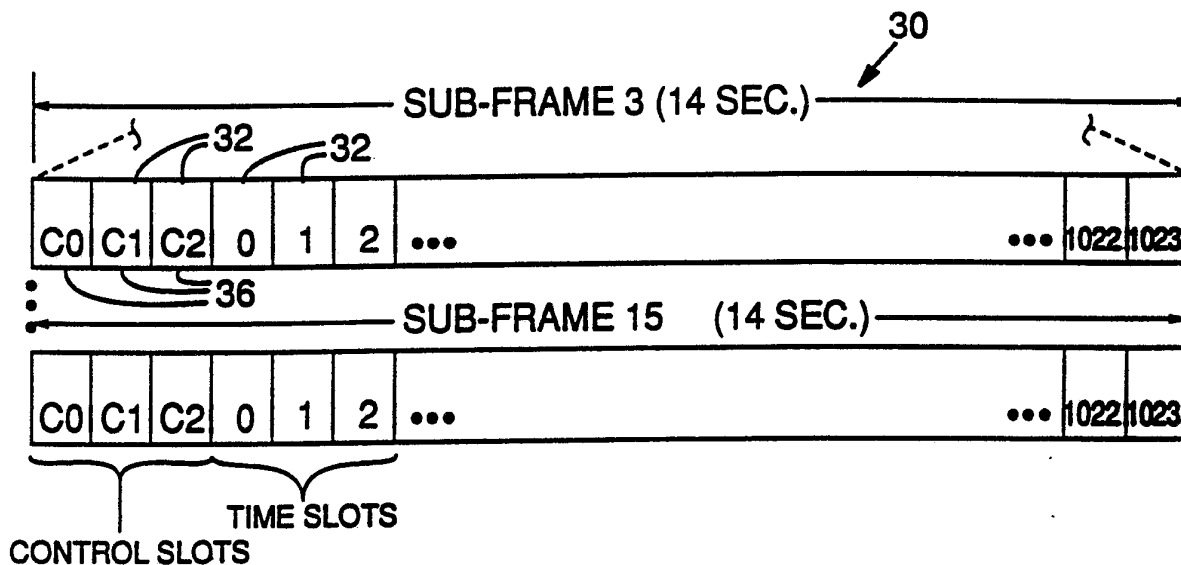




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<p>(21) International Application Number: PCT/US91/00614 (22) International Filing Date: 29 January 1991 (29.01.91) (30) Priority data: 471,847 29 January 1990 (29.01.90) US (71) Applicant: AT&E CORPORATION [US/US]; One Maritime Plaza, Suite 500, San Francisco, CA 94111 (US). (72) Inventor: OWEN, Jeffrey, R. ; 11120 N.W. Lost Park Drive, Portland, OR 97229 (US). (74) Agent: GALBI, Elmer, W.; AT&E Corporation, 10450 S.W. Nimbus Avenue, Portland, OR 97223 (US).</p>		<p>(81) Designated States: AT (European patent), AU, BE (European patent), CA, CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB (European patent), GR (European patent), IT (European patent), JP, KR, LU (European patent), NL (European patent), SE (European patent). Published <i>With international search report.</i></p>

(54) Title: PAGING SYSTEM WITH TIME SLOT REASSIGNMENT



(57) Abstract

A time division multiplexed paging method (30) includes transmitting in a single time slot the addresses of a plurality of receivers. Associated in the time slot with each address is a message datum. This datum can either be a code signifying a predetermined message, or a pointer to a subsequent time slot in which a message for the corresponding receiver is to be transmitted.

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PAGING SYSTEM WITH
TIME SLOT REASSIGNMENT

Related Application Data

5 This application is a continuation-in-part of
copen ding allowed application Serial No. 07/352,635, filed
May 12, 1989, which is a continuation-in-part of
application Serial No. 06/802,844, filed November 27,
1985, now U.S. Patent 4,713,808, both of which are
10 incorporated herein by reference.

Field of the Invention

The present invention relates to time-division
multiplexed paging systems, and more particularly relates
15 to a method of dynamically reassigning time slots so as to
avoid several messages conflicting in the same time slot.

Background and Summary of the Invention

Time-division multiplexed paging systems are well
20 known in the art, as illustrated by the above-referenced
patent and allowed patent application. In such systems,
each paging receiver energizes at a predetermined time
slot and decodes a recipient identifier code transmitted
therein. If this identifier matches the receiver's own,
25 the receiver remains energized to receive the accompanying
message. At the conclusion of this operation, the
receiver is deenergized until the beginning of the next
predetermined time slot.

The transmission of a recipient identifier code
30 permits multiple receivers to be assigned to a single time
slot. A problem arises, however, when messages must be
broadcast to two receivers that share the same time slot.

One possible solution to this problem is to
transmit a first one of the messages in the time slot,
35 together with a data bit indicating that there are other
messages for that time slot. The other message(s) are

deferred and transmitted in a following time slot(s). If the data bit is set, all receivers (other than the one that did receive a message) energize in a time slot a predetermined number of slots later and compare the identifier code transmitted therein with their own. This process continues until all messages have been sent.

While the foregoing approach solves the basic problem, it adds several of its own. One is the power consumed when all but one of the receivers assigned to a certain time slot energize two or more times to determine the recipient for the deferred message(s). Further, any message normally intended for the slot to which a message has been deferred must itself be deferred, causing all of the receivers associated with that time slot to energize in another time slot. At times of peak message traffic, this problem can quickly compound and cause large numbers of paging receivers to monitor large numbers of sequential time slots in order to determine the few receivers for which the deferred messages are intended.

In accordance with the preferred embodiment of the present invention, this problem is advantageously solved by transmitting, in the single time slot for which there are several messages, several target receiver addresses and a corresponding number of abbreviated message data. These data may either be binary codes representing predetermined messages, or can be binary pointers indexing the addressed receivers to subsequent time slots in which their respective messages will be transmitted. The time slots indexed by these pointers are chosen by the paging system from time slots that would otherwise be empty. By this arrangement, only those receivers for which messages have been deferred need to reenergize, and these receivers need reenergize only once, since they are assured the message will be transmitted in the time slots to which they have been pointed. The

receivers that normally monitor these latter time slots themselves need only energize once, since they recognize immediately that the time slot contains no messages tagged with their identifier codes.

5 The foregoing and additional objects, features and advantages of the present invention will be more readily apparent from the following detailed description thereof, which proceeds with reference to the accompanying drawings.

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Brief Description of the Drawings

Fig. 1 is a schematic block diagram illustrating a paging system that may use the present invention.

15 Fig. 2 is a schematic block diagram illustrating a wristwatch paging receiver used in the system of Fig. 1.

Fig. 3 is a block diagram illustrating the partial contents of a microprocessor memory used in the paging receiver of Fig. 2.

20 Fig. 4 illustrates the format of a frame that may be used in a paging system according to the present invention.

Fig. 5 illustrates the format of a subframe that may be used in a paging system according to the present invention.

25 Fig. 6 illustrates the format of an A1 time slot that may be used in a paging system according to the present invention.

30 Fig. 7 illustrates the format of an A2 time slot that may be used in a paging system according to the present invention.

Detailed Description

For expository convenience, the present invention is illustrated with reference to a paging system (the "Gaskill" system) described in U.S. Patents 4,713,808 and

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4,897,835. However, it will be recognized that the invention is not so limited.

As shown in Fig. 1, the Gaskill system includes clearinghouses 10, broadcasting facilities 12 and wristwatch paging receivers 14. The clearinghouses 10 are fully automated centralized facilities which accept messages, validate subscriber identification, determine message destinations and route messages to the appropriate broadcast facilities for transmission. Callers to the system dial a local clearinghouse telephone number and hear voice prompts that guide them through a simple process for sending messages.

The broadcast facilities 12 are typically conventional FM broadcast stations that carry paging data on subcarriers of their signals. Multiple stations are used for transmission in a given area. Diversity of signals combined with repeated transmission insures that the paging subscribers receive their messages with a high degree of reliability.

The wristwatch paging receivers 14 are worn by the subscribers and receive the paging messages broadcast by the broadcast facilities. A block diagram of such a receiver is shown in Fig. 2. The receiver basically includes an antenna 16, a frequency agile receiver 18, a data demodulator 20, a protocol decoder 21, a microprocessor 22 (with associated memory 24) and a user interface 26. Memory 24 contains various data and programs relating to operation of the watch, such as a subroutine for finding a new station, a subroutine for obtaining a local channel list, a datum indicative of the frequency to which the watch is presently tuned, and a local channel list. Fig. 3 illustrates some of the contents of this memory 24.

To review operation of the receiver briefly, antenna 16 receives radio frequency signals in the desired reception band (here 88 to 108 MHz) and couples them to

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the frequency agile receiver 18. The frequency agile receiver 18 processes the RF signals from the antenna and produces baseband output signals corresponding to a desired FM station within the reception band -- typically an FM signal carrying the paging data on an SCA subcarrier thereof. This SCA paging data is detected by the data demodulator 20, decoded by the protocol decoder 21 and is provided to the microprocessor 22 for processing. The microprocessor 22 drives the user interface 26 to alert the subscriber of paging messages.

The format for transmitting messages is shown in Figs. 4 - 7. The format comprises a time frame 28 (Fig. 4) of predetermined length, such as fifteen minutes, which is repeated cyclically. Within each frame 28 are a predetermined number of subframes 30 (sixty four in the illustrated embodiment). Each subframe is uniquely numbered 0,1,2...63.

Moving to Fig. 5, each subframe comprises a predetermined number of time slots 32 during which a packet of data is transmitted. In Fig. 5, 1024 time slots of about fourteen milliseconds each are shown. Each time slot is uniquely numbered 0,1,2,3...1023. Subframe and time slot number information are sent in the transmitted data and are used by the receivers to determine a reference point within a frame.

The 1024 time slots in each subframe are preceded by three control time slots 36 which include packets of control information. Control slots 36 are like time slots 32 in both duration and format, but differ in information content, as disclosed in the above-referenced patents.

Each paging receiver is assigned a particular time slot 32 (Fig. 5) in a subframe in which its messages will be broadcast. In the illustrated system, there are 65,536 such time slots. To increase system capacity, each time slot serves several receivers. (Each paging receiver is uniquely identified by a 32 bit ID code. The time slot

to which it is assigned is the time slot identified by the ten least significant bits of its ID code. Consequently, it will share use of this time slot with all other receivers that have the same ten least significant ID code bits.) The data packet transmitted during a given time slot may be one of two types. In the first, illustrated in Fig. 6 and termed "A1," the address of a single targeted receiver is transmitted, together with an associated message datum. The targeted receiver address (i.e. ID code) is transmitted in two 16-bit segments, the least significant bits being transmitted first. In between these two segments is a datum indicating that the packet is of the A1 format. Following the address data is the message data, which consists of 22 4-bit bytes. These data are typically used to transmit a telephone number for display on the recipient's pager. Also included in the packet is a sequential message number datum.

The above-described A1 data packet is used if the paging system has a message for only a single receiver in the time slot, and if a user-defined message (i.e. telephone number) is to be sent thereto. A different, "A2," data packet is used if several receivers need to be addressed in a given time slot, or if standardized ("predetermined") messages are to be sent.

The format of the A2 packet is shown in Fig. 7. In this format, several addresses and several associated message data are transmitted. As noted, all the receivers monitoring a given time-slot have the 10 least significant bits of their addresses in common. These ten bits are transmitted at the beginning of the A2 packet, followed by a datum that indicates the packet is of the A2 type. Following this introductory data are three blocks of data, one intended for each of (up to) three receivers monitoring this time slot. These blocks each include the 22 additional most significant bits of address data needed to complete a targeted receiver's 32-bit address, and a

ten-bit message datum. The message datum can either represent a predetermined message (such as "Call Home," "Call Office," etc.), or can serve as a pointer to a subsequent time slot in which a user-defined message will be transmitted, typically in an A1 packet. (The paging system selects this subsequent time slot from those that would otherwise not convey a message.) Also included in each of these three message blocks is a sequential message number datum and a format datum. The format datum can assume several values to indicate (a) that the block is devoid of a message; or (b) that the message datum represents a predetermined message; or (c) that the message datum is a pointer to a subsequent time slot.

In the preferred embodiment, the A2 packet format is used whenever a predetermined message is to be sent (regardless of the number of receivers addressed), or whenever more than one receiver is to be addressed (regardless of the message type - predetermined or user-defined).

From the foregoing, it will be recognized that the present invention advantageously solves the problem of serving several receivers simultaneously from a single time slot, and does so in a manner that balances the message load among the time slots, rather than imposing additional message burden on time slots that may already convey messages.

Having described and illustrated the principles of my invention with reference to a preferred embodiment, it will be apparent that the invention can be modified in arrangement and detail without departing from such principles. Accordingly, I claim as my invention all such modifications as may come within the scope and spirit of the following claims and equivalents thereto.

I CLAIM:

1. A paging method comprising the steps:
broadcasting a paging signal formatted into a plurality of time slots;
5 assigning a plurality of paging receivers to monitor a predetermined one of said time slots, each of said plurality of receivers monitoring said predetermined time slot for an address code corresponding to said receiver;
10 transmitting in one of said time slots a first address code and a first message datum associated therewith, and also transmitting in said same time slot a second address code and a second message datum associated therewith.
15
2. The paging method of claim 1 which further includes transmitting in said same time slot a third address code and a third message datum associated therewith.
20
3. The paging method of claim 1 in which at least one of said message data comprises a binary code corresponding to a predetermined message.
- 25 4. The paging method of claim 1 in which at least one of said message data comprises a pointer datum, said datum indicating to the addressed receiver a target time slot in which a message addressed to said receiver may be received.
30
5. In a time division multiplexed communication method comprising:
transmitting data subdivided into time slots;
assigning a plurality of receivers to monitor a
35 predetermined one of said time slots for message data addressed thereto;

an improvement comprising:

providing to each of two receivers, from a single time slot, data indicating two future target time slots in which messages addressed to said two receivers may be received, respectively.

6. The method of claim 5 which further includes providing to each of three receivers, from said single time slot, data indicating three future target time slots in which messages addressed to said three receivers may be received, respectively.

7. In a time division multiplexed communications system that includes transmitting data in packet form to a plurality of receivers that monitor a periodically recurring time slot, an improved packet format comprising:

a first address field containing data identifying a first receiver;

a first message field containing a message datum intended for the first receiver;

a second address field containing data identifying a second receiver; and

a second message field containing a message datum intended for the second receiver;

wherein said plurality of receivers numbers more than two.

8. The time division multiplexed communications system of claim 7 in which the packet format further includes:

a third address field containing data identifying a second receiver; and

a third message field containing a message datum intended for the third receiver;

wherein said plurality of receivers numbers more than three.

9. The time division multiplexed communications system of claim 7 in which one of said message data is a binary code signifying a predetermined message.

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10. The time division multiplexed communications system of claim 7 in which one of said message data is a pointer to a future time slot in which a message addressed to the receiver to which said message data corresponds will be transmitted.

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11. The time division multiplexed communications system of claim 7 in which two of said message data are pointers to future time slots in which messages addressed to the receivers to which said message data correspond will be transmitted.

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FIG. 1

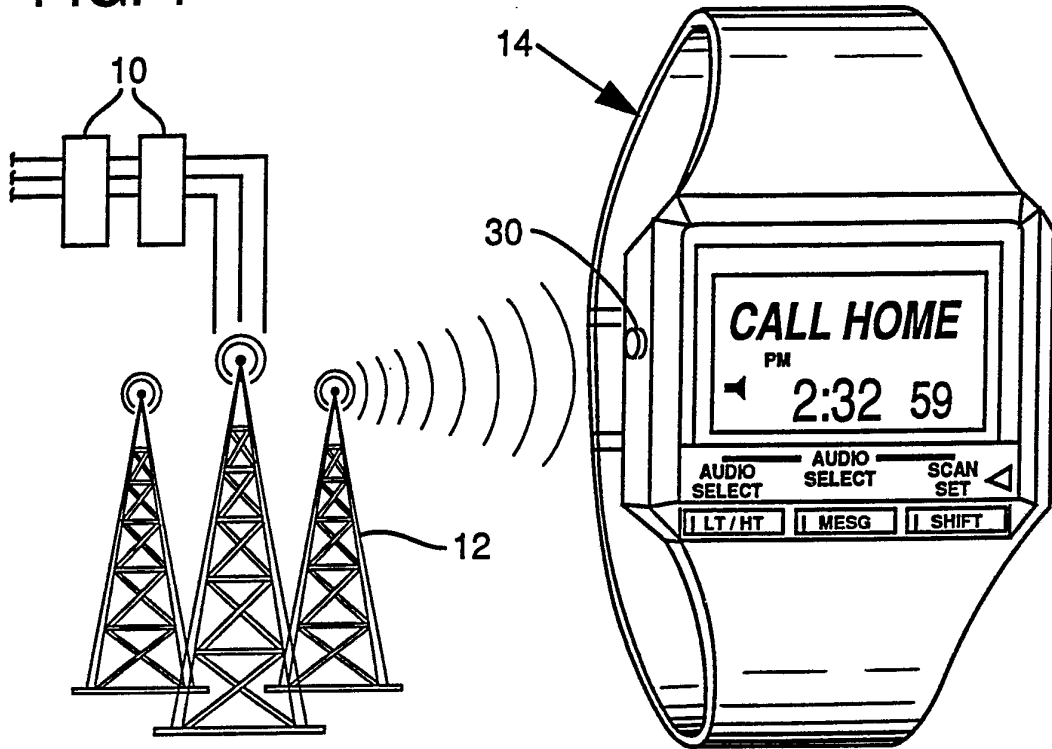


FIG. 2

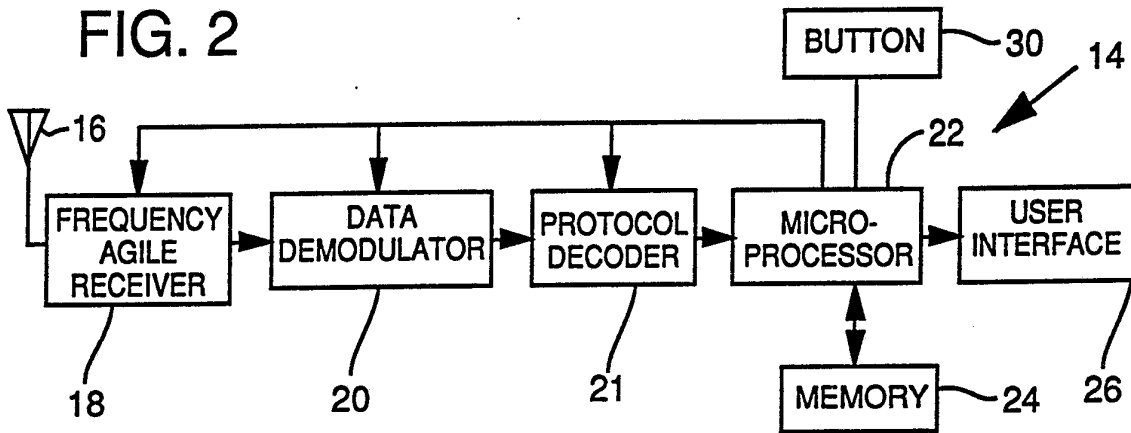


FIG. 3

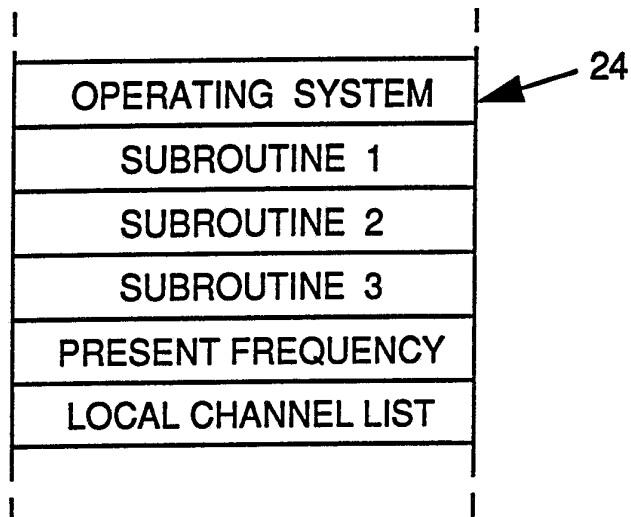


FIG. 4

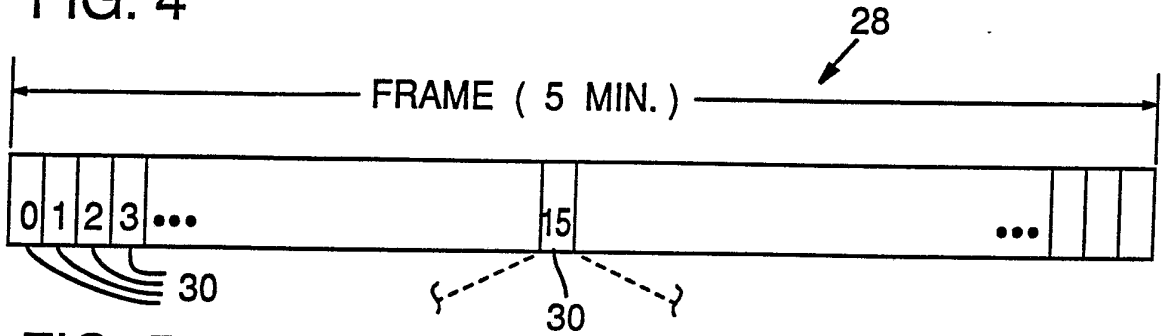


FIG. 5

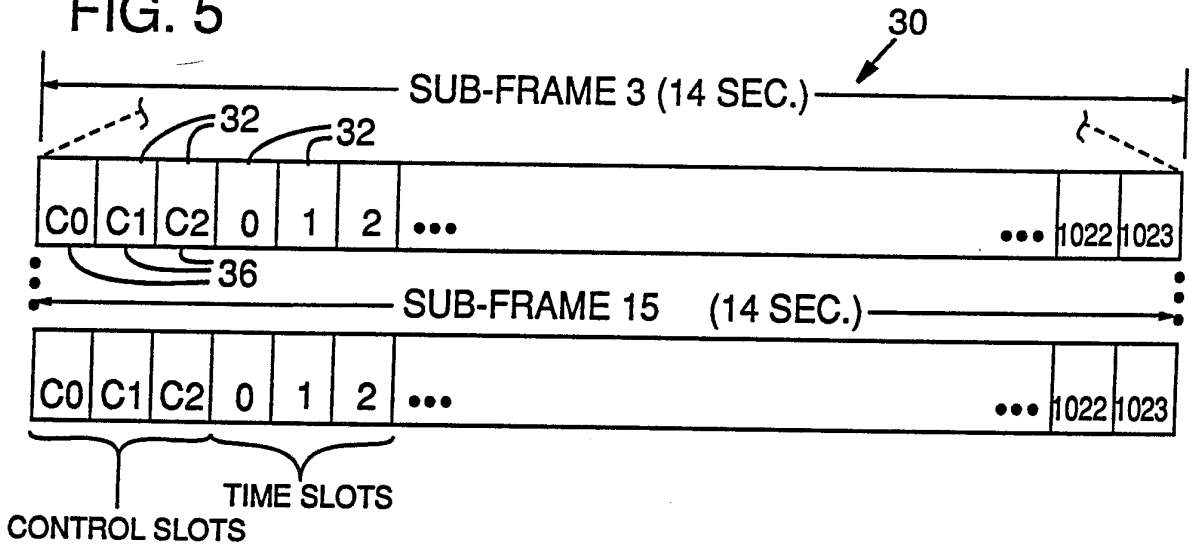


FIG. 6

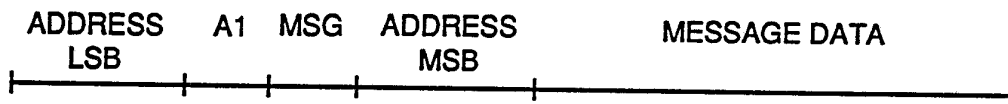
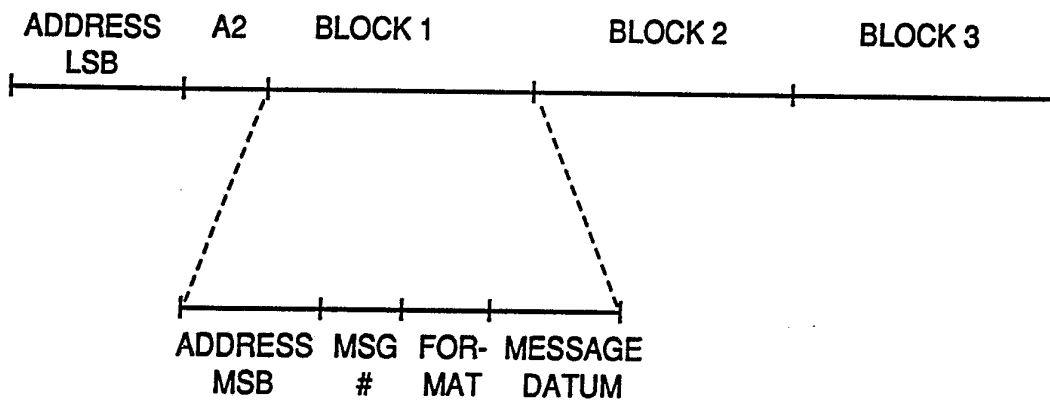


FIG. 7



INTERNATIONAL SEARCH REPORT

International Application No **PCT/US91/00614**

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC IPC(5): H04J 3/26 US CL. 370/94.1		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System :	Classification Symbols	
US	370/93, 94.1, 95.1, 95 3 340/825.44 379/57, 63	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category *	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁶
X Y Y A, P A	US, A, 4,706,272 (Nishimura et al.), 10 November 1987, Column 2, line 59 to column 3, line 45. US, A, 4,713,808 (Gaskill et al.), 15 December 1987 column 23, lines 22-26 and 39-43. US, A, 4,897,835, (Gaskill et al.), 30 January 1990. US, A, 4,641,304, (Raychandhuri) 03 February 1987.	1,2,7,8 3-6,9-11 3-6,9-11
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IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²	
11 March 1991	24 APR 1991	
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