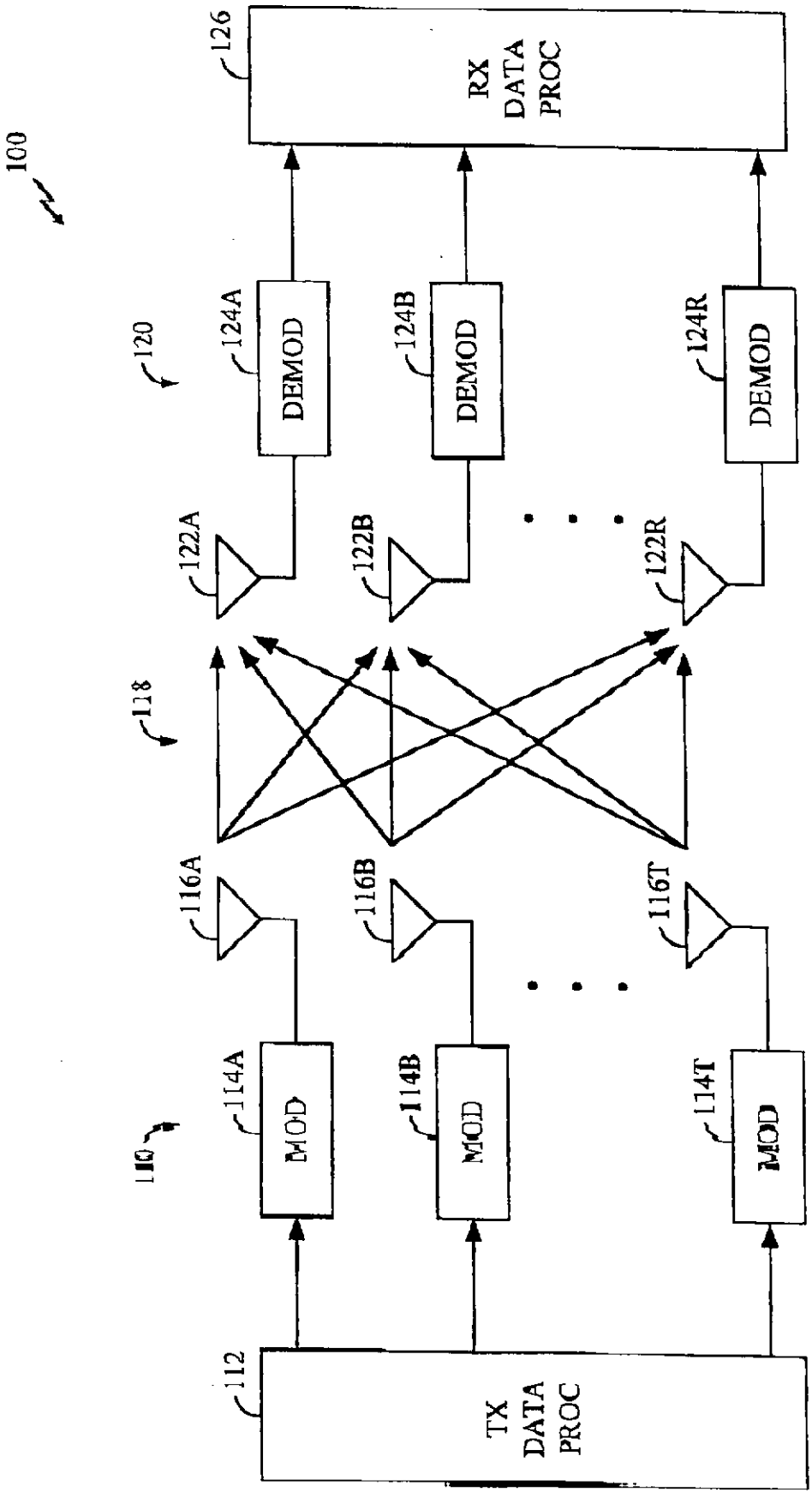
100
110
112
TX DATA PROC
114A
MOD
114B
MOD
114T
MOD
116A
116B
116T
118
120
122A
122B
122R
124A
DEMOD
124B
DEMOD
124R
DEMOD
126
RX DATA PROC

FIG. 1A

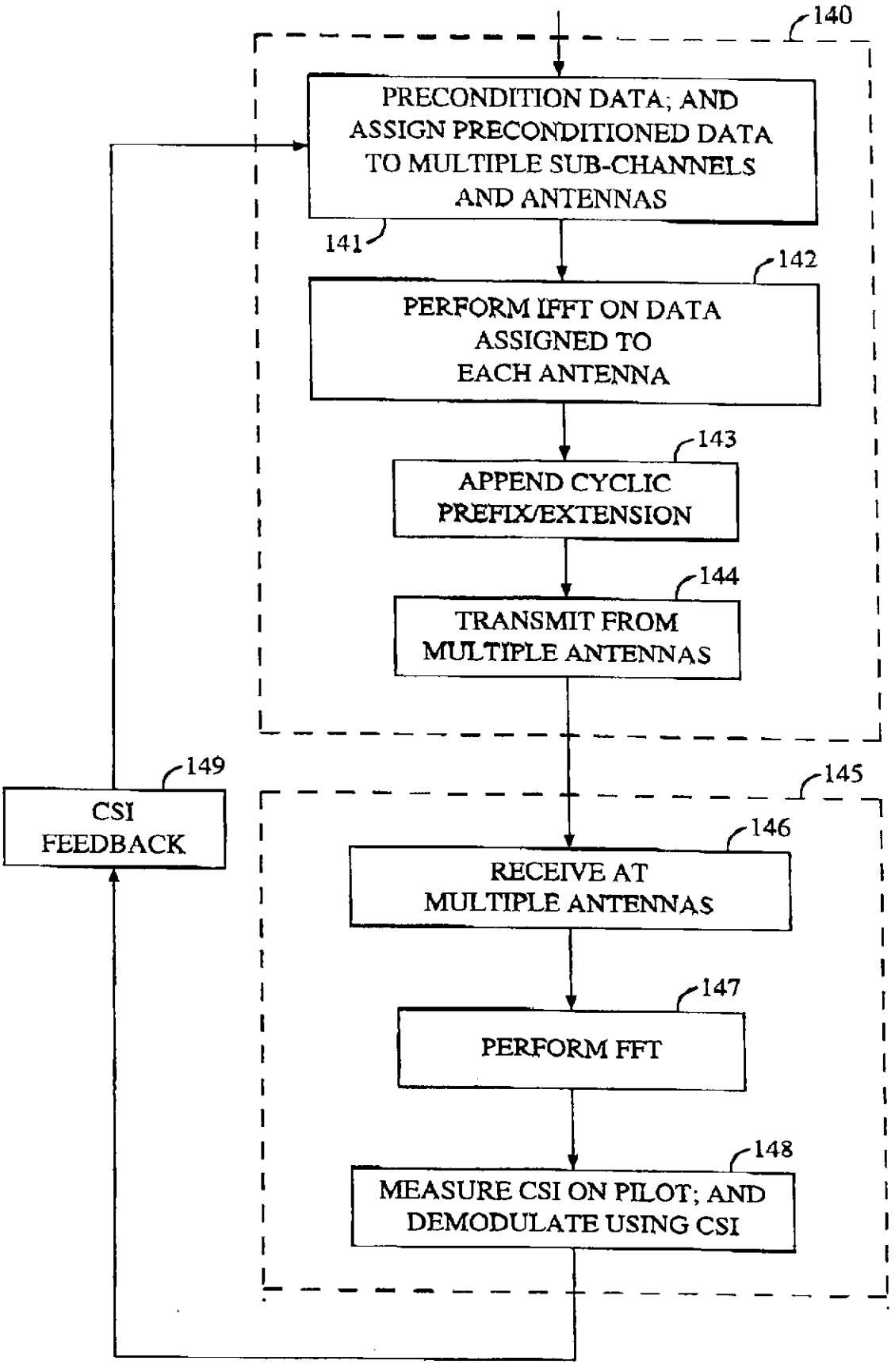
140
PRECONDITION DATA; AND ASSIGN PRECONDITIONED DATA TO MULTIPLE SUB-CHANNELS AND ANTENNAS
141
142
PERFORM IFFT ON DATA ASSIGNED TO EACH ANTENNA
143
APPEND CYCLIC PREFIX/EXTENSION
144
TRANSMIT FROM MULTIPLE ANTENNAS
145
146
RECEIVE AT MULTIPLE ANTENNAS
147
PERFORM FFT
148
MEASURE CSI ON PILOT; AND DEMODULATE USING CSI
149
CSI FEEDBACK

FIG. 1B

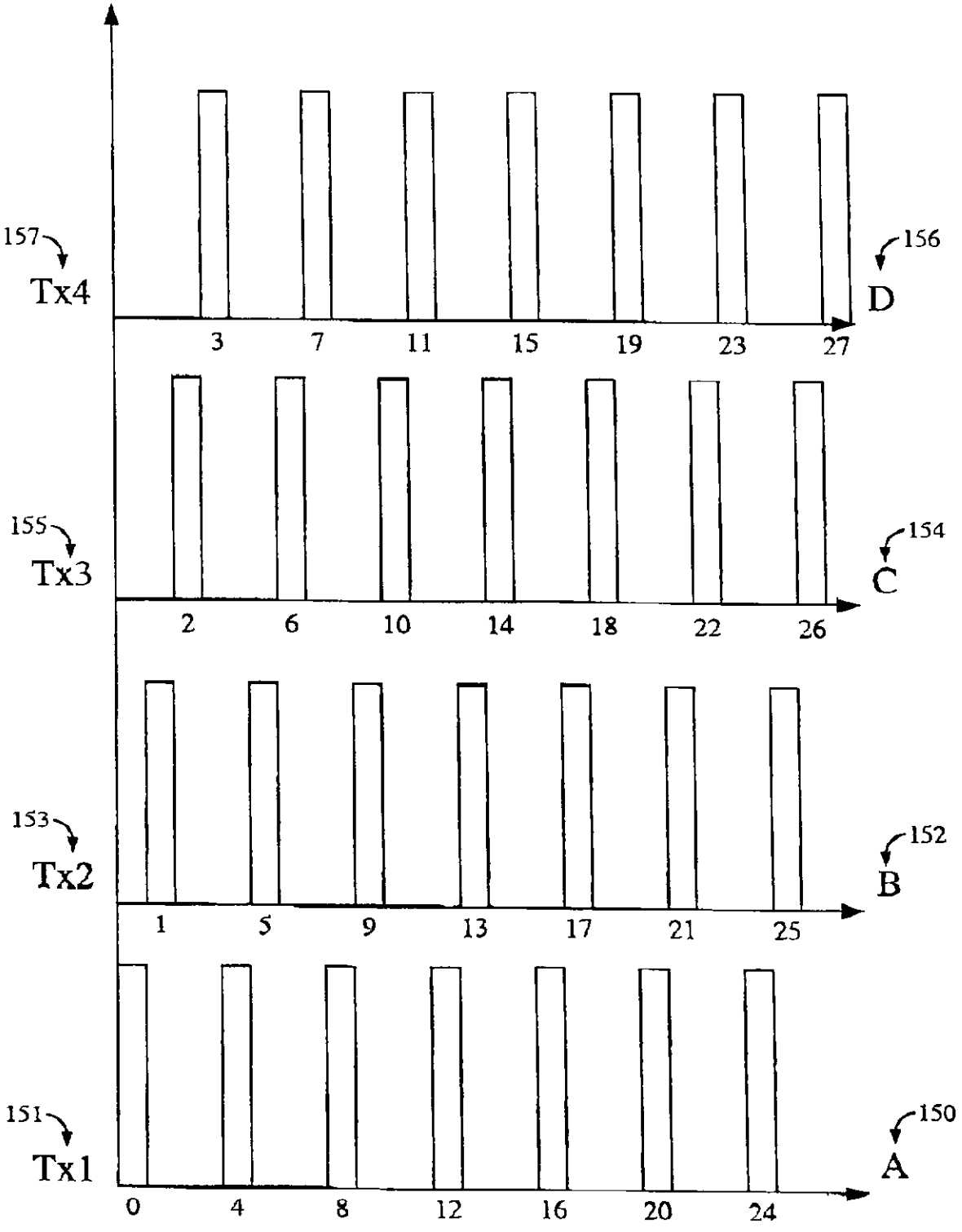
157
Tx4
156
D
3
7
11
15
19
23
27
155
Tx3
154
C
2
6
10
14
18
22
26
153
Tx2
152
B
1
5
9
13
17
21
25
151
Tx1
150
A
0
4
8
12
16
20
24
OFDM SUB-CHANNELS

FIG. 1C

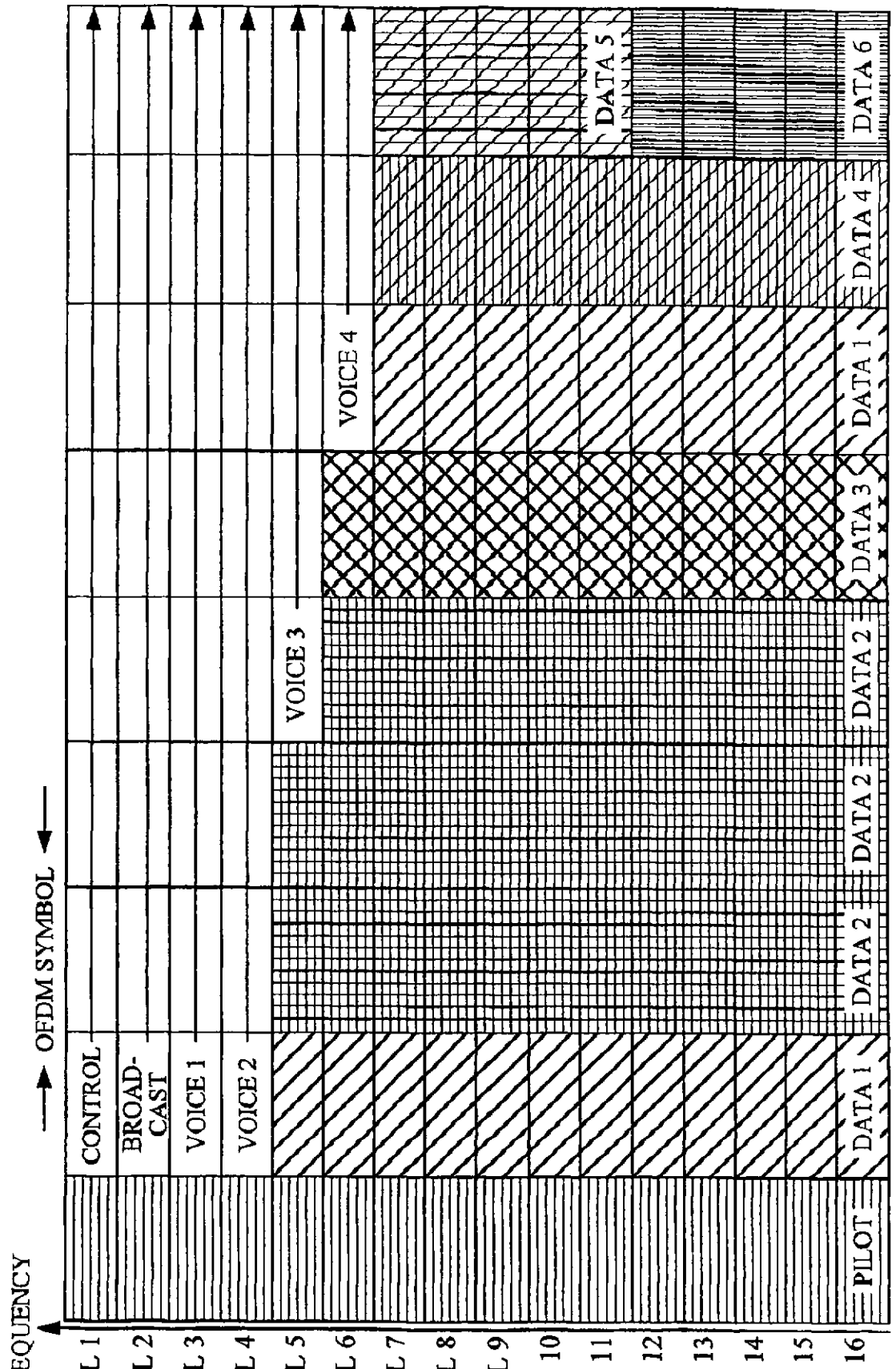
FREQUENCY
OFDM SYMBOL
SUB-CHANNEL 1
SUB-CHANNEL 2
SUB-CHANNEL 3
SUB-CHANNEL 4
SUB-CHANNEL 5
SUB-CHANNEL 6
SUB-CHANNEL 7
SUB-CHANNEL 8
SUB-CHANNEL 9
SUB-CHANNEL 10
SUB-CHANNEL 11
SUB-CHANNEL 12
SUB-CHANNEL 13
SUB-CHANNEL 14
SUB-CHANNEL 15
SUB-CHANNEL 16
CONTROL
BROAD-CAST
VOICE 1
VOICE 2
VOICE 3
VOICE 4
PILOT
DATA 1
DATA 2
DATA 3
DATA 4
DATA 5
DATA 6
TS1
TS2
TS3
TS4
TS5
TS6
TS7
TS8
TS9
TIME

FIG. 2

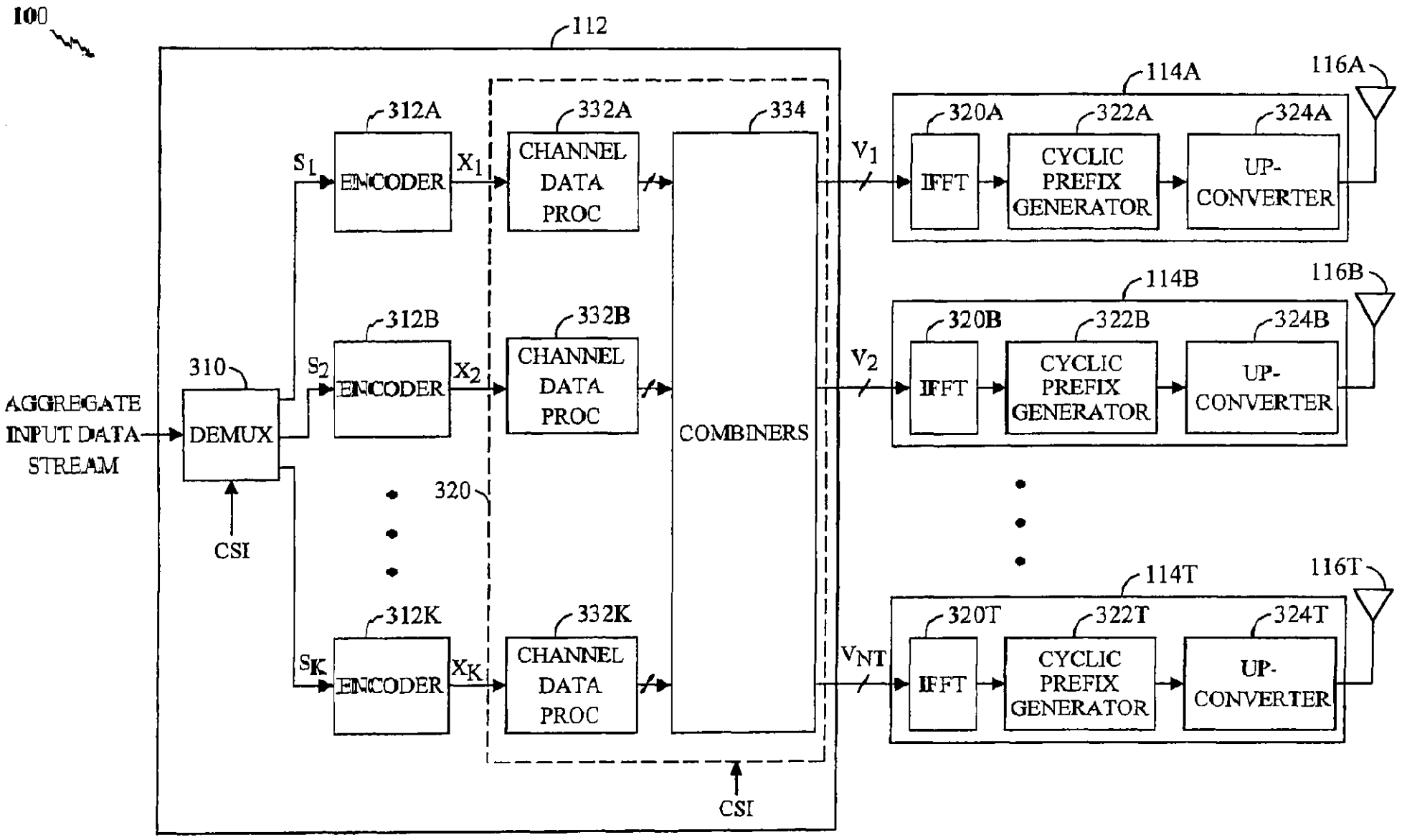
100
112
312A
332A
334
S1
ENCODER
X1
CHANNEL DATA PROC
V1
114A
116A
320A
322A
324A
IFFT
CYCLIC PREFIX GENERATOR
UP-CONVERTER
312B
332B
S2
X2
V2
114B
116B
320B
322B
324B
310
AGGREGATE INPUT DATA STREAM
DEMUX
COMBINERS
CSI
320
312K
332K
SK
XK
VNT
114T
116T
320T
322T
324T

FIG. 3

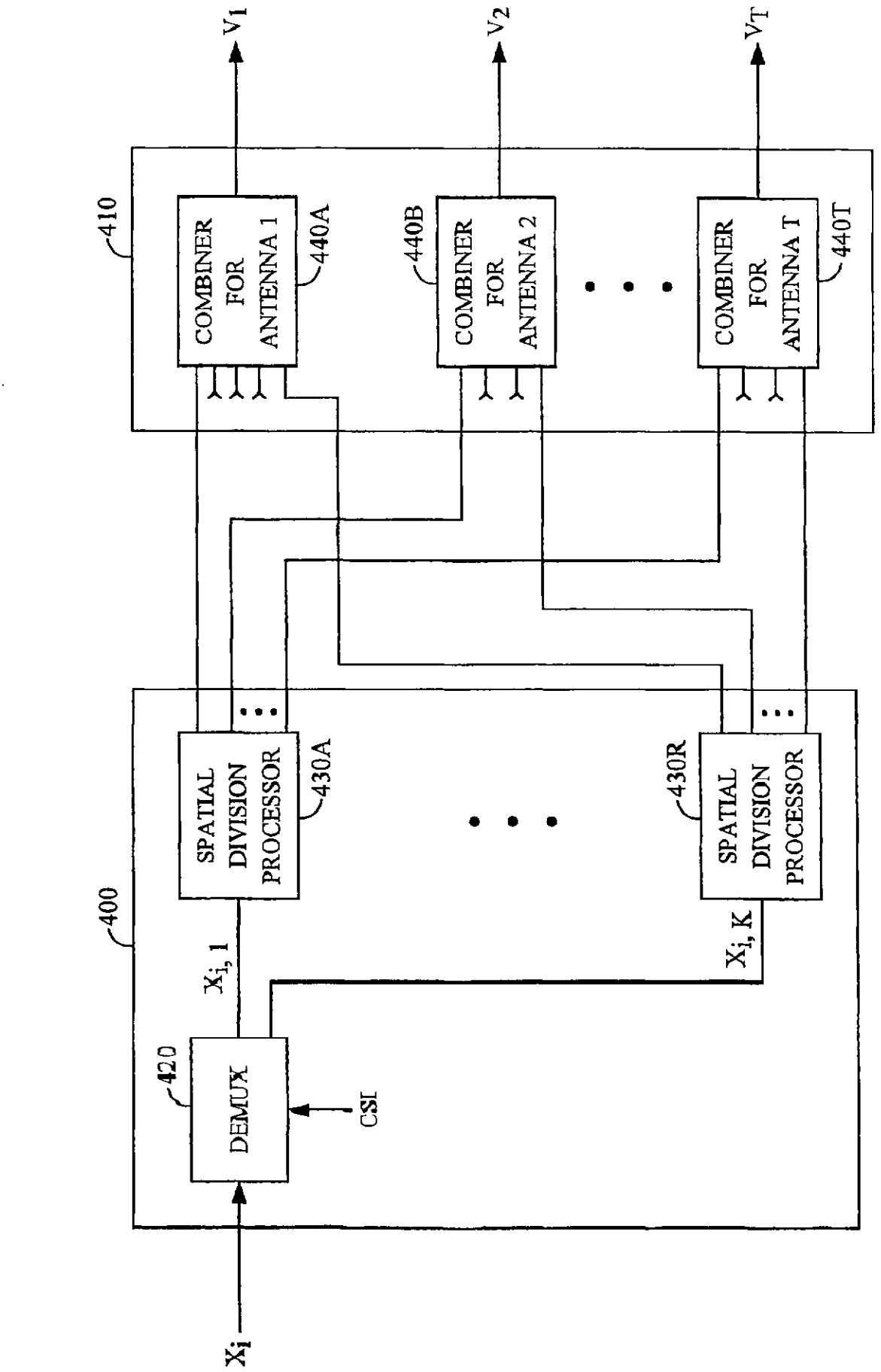
V_1
V_2
V_T
410
COMBINER FOR ANTENNA 1
440A
440B
COMBINER FOR ANTENNA 2
COMBINER FOR ANTENNA T
440T
400
SPATIAL DIVISION PROCESSOR
430A
430R
SPATIAL DIVISION PROCESSOR
$X_{i,1}$
$X_{i,K}$
420
DEMUX
CSI
X_i

FIG. 4A

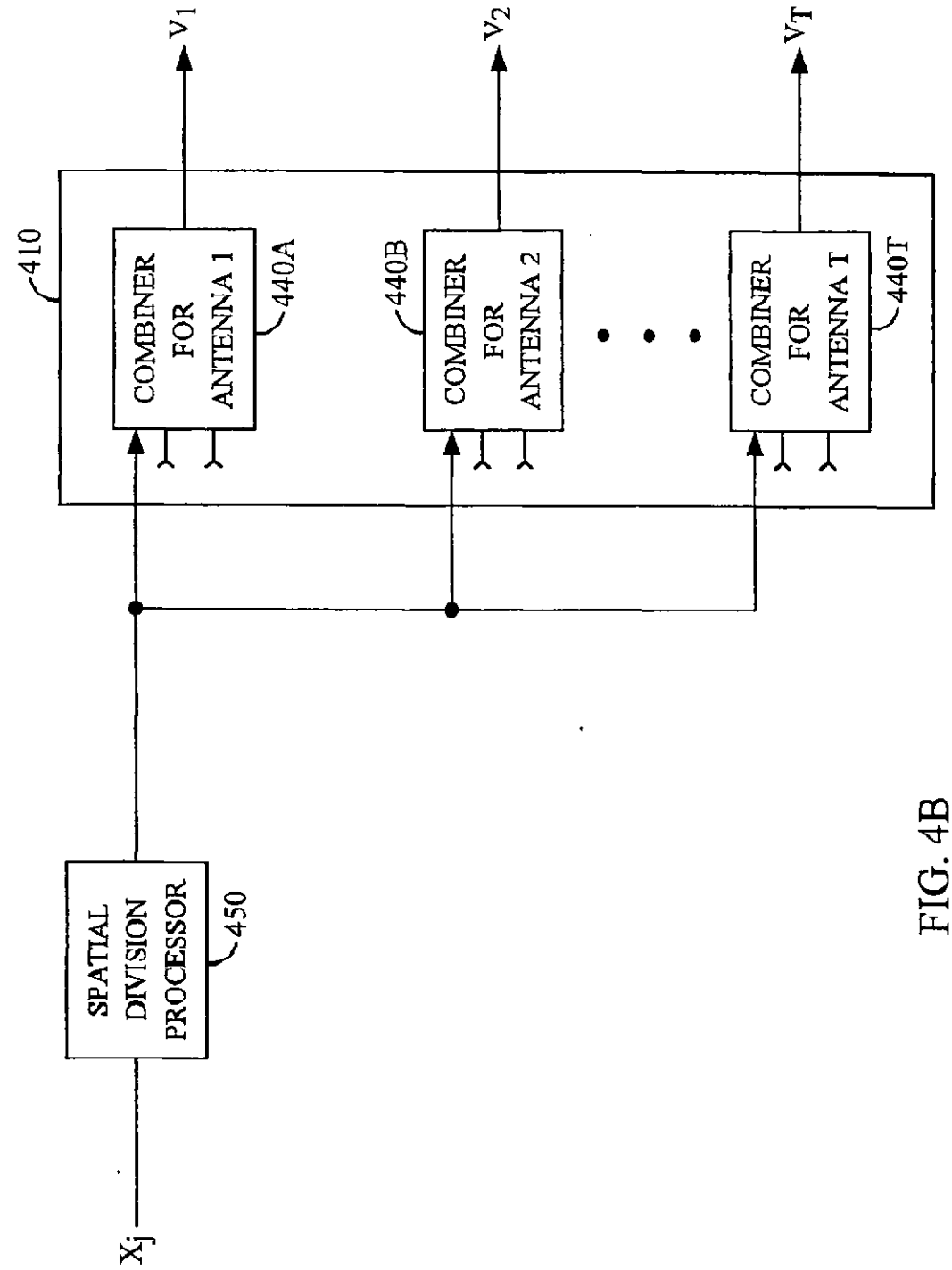
X_j
SPATIAL DIVISION PROCESSOR
450
410
COMBINER FOR ANTENNA 1
440A
COMBINER FOR ANTENNA 2
440B
COMBINER FOR ANTENNA T
440T
V_1
V_2
V_T

FIG. 4B

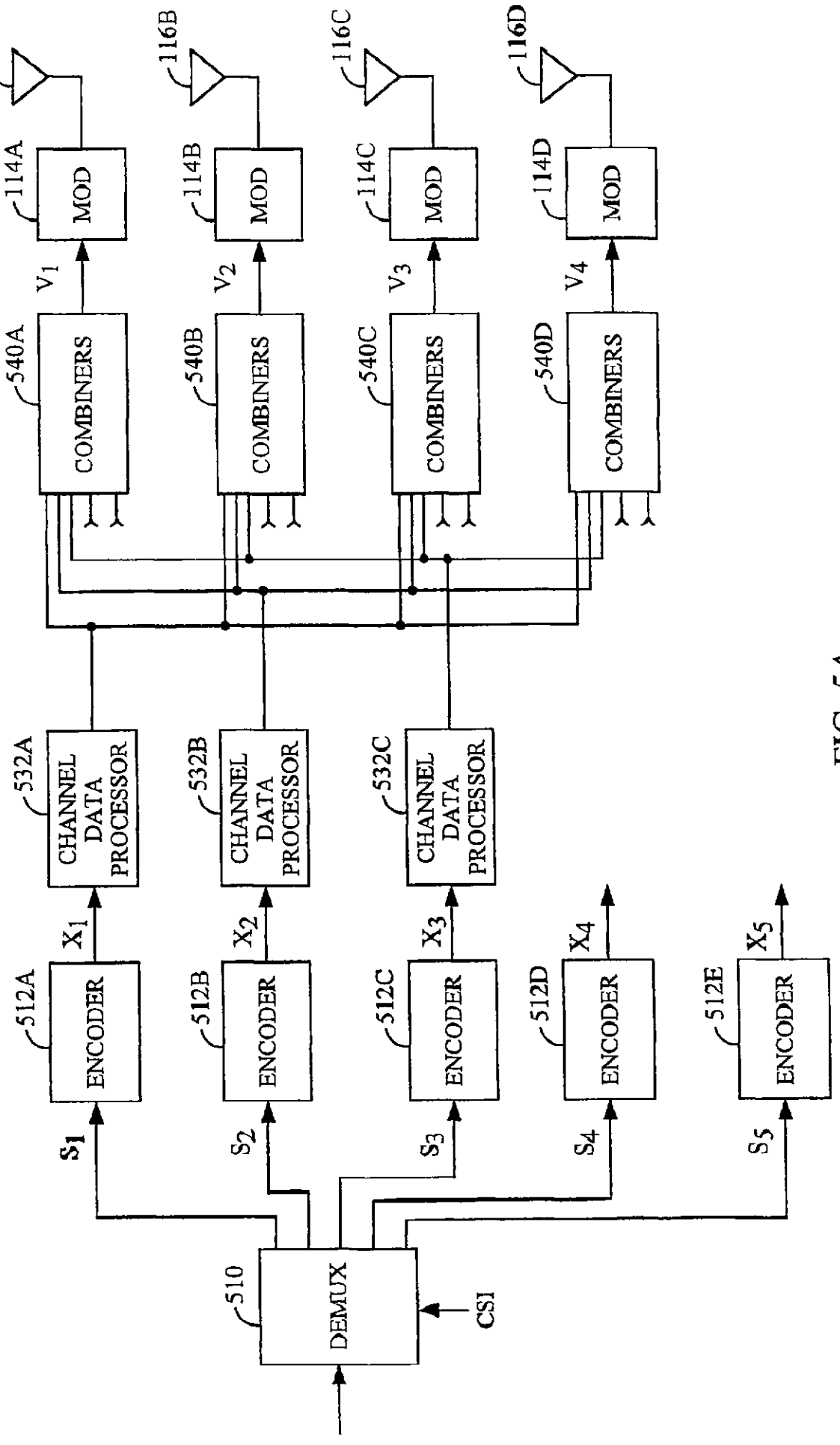
DEMUX
510
CSI
ENCODER
512A
512B
512C
512D
512E
CHANNEL DATA PROCESSOR
532A
532B
532C
COMBINERS
540A
540B
540C
540D
MOD
114A
114B
114C
114D
116A
116B
116C
116D
S1
S2
S3
S4
S5
X1
X2
X3
X4
X5
V1
V2
V3
V4

FIG. 5A

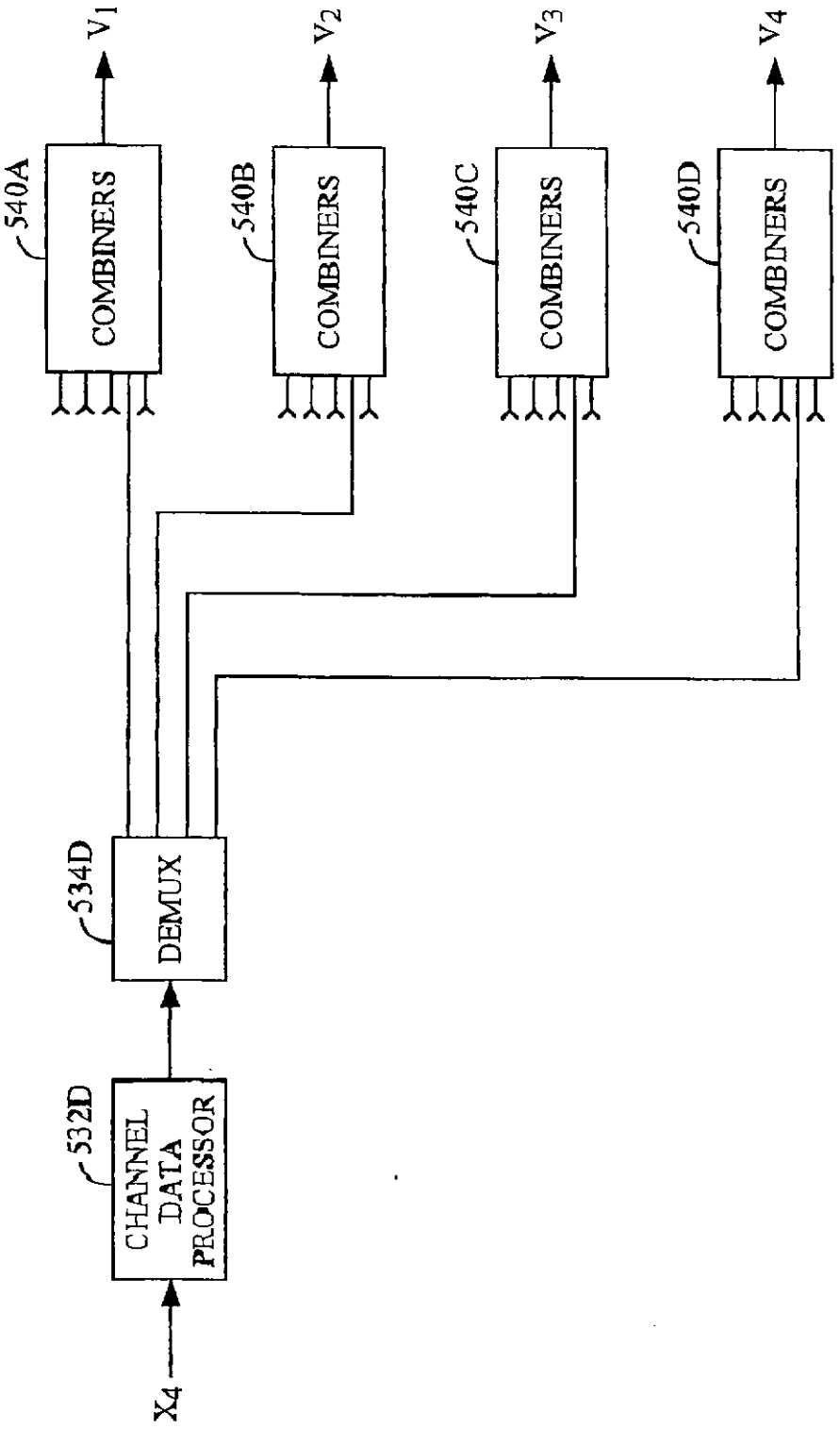
X4
532D
CHANNEL DATA PROCESSOR
534D
DEMUX
540A
COMBINERS
540B
COMBINERS
540C
COMBINERS
540D
COMBINERS
V1
V2
V3
V4

FIG. 5B

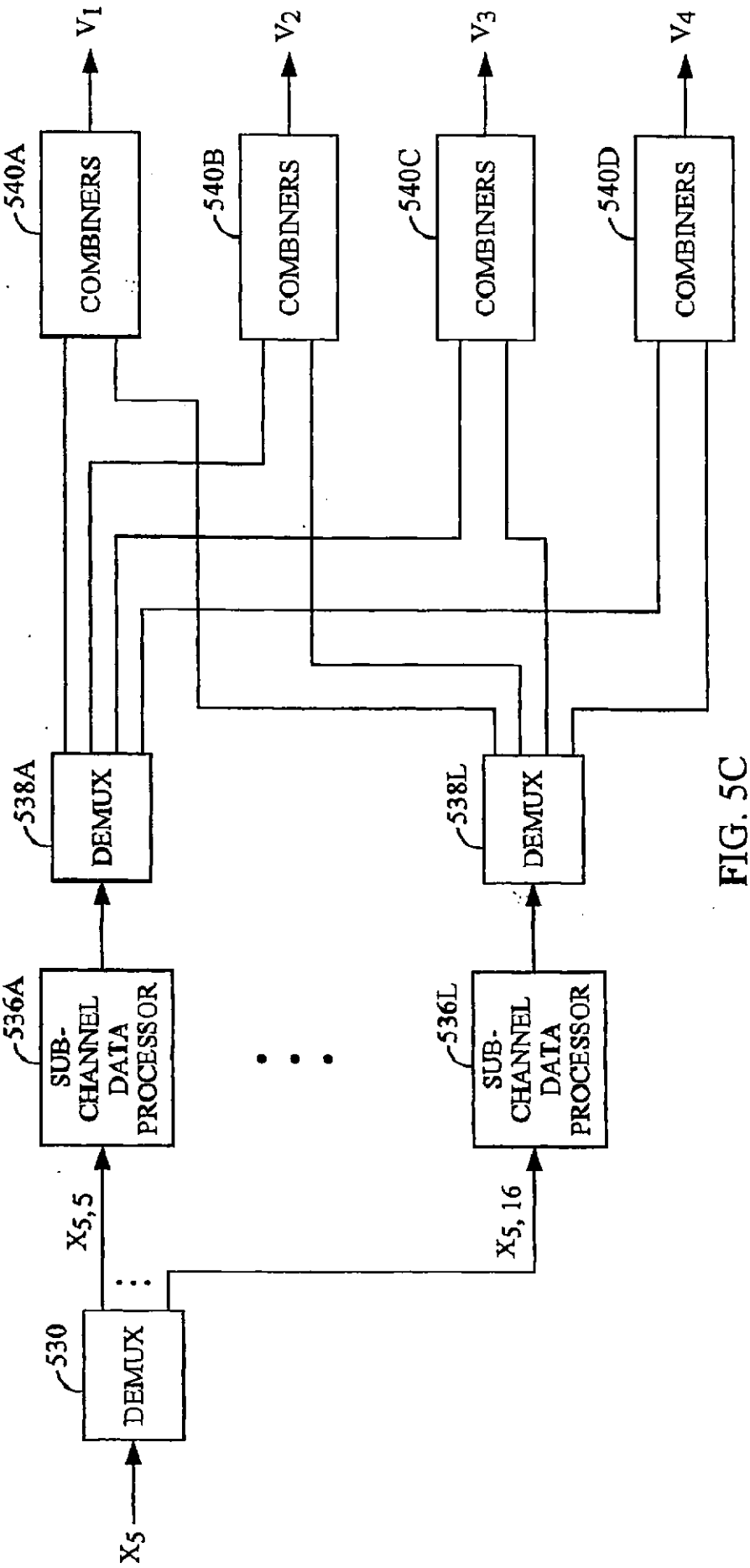
X_5
530
DEMUX
$X_{5,5}$
$X_{5,16}$
536A
SUB-CHANNEL DATA PROCESSOR
536L
SUB-CHANNEL DATA PROCESSOR
538A
DEMUX
538L
DEMUX
540A
COMBINERS
540B
COMBINERS
540C
COMBINERS
540D
COMBINERS
V_1
V_2
V_3
V_4

FIG. 5C

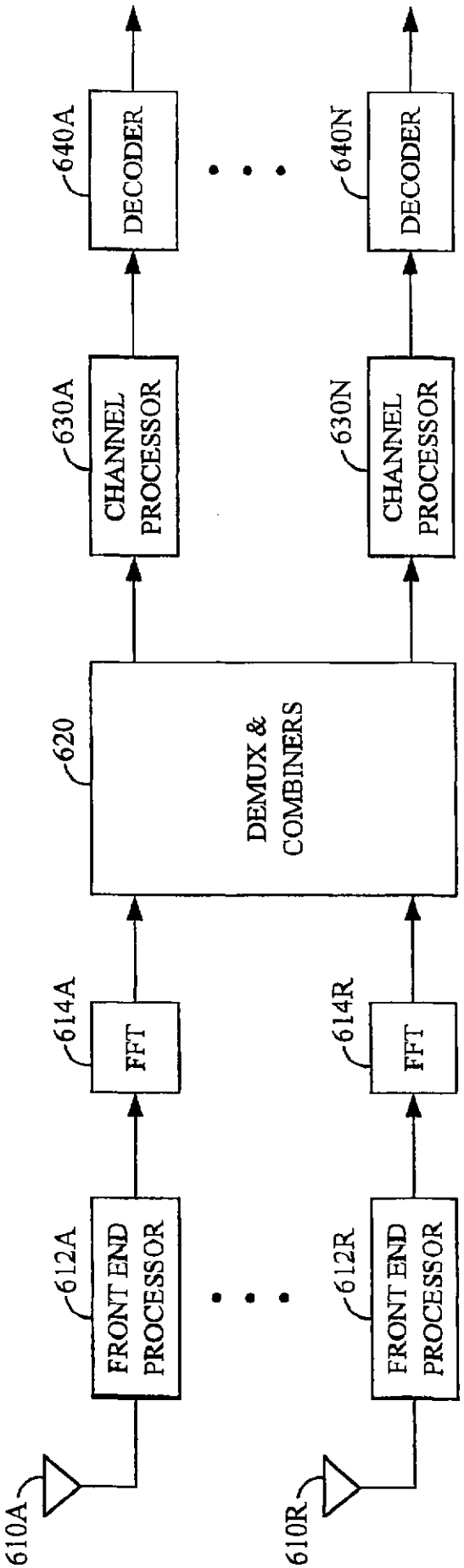
610A
610R
612A
FRONT END PROCESSOR
612R
FRONT END PROCESSOR
614A
FFT
614R
FFT
620
DEMUX & COMBINERS
630A
CHANNEL PROCESSOR
630N
CHANNEL PROCESSOR
640A
DECODER
640N
DECODER

FIG. 6

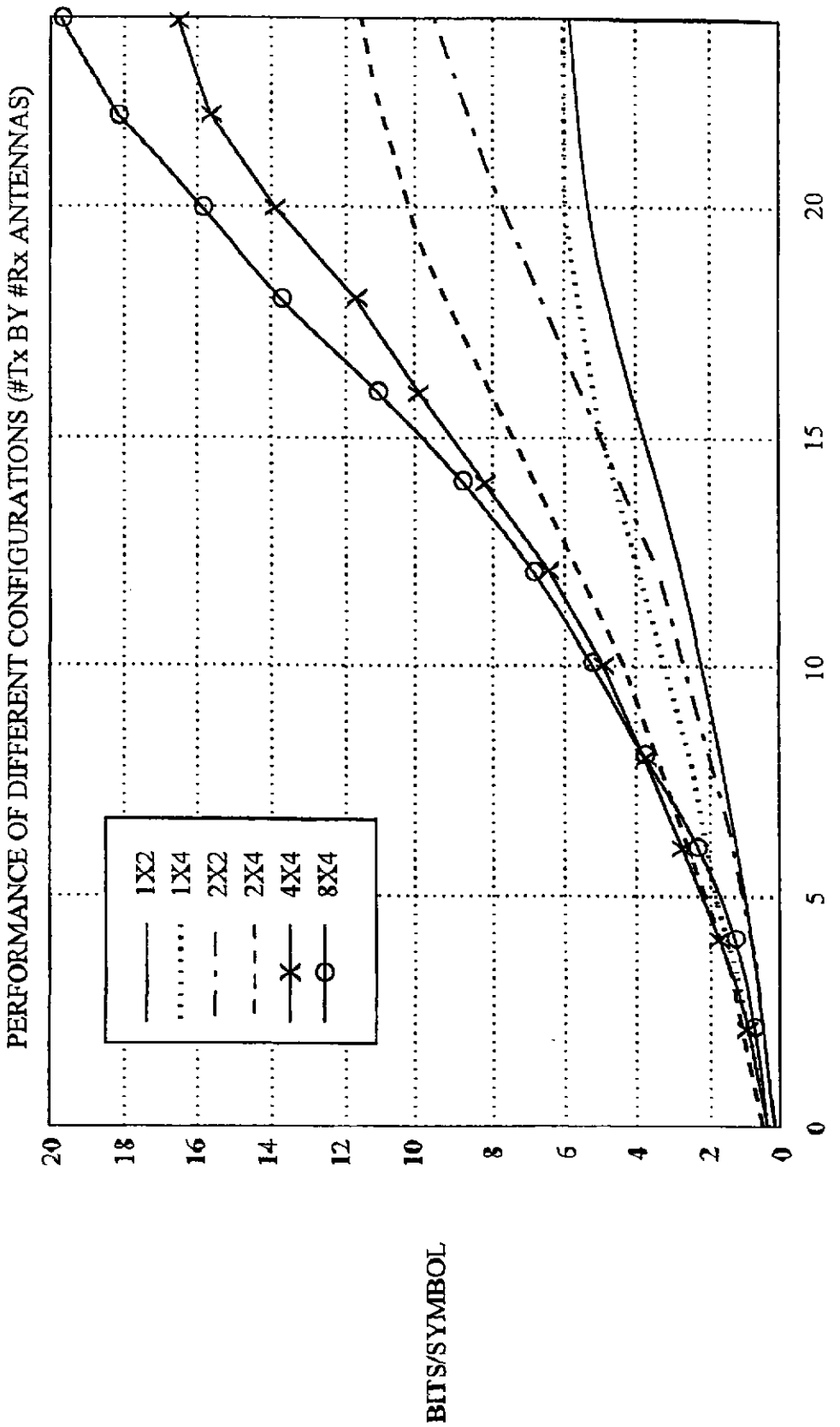
PERFORMANCE OF DIFFERENT CONFIGURATIONS (#Tx BY #Rx ANTENNAS)
1X2
1X4
2X2
2X4
4X4
8X4
BITS/SYMBOL
C/I (dB)
0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20

FIG. 7