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ABSTRACT

A target positioner for use in the accelerating chamber of the Bevatron is described. This positioner has a rise time of 75-msec and an equally fast drivedown. The mechanism has proven reliable to 10^6 cycles between maintenance periods.

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The primary beam cannot be efficiently extracted from the Bevatron, the 6.2-Bev proton synchrotron at Berkeley. An external beam is produced by inserting a target into the path of the circulating primary beam, causing scattering. The secondary beam thus produced is then led off via a suitably located thin metal window in the accelerating chamber.

For many experiments, such as those involving bubble chambers, only a short-duration pulse is needed. Therefore, more efficient use can be made of the Bevatron primary beam by rapidly raising a target, clipping only a fraction of the circulating beam, then driving the target down and raising a different target during the same beam pulse. In this way, several different secondary beams are produced and a corresponding number of experiments can be in progress concurrently.

A target positioner, called the "Mark VIII flip-coil target positioner," has been developed which has a rise time of 75-msec and an equally fast drivedown (Fig. 1). This rapid action in both directions is achieved by rigidly mounting two electrically independent coils at 90° and using them alternately as driver and damper. With this arrangement the net torque causes a rapid increase in angular velocity as the target rotates to 45°, and a rapid decrease in angular velocity (approaching zero)

*Work done under auspices of the U.S. Atomic Energy Commission.

as the target rotates to 90°, reaching the mechanical stop.

The braking action is achieved in the following way: A voltage is generated in the damping coil as it rotates in the Bevatron field. The current flowing as a result of this voltage is controlled by a series resistance varying from zero Ω at 0 - 8000 gauss to 40Ω at 16,000 gauss. If the target were rotated at a constant angular velocity, the voltage in the damping winding would be a sine function. Since the target has a varying angular velocity, ω, the induced voltage is proportional to $\omega \sin \omega t$. The current flowing as a result of the induced voltage generates a magnetic field opposing the rotation of the target. Greatly reduced shock loads and hence higher speeds are possible by programming the series resistance.*

The Mk VIII overcomes a difficulty with earlier target positioners, which used only one coil with damping supplied by an eddy-current vane interacting with the Bevatron field. These earilier positioners developed damping in the upward direction but almost none in the downward direction. As a result, the drivedown had to be relatively slow to avoid damaging the mechanism.

Microswitches are used on the Mk VIII as the primary target-position monitor. Shock load on the switches is minimized by using cam actuation. Two other methods of position monitoring were tried with the hope of obtaining more information than with the microswitch system: a continuous indicating capacitor mounted in the coil region, and voltage monitoring of the damper coil. Unfortunately, both systems are more difficult to set up and properly interpret.

Target positioners of this type have proven reliable to 10^6 cycles between maintenance periods. Modifications in the electronic circuit are now being undertaken which indicate that the rise time may be reduced from the present 75 msec to about 50 msec.

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*Differences in programming are required for operation at different magnetic field intensities, i.e. different Bevatron energies.

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The authors wish to acknowledge the assistance of Robert Edwards, who has contributed many ideas for the improvement of these target positioners.

LEGEND

Fig. 1. Mark VIII flip-coil target positioner in dimmy accelerator gap:

(a) down position: coil A dampe, coil B drives;

(b) up position: coil A drives, coil B damps.

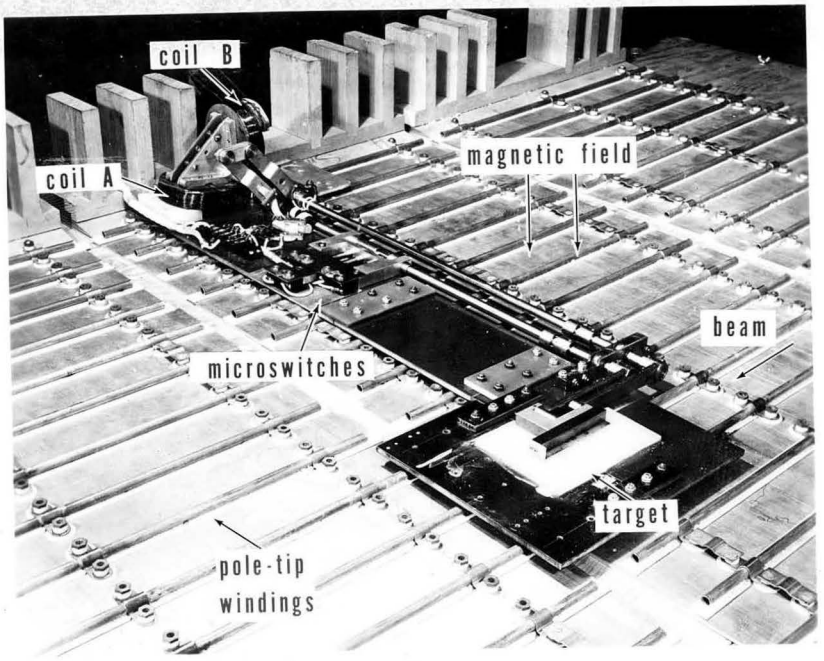
coil B
coil A
magnetic field
beam
microswitches
target
pole-tip
windings

Fig. 1A

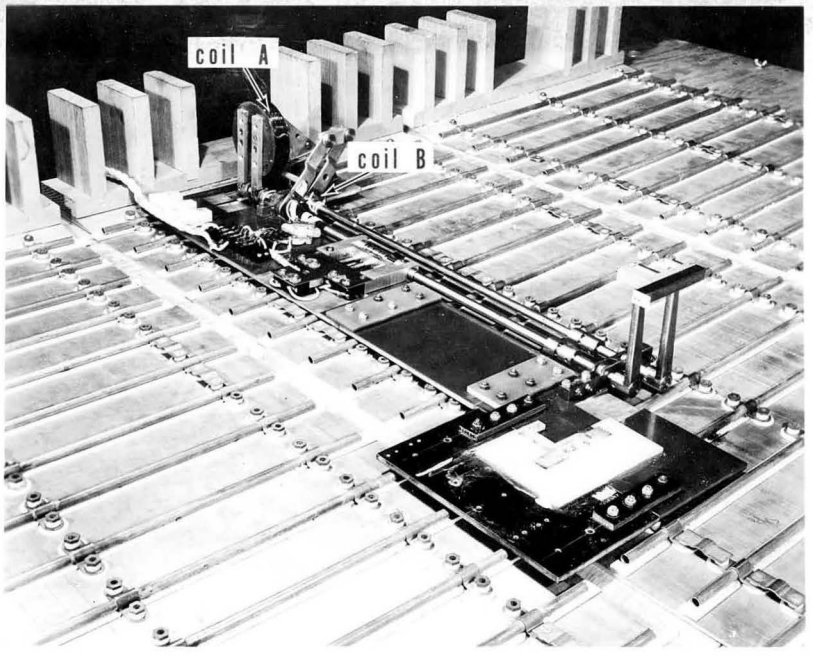
coil A
coil B

Fig. 1B