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REMANENT FIELDS AND THEIR LONGITUDINAL AXIS IN AGS DEFLECTION ELEMENTS

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The recent replacement of a skew quadrupole at straight section E15 enabled us to measure the magnetic fields about the center of the quadrupole. The purpose of this note is to present one result of these measurements with implications to AGS injection.

The skew quadrupoles require at present currents of the order of .5 ampere in order to optimize the beam at injection. These currents correspond to quadrupole gradient compensations of the order of 1.0 gauss/inch. Such remanent fields were expected and were measured in both the previous and the newly installed quadrupoles at E15. It was found that due to asymmetries the locations of the longitudinal axis of the remanent fields depend on the individual history of a quadrupole and on the compensation current through its coils. The coordinates of the above axis are shown in Fig. 1. Also shown in this figure are the quadrupole field vectors at the respective points. Comparing the previous with the newly installed quadrupoles it was found that the remanent field of the first one had had a considerably greater asymmetry and with a noticeable sextupole field. A comparison between these two quadrupoles is shown in Fig. 2

Considering the dependence of the two parameters, location of axis and magnitude of quadrupole field, on the compensating current one comes to the conclusion that two parameters are needed in a proper application of a quadrupole as a compensating element. This can be done by sending current through all the elements' coils and another source of current through adjacent dipole coils. An alternative way would be the application of two independent current sources to different coil groups of the same quadrupole (more than two sources would be required when the transverse axis have also to be rotated). This method is quite practicable and possesses the advantage that the correct proportions of the different compensating currents can be determined independent of beam performance at injection. The center and intensity of the field could be determined by a simple magnetic measurement technique without interference with the operation of the machine. This would then leave only one independent parameter to vary in the beam optimizing process.

The remanent fields of all elements around the ring are as yet unknown. It seems advisable, therefore, to plan a remanent field survey program that could be carried out at some future shutdown of the AGS. This should lead eventually to a better beam in the accelerator since, as we have seen, unknown remanent fields involve equivalent unknown shifts in magnet positions a compensation of which in a multiparameter system by means of measured total performance is limited by measurement accuracy.

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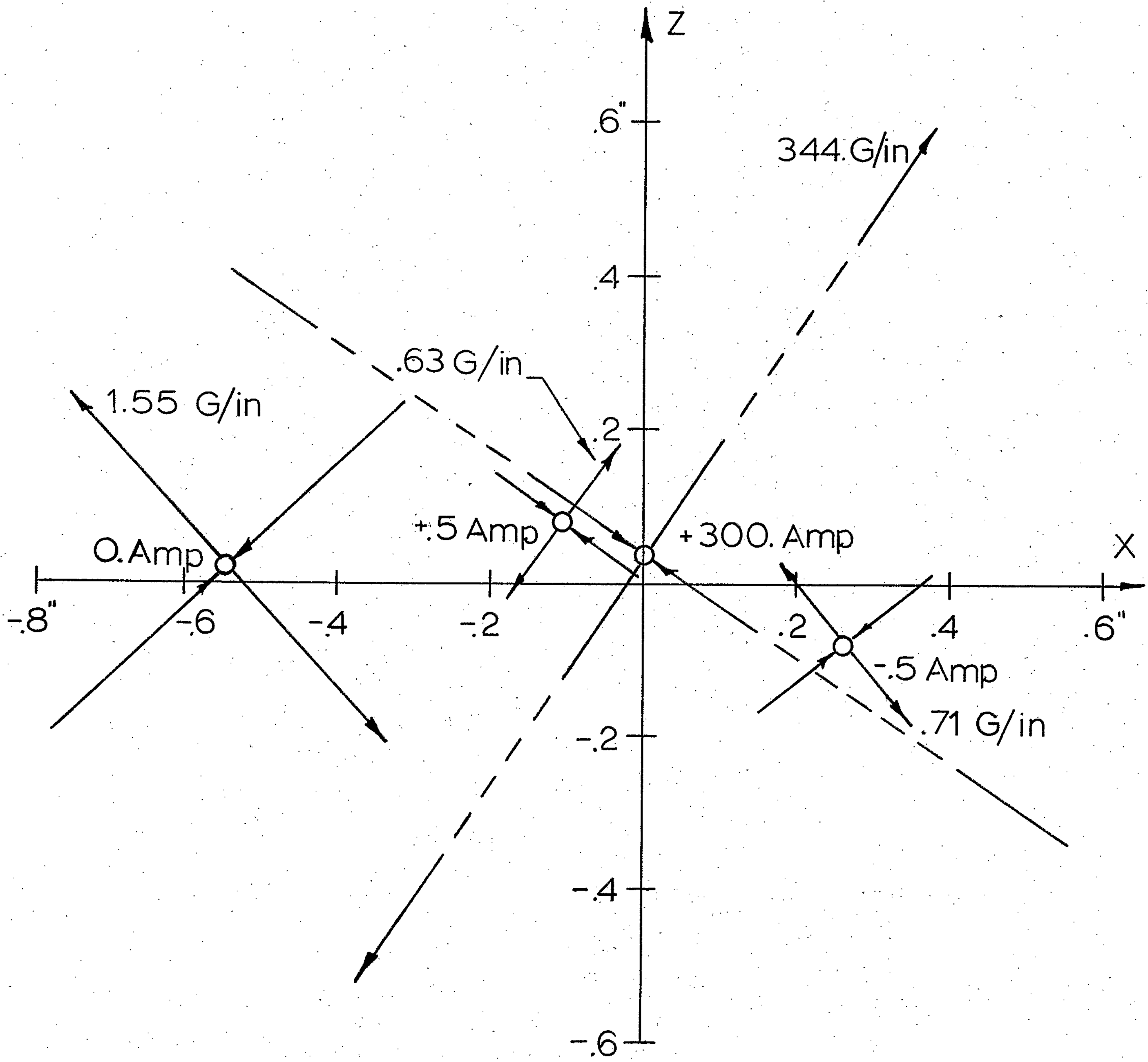

Fig. 1 Axis and field gradients of skew quadrupole at E15. Axis is defined as point of zero field. X, Z is a system of coordinates whose origin is within 100 mils of the physical center of quadrupole.

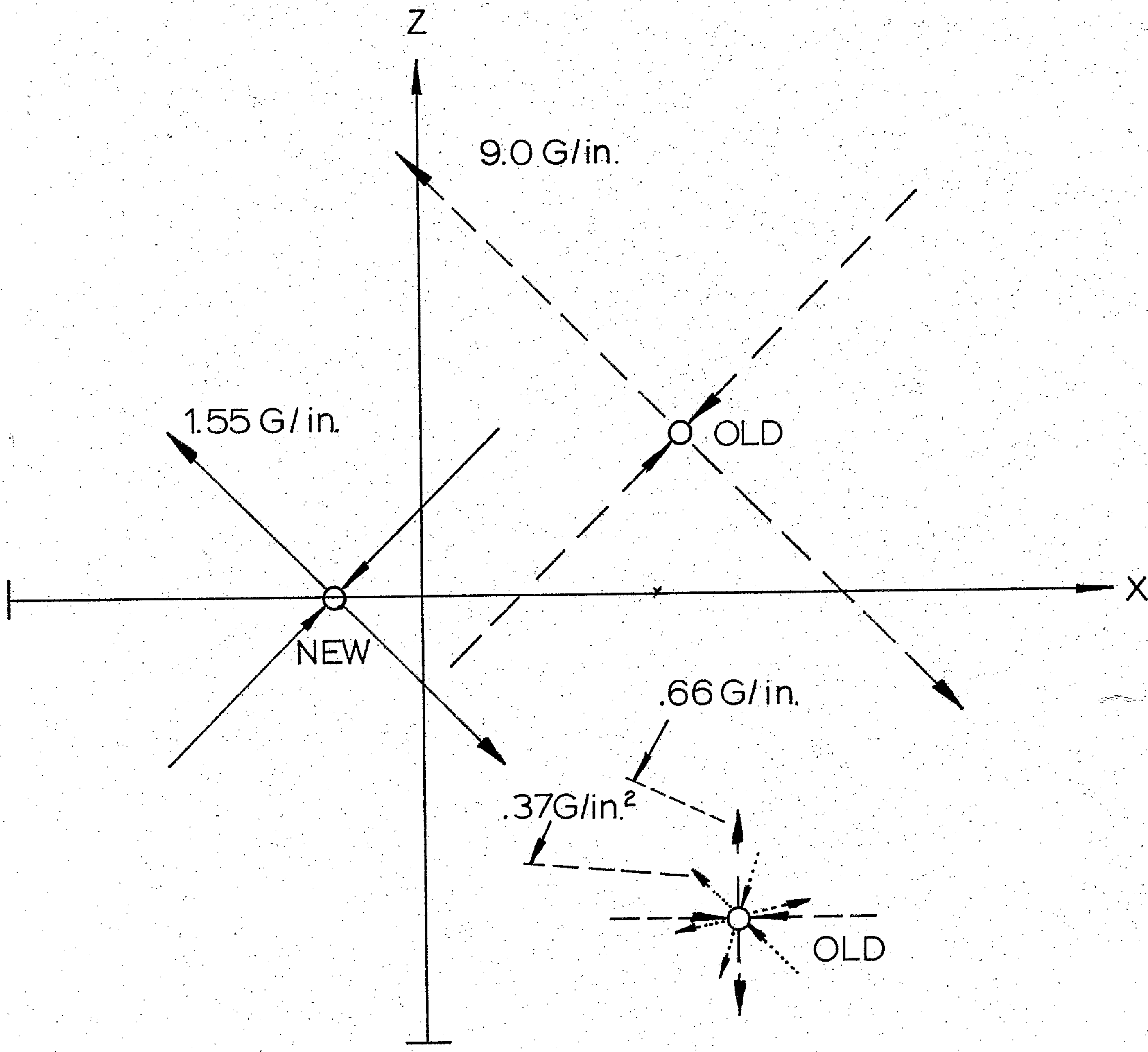

Fig. 2 Axis of old and new quadrupole magnets. The dashed and dotted vectors indicate the quadrupole and sextupole field gradients of the old magnet respectively. Two zero field points were found in this magnet.