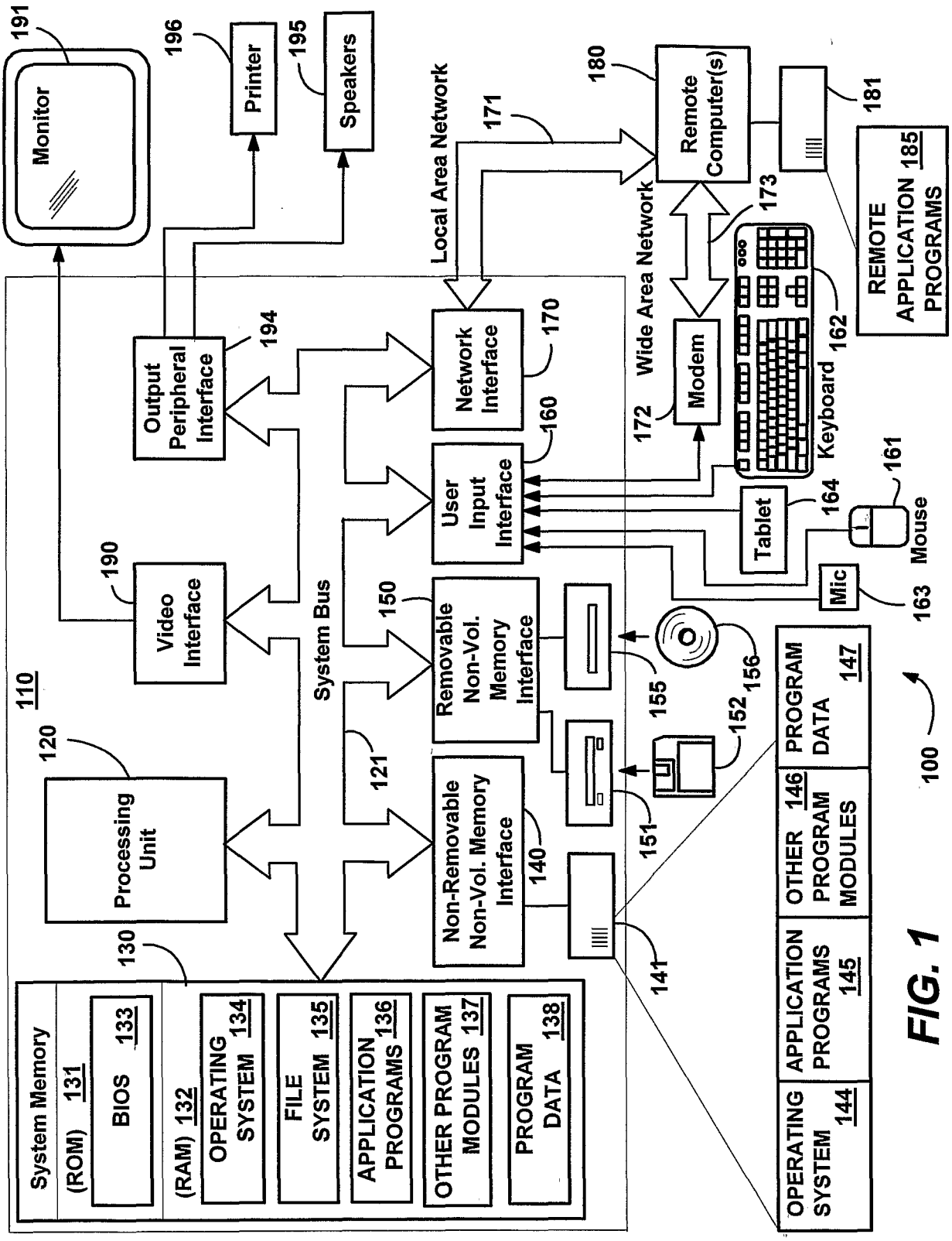

100
110
120
130
131
132
133
134
135
136
137
138
140
141
144
145
146
147
150
151
152
155
156
160
161
162
163
164
170
171
172
173
180
181
185
190
191
194
195
196
Monitor
Printer
Speakers
Output Peripheral Interface
Network Interface
Local Area Network
Wide Area Network
Modem
Remote Computer(s)
REMOTE APPLICATION PROGRAMS
Keyboard
Tablet
Mouse
Mic
User Input Interface
Video Interface
System Bus
Removable Non-Vol. Memory Interface
Non-Removable Non-Vol. Memory Interface
Processing Unit
System Memory
(ROM)
BIOS
(RAM)
OPERATING SYSTEM
FILE SYSTEM
APPLICATION PROGRAMS
OTHER PROGRAM MODULES
PROGRAM DATA
OPERATING SYSTEM
APPLICATION PROGRAMS
OTHER PROGRAM MODULES
PROGRAM DATA

FIG. 1

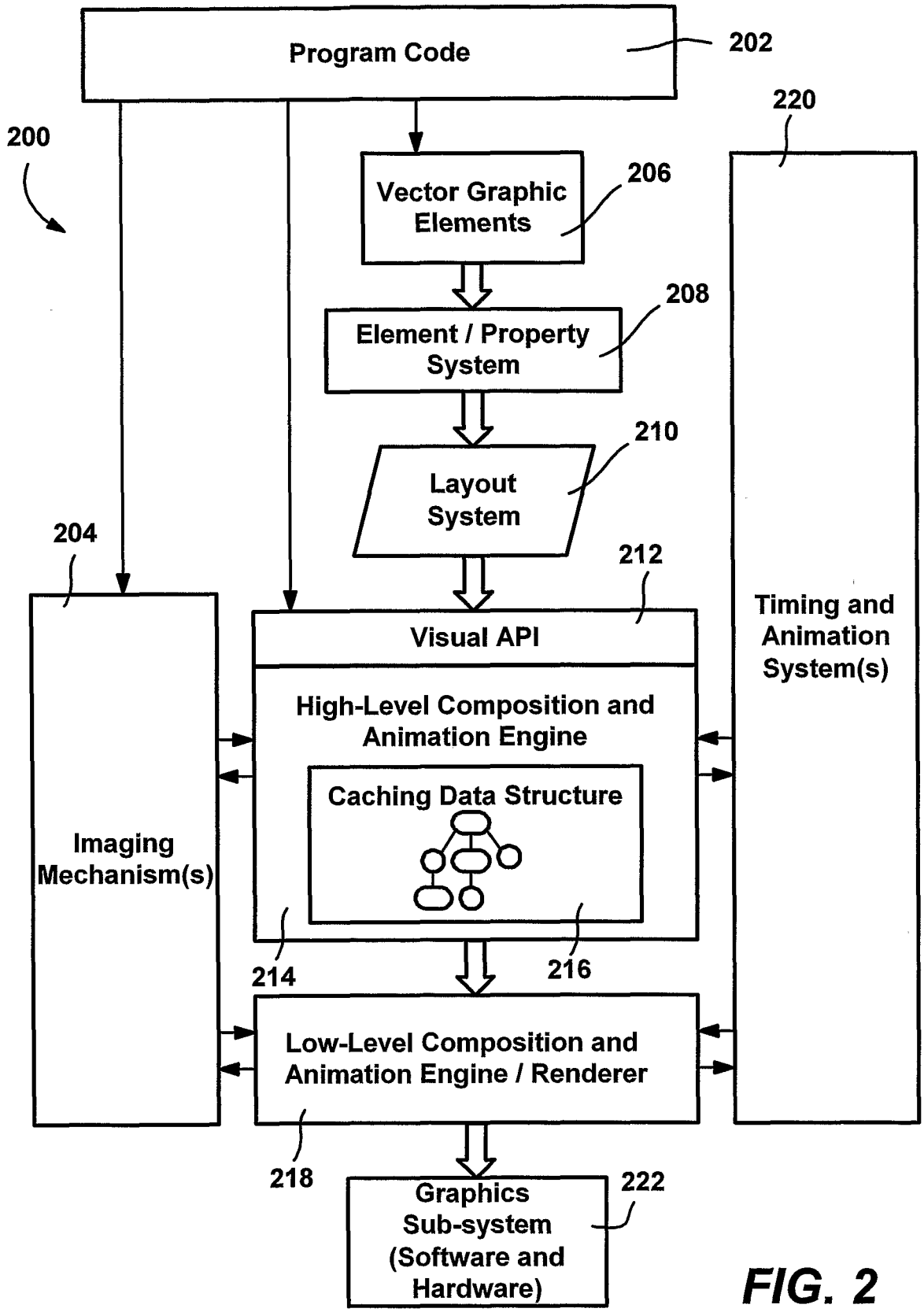

Program Code
202
220
200
Vector Graphic Elements
206
208
Element / Property System
210
Layout System
204
212
Visual API
Timing and Animation System(s)
High-Level Composition and Animation Engine
Caching Data Structure
Imaging Mechanism(s)
214
216
Low-Level Composition and Animation Engine / Renderer
218
222
Graphics Sub-system (Software and Hardware)

FIG. 2

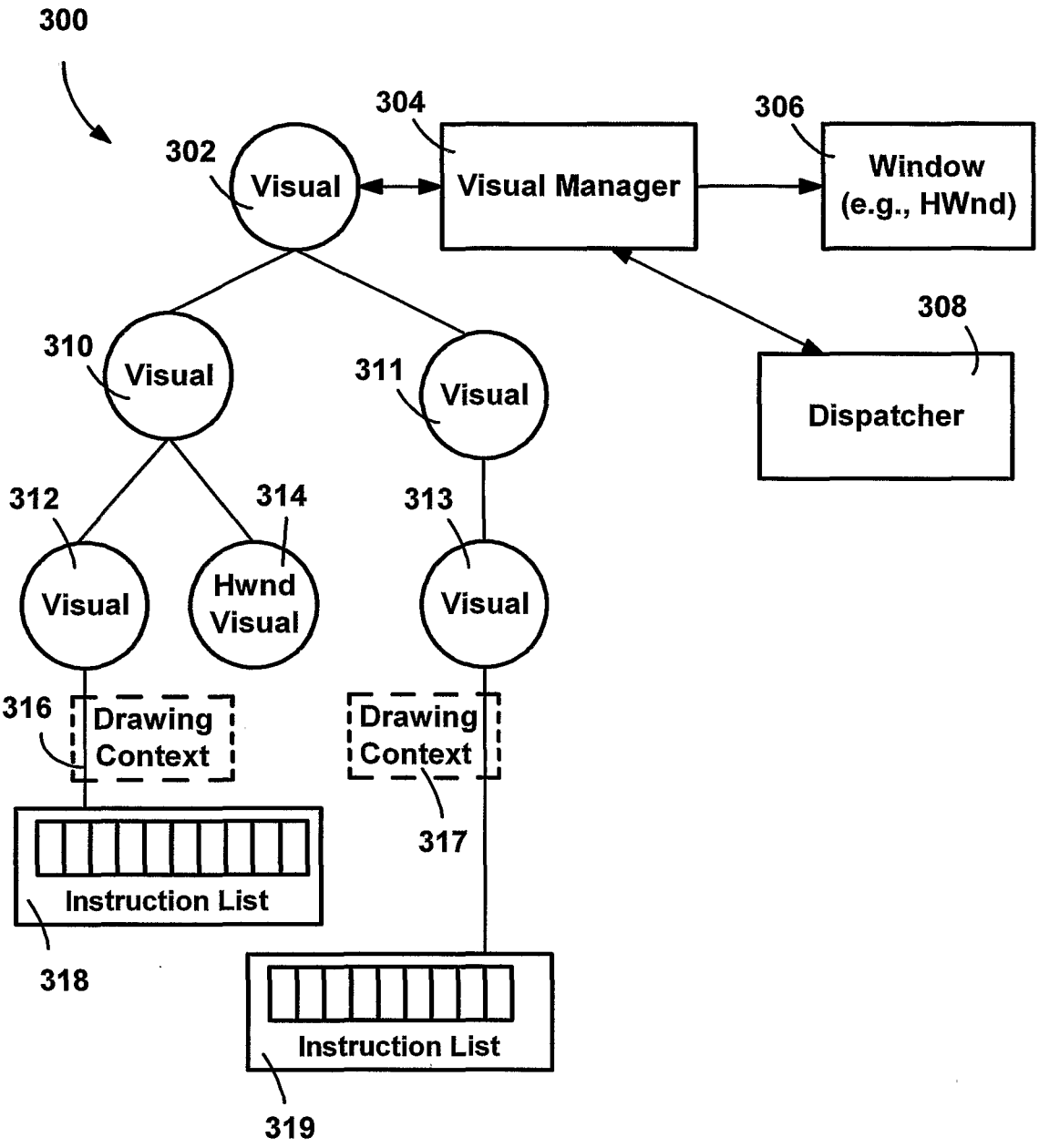

300
302
Visual
304
Visual Manager
306
Window
(e.g., HWnd)
308
Dispatcher
310
Visual
311
Visual
312
Visual
314
Hwnd
Visual
313
Visual
316
Drawing
Context
Drawing
Context
317
Instruction List
318
Instruction List
319

FIG. 3

FIG. 4

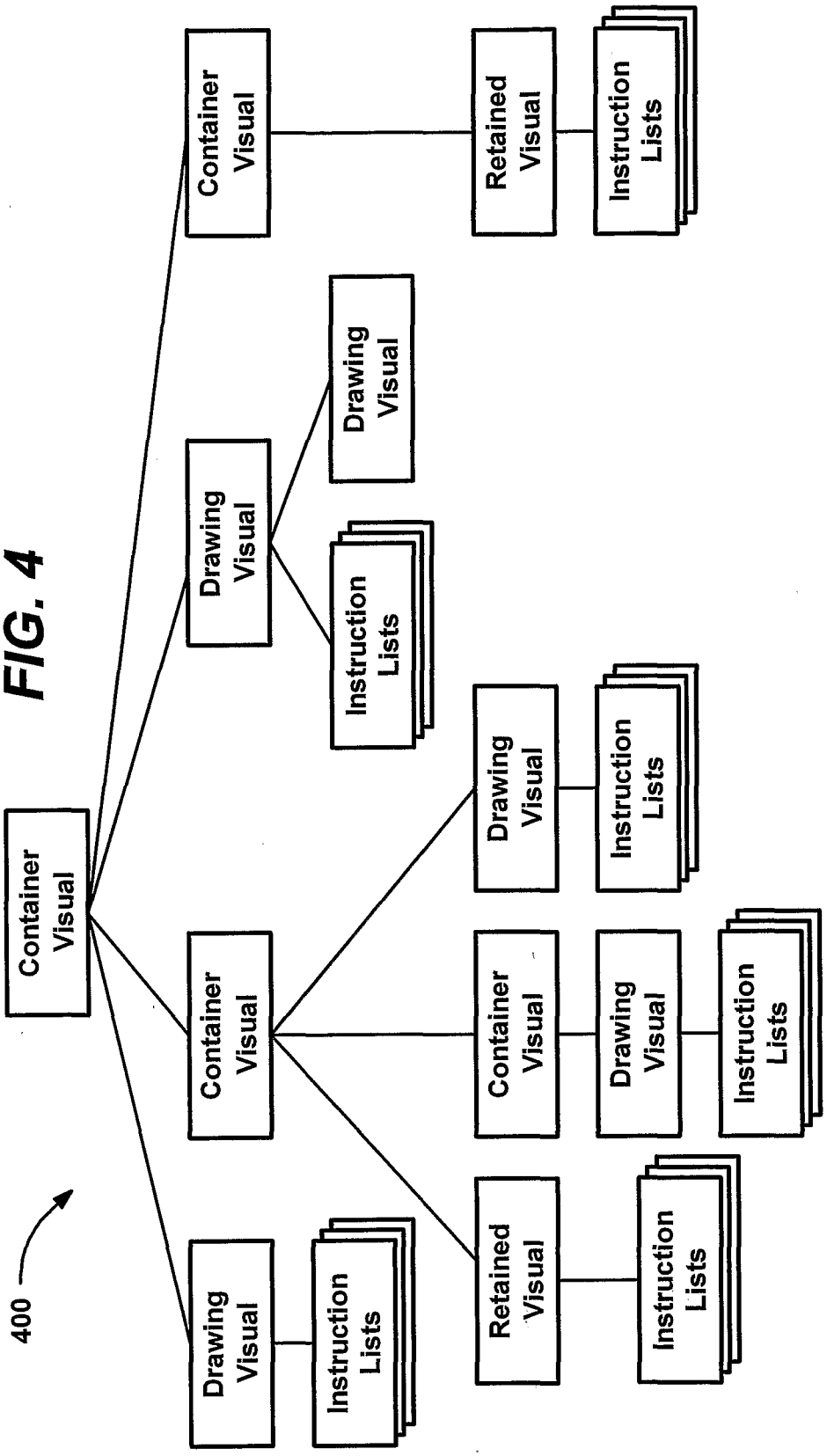
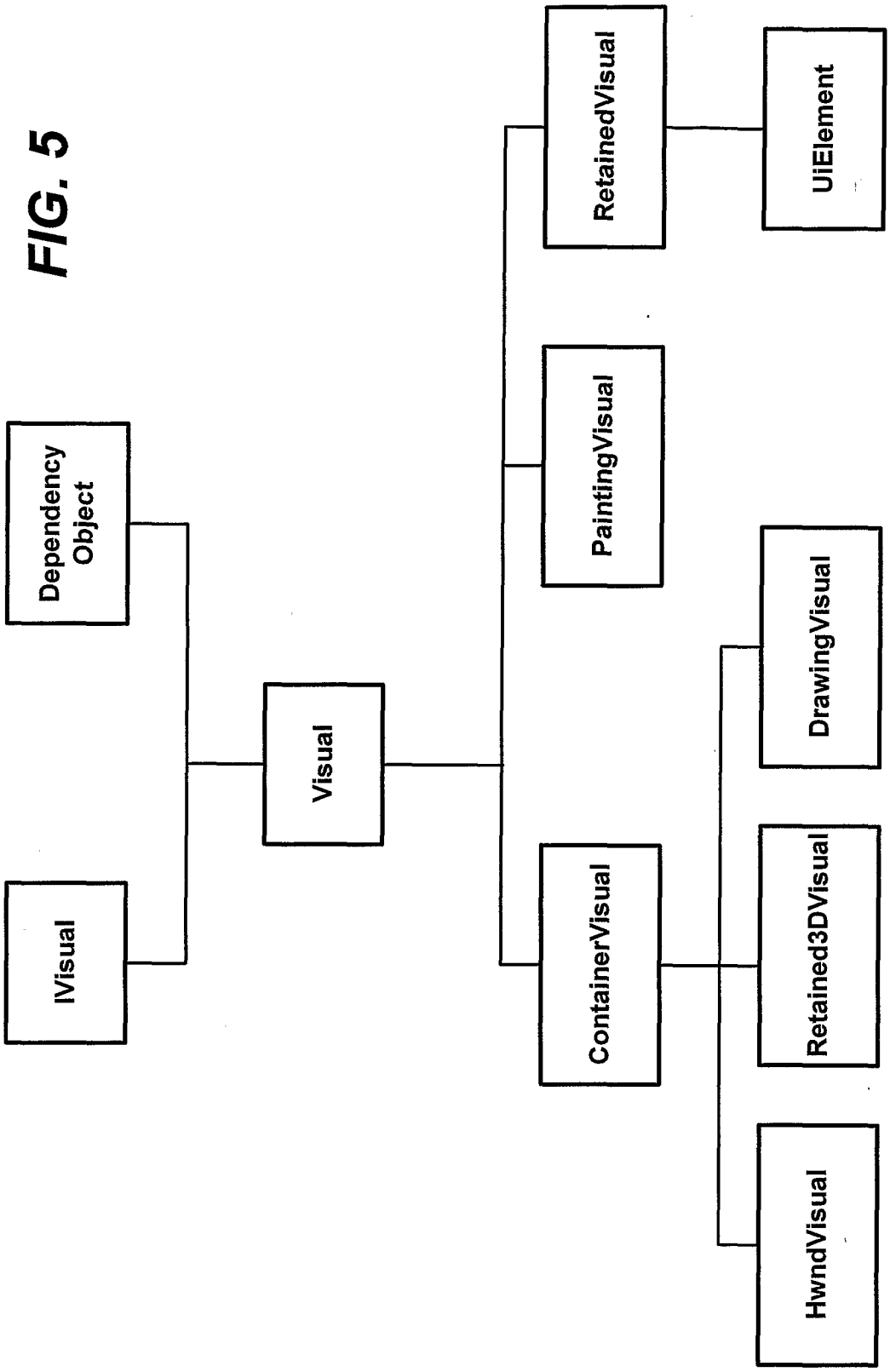

400
Container Visual
Container Visual
Retained Visual
Instruction Lists
Drawing Visual
Drawing Visual
Instruction Lists
Container Visual
Drawing Visual
Instruction Lists
Container Visual
Drawing Visual
Instruction Lists
Drawing Visual
Instruction Lists
Retained Visual
Instruction Lists

FIG. 5


Dependency Object
IVisual
Visual
RetainedVisual
UiElement
PaintingVisual
ContainerVisual
DrawingVisual
Retained3DVisual
HwndVisual

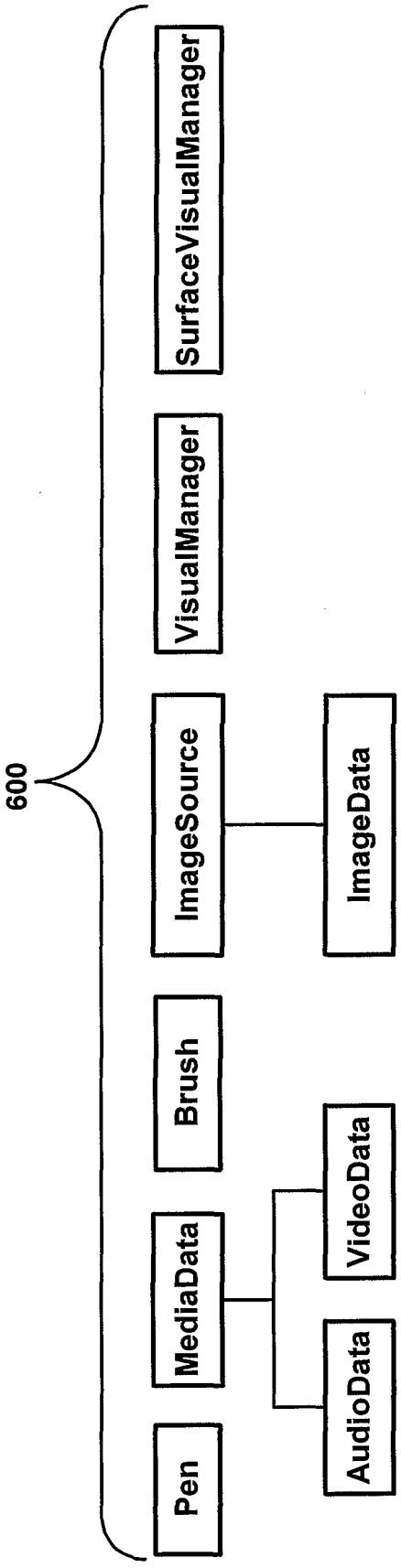

600
Pen
MediaData
AudioData
VideoData
Brush
ImageSource
ImageData
VisualManager
SurfaceVisualManager

FIG. 6

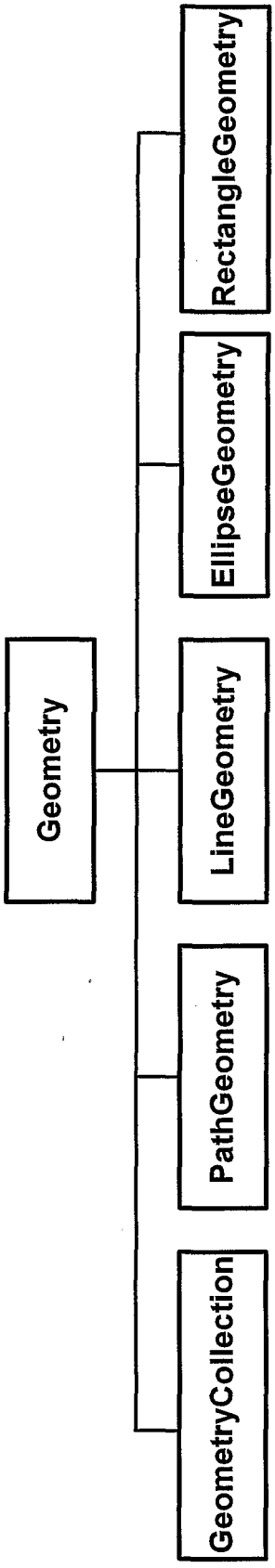

Geometry
GeometryCollection
PathGeometry
LineGeometry
EllipseGeometry
RectangleGeometry

FIG. 10

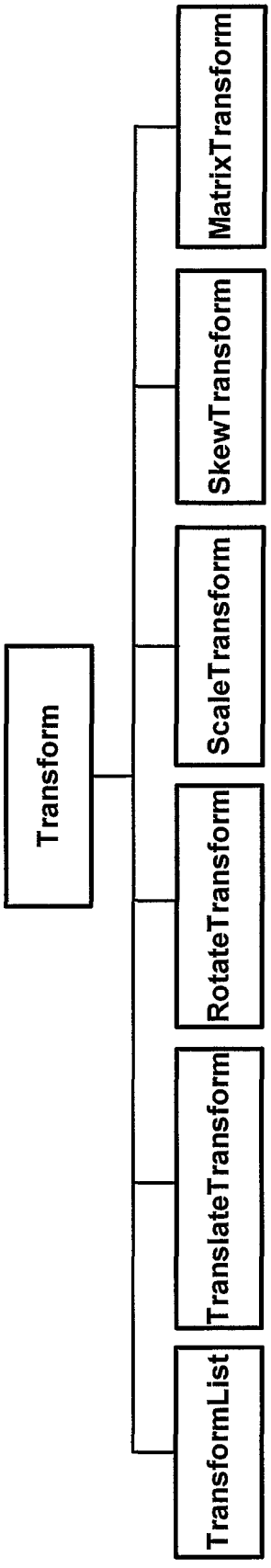

Transform
TransformList
TranslateTransform
RotateTransform
ScaleTransform
SkewTransform
MatrixTransform

FIG. 7

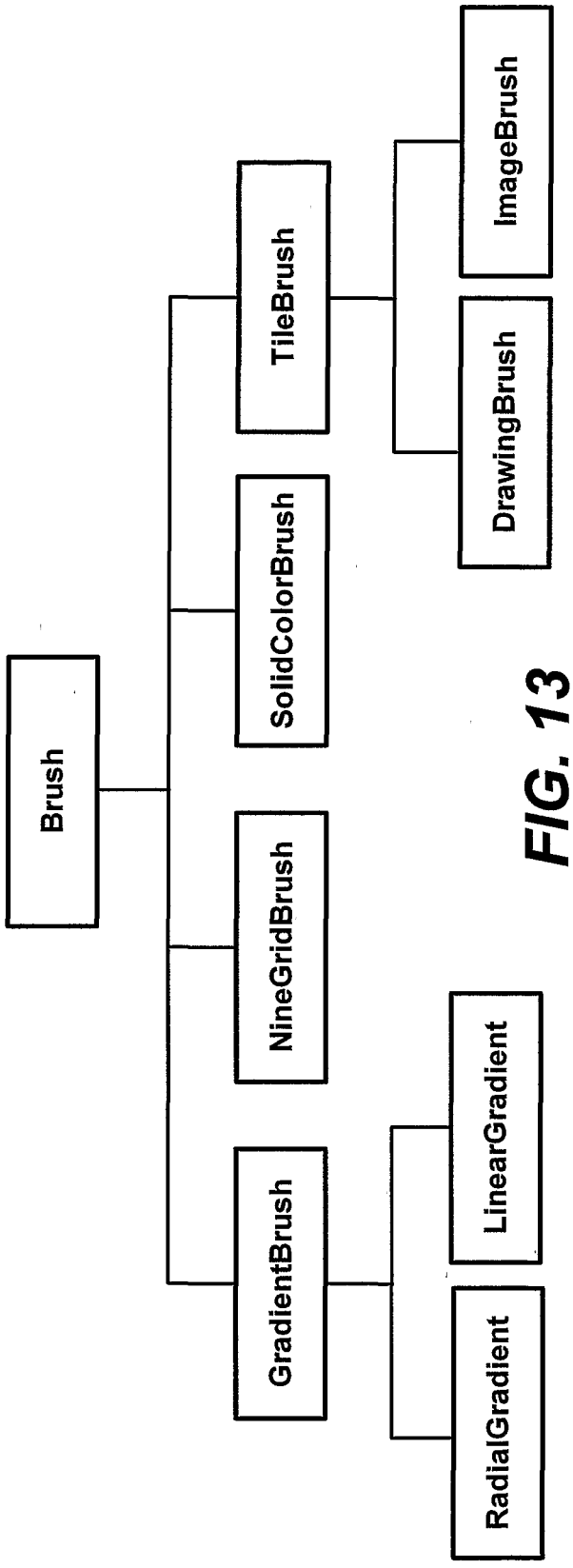

Brush
GradientBrush
RadialGradient
LinearGradient
NineGridBrush
SolidColorBrush
TileBrush
DrawingBrush
ImageBrush

FIG. 13

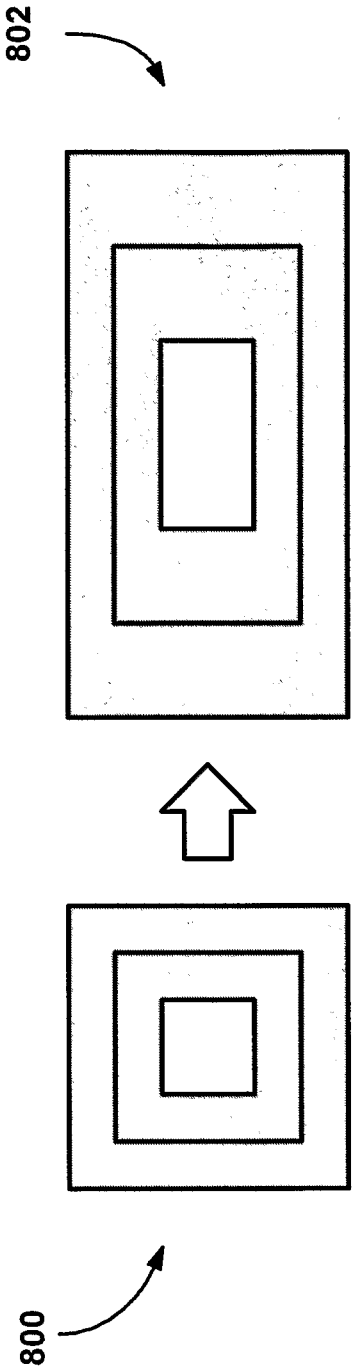


FIG. 8

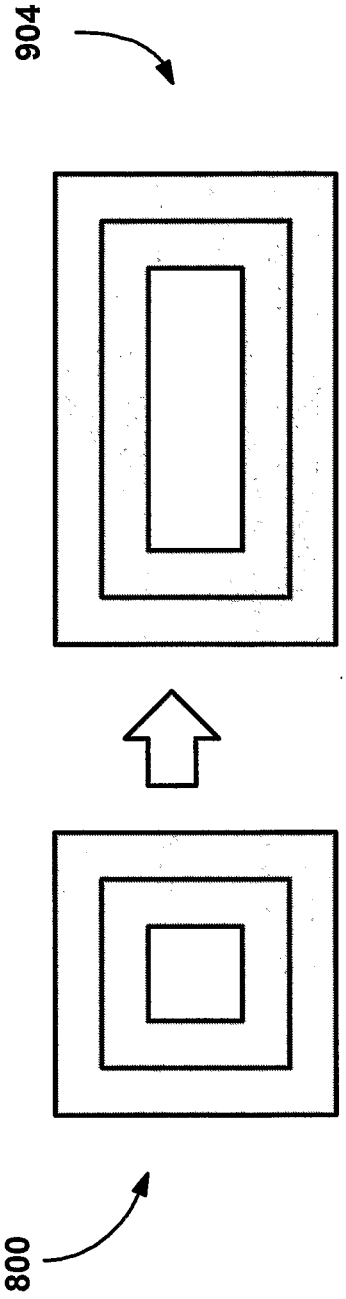


FIG. 9

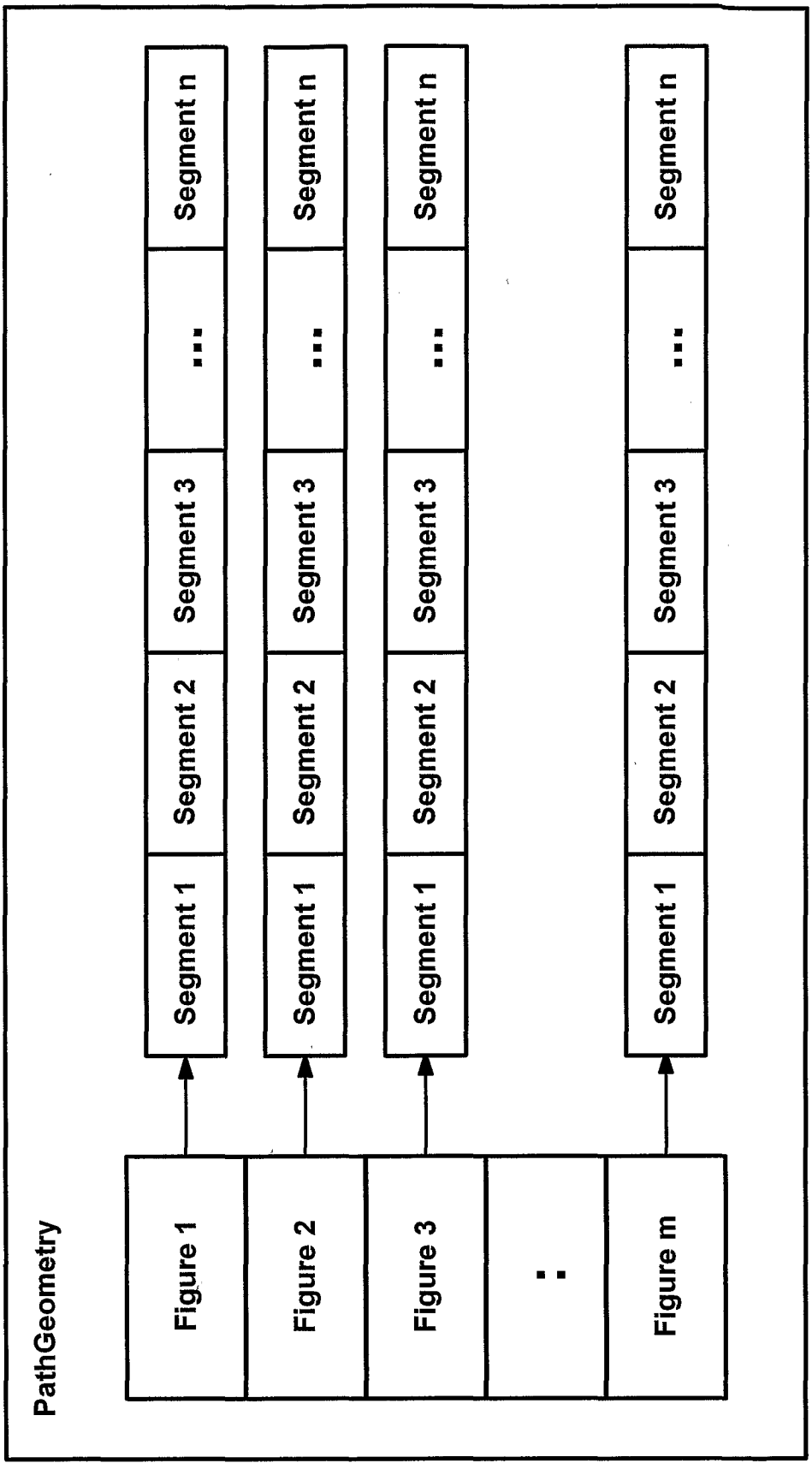

PathGeometry
Figure 1
Figure 2
Figure 3
:
Figure m
Segment 1
Segment 2
Segment 3
...
Segment n

FIG. 11

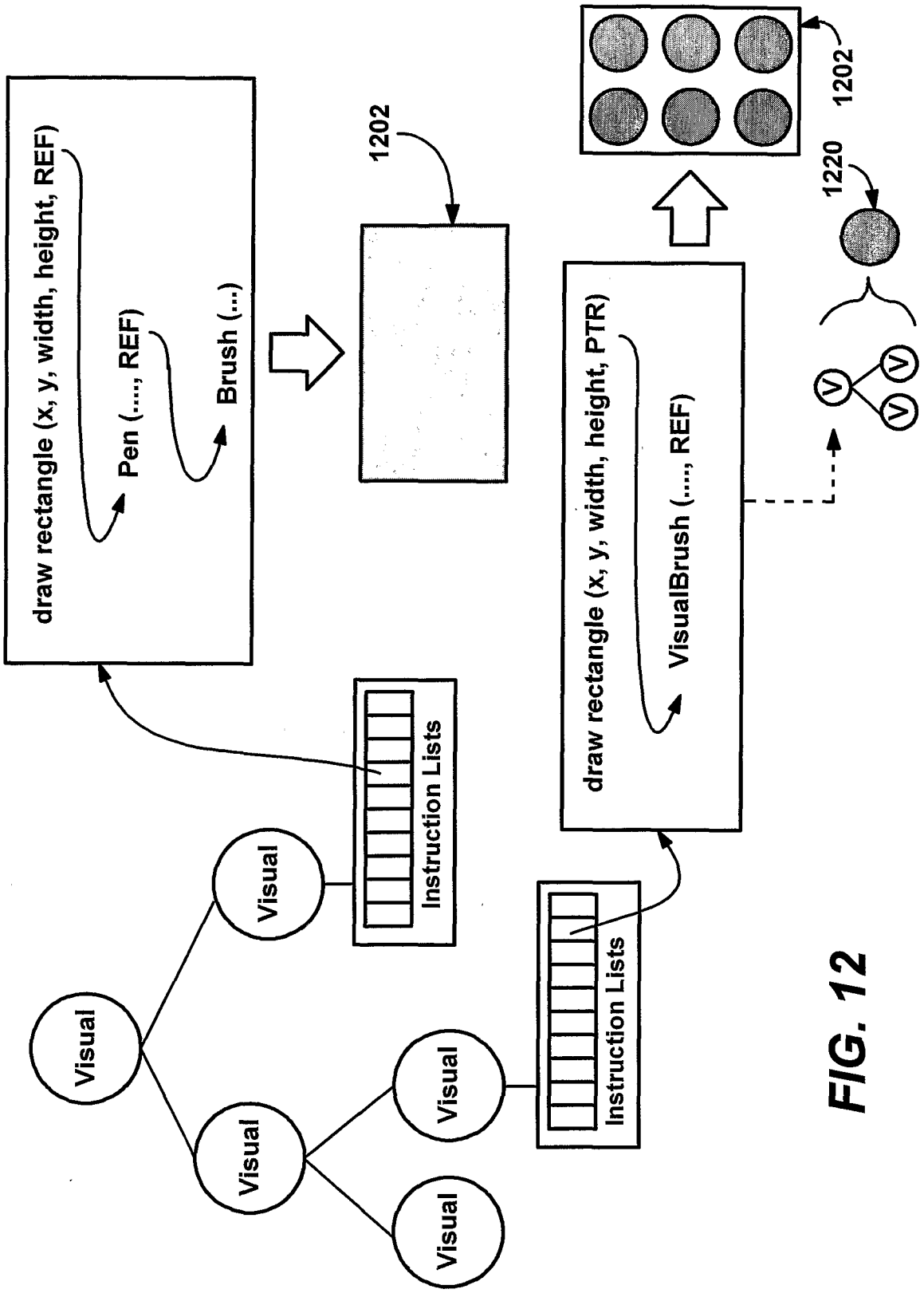

draw rectangle (x, y, width, height, REF)
Pen (...., REF)
Brush (...)
1202
1202
1220
draw rectangle (x, y, width, height, PTR)
VisualBrush (...., REF)
Instruction Lists
Instruction Lists
Visual
Visual
Visual
Visual
Visual

FIG. 12

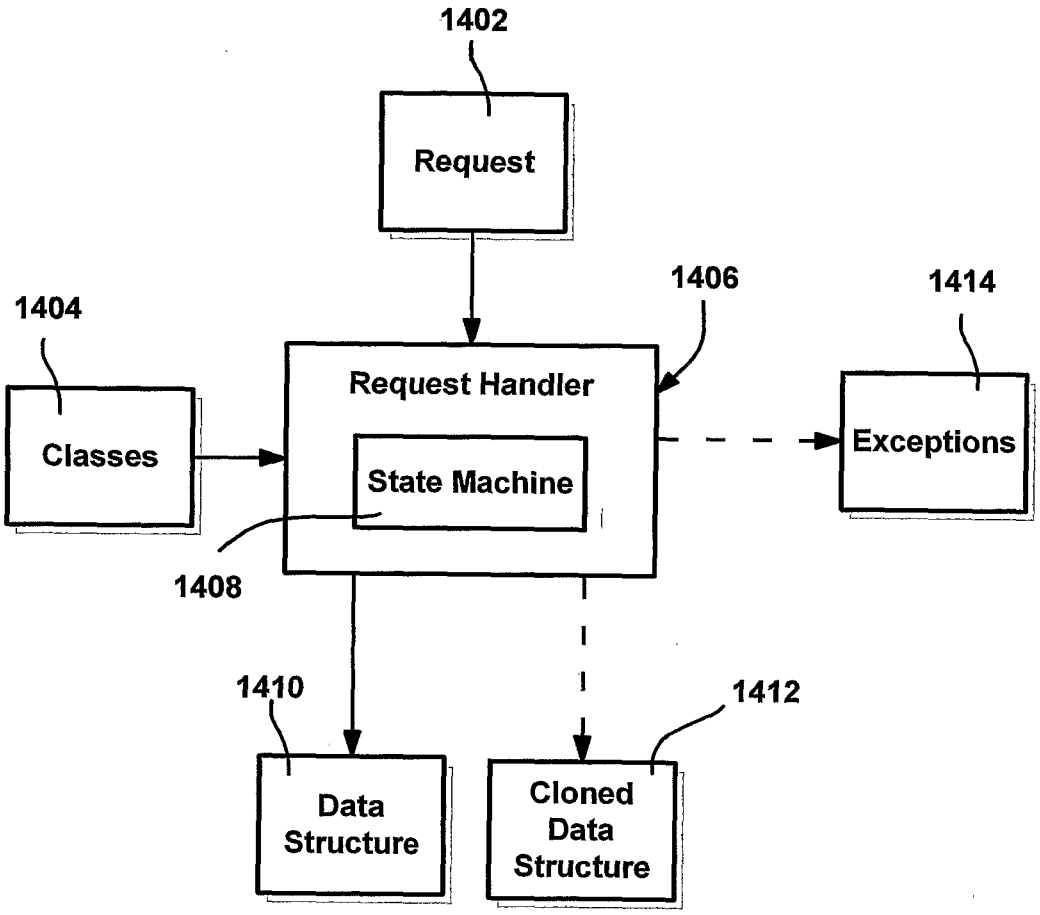

1402
Request
1406
1414
1404
Request Handler
Classes
State Machine
Exceptions
1408
1410
1412
Data Structure
Cloned Data Structure

FIG. 14

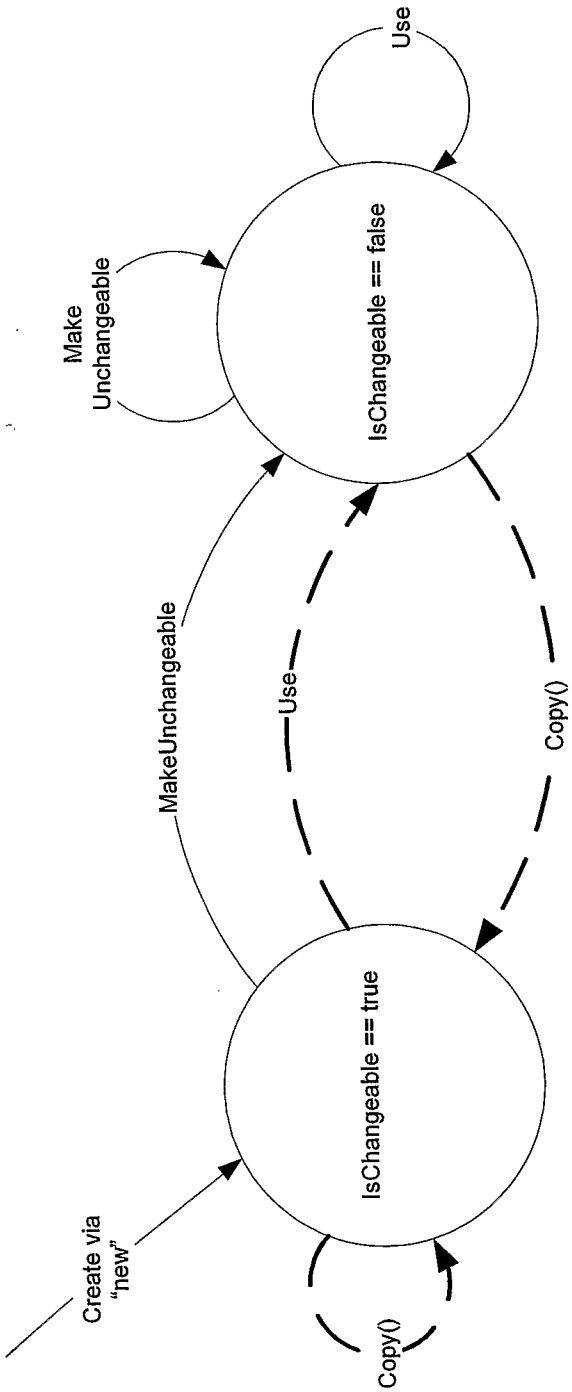

Use
Make
Unchangeable
IsChangeable == false
MakeUnchangeable
Use
Copy()
IsChangeable == true
Create via
"new"
Copy()

FIG. 15

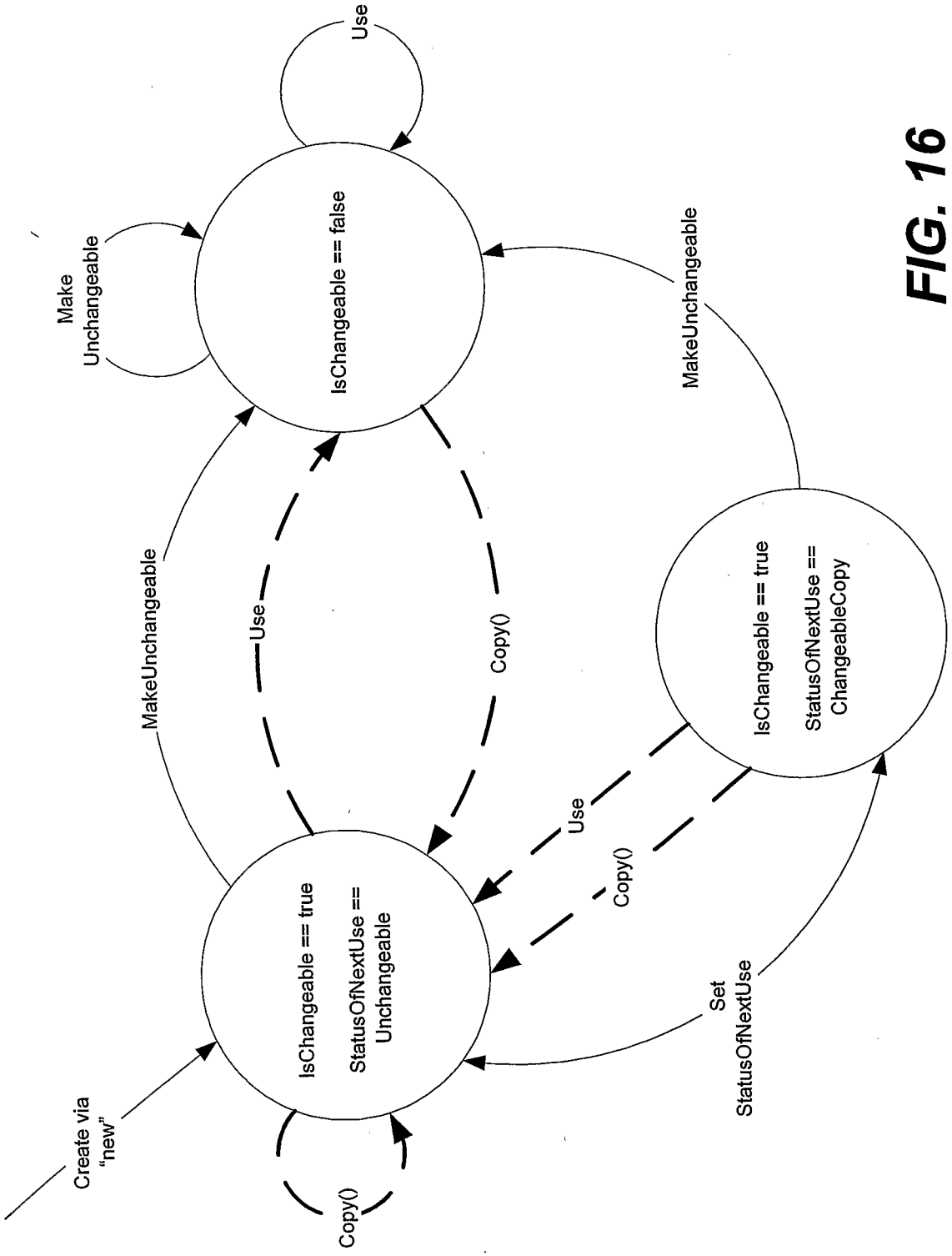

Use
Make
Unchangeable
IsChangeable == false
MakeUnchangeable
MakeUnchangeable
Use
Copy()
IsChangeable == true
StatusOfNextUse ==
ChangeableCopy
Use
Copy()
IsChangeable == true
StatusOfNextUse ==
Unchangeable
Set
StatusOfNextUse
Create via
"new"
Copy()

FIG. 16

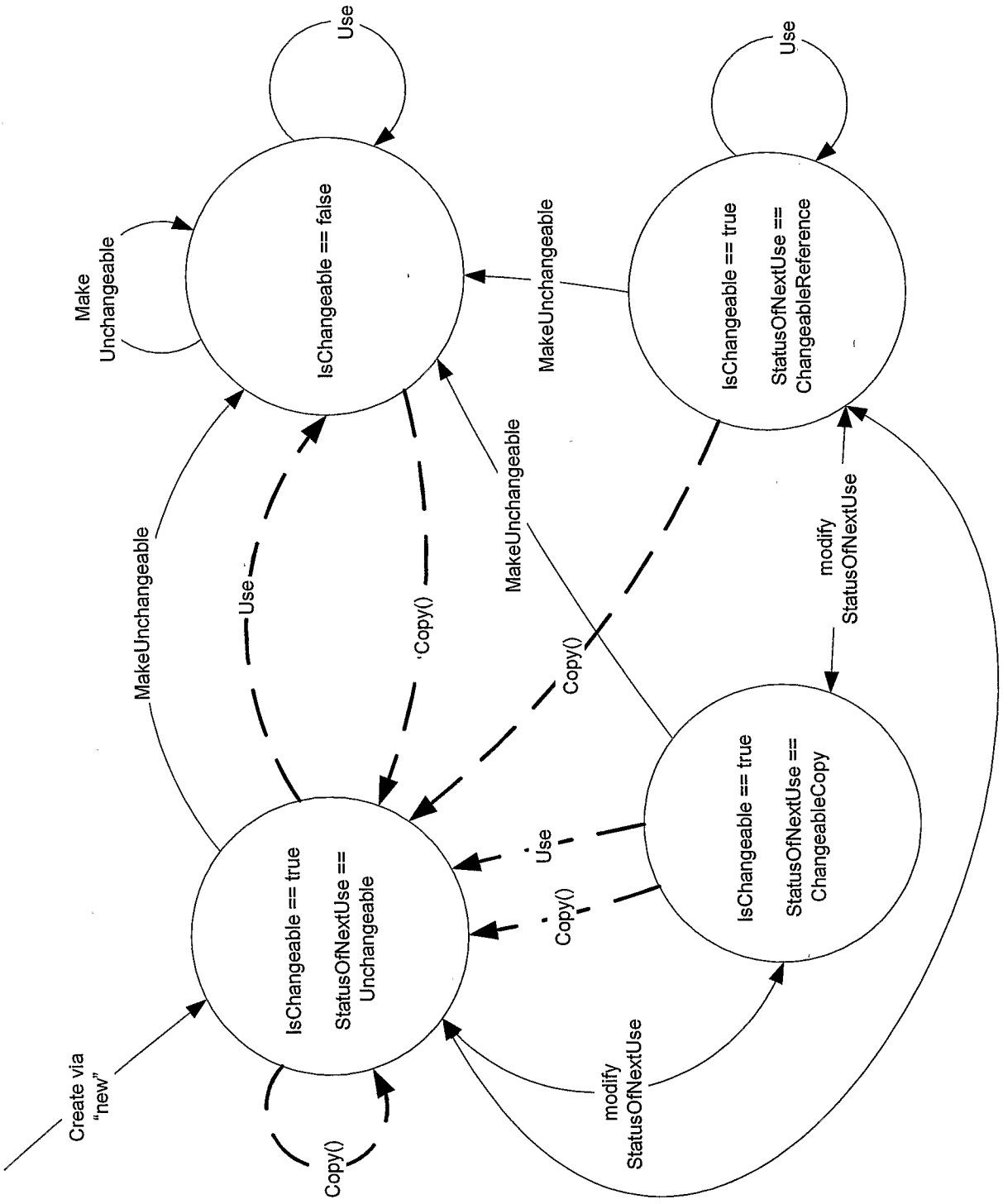

Use
Make
Unchangeable
IsChangeable == false
MakeUnchangeable
IsChangeable == true
StatusOfNextUse ==
ChangeableReference
Use
MakeUnchangeable
Use
Copy()
MakeUnchangeable
Copy()
modify
StatusOfNextUse
Use
Copy()
IsChangeable == true
StatusOfNextUse ==
Unchangeable
IsChangeable == true
StatusOfNextUse ==
ChangeableCopy
Create via
"new"
Copy()
modify
StatusOfNextUse

FIG. 17

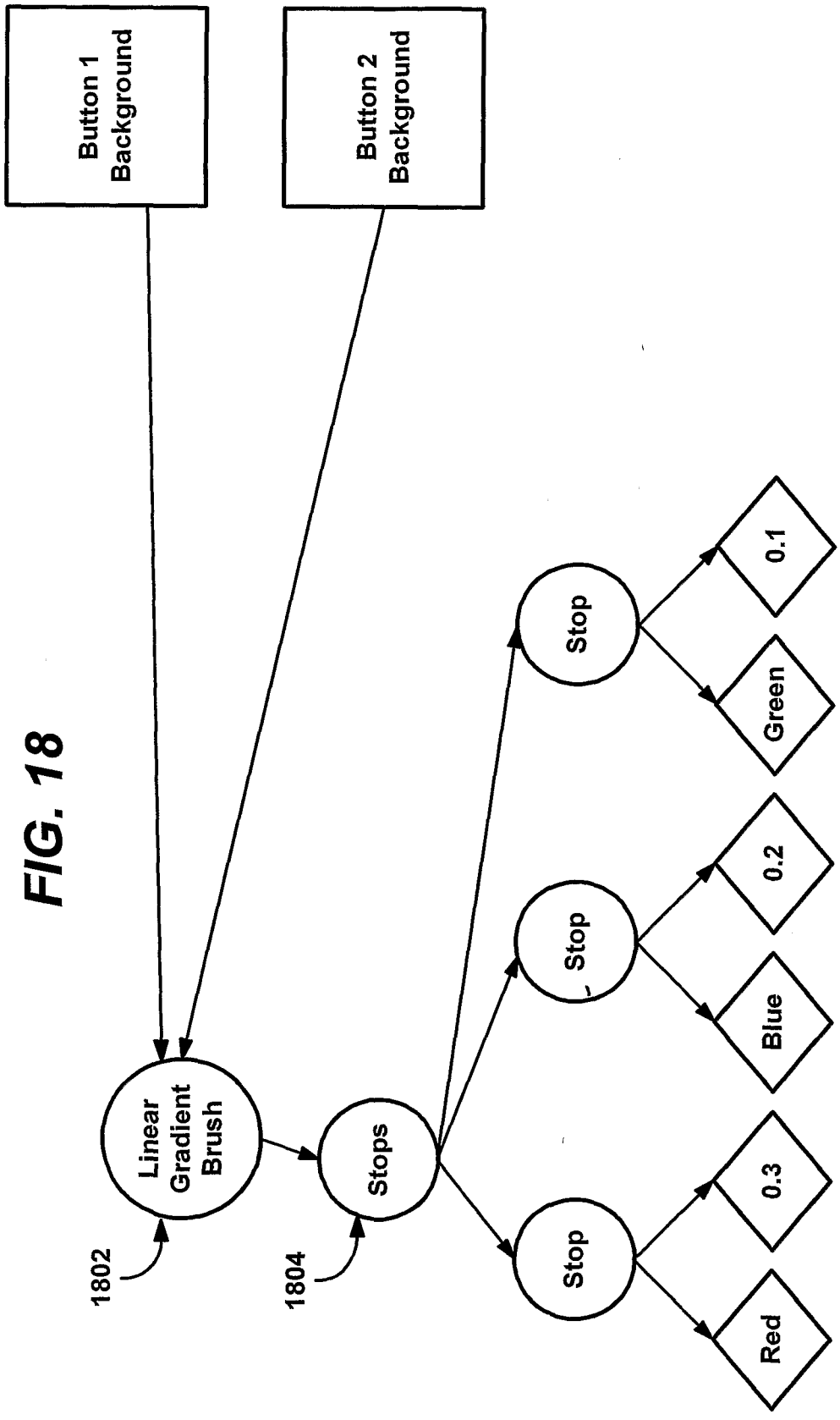

Button 1 Background
Button 2 Background
Linear Gradient Brush
Stops
Stop
Stop
Stop
0.1
Green
0.2
Blue
0.3
Red
1802
1804

FIG. 18

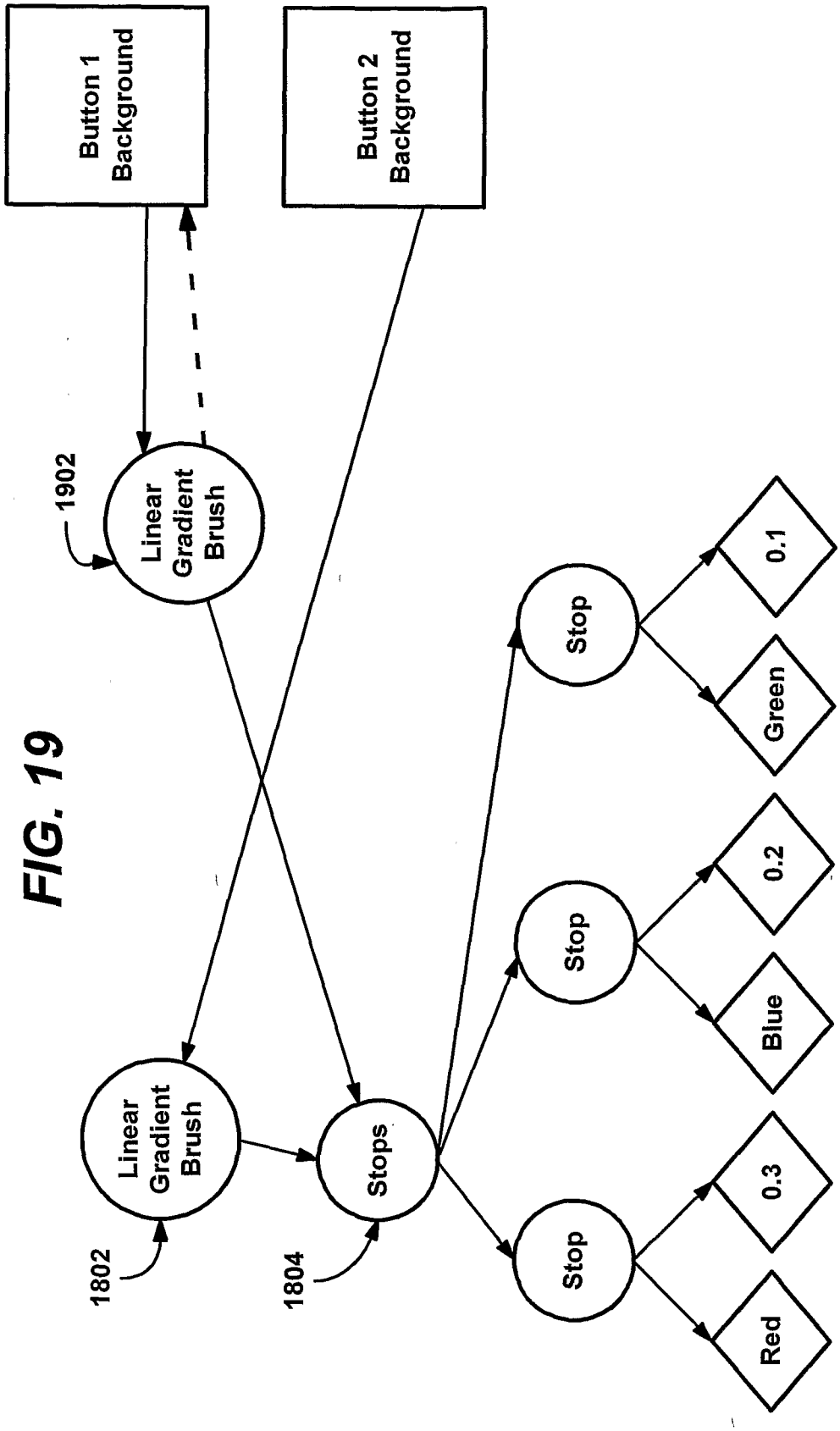

Button 1 Background
Button 2 Background
1902
Linear Gradient Brush
Linear Gradient Brush
1802
Stops
1804
Stop
Stop
Stop
0.1
Green
0.2
Blue
0.3
Red

FIG. 19

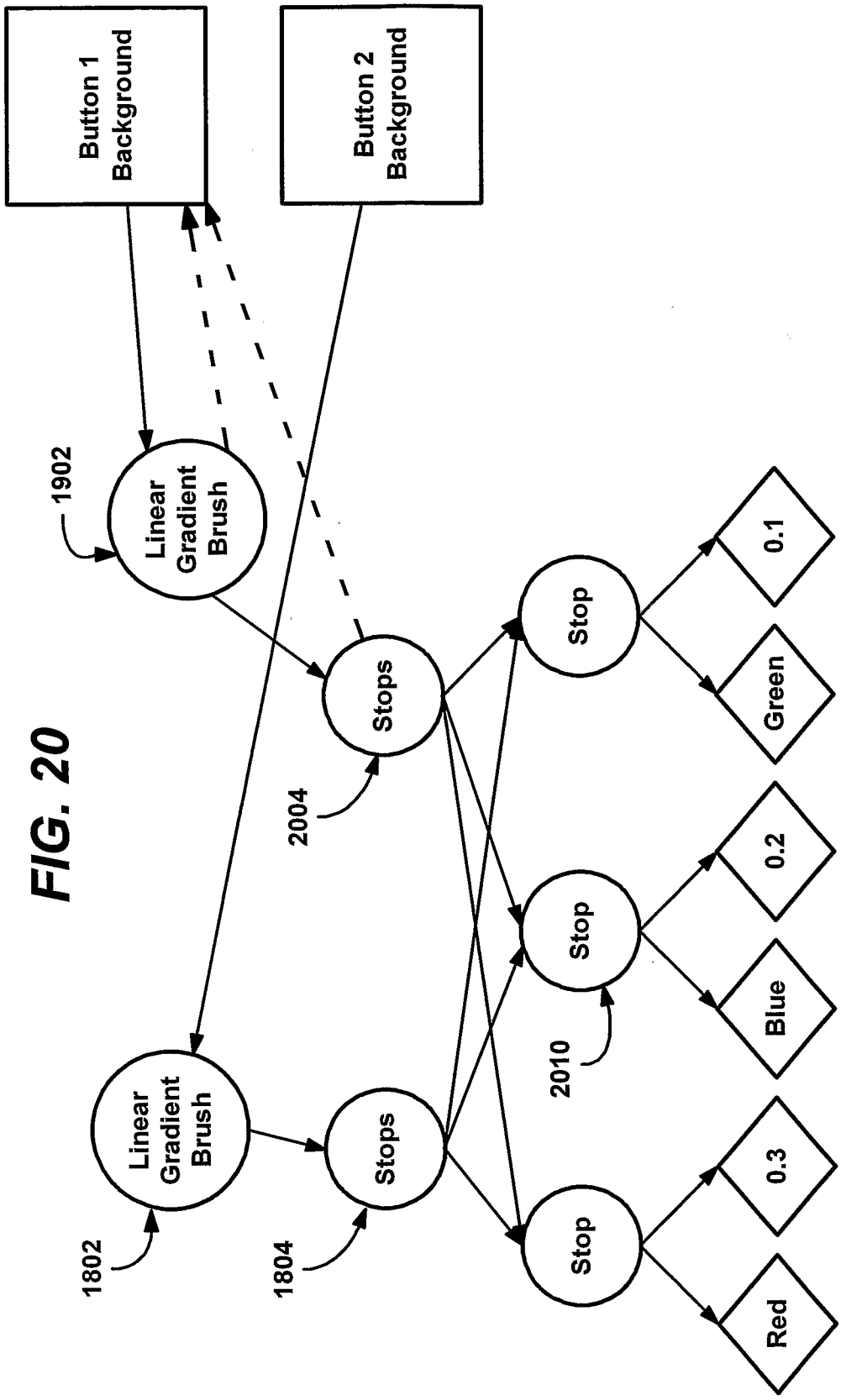

Button 1 Background
Button 2 Background
1902
Linear Gradient Brush
Stops
2004
Stop
0.1
Green
Stop
0.2
Blue
2010
Stop
0.3
Red
Linear Gradient Brush
1802
Stops
1804

FIG. 20

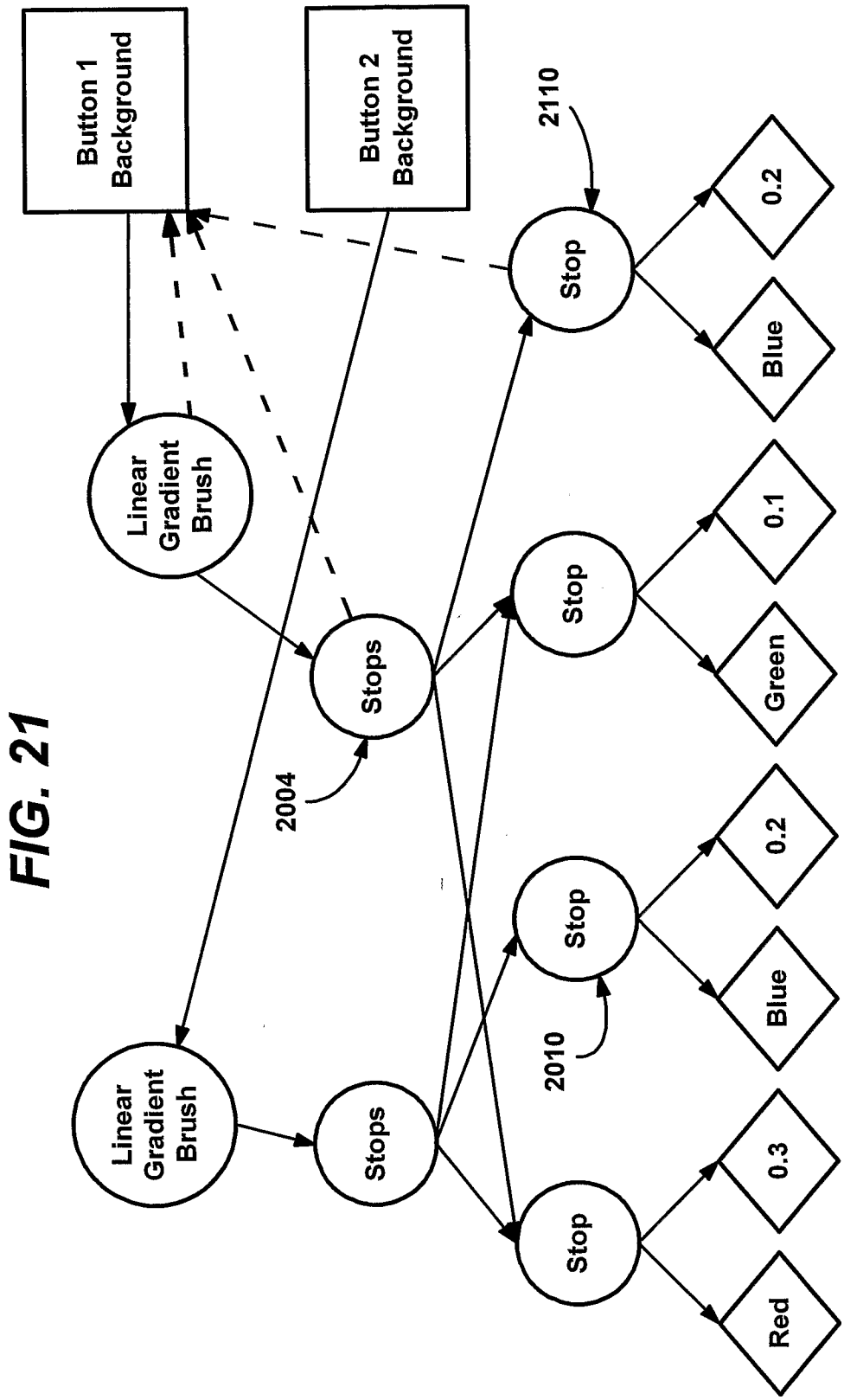

Button 1 Background
Button 2 Background
2110
Linear Gradient Brush
Stops
2004
Stop
0.2
Blue
Stop
0.1
Green
Stop
0.2
Blue
2010
Linear Gradient Brush
Stops
Stop
0.3
Red

FIG. 21

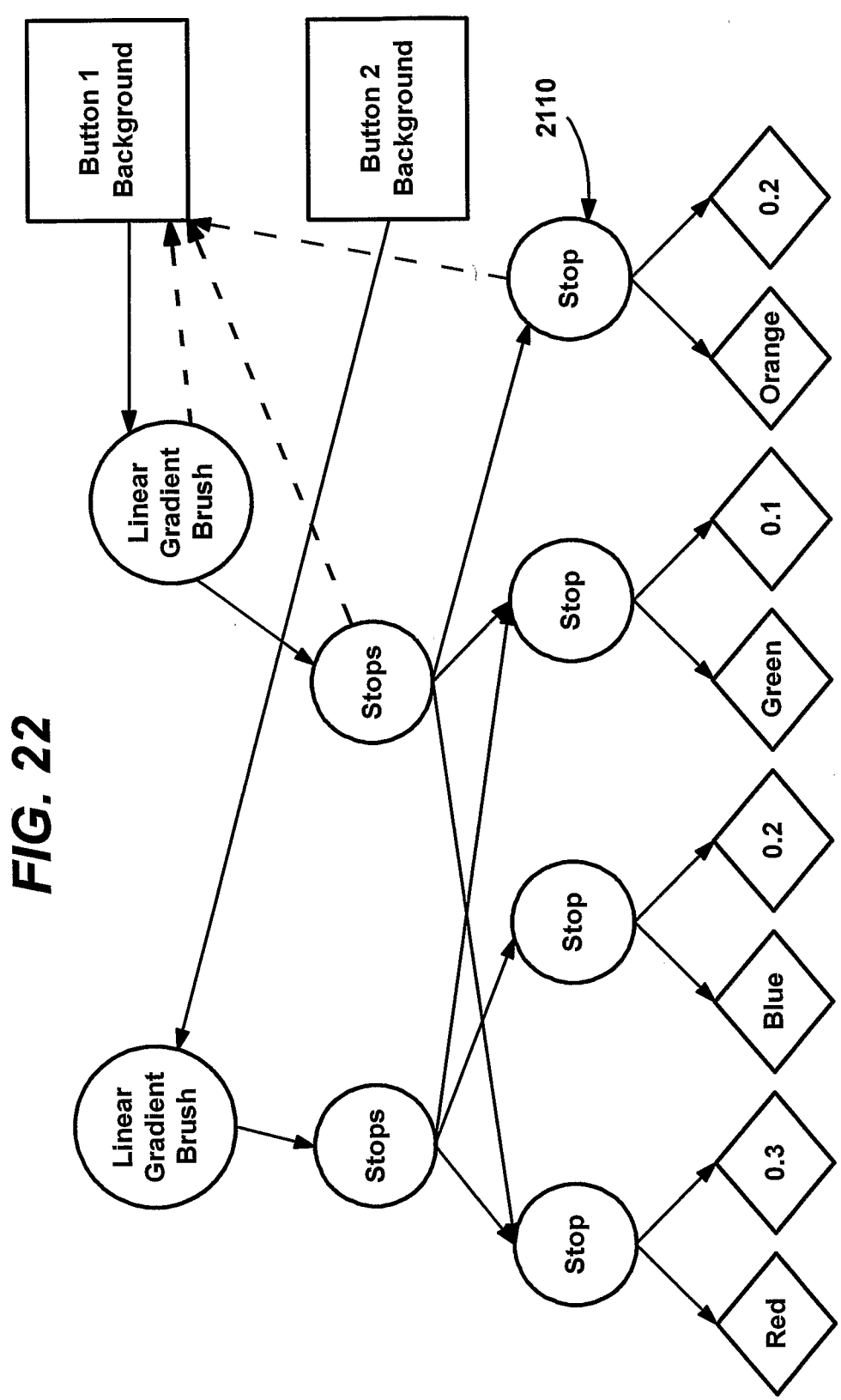

Button 1 Background
Button 2 Background
2110
Linear Gradient Brush
Stops
Stop
0.2
Orange
Stop
0.1
Green
Linear Gradient Brush
Stops
Stop
0.2
Blue
Stop
0.3
Red

FIG. 22

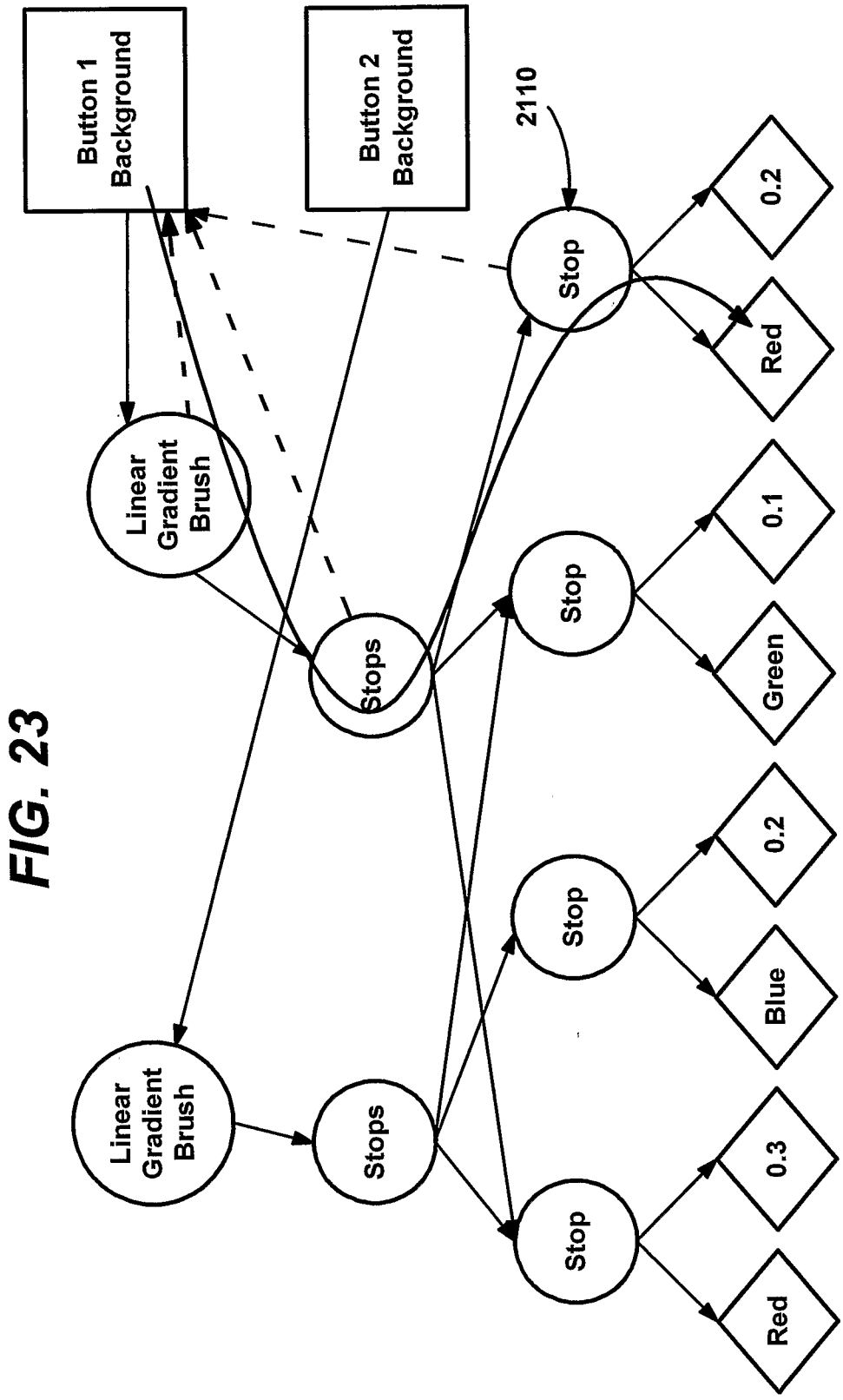

Button 1 Background
Button 2 Background
2110
Linear Gradient Brush
Stops
Stop
0.2
Red
Linear Gradient Brush
Stops
Stop
0.1
Green
Stop
0.2
Blue
Stop
0.3
Red

FIG. 23

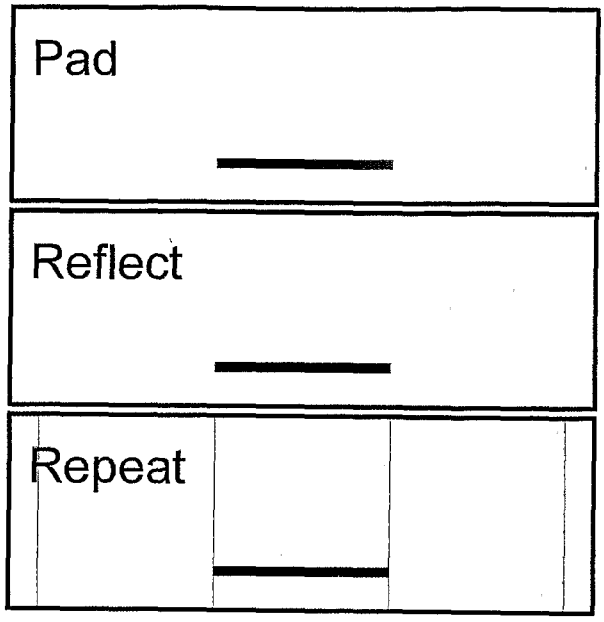


FIG. 24

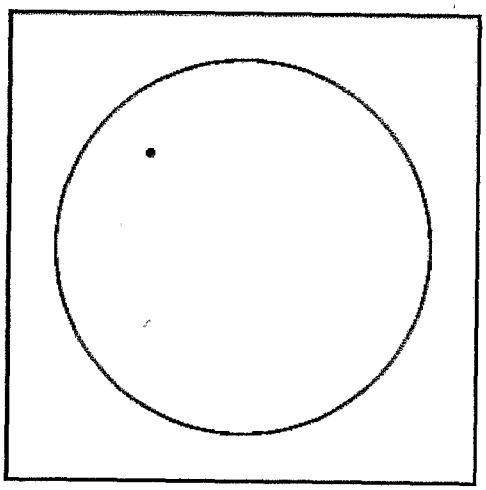


FIG. 25

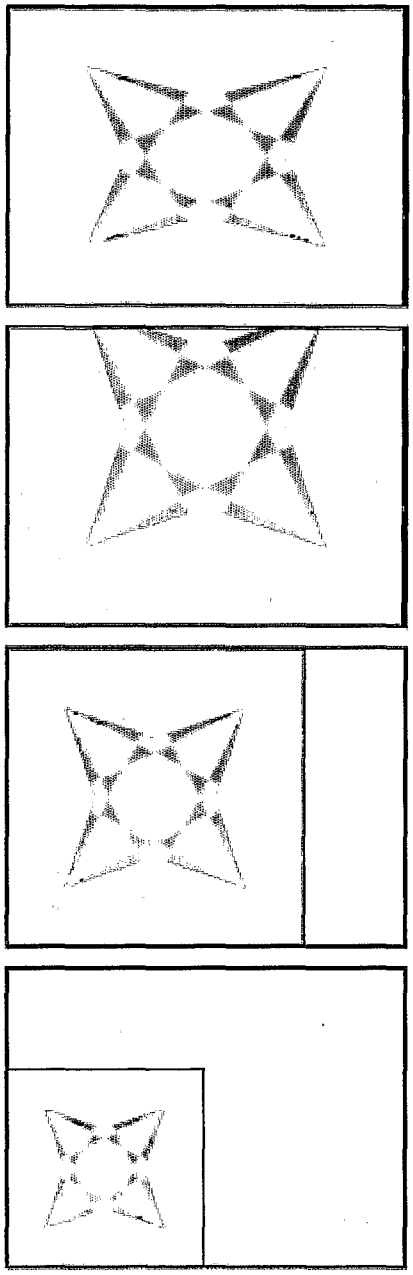


FIG. 26

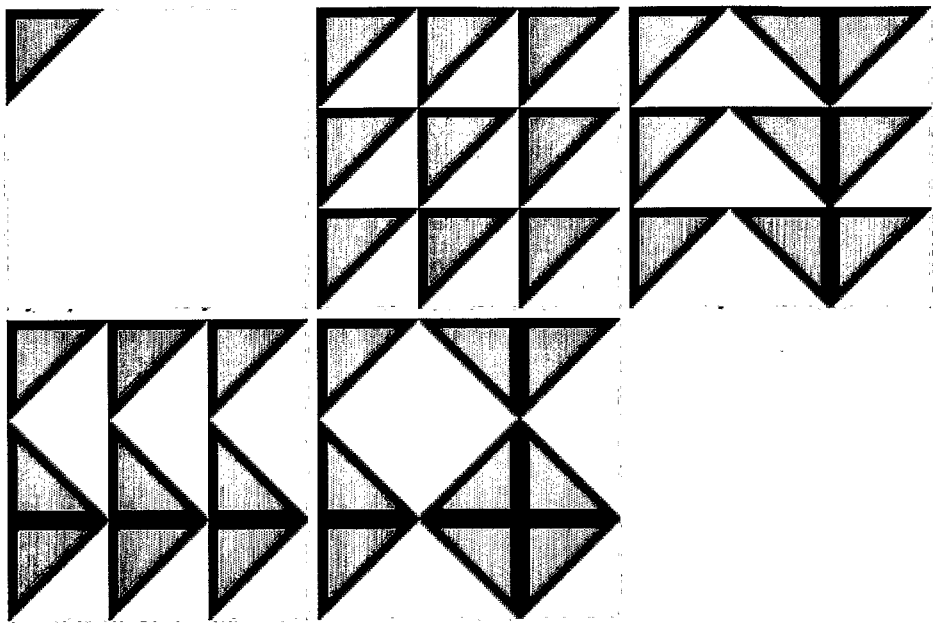


FIG. 27

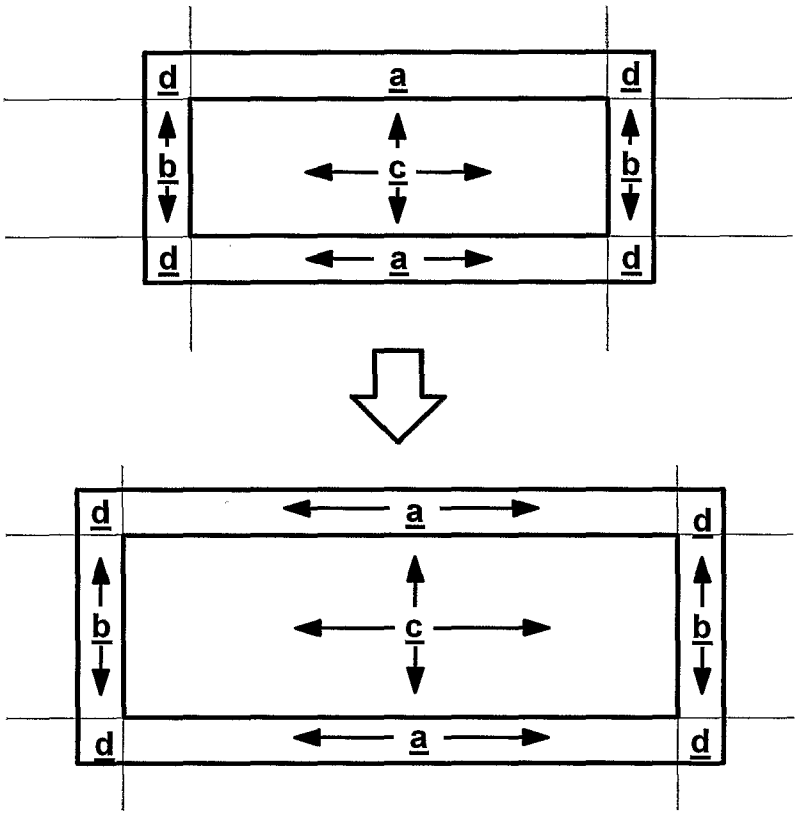


FIG. 28

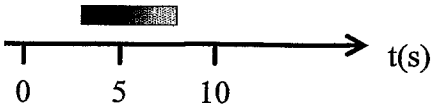


FIG. 29

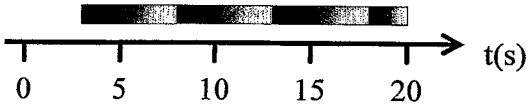


FIG. 30

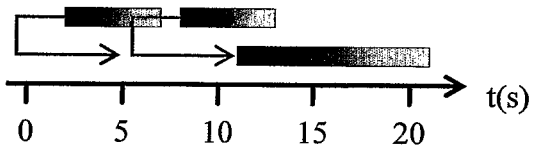


FIG. 31

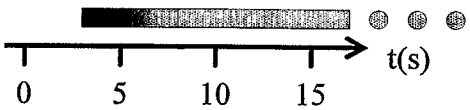


FIG. 32

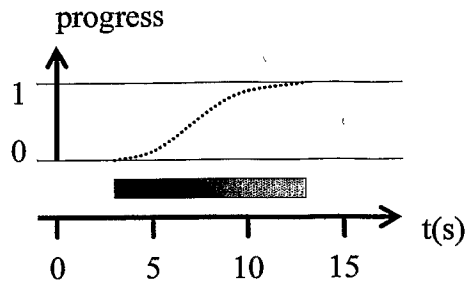


FIG. 33

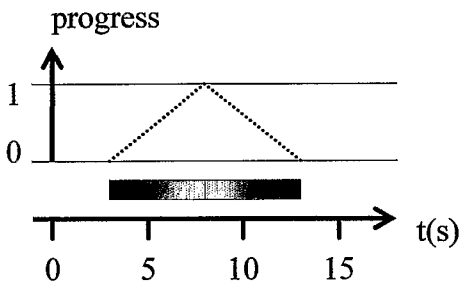


FIG. 34

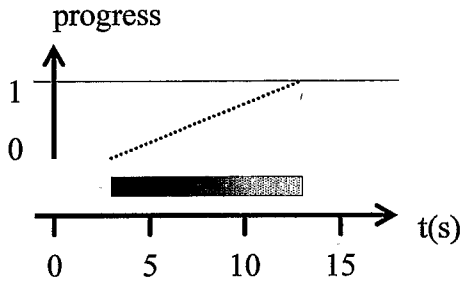


FIG. 35

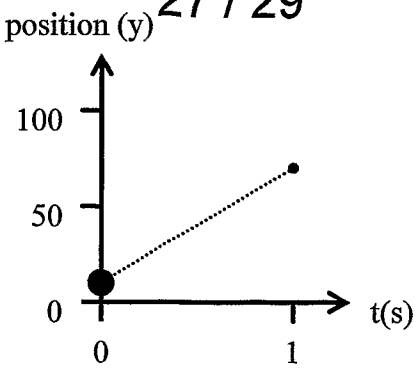


FIG. 36

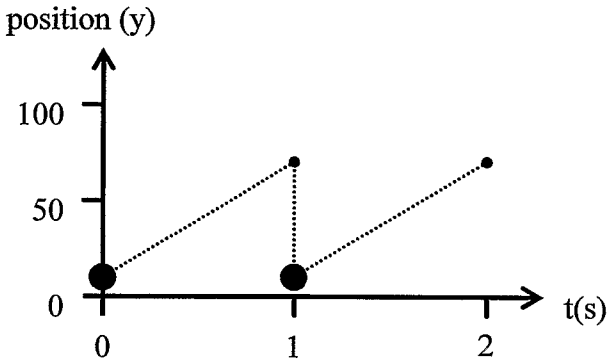


FIG. 37

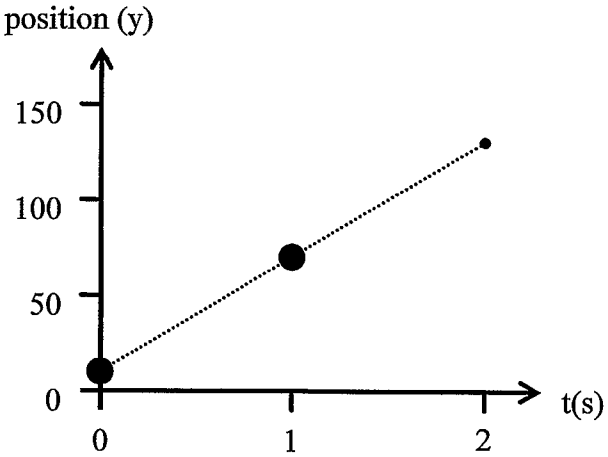


FIG. 38

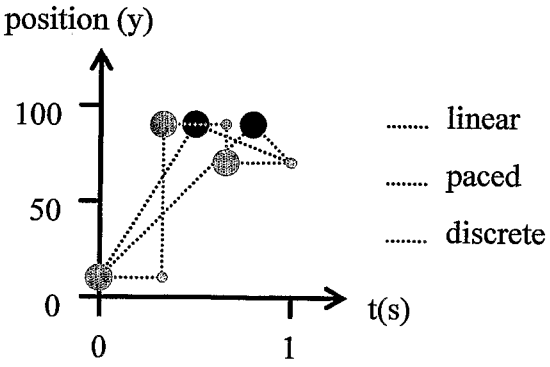

position (y)
100
50
0
0
1
t(s)
linear
paced
discrete

FIG. 39

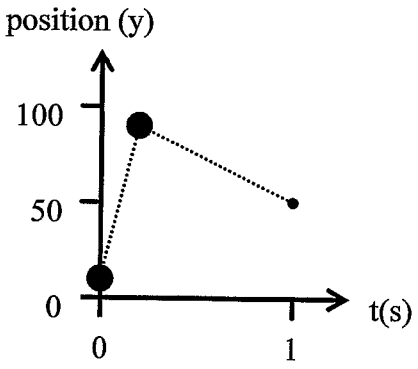

position (y)
100
50
0
0
1
t(s)

FIG. 40

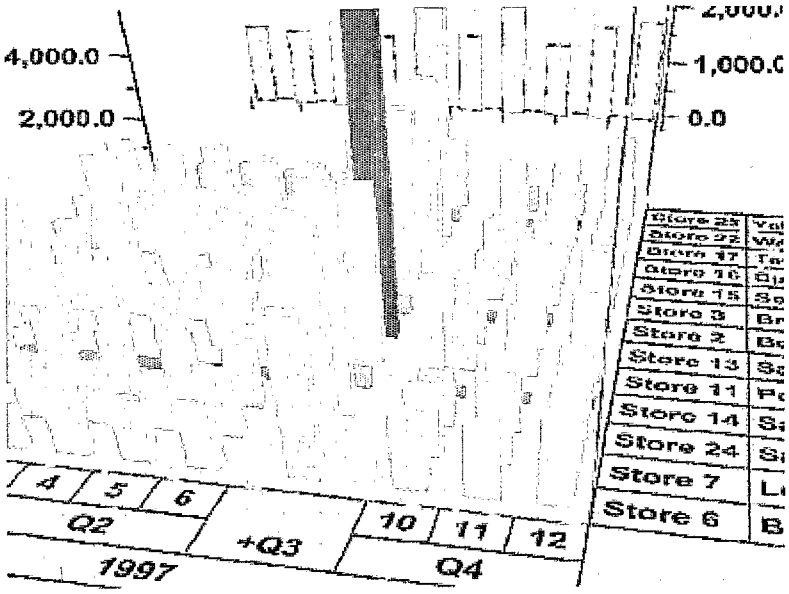

4,000.0
2,000.0
1,000.0
0.0
Store 25
Store 22
Store 17
Store 16
Store 15
Store 3
Store 2
Store 13
Store 11
Store 14
Store 24
Store 7
Store 6
4
5
6
Q2
+Q3
10
11
12
Q4
1997

FIG. 41

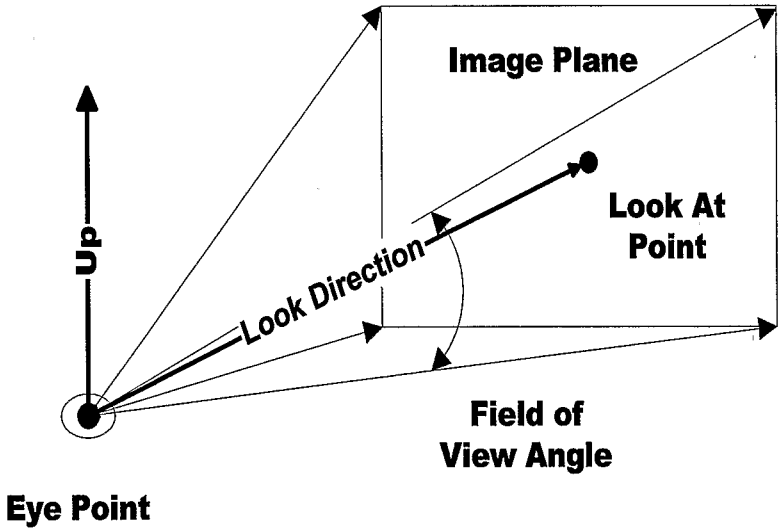

Image Plane
Look At Point
Up
Look Direction
Field of View Angle
Eye Point

FIG. 42