PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 :		(11) International Publication Number:
H04M 11/00	A1	WO 95/02935
		(43) International Publication Date: 26 January 1995 (26.01.95)

(21) International Application Number: PCT/US94/06955

(22) International Filing Date: 21 June 1994 (21.06.94)

(30) Priority Data:
08/090,372 13 July 1993 (13.07.93) US

(71) Applicant: MOTOROLA INC. [US/US]; 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

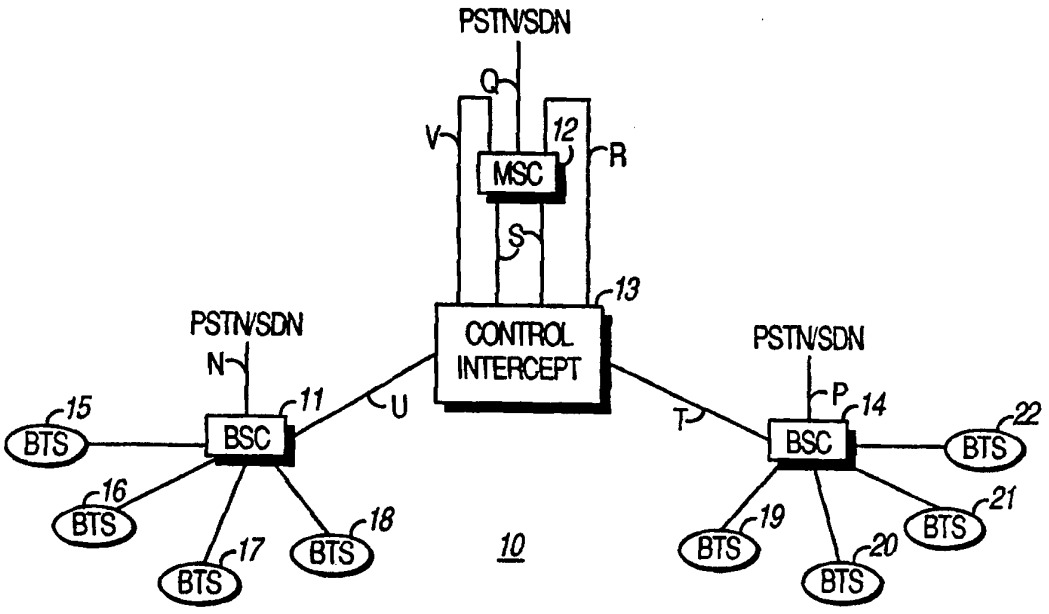
(72) Inventor: SPEAR, Stephen, Lee; 25 Williamsburg Terrace, Stokie, IL 60203 (US).

(74) Agents: PARMELEE, Steven, G. et al.; Motorola Inc., Intellectual Property Dept./RAS, 1303 East Algonquin Road, Schaumburg, IL 60196 (US).

(81) Designated States: CA, CN, FI, JP, KR, SK, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.

(54) Title: METHOD OF AND APPARATUS FOR PROVIDING A LOCAL PSTN INTERCONNECT WITH A CELLULAR BASE SITE



(57) Abstract

A method and apparatus is provided for routing calls between a PSTN and a base station system (11, 14-18). The method includes the step of associating a port of a mobile switching center (12) of the cellular communication system (10) with a PSTN interconnect port of a PSTN interconnect of the base station system (11, 14-18). The method further includes translating an identifier of the PSTN interconnect port and associated port of the mobile switching center (12) between the mobile switching center (12) and base station system (11, 14-18) and exchanging control information between the PSTN interconnect port of the base station system (11, 14-18) and the associated port of the mobile switching center (12). The apparatus provides means for accomplishing the method.

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.

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

METHOD OF AND APPARATUS FOR PROVIDING A LOCAL PSTN INTERCONNECT WITH A CELLULAR BASE SITE

Field of the Invention

The field of the invention relates generally to cellular communication systems and more specifically to PSTN interconnects with cellular communication systems.

Background of the Invention

A coverage area or cell in a cellular radiotelephone communication systems is provided by a Base Transceiver Station (BTS). The BTS communicates with the Mobile Subscribers (MS) via a defined air interface. In early cellular systems, each BTS communicated directly with a Mobile Switching Center (MSC). Later network architecture provided for each BTS to be connected and controlled by a Base Station Controller (BSC). The BSC and controlled BTSs form a Base Station System (BSS). A number of BSS's may be combined into a cellular radiotelephone communication system (FIG. 1) controlled by a MSC that, in turn, may be interconnected with a public service telephone network (PSTN) composed of a number of trunk groups (N, Q, and P) (e.g. T1 lines).

The cellular system, covering a geographic area, allows MS's to communicate among MS's or a MS to communicate with a public switch telephone network (PSTN) subscriber through the PSTN interconnect provided at the MSC. Calls received through a BTS are routed to the BSC which, in turn, routes the call request to the MSC. The MSC then routes the call to a land party through the PSTN or to another MS back through a BSC and BTS.

The BSC provides message transfer and call switching as directed by the MSC. Control information received from an MS through a BTS of the BSC are routed to the MSC. Calls received by a BSC through the MSC, on a channel of communication link A, are switched under control of the

BSC to the appropriate BTS in communication with the MS. Routing of all calls including those between MS's communicating through BTS's under the same BSC are routed through the MSC.

The MSC upon receipt of a call from an MS first determines whether the called party (target) is another MS under its control. If the target is another MS the MSC causes a page message to be generated for the target which is then transferred to each BSC which covers the location area in which the MS was last known to be in. The BSCs then cause the page to be transmitted through each antenna of each BTS connected to the BSC. Upon identification of a location of a target the MSC issues switching commands, directed to requesting and target BSCs, providing a signal path between the MS initiating the call and the BTS/BSC where the called party has been located.

If the MSC determines the target to be a PSTN subscriber, then the MSC composes a call request message to be transmitted into the proper trunk group of the PSTN interconnect. Trunk groups, in general and channels within trunk groups in particular, are associated with specific geographic areas. An MSC determines the geographic area in which the target is located by a translation of the called number and transmits the call request into the trunk group associated with the target's geographic area.

If the call request is received from the PSTN interconnect, then the MSC composes a page message for transmission through each BSS within the system. If the MS is within the system the MS responds through the nearest BTS. The response is transferred to the BSC, which in turn transfers the response to the MSC along with an identification of the receiving BTS. The MSC matches the call response with the call request and allocates a signal path from the PSTN interconnect to a selected trunk of the MSC to the BSC. The MSC instructs the BSC to connect the selected channel of the receiving BTS to the selected MSC trunk.

The BSCs is often located miles from the MSC, perhaps even in different PSTN area codes. Such remote locations can result in a landline telephone user having to pay toll call charges associated with having the voice "backhauled" to the MSC even when reaching a radiotelephone that is physically near the landline user. Similarly, a call from a radiotelephone to a nearby landline user may be routed miles to the MSC for connection to the PSTN and back to the landline user.

Spear (U.S. Patent 5,036,531) provides one solution to this problem. The instant invention extends that solution by minimizing the charge impact on previously installed BSCs and "tricking" them into providing local PSTN interconnect functionality. The instant invention employs a control intercept to trick existing MSCs and BSCs into performing a similar function.

Summary of the Invention

A method and apparatus is provided for routing calls between a PSTN and a base station system. The method includes the step of associating a port of a mobile switching center of the cellular communication system with a PSTN interconnect port of a PSTN interconnect of the base station system. The method further includes translating an identifier of the PSTN interconnect port and associated port of the mobile switching center between the mobile switching center and base station system and exchanging control information between the PSTN interconnect port of the base station system and the associated port of the mobile switching center. The apparatus provides a means for accomplishing the method.

Brief Description of the Drawings

FIG. 1 illustrates a typical cellular communication system.

FIG. 2 illustrates a cellular communication system including a PSTN enabler in accordance with one embodiment of the invention.

Detailed Description of the Preferred Embodiment

The solution to the problem of providing local PSTN interconnects without the involvement of the MSC, is provided by locating a PSTN interconnect at the base station system (BSC) and remotely controlling the PSTN interconnect through the use of a remote PSTN enabler (control intercept) located at the MSC. The control intercept is located at the MSC in order that PSTN interconnects of a number of BSSs may be controlled through the same control intercept resulting in toll-call reduction where ever call entry occurs.

Remote control of the PSTN interconnect is accomplished, in accordance with one embodiment of the invention, by the interception of PSTN command information at the MSC and translating such commands to the PSTN interconnect at the BSC by the control intercept. Control information (calls) received from the PSTN interconnect are, in turn, intercepted by the BSC from the PSTN interconnect and translated to the MSC by the control intercept. Such an approach minimizes signal path distance from caller to target while causing only a small increase in control traffic between BSC and control intercept.

FIG. 2 is a block diagram of a cellular communication system 10, generally, in accordance with the invention. Included within the communication system 10 is a first BSC 11 having a number of BTSs 15-18, and a second BSC 14

with a number of BTSs 19-22. The first and second BSCs 11 and 14 are interconnected with a control intercept 13 through use of interconnects U and T. Interconnects U and T may be any appropriate communications medium (e.g. T1 lines). The control intercept 13 is, in turn, interconnected with the MSC 12 through PSTN control link R and V and communication link S.

BSC 11 has a PSTN interconnect with PSTN trunk group N. PSTN trunk group N, in accordance with one embodiment of the invention, provides access to PSTN subscribers in a geographic area proximate the BSC 11 and BTSs 15-18. Likewise, BSC 14 has an interconnect with PSTN trunk group P. PSTN trunk group P, in accordance with one embodiment of the invention, provides access to PSTN subscribers in a geographic area proximate the BSC 14 and BTSs 19-22.

The control intercept 13 is constructed to intercept PSTN command information from an PSTN port of the MSC 12 (intended for a port of PSTN trunk group N at the PSTN interconnect of the BSC 11) on a channel of control link V and transfer such information to BSC 11. BSC 11, in turn, transfers such information to a control channel of trunk group N associated with the PSTN port of the MSC 12. The number of channels on control link V is the same as the number of ports on PSTN trunk group N. Each PSTN port of the MSC 12 on control link V has an associated port of PSTN trunk group N.

Call requests from a port of PSTN trunk group N (PSTN call requests) are transferred from the BSC 11 to the control intercept 13. The remote PSTN enabler 13 transfers the requests to the associated PSTN port of the MSC 12 on a corresponding channel of communication link V. Upon a determination that the call on a port of the PSTN trunk group N terminates/originates through a BTS 15-18 associated with BSC 11, the control intercept 13 recognizes such case and commands the BSC 11 to provide a local interconnect between the BTS 15-18 and the port of PSTN trunk group N providing the PSTN call request.

The control intercept 13 identifies the BSC to which the PSTN call is to be directed by placing a digital pattern or tone on the channel of communication link V (port of trunk group N) providing the PSTN call request and detects the pattern or tone on a traffic channel allocated in support of the call on communication link S. Where the channel on communication link S corresponds to BSC 11 the control intercept determines that the call is destined for a BTS 15-18 of BSC 11 and commands the BSC 11 to make a local connection with BTS 15-18 and the requesting port of trunk group N.

If the control intercept 13 determines that the PSTN call request is to be directed to another BSC 14 then the control intercept 13 may compose and transmit a re-route request to the PSTN through the PSTN interconnect port. The re-route request causes the PSTN call, received on trunk group N, to be transferred to trunk group Q at the MSC 12. The call request may also be handled by allocating a channel of communication link U to carry the call from the PSTN connection N to the MSC via the communication link U and the associated port of communication link V.

By way of example a call request is received by BTS 15 from a MS (not shown) for a PSTN subscriber (not shown) associated with PSTN trunk group N. The BSC 11 upon receipt of the call request transfers the call request to the control intercept 13 over a channel of communication link U. The control intercept 13, in turn transfers the call request to a port of the MSC 12 on communication link S.

The MSC 12, in turn, transmits certain PSTN commands from a PSTN port of the MSC 12 over a selected channel on communication link V. The control intercept 13 transfers such commands to BSC 11 with instructions to switch the commands into the corresponding control channel of the selected channel of PSTN trunk group N.

The MSC 12 allocates a channel of communication link U to the call from BTS 15. The control intercept 13 then transmits a unique pattern or tone on the allocated channel into the MSC 12 and listens for the repeated pattern or tone

on communication link V. If the control intercept 13 is able to match transmitted and received signals then the control intercept 13 transmits commands to the BSC 11 to switch the channel of trunk group N on which the signal was detected to BTS 15 through a local connection, thereby completing the connection.

If, on the other hand, a call were received on a port of PSTN trunk group N a similar procedure is used. As above and upon receipt of the call request from the PSTN (PSTN call request), the BSC 11 transfers the information, along with an identifier of the port to the control intercept 13. The control intercept based upon the identify of the port of PSTN trunk group N transfers the information to an associated PSTN port of the MSC 12 on the corresponding channel of communication link V.

If the PSTN call is to a mobile which is being served by BTS 18, then the MSC 12 would allocate a traffic port of the MSC 12 and a traffic channel between the MSC 12 and BSC 11 in support of the PSTN call request. The control intercept 13, at this point, would transmit a signal of a unique pattern or tone on the corresponding channel of communication group V into the MSC 12 and listens for the signal on traffic channels (communication link S) for BSC 11. The control intercept would detect the repeated signal on an allocated channel to BSC 11 and generate a switching command to the BSC 11 requesting interconnection of the PSTN interconnect port providing the PSTN call request with BTS 18.

If, on the other hand, the control intercept 13 were not able to detect the signal on traffic channels (communication link S) for BSC 11. (e.g., the call is for BTS 22) then the control intercept 13 would determine that the call was directed to another BSC 14 and attempt to either re-route the call to the MSC 12 (through trunk group Q) or pass the call through to the MSC 12 via communications links U and V. The control intercept 13 re-routes the call by transfering a PSTN command to the calling port of PSTN

group N requesting that the call be re-routed to PSTN trunk group Q.

Use of the control intercept 13 beneficially allows calls between BTSs and PSTN subscribers to occupy the shortest signal path possible. The use of a local PSTN interconnect with the cellular system allows the system to identify the physical location of a target and shorten signal paths where ever possible. Where signal paths cannot be shortened the control intercept re-routes the PSTN call to the most efficient entry point of the cellular system (the MSC) resulting in toll-call reduction.

The many features and advantages of this invention are apparent from the detailed specification and thus it is intended by the appended claims to cover all such features and advantages of the system which fall within the true spirit and scope of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art (e.g., call transfer from one BSC to another), it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

It is, of course, to be understood that the present invention is, by no means, limited to the specific showing in the drawing, but also comprises any modification within the scope of the appended claims.

Claims

1. A method of routing calls between a PSTN and base station system of a cellular communication system comprising the steps of: associating a port of a mobile switching center of the cellular communication system with a PSTN interconnect port of a PSTN interconnect of the base station system; translating an identifier of the PSTN interconnect port and associated port of the mobile switching center between the mobile switching center and base station system; and exchanging control information between the PSTN interconnect port of the base station system and the associated port of the mobile switching center.

2. The method as in claim 1 further comprising the step of providing a local interconnect between a base transceiver station of the base station system and the PSTN interconnect port of the base station system when a call involves a base transceiver station of the base station system.

3. The method as in claim 1 further comprising the step of re-routing the call within the PSTN when a call does not involve a base transceiver station of the base station system.

4. A apparatus for routing calls between a PSTN and a base site comprising: means for associating a port of a mobile switching center with a PSTN interconnect port of a PSTN interconnect of the base site; means for translating an identifier of one of the mobile switching center ports and the associated PSTN interconnect port of the base site between the mobile switching center and base site; and means for exchanging control information between the associated PSTN interconnect of the base site and the mobile switching center.

5. The apparatus as in claim 4 wherein the means for associating a port of a mobile switching center with a PSTN interconnect port of the base site further comprises, when a call request is from the base site, means for associating a PSTN port of a mobile switching center to PSTN control link, of the mobile switching center, with a port of the PSTN interconnect of the base site.

6. The apparatus as in claim 4 wherein the means for associating a port assignment of a mobile switching center with a PSTN interconnect port of the base site further comprises, when a call request is from the PSTN, means for associating a call assignment to the base site on a traffic port of the mobile switching center with the call request on a PSTN interconnect port of the PSTN interconnect at the base site.

7. The apparatus as in claim 4 wherein the means for translating an identifier of one of the mobile switching center port and the associated PSTN interconnect port of the base site between the mobile switching center and base site further comprises, when a call request is from the PSTN, means for translating the identity of the PSTN interconnect port to a designated port of a mobile switching center to PSTN control link.

8. The apparatus as in claim 7 wherein the means for exchanging control information between a PSTN interconnect at the base site and a mobile switching center further comprises means for transferring the call request from the PSTN to the designated port of the mobile switching center to PSTN control link.

9. A method of providing a local PSTN interconnect, in support of a call involving a local PSTN subscriber, to a base station system within a cellular communication system also having a mobile switching center, such method comprising

the steps of: detecting, by the base station system, a call request at the mobile switching center involving a PSTN subscriber local to the base station system and a communication unit, also local to the base station system; and allocating a local PSTN interconnect between the local PSTN subscriber and local communication unit.

10. A method of providing a local PSTN interconnect, in support of a call involving a local PSTN subscriber, to a base station system within a cellular communication system having a plurality of base station systems operatively connected to a mobile switching center, such method comprising the steps of: operatively connecting a control intercept between the mobile switching center and plurality of base station systems; detecting a request for a call between a communication unit located within a base station system, of the plurality of base station systems, and a PSTN subscriber local to the base station system; and allocating a PSTN interconnect local to the base station system in support of the call between the PSTN subscriber and communication unit.

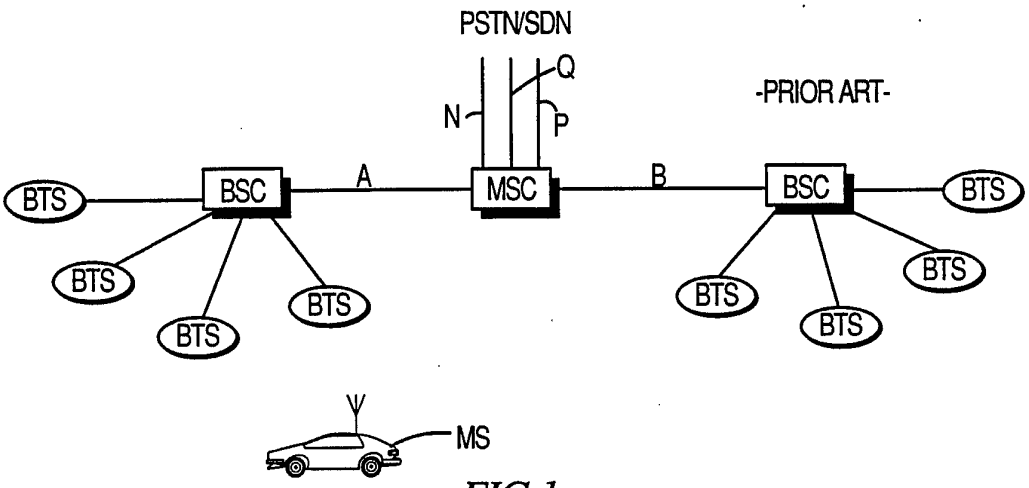

PSTN/SDN
Q
N
P
-PRIOR ART-
BTS
BSC
A
MSC
B
BSC
BTS
BTS
BTS
BTS
BTS
BTS
BTS
V
MS

FIG.1

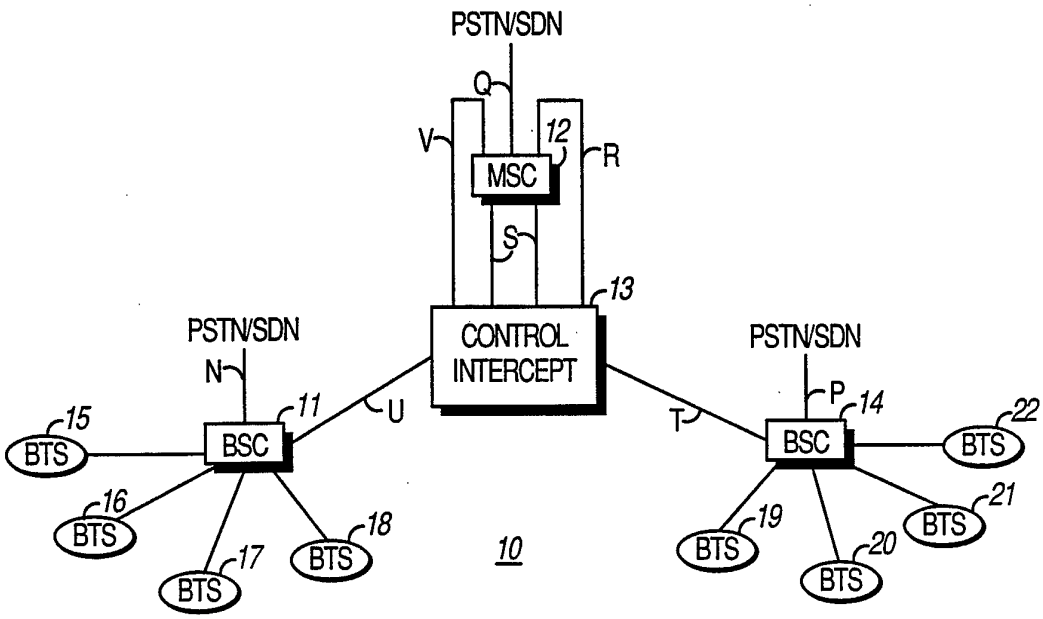

PSTN/SDN
Q
V
12
MSC
R
S
13
CONTROL
INTERCEPT
PSTN/SDN
N
PSTN/SDN
P
15
11
U
T
14
22
BTS
BSC
BSC
BTS
16
BTS
18
BTS
21
BTS
17
BTS
19
BTS
20
BTS
10

FIG.2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/06955

A. CLASSIFICATION OF SUBJECT MATTER

IPC(5) :H04M 11/00
US CL :379/59, 63

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 379/59, 63; 455/33.1

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 practicable, 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.
A	US, A, 4,163,121 (YOSHIKAWA ET AL.) 31 July 1979; see figures 1-3.	1-5, 9
X -- Y	US, A, 5,036,531 (SPEAR) 30 JULY 1991; see entire document.	9 -- 10
A	US, A, 4,833,701 (COMROE ET AL.) 23 May 1989; see figure 1, and column 6, line 56 through column 7, line 4.	10
A	US, A, 4,726,014 (GOLDMAN et al.) 16 February 1988; see figure 8; column 6, line 66 through column 7, line 11, and lines 36-44.	1-10

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"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
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"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)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 01 AUGUST 1994	Date of mailing of the international search report 06 OCT 1994
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer Dwayne Bost Telephone No. (703) 305-4778

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US94/06955

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, A, 4,562,572 (GOLDMAN et al.) 31 December 1985; see column 6, line 56 through column 7, line 57.	1-10