

ATTACHMENT A

Steam Generator Inspection Program and Results

Answers to Questions

Indian Point Unit No.2
Docket No. 50-247
May, 1978

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Question No. 1

Please provide a map which shows the locations of steam generator tubes tested during the March, 1978 inspection which did not permit passage of the standard 700 mil eddy current probe.

Response

Maps of the locations of all tubes which did not permit passage of the standard 700 mil probe are forwarded as Attachment B to this letter. These locations are coded to indicate the smallest probe size that would not pass through the tube. Those tubes for which the 700 mil probe was the smallest probe size not able to pass through the tubes are indicated by the heavily drawn circle at those tube locations.

The distribution of tubes which permitted passage of probes smaller than the 700 mil diameter probe is slightly different from that shown in our March 24, 1978 submittal because the tubes were reprobed and the data tabulated below is the most recent:

<u>Steam Generator 23</u>		<u>Steam Generator 24</u>	
<u>Smallest Probe Not Passed by Tube</u>	<u>Number of Tubes</u>	<u>Smallest Probe Not Passed by Tube</u>	<u>Number of Tubes</u>
700 mil	28	700 mil	55
675 mil	16	675 mil	7
640 mil	1	640 mil	2
610 mil	1*	610 mil	3*
540 mil	1*	540 mil	3*

*Plugged during 3/78 inspection program

Question No. 2

Discuss the integrity of the tubes surrounding the two cracks observed in the second tube support plate in Steam Generator No. 24.

Response

The integrity of the tubes adjacent to the observed cracks is not compromised because:

- All row 1 tubes in the four steam generators were plugged during the construction phase when modifications were made to the channel head divider plates. Therefore, all tubes immediately adjacent to the two cracks are plugged.
- There is no significant grouping of tubes which did not permit passage of eddy current probes. As indicated in the maps which are provided as Attachment B to this letter, these "restricted" tubes are distributed in a random manner and only a small number of these tubes are located near the flow lane or near flow slots.
- The eddy current examinations and visual examinations which were just completed indicate that the condition of the Indian Point Unit No. 2 steam generators is better than that observed at other facilities. No significant number of tube restrictions were detected.
- Flow-induced vibration effects in the steam generators are significant where there is cross-flow of the boiler water, as in the region between the tube sheet and the first tube support plate, and in the region above the top tube support plate. In the vicinity of the two support plate cracks that were observed in Steam Generator 24, the boiler water flow is essentially parallel to the tube axis. The vibration effects are, therefore, minimal.
- A conservative Westinghouse analysis, forwarded with a Turkey Point Unit No. 4 (NRC Docket No. 50-251) submittal dated June 9, 1977 and identified as FPL-77-173, Appendix 3C1, indicates that flow induced vibration effects may result in extensive vibration and wear only when three or more tube support plates are missing. This is not the case at Indian Point Unit No. 2.

Question No. 3

Justify your proposed schedule for performing the next inspection of Indian Point Unit No. 2 Steam Generators.

Response

In Attachment A to our March 24, 1978 letter, we proposed to schedule our next Steam Generator inspection during the next refueling outage planned for the Fall of 1979. This would correspond to a period of no more than sixteen equivalent months of operation following the unit's return to operation after this ongoing refueling outage.

The basis for the proposed schedule is the evaluation of the results of the Steam Generator inspections performed during the current refueling outage. The Attachments to our March 24, 1978 letter contain the results of the inspections performed to that time. In addition, as mentioned in Attachment A to our January 11, 1978 letter, we had been evaluating the feasibility of removing tube and tube support plate samples from a Steam Generator at Indian Point Unit No. 2. Following extensive development efforts in remote EDM (Electro Discharge Machining) Techniques, a sample of tubes and tube support plate was removed from TSP #1 in Steam Generator No. 23. This was done as a research project in support of the chemical cleaning development program. The support plate sample contained several pieces as a result of cracks in ligaments between flow holes and second and third row tube holes (a local area adjacent to the Hot Leg side of the flow slot). Subsequent borescopic examination of flow holes and tube hole ligaments beyond row 3 did not reveal additional cracking or observable elongation of flow holes. This localized cracking condition is possible since measurements of flow hole elongation between rows 1 and 2 and rows 2 and 3 accounts for virtually all of the Hot Leg side flow slot hourglassing. Nevertheless, a strongback has been installed in the flow slot/sample space to resist displacement beyond that which would exist had the sample not been removed.

In summary, the proposed schedule is justified for the following reasons:

- Our experience with steam generator tubes has been good. During the operation of Indian Point Unit No. 2 there have been only two instances of primary to secondary tube leakage. One leak occurred in the first quarter of 1975. The leak was one tube near the tube sheet in Steam Generator 22. The second leak occurred in the fourth quarter of 1976. The leak was in two tubes near the top tube support plate in Steam Generator 24. These leaks were very small.

- During the steam generator inspection of April, 1977, all tubes that did not pass a 700 mil eddy current probe were probed with smaller diameter probes. Eight tubes in Steam Generator 21 and three tubes in Steam Generator 22 were in this category. In five of the eight tubes in Steam Generator 21, a 675 mil probe was passed. In the remaining six, a 610 mil probe was passed. No progressive tube degradation or tube failures were observed during unit operations after this April, 1977 inspection.

Based on the recommendation of the NRC, tubes inspected during this past March, 1978 inspection which did not pass a 610 mil probe were plugged. No onset of increased tube degradation accompanied by tube leaks is expected to occur after the unit is returned to service following the present outage.

- Should any tube leak occur, our present Technical Specifications, section 3.1.F, require a thorough assessment of its significance. The reactor must be brought to a cold shutdown condition if the total leakage exceeds 1 gpm, or if the leakage frequency is two or more tubes within a period of 20 days. Furthermore, NRC approval to resume reactor operation must be obtained and Con Edison must inform the NRC before any tube is plugged or repaired.
- As explained in our answer to Question No. 2, the eddy current examinations and visual examinations that were completed in March of 1978 indicate that the condition of the Indian Point Unit No. 2 steam generators is much better than was observed at those facilities where preventive plugging is being implemented. There is less hourglassing of flow slots, fewer tubes that are "restricted" and fewer instances of primary to secondary leaks at Indian Point Unit No. 2.
- Westinghouse has reviewed the results of our steam generator inspections. Based upon analysis performed for similar steam generators at other facilities, operation of the Indian Point Unit No. 2 steam generators is justified for a period in excess of 16 months.

ATTACHMENT B

Steam Generator Inspection Program and Results

Maps of locations of Tubes Which
Did Not Permit Passage of the
700 Mil Probe

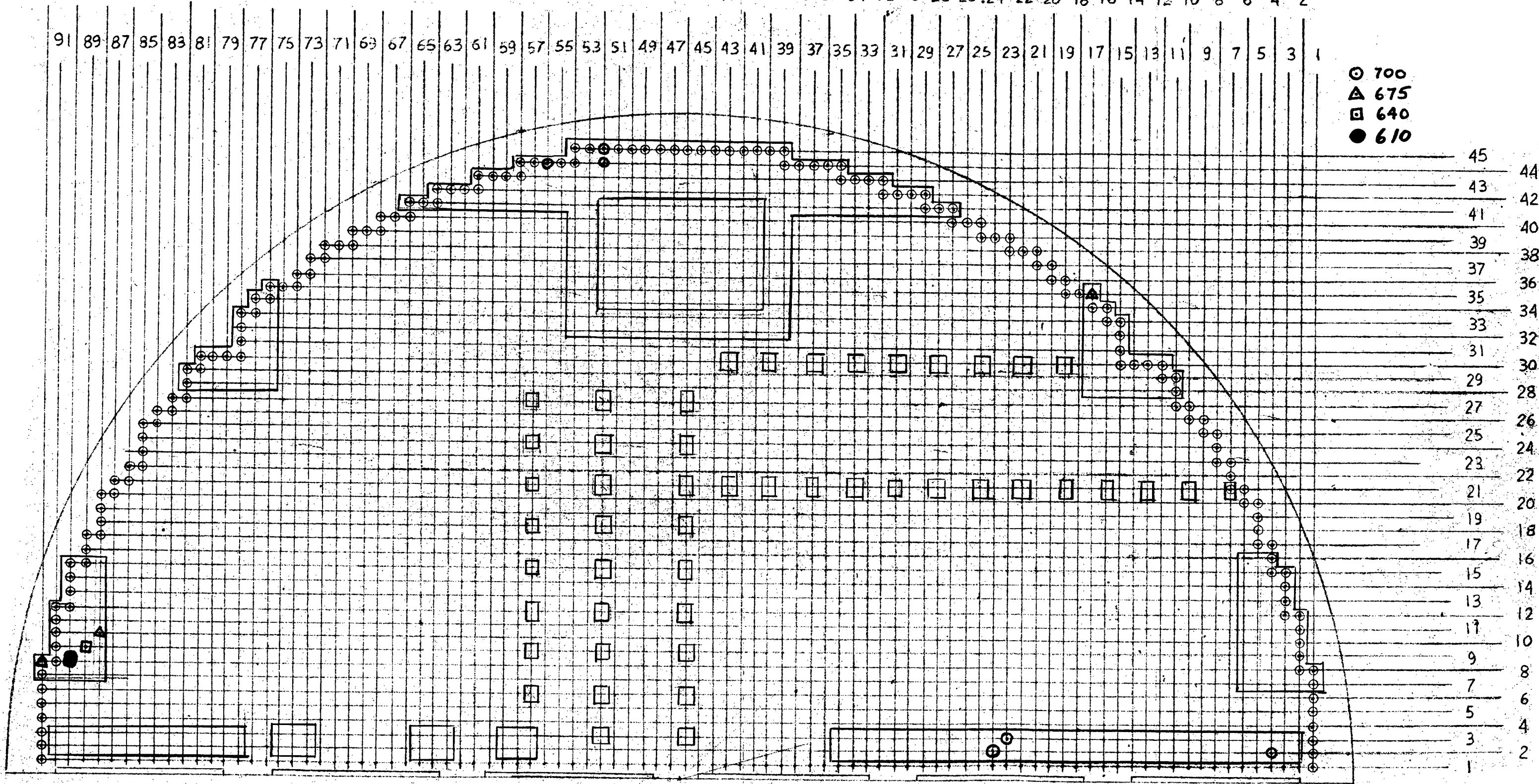
Indian Point Unit No. 2
Docket No. 50-247
May, 1978

COLUMNS

92 90 88 86 84 82 80 78 76 74 72 70 68 66 64 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2

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← MANWAY

29 STEAM GENERATOR 1 S.P.

NOZZLE →

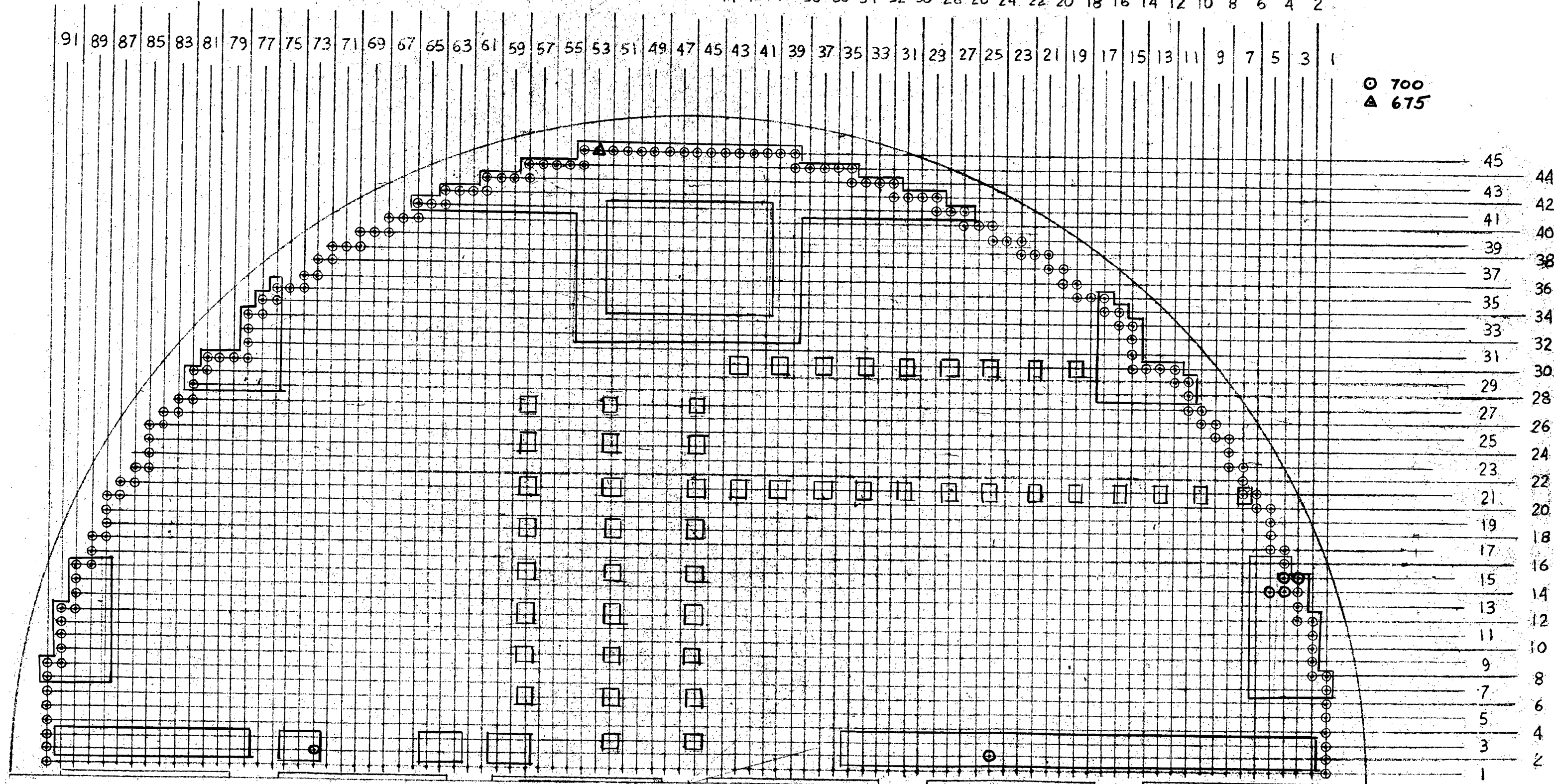
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COLUMNS

92 90 88 86 84 82 80 78 76 74 72 70 68 66 64 62 60 58 56 54 52 50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 8 6 4 2

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23 STEAM GENERATOR 2 S.P.

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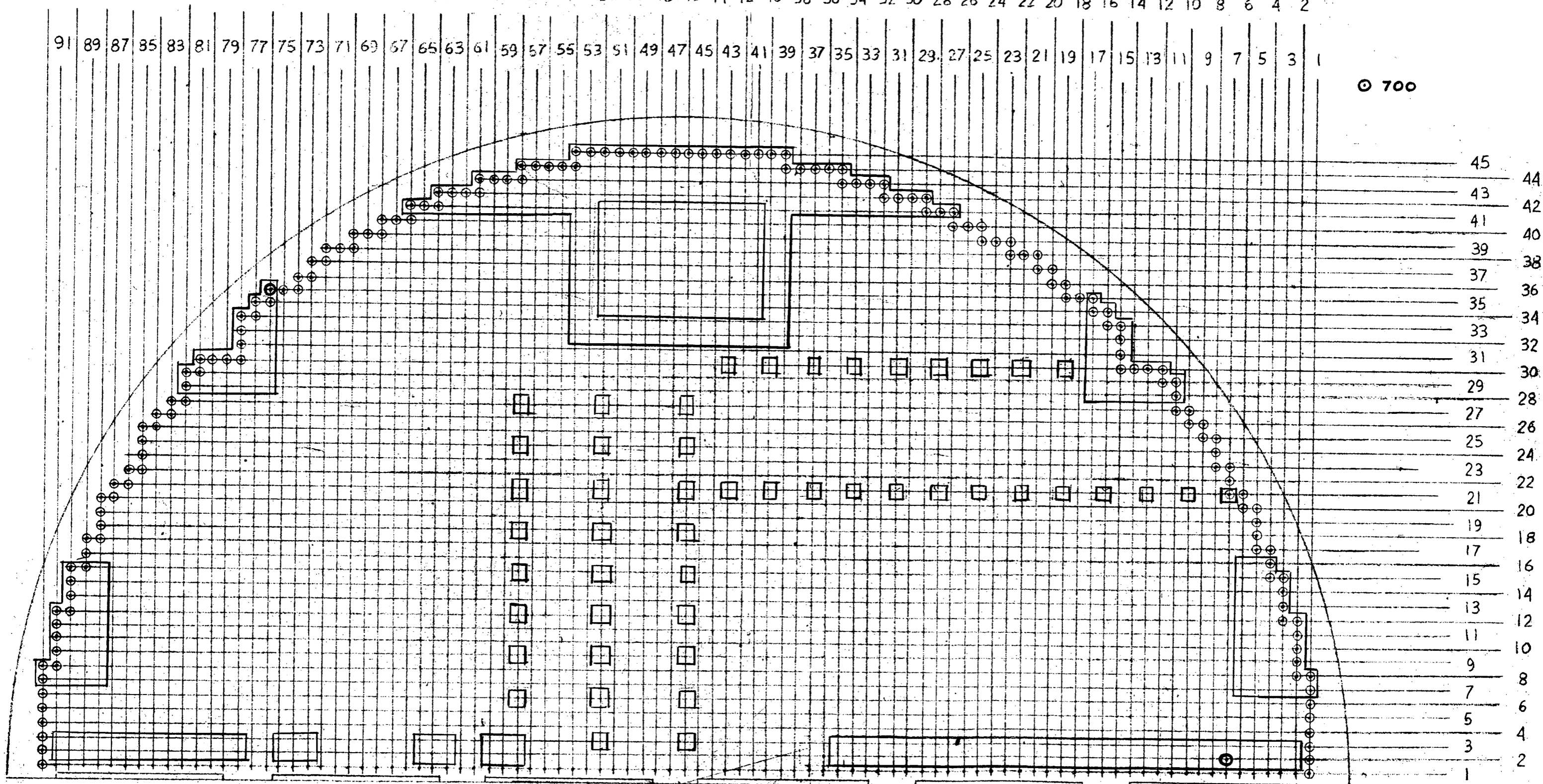
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23 STEAM GENERATOR 3 S.P.

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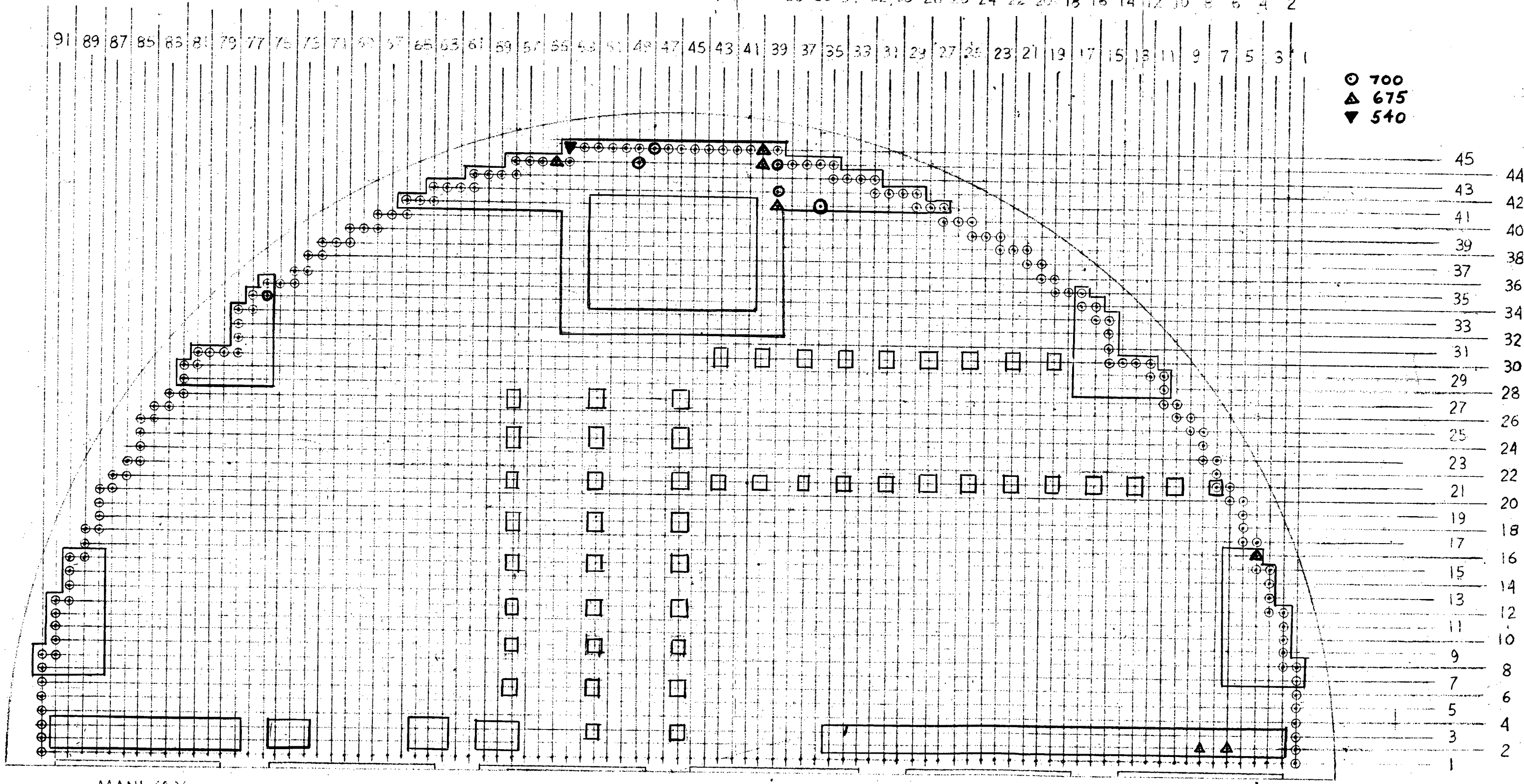
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23 STEAM GENERATOR 4 S.P.

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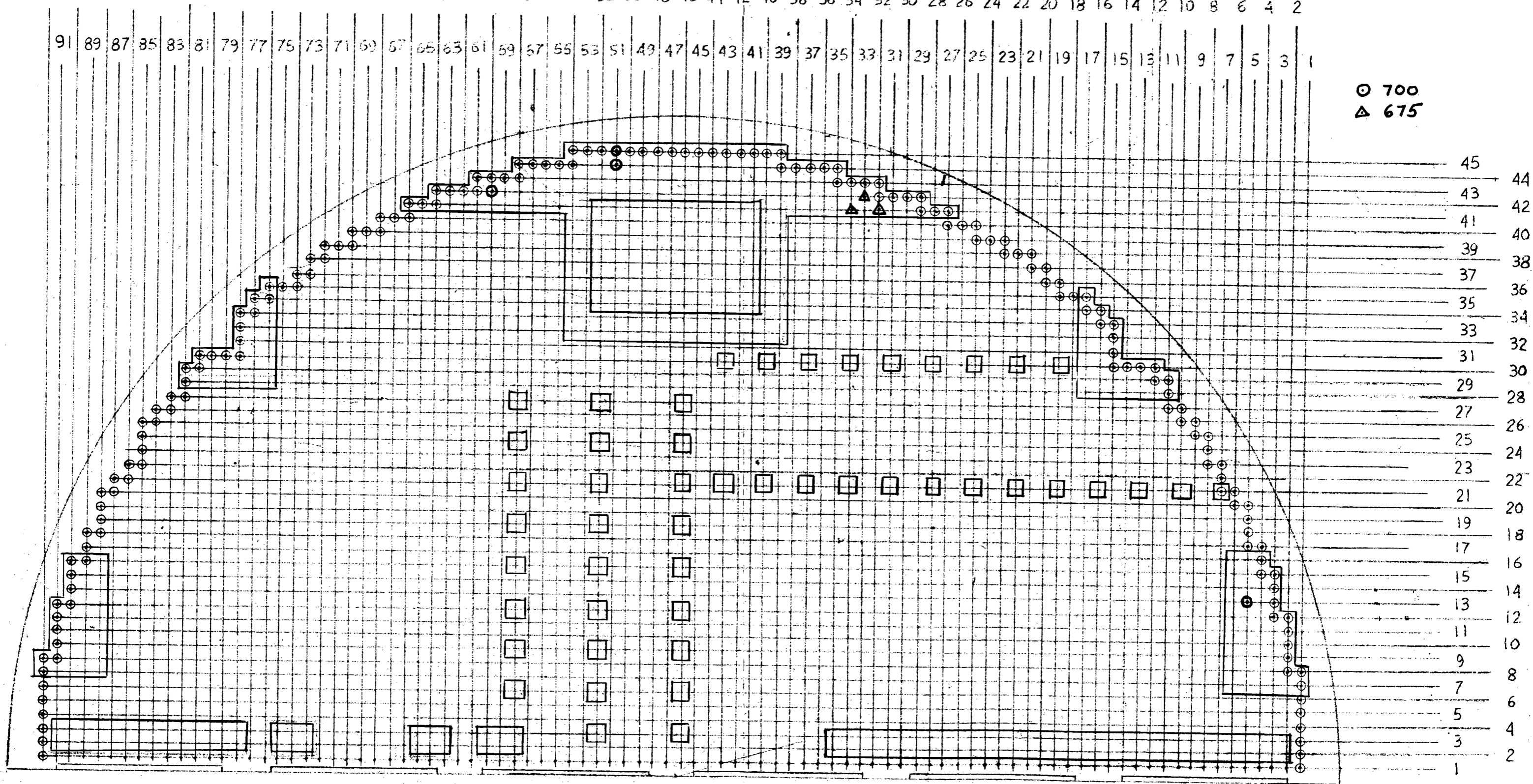
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23 STEAM GENERATOR

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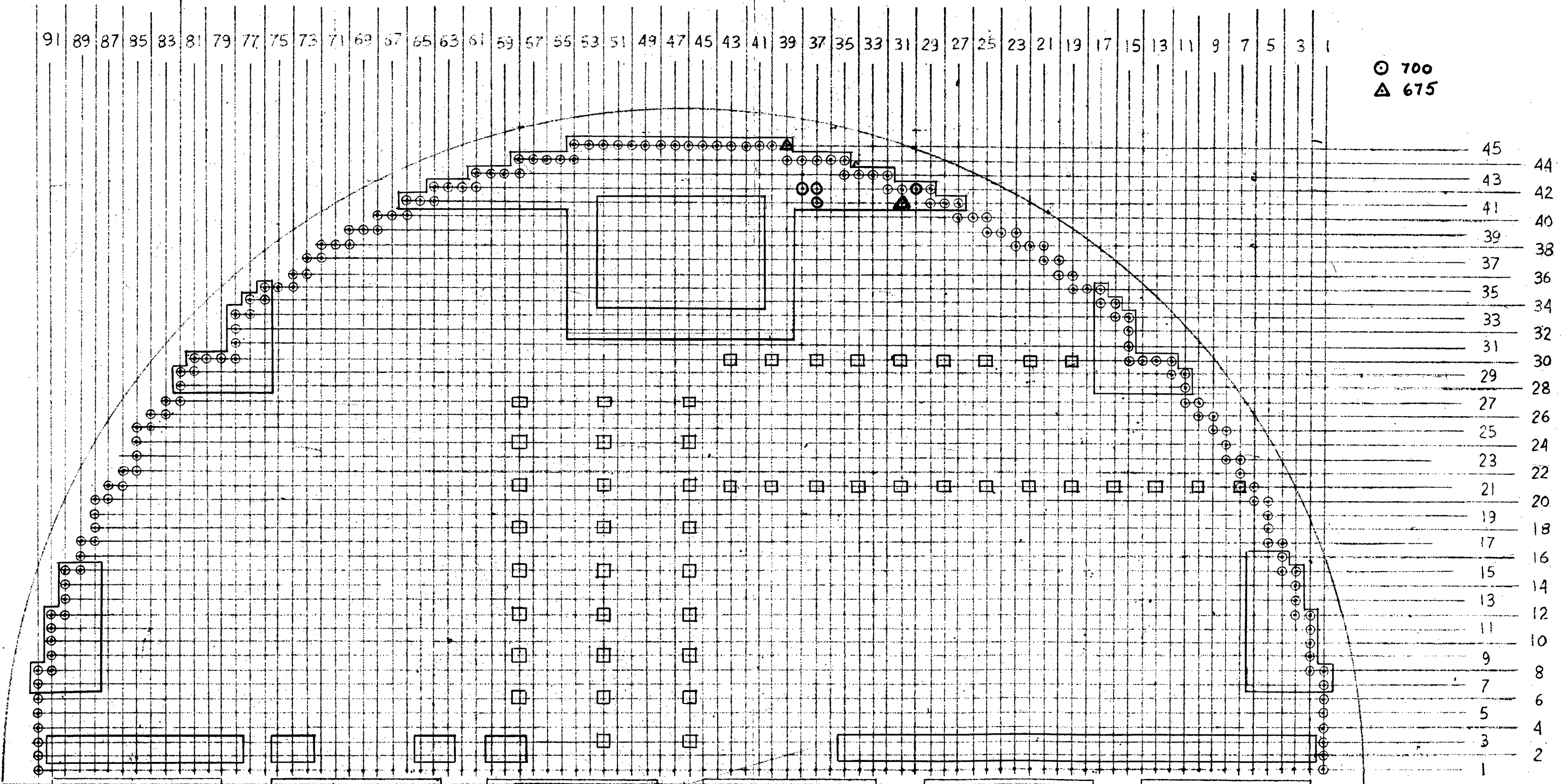
NOZZLE →

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23 STEAM GENERATOR

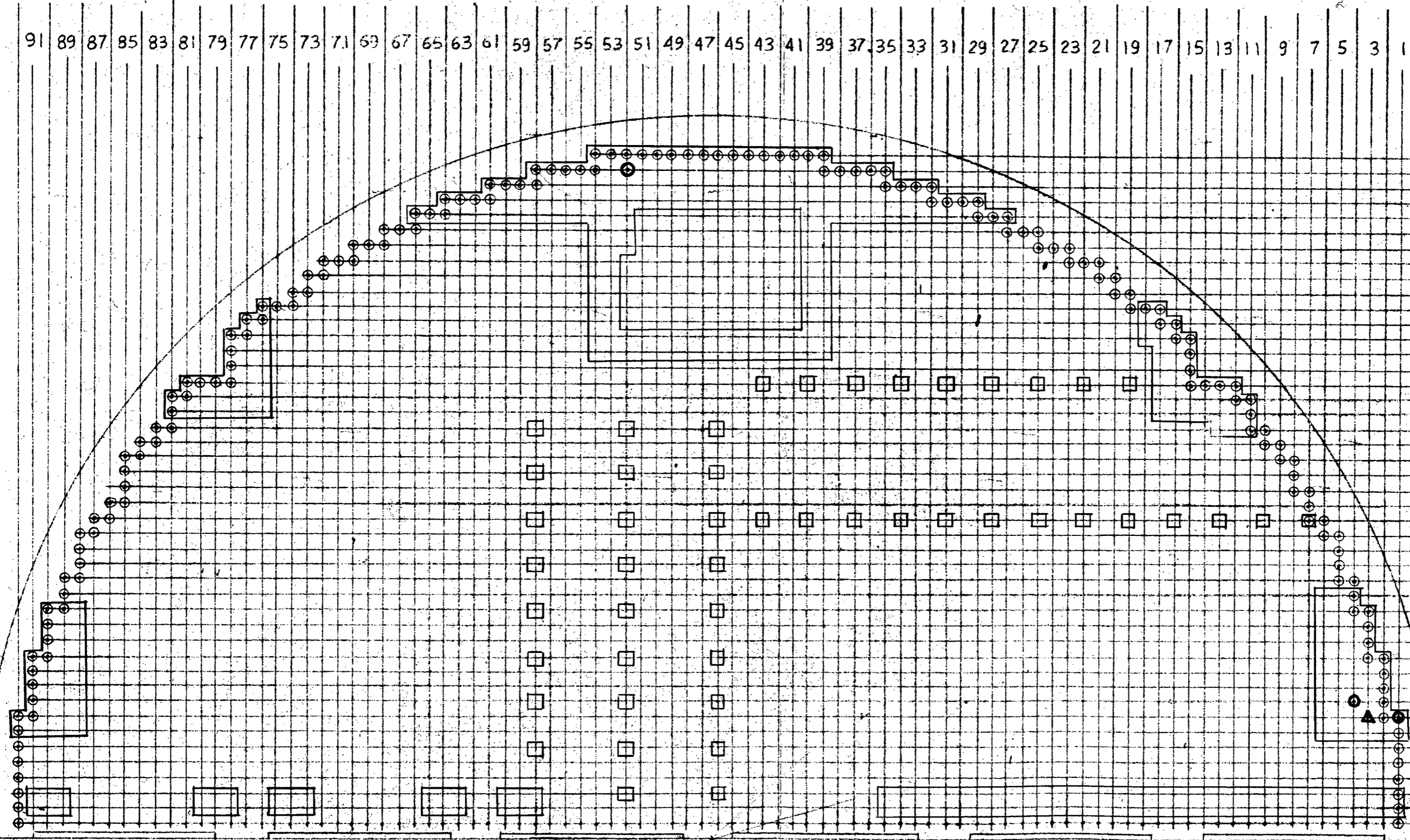
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24 STEAM GENERATOR I.S.P.

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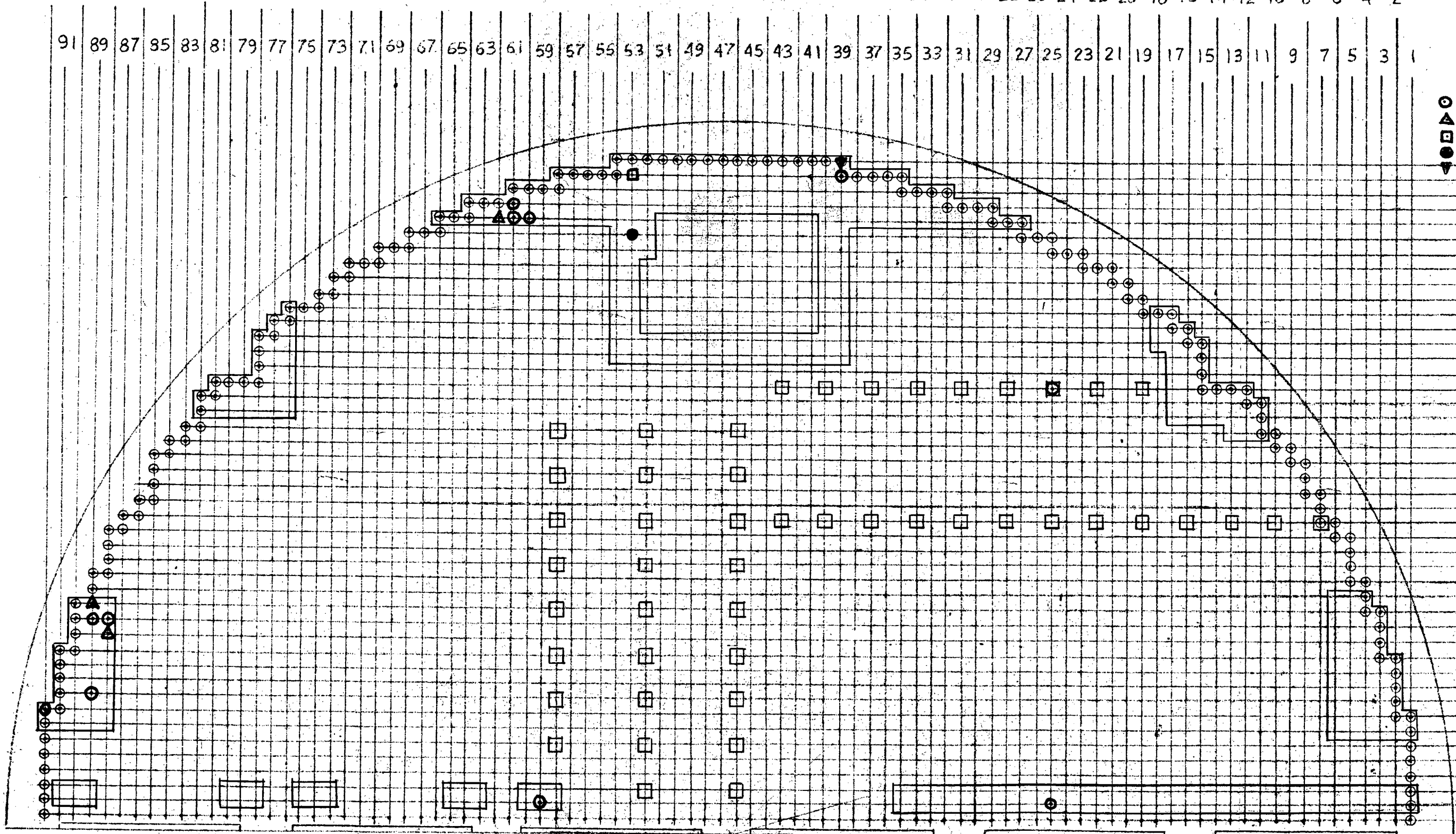
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24 STEAM GENERATOR 2 S.P.

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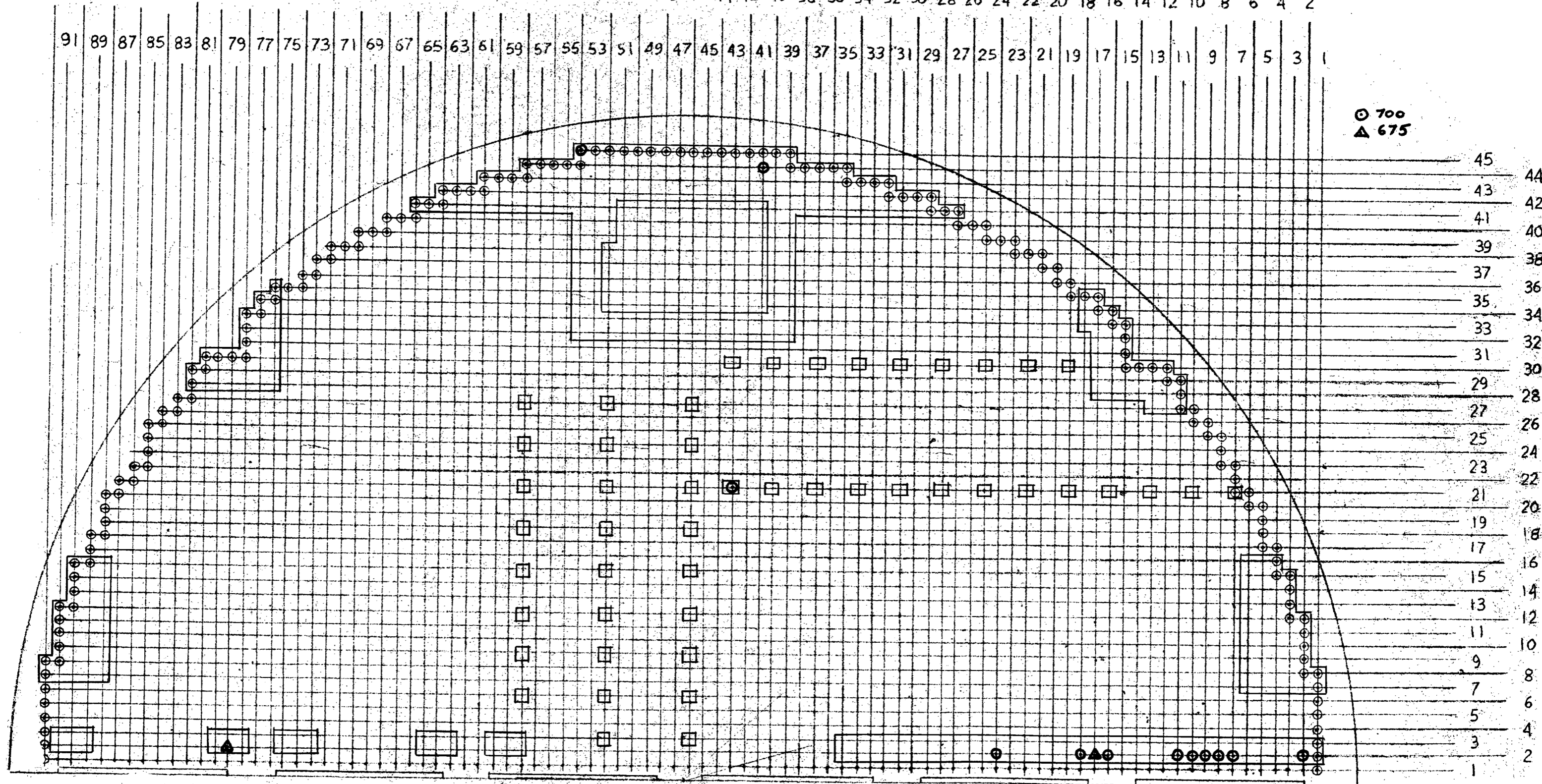
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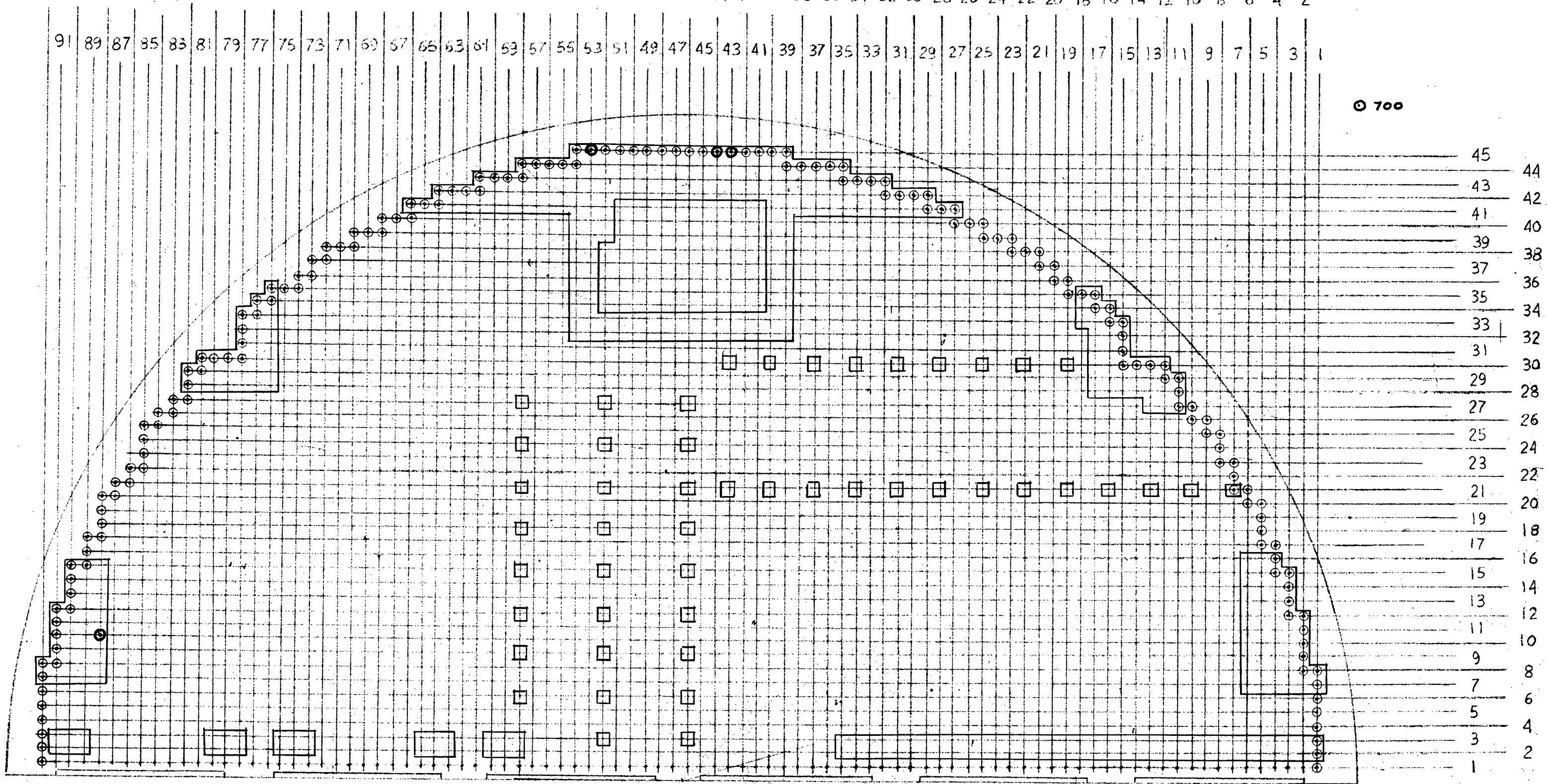
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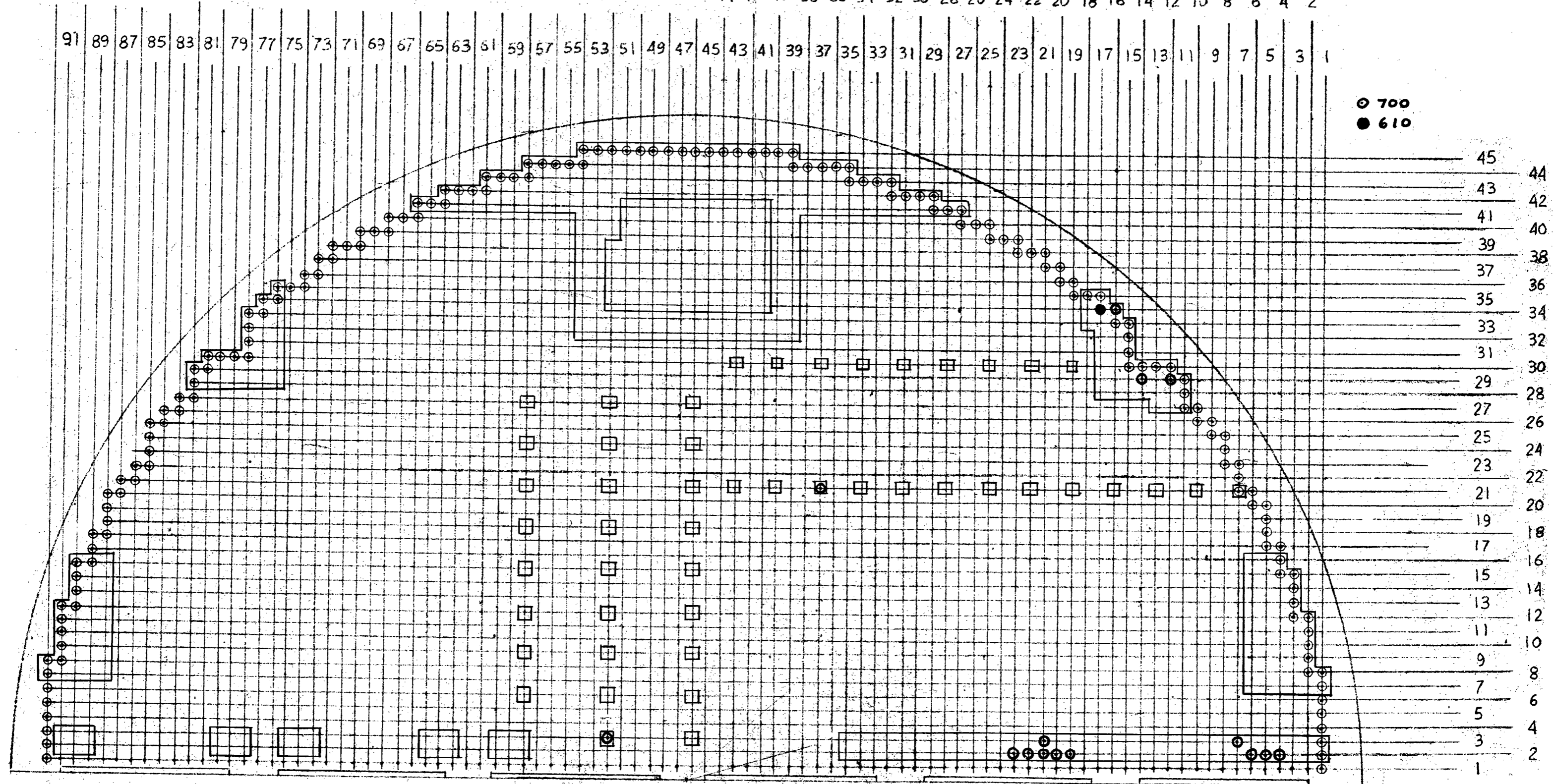
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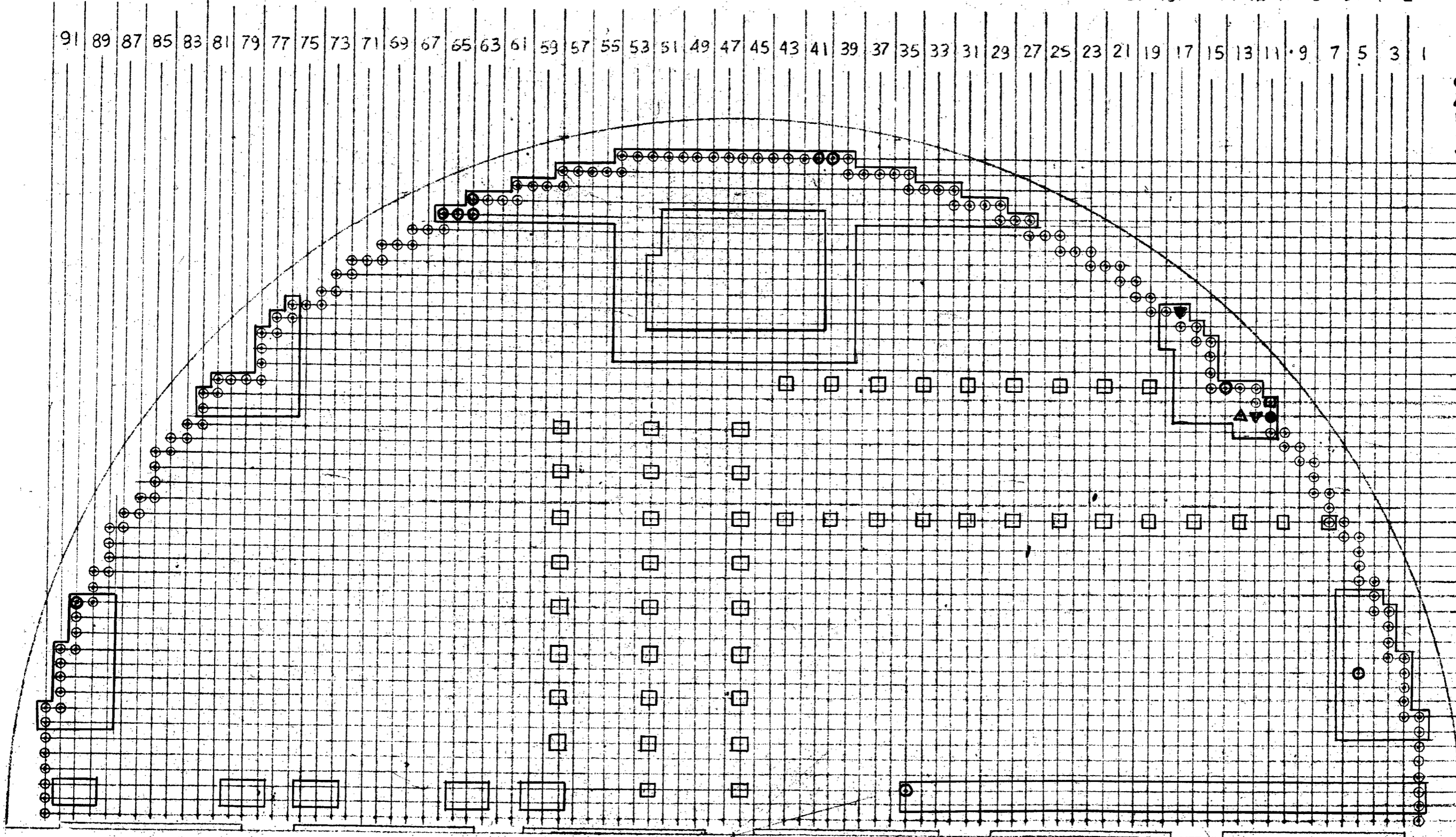
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24 STEAM GENERATOR 6 S.P.

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