

THE PLUNGING MECHANISM

NIMROD proton beam is accelerated in a closed orbit and has to be deflected magnetically out of its orbit. This is achieved by arranging for a target to spiral the beam into a quadrupole focussing magnet and thence into an extraction magnet which deflects the beam outwards. To accomplish this without cutting off a major portion of the proton beam, these magnets must move in sympathy with the leading edge of the beam.

The quadrupole magnet weighs about 3 cwt. and the extraction magnet about 1 ton, and they both move radially outwards into the beam orbit a distance of 20 inches, the time for such movement can be varied and may be as short as 200 milliseconds (0.2 seconds). The dwell time before return may also be varied and the whole cycle may be repeated as frequently as twice per second.

These movements or plunging actions are obtained from an oil hydraulically operated ram driven by a variable delivery pump. The output of the pump is controlled by a small electro-hydraulic servo valve fed from an analogue control system. Safety devices and interlocks are built in to the control system to cater for faults such as excess position error and pick-off failure.

The ram and cylinder, variable delivery pump, servo valve, electric driving motors, auxiliary pumps, hydraulic circuit and oil tank are assembled on a steel structure. This assembly is held down on to a fixed steel bedplate with preloaded clamps, the fixed bedplate being solidly bolted to the main magnet monolith. Adjustment to the terminal position of the 20 inch stroke is made by a suitably interlocked hydraulically operated clamping system. Variation in the weights and inertia of the magnets is catered for by adjustment to the ram operating pressure and control characteristics.

Each magnet and its undercarriage move on a three rail system, two outer rails supporting the weight, the centre rail controlling direction. Columns from floor level pass through the base of the Straight Section box to support the rails, bellows being provided between the base and the column to ensure vacuum tightness and to prevent loads and vibrations from the magnet being transmitted to the box.

A hollow steel shaft connects the magnet to the ram, the connection being a friction coupling which permits a small free endwise movement of the shaft relative to the ram which caters for fault conditions in acceleration or retardation. The steel shaft passes through a self-aligning seal assembly where it passes into the high vacuum of the straight section box.

Trials with the mechanism are shown below in Fig. 1 and a fully commissioned mechanism shown in Fig. 2, can be seen in the Magnet Room.

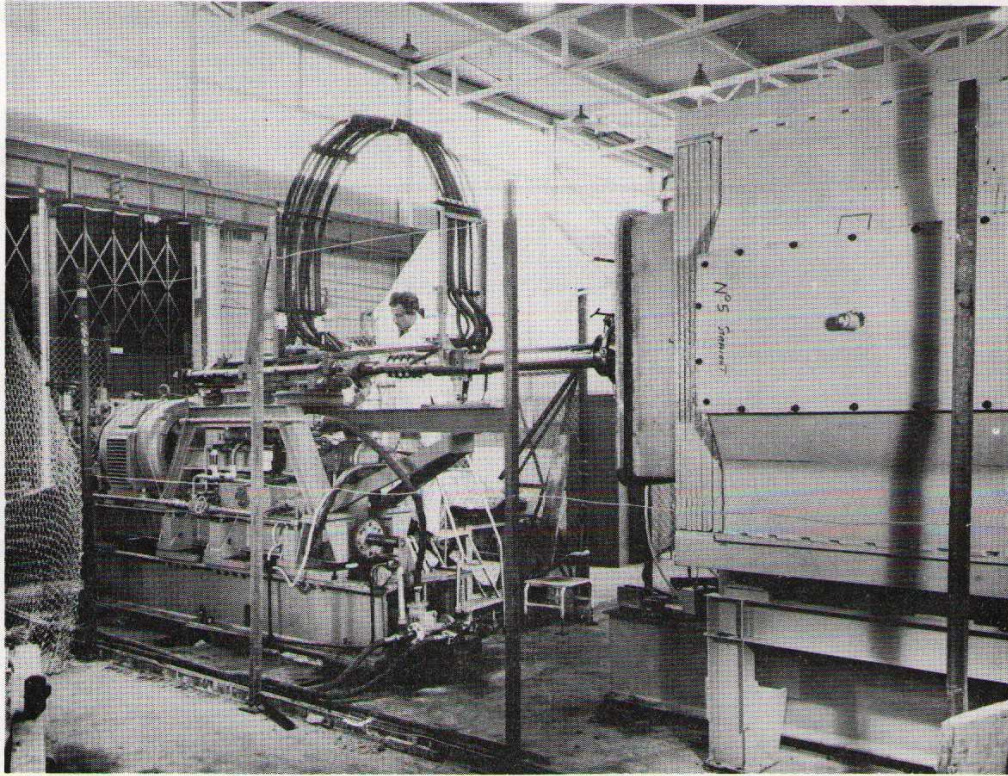


FIGURE 1. TRIALS WITH PLUNGING MECHANISMS

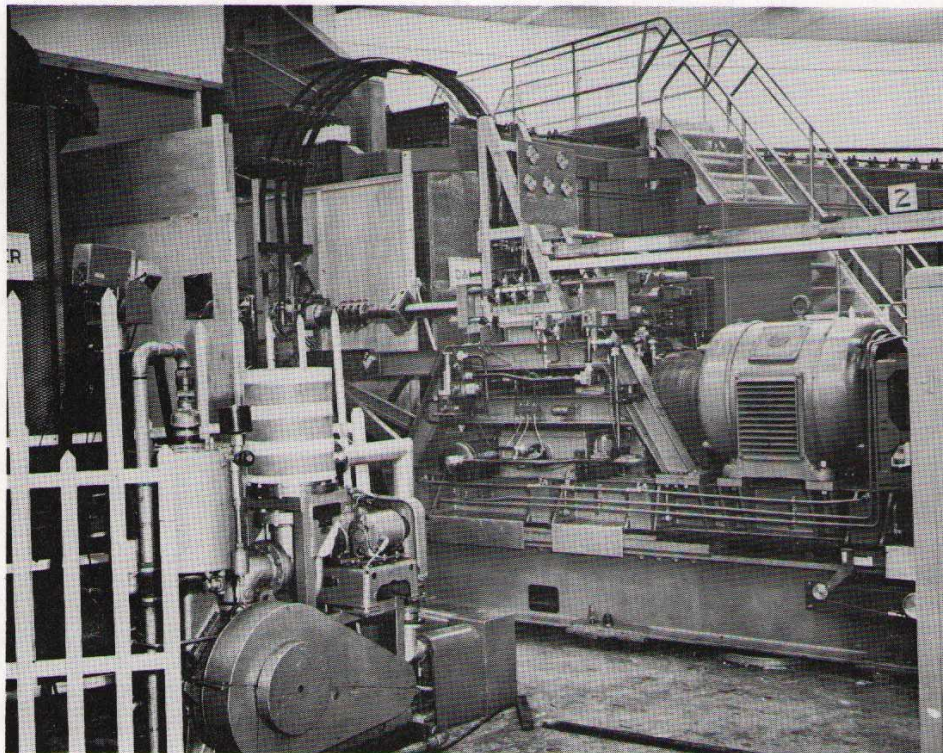


FIGURE 2. PLUNGING MECHANISM IN NIMROD