WORK ON THE ENERGY DOUBLER/SAVER

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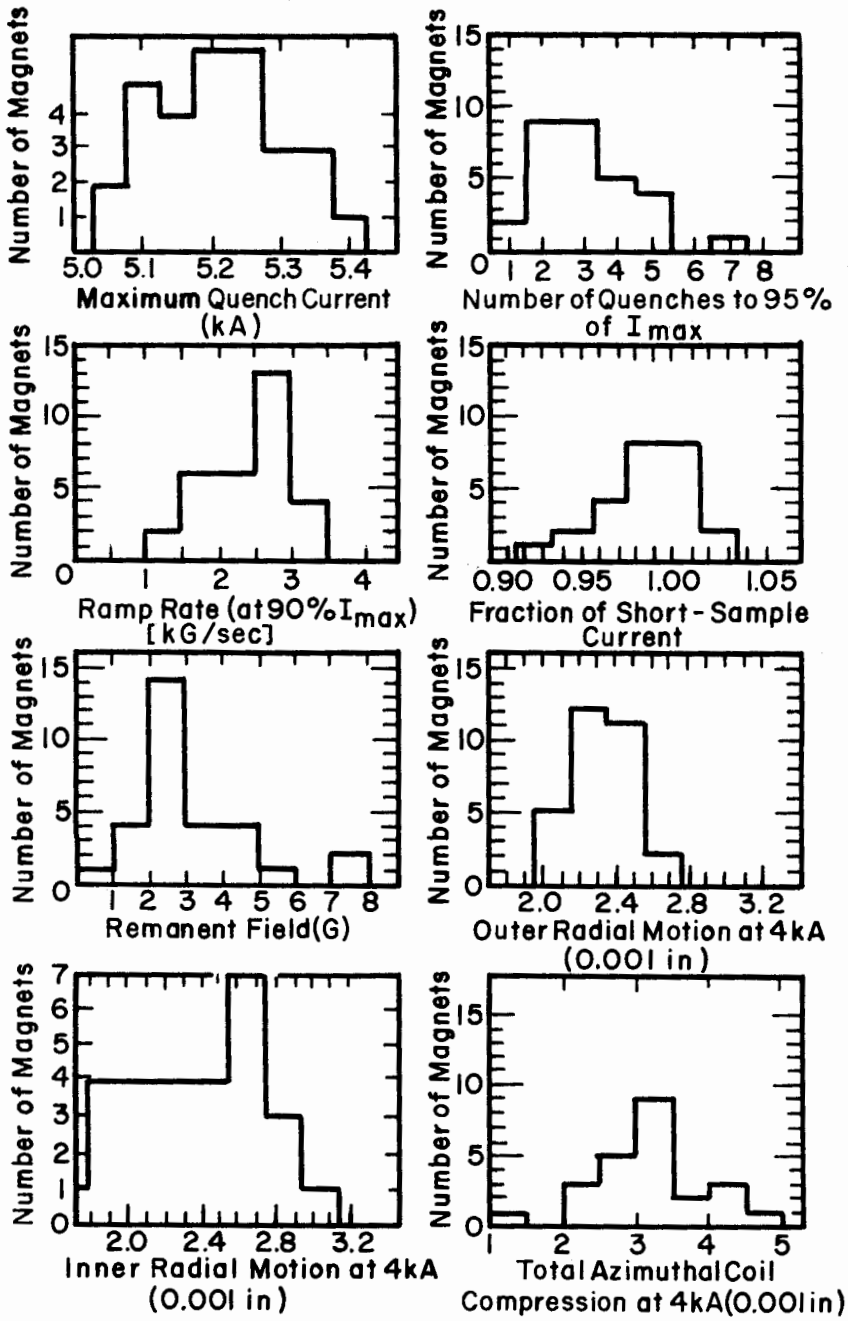
A progress report on the Energy Doubler was given relatively recently in these pages in the January, 1978 Fermilab Report. There have been enough new developments in the intervening seven months to justify another report.

One of the results of the Fermilab Energy Doubler program has been the realization that the design and construction of a superconducting magnet is far more complex than that of a conventional magnet system for an accelerator. In addition there has been until now little or no experience on large systems of superconducting magnets. Remember that in a superconducting accelerator the extensive liquid-helium-temperature refrigeration system adds complexity beyond that of a conventional accelerator. Therefore far more development work is needed for a superconducting accelerator. The Energy Doubler work at Fermilab is now in the stage of designing, building, and testing complete magnet and accelerator systems, moving toward our goal of an installed 1-TeV ring in 1980.

The Sector Test

Twenty dipole magnets have been built and installed in A Sector of the Main Ring as part of the "Sector Test." This is the largest set of superconducting magnets ever built to an identical design and it is of considerable interest to compare their performance.


Number of Magnets
Maximum Quench Current (kA)
Number of Quenches to 95% of I max
Ramp Rate (at 90% I max) [kG/sec]
Fraction of Short-Sample Current
Remanent Field(G)
Outer Radial Motion at 4kA (0.001 in)
Inner Radial Motion at 4kA (0.001 in)
Total Azimuthal Coil Compression at 4kA(0.001in)

The eight histograms on the facing page are distributions among the magnets (including some spares) of the measured properties listed. These performance characteristics show that all the magnets meet minimum standards. They also are more uniform in these characteristics (for example, in maximum quench current) than magnets in other superconducting programs.

These production magnets have also been used in four-magnet string tests of rapid ramping and magnet protection. It has been possible, utilizing a modified Main-Ring power supply to produce successfully the following ramps:

	Injection Energy (GeV)	Final Energy (GeV)	Dwell Time (Sec)	Rise Time (Sec)	Flattop Time (Sec)	Fall Time (Sec)
Energy Saver Ramp	100	500	2	6	2	6
Energy Doubler Ramp	100	1000	5	20	15	20

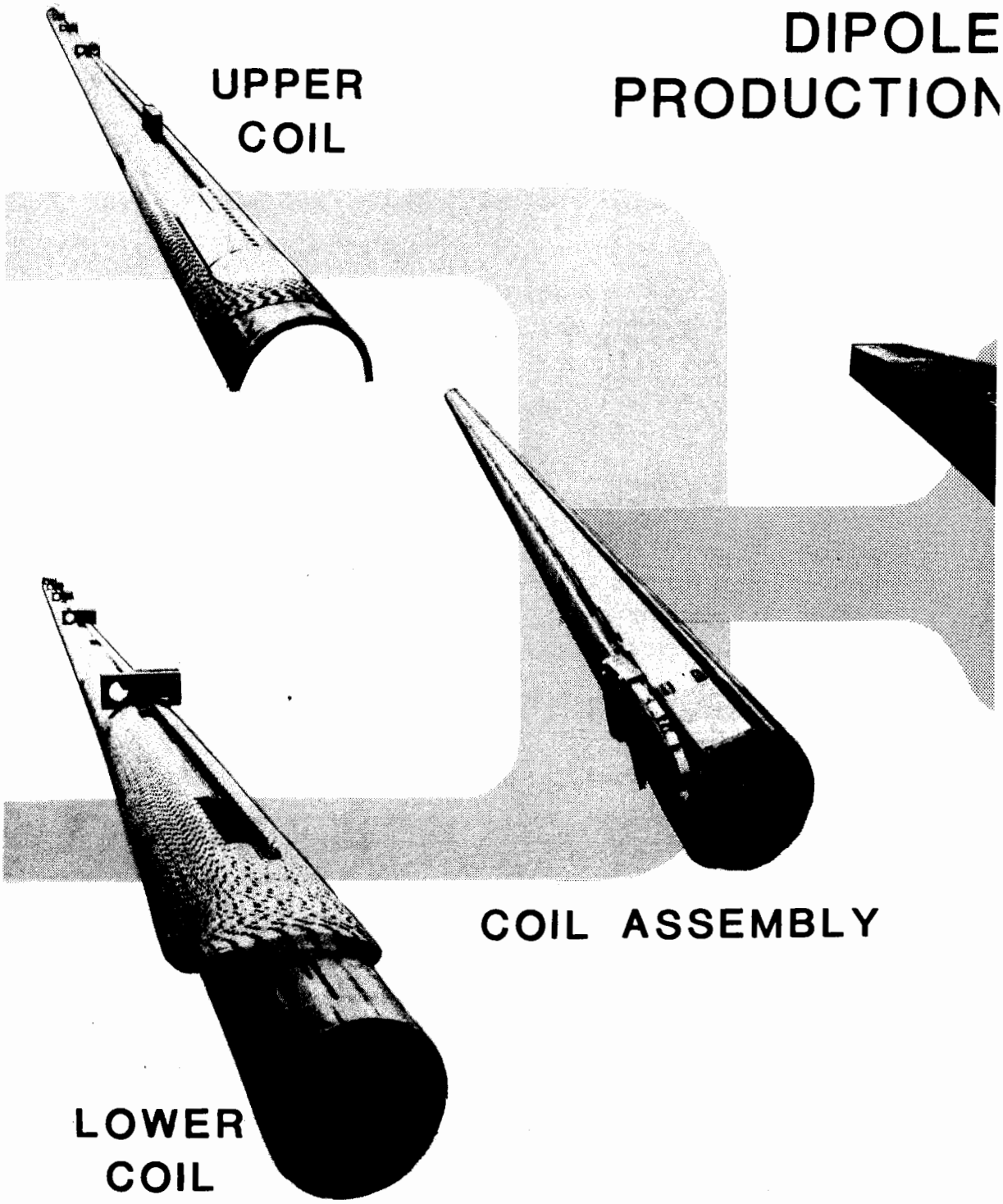
This represents by far the largest energy transfer into and out of superconducting magnets.

Another set of precision measurements has been made of the magnetic characteristics of these magnets. These results are not yet in a form suitable for detailed reporting, but it may be remarked that the magnetic properties of the magnet meet our specifications.

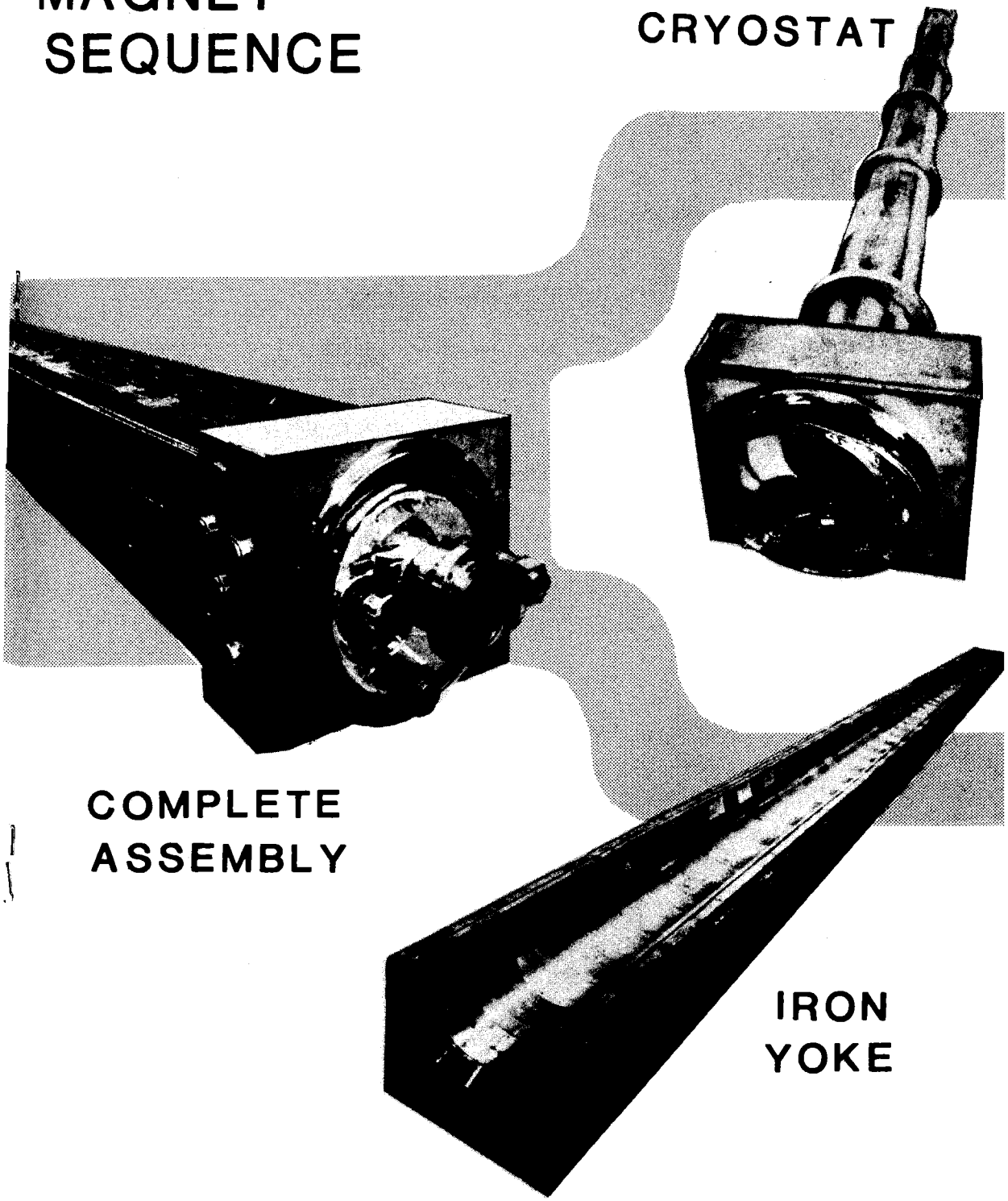
Magnet Design and Assembly

The photographs of the next pages (our centerfold) show the various steps in the construction and assembly of an Energy Doubler/Saver dipole magnet. The upper and lower coils each have inner and outer coils. The coils are clamped in place in a cryostat, which is then installed inside the iron magnet yoke.

DIPOLE PRODUCTION



MAGNET SEQUENCE



Junction Design

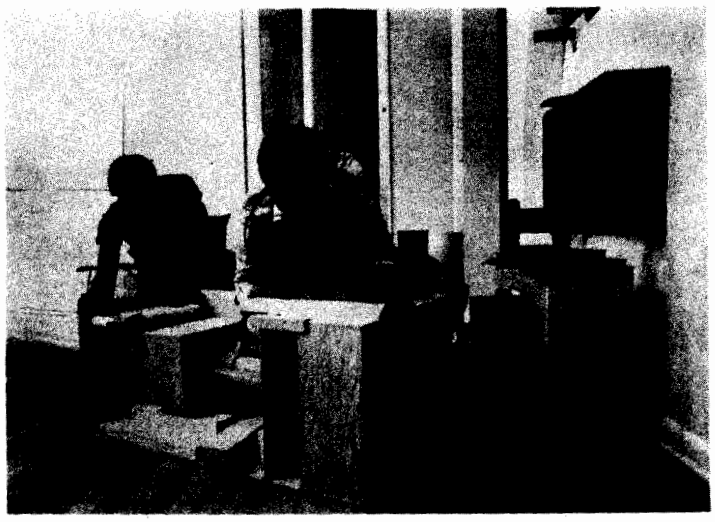
At a quadrupole location, the space between the two adjacent dipoles is 115 in. This space must contain the quadrupole, the correction-magnet package, and one of the following cryogenic assemblies:

A) A standard feedthrough connection.

B) A double turnaround box at the end of two helium runs.

C) Feed point.

Considerable attention is being given at this time to the design of this quadrupole point with all its appurtenances. This design effort includes models of different options, as well as experience gained in the Sector Test. The photograph below is a model assembled to check out the current design.



Model of a quadrupole straight section.

(Photograph by Fermilab Photo Unit)

HIGH-INTENSITY LABORATORY

The new High Intensity Laboratory in the Proton Area came on the air on July 25, when a focused beam of negative pions was detected on a SWIC. The beam was achieved after a two day period of tuning to set up the beam line.

The High-Intensity Area is designed to produce higher-intensity pion and antiproton beams on target than any other facility. It is estimated that beams of 5×10^9 π^- and 10^7 $\bar{p}$ will be produced for 10^{13} protons on target.

Design work began in the summer of 1975. Construction took place in 1976 and 1977 and installation of the beam lines has occupied the last nine months. All groups in the Proton Laboratory participated in the effort, as well as the Architectural Services group, many people in the Research and Accelerator Divisions and several outside contractors.

The first three experiments are to be installed in the next few months and data taking will begin in the middle of October.