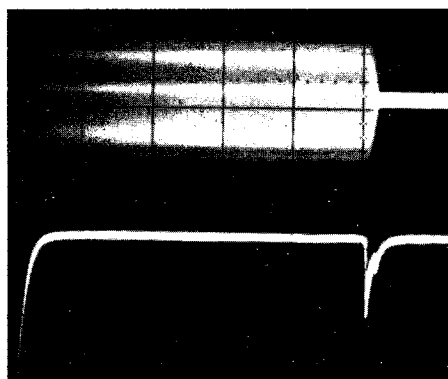


News from abroad



An oscilloscope photograph, taken in the control room at the Daresbury Laboratory on 2 December, showing the first acceleration of electrons to high energy in Nina.

The top trace is taken from a pick-up electrode in the machine which sends out its signal each time the electron beam passes.

The trace starts on the left when the electrons are injected and moves across the screen to the right, each graticule division in the horizontal direction being equivalent to 2 ms. The pick-up electrode therefore indicates that electrons were orbiting the machine for about 10 ms. In this time the magnetic field rose to a value near that required to hold 4 GeV electrons in the ring.

The lower trace comes from a scintillation counter which sends out a signal when charged particles pass through it. On the left the trace dips when electrons are lost from the beam while injection is in progress. It then remains steady until, after about 10 ms at an energy near 4 GeV, another dip records a high energy spill of electrons from the beam.

Nina in action

The electron synchrotron, Nina, at the Daresbury Nuclear Physics Laboratory, UK, produced its first high energy beams on 2 December 1966. The following day the design energy of 4 GeV was reached and an energy of 4.5 GeV was achieved on 5 December.

Nina joins two other electron synchrotrons, DESY at Hamburg, Federal Republic of Germany, and CEA at Cambridge, USA, as the major electron circular machines in the world. (A similar machine is under construction at Erevan in Armenia.) Within the UK itself, it is complementary in its physics potential to the proton synchrotron, Nimrod, at the Rutherford Laboratory. It is also complementary in its siting, in the north-west of England to serve particularly the northern universities, such as Manchester, Liverpool and Glasgow, whereas Nimrod is more conveniently positioned for the southern universities such as London, Bristol and Southampton.

The decision to build Nina was taken in 1962 and work began on the site in November 1963. In order to have the machine ready for physics as quickly as possible the machine designers drew heavily on the experience of CEA and DESY and succeeded in constructing and commissioning the machine in a very short time. Teams are already setting up their experiments in the experimental hall and it was hoped to provide them with their first photons in January.

Nina is an alternating-gradient synchrotron with a ring 70.2 m in diameter with 40 magnet units and 5 radio-frequency accelerating stations. Each magnet unit is 3.3 m long separated by straight-sections alternately of 1 m and 3.5 m. The longer straight-sections give easy access to the beam for experiments. The design energy is 4 GeV but the magnet and power supply system is capable of perhaps as much as 5.3 GeV. Injection is from a 40 MeV electron linear accelerator, which will also be able to inject positrons if desired at some later date. One of the most important design features is that it should be possible to accelerate currents in excess of 1 μ A and possibly up to 10 μ A. If this can be achieved it will make the beam

intensity in Nina considerably higher than in any other electron synchrotron in the world.

The results coming from CEA and DESY have already shown that the field of particle physics to which Nina will contribute is full of interest. The experimental programme will cover such topics as the study of the structure of the nucleon (pioneered on the Mark III Stanford electron linear accelerator), the study of resonances and short-lived particles (where beams of electrons and photons can have some advantages over the conventional beams at proton accelerators) and refined tests of quantum electrodynamics.

The Director of the Laboratory is Professor A. Merrison, now Professor of Experimental Physics at Liverpool University, who was a well-known experimenter at CERN in its early days. We congratulate Professor Merrison and his staff on their achievement and wish the Laboratory a very successful future in particle physics research.

Weston wins

The decision on the site for the proposed USA 200 GeV accelerator was announced on 16 December. From more than 200 sites, 85 were investigated by the National Academy of Sciences to arrive at a short list of six in April 1966 (Ann Arbor, Michigan; Brookhaven; Denver, Colorado; Sierra foothills, California; Madison, Wisconsin and Weston, Illinois). From these, the US Atomic Energy Commission selected Weston a suburb of Chicago, not far from the Argonne National Laboratory where there is a 12.5 GeV proton synchrotron (ZGS).

The decision placates the Mid-Western States who have complained of the brain-drain within America to the centres of big science on the East and West coasts. The site has 6800 acres of flat land and is about 50 km south-west of the Chicago airport which is served by planes from many cities in the USA and from Europe. This accessibility to scientists from throughout the USA was no doubt another factor in the decision.

The Atomic Energy Commission plan to ask for \$10 million for continuing design work in 1968 (the initial design study was

The magnet ring of Nina where it passes through the experimental hall. Almost in the centre of the photograph can be seen one of the radio-frequency accelerating cavities with its wave-guide. When the machine is in operation this section of the ring is surrounded by shielding to keep the radiation produced in the ring, down to acceptable levels in the experimental hall.

done at Berkeley, California) and for money for the actual construction of the machine at an unspecified later time.

Experiments at Stanford

Experiments began at the end of November 1966, at the Stanford Linear Accelerator Centre using the 20 GeV linear accelerator. This was six months ahead of the original schedule. Electron beams with an energy of 10 GeV were achieved for the first time in May 1966 and since then the available energy has been increased so that beams in the energy range 10 to 18 GeV can be used in the experiments.

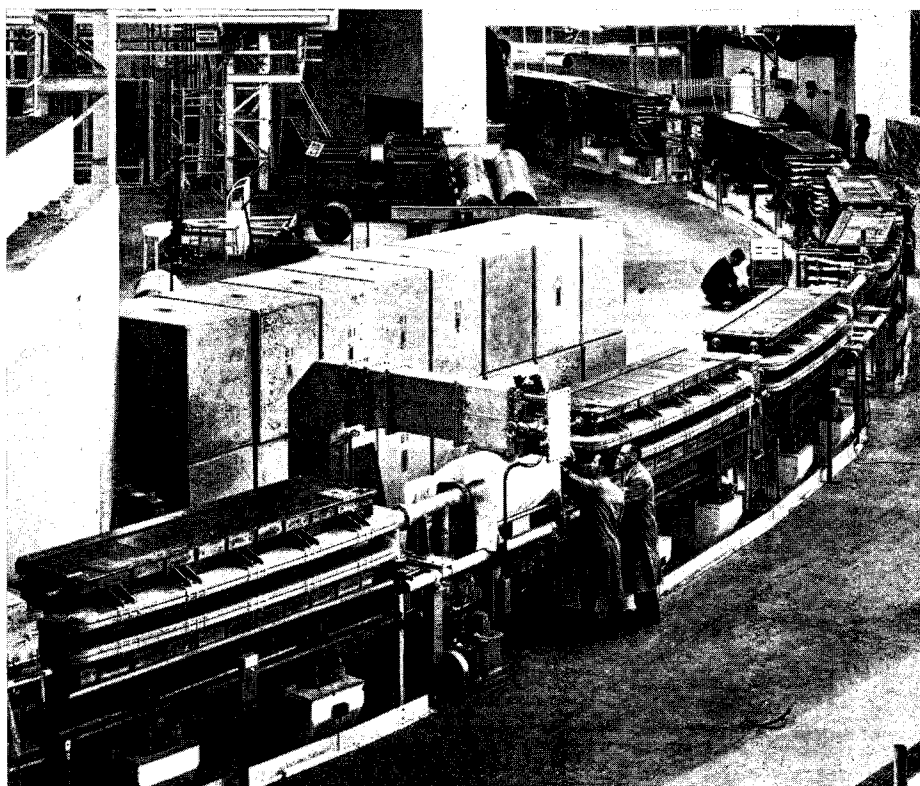
At present, about half the operating time is given to the physics programme and the other half to improving the performance of the accelerator itself. By mid-1967 it is intended to give 90 % of the operating time to the experimental programme.

Gravity

The preliminary results of a highly refined experiment carried out by Stanford University physicists F.C. Witteborn and W. M. Fairbank were announced at the end of December. They have succeeded in measuring the effect of gravity on electrons, the lightest of all the particles.

The difficulty of the experiment however does not lie in the light weight of the particle but in the fact that the force that the electron feels due to gravity is very much weaker than the electromagnetic force that it feels from other charged particles. The force on an electron due to the gravitational field of the whole earth is equaled by the force on an electron due to another electron at a distance of about 5 m by virtue of their electric charges, and this electromagnetic force grows more powerful the nearer the charged particles are together. Thus, to look at the effect of gravity it is necessary to shield the electron as far as possible from all electromagnetic fields including those from the material used in the experiment itself.

The electrons emerged from a cathode positioned at the bottom of a vertical copper tube 5 cm high which served to shield



the particles from external fields. A large superconducting magnet formed a 'magnetic bottle' for the electrons in the centre of the tube. Most of the electrons emerged from the cathode with velocities too high to be measured but a few were moving slowly enough for the time that they took to spiral up to the top of the tube to be measured with an accuracy of about 2 %. The gravitational force could then be determined from the flight times of these slow electrons and by measuring the electric field required to prevent a slow electron from accelerating.

The experimenters now hope to look at the effect of gravity on positrons (anti-electrons) and a positron source is being developed. The problem here is to obtain positrons with sufficiently low energies and the source consists of a radioactive positron emitter followed by gas to slow down the positrons before they enter the copper tube. If measurements on anti-matter prove feasible, they will be a test of the idea, beloved of science fiction writers, that anti-matter may fall up instead of down in a gravitational field.

Cosmotron

On 30 December 1966, the world's first proton synchrotron to contribute to particle physics — the Cosmotron at Brookhaven National Laboratory, USA — was closed down. The machine began operation in 1952, and was capable of a maximum energy of 3 GeV. With the advent of the 33 GeV machine at Brookhaven in 1960, the high energy physics experiments went more and more to the bigger machine. The Cosmotron thus became the first major accelerator to suffer from the recommendation in the Ramsey Report of 1963 that 'accelerators which become relatively unproductive' be closed down.

Quite recently however there has been increasing use of the Cosmotron for nuclear structure research and considerable efforts have been made to persuade the US Atomic Energy Commission to provide the money for continued operation. It is still possible that this will come about. The machine is not yet being dismantled and we may not have heard the last of the Cosmotron.

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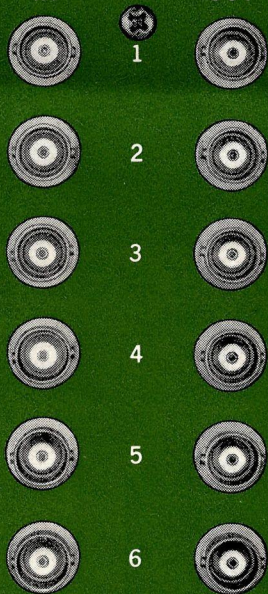


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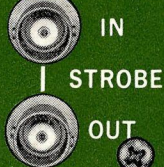
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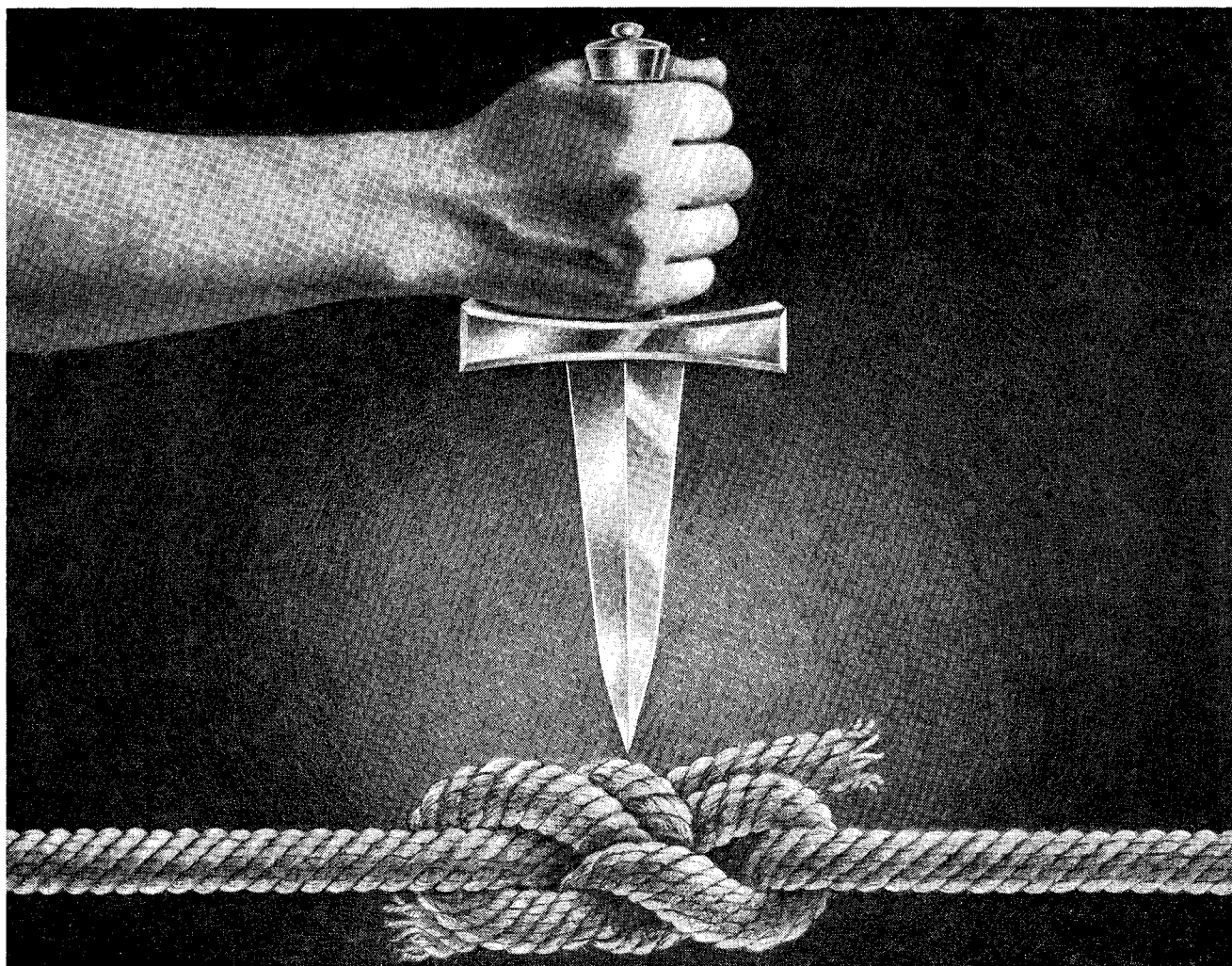
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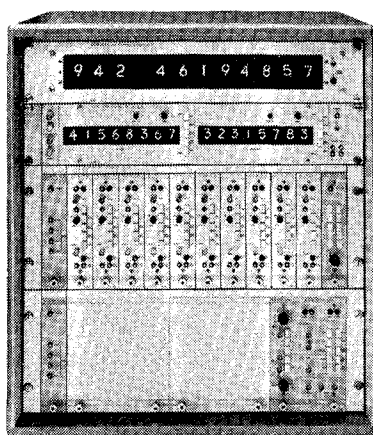
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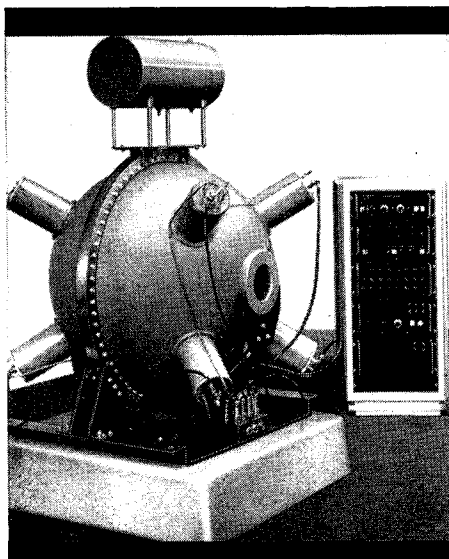
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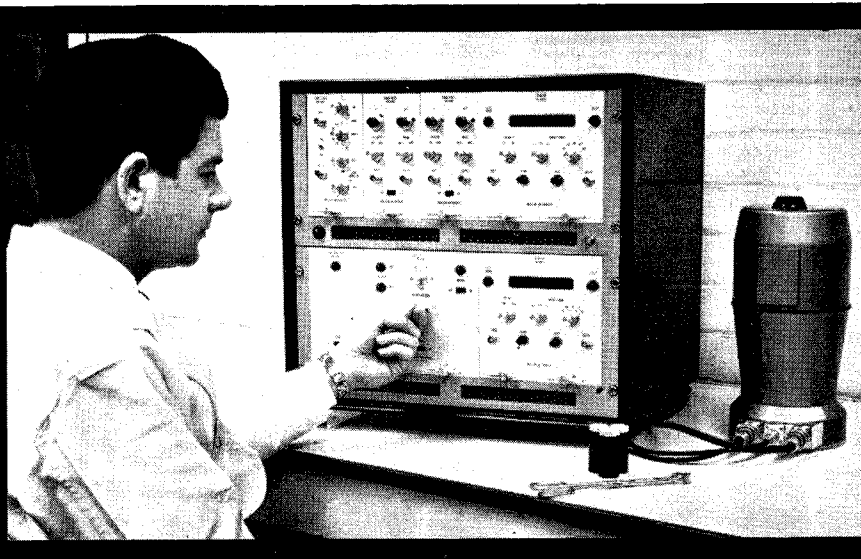
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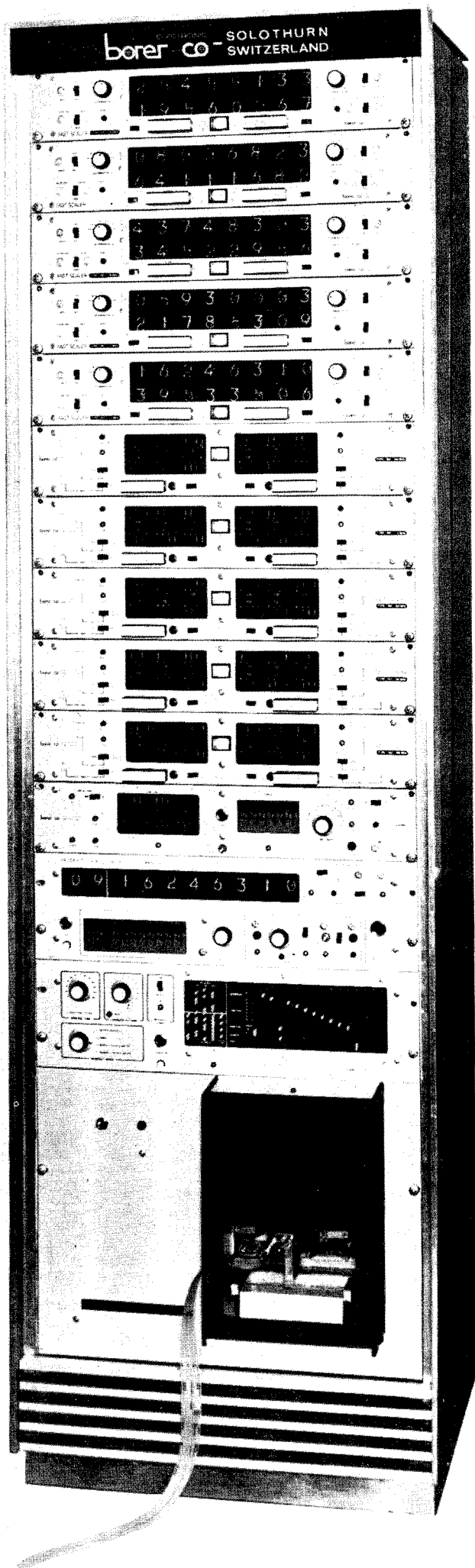
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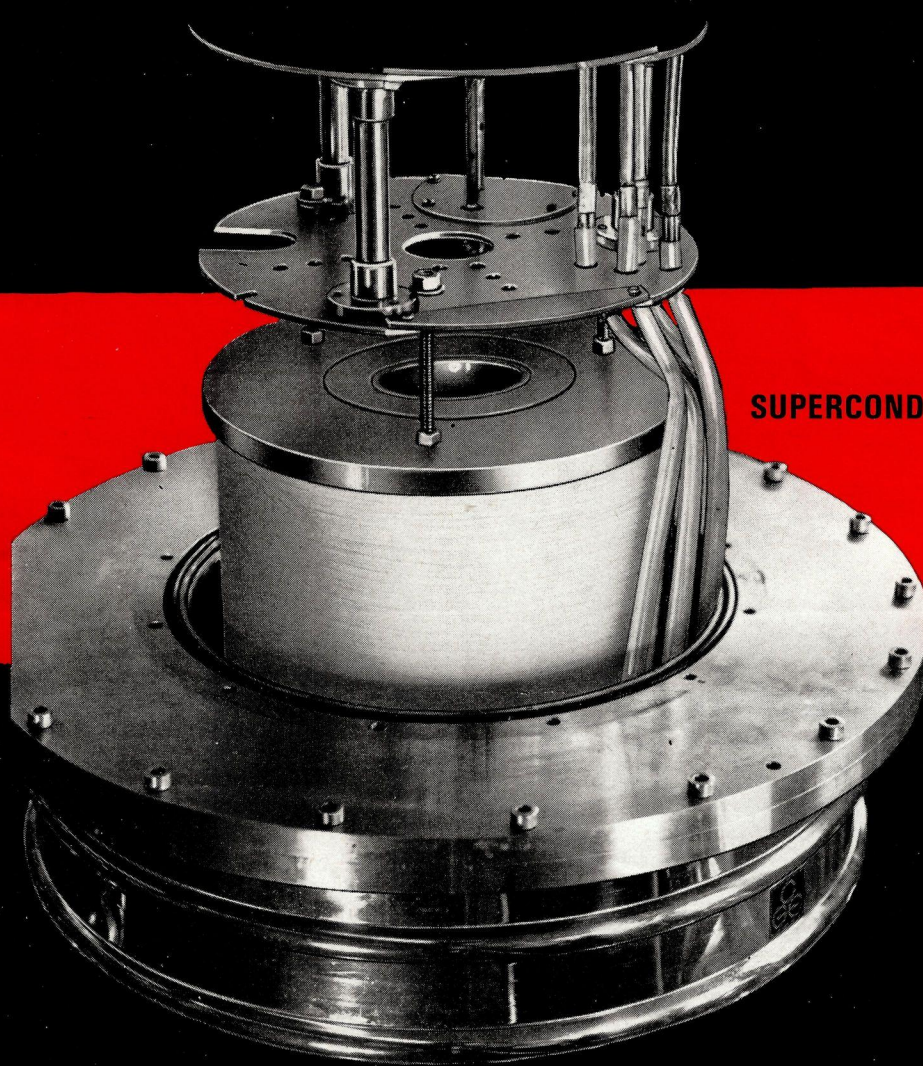
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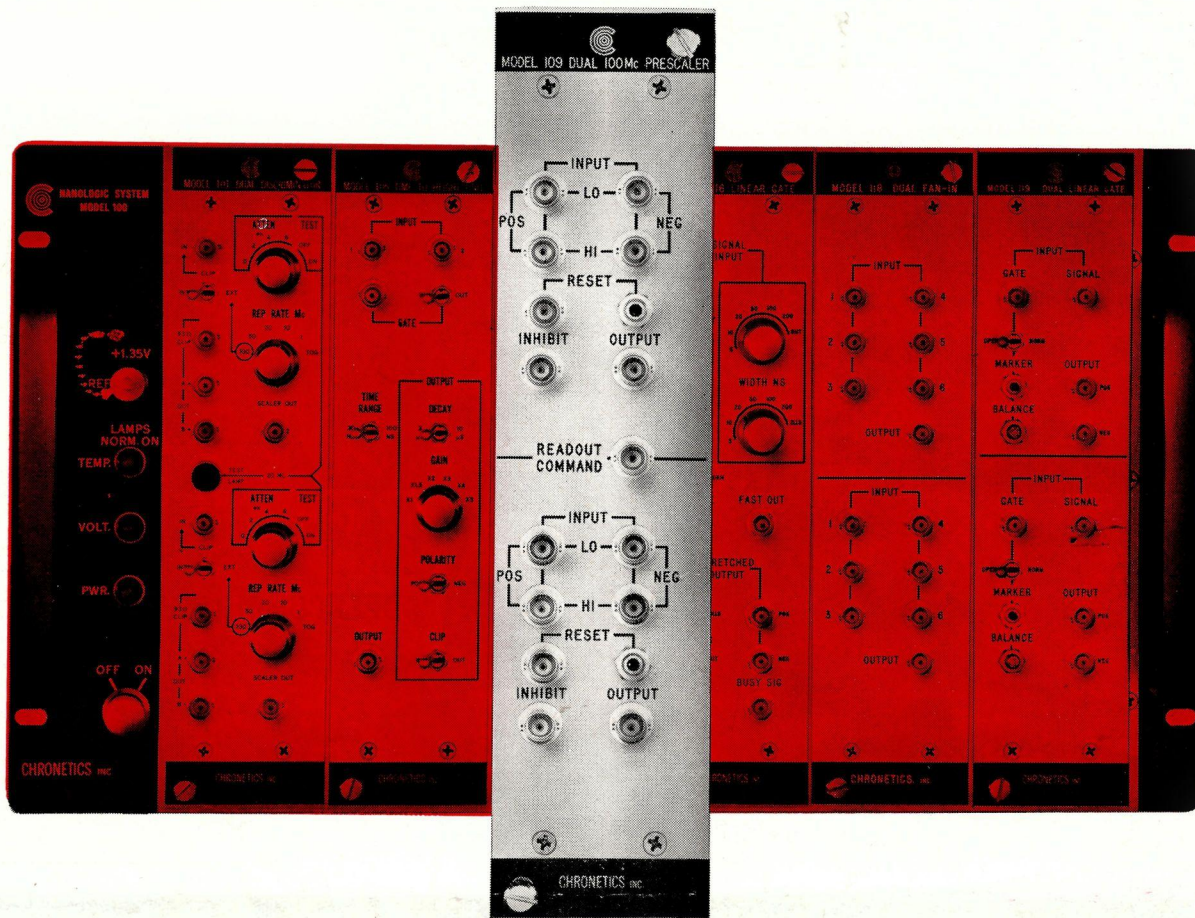
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