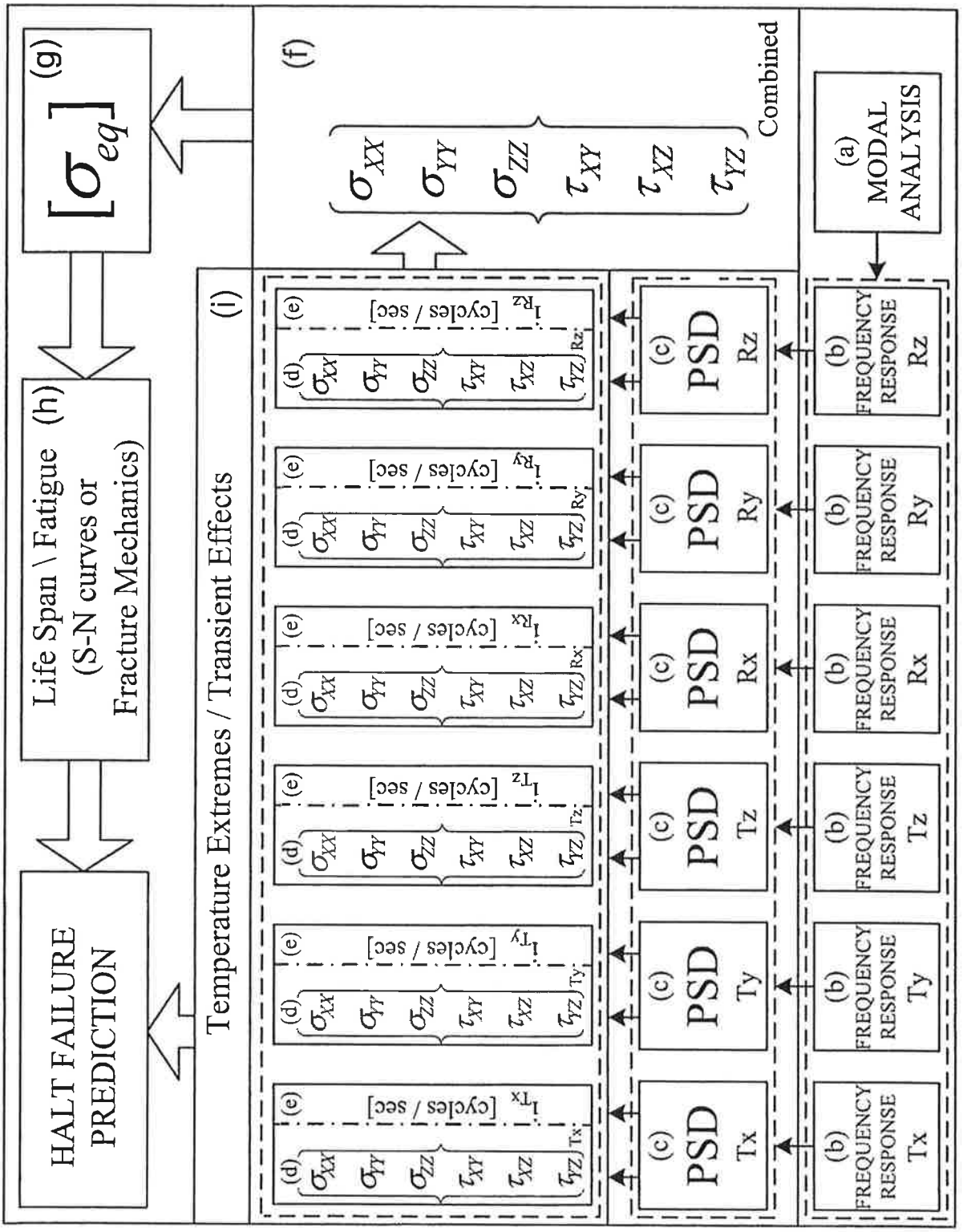


Fig. 1 PRIOR ART (HYPOTHETICAL)

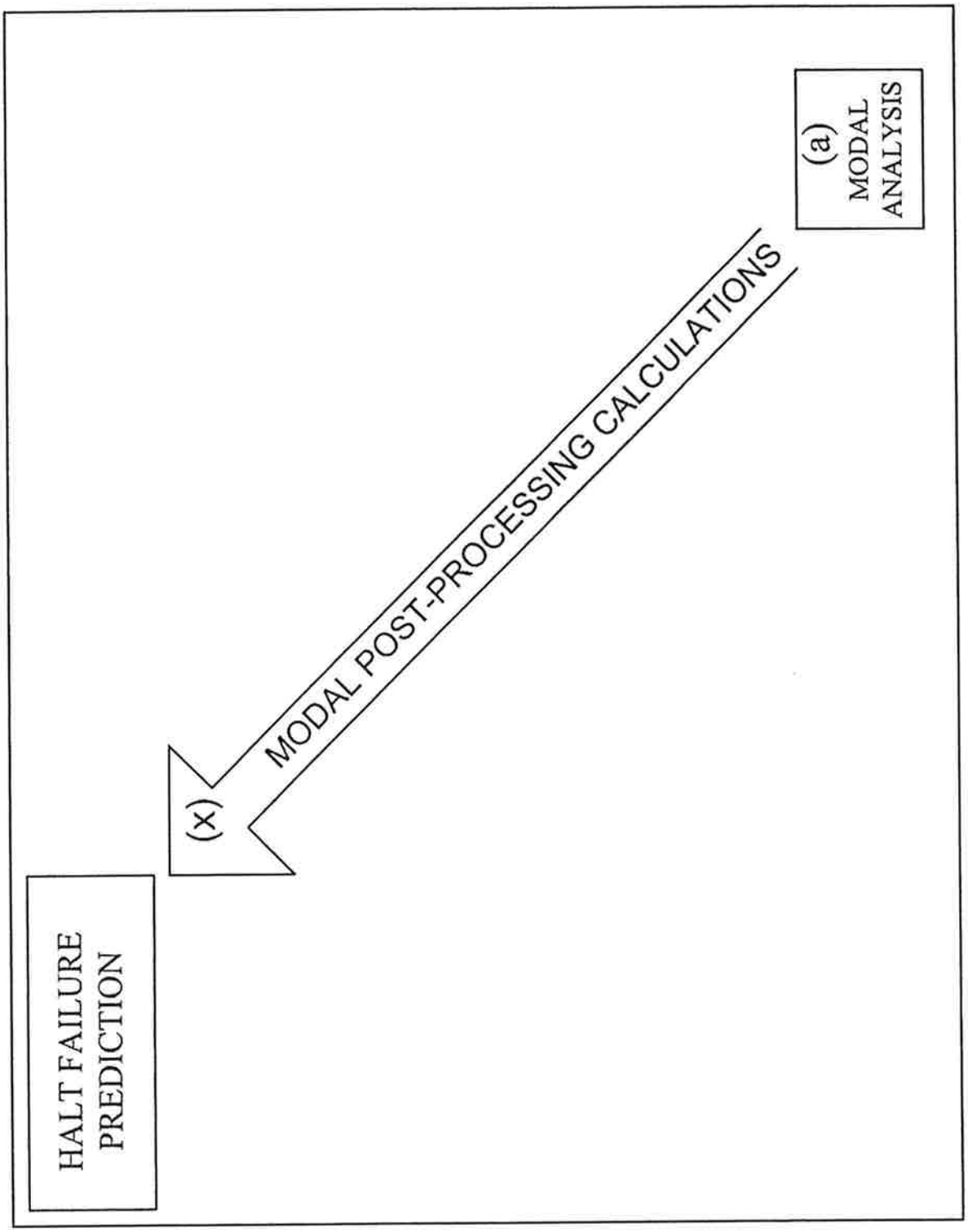

HALT FAILURE PREDICTION
(x)
MODAL POST-PROCESSING CALCULATIONS
(a) MODAL ANALYSIS

Fig. 2

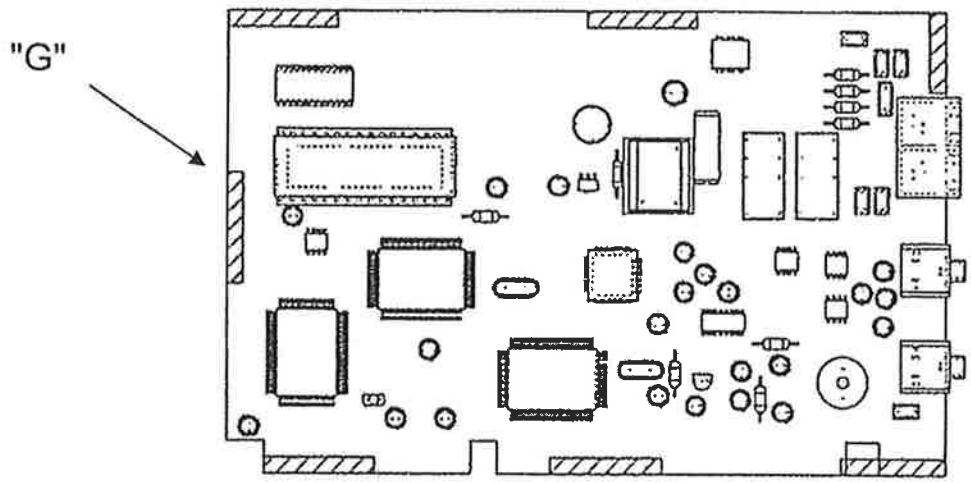


Fig. 3a

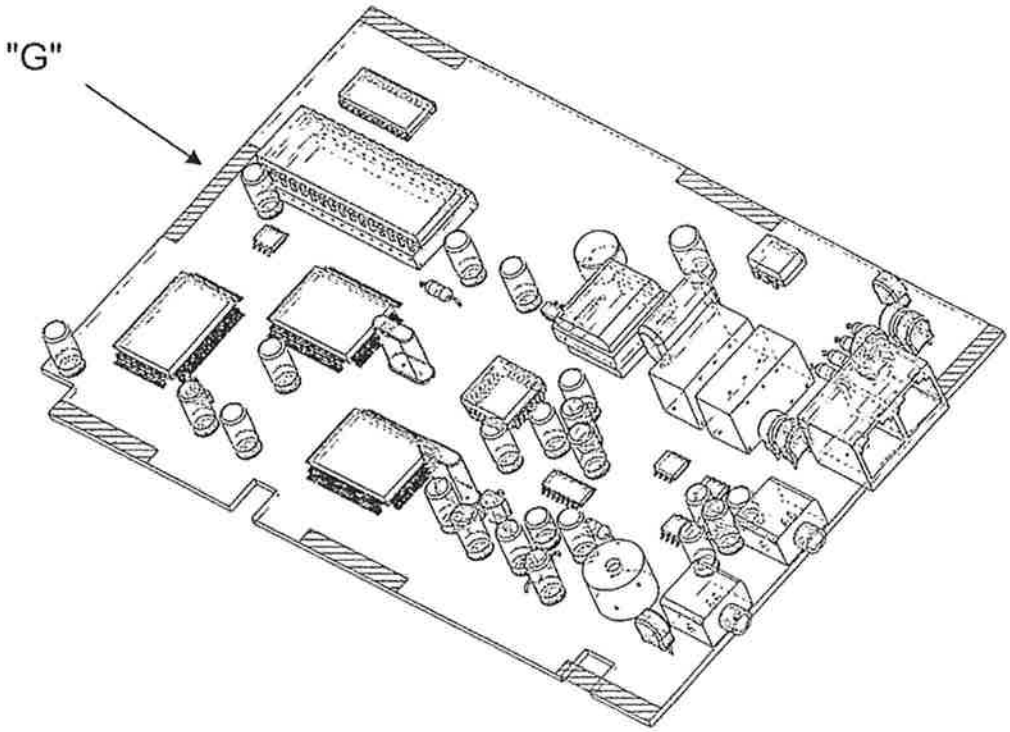


Fig. 3b

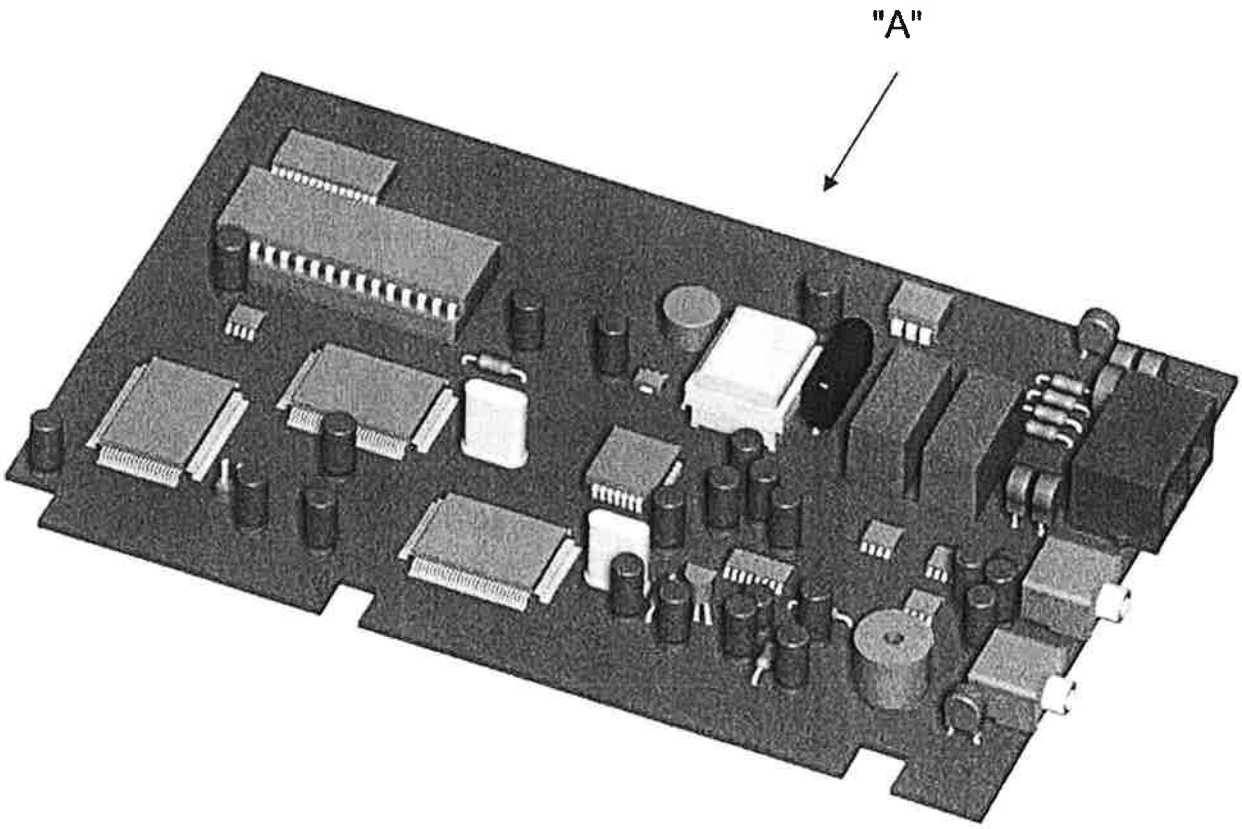


Fig. 3c

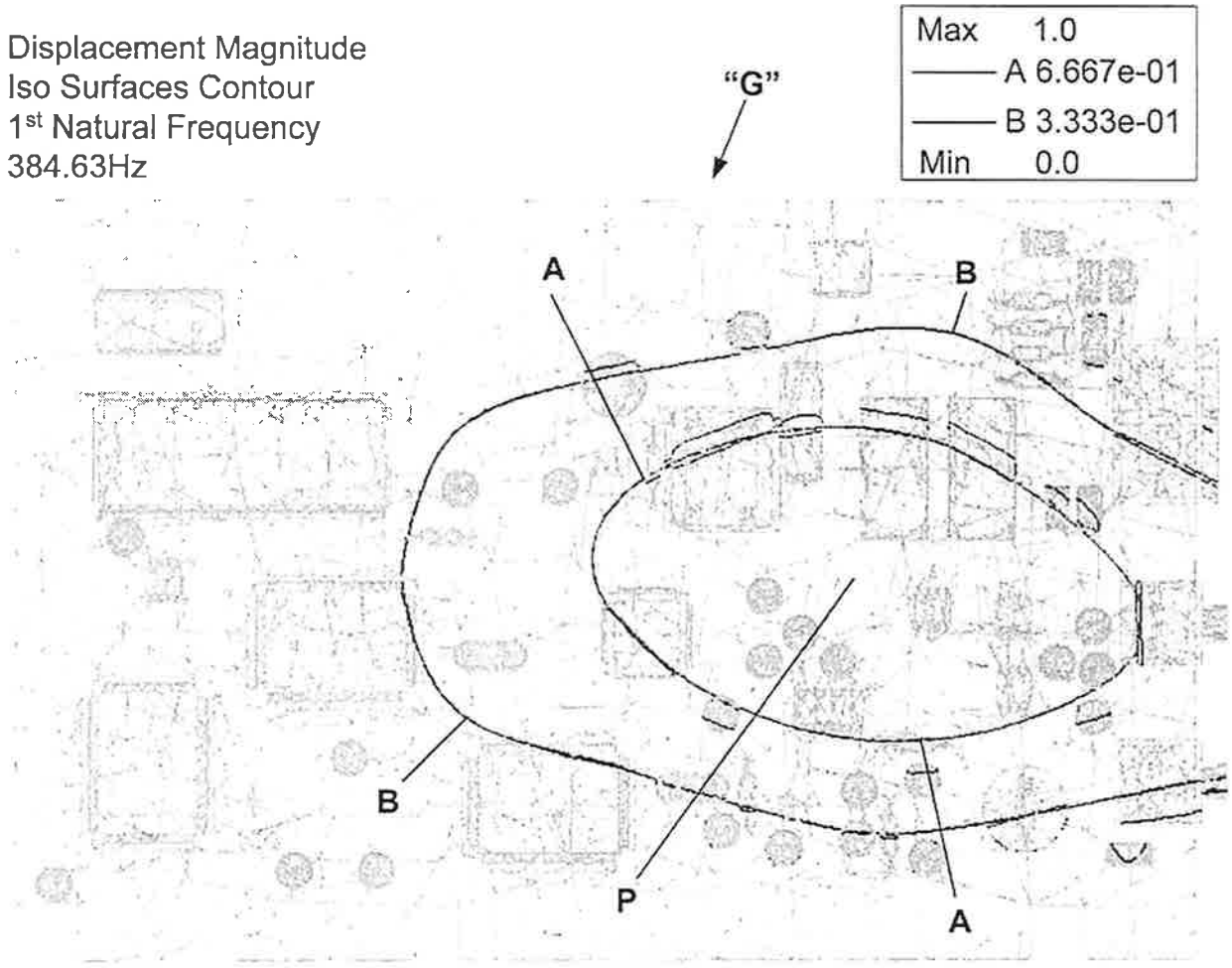

Displacement Magnitude
Iso Surfaces Contour
1st Natural Frequency
384.63Hz
"G"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
A
B
B
P
A

Fig. 4a

Displacement Magnitude
Deformed Shape
1st Natural Frequency
384.63Hz

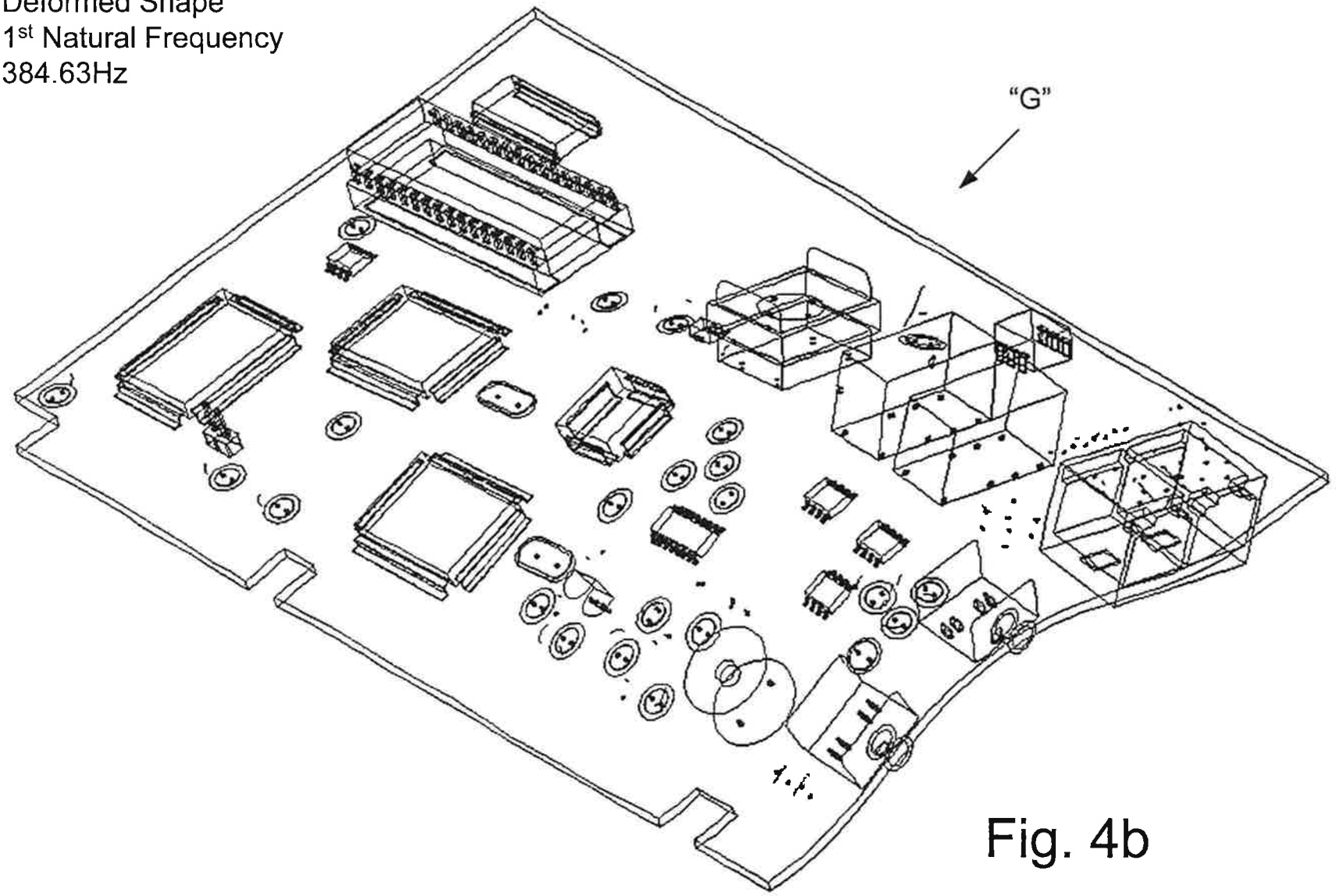


Fig. 4b

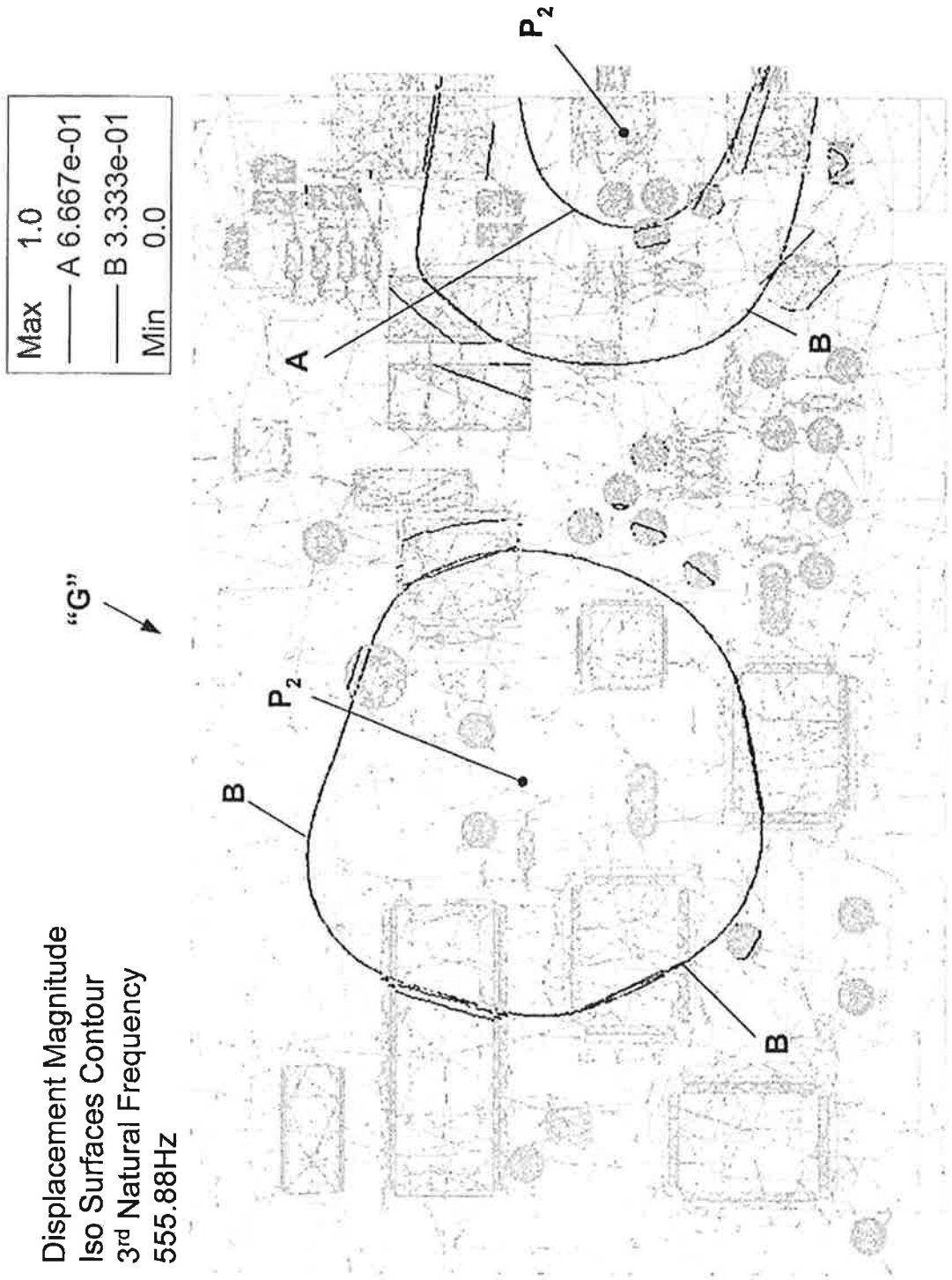

Displacement Magnitude
Iso Surfaces Contour
3rd Natural Frequency
555.88Hz
"G"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
A
B
B
B
P2
P2

Fig. 5a

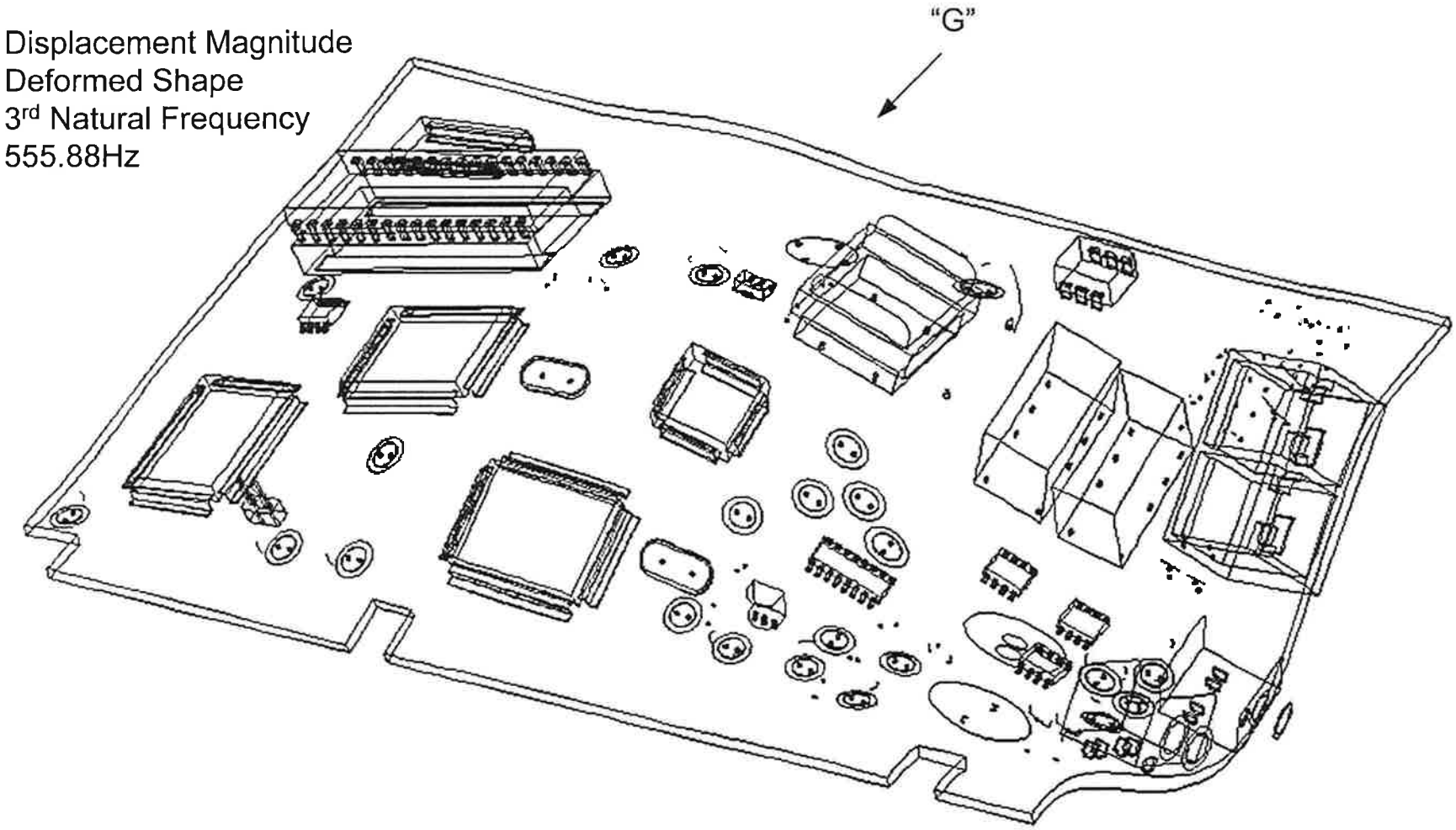

Displacement Magnitude
Deformed Shape
3rd Natural Frequency
555.88Hz
"G"

Fig. 5b

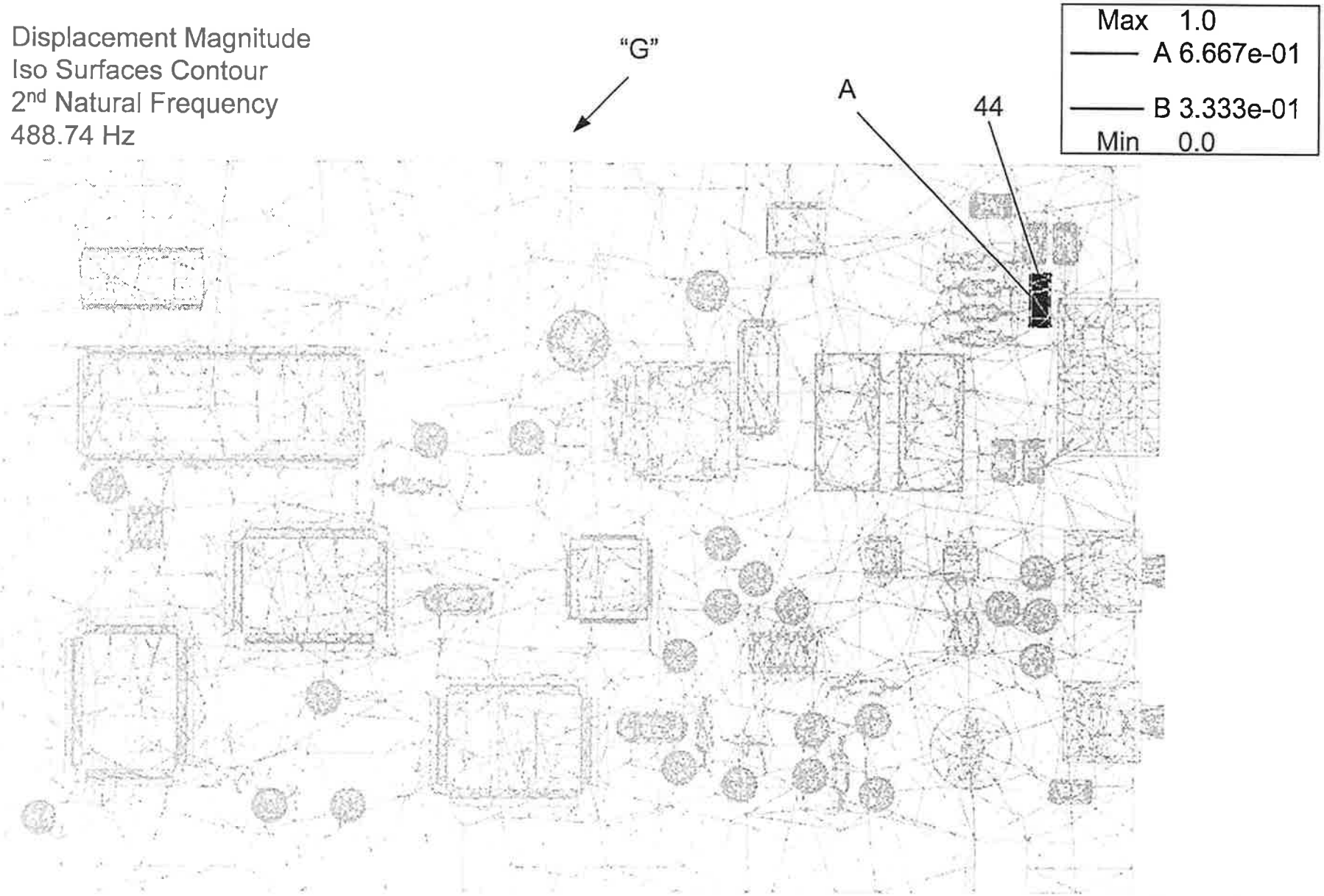

Displacement Magnitude
Iso Surfaces Contour
2nd Natural Frequency
488.74 Hz
"G"
A
44
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0

Fig. 6a

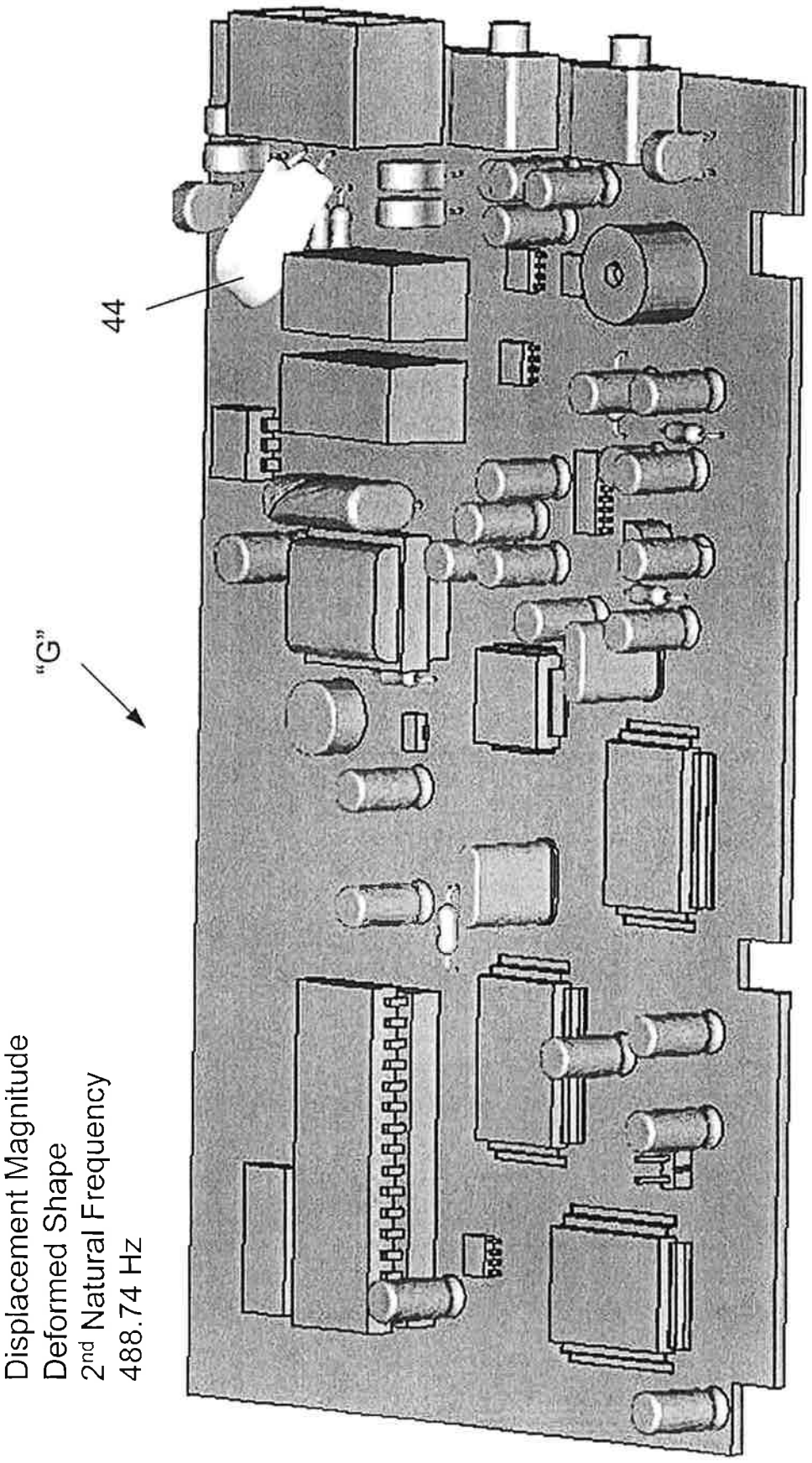

Displacement Magnitude
Deformed Shape
2nd Natural Frequency
488.74 Hz
"G"
44

Fig. 6b

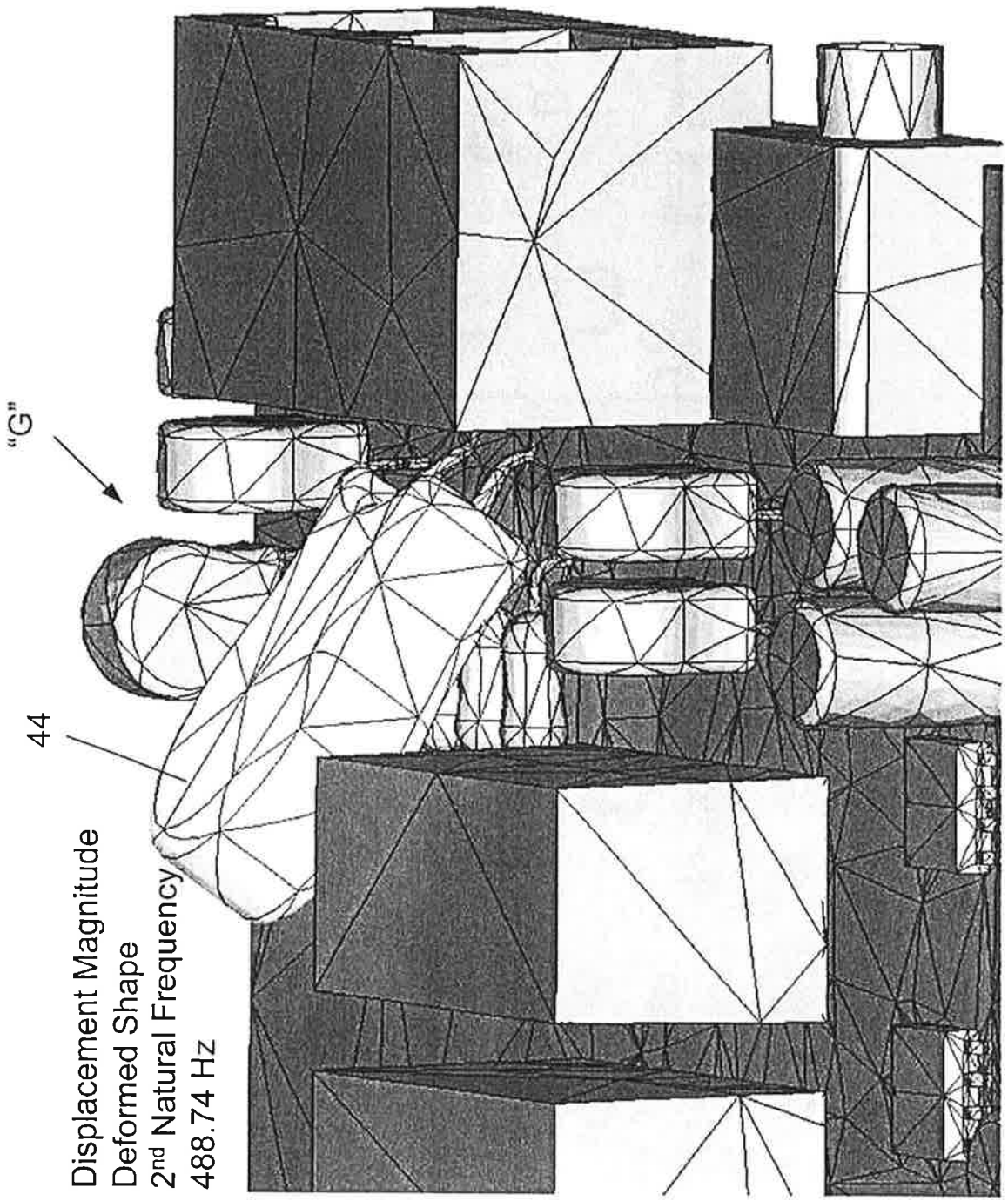

Displacement Magnitude
Deformed Shape
2nd Natural Frequency
488.74 Hz
44
"G"

Fig. 6c

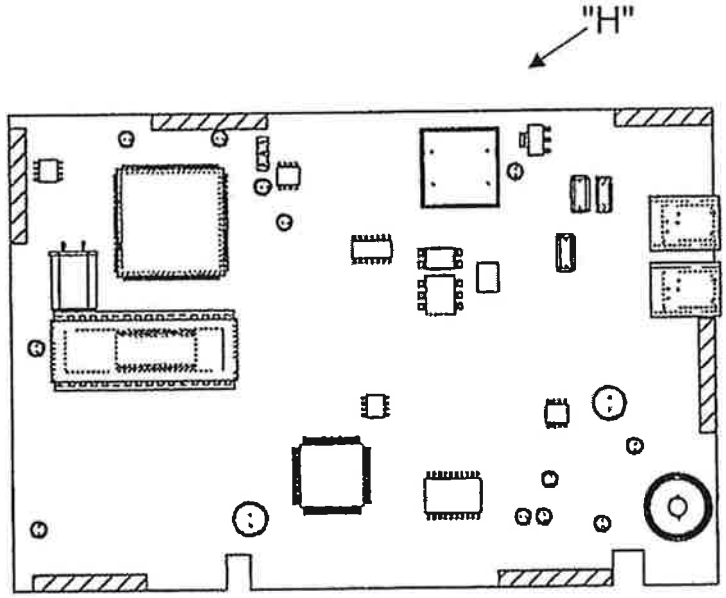


Fig. 7a

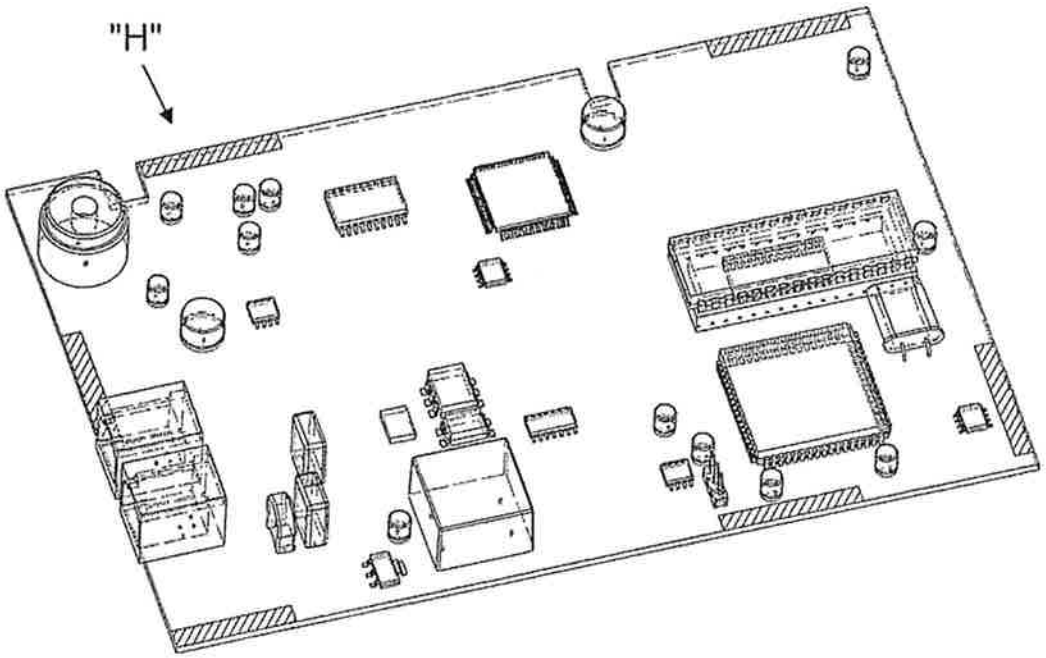


Fig. 7b

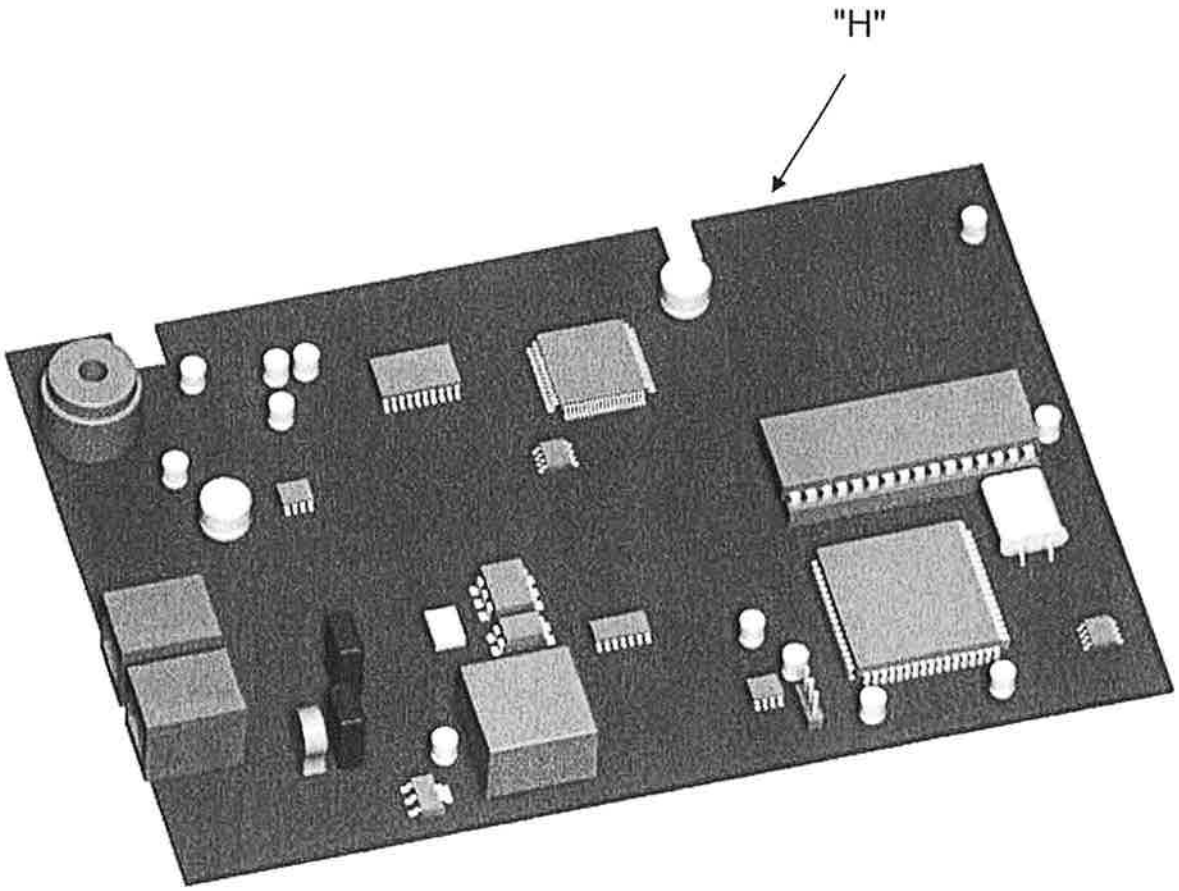


Fig. 7c

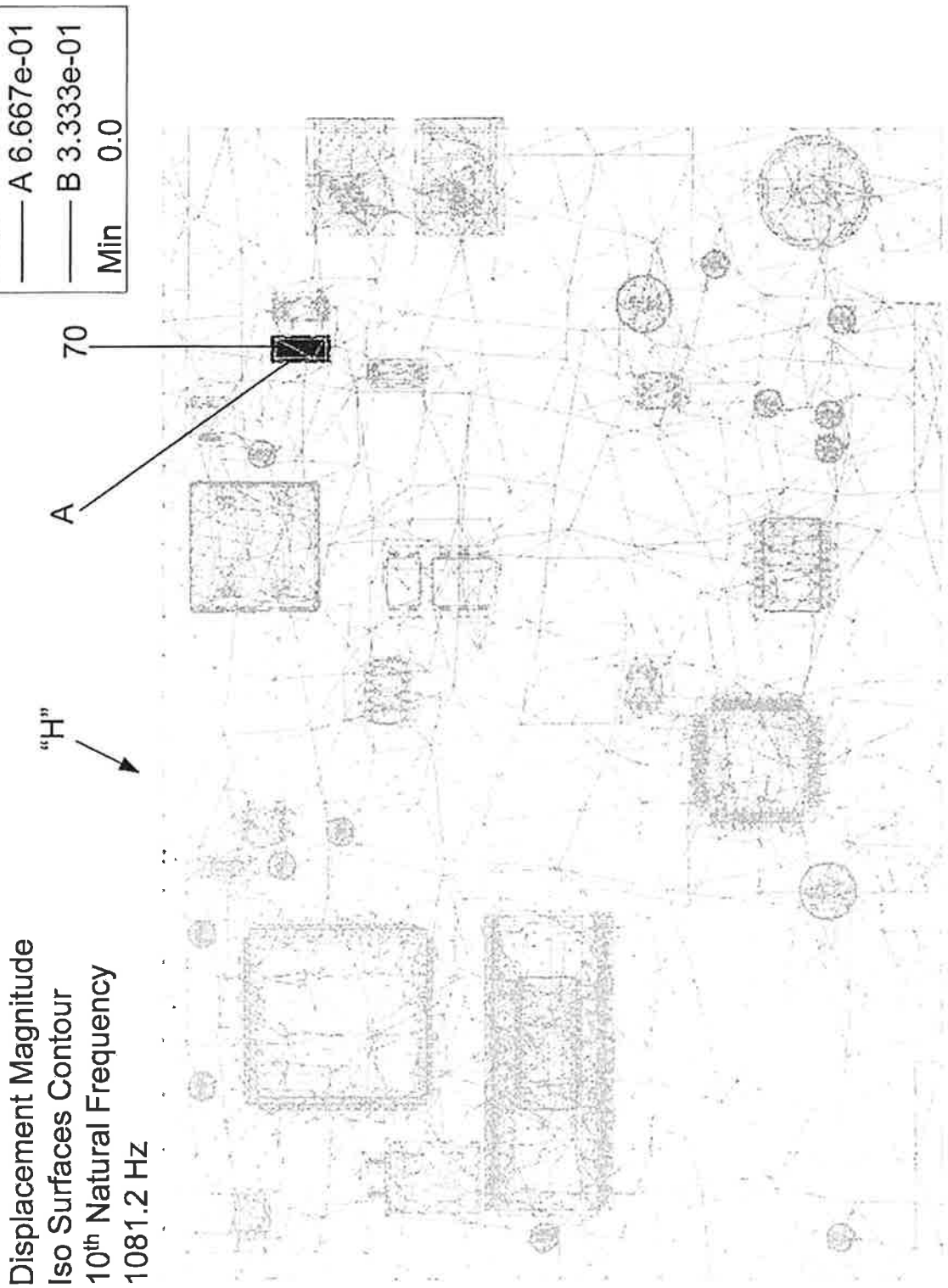

Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
70
A
"H"
Displacement Magnitude
Iso Surfaces Contour
10th Natural Frequency
1081.2 Hz

Fig. 8a

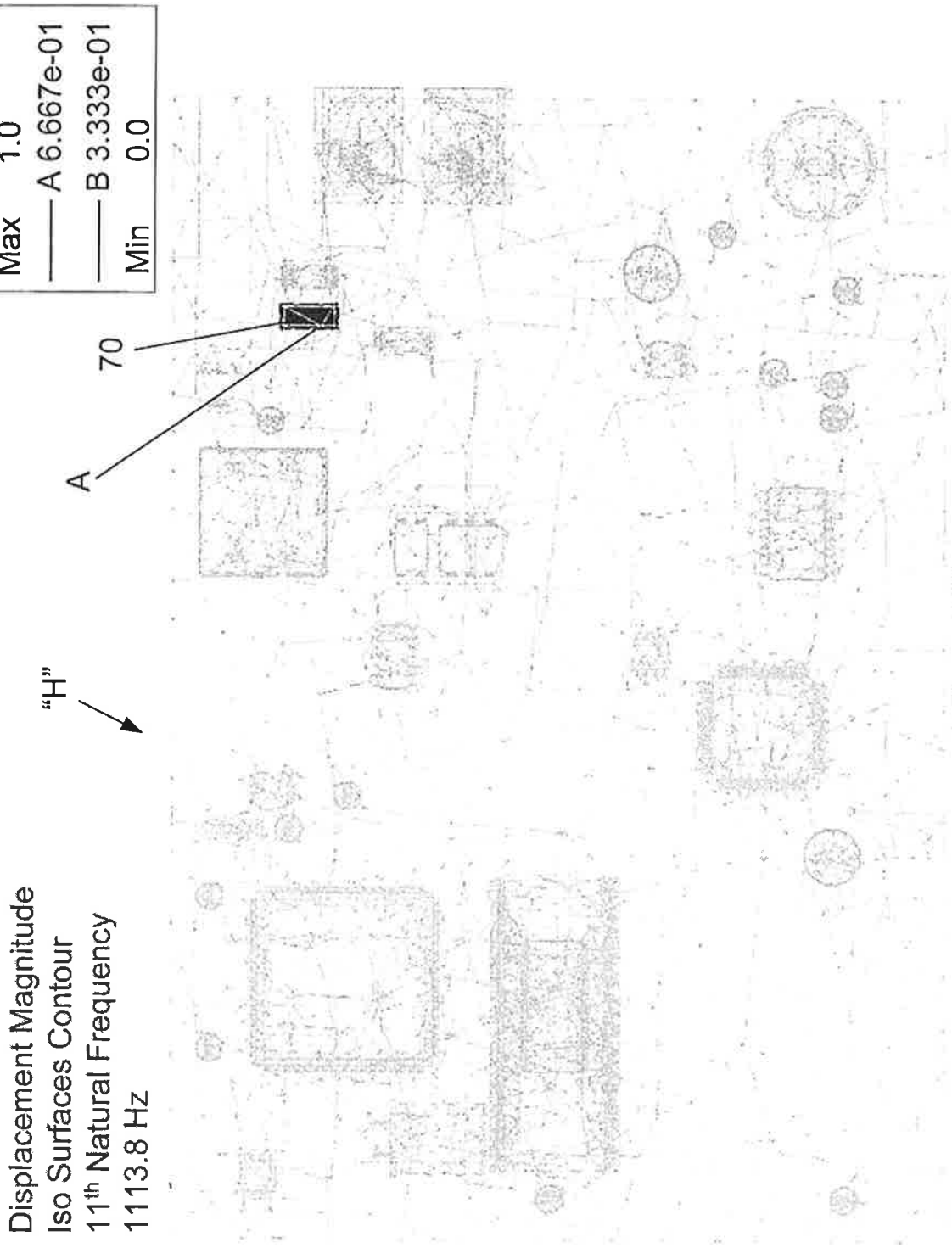

Displacement Magnitude
Iso Surfaces Contour
11th Natural Frequency
1113.8 Hz
"H"
A
70
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0

Fig. 8b

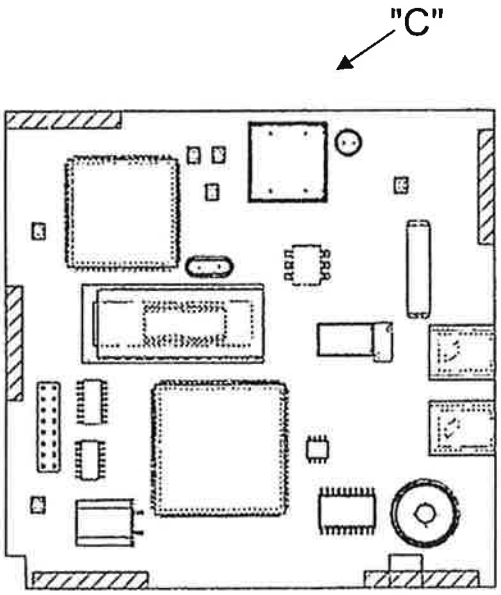


Fig. 9a

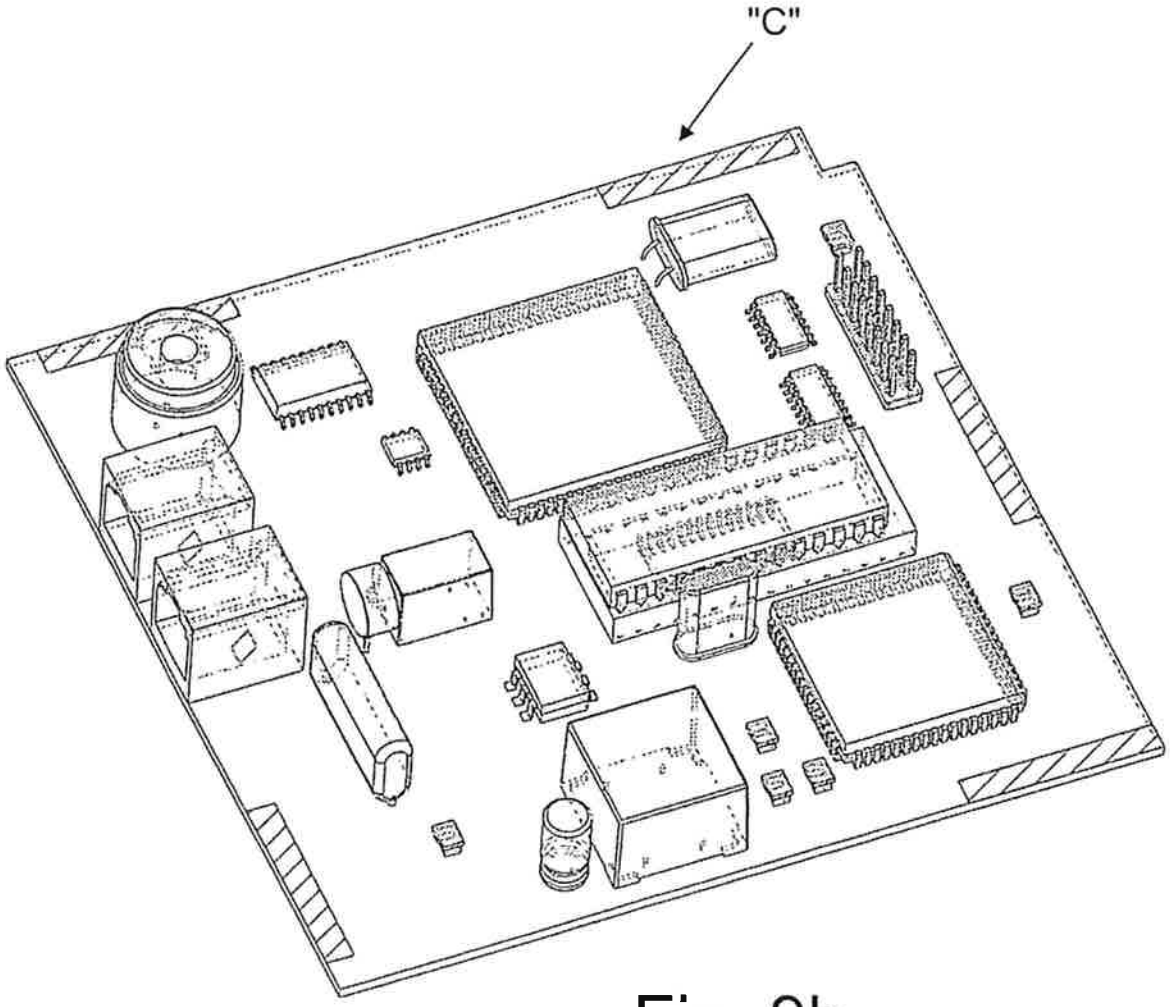


Fig. 9b

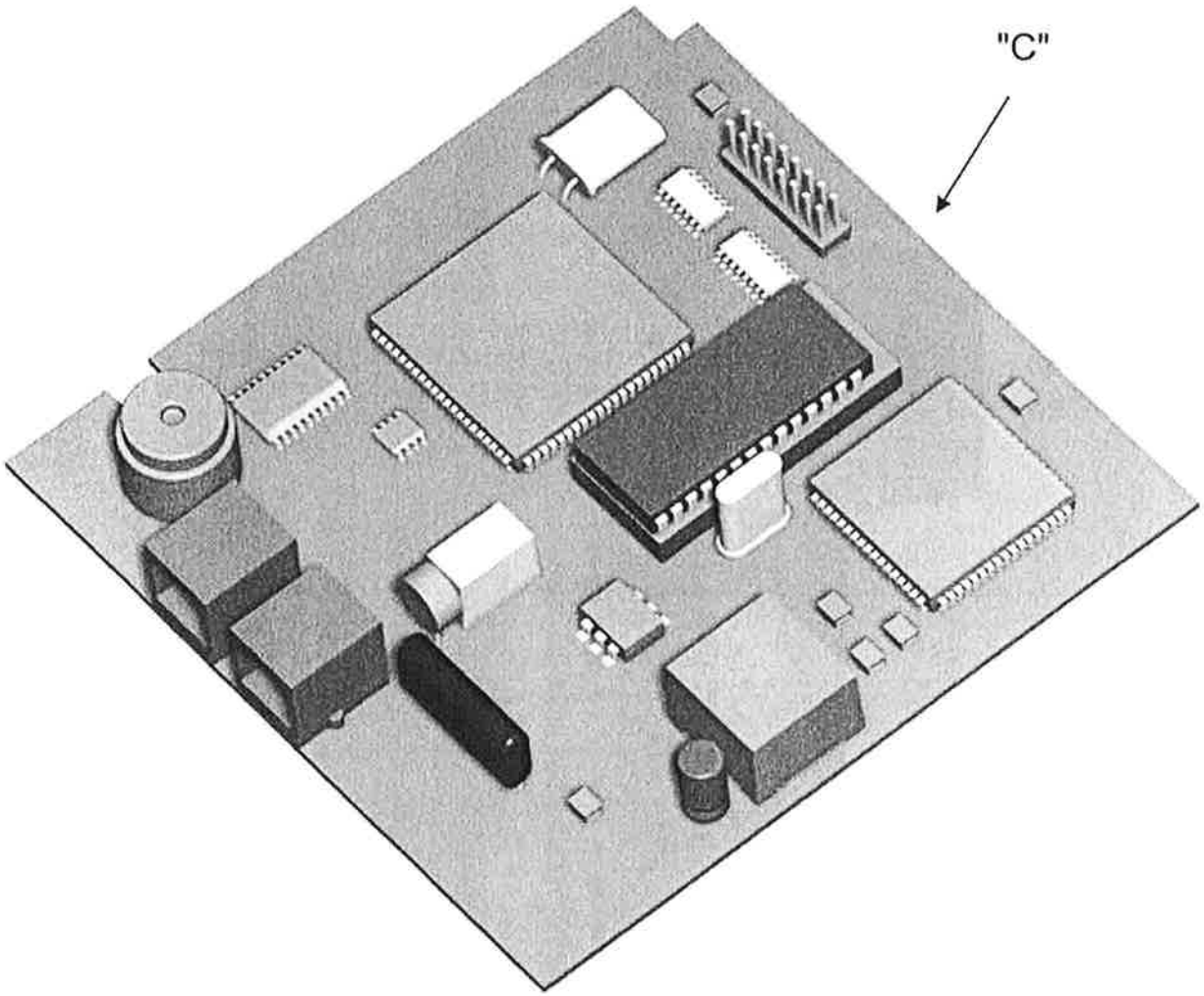


Fig. 9c

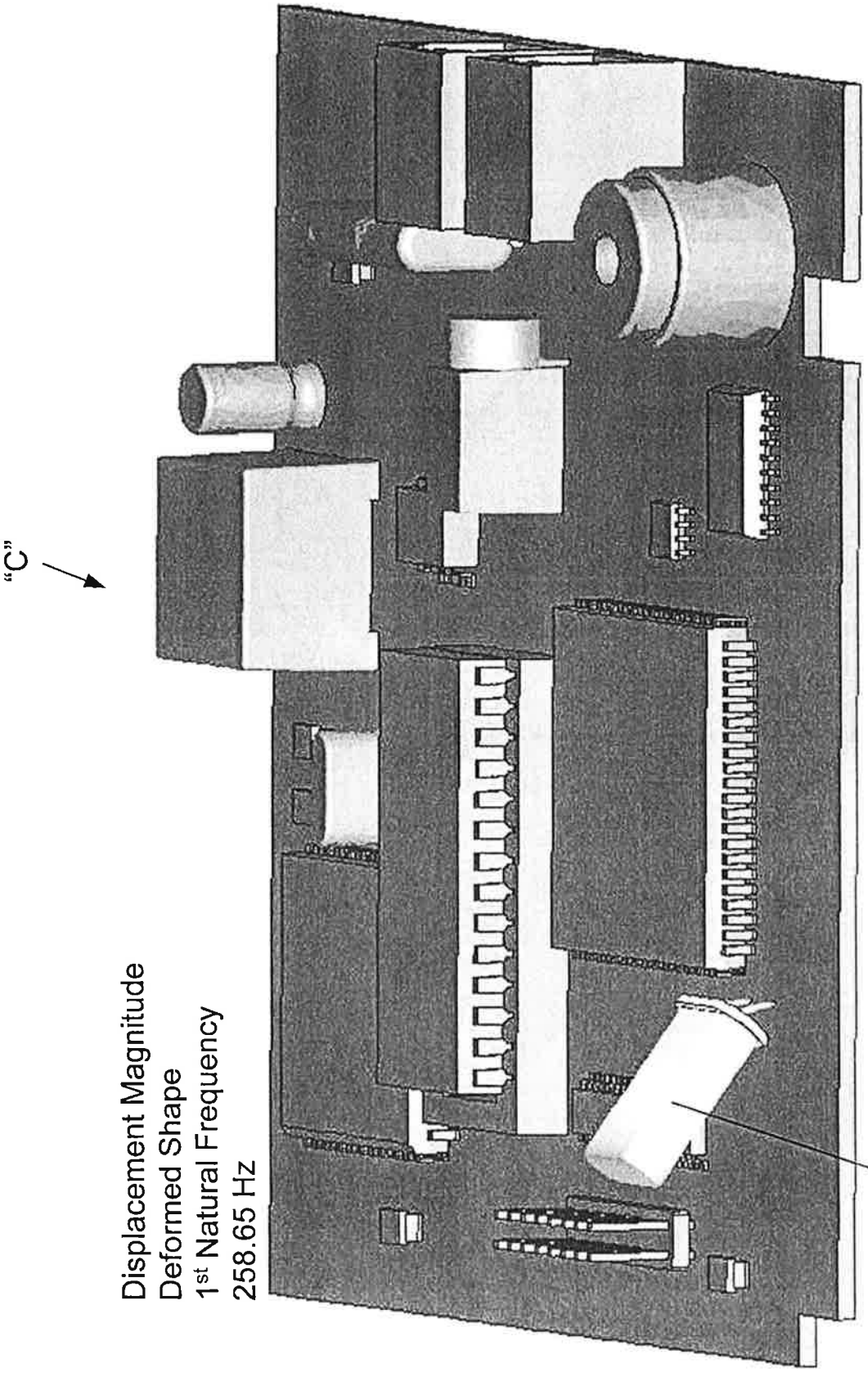

"C"
Displacement Magnitude
Deformed Shape
1st Natural Frequency
258.65 Hz
75

Fig. 10a

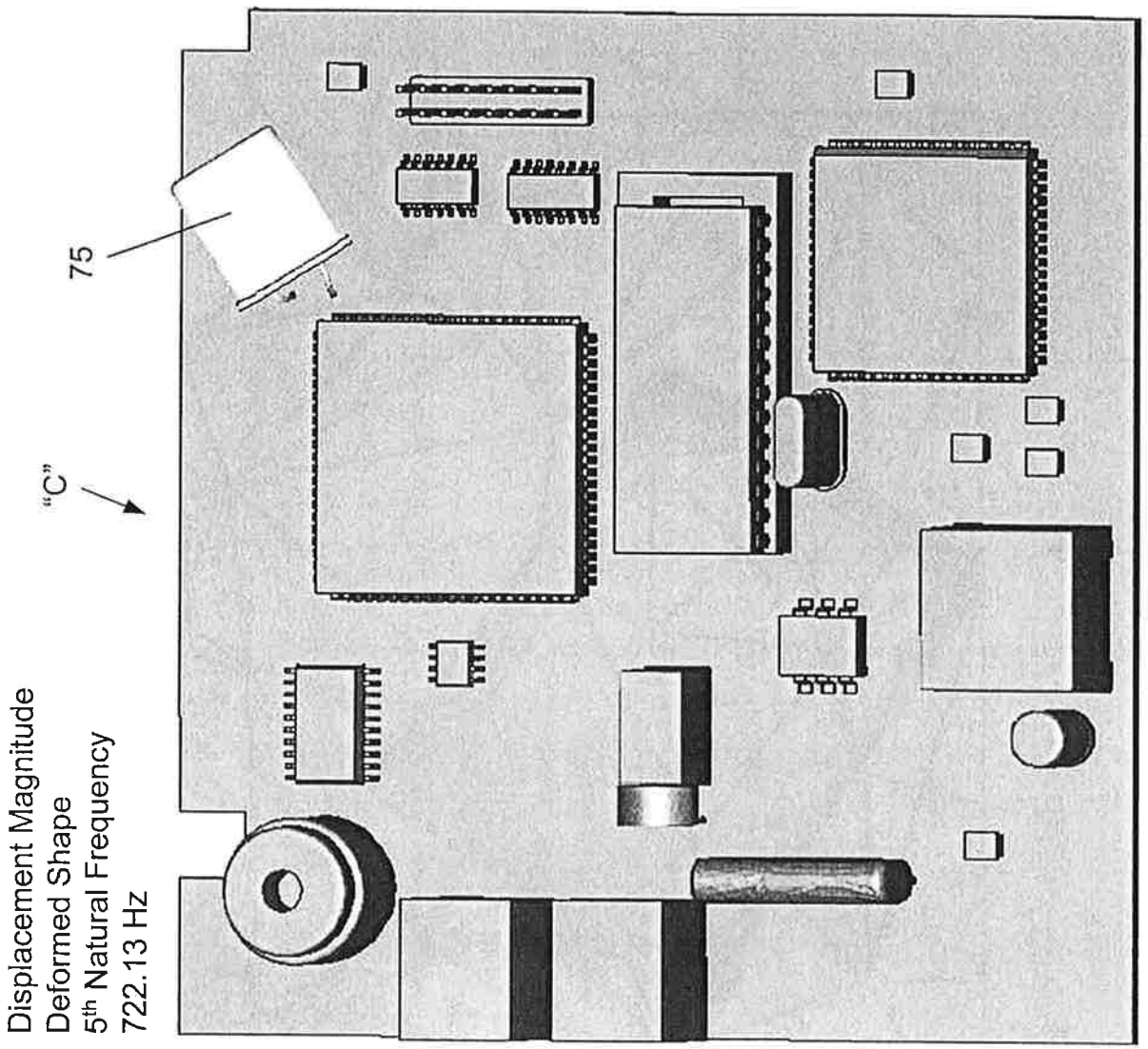

Displacement Magnitude
Deformed Shape
5th Natural Frequency
722.13 Hz
"C"
75

Fig. 10b

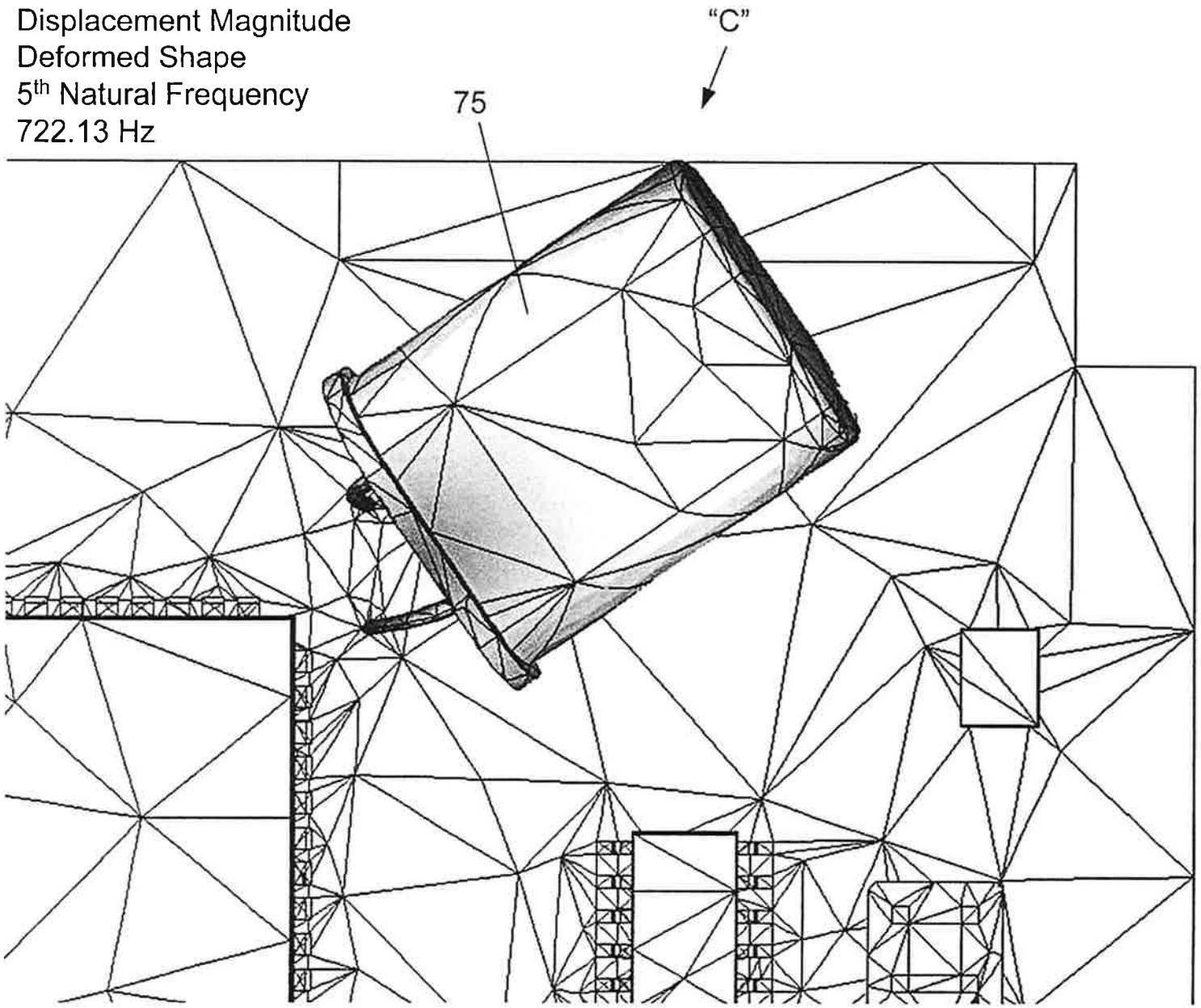

Displacement Magnitude
Deformed Shape
5th Natural Frequency
722.13 Hz
"C"
75

Fig. 10c

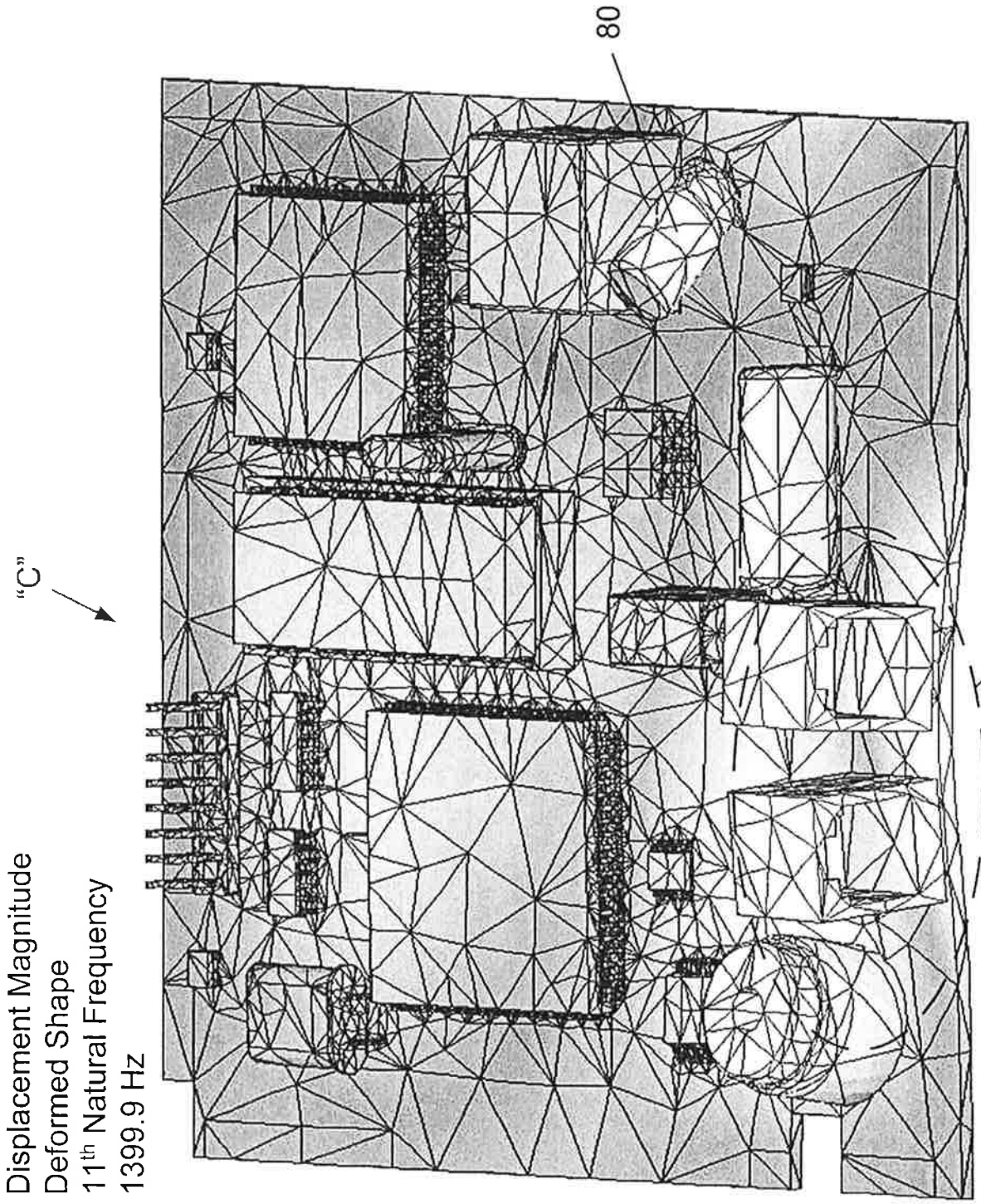

Displacement Magnitude
Deformed Shape
11th Natural Frequency
1399.9 Hz
"C"
80
81

Fig. 11

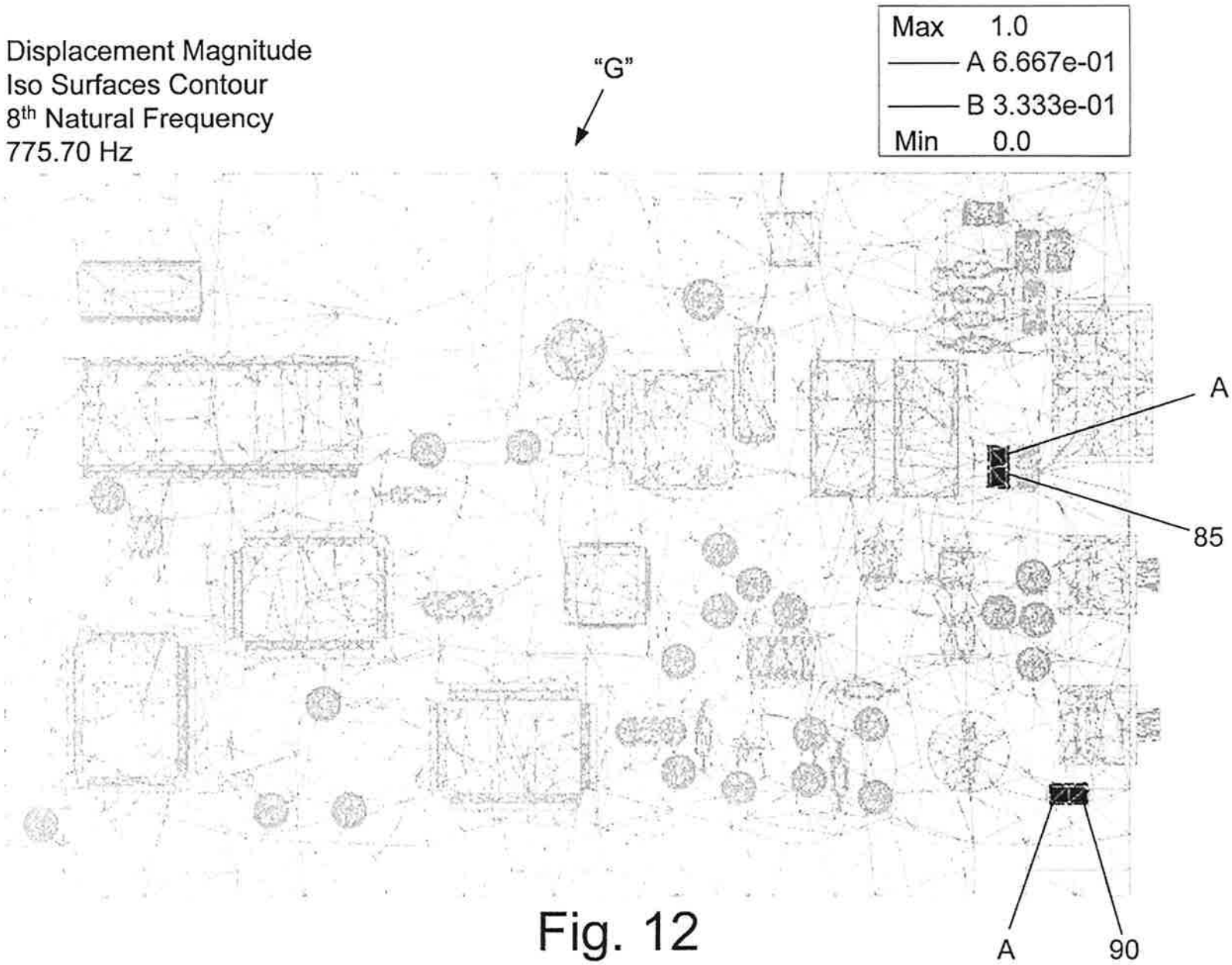

Displacement Magnitude
Iso Surfaces Contour
8th Natural Frequency
775.70 Hz
"G"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
A
85
A
90

Fig. 12

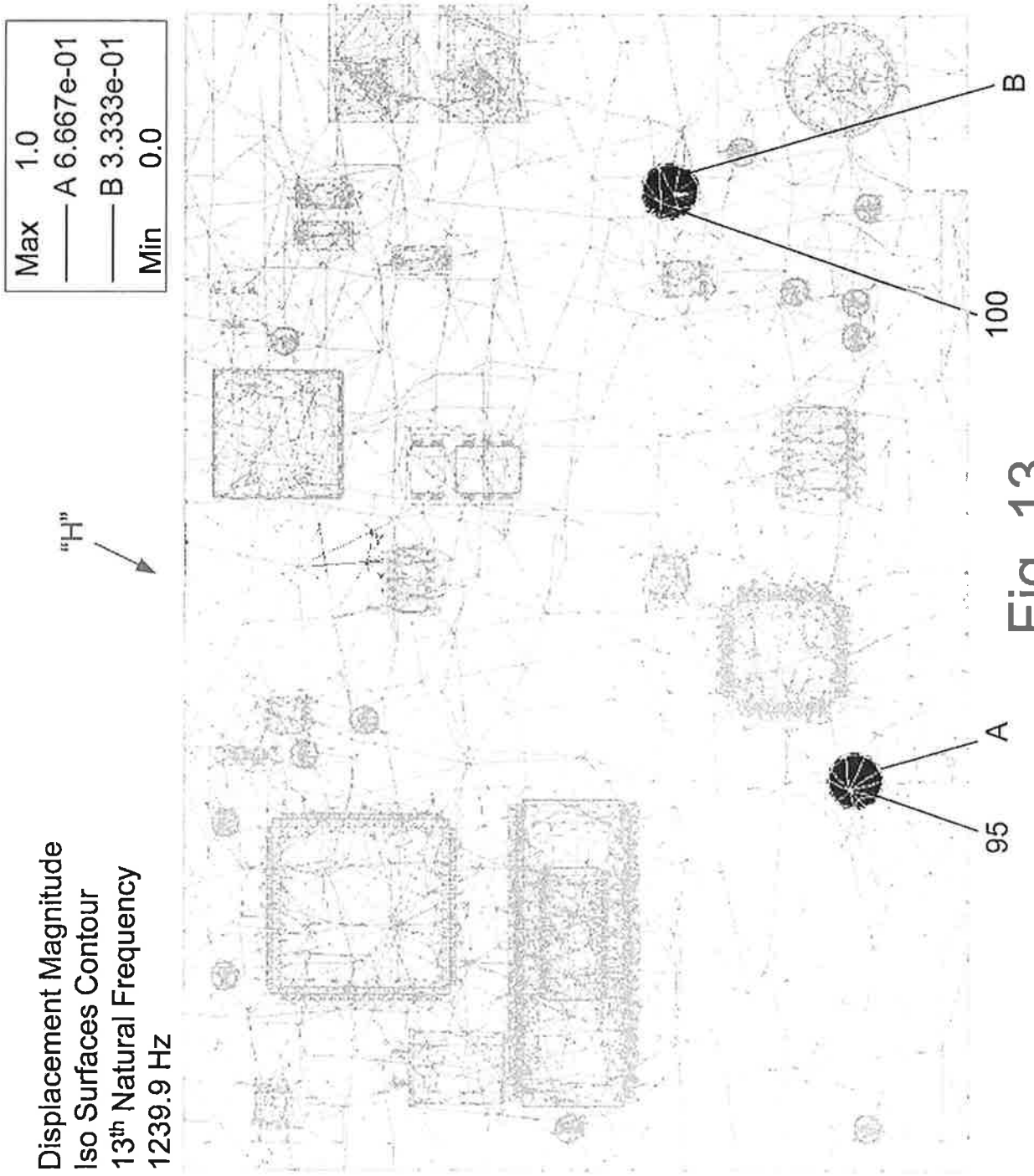

Displacement Magnitude
Iso Surfaces Contour
13th Natural Frequency
1239.9 Hz
"H"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
95
A
100
B

Fig. 13

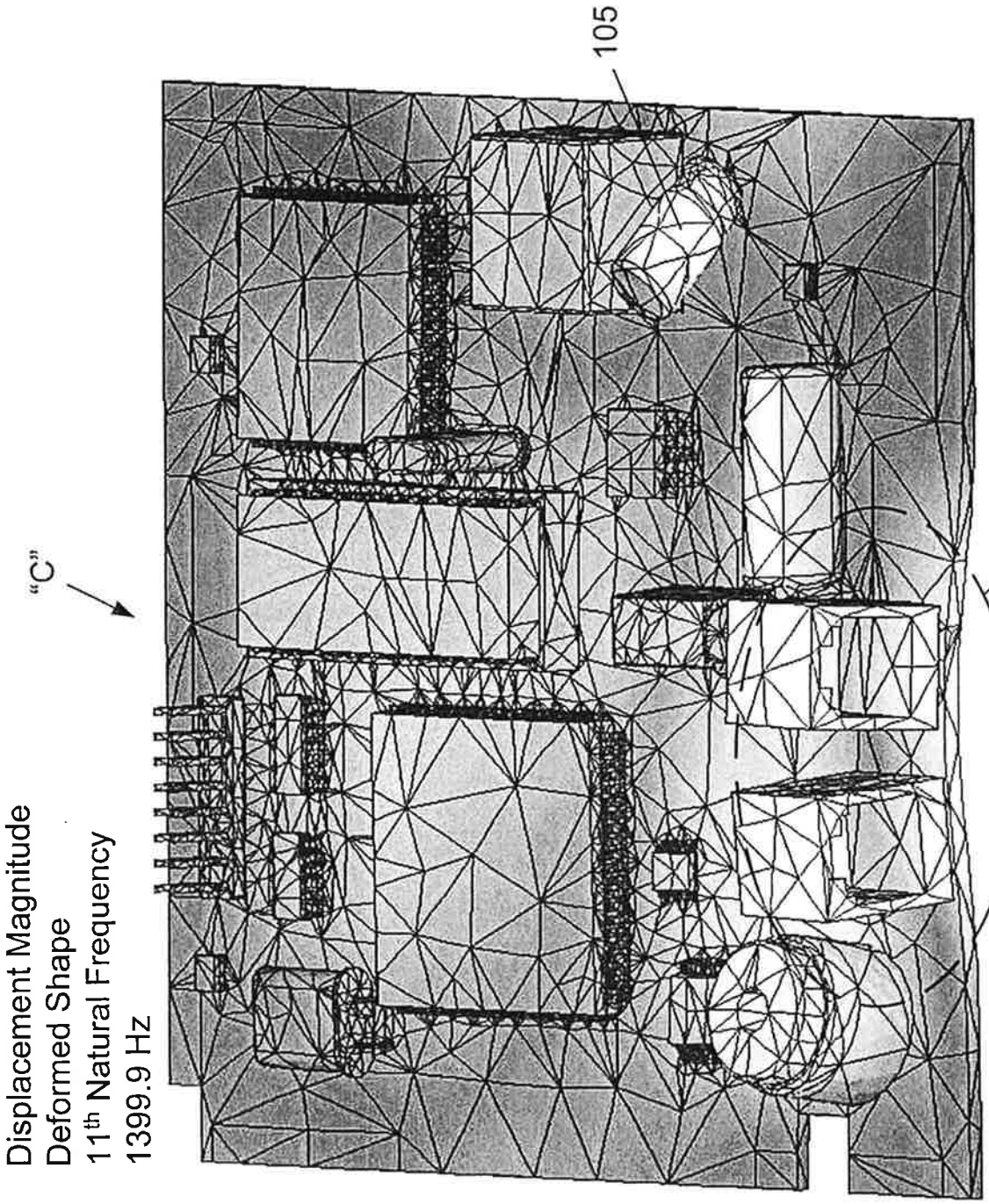

Displacement Magnitude
Deformed Shape
11th Natural Frequency
1399.9 Hz
"C"
105
106

Fig. 14a

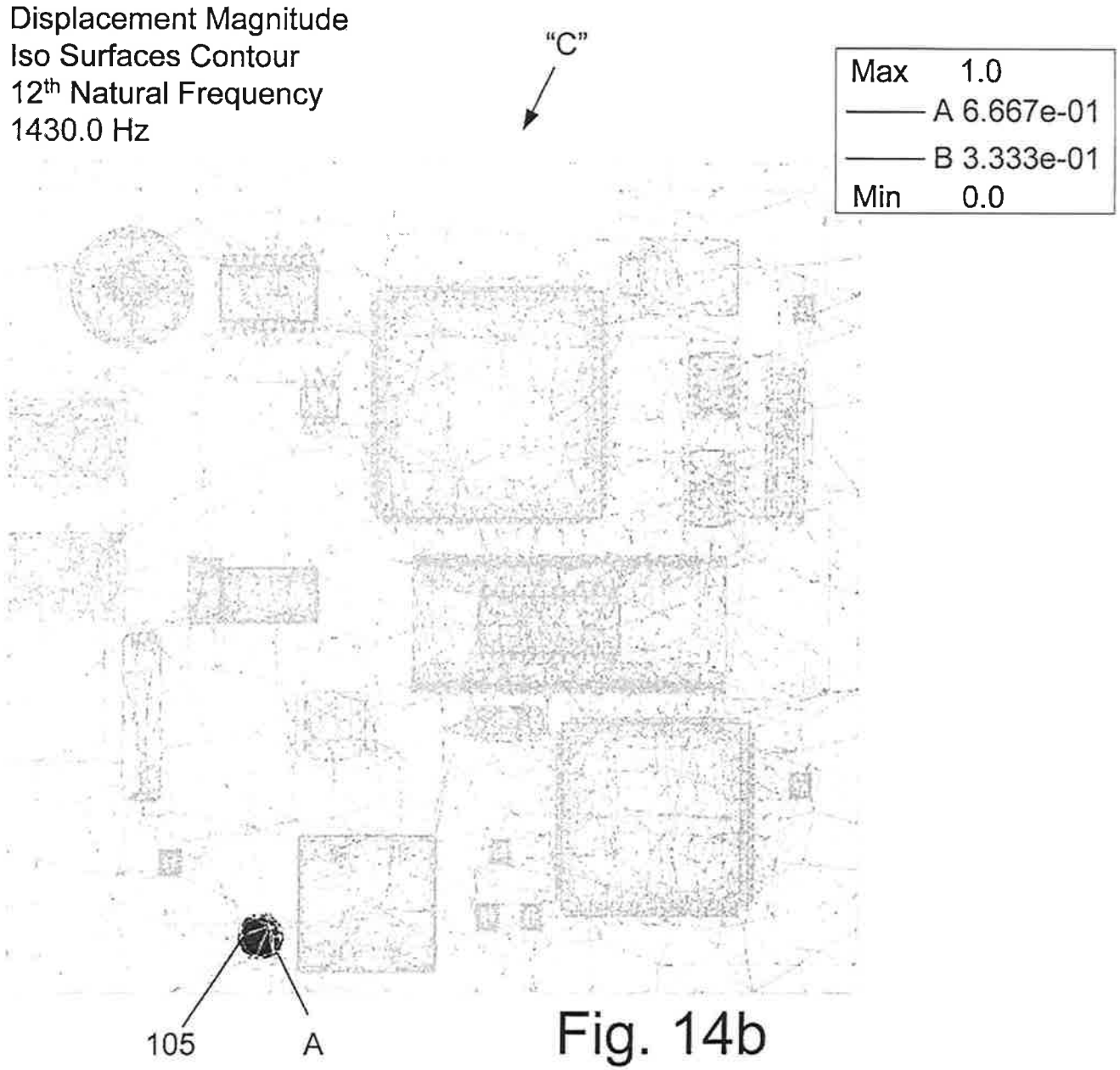

Displacement Magnitude
Iso Surfaces Contour
12th Natural Frequency
1430.0 Hz
"C"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
105
A

Fig. 14b

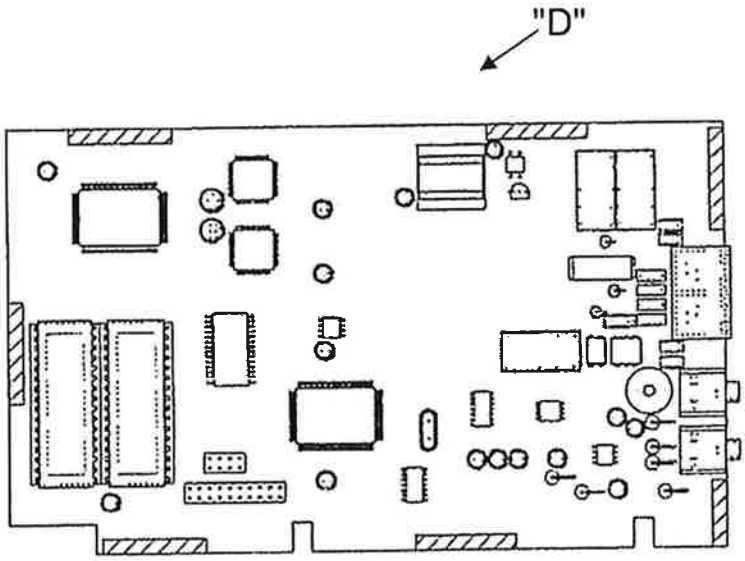


Fig. 15a

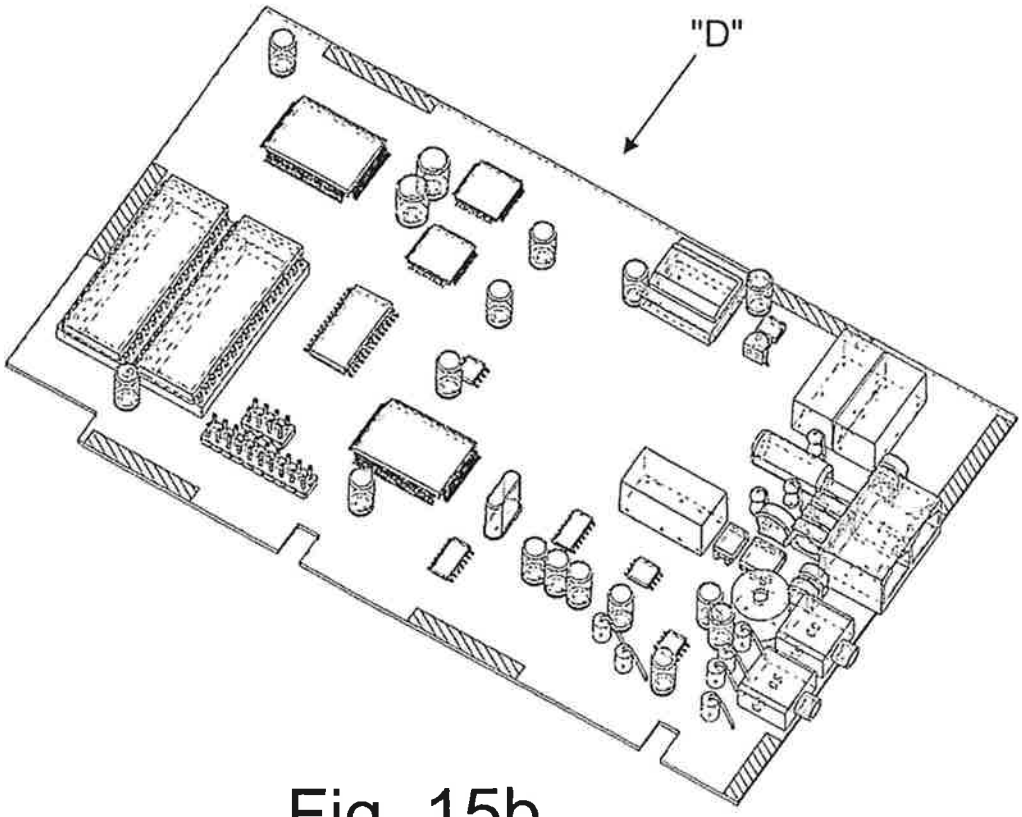


Fig. 15b

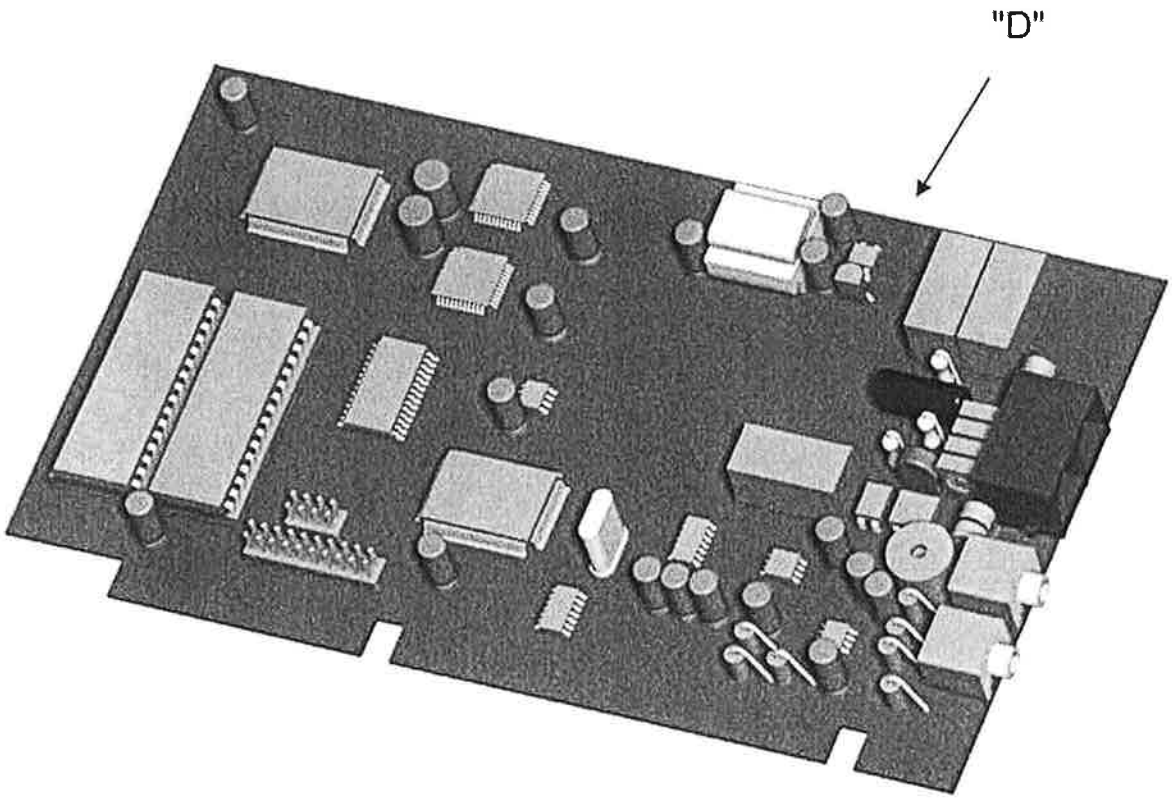


Fig. 15c

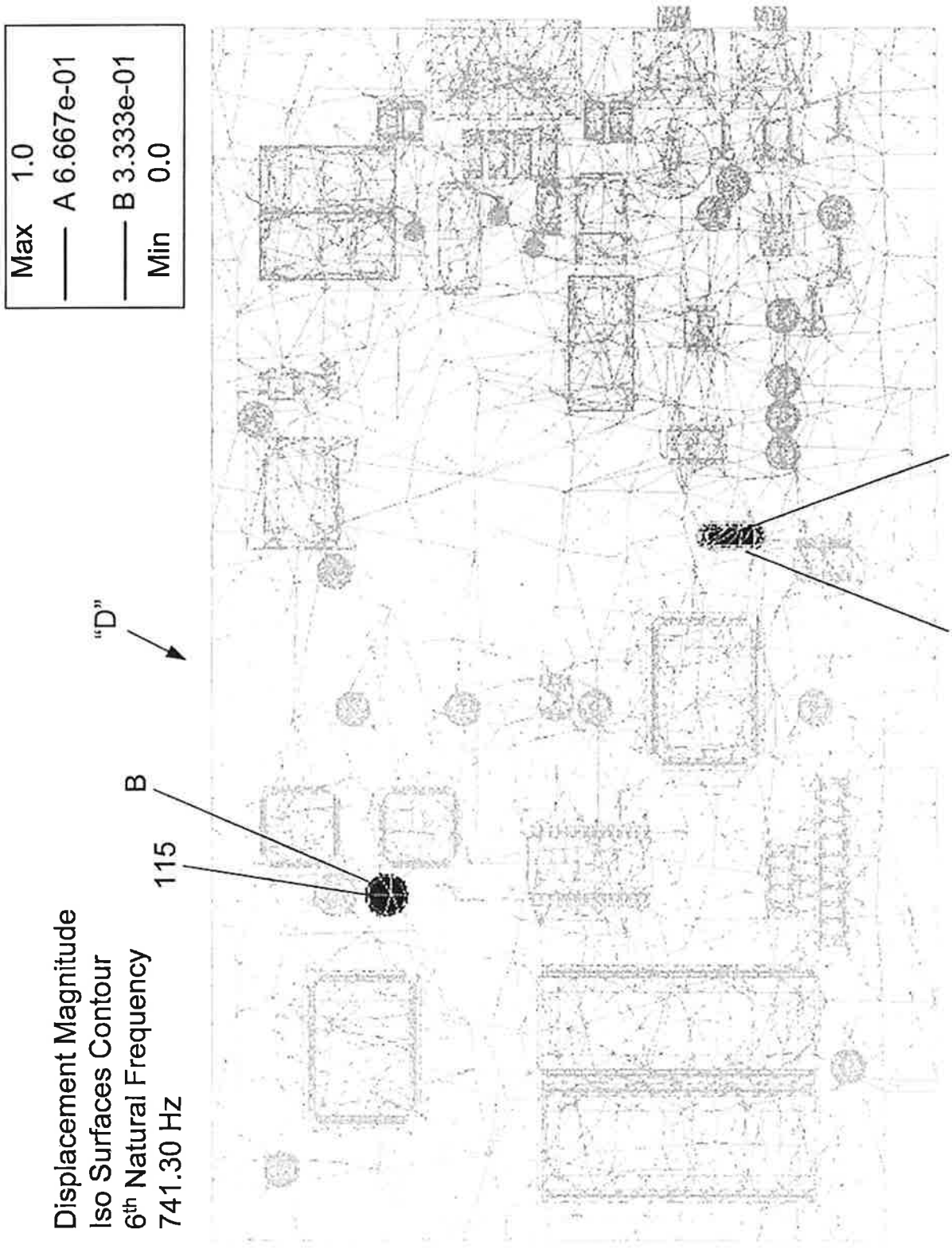

Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
Displacement Magnitude
Iso Surfaces Contour
6th Natural Frequency
741.30 Hz
"D"
B
115
A
110

Fig. 16a

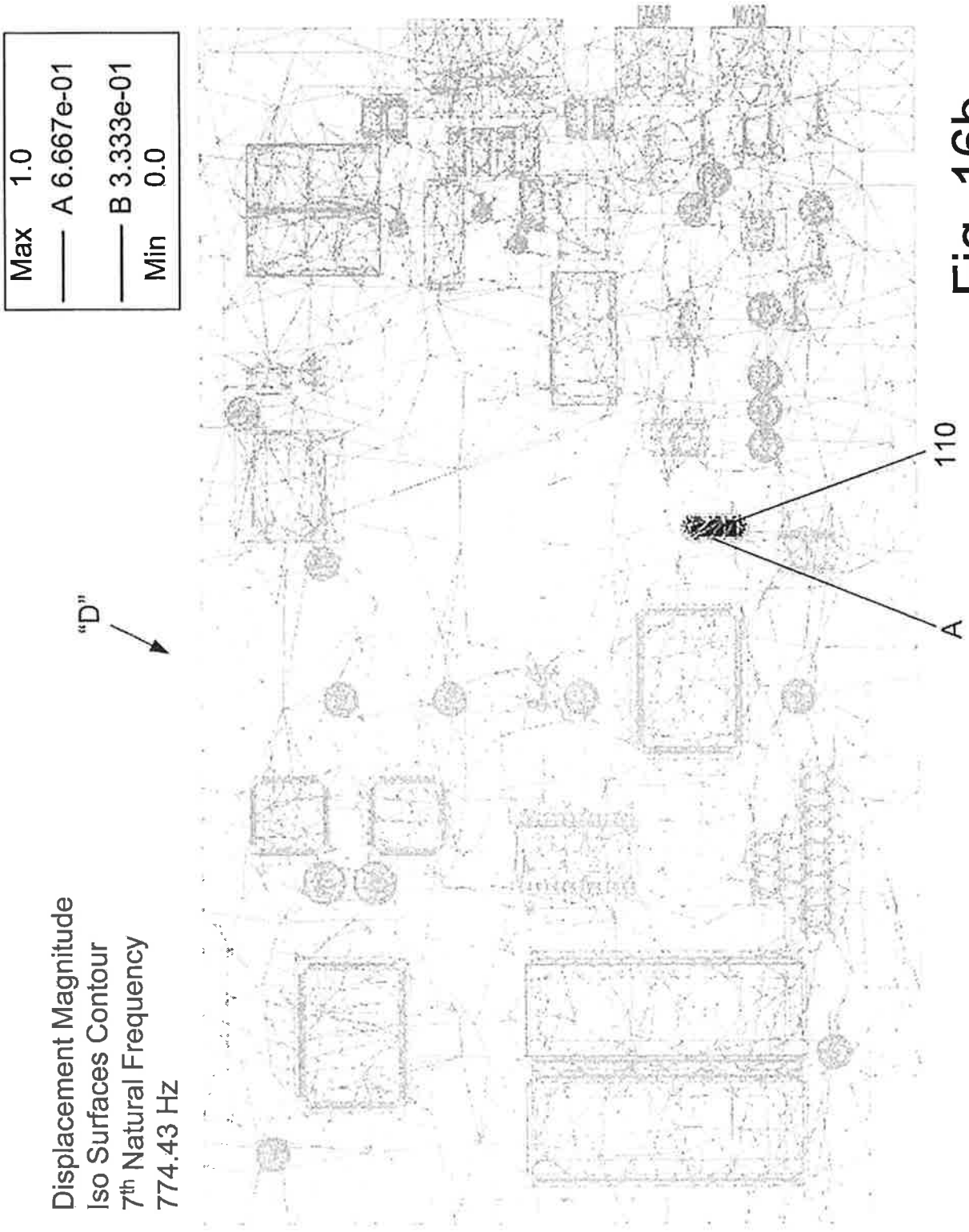

Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
"D"
A
110
Displacement Magnitude
Iso Surfaces Contour
7th Natural Frequency
774.43 Hz

Fig. 16b

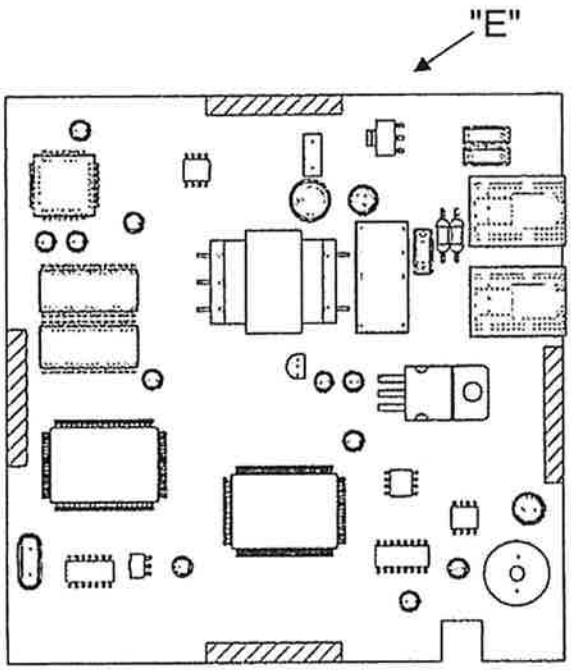


Fig. 17a

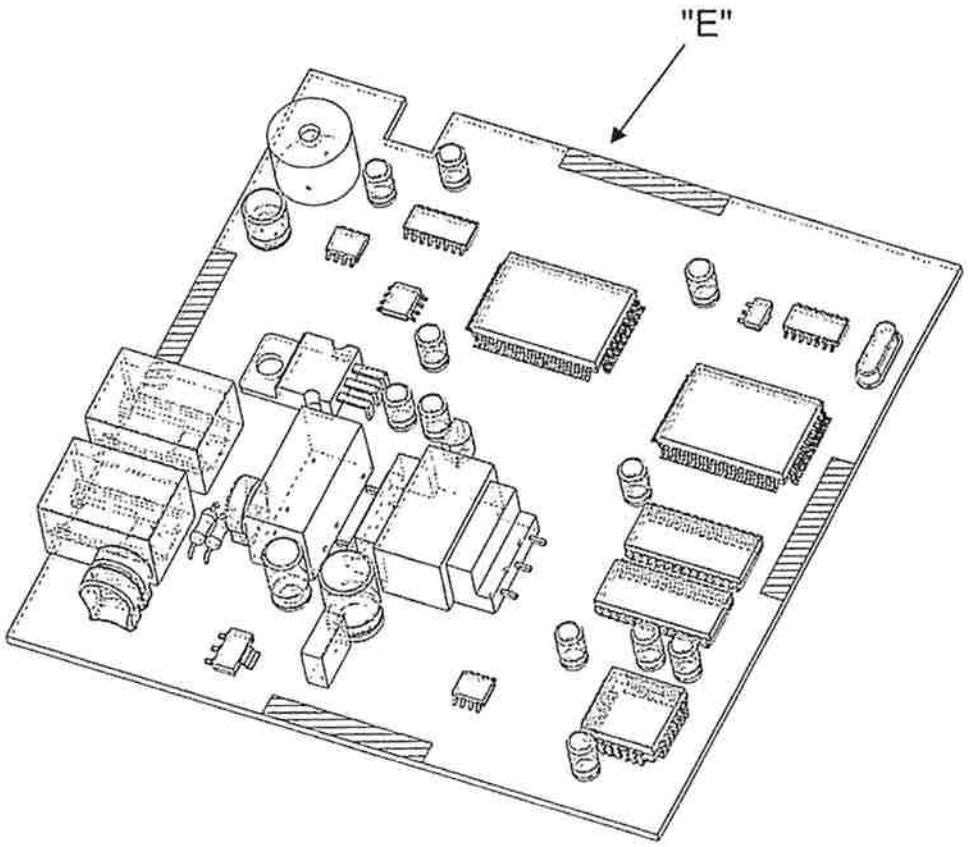


Fig. 17b

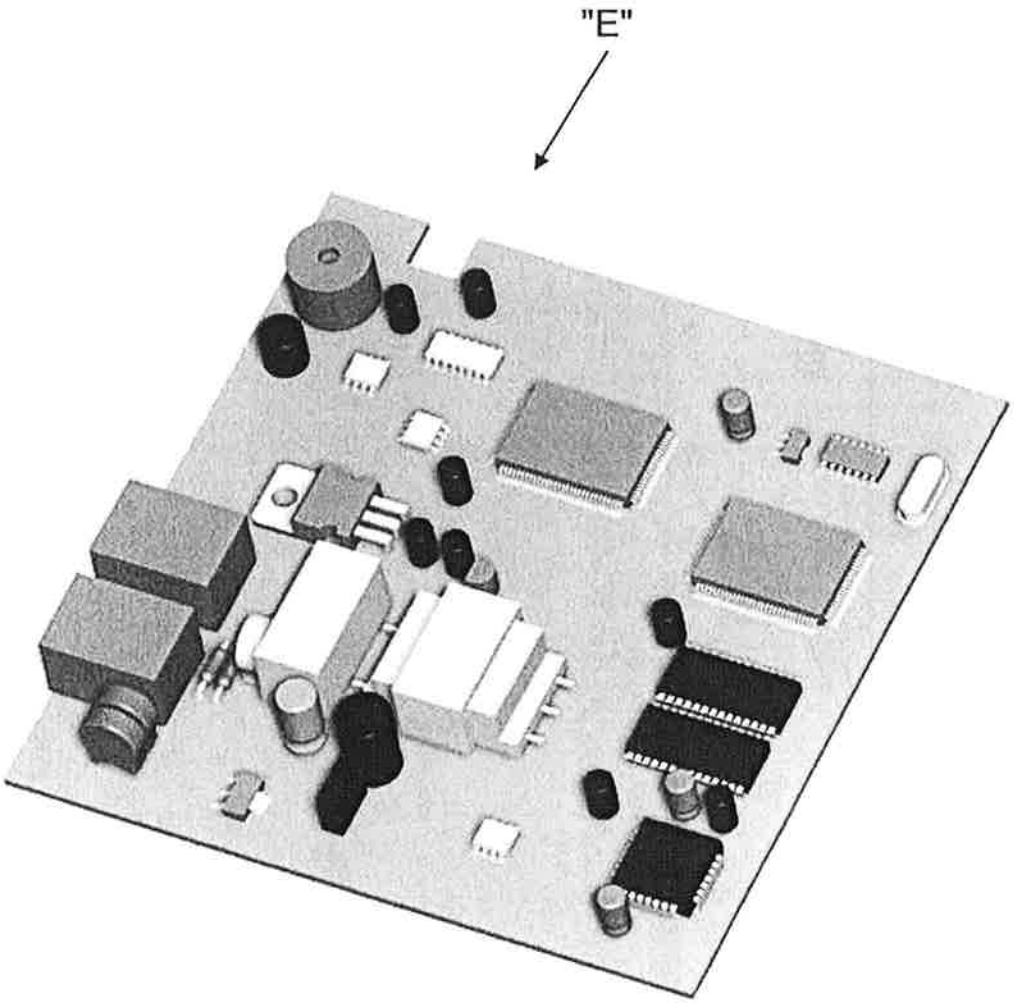


Fig. 17c

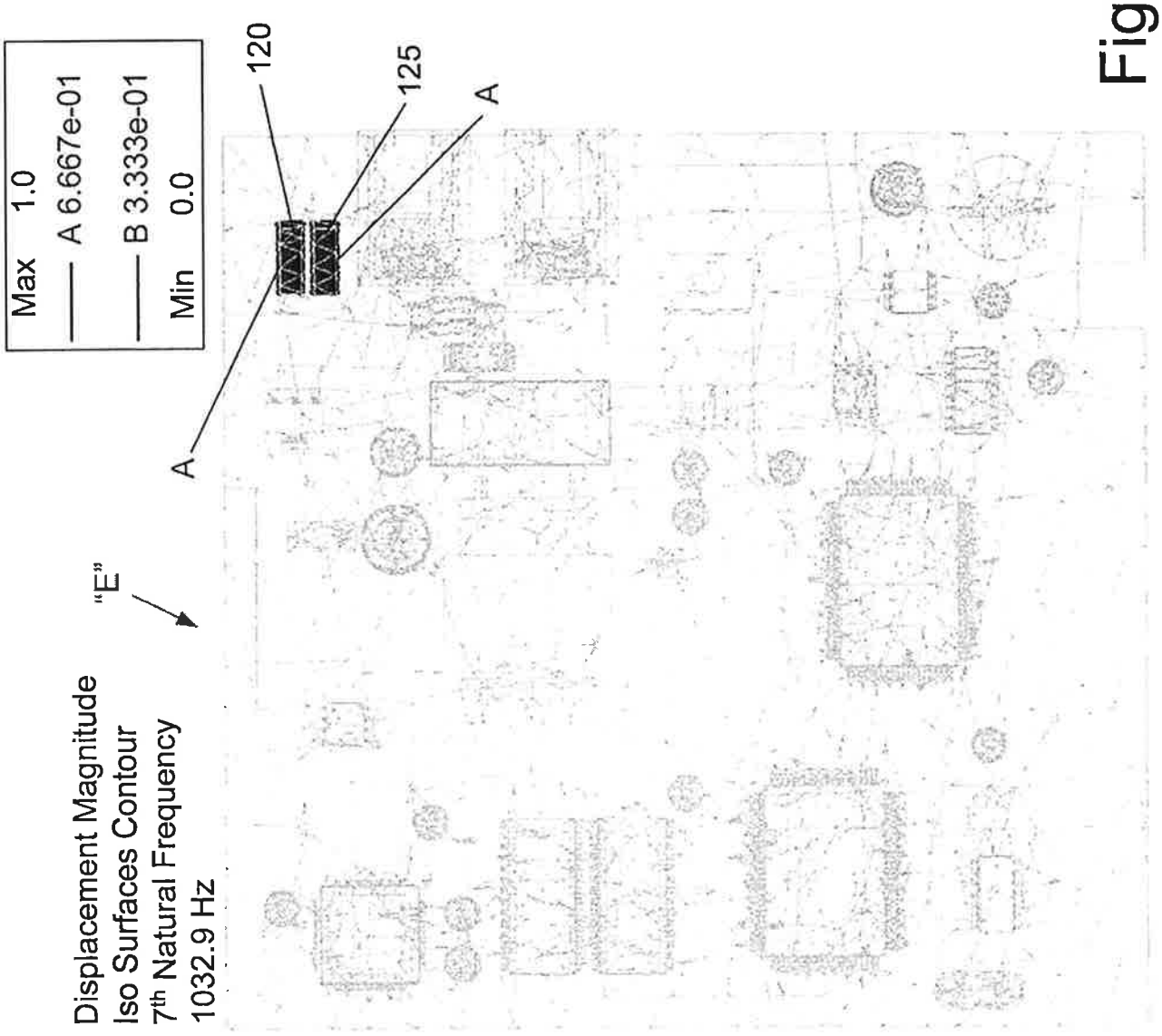

Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
120
125
A
A
"E"
Displacement Magnitude
Iso Surfaces Contour
7th Natural Frequency
1032.9 Hz

Fig. 18a

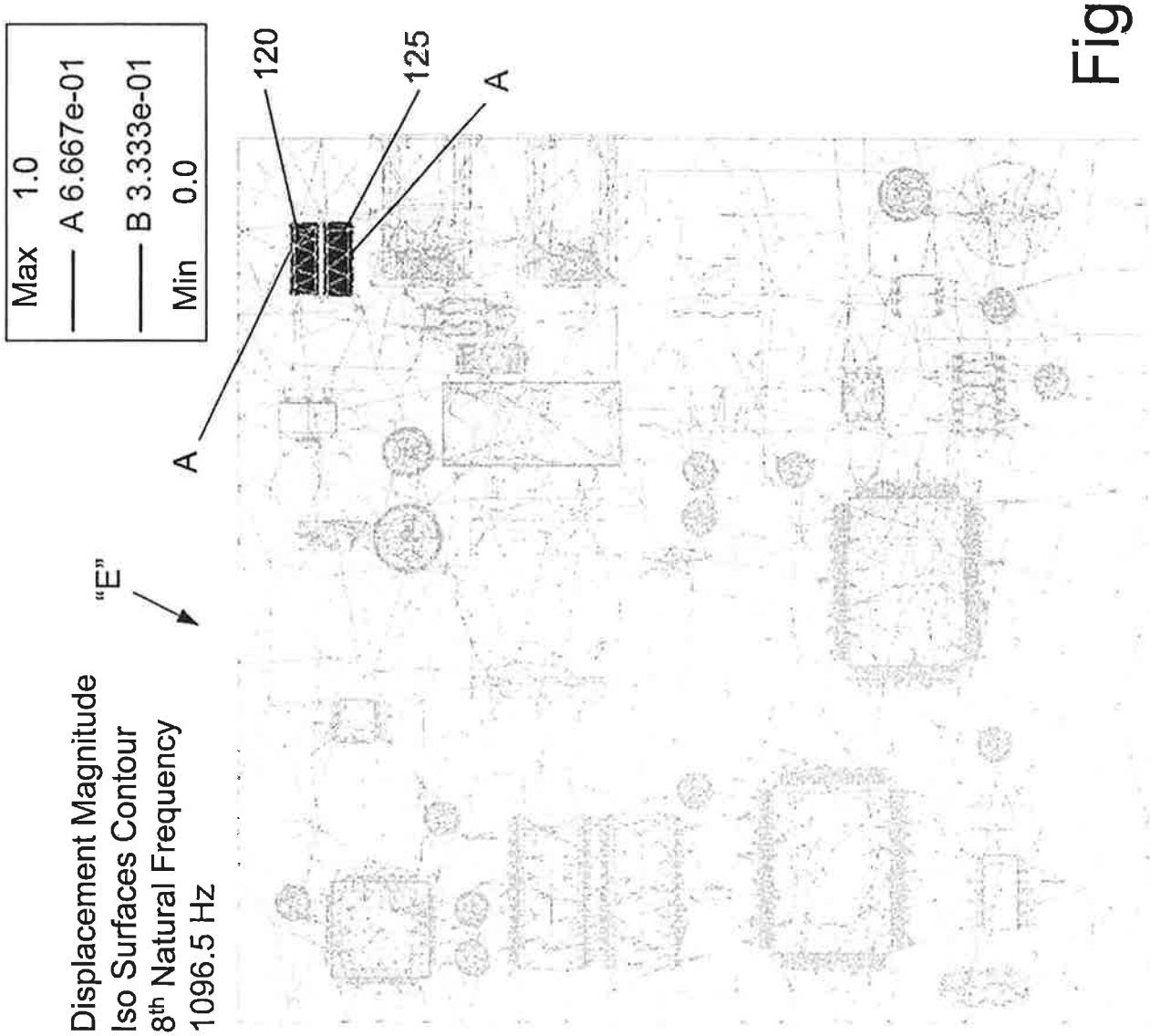

Displacement Magnitude
Iso Surfaces Contour
8th Natural Frequency
1096.5 Hz
"E"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
120
125
A
A

Fig. 18b

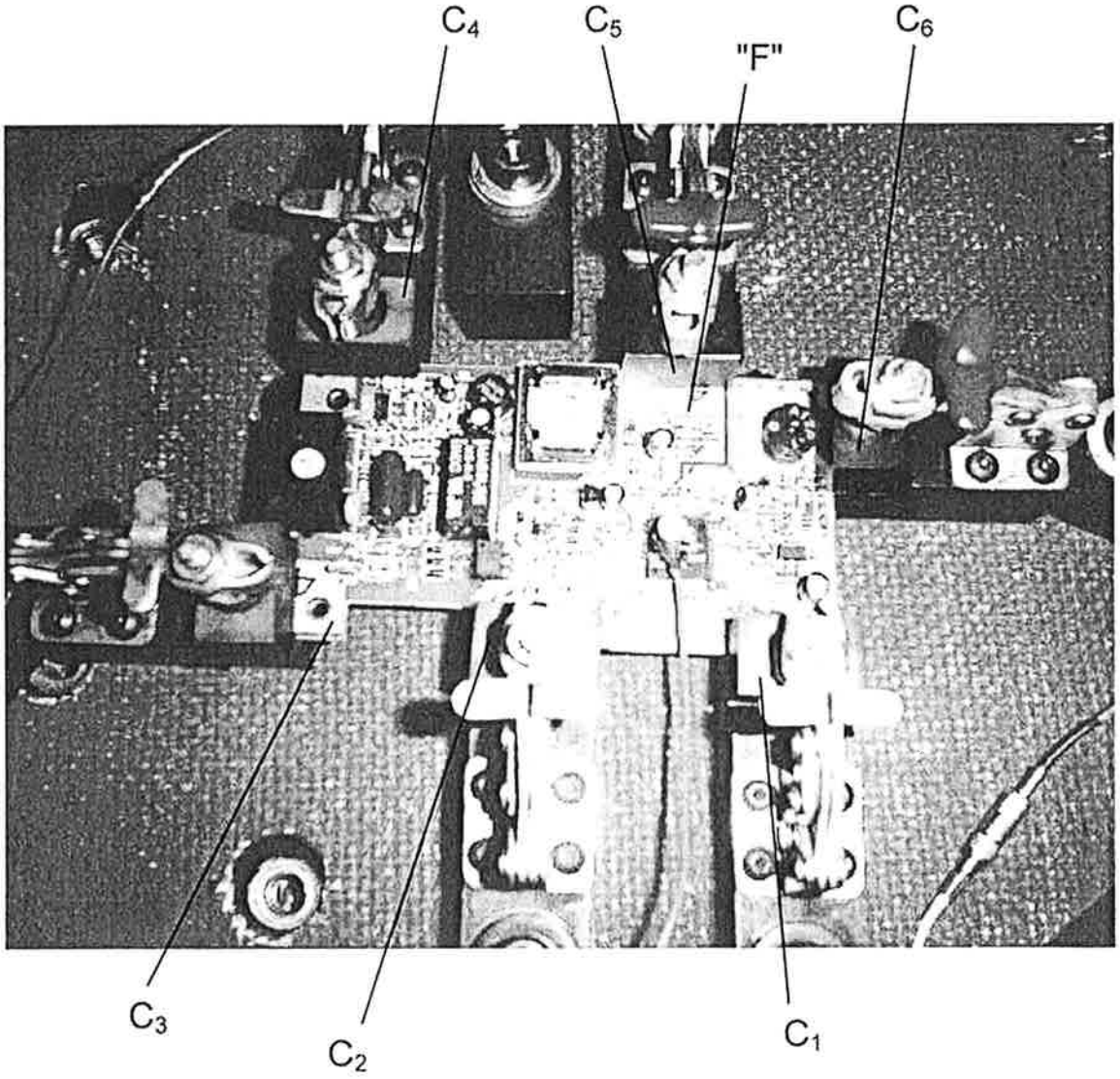


Fig. 19

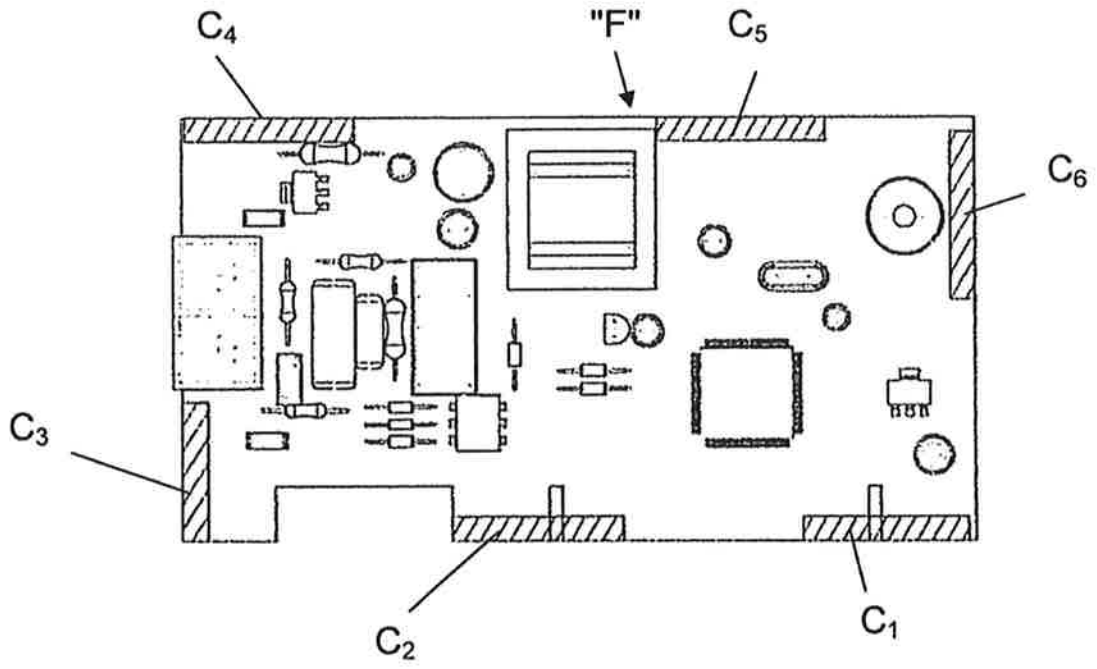


Fig. 20a

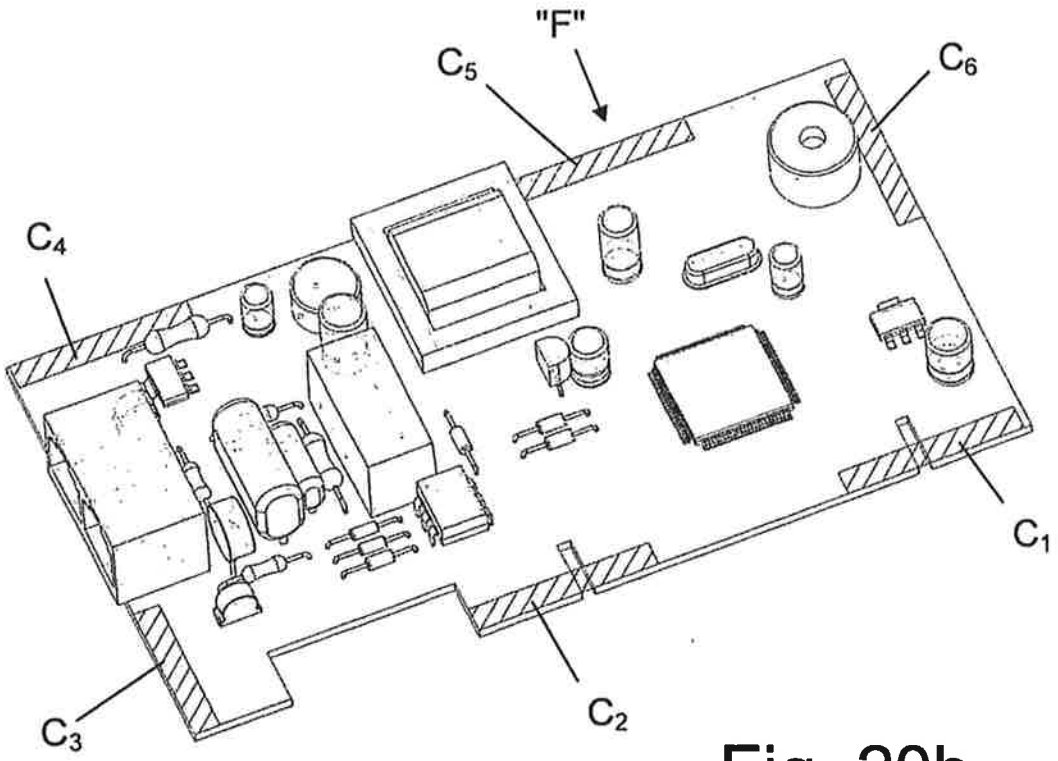


Fig. 20b

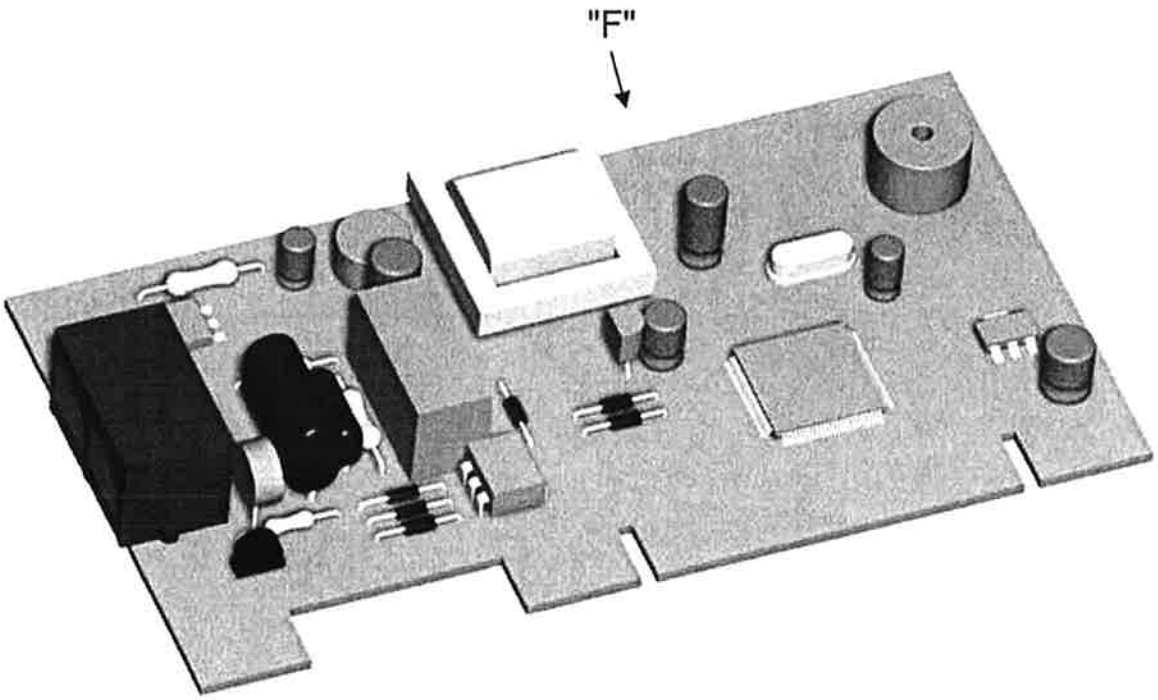


Fig. 21

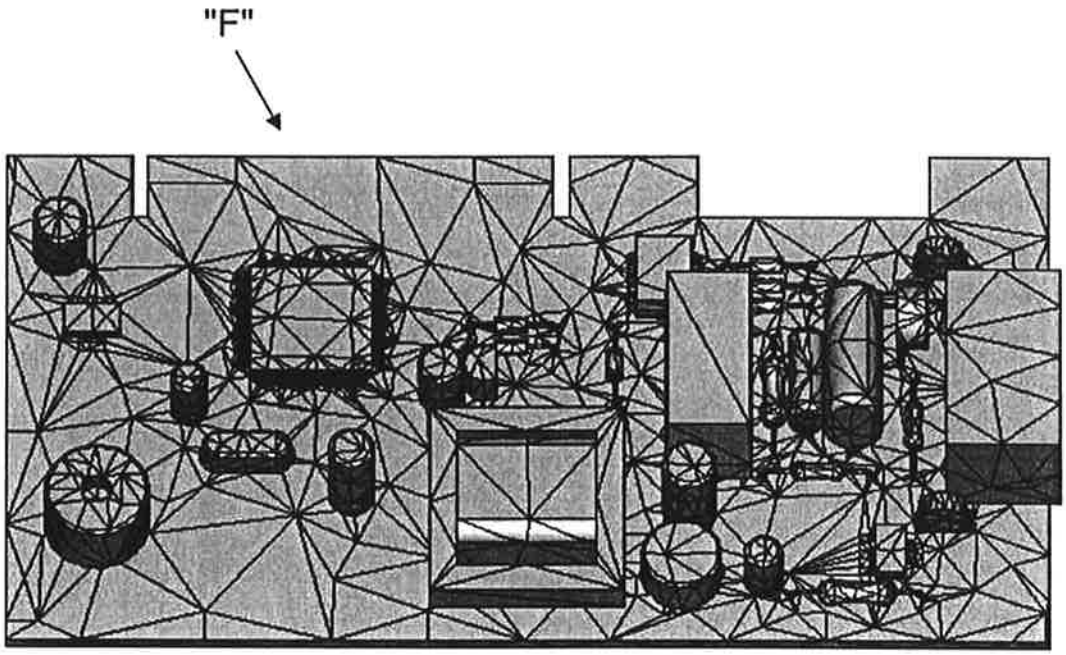


Fig. 22a

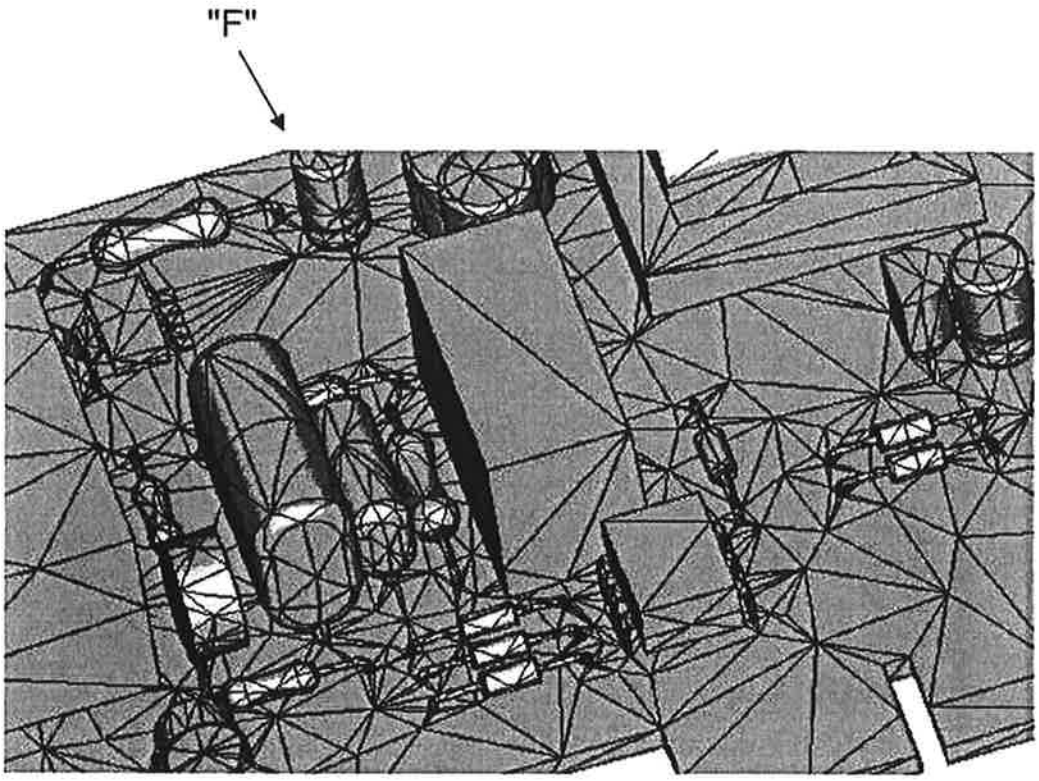


Fig. 22b

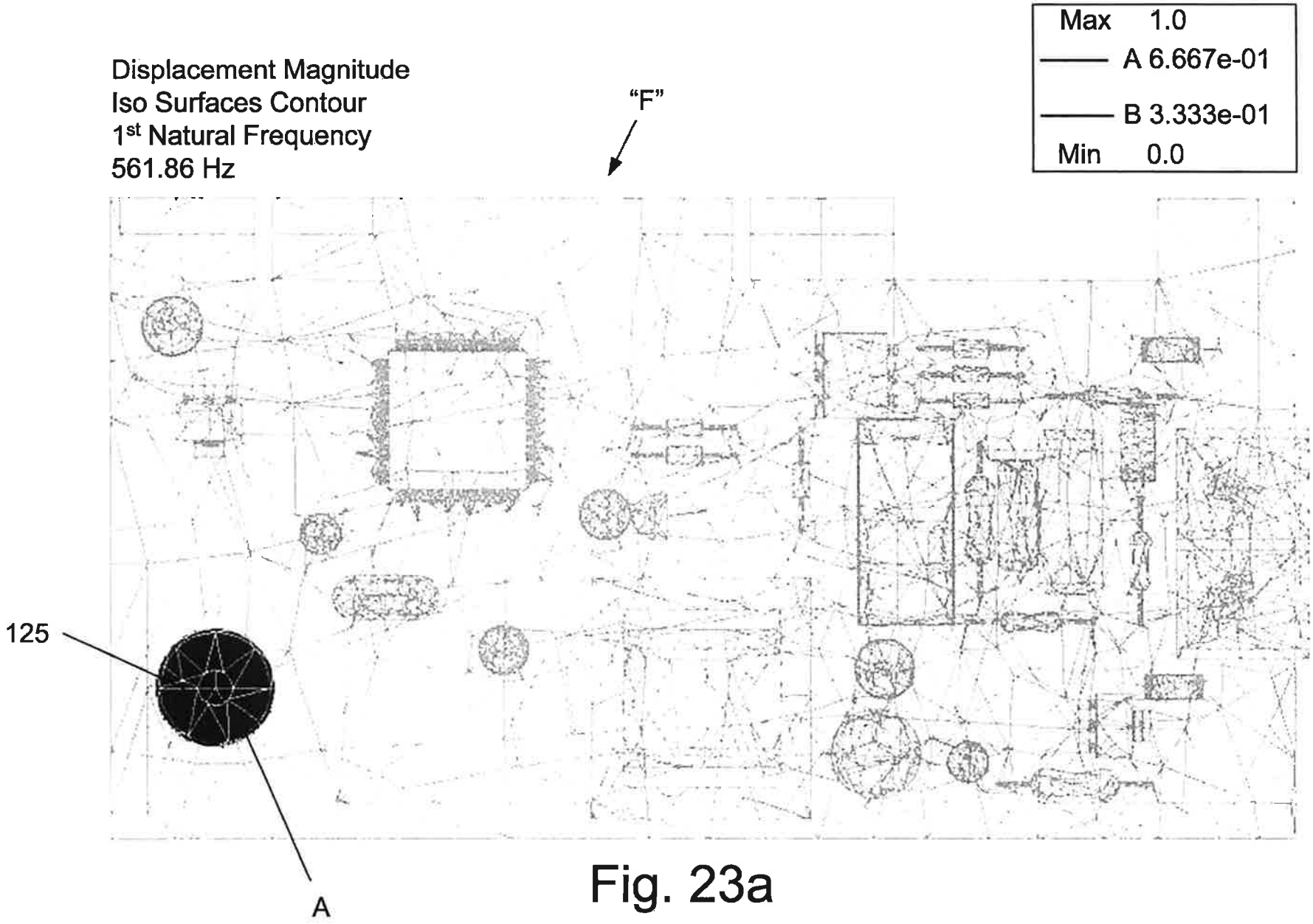

Displacement Magnitude
Iso Surfaces Contour
1st Natural Frequency
561.86 Hz
"F"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
125
A

Fig. 23a

Displacement Magnitude
Deformed Shape
1st Natural Frequency
561.86 Hz

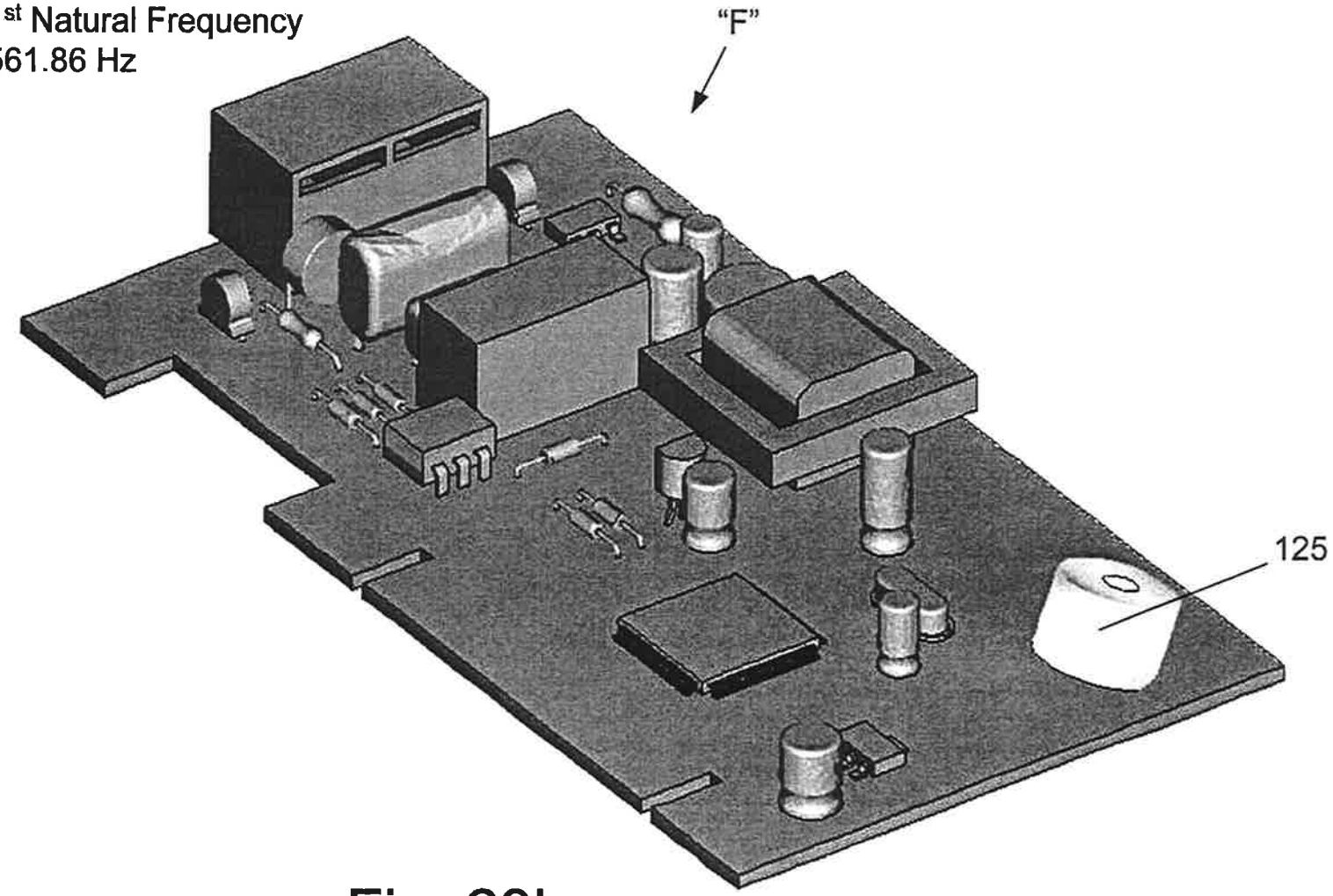


Fig. 23b

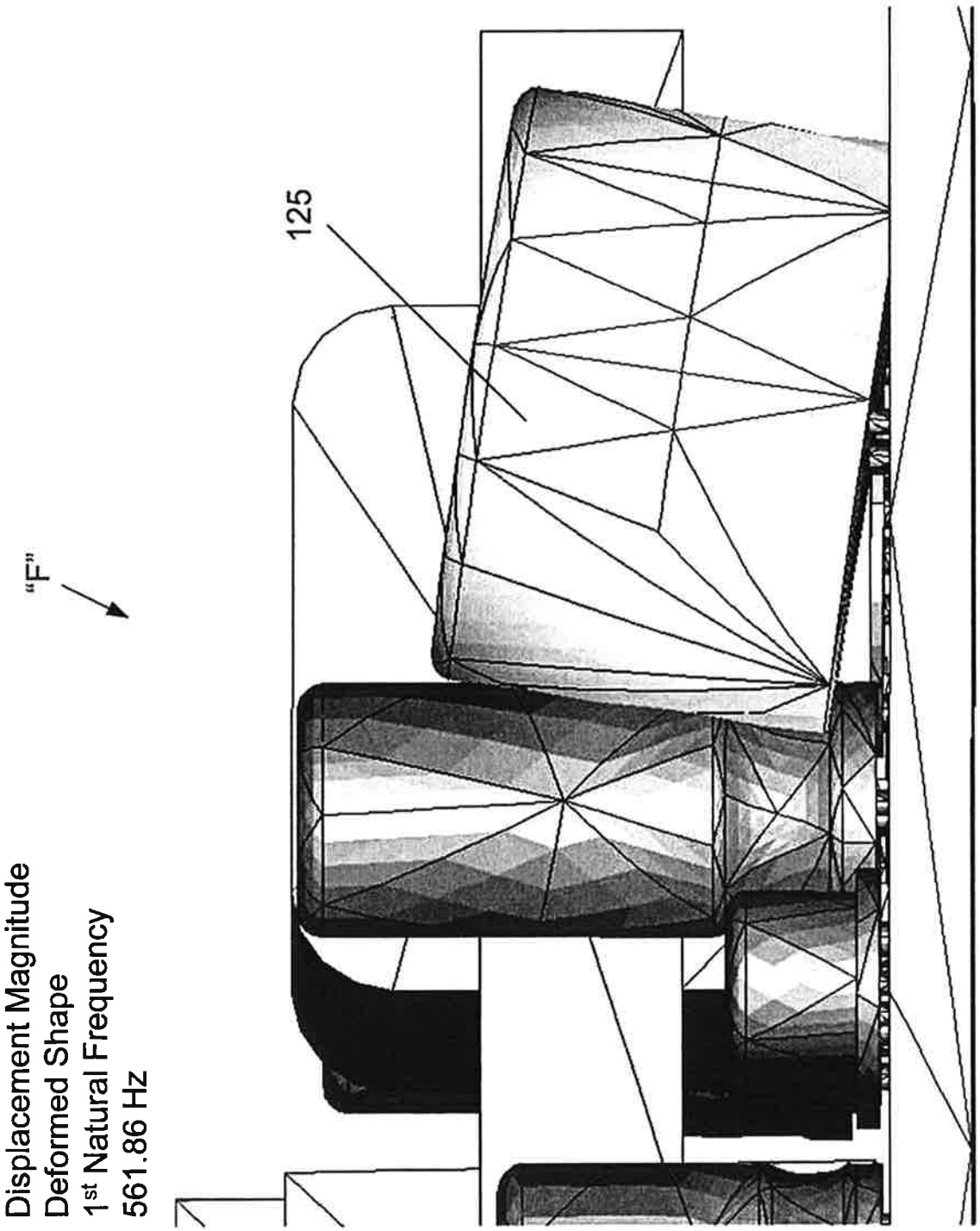

Displacement Magnitude
Deformed Shape
1st Natural Frequency
561.86 Hz
"F"
125

Fig. 23c

Displacement Magnitude
Iso Surfaces Contour
2nd Natural Frequency
796.36 Hz

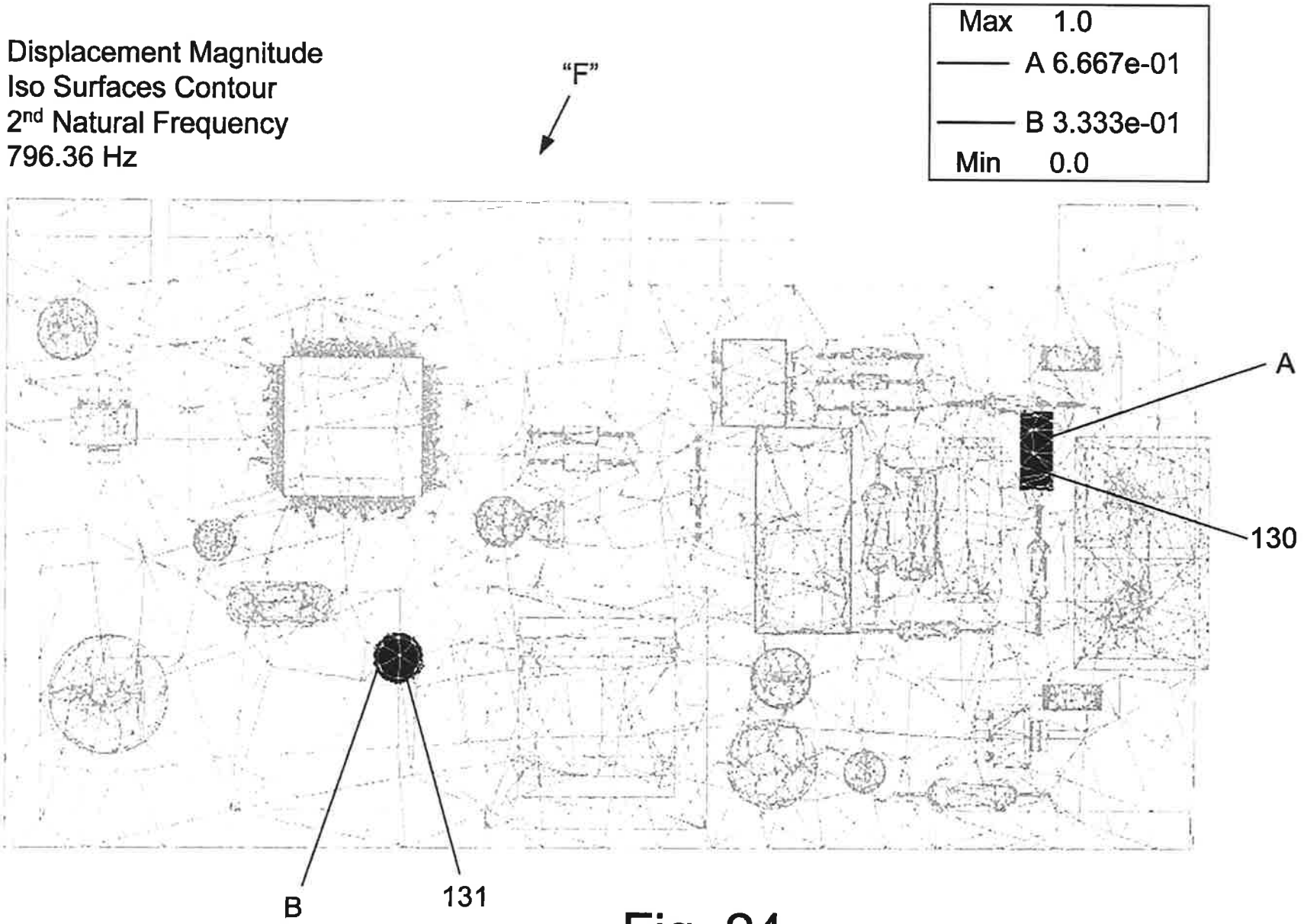


Fig. 24

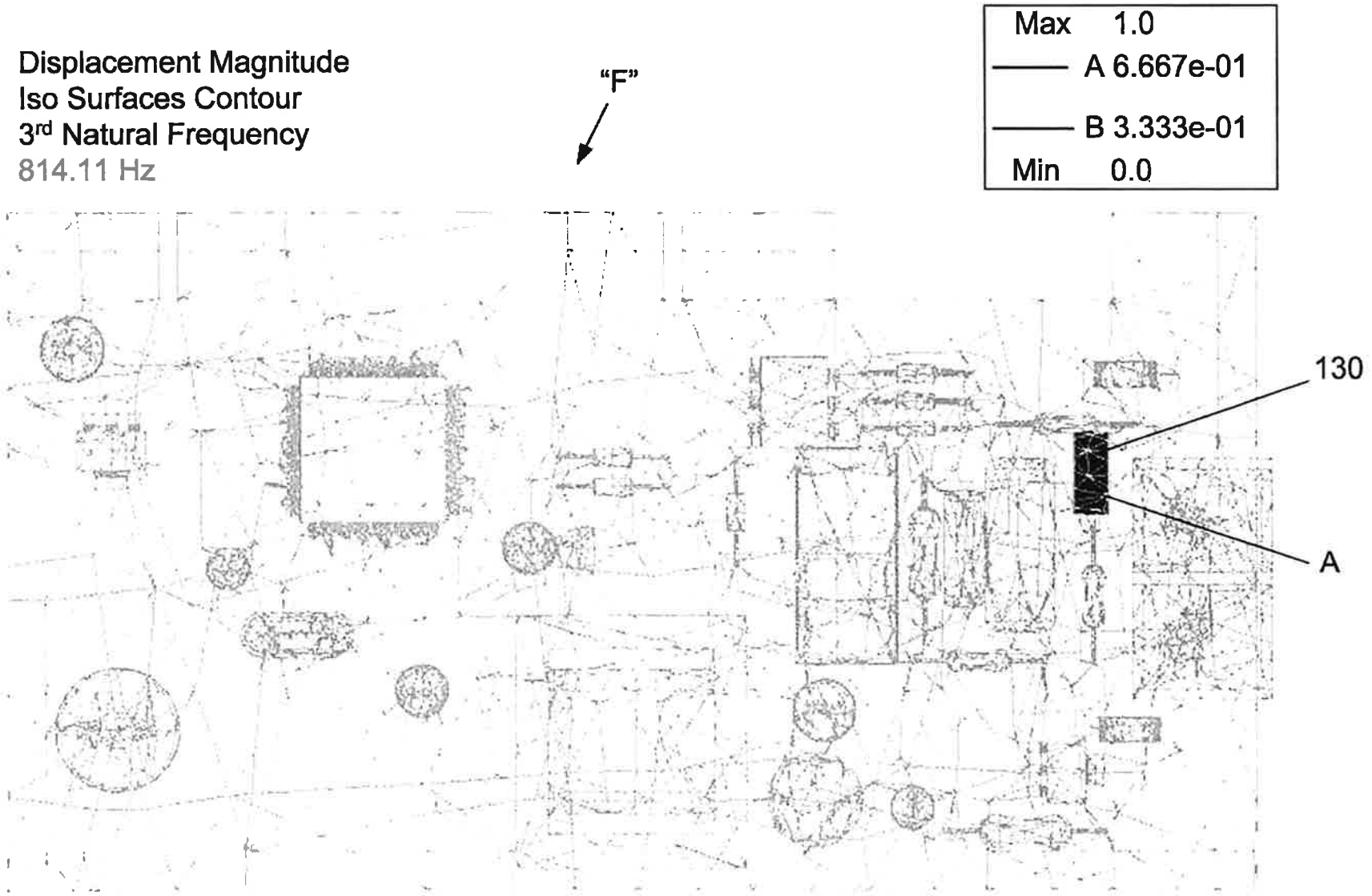

Displacement Magnitude
Iso Surfaces Contour
3rd Natural Frequency
814.11 Hz
"F"
Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
130
A

Fig. 25a

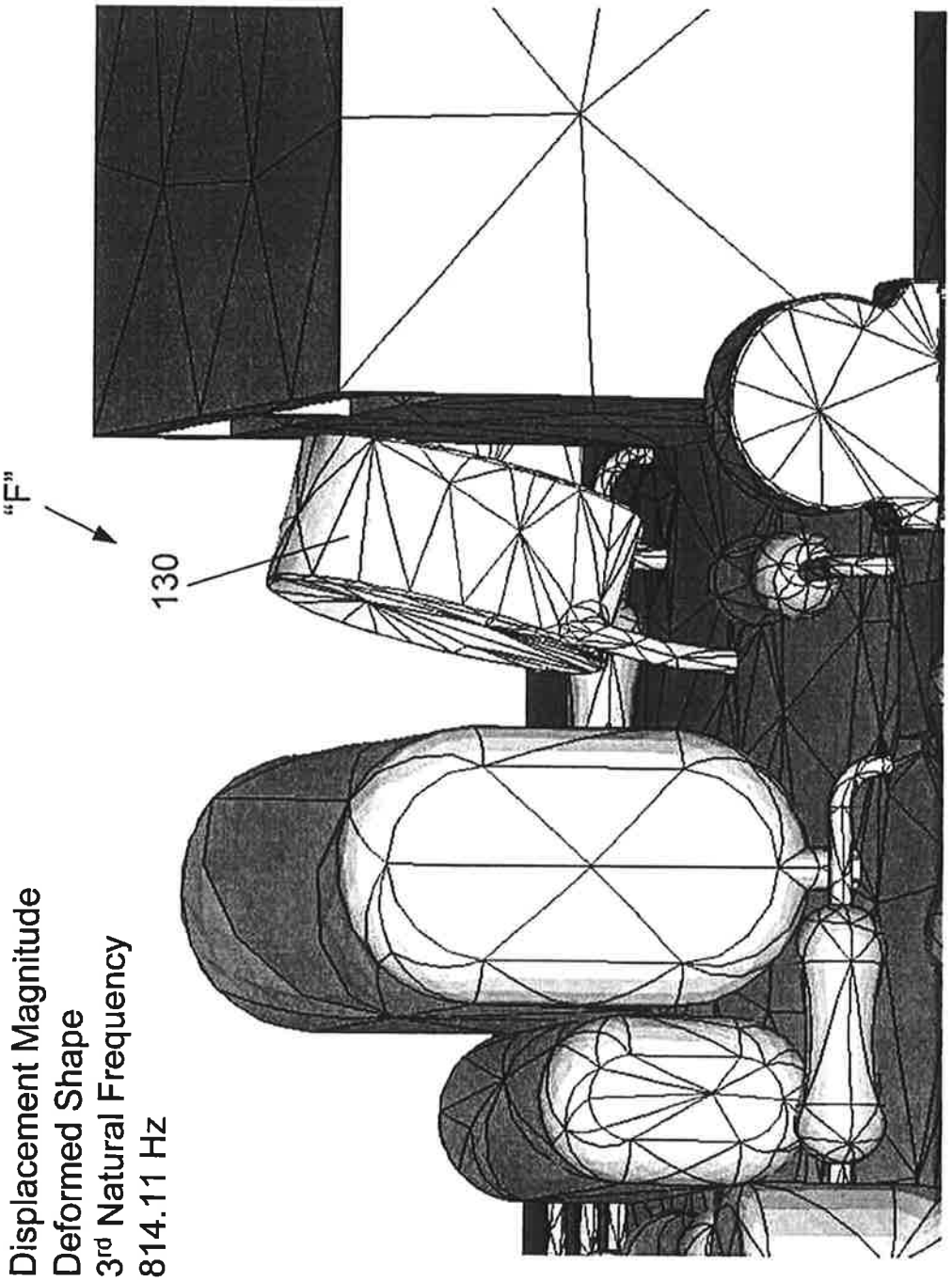

Displacement Magnitude
Deformed Shape
3rd Natural Frequency
814.11 Hz
"F"
130

Fig. 25b

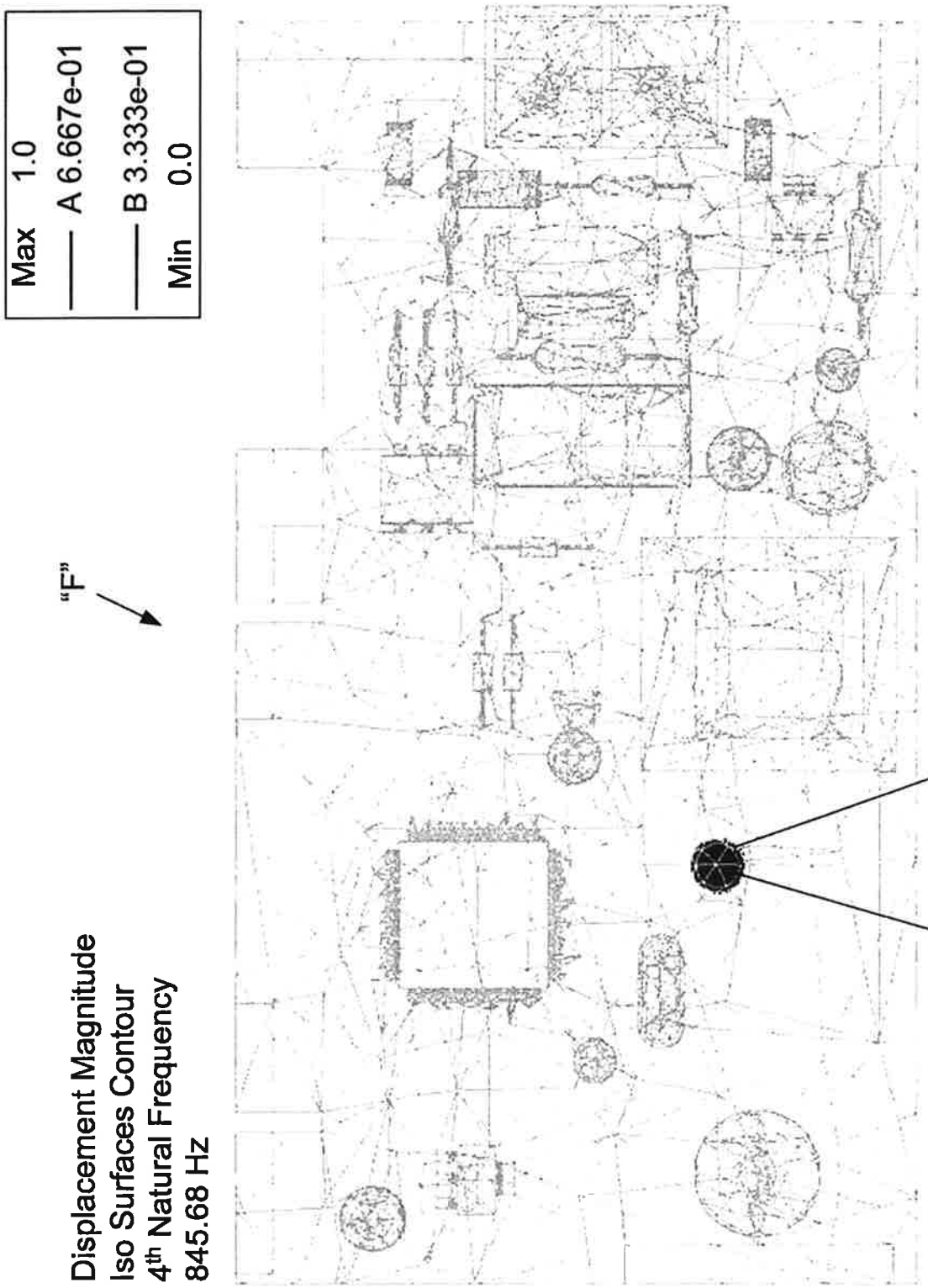

Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
"F"
Displacement Magnitude
Iso Surfaces Contour
4th Natural Frequency
845.68 Hz
A
131

Fig. 26

Displacement Magnitude
Deformed Shape
5th Natural Frequency
1291.7 Hz

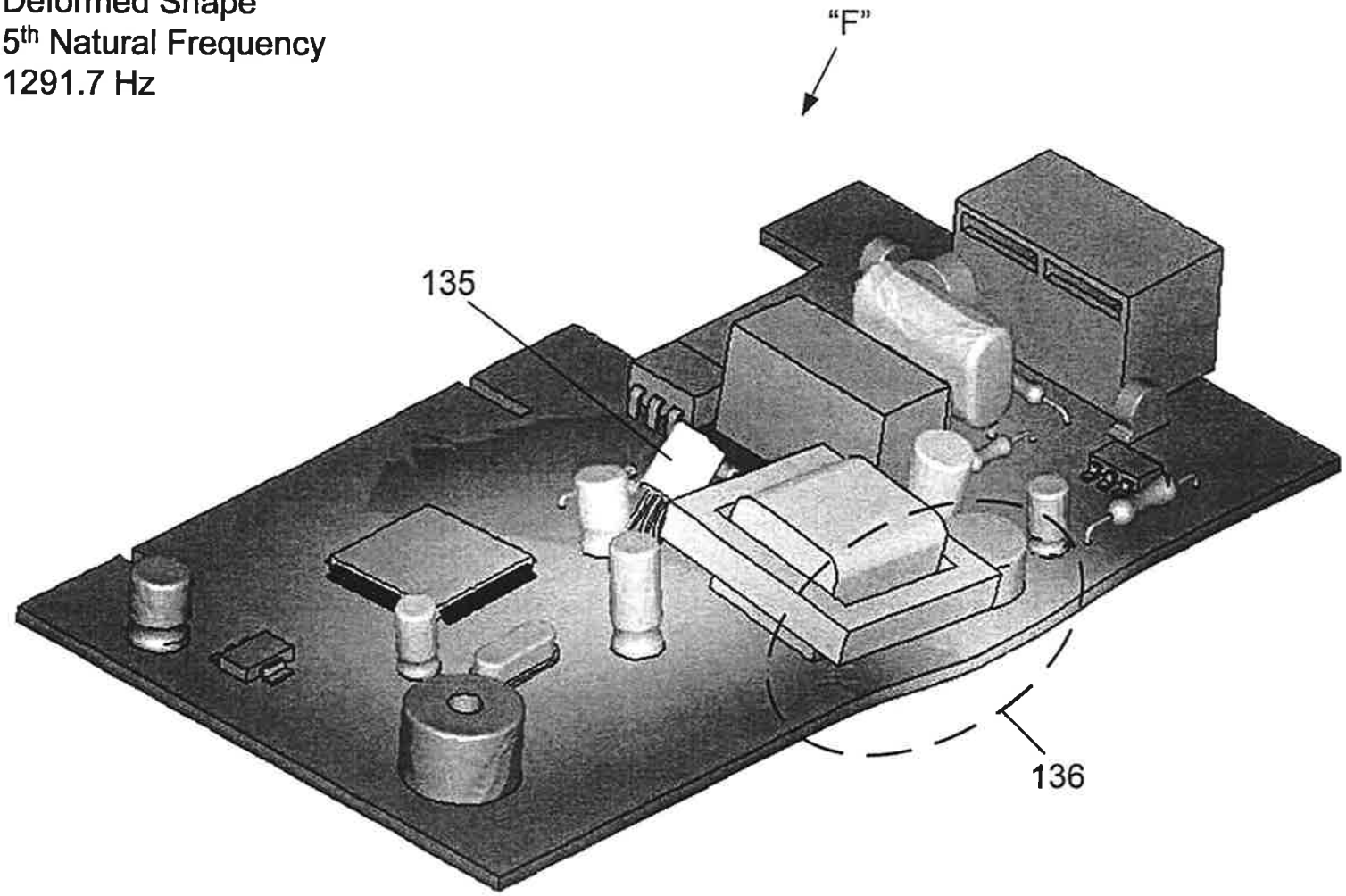


Fig. 27a

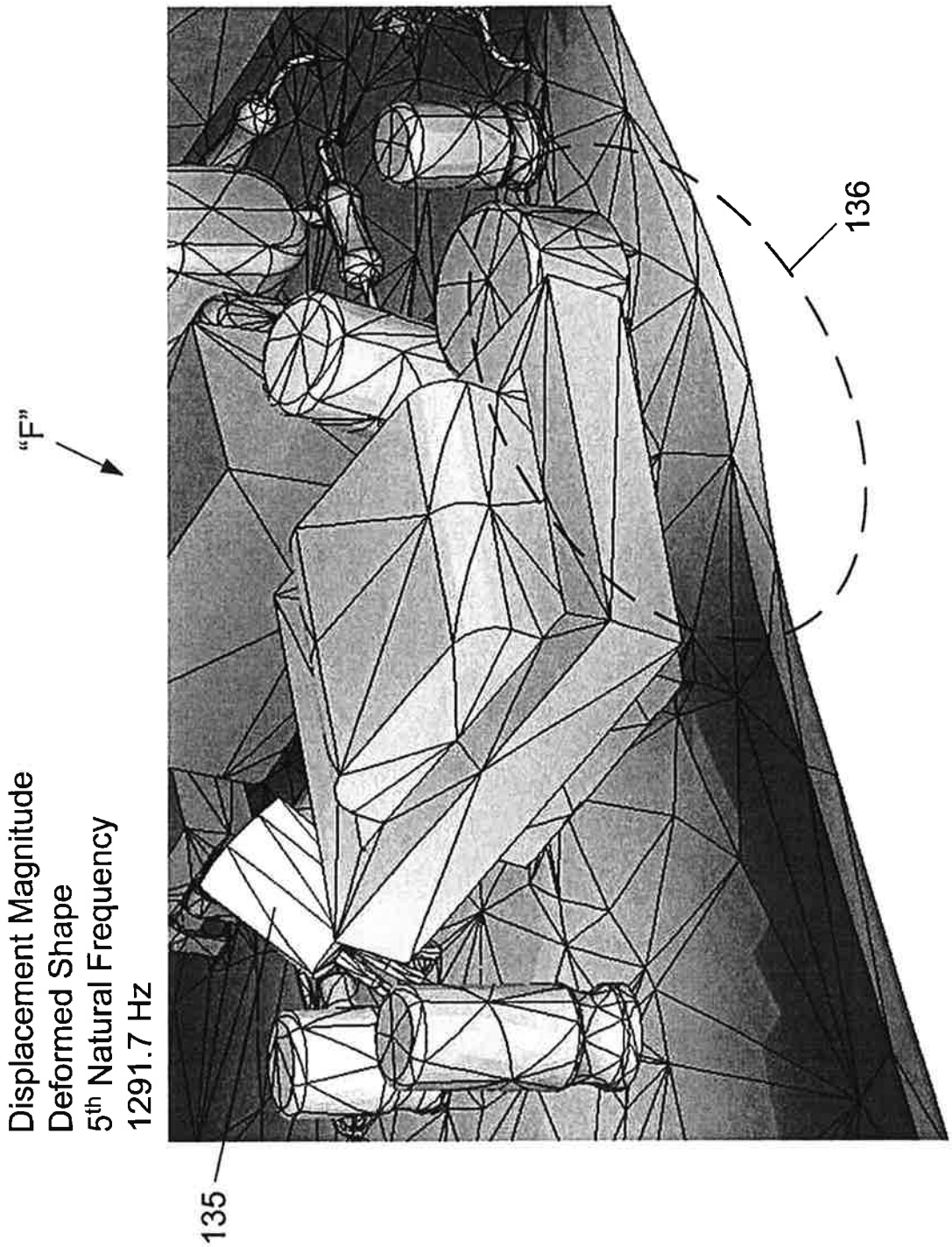

Displacement Magnitude
Deformed Shape
5th Natural Frequency
1291.7 Hz
"F"
135
136

Fig. 27b

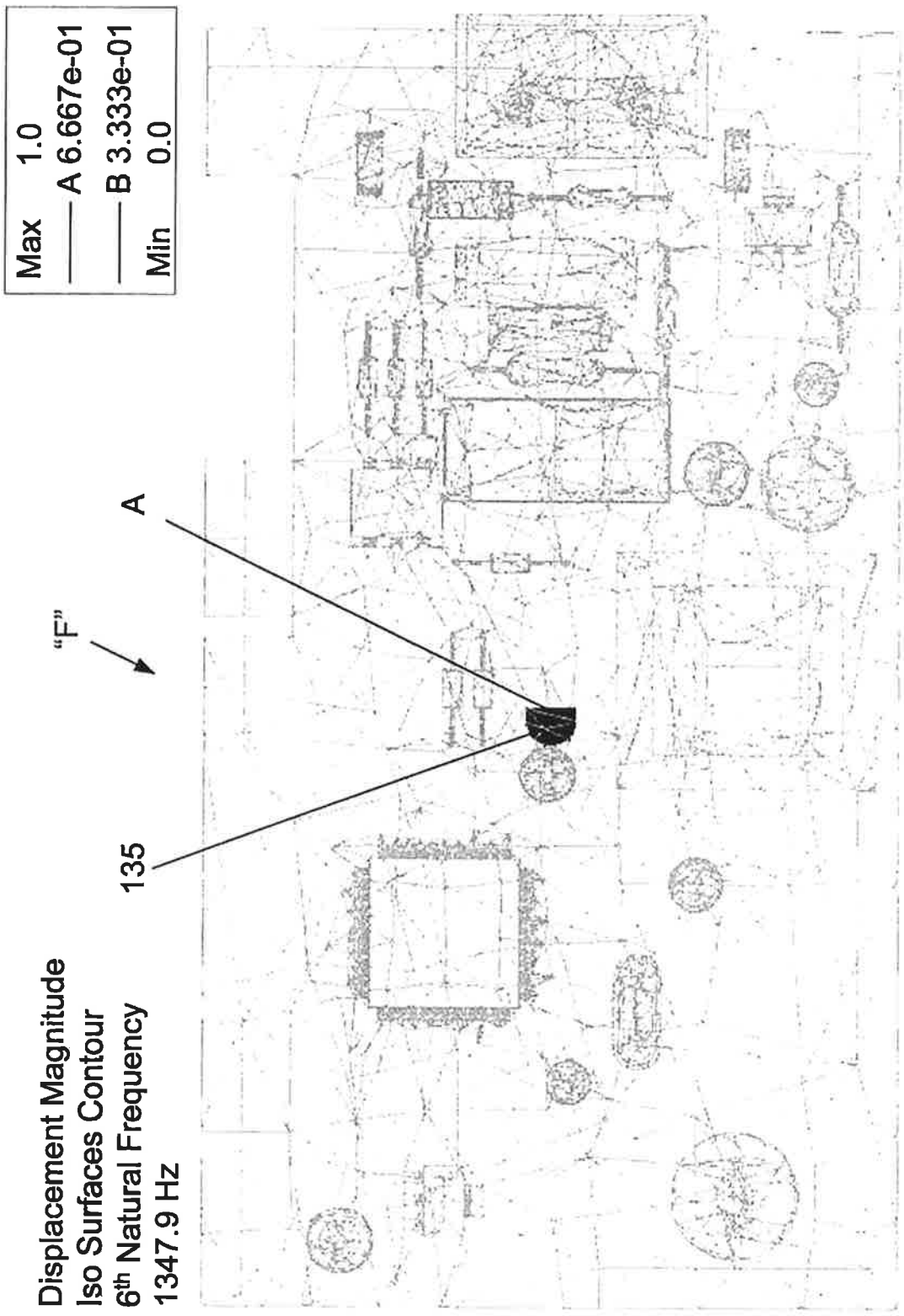

Max 1.0
A 6.667e-01
B 3.333e-01
Min 0.0
Displacement Magnitude
Iso Surfaces Contour
6th Natural Frequency
1347.9 Hz
"F"
A
135

Fig. 28a

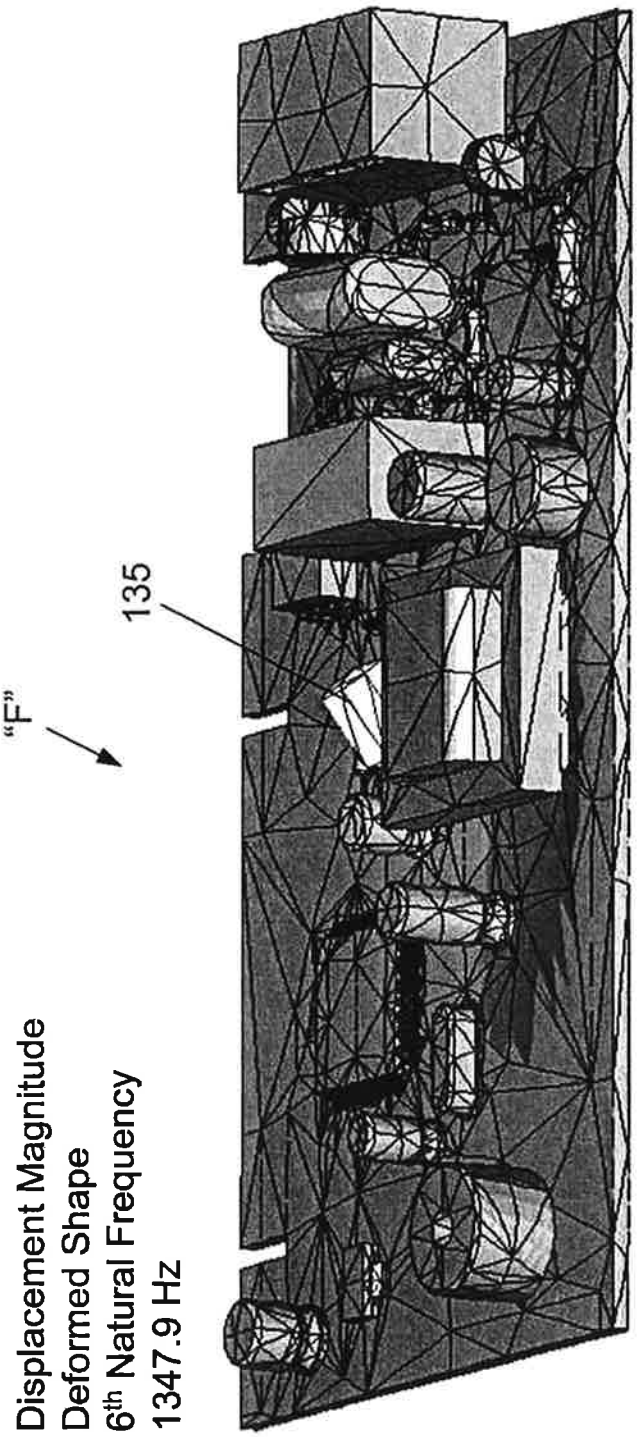

Displacement Magnitude
Deformed Shape
6th Natural Frequency
1347.9 Hz
"F"
135

Fig. 28b

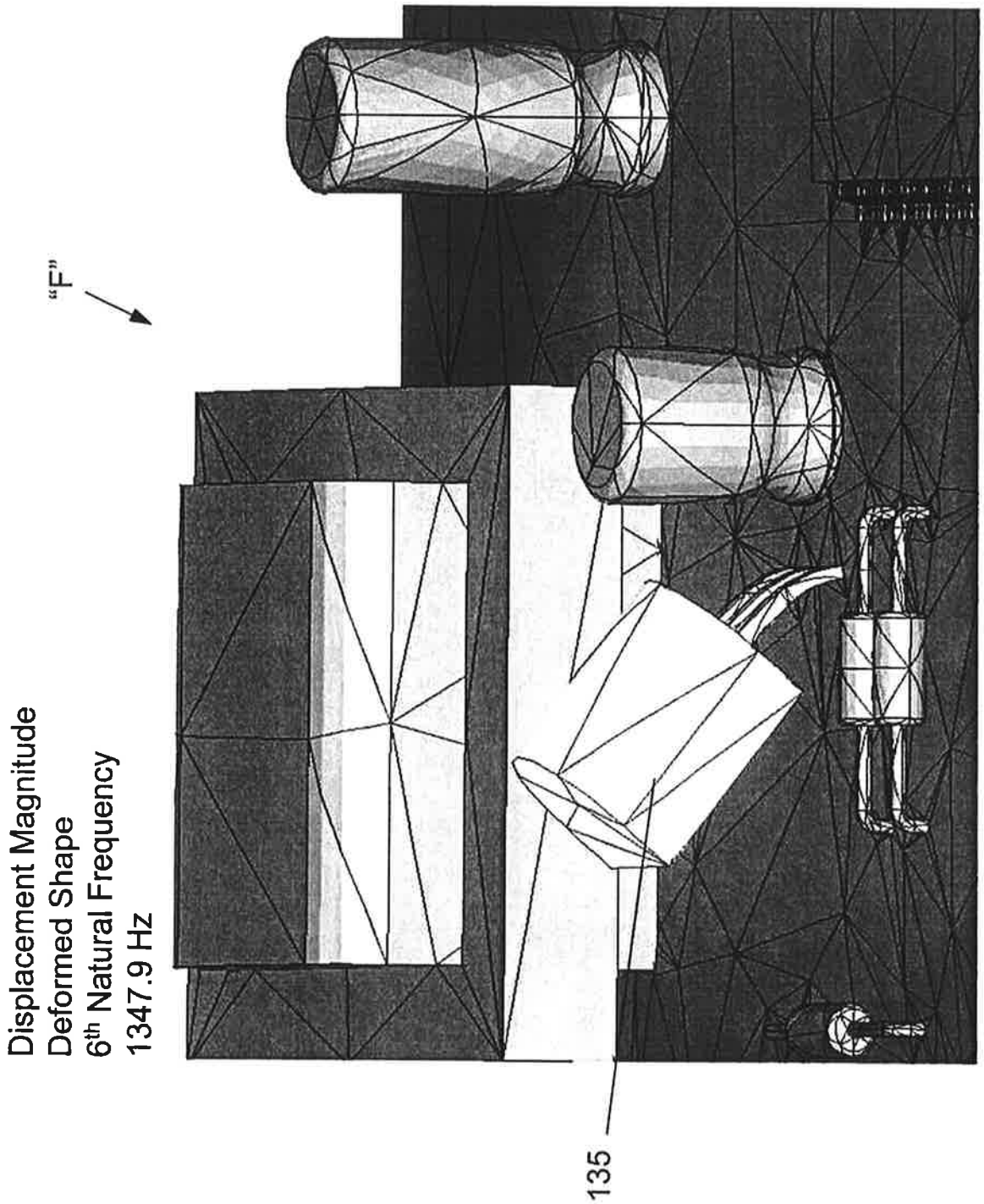

Displacement Magnitude
Deformed Shape
6th Natural Frequency
1347.9 Hz
"F"
135

Fig. 28c

FAILED COMPONENTS

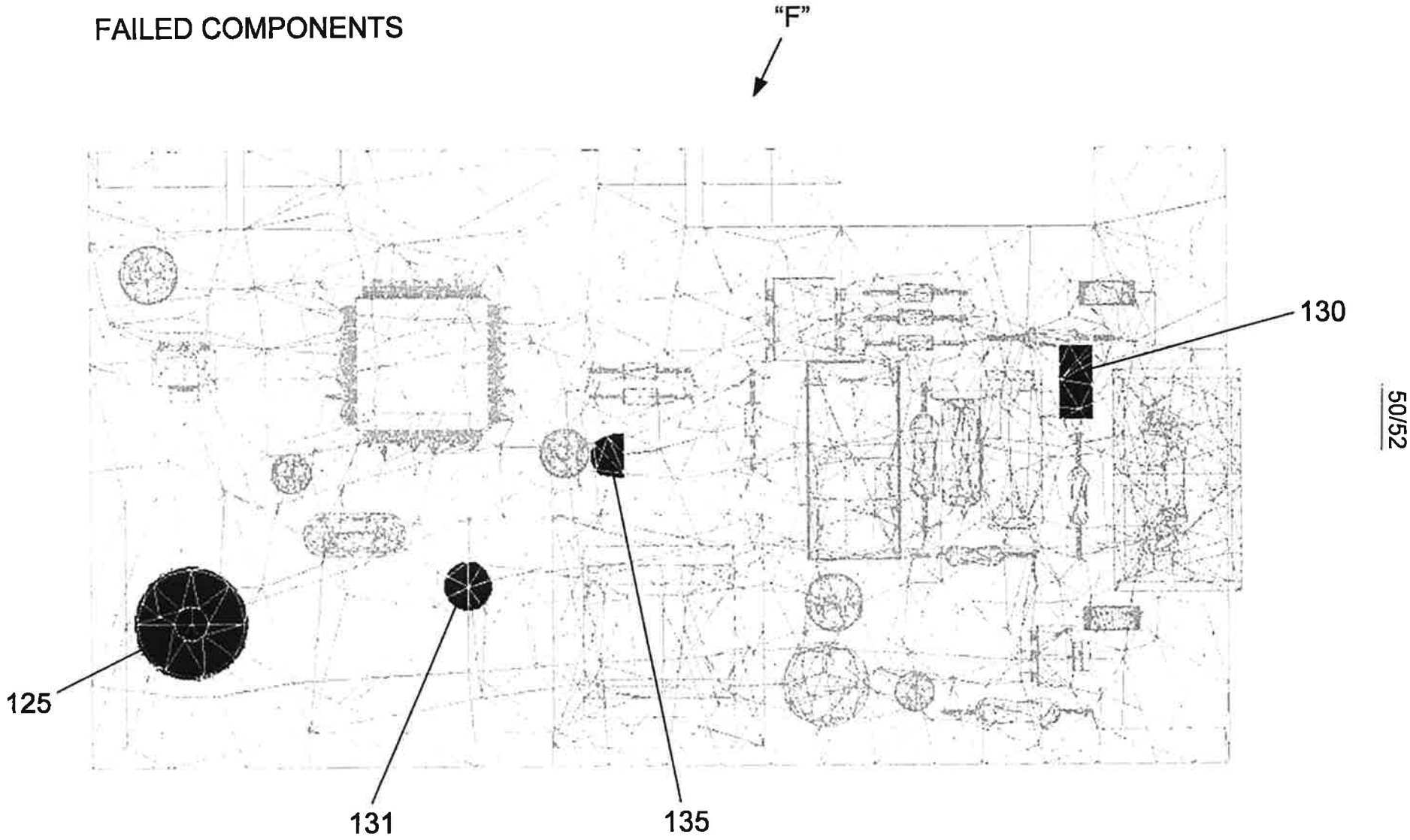


Fig. 29

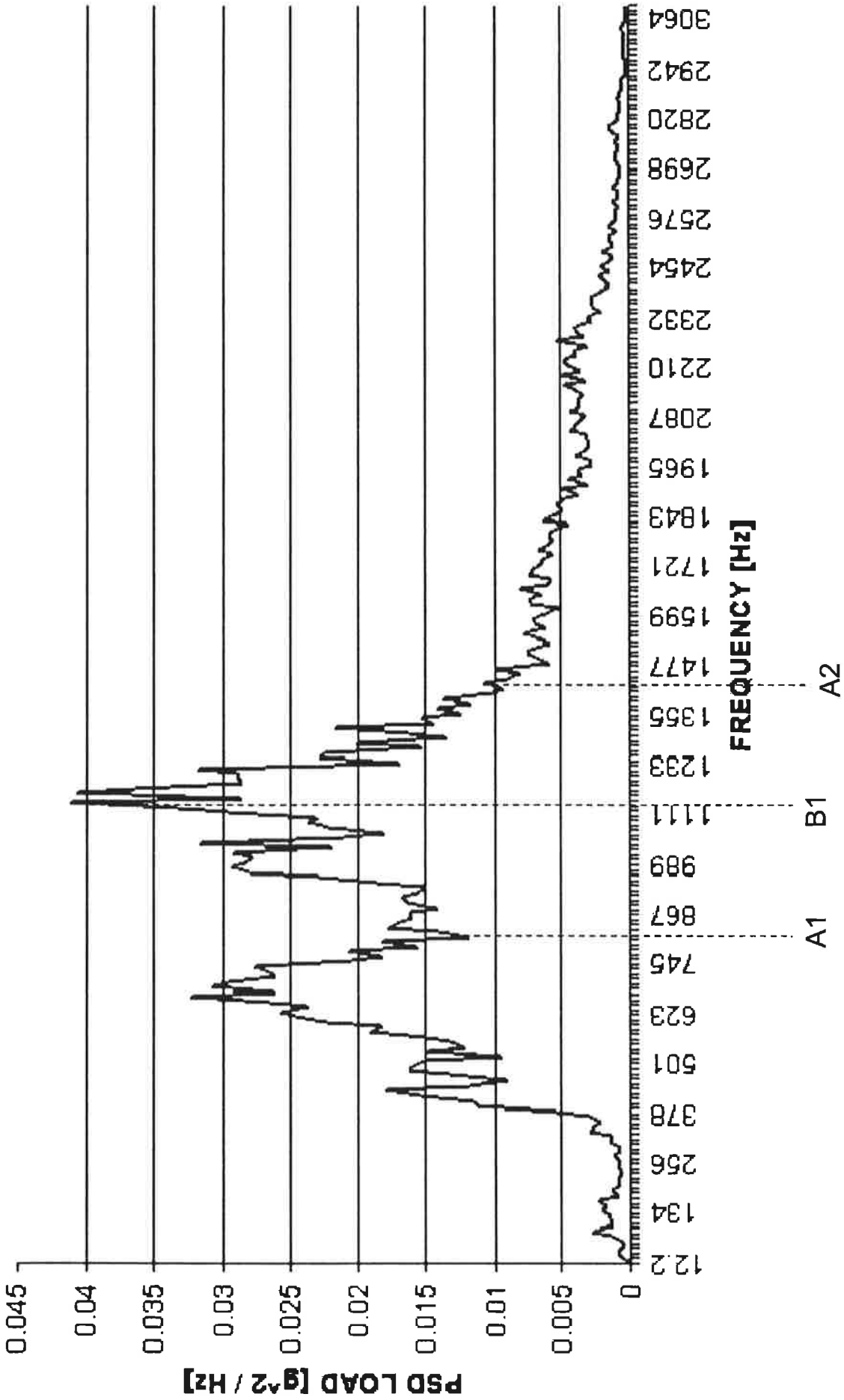

PSD LOAD [g^2 / Hz]
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
FREQUENCY [Hz]
12.2
134
256
378
501
623
745
867
989
1111
1233
1355
1477
1599
1721
1843
1965
2087
2210
2332
2454
2576
2698
2820
2942
3064
A1
B1
A2

Fig. 31

No. of failures in each frequency range (of natural frequencies) [Hz]				Last natural frequency required for identifying all failures [Hz]	Last natural frequency index required for identifying all failures	Number of components failed in the test but not in the simulation	Number of components failed in the simulation out of those failed in the laboratory HALT test	PCB index
1.5K to 2.0K	1K to 1.5K	500 to 1K	0 to 500					
1	1	2	1	164.1	13	0	5 out of 5	1
0	0	6	1	814.85	13	2	7 out of 9	2
0	4	1	2	1203.30	12	1	7 out of 8	3
0	0	2	0	870.00	11	0	2 out of 2	4
3	0	1	0	1725.65	17	0	4 out of 4	5
0	0	0	1	185.08	4	0	1 out of 1	6
0	0	3	3	575.31	12	0	6 out of 6	7
0	5	1	0	1324.7	14	0	6 out of 6	8
0	0	5	3	787.10	11	1	8 out of 9	9
0	2	2	0	1376.87	7	0	4 מתוך 4	10
4	**12**	**23**	**11**			**4**	**50 out of 54**	

Fig. 30