Rutherford Laboratory

Technical Leaflet

A 5.1

PEAKING STRIPS FOR THE NIMROD MAGNET

The pulsed magnet of Nimrod runs at its own rate and the rest of the machine is synchronised to it. Peaking strips are the devices which produce signals to initiate the cycle.

One peaking strip triggers the injection of the protons into the magnet ring and starts the radio frequency sweep generator linking the frequency of the accelerating cavity to the magnetic field, and a second starts a train of marker pulses at 20 gauss intervals. A peaking strip is shown in Fig.I and consists of a fine mu-metal wire two inches long carrying a central coil of 3,000 turns which responds to flux changes within it. The magnetisation of the mu-metal wire is saturated in the opposite direction to the field in the magnet by an air-cored solenoid. When the magnet's field is sufficient to overcome that of the solenoid, the wire switches to saturation in the opposite direction, the sudden flux change producing a pulse in the pick-up coil which is amplified, shaped and sent to the injector or r.f. generator.

A very exacting requirement of the design was a stability of 0.01%, or 30 milli-gauss in 300 gauss, which meant that the current in the solenoid had to be stabilised to the same accuracy against both a.c. noise and slow drifts. Furthermore, the high rate of rise of the magnetic field (up to 20,000 gauss/second), required the output pulse to occur within a few microseconds of the time of the required field level.

The stabilisation of the current was achieved with the simple servo loop shown in Fig. 2. A very stable reference voltage, produced by a zener diode circuit, is subtracted from the voltage developed in resistor R_1 which carries the solenoid current. The difference is then amplified and fed back. The temperature of R_1 is thermostatically controlled to 1°C while resistors R_2 and R_3 have temperature coefficients which are accurately matched.

To obtain the necessary dimensional stability, the solenoid is impregnated with epoxy resin and coated with copper to avoid out-gassing. The copper coating is divided into strips to reduce the eddy currents which would otherwise modify the field produced by the solenoid. Each solenoid is connected in opposite sense to a similar solenoid which cancels voltages induced by the rising field.

The exhibit shows a complete assembly, and a separate mu-metal wire with its pick-up coil. The wire is threaded down a glass capillary tube for protection and the whole sub-assembly is impregnated in epoxy resin.

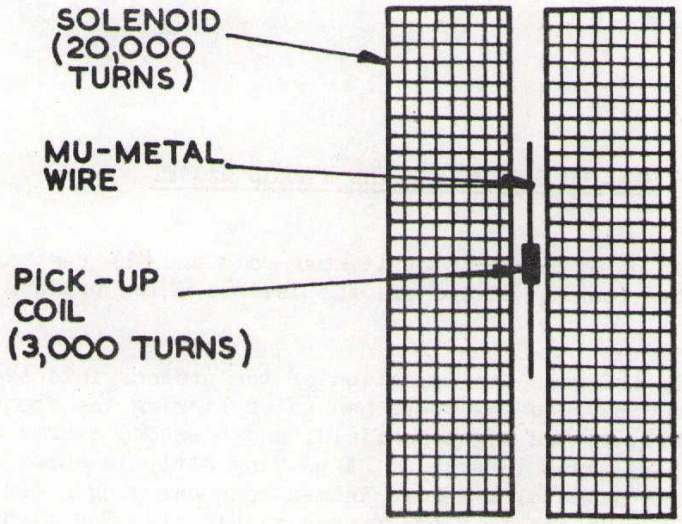

FIGURE 1

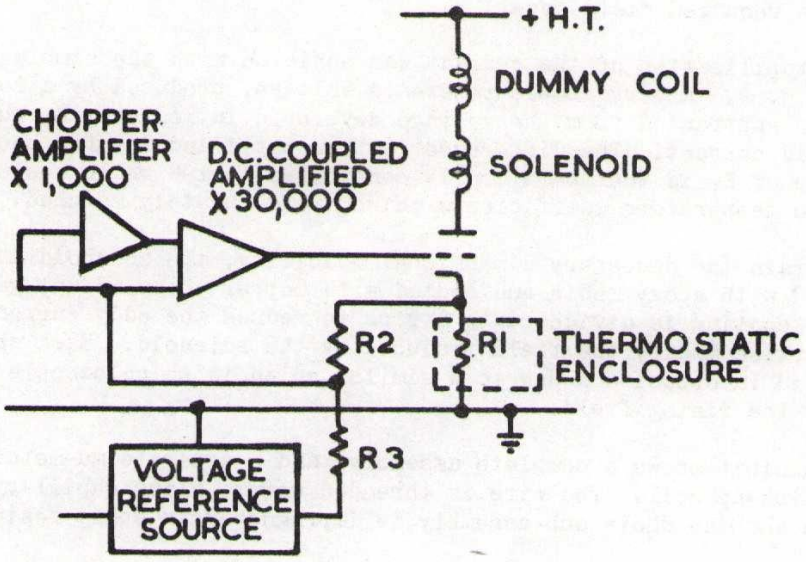

FIGURE 2