

AN ION PIPE. AN EXTREME FORM OF A.G. MAGNET

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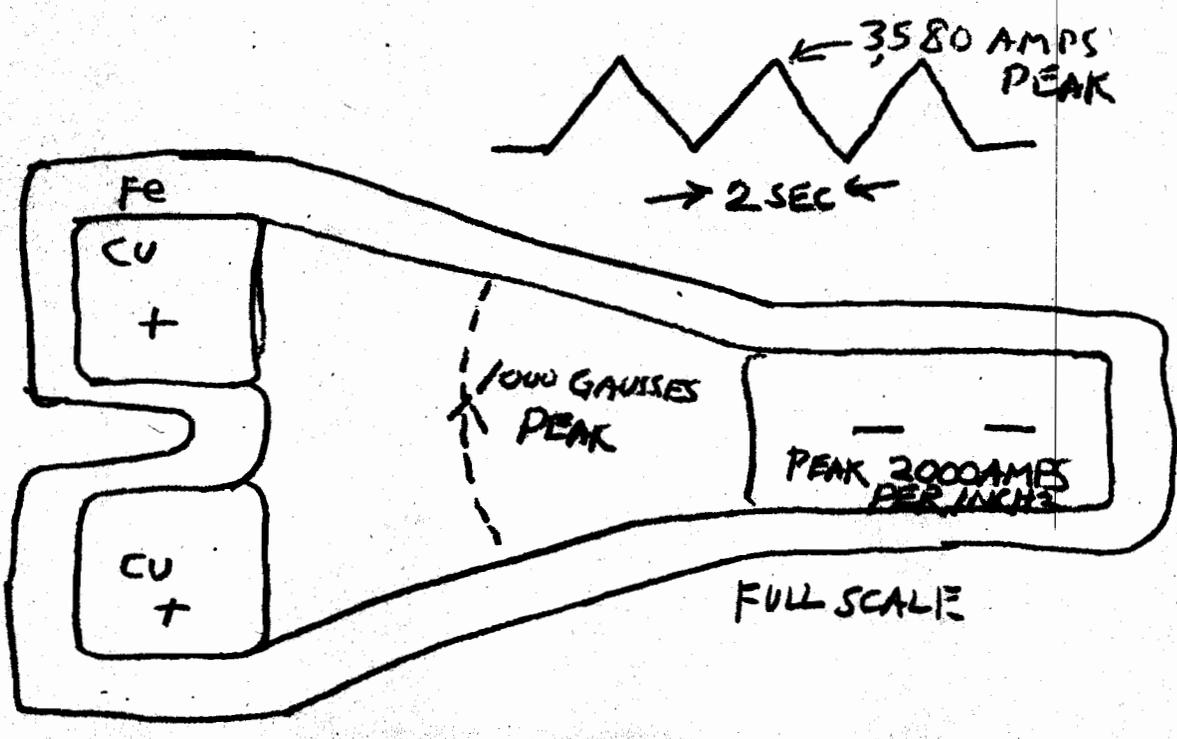
Some of the interesting characteristics of a low field and high n A.G. proton synchrotron are reviewed here.

If we have a small gap (4 cm) and a high magnetic field (14,000 gauss) the coil space is so large that:

- (1) There is much extra stored magnetic energy and flux which must be carried by extra iron.
- (2) There is a long iron path length.
- (3) High remnant field.

If we keep a similar aperture and drop the magnetic field to 1000 gauss we can put the copper right in the field, and the return path is so short that remnant field is low.

Suppose the excitation and the structure are as shown



The skin depth in the iron is about 1.2 cm so it is not necessary to laminate and the structure could take the form of a pipe. The skin depth in the copper is 9 cm so solid bars can be insulated and pressed into thermal contact with the iron pipe. No cooling would be needed in the structure shown.

Energy = 30 Bev

$R_0 = 10^5$ cm

$M = 52,000$

Transition energy = 94 Bev (never reached)

Remnant field = $H_{coercive}$ $l/G \sim 1.2$ gauss

Rotational frequency = 47 kilocycles

Volts/turn = 630,000 volts/turn

Weight of iron = 150 tons

Weight of copper = 163 tons

Power = 0.75 megawatt average

Power factor = 88% (if a flywheel were used it would be just to smooth the load on the utility, not to store magnetic energy)

Magnetic energy = 100,000 joules

At .001 radian of injected beam spread the betatron oscillation is 1 cm

Coil voltage = 55 volts inductive plus
620 volts peak IR

The characteristics of an intermediate machine as pointed out by P. G. Kruger are:

30 Bev, 4,000 gauss, $R = 2.5 \times 10^4$ cm
and $M = 5,200$

Transition energy = 30.3 Bev (approximately at desired peak) so there is no transition problem

Fundamental R.F. = 150 kilocycles

The pipe might have to be replaced by washers (laminations) slipped over the copper conductors.