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MAGNET MODEL 2 RESULTS FOR n = 400

by

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The measurements described below were made in Bergen during the latter half of September, 1953. After the meeting at Harwell which resulted in the choice of an n-value of 400 for the design to be presented at the Geneva conference, model 2 (originally a 1/5 scale model for n = 100) was changed to a 1/8 scale model at n = 400. The yoke and coil structures remain as described in JPB/2; only the pole pieces were changed.

Pole Configuration

The ideal hyperbolic pole contour for n = 400 was simulated by five straight cuts as indicated in Fig. 1. The actual pole shape is indicated in Fig. 1 by solid lines. At the radial center of the gap, the gap length is 1.25 cm.

Method of Measurement

As before, fields were measured by reversing magnet current and observing the output of a search coil into a Cambridge fluxmeter. The standard operating current was 11.5 amperes at which the computed field at the "equilibrium orbit" was 2500 gauss. The measured field at this position was 2520 gauss. The search coils used were roughly 5mm x 5mm and have area-turns products of 40.8 cm^2.

Field Distribution in the Median Plane

The observed field distribution across the gap and in the fringing fields is shown in Fig. 2. The observed slope corresponds to an n-value of 414. No visible discontinuities have resulted from the approximate method for cutting the poles.

Due to the absence of the neutral pole, the field deviates from the linear at a distance of about 8mm (6.4 cm full scale) on the low field side of the equilibrium orbit. To correct this the gap must open materially faster than in an attempt to improve this field distribution, the 27° cut should be changed to approximately a 45° cut.

Field Distribution around the Ends of the Model

Fields were measured at several points around the end of the model and approximate contours of equal field were derived as indicated in Fig. 3. Radial runs just outside of the pole end indicated that the n-value drops rapidly as a function of distance away from the end of the magnet. At 4.5mm (3.6 cm full scale) from the end of the pole the n-value has fallen to 300 (n defined in terms of the field at the equilibrium orbit at this distance from the end of the pole). At a distance of 1.4 cm (11.2 cm full scale) the n-value is about 200 and varies radically across the beam region. At this point the field is still about 20 percent of the field in the gap at the equilibrium orbit. It would appear that some shaping of the poles at the ends of the magnet sectors will be necessary although high precision probably will not be required.

Flux Distribution in the Magnet Structure

Flux loops were imbedded in the magnet structure at the locations indicated in Fig. 4. Each loop enclosed the central 4.4 cm of the 12.2 cm extent of the model. In terms of a unit flux given by the product of the field at the equilibrium orbit and the area of the central 4.4 cm of the poles, the fluxes measured were as follows:

Position	1	1.10
	2	1.17
	3	1.19
	4	1.18
	5	1.18
	6	1.19
	7	1.16

For 12 kilogauss at the orbit and poles 36 cm in radial extent, it is easy to show from these figures that the average field in the pole base will be about 15.2 kilogauss.

Stored Energy

The stored energy is given by the product

$$\frac{\text{total flux} \times \text{total ampere turns}}{2}$$

For the 4.4 cm section of this model the stored energy at 12000 gauss would be 19.1 joules. For the full scale 30-Gev magnet the peak stored energy would be 14.3×10^{6} joules.

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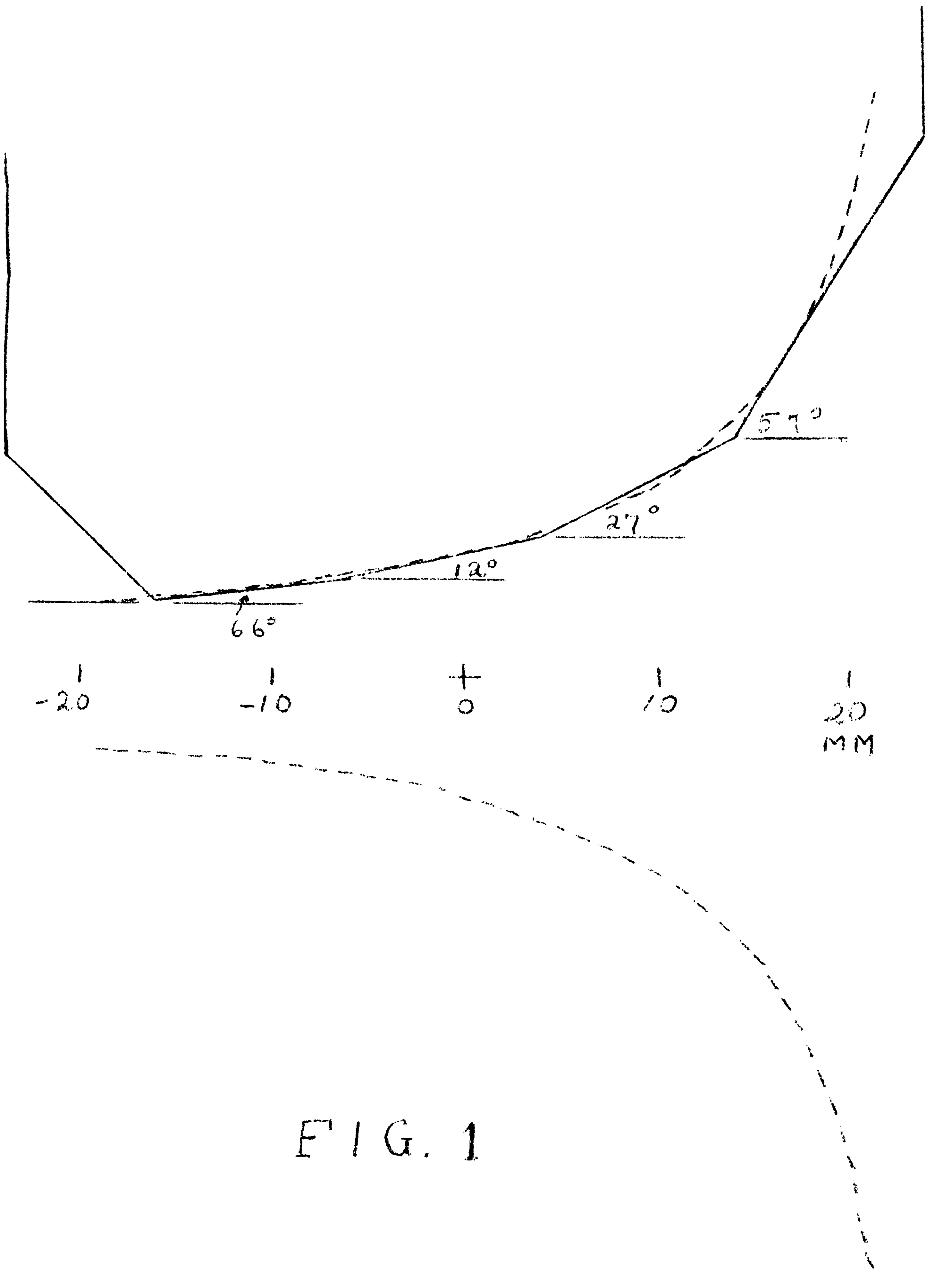
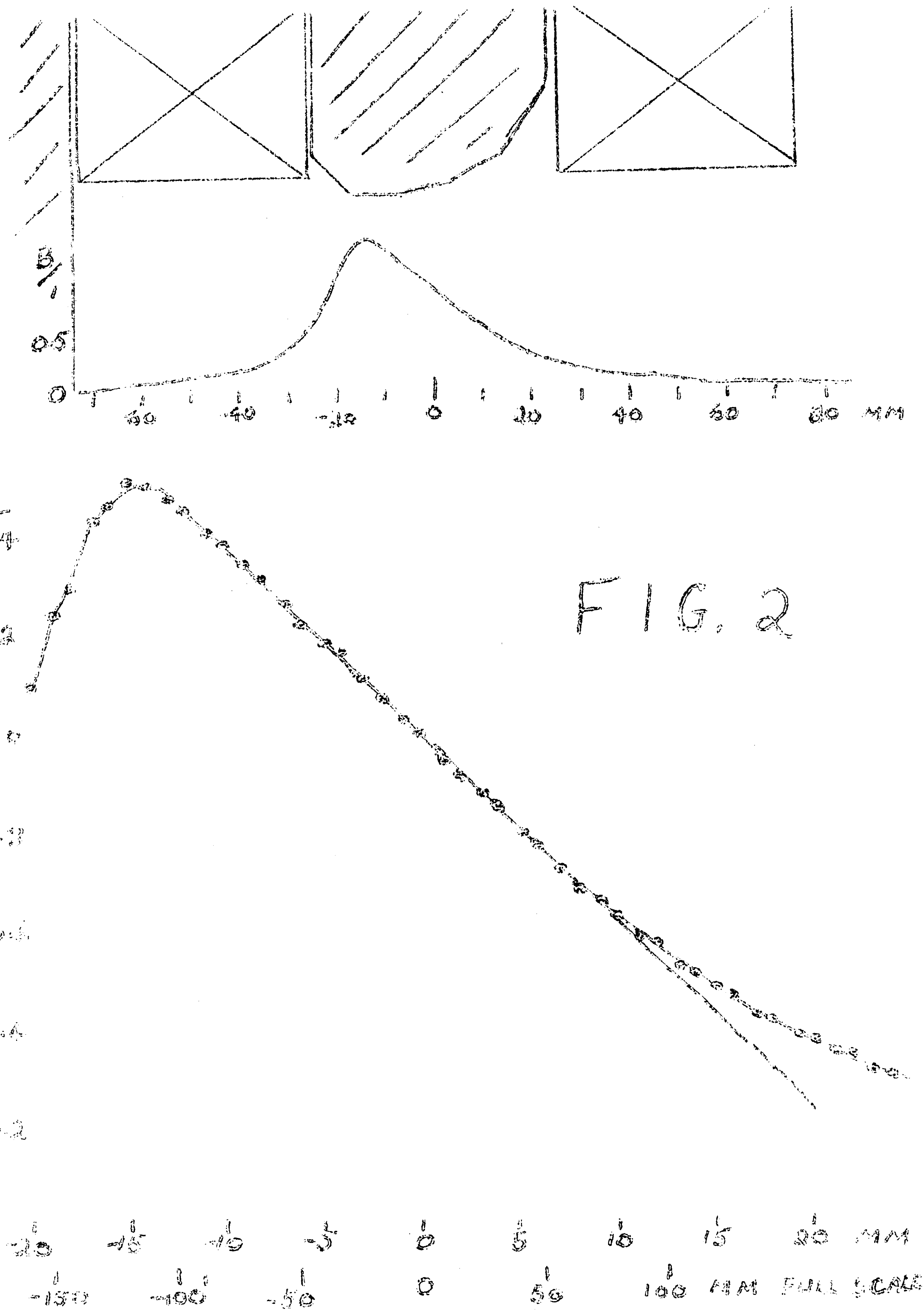


FIG. 1



B/I
0.5
0
80 40 20 0 20 40 60 80 MM
B/I
1.4
1.2
1.0
0.8
0.6
0.4
0.2
20 15 10 5 0 5 10 15 20 MM
-150 -100 -50 0 50 100 MM FULL SCALE

FIG. 2

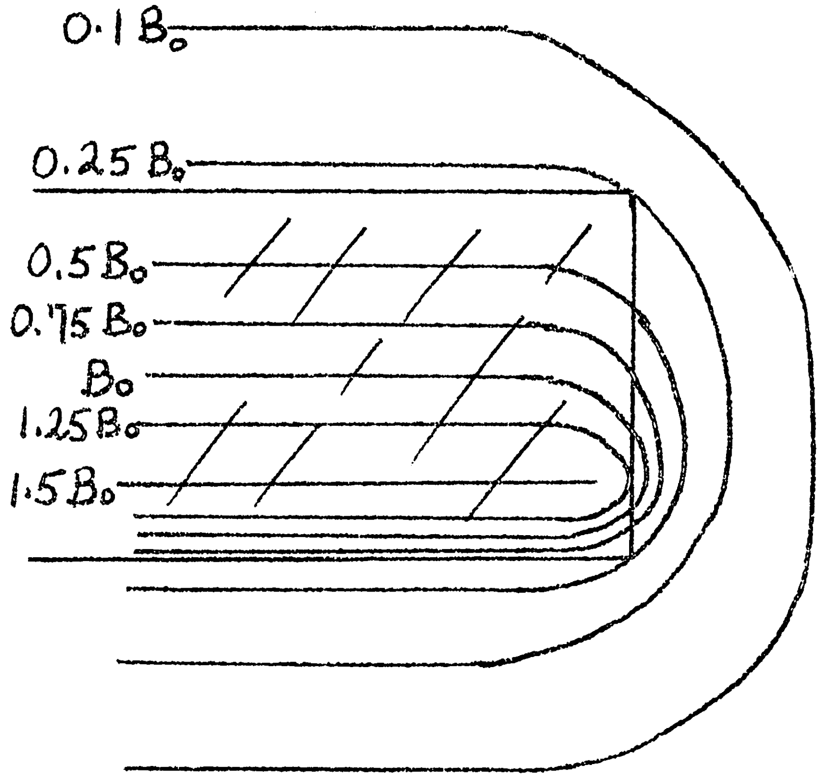


FIG. 3

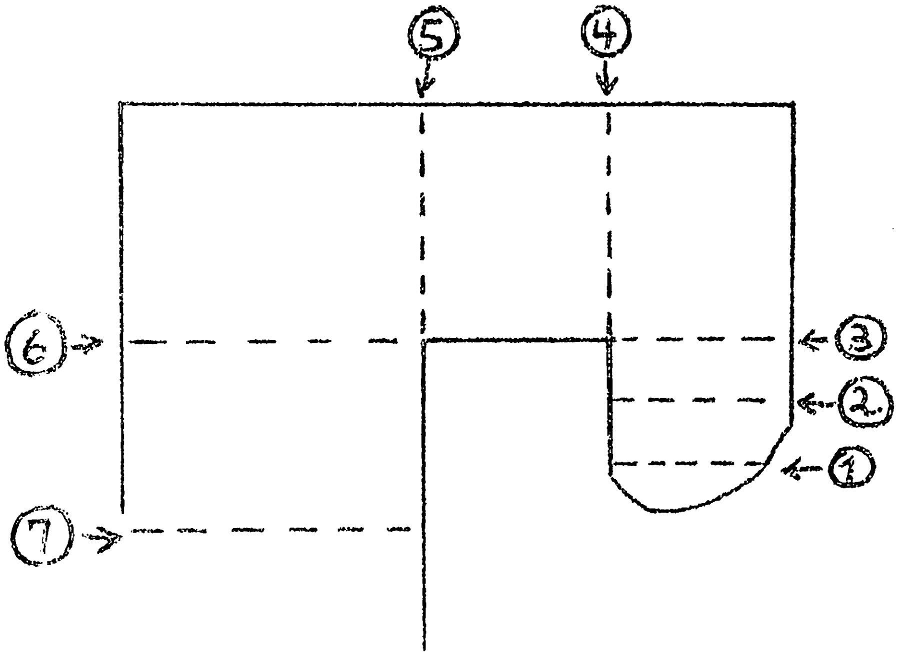


FIG 4