

**HANDBOOK OF
SCIENTIFIC INSTRUMENTS
AND APPARATUS
1962**

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**46th ANNUAL EXHIBITION
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THE PHYSICAL SOCIETY**

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**ROYAL HORTICULTURAL SOCIETY
WESTMINSTER, LONDON**

from Monday, 15th January to Friday, 19th January

**THE INSTITUTE OF PHYSICS AND THE PHYSICAL SOCIETY
47 BELGRAVE SQUARE
LONDON, S.W.1**

THE INSTITUTE OF PHYSICS

AND

THE PHYSICAL SOCIETY

FORTY-SIXTH ANNUAL EXHIBITION

The Exhibition is certified by the Board of Trade for the purposes of Section 51 (2) of the Patents Act 1949 and of Section 6 (2) of the Registered Designs Act 1949.

Stand 1

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Information Branch

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ROYAL AIRCRAFT ESTABLISHMENT

Farnborough, Hants.

An Automatic Camera for Satellite Observation. The rocking camera is a means of obtaining accurately timed positional data for the transit of an artificial satellite. The apparatus, which is simple, can be set up the previous day and left unattended to record automatically the predicted transit of a satellite during the night.

The camera is set up pointing at the culmination or some other suitable point of the transit. The rocking motion is arranged to take place in the direction of motion of the satellite and is of such an amplitude and period that the maximum angular speed of the camera exceeds the apparent angular speed of the satellite by a small margin. The resulting record shows a track consisting of a pair of dots (nodes of increased exposure) for each rocking cycle. The star images are drawn out by the camera motion but the mid points of the star images and mid points of the pairs of satellite dots bear the correct geometrical relation to each other for the instant at which the camera passed through its mean position.

The film is wound on to a fresh frame every fifteen seconds and the times of each rock and of each change of film are recorded against radio time signals.

DEMONSTRATION

Measurement of Friction Torques in Pivot and Jewel Bearings. In precision gyros suitable for use in inertial navigation systems, it is important that the error torques about the output axis are as low as possible. Those due to friction

in the gimbal supports have been reduced drastically by the use of air or oil flotation to minimize the loads and small diameter pivot and jewel bearings (see figure 1).

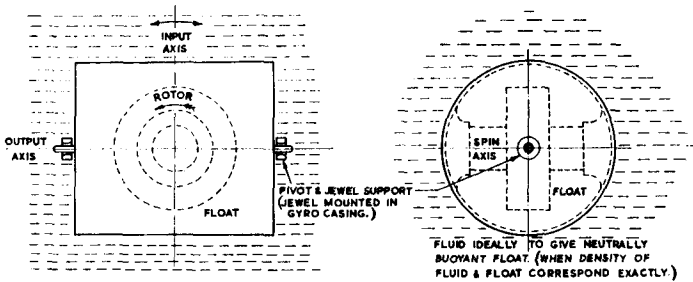


Figure 1. Application of Pivot and Jewel Support Bearings in a Floated Gyro.

It is still possible, however, to generate significantly high torques at these bearings and an investigation of the effects of surface finish, roundness, type of material, etc., on the performance of such bearing pairs is being pursued at R.A.E.

The apparatus exhibited (figure 2) is a simple torque balance in which the bearing pair forms the hinge of a small pendulum. The fixed element of the bearing

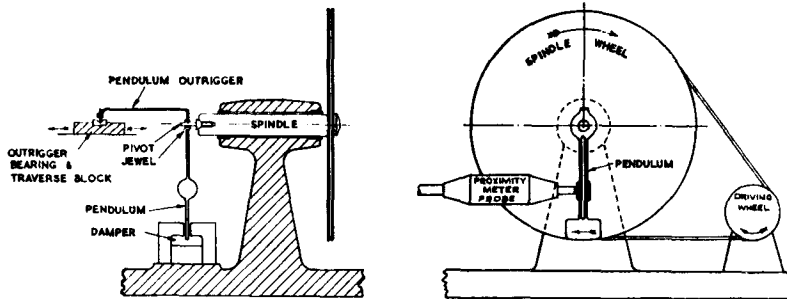


Figure 2. Pivot and Jewel Torque Balance.

is carried on a slowly rotating spindle and the angular deflection of the pendulum provides a measure of the friction torque generated at the bearing. A capacitance proximity meter is used to give a continuous record of pendulum position.

Typical records are shown.

DEMONSTRATION

The Detection of Explosive Fuel/Air Mixtures. Aircraft carry large quantities of volatile fuel which can, under the right conditions, give rise to explosive fuel/air mixtures. Any source of ignition (e.g. an electric spark) in such a mixture might cause an explosion. A step in calculating the risk of such explosions is to find the fraction of the flying time during which explosive conditions exist.

The exhibit is a detector for this purpose having as its basic component a 5 cm³ two-stroke internal combustion engine with spark ignition. The engine is driven at a uniform speed (between 200 and 400 rev/min) by an electric motor and has its induction port connected by a pipe to the space to be monitored. The pumping action of the engine continually withdraws samples of gas from this space and, if the samples become explosive, the engine 'fires' causing relative movement of the two parts of a special driving coupling. Movement of this coupling makes a

record by operating contacts connected to a P.O. counter. The ratio of the number on the counter to the total number of ignition sparks in a given period is the fraction of the time during which the space monitored has contained explosive vapours.

The demonstration shows the effect of varying the fuel to air ratio.

DEMONSTRATION

ROYAL RADAR ESTABLISHMENT

Malvern, Worcs.

Fast Photodetectors for Sub-millimetre and Millimetre Wavelengths, and their Application to Plasma Physics. Measurement of electromagnetic radiation emitted by, or which has interacted with, hot plasma is a valuable technique for plasma research, but fast detectors are necessary since plasma machines often operate in pulses of short duration. Photodetectors, responding in 1 μ sec or less and sensitive in the far infra-red, have been developed primarily for plasma research, but it is believed that these detectors will find application to other problems in this part of the spectrum. Their development has been possible very largely as a result of recent advances in the technology of semiconducting materials, particularly indium antimonide.

(a) *Materials Research: the Growth of High-purity Indium Antimonide Crystals.* A static display of crystals and photographs shows the origin of various types of defect in indium antimonide crystals and illustrates how material is prepared of sufficient quality for use in far infra-red detectors.

(b) *Long-wave Photodetectors.* The exhibit includes a detector made from high purity n-type indium antimonide working in a cryostat at 1.5° K. The cryostat contains a coil of superconducting niobium wire which provides a magnetic field of about 6000 gauss required to obtain the optimum detector performance. Radiation is condensed on the detector through a light pipe. In the demonstration the source of radiation is a millimetre-wave klystron.

(c) *Observation of Radiation from Plasma.* The application and performance of the detectors is illustrated by results obtained on various plasma sources, including ZETA. Some of these results were obtained in collaboration with the Culham Laboratory of the United Kingdom Atomic Energy Authority's Research Group.

DEMONSTRATION

Masers and Lasers. Microwave amplification by stimulated emission of radiation (Maser) is no longer a laboratory phenomenon, and masers are in use as very low noise receivers for radio astronomy and other purposes. Research effort is now being applied to the problem of maser operation at millimetric wavelengths. Various components illustrating this work will be exhibited.

The same physical principles can be applied to produce coherent oscillators (Lasers) in the optical and infra-red regions of the spectrum. Lasers are, however, still in their infancy. Components of a solid state laser for pulse operation and of a gas laser for continuous wave operation will be shown.

DEMONSTRATION

Developments in Cathode-ray Tubes for Photographic Recording.

(a) *Fine Particle Screen Cathode-ray Tube.* A high-resolution cathode-ray tube with a very fine particle screen is shown in conjunction with various focusing systems. A spatial bandwidth of 40 cycles/mm is achieved with this cathode-ray tube. The displayed pattern may be examined with a calibrated microscope.

(b) *Fibre Optics Cathode-ray Tube.* A cathode-ray tube with a fibre optics face-plate transfers the image from the phosphor to the front face of the fibre stack. Photographic recording can be achieved by direct contact exposure, avoiding the need for the lens used in a conventional optical system.

The experiment shows that the efficiency of the light transfer is greater in the case of the fibre optics tube by virtue of a larger accepted angle. Measurements with a photomultiplier are made at the face of a fibre optics tube and at the image plane of a conventional cathode-ray tube and lens system, demonstrating this improvement in light transfer. The pattern of the fibre stack may be examined through a microscope.

(c) *Phosphor Noise Measurement.* The spot size of high resolution cathode-ray tubes is largely dependent on the quality of the screen. The apparatus examines the screen with a sampling hole which is small compared with the particle agglomerates. Variations in light output due to non-uniformity of the screen are shown on a monitor oscilloscope as changes in vertical deflection of its spot as it scans across the screen in synchronism with the sampling hole of a scanning microscope.

DEMONSTRATION

AERONAUTICAL INSPECTION DIRECTORATE LABORATORIES Harefield, Middlesex

Metal-to-Metal Adhesive Bond Tester. The purpose of this apparatus is to determine non-destructively the strength of joints in which two metal sheets are bonded together by means of a non-metallic adhesive. It consists of an extensometer, the two knife-edges of which are placed upon the workpiece which is initially at room temperature, an associated electronic comparator to record changes in the separation of the knife-edges and a means of slightly raising the temperature of the part of the workpiece which lies between the knife-edges. The rate of thermal expansion of the upper sheet has been found to be closely related to the mechanical strength of the bond itself.

DEMONSTRATION

Metal Section Thickness Meter. This equipment is intended for the non-destructive estimation of the thickness of thin metallic sections which are difficult of access on one side. When the electrically heated probe is placed in contact with the workpiece, the consequent drop in probe temperature depends on the rate of heat transfer and hence on the thickness of the workpiece at the area of contact. The temperature change is observed by means of a thermocouple incorporated in the probe and a galvanometer which quickly attains a steady deflection related to the thickness to be estimated.

DEMONSTRATION

ELECTRICAL INSPECTION DIRECTORATE "Aquila", Golf Road, Bromley, Kent

Attenuation Measuring Apparatus, 100 kc/s to 200 Mc/s. The function of this is to compare increments of attenuation with increments of a standard attenuator which is operated at a frequency of 1 Mc/s, using the 'parallel' method. When the attenuator being calibrated is operated at frequencies other than 1 Mc/s, a linear frequency changer is used with automatic frequency control applied to the local oscillator.

The accuracy is such that increments of attenuation up to 80 db, corresponding to levels between 0.1 v and 10 μ v can be measured with an uncertainty of ± 0.05 db. Variable attenuators can be calibrated in two or more steps up to a total of 120 db corresponding to levels between 1 v and 1 μ v, with an uncertainty of about ± 0.1 db.

DEMONSTRATION

Noise Generator for Measurements at Frequencies between 30 Mc/s and 1250 Mc/s. A pair of thermionic diodes (Type E2790) operated with saturated emission provides the variable source of noise. Precautions in the design of the diodes and the mount ensure that the inevitable transformation of noise current between the electrodes, the source resistor and the outlet is well defined. A feature is the realization of a source impedance with a voltage standing-wave ratio better than 0.98 relative to 50 ohms at all frequencies in the band. The power unit provides adequate stabilization of the adjustable emission current against mains voltage variation. The diode current can be switched off and on again and become steady at the original value in about 5 seconds.

DEMONSTRATION

Precision Coaxial Directional Couplers. These symmetrical couplers are simply pairs of precisely made rigid coaxial lines in which the outer conductors overlap over a given length to form a coupling slot. The slot design is based on the theoretical work of G. D. Monteath (*Proc. I.E.E.*, 1955, 102B, 388). The coupling coefficient follows a sine function of frequency so that for a given allowed range of coupling coefficient, several frequency bands are available in a single coupler. Thus, allowing for 8.4 db variation in coupling with frequency, two couplers can cover all frequencies between 150 Mc/s and 4000 Mc/s. Types with minimum coupling attenuations of 10, 20 and 30 db have been made, with directivities better than 30 db and inherent values of voltage standing-wave ratio better than 0.98 relative to 50 ohms.

Self Balancing Bridge for a Coaxial Film Bolometer. This bridge is for use with the bolometer described by Harris (*Proc. I.E.E.*, 1960, 107B, 67), for which all four arms of the bridge are maintained at 200 ohms. The rectified output of a sensitive d.c. bridge-balance detector, comprising a transistor 'chopper' and high gain amplifier, controls the d.c. supply to the bridge to maintain balance with the bolometer element at 200 ohms. Differences in the d.c. power supplied to the bolometer are determined from the decrement in voltage across the bridge and the initial voltage across the bridge before the radio frequency is applied to the bolometer. The bridge accuracy is within 1% at 2 mw improving to about 0.2% at 200 mw.

DEMONSTRATION

Stand 2

NATIONAL INSTITUTE OF AGRICULTURAL ENGINEERING

Wrest Park, Silsoe, Bedfordshire

Tel: Silsoe 421

Weighing Unit for Mobile Weighbridge. This is a resistance strain-gauge weighing unit for a transportable weighbridge. Four of these units, with matched sensitivity, support the corners of a weighing platform of 8 tons' capacity. The

four units are electrically connected in parallel and are sufficiently sensitive to be used in a simple d.c. circuit, having a microammeter or spot galvanometer load indicator. Positive mechanical overload protection is provided in each unit, together with electrical means for indicating that an overload has occurred. Accuracy of weighing for the complete weighbridge is $\pm 0.6\%$ of full scale.

PROTOTYPE

Tractor Test Recorder. This dual X-Y recorder automatically plots points on the performance curve of a tractor being tested on a treadmill. The percentage slip (between the tractor wheels and the tracks of the treadmill) and the available drawbar horsepower are plotted against exerted drawbar pull. The slip signal is derived from two d.c. tachometer generators, one driven from the rear wheels of the tractor and the other from the tracks of the treadmill. The horsepower signal is obtained from a potentiometer, across which there is developed a voltage proportional to true forward speed, its sliding contact being positioned corresponding to the drawbar pull.

DEMONSTRATION

UNDER DEVELOPMENT

Environmental Control Cabinet for Plant Growth. The exhibit is a research tool for biological experiments related to botany, horticulture and agriculture. Its object is to provide an environment for plant growth that is spatially uniform and controlled with time as regards air temperature, humidity and light intensity.

The cabinet is constructed in three separate units, namely, base unit, plant housing, and lighting unit. This type of construction permits erection in a building with limited access, permits the use of the base unit as a free standing air-conditioned bench for use in a room or glasshouse and permits variation in design of one of the units, for example, plant housings of different heights or lighting units utilizing different kinds of lamp.

The base unit consists of a strong bench, 3 ft high \times 4 ft 6 in. \times 4 ft 6 in., mounted on castors, and housing cooling coils, electrical heaters and the variable-speed circulating fan. Conditioned air passes upwards through the perforated top of the bench upon which plants rest. The uniform vertical air flow ensures that all plants receive air of the same condition.

The plant housing is a cubicle, 4 ft high, which rests on the base unit, has doors back and front and the walls of which are lined with a material of high specular reflectivity. Ducting returns air from outlets near the top of the side walls to the cooling coils. The top of the housing is sealed with a double-glazed transparent Perspex ceiling which isolates the plant and lamp chambers and which absorbs 70% of the far infra-red radiation from the lamps, but, due to multiple reflections, only 5% of the light.

The lighting unit rests on top of the plant housing and contains 57 5-ft, 80-w fluorescent tubes which are uniformly cooled by forced draught from perforations in the reflector above the lamps. A separate fan is used which maintains a constant lamp temperature and hence constant light output by automatic volume control. The lamps are operated on stabilized voltage which can also be used to counteract lamp ageing. The principle of illumination, namely, a uniform horizontal bank of lamps which overlaps walls of perfect specular reflectivity can theoretically give uniform illumination throughout the plant housing.

The cabinet is reasonably airtight and a controlled fresh-air intake is provided.

Control of humidity and air temperature is achieved by cooling to the required dew-point after the cooler and then heating to the required dry-bulb temperature. This method of control is feasible because firstly, plants tend to release moisture in the cabinet, and secondly, excessive drying is avoided by the use of modulating control of the cooler, utilizing glycol solution at 33°F from a reservoir chilled by a compressor unit. As exhibited, the cooler is not in operation.

The cabinet is being developed commercially.

DEMONSTRATION

PRE-PRODUCTION

Stand 3

20th CENTURY ELECTRONICS Ltd.

Centronics Works, King Henry's Drive, New Addington,
Croydon, Surrey

Tel: LODge Hill 2121/6

Precision Cathode Ray Tubes

Travelling Wave Deflection Cathode-ray Tubes for the presentation of transient and repetitive phenomena in milli- and sub-nanosecond regions.

PRODUCTION

Storage Tubes. Development work in the field of storage devices is illustrated by a tube of the Graphicon type. The new design aims at improving both writing speed and resolution with respect to existing types.

PROTOTYPE

Rectangular Faced Instrument Cathode-ray Tubes. These tubes introduce a new range of instrument cathode-ray tubes. The tubes are flat faced, of rectangular shape and single and double gun types are available. The single-gun tube, Type S6RB/126, has deflection sensitivities of 9 v/cm per kV_{A_3} (X) and 6.5 v/cm per kV_{A_3} (Y). The double-gun tube, Type D6RB/710, gives full screen coverage for each gun and minimum trace distortion.

PROTOTYPE

High Sensitivity Cathode-ray Tube for Transistorized Oscilloscopes. The S5AB-800 is a new high-sensitivity single-gun cathode-ray tube with electrostatic isolation of the deflection and post-deflection acceleration systems. Deflection sensitivities of 18 v/cm (X) and 5 v/cm (Y). Large post-deflection acceleration ratios are possible without introducing trace distortion.

PRODUCTION

High Sensitivity Double-gun Tubes. The latest addition to the range, Type D5AB/611, is exhibited.

PRODUCTION

Photomultiplier Tubes

BMS Series. A miniature photomultiplier $\frac{1}{4}$ in. diameter, Type RBMS 10/14, has recently been developed for airborne and industrial applications. The tube is

of rugged construction designed to withstand severe shock and vibration. The tube was developed under a United Kingdom Atomic Energy Authority development contract.

VM Series. New types are now available. The VMP 13/44S has been developed for the counting of tritium and carbon 14 by liquid scintillation counting techniques. A counting test using a standardized tritium sample forms part of the production testing of this tube. The VMP 11/44F, developed for gamma-ray spectroscopy, is a photomultiplier with a uniform photocathode of high sensitivity. Specially suited for photomultiplier-crystal assemblies for spectrometry applications where peak/valley ratios of 4 : 1 for ^{60}Co radiation are readily obtained.

Photoelectric Cells. Large area vacuum photocells with an output current of 1 mA max. are shown.

PRODUCTION

FMK Series. The FMK 5/R10 high-current photomultiplier has been designed to be coupled directly to the 20th century travelling wave deflection cathode-ray tube, Type TWK.3, without intermediate amplifiers.

PRODUCTION

Image Intensifier Tubes.

Multi-stage Image Intensifier Tubes have been further developed and a range of production models are shown. A new five-stage tube is shown with increased resolution and picture size. This development is being carried out under an Admiralty contract.

PRODUCTION

Particle Multipliers

Twelve- and sixteen-stage demountable electron multipliers are available with focused Allen type dynode structures. The dynode material is beryllium-copper. A gain of up to 8 per stage at 300 v can be obtained and in mass-spectrometry applications ion currents in the region of 10^{-17} A can be measured.

PRODUCTION

Geiger Counter Tubes. In addition to the well known extensive range of Geiger counter tubes the following tubes are shown :

Type SW12. This is a counter designed for the counting of low-energy beta emitters, such as sulphur 35 and carbon 14. It is of cylindrical construction with a thin mica window 10 cm long \times 1 cm wide \times 1 mg/cm² in thickness along the length of the counter. The tube is frequently employed on bench top monitors and its use is complimentary to the well-known Type B.12 β - γ counter.

PRODUCTION

Windowless Flow Counters. These counters have been designed to give high sensitivity to soft radiation from solid samples. Four models are now available.

Type WF2. This type is fitted with a three-position sample holder and can be supplied with either a Geiger or proportional counting head.

PRODUCTION

Type WF4. This type is a large area counter for the measurement of metallic turnings from fuel elements during manufacture.

Type WF6. This type is designed to provide good energy resolution for low-energy beta emitters.

High Temperature Pulse Fission Chambers. Extensive development work has been carried out in collaboration with the U.K.A.E.A. on pulse fission chambers for high-temperature operation in conjunction with the new high-temperature reactor programmes. Chambers with various fissile coatings, including ^{235}U , ^{238}U , ^{233}U , ^{237}Np , ^{232}Th and ^{239}Pu , are available.

Miniature High Temperature Fission Chambers. Fission chambers types FC08/1000/B and FC02/1000/B have been designed for measurements of flux distribution in nuclear fuel elements. The chambers are 8 mm and 1 mm in diameter respectively and operate at temperatures up to 600°C. They are mounted on rigid extension probes up to 48 in. in length.

PRODUCTION

$\frac{1}{4}$ in. Diameter Fission Chambers. These chambers are designed and tested for operation up to 850°C and are being employed in the 'Zenith' reactor programme.

PRODUCTION

High Sensitivity Fission Chambers. The Type FC588/1000 high sensitivity fission chamber is designed as a reactor control chamber and is being employed in the instrumentation of the 'A.G.R.' and 'Hero' reactors. These chambers operate up to 575°C and are mounted on 12-ft and 15-ft probe assemblies.

PRODUCTION

Miniature High Temperature Fission Chambers. Type FC08/1000/A is a 8-mm diameter chamber with a confined gas volume. The chamber is capable of operating at 600°C. The sensitivity is unaffected by temperature.

PRODUCTION

$\frac{1}{4}$ in. diameter Fission Chambers. Type HTFC8/1000/B is designed for operation at 850°C. These chambers are used for core flux distribution in the Zenith reactor. Type HTFC4/1000/A is a confined gas volume capable of operating at 500°C.

PRODUCTION

Mean Current Ionization Chambers. The RC6 incorporates gamma compensation which extends the useful measured range of neutron flux. The RC6 and RC7 are shown and both chambers are available with enriched boron for increased neutron sensitivity.

PRODUCTION

Inpile Ionization Chamber. This is a fission ionization chamber designed for installed operation in gas-cooled reactors. The design of chamber for the A.G.R. shutdown channel are shown. The chambers were designed in collaboration with the U.K.A.E.A. and are capable of operation at 600°C.

Fission Chamber for Beam Measurements. Parallel-plate fission chambers for measurement of neutron beams in nuclear physics experiments. The chamber is constructed entirely in stainless steel; the entry and exit windows for the beam being extremely thin to reduce absorption.

PRODUCTION

Ionization Chamber for Reactor Dosimetry. The Type IG.8 is a miniature ion chamber for the measurement of energy deposition in materials under irradiation.
PROTOTYPE

Air-Wall Equivalent Ionization Chambers. A new design of ionization chamber IG.1 for the measurement of gamma-ray dose rate is shown. The characteristics of the tube are air equivalent; the outside case is constructed of stainless steel.
PRODUCTION

High Temperature Pulse Transformers for Detectors. Pulse transformers for use up to 500°C in conjunction with fission chambers.
PROTOTYPE

Rigid Extension for High Temperature Detectors. Designs of detachable extensions are shown. Lengths up to 45 ft can be produced.
PRODUCTION

Proportional Counters.

BF₃ Proportional Counters. The range of BF₃ thermal neutron counters has been extended to include $\frac{1}{4}$ in. diameter tubes.
PRODUCTION

Boron Lined Proportional Counters. Boron-lined proportional counters capable of operating at temperatures up to 250°C are shown. These counters were designed for reactor commissioning experiments.
PRODUCTION

Fission Proportional Counters. Proportional counters with fissile-material coated electrodes are shown. The tubes offer the possibility of using longer cables or extensions.

Aluminium Walled BF₃ Counters. A number of aluminium walled BF₃ counters are exhibited for special application.
DEVELOPMENT

X-ray Proportional Counters. A new range of x-ray proportional counters are shown to cover energies from 1 kev to 120 kev, including the continuous-flow counter for soft x-rays.
PRODUCTION

Metal-Ceramic Vacuum Seals. A number of metal-ceramic vacuum seals constructed for high temperature using pure alumina ceramic are shown. A particular feature of the seals is the resistance to radiation in addition to their insulation at high temperatures. The seals have been developed under a U.K.A.F.A. development contract.
PRODUCTION

Semiconductor Devices.

Semiconductor Radiation Detectors. 20th Century Electronics Ltd. have developed a wide range of semiconductor radiation detectors to suit many different applications.

(a) *Surface Barrier Detectors.* Examples of the surface barrier type of detector is shown, including neutron counters and large-area types for health monitoring. Differential neutron detectors are also shown.

(b) *Phosphorus Diffused Junctions.* Examples of this type of detector are shown, including types for small gamma monitors. Large-area types are also available with good gamma resolution for heavy particles.

(c) *Lithium Drifted Detectors.* This type of detector has a wide depletion layer and is suitable for very high energy charged particles in addition to electrons and gamma rays. Some examples for x-ray spectroscopy are shown.

Solar Cells. Development types are shown.

Neutron Generator. This neutron generator is designed for continuous operation and produces fluxes of greater than 10^{10} neutrons/sec. It employs the (D, T) reaction for production of 14 mev neutrons. Typical applications include activation analysis, critical assembly measurements and the production of short-lived isotopes. The generator is also suitable for pulse operation.

PRODUCTION

Mass Spectrometer Leak Detector. This instrument has extremely high detection sensitivity for small leaks coupled with a rapid response time. It meets the many routine production applications for the detection of small leaks in vacuum and pressurized components. Two models are now available:

Mark II is a complete instrument including high-speed pumping system for portable use.

Mark III comprises indicator unit and separate mass spectrometer head units for fixed installation.

PRODUCTION

Stable Isotopes. The following stable isotopes can be supplied and numerous compounds are available enriched in these materials: boron 10, boron 11, carbon 13, carbon 12, oxygen 18 and nitrogen 15.

Fissile Coated Foils. Foils and various other components coated with fissile materials are illustrated. The following materials can be provided: ^{235}U , ^{238}U , ^{233}U , ^{237}Np , ^{232}Th , ^{239}Pu .

Stand 4

"SHELL" RESEARCH Ltd.

Thornton Research Centre, P.O. Box 1, Chester

Tel: Ellesmere Port 3600

Periphery Camera. This apparatus produces developed views of cylinders and nearly cylindrical shapes. The object to be photographed stands on a turntable which is rotated, through gearing, by a synchronous motor. The camera is a separate unit which carries another synchronous motor. This drives the photographic film at a speed which matches that of the moving image. The apparatus will photograph internal and external cylinders in a wide range of sizes.

RESEARCH APPARATUS, NOT FOR PRODUCTION

Engine Service Analyser. This apparatus has been built to find out how the engines of road vehicles spend their working lives. It reserves one track of standard $\frac{1}{8}$ in. wide paper tape for each of the following quantities: revolutions of the crankshaft, fuel consumed, distance travelled, time. It punches a hole in the appropriate track whenever any of these quantities increases by a pre-determined increment. This information is enough to define the engine's running condition during each increment of crankshaft revolutions, i.e. its speed (as a fraction of its maximum speed) and torque (as a fraction of its maximum torque).

The punched tape is fed to a digital computer which has been programmed to answer the question "what percentage of its running time does the engine spend at each combination of speed and load?" If it is desired to analyse the same data in some other way, all that is required is a suitable programme for the computer.

RESEARCH APPARATUS, NOT FOR PRODUCTION

DEMONSTRATION

Trace Reader for Opaque Records. The trace reader has been designed for the analysis of opaque records up to 120 mm wide. The section of chart being examined is strongly illuminated and is back projected at a magnification of $4 \times$. (This is particularly convenient for examining charts from high speed pen recorders whose deflections do not usually exceed about ± 1 cm.)

The viewing screen carries a pair of cross lines and the image of each point on the trace whose coordinates are to be measured is brought into coincidence with their point of intersection by means of two lead screws. These translate the carriage on which the chart rests and are used indirectly to measure coordinates. Each lead screw is associated with a simple displacement-to-voltage transducer provided with a zero adjustment and a range adjustment. By correctly setting these adjustments the chart may be measured in units appropriate to the original data, e.g. X in msec, Y in lb/in² for a pressure/time record. A digital voltmeter is used for reading out the voltage analogues of coordinates.

RESEARCH APPARATUS, NOT FOR PRODUCTION

DEMONSTRATION

General Purpose Equipment for Gas-Liquid Chromatography. Gas-liquid chromatography is useful in so many analytical problems that in a large laboratory there are frequent demands for the requisite apparatus. Although this apparatus varies in detail from problem to problem, some requirements constantly recur and it is economical to design standard units to meet them. Some of these are exhibited. The Katharometer is constructed entirely of metals, mica, and glass, and will work at temperatures up to 350°C. It is used in conjunction with a bridge and thermometer unit incorporating the ancillary bridge resistors, a multi-range bridge current meter and adjustable stabilized current supply. As it is usually necessary to measure several temperatures, such as those of the sample inlet, chromatographic column, katharometer and so on, the unit includes a six-point thermoelectric pyrometer which, by switching, shares the galvanometer of the current meter. For joining the small stainless steel tubing which conducts the carrier gas and sample vapours, tube connectors of the copper compression ring type are employed. A miniature self-balancing potentiometric recorder records the chromatograms; this instrument has an exceptionally stable semiconductor d.c. to a.c. signal converter and contains its own dry battery power supplies.

RESEARCH APPARATUS, NOT FOR PRODUCTION

DEMONSTRATION

Stand 5

NAGARD Ltd.

18 Avenue Road, Belmont, Surrey

Tel: VIGilant 9161/2/3

Two Channel High Speed Oscilloscope Model 321 (figure 1). The model shown last year has now been further developed, and the instrument shown has the following features.

The cathode-ray tube has two independent Y deflection systems, and is operated with a helical post deflection accelerator at 10 kv. The resultant small spot size

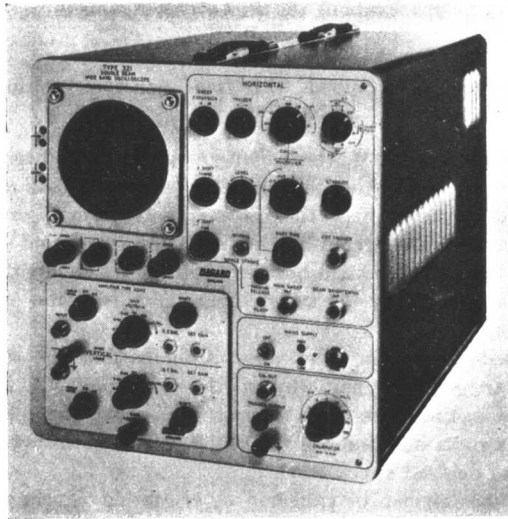


Figure 1. Two-Channel High-Speed Oscilloscope Model 321.

and high intensity enables the recording of high speed single transients with good resolution of details.

The X deflection system is common to both channels and is driven by a wide range time base giving calibrated sweep times from 0.1 μ sec to 0.5 sec per cm in 21 fixed steps. Sweep expansion operates symmetrically and increases the speeds by a factor of 5 giving a maximum velocity of 1 cm/0.02 μ sec.

A continuously variable fine control permits adjustment of sweep time to any value between 0.02 μ sec to 1.2 sec per cm.

Triggering and synchronization controls give great versatility and include a single sweep facility with lock out and resetting control.

The main Y amplifier provides, in two channels, a response of d.c. to 27 Mc/s, and has, in each output, a balanced signal delay line enabling the leading edges of waveforms to be clearly displayed.

Plug-in pre-amplifier unit Type 821A has a rise time of 9.8 nsec, and when feeding signals to the main amplifier the combined effect is to give a rise time of 18 nsec, a bandwidth of d.c. to 20 Mc/s (-3dB), and a deflection factor from 10 mv/cm to 5 v/cm in calibrated steps. A switch is provided for displaying the d.c. level of the input signal.

Two R/C probes with attenuation factors of 10 are provided so that the signal amplitudes using pre-amplifier 821A may be extended to 50 v/cm. Probes with greater attenuation factors, and therefore lower input capacities, are also available.

An alternative high-sensitivity plug-in pre-amplifier is Type 821D, which provides a deflection factor of 1 mv/cm over a bandwidth of d.c. to 5 Mc/s and has differential inputs.

All power supplies are highly stabilized, including the e.h.t., so that the calibration in both X and Y directions is consistently accurate.

A square wave calibrating unit is built in and provides standard voltages from 200 μv to 100 v in 18 steps, enabling the pre-amplifier gains to be accurately set up.

PRODUCTION

The 821 oscilloscope is provided with front panel connecting plugs for the addition of:

Trigger Delay Unit Type 8201 which then gives a calibrated trigger delay up to 50 msec. It can be arranged either that the time base of the oscilloscope is triggered by the trigger delay unit after the selected delay time, or that the time base of the oscilloscope is triggered by the first triggering signal after the selected delay time. The latter arrangement has the advantage of eliminating jitter. Jitter, when triggering is effected by the trigger delay unit, is of the order of 1 part in 20,000 of the delay time.

Provision is made for driving the sweep of the oscilloscope with the delaying waveform of the trigger delay unit while at the same time applying a brightening signal from the main time base when it runs. This allows the delay to be selected to coincide with a particular point of the observed waveform before switching the oscilloscope to the delayed sweep condition.

The trigger delay unit can be triggered by triggering signals of either polarity or can be actuated manually by a push-button.

Although intended primarily for use with the Nagard oscilloscopes Types 821 and 802, the trigger delay unit is self-contained, and can be used with most other oscilloscopes for producing trigger delay; but the facility of selecting the delay to coincide with a particular point of the observed waveform would not be available with these other oscilloscopes.

DEMONSTRATION

PROTOTYPE

Monitor Units Types 1009 and 1008. These units are available for use with the 811 oscilloscope. Type 1009 (see figure 2) provides four independent display channels on two cathode-ray tubes placed closely together, and when driven by two oscilloscopes gives a very versatile four-channel display system. The facilities of the various plug-in units are able to deal with a wide range of signal requirements, and the unit can easily be attached to a moving film recording camera using 70-mm film or paper. By using plug-in signal unit 811Q an eight-channel display can be obtained.

Type 1008 monitor unit provides two channels which repeat the display on the cathode-ray oscilloscope screen. Such monitors may be situated at a reasonable distance from the oscilloscope.

PRODUCTION

DEMONSTRATION

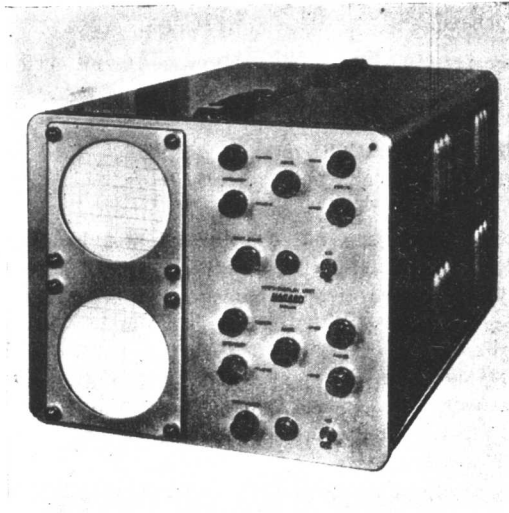


Figure 2. Monitor Unit Type 1009.

Pulse Group and Square Pulse Generator, Type 5101 (see figure 3). This generator has now been redesigned to provide a greater range than the model shown last year, and is consequently more versatile.

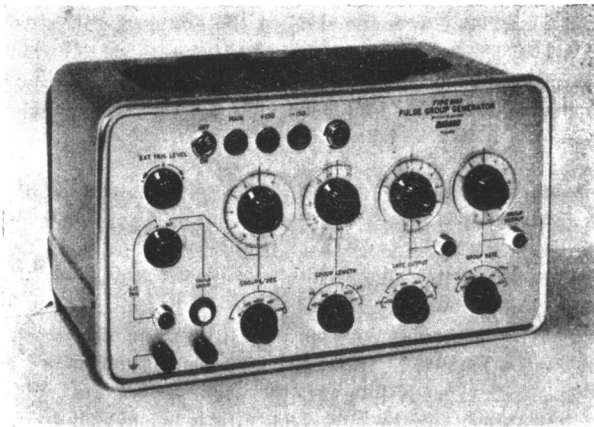


Figure 3. Pulse Group Generator Type 5101.

It is particularly valuable in extending the facilities provided by the well-known Nagard Double Pulse Generator Model 5002, and by the use of the calibrated

delay and other features of this instrument it is possible to control the following characteristics of the output signal :

- (1) Number of groups per second or signal groups.
- (2) Group length in terms of time.
- (3) Frequency of pulses or pairs of pulses within group.
- (4) Delay time between output pulses from 5101 and 5002 (using 5002 delay generator).
- (5) Width of pulses within group.
- (6) Amplitude of pulses within group.
- (7) Polarity of pulses within group.

An internal rate generator controls the number of pulse groups produced per second, which is the same as the repetition frequency of the square pulse output. The rate generator frequency is continuously variable over the range 1 c/s to 100 kc/s by calibrated controls. Alternatively, the instrument may itself be triggered externally by either positive or negative going signals of any shape, the triggering point on a complex input signal being adjusted by means of trigger level and slope controls. Single groups may be produced by use of a push-button on the panel or by external contacts connected to terminals on the panel.

The length of the group or groups may be adjusted to any value from 5 μ sec to 0.5 sec and the frequency of the pulses within the group may be adjusted between 10 c/s and 1 Mc/s. The amplitude (10 v positive), width (0.2 μ sec approx.) and rise time (0.06 μ sec approx.) of the trigger pulses remain constant throughout the range of the instrument.

The square pulse output, which is positive going from earth, is continuously variable in amplitude from 100 μ v to 100 v by calibrated controls. The leading edge of the pulse coincides with the start of the group of pulses from the group output socket, whilst the back edge of the pulse coincides with the end of the pulse group. The duration of the square pulse thus corresponds to the trigger pulse group length and the repetition frequency of the pulse corresponds to the group repetition rate.

The exceptionally wide range covered by the square pulse amplitude controls, together with the combination of large available amplitudes and short rise-time (approx. 0.4 μ sec for 100 v), renders this output very useful for a wide variety of test procedures such as the adjustment of capacity-compensated attenuators. Whilst the output impedance is normally 300-1800 ohms, depending upon the amplitude setting, the generator may be worked into low impedance if an uncalibrated output can be tolerated. In such a case a mean current of 40 mA can be taken from the output cathode follower, the peak current available being of the order of 80 mA provided that the pulse length does not exceed 10 msec.

Internal trigger generator gives 1-100,000 groups per sec.

Group length is from 5 μ sec to 0.5 sec.

Pulse frequency in group is from 10 c/s to 1 Mc/s. Gate (square pulse) output amplitude is positive going and may be continuously varied from 100 μ v to 100 v.