Rutherford Laboratory

Technical leaflet

SIGNAL SIMULATOR

Much of the equipment in Nimrod is synchronised to the magnet and consequently stops running when the magnet power supply is off. Since its stability is improved if it is run continuously, equipment has been designed to substitute an artificial set of synchronising signals as soon as the power supply stops.

The signals needed (Fig. 1) are:-

(1) A series of seven pulses separated by time intervals ranging from 5 msec. to 1sec.

(2) Three pulses, normally at fixed fields early on in the magnet cycle, derived from Peaking Strips.

(3) A pulse train at eight times the repetition frequency of the magnet cycle.

(4) A voltage normally proportional to the rate of change of field in the magnet gap. This is a roughly rectangular waveform.

All repeat at the magnet repetition frequency of $\frac{1}{2}$ cycle/second.

All the pulses are generated by delay circuits connected in cascade (Fig. 2). The timing is performed by resistance and capacitance using, in most cases, solid tantalum electrolytic capacitors. Mullard 100 Kc/s Circuit Blocks are used largely, the smaller delays being generated by OS2's and the larger ones by a special oscillator using the PS1. Delay 4 is used twice over in the cycle: once between pulses 5 and 8 and again between pulses 9 and 10. The bistable and gates 2 and 3 perform the appropriate switching for this purpose.

The repetition period and the delays are adjustable so in order to avoid the ill effects of an operator setting up a repetition period less than the cycle length determined by the delays, gate 1 shuts off the repetition pulses until the cycle has finished. It is also used to stop the simulator functioning while the magnet is running.

Switching Circuit

To disconnect the pulses coming from the power supply and switch in the artificial pulses requires reliable switching circuits. Fig. 3 shows one of the circuits used. It is entirely electronic and automatically goes over to the power supply pulses if the control line becomes open circuit. D1 and D2 are an AND gate for positive pulses, and D3 and D4 an AND gate for negative going (with respect to the positive line) signals. The power supply pulses

are the positive ones. When the control line is disconnected from ground it rises to the positive line, opening the gate D1, D2 and closing D3, D4. When earthed, the reverse happens. The positive pulses are inverted before reaching the output.

Take-Over Sequence

This has been designed so that the power supply does not break into the middle of a simulated cycle when it starts up again. When the operator presses the start button a signal is sent to the simulator. When it reaches the end of its current cycle, the simulator stops, switches over to the power supply signals, and sends a signal back to the power supply to start up.

Field Signal

The voltage proportional to rate of change of field can be simulated by a rectangular waveform. This is generated very simply by a mercury wetted reed switching a stabilised d.c. source. The timing is satisfactory, the contact closure being within a millisecond of the trigger pulse initiating it. The mercury wetting provides a make and break which is free of bounce.

Position

The simulator may be seen functioning in Rack 55B at the rear left hand end of the Nimrod Main Control Room in Building R2.

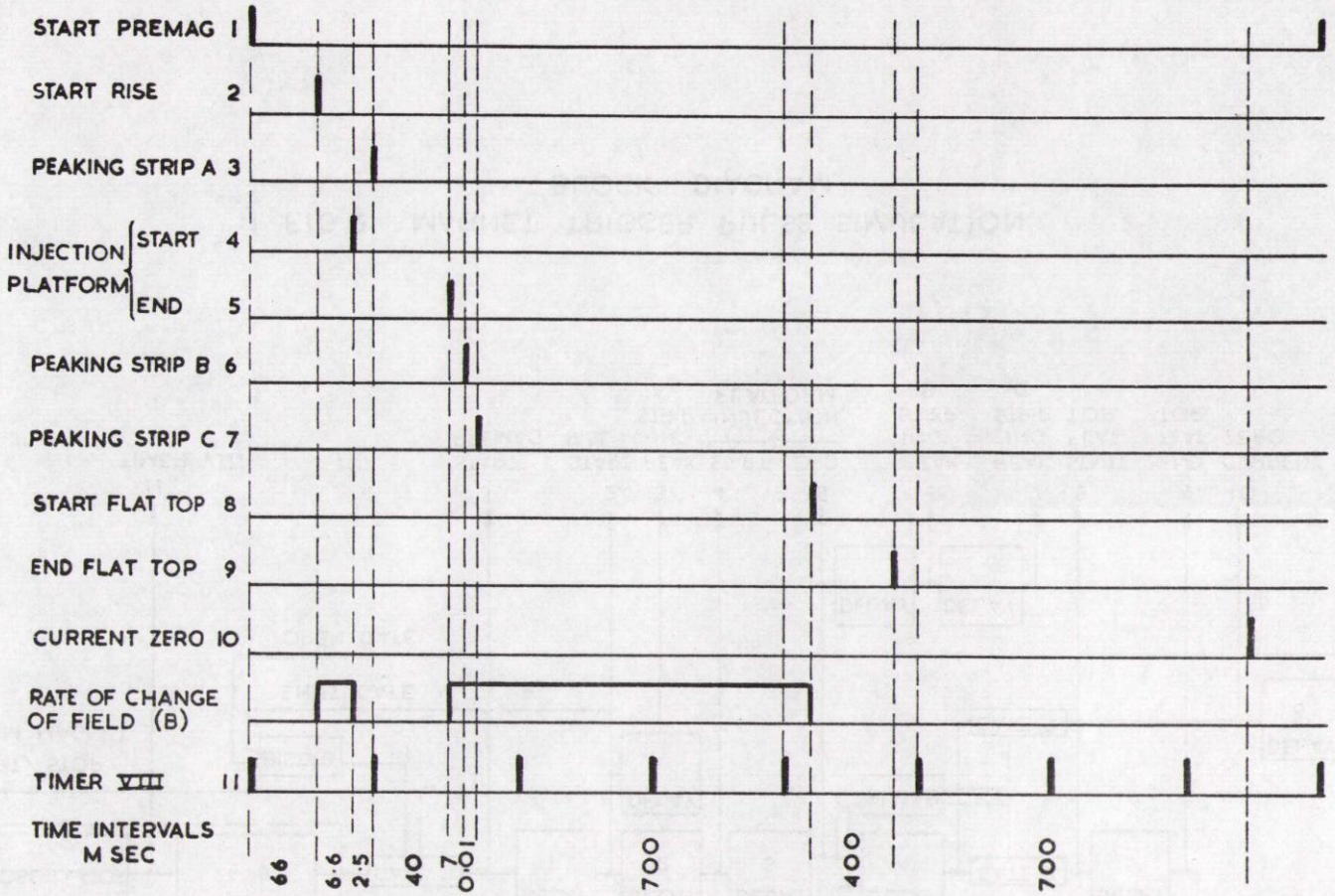

FIG 1 MAGNET SYNCHRONISING SIGNALS

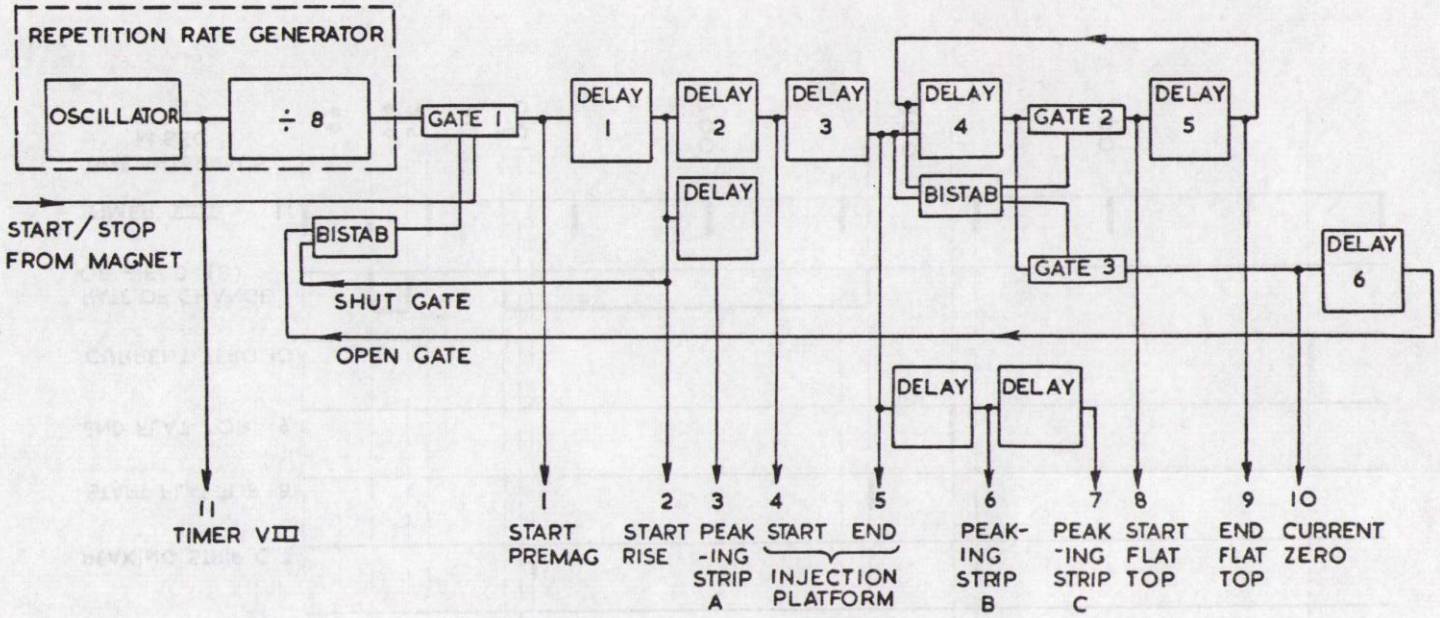

FIG 2. MAGNET TRIGGER PULSE SIMULATION BLOCK DIAGRAM.

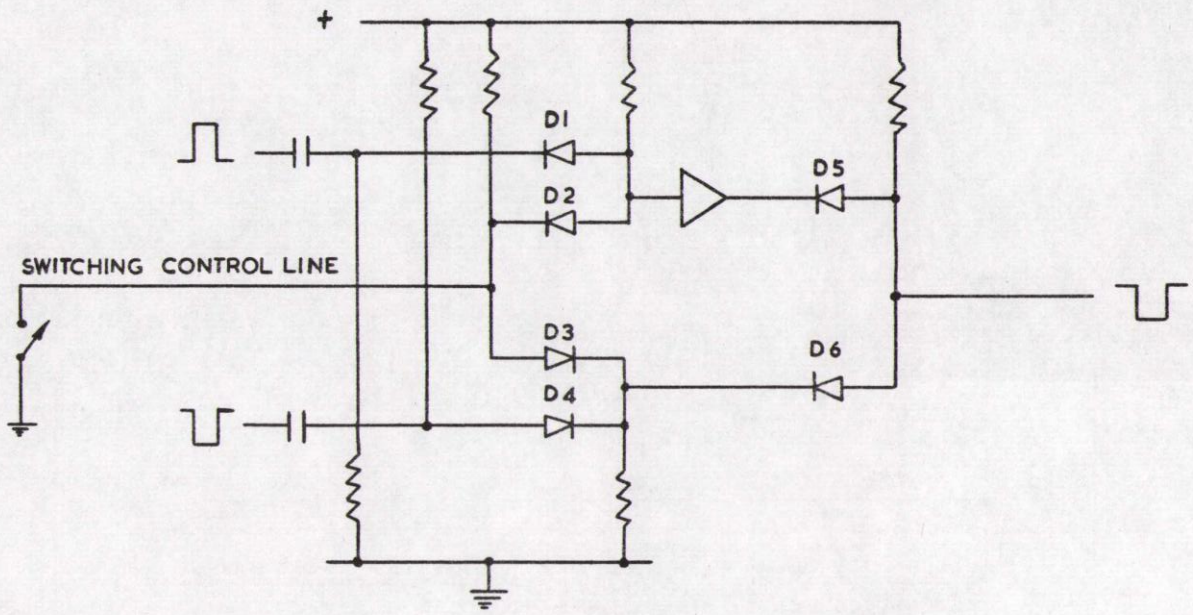

FIG 3 SWITCHING CIRCUIT