

z -axis, but the x -cut has its face perpendicular to the x -axis and its length parallel to the y -axis, while the y -cut has its face perpendicular to the y -axis, and its length parallel to the x -axis. For the x -cut crystal the voltage is applied along the electrical axis, and the vibration occurs parallel to the mechanical axis; the frequency is a function chiefly of the crystal length. For the y -cut crystal, the voltage is applied along the mechanical axis; voltages appear along this axis when the applied pressure is at 45° to the mechanical and electrical axes, and thus, when voltage is applied along the y -axis, the vibration is one of shear.

The factors that make it desirable to seek other forms of cuts may be illustrated with the x -cut crystal in which, when voltage is applied along the electrical axis, the vibration is along the mechanical axis. Motion along the electrical axis also gives a displacement of charge along the electrical axis, and thus the x -cut crystal could vibrate in either direction; but the vibration frequency, which will be determined chiefly by the dimension of the crystal in the direction of its vibration, will be much lower when the vibration is along the y -axis than when it is along the x -axis. As used, a voltage frequency was applied corresponding to the length vibration, and thus was comparatively low. If an effort were made to use the crystal for a high frequency, utilizing vibration along the x -axis, difficulties would occur because harmonics of the y -axis frequency might be very close to the x -axis frequency, and slight changes in conditions might cause the controlling vibration to shift from that of the x -frequency to a harmonic of a y -frequency.

The most common of such changes of conditions is the temperature, since the frequency of the x -cut crystal, and of the y -cut, is very sensitive to temperature changes. With a crystal of zero temperature coefficient, the frequency can be held to almost negligible variations by maintaining the crystal at the proper temperature. Accurate temperature control apparatus, however, is necessary when high constancy of frequency is desired. It would be very desirable if a crystal cut were available that had a zero temperature coefficient over a wide range of temperature, since this would make temperature control unnecessary over this range. Search for such a cut resulted in a crystal having a temperature coefficient essentially zero from 0° to 100° C. The various cuts, besides giving the temperature characteristics desired, are also selected, and the dimensions of the crystal chosen, so that there will be only one mode of vibration of fundamental or harmonic frequency in the neighbourhood of the frequency at which the crystal is to be operated.

THE 'MICROTIMER'

AN electronic timing device called the 'Micro-timer' has been produced by R. K. Dundas, Ltd., The Airport, Portsmouth. This measures the time interval between the making, or alternatively, the breaking, of two electrical contacts, or between any other combination of contacts. In addition it may be operated, without contacts, by a suitable valve amplifier in conjunction with, for example, a photo-electric cell. The time indication is given by the position of a pointer moving over the dial of a meter, and the standard instrument has ranges covering 10 to 1,000 milliseconds for full-scale

deflexion. It operates entirely from the standard a.c. mains, although a battery model is available. Tests show that the instrument has negligible zero drift, is simple to calibrate and use and is of rugged construction. After taking a measurement, the deflexion of the meter is maintained for several minutes without appreciable drift; throwing a switch brings the meter back to zero for the next measurement. The accuracy claimed is within ± 2 per cent of the full scale deflexion on any range, even allowing for violent changes in mains voltage or changes of the valves.

The principle of the circuit, which incorporates patented features, may be briefly described. A condenser is charged up from the high-tension supply, and at the beginning of the interval to be timed, the energy in this condenser is allowed to flow through a constant-current pentode valve into a precision condenser. At the end of the timed interval this current is stopped, and the voltage which has been built up across the precision condenser is measured by means of a high-impedance valve voltmeter, to which the output meter is connected, this meter being, of course, calibrated in milliseconds. A voltage stabilizer in the high-tension supply and the provision of considerable negative-feedback assist in maintaining the accuracy of calibration and freedom from drift.

The 'Microtimer', although designed as a laboratory instrument, may be readily operated in routine work by unskilled personnel, and may have a large variety of applications, such as timing the operation of relays, switches, fuses, contact breakers, camera shutters and automatic machinery of all kinds, and in radio, physical and explosives research.

FORTHCOMING EVENTS

Monday, May 15

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 4 p.m.—Prof. John Beattie: "Clinical Aspects of Methionine Metabolism".

ROYAL GEOGRAPHICAL SOCIETY (at Kensington Gore, London, S.W.7), at 5 p.m.—Dr. Olaf Devik: "The Formation of Ice in Lakes and Rivers".

INSTITUTION OF ELECTRICAL ENGINEERS (LONDON STUDENTS' SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 7 p.m.—Annual General Meeting.

Tuesday, May 16

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Lieut. Bernard Mishkin: "The Indians of the Andes".

Wednesday, May 17

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Scientific Papers.

ROYAL COLLEGE OF SURGEONS OF ENGLAND (at Lincoln's Inn Fields, London, W.C.2), at 4 p.m.—Prof. John Beattie: "Clinical Aspects of Methionine Metabolism".

ZOOLOGICAL SOCIETY OF LONDON (at Regent's Park, London, N.W.8), at 4.30 p.m.—Exhibition of a Soviet Film on "Animal Life in the Kara-Kum Desert", with commentary by Dr. Edward Hindle, F.R.S.; Dr. Ruth Deansley: "Demonstration of the Breeding Habits and Life-cycle of *Xenopus*"; Mr. G. P. Wells: "The Parapodia of *Arenicola marina* L. (Polycheta)".

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. R. B. Armstrong and Mr. J. A. Smale: "High Speed Recording of Radio-Telegraph Signals".

INSTITUTE OF WELDING (joint meeting with the INSTITUTE OF THE PLASTICS INDUSTRY) (at the Institution of Civil Engineers, Great George Street, Westminster, London, S.W.1), at 6 p.m.—Dr. J. H. Paterson: "The Welding of Plastics".

BRITISH INSTITUTION OF RADIO ENGINEERS (MIDLAND SECTION) (at the University (Latin Theatre), Edmund Street, Birmingham), at 6.30 p.m.—Dr. Emrys Williams: "Relaxation Oscillators and Trigger Circuits".

Thursday, May 18

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Mr. H. C. Waite: "African Art".