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Giallorenzi et al.

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[54] **NON-RECURSIVELY GENERATED ORTHOGONAL PN CODES FOR VARIABLE RATE CDMA**

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[73] Assignee: **L-3 Communications Corporation**, New York, N.Y.

[21] Appl. No.: **09/329,473**

[22] Filed: **Jun. 10, 1999**

Related U.S. Application Data

[63] Continuation-in-part of application No. 09/328,546, Jun. 9, 1999.
[60] Provisional application No. 60/091,070, Jun. 29, 1998.

[51] **Int. Cl.**[7] **H04B 7/216**
[52] **U.S. Cl.** **375/140**; 370/208; 370/342
[58] **Field of Search** 375/130, 140, 375/141, 145, 146; 370/203, 208, 320, 335, 342, 441, 479

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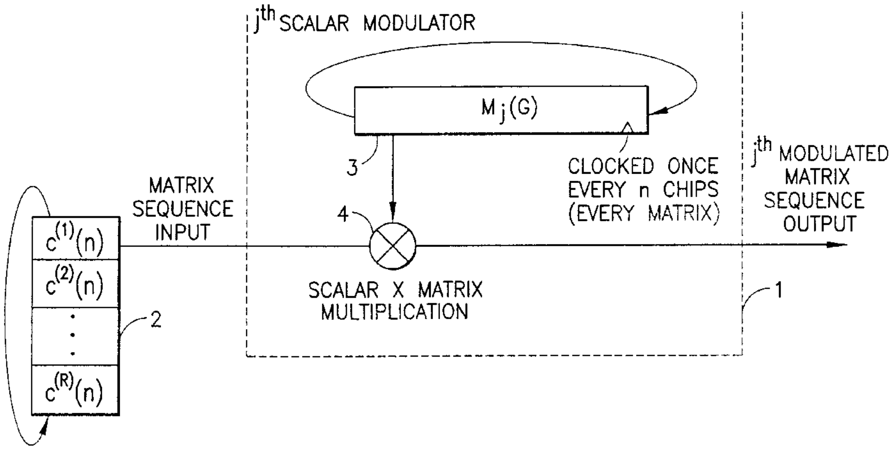
Primary Examiner—Young T. Tse
Attorney, Agent, or Firm—Perman & Green, LLP

[57] **ABSTRACT**

A method and apparatus for constructing a series of PN code sets that can be used for multirate synchronous and quasi-synchronous CDMA systems. The construction technique produces PN codes that are balanced, and that furthermore do not require any synchronization of neighboring base stations. The method is a non-recursive method that uses a permuted orthogonal matrix to modulate permuted orthogonal matrices to create PN codes that support multirate operation. Furthermore, the codes constructed using the method have very good spectral properties (if chosen properly) when the code length, n, is reasonably large.

20 Claims, 13 Drawing Sheets



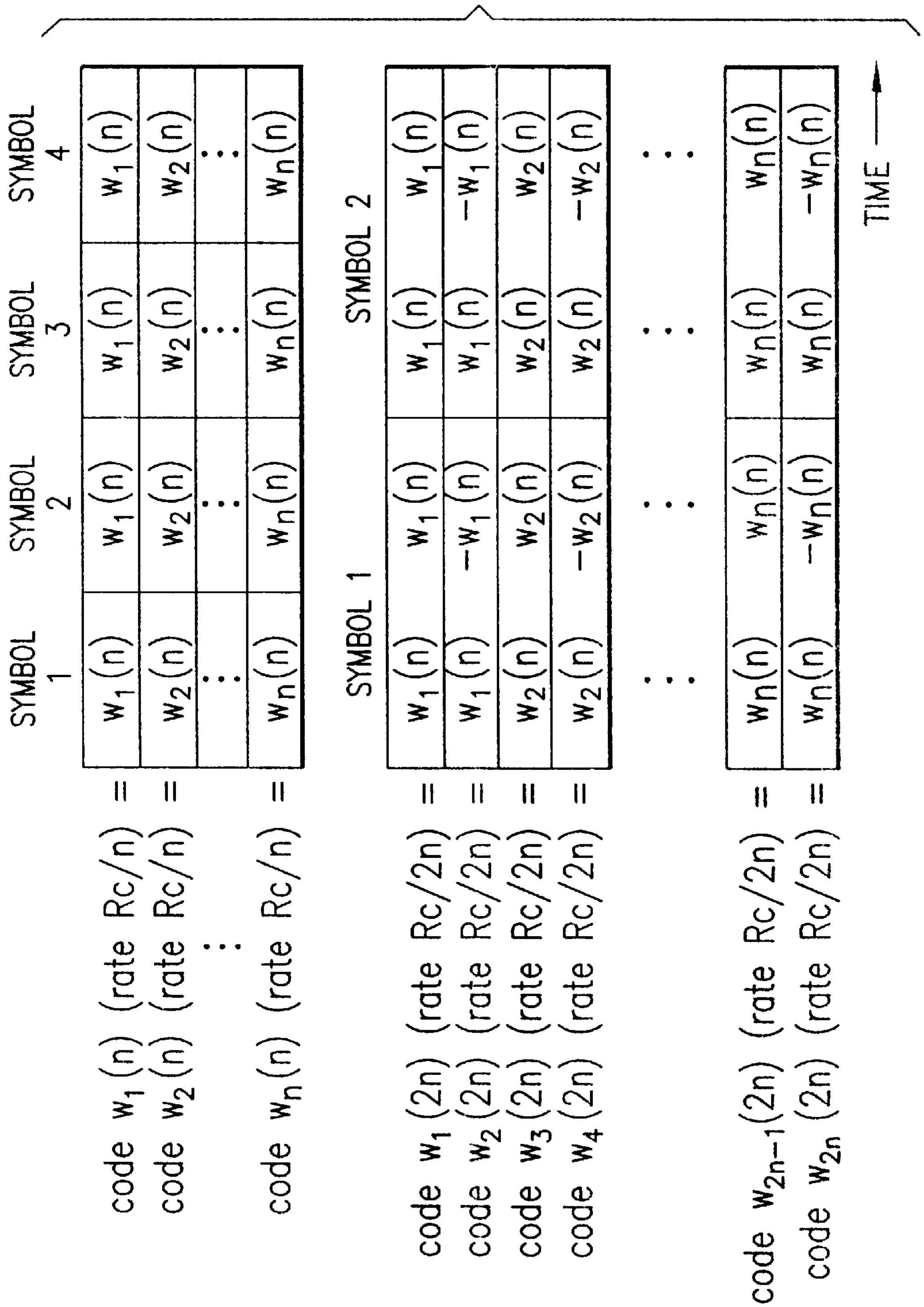


FIG. 1a
PRIOR ART

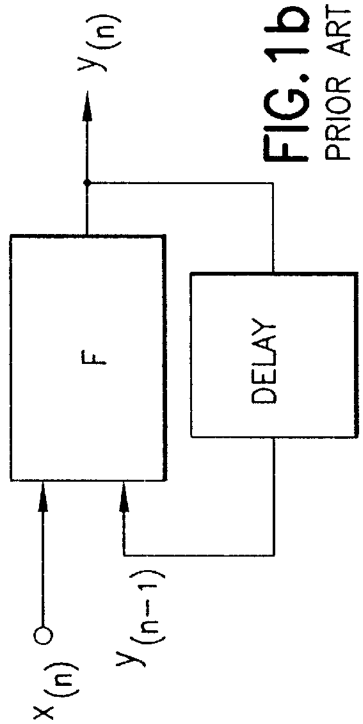


FIG. 1b
PRIOR ART

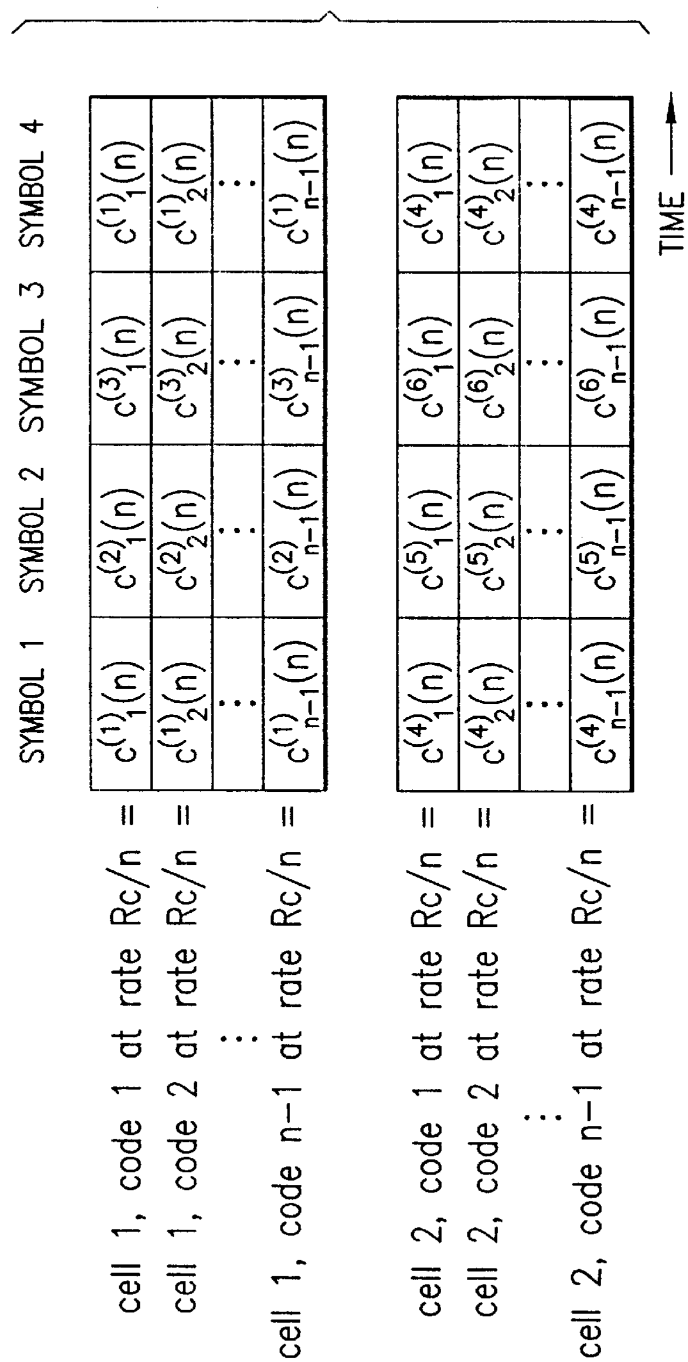


FIG. 2

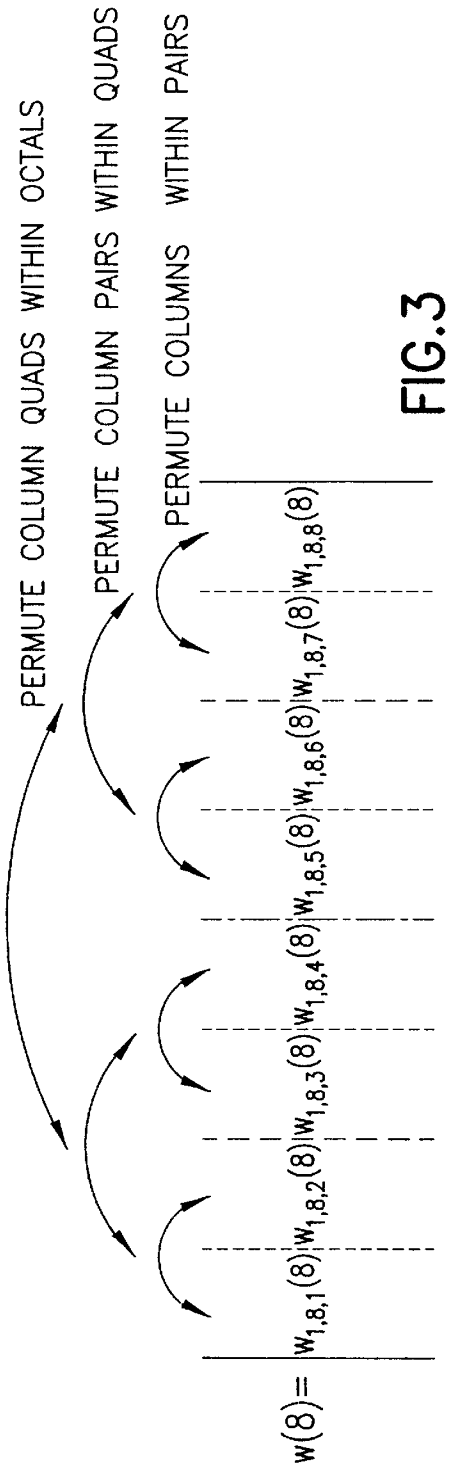

PERMUTE COLUMN QUADS WITHIN OCTALS
PERMUTE COLUMN PAIRS WITHIN QUADS
PERMUTE COLUMNS WITHIN PAIRS
w(8)=
w1,8,1(8)
w1,8,2(8)
w1,8,3(8)
w1,8,4(8)
w1,8,5(8)
w1,8,6(8)
w1,8,7(8)
w1,8,8(8)

FIG.3

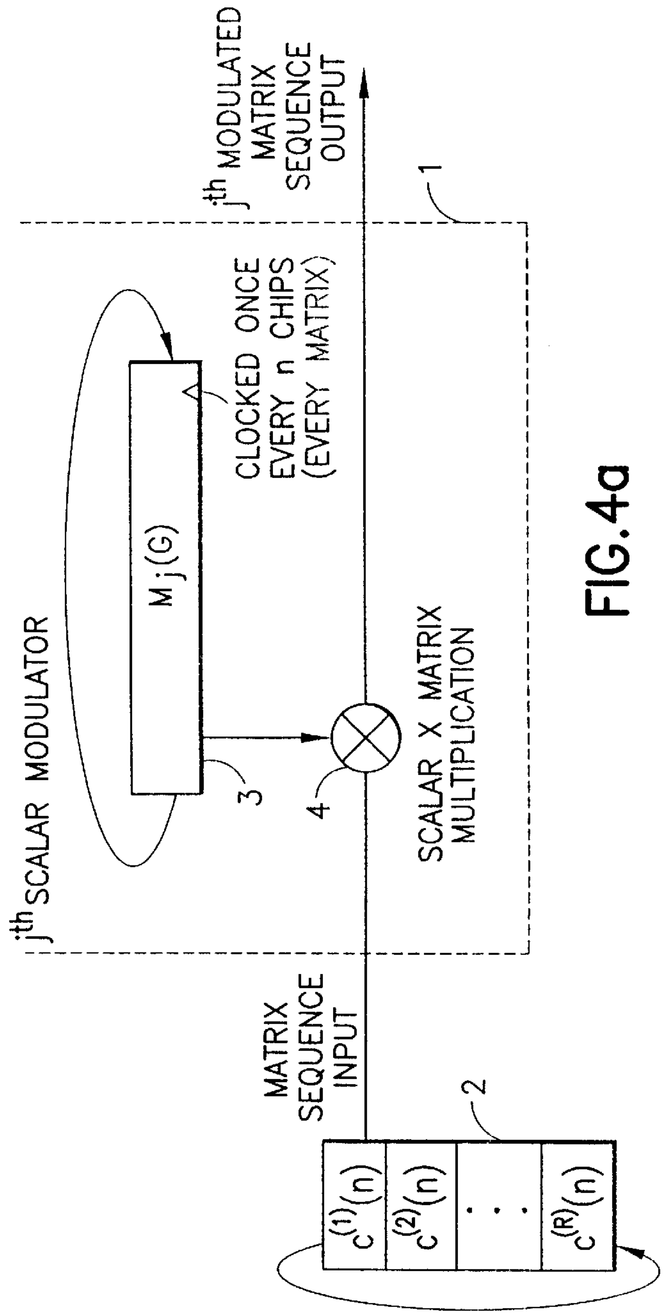

jth MODULATED MATRIX SEQUENCE OUTPUT
1
CLOCKED ONCE EVERY n CHIPS (EVERY MATRIX)
Mj(G)
jth SCALAR MODULATOR
3
4
SCALAR X MATRIX MULTIPLICATION
MATRIX SEQUENCE INPUT
2
c(1)(n)
c(2)(n)
. . .
c(R)(n)

FIG.4a

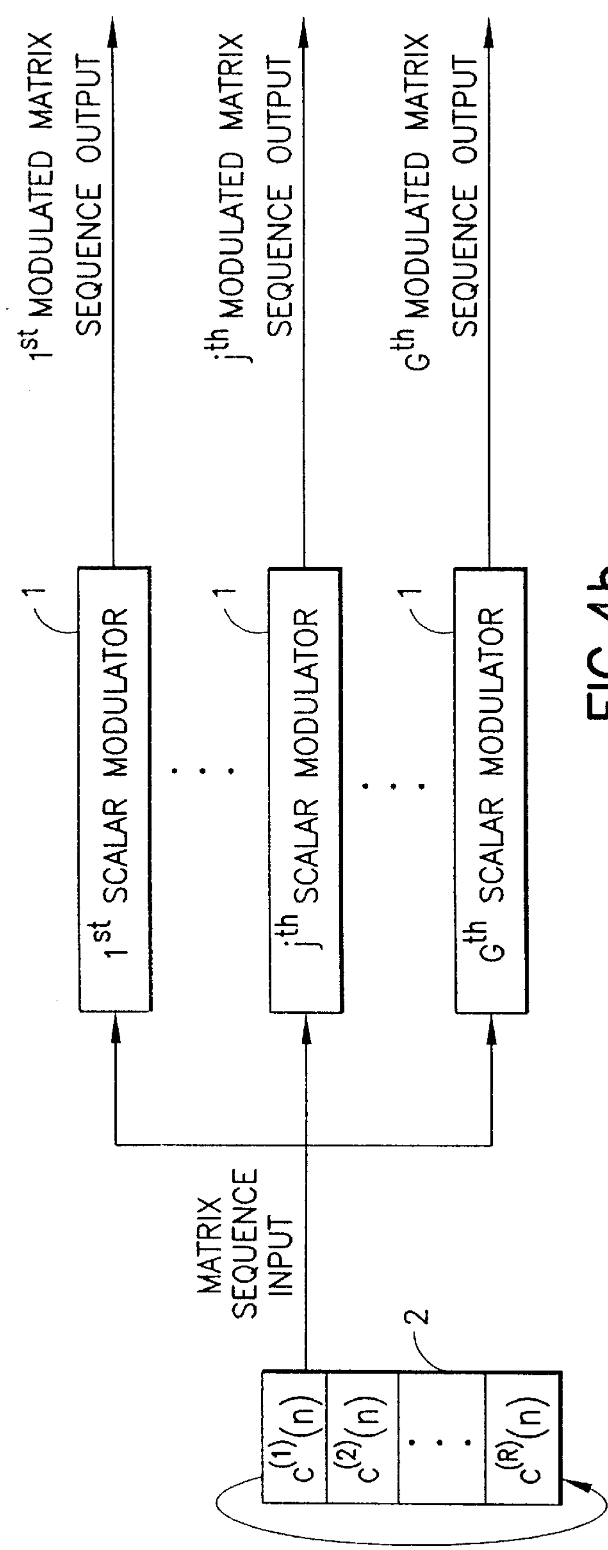

1st MODULATED MATRIX SEQUENCE OUTPUT
jth MODULATED MATRIX SEQUENCE OUTPUT
Gth MODULATED MATRIX SEQUENCE OUTPUT
1
1st SCALAR MODULATOR
jth SCALAR MODULATOR
Gth SCALAR MODULATOR
MATRIX SEQUENCE INPUT
2
c(1)(n)
c(2)(n)
c(R)(n)

FIG.4b

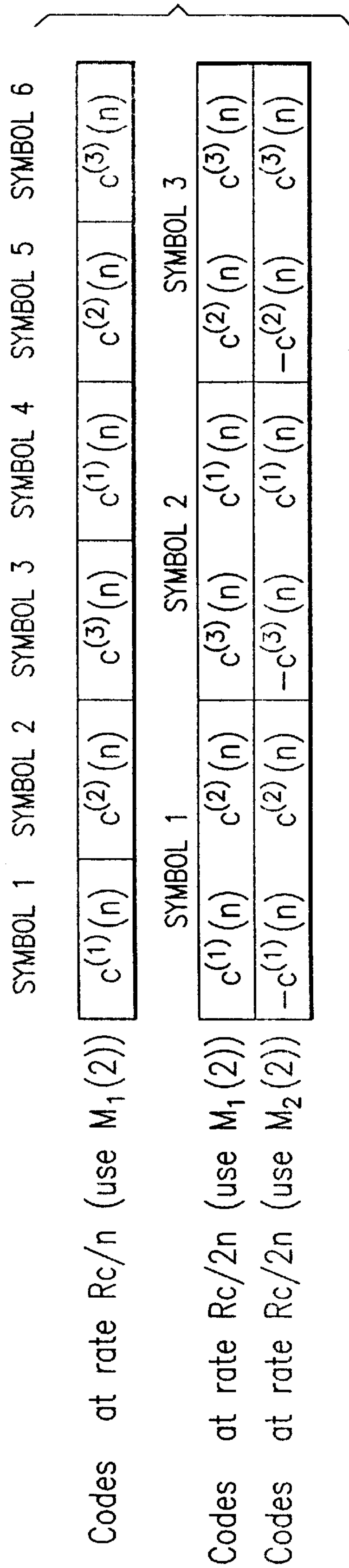

SYMBOL 1
SYMBOL 2
SYMBOL 3
SYMBOL 4
SYMBOL 5
SYMBOL 6
Codes at rate Rc/n (use M1(2))
c(1)(n) c(2)(n) c(3)(n) c(1)(n) c(2)(n) c(3)(n)
Codes at rate Rc/2n (use M1(2))
c(1)(n) c(2)(n) c(3)(n) c(1)(n) c(2)(n) c(3)(n)
Codes at rate Rc/2n (use M2(2))
−c(1)(n) c(2)(n) −c(3)(n) c(1)(n) −c(2)(n) c(3)(n)

FIG.5

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