BCV progetti s.r.l.

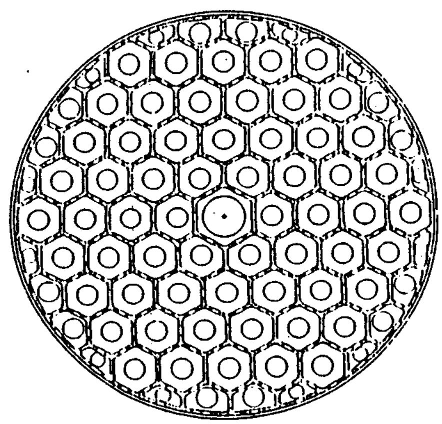
COLUMBUS PROJECT

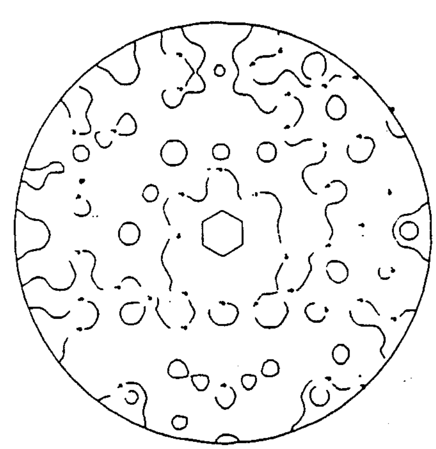
MIRROR BLANK 1.8 DIAM F1

FINITE ELEMENT ANALYSIS

REAL THICKNESS PATTERN EFFECTS

REPORT N.6
REV. 0
MILANO, 1987, MARCH 30TH





1. MODEL WITH REAL THICKNESS

In order to verify the validity of the mirror's E.F. model with average elements thicknesses, we have prepared another E.F. model with real thicknesses and we have compared the results for a load case.

The new E.F. model has the same mesh described at first chapter of the report N 1 REV 0 and it differs from the old model only in the thickness of the upper and lower plate.
Instead, the elements modelling the webs have'nt been modified because of the little contributions of these elements on the global flexural inertia of the structure. Some local variations of the web's thickness in comparison with the average values are not able to affect the structural behaviour.

The dead weight of the two models are nearly the same. The difference (0.05 %) is caused only by the numerical approximation of the thickness values.

Dead weight of the old model = 5489.5 N
" " " new model = 5486.7 N

Difference = 2.8 N

This result prove the precision of the model with average thickness distribution.

In the next figures 1-2 we give the thickness (inches) of each element.
These values must be modified substracting 0.35 inches, to represent the effects of the surface grinding.

		MODEL WITH AVERAGE THICKNESS	MODEL WITH REAL THICKNESS
FORCES	Ring 2 - 5	112.20 N	112.32 N
	Ring 8	120.17 N	119.67 N
	Ring 13	225.09 N	225.23 N
Average Z displacement		4.20 nm	4.10 nm
Minimum Z "		-15.30 nm	-19.94 nm
Maximum Z "		7.60 nm	11.52 nm
Peack to peack		22.90 nm	31.46 nm
RMS		5.40 nm	6.22 nm
DEAD WEIGHT		5489.50 N	5486.70 N

*** Minimum and Maximum Z displacements are evaluated from the Average Z displacement

To compare the situation between the two models you can see figures 4-5.
These figures represents the displacement isocontours.

2.2. CHECK 2)

The new model, with the real thickness distribution, has been loaded with forces equal to that used for the case with average thickness.
Because of the little difference of dead weight (model with average thickness: 5489.5 N - model with real thickness: 5486.7 N) these forces have been multiplied for a coefficient K equal to the ratio between the two values:

K = 5486.7/5489.5 = 0.9995

We have obtained:

		MODEL WITH AVERAGE THICKNESS	MODEL WITH REAL THICKNESS
FORCES	Ring 2 - 5	112.20 N	112.14 N
	Ring 8	120.17 N	120.11 N
	Ring 13	225.09 N	224.98 N
Average Z displacement		4.20 nm	4.31 nm
Minimum Z "		-15.30 nm	-19.99 nm
Maximum Z "		7.60 nm	11.70 nm
Peack to peack		22.90 nm	31.69 nm
RMS		5.40 nm	6.23 nm
DEAD WEIGHT		5489.50 N	5486.70 N

*** Minimum and Maximum Z displacements are evaluated from the Average Z displacement

Figure 6 shows the displacements isocontours due to this second loading condition.

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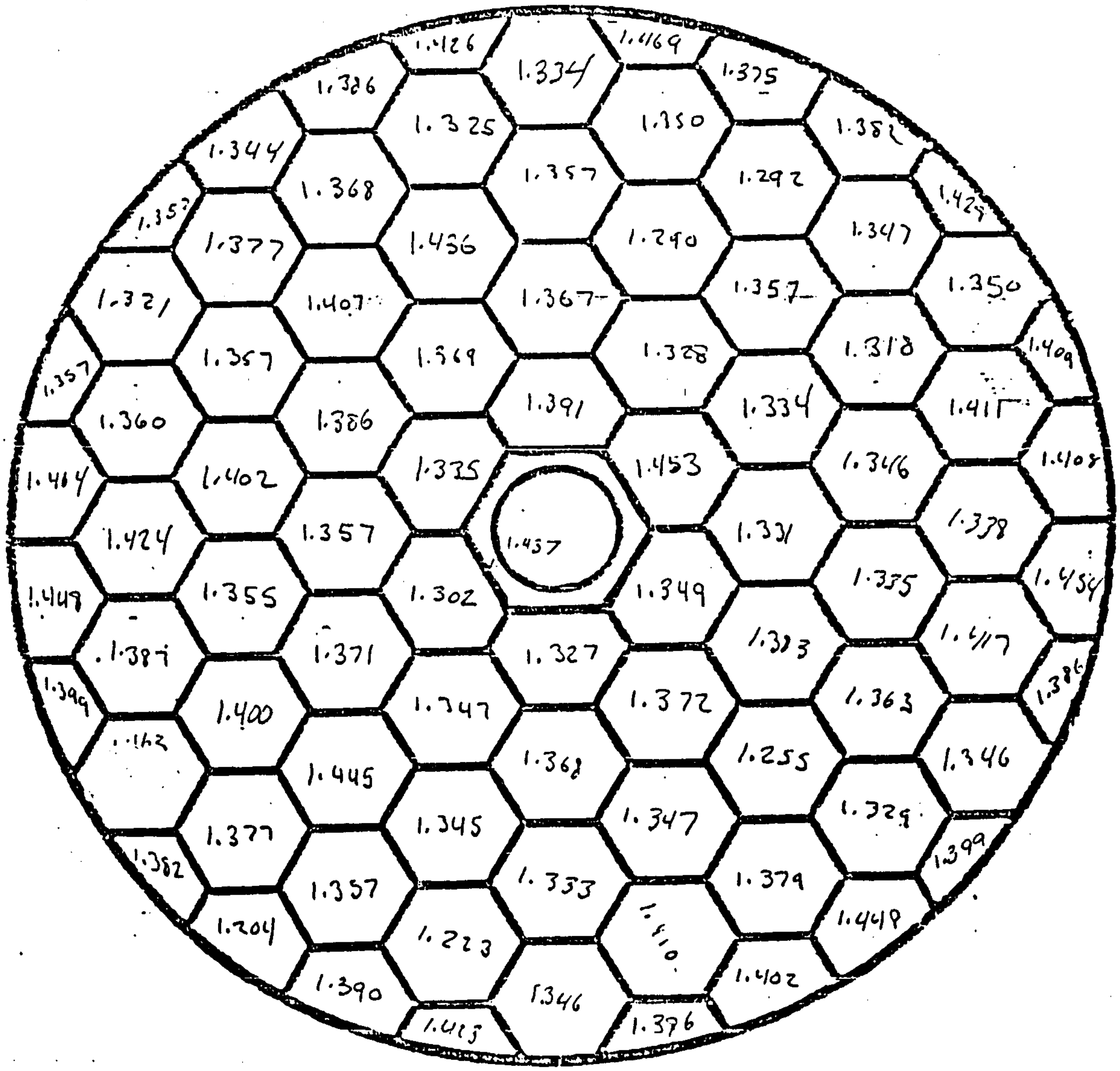
2.3. CONCLUSIONS

The results 1) and 2) are very similar. The difference between the model with real thicknesses and the model with average ones are expecially on the "peack to peack" displacements, because this parameter can be influenced by the local variation of thickness.

Instead forces and the others parameters of displacements (RMS and average Z displacements) are nearly equal to the values found using the model with average thicknesses: the differences are very little and they may be disregarded in the design.

Because of these reasons we can say that the global behaviour is well represented by both the models, without significative differences, so that the analysis of the best position and force actuators values can be performed as we have previously done.

Back Plate Thickness (inches)



[FIG. 1]

Front Plate Thickness

(inches)

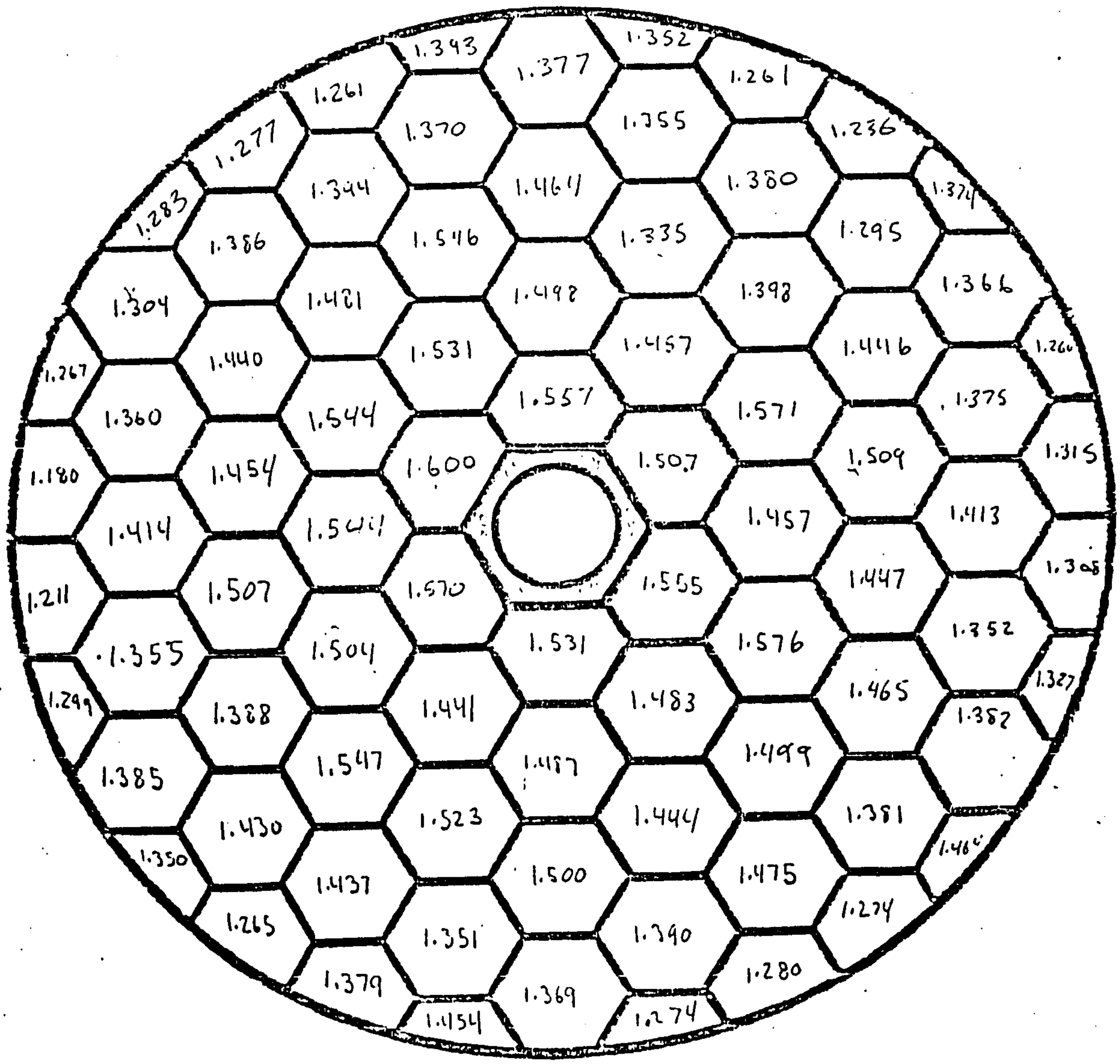
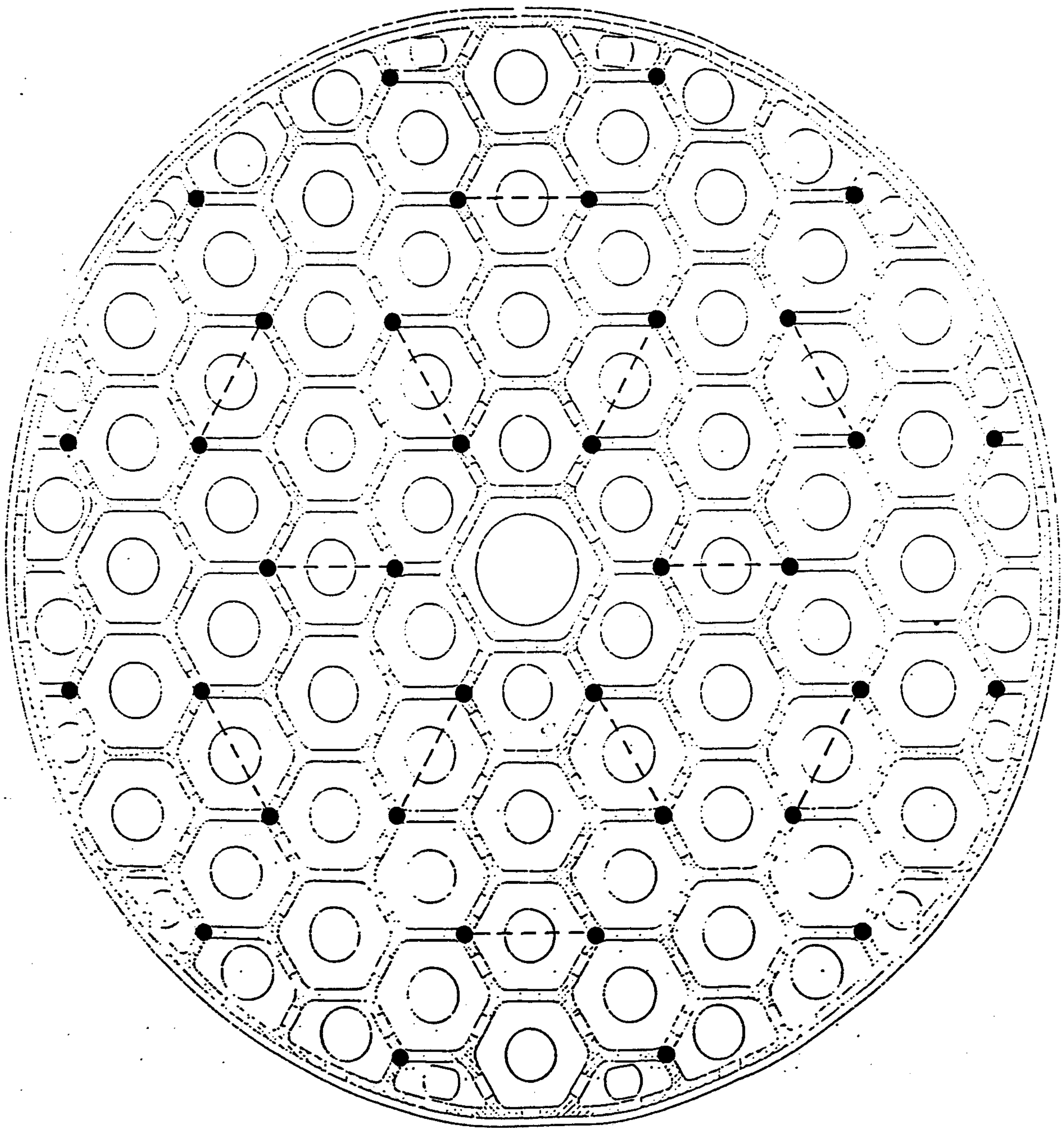
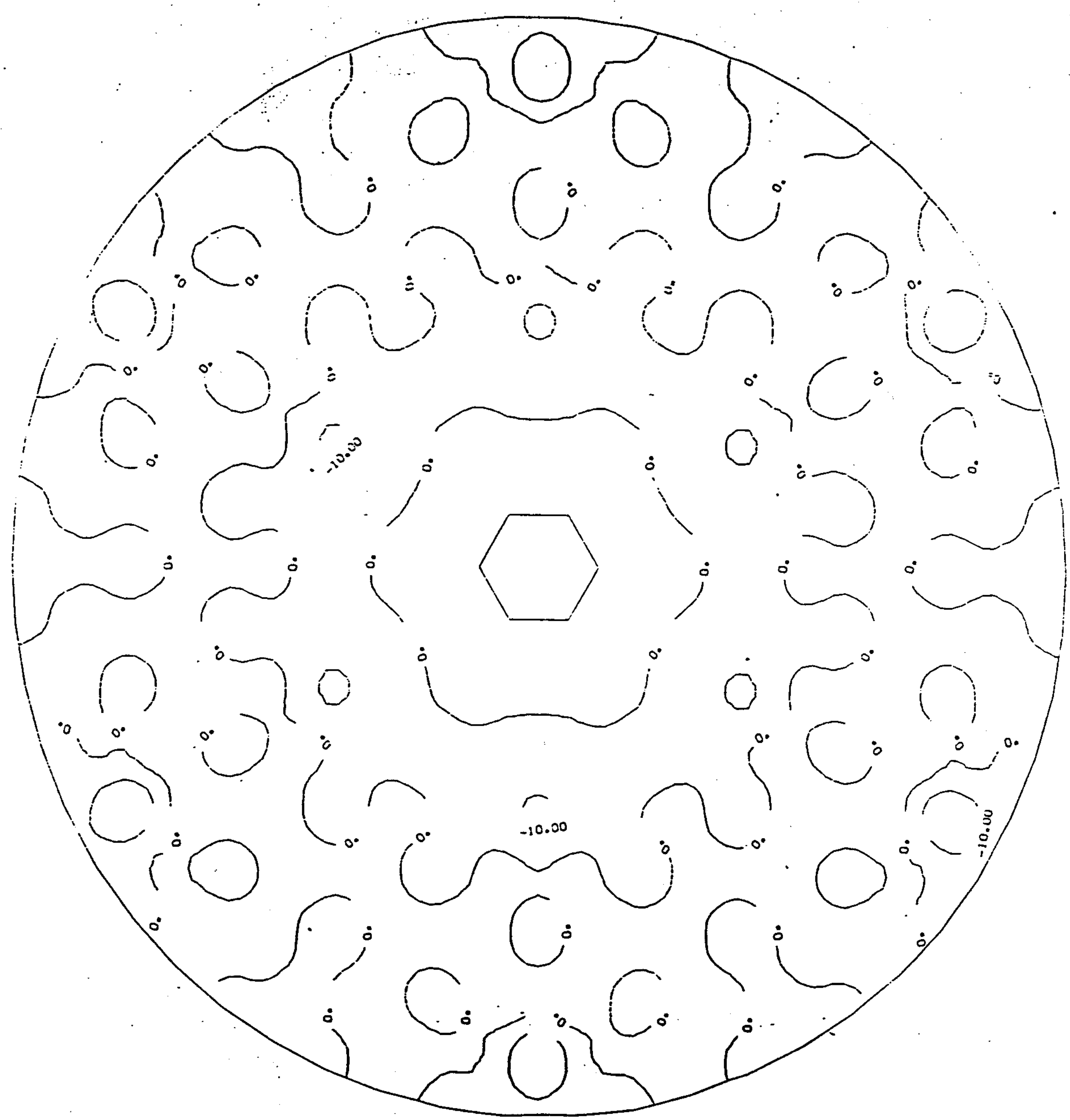


FIG. 2



ACTUATORS POSITION

[FIG. 3]



COMBINATION 1

(II = V) + VIII + XIII

1.1220 * (II + V) + 1.2017 * VIII + 2.2509 * XIII

Average Axial Displacement = 4.2 nm.

RMS = 5.4 nm.

Peak to Peak = 22.9 nm.

[FIG. 4]

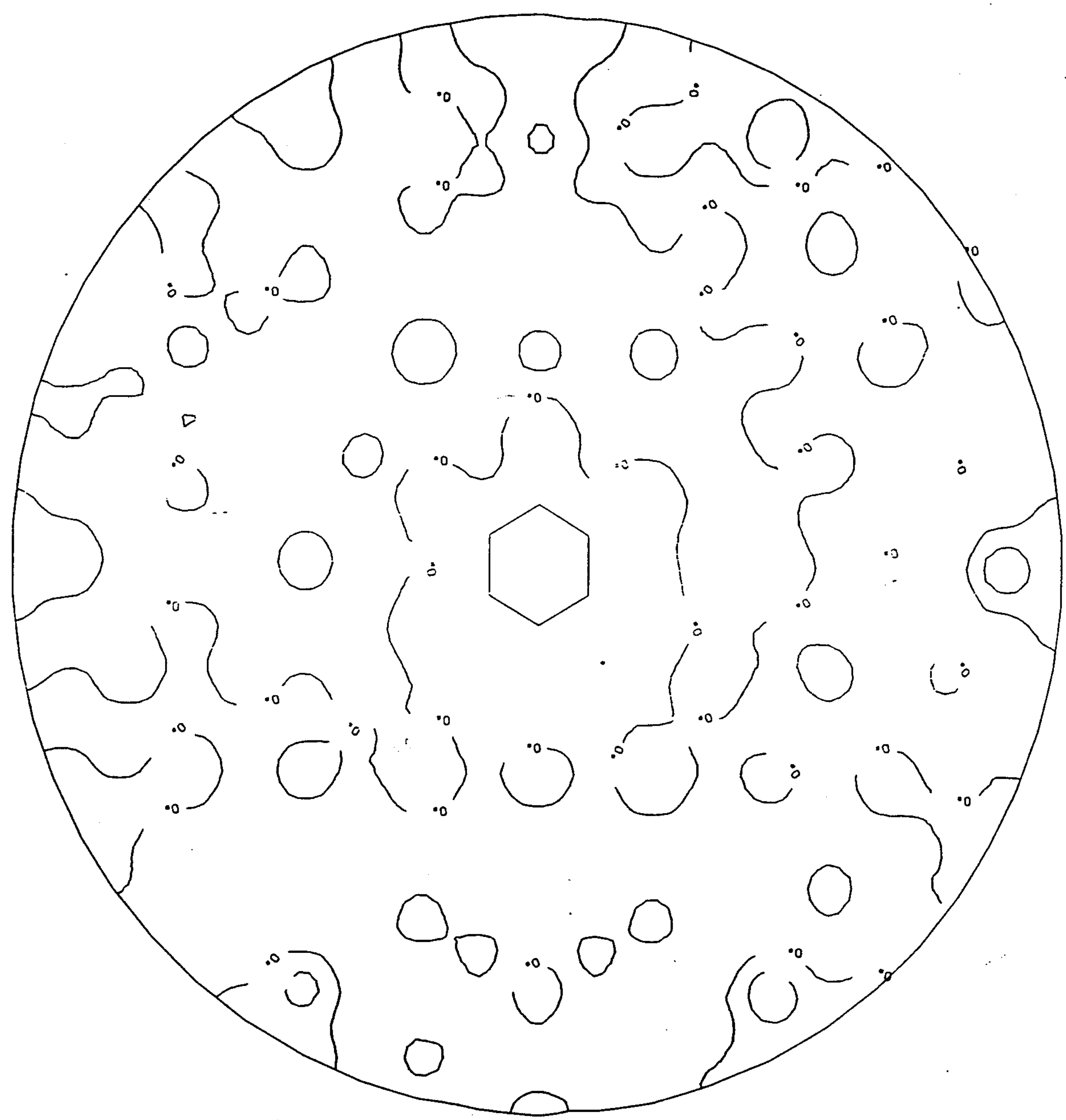
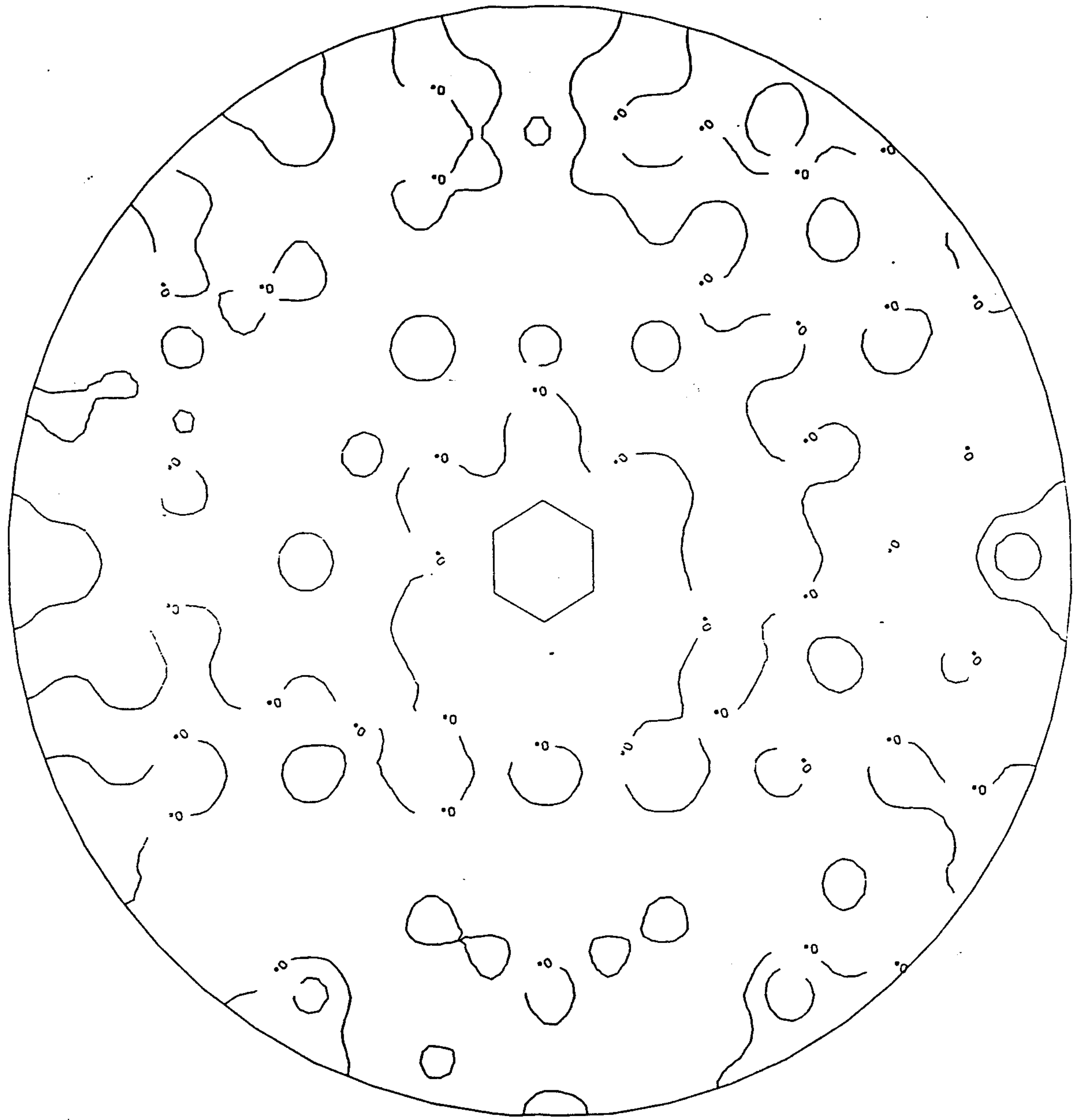


FIG. 5

CHECK 2



[FIG. 6]