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PREINJECTOR DOUBLET

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Technical Note

No. 230

PREINJECTOR DOUBLET

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Introduction

In order to reduce preinjector down time, a conventional pulsed quadrupole doublet has been designed and constructed as a replacement for the septier quadrupoles used in both Linac preinjectors. These new quadrupoles have proven to be extremely reliable because of their simple mechanical construction and low operating power requirements. In addition, a much higher quality field has been obtained with the new quadrupoles.

Quadrupole Parameters

A comparison of operating parameters is as follows:

	Septier Quads	New Quads
Operating Current (Pulsed)	200 Amps	40 Amps
Resistance	0.155 Ohms	0.130 Ohms
Operating Voltage	40 V	60 V
Inductance	1.5 mh	2.5 mh
Power	6,200 W x D cycle	210 W x D cycle
Gradient at Operating Current	400 G/cm	400 G/cm

(duty cycle is equal for both quads)

Construction

Quadrupole coils were constructed of 0.100" diameter copper wire with 0.002" thick Kapton insulation. The total number of turns required for one quadrupole was 140 (35 turns per pole). In order to avoid building expensive coil winding fixtures, coils were wound as shown on Figure 4, in the upward direction only. Plastic inserts equal to the thickness of the coil wire were used to eliminate uneven coil sides introduced by wire cross-overs from top to bottom. One cross-over on each side of the coil was required. Each coil was epoxy impregnated and lashed with 1" wide glass cloth.

Figure 1 illustrates construction of the quadrupole iron. The magnet yoke and pole tips were machined from epoxy painted 0.031" thick, 7" square laminations backed by two 0.100" thick low carbon steel plates and held together with 3/16 diameter x 2-3/4 long stainless steel rods and #6-32 ft. hd. screws. In all, 83 laminations were used with nominal 0.002" thick epoxy layer between them. Pole tips were machined from the plug cut out from stacked laminations as shown on Figure 1. Pole tip dimensions and their shape are shown on Figure 2. Assembly of back iron and pole tips is illustred on Figure 3.

Magnet Deisgn and Measurements

The pole profile for these magnets has been adapted from the LESB II 12Q12 quadrupoles and from Brookhaven "narrow quadrupole" studies.[1] The coil slot dimension has been chosen such that the integral effect of the first harmonic of the quadrupole ($6\theta/2\theta$) is essentially zero. Field harmonics have been measured at 75% of the pole tip radius and are $< 0.1\%$ except for the $10\theta/2\theta$ term which is 0.6% and agrees with the scaling prediction.

Conclusion

Initial tests indicate some increased Linac performance. A program of emittance measurements is being initiated in order to quantify this effect.

Acknowledgments

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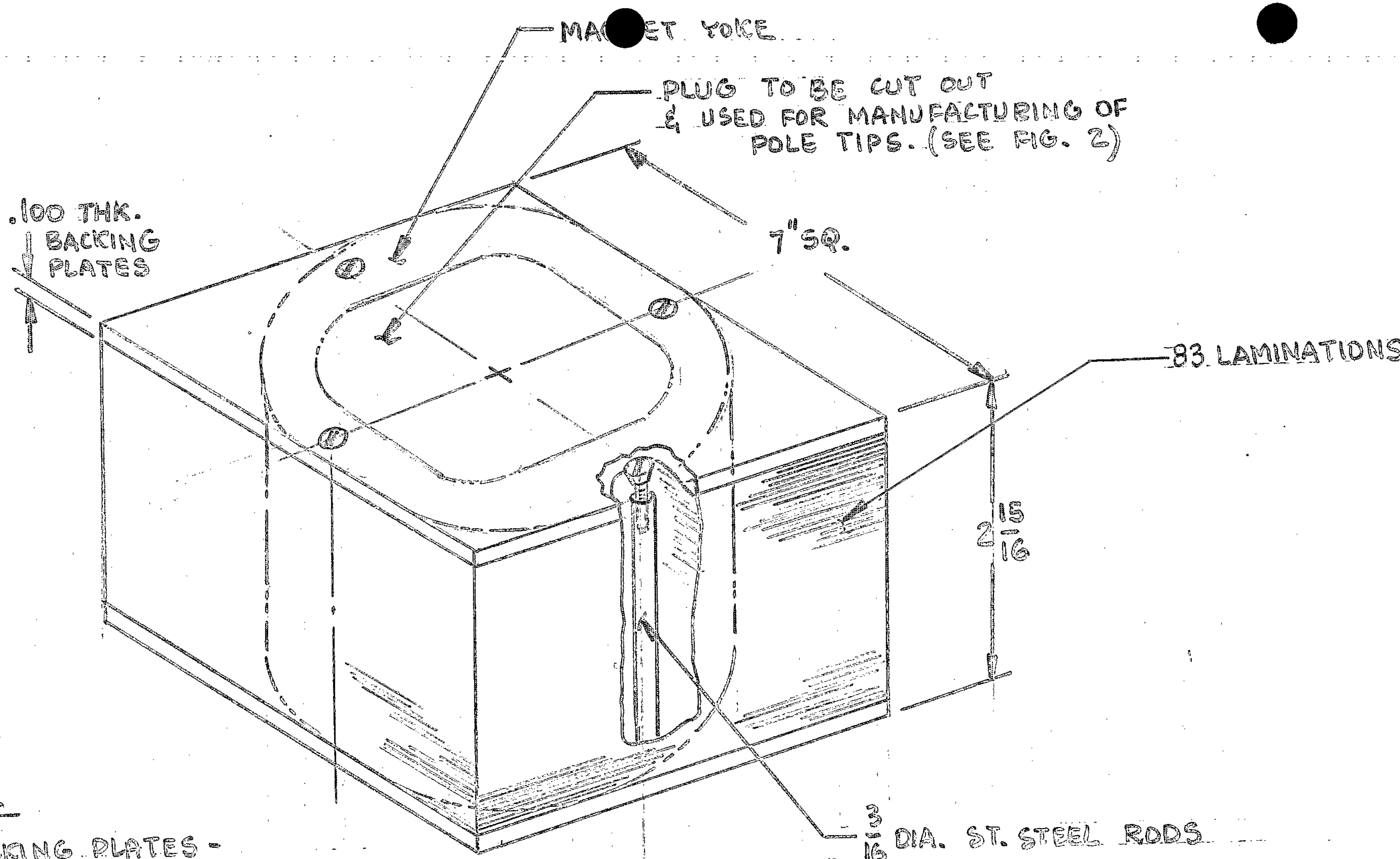
Reference

1. G.T. Danby and J.W. Jackson. Theory, design and measurement of the Brookhaven narrow quadrupoles. Proc. 1967 National Particle Accelerator Conf., March, 1967.

mvh



MAT'L

1) BACKING PLATES - 1006/1010 LOW CARBON ST.

2) ELECTRICAL GRADE STEEL (M-36) .031" THK. (AGS SPEC #2)

FIG. 1

LAMINATIONS STACKED WITH EPOXY

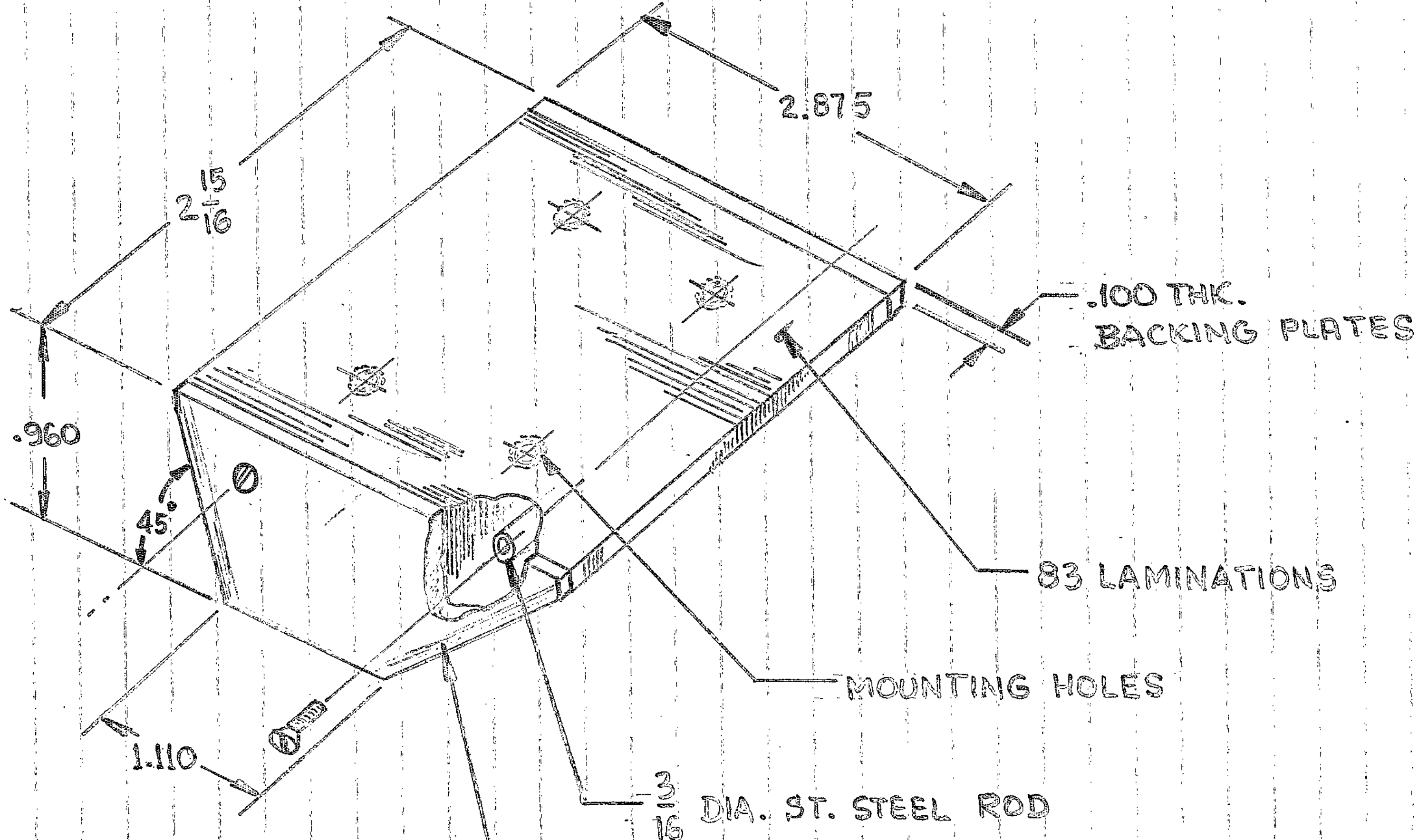


FIG. 2

POLE TIP

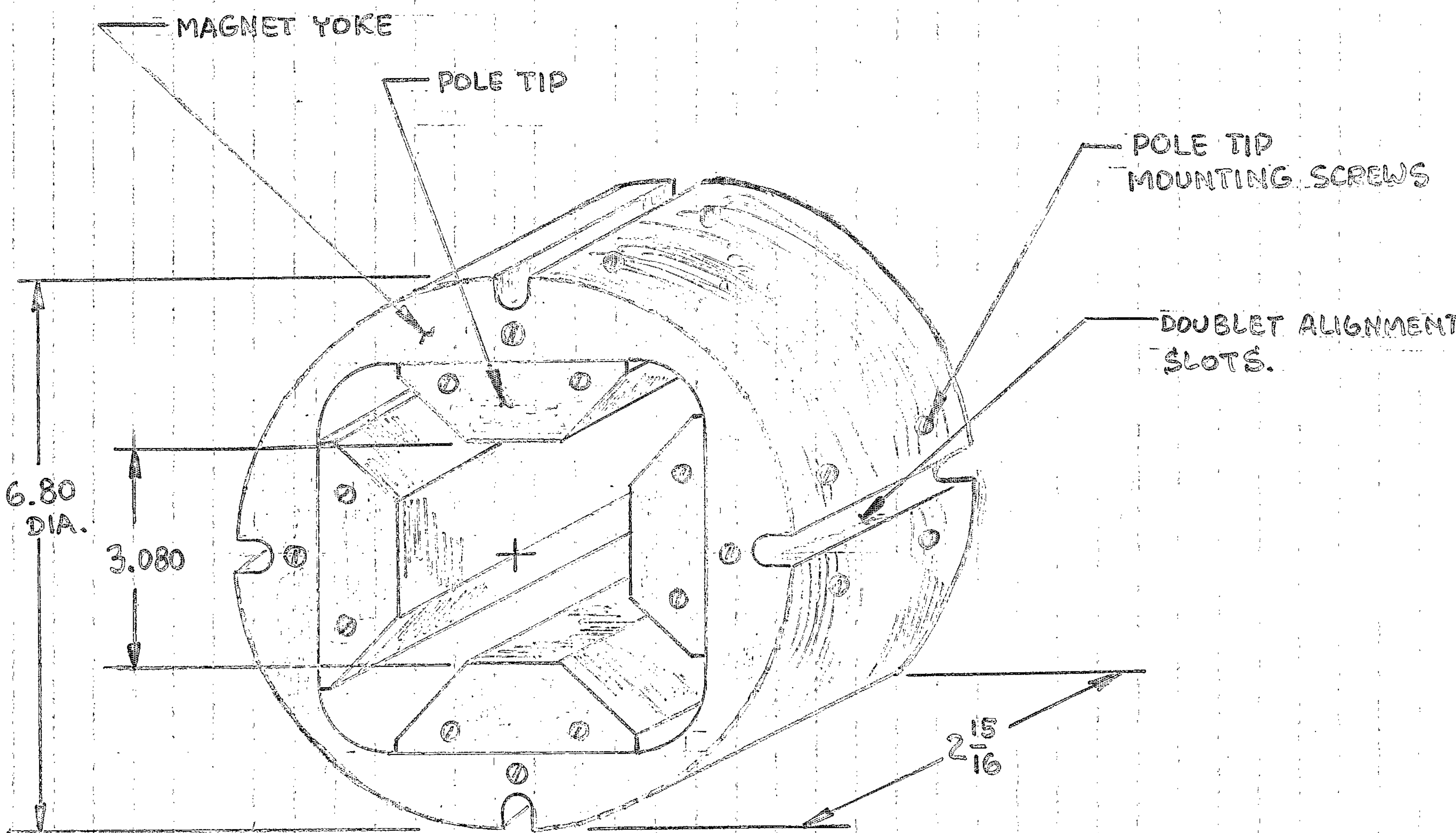


FIG. 3
MAGNET IRON ASS'Y

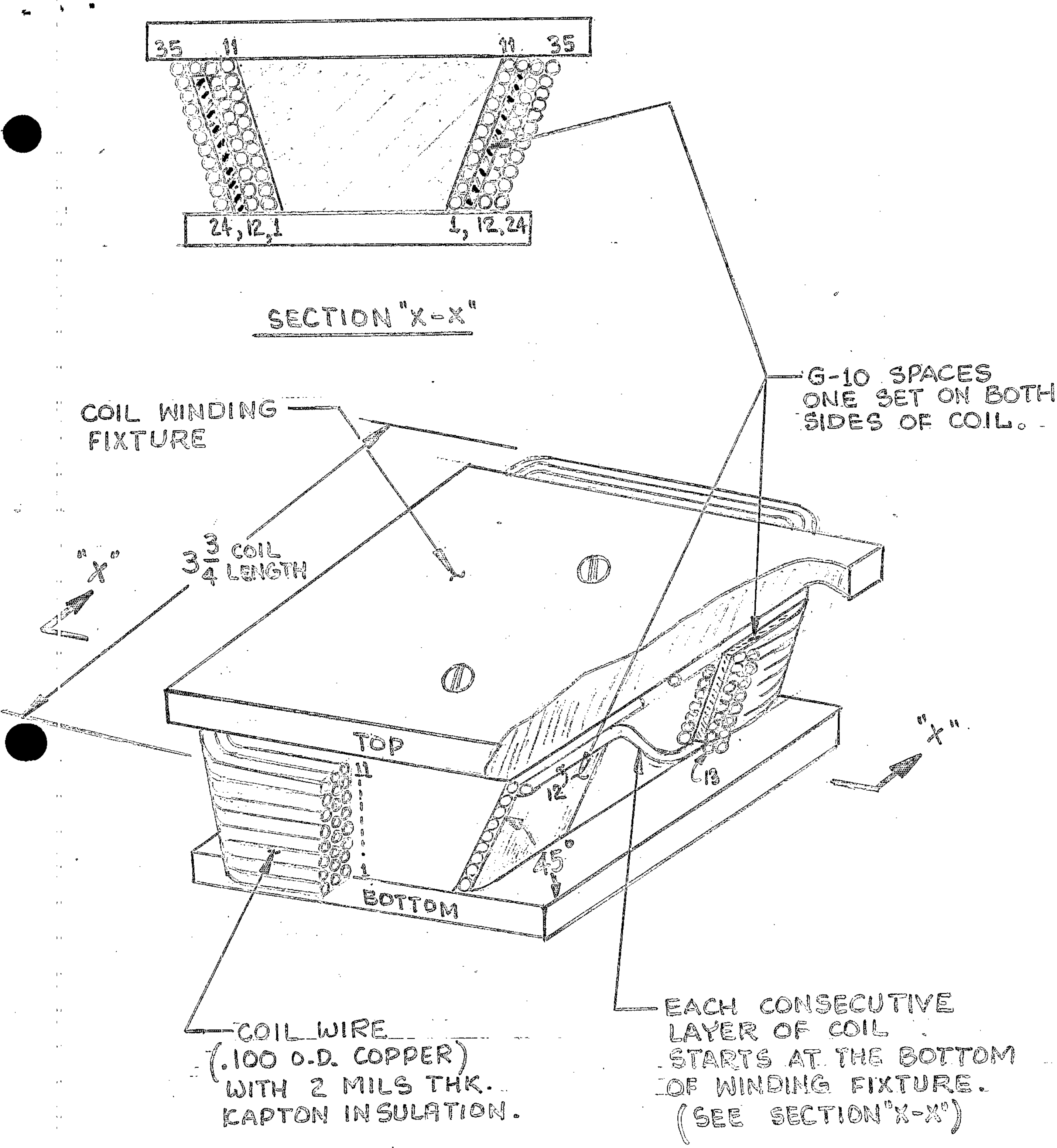


FIG. 4

COIL & COIL WINDING
FIXTURE

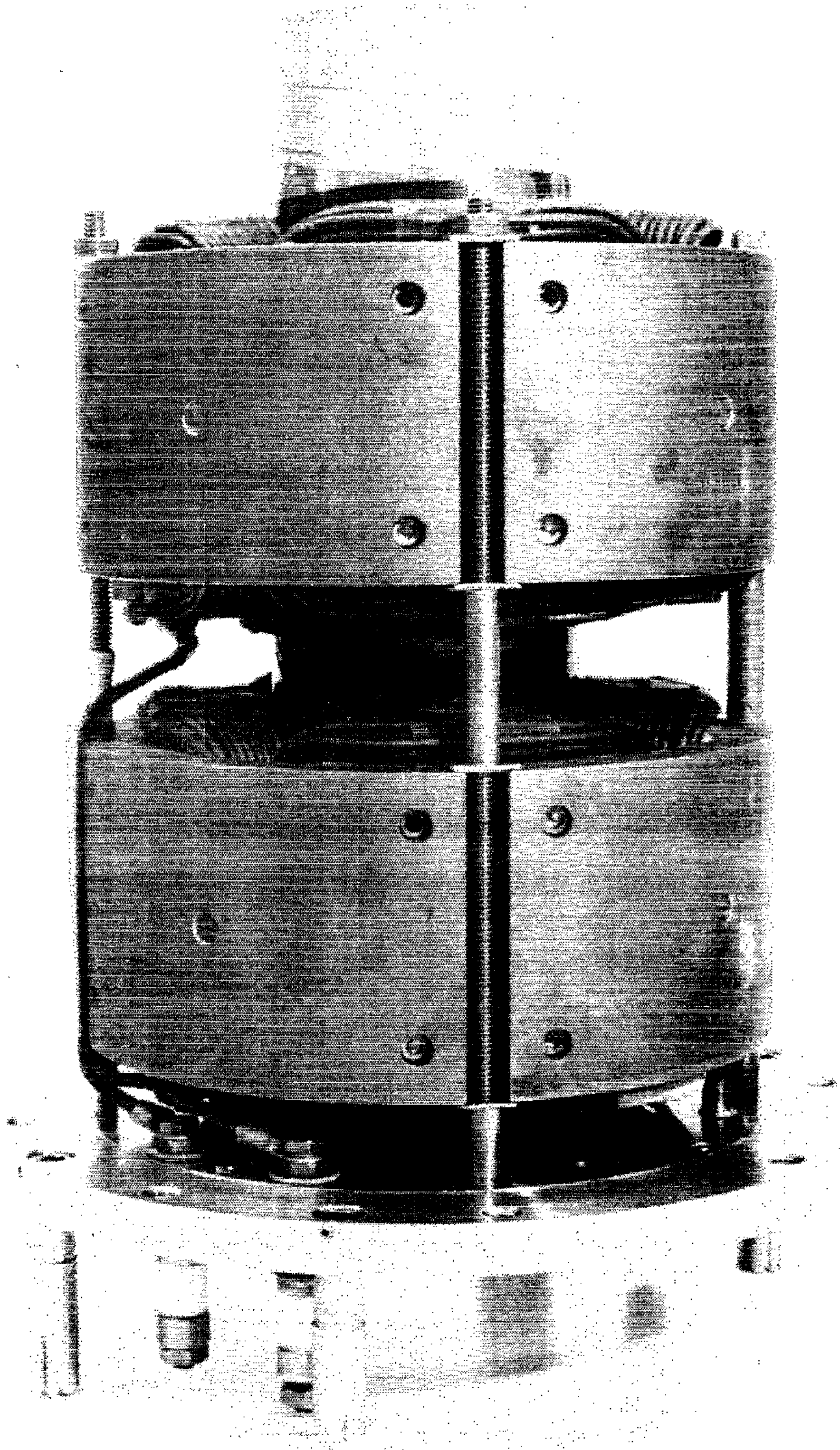


FIG. 5

MAIN ASSEMBLY