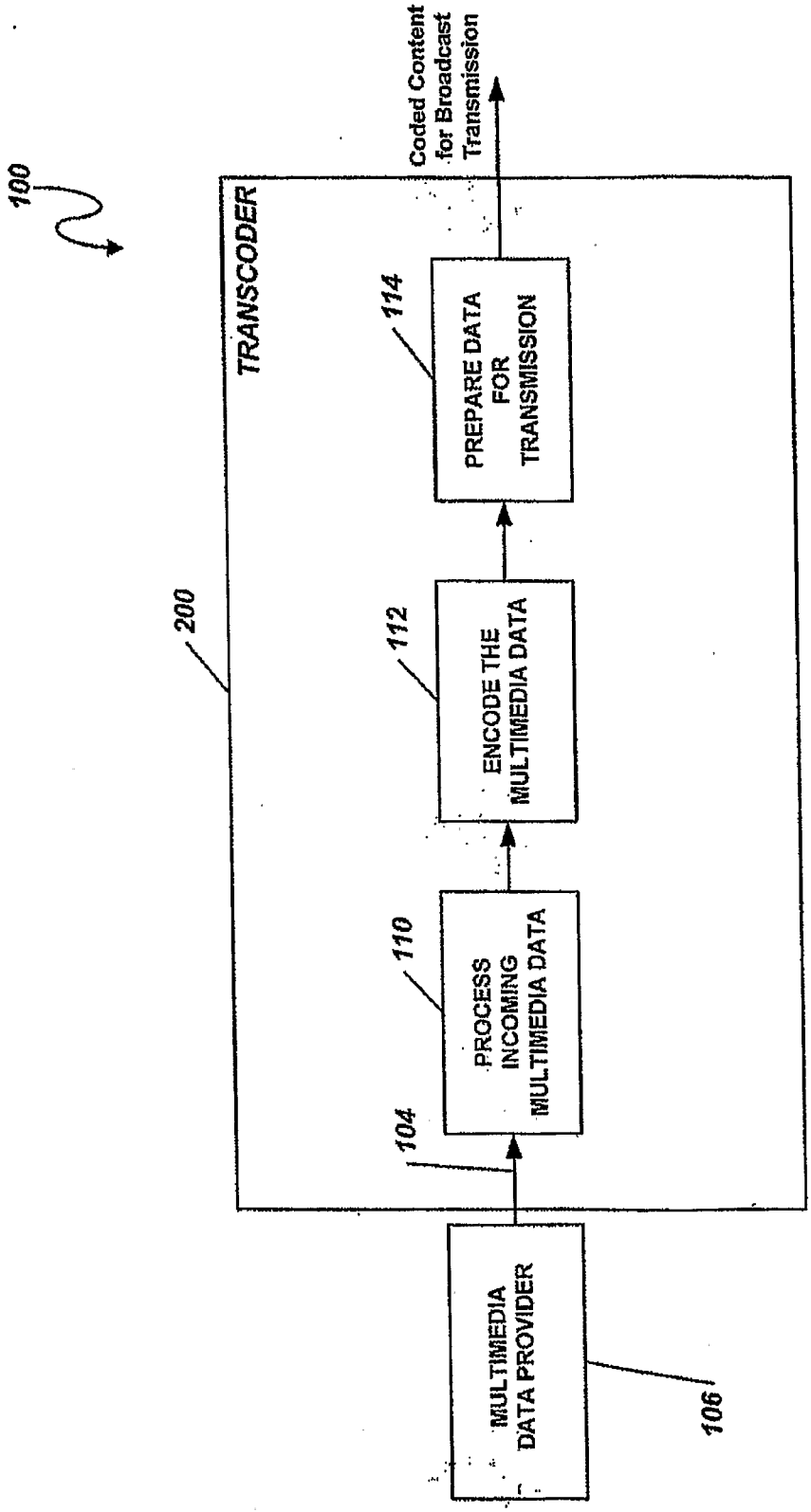

100
TRANSCODER
200
Coded Content for Broadcast Transmission
114
PREPARE DATA FOR TRANSMISSION
112
ENCODE THE MULTIMEDIA DATA
110
PROCESS INCOMING MULTIMEDIA DATA
104
MULTIMEDIA DATA PROVIDER
106

FIG. 1A

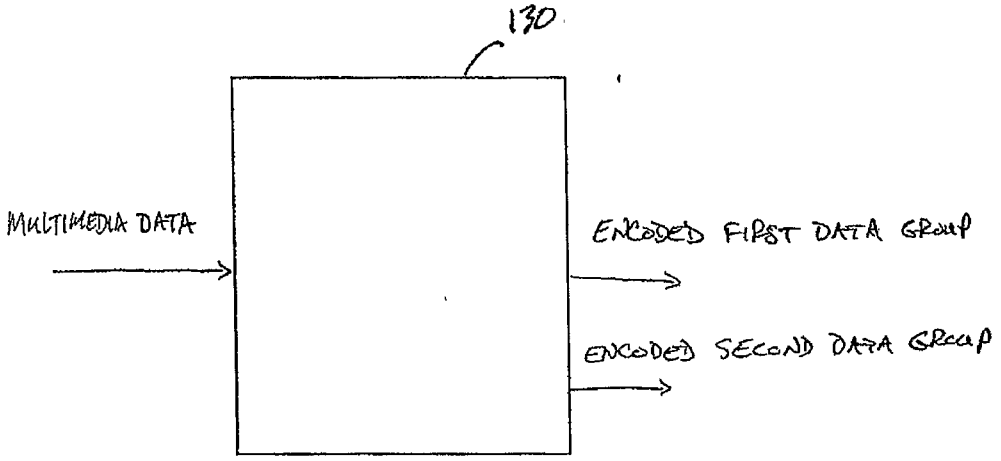

130
MULTIMEDIA DATA
ENCODED FIRST DATA GROUP
ENCODED SECOND DATA GROUP

FIG. 1B

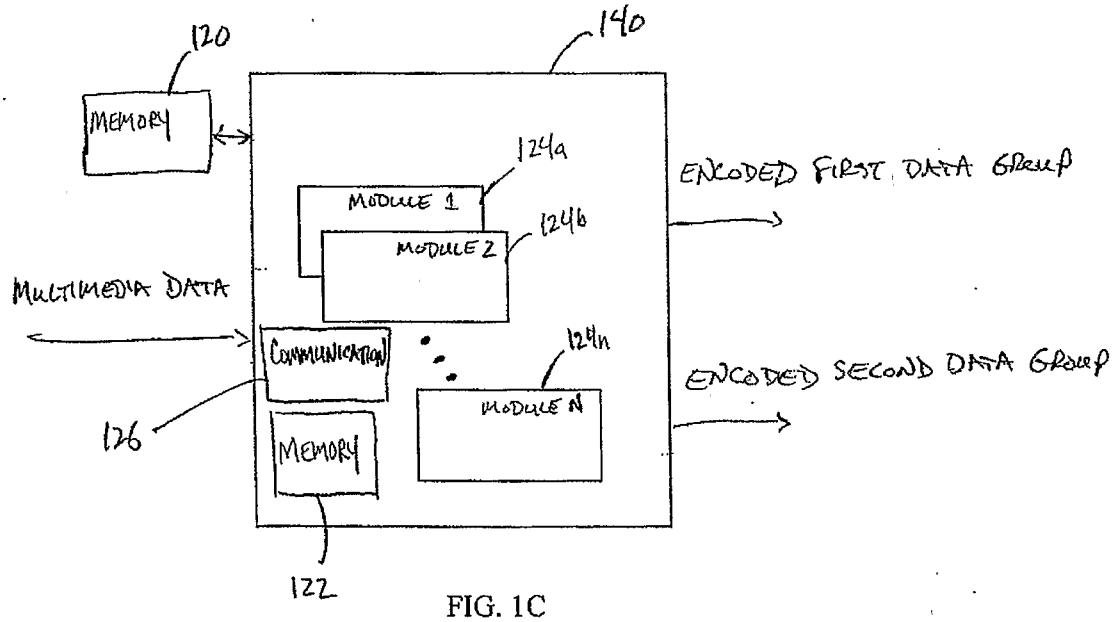

120
140
MEMORY
124a
MODULE 1
124b
MODULE 2
MULTIMEDIA DATA
COMMUNICATION
124n
MODULE N
126
MEMORY
122
ENCODED FIRST DATA GROUP
ENCODED SECOND DATA GROUP

FIG. 1C

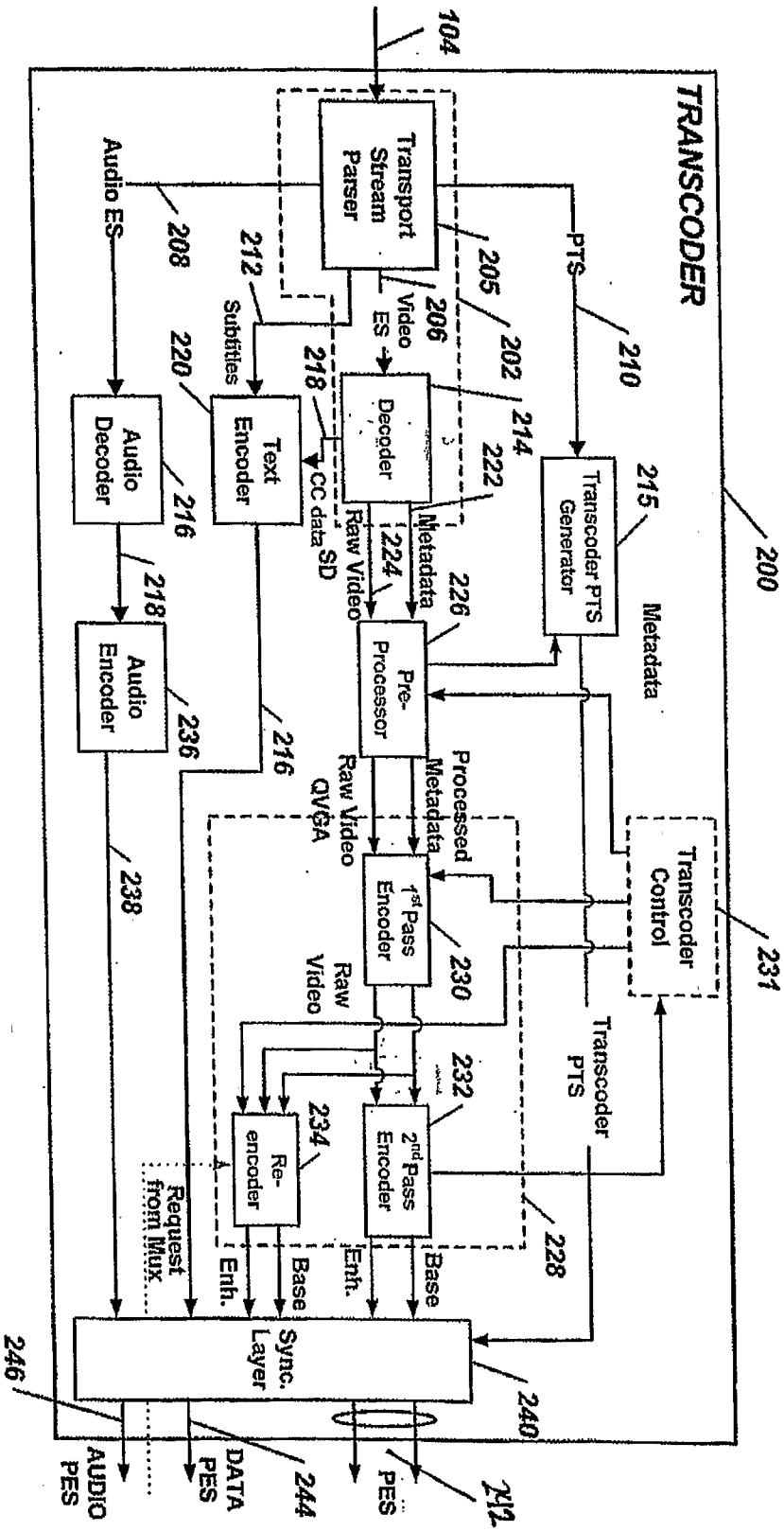

TRANSCODER
104
200
Transport Stream Parser
205
Audio ES
208
Video ES
206
202
Subtitles
212
220
218
Decoder
214
222
Audio Decoder
216
Text Encoder
CC data SD
Raw Video
224
Metadata
226
PTS
210
Transcoder PTS Generator
215
Metadata
Pre-Processor
Processed Metadata
Raw Video QVGA
Audio Encoder
236
216
238
1st Pass Encoder
230
Raw Video
Transcoder Control
231
Transcoder PTS
232
2nd Pass Encoder
234
Re-encoder
Request from Mux
228
Enh.
Base
Enh.
Base
Sync. Layer
240
246
AUDIO PES
DATA PES
244
PES
242

FIG. 2

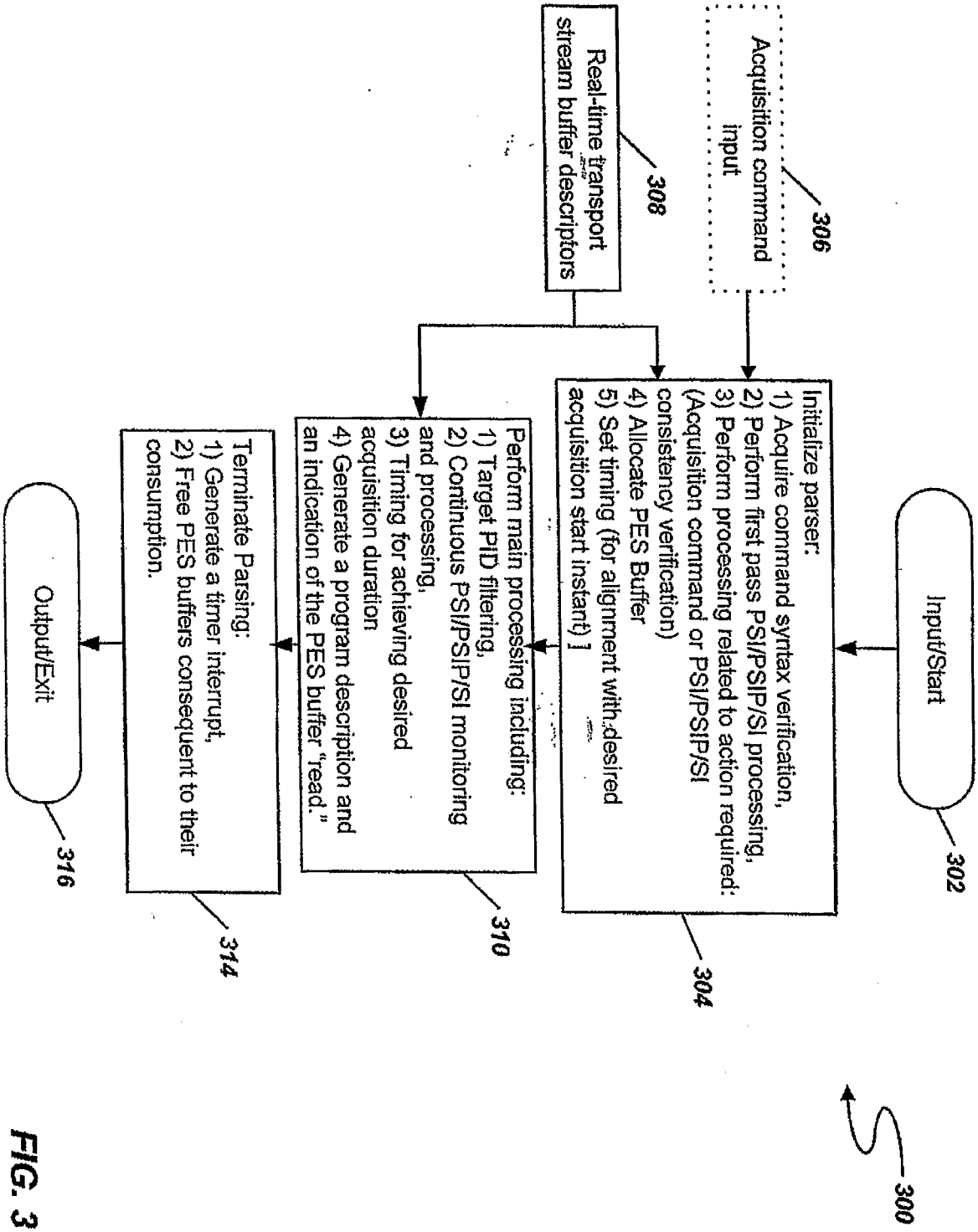

Input/Start
302
Initialize parser:
1) Acquire command syntax verification,
2) Perform first pass PSI/PSIP/SI processing,
3) Perform processing related to action required:
(Acquisition command or PSI/PSIP/SI
consistency verification)
4) Allocate PES Buffer
5) Set timing (for alignment with desired
acquisition start instant)]
304
Perform main processing including:
1) Target PID filtering,
2) Continuous PSI/PSIP/SI monitoring
and processing,
3) Timing for achieving desired
acquisition duration
4) Generate a program description and
an indication of the PES buffer "read."
310
Terminate Parsing:
1) Generate a timer interrupt,
2) Free PES buffers consequent to their
consumption.
314
Output/Exit
316
Acquisition command
input
306
Real-time transport
stream buffer descriptors
308
300

FIG. 3

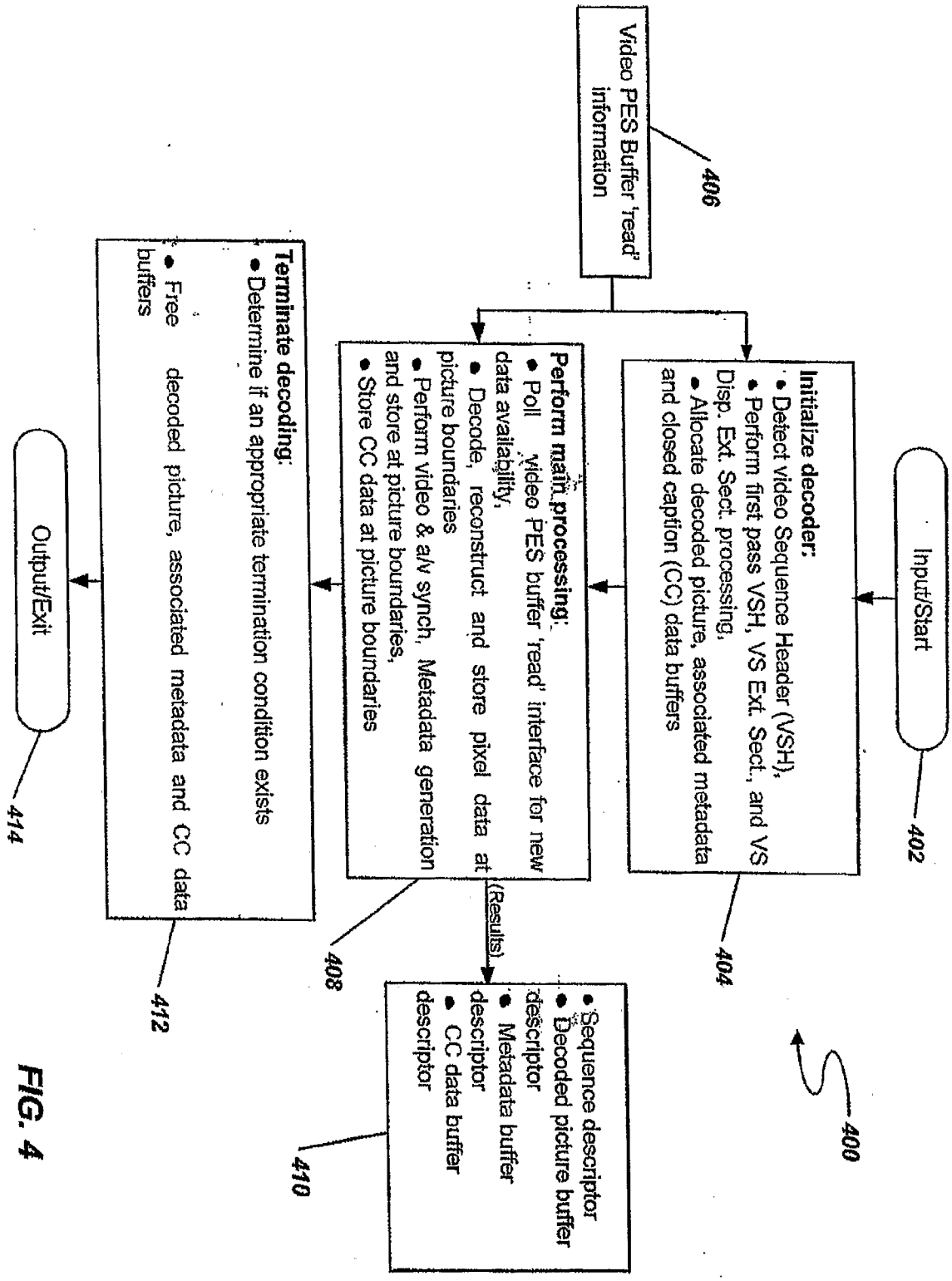

Input/Start
402
Initialize decoder:
• Detect video Sequence Header (VSH),
• Perform first pass VSH, VS Ext. Sect., and VS Disp. Ext. Sect. processing,
• Allocate decoded picture, associated metadata and closed caption (CC) data buffers
404
400
Video PES Buffer 'read' information
406
Perform main processing:
• Poll video PES buffer 'read' interface for new data availability,
• Decode, reconstruct and store pixel data at picture boundaries
• Perform video & a/v synch, Metadata generation and store at picture boundaries,
• Store CC data at picture boundaries
408
(Results)
• Sequence descriptor
• Decoded picture buffer descriptor
• Metadata buffer descriptor
• CC data buffer descriptor
410
Terminate decoding:
• Determine if an appropriate termination condition exists
• Free decoded picture, associated metadata and CC data buffers
412
Output/Exit
414

FIG. 4

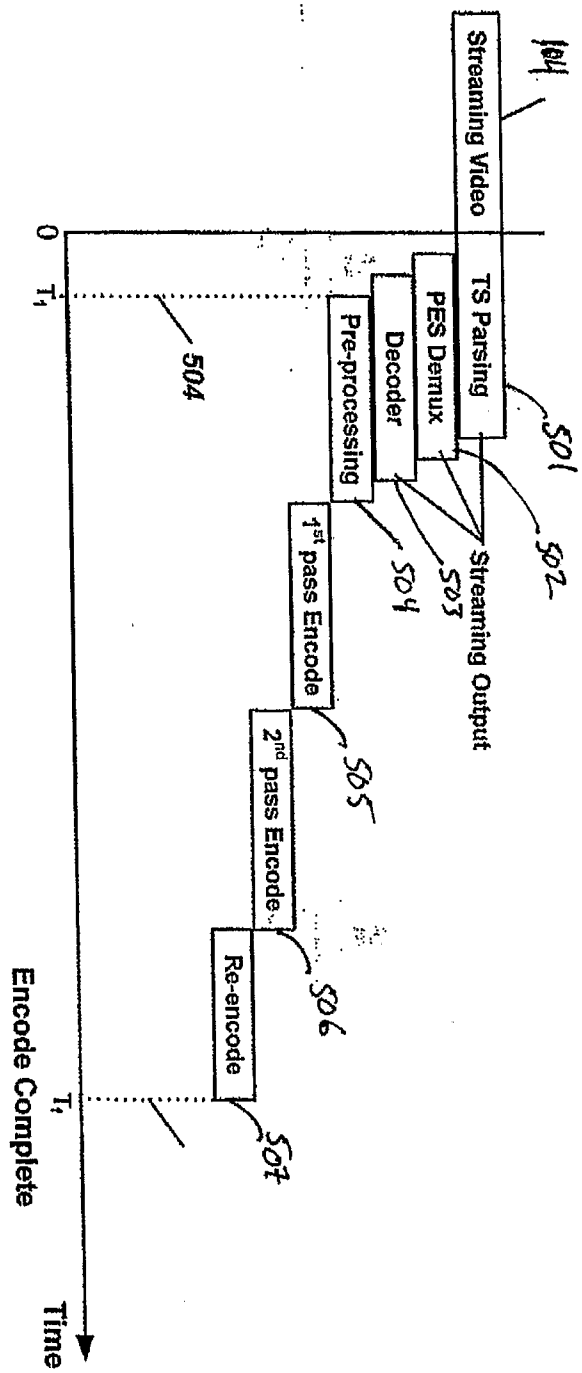

Streaming Video
TS Parsing
PES Demux
Decoder
Pre-processing
1st pass Encode
2nd pass Encode
Re-encode
Streaming Output
0
T1
Tf
Encode Complete
Time
501
502
503
504
505
506
507
504

FIG. 5

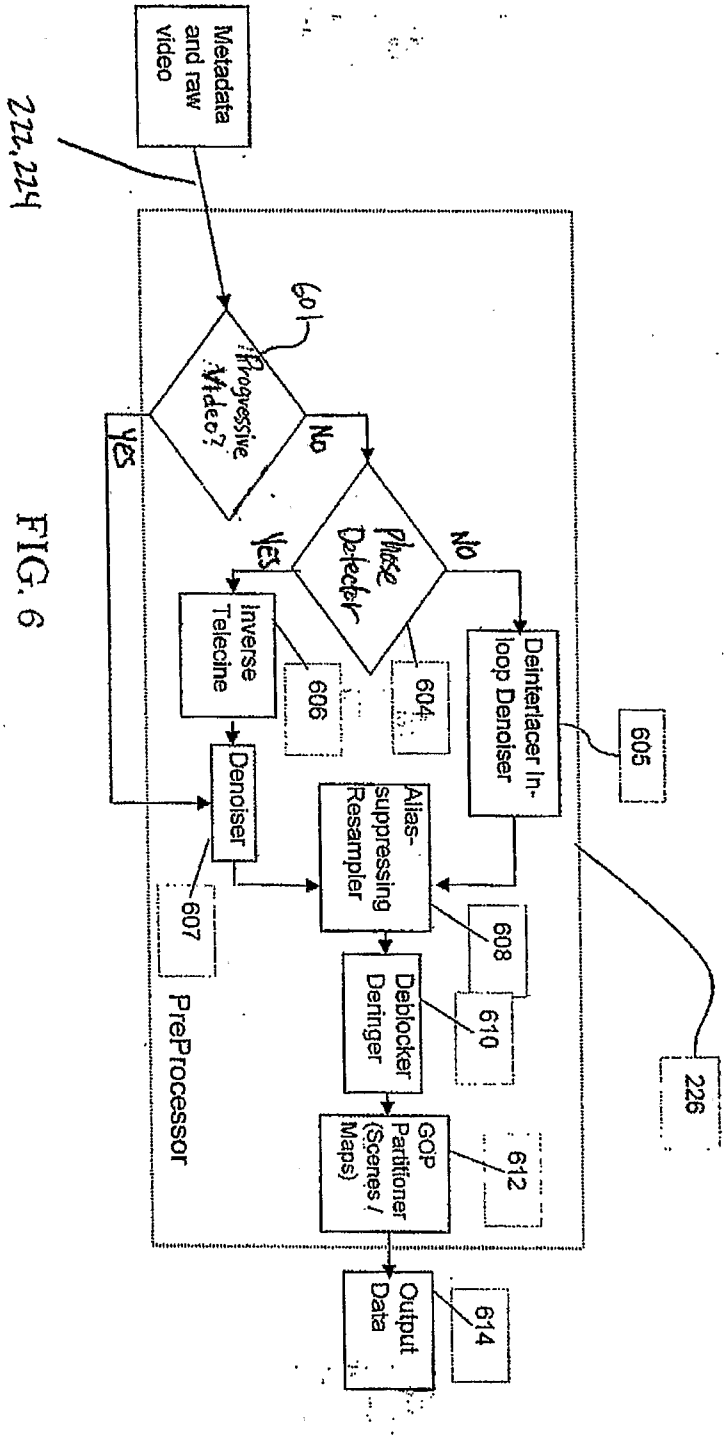

222, 224
Metadata and raw video
601
Progressive Video?
No
Yes
Yes
Pulse Detector
No
Inverse Telecine
606
604
Deinterlacer In-loop Denoiser
605
Denoiser
607
Alias-suppressing Resampler
608
Deblocker Deringer
610
GOP Partitioner (Scenes / Maps)
612
PreProcessor
226
Output Data
614

FIG. 6

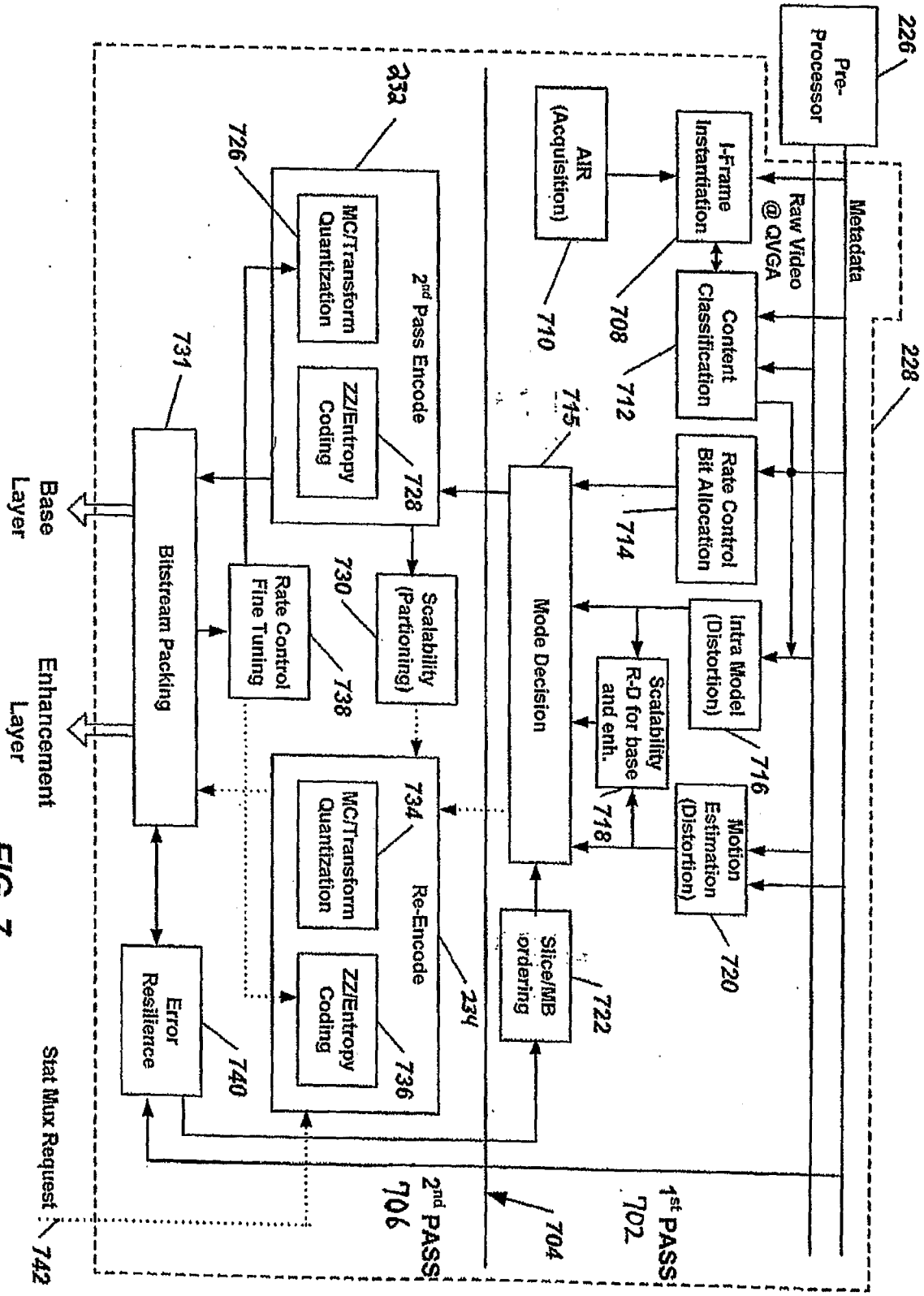

Pre-Processor
226
Metadata
228
Raw Video @ QVGA
I-Frame Instantiation
AIR (Acquisition)
710
708
Content Classification
712
Rate Control Bit Allocation
714
715
Mode Decision
Intra Model (Distortion)
716
Scalability R-D for base and enh.
718
Motion Estimation (Distortion)
720
Slice/MB ordering
722
1st PASS
702
704
2nd PASS
706
732
2nd Pass Encode
726
MC/Transform Quantization
ZZ/Entropy Coding
728
731
Bitstream Packing
Base Layer
Enhancement Layer
730
Scalability (Partioning)
Rate Control Fine Tuning
738
Re-Encode
234
734
MC/Transform Quantization
ZZ/Entropy Coding
736
Error Resilience
740
Stat Mux Request
742

FIG. 7

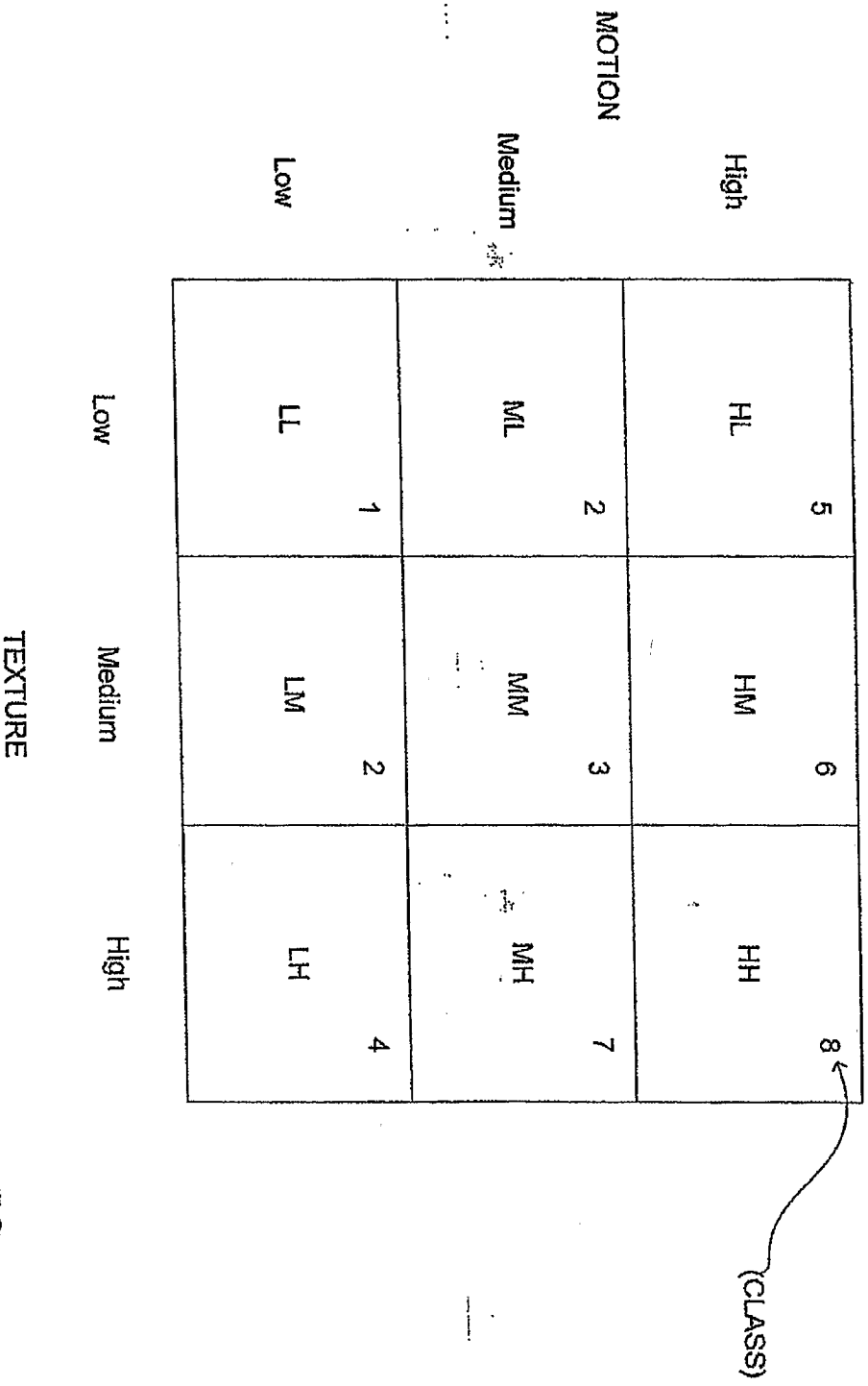

MOTION
High
Medium
Low
HL
5
ML
2
LL
1
HM
6
MM
3
LM
2
HH
8
MH
7
LH
4
(CLASS)
Low
Medium
High
TEXTURE

FIG. 8

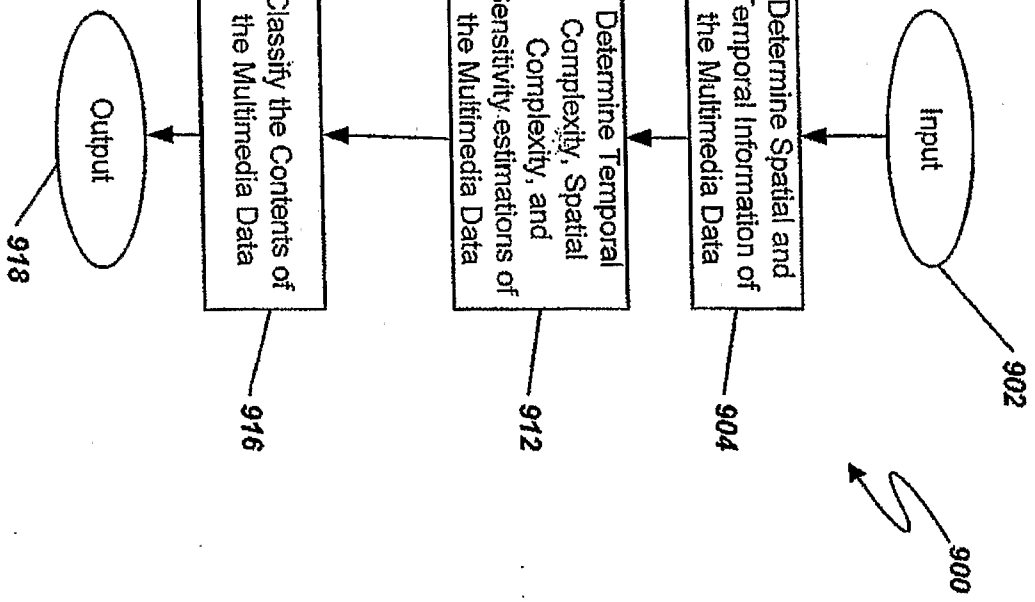

Input
902
Determine Spatial and Temporal Information of the Multimedia Data
904
Determine Temporal Complexity, Spatial Complexity, and Sensitivity estimations of the Multimedia Data
912
Classify the Contents of the Multimedia Data
916
Output
918
900

FIG. 9

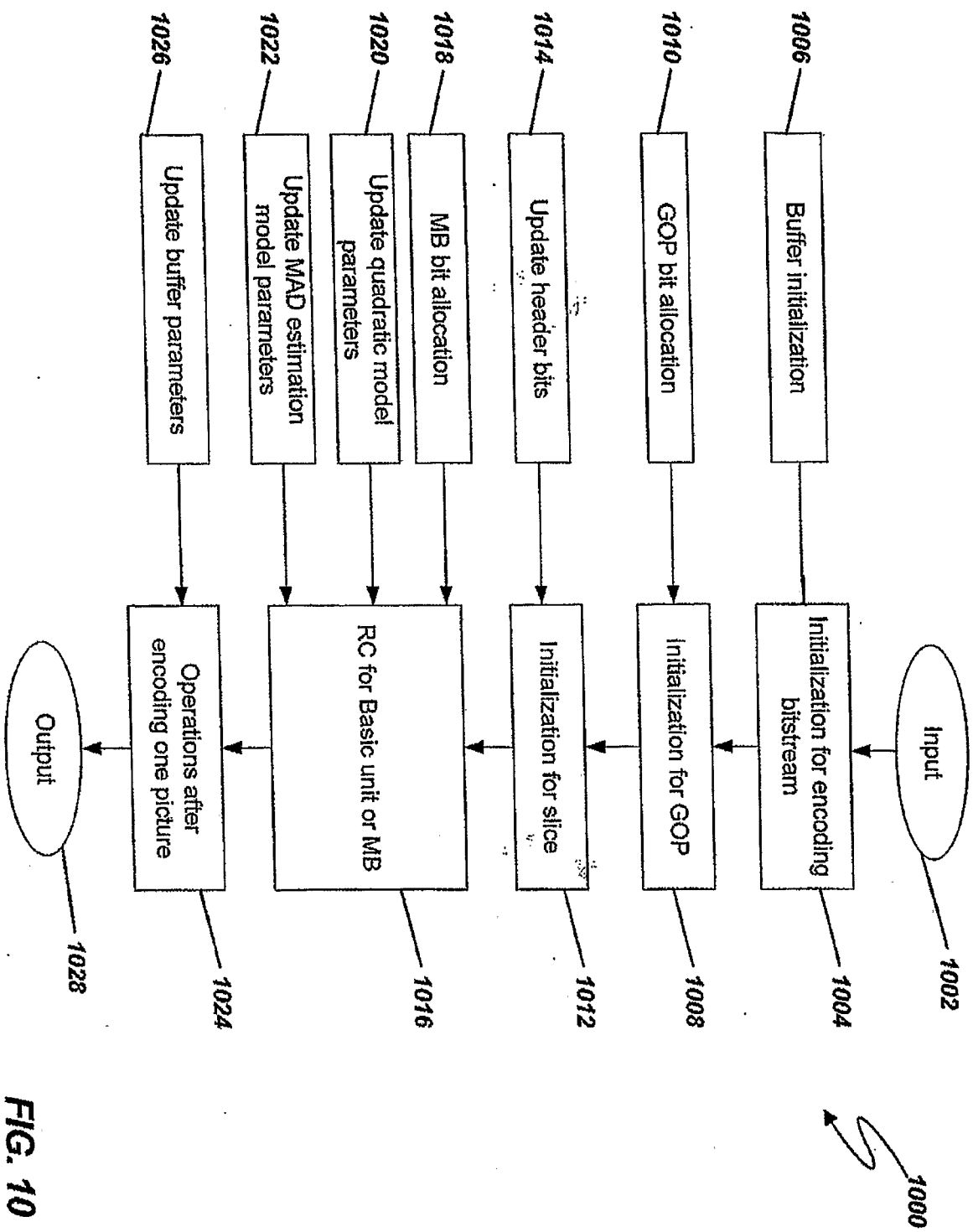

Input
1002
Initialization for encoding bitstream
1004
Initialization for GOP
1008
Initialization for slice
1012
RC for Basic unit or MB
1016
Operations after encoding one picture
1024
Output
1028
Buffer initialization
1006
GOP bit allocation
1010
Update header bits
1014
MB bit allocation
1018
Update quadratic model parameters
1020
Update MAD estimation model parameters
1022
Update buffer parameters
1026
1000

FIG. 10

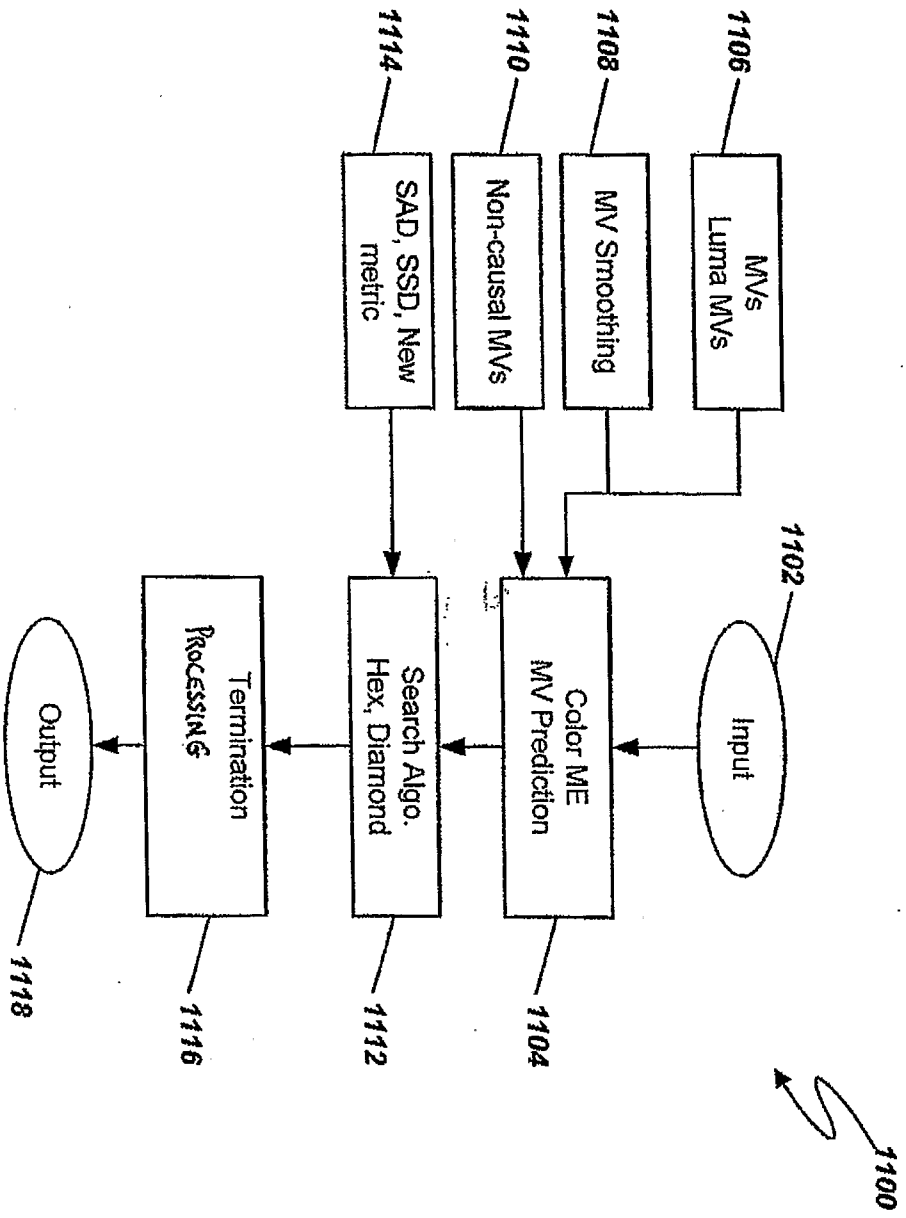

1106
MVs
Luma MVs
1108
MV Smoothing
1110
Non-causal MVs
1114
SAD, SSD, New metric
1102
Input
Color ME
MV Prediction
1104
Search Algo.
Hex, Diamond
1112
Termination
Processing
1116
Output
1118
1100

FIG. 11

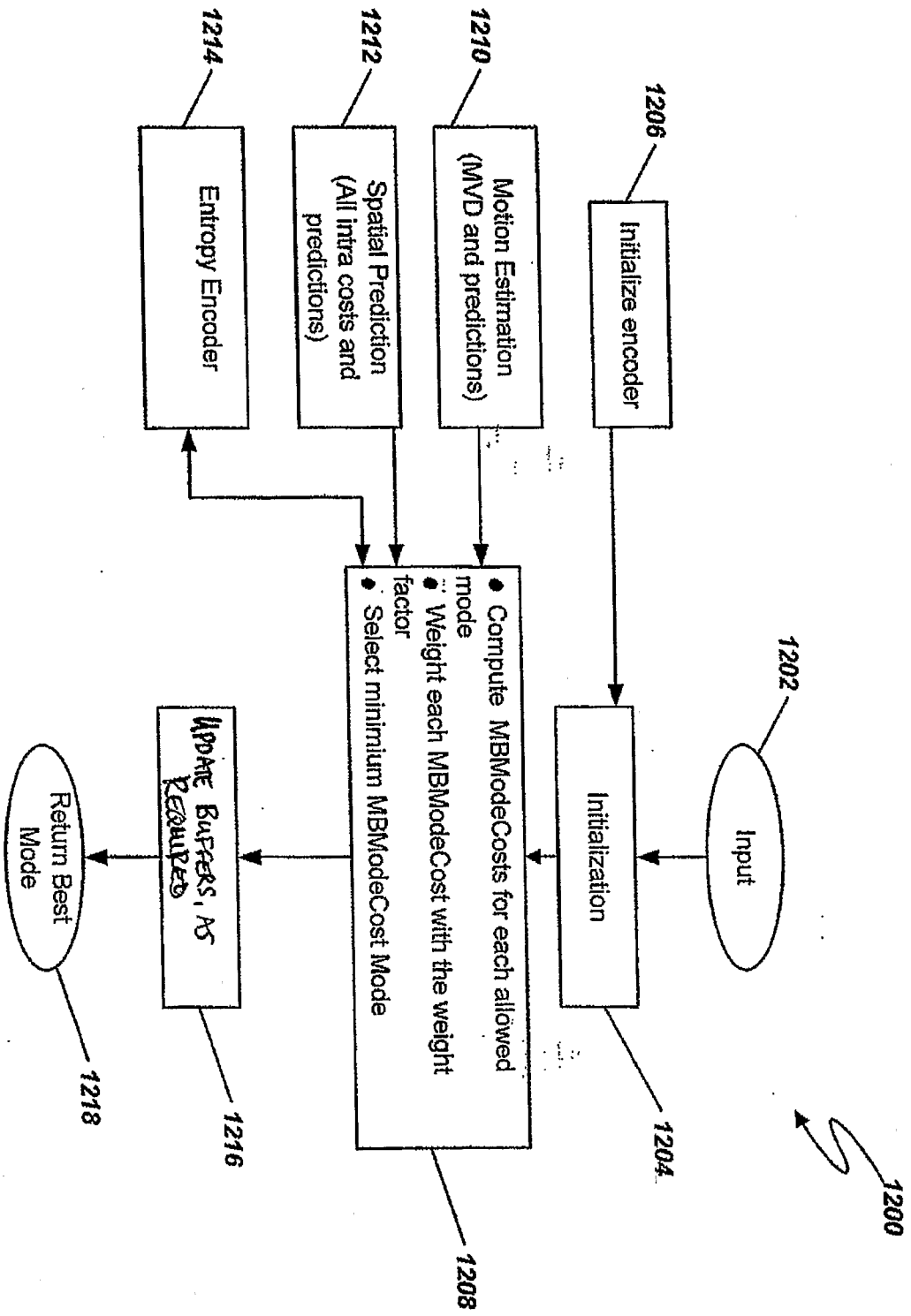

1200
1202
Input
1204
Initialization
1206
Initialize encoder
1208
Compute MBModeCosts for each allowed mode
Weight each MBModeCost with the weight factor
Select minimum MBModeCost Mode
1210
Motion Estimation (MVD and predictions)
1212
Spatial Prediction (All intra costs and predictions)
1214
Entropy Encoder
1216
Update Buffers, As Required
1218
Return Best Mode

FIG. 12

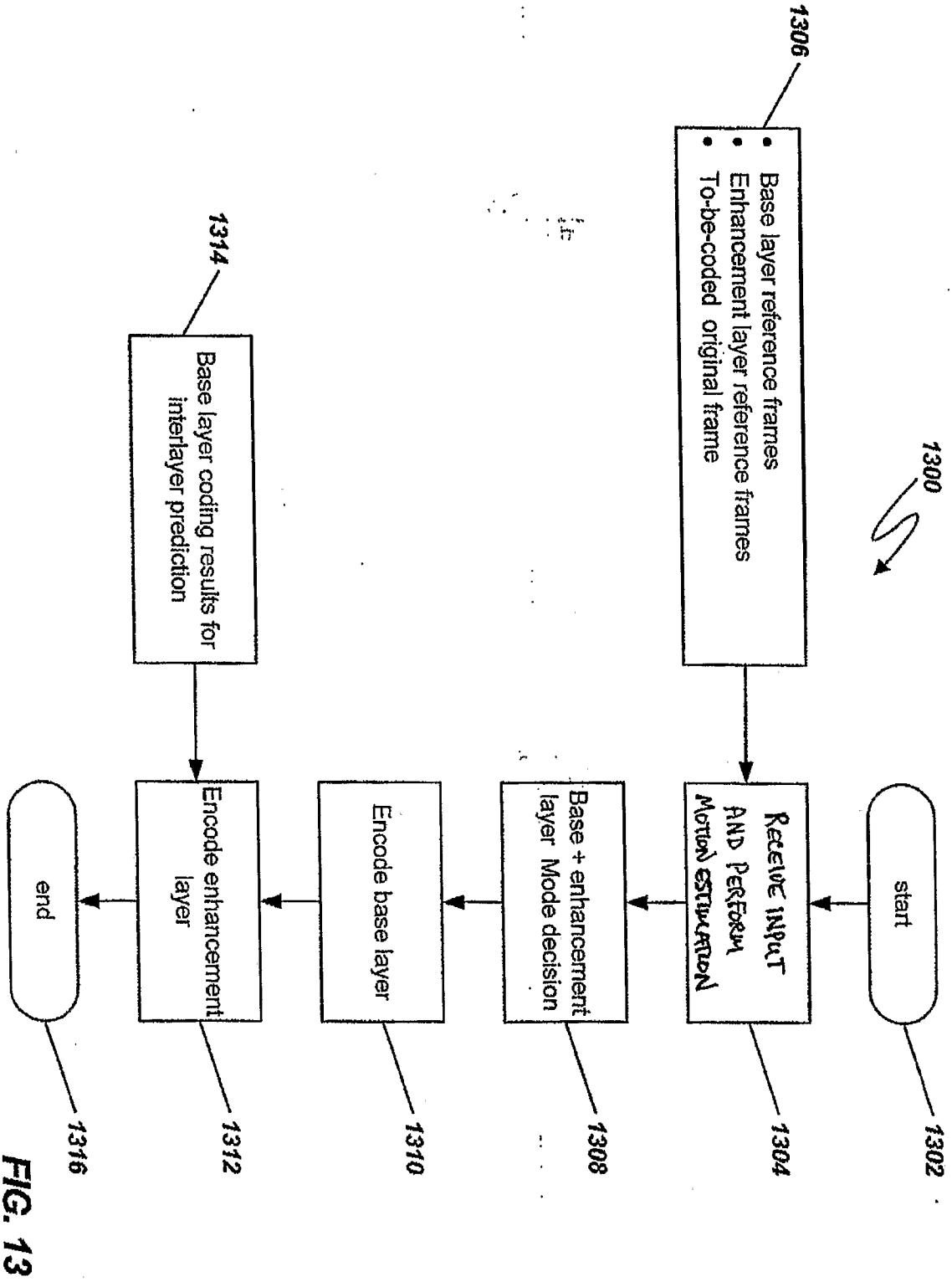

1300
start
1302
Receive input and perform motion estimation
1304
Base + enhancement layer Mode decision
1308
Encode base layer
1310
Encode enhancement layer
1312
end
1316
Base layer coding results for interlayer prediction
1314
Base layer reference frames
Enhancement layer reference frames
To-be-coded original frame
1306

FIG. 13

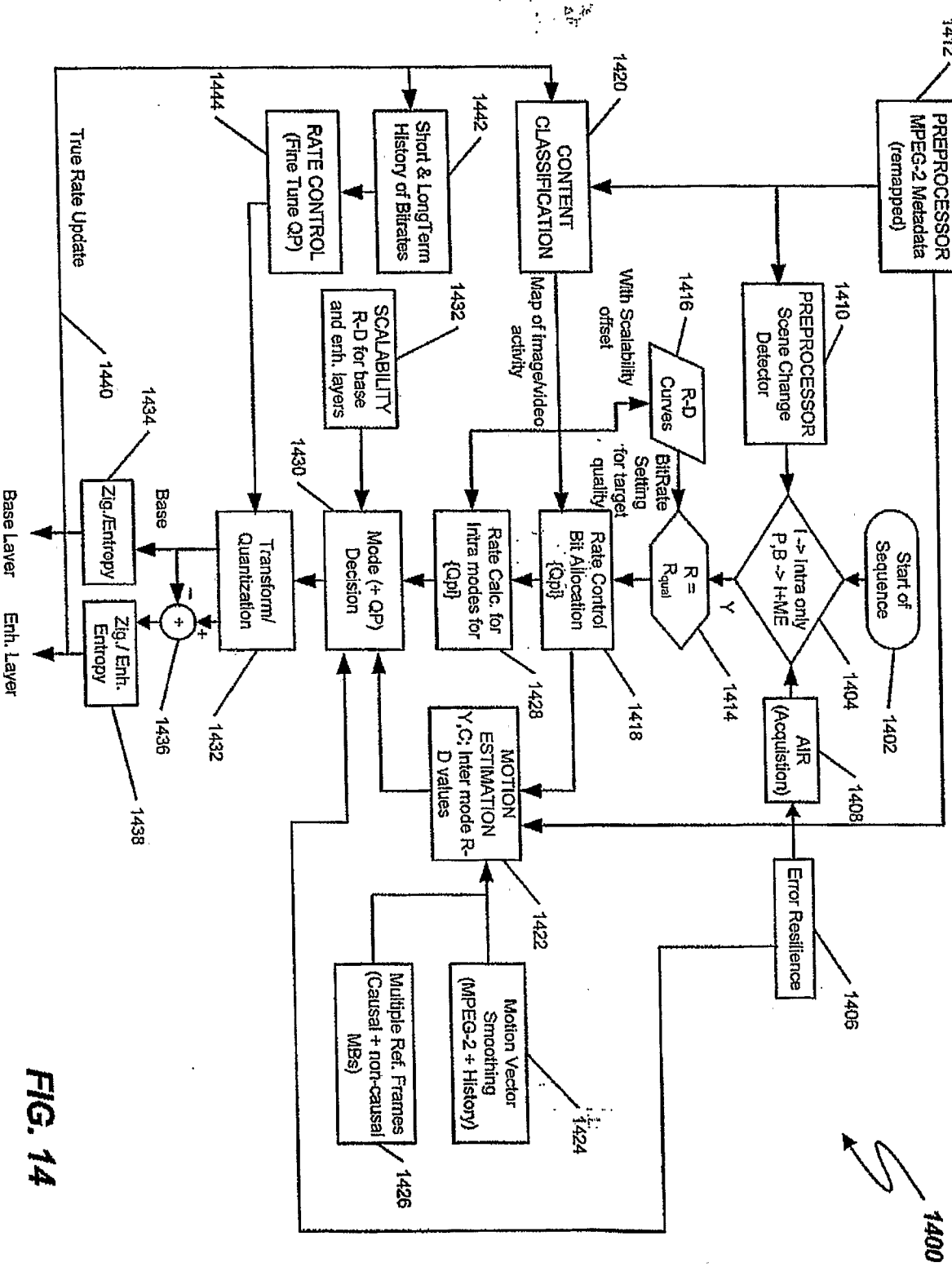

1412
PREPROCESSOR MPEG-2 Metadata (remapped)
1420
CONTENT CLASSIFICATION
1442
Short & LongTerm History of Bitrates
1444
RATE CONTROL (Fine Tune QP)
1410
PREPROCESSOR Scene Change Detector
1416
R-D Curves
1432
SCALABILITY R-D for base and enh. layers
1440
True Rate Update
1434
Zig./Entropy
Base
Base Layer
1430
Mode (+ QP) Decision
Transform/ Quantization
1436
Zig./ Enh. Entropy
Enh. Layer
1438
1432
Rate Calc. for Intra modes for {Qpi}
1428
Rate Control Bit Allocation {Qpi}
1418
R = R_qual
1414
Y
I -> Intra only P,B -> I+ME
1404
Start of Sequence
1402
AIR (Acquisition)
1408
Error Resilience
1406
MOTION ESTIMATION Y,C; Inter mode R-D values
1422
Multiple Ref. Frames (Causal + non-causal MBs)
1426
Motion Vector Smoothing (MPEG-2 + History)
1424
Map of image/video activity
With Scalability offset
BitRate Setting for target quality
1400

FIG. 14

FIG. 15

FIG. 16

lambda
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
lambda*(2lambda+1)
0
1
2
3
4
5
6
7
8
9
10

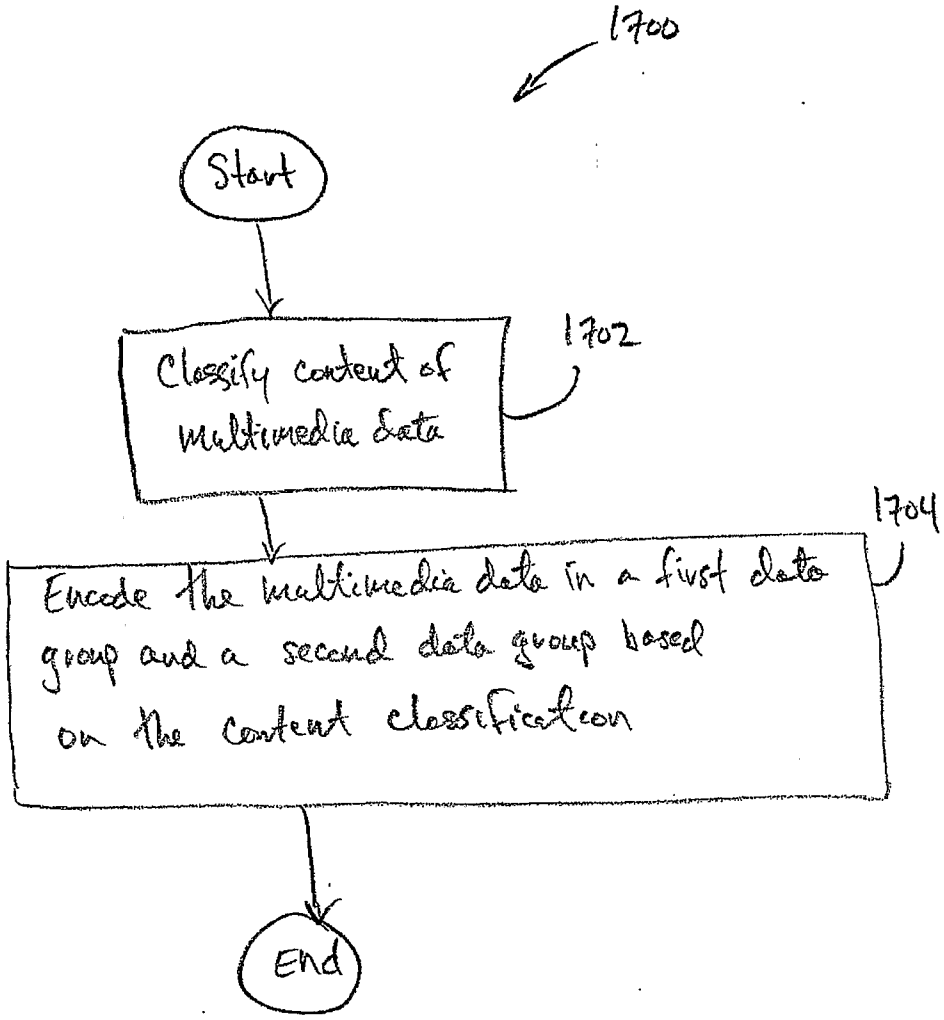

1700
Start
Classify content of multimedia data
1702
1704
Encode the multimedia data in a first data group and a second data group based on the content classification
End

FIG. 17A

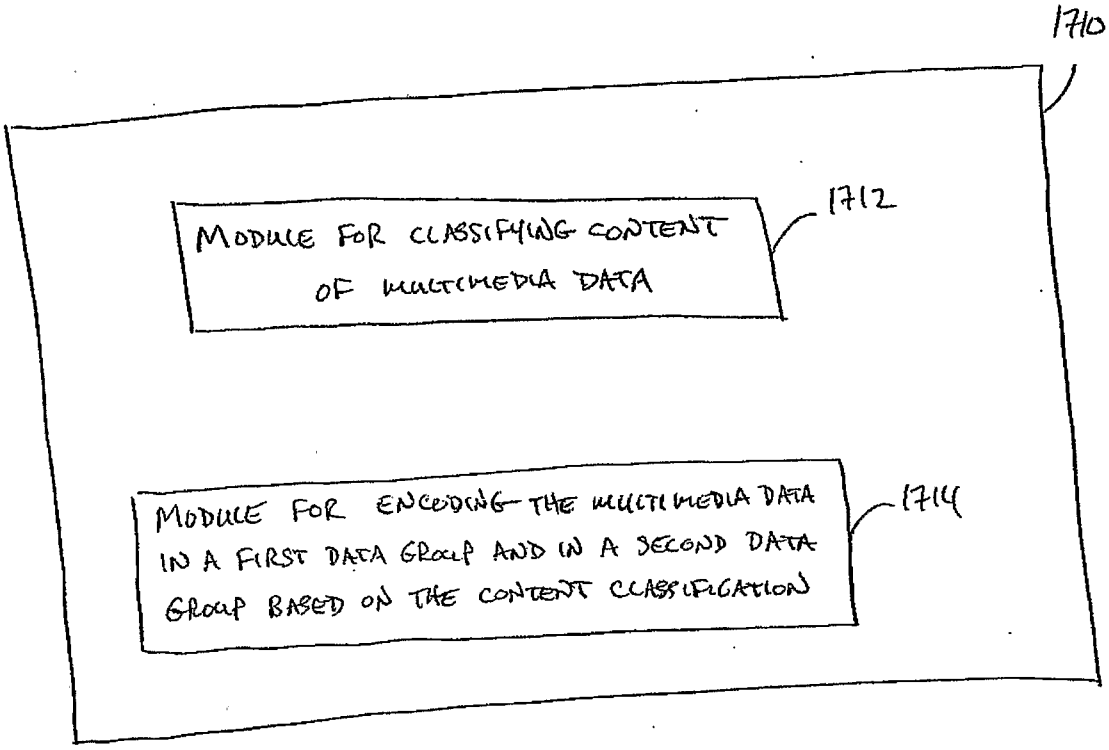

1710
MODULE FOR CLASSIFYING CONTENT OF MULTIMEDIA DATA
1712
MODULE FOR ENCODING THE MULTIMEDIA DATA IN A FIRST DATA GROUP AND IN A SECOND DATA GROUP BASED ON THE CONTENT CLASSIFICATION
1714

FIG. 17B

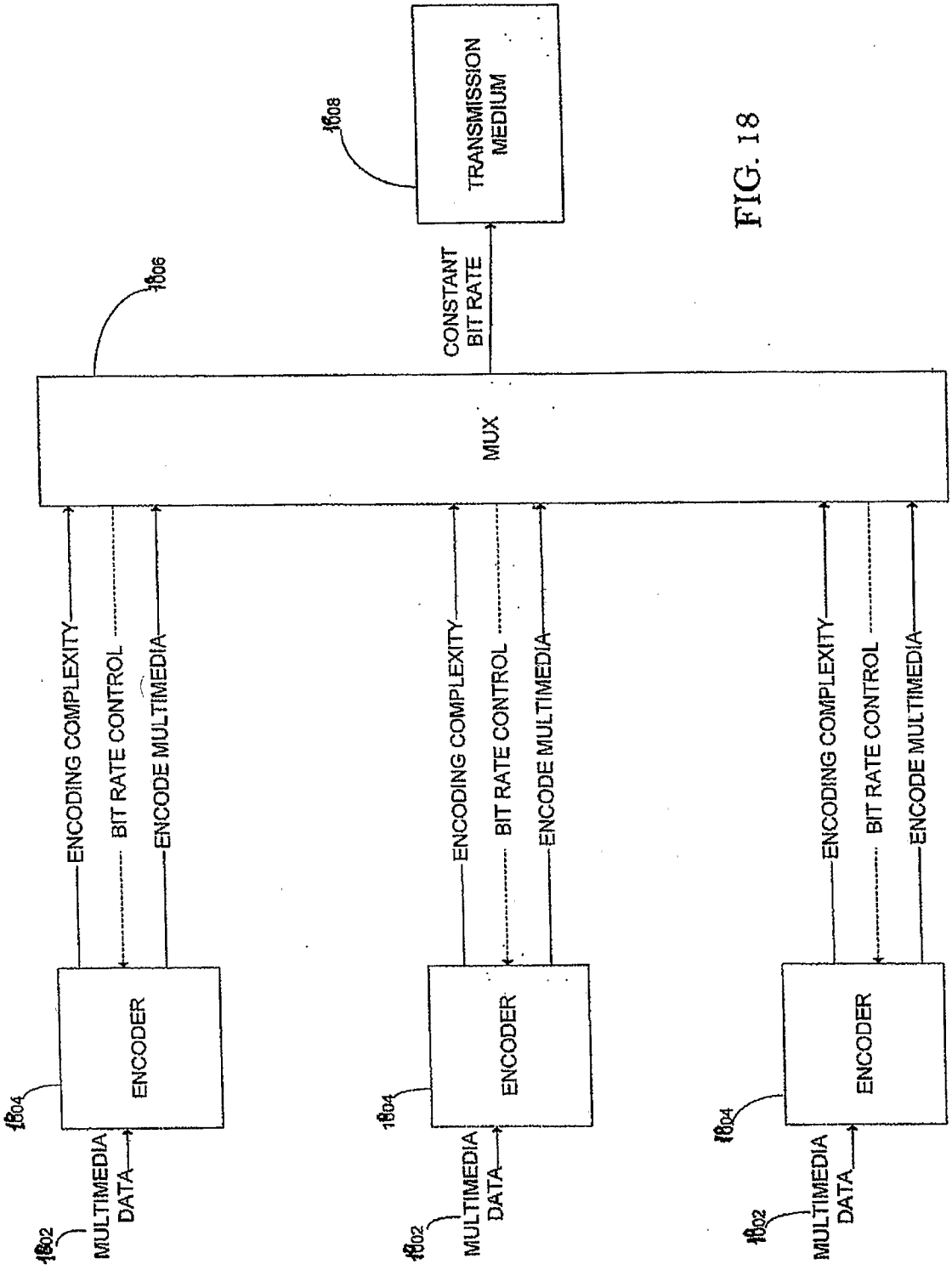

1608
TRANSMISSION MEDIUM
CONSTANT BIT RATE
1606
MUX
ENCODING COMPLEXITY
BIT RATE CONTROL
ENCODE MULTIMEDIA
1604
ENCODER
1602
MULTIMEDIA DATA

FIG. 18

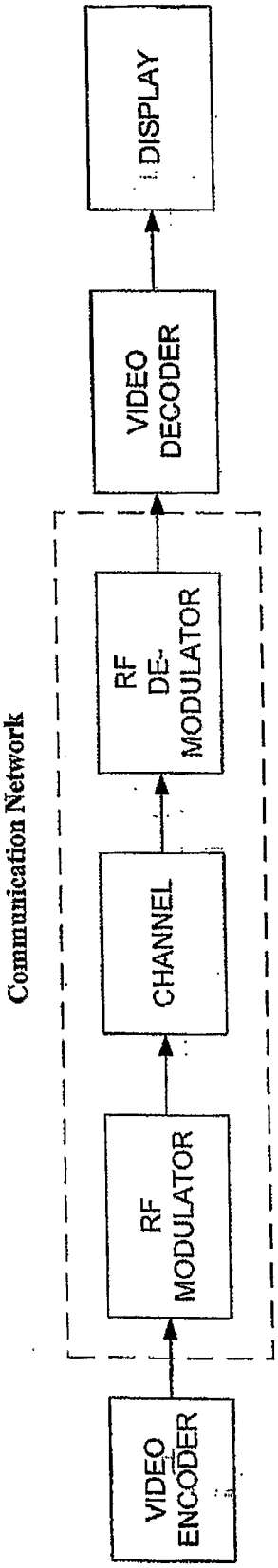

DISPLAY
VIDEO DECODER
RF DE-MODULATOR
CHANNEL
RF MODULATOR
VIDEO ENCODER
Communication Network

FIG. 19

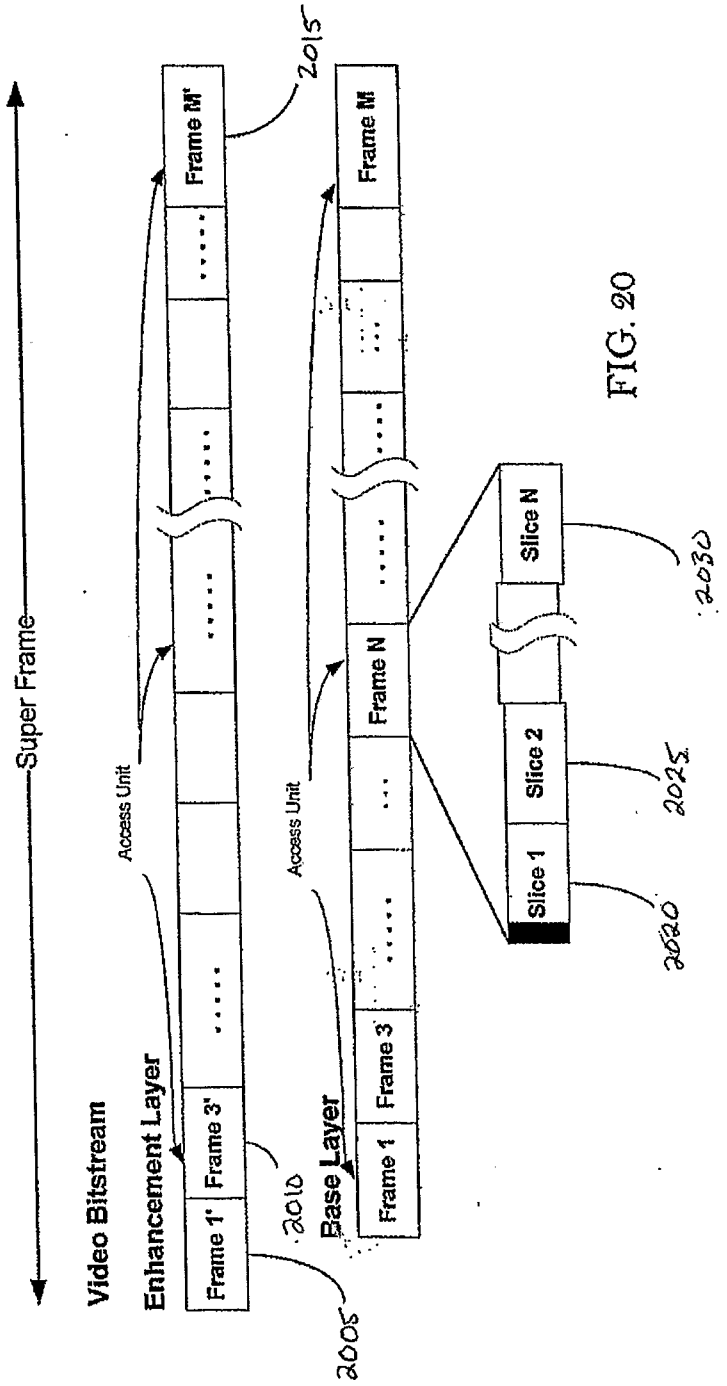

Super Frame
Video Bitstream
Enhancement Layer
Base Layer
Access Unit
Access Unit
Frame 1'
Frame 3'
Frame M'
Frame 1
Frame 3
Frame N
Frame M
Slice 1
Slice 2
Slice N
2005
2010
2015
2020
2025
2030

FIG. 20

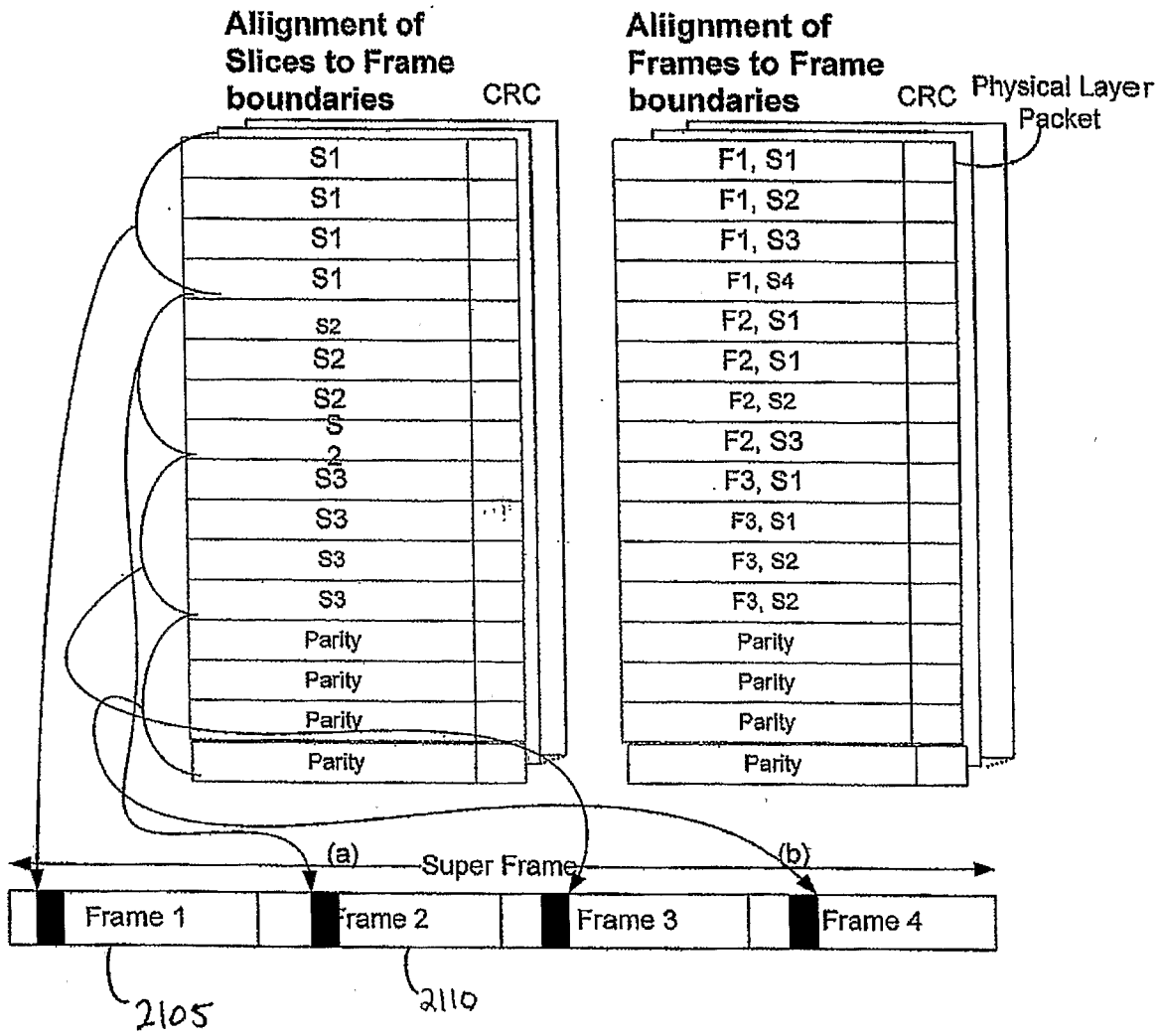

Alignment of Slices to Frame boundaries
CRC
S1
S1
S1
S1
S2
S2
S2
S2
S3
S3
S3
S3
Parity
Parity
Parity
Parity
Alignment of Frames to Frame boundaries
CRC
Physical Layer Packet
F1, S1
F1, S2
F1, S3
F1, S4
F2, S1
F2, S1
F2, S2
F2, S3
F3, S1
F3, S1
F3, S2
F3, S2
Parity
Parity
Parity
Parity
(a)
Super Frame
(b)
Frame 1
Frame 2
Frame 3
Frame 4
2105
2110

FIG. 21

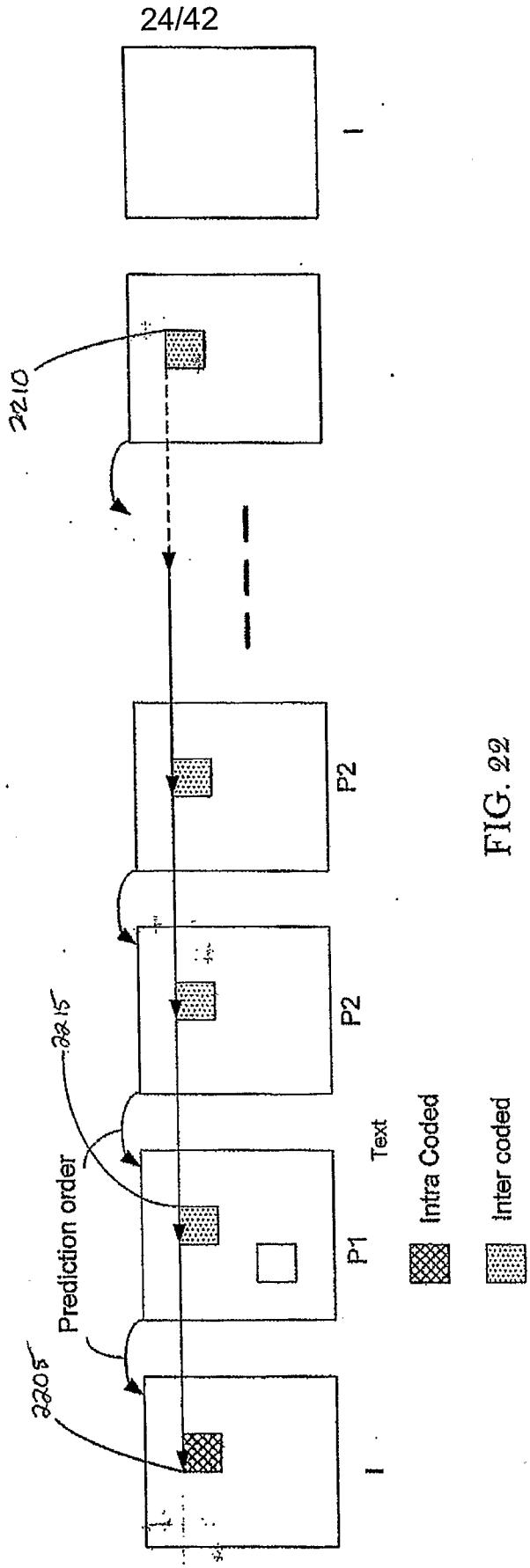

2210
I
P2
P2
2215
Prediction order
P1
2205
I
Text
Intra Coded
Inter coded

FIG. 22

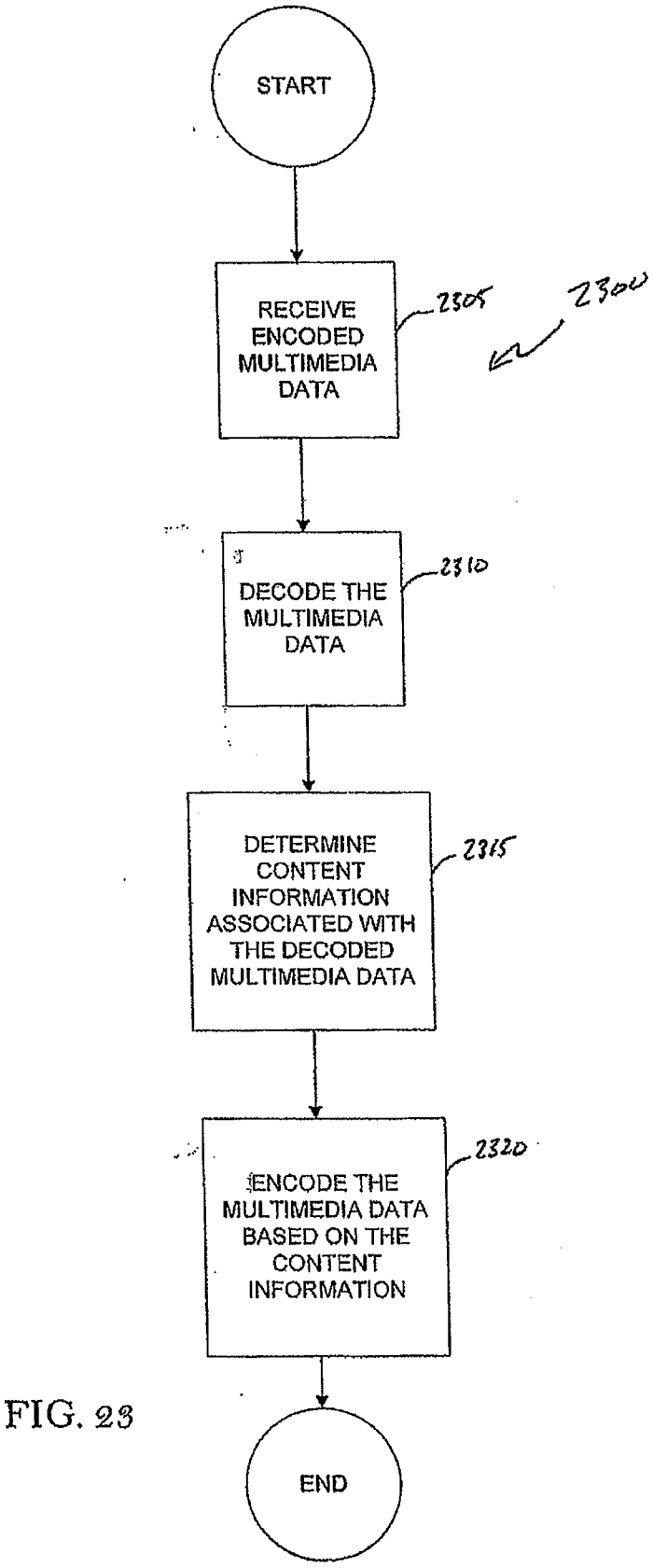

START
RECEIVE ENCODED MULTIMEDIA DATA
2305
2300
DECODE THE MULTIMEDIA DATA
2310
DETERMINE CONTENT INFORMATION ASSOCIATED WITH THE DECODED MULTIMEDIA DATA
2315
ENCODE THE MULTIMEDIA DATA BASED ON THE CONTENT INFORMATION
2320
END

FIG. 23

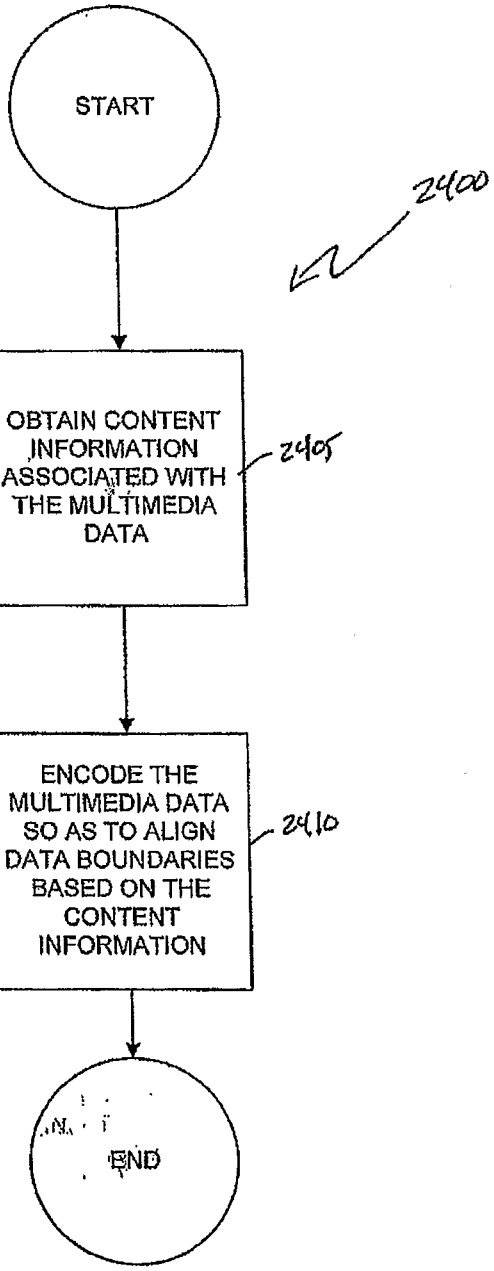

START
2400
OBTAIN CONTENT INFORMATION ASSOCIATED WITH THE MULTIMEDIA DATA
2405
ENCODE THE MULTIMEDIA DATA SO AS TO ALIGN DATA BOUNDARIES BASED ON THE CONTENT INFORMATION
2410
END

FIG. 24

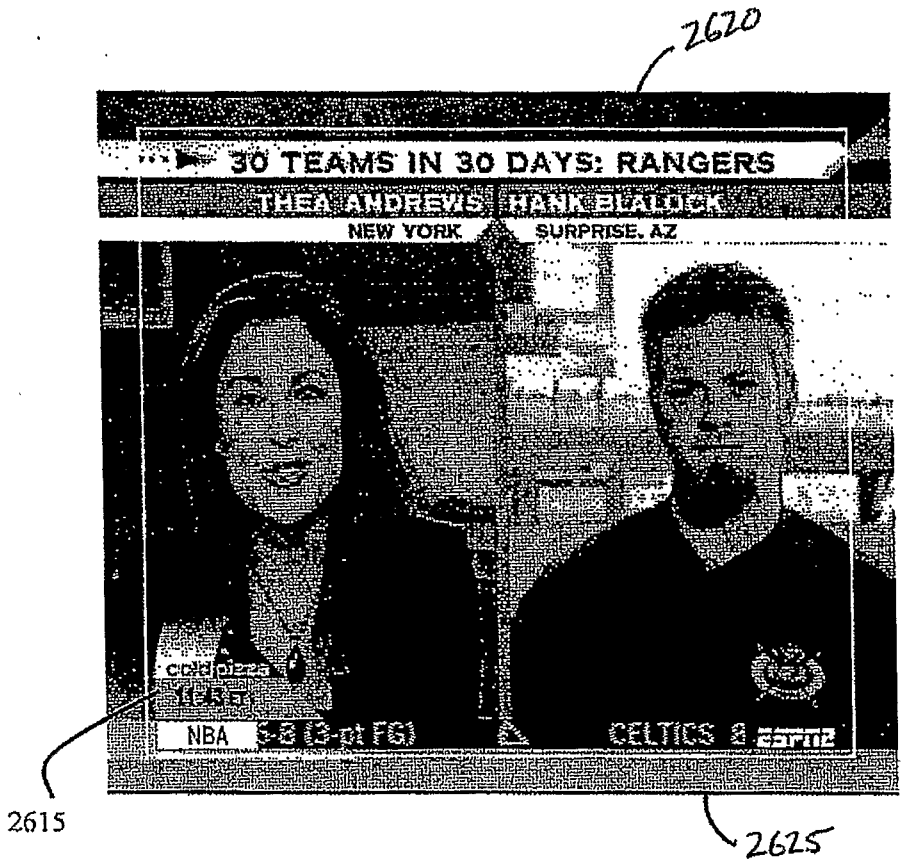

2620
30 TEAMS IN 30 DAYS: RANGERS
THEA ANDREWS
HANK BLALOCK
NEW YORK
SURPRISE, AZ
NBA
CELTICS
2615
2625

FIG. 26

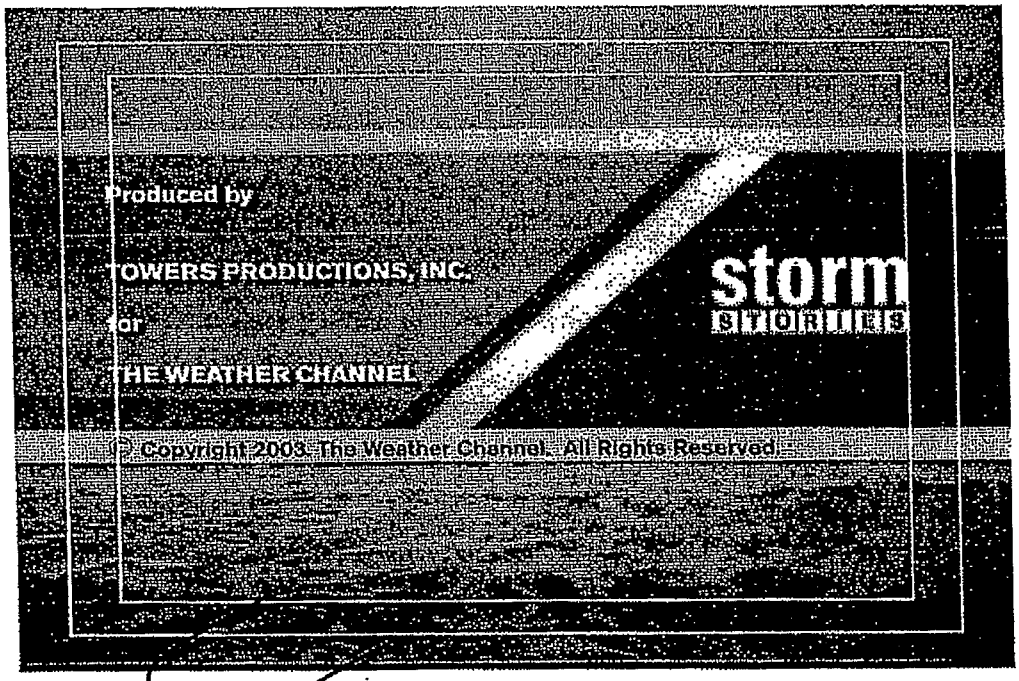

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for
THE WEATHER CHANNEL
storm
STORIES
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2510
2505

FIG. 25

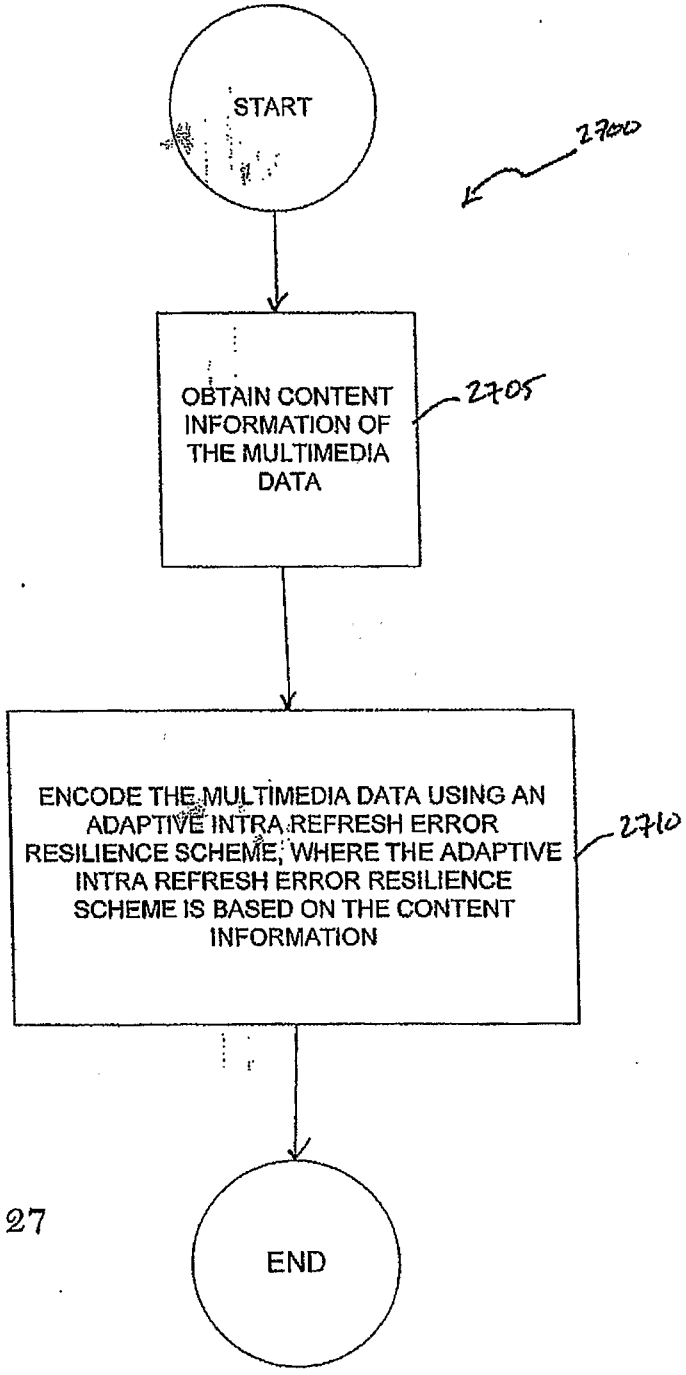

START
2700
OBTAIN CONTENT INFORMATION OF THE MULTIMEDIA DATA
2705
ENCODE THE MULTIMEDIA DATA USING AN ADAPTIVE INTRA REFRESH ERROR RESILIENCE SCHEME, WHERE THE ADAPTIVE INTRA REFRESH ERROR RESILIENCE SCHEME IS BASED ON THE CONTENT INFORMATION
2710
END

FIG. 27

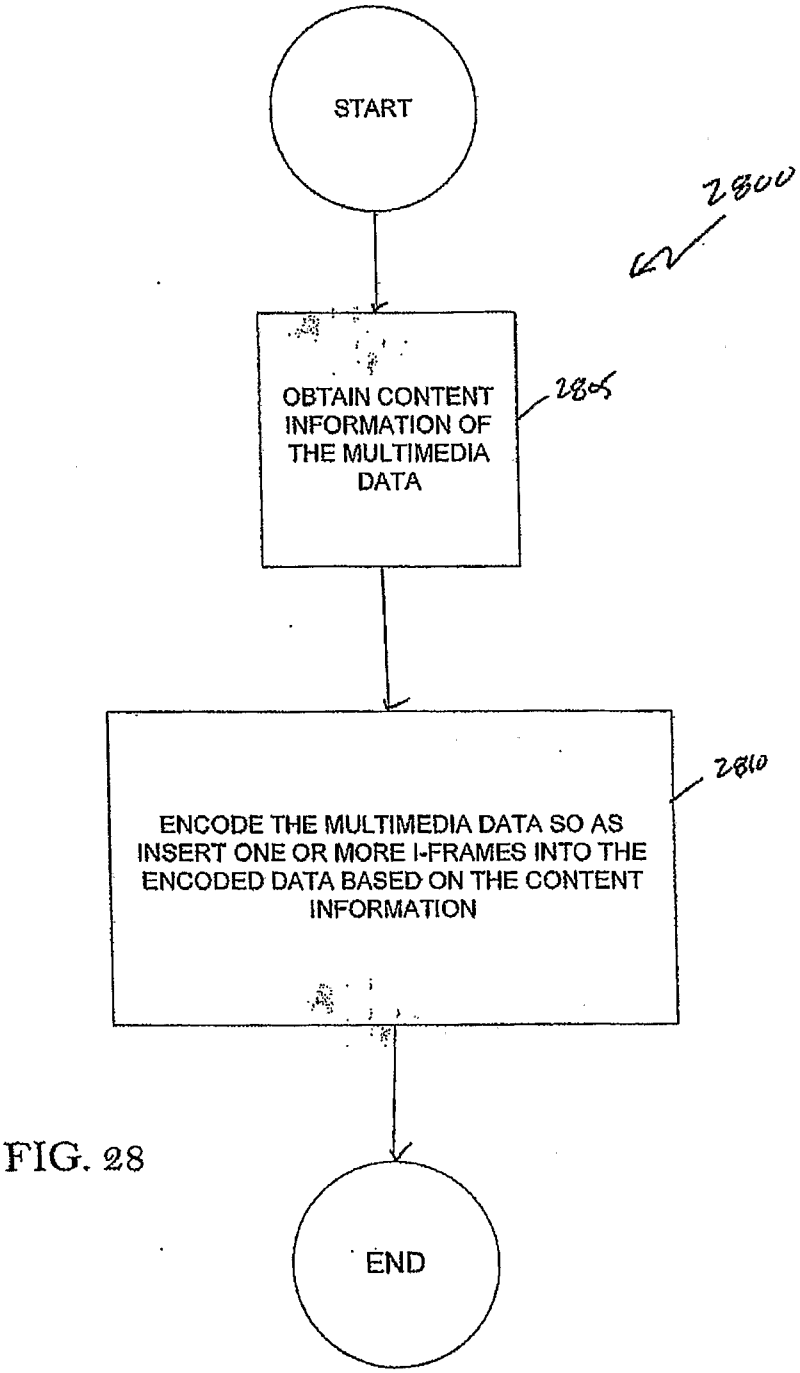

START
2800
OBTAIN CONTENT INFORMATION OF THE MULTIMEDIA DATA
2805
ENCODE THE MULTIMEDIA DATA SO AS INSERT ONE OR MORE I-FRAMES INTO THE ENCODED DATA BASED ON THE CONTENT INFORMATION
2810
END

FIG. 28

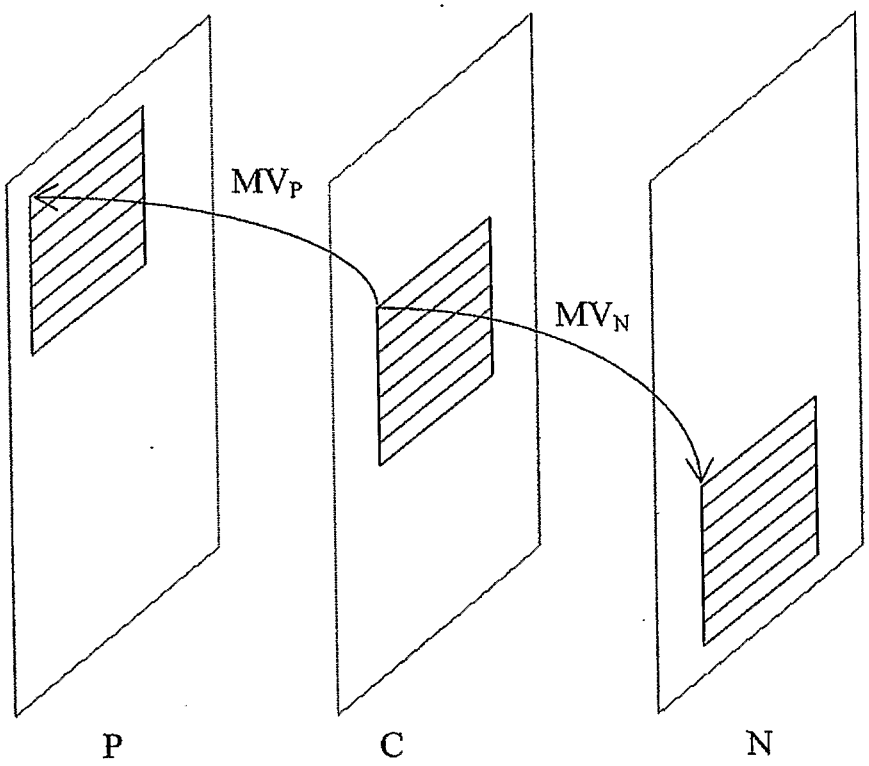


FIG. 29

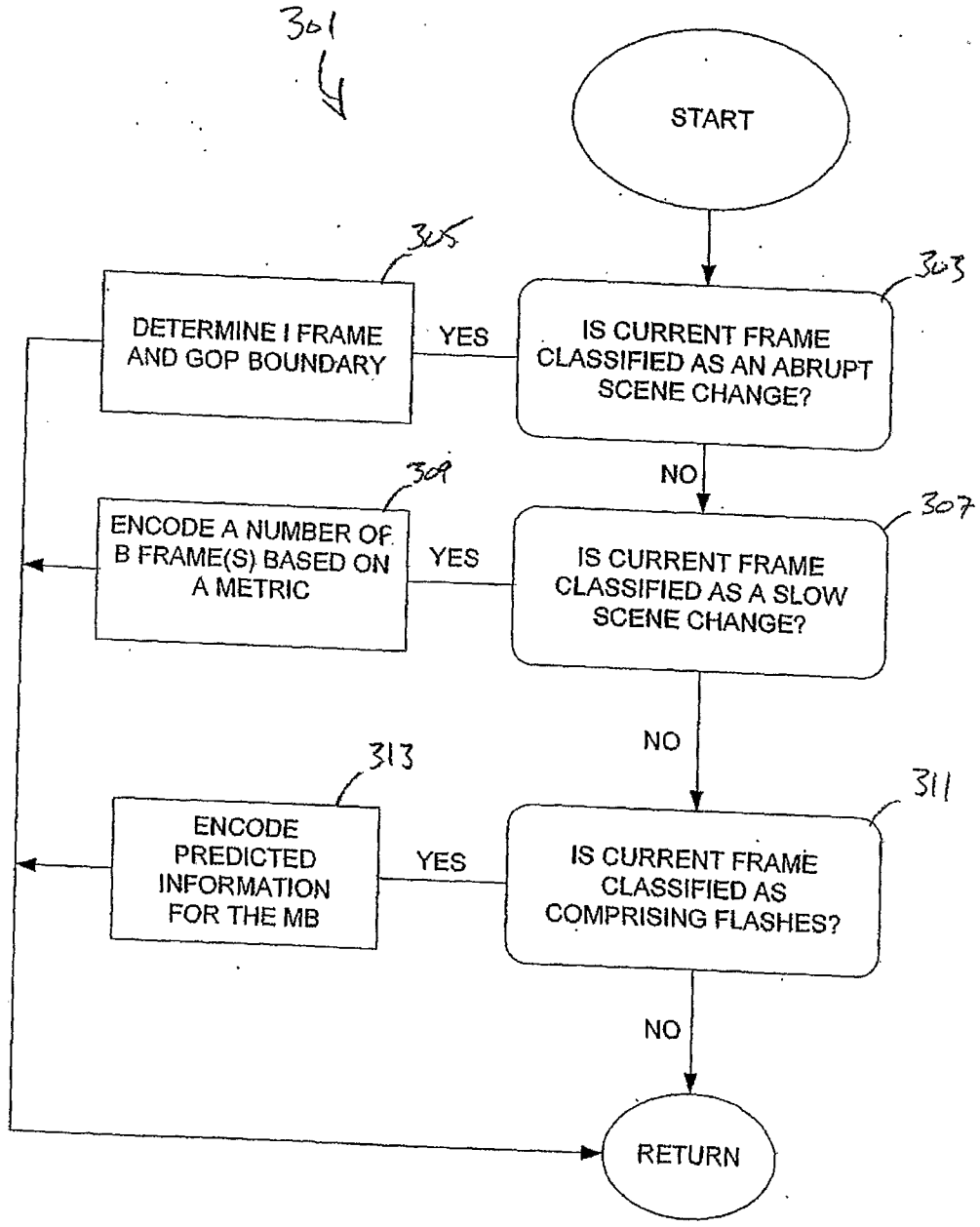

301
START
303
IS CURRENT FRAME CLASSIFIED AS AN ABRUPT SCENE CHANGE?
YES
305
DETERMINE I FRAME AND GOP BOUNDARY
NO
307
IS CURRENT FRAME CLASSIFIED AS A SLOW SCENE CHANGE?
YES
309
ENCODE A NUMBER OF B FRAME(S) BASED ON A METRIC
NO
311
IS CURRENT FRAME CLASSIFIED AS COMPRISING FLASHES?
YES
313
ENCODE PREDICTED INFORMATION FOR THE MB
NO
RETURN

FIG. 3D

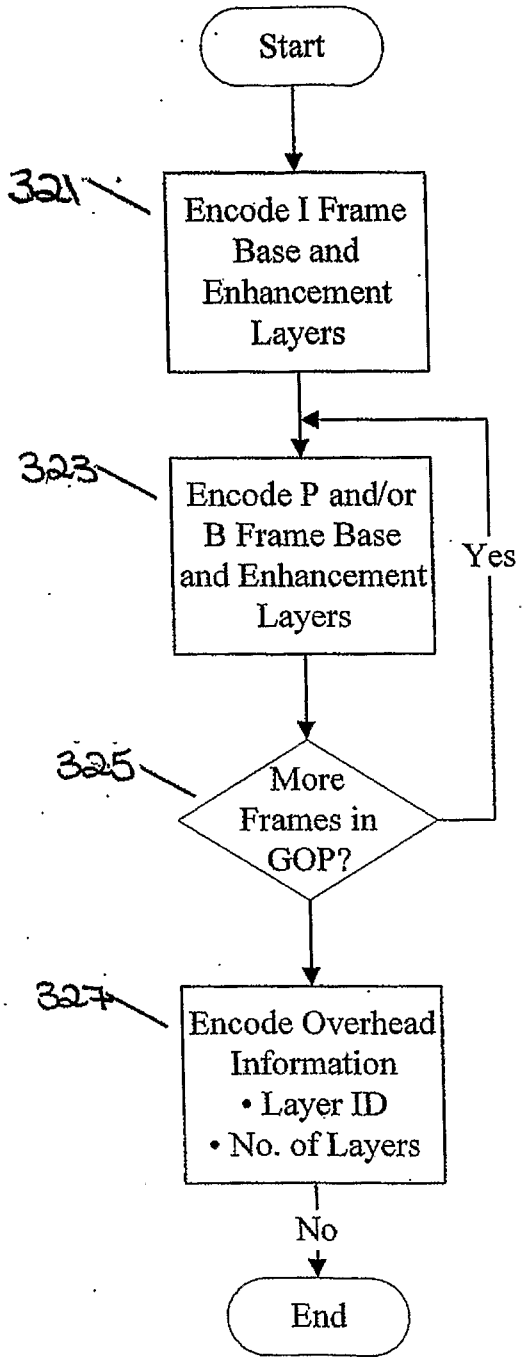
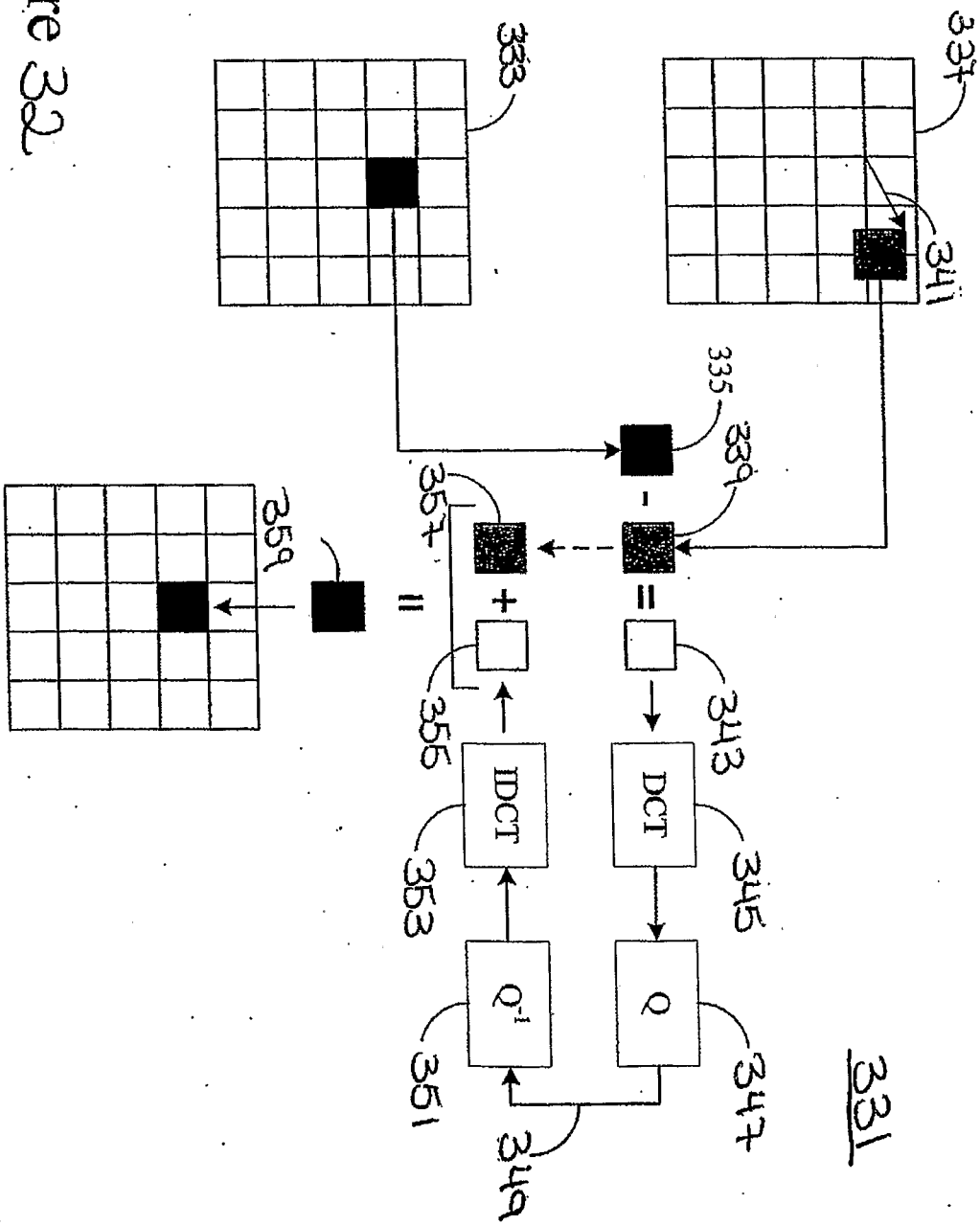

Start
321
Encode I Frame Base and Enhancement Layers
323
Encode P and/or B Frame Base and Enhancement Layers
Yes
325
More Frames in GOP?
327
Encode Overhead Information
• Layer ID
• No. of Layers
No
End

Figure 3

Figure 32


333
337
341
335
339
357
359
355
343
IDCT
DCT
353
345
Q⁻¹
Q
351
347
349
331

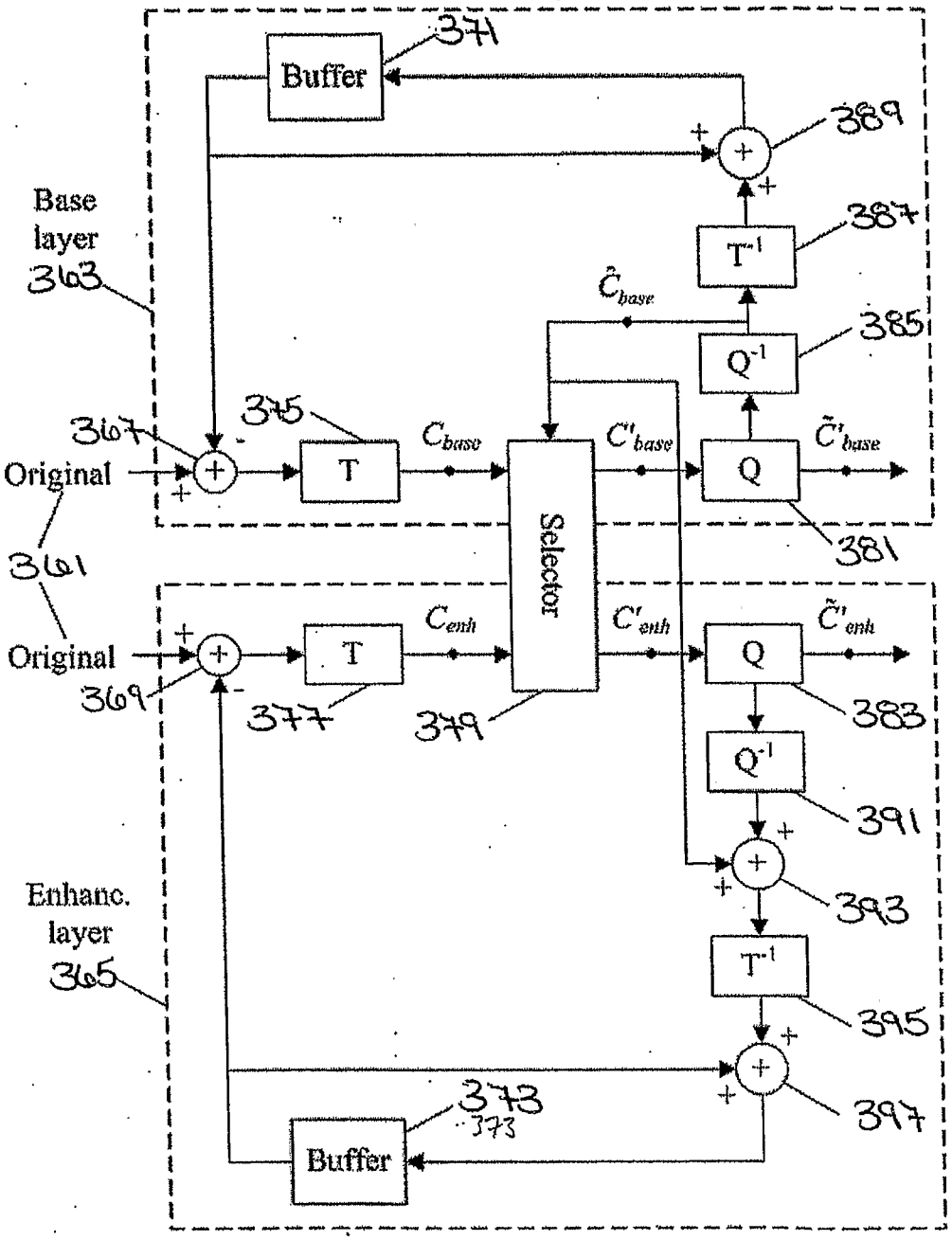

Buffer
371
389
Base layer 363
387
T-1
$\hat{C}_{base}$
385
Q-1
367
375
Original
T
C_{base}
C'_{base}
Q
$\tilde{C}'_{base}$
Selector
381
361
Original
369
377
T
C_{enh}
379
C'_{enh}
Q
$\tilde{C}'_{enh}$
383
Q-1
391
393
Enhanc. layer 365
T-1
395
373
373
Buffer
397

Figure 33

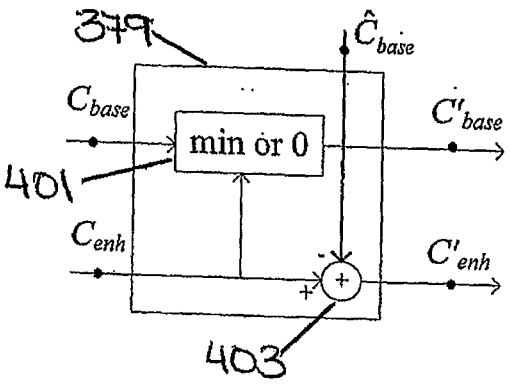


Figure 34

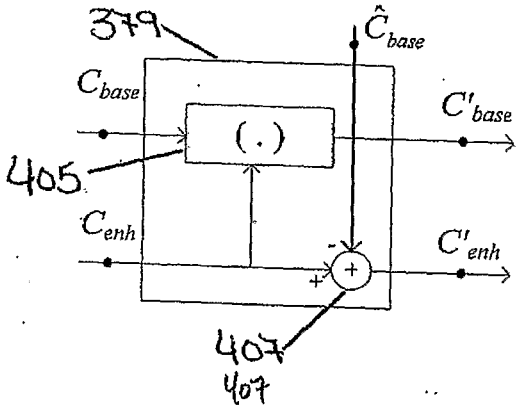


Figure 35

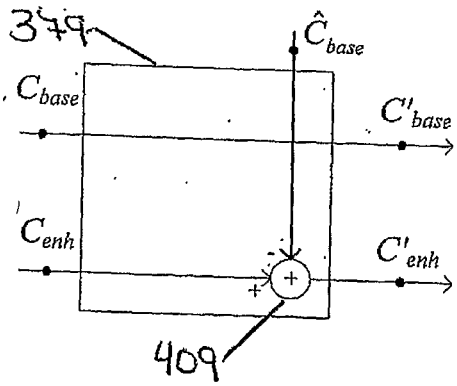


Figure 36

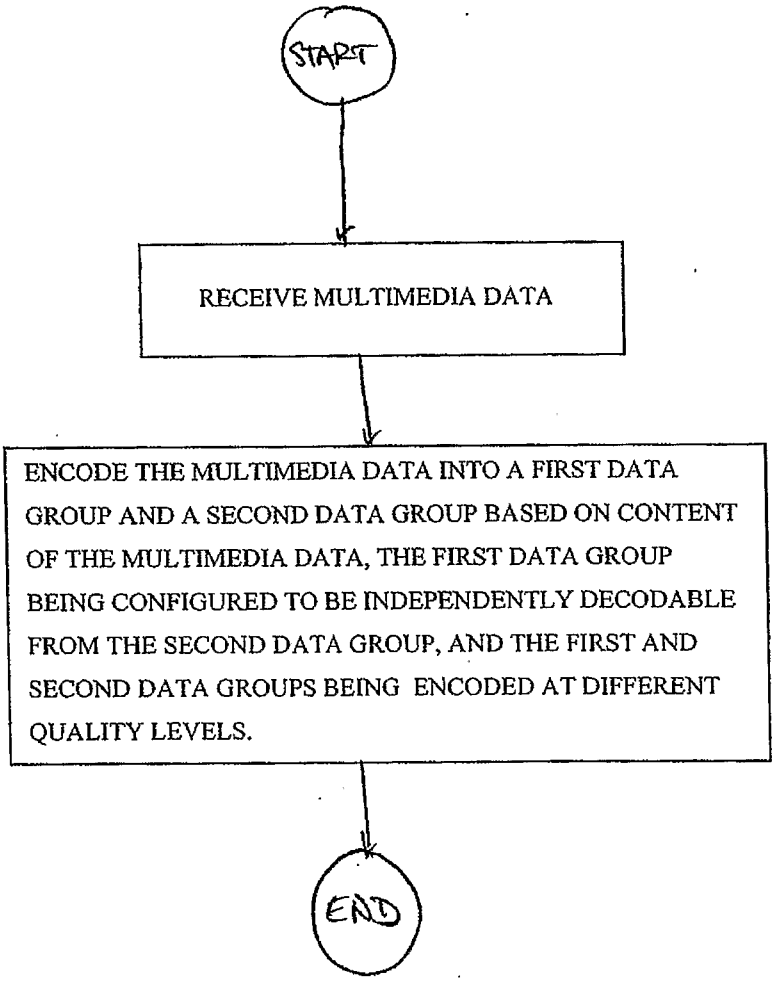

START
RECEIVE MULTIMEDIA DATA
ENCODE THE MULTIMEDIA DATA INTO A FIRST DATA GROUP AND A SECOND DATA GROUP BASED ON CONTENT OF THE MULTIMEDIA DATA, THE FIRST DATA GROUP BEING CONFIGURED TO BE INDEPENDENTLY DECODABLE FROM THE SECOND DATA GROUP, AND THE FIRST AND SECOND DATA GROUPS BEING ENCODED AT DIFFERENT QUALITY LEVELS.
END

FIG. 37

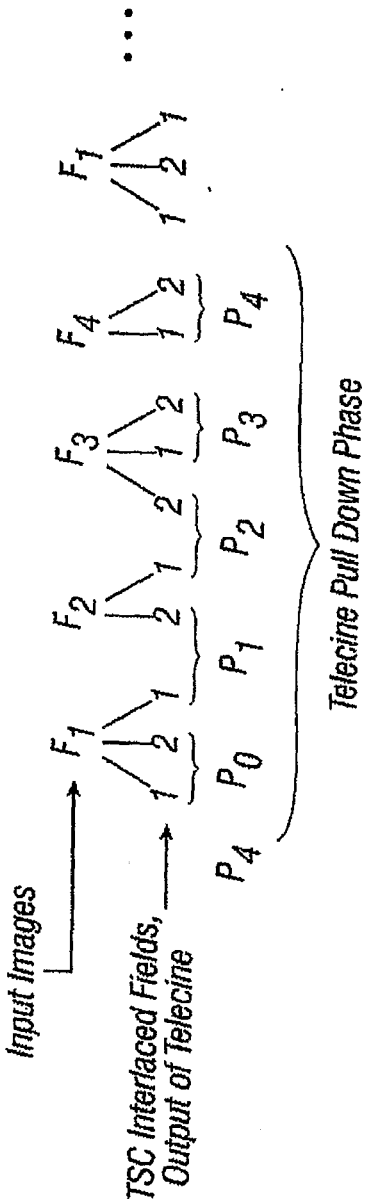
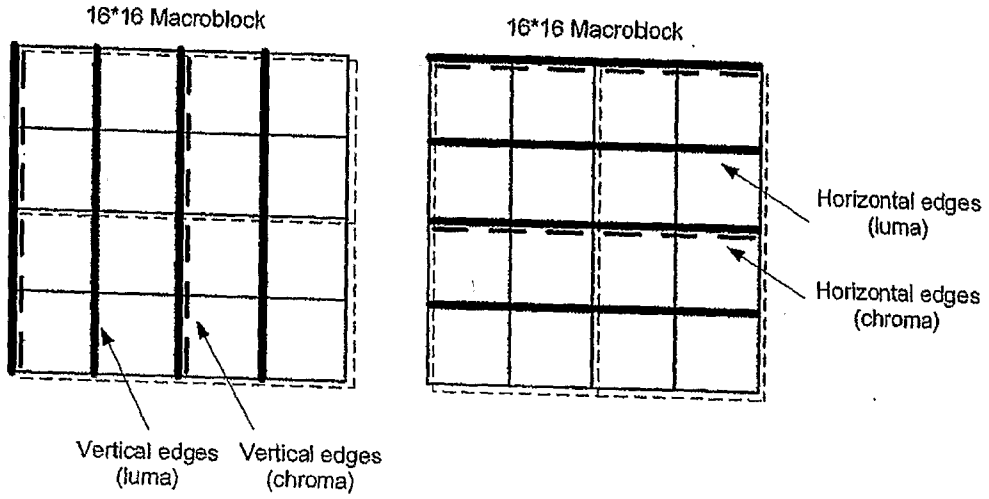

Input Images
NTSC Interlaced Fields, Output of Telecine
F1
F2
F3
F4
F1
1 2 1 2 1 2 1 2 1 2
P4 P0 P1 P2 P3 P4
Telecine Pull Down Phase
Possible System Decisions

FIG. 38



Boundaries in a macroblock to be filtered (luma boundaries shown with solid lines and chroma boundaries shown with dashed lines)

FIG. 39

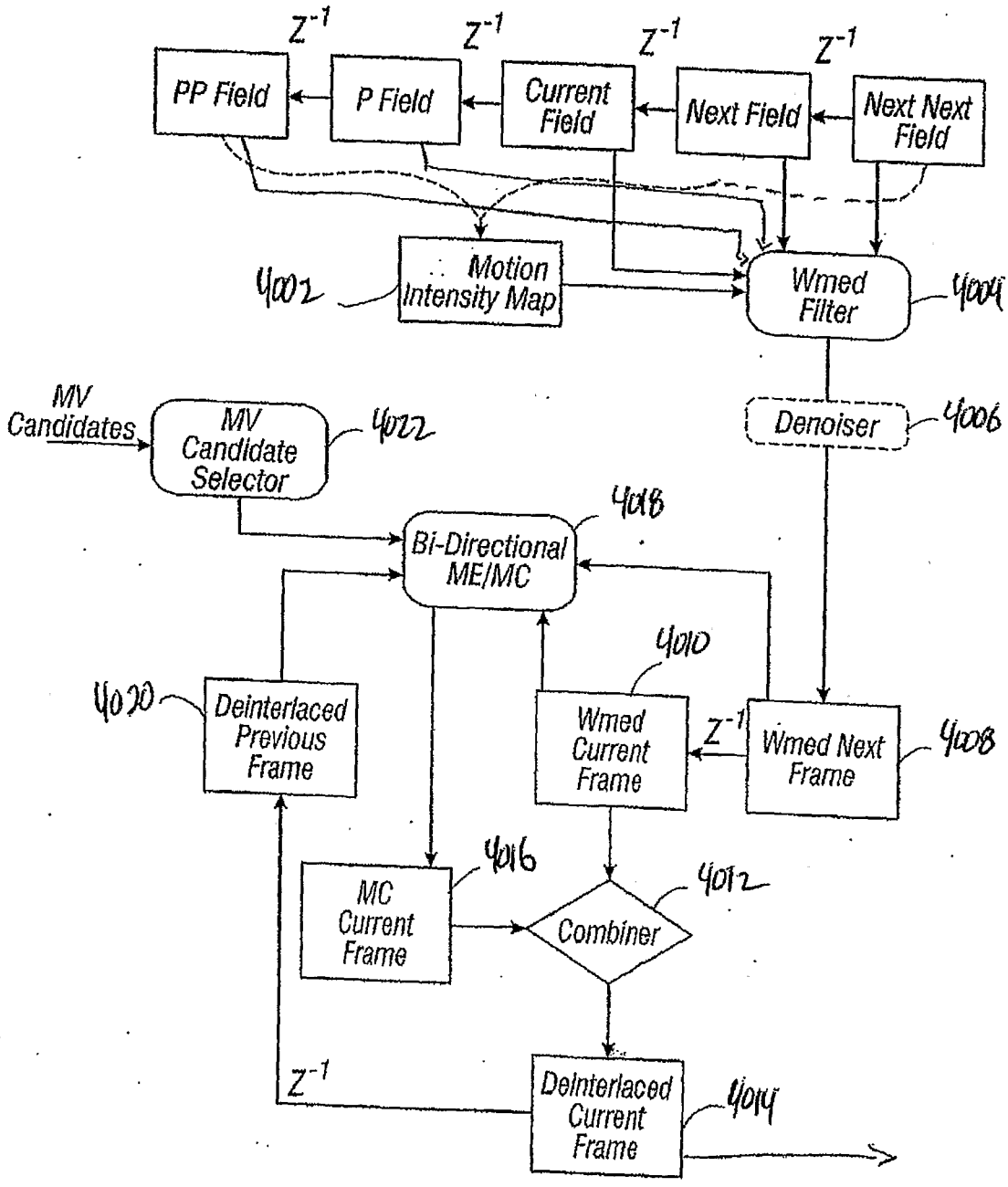

Z-1
Z-1
Z-1
Z-1
PP Field
P Field
Current Field
Next Field
Next Next Field
4002
Motion Intensity Map
Wmed Filter
4004
MV Candidates
MV Candidate Selector
4022
Denoiser
4006
4018
Bi-Directional ME/MC
4010
4020
Deinterlaced Previous Frame
Wmed Current Frame
Z-1
Wmed Next Frame
4008
4016
MC Current Frame
4012
Combiner
Z-1
Deinterlaced Current Frame
4014

FIG. 40

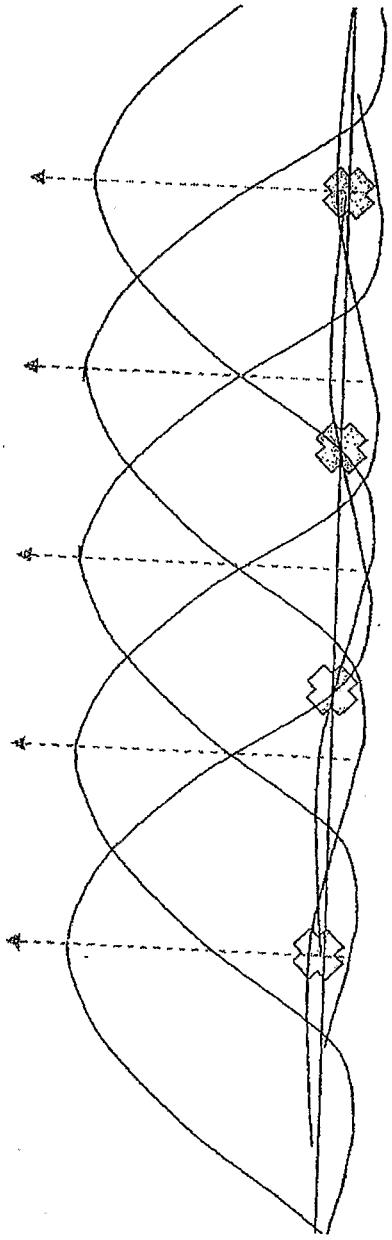


FIG. 41

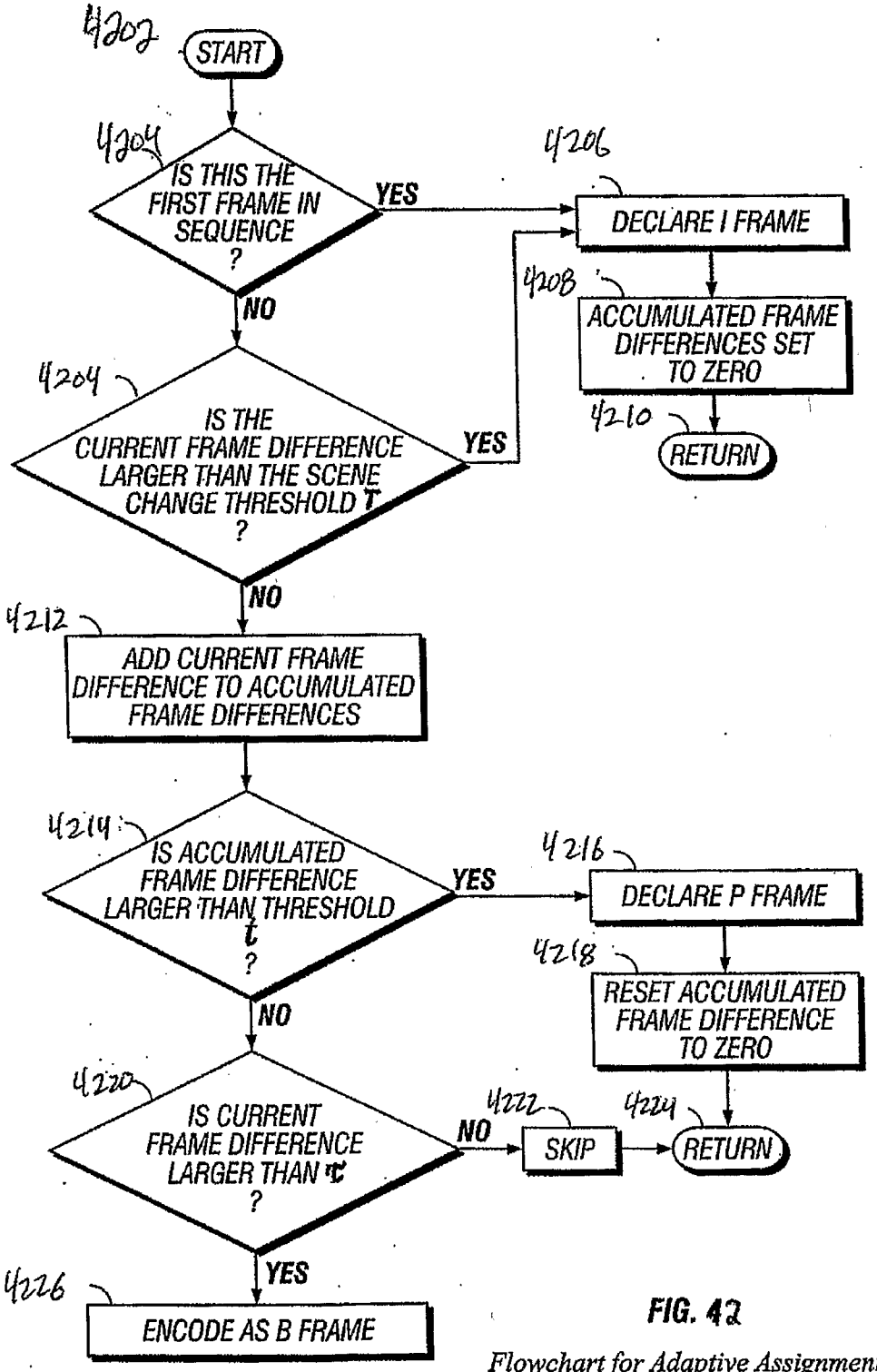


FIG. 42

Flowchart for Adaptive Assignment of Frame Types to Frames