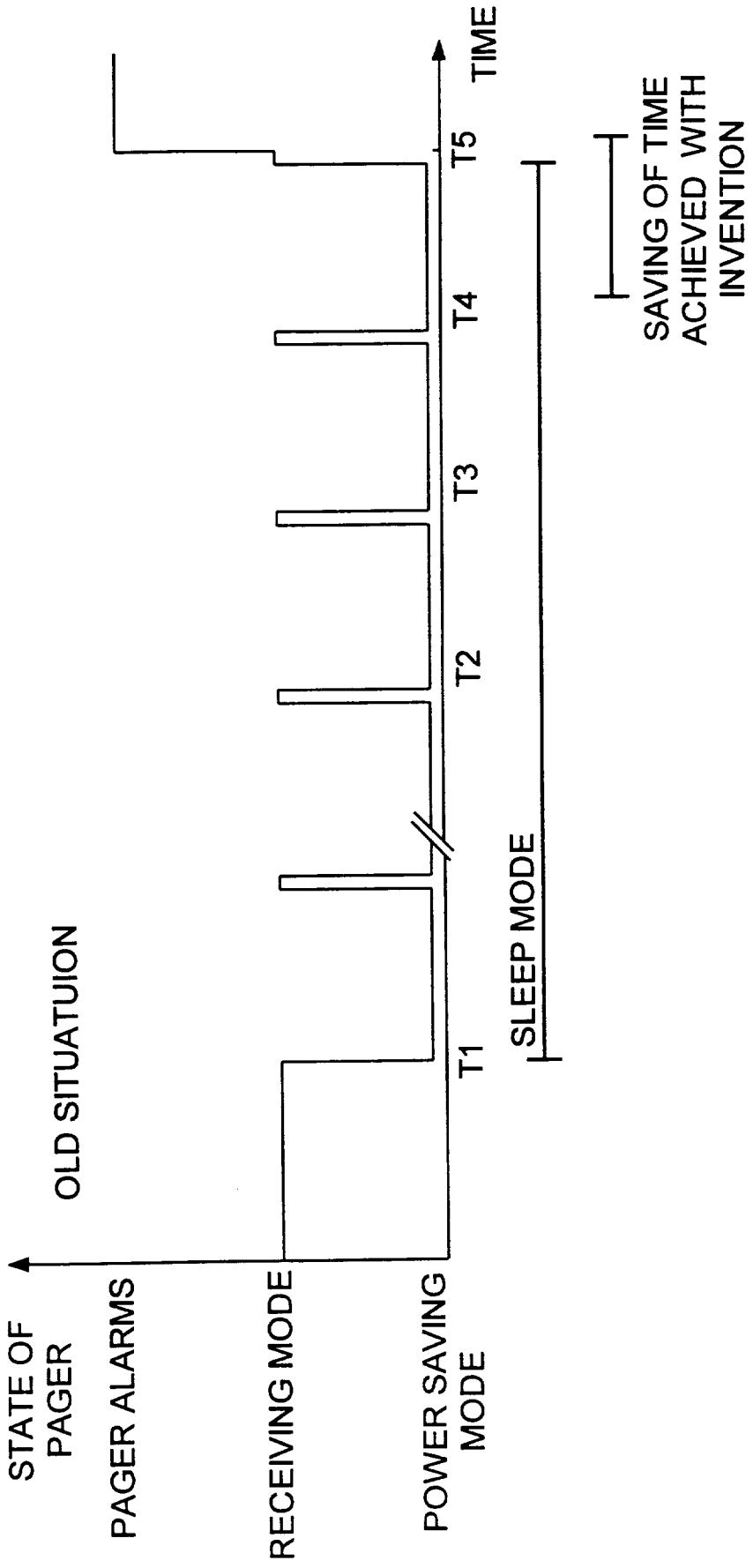

STATE OF PAGER
PAGER ALARMS
RECEIVING MODE
POWER SAVING MODE
OLD SITUATUION
T1
T2
T3
T4
T5
TIME
SLEEP MODE
SAVING OF TIME ACHIEVED WITH INVENTION

FIG. 2

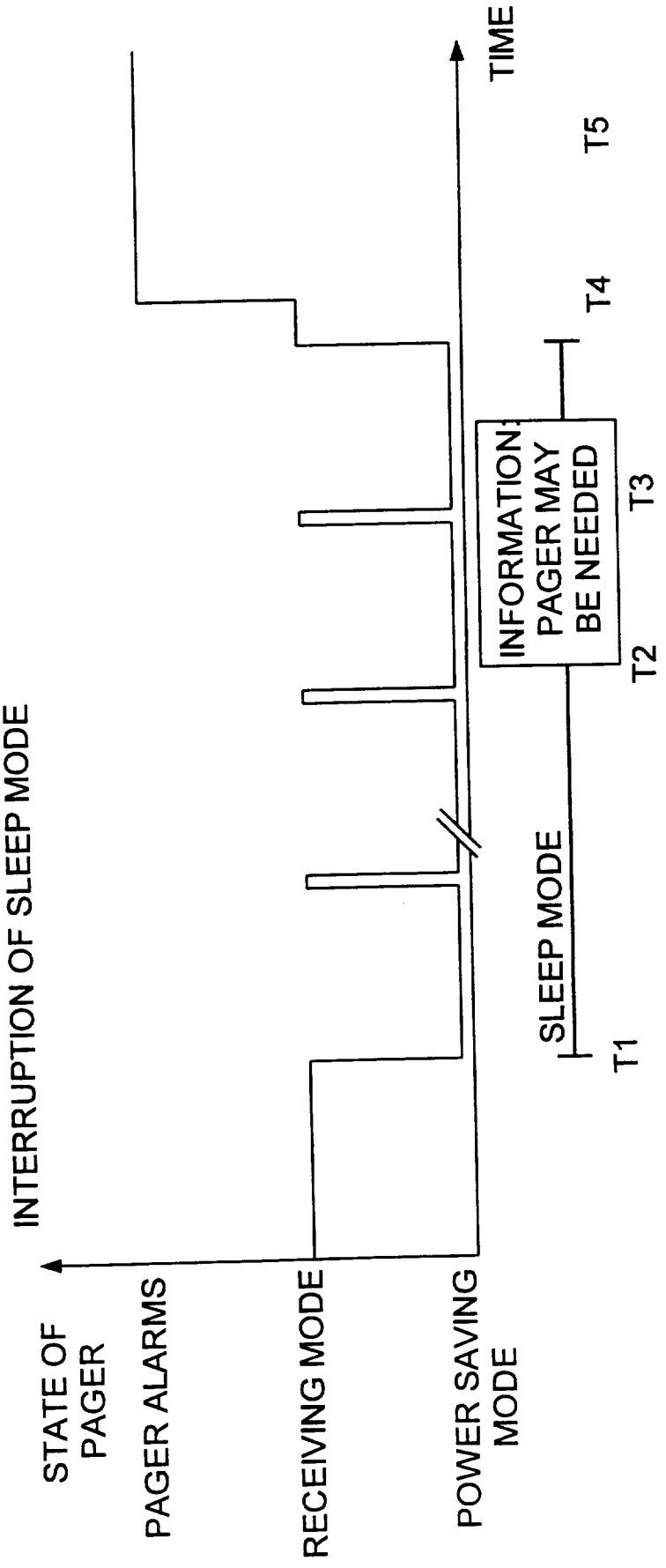

STATE OF PAGER
PAGER ALARMS
RECEIVING MODE
POWER SAVING MODE
INTERRUPTION OF SLEEP MODE
TIME
SLEEP MODE
INFORMATION PAGER MAY BE NEEDED
T1
T2
T3
T4
T5

FIG. 3

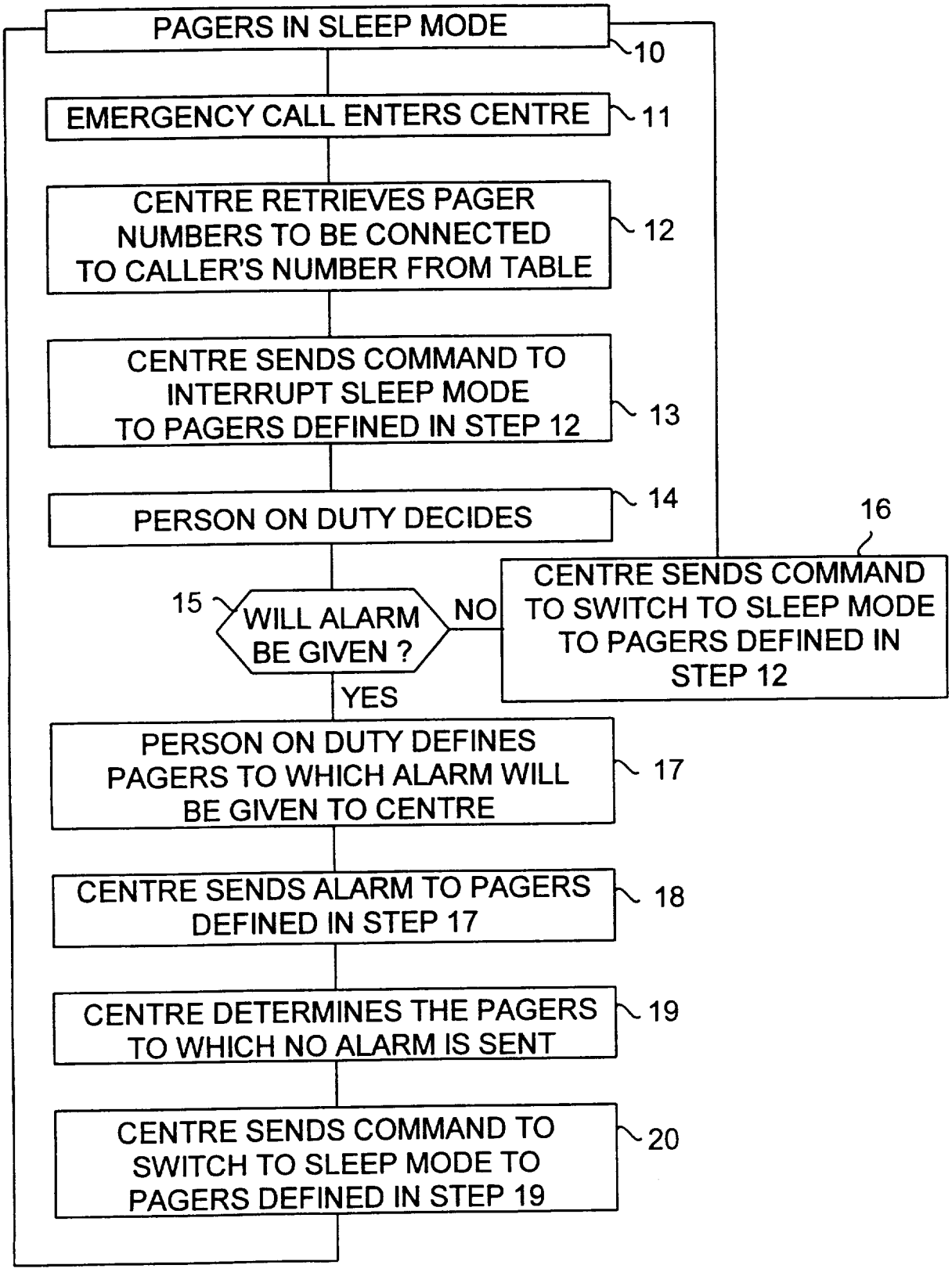

PAGERS IN SLEEP MODE
10
EMERGENCY CALL ENTERS CENTRE
11
CENTRE RETRIEVES PAGER NUMBERS TO BE CONNECTED TO CALLER'S NUMBER FROM TABLE
12
CENTRE SENDS COMMAND TO INTERRUPT SLEEP MODE TO PAGERS DEFINED IN STEP 12
13
PERSON ON DUTY DECIDES
14
16
15
WILL ALARM BE GIVEN ?
NO
CENTRE SENDS COMMAND TO SWITCH TO SLEEP MODE TO PAGERS DEFINED IN STEP 12
YES
PERSON ON DUTY DEFINES PAGERS TO WHICH ALARM WILL BE GIVEN TO CENTRE
17
CENTRE SENDS ALARM TO PAGERS DEFINED IN STEP 17
18
CENTRE DETERMINES THE PAGERS TO WHICH NO ALARM IS SENT
19
CENTRE SENDS COMMAND TO SWITCH TO SLEEP MODE TO PAGERS DEFINED IN STEP 19
20

FIG. 4