**Title:** PAGING MESSAGE INTERFACE AND MISSED MESSAGE RETRIEVAL METHOD

**Abstract**

A paging message interface and missed message retrieval system and method enables a user of a display pager (20) to determine whether any message out of a series of transmitted messages has been missed. The messages are numbered sequentially and are stored for retrieval at an originating clearinghouse (34, 36) in association with the user number and message number. The message numbers are encoded in the message itself and are displayed to the user with the messages. If a numbered message is missing from the sequence, the user can telephone at the clearinghouse (34, 36) and retrieve the missed message. A telephonic caller can back up a voice response sequence to correct message input errors and to re-hear instructions or messages. The system also enables the messages to be flagged with status indicators displayed in a multistate field (21) on the pager. Caller input codes allow incoming messages to be screened and are programmable so that the subscriber can determine how incoming messages are processed and which status flags to use.

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PAGING MESSAGE INTERFACE AND

MISSING MESSAGE RETRIEVAL METHOD

RELATED APPLICATION DATA

This application is related to commonly-assigned
U.S. patent application Ser. No. 802,844, filed November
27, 1985, now U.S. Pat. No. 4,713,808, and copending
division(s) thereof, Ser. No. ________, filed

BACKGROUND OF THE INVENTION

This invention relates to wide area one-way paging
systems and low-power portable paging receivers and, more
particularly, to user interface aspects of input, readout
and use of such paging systems.

Commonly-assigned U.S. Pat. No. 4,713,808,
incorporated by reference herein, discloses a wide area
paging system that enables one-way paging of a user at a
very distant location. This system includes a paging
receiver that accepts, decodes and stores digitally
transmitted messages for user-actuated recall and
display. Pagers of this type are also known as display
pagers.

Briefly, the system of U.S. Pat. No. 4,713,808
accepts and sends paging messages via a series of
communications modes, including telephone input, computer
message processing, data packet transmission to a local
area transmitter, and local FM-sideband broadcast of the
message. A method of system operation and a digital data
protocol are provided to facilitate routing of a message
input from a source telephone or modem via one or more
clearinghouse computers to a local area transmitter in an
area where the user of the paging receiver is known by
the computer to be located. This protocol further
enables each paging receiver to discriminate broadcast
messages intended for it from those intended for other
receivers of the same type in the same area.

The paging system includes a subscriber
clearinghouse which has a computer programmed for
receiving telephoned messages intended for local area
subscribers, encoding them for digital transmission with
address information associated with the intended
recipient, and broadcasting them locally or sending them
to another area where the recipient is located for
broadcast. The messages for a particular user are
broadcast in a predetermined time slot corresponding to
that user's address. The receiver, preferably in the
form of a wristwatch pager, includes digital logic and
memory for identifying messages intended for it from the
time slot data, decoding any messages thus identified,
and storing the message data for display of the messages
when the user is able to return them. This arrangement
permits a number of messages to accumulate before they
are read out by the user.

Prior patents address a number of problems that
arise in connection with the use of display pagers. Such
1. Pagers use a first-in first-out memory or shift register. The oldest message is lost when a new message is input, and all messages are saved until they are replaced by new messages. The user may, on one hand, neglect to return messages before they are lost from memory and, on the other, may forget that a message, still retained in memory, has already been returned. Known pagers include means for counting the number of messages received since the last time the user read out messages and for keeping track of stored messages that have already been read.

A problem remains, however, if a message is missed altogether by the paging receiver. A message can be sent several times to improve the likelihood of reception but messages may still be missed. If the user is outside the paging area, any messages will likely be missed. The user of prior pagers has no way to know that a message was missed when reading out the stored messages.

Commonly-assigned U.S. Pat. No. 4,713,808 proposes a message protocol which includes a data field for message numbering. No way is disclosed, however, to make use of the information thus made available to provide the missed messages to the user. Apart from the field of paging, numbering of messages is used in the Telex system.

Most prior systems effectively treat all messages with equal urgency. Nondisplay pagers announce each message by an audible beep. If having such a pager beep is inconvenient, such as at a play, the user may turn off the audible signal but then no messages will be signalled
to the user. Display pagers are known which have an audible signalling capability to indicate an urgent message without an audible signal, but are not known to provide any alternative message status information.

Prior paging systems have been automated to use a voice response unit to prompt a caller to input message data following a programmed script. Without a human operator, however, the system can be difficult to use. If the caller does not understand an instruction or makes a mistake entering a response, it may be necessary to repeat the entire message sequence to recover. A more human-like automatic voice communications protocol would be preferable.

Another desirable user interface feature is the ability for a subscriber to screen incoming messages and to determine how different classes of messages will be handled by the system dependant upon the originator of a message. This capability is not provided in the prior art.

Accordingly, a need remains for an improved wide area paging system.

SUMMARY OF THE INVENTION

One object of the invention is to improve wide area paging systems and, more particularly, the user interface and information that can be provided to a user by such systems.
Another object is to signal subscribers of one-way paging systems when their paging receivers have missed a transmitted message.

A further object is to enable subscribers to retrieve missed messages.

Yet another object is to enable a user to program the system to screen or otherwise process incoming messages in a plurality of ways selectable by the subscriber.

An additional object is to transmit and display a subscriber-programmable message status indicator.

The invention provides a method and apparatus for signalling to a subscriber of a one-way paging service that a paging message had been sent to but not received by the subscriber's assigned paging message receiver, and enabling the subscriber to retrieve the missed message. The invention can also improve the paging system user interface by enabling the subscriber to program various aspects of message processing and message status indication and by enabling a message originator to interact more easily with the system when operated in an automatic voice response mode.

The method comprises, at a location of message origination, inputting a series of messages to be sent to a selected subscriber; assigning a message number to each message intended for the selected subscriber; encoding each message and assigned message number as a packet of encoded paging data; and transmitting each packet of
encoded paging data from a transmitter to paging receivers in a local area. In the paging receiver of the selected subscriber, the method further includes receiving some but not necessarily all of the transmitted packets of encoded paging data; decoding the received packets of encoded paging data including the assigned message numbers thereof; storing the decoded paging data for each received message and associated message number; and displaying each message and associated message number so that the subscriber can determine from the numerical sequence of the message numbers whether all messages have been received and the assigned number of any missed messages. The method further includes storing each input message at the message origin for voice retrieval in association with the assigned message number of the message and, responsive to a telephonic request from the selected subscriber inputting the number of a missed message, recalling the corresponding stored message and transmitting same to the requesting subscriber by voice telephone.

The method can further include provision for inputting a code number, comparing a caller input code number with prestored code numbers, selecting a corresponding set of program instructions, and processing the input message in accordance with the selected set of instructions. Such processing can include refusing a message, accepting but not sending or storing the message, storing but not sending the message, sending but
not storing the message, and enabling the user to input
one of a predetermined, programmable set of message
status flags.

The method can allow an input message to have an
assigned status, programmable by the subscriber and
dependant upon the code number entered by each message
originator. This method includes inputting the status
together with the message and code number and, for
messages that are permitted to be transmitted, encoding
and transmitting the status in a packet of paging data.
In the pager, decoding and displaying the message
includes decoding and displaying a corresponding message
status indicator to the subscriber.

In a preferred embodiment, the encoded packet of
paging data includes a transport data field for
transmitting message data, the transport data field
including two bit locations dedicated to indicating the
status of the message. The encoded packet of paging data
also includes a packet assembly field of binary data
bits, the packet assembly field including a predetermined
number of bits being assigned as message count bits.

The apparatus is wide area paging system for sending
messages from a message origin to subscribers bearing
display-type pagers. The system comprises message input
means for originating a paging message to be sent to a
selected subscriber; transmitting means for broadcasting
the paging messages to the subscribers; and a display
pager assigned to each subscriber. The pager includes
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means for receiving broadcast paging messages uniquely
addressed to the particular pager, decoding means for
decoding received messages, memory means for storing a
predetermined number of the received messages and display
means actuable by the subscriber for displaying the
stored messages. The message input means includes means
for sequentially numbering each message to be sent to
each selected subscriber and means for encoding the
number within the message for broadcast as a part
thereof. The decoding means in each pager is operable to
decode said number and place the number in the pager
memory means in association with the corresponding
decoded message. The display means in each pager means
is arranged to display said number in association with
the corresponding message. The subscriber, upon
displaying each stored message in turn, can determine
from a gap between the numbers of successive stored
messages that an intervening-numbered message had been
transmitted but not received.

The system further includes means coupled to the
message input means for storing each input message for
voice retrieval in association with the assigned message
number of the message and means responsive to a
telephonic request from the selected subscriber inputting
the number of a missed message for recalling the
corresponding stored message and transmitting same to the
requesting subscriber by voice telephone. The system
preferably has a voice response unit which handles both
calls from the subscriber and from message originators automatically, without human operator intervention.

The system can further include means responsive to a user inputting a code number for comparing the code number with a set of security code numbers associated with the selected subscriber and processing the message in accordance with subscriber-programmed instructions depending upon the input code. Such means can also control what status inputs a message originator can enter into the system for transmitting to the subscriber.

The voice response unit can be programmed, in accordance with a further aspect of the invention, to enable a caller to cause the automatic voice script to back up to a preceding step in a message sequence, to repeat instructions or correct prior responses. The storage unit can be controlled to back up with the script for repeating or overwriting a stored response, depending on whether it is a message originator or subscriber who is using the system.

The foregoing and other objects, features and advantages of the invention will become more readily apparent from the following detailed description of a preferred embodiment which proceeds with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a simplified block diagram of a system in which the present invention is implemented.
FIG. 2 is the digital data protocol of each individual encoded packet of paging data in which the invention is implemented.

FIG. 3 is a more detailed view of the packet assembly field of FIG. 2.

FIG. 4 is a two-part flowchart showing operation of the present invention at a message origination location and at a pager.

FIG. 5 is a flowchart of a series of steps in an automatic voice response unit's operating sequence showing provision for a caller to actuate backing up the voice response script.

FIG. 6 is flowchart showing branching of the message input routine of FIG. 4 dependant upon the security code input by a message originator.

DETAILED DESCRIPTION

The system in which the present invention is embodied is shown in summary fashion in FIG. 1. A more detailed description of the system and its operation are set forth in commonly-assigned U.S. Pat. No. 4,713,808, incorporated by reference herein, and need not be repeated. Briefly, the system comprises a paging message input device such as a touchtone telephone 24A, a clearinghouse computer 34,36 arranged to receive telephonic messages via a voice response unit (not shown) and encode same into message packets, a transmitter facility 44 for receiving the message packets and
modulating and broadcasting them on FM signals. A
watch-type display pager 20 receives, demodulates,
decodes, stores and, upon recall by the user, displays
the received messages.

Messages that are sent to the pagers are also
stored, by subscriber number and message number, for
later voice retrieval and playback. For this purpose, a
dTMF or other suitable signal line 60 connects a digital
message storage and retrieval subsystem 62 to the
clearinghouse computer 34. Subsystem 62 includes a
message input unit 64 connected to signal line 60. The
input unit is connected to input received messages into a
computerized message storage unit 66. Coupled to the
storage unit is a message retrieval unit 68. A voice
response unit 70, which can be remotely accessed by a
subscriber via touchtone telephone 24B, is controllably
connected to the retrieval unit. Responsive to input
commands from the caller, the voice response unit causes
the retrieval unit 68 to recall a message stored in the
storage unit 66 and forward the recalled message in voice
format to the caller at telephone 24B. The foregoing
units are known and need not be further described. The
operation thereof in accordance with the invention is
controlled by suitable programming further described
below with reference to FIGS. 4, 5 and 6.

The invention improves the utility of the paging
system by enabling a recipient of paging messages to tell
if a message has been missed by the pager and to call in
and retrieve the missed message. It also enables an originator of a message to convey to the recipient additional status information about the message. It additionally enables the subscriber to control who can send messages through the system to his/her pager and to program how messages from different classes of callers will be handled. This includes whether messages from a particular caller will be accepted, sent or not sent, stored or not stored, and whether the caller can send status information and what kind each can send. It also enables callers to back up the voice response script and storage unit at any point in a message sequence. The message originator can actuate repeat of instructions and change responses. A subscriber can repeat stored messages.

Referring to FIG. 4, the method of paging of the present invention commences when a person calls in from a touchtone telephone 24A to a message center and inputs a message for transmittal to a selected subscriber. The caller calls in and receives an automatic voice response, which includes a series of instructions to the caller. Each instruction in the sequence is followed by an opportunity of the caller to input data via the numbered and "#" keys of the telephone. If the user enters data from these 11 keys, the sequence proceeds to the next step.

As shown in FIG. 5, the user also has the opportunity at each step to cause the script to back up
to an earlier point in the sequence. The user actuates backup by depressing the "*" sign on the telephone a number time to indicate the number of times to back up. Once the system has backed up, it repeats the subsequent instructions, requiring the user to reenter data in response to the instructions through the point where the user backed up, and then proceeds to any remaining instructions. The data input by the user is saved in temporary memory until the message sequence has been completed. Then, usually, the data is stored for later voice retrieval as discussed further below.

Returning to FIG.4, the input step 26 includes a request to the user to indicate a message status, by pressing a designated key on the telephone, for example, to indicate whether the message is urgent (U) or normal (N), or other indicators programmable by the subscriber. If a status indicator is not entered, the clearinghouse computer 34 enters by default an indication (N) that the message status is normal, i.e., not urgent. The input sequence also calls for entry of a caller input code. The caller input code includes a security code field for the user to key in a security code which the computer verifies (step 28) and a subscriber-programmable function field for entering data which the computer further processes before formatting a message for transmission and storage. This step can also be performed before message input.
Referring to FIG. 6, the subscriber can program a number of different system responses dependant upon the subscriber-programmable function field of the caller input code number. For example, the subscriber can furnish certain callers with a code number to identify their message as very important. Such messages are normally processed as urgent, including placing an urgent (U) status indicator in their messages. The status indicator is displayed on the watch pager 20 in a multistate flag field 21 as shown in FIG. 1. Other callers may be given a code number with a function field code that only permits them to send "normal" (N) status flagged messages. Messages in either the urgent or normal category will ordinarily be both stored and sent, with their associated status flags. Callers who fail to input a caller input number, or input an unaccepted number are refused entry to the system without storing or sending their message. Other classes of message status which can be programmed include (1) store message but do not transmit, i.e., hold it until the subscriber calls in for it; (2) store message for a period of time before transmitting it; (3) store message until the subscriber calls in for it but if not called for in a specified time period either transmit it or mail it, as programmed by the subscriber. Callers can be given more than one caller input number, or variable data to use in the subscriber programmable function field, so that they can vary the status of message that they can input.
Once the caller input code is processed, if the message is not refused, the message is assigned a message number. This number is incremented from 1 to 32 for each successive message directed to a particular subscriber. Then, in step 32, message number is stored digitally and the message itself is stored in coded format in the digital message storage unit 62 under an address (i.e., telephone number and access code) known to the particular subscriber. The message, message number and status (urgent(U), normal(N), etc.) are encoded digitally in a paging message packet, as shown in step 38. Packets of paging messages are sent to a transmitter 44, either directly or via another clearing house 36, where the messages are modulated onto an FM carrier for broadcast to pagers 20.

The digital message storage unit 62 can be accessed by subscribers via telephone 24B. The subscriber enters an assigned subscriber number followed by a message number. Once the subscriber number is verified (step 42), access to the voice mail machine is granted. The subscriber number and message number are then used to recall a particular stored message and play it back via telephone to the subscriber. As mentioned above, the voice response script can be backed up as shown in FIG. 5 to repeat messages.

When a message packet is broadcast, it is received by a pager 20 to which it is directed; it is decoded in step 48. The next step 50 is to detect the message
number, the message, and the status of the message from
the decoded packet. The message and its number are
stored in digital memory in the pager (step 52). The
message status is checked in step 54 and, if the status
is urgent, a corresponding symbol (U) is displayed
visually on the face of the pager. In step 56,
responsive to actuation by the user of the pager, the
message, its number and status are displayed, as shown in
FIG. 1.

The preferred implementation of the present
invention utilizes the message protocol shown and
described in the aforementioned patent. This protocol
includes an individual message or packet format 604 which
is shown generally in FIG. 2. This format includes a
transport data field 605, which carries the digital
message, and a packet assembly field 612. Field 612 is
shown in further detail in FIG. 3. It includes three
bits (SOC, EOC and EOM) which are used in chaining
messages together. The next five bits (MSG#) are used to
carry the message number. The remaining 16 bits are used
for a continuation number (8 bits), also used in
chaining, and for error correction coding (ECC).

When the message number bits are decoded from the
received broadcast, they are stored in memory in
association with the message which is stored from the
transport data of the same packet. When the display is
actuated to read out messages, the message number is
displayed in a message number field 22 simultaneously
with the associated message, e.g., message number 27 as shown in FIG. 1. If the previous message had a message number 25, the user would know that an intervening message (number 26) was transmitted but missed. The message status is also displayed in field 21, based on the state of at least two predetermined bits in the transport data field.

The subscriber can then call in to the voice mailbox at his/her home clearinghouse 34 and enter his/her subscriber number and missed message number. The clearinghouse computer verifies access and then, using the input numbers as an address, looks up the message that was previously stored for voice retrieval. The message is then played back for the subscriber via telephone 24B.

Having illustrated and described the principles of the invention in a preferred embodiment thereof, it should be apparent that the invention can be modified in arrangement and detail without departing from such principles. We claim all modifications and variations coming within the spirit and scope of the following claims.
1 CLAIMS
2 1. A method of signalling to a subscriber of a
3 one-way paging service that a paging message had been
4 sent to but not received by the subscriber's assigned
5 paging message receiver, the method comprising:
6 at a location of message origination, inputting a
7 series of messages to be sent to a selected subscriber;
8 assigning a message number to each message intended
9 for the selected subscriber;
10 encoding each message and assigned message number as
11 a packet of encoded paging data; and
12 transmitting each packet of encoded paging data from
13 a transmitter to paging receivers in a local area; and
14 in the paging receiver of the selected subscriber,
15 receiving some but not necessarily all of the transmitted
16 packets of encoded paging data;
17 decoding the received packets of encoded paging data
18 including the assigned message numbers thereof;
19 storing the decoded paging data for each received
20 message and associated message number; and
21 displaying each message and associated message
22 number so that the subscriber can determine from the
23 numerical sequence of the message numbers whether all
24 messages have been received and the assigned number of
25 any missed messages.
2. A method according to claim 1 including:
   storing each input message for retrieval in
   association with the assigned message number of the
   message; and
   responsive to a telephonic request from the selected
   subscriber inputting the number of a missed message,
   recalling the corresponding stored message and
   transmitting same to the requesting subscriber by voice
   telephone.

3. A method according to claim 1 in which an input
   message has a predetermined status, including:
   inputting said status together with the message;
   encoding and transmitting the status in the packet
   of paging data; and
   in the pager, decoding and displaying said status in
   a multistate status indicator field so that the
   subscriber, seeing same, is informed of the status or
   originator of a received message.

4. A method according to claim 3 in which the
   encoded packet of paging data includes a transport data
   field for transmitting message data, the transport data
   field including at least two bit locations dedicated to
   indicating the status of the message.

5. A method according to claim 1 in which the
   encoded packet of paging data includes a packet assembly
   field of binary data bits, the packet assembly field
   including a predetermined number of bits being assigned
   as message count bits.
6. A method according to claim 1 in which inputting a message includes inputting a code number, comparing the code number with a set of prestored caller input code numbers associated with the selected subscriber, selecting one of a plurality of sets of prestored programmed instructions uniquely associated with each caller input code number and processing the caller's message in accordance with the selected set of programmed instructions.

7. A method according to claim 6 in which the sets of instructions include at least one instruction which sets a message status flag.

8. A method according to claim 6 in which the sets of instructions include at least one instruction which determines whether the message will be sent.

9. A method according to claim 6 in which the sets of instructions include at least one instruction which determines whether the message will be stored.

10. A method according to claim 1 in which the step of inputting messages includes, automatically via telephone voice responder, emitting a sequence of instructions to a caller; accepting responses to the instructions keyed into a telephone by the caller; and responsive to a predetermined telephone key input, repeating a number of prior instruction steps determined by said key input.
11. A wide area paging system for sending messages from a message origin to subscribers bearing display-type pagers, the system comprising:

message input means for originating a paging message to be sent to a selected subscriber;

transmitting means for broadcasting the paging messages to the subscribers;

da display pager assigned to each subscriber, including means for receiving broadcast paging messages uniquely addressed to the particular pager, decoding means for decoding received messages, memory means for storing a predetermined number of the received messages and display means actuable by the subscriber for displaying the stored messages;

the message input means including means for sequentially numbering each message to be sent to each selected subscriber and means for encoding the number within the message for broadcast as a part thereof; and the decoding means in each pager being operable to decode said number and placing the number in the pager memory means in association with the corresponding decoded message;

the display means in each pager means being arranged to display said number in association with the corresponding message so that the subscriber, upon displaying each stored message in turn, can determine from a gap between the numbers of successive stored
1 messages that an intervening-numbered message had been
2 transmitted but not received.
3
4 12. A system according to claim 11 including:
5 means coupled to the message input means for storing
6 each input message for retrieval in association with the
7 assigned message number of the message; and
8 means responsive to a telephonic request from the
9 selected subscriber inputting the number of a missed
10 message for recalling the corresponding stored message
11 and transmitting same to the requesting subscriber by
12 voice telephone.
13
14 13. A system according to claim 11 in which an
15 input message has a predetermined status, including:
16 means for inputting said status together with the
17 message;
18 means for encoding and transmitting the status in
19 the packet of paging data; and
20 in the pager, means for decoding and displaying said
21 status.
22
23 14. A system according to claim 13 in which the
24 encoded packet of paging data includes a transport data
25 field for transmitting message data, the transport data
26 field including at least two bit locations dedicated to
27 indicating the status of the message.
28
29 15. A system according to claim 11 in which the
30 encoded packet of paging data includes a packet assembly
31 field of binary data bits, the packet assembly field
including a predetermined number of bits being assigned
as message count bits.

16. A system according to claim 11 in which the
input means includes:

   means, responsive to a user inputting a code number,
for comparing the code number with a set of prestored
caller input code numbers associated with the selected
subscriber;

   means for storing a plurality of sets of programmed
instructions uniquely associated with each caller input
code number; and

   means responsive to a match between the code number
input by the caller a selected one of the prestored code
numbers for processing the caller's message in accordance
with the set of programmed instructions associated with
the prestored code number that matches the code number
input by the user.

17. A method according to claim 16 in which the
sets of instructions include at least one instruction
which sets a message status flag.

18. A method according to claim 16 in which the
sets of instructions include at least one instruction
which determines whether the message will be sent.

19. A method according to claim 16 in which the
sets of instructions include at least one instruction
which determines whether the message will be stored.

20. A method according to claim 11 in which the
input means includes:
means including a telephone voice responder for
emitting a sequence of instructions to a caller;
means for accepting responses to the instructions
keyed into a telephone by the caller; and
means responsive to a predetermined telephone key
input for backing up in the sequence of instruction steps
to repeat a number of prior instruction steps determined
by said key input.
FIG. 6

- CHECK CODE
- STORE AND MAIL IF NOT CALLED FOR IN X DAYS
- RESPONSES PROGRAMMED BY USER
- DO NOT STORE OR SEND MSG
- SEND MSG WITH A "N" FLAG
- SEND MSG WITH A "U" FLAG
- STORE MSG BUT DO NOT SEND IT
**INTERNATIONAL SEARCH REPORT**

International Application No: PCT/US90/04019

### I. CLASSIFICATION OF SUBJECT MATTER

If several classification symbols apply, indicate all.

- IPC (5): H04M 11/00, 1/64; H04J 3/24; G06B 5/22
- U.S. Cl.: 379/57, 88, 89; 340/825, 44; 370/93, 94

### II. FIELDS SEARCHED

**Minimum Documentation Searched**

<table>
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<tr>
<th>Classification System</th>
<th>Classification Symbols</th>
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<td>U.S.</td>
<td>379/57, 88, 89; 340/825, 44; 370/93, 94</td>
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</table>

**Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched**

### III. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of Document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to Claim No.</th>
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<tr>
<td>X</td>
<td>US, A 4,713,808 (GASKILL ET AL) 15 December 1987 See the entire document.</td>
<td>1, 3-11, 13-20</td>
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<td>Y,P</td>
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<td>A</td>
<td>US, A 4,392,135 (OHYAGI) 05 July 1983</td>
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  - "A" document defining the general state of the art which is not considered to be of particular relevance
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  - "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  - "O" document referring to an oral disclosure, use, exhibition or other means
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- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step
- "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

### IV. CERTIFICATION

Date of Actual Completion of the International Search: 23 AUGUST 1990

Date of Mailing of this International Search Report: 14 DEC 1990

International Searching Authority: ISA/US

Signature of Authorized Officer: KING-MICHAEL NEGASH