PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 7/22, 7/38	A1	(11) International Publication Number: WO 97/24006
		(43) International Publication Date: 3 July 1997 (03.07.97)

(21) International Application Number: PCT/US96/20001

(22) International Filing Date: 19 December 1996 (19.12.96)

(30) Priority Data:
08/576,350 21 December 1995 (21.12.95) US

(71) Applicant: ERICSSON INC. [US/US]; 7001 Development Drive, P.O. Box 13969, Research Triangle Park, NC 27709 (US).

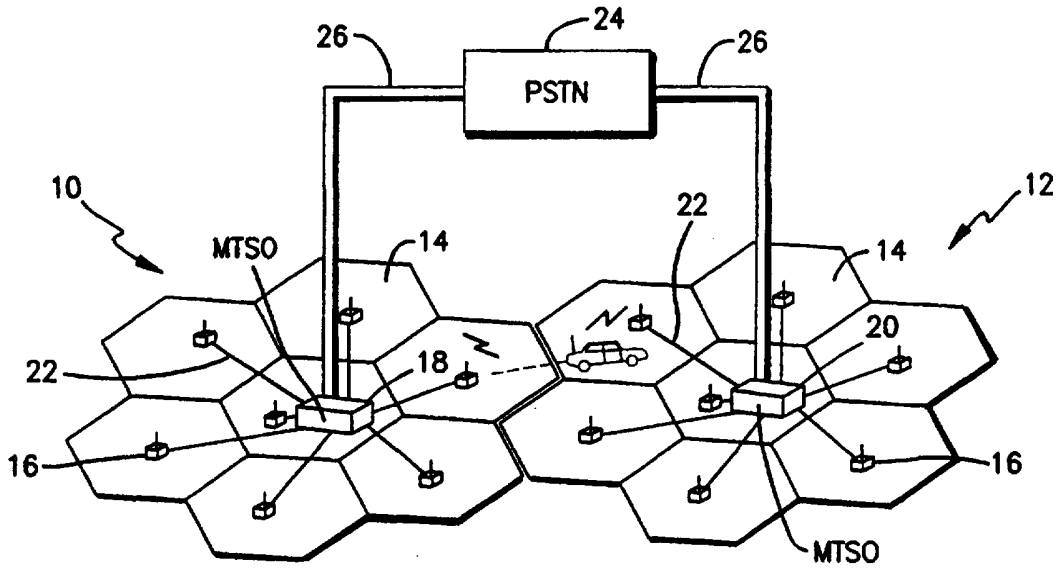
(72) Inventor: ZAK, Robert, A.; 12324 Inglehurst Drive, Raleigh, NC 27613 (US).

(74) Agent: LASTOVA, John, R.; Nixon & Vanderhye P.C., 8th floor, 1100 North Glebe Road, Arlington, VA 22201-4714 (US).

(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LC, 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, 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.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: AUTOMATIC CALL-FORWARDING IN A MOBILE RADIOTELEPHONE



(57) Abstract

A mobile radio and a method of operation to automatically activate call-fowarding when roaming in a foreign system is presented. The mobile radio receives a system ID and compares it with a system ID of the mobile radio's home system. If the received system ID differs from the home system ID, the mobile radio automatically retrieves an appropriate code required to enable call-forwardng and transmits the retrieved code to the foreign system.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	**GB**	United Kingdom	**MW**	Malawi
AT	Austria	**GE**	Georgia	**MX**	Mexico
AU	Australia	**GN**	Guinea	**NE**	Niger
BB	Barbados	**GR**	Greece	**NL**	Netherlands
BE	Belgium	**HU**	Hungary	**NO**	Norway
BF	Burkina Faso	**IE**	Ireland	**NZ**	New Zealand
BG	Bulgaria	**IT**	Italy	**PL**	Poland
BJ	Benin	**JP**	Japan	**PT**	Portugal
BR	Brazil	**KE**	Kenya	**RO**	Romania
BY	Belarus	**KG**	Kyrgystan	**RU**	Russian Federation
CA	Canada	**KP**	Democratic People's Republic of Korea	**SD**	Sudan
CF	Central African Republic			**SE**	Sweden
CG	Congo	**KR**	Republic of Korea	**SG**	Singapore
CH	Switzerland	**KZ**	Kazakhstan	**SI**	Slovenia
CI	Côte d'Ivoire	**LI**	Liechtenstein	**SK**	Slovakia
CM	Cameroon	**LK**	Sri Lanka	**SN**	Senegal
CN	China	**LR**	Liberia	**SZ**	Swaziland
CS	Czechoslovakia	**LT**	Lithuania	**TD**	Chad
CZ	Czech Republic	**LU**	Luxembourg	**TG**	Togo
DE	Germany	**LV**	Latvia	**TJ**	Tajikistan
DK	Denmark	**MC**	Monaco	**TT**	Trinidad and Tobago
EE	Estonia	**MD**	Republic of Moldova	**UA**	Ukraine
ES	Spain	**MG**	Madagascar	**UG**	Uganda
FI	Finland	**ML**	Mali	**US**	United States of America
FR	France	**MN**	Mongolia	**UZ**	Uzbekistan
GA	Gabon	**MR**	Mauritania	**VN**	Viet Nam

AUTOMATIC CALL FORWARDING IN A MOBILE RADIOTELEPHONE

BACKGROUND OF THE INVENTION

The present invention relates generally to radiotelephone communications systems, and more particularly to a mobile radiotelephone which automatically activates call-forwarding when the mobile radio is roaming in a foreign communications system outside its home system.

A typical mobile radiotelephone communications system consists of the following basic elements: at least one mobile terminal, a plurality of base stations, and at least one mobile telephone switching office (MTSO). These elements are integrated to form a cellular mobile radiotelephone system that is connected to a public switched telephone network (PSTN).

A mobile radiotelephone communicates in radio frequency (RF) signals with a base station. The base station provides RF communications in a predetermined geographic area commonly referred to as a cell. When the base station receives a signal transmitted by the mobile radiotelephone, it transfers the signal to a MTSO via land line or alternate communications link. The MTSO may route the signal to another mobile radio in the same cellular system or to a PSTN over an appropriate land line for transmission to a wireline subscriber or to another MTSO of the same or another cellular system.

Each mobile radiotelephone has an electronic serial number (ESN) and a telephone number (NAM) that is assigned to the mobile radiotelephone, and is listed with its home cellular system. The cellular system also has a system ID code which is transmitted by each of its base stations on radio control channels. When a mobile radio registers with the cellular system or when it

attempts to place a call, it identifies the cellular system by receiving the information transmitted on one of the control channels, and identifies itself to the cellular system by transmitting its ESN and NAM.

Most cellular systems allow mobile radios to "roam," i.e., to place and receive calls in a foreign system outside their home system even though the mobile radio user does not subscribe to the foreign system. A mobile telephone user may subscribe to multiple home systems and be assigned to a NAM therein. For clarity, the term "home system" will hereafter refer to any system to which the user has subscribed. Additionally, most cellular systems allow "call-forwarding," whereby, a mobile radio's home system forwards the mobile radio's incoming calls to the roaming system so that anyone attempting to call the mobile radio is not required to dial system-specific roamer access codes.

GTE Mobilnet's "Follow-Me Roaming" is a system which allows call-forwarding to mobile radios roaming in foreign systems, and is disclosed in U.S. Patent No. 4,901,340 entitled "SYSTEM FOR THE EXTENDED PROVISION OF CELLULAR MOBILE RADIOTELEPHONE SERVICE" by Parker et al. This system requires a mobile radio subscriber to manually dial a code (*31 or *18) to activate call-forwarding and does not disclose or suggest a mobile radio that automatically detects when it has entered a new roaming system and automatically sends the appropriate code to activate call-forwarding.

U.S. Patent No. 5,142,654 entitled "CELLULAR TELEPHONE SYSTEM AND METHOD FOR DYNAMICALLY SWITCHING BETWEEN CALL ROUTING OPTIONS" by Sonberg et al. discloses a cellular system which uses a central host computer to keep track of call delivery options for all mobile radios that are active in its network of MTSOs. The roaming user must initially manually enter a code (*18 or *31) from the keypad of the terminal. The code is received by one of the MTSOs and stored by the central computer. If the roaming user does not select the automatic call-forwarding option by entering the code, the system will automatically activate call-forwarding when the roaming user makes his first call from

the foreign system. Once the code is entered, the call-forwarding options remain in effect even if the user roams to a new system so long as the new MTSO has access to the same central computer. Because the call-forwarding options are stored in the central computer, they would most likely be purged at the end of the day to make room for new roaming mobile radios. Hence, the call-forwarding options would be lost unless the user enters a code (*31 or *18) or initiates a call from the foreign system the next day.

U.S. Patent No. 5,090,050 entitled "METHOD AND APPARATUS FOR COMMUNICATING WITH RADIO TELEPHONES" by Hefernan discloses a cellular system which allows mobile radios to roam in foreign systems. The mobile radio user must inform his home system by calling the home system from a mobile or a landline phone and entering codes describing where he is roaming. The mobile user must repeat this manually every time he roams in a new system, and must know the 5-digit "city code." There is also a description of cellular systems that are networked with the home system, where calls would automatically be forwarded when the mobile radio user registers. But this feature is available only if the foreign system is configured to automatically register the presence of a roamer and transmit a signal automatically to other associated cellular systems, including the home system, which identifies the roamer and its presence within the geographical area covered by the foreign system.

The prior art documents discussed supra do not disclose, suggest, or teach a mobile radio that automatically detects when it enters a roaming system and automatically transmits a call-forwarding activation code to the system without any cognitive acts being required by the user or subscriber. Additionally, none of these prior art documents describe storing call-forwarding codes in a mobile radio; rather, such codes are stored by a central computer in which case the call-forwarding codes are likely to be purged at the end of the day and require re-entry if the user remains in the foreign system.

Thus, there is a need for a mobile radio and a method of operation which automatically detects when the mobile radio has

entered a roaming system and automatically transmits a call-forwarding code. In addition, there is a need for storing the call-forwarding code in the mobile radio rather than in a central computer in the cellular system.

SUMMARY OF THE INVENTION

It is, accordingly, a primary object of the present invention to provide a novel mobile radiotelephone and method of operation which automatically detects when the mobile radiotelephone has entered a foreign cellular system and automatically transmits a proper, required call-forwarding activation code to the foreign cellular system.

It is another object of the present invention to provide a mobile radiotelephone which stores the call-forwarding activation codes in the mobile radiotelephone, selects a proper code, and transmits the code to the foreign cellular system.

In accordance with the present invention, a mobile radiotelephone to automatically activate call-forwarding when the mobile radiotelephone is roaming in a foreign cellular system is presented wherein the mobile radiotelephone receives a cellular system ID and compares it to the home cellular system ID for the radiotelephone stored in its memory. If the received cellular system ID differs from the stored home cellular system ID, the mobile radio retrieves from its memory an appropriate code required to enable call-forwarding and transmits the retrieved code to the foreign cellular system.

These and other objects of the present invention, together with the features and advantages thereof, will become apparent from the following detailed specification when read with the accompanying drawings in which like reference numerals refer to like elements.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a basic cellular communication system.

Figure 2 is a schematic block diagram of the basic cellular communications system of Figure 1.

Figure 3 is a schematic block diagram of a mobile radio in which the automatic call-forwarding process of the present invention may be implemented.

Figure 4 is a flow chart illustrating automatic call-forwarding in a mobile radio in accordance with the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows two cellular systems 10 and 12 which are each divided into a plurality of smaller cells 14. Each cell 14 includes a base station 16. The cellular system 10 is served by a MTSO 18, while the cellular system 12 is served by another MTSO 20. The MTSOs 18 and 20 are linked respectively to each of their associated base stations 16 by dedicated land lines 22. The MTSOs 18 and 20 route signals from the base stations 16 to the PSTN 24 by communications link 26 which may be wirelines, microwave, or fiber optics.

Referring also to Figure 2 the two cellular systems 10 and 12 may also be referred to as a home system 28 and a foreign system 30, respectively. For purposes of explanation and clarity, the home system 28 and the foreign system 30 are each shown having two base stations 16a, 16b, and 16c, 16d, respectively, and each base station 16 has an associated antenna 40.

In order to originate or to receive telephone calls while roaming in the foreign system 30, a mobile radio 42 establishes radio communications with the nearest base station 16d. Communications link 22 carries audio, control and routing information between the base station 16d and the MTSO 20. For example, as a function of the control and routing information, the MTSO 20 might establish a voice communications path between the base station 16d and the PSTN 24, and the PSTN 24 might further establish a voice communications path with the MTSO 18 of the home system 28 through communications link 26; the MTSO 18 then establishes voice communications with the appropriate base station (in the present example base station 16a) pursuant to the control and routing information, and the MTSO 18, in turn, signals the called mobile radio 44 and voice communications are established between the mobile radio 44 and the MTSO 18 via base station 16a when the user or subscriber answers.

This network of base stations 16, MTSOs 18 and 20, and the PSTN 24 amply illustrates how communications can be established between the mobile radio 42 if roaming in the foreign system 30 and a mobile radio 44 in the home system 28. As an additional example, depending upon the routing and control information, the

PSTN 24 may also establish voice communications between the MTSOs 18 and 20 and a conventional fixed site telephone 46, thus establishing a communications link between the calling mobile radio 42 and the conventional fixed site telephone 46.

Referring now to Figure 3 a typical mobile radio 42 includes, as basic components, a transmitter unit 52, a receiver unit 54, a control head assembly 56, a microprocessor 58, a non-volatile memory 60, and an antenna assembly 62.

The automatic call-forwarding feature of the present invention is stored and retained in the non-volatile memory 60 and is executed by the microprocessor 58. The non-volatile memory 60 retains stored data even after the power is turned off and accordingly, information and instructions required to carry out the automatic call-forwarding.

The call-forwarding activation codes (typically *18 or *31), which had to be manually entered by the user prior to the present invention are also stored in the mobile radio's non-volatile memory 60. The non-volatile memory 60 also stores three user-definable flags: "New System Notification," "Auto-Forwarding Activation," and "Confirmation Message." These flags may be toggled either "on" or "off" by the user by scrolling through a menu of features shown on the display 56a using the keypad 56b and selecting the desired feature by operating predetermined keys on the keypad. These flags are pre-set to default values when the mobile radio 42 is manufactured but may be changed by the user.

Figure 4 shows the automatic call-forwarding activation process in accordance with the present invention. The process begins with the mobile radio initiating a telephone call by scanning a cell's dedicated communications channels to find a control channel as indicated by block 64.

Once a control channel is found, the mobile radio 42 receives the system identification (SID) from the nearest base station assigned to that particular system over the control channel as indicated by block 68. The SID code is then compared to a list of SID codes stored in the mobile radio's memory 60 as indicated by block 70.

In the decision block 72, if the received SID code matches the SID code for the home system stored in the mobile radio's memory 60, the mobile radio 42 is in its home system 18 (Figure 2), and the mobile radio 42 then enters an idle state and monitors the control channel as indicated by block 74. If, alternatively, the received SID code does not match the SID code for the home system stored in the mobile radio's memory 60, the mobile radio 42 is a roaming unit in the system serving the geographic area where the mobile radio 42 is presently located.

If the user has configured the mobile radio 42 to notify him or her when roaming in a foreign system 30 (Figure 2) by setting the new system notification feature flag (block 76), the mobile radio 42 will then generate an audible and/or visible message as indicated by block 78. In a preferred embodiment of this invention, the mobile radio 42 will emit an audible "beep" and display a message such as "ROAMING IN SYSTEM XXXXX" where "XXXXX" is the SID.

If the user has previously configured the mobile radio 42 to automatically transmit the call-forwarding activation code by setting the automatic call-forwarding feature flag (block 80), the appropriate code for the foreign system will then be automatically retrieved from the non-volatile memory 60 and transmitted to the base station 16 of the foreign system 30 (block 84); this is in contrast to the prior art where the user had to look up the proper code in a roaming guide if he didn't know the code for the foreign system and manually transmit it to the base station 16.

Alternatively, if the user has not configured the mobile radio 42 to automatically transmit the appropriate call-forwarding activation code (decision block 80), the mobile radio 42 enters the idle state and monitors the control channel as indicated by block 82.

If the mobile radio 42 automatically transmits the call-forwarding activation code to the foreign system 30, the foreign system 30 will direct the mobile radio 42 to a voice channel containing audio signals as indicated by block 98. The foreign system 30 responds by transmitting back an audio confirmation

message to the mobile radio 42 as indicated by block 86. If the confirmation message flag was set by the user (block 88), the confirmation message is further examined by the mobile radio 42 to determine whether the confirmation message indicates that the call-forwarding has been activated as indicated by decision block 92. If, on the other hand, the confirmation message flag was not set, the mobile radio 42 remains mute, terminates the call, and continues to the monitor the control channel as indicated by block 90.

If the confirmation message indicates that the call-forwarding activation code was successfully sent, the mobile radio 42 will generate an audio message as indicated by block 96. If, on the other hand, the foreign system 30 does not accept the call-forwarding activation code, the foreign system 30 will transmit an error message or a message which instructs the user to call the operator as indicated by block 94. The user will hear these audio messages from the foreign system 30 only if the user had previously configured the mobile radio 42 to play the audio message by setting the confirmation message flag; otherwise, the mobile radio 42 will remain mute (block 90).

After the mobile radio 42 has been on the voice channel for a predetermined time period, the mobile radio 42 terminates the call, enters an idle state, and monitors the control channel as indicated by block 100.

While the present invention has been described with respect to its preferred embodiments, those skilled in the art will recognize that the present invention is not limited to the specific embodiments described and illustrated herein. Different embodiments and adaptations besides those shown herein and described as well as many variations, modifications and equivalent arrangements will now be apparent or will be reasonably suggested by the foregoing specification and drawings, without departing from the substance or scope of the invention. While the present invention has been described herein in detail in relation to its preferred embodiments, it is to be understood that this disclosure is only illustrative and exemplary of the present invention and is made merely for purposes of providing a

full and enabling disclosure of the invention. Accordingly, it is intended that the invention be limited only by the spirit and scope of the claims appended hereto.

What is claimed is:

1. A method for automatically activating call-forwarding when a mobile radio is roaming in a foreign system, the method comprising the steps of:

receiving a system ID transmitted from the foreign system to the mobile radio;

comparing the received system ID to a system ID for the mobile radio's home system;

retrieving by a processor of the mobile radio from a memory an appropriate code based on the received system ID if the received system ID is not the home system ID; and

automatically transmitting the retrieved code to the foreign system to enable call-forwarding.

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

generating a signal when the mobile radio is roaming if the received system ID is not the home system ID.

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

generating an error message if call-forwarding is not activated.

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

generating a confirmation signal if call-forwarding is activated.

5. A mobile radio for automatically activating call-forwarding when roaming in a foreign system, comprising:

a receiver unit for receiving a system ID from a mobile telephone system;

means for comparing the received system ID to a home system ID;

means for retrieving from a memory of the mobile radio an appropriate code if the received system ID is different from the home system ID; and

a transmitter unit for transmitting said retrieved code to the foreign system to enable call-forwarding.

6. The mobile radio of claim 5, further comprising:

means for generating a signal when the mobile radio is roaming if the received system ID is not the home system ID.

7. The mobile radio of claim 5, further comprising:

means for generating an error message if call-forwarding is not activated.

8. The mobile radio of claim 5, further comprising:

means for generating a confirmation signal if call-forwarding is activated.

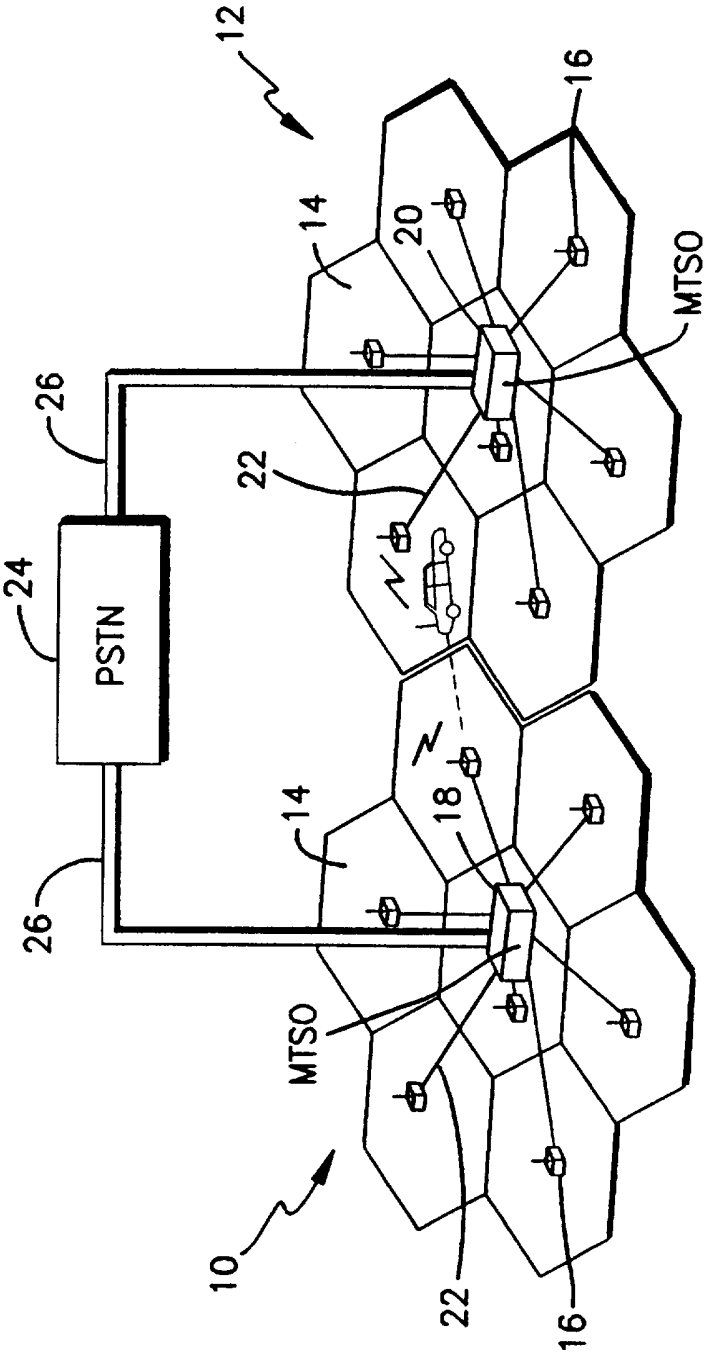


FIG. 1

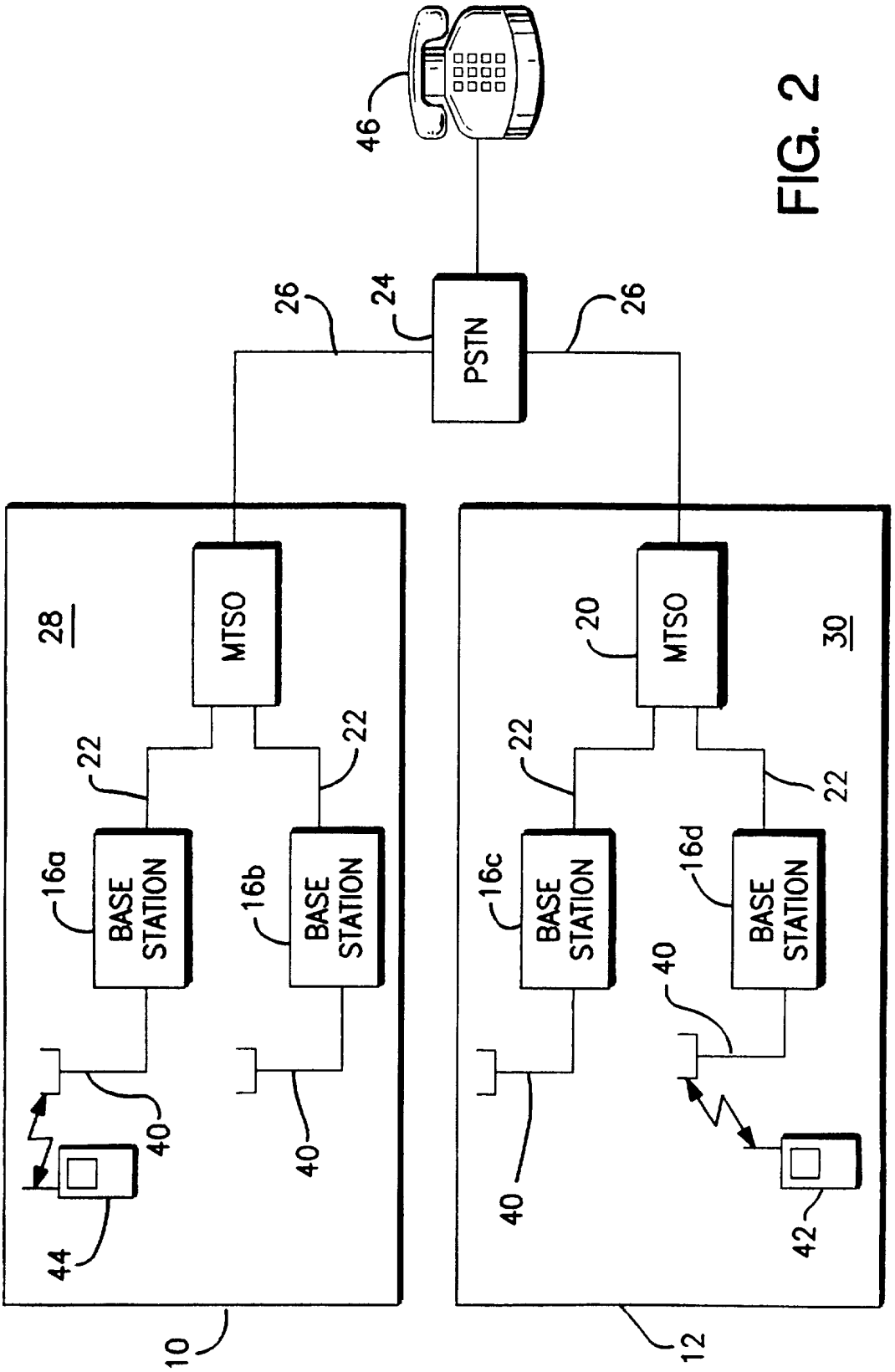

46
PSTN
24
26
26
28
MTSO
22
22
16a
BASE STATION
16b
BASE STATION
40
40
44
10
30
MTSO
20
22
22
16c
BASE STATION
16d
BASE STATION
40
40
42
12

FIG. 2

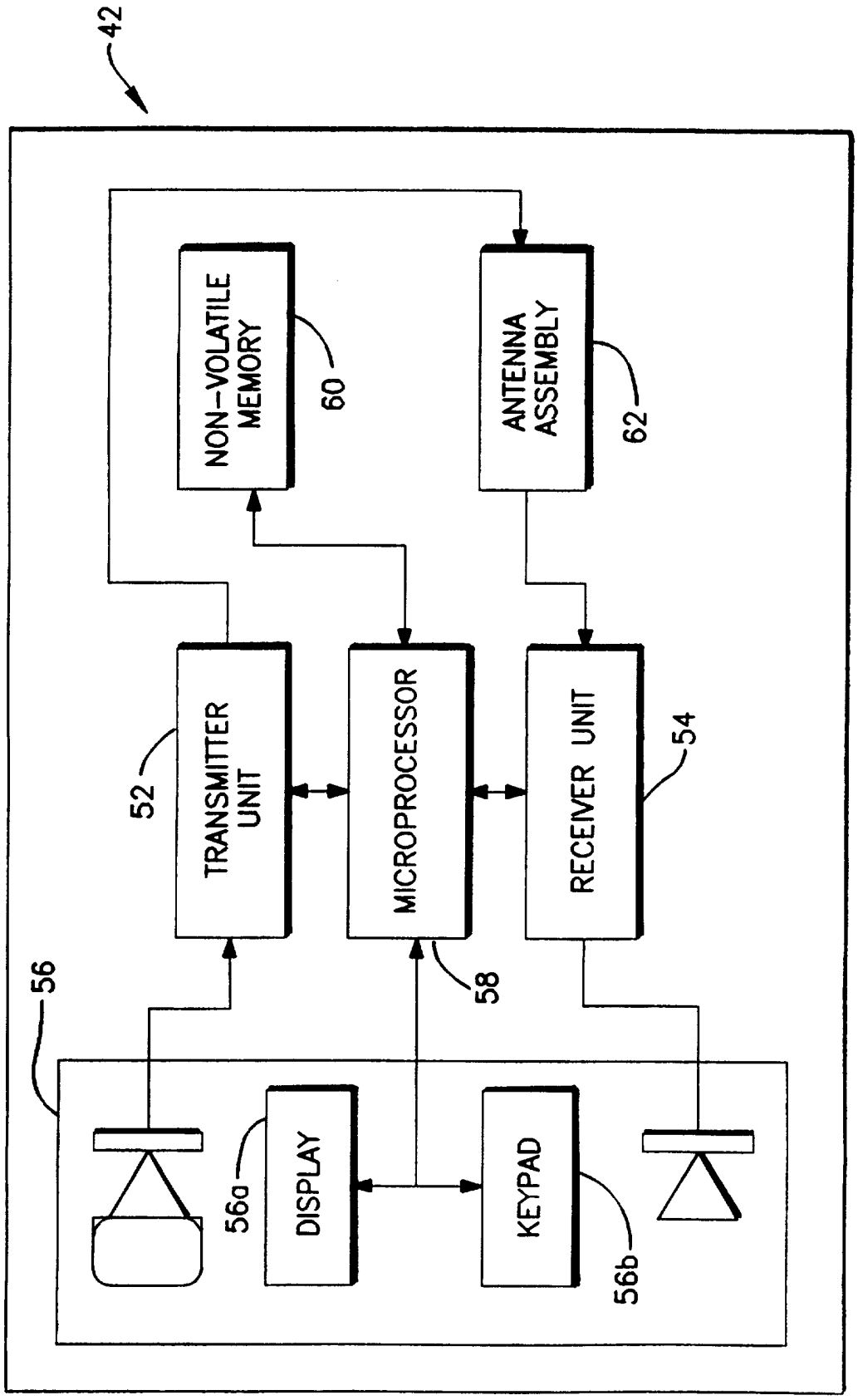

42
NON-VOLATILE MEMORY
60
ANTENNA ASSEMBLY
62
TRANSMITTER UNIT
52
MICROPROCESSOR
RECEIVER UNIT
54
58
56
DISPLAY
56a
KEYPAD
56b

FIG. 3

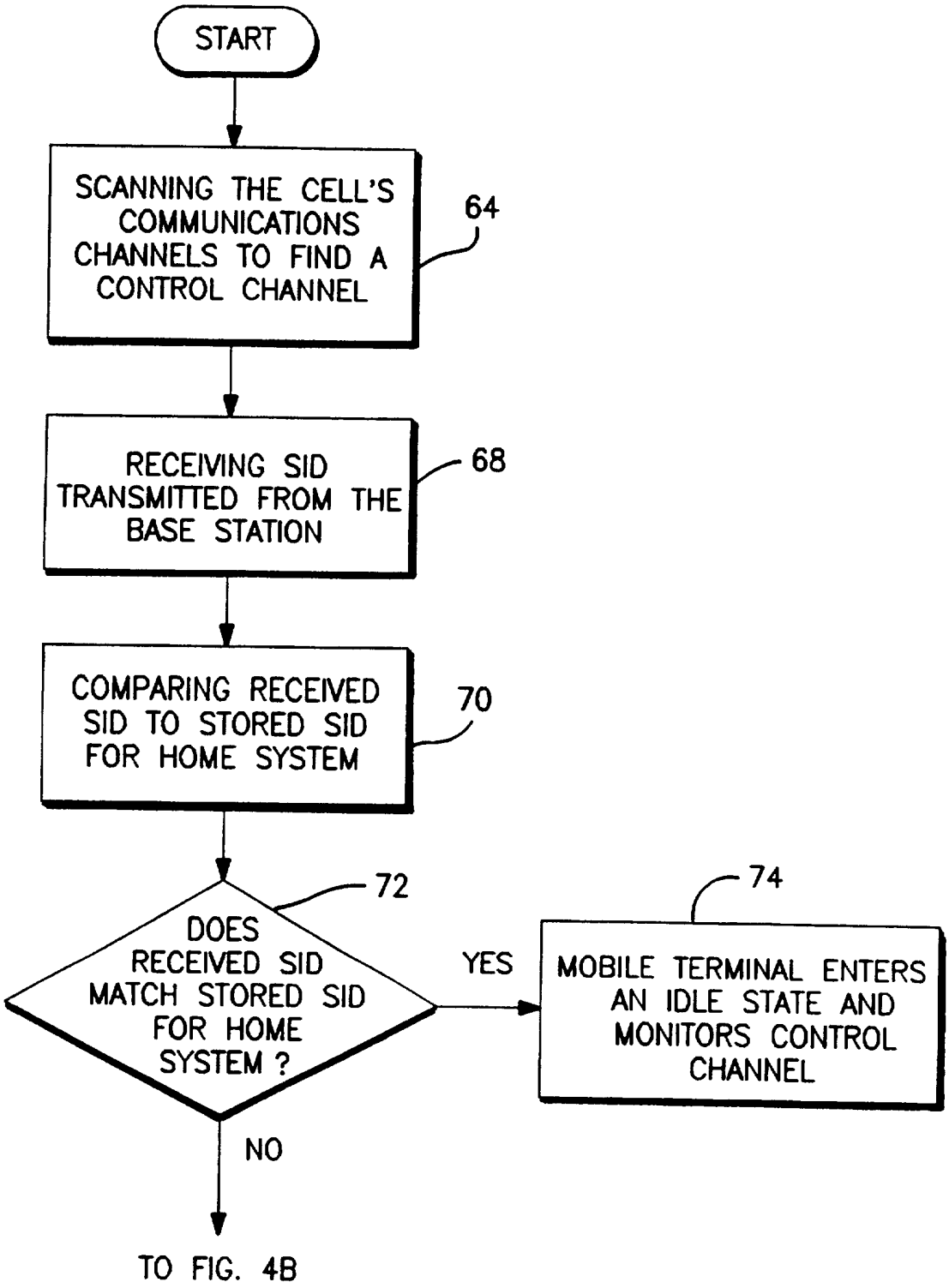

START
SCANNING THE CELL'S COMMUNICATIONS CHANNELS TO FIND A CONTROL CHANNEL
64
RECEIVING SID TRANSMITTED FROM THE BASE STATION
68
COMPARING RECEIVED SID TO STORED SID FOR HOME SYSTEM
70
72
DOES RECEIVED SID MATCH STORED SID FOR HOME SYSTEM ?
YES
74
MOBILE TERMINAL ENTERS AN IDLE STATE AND MONITORS CONTROL CHANNEL
NO
TO FIG. 4B

FIG. 4A

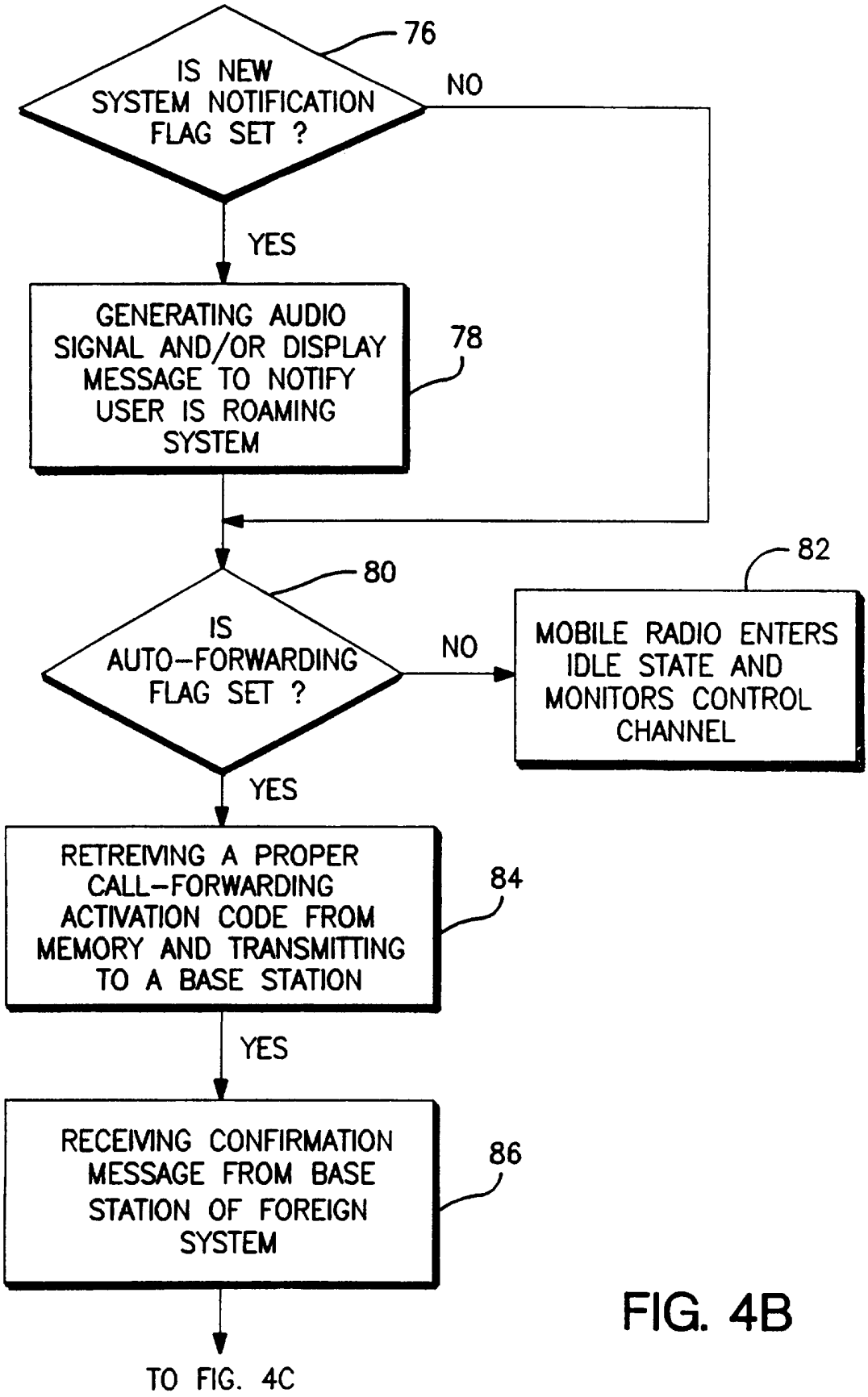

IS NEW SYSTEM NOTIFICATION FLAG SET ?
76
NO
YES
GENERATING AUDIO SIGNAL AND/OR DISPLAY MESSAGE TO NOTIFY USER IS ROAMING SYSTEM
78
IS AUTO-FORWARDING FLAG SET ?
80
NO
MOBILE RADIO ENTERS IDLE STATE AND MONITORS CONTROL CHANNEL
82
YES
RETREIVING A PROPER CALL-FORWARDING ACTIVATION CODE FROM MEMORY AND TRANSMITTING TO A BASE STATION
84
YES
RECEIVING CONFIRMATION MESSAGE FROM BASE STATION OF FOREIGN SYSTEM
86
TO FIG. 4C

FIG. 4B

INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/US 96/20001

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/22 H04Q7/38

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)
IPC 6 H04Q H04M

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

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 5 454 027 A (KENNEDY III WILLIAM C ET AL) 26 September 1995 see column 3, line 18 - line 40; figures 3,4	1,4,5,8 2,3,6,7
Y A	US 4 901 340 A (PARKER TERRY S ET AL) 13 February 1990 cited in the application see column 2, line 26 - line 45	2,6 1,5
Y	EP 0 622 928 A (ERICSSON TELEFON AB L M) 2 November 1994 see column 3, line 35 - line 45 see column 10, line 3 - line 18	3,7

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"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

"P" document published prior to the international filing date but later than the priority date claimed

"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 when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

1

Date of the actual completion of the international search	Date of mailing of the international search report
16 May 1997	- 4. 06. 97
Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Authorized officer Schut, G

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

INTERNATIONAL SEARCH REPORT

Interr ıal Application No
PCT/US 96/20001

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 142 654 A (SONBERG KENNETH W ET AL) 25 August 1992 cited in the application see column 1, line 55 - column 2, line 10 see column 7, line 33 - column 8, line 4; figure 5A -----	1,5

1

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

....ormation on patent family members

Intern ıal Application No
PCT/US 96/20001

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5454027 A	26-09-95	US 5579376 A	26-11-96
		US 5539810 A	23-07-96
		US 5544225 A	06-08-96
US 4901340 A	13-02-90	CA 1322397 A	21-09-93
		EP 0379642 A	01-08-90
EP 0622928 A	02-11-94	SE 500884 C	26-09-94
		AU 673709 B	21-11-96
		AU 5498794 A	18-08-94
		CN 1095208 A	16-11-94
		FI 940616 A	11-08-94
		SE 9300430 A	11-08-94
US 5142654 A	25-08-92	US 5440614 A	08-08-95