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# MACHINE DEVELOPMENT OF 4TH JULY, 1969

## Test of mean radial position measurement system

During this measurement we tried to compare the old and the new mean radial position measuring system (MRPM). We furthermore got some more information on the stability of the radial position depending on the mean radial position, intensity or attenuation of the pick-up signals entering the radial loop of beam control.

## I. Measurement conditions

The reference frequency of the old MRPM system in the 18 GeV position was measured to be 9539896 Hz. This corresponds to an energy of 19.1123 GeV/c and a theoretical magnetic field of 9100 G. After correction (1) we get an average field of 9138 G. The length of the flat top was 400 ms and we adjusted the second half of it to obtain an optimum flat portion during the measurement. The measured field at this point of the flat top varied between 9130 and 9140 G during the MD time but showed a rapid jitter of $\pm$ 2 G from cycle to cycle.

The reference frequency of the new MRPM system was set to the same value as the old one. The gate time of the old MRPM system was changed to 11.52 ms corresponding to $1/\Delta f$ at this energy, $\Delta f$ being the difference of the reference frequency and the RF frequency when the mean radial position of the beam corresponds to the nominal mean orbit radius.

Due to the longer measuring time of the old MRPM system the trigger of this system was adjusted two M-pulses earlier than the trigger of the new one.

We used a printer for each system to print out about 50 measurements for each condition.

The beam was steered into the desired radial position by the normal perturbation generator used for machine operation (MCR). This perturbation was triggered 200 ms before the measurement and lasted as long as the flat top.

The radial pick-up stations for the radial loop were both in operation.

## II. Measurements

a) Stability of radial position (normal conditions):

During this measurement the beam was brought to different radial positions up to the limit where the beam began to be lost. The results are given in fig. 1 for a beam intensity around $1.3 \times 10^{12}$ p/p. We took the average of all measurements in a single point as the mean value of radial position so as to obtain a symmetrical distribution around this point. It is seen that the reproducibility of a radial position diminishes for extreme values.

b) Stability of radial position (pick-up signals attenuated):

We put a 12 dB attenuator in the signal paths of $\Delta$ and $\Sigma$ signals of the two pick-up stations 78 and 87 at the input of the radial loop in the central building. Due to lack of time we measured only in three positions (60.0, 70.0 and 120.0). As seen in fig. 1, the reproducibility is better for the internal positions (60.0 and 70.0) and about the same for the external position (120.0).

c) Radial position as a function of intensity:

We put the beam in an internal position at high intensity and then reduced the beam intensity by closing the horizontal and vertical flags near BM43. The results are shown in fig. 2. As can be seen from this figure, the average value of the mean radial poiition was shifted to the outside and the spread around this value diminished with lower intensities. The spread in radial position at $5 \times 10^{11}$ p/p is comparable to the spread at full beam intensity but with the 12 dB attenuators in the pick-up signal paths.

d) Comparison of the two MRPM systems:

Since we printed the values obtained by the two measuring systems we can compare them (fig. 3). We took the value of the old system as a reference and represent the number of measurements of the new system with a certain deviation. Since the old system is a counting process with an unsynchronized gate, we expect the $\pm$ 1 count uncertainty (corresponding to $\pm$ 0.1 mm). The precision of the new system is $\pm$ 0.05 mm. Therefore, the total error between the two systems should not exceed $\pm$ 0.15 mm.

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(1) H. H. Umstätter : Tables of dynamic parameters of the CPS
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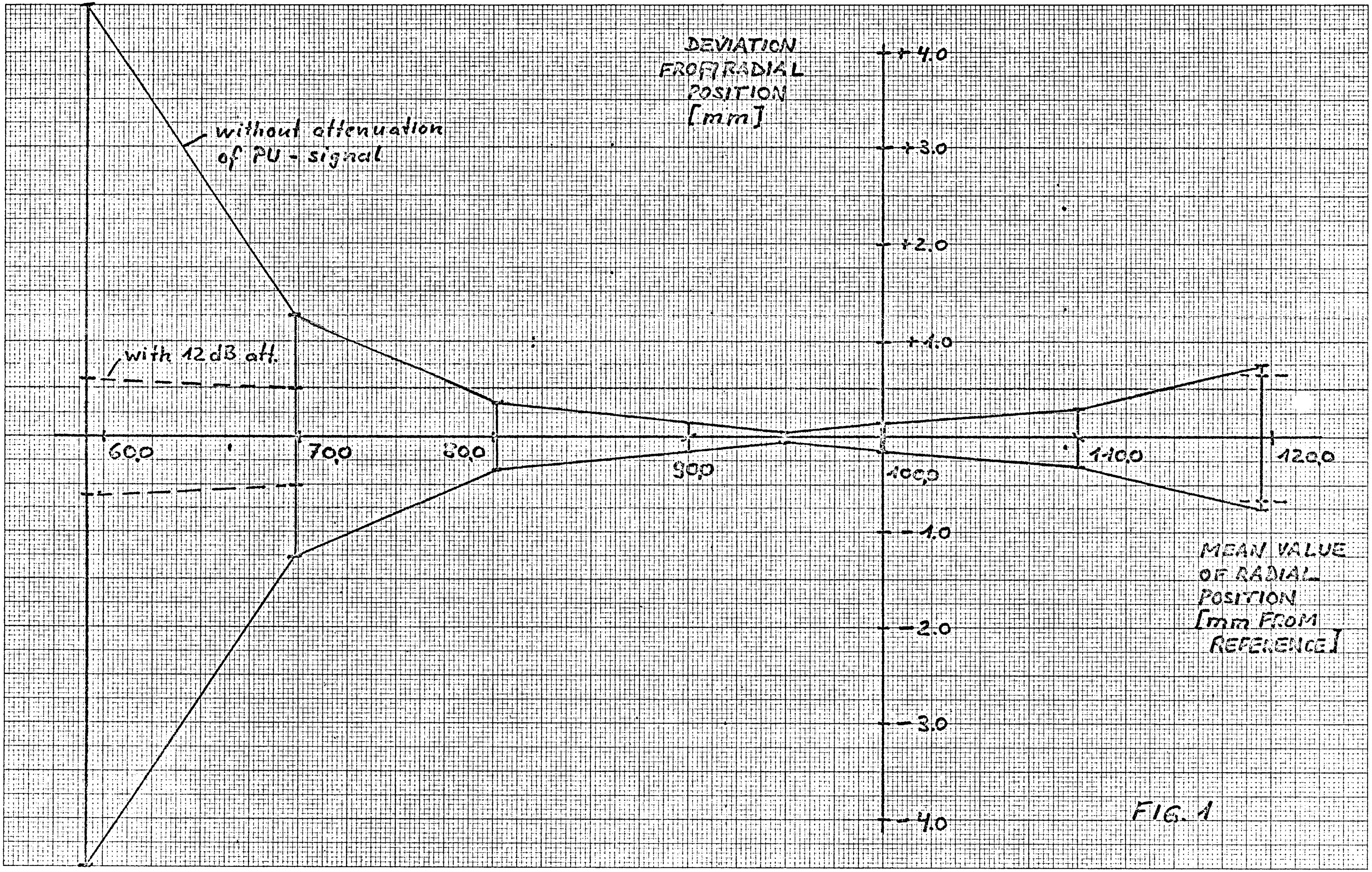
DEVIATION FROM RADIAL POSITION [mm]
+4.0
+3.0
+2.0
+1.0
-1.0
-2.0
-3.0
-4.0
without attenuation of PU - signal
with 12 dB att.
60,0
70,0
80,0
90,0
100,0
110,0
120,0
MEAN VALUE OF RADIAL POSITION [mm FROM REFERENCE]

FIG. 1

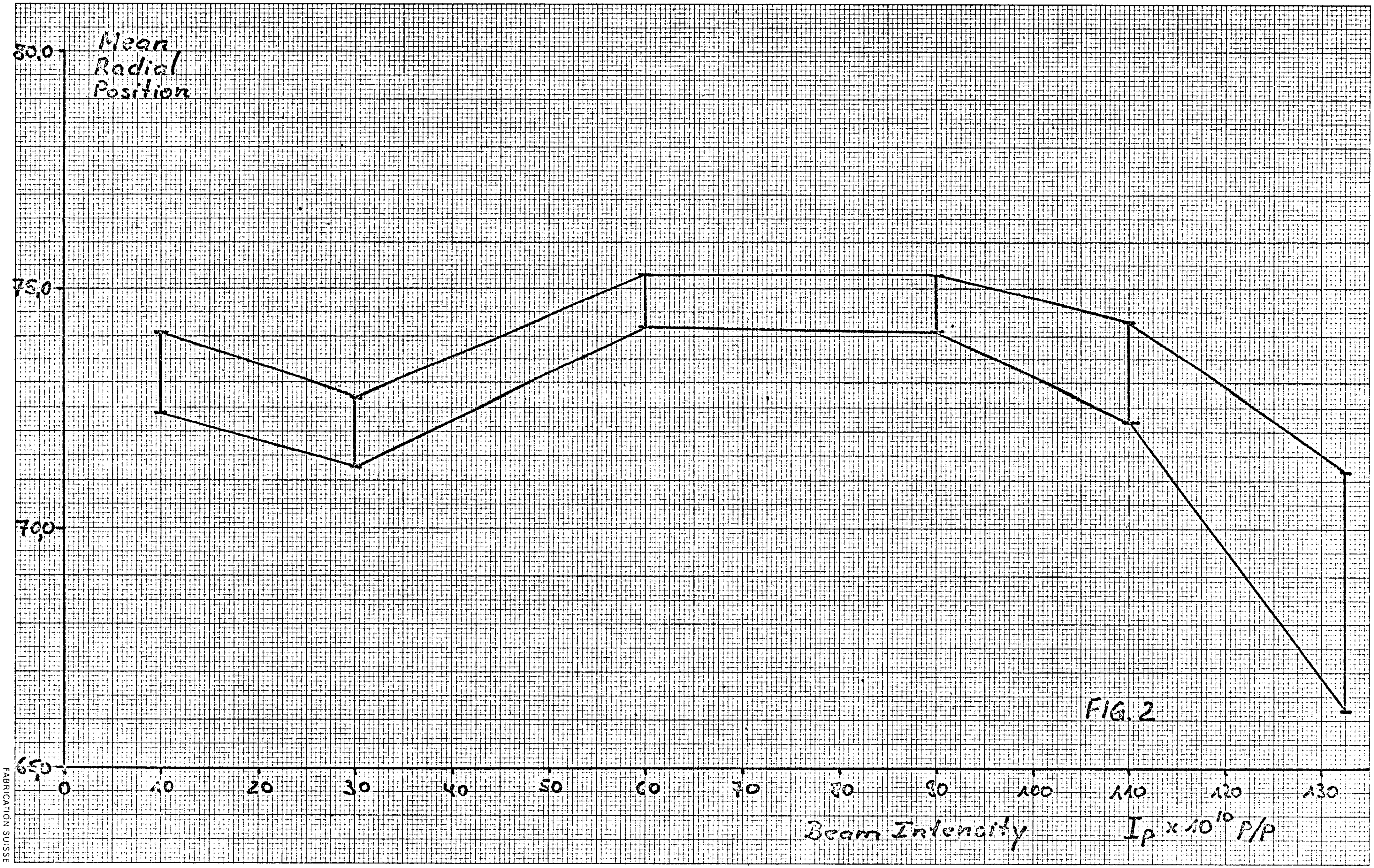


FIG. 2

FABRICATION SUISSE

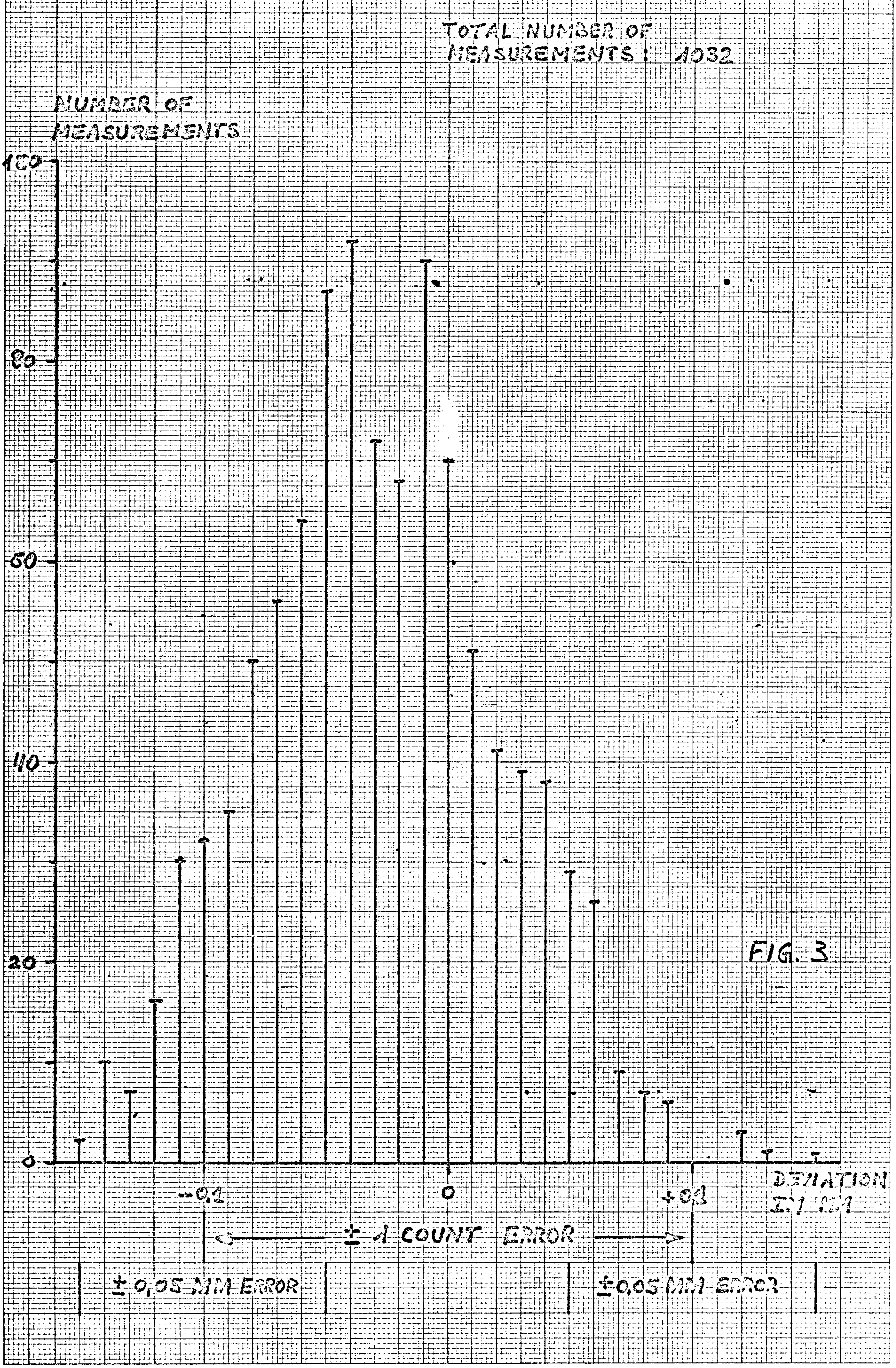


FIG. 3

FABRICATION SUISSE