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912 O.G. 1232

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METHOD AND SYSTEM FOR GENERATING SHADED PICTURES

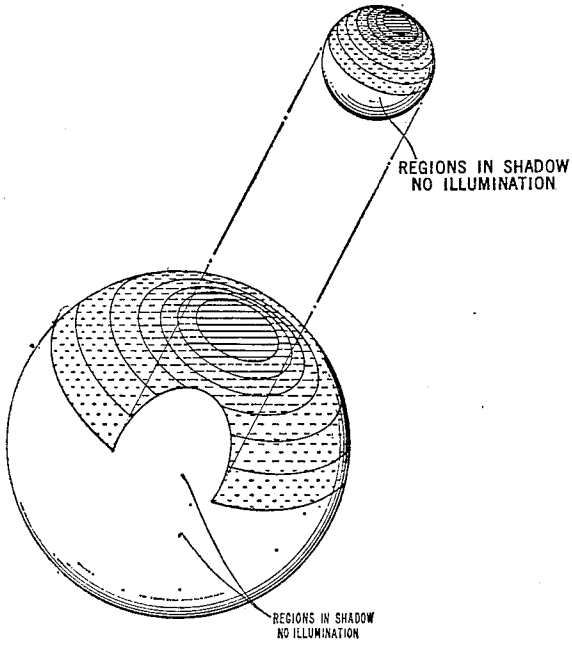
Arthur Appel and Joseph E. Harry, Yorktown Heights, and Arthur J. Stein, Peekskill, N.Y., assignors to International Business Machines Corporation, Armonk, N.Y.

Filed June 30, 1972, Ser. No. 267,801

Int. Cl. G06k *15/20;* **G06f** *3/14*

U.S. Cl. 444—1

16 Sheets Drawing. 42 Pages Specification



A method for use in a computer for generating shaded renderings of a scene which comprises the treating of each surface in the scene as a plurality of horizontal scan lines and the treating of each scan line on a surface as a plurality of segments. In a first embodiment of the method, there are provided specific values for illumination intensity for each surface and random number values, the minimum random number value being less than or equal to lowest value illumination intensity value for any of the surfaces. As a segment of a line is considered, the illumination intensity of the surface it falls on is compared with the random number concurrently being generated. If the random number is less than illumination intensity, then the line segment is drawn, i.e., illuminated. However, if the random number concurrently exceeds the generated segment's illumination intensity, then the segment is not drawn, i.e., not illuminated. In a second embodiment, each segment is provided with a value which is the sum of its orthographic or perspective projection coordinates, X and Y. If the illumination intensity of the surface on which the segment being considered currently lies falls within a chosen range of coordinate sums and if the sums of the X and Y coordinates of the segment is an integer multiple of a function of the illumination intensity of the segment, then the segment is drawn.

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FIG. 1

RANDOM TECHNIQUE

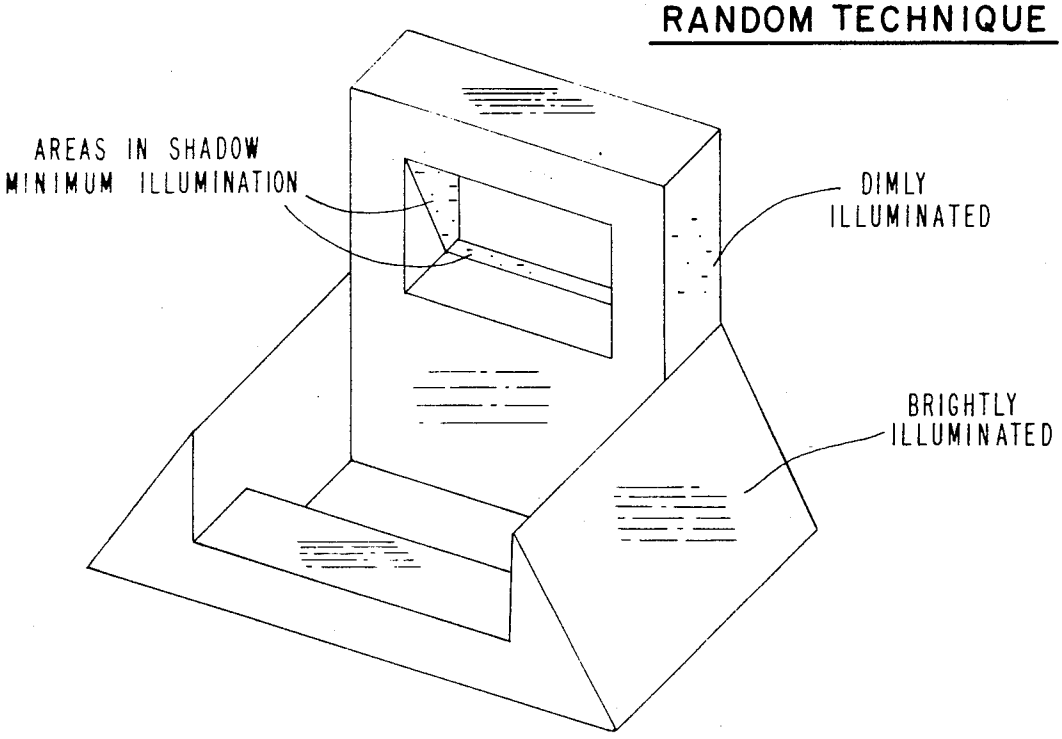
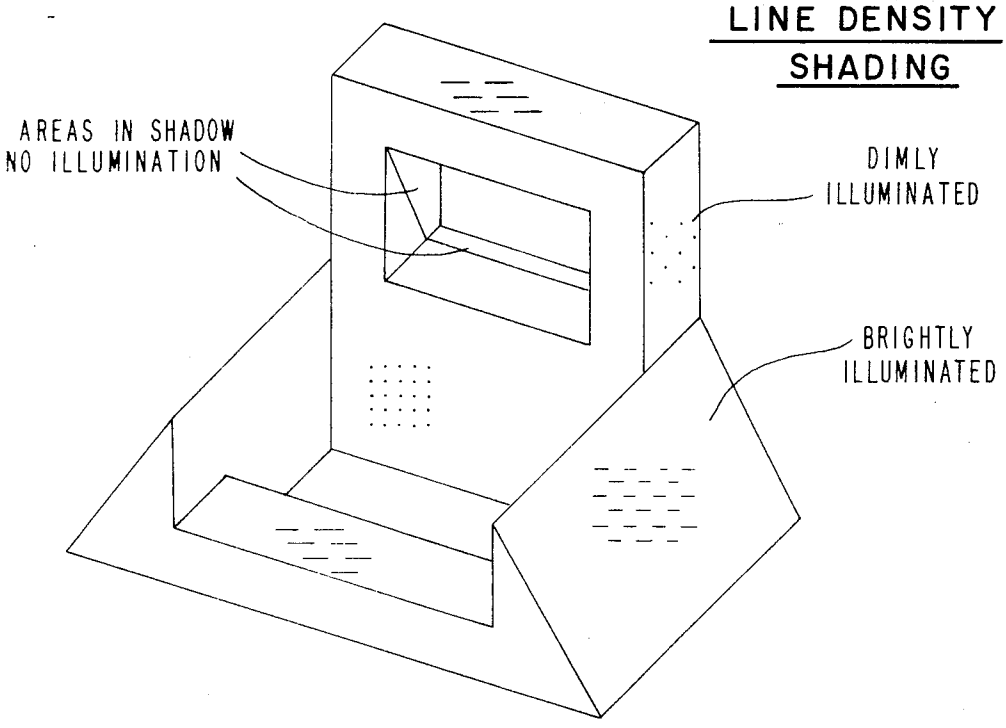


FIG. 2

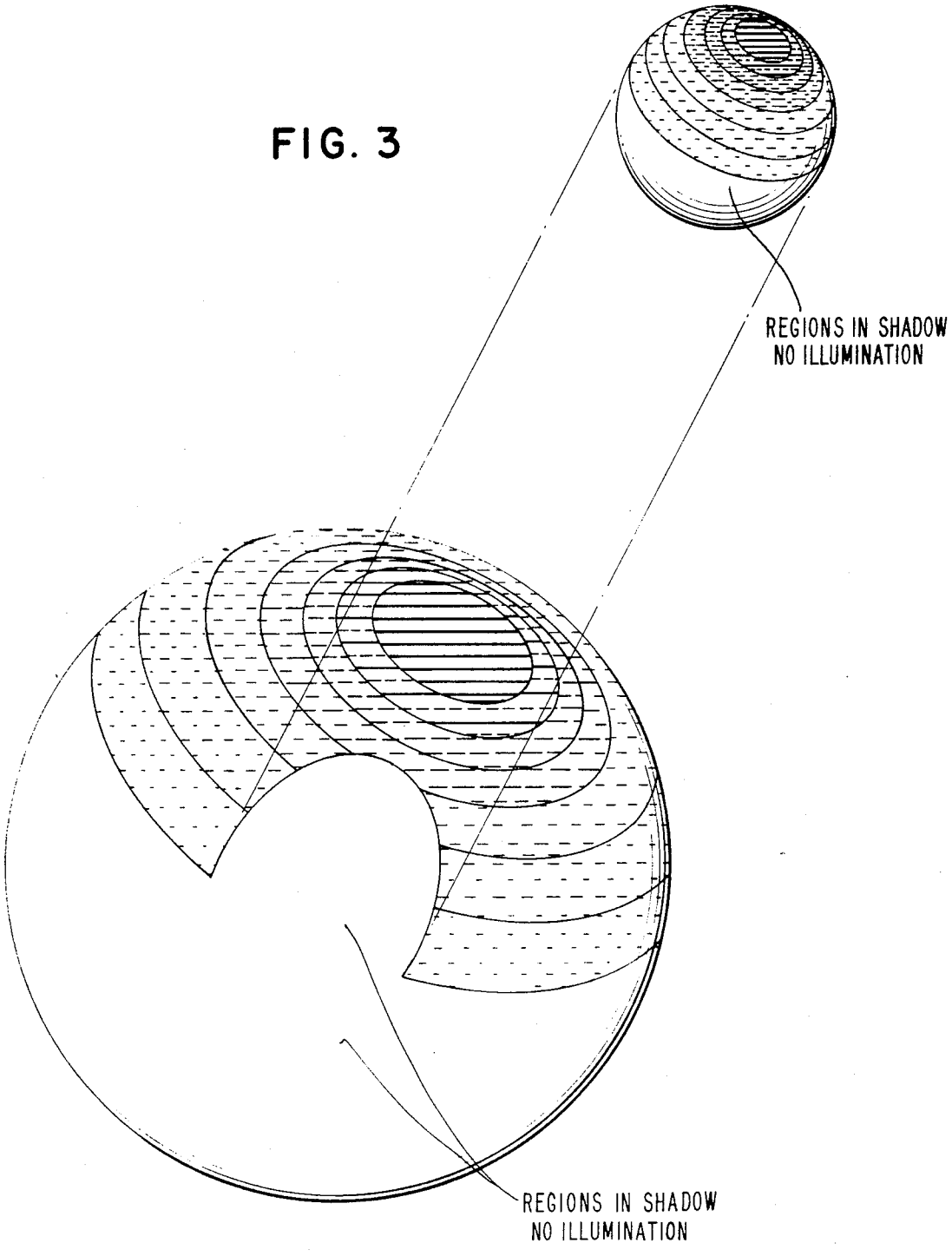
LINE DENSITY
SHADING



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FIG. 3



METHOD AND SYSTEM FOR GENERATING SHADED PICTURES

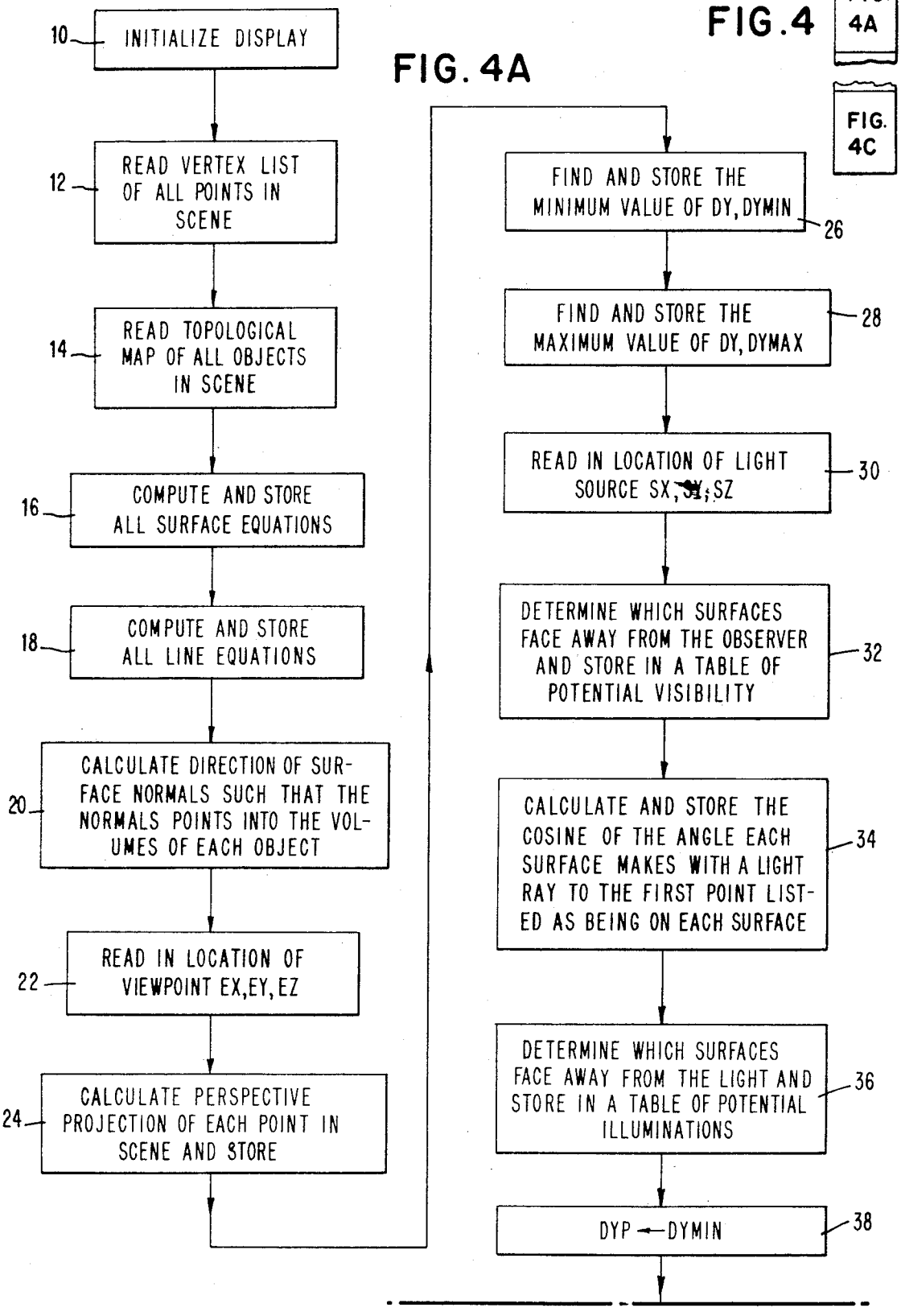
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FIG. 4

FIG. 4A

FIG. 4A

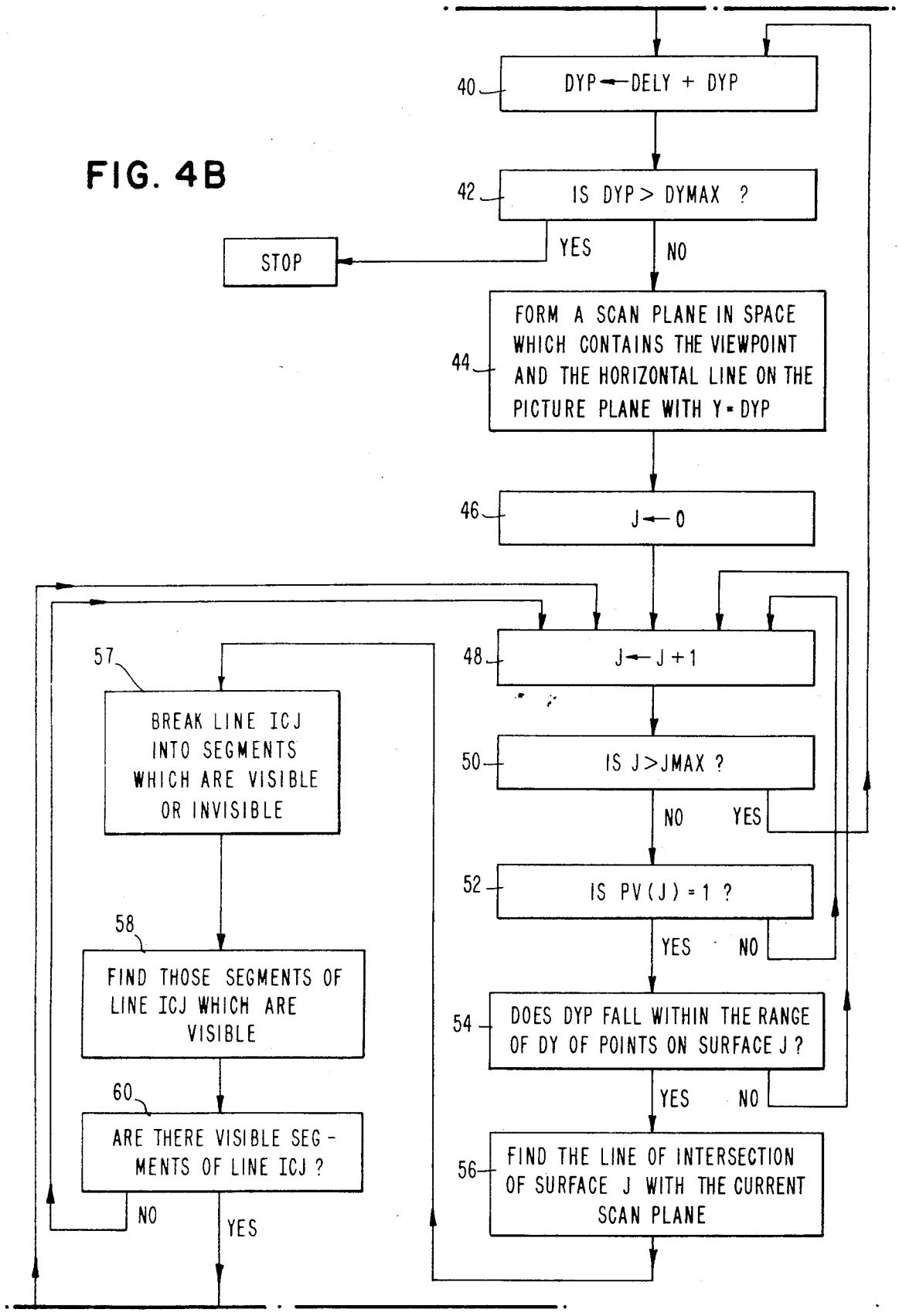
FIG. 4C



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FIG. 4B



METHOD AND SYSTEM FOR GENERATING SHADED PICTURES

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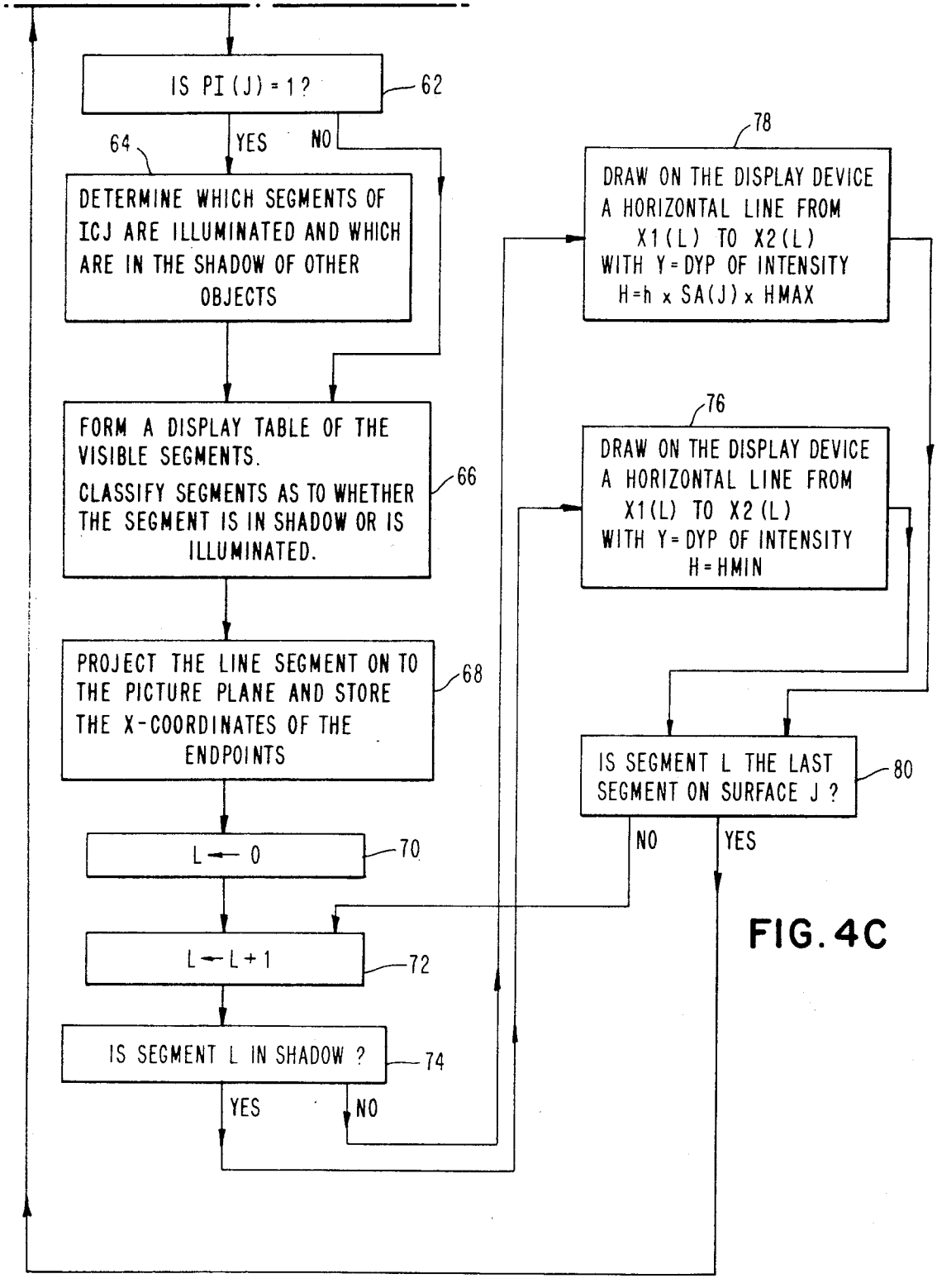


FIG. 4C

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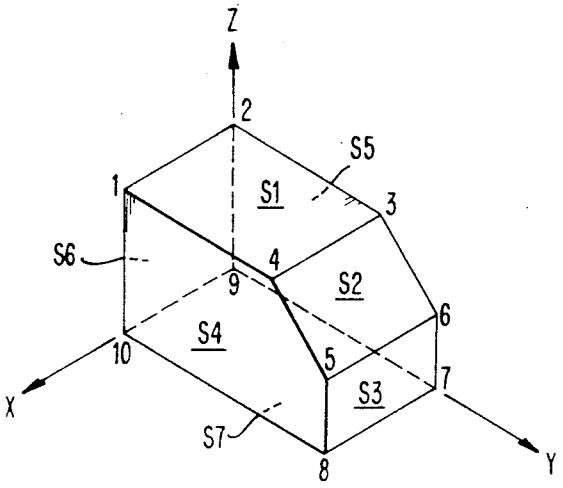


FIG. 5

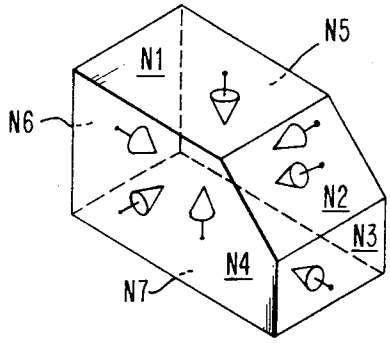


FIG. 6

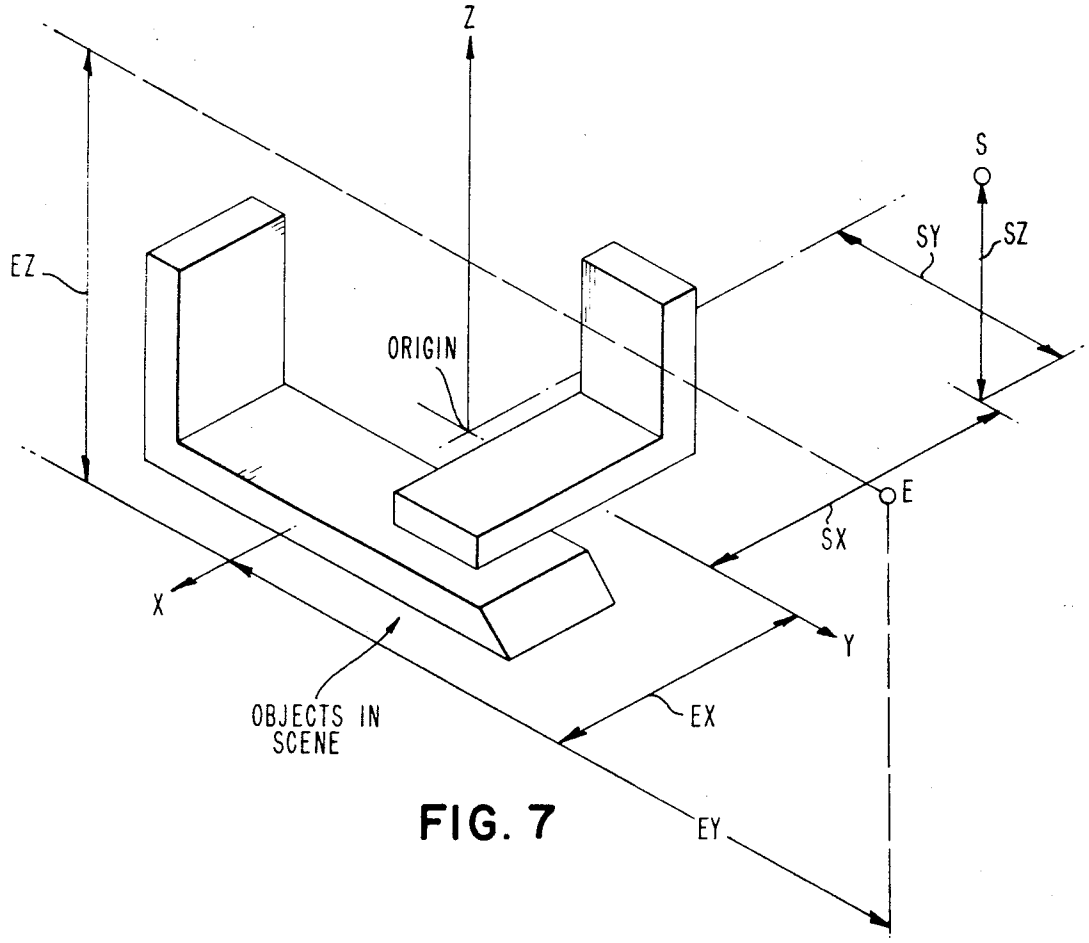


FIG. 7

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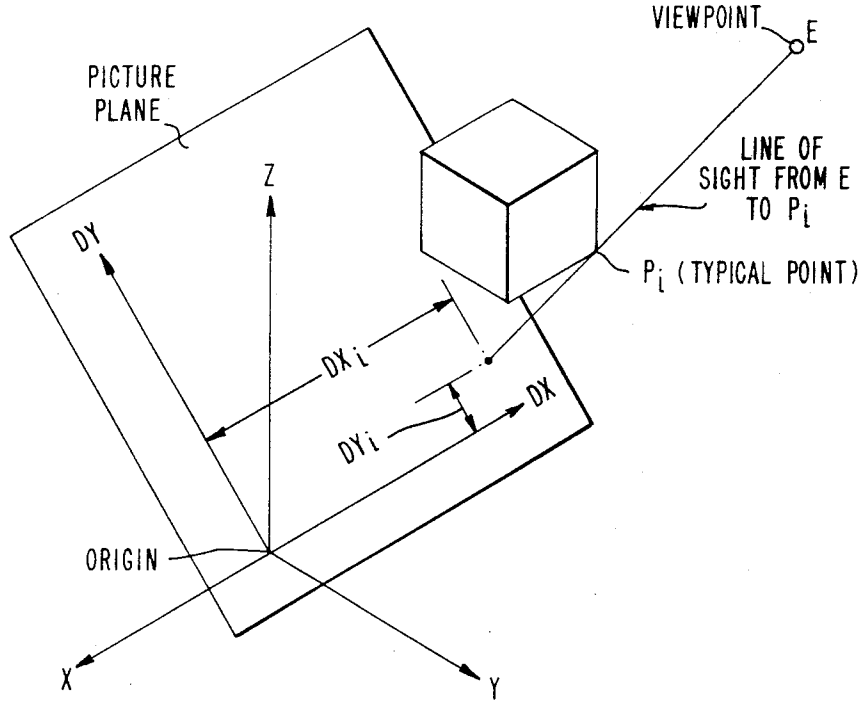


FIG. 8

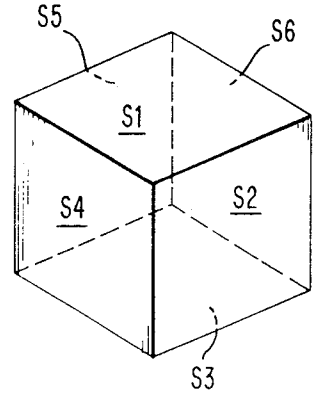
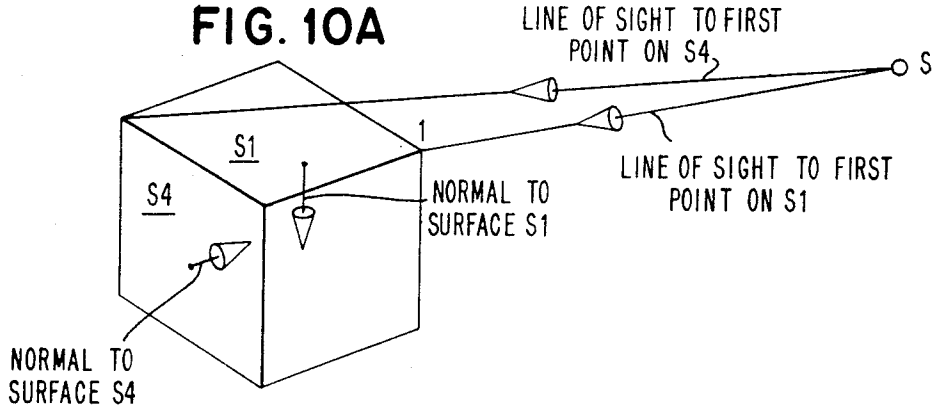


FIG. 9

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FIG. 10A



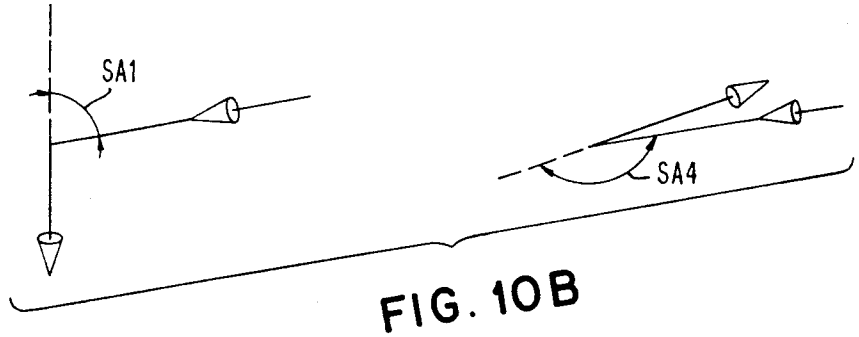


FIG. 10B

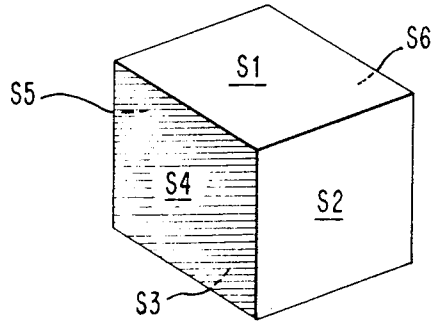


FIG. 10C

FIG. 11

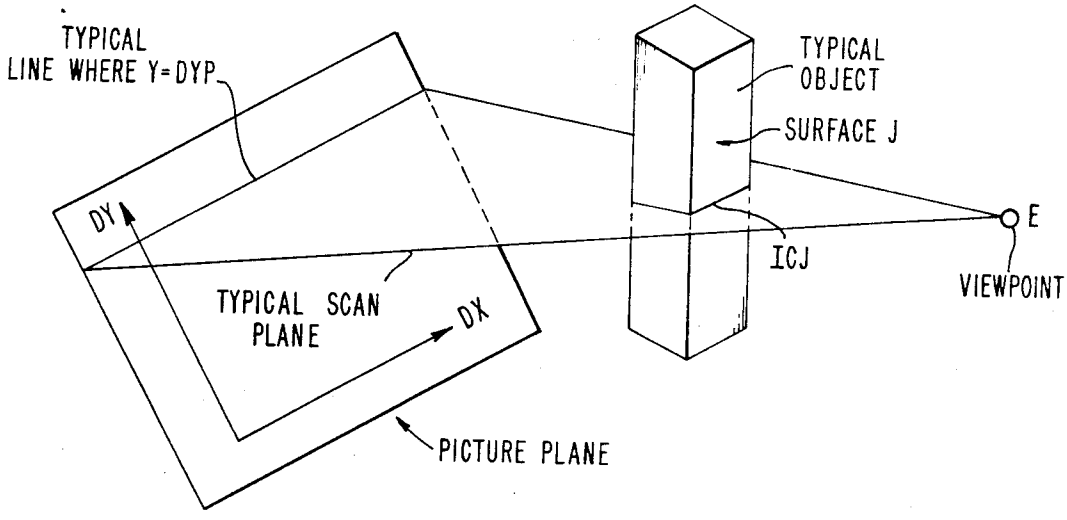
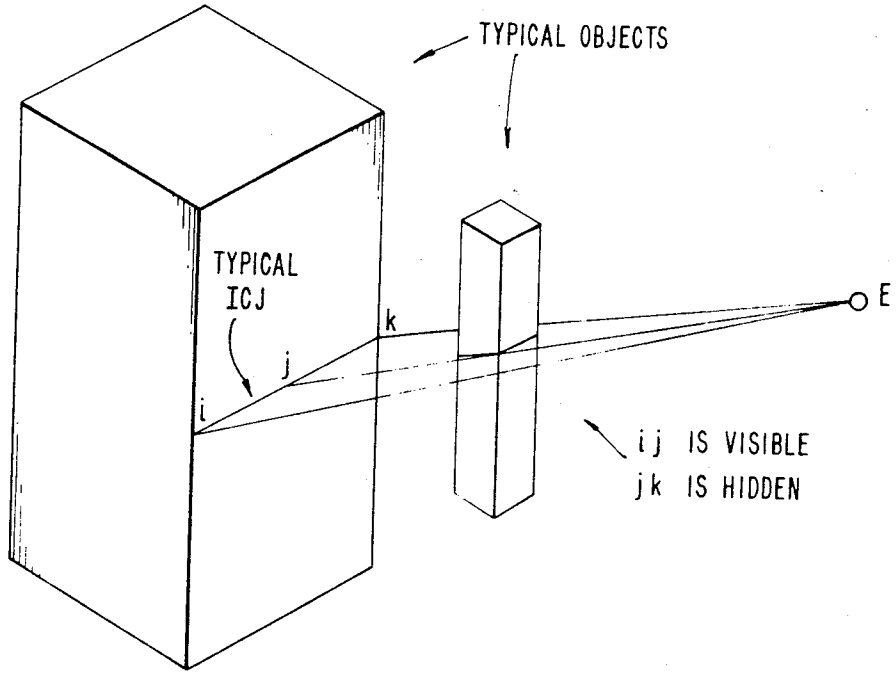

TYPICAL
LINE WHERE Y=DYP
DY
TYPICAL SCAN
PLANE
DX
PICTURE PLANE
TYPICAL
OBJECT
SURFACE J
ICJ
E
VIEWPOINT

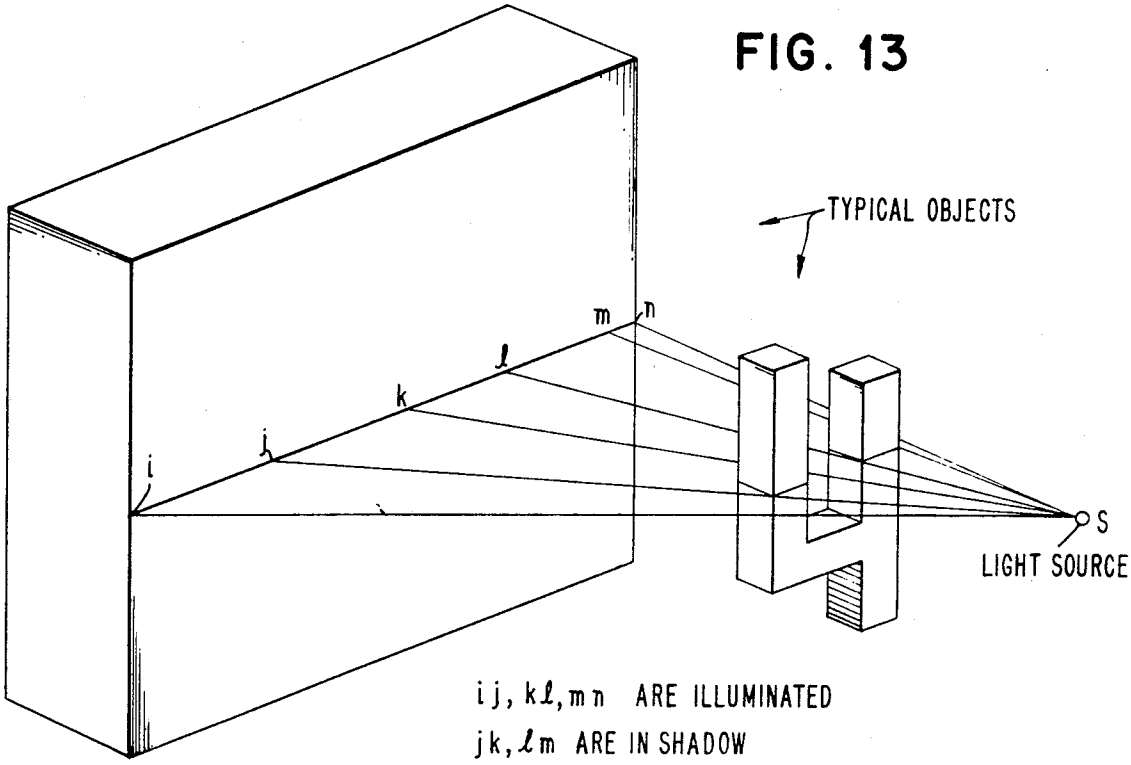
FIG. 12


TYPICAL OBJECTS
TYPICAL
ICJ
i
j
k
E
ij IS VISIBLE
jk IS HIDDEN

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FIG. 13



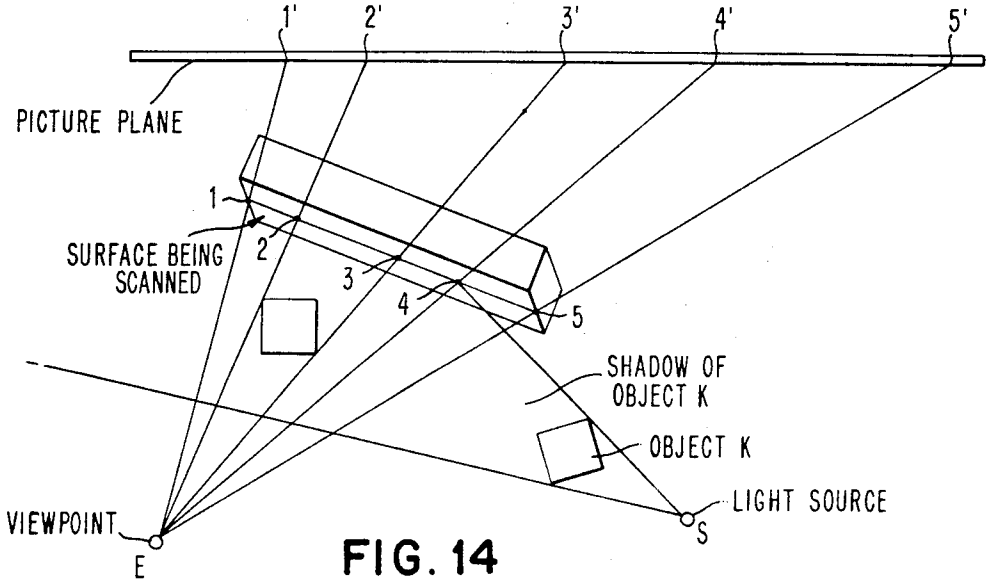


FIG. 14

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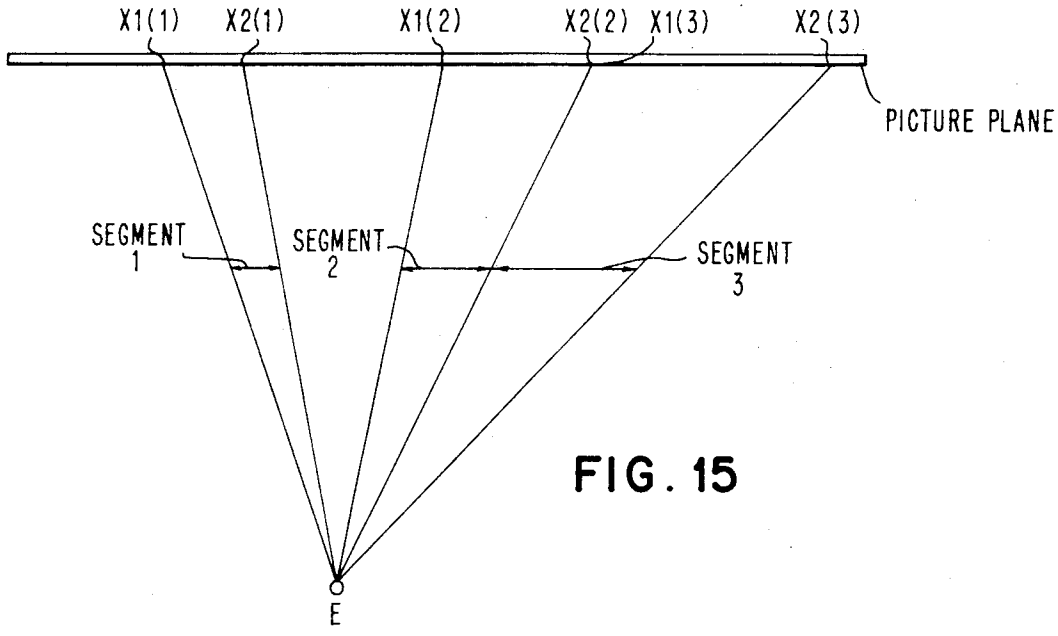


FIG. 15

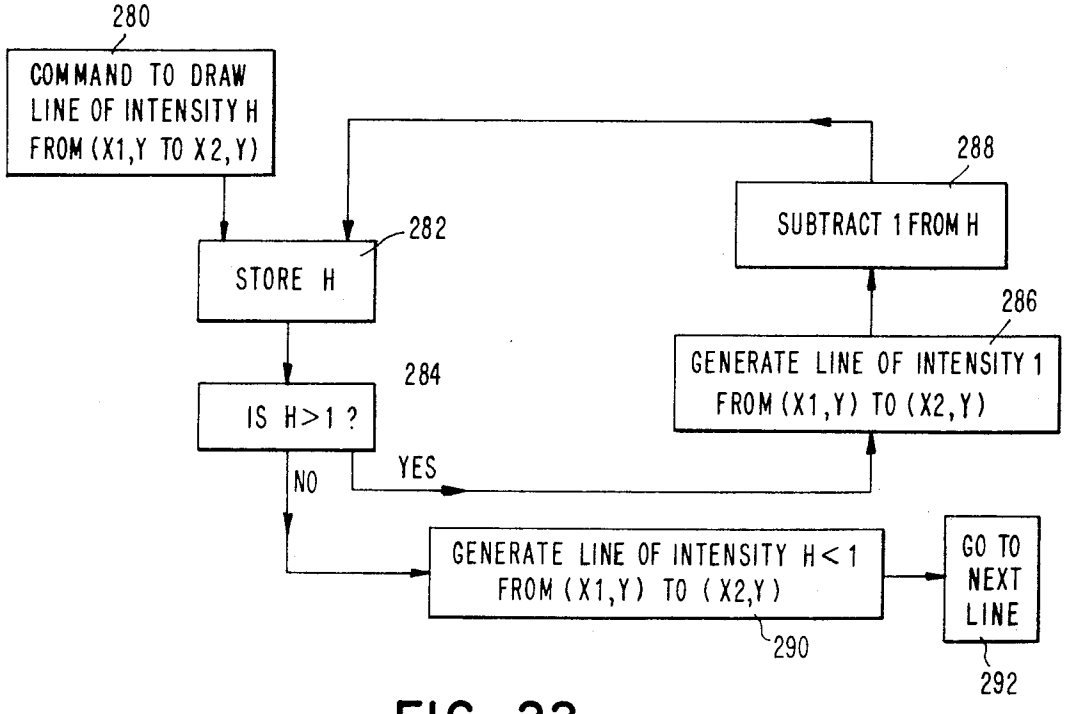


FIG. 22

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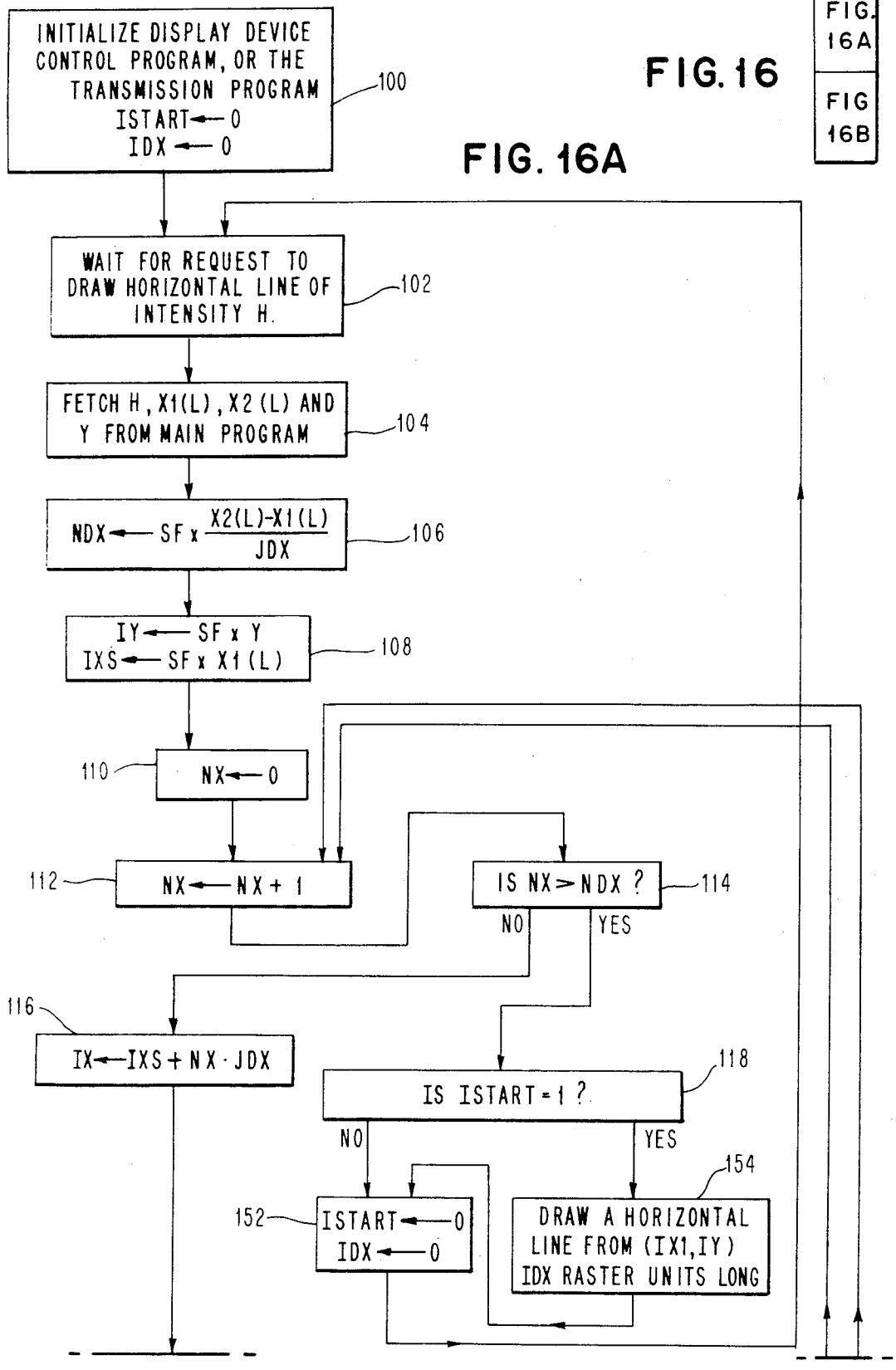
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FIG. 16

FIG. 16A

FIG. 16A

FIG. 16B



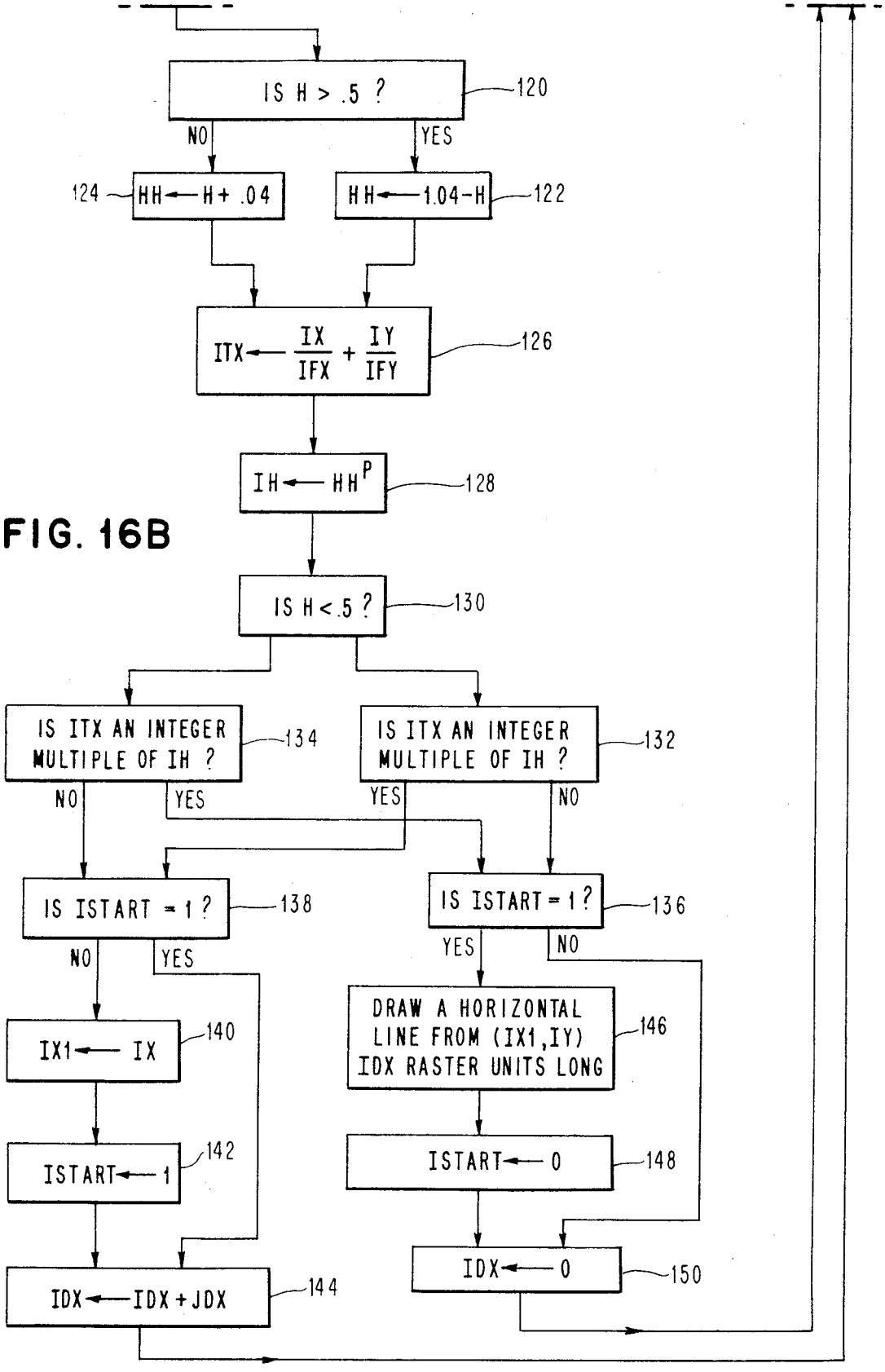

IS H > .5 ?
120
NO
YES
124
HH ← H + .04
HH ← 1.04 - H
122
ITX ← IX/IFX + IY/IFY
126
IH ← HH^P
128
IS H < .5 ?
130
IS ITX AN INTEGER MULTIPLE OF IH ?
134
IS ITX AN INTEGER MULTIPLE OF IH ?
132
NO
YES
YES
NO
IS ISTART = 1 ?
138
IS ISTART = 1 ?
136
NO
YES
YES
NO
IX1 ← IX
140
DRAW A HORIZONTAL LINE FROM (IX1,IY) IDX RASTER UNITS LONG
146
ISTART ← 1
142
ISTART ← 0
148
IDX ← IDX + JDX
144
IDX ← 0
150

FIG. 16B

FIG. 17A

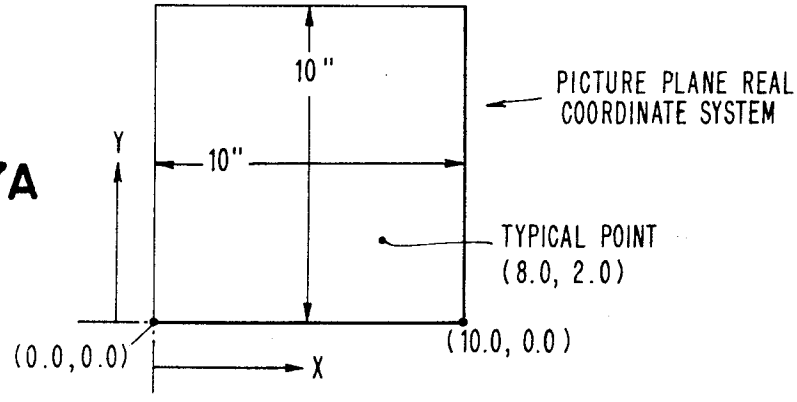


FIG. 17B

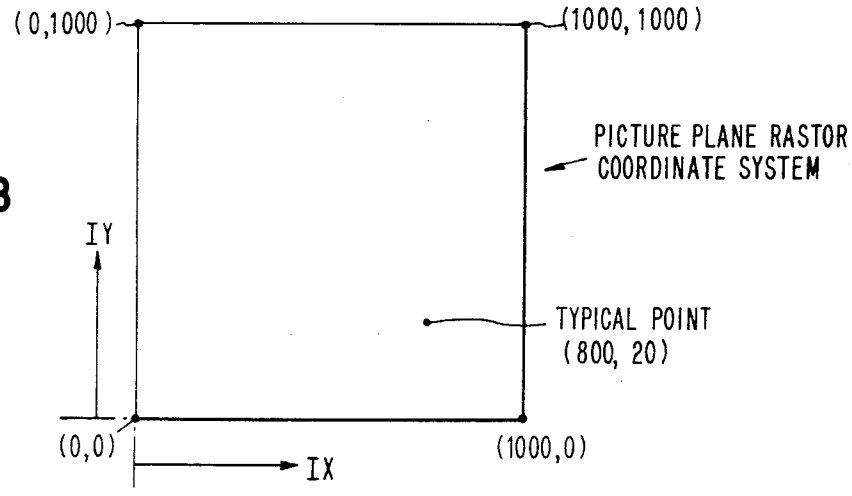


FIG. 18A — — — — H > .5

FIG. 18B - - - - H < .5

FIG. 19

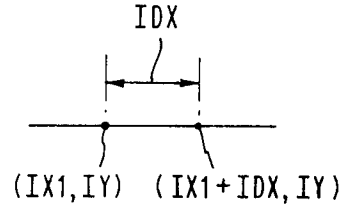
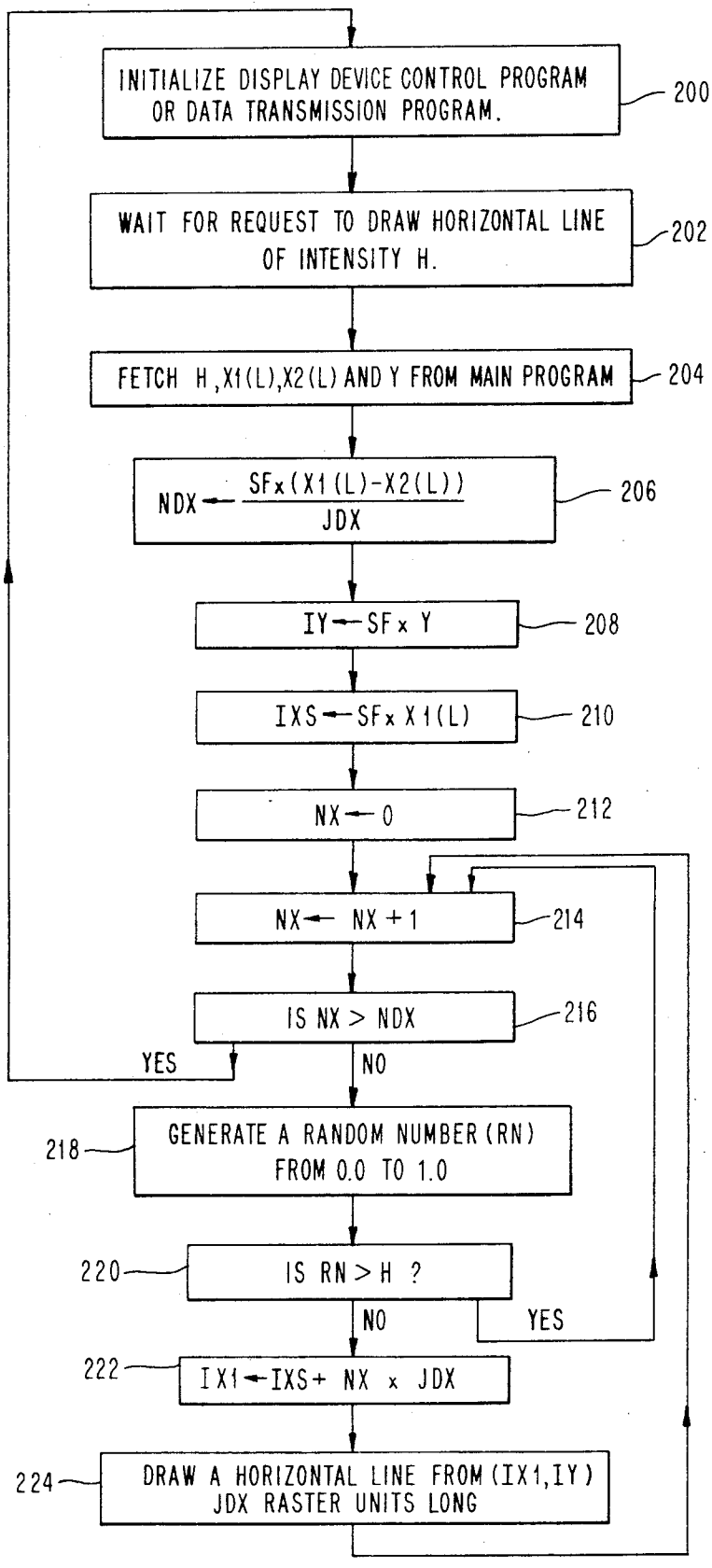


FIG. 20


INITIALIZE DISPLAY DEVICE CONTROL PROGRAM OR DATA TRANSMISSION PROGRAM.
200
WAIT FOR REQUEST TO DRAW HORIZONTAL LINE OF INTENSITY H.
202
FETCH H, X1(L), X2(L) AND Y FROM MAIN PROGRAM
204
NDX ← SFx(X1(L)-X2(L)) / JDX
206
IY ← SF x Y
208
IXS ← SFx X1(L)
210
NX ← 0
212
NX ← NX + 1
214
IS NX > NDX
216
YES
NO
218
GENERATE A RANDOM NUMBER (RN) FROM 0.0 TO 1.0
220
IS RN > H ?
NO
YES
222
IX1 ← IXS + NX x JDX
224
DRAW A HORIZONTAL LINE FROM (IX1, IY) JDX RASTER UNITS LONG

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FIG. 21

