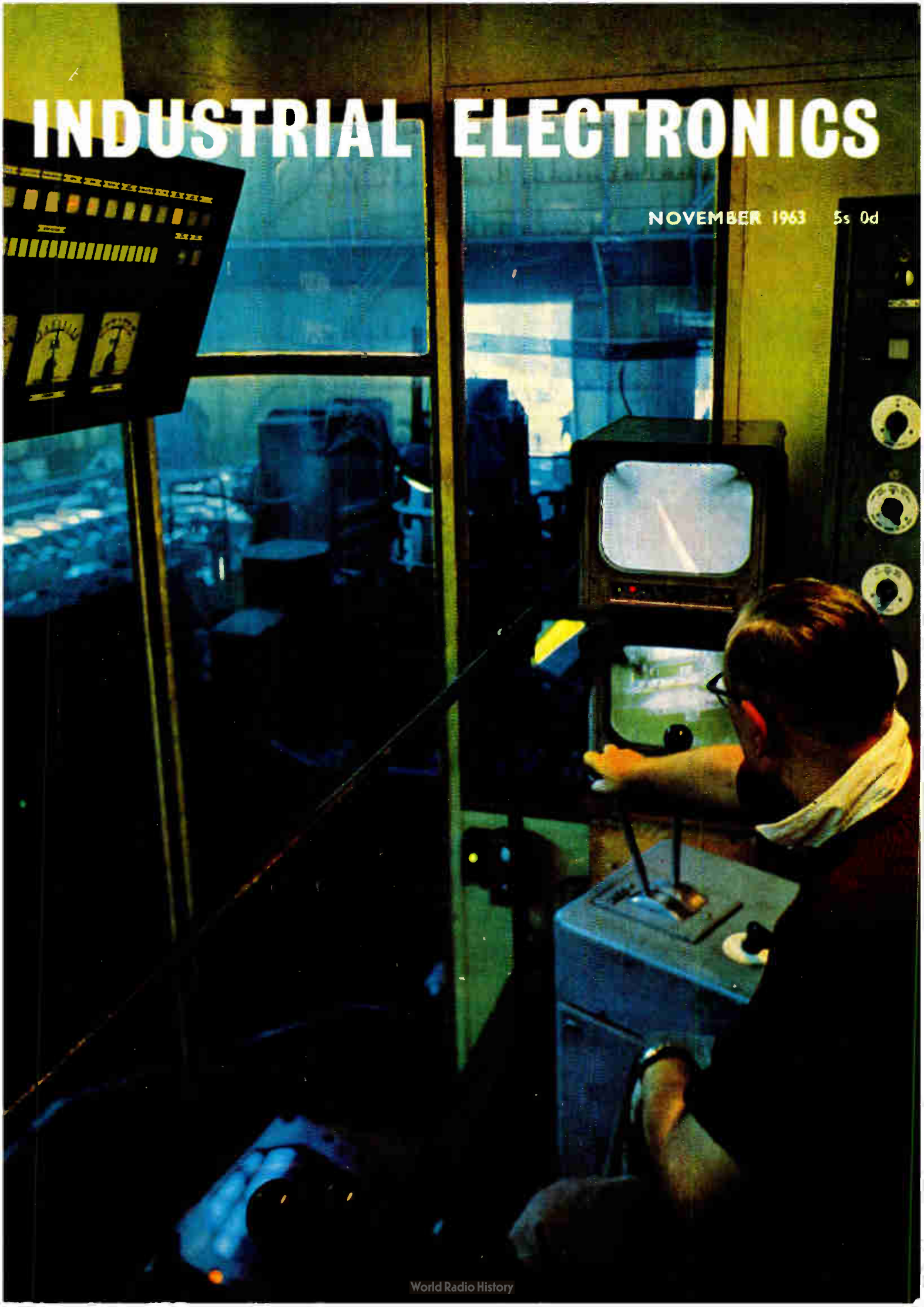
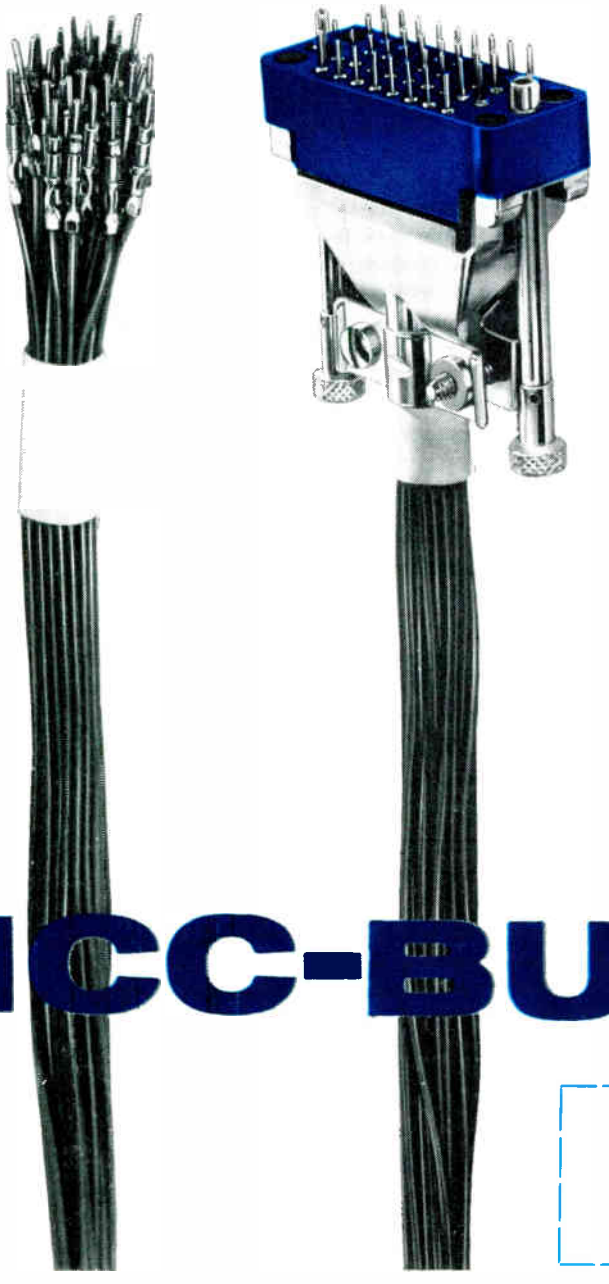
INDUSTRIAL ELECTRONICS

NOVEMBER 1963 5s 0d



an OPEN & SHUT case for the MS HYFEN connector



NOTE THESE FEATURES:

crimped snap-lock removable contacts / high speed assembly / factory pre-assembled hardware / fault finding and commissioning simplified / low mating forces / manual or automatic installation tooling / reduced production costs / hood accommodates multi-core cable sheath

Plated to maintain low contact resistance under the most severe conditions of environment, the miniature Hyfen connector provides reliable high-density connections. It is available in 14, 20, 26, 34, 42, 50, 75 and 104 contact sizes. The new hinged protective hood swings wide open to give full access for easy insertion, removal and inspection of contacts. BICC-BURNDY manufacture all types of connectors for the electronics industry.

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INDUSTRIAL ELECTRONICS

incorporating *ELECTRONIC TECHNOLOGY*

Volume 1 Number 14 November 1963

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Editor **W. T. COCKING**, M.I.E.E.

Assistant Editor **T. J. BURTON**

Advertisement Manager **G. H. GALLOWAY**

701 **Comment**

703 **Remote Control of Closed-Circuit Television Systems**
by D. G. Ashton Davies

A television camera can be controlled from a considerable distance and this article describes some of the applications in which such control is advantageous. In the air and underwater, in archaeology and in hospital, for traffic control and for sewage inspection, the uses of closed-circuit television are as varied as they are many.

707 **Industrial Television in the Generating Industry** *by R. E. Blythe*

Closed-circuit television is being increasingly used in the electricity generating industry. Some applications, such as furnace flame viewing, drum water level gauge viewing and smoke stack inspection are discussed in this article.

711 **Closed-Circuit Television and the Stroboscope** *by N. L. Glew*

It is not always realized that it is possible to use a stroboscope and a closed-circuit television system together to examine high-speed machinery from a remote point. This article discusses one application of the combination.

713 **Tachometry in Industry** *by E. K. Elphee*

The instrument described in this article is basically an electronic tachometer. A pick-up device produces pulses corresponding to the revolutions of a shaft and the instrument utilizes these to operate a meter having a scale calibrated in revolutions per minute.

717 **Radioactive Static Eliminators** *by Denis Taylor, M.Sc., Ph.D.*

Static charges are a nuisance in a great many industries and are especially so in printing and weaving. Their effects can be overcome with the aid of radioactive materials as explained in this article.

733 **Continuously Controlled Machine Tool**
by J. N. Muir, B.Sc.(Eng.)

The use of continuous control of a jig-boring and milling machine is described in this article. As well as explaining how it functions, the article gives an example of the magnitude of cost reduction which has been achieved by its use.

continued overleaf

Published on the first Thursday after the 5th of each month by

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Managing Director: W. E. Miller M.A., M.Brit.I.R.E.
Dorset House, Stamford Street, London, S.E.1.
Telephone: Waterloo 3333.
Telegrams: Wirenger, London, Telex.
Cables: Wirenger, London, S.E.1.

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739 **Special Types of Vidicon Camera Tubes**
by A. C. Dawe, B.Sc.(Eng.)

Vidicon camera tubes are obtainable in standard, high-resolution, ultra-violet, infra-red and storage types. This article explains the characteristics of the special types and indicates some of the applications for which their use is advantageous.

744 **Strip Conductors for Magnetic Field Generation**
by T. H. Beeforth, B.A.

Charts are given for designing current-carrying strip conductors for producing magnetic fields of known amplitude and uniformity. For high-frequency applications, the strip impedance is introduced as an additional design parameter.

FEATURES

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Next Month

The December issue will contain an article describing the automatic control of blade angle in a grader. This is a machine used for contouring ground, as in road and airfield construction. Other articles will deal with dynamic balancing and with the automatic testing of gearboxes under load.

OUR COVER

This month's picture shows one of the many applications in industry of closed-circuit television. Here it is being used by a steel rolling mill operator to view the steel as it is going through and leaving the mill. The c.c.t.v. system is by The Marconi Company and it is installed in the Cargo Fleet Iron Works of the South Durham Steel & Iron Co. at Middlesbrough.

TO SAVE YOUR TIME

We will assist you to obtain further information on any products or processes described or advertised in this issue. Just use the enquiry cards to be found in the front and back of the journal.

It's POSITIVELY SIMPLE !

Fast, positive connections with the PAINTON CAMBLOCK

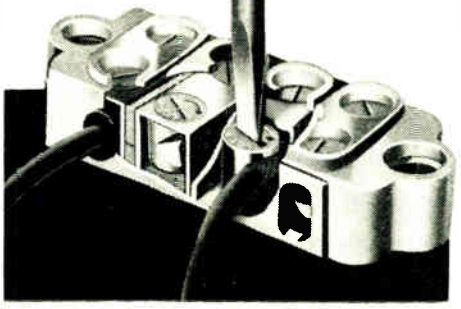
This entirely new concept in wire connections, already fully proved and widely used in the U. S. A., represents a major advance in terminal block design.

FAST POSITIVE CAM ACTION compresses wire against the busbar giving a positive locking connection —with less than a single turn of a screwdriver.

DAMAGE TO WIRES ELIMINATED: Conventional threaded screw (which can have sharp-edged protrusions) replaced by smooth-surfaced cam connector.

MORE EFFICIENT CONDUCTION is achieved since individual strands become mechanically fused together and each carries its load; and because of the reduction in the number of contacting parts and surfaces.

SAVINGS IN WIRING LABOUR COSTS achieved by simple three-step action: (a) Strip Wire, (b) Insert in to Cam block, (c) Turn Cam. Great ease of changing connections and improved quality control also accrue from the foolproof simplicity of this system.



WIDE RANGE OF SIZES of wires (solid & stranded) or multiple leads can be accommodated. This factor, in conjunction with high current carrying capacity, makes a single series Camblock equivalent to three series of a conventional terminal block.

THE PAINTON CAMBLOCK is available in Medium, Miniature & Subminiature ranges. Please send for details.

The CAMBLOCK principle secures wire with a partial turn of a screwdriver

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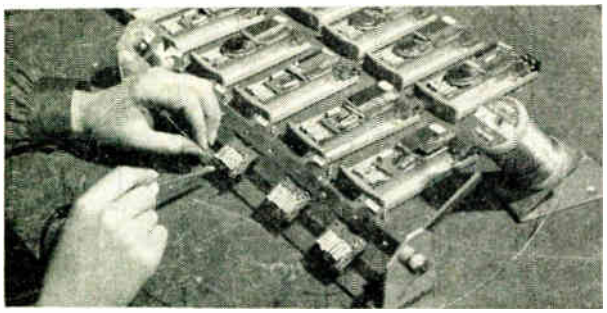
SOLDERING MINIATURE COMPONENTS



Multicore being used to solder connections on pocket receivers—part of the Westrex personal call system.

CHOOSE THE BEST SPECIFICATION OF ERSIN MULTICORE SOLDER FOR YOUR PRODUCTION SOLDERING PROCESS

The continual reduction in size of electronic components may make it advisable for you to use new specifications of Ersin Multicore Solder to obtain maximum efficiency and reliability. Alloy, diameter of the solder, type and percentage of flux in the solder and wear of soldering iron bits are all points to be considered.

ALLOYS

Generally only 60/40 or Savbit Type 1 alloys should be used. Savbit will promote soldering efficiency by reducing considerably the wear of miniature soldering iron bits.

ERSIN Multicore SOLDER

MULTICORE SOLDERS LTD. HEMEL HEMPSTEAD HERTS.

DIAMETERS

18 s.w.g. to 22 s.w.g. are the gauges most suitable. Ersin Multicore is also available in even gauges down to 34 s.w.g.

The use of gauges of 18 s.w.g. and finer will reduce the amount of solder used per joint with consequent saving in cost of solder and reduction in flux residue. The following table gives details of the number of feet per lb. of fine gauges. Compare these lengths with 60/40 16 s.w.g. which has 102 feet per lb.

SWG	FEET PER LB	
	60/40	SAVBIT No. 1
18	182	170
19	262	244
20	324	307
22	536	508
24	865	856
26	1292	1279
28	1911	1892
30	2730	2695
32	3585	3552
34	4950	4895

FLUX

The rapid soldering of miniature components makes it essential that the flux in the solder shall be very active and fast, yet of course entirely non-corrosive. Ersin Type 362 flux, incorporated in Ersin Multicore Solder, has won world wide recognition for utmost reliability and consistent high quality. It complies with all relevant British and U.S.A. Government specifications.

As standard the flux percentage by weight of solder is 3.4%. **Now available for production soldering processes is Ersin Multicore Solder with 362P flux in 60/40 and Savbit No. 1 alloys. These solders have a flux percentage of 1.6 and 1.55 respectively, less than half that hitherto incorporated in standard Ersin Multicore Solder. To promote the extra rapid spread of the considerably lower percentage of flux contained in the cores and to deodorise the resin base, an exclusive agent, Pentacol, has now been combined with the flux. The well-known, approved, non-corrosive qualities of Ersin flux type 362 remain unchanged.**

Ersin Multicore Solder with 362P flux thus provides the same high speed soldering as standard Ersin Multicore Solder with the advantage that less fumes are liberated during the soldering process and less flux residue is left. Due to the lower percentage of flux, a greater amount of solder is obtained for a standard length of wire. Economies are achieved by the fact that it is often possible to use a finer gauge of the new solder to provide the same amount of solder on a joint as compared with the standard Multicore product.

All Multicore Solders are covered by one or more of the following Patents: 433,194; 675,954; 704,763; 721,881.

SAMPLES FREE to Production Engineers

We will be delighted to send free samples of any of the above specifications to production engineers who apply for them on their Company's notepaper. Please state alloy and gauge required, and if samples should be in standard Ersin Multicore Solder or 362P low flux content solder.

We will also send a complimentary copy of the technical reprint "Erosion of Soldering Iron Bits."

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CMMS10

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a.c. and d.c.
0 to 10 amps.

VOLTAGE
a.c. and d.c.
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RESISTANCE
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DECIBELS
−15dB to +15dB

THE world's most widely used multi-range electrical measuring instrument is available in several different models, specially designed to supply the needs of every field of industrial and scientific endeavour.

The Model 8 AvoMeter provides 30 ranges of direct readings of a.c. and d.c. Voltage, a.c. and d.c. Current, and Resistance on a 5-inch hand calibrated scale with an anti-parallax mirror. Two rotary switches provide instant range selection, and the meter is provided with a polarity reversing switch and an automatic overload cut-out device.

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A8.7

Mullard introduces first solid aluminium capacitor range

Improved Stability over Wide Temperature Range

Available for the first time in the United Kingdom is a new type of electrolytic capacitor—the solid-electrolyte aluminium capacitor. Intended for use in professional equipment, this type of capacitor offers the circuit designer more stable characteristics over the service life than is obtained with the liquid-electrolyte capacitor, operation over a wide temperature range, and a long shelf and service life. The range of capacitance values available is from 2 to 100μF with six voltage ratings from 4 to 40Vd.c.

CONSTRUCTION

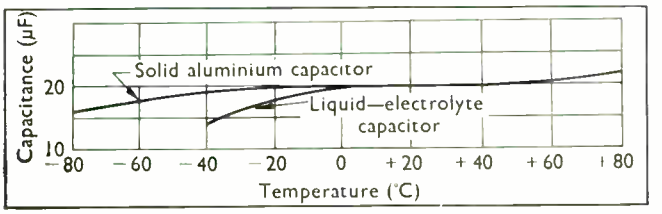
The construction of a solid-electrolyte aluminium capacitor is basically that of the conventional wound-foil type, the main difference being that instead of using a liquid-impregnated paper, a dry semiconductor (manganese dioxide) is deposited on glass cloth. The anode and cathode consist of etched aluminium foil.

The capacitor is 'formed' in the same way as other electrolytic types, a layer of aluminium oxide being deposited on the anode. Unlike the conventional types of electrolytic capacitor, this layer does not dissociate when the working voltage is removed. Solid-electrolyte aluminium capacitors therefore have to be formed once only and do not exhibit reforming characteristics each time the working voltage is applied.

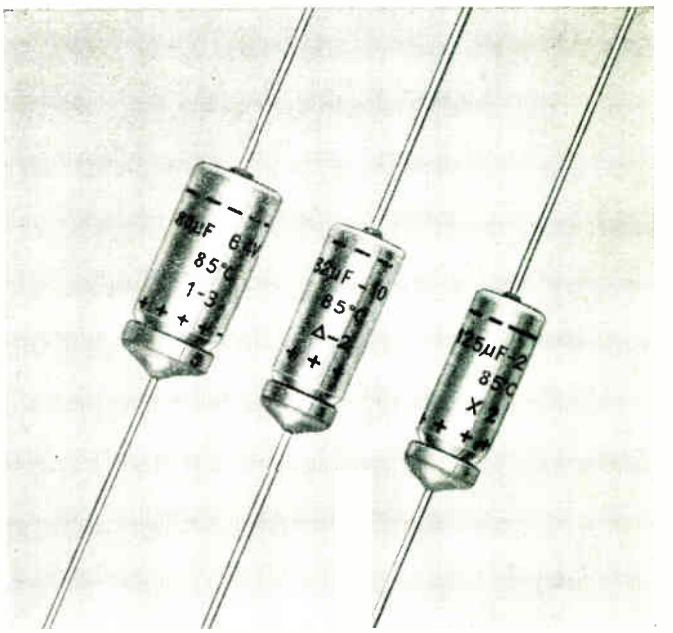
GOOD LOW-TEMPERATURE PERFORMANCE

The rise in high-frequency impedance with decreasing temperature of a solid-electrolyte aluminium capacitor is much smaller than that of the liquid-electrolyte type. At −80 °C the impedance of a solid-electrolyte aluminium capacitor is typically only three times the value at 20 °C, allowing operation at these low temperatures. The good low-temperature performance is not gained at the expense of the upper temperature limit; this type of capacitor can be operated at a maximum continuous temperature of 85 °C, the maximum temperature being limited at present only by the current method of sealing.

The variation of capacitance with temperature for a solid-electrolyte aluminium capacitor is shown in the figure below with, for comparison, that of the liquid-electrolyte type.



Capacitance plotted against temperature for solid-electrolyte aluminium capacitor compared with liquid-electrolyte type.



Solid-electrolyte aluminium capacitors

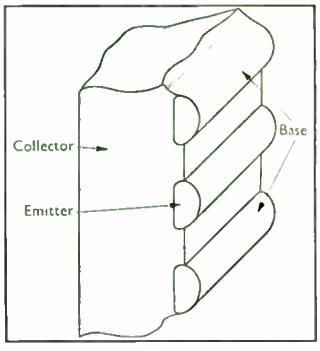
In common with other types of electrolytic capacitor, the value of capacitance and dissipation factor (tan δ) of a solid-electrolyte aluminium capacitor vary with frequency. The leakage current is slightly higher than in other types of electrolytic capacitor but the variation after applying the working voltage is considerably less, there being no reforming characteristic.

LONG SERVICE LIFE

Solid-electrolyte aluminium capacitors do not suffer from drying of the electrolyte and so there is a negligible change in the characteristic values over the service life. This type of capacitor therefore offers a long service life with highly stable characteristics capable, of operating over a very wide temperature range.

For further information on the Mullard range of solid-electrolyte aluminium capacitors, please use the reader reply card of this journal (see reference number opposite.)

What's new from **Mullard**



'STRIPE CONSTRUCTION' USED IN V.H.F. TRANSISTOR

A recently introduced germanium p-n-p transistor, the AFY19, uses a 'stripe construction' which enables a narrow base width and low collector capacitance to be achieved, thereby ensuring efficient operation at very high frequencies.

The AFY19 will dissipate a total power of 800mW in an ambient temperature of 25°C, and has a typical f_t value of 350Mc/s. The transistor is therefore ideal for operation as a power amplifier in v.h.f. transmitters operating at frequencies up to 180Mc/s.

LEAK DETECTOR FOR OPERATION DOWN TO 10^{-14}atm.l/s

A high-sensitivity semi-automatic leak detector has been introduced, capable of detecting leaks of magnitude as small as 10^{-14}atm.l/s of helium. As an air-cooled pumping system is used, the only services required for the detector are a small quantity of liquid nitrogen for the trap and an a.c. mains supply. The detector therefore forms a highly sensitive yet mobile unit for high vacuum and ultra-high vacuum installations.

The unit incorporates many features making it easy to operate. The pumping and test sequences are controlled by one switch. Two pumping systems are used, one for evacuating the test component and the other for the operation of the sensing head. Changeover between the systems is automatic, and the test component is automatically vented to atmosphere after the measurement is completed, giving a fast recovery time.

The detector is in console form with the top designed as a work table. The meter for indicating leak rates is mounted above this work table and can be rotated through 360° to enable it to be visible even when the detector is connected to large apparatus, or demounted for remote monitoring.

The circuitry is transistorised to ensure stability and a fast warm-up time. Safety devices are fitted so that the unit will 'fail safe' in the event of a mains supply or pressure failure.

FLAME-FAILURE PHOTOCELL WITH SENSITIVITY TWICE THAT OF ORP50

Operation at low illumination levels

A photocell with a sensitivity twice as great as the established ORP50 has been introduced to meet the demand for more-sensitive combustion safeguard equipment to work at low illumination levels. This new cell, the ORP52, is a cadmium sulphide photo-conductive type.

The ORP52 is in miniature construction with flying-lead connections. The sensitive tablet is set at 45° to the cell axis, allowing both side and end-on incidence which allows flexibility in the placing of the cell in the equipment. Besides the uses in combustion safeguard equipment, the ORP52 can also be used in a wide range of industrial on/off applications.

Reader Enquiry Service

Further details of the Mullard products described in this advertisement can be obtained through the Reader Enquiry Service of Industrial Electronics, using the appropriate code number shown below.

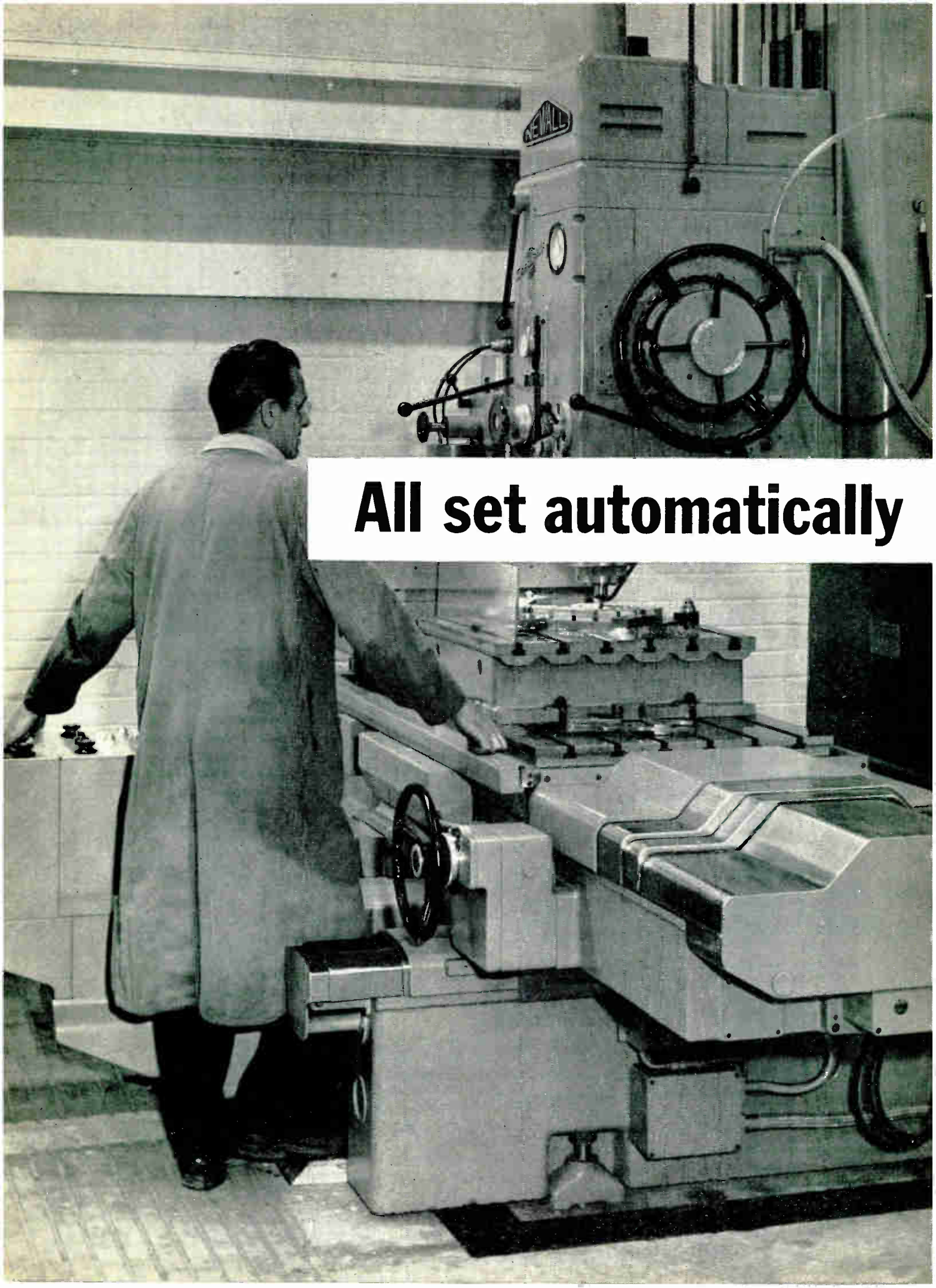
Solid-electrolyte aluminium capacitors	206
Leak detector	207
High-sensitivity photocell ORP52	208
Oscilloscope tube E10-10GH	209
V.H.F. transistor AFY19	210

Double-gun Oscilloscope Tube with negligible interaction between beams

A new double-gun oscilloscope tube, the E10-10GH, will handle signals of different frequencies and different amplitudes on the deflection plates with negligible interaction between the two beams. The deflection of one beam when balanced d.c. potentials are applied to the deflection plates of the other beam is less than 2×10^{-3}mm/V. The tube can be used in oscilloscopes with a frequency range up to 15Mc/s.

The tight-tolerance tube has a 4in. diameter flat faceplate with a metal-backed screen. A helical p.d.a. system is used and connections to the two sets of deflection plates are brought out to the side of the tube.

The E10-10GH has a green screen phosphor with a medium-short persistence. A version with a screen phosphor having a longer persistence will be available later.



All set automatically

For further information circle 216 on Service Card

Repeat accuracy of ± 0.002" has been achieved in milling, on a long run.

...for increased machine-tool output and accuracy

Greatly improved machine-tool output, together with high accuracy. These advantages are gained using AEI Automatic Co-Ordinate Setting Equipment. Much quicker, simpler and accurate setting of machine-tool slides is achieved, completely automatically, using standard-commercial punched tape, or by convenient manually-set dials on the machine operator's console desk. Solid state circuit components minimise maintenance. Servicing can be carried out by an ordinary plant electrician. This reliable automatic electronic control equipment holds vital benefits for both users and manufacturers of modern machine tools. Talk with our experts and learn how far ahead AEI are today in the application of electronic control to machine-tools.

Is there an 'Electronic Answer' to your problem? . . . AEI equipments and AEI experience cover every kind of electronic control application. Let AEI bring you up to date now on latest electronic progress in your special field: write for information to your nearest AEI office or to:

'AEI INDUSTRIAL ELECTRONICS' achieving efficiency *efficiently*

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NEW PARKS · LEICESTER

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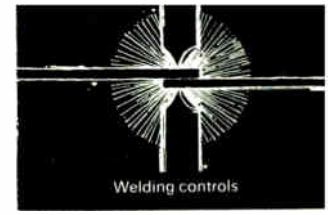

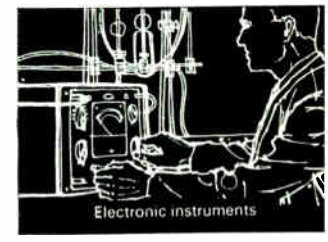

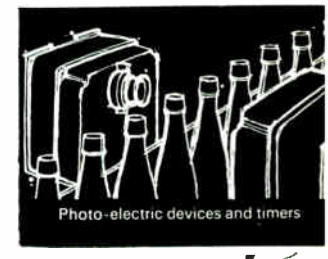

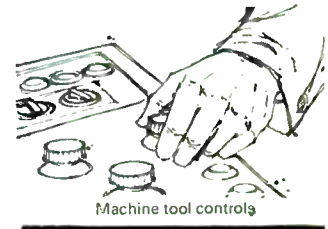

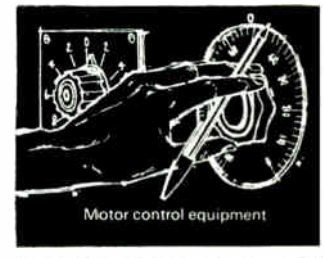

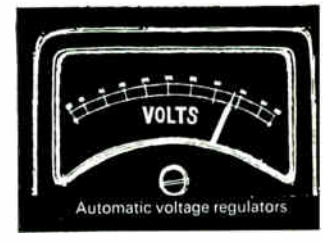

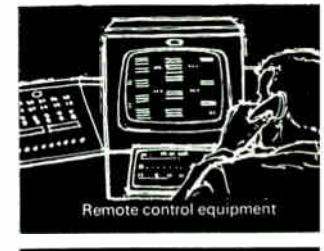

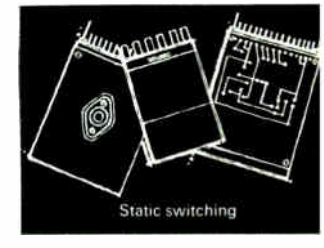

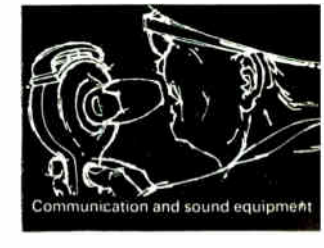

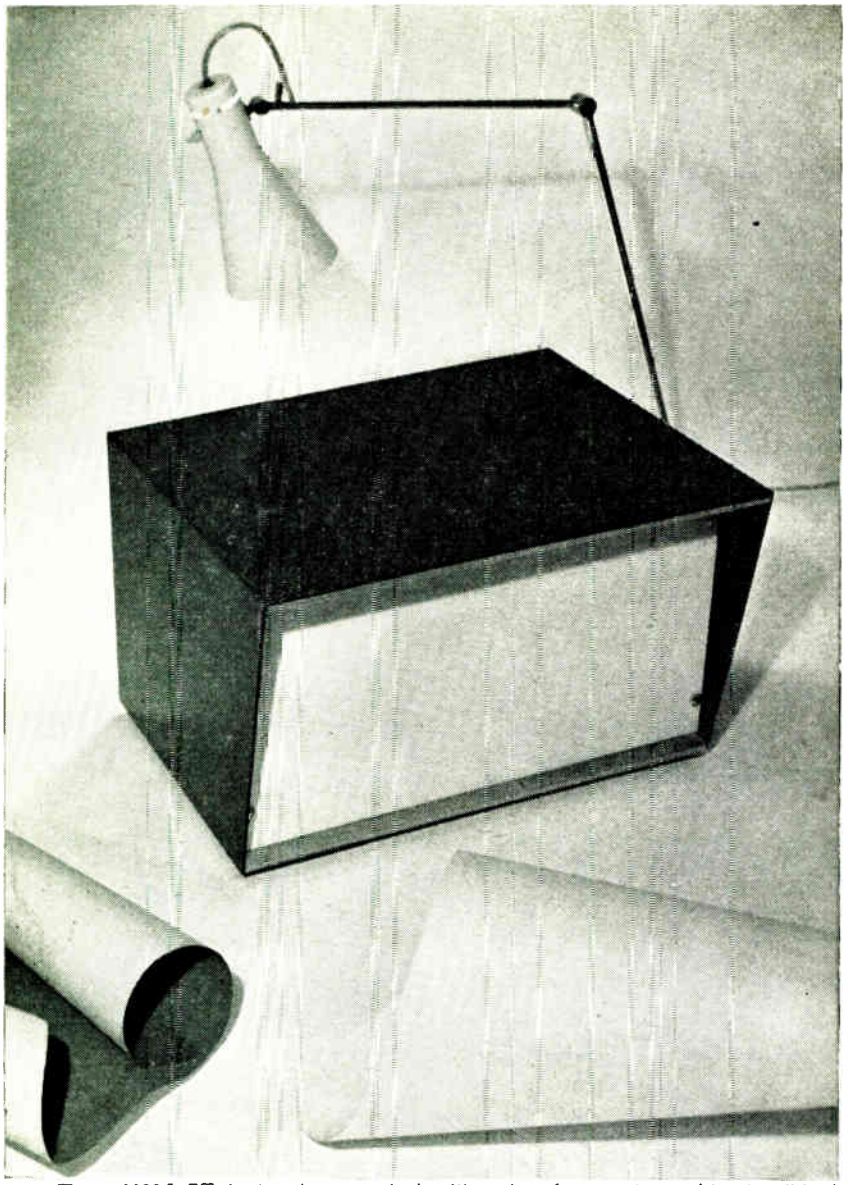

Type 1100A Efficient and economical, with a visor front, enhanced by the ribbed aluminium trim fitted above and below the 19" x 10½" front panel. *Price: £7.4.0.*

a case of good design

Good design demands: a really attractive appearance combined with practicability — at an economical cost. These three essentials are "built-in" to more than 100 standard Imhof instrument cases. To prove the point, we show here a typical example from their range — look at the lines! Look at the price! The standard of manufacture and finish is, of course, of a superb quality that will satisfy the requirements of the most discerning. Send today for Imhofs' 48 page catalogue on Instrument Cases — it contains full dimensional details of their range and is lavishly illustrated in full colour

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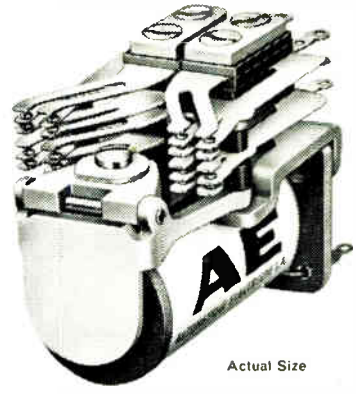


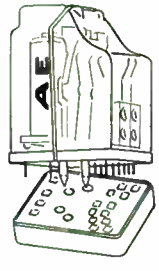
Actual Size

CLASS E RELAYS

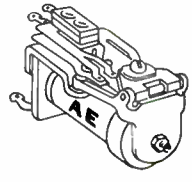
- ✳ 100-200 MILLION OPERATIONS
- ✳ Extremely stable adjustment
- ✳ Contacts for all current ranges
- ✳ Hermetic sealing
- ✳ Operate and release delays
- ✳ Coils for AC and DC
- ✳ Plug mounting
- ✳ Fully independent twin-contacts

The Class E relay is a miniaturised telephone type with exceptional long life combining small size with light weight. This makes it ideal for many applications (small size computers, light-weight portable equipment, etc.) where space and weight saving are all-important. The design and construction of the Class E relay ensures maximum ease of installation, stability of adjustment and reliability.

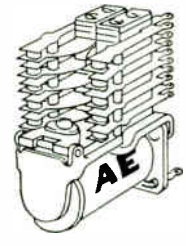
Some technical details: Coils: From 0.3 to 20,000 ohms handling all voltages AC or DC up to 220. Up to 3 separate windings. Power dissipating ability: 6 watts maximum (self-protecting). Contact spring capacity: 32 springs maximum (16 per pile-up). Contacts: *Standard*—twin, palladium silver, make or break 135 watts (max. 3 amps N.I.). *Special*—gold alloy (for dry circuits), silver cadmium oxide (heavy currents to 10 amps). and others. Terminals: Solder, plug-in, printed circuit, taper tab, wire wrap. Net weight: 2½ oz. approx.



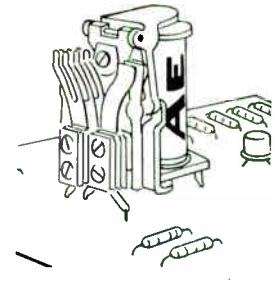
Plug-in socket and dust cover



Slow to operate version



With power contacts



Mounted in a printed circuit

Hermetically sealed version also available (not illustrated)

Please write for full details to the U.K. distributors:—

THORN ELECTRONICS LIMITED

SPECIAL PRODUCTS DIVISION, 105-109 JUDD STREET, LONDON, W.C.1. TELEPHONE: EUSTON 4433

U.K. distributors for Automatique Electrique Products.

DTV/7

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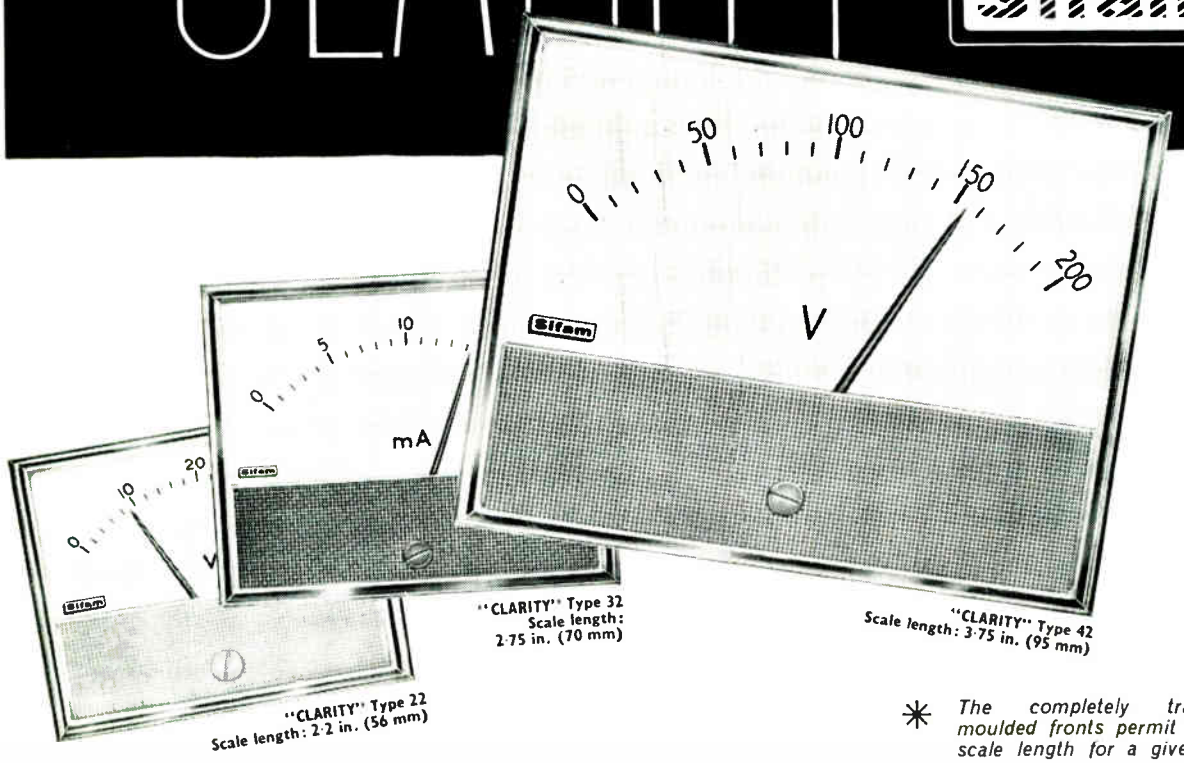
CLARITY

A NEW RANGE WITH A NEW LOOK FROM Sifam



"CLARITY" Type 22
Scale length: 2·2 in. (56 mm)

"CLARITY" Type 32
Scale length:
2·75 in. (70 mm)

"CLARITY" Type 42
Scale length: 3·75 in. (95 mm)

The new **SIFAM "CLARITY"** instruments are the result of a long period of development, for which the name **"CLARITY"** was chosen at the beginning of the programme as best expressing the most striking features of instruments designed to fulfil the demand for clean, modern and functional presentation. Designers will find the **"CLARITY"** range completely satisfactory for use in equipment following the contemporary approach to styling – particularly when considering ergonomic factors.
Scale arcs or markings can be supplied in accordance with the new British Standard recommendations or to individual requirements.

Let us arrange for a Sifam Technical Representative to show you the new "CLARITY" range or write for the new Data Sheet 106IC.

- *The completely transparent moulded fronts permit a greater scale length for a given frontal area.*
- *The lance type pointer is readily visible when the instrument is read at a distance, whilst its fine point allows accurate reading of indicated values.*
- *Interchangeable masks are available in a choice of contemporary colours to blend with customers' equipment.*
- *Elimination of solid surround provides both greater clarity and readability.*

Sifam Instruments

SIFAM ELECTRICAL INSTRUMENT CO. LTD. Woodland Road, Torquay, Devon
Telephone: Torquay 63822/3/4

it seems like a hundred years . . .

. . . since we solved our first problem in air movement. It isn't, of course, but we've solved so many that we are beginning to feel old and wise.

Custom built blowers

There have been special problems which we have solved with special designs, creating in the process more than 800 different types of blower. As new problems arise we shall continue to draw on the vast fund of knowledge gained through this work.

Standard ranges

Many customers come up with similar problems. To solve these we have developed some standard blowers, which are now available from stock. This doesn't mean that we are any less keen to solve the problems that these standard blowers will not cope with—far from it, we are still anxious to blow on your designs—and it doesn't mean that we don't want to give you advice on their application—we are still just as anxious to make sure that you get the right blower for the job. It's just that we felt it would be easier and quicker for you if we made some of the most useful ones readily available. You can see them on the next two pages, including a new miniature blower and additions to the Plannette range.

Consultation service

Many manufacturers requiring temperature control for their equipment are now appreciating the value of calling in Plannair at their early design meetings. Why don't you plan with Plannair?

Plannair standard blowers—available from stock

a new miniature blower—the thimble

Designed to get rid of hot spots on crowded chassis, the Thimble blower is probably the smallest high performance axial flow blower in production in the world. Specially designed for easy mounting, and meeting all current military specifications, it can direct up to 4.5 cubic feet of air per minute on to a selected component.

Performance:	2.5 c.f.m. at 1.0″ s.w.g. 4.5 c.f.m. at 0.5″ s.w.g.
Power Input:	10 Watts
Power Supply:	115V or 200V, 3-ph. 400 c/s.
Dimensions:	1.6″ (40 mm.) long x 1.14″ (30 mm.) dia.
Weight:	2½ ozs. (77.75 gr.)

The Thimble is the latest in our wide range of miniature blowers. If it does not completely answer your problem it is probable we have a miniature that will.

FOR FURTHER INFORMATION OF PLANNAIR THIMBLE BLOWER CIRCLE 212 ON SERVICE CARD

centrifugal blowers

Light and compact, these units are ideal in a variety of applications including temperature control on television cameras, tungsten projector units and similar equipment.

Typical performance:	12 c.f.m. at 0.25″ s.w.g.
Power Input:	12 Watts
Power Supply:	115V or 230V, 1-ph. 50 c/s.

FOR FURTHER INFORMATION OF PLANNAIR CENTRIFUGAL BLOWERS CIRCLE 213 ON SERVICE CARD

two new Plannettes—10″ and 12″ dia.—only 3″ deep

Designed for applications requiring larger air flows than the 4½″ dia. and 6″ dia. Plannettes, the 10″ and 12″ dia. Plannettes carry on the unique Plannette feature of slimness—they are only 3″ deep.

Plannettes can be fitted inside, outside or on top of a cabinet, horizontally or vertically—wherever space is limited. The ability to operate in either direction adds further to the adaptability of the Plannette.

Design engineers throughout the world have appreciated the value of this compact, reliable unit for many thousands of the smaller sizes—only 2″ wide—are now in service in the U.K. and overseas.

Performance:	12″ dia.	1,000 cfm in free air conditions 600 cfm at 0.2″ swg at 1,400 rpm
	10″ dia.	560 cfm in free air conditions 300 cfm at 0.16 swg at 1,400 rpm
	6″ dia.	220 cfm in free air conditions 150 cfm at 0.25 swg at 2,800 rpm
	4½″ dia.	100 cfm in free air conditions 80 cfm at 0.15 swg at 2,800 rpm

Power supply: 230V or 110V, 1-ph, 50/60 c/s.

FOR FURTHER INFORMATION OF PLANNAIR PLANNETTES
CIRCLE 214 ON SERVICE CARD

Wafters

This range has been designed for general purpose low cost cooling and air circulation tasks. The basic unit, consisting of the motor and moulded fibreglass impeller, can be mounted in any of three different housings, according to need.

Like many other Plannair designs, Wafters are in use in a wide variety of applications all over the world.

Performance:	50.0 cfm in free air 26.0 cfm at 0.1″ swg
Power input:	12 Watts
Power supply:	115/230V, 1-ph, 50/60 c/s or various D.C. on application.

FOR FURTHER INFORMATION OF PLANNAIR WAFTERS
CIRCLE 215 ON SERVICE CARD

Plan with Plannair

transportable radio station

HMS Dreadnought

Make Plannair a member of your own design team. More and more manufacturers requiring temperature control by planned air movement are realising the need to consider this special problem at an early stage, and are calling in Plannair at the outset. Here are two examples:

Racal called in Plannair at the planning stage for temperature control of the console and transmitter drive unit in their transportable radio station (top left), currently used by NATO throughout Europe.

Temperature control of vital electronic equipment aboard HMS Dreadnought—Britain's first nuclear submarine—is achieved by special, sound-deadened Plannair Blowers.

Plannair was called in by the Admiralty at the planning stage and, in liaison with Lancashire Dynamo Electronic Products Ltd., designed these high efficiency blowers. In addition to this vital role in the Dreadnought, Plannair equipment also plays an important part in the Royal Navy's new guided missile ships and aircraft carriers.

Plannair blowers are designed for solving problems in aero-thermal control—the art of *planned air movement*. As the electronics industry progresses we shall continue to endeavour to maintain our supremacy in this field. If you think you have come across a problem as yet unanswered, get in touch with us—if we do not already have the answer we'll find it.

PLAN WITH PLANNAIR— SPECIALISTS IN AERO-THERMAL CONTROL

PLANNAIR

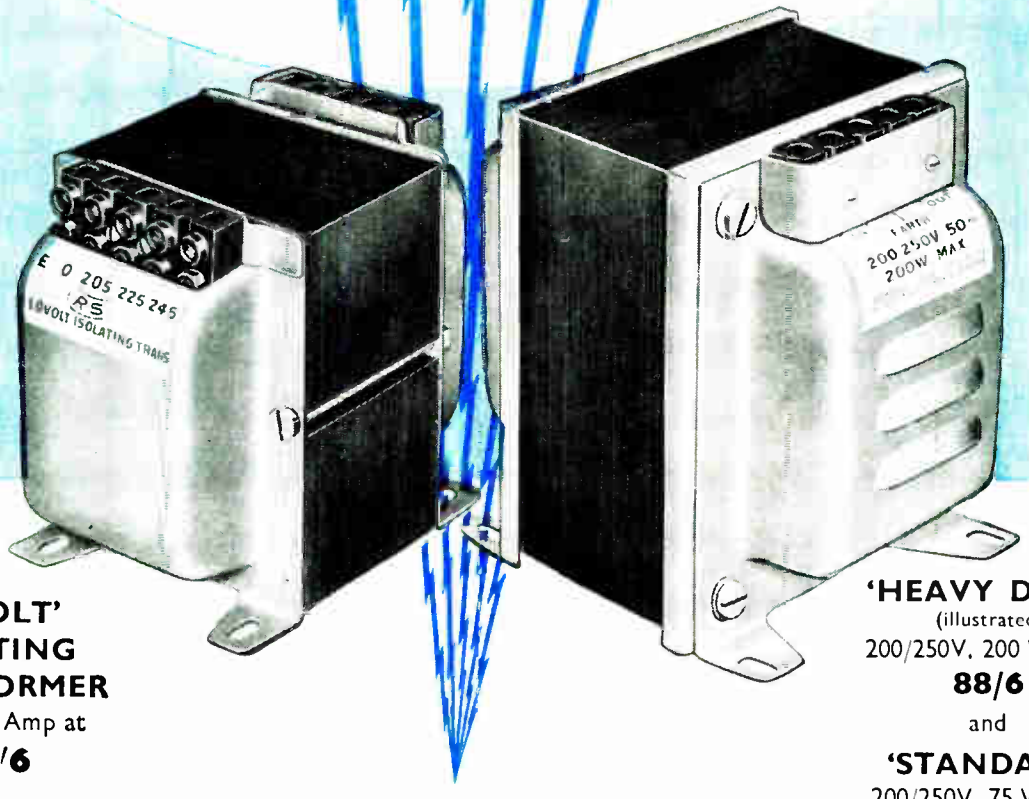
PLANNAIR LIMITED Windfield House, Leatherhead, Surrey. Leatherhead 4091.

VITAL PROTECTION

for you or your staff - in a JIFFY!

INSTALL OUR

ISOLATING TRANSFORMERS



'LOVOLT' ISOLATING TRANSFORMER
2 x 12V, 4 Amp at
47/6

'HEAVY DUTY'
(illustrated)
200/250V, 200 Watt at
88/6
and
'STANDARD'
200/250V, 75 Watt at
37/6

An essential guard against electric shock hazards, our Bench Isolating Transformers are carefully constructed and tested to ensure a very high degree of safety. The "Heavy Duty" and "Standard" Types supply equipment under test, whilst the "Lovolt" Type is recommended for Soldering Irons and Bench Lamps.

Remember—our catalogue contains a range of nearly 3,000 other QUALITY COMPONENTS which we deliver BY RETURN!

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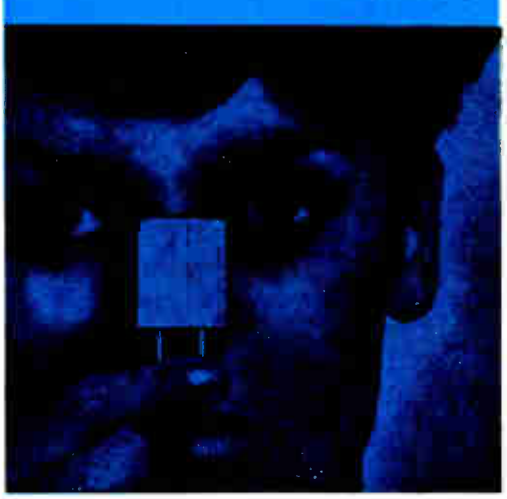
TELEGRAMS: RADOSPERES, WESDO, LONDON *CABLES:* RADOSPERES, LONDON W1

BRUSH QUARTZ CRYSTAL UNITS

Brush Crystal Company Limited manufacture a wide range of crystal units and are familiar with the problems of frequency selection and control and it is our policy to keep ahead with the crystal units tailored to meet existing and future demands. It is for this reason that we are now able to offer units manufactured to meet the Defence Specification DEF5271A. These possess zero frequency-temperature coefficient AT cut crystal elements which are capable of meeting current requirements for miniaturised communication systems.

Brush replacement Quartz Crystal Units for existing equipment are available to a wide range of specifications. The high stability gold plated units are wire mounted in hermetically sealed metal containers. Brush Quartz Crystal units in low loss evacuation glass envelopes are particularly recommended for low ageing rates.

KEEP YOUR EYE ON **BRUSH**



Brush Crystal Co. Ltd. are playing an expanding role in electrics and electronics. They are alert to the increasing demands of the industry and now add the vast technical resources of the Clevite Corporation of America to their own twenty-five years of experience. This makes it possible to devise, plan and produce the most versatile range of products in Europe—for either tailor-made or mass-produced devices in all divisions. Brush are quickly making a name for themselves as the company you can rely on for advanced know-how, competitive prices and good delivery.

BRUSH CRYSTAL

COMPANY LIMITED · HYTHE · SOUTHAMPTON · Telephone Hythe 3031

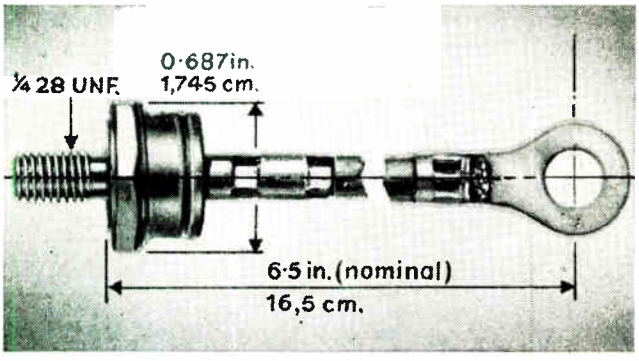
STC components review
NOVEMBER, 1963

25 AMPERES SILICON RECTIFIERS with dual polarity

Available from Stock

STC RS600 Series silicon rectifiers are rated at 25 amperes at 125°C stud temperature with crest working voltages from 100 to 600V. They are available with a choice of stud polarities to facilitate the assembly of diodes with heat sinks.

RS600 diodes conform to VASCA outline SO.32A and are flexible lead versions of VASCA outline SO.13, JEDEC DO-5 and IEC 1-104.



RS600 MAXIMUM RATINGS (125°C stud temperature)

Average forward current	25A
Surge current (5 milliseconds)	500A
Crest working reverse voltage	up to 600V
Non-repetitive peak reverse voltage (one cycle)	up to 800V
Storage temperature range	−60°C to +150°C
Mean dissipation	30W

RS600 ELECTRICAL CHARACTERISTICS (max. values)

Average reverse current at 125°C stud temperature and at rated voltage and current	1·5 mA
Forward voltage drop at 30 A d.c.	1·0 V

Diodes and heat sinks, assembled into stacks, are available in all circuit configurations.

Write, 'phone or Telex for Data Sheets and prices to STC Semiconductor Division (Rectifiers), Edinburgh Way, Harlow, Essex. Telephone Harlow 26811. Telex 81146.

NEW THERMAL DELAY SWITCHES

Three miniature switches, designed for operation at full mains voltage and with 1A contact currents, have been added to the already extensive range of STC Thermal Delay Switches. They have B7G bases and incorporate a single pair of contacts which make after a specified delay, following the application of heater voltage. Heaters are made for operation at 6·3V. Extended delays can be obtained by cascade connexion of these switches.

Changes of ambient temperature over the range −25 C to +70°C do not seriously affect the delay time, since the switches include a bimetal stationary strip to compensate for any movement of the active contact due to changes in ambient temperature.

Thermal delay switches are particularly suitable for delaying the application of h.t. voltage to valves which require a pre-heat time. In addition, they can be used as v.l.f. relaxation oscillators, for switching 3-phase circuits from star to delta arrangements when starting induction motors and for automatically reclosing a circuit breaker after a temporary current surge has caused it to trip. These applications are described fully in booklet MS/117.

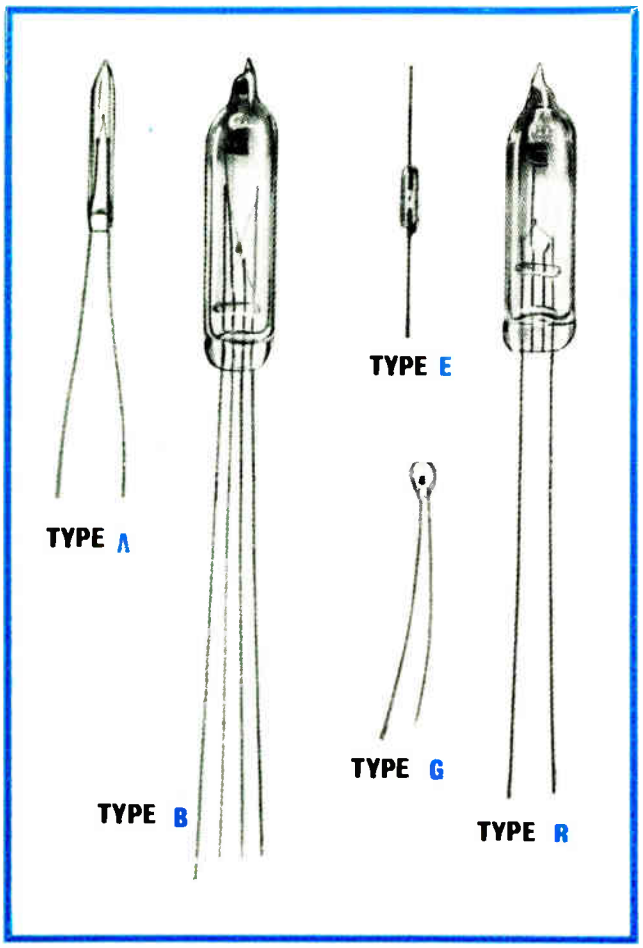
ABRIDGED DATA

	V_h (V)	I_h (A)	Delay Time at 20°C Min. (sec)	Delay Time at 20°C Max. (sec)	Max. open circuit voltage between contacts d.c.	Max. open circuit voltage between contacts a.c.
S102/2K	6·3	0·5	44	66	250	250
S104/2K, S204/2K*	6·3	0·5	25	35	250	250

*Has special pin connexion arrangement

Write, 'phone or Telex for Brochure MS/117 to STC Valve Division, Brixham Road, Paignton, Devon or London Sales Office, Footscray, Kent. Telephone FOOtscray 3333. Telex 21836.

THERMISTORS IN ELECTRONICS



SENSITIVE / SMALL / ROBUST / RELIABLE

The use of thermistors in electronic circuits is now well established, especially for the control of output power and the measurement of the power in complex waveforms. STC offer a very wide range of thermistors designed specifically for these and many allied applications. For example, the type R thermistor was designed for circuits operating at very low power levels. A power input of only 3 mW will reduce the resistance of this device to less than 1/20 of its value when cold.

Write, 'phone or Telex for leaflet MK/140 to STC Semiconductor Division (Transistors), Footscray, Sidcup, Kent. Telephone FOOtscray 3333. Telex 21836.

SILICON AVALANCHE RECTIFIERS TYPE RAS 310 AF

For the first time—a Silicon Rectifier which is self-protecting against voltage transients.
The avalanche property of this device has a voltage limiting characteristic that permits surges fifty times greater than the conventional silicon rectifier can withstand.
High voltage stack construction is simplified—avalanche rectifiers can be series connected without voltage equalizing resistors and, in many applications, equalizing capacitors are unnecessary.

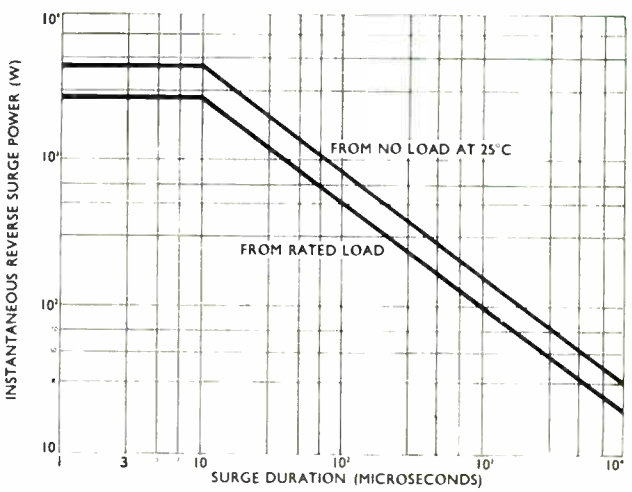
TYPE RAS 310 AF

Rated Forward Current (at 25°C)	*1·25 A*
Rated Crest Working Reverse Voltage	*1000 V*
Minimum Reverse Avalanche Voltage	*1250 V*
Rated Maximum Reverse Surge Power	*4 kW*
Rated Maximum Temperature	*140°C*
Standard Outline	*VASCA SO-16, JEDEC DO 1, IEC 1-101*

NOW AVAILABLE FROM PRODUCTION

ACTUAL SIZE

SURGE (NON RECURRENT) REVERSE POWER



Write, 'phone or Telex for Data Sheet MF/125 to STC Semiconductor Division (Rectifiers), Edinburgh Way, Harlow, Essex. Telephone Harlow 26811. Telex 81146.

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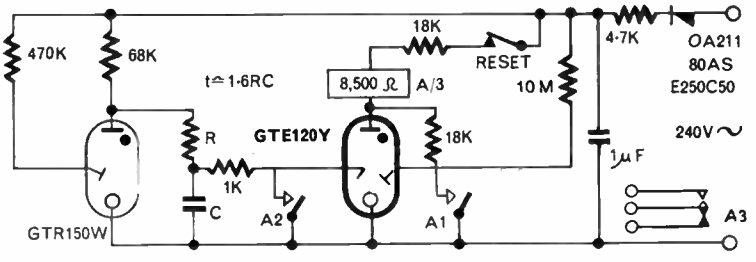
PROCESS TIMER

Perfectly adequate for simple repetitive timing but hardly a practical proposition for the hundreds of timing applications in industry. For simple reliable electronic timing and sequence switching without fuss the answer is inexpensive Trigger tubes.

GTE 120 Y TRIGGER TUBE

Operating directly from rectified mains, they require no special power supplies, they are not affected by severe transient overloads, they give visual indication of current flow and their characteristics are unchanged by temperature fluctuations. Reliable to the point of outlasting the useful life of their parent equipments, Ericsson Trigger tubes meet the most exacting industrial and commercial requirements. The simple timing circuit illustrated gives for example an accuracy of better than 1%. For tube data and other timing circuits please write to the address below.



Tube Division
Technical Services Dept.,
Beeston, Notts. Tel: 254831.

ERICSSON TELEPHONES LIMITED
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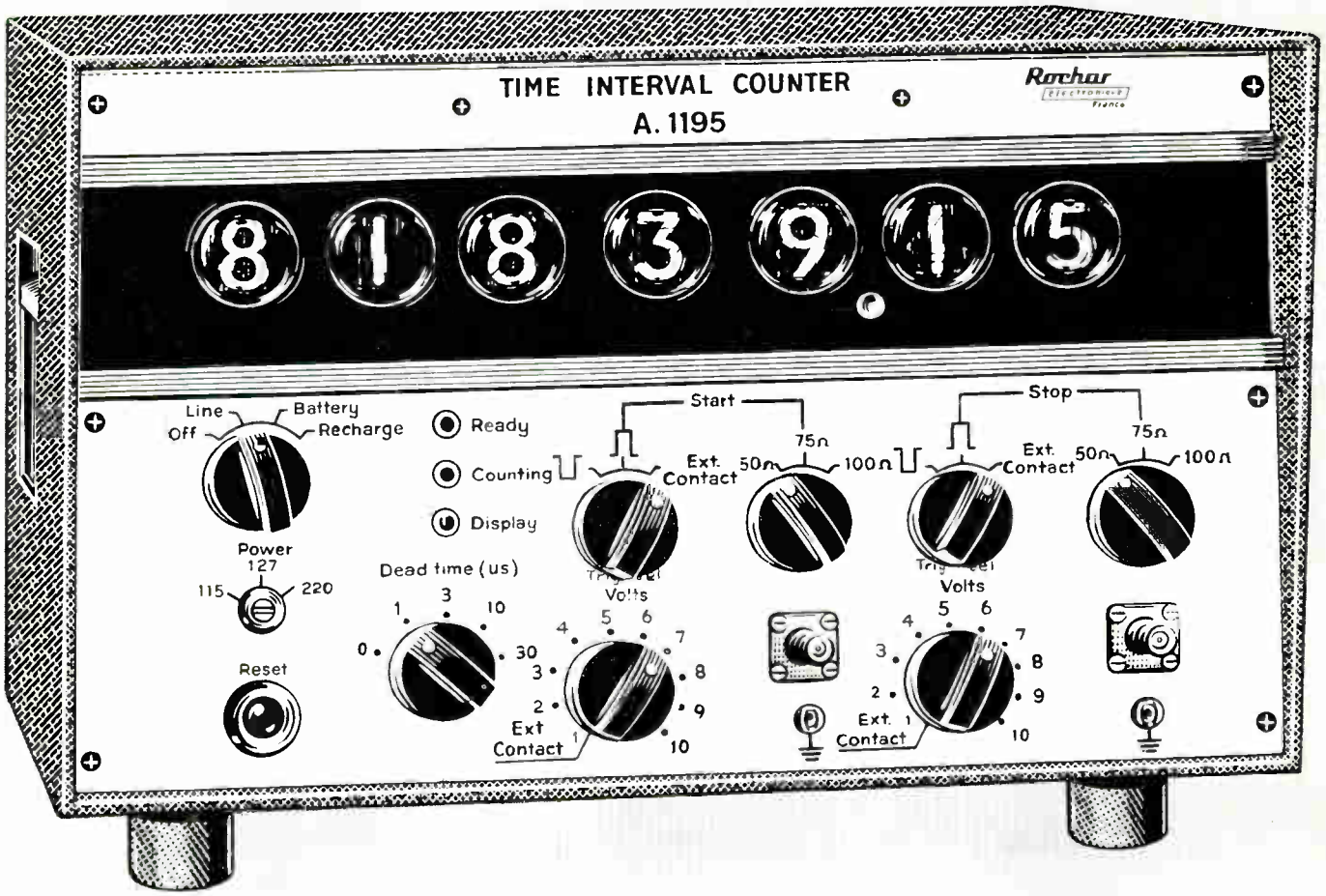
ER 53

SOLARTRON

TIME INTERVAL COUNTER TYPE A 1195



A tool for progress in every Industry

DIGITAL
TIME MEASUREMENT

SINGLE SHOT PHENOMENA
DOWN TO 25 NANOSECONDS

The Type A 1195 25 Nanosecond Chronometer is an advanced digital time measuring instrument capable of resolving the time interval between two pulses down to 25 nanoseconds.
The reading is stored on the display until cleared by a manual or external command making the instrument an essential tool in recording the measurements associated with ballistics, shock tubes, range finding or any application where the information is presented as short time intervals in a 'once only' form.
The instrument is designed for field and laboratory use and is portable (22 lb weight) and may be energized from a.c. mains, external battery or internal (chargeable) battery.
The Type A 1195 is manufactured for the Solartron Electronic Group by their associates Rochar Electronique (both Companies are members of the Schlumberger Group) and is the latest addition to the Rochar range of advanced digital time and frequency measuring instruments. Fuller information on the Chronometer or the range of Counter/Timers will be gladly sent on request and Solartron Engineers are available to demonstrate and discuss the equipment.

BRIEF SPECIFICATION
Three versions are available differing only in dynamic range.
TYPE 'A' 25 nS to 1 mS
TYPE 'B' 25 nS to 10 mS
TYPE 'C' 25 nS to 100 mS

INTERNAL CLOCK FREQUENCY ACCURACY
± 5 parts in 10^5

INDEPENDENT 'STOP' AND 'START' CHANNELS
Input Impedance: 50, 75 and 100Ω
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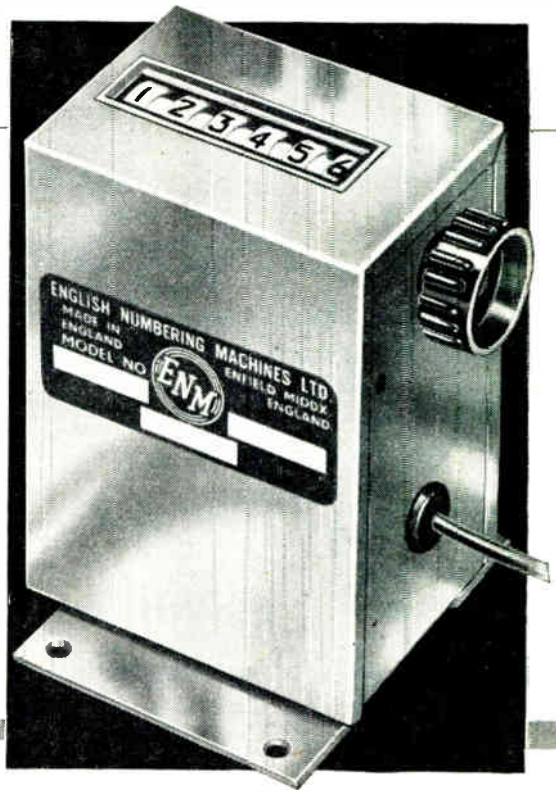

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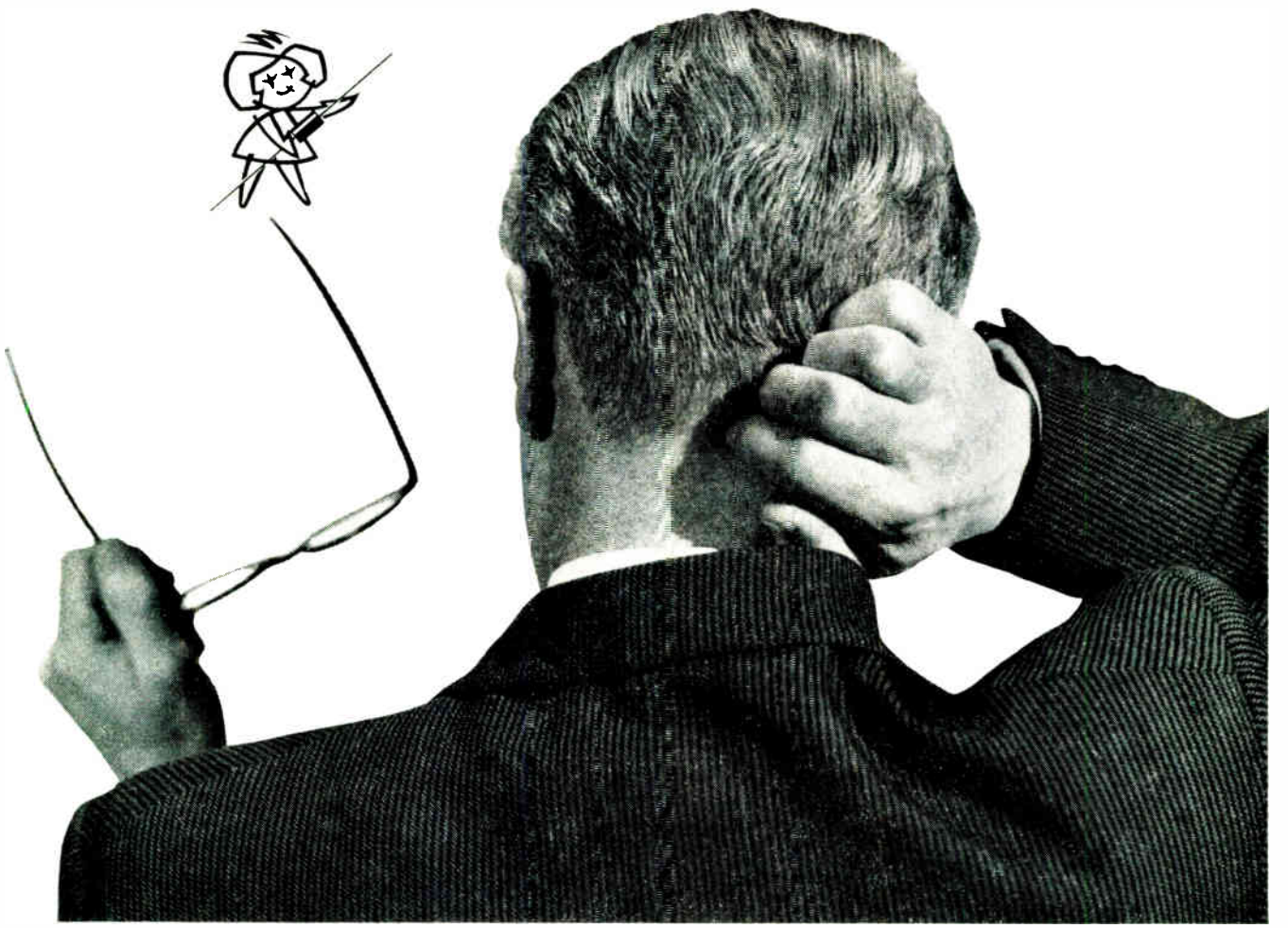

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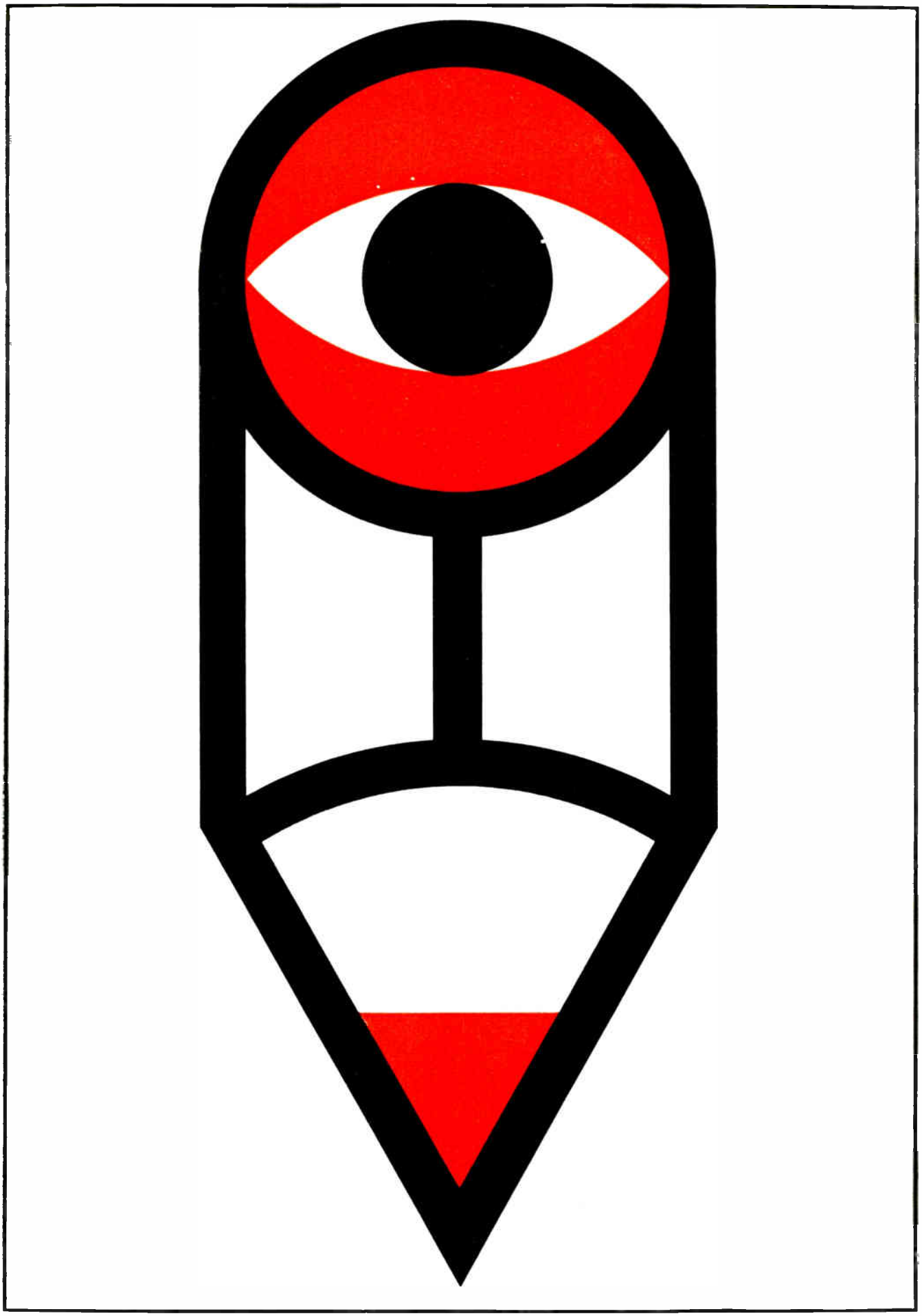

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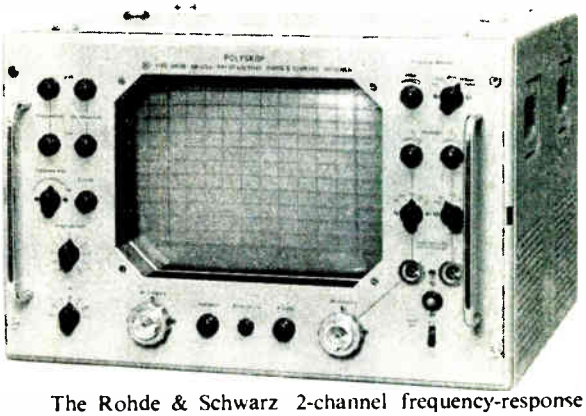

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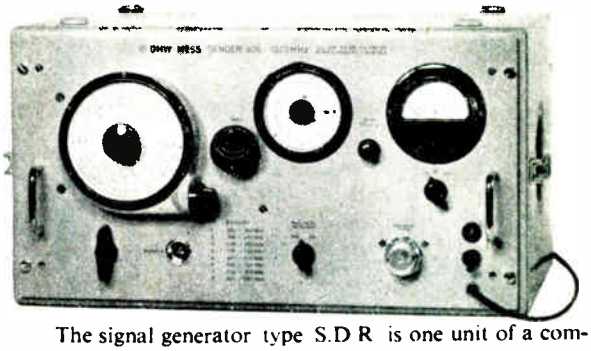

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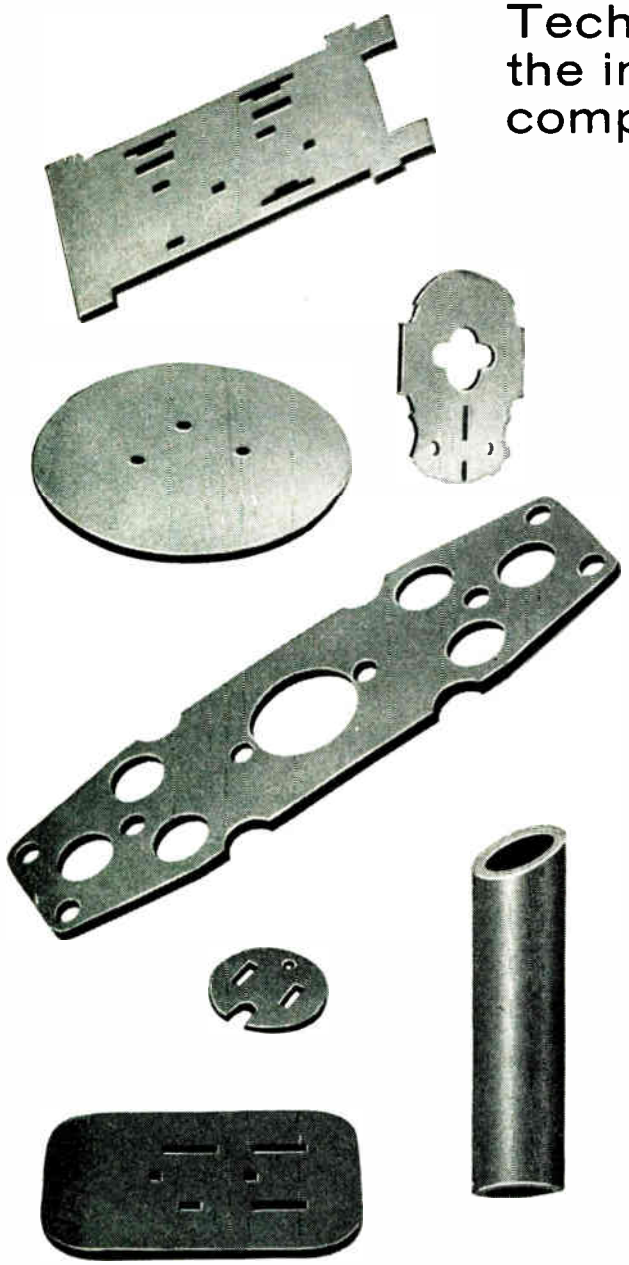

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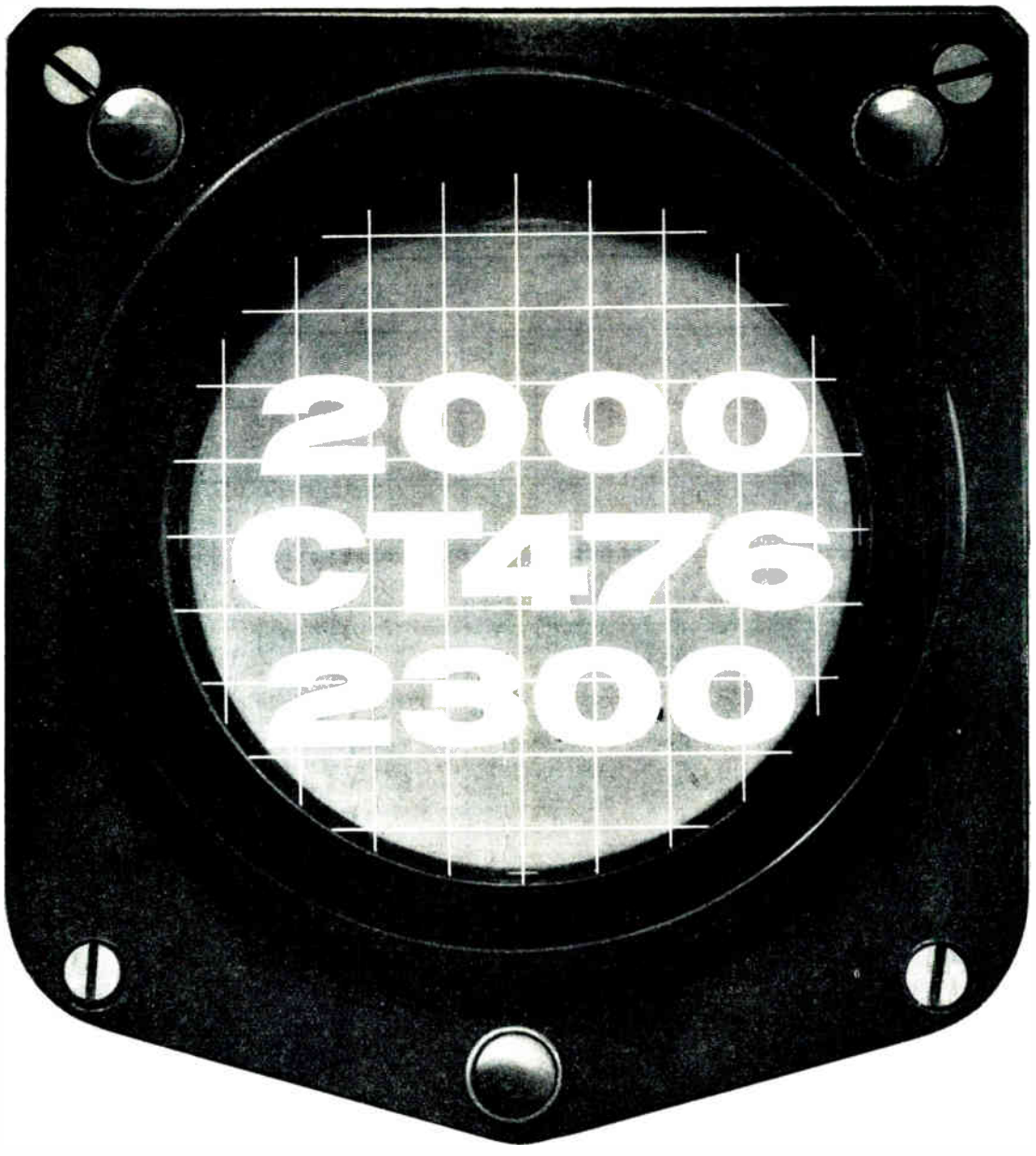

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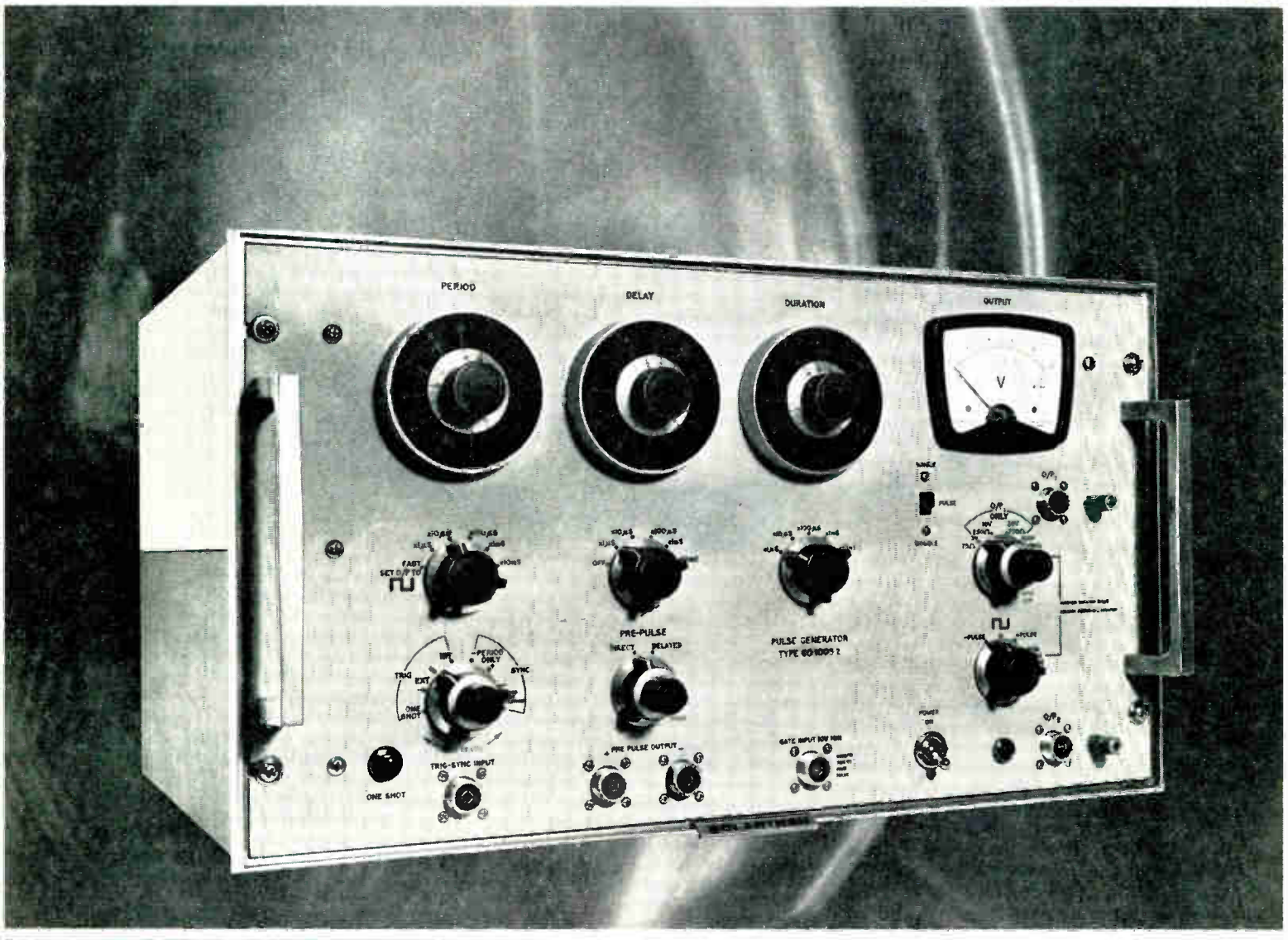

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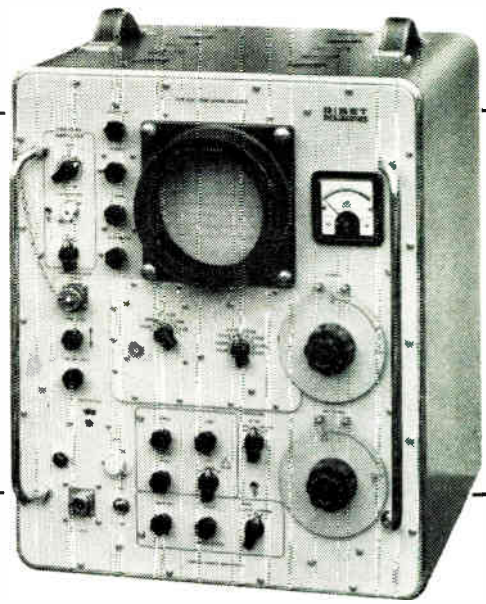

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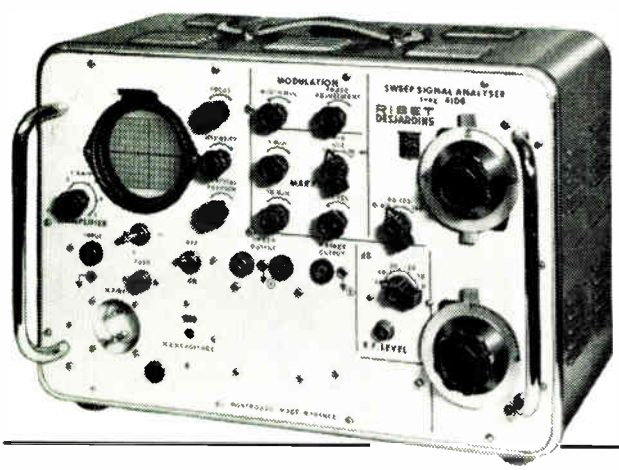
Frequency range is 0 to 320 Mc/s in three ranges, with sweep width adjustable from 0 to ± 25 Mc/s depending on the range.



◀ TV-FM SWEEP SIGNAL GENERATOR TYPE 410B

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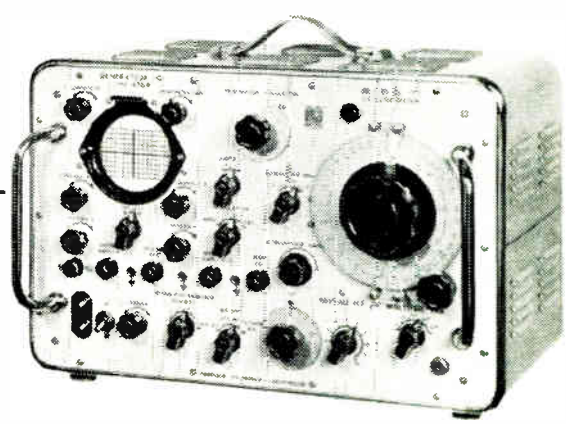

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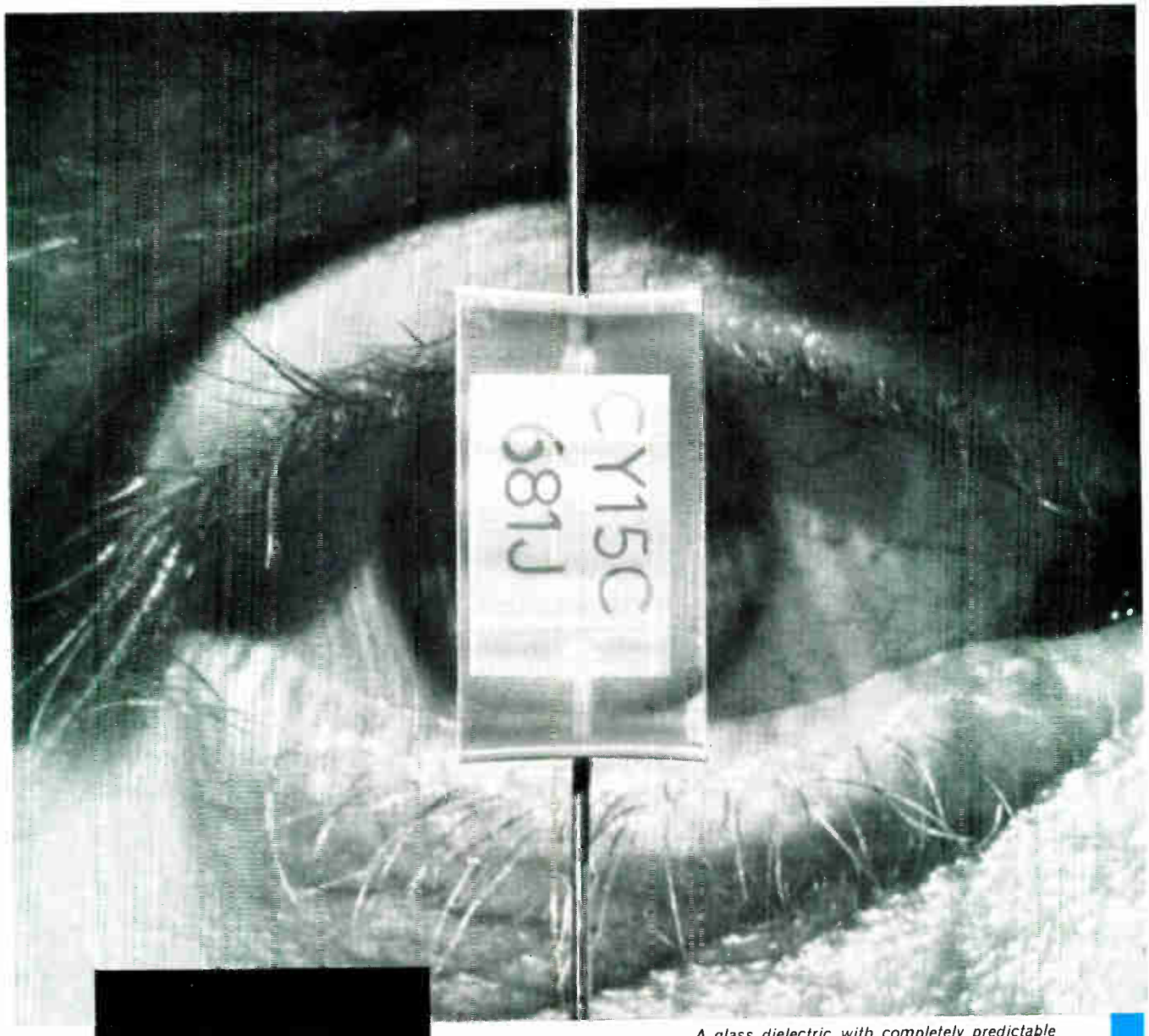

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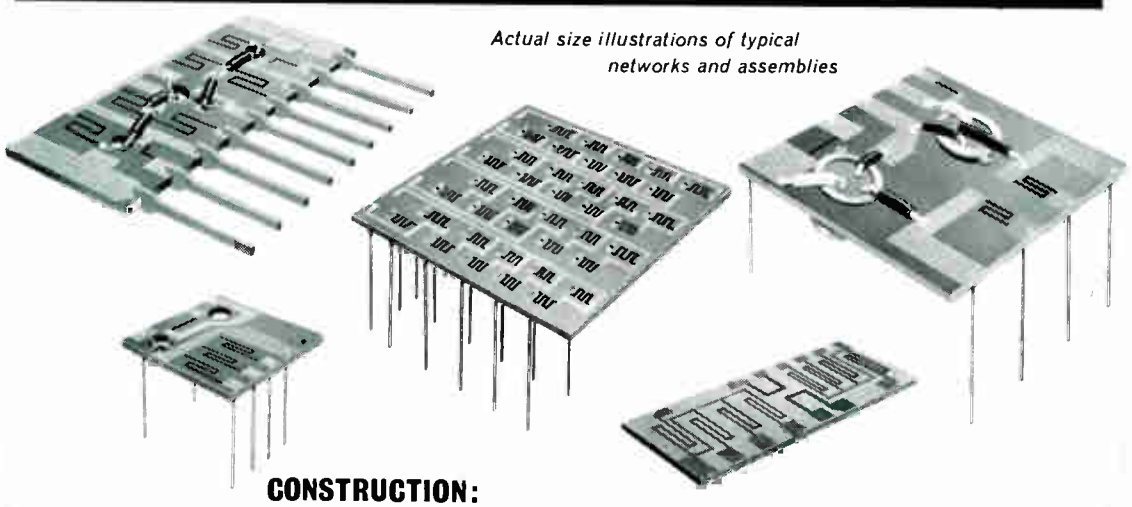

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FACTORIES IN AUSTRALIA AND CANADA

Comment

In this issue we are including an unusually large number of articles relating to the same subject, which is closed-circuit television. We are doing this partly because we feel that the usefulness of closed-circuit television in industry is not as fully appreciated as it should be and partly because there is an exhibition this month at which industrial television apparatus will be on view. This is the Industrial Photographic and Television Exhibition which opens at Earls Court on 11th November.

Television does not form a major part of this show, for a great many of the exhibitors are showing industrial photographic equipment, a term which includes photocopying equipment. At the same time the Engineering Materials and Design Exhibition and the International Factory Equipment Exhibition are being held, also at Earls Court. A ticket for one exhibition is, in fact, valid for the other two.

It does not appear that much in the way of electronics will be shown at these last two exhibitions. Nevertheless, there appear to be a good many items of interest to electronic engineers. It seems that a visit to Earls Court from 11th to 16th November (9.30 a.m.–6 p.m. except on the last day) will offer a very wide variety of exhibits of importance to electronic engineers as well as to others. Like all other engineers, they are interested in materials and design; and they are most certainly interested in factory equipment.

Photography

We normally consider that photography is outside our field. Most people would say that it is one of the few activities which makes no use of electronics. But they would be wrong. Every user of an exposure meter, or of a so-called automatic camera which embodies an exposure meter, is making use of an electronic device! The photocells employed are usually selenium types and selenium is a semiconductor and electronics is most certainly concerned with the conduction of electricity in semiconductors.

However, even if exposure meters and some cameras are strictly electronic most people undoubtedly feel that the amount of electronics embodied is not enough to justify calling the devices electronic. We agree. There is, however, now news of a camera which does embody much more electronics, for it has electronic timing of the shutter speed.

It is rather simple electronics, there being two transistors in a monostable multivibrator type of circuit. The shutter is unconventional and has two separate blades. On pressing the shutter release a switch is closed which connects a 4·5-V battery. Current flows through one transistor and an electromagnet, which holds one shutter blade 'open' against a spring. At the same time the other blade is released to open the shutter, which it does under spring tension. A second switch is actuated and permits current to flow from the battery into a capacitor, but through a cadmium sulphide photocell, the resistance of which depends on light intensity. The time taken for the capacitor to charge to a fixed voltage thus depends on how strong the light is.

When the voltage reaches its preset value, it turns on a transistor which in

turn turns off the other transistor and interrupts the current to the electromagnet. This releases the shutter blade and it closes the shutter.

Thus the shutter is opened mechanically and closed by the action of the electronic circuit when the proper amount of light has passed through the lens. To cater for the use of various apertures and film speeds, the capacitor value is changed with the aperture and film speed setting.

Operating Conditions

As a result of the electronic timing circuit and the closure of the shutter by this circuit, the camera has a unique feature. It makes use of the light prevailing while the shutter is actually open to determine the exposure. As a result, the automatic control is still operative even when using flash. All other systems measure the light intensity before the shutter is opened and so cannot work on flash at all.

Any change of aperture requires an alteration of capacitance or resistance in the timing circuit to keep the exposure correct. The use of only six different apertures is catered for and because aperture is also used as a film speed adjustment, it works out that with any given film the user has a choice of only two apertures. Only over a limited range of light intensities has he really a choice, for the two apertures are really intended for extending the range of the automatic control. One aperture is intended for bright light, the other for dim.

Many people will feel that it would be advantageous to arrange matters so that the photocell is actuated by light passing through the lens. A continuous control of aperture would then be possible without complications in the timing circuit, and it would be necessary to alter this only to adjust for film speed.

The new shutter is fitted to the Land Polaroid Automatic 100, which uses Polaroid monochrome or colour film and produces a finished print in under one minute. It is an interesting example of an automatic camera and especially so to us since it really does depend on electronics.

Automation

While we are on the subject of photography it may be as well to point out that the numerous automatic cameras now available all embody open-loop control. The light is measured by a photo-cell and the shutter and/or aperture are set in accordance with the output of the photo-cell, an adjustment being provided to take film speed into account.

There is no feedback at all, so that the accuracy of exposure depends directly on the individual accuracies of photo-cell, shutter, and aperture, to say nothing of film-speed rating. This strikes an electronic engineer, accustomed to closed-loop control, unfavourably and he always feels surprised at the good results which are actually obtained. The reason, of course, is that high accuracy of exposure is not really necessary.

The photographer will say that it is, but it all turns on what is meant by high accuracy. To the electronic engineer, high accuracy usually means a tolerance of 1% or less; to a photographer, however, it means a tolerance of perhaps $\pm$ 40% in exposure. It is a fact that in colour photography, for which exposure is said to be critical, an increase or decrease of 40% in exposure time produces a difference which can be plain in a direct comparison, but which is of little significance without it.

If three photographs are taken in succession of the same subject, one with the correct exposure, one with 40% more exposure and the other with 40% less, each picture considered in isolation will usually be considered satisfactory. It is probably true that an error of $\pm$ 20% will be barely perceptible even in direct comparison.

This is, of course, the reason why open-loop control is satisfactory. It is fortunate that it is, for closed-loop control appears impossible. Certainly it is impossible if film speed comes within the feedback loop. With processing times of anything up to a week, the time lag is far too great. Even with the Polaroid system, which produces a print in under a minute, the time lag is still far too great for a retake to be possible with many subjects. It is with static subjects, of course, but although in principle this does become a closed-loop system, it is not what control engineers usually mean by it.

Time Capsule

During the 1964–65 New York World's Fair a so-called time capsule is to be buried. It will contain a message to people living 5,000 years hence!

It is being constructed from an alloy known as Kromarc stainless steel developed by the Westinghouse Research Laboratories. It is claimed to be so strong that no temperatures that could normally exist on earth could affect it, and so tough that no earthquake or man-made shock wave could crack or rupture it. It is also resistant to chemical attack. The message will be sealed in an air-tight glass envelope. The capsule itself will be welded together.

One thing only seems to have been overlooked. If it is so impervious to all attack, how will the people who find it in 5,000 years' time open it? And how will they know that they ought to try to open it?

REMOTE CONTROL OF CLOSED-CIRCUIT TELEVISION SYSTEMS

By D. G. ASHTON DAVIES *

A television camera can be controlled from a considerable distance and this article describes some of the applications in which such control is advantageous. In the air and underwater, in archaeology and in hospital, for traffic control and for sewage inspection, the uses of closed-circuit television are as varied as they are many.

ONE of the advantages of closed-circuit television (c.c.t.v.) is that all the main functions of the camera can be controlled remotely. Remote control can be carried out over considerable distances, the specific distance depending upon the function to be controlled.

A camera can be 'panned' or swivelled through an arc of 355° or tilted, up or down, through plus or minus 60° —or more. A heavy-duty mounting for this is shown in Fig. 1.

The camera's lens can be focused and its iris opened or closed, both remotely, depending upon the light falling on it. The component parts of a control system are shown in Fig. 2. Alternatively, zoom lenses are available which combine the adjustment of focal length, iris and focus; or two or three lens turrets can be operated remotely, giving the operator a choice of two or three preferred focal lengths.

In this connection, it is interesting to note that the Voigtlander range of Zoomar motorized closed-circuit television lenses, now available in this country, can be fitted to any conventional c.c.t.v. camera now in production. Zoomar Mark VI lens type 74680 is already in stock and the range is being extended. When this lens is fitted to a closed-circuit television camera, remote control becomes more flexible and speedier than was previously possible. Zoom, aperture and focus are remotely controlled by button switches on the control box. Fig. 3 shows the lens fitted to a camera. A nine-core cable which connects the control box to the zoom lens unit can be up to 160 ft long. The lens can be operated over longer distances by using relay control.

Instead of remotely controlling the iris mechanically, this can be done electrically by the use of automatic light control which is analogous to a.g.c. in a radio receiver.

The electrical parameters of a camera also can easily be controlled remotely. These include electrical focus, as distinct from optical focus, target voltage and beam current. The controls can be fitted to the picture monitor and Fig. 4 shows one example of this.

Cameras can be switched remotely so that, for example, four cameras are feeding, via a switching unit, into one monitor or receiver.

Equally as important as remote controls are the housings into which the camera can be fitted for different applications. These include weatherproof housings, acoustic housings, dust-proof housings, housings for inspection of drains, underwater housings, explosion-proof housings, etc. So not only can man's 'third eye' be operated remotely in all respects, but the camera can be operated under extreme conditions which no unprotected television camera, nor human eye, would survive.

An obvious application of remote control is to save life

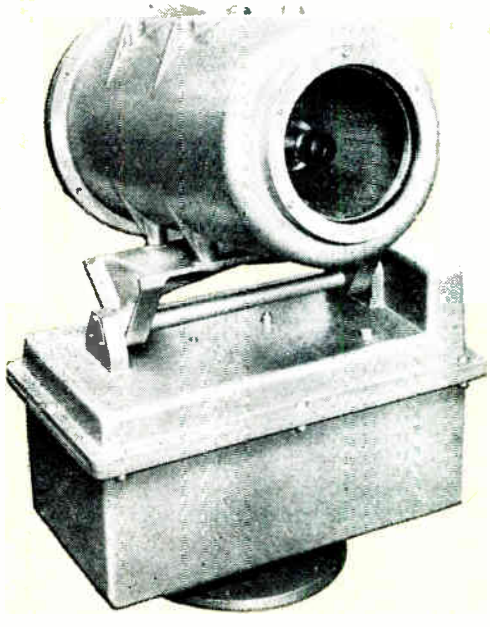


Fig. 1. A camera, mounted in sound proof housing fitted to a heavy duty pan and tilt unit

* E.M.I. Electronics Ltd. (Instrument Division).

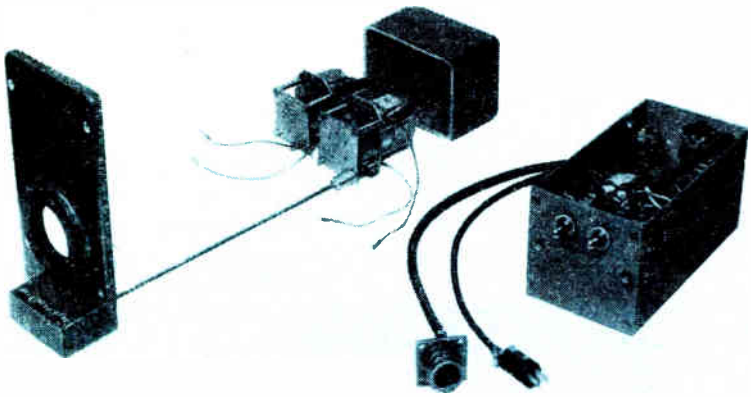


Fig. 2. A remote iris focus kit before assembly into a c.c.t.v. camera

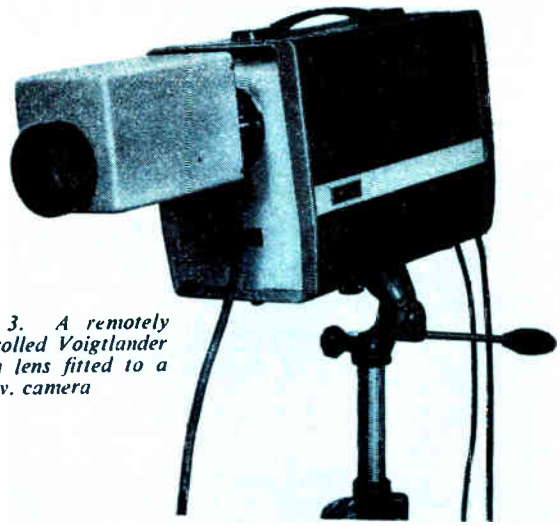


Fig. 3. A remotely controlled Voigtlander zoom lens fitted to a c.c.t.v. camera

in dangerous working environments. Engineers at B.F. Goodrich Company's new indoor tyre testing laboratory at Brecksville, Ohio, are now able to watch close-up views of car and lorry tyres undergoing high-speed endurance tests, without exposing themselves to injury.

Constant observation of test operations is made possible by four E.M.I. cameras which form part of two comprehensive road test simulators designed to measure the response of new tyre designs to the most severe operating conditions. Test engineers are shielded from the severe explosion hazard that can result from failure of a tyre or test assembly at high speed, as four remotely-controlled cameras, with automatic light control, keep constant watch on the laboratory's powerful dynamometer wheels.

Remotely-controlled zoom camera lenses give operators in the laboratory's main control room close-up views on large-screen receivers. An operator can adjust the test machines and automatically select the viewing angles of the cameras without leaving the main control panel.

Jet aircraft tyres are tested in the same way at the Baltimore, Maryland, factory of Schenuit Rubber Company.

Nuclear reactors also offer scope for the use of remotely-controlled cameras. Harwell's Pluto contains such a camera for remote observation of activity inside the reactor.

Zebra, the UKAEA's zero-power fast reactor at Winfrith, Dorset, uses an E.M.I. close-circuit television system to inform the control room staff of all operations taking place in the reactor building.

A concrete biological shield surrounds the reactor, and two concrete doors can be rolled apart to give access from above for fuel loading. Normally mounted so that it looks down on the concrete doors, the camera is fitted with a zoom lens and is remotely-controlled from the control room, where the receiver is situated.

The police authorities have also discovered the uses of remote control. Closed-circuit television enabled one policeman to control four busy traffic lanes at West Drayton, Middlesex, during road widening work. Without the aid of television, three policemen would have been required to regulate traffic. The point duty policeman was able to watch traffic conditions on two roads, which he would not otherwise have been able to see, on a monitor screen set up in a special police box.

The television camera was mounted on a lamp standard twenty feet above the ground. To protect it from rain and frost, the camera was enclosed in a special weatherproof housing. Closed-circuit television was chosen because there was no other effective way of controlling the intersections during periods of heavy traffic.

When the King and Queen of Thailand paid a State Visit to London, the Metropolitan Police used a closed-circuit television system for crowd and traffic observation in the Trafalgar Square area. Two cameras, mounted on a 20-ft high tower, were remotely controlled from a police vehicle containing two television receivers, stationed at the base of the tower. Police officers were able to make one or both cameras pan round or remain stationary at will.

Another development has been the use of closed-circuit television underwater and below ground. Underwater television equipment was demonstrated at this year's International Boat Show at Earls Court. Two closed-circuit television mini-cameras transmitted pictures from the bottom of the Deep Lagoon. The mini-cameras were housed in underwater pressure cases which had been tested to depths of up to 300 ft.

A mobile camera was used by a diver moving around in the tank to televise demonstrations of dinghy capsize drill. A second camera, fixed at the bottom of the tank, transmitted general pictures of the underwater scene. Closed-circuit television receivers were positioned at the four corners of the lagoon so that visitors could view events below the water.

What can be done below water can also be done underground. Sewers in certain areas of Axbridge, Somerset, were installed sixty years ago and, in some sections, serious infiltrations had been suspected. So Axbridge Rural District Council used a special closed-circuit television camera to determine the sources and extents of the faults. For this, they were commended by the judges of NALGO's 'Accolade for Enterprise' competition.

This camera, which is contained in a stainless steel case only 4 in. in diameter, can be pulled through the sewage pipes by a rope attached to a winch at the far end. A special lens and lighting attachment enable pictures of the interior of each pipe to be displayed on a television receiver located in a nearby motor vehicle.

A technique for borehole inspection using a closed-circuit television camera, which offers several advantages over conventional methods, was recently demonstrated to local authorities and civil engineers.

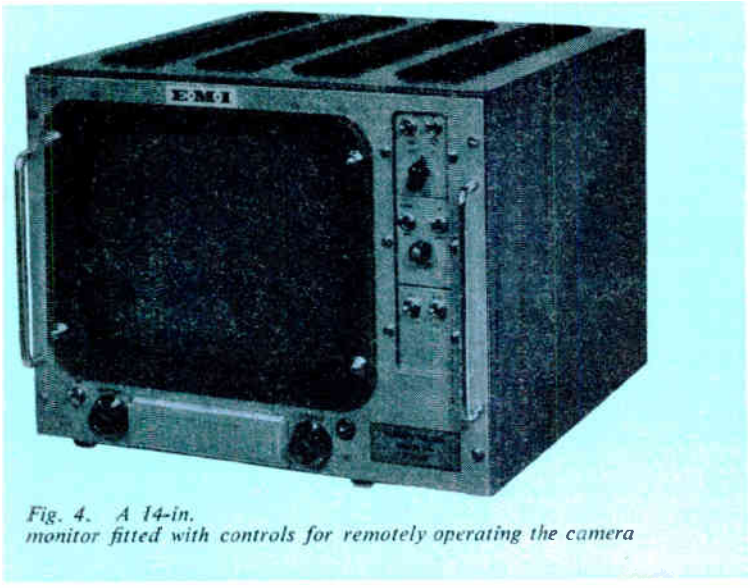


Fig. 4. A 14-in. monitor fitted with controls for remotely operating the camera

When surveying sites for bridges, cuttings and tunnels, it is essential to ascertain the geological structure of the ground and the position of any cavities, such as old mine-workings or swallow-holes caused by water seepage. Conventional methods necessitate boring a small hole and dragging out cores of different strata for inspection, but it is obviously impossible to extract specimens of cavities.

When using the television technique, a hole is bored and a cylindrical camera in a special housing is inserted, to inspect strata and cavities. This is shown in Fig. 5 and a constantly changing picture of the composition of the walls, as the camera is lowered, is shown on a television receiver above ground.

Perhaps one of the most glamorous applications of closed-circuit television was to save time and improve all-round control during archaeological excavations at the prehistoric Wilsford Shaft, near Stonehenge.

A closed-circuit camera situated at the bottom of the shaft and a television receiver in a hut at ground level enabled visual contact to be maintained at all times between the one or two operators who could work in the limited area at the base of the shaft and the remainder of the team above ground. It was also possible to take immediate photographs from the receiver screen of any finds which were in inaccessible positions and could not therefore be quickly removed.

But just as closed-circuit television is finding more and more uses below the surface, so is it becoming increasingly popular for use in the air. Thirty thousand feet above the ground, a c.c.t.v. camera hurtled through the air at speeds up to 400 m.p.h. in a Royal Air Force Meteor TT 20 aircraft during evaluation tests of the Del Mar towed target system, at the Ministry of Aviation's experimental establishment at Boscombe Down, Wiltshire.

It is possible for a target to gyrate in the airstream as it leaves and approaches the aircraft during the winching operation. If it were to wrap itself around the tail, the aircraft would tend to go out of control, with consequent danger to the crew. The camera lens peeks out through a small aperture facing aft. If the target gyrates at a critical moment, the navigator can modify the winching procedure, or, in an emergency, cut the target adrift.

Another application in aeronautics is in air traffic control. Radar equipment is used nowadays at most airfields to advise the control room staff of the exact whereabouts of

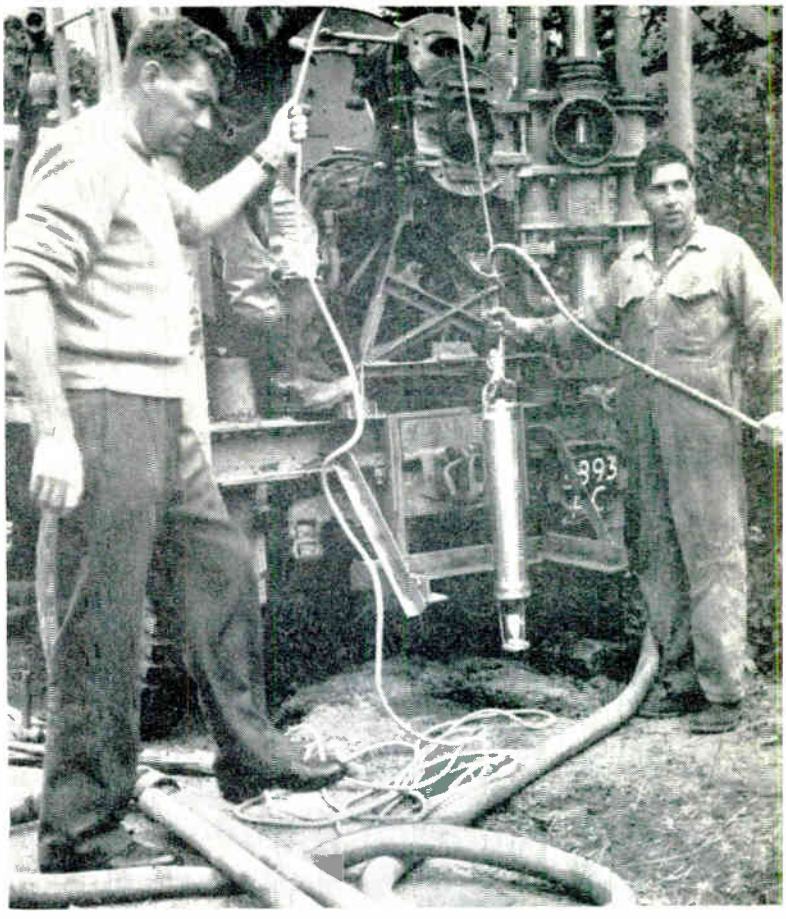
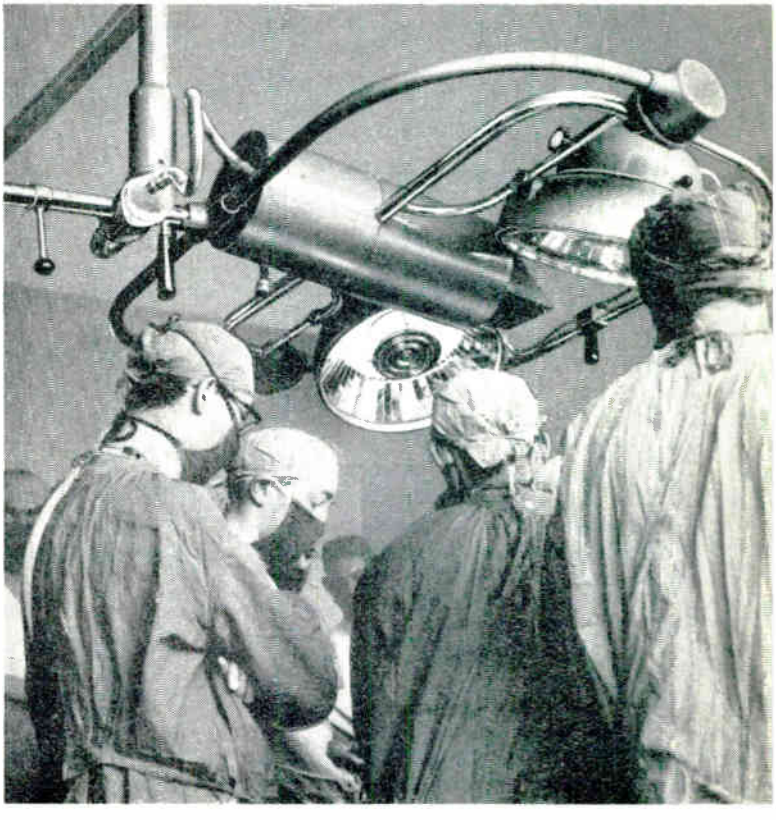


Fig. 5. An E.M.I. mini-camera in a cylindrical housing prior to being lowered into a bore-hole

Fig. 6. Camera built into a surgical lamp used in the operating theatre of Queen Elizabeth Hospital, Birmingham



all airborne craft over or in the vicinity of the airfield. But, in order that the radar signals may be observed, the control room must be kept in darkness.

As most radar equipment does not indicate the positions of aircraft on the ground, and radar operating conditions make it impractical to equip the control room with a window to give direct observation of the airfield, the radar controllers who authorize pilots to land and take off need some visual means of ascertaining whether the runways are clear of other aircraft.

This problem has been solved at the Royal Aircraft Establishment, Farnborough, by the installation of an E.M.I. closed-circuit television system.

Adjacent to the receiver in the Approach Control Room is the camera control unit, from which the radar controller can remotely operate the camera on the control tower. He can cause it to pan and tilt so that it will cover any part of the airfield, and he can select the appropriate lens to give a panoramic view or a close-up shot. He can also adjust, remotely, the lens focus and operate the windscreen wiper. An automatic light control compensates for any changes in light on the airfield during the day.

One use of closed-circuit television which has received considerable publicity is the televising of surgical operations as a teaching aid for medical students.

In 1961 Queen Elizabeth Hospital, Birmingham, became the first hospital in this country to be permanently equipped with a new type closed-circuit television assembly, with the camera built into the surgical lamp over the operating table, as shown in Fig. 6. The camera installed in the operating theatre enables 40 students in an adjoining lecture room to watch, on large screen television receivers, operations performed by the tutorial staff of the Medical School.

A two-way microphone talk-back system between the lecture room and the operating theatre enables surgeons to explain operations step by step, and to give an immediate answer to questions raised by the medical students.

The camera, operated by remote control from the adjoining lecture room, is fitted with a motorized zoom lens which allows for general long shots and detailed close-up study. This camera, in a sterilized housing, is built into the surgical lamp above the operating table. By means of a reflecting mirror the camera is always centred exactly on the area of surgery, and requires no adjustment by the surgeon or his assistants.

What can be done in monochrome can, of course, be done even better in colour. One of the most modern surgical clinics in Greece—the 'B' Surgical Clinic in the University of Thessaloniki—is equipped with E.M.I. colour television. To avoid unnecessary encumbrance of the floor of the operating theatre, the remotely-controlled camera is suspended from a track on the ceiling. This facilitates movement across the theatre. It is the first time that a colour camera has been installed in an operating theatre in this manner.

At Halifax Infirmary, Nova Scotia, the technique has been taken a step further. Permanent visual records of surgical operations are kept by means of a video recorder which stores information in colour on video tape. This tape can be played back at any time either in colour or monochrome.

Designed so as to be readily transportable from one operating theatre to another, the colour camera is used to observe operations via a remotely-controlled mirror mounted on a boom over the operating table. This camera is under the control of a local cameraman—usually a member of the hospital medical staff—who can at all times keep the operation under the closest observation.

Of more direct interest to industry is a colour television camera which can be sited in hazardous positions and controlled by an operator a thousand feet away. It can televise true-to-life colour pictures from inside a steel furnace of the moment when a charge of metal reaches white heat, or even tell a baker when his cakes are done to a turn—in both cases, without opening the door and losing valuable heat.

Use of this camera will enable extremely graphic documentary programmes to be televised, when a broadcast colour television service is started in this country. It is also of great value in many other industries where the communication of information involving colour is important. Colour pictures can be displayed on a 21-in. receiver or on large-screen projectors up to 18 ft × 12 ft.

The camera casing is dustproof, and does not require forced cooling. Any number of receivers and projectors can be fed from the same camera, and it is possible to switch from one camera to another in large installations. Remote control facilities are provided for panning and tilting, and focus, iris and lens changing.

This, then, is the ultimate in using man's 'third eye' where it is difficult, dangerous and sometimes impossible for man himself to be.

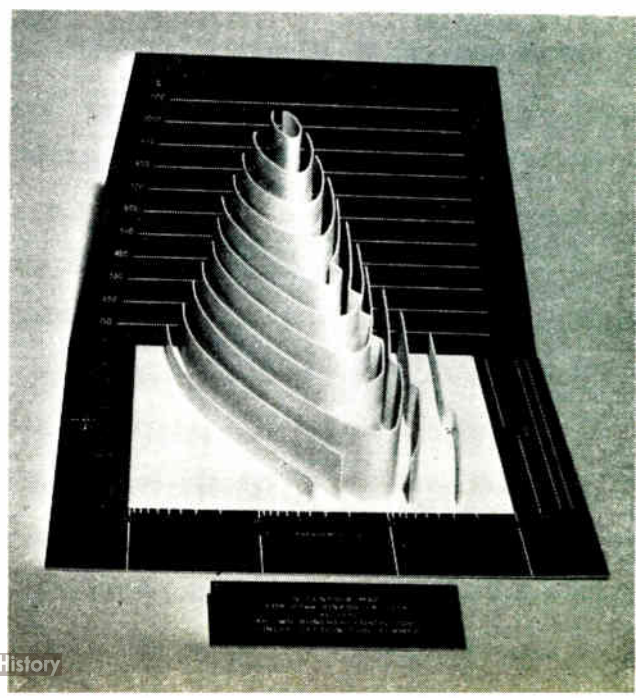
Q-MAPS — New Presentation of Coil Design Data

A new and more comprehensive method of displaying performance and design information on inductors has been evolved by Mullard engineers.

Published data on the Company's range of Vinkor pot-cores now contains 'Q-contour maps', or Iso-Q curves, which show at a glance the variation in Q-factor with frequency for any value of inductance. Curves are given for both solid and stranded wire on each size of Vinkor, and for each value of permeability. Almost all coil designs of interest are represented.

The model shown in this photograph is a three-dimensional representation on the Q-map for a typical Vinkor.

For further information circle 39 on Service Card



INDUSTRIAL TELEVISION IN THE GENERATING INDUSTRY

By R. E. BLYTHE*

Closed-circuit television is being increasingly used in the electricity generating industry. Some applications, such as furnace flame viewing, drum water level gauge viewing and smoke stack inspection are discussed in this article.

FROM 1938 to 1961 the nation's power demand in terms of electricity generated and sold, increased from 20,404 million kWh to 102,363 million kWh. The industrial and domestic consumer demand is rising at the rate of approximately 10 per cent per annum. Thus the supply and generating industry has been committed for a number of years to a large plant expansion programme and a programme of accelerated rate extends for many years ahead.

Within the last ten years an extraordinary degree of progress has been achieved in the design of steam-raising and generating plant. For example, 1957 saw the commissioning of a station of six 100 megawatt units. It was then the largest in the United Kingdom. Today, there are under construction stations with an installed capacity of 2,000 megawatts, while even bigger stations have been planned and approved. Such units involve large turbine and boiler houses, and their operation by a small group of engineers poses many control problems. Several hundred parameters have to be continuously monitored and reconciled to ensure safe and most economical working. Closed-circuit industrial television is being used on an increasing scale to solve some of these control problems.

The manner in which closed-circuit television equipment is applied in the industry may be broadly grouped into the four categories of (i) monitoring, (ii) surveillance, (iii) inspection, and (iv) communication. The article provides brief details of examples within these categories and one monitoring application now extensively used is described in some detail.

Equipment Characteristics

Current applications in the industry are met by basic camera channels comprised of camera with vidicon pick-up tube, camera-control unit, signal transmission link and a picture-reproduction monitor. While the system requirements are relatively simple the environmental conditions in terms of temperature, vibration, dust and operational hours are extremely stringent and demand equipment engineered to a high standard.

Ideally, for power stations the electronic equipment should have a life of 20 years and 100 per cent reliability. Certain applications demand continuous availability throughout a period in excess of 10,000 hours. Ambient temperatures in areas adjacent to the furnace casing and main steam

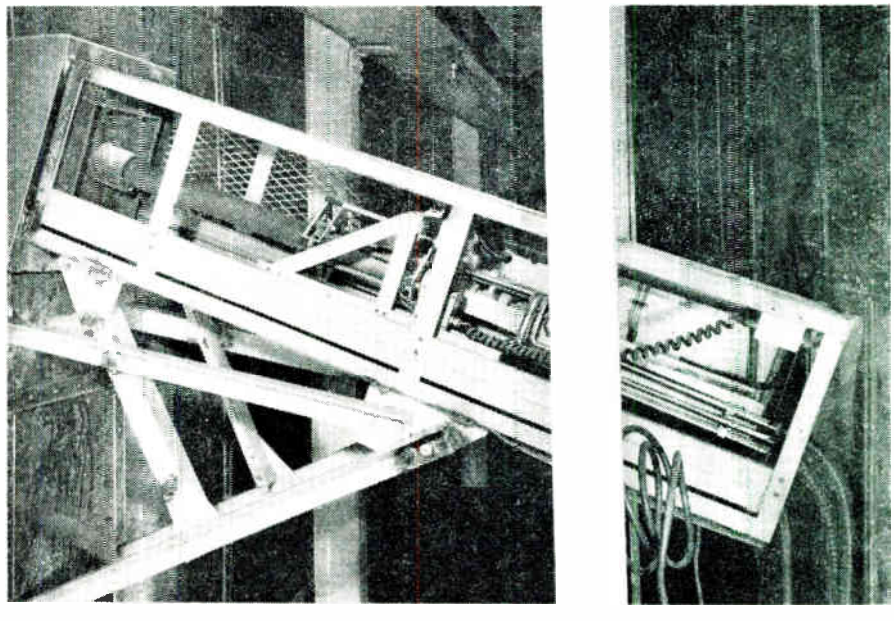


Fig. 1. A periscope-coupled camera in use for flame-viewing

* The Marconi Co. Ltd. (CCTV Division).

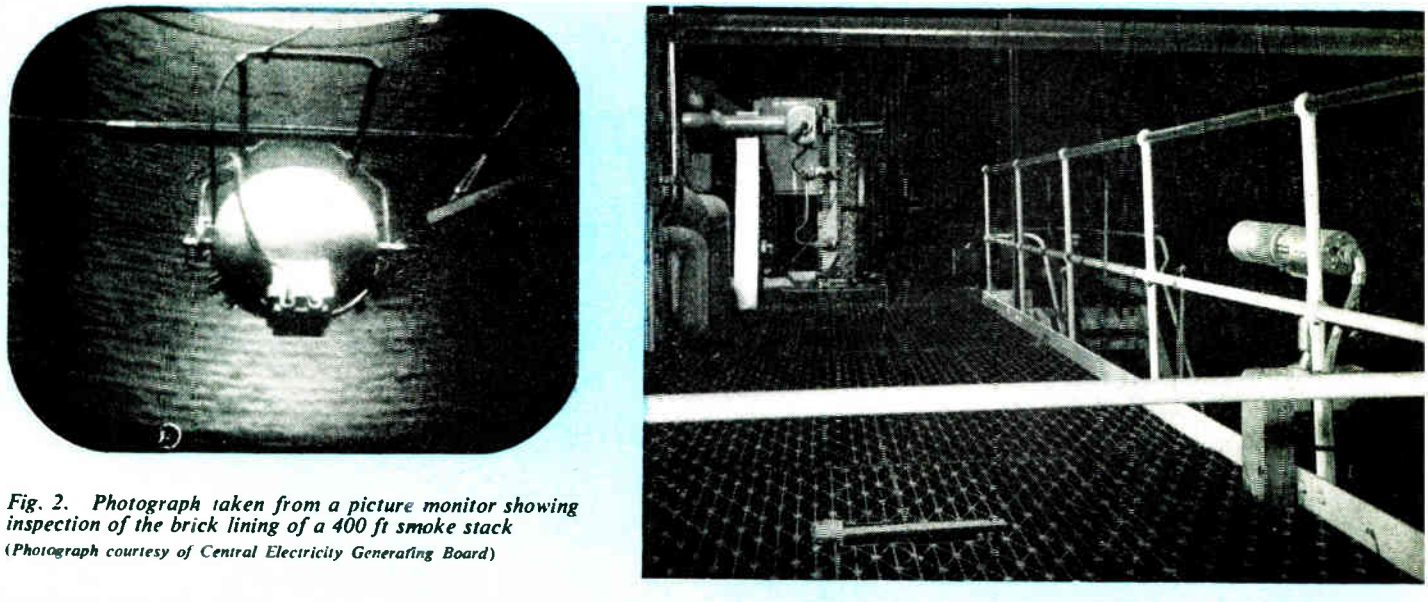


Fig. 2. Photograph taken from a picture monitor showing inspection of the brick lining of a 400 ft smoke stack
(Photograph courtesy of Central Electricity Generating Board)

pipes frequently exceed 60 °C. From the sphere of military electronics much experience has been gained in the design of reliable electronic equipment and it is logical to apply this experience to industrial equipment. The important factors are valve or transistor life-expectancy, component ratings and mechanical characteristics. By careful design all the relevant sections of the military specification K114 can be met and when achieved in industrial television equipment the users' requirements are satisfied. This cannot be achieved in low-cost equipment.

Applications

Two examples of closed-circuit television monitoring now being used are drum water level and furnace flame viewing. The former is dealt with in some detail later in this article. Considering furnace flame viewing, a suitably located industrial television camera can provide control room personnel with a clear idea of the conditions prevailing in the combustion chamber. Needle movements or telephonic descriptions of visual impressions, particularly at the lighting-up stage, are far from satisfactory. Television makes good this information deficiency and provides details of firing, location and flame formation.

For flame viewing there are two approaches which have been adopted. These comprise, firstly, direct viewing with a camera suitably housed, and secondly a periscope coupled camera. The photograph at Fig. 1 depicts a periscope coupled camera system. It will be appreciated that major difficulties had to be overcome such as the effects of intense heat, fouling up of the viewing aperture, vibration as a result of load changes and, of course, marked fluctuations in brightness. In the system shown the periscope provides a field of view of 55° × 55°. It has a water-cooled jacket permitting operation in an environment of up to 1,500 °C. Compressed air is used to purge the viewing aperture and cool the camera head and an air-actuated cylinder enables the periscope to be inserted or withdrawn by remote control from the boiler control panel. Facilities are embodied whereby in the event of failure of air, water or mains supplies the system fails safe. To extend the viewing zone, the periscope can be provided with remotely-controlled rotation through an angle of 110°.

In the surveillance role, television is being used as a control aid for coal-handling plant. The magnitude of such plant may be gauged from the fact that a modern power station consumes fuel at the rate of 14,000 tons per day, and to provide this input the railway sidings, conveyors and bunkering facilities are extensive. Interruption of flow at any conveyor or transfer point would involve spillage of many tons. Thus, multi-camera systems are being used to provide remote viewing of conveyor points at the Plant Control Room.

As an inspection tool closed-circuit television offers many advantages and it is being used to an increasing degree for the direct viewing of pipe systems and in inaccessible and hazardous locations. At Fig. 2 is shown a photograph from the picture monitor of a system set up for the inspection of the brick lining of a 400-ft smoke stack. Here, a framework was erected in the base of the stack to mount an industrial flood light and a camera head with remotely controlled pan/tilt head and dual-lens turret. The framework was hoisted by two winches and inspection effected at an ascent rate of 30–40 ft per minute. A long focal-length lens provided close up views of suspected defects and a photographic record can be obtained with a 35-mm Shackman camera on-mounted to a precision picture monitor.

Drum Water Level Gauge Viewing

The instantaneous and continuous indication of drum water level is essential in the operation of high pressure boiler units as can be judged from the fact that if the boiler water feed pump stops, the water can be completely evaporated from the drum in about 40 seconds.

The size of modern units and the need of central grouping of boiler control facilities have rendered drum level gauge viewing beyond the means of direct optical systems. It is no longer practicable to project gauge images by periscope systems over the distances and displacements that exist between the drum level and the boiler control panel. Pressure differential systems have inherent limitations with units of high steam producing rates because of their relatively long time responses and the fact that system faults are not immediately evident.

Fig. 3. (left) C.C.T.V. camera used for water level gauge observation in Central Electricity Generating Board power station

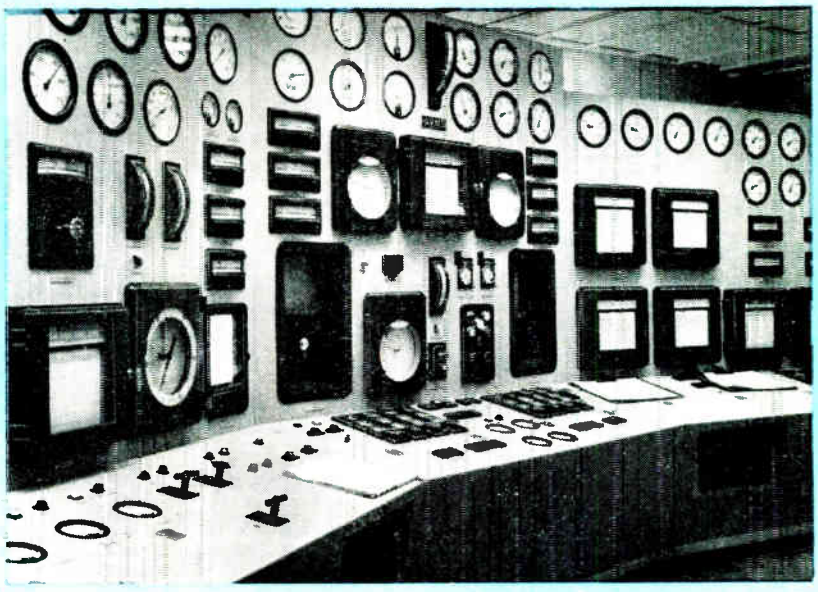


Fig. 4. (right) Water gauge viewing, showing monitor screen embodied in the control panel

Television provides an instantaneous and continuous means of direct gauge viewing from the plant control room. The camera provides a true picture of the gauge system and it cannot render false or ambiguous levels. The system is self-proving inasmuch as failure in operation or incorrect working is immediately apparent in the loss or distortion of all scene information.

Water level gauge operation is based on light refraction. A rear mounted illuminator assembly provides a beam of light which is refracted to differing extents in water and steam so that the water and steam spaces exhibit different shades of brightness.

A camera is rigidly mounted a few feet from the front of the gauge in the manner shown in Fig. 3 and aligned in azimuth and elevation. To achieve maximum contrast range between steam and water in presentation at the monitor this alignment is critical. It will be observed that the camera head and lens are fully protected against fuel dust and ash by their dust-tight housings and sealing rings. The complementary camera control unit is normally housed at the rear of the boiler control panel with presentation of information on an industrial picture monitor embodied in the control panel as shown in Fig. 4.

While the camera circuit design can automatically maintain a constant picture presentation for changing scene illumination of the order of 200 to 1, it is necessary to provide illumination on the gauge front so that adequate scene lighting is available for night and late winter afternoon working. This is normally effected by two 150-watt spotlamps to provide an average scene illumination of 20–30 foot candles.

Certain measures are sometimes necessary to eliminate ambiguous results which can arise from sunlight and light bounce from brightly painted structures at drum level. This circumstance is a function of station layout and orientation. It is eliminated by gauge shielding.

Conclusions

The trend in power station design is to concentrate control of boiler units in a single plant control room and much effort is now directed for full automation to achieve what is colloquially known as 'push-button' start-up by which power from large boiler units can be made available to the grid at very short notice. Obviously monitoring and surveillance by industrial television has a part to play in these developments. The television requirement is for fully automatic camera channels capable of operation for several thousand hours without any attention, and requiring the operations staff merely to switch on. Equipment is now available which is capable of all this.

The author expresses his thanks to the Manager of the CCTV Division, The Marconi Co. Ltd., for permission to publish this article.

Efficient Laser Modulation

An amplitude modulator for laser beams now being developed at General Telephone & Electronics Laboratories promises a radical advance over existing techniques.

The initial stage of the modulator is basically the same as in previous types: the laser beam is passed through a crystal, the optical properties of which are varied by a microwave electric field, to produce an emergent beam comprising two amplitude-modulated components polarized at right angles to each other but with their modulation envelopes 180° out of phase. As the resultant intensity is constant, it has until now been necessary to pass the beam through a polarization filter to remove one of the components, thus losing about 50% of the power.

In this new device the laser beam is passed through a double-refracting crystal in which the two components have different velocities. The length of the crystal is so arranged that, in the final emergent beam, the modulation envelopes of the two components are in phase.

NordSAM '63

FINLAND has often been called 'the land of a thousand lakes' and the reason for this very apt description could easily be appreciated as one flew low on approaching Helsinki airport. The undulating countryside, well covered with green forests, is studded with lakes of every size, on which a myriad of tiny islands seemed to float. Nestled in the trees by the waterside could be seen the multitude of little huts to which the Finns retire for the summer to enjoy their annual vacation in solitude and peace.

Interrupting, for the most part, their four-week holiday period—when commercial life comes almost to a standstill—over 600 engineers, scientists, businessmen and others concerned with the use of computers and computing techniques gathered in Helsinki from August 16th to the 20th for the annual NordSAM Conference in the university buildings.

This meeting, whose name is formed from an abbreviation of the full title 'Nordiskt Symposium över Anvandning av Matematikmaskiner' is attended almost exclusively by representatives from Finland, Denmark, Norway and Sweden. There were in addition a mere handful of people from France, Germany and England, most of whom were invited as lecturers, which rather emphasized the general lack of commercial interest shown in this part of the world, especially by England. One aspect of this is that none of the English technical journals announced the conference in their diary of forthcoming events. However, as could be appreciated from the conference, here is a ready market for industrial electronic devices and computer systems and any manufacturer who is prepared to embark on a determined effort to sell in this area will certainly find that his efforts have not been in vain.

The conference itself was exceptionally well organized, and the various lectures provided a wide range of topics so as to appeal to a large audience. Although there were a few specialized papers, the lectures were, in the main, fully comprehensible to the majority of the delegates and this provided them with an opportunity for an introduction to those aspects of computing techniques which were outside their normal daily life.

In this, the conference fulfilled one of the primary purposes of such a gathering, that of widening the horizons of those attending and implanting ideas which, with the passing of time, will be nurtured and may well flourish to reveal new lines of development. Another purpose of a conference, that of providing a platform for discussion, was not so well fulfilled. The strict control over the time schedule, which was necessary because three sessions were running concurrently, limited the discussion time following each lecture to far too short a period. One or two lectures were even brought to a premature end by their over-zealous chairmen who seemed to be a little too concerned with the clock!

Over a period of four days some 80 papers were read, being delivered in a variety of languages. The ease with which some of the participants were capable of changing from language to language was rather startling and embarrassing to the average Englishman who knows only his own tongue.

Every delegate was provided with a bound volume containing a synopsis of each lecture so that he could select in advance those which he wished to attend, but it is to be regretted that some of the lecturers were unable to provide even a few lines to indicate the contents of their papers.

The difficulties of Finnish as a language when it comes to information retrieval was explained by Winthrop Vermillion of I.B.M., although, possibly to prove his point, he did choose to deliver his paper in English! Data-handling systems and processing methods as well as programming techniques received attention from a number of speakers. The use of computers for management and budgeting control purposes was also dealt with, project planning by computer being discussed by Professor Rhodes of I.C.T. Numerous off-line applications were described and it was intriguing to listen (in Helsinki) to Vincent Miller of I.B.M. describing how traffic problems in England are being tackled with computers.

The general problems of on line computer systems was covered by Ronald Bougge of Remington Rand, although one wondered why he used the expression 'a new dimension in data processing' in his title seeing that real time systems were first launched five years ago and there are now at least 340 such installations. Actual on-line systems were described by Tage Frisk of I.B.M. who dealt with the paper industry and Joseph Roth of Elliotts who described a selection of applications for steel production.

A further function of a conference is to encourage the delegates to mix and discuss technical problems with others. The success of this aspect was reflected by the numerous groups carrying on animated discussions outside the lecture halls and in the restaurant and this to some extent compensated for the lack of public discussion at the lectures themselves. Also the social functions, which included a cocktail party given by the Mayor in the resplendent City Hall, the conference banquet at the exclusive Fisherman's Hut restaurant, an excursion through the Finnish countryside and lakes, and in true Finnish tradition—Sauna Bath parties—provided ample opportunity for further discussion and relaxation. On reflection, it can be said that this conference reached a high standard providing an instructive and also enjoyable programme for the delegates and the organizers are to be warmly congratulated on their fine achievement.

CLOSED-CIRCUIT TELEVISION AND THE STROBOSCOPE

By N. L. GLEW*

It is not always realized that it is possible to use a stroboscope and a closed-circuit television system together to examine high-speed machinery from a remote point. This article discusses one application of the combination.

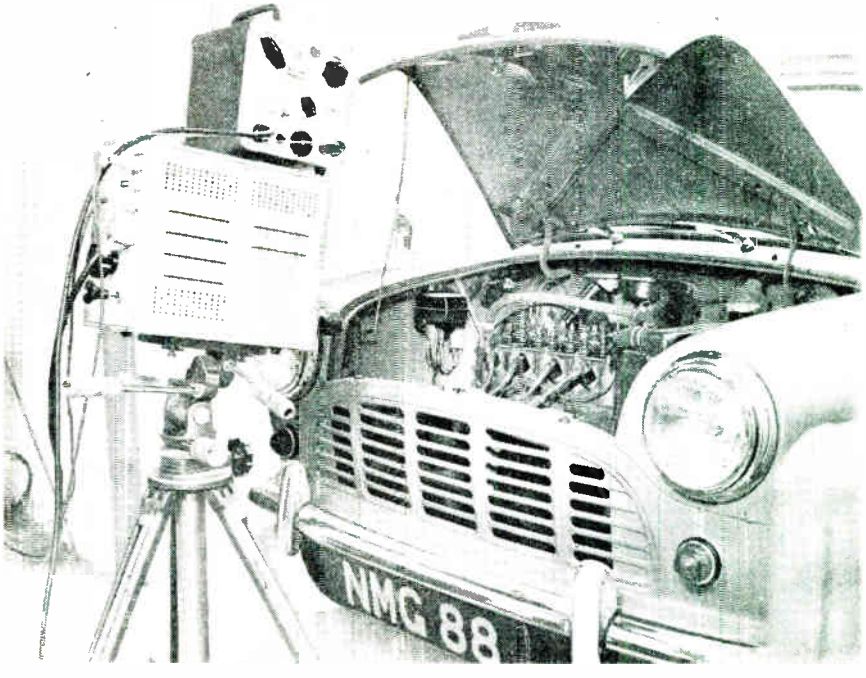
A NEW technique for examining high-speed machinery in close-up, and yet viewing it from a point remote from the actual operation, has been developed. Closed-circuit television is used in conjunction with a high-energy stroboscope, which has a remote trigger-frequency control facility. The television monitor and the oscillator which controls the strobe flash frequency can be situated some distance away from the machinery under observation, in fact, as far away as 1,000 feet.

In the illustration the operator is examining the effect of incremental change in tappet clearance on an overhead valve engine with the engine running at speed. In addition to viewing the valve spring and tappet assembly on the monitor, a very useful magnification is also achieved.

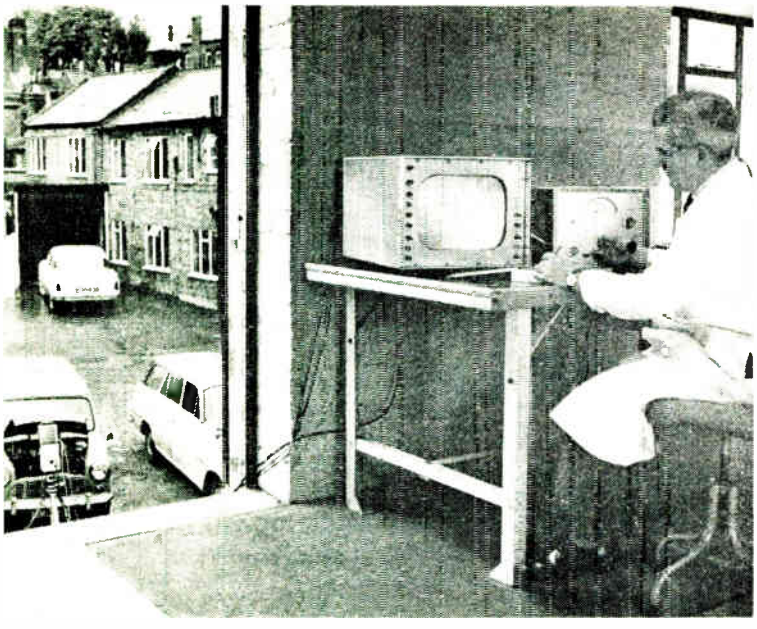
As well as arresting motion, the stroboscope can be phased over a complete cycle, by slightly altering, and then re-setting to the original frequency on the dial of the oscillator. Alternatively, the machinery can be made apparently to move very slowly or speed up, depending on a change in the setting of the oscillator frequency dial. Thus it is possible to slow the operation cycle down to less than one revolution every 10 seconds, although the machinery is rotating at very high speed.

This technique can be used for examining most kinds of

* Livingston Control Ltd.

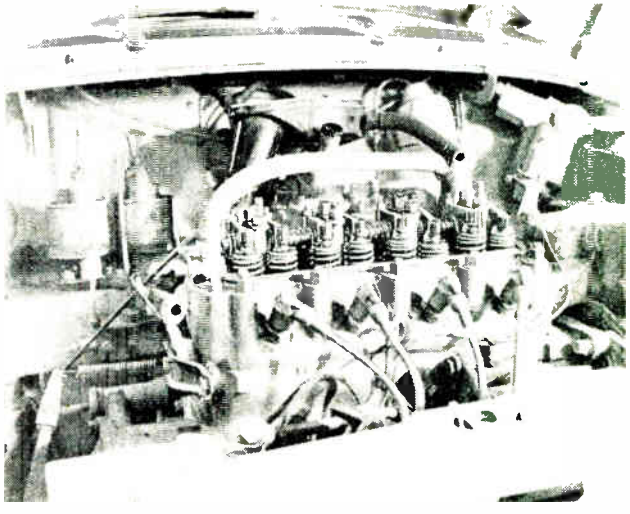


The camera is solidly mounted on its tripod and is focused on the engine. It is quite able to support the stroboscope without danger of overbalancing



(Left) The operator observing the monitor with the subject in the background

(Below) A close-up of the subject



high-speed reciprocating or rotating machinery where, generally speaking, it would be difficult or even hazardous for a human operator to be. There are no lighting difficulties except where the ambient light is very high, as sufficient illumination for the camera comes from the strobe flash.

Camera Description

The camera operates on a 625-line system with a line frequency of approximately 15 kc/s. This frequency is far away from the strobe frequency and does not cause beats. For example, a rotational speed of 6,000 r.p.m. is 100 cycles per second, quite slow electronically, but very fast mechanically.

This particular television system has been chosen because all the camera controls are mounted on the monitor, which also acts as a control unit providing the necessary synchronizing signals for both camera and monitor, which makes for easy operation and simplified remote control. For this application an 'automatic brightness' facility would not help, as the response is not fast enough for the strobe flash.

A standard 1-in. vidicon tube is used in conjunction with a 2-in. lens, giving a vertical resolution of 450 lines random interlaced. On the camera a turret offers a choice of three lenses from 1 to 6 inches; also there is a zoom lens available.

Additional monitors may be used from the same camera and control unit with no degradation of performance. This facility is desirable for teaching and lectures.

When triggered externally the stroboscope employed works over the frequency range 10–150 c/s, corresponding to 600 to 9,000 r.p.m. There is no reason, however, why this figure should not be increased using other stroboscopes, as there is a range available.

£1½ Million Computer Project

The first contract in a four-year £1½ million joint research project being planned as a further aid to long-range British computer development is announced by the Department of Scientific and Industrial Research. The contract has been agreed with Mullard Research Laboratories and will extend their existing programme of research in low temperature computer devices. Spread over two years, the work will cost a total of £100,000 to which the Department will contribute half. More contracts with other leading electronics firms are expected shortly: together, they will help towards cheaper and faster computing power in the future.

The scheme is designed to support the British computer industry's already considerable research and development efforts in the face of future widespread technological change. To develop improved reliability, smaller components, greater simplicity, cheaper units and faster speeds, scientists in this country and elsewhere are enquiring beyond existing electronic techniques into a range of physical properties hitherto unexplored. The devices and equipments which emerge could well be as important to the computers of the next decade as the transistor has become to present-day machines.

Neither peripheral equipment nor the development of programming techniques and programmes will be supported under this project, which will stop short of prototype computer production. As now planned, the programme includes the following subjects: (1) semiconductor integrated circuits, logical design, interconnections and computer-assisted layout; (2) tunnel diodes for fast logic, either by themselves or in conjunction with transistors; (3) magnetic thin film logic; (4) cryotrons, as a logic element and in stores, and other superconducting stores; (5) opto-electronic devices for special purposes; (6) built-in redundancy to improve reliability. Further areas of research are being considered for the future.

The instrument described in this article is basically an electronic tachometer. A pick-up device produces pulses corresponding to the revolutions of a shaft and the instrument utilizes these to operate a meter having a scale calibrated in revolutions per minute.

TACHOMETRY IN INDUSTRY

By E. K. ELPHEE*

WHERE shafts, gears or rotating machine parts are used, some form of tachometry, or revolution counting, has long been relied upon in industry. The following considerations of progress in this field concern an all-electronic system in particular, and the article describes a portable transistorized instrument, as well as some of its functions.

For the benefit of those not already familiar with the subject, the problems involved can be reduced to three basic requirements:—(a) getting information from, or sensing the occurrence of, each revolution; (b) evaluating (a) with reference to a time interval standard; (c) converting the latter to visual indication, or recording.

The means of achieving these objectives can thus be labelled—sensing, counting and displaying, respectively. Various methods of sensing include stroboscopic, photo-optic, and electro-magnetic devices: the last mentioned requires no marking of, or physical interference with, the object to be sensed and Fig. 1 illustrates the principle on which it works.

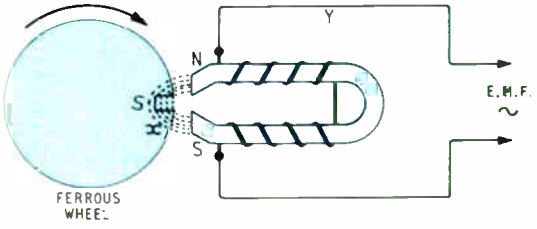


Fig. 1. Basic arrangement of pick-up device

* E.K. Electronics (Industrial Amplifiers) Ltd.

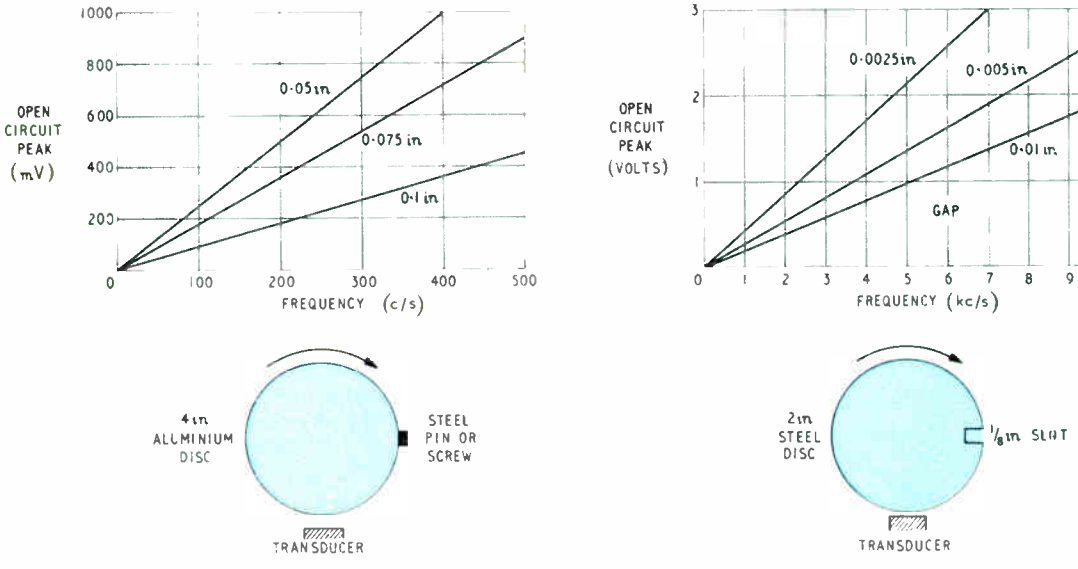


Fig. 2. Transducer output as functions of frequency and air gap

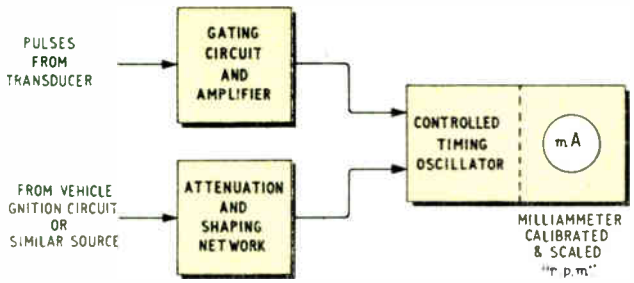
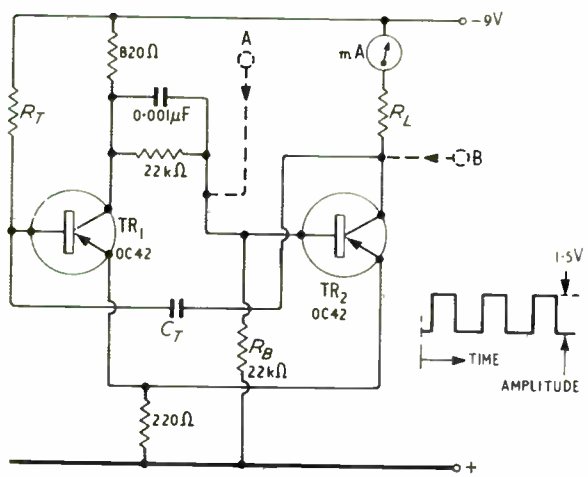
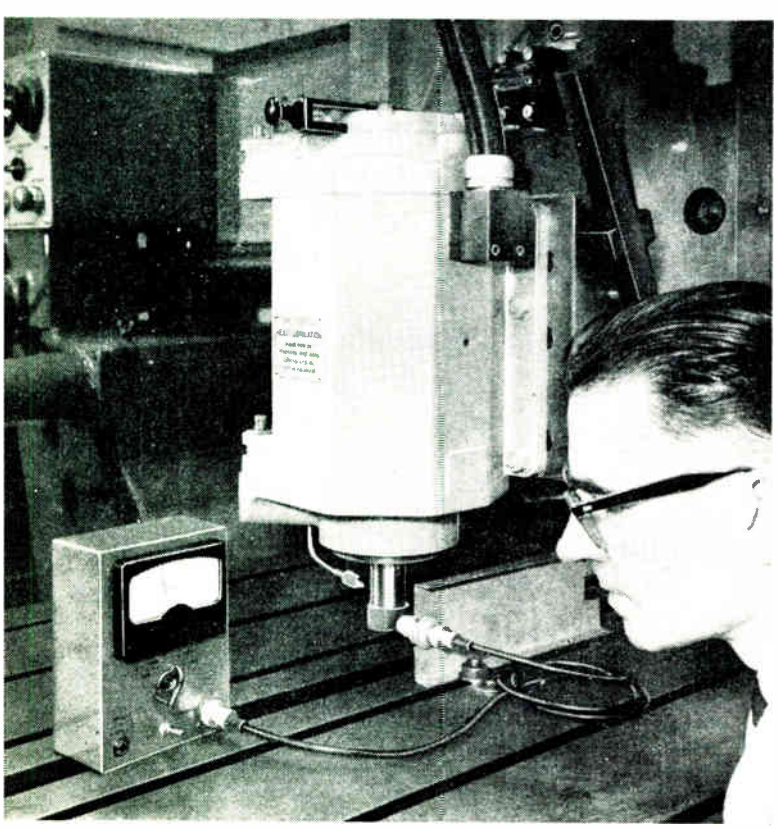


Fig. 3. Block diagram of equipment

Fig. 4. Monostable multivibrator





Using the tachometer to measure the tool speed of a template-ollower cutting machine

A sudden alteration of the magnetic field X produces an e.m.f. in the conductor Y; the resulting current in a closed circuit is in such a direction that its own field opposes the original change. The chief characteristics of such a transducer may be briefly listed as:—The waveform of the pulse is dependent upon consistent rigid fixing in relation to the revolving shaft; the amplitude of the pulse varies according to the sharpness of the flux change. This itself depends on the rate of rotation of the shaft. It is affected also by the spacing between the pole piece and the irregularity to be sensed. The graphs of Fig. 2 give some examples.

Pulse Counting and Display

Having obtained a pulse (or regular number of pulses) from each revolution, and thus solved the problem of 'sensing', we must next consider the instrument which fulfils requirements (b) and (c). A simplified block diagram is shown in Fig. 3; the tachometer uses germanium transistors throughout and its total consumption is of the order of 100 mW.

One section involves a form of monostable switching and has the circuit shown in Fig. 4. In the stable state TR_1 conducts while TR_2 is cut off since its base is over a volt positive with respect to the common emitter potential. This condition exists until such time as a negative pulse is applied to the base of TR_2, which then conducts. The resulting positive pulse at the collector of TR_2 is applied through C_T to the base of TR_1, cutting it off. C_T then discharges and eventually allows TR_1 to conduct again thus turning off TR_2. The conditions have then reverted to the original stable state. Alternatively, a positive pulse can be applied to the collector of TR_2 (i.e., at B). This turns off TR_1, and hence turns on TR_2. The end result is the same.

Fig. 4 also shows the type of pulses needed for triggering. A circuit of this kind used for delay or shaping purposes would have equal collector resistances of, say, 1 kΩ each. In this instance R_L is made variable and adjusted to attain full-scale deflection in the meter for given rate of pulse repetition. Typical values for 5 mA in R_L at 4 kc/s would be R_T=15 kΩ, C_T=0·01 μF (timing components), R_L=680 Ω. By simple switching of substitute values for R_L (each adjustable) and C_T per range, the scope of the circuit can easily embrace 20 c/s to 20 kc/s for full-scale deflection; i.e., 1,200 to over a million r.p.m.

The higher ranges are not of great practical use and it is better to concentrate on accuracy over selected useful scales than to provide a very wide coverage. Careful attention must be paid to voltage stabilization and all capacitors must have the lowest possible leakage. Lower frequency limits are set, not by loop gain or time constant factors, but rather by needle flicker which tends to become noticeable below 16 'kicks' per second.

The full schematic, including an economical battery or mains power-supply unit, is shown in Fig. 5. The monostable section is apparent and the two-stage amplifier can be recognized as a straightforward RC coupled common-emitter type.

The first electrolytic capacitor isolates base of TR_1 from the low impedance source of transducer e.m.f. and D_1 with 4·7 kΩ signal return path permits positive pulses only to pass to TR_1. Sockets marked 'vehicle input' increase the usefulness of the instrument by facilitating direct connection to l.t. contacts on motor-car ignition systems; the r.p.m. then showing on the scale must be divided by 2 for four-cylinder, and by 3 for six-cylinder engines.

No special value components or temperature sensitive resistors are needed; furthermore none of the transistors requires a heat sink. Neither OC42s can exceed 40 mW;

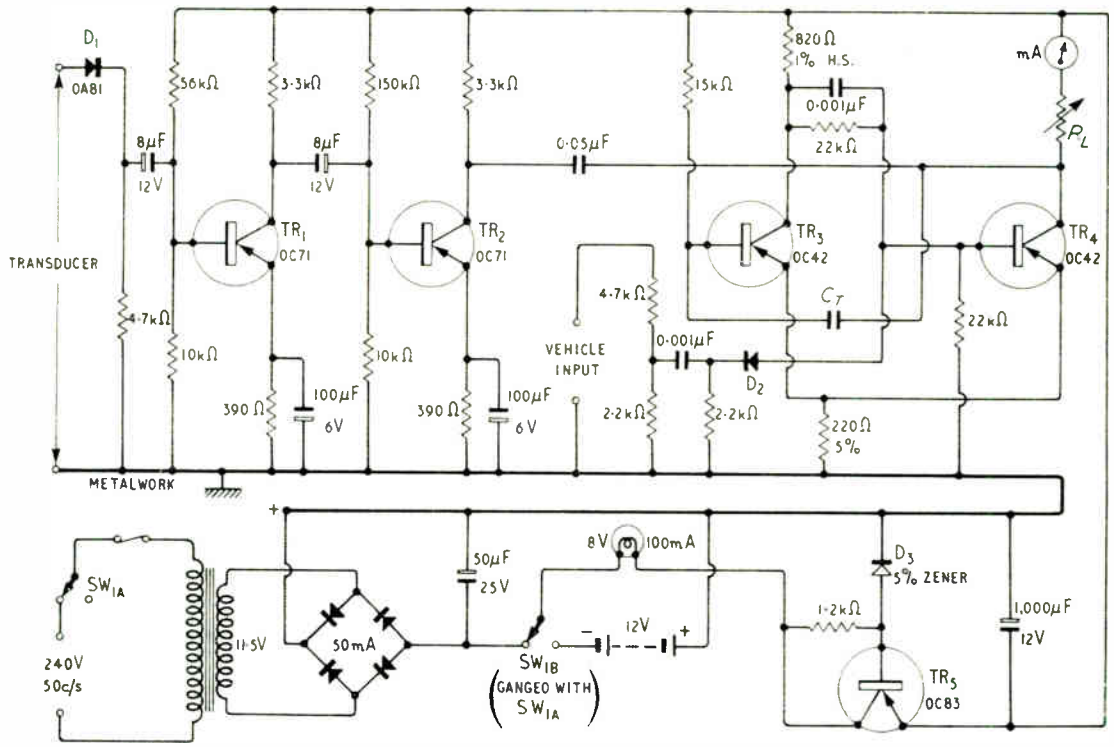


Fig. 5. Complete circuit diagram

likewise the OC83 is well inside the makers' rating of 100 mW for 60 °C ambient temperature operation. Regulated and stabilized supply holds to ±0·15 V from open-circuit to twice normal load conditions, and lamp L efficiently serves for overload cut-out duty. Stable wire-wound potentiometers are definitely advantageous for R_L position(s) as sprayed or impregnated tracks are not always trustworthy in conditions where small direct currents are concerned. One such instrument can be housed inside a 9 in. × 5 in. × 4½ in. steel case; the total weight of which is under 5¾ lb; or, a battery only version can be in a 7 in. × 4½ in. × 3 in. space.

Some readers will probably know of circumstances calling for such an instrument, but for those who wonder just where its particular utility applies, one or two instances may be summarized. Glossing over such obvious uses as shaft, gear or bearing checking, the savings to be made in large industrial fields may not quickly be appreciated. For example, in large paper making works there is generally electronic equipment to control accurately line or belt speeds. Briefly this may consist of d.c. amplifiers, anti-hunt circuits, and large thyratrons which govern d.c. excitation of generator fields. Information is commonly fed to such equipment by a tachometer generator. The latter could easily be replaced by a small reference amplifier working from one section of the transistorized instrument.

A second practical use is demonstrated in the photograph. This shows one of the latest U.K. template-follower cutting machines undergoing routine tests at the factory before despatch. The machine's cutting tool is capable of three, six, nine or twelve thousand revolutions per minute and, in this instance, was fitted with a twin-flute tool doing 9,000 r.p.m. This resulted in two pulses per revolution in the transducer, which is clearly seen bolted to the bed, close to the cutting tool. The meter thus indicates 18,000 r.p.m. within a few moments of setting up.

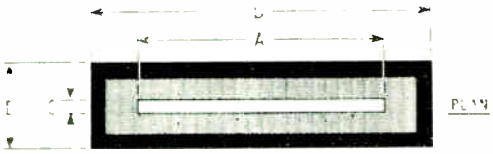
In conclusion, the writer would like to make acknowledgments to E. K. Electronics (Industrial Amplifiers) Ltd., Ericsson Telephones Ltd., and Marwin Ltd., for co-operation in producing this article.

Deflected 'Ink Beam' Recorder

An engineer at Stamford University has developed an electronic pen recorder with a principle of operation analogous to that of the cathode-ray tube. Recorders in which there is no physical contact between pen and paper are not new, but in this case the deflection is actually applied to the ink stream itself.

The ink first passes through a finely drawn glass tube which is vibrated at 100 kc/s to break up the stream into 0·002 in. diameter droplets. These are then passed through a cylindrical electrode which imparts to each one an electrostatic charge proportional to the signal amplitude. The 'beam' of ink finally passes between two charged plates which attract or repel each droplet according to its charge. Trace velocity is such that a full-scale deflection of 0·5 in. is achieved in a minimum of 10 μsec.

In its present form this system is capable of recording signals with frequencies of up to 10 kc/s.



RADIOISOTOPE THALLIUM 204

CODE	STRENGTH (MILLICURIE)	(mc/cm)	LENGTH (mm) ACTIVE A	LENGTH (mm) TOTAL B	WIDTH (mm) ACTIVE C	WIDTH (mm) TOTAL D
TEC. 7	10	0·4	250	300	17	30
TEC. 8	20	0·8	250	300	17	30
TEC. 9	30	1·2	250	300	17	30

Fig. 1. Details of thallium 204 radioactive sources

charges in high-speed printing presses, allowing higher speed operation. Beta-particle emitters are less efficient as local ionizing agents, but because of the longer range of beta-particles (as compared with alpha-particles) they can cover a wider range.

Both alpha- and beta-active emitters, because of their relatively short range are easily shielded, so as to restrict the emission of the particles except in the desired direction, and to prevent irradiation of the operators working in the vicinity of the static eliminators. One popular source for discharging static is radioactive thallium (^{204}Tl) which emits beta-particles. A typical arrangement of such a source is shown in Fig. 1. The suppliers (Radiochemical Centre, U.K.A.E.A., Amersham) state that the beta-particles

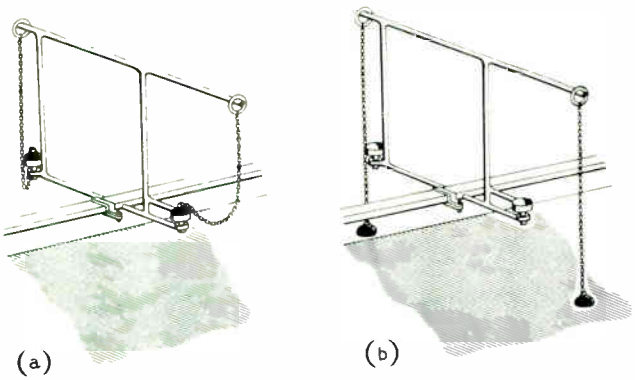


Fig. 2. This sketch shows how static eliminators are arranged in a loom. When personnel are working the eliminators rest in screening cups (a) but they are removed at night to hang over the warp (b)

can be stopped by $\frac{1}{4}$ in. of Perspex, and it is usual to mount the source in a block of this material so as to restrict the emission of the particles except in the desired direction. It is also necessary to mount the source so that it produces the ionization where it is required, but the irradiation received by operating personnel is either nil, or at least very small*. Thus in the case of static eliminators in use in the weaving industry to prevent fog-marking small units containing ^{204}Tl are employed. These rest in shielded containers during the day-time operation of the loom, but they are removed at night and left suspended over the warp threads as shown in Fig. 2. The use of static eliminators prevents the accumulation of dust on the warp threads with consequent deterioration of the product.

* This means that the radiation received per working week must be small compared with the maximum permissible levels laid down by the International Committee of Radiological Protection — see D. E. Barnes and D. Taylor "Radiation Hazards and Protection" 2nd Edition, 1963, Geo. Newnes Ltd., London.

Radioisotopes Used

Some radioactive sources emit gamma-rays as well as alpha-particles (or beta-particles), and because of the greater range of the gamma-rays, a heavier shielding is necessary to protect personnel, whereas quite light shielding is sufficient for pure alpha- or pure beta-emitters. Some of the radioactive materials which have been used for static eliminators are given in Table 1, together with their revelant characteristics.

TABLE 1

Radioisotopes for Static Eliminators

Emitters	Half Life ($T_{1/2}$)	Energy (MeV)	Max. Perm. Conc. in Air (μC/cm^3)
α-emitters	years		
^{226}Ra	15·90	4·77	8×10^{-12}
^{210}Po	0·379	5·3	10^{-11}
β-emitters			
^{204}Tl	3·5	0·765	5×10^{-11}
^{90}Sr	19·9	0·61	2×10^{-10}
^{35}S	0·239	0·167	10^{-9}
^{147}Pm	2·6	0·233	5×10^{-11}
^{45}Ca	0·493	0·25	5×10^{-11}
^{3}H (tritium)	12·26	0·018	10^{-5}

It should be noted that the popular materials (e.g., ^{204}Tl and ^{90}Sr) have relatively long half lives, which means that they can be employed for a long time without replacement.

It is interesting to note that tritium has now been reported as highly satisfactory as an eliminator in certain difficult cases of static electrification. This was again in high-speed printing machinery†. In the case of tritium because of its low energy (and correspondingly short range) its effect can be very localized. As used tritium is absorbed into a thin evaporated layer of titanium, and these strips are mounted as shown in Fig. 3. As the titanium/tritium strips can leak tritium to the atmosphere careful experiments have been made by Reasbeck to determine the maximum leakage and the effect of this on the maximum concentration of tritium in the air at the operator's position as compared with the m.p.l. agreed as safe. These calculations showed that the concentration levels were well below the m.p.l., especially as draughts and air extraction will, of course, reduce the level to be expected from normal diffusion considerations.

Another possible application of tritium according to Reasbeck is that of removing static electrification from

† P. Reasbeck, "Use of Tritium as a Static Eliminator at the 10-20 Curie Level of Activity", I.A.E.A. Conference on Radioisotopes, Copenhagen 1960, Vol. 2, pp. 157-164. International Atomic Energy Agency, Vienna 1962.

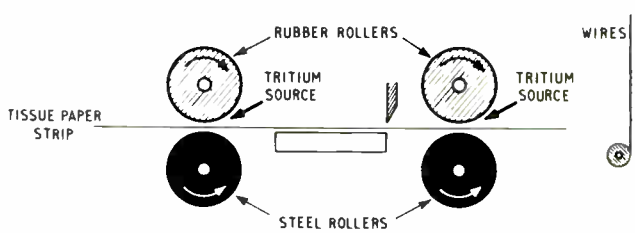
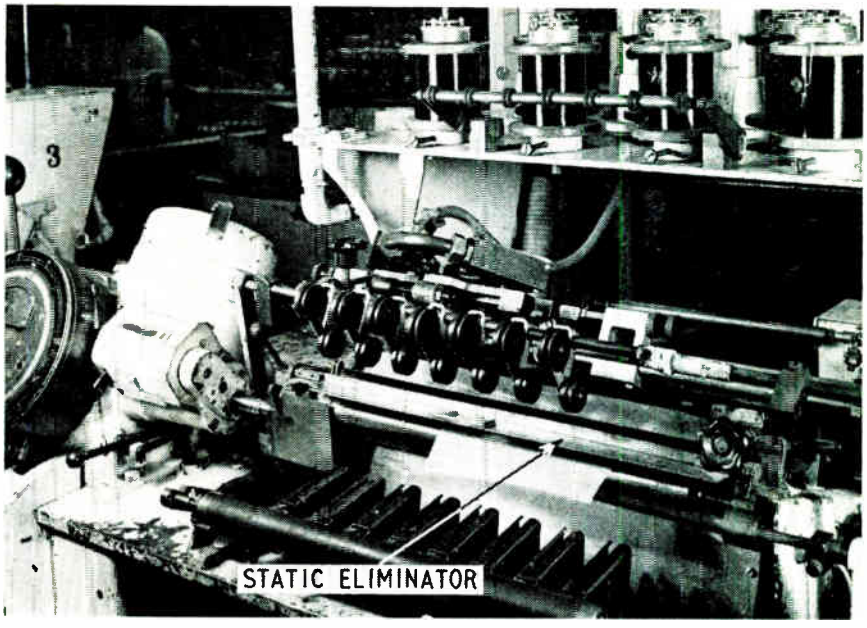


Fig. 3. Tritium is used to eliminate static charges in high-speed printing machinery



A static eliminator is fitted to the machine just over the paper as it comes out from between the rollers

plastic mouldings. The method would be to drop the newly produced article into a suitably shaped mould coated with titanium-tritium-aluminium source. The article could be removed after a second or two, and then should be free from the tendency to collect and retain dust on its surface.

Ion Blowers

Still another technique which has proved useful is totally to enclose the radioactive source so as to produce ionization in a cavity, and the ions so formed are blown out by a stream of air into the charged surface. These ion-blowers, as they are called, are convenient to employ when any exposed radioactive material can be an embarrassment, and where adequate screening is difficult or impossible. They have been used in hospital operating theatres. A. Quinten‡ has done some interesting work with ion blowers using ^{32}P, ^{35}S, ^{204}Tl, ^{210}Po and studied the design of different types of nozzle. One type of blower due to Quinten is shown in Fig. 4. As already indicated the ionized air is blown towards the static charge it is desired to neutralize, and the experiments indicate that using a ^{204}Tl source static charges on insulated surfaces 6 ft away can be removed using a very gentle breeze of air across the thallium surface.

Other Applications of Ionization

Radioactive sources to produce ionization find other applications. Thus small radioactive sources are now placed in cold-cathode trigger tubes to ensure fast operation. Originally derivatives of radium and thorium were used for this purpose and were most effective. However, some of these materials also emit gamma-rays, and if many of these cold-cathode tubes are stacked together, the total gamma-radiation can add up to a dangerous level. This difficulty is now avoided by the use of tritium (a gas), and a pure beta-emitter. The beta-particles from tritium have sufficient energy to enable them to produce ionization when they pass through the low-pressure gas, but not enough energy to penetrate the glass envelope. There is, therefore, no external radiation hazard.

‡ Use of Radioisotopes to Overcome Electrostatic Dangers in Hospitals and Industry", Radioisotope Conference Oxford 1954, Vol. 2, pp. 188-197, London, Butterworths Scientific Publications.

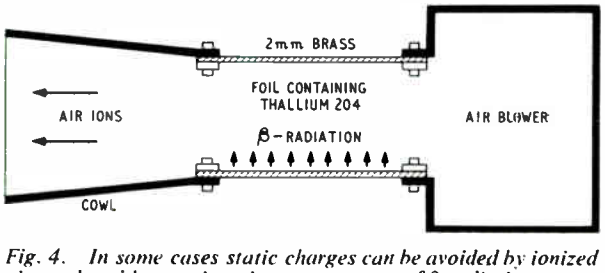


Fig. 4. In some cases static charges can be avoided by ionized air produced by passing air over a source of β radiation

HIGH VOLTAGE SILICON CONTROLLED RECTIFIERS

After two years' research in the group's R. & D. laboratories in California, International Rectifier has developed an epitaxial process for the manufacture of silicon controlled rectifiers with bulk avalanche characteristics extending up to 1,500 V.

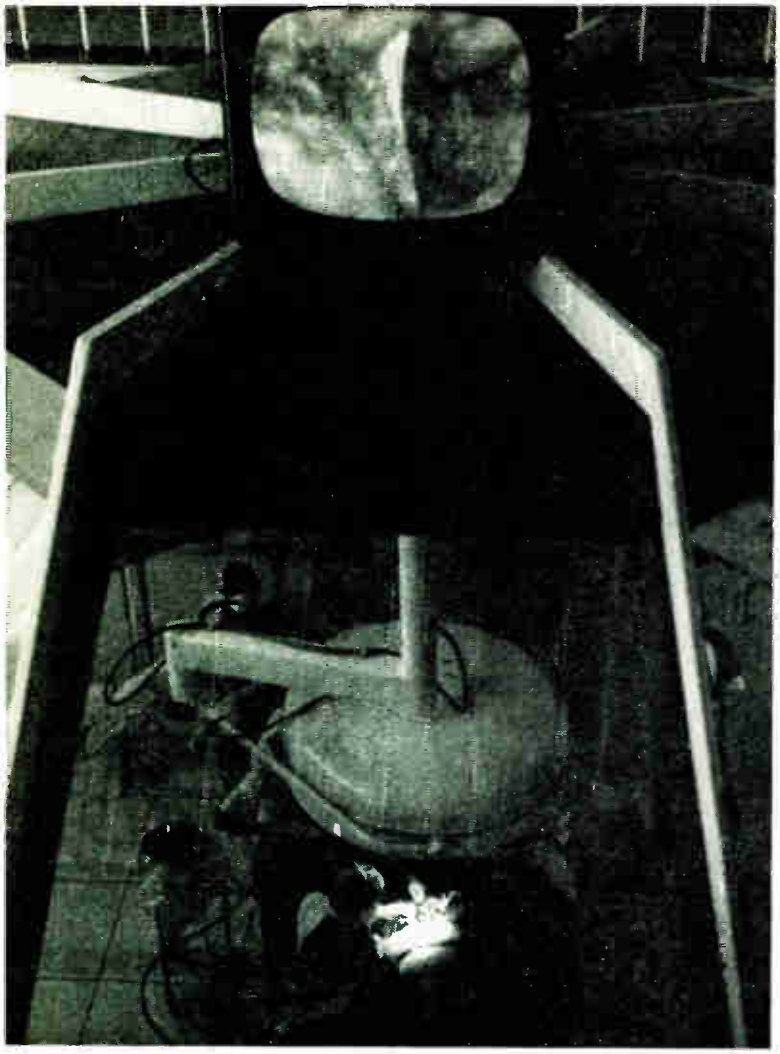
The process is the first known successful application of epitaxial techniques to multi-layer, high-power, semiconductor devices.

International Rectifier Corporation is already in production on a range of 70 A (110 A r.m.s.) silicon controlled rectifiers, using this new process, and units up to 1,500 p.i.v. are now available in America. They will be available later this year in the U.K. and Europe.

Prior to this new process, the highest voltage controlled rectifiers available were about 800 V devices. This development makes practical the replacement of ignitrons, thyratrons and motor-generator sets, since it will no longer be necessary to operate lower voltage devices in series, with the associated complex firing and voltage division problems.

Because of their bulk avalanche characteristics these s.c.rs also assure built-in protection against high-voltage transients and thereby enhance reliability.

For further information circle 41 on Service Card



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APPLICATIONS ILLUSTRATED

CLOSED-CIRCUIT TELEVISION

As a logical and extremely satisfactory solution to a wide range of problems of remote supervision and inspection closed-circuit television is rapidly establishing itself in industry.

No one application of c.c.t.v. can be claimed to be the most successful. It is used in the air, on the land and under the sea to provide pictures of processes, installations, data etc. So multitudinous are the applications that they could, if listed, occupy many pages. Suffice to say here that for a modest outlay c.c.t.v. can extend that most valuable of human senses, sight, into remote or hazardous areas.

The accompanying pictures illustrate a few interesting applications of Pye closed-circuit television, but none quite so exotic as that which enables the Sheikh of Bahrein, a keen angler, to see the floats of his fishing rods while sitting in the air-conditioned stateroom of his luxury yacht.

For further information circle 42 on Service Card

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3

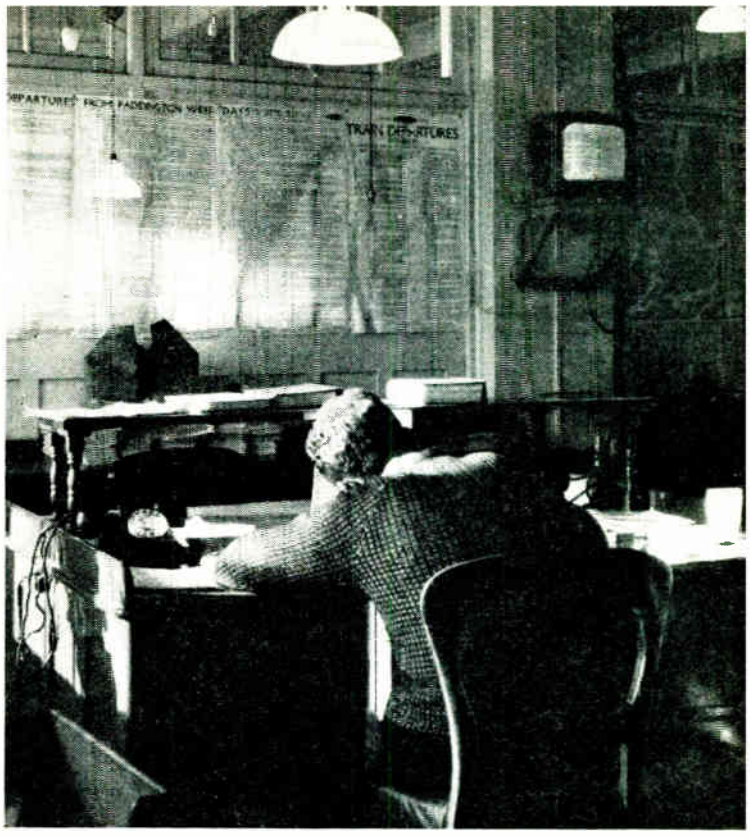
1. *This installation is the most comprehensive of its kind in Europe, and is used to teach medical students in operative surgery at Liverpool Royal Infirmary. As surgeons operate under this Scialytic light the operation is televised by a camera concealed in the centre of the light fitting and the picture is transmitted to monitors, in lecture halls and other rooms*

2. *Customers' accounts, covering two branches of the Westminster Bank in Manchester, are being handled with the aid of c.c.t.v.*

3. *The Vickers VA-3 Hovercraft has an unusual rear-mirror fitted to aid its driver. A closed-circuit television system is being used so that the driver can see backwards*

4

4. *An attendant reads meters by television in the central control room of the Sunderland Gasworks. Using a closed-circuit television system, the attendant can bring to his screen pictures from any one of five cameras strategically positioned throughout the gasworks*



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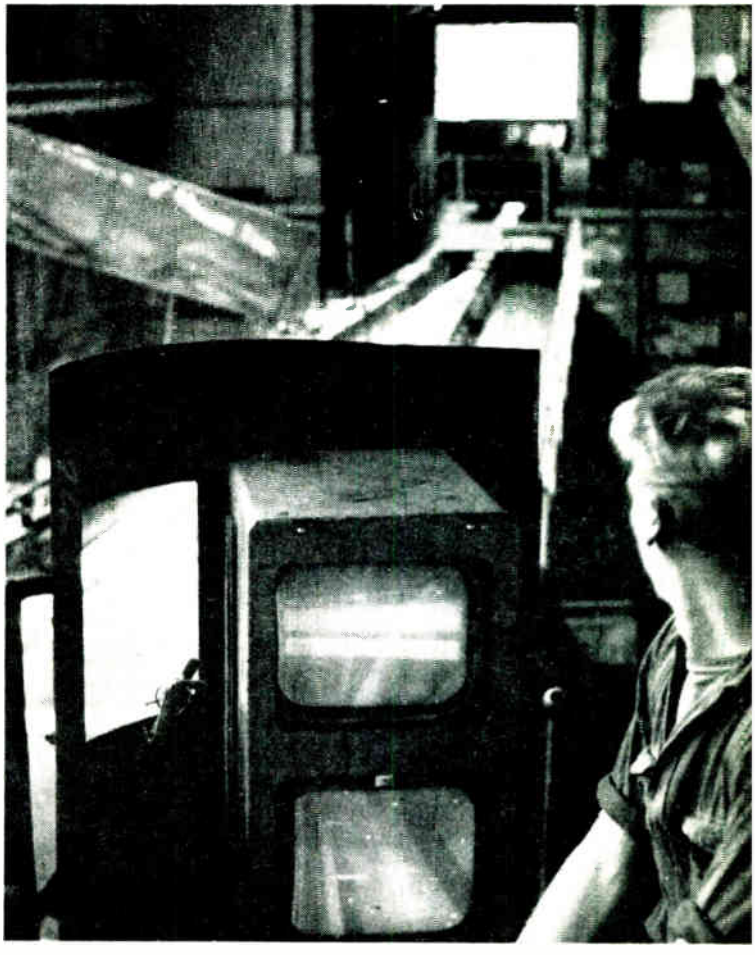

5. *Closed-circuit television in the London Division Passenger Control Room at Paddington Station sends information on running times of all 'up' trains to six important control points throughout the station. Shown here is a receiver operating at one of the control points*

6. *Closed-circuit television is being used here to assist in the production of steel at Fox's Steel Mill in Sheffield*

EQUIPMENT review

1. High Current Photocell

A new high current photocell, type 9608, is announced by E.M.I. Electronics. This is an opaque cathode photocell, having a high transmission mesh anode mounted close to the flat window a few millimetres from the plane cathode.

The high anode–cathode field with voltages of about 2 kV enables large peak currents to be drawn, up to 1 A, for illumination from pulsed light sources such as lasers.

The tube is available with caesium antimony (S4) or bismuth silver caesium (S10) or silver oxide caesium (S1) cathodes. — *E.M.I. Electronics Ltd., Hayes, Middlesex.*

For further information circle 1 on Service Card

2. Heavy Duty Relay

The Kuhnke series KS power relay is a heavy duty contactor with overall dimensions of $2\frac{1}{4} \times 2\frac{1}{16} \times 2\frac{3}{16}$ in., weighing $7\frac{1}{2}$ oz max. The $\frac{1}{4}$ in. diameter contacts are of silver-cadmium-oxide.

This relay can be supplied with one normally-open, double-make or one normally-closed, double-break contact rated at 50 A, 440 V; 2·5 kVA/1·5 W max. resistive load. Coils are available for operation up to 240 V a.c./220 V d.c. Both contact and coil terminals are of heavy duty screw type.

This rugged relay is available off the shelf and standard normally-open contact 230-V a.c. relays are priced at 30s. For special requirements the relay can be furnished with one change-over auxiliary contact rated at 2 A, 250 V; 100 VA/70 W resistive load.— *H. Kuhnke Ltd., 163 Stanwell Road, Ashford, Middlesex.*

For further information circle 2 on Service Card

3. Miniature Axial Blower

To meet the increasing demand for forced cooling of densely packed electronic equipment, Plessey has developed a compact 5-oz a.c. axial blower capable of operating continuously at a maximum ambient temperature of 100 °C. The maintenance-free life of the unit under normal working conditions is 2,500 hours.

Designed to meet Ministry of Aviation Specification EL 2005, it utilizes a totally enclosed three-phase squirrel cage induction motor working from a 115/200 V, 400 c/s a.c. supply. Single phase operation is achieved by means of a 0·75-μF capacitor.

Measuring $1\frac{5}{8}$ in. in diameter by $2\frac{1}{4}$ in. long, the blower develops through its moulded impeller an airflow of 20 c.f.m. in free air or 10 c.f.m. when working against a back pressure of 1·5 in. s.w.g. Although designed primarily for the aircraft industry, the blower has a wide range of applications in other industries where compact temperature regulating equipment is required.—*Aircraft Equipment Group, The Plessey Co. (U.K.) Ltd., Eastern Avenue West, Mawneys, Romford, Essex.*

For further information circle 3 on Service Card

4. Low Cost Transistor Tester

A transistor tester, listed at £27, has been introduced by Philips under the type No. PM6501. It is stated to be exceptionally easy to operate and can be used by unskilled staff for component acceptance checking and similar jobs.

All leads of 3- and 4-wire transistors can be quickly connected or released by a flick-operated clamp. The test required is selected by a simple thumb-operated measurement switch, and rapid checks can be made on p-n-p and n-p-n transistors of both low and high power ratings.

The instrument is mains operated and the applied test voltages are rectified sine waves with a peak value of 7 V. Tests may be made for emitter-

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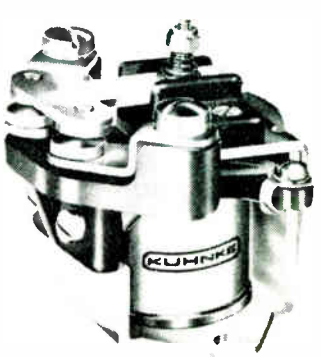

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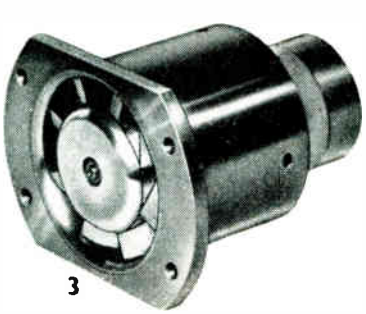

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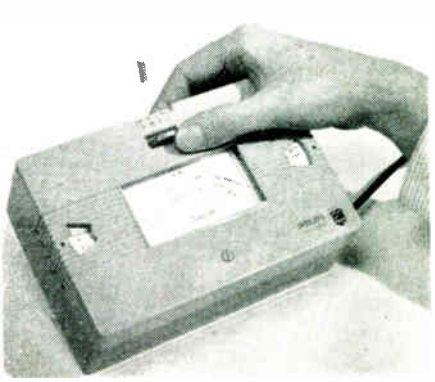

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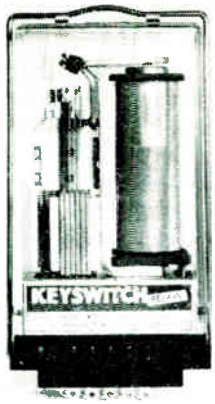

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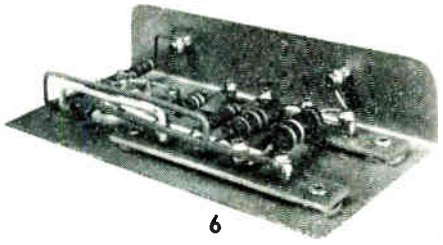

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collector short circuit, collector leakage current and current gain.

There are two measuring ranges for collector leakage currents: 250 μA and 2·5 mA. Current gain may be measured at four different peak collector dissipations: 10 mW, 40 mW, 0·4 W and 4 W at f.s.d.

Overall dimensions of the instrument are 8 × 5 × 3 in. and weight is 2 lb 14 oz.—*Research and Control Instruments Ltd., Instrument House, 207 King's Cross Road, London, W.C.1.*

For further information circle 4 on Service Card

5. Plug-in Relay

The Keyswitch P33 plug-in 3000 type relay combines the design of the standard 3000 type relay with a new quick-change plug-in base of tough moulded non-hygroscopic phenolic. Initially the sockets are supplied, together with circuit diagrams, thus enabling customers to proceed with the wiring of their equipment before delivery of the relays.

The P33 is supplied fitted with a metal or transparent cover, can switch up to 10 A per contact, and the contact assembly can be built up to any required B.P.O. 3000 type specification up to a maximum combination of 18 light duty springs (300 mA to 1 A), or 12 heavy duty springs (2 to 8 A), or equivalent combinations.

In addition to those schemes where the facility of quick replacement is important, this plug-in relay is suitable for installation in equipment located in dust-laden and other impure atmospheres. — *Keyswitch Relays Ltd., 120-132 Cricklewood Lane, London, N.W.2.*

For further information circle 5 on Service Card

6. Terminal Panels

Vero Electronics has introduced a range of perforated boards and strip for use in conjunction with Avlug terminal lugs.

The Avlug consists of a tubular tinned brass terminal lug having annular grooves for the attachment of wires, and may be installed at very high speeds by using bench-mounted or portable power tools and magazine-loading to provide repetition feeding. The range of panels and strips is punched with a matrix of 0·103 in. diameter holes to accept Avlugs, and provides a rigid base for the construction of any type of circuit.

Standard panels measuring 17·1 by 8 in. with a matrix of holes at 0·3 in. centres, and 0·3 in. wide strips 8·55 in. long perforated with a single row of holes, are available from stock. A range of special size boards and single or multiple row strips can be supplied to order, in which the hole pitch may be 0·1, 0·2, 0·3, 0·4, or 0·5 in. as required. All boards and strips are available in $\frac{1}{16}$, $\frac{3}{32}$ and $\frac{1}{8}$ in. thickness.

The mechanical strength of the Vero panels allows them to be used as a complete baseboard for the construction of a circuit. Alternatively, panels or strips may be attached by Avlugs to a metal chassis. The system is equally suitable for prototype or production work, the fixed relationship of the pierced holes ensuring that the parameters of a prototype circuit will remain constant when transferred to a production basis.—*Vero Electronics Ltd., South Mill Road, Regent's Park, Southampton.*

For further information circle 6 on Service Card

7. Low Cost Graph Plotter

The X-Y Autoplotter, now available from Scientific Furnishings, provides a precision two-axis plotter in the same price range as the conventional potentiometric chart recorder, and is designed to bring automatic graph plotting within reach of the budget-minded laboratory.

Although low in cost, the performance of this unit is comparable with much higher priced recorders. Its features include 10-turn helipot span control with 120 kΩ input impedance to minimize loading errors and built-in reference sources designed to provide long-term stability and accuracy, requiring only an annual calibration check. The accuracy is 0·25%, repeatability 0·1% and response time 1 sec. The maximum sensitivity is 1 mV/in.

The X-Y Autoplotter employs two independent self-balancing potentiometers designed to draw Cartesian co-ordinate curves on an 8½ by 11 in. chart from two related d.c. voltages derived from a wide variety of sources such as temperature, pressure, strain, flow and other transducers, analogue computers, acoustic and magnetic devices, semiconductors and many low frequency phenomena found in chemical and physical research. Three standard models are available with manual pen lift, electric pen lift and built-in time base on the X-axis.—*Scientific Furnishings Ltd., Electronics Division, Poynton, Cheshire.*

For further information circle 7 on Service Card

8. Welding Controller

British Federal have announced the combination HC/7-SWU/2 controller for use with resistance welding machines where solenoid valves control electrode movement, either by air or hydraulic pressure, and precise time/amplitude control of weld current is of first importance. In addition to providing synchronous timing, this equipment has full four-interval sequencing to suit spot, projection, portable gun machines, etc. Sequencing is achieved by magnetic/semiconductor static switching techniques enabling welding speeds of up to 400 spots per minute to be attained, one

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review

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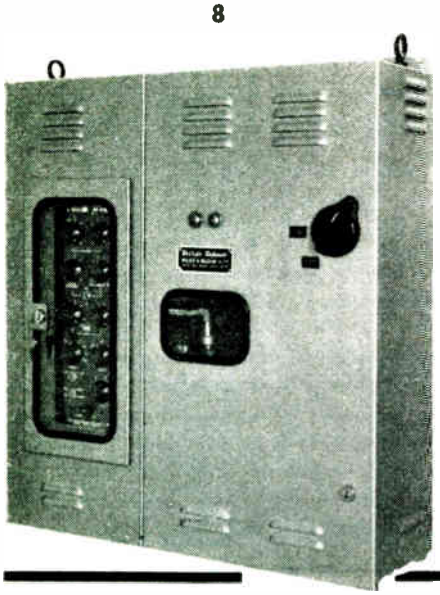

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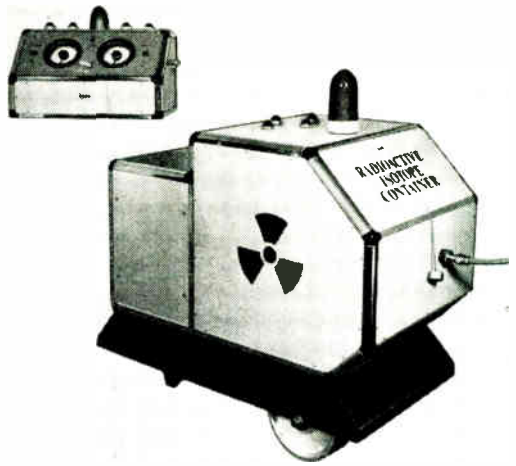

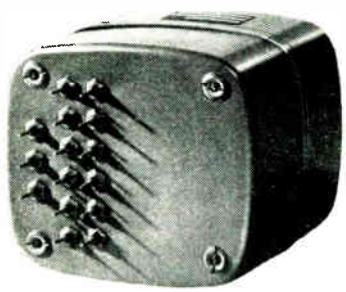

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sequencing relay only being used for air/hydraulic valve control.

Single or repeat operation is catered for, on single operation the controller completing one welding sequence for each closure of the initiation switch. A single on/off initiation switch is all that is required for complete machine control; a pressure switch is not required since a squeeze period is provided.

An improved method of C'R timing is employed in a circuit characterized by its simplicity and inherent 'fail safe' operation. Providing synchronous starting/stopping of the weld current, all weld heat variables due to current transients are eliminated and with absolute accuracy of timing a uniform weld is ensured.

The equipment is suitable for use on 50/60 c/s supply in the range 350 to 520 V; for other operating voltages a separate autotransformer is supplied. Ignitron sizes A, B or C can be fitted, and an over-temperature protective thermostat is provided as standard. A number of variations on the standard HC·7-SWU/2 sequence/timing are available and include for dual gun/heat/time/pressure control, high lift, pre-squeeze, etc. — *British Federal Welder & Machine Co. Ltd., Castle Mill Works, Dudley, Worcs.*

For further information circle 8 on Service Card

9. Radio-isotope Container

An isotope container for industrial radiography has been developed by Gamma-Rays. It uses the source protrusion system, giving great flexibility in use. The source can be protruded in a nylon tube up to 50 ft from the container; operation is by electric motor from a remotely situated control box.

The exposure time can be preset for any period between 30 sec and 24 hr. When the exposure is complete, the source is automatically withdrawn into the container which has many safety features, including provision for door interlock switches and external warning lights and alarms. Indicating lights on the control box show the position of the source at all times.

Three different capacity containers are available, for 5, 20 and 50 curies of cobalt 60, giving a dose-rate of 0·75 mr/hr on the surface of the container. If a dose-rate of 2·5 mr/hr is acceptable, then appropriately larger sources can be housed, the maximum being 150 curies.—*Watson & Sons (Electro-Medical) Ltd., Industrial Division, East Lane, North Wembley, Middlesex.*

For further information circle 9 on Service Card

10. S.C.R. Servo Amplifier

A solid-state amplifier designed to provide whole motor power through its silicon controlled rectifier system, without the use of additional reference supplies to the motor, is now available from Ketay. The amplifier will drive a two-phase servo motor up to a rating of 700 W, with sufficient protection incorporated in the unit for double-voltage transients on a 250-V mains supply. In heavy industrial areas quadruple-voltage transients may occur, in which case an additional unit is available for amplifier protection.

The appropriate transient protection increases the reliability of the amplifier (normal efficiency is 96%) to a degree comparable with that of the magnetic

amplifier, while leaving the unit extremely compact (4½ by 4 by 5 in. high). The very low output impedance renders matching of load to amplifier unnecessary and also permits the inherent damping characteristic of the a.c. servo motor to be exploited in system damping.

The amplifier consists of two channels, selected by a phase-sensitive gate, one for clockwise rotation of the servo motor, the other for anti-clockwise rotation. Each channel uses pulse techniques and consists of a drive unit producing a synchronized trigger signal, followed by an s.c.r. power stage. The trigger-signal phase angle to the a.c. supply varies as a direct function of the input signal, and application of the trigger signal to the s.c.r. varies its conduction angle to produce proportional control of the motor.—*Ketay Ltd., Eddes House, Eastern Avenue West, Romford, Essex.*

For further information circle 10 on Service Card

11. F.M. Signal Generator

The TF 1066B/6 provides c.w., f.m., and a.m. outputs over the frequency range 10 to 470 Mc/s. It is particularly suitable for testing multi-channel telemetry equipment requiring a signal source providing high modulating frequencies and wide deviations with low distortion.

This instrument offers wider deviations than the other models in the TF 1066B series; up to 400 kc/s between 50 and 270 Mc/s. The response of the frequency-modulating circuit is extended to 100 kc/s. A transistorized crystal calibrator is fitted, with calibration points at 10 Mc/s and 1 Mc/s intervals.

Features the TF 1066B/6 shares with other instruments in the series include: an incremental tuning system by which small, precise changes can be made in carrier frequency, either continuously variable or stepped, and read directly from a panel meter: the stepped control provides six preset incremental shifts up to ±100 kc/s; an internal oscillator providing 1 kc/s and 5 kc/s modulating frequencies for f.m. and a.m.; r.f. output level controlled by a directly calibrated constant impedance piston-attenuator.

A rack-mounting version of this equipment is available. — *Marconi Instruments Ltd., St. Albans, Herts.*

For further information circle 11 on Service Card

12. Encapsulated Attenuators

A range of precision encapsulated attenuators, being manufactured for the G.P.O. by Plessey, make use of 'Metallux' metal-film resistors, in which a special nickel chromium alloy is used in association with silver contacts. The resistive film overlaps the silver film to produce a reliable termination point for the element. The process allows production of resistance tolerances of 0·1%.

The range comprises eight colour-coded styles, covering 'T' and 'π' attenuators suitable for line impedances of 75, 140 and 600 Ω. They have been designed in the form of plug-in units and are encapsulated in 'Delrin'. —*The Plessey Co. (U.K.) Ltd., Resistor Division, Ilford, Essex.*

For further information circle 12 on Service Card

13. Solid-State Amplifiers

The Nexus range of silicon solid-state operational amplifiers is now available in this country from Livingston Control. These units, measuring only ½ by ¾ by ¾ in., are highly stable, high gain, differential d.c. amplifiers designed primarily for use in circuit applications involving inverse feedback supplied via external resistive networks. The gain-phase-frequency characteristics of these units are carefully tailored so that they will be loop stable with any amount of feedback up to 100%.

Ten models are available with open-loop gains from 10,000 to 100,000; input impedance varies with the model and is between the limits of 100 kΩ and 500 kΩ. They are able to discriminate against a common mode input signal of ±11 V.

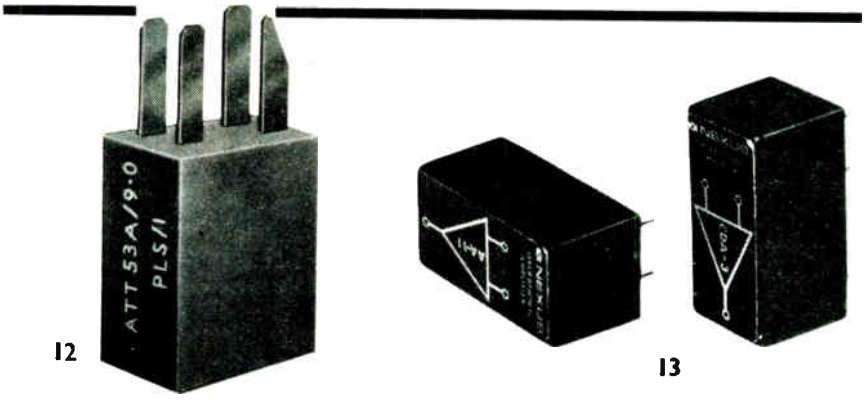
Operating temperature is −25 to +85 C and the drift stability is comparable to chopper-stabilized types, a typical voltage offset being 15 mV/°C. Fixing arrangements are standard circuit board 0·2 in. spacing. Prices range from £43 to £95. — *Livingston Control Ltd., Retcar Street, London, N.19.*

For further information circle 13 on Service Card

14. Pressure Test Set

B.S. 480 Part 1 calls for cables to be tested at 17·5 kV d.c. from each line to earth and 30 kV from line to line. F. C. Robinson & Partners are now marketing a 750-V to 20-kV, 5-mA test set, specifically designed to carry out these tests.

Remote switching facilities are pro-



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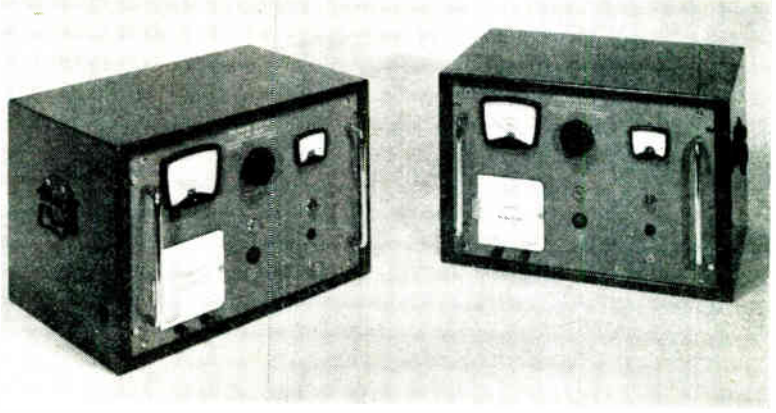

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vided to enable suitable jigs, probes or automatic controls to be used, and to contribute to the safety of the operator. Other safety precautions include current limiting up to 12 kV with an automatic trip circuit to protect the unit at higher voltages, and a safety interlock on the terminal panels. A discharge probe is available to ensure that specimens are safe to handle after testing.

Two models are in production, one with positive and one with negative output with respect to earth. One of these is adequate for the lower voltage test, while both are necessary for the higher voltage test, with the centre point at earth potential. The price of either model is £175 5s. 6d., and the discharge probe costs £12 5s.—*F. C. Robinson & Partners Ltd., Davies House, 181 Arthur Road, Wimbledon, London, S.W.19.*

For further information circle 14 on Service Card

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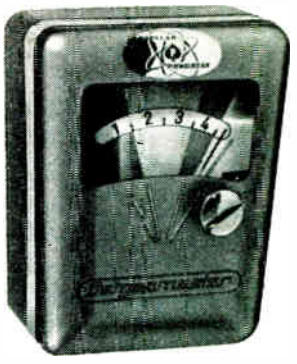

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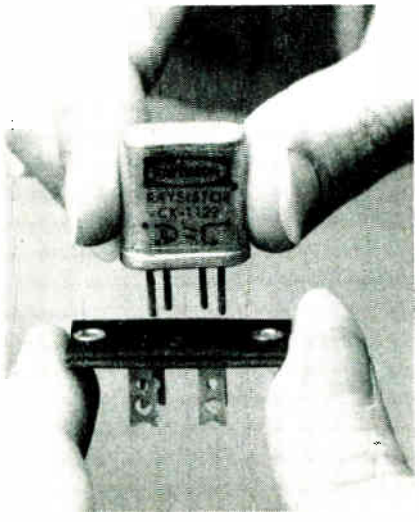

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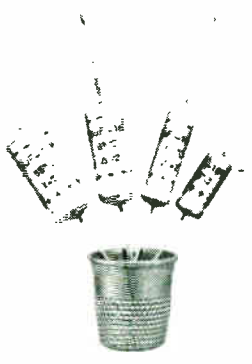

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15. Opto-Electronic Controls

A new series of Raysistor opto-electronic controls designed for use with either dip-solder assemblies or sockets has been introduced by Raytheon.

The CK1121 (illustrated), CK1122, and CK1123 are designed for use in a variety of electronic control functions requiring noise-free operation with either a.c. or d.c. signals. Employing an internal light source and a light-dependent resistor, they operate without wiper or contact chatter or switching transients. Typical applications include solid-state variable resistor, switch, dry-circuit relay, circuit isolator, a.g.c. decoupler, and voltage and power amplifier.

Compact and light weight (0·1 oz), these units employ cadmium selenide light-dependent resistor (L.D.R.) cells. Dissipation is rated at 100 mW and the maximum potential rating is 200 V.

The L.D.R. unit is resistive over very wide ranges of applied voltage and illumination. Minimum-to-maximum resistance ranges of one million and greater are available; typical switching times can be obtained from 4 to 30 msec for 'on' and 225 to 300 msec for 'off'. Shunt capacitance is 2 pF.

Maximum ratings for the electrically-isolated control lamps are: (CK1121) 5·0 V at 55 mA, (CK1122) 10·0 V at 17 mA, and (CK1123) 25·0 V at 36 mA. Lamp capacitance to the cell is 0·1 pF.

These rugged units are hermetically sealed for use in severe environments and packaged in aluminium cans measuring approximately $\frac{1}{4}$ in. square by 0·35 in. thick, exclusive of terminal pins. Four polarized pins, each 0·040 in. in diameter and 0·31 in. long, are positioned for use in 100-mil-grid printed circuit boards. — *Raytheon-ELSI, S.p.A., Villagrazia, Palermo, Italy.*

For further information circle 15 on Service Card

16. Radiation Warning Instrument

A pocket-size radiation-warning instrument, similar in appearance to a photographic exposure meter and known as the Geigermaster, is being marketed by Henri Picard & Frere.

The Geigermaster, which incorporates the Valvo-Geiger-Muller counter 18 509/02, indicates the occurrence of radiation and determines the place of incidence.

Indication of ion dosage output, through a pointer traversing a calibrated dial divided into green, yellow and red fields, is effected by an instrument with an indicating range of 0·15 to 30 mr/hr. The detector is powered by a built-in generator, charged by means of a clockwork motor. Every incidence of radiation is measured by the deflection of the pointer which oscillates, according to the intensity of the radiation, from the green into the yellow or red field.

Operation is quite straightforward. After winding up the clockwork motor of the generator, it is allowed to stand for approximately three minutes in order to permit charging. Apart from audible indication of the charging process, similar to the ticking of an alarm clock, the pointer moves from its normal discharge position across the scale from the red to the green. When it reaches the stop in the green field, the generator is charged and the instrument ready for use.

The instrument has been designed to show only detrimental dosages and does not indicate soil and natural cosmic radiation (within the range of approximately 0·017 to 0·034 mr/hr).—*Henri Picard & Frere Ltd., 34/35 Furnival Street, London, E.C.4.*

For further information circle 16 on Service Card

17. Solid Electrolyte Capacitors

Aluminium foil capacitors with solid electrolyte, the first to be marketed in this country, have been introduced by the Mullard Component Division.

These capacitors, which are designed for professional equipment, use manganese dioxide in place of the usual liquid electrolyte. As a result their impedance characteristic at high frequencies is better than that of conventional electrolytics, particularly at low temperatures and because the electrolyte cannot dry-up their electrical stability during service life is improved.

The electrical characteristics of solid aluminium capacitors are similar to those of solid tantalum capacitors for which, in many applications, they afford an economic replacement. The present range covers values from 12 μF, 40 V d.c. to 100 μF, 4 V d.c. housed, according to capacitance and voltage rating, in insulated aluminium cans of four sizes. The smallest can measures 6·4 by 14·0 mm and the largest 10·3 by 21 mm. Working temperature range for all values is −80 to +85 °C.—*Mullard Ltd., Mullard House, Torrington Place, London, W.C.*1.

For further information circle 17 on Service Card

18. Ultrasonic Cleaning Equipment

Headland Engineering Developments announce the introduction of a range of ultrasonic cleaners. These units range in size from the Model H.55 (illustrated) of 3½-pint tank capacity, to large custom built tanks of any size and shape to suit customers' requirements.

Operating at a frequency of 80 kc/s, the power is pulsed through transducers of modified barium titanate. The generators are mains operated and have no controls or metered adjustments: merely an on/off switch which brings the unit into immediate action. There is no warming-up period and the output is not subject to change by drift.

As well as standard cleaning equipment, 3-stage ultrasonic degreasing equipment to customers' specific requirements is available. Accessories such as filtering equipment, lids, baskets, timer kits, switching boxes for use with two or more tanks, etc., are also available.—*Headland Engineering Developments Ltd., Electro-Mechanical Division, Melon Road, London, S.E.*15.

For further information circle 18 on Service Card

19. Miniature Transducer

The miniature Lintran displacement transducer, announced recently by James Scott, is mains-frequency operated and ruggedly constructed to ensure trouble-free operation and long life. An important feature is that unlimited free overtravel is provided, making it particularly suitable for machine position sensing and control.

The linearity of the transducer is better than ±1% over total ranges of travel between 0·125 and 0·250 in., the nominal output when using the standard Lintran demodulator and indicator unit (illustrated) being ±150 μA d.c. into a 1 kΩ load.

Approximate dimensions of the transducer are 2¾ in. long by ⅞ in. diameter and the weight (including armature) is 5½ oz.—*James Scott (Electronic Engineering) Ltd., 68 Brockville Street, Carntyne Industrial Estate, Glasgow, E.2.*

For further information circle 19 on Service Card

20. Standing-Wave Amplifier

Designed as an extremely low noise level (0·007 μV at minimum bandwidth) standing-wave amplifier, the PRD 277-B is now available in this country from Roberts Electronics. This amplifier is claimed to be capable of detecting weak signals normally undetected by conventional instruments.

Attenuation is in 3-dB steps combined with four v.s.w.r. scales. The large 5¾-in. meter with 1% linearity allows v.s.w.r. measurements of a very high accuracy. Meter scales are automatically normalized when switching from one of the four regular scales to the expanded scale. There is a high and low bolometer bias supply and bolometer bias is read directly from the meter.

A high-gain audio amplifier, the 277-B is designed primarily for use with slotted sections in making standing-wave measurements. The dB scales can be used for relative power and attenuation measurements by using the amplifier in conjunction with crystal or bolometer detectors.—*Roberts Electronics Limited, 17 Hermitage Road, Hitchin, Herts.*

For further information circle 20 on Service Card

21. High-Speed Counters

The Hengstler 093 range of predetermining counters will, in the standard revolution form, operate at 6,000 r.p.m. and a special modification permits operation at twice this speed. Both revolution and ratchet types have 4- or 5-figure capacity, are available for base or panel mounting and are reset by angular movement of a lever or partial rotation of an elongated knob.

In their simplest form, as base-mounted units, they are predetermined by opening a door below the reading face and manipulating the figure wheels; but where ease and speed of presetting are necessary this is achieved by rotating knobs in place of the door. In the base-mounted revolution model only, a six-figure totalizer can be built in; or if required this can be a two- or three-shift section totalizer, each section being individually reset by detachable key. In all versions a

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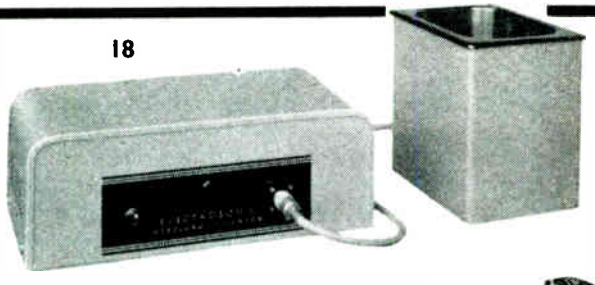

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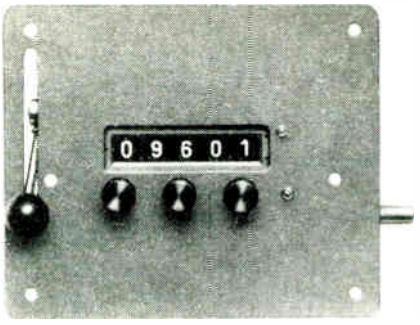
built-in pre-signal device can be incorporated to operate at any multiple of 10 digits between 20 and 90 in advance of the final predetermined figure.

Each pair of contacts carries a maximum load of 2 A at 250 V a.c. and when operated remain so until the counter is reset, or a new preset figure selected. They are of the reversing type and can therefore be wired to make or break a circuit, to stop a motor, start a further sequence or as may be required. The pre-signal device can operate a built-in signal lamp, which will indicate to an operator of several machines when each is about to complete a run.—*J. Hengstler Co. Great Britain Ltd., Highbridge Street, Waltham Abbey, Essex.*

For further information circle 21 on Service Card



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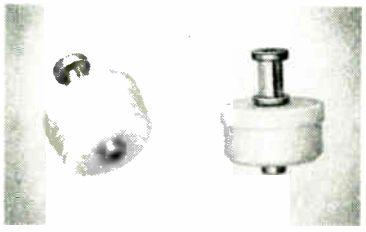

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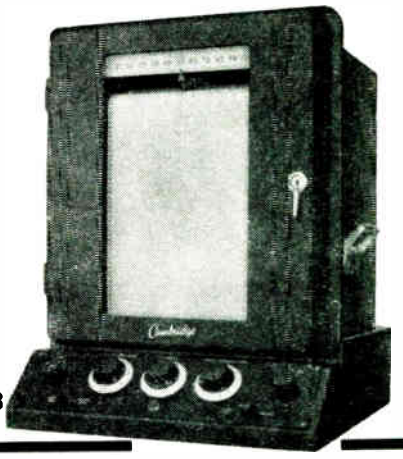

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EQUIPMENT review

22. Feed-Through Terminals

For electronic assemblies where height above the chassis is limited and where increased flashover protection is desired, Sealectro Corporation announces the availability of a feed-through 'Press-Fit' terminal designated FT-SM-71-C10.

This new unit features a Teflon body with a 0·264-in. major diameter but with an overall height of only 0·303 in. The wide diameter body offers the flashover protection desired while keeping the height of the terminal well within the restrictions of limited height assemblies. Additional terminals in this series maintain the same height but with varying body diameters for chassis where differing voltages are applied.

To ease insertion into a 0·060-in. maximum thickness chassis, it is recommended that the B-26-2-1 insertion tool be used. Units are available in the ten standard EIA colours.—*Sealectro Corporation, Hersham Trading Estate, Walton-on-Thames, Surrey.*

For further information circle 22 on Service Card

23. Multi-Range Recorder

This instrument, based upon the standard Cambridge electronic potentiometer recorder, is designed to meet requirements arising daily in research and development laboratories. It provides millivolt ranges from −0·5 to 0 to + 0·5 mV up to 1,400 to 1,500 mV full scale. The unit is available as a single-point continuous line drawing recorder, or as a 6- or 12-point dotting recorder.

There are seven basic ranges of 1, 2, 5, 10, 20, 50 and 100 mV obtainable by operating one rotary switch and 30 zero displacements obtainable on another rotary switch, giving a total of 210 discrete spans. In addition, a two-way switch used in conjunction with a rheostat permits continuous adjustment of any range between × 0·4 and × 1 of its basic value. This is particularly useful for adjusting the recorder to an odd mV value, for example in temperature measurements with thermocouples. The number of ranges obtainable on the recorder is therefore practically unlimited.

The slidewire circuit is supplied from a.c. mains through a stabilizer, but standardizing circuits are provided for occasional checking against the internal standard cell. The control panel, which is mounted on the base of the recorder, incorporates a mains switch with a stand-by position. This enables the amplifier circuits to be energized for immediate readiness, but as the chart motor is not energized paper wastage is avoided.—*Cambridge Instrument Company Ltd., 13 Grosvenor Place, London, S.W.1.*

For further information circle 23 on Service Card

24. Rotary Ovens

A range of rotary ovens has recently been introduced by Hedin. The rotary working chamber allows continuous loading and unloading of components at frequent intervals by one operator. The heat losses from the door are small and loading the oven is light and simple work.

Typical applications include preheating and fusing plastic powder-coated components; preheating and stoving varnished electric motors and coils; drying adhesives or damp articles; curing rubber, plastics and resins.

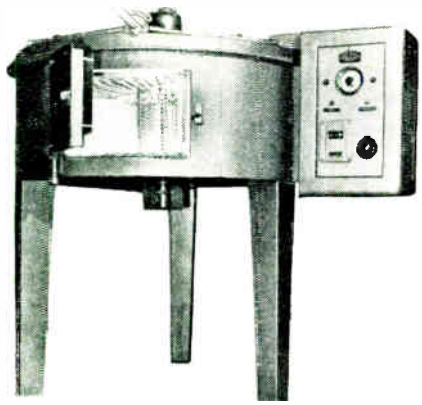
The oven may be rotated manually, linked to the movement of the door, or it can be driven by an electric motor. Access is by a hinged door, or through a permanent opening sealed by an air curtain. Heating is generally by electricity, with forced air circulation to ensure rapid, even baking and drying at temperatures up to 450 °C. Normal oven sizes range from 3 to 8 ft in diameter by 1 to 3 ft high.—*Hedin Ltd., Commerce Estate, South Woodford, London, E.18.*

For further information circle 24 on Service Card

25. Low Velocity Blower

The Beaconair low velocity blower by Automatic Switchgear is suitable in applications where a quiet low-cost unit is required to provide a small displacement of air to cool electric or electronic equipment, or to reduce condensation.

It consists of a shaded-pole motor fitted with a 2½-in. diameter blade



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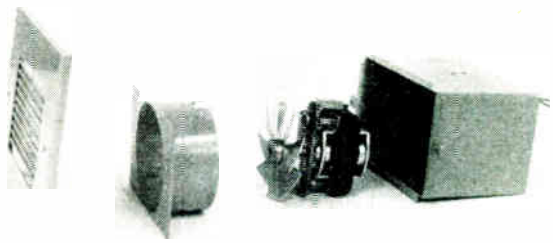

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contained in a well finished sheet-steel brick-shaped enclosure and completed with a neat front ventilator plate.

Displacement: 120 cu ft/hr; supply: 230 V, single phase; box size: 4 by 3½ by 3½ in.; grille size: 4¼ by 6 in. long. Price: 58s. 6d. plus carriage.—*Automatic Switchgear Co., 1 Twatling Road, Barnt Green, Nr. Birmingham.*

For further information circle 25 on Service Card

26. Delay Generator

Lunarton Electronics have announced the Model 20 delay generator with a range of delay continuously variable from 20 to 2,000 μsec. Its primary function is to receive a pulse from a transducer, via a suitable amplifier, and delay that pulse to position correctly, in time, a signal intended to initiate a high-speed flashlamp for photographing rotating machinery or missiles in flight.

However, the Model 20 delay unit has many other applications, e.g. in delayed-triggering pulse generators and for delaying timebases in oscilloscopes. The input requirement is a 7- to 50-V positive pulse. The 'set delay' control can be set to within 2% of the delay required with a repeat pulse accuracy of better than 1%. The output at 45 V is more than adequate to trip time bases, thyratron pulse generators or gates. The unit is fully transistorized and measures 9 by 3½ by 10 in. deep.—*Lunarton Electronics Ltd., 40-42 Langley Street, Luton, Beds.*

For further information circle 26 on Service Card

27. Light-Operated Switch

A sturdy, compact, easy-to-fit electronic unit for automatically switching on electric lighting installations at dusk and turning them off at dawn is now being made and marketed by Television Installation Services.

The equipment, housed in a box measuring 6½ by 4½ by 2¾ in., is primarily for use in blocks of flats, communal dwellings, public passageways, shop lighting, neon signs, street and bollard lighting and similar places where accurate timing is required.

The unit consists of a cadmium sulphide cell, transistor amplifier, sensitivity control, relay, power supply, fuse and mains connecting panel. The power consumption is less than 5 W from 250 V a.c. mains. The relay contacts are rated at 10 A a.c.

A sensitivity control on the unit allows the equipment to be adjusted to suit wide variations in environmental light.

The price of the equipment is £6, with the external cell on a 12 ft extension cable costing £1 7s. 6d.—*Television Installation Services (Mansfield) Ltd., Nursery Street, Mansfield, Notts.*

For further information circle 27 on Service Card

28. Portable Measuring Wire Cutter

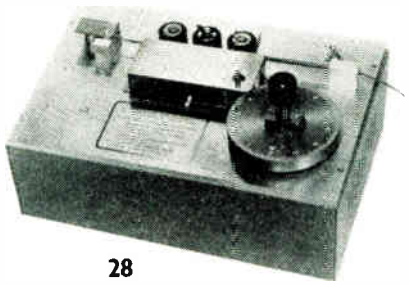
Western Electronics Products have announced the release of the Model MC-2 automatic measuring cutter. This unit is for use where moderate quantities of accurately-cut wire or tubing are required. Its outstanding feature is quick, direct-reading length setup which can be made easily by unskilled personnel in approximately 30 sec.

The MC-2 is especially adaptable for operations requiring small quantities of different colour-coded wires of various lengths. It cuts and measures from ½ in. to 10 ft, with an accuracy of 1%. Maximum wire diameter is ⅛ in. and sizes smaller than 30 a.w.g. can be handled easily, with no adjustment. Wire is advanced continuously at a single speed for cutting and more than 10,000 one-inch pieces can be produced in an hour.

The MC-2 is portable and weighs 12 lb; it is housed in a metal case with overall dimensions of 4 by 8 by 12 in. All operating components are mounted on a horizontal aluminium panel.

EQUIPMENT

review



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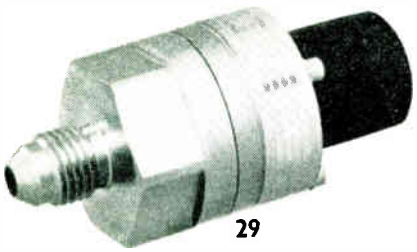
Neoprene-covered rollers pull the wire past a measuring wheel mechanism and feed it through a solenoid-actuated cutter.—*Export Division Dept. 6394, Emec Inc., 160 Terminal Dr., Plainview, L.I., New York, U.S.A.*

For further information circle 28 on Service Card



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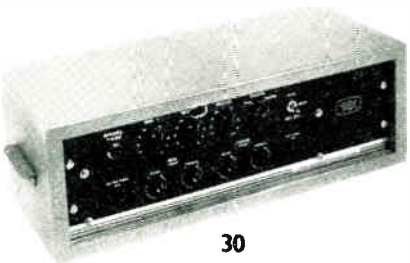
29. Low-Temperature Strain Gauge

The latest strain-gauge pressure transducer Type 4-354 of the Consolidated Electrodynamics Division of Bell & Howell, will operate accurately in cryogenic temperature environments.

The transducer utilizes the unbonded strain-gauge principle with a four-active-arm spring-type sensing element and a force-summing diaphragm. With this sensing element attached to the diaphragm, pressure against the diaphragm produces a displacement which changes the resistance of the active arms. This in turn causes an electrical output proportional to applied pressure.

The Type 4-354 operates accurately under conditions of acceleration, vibration, and shock at temperatures ranging from −273 to +150 °C. It will measure absolute and gauge pressures of fluids in ranges from 0 to 100 to 0 to 5,000 lb/sq. in. and will provide a 20-mV output compatible with millivoltmeters, oscillographs, galvanometers, oscilloscopes, amplifiers, and other equipment. A special stress isolation design prevents erroneous outputs caused by distortion or vibration. — *Consolidated Electrodynamics Division of Bell & Howell Ltd., 14 Commercial Road, Woking, Surrey.*

For further information circle 29 on Service Card



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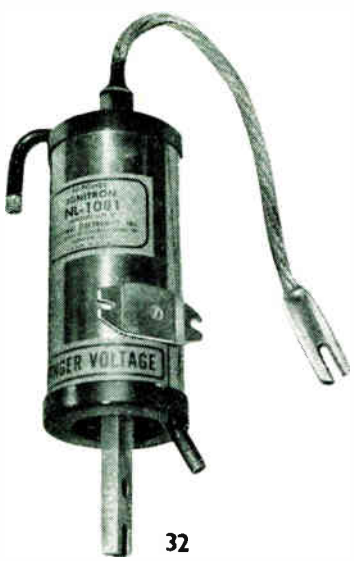
30. Transistorized Audio Amplifier

A high-quality, general-purpose amplifier, fully-transistorized and embodying all the features needed in the majority of sound installations, is the latest addition to the Trix range. The model T636, complete in one unit, includes provision for 12-V battery operation, as well as the necessary power pack for a.c. mains supply, 115 or 200–240 V.

Inputs are provided for two microphones and for one music input, with mixing controls and selector switch for pick-up, tape and radio. All three inputs can be faded or mixed as required. There are separate tone controls, for bass and treble, fitted for both music and microphone circuits; i.e., four tone controls in all. These enable adjustment of the overall frequency response to be made to compensate for pick-up and recording characteristics. When used with



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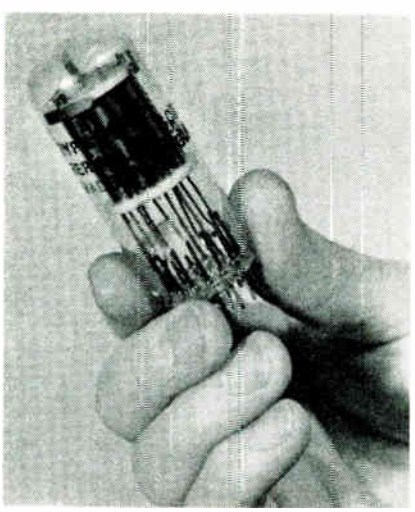

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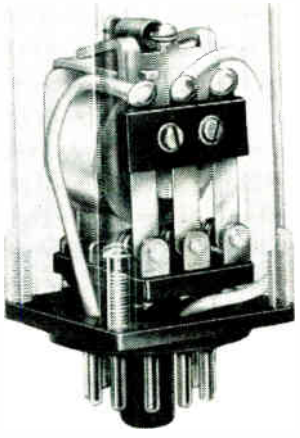
microphones, they also assist to a great extent in dealing with acoustic problems encountered in varying types of buildings and halls.

The amplifier is a high-gain type, with a total of 11 transistors, and incorporates output matching for high- and low-impedance circuits.

The power output, with less than 5% total distortion, is 30 W. Overall dimensions are 20¾ by 9 by 7 in., the front panel being the standard 19-in. type which can be removed for rack mounting. The complete weight, including case, is 22 lb, or 17½ lb without the power pack. For vehicle installation, the amplifier is adaptable, by simple adjustment, for either positive or negative earthed chassis.—*Trix Electronics Ltd., 1-5 Maple Place, London, W.1.*

For further information circle 30 on Service Card



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31. Radio-Telephone

Storno-Southern have announced the Viscount, a transistorized f.m. radio-telephone for use in the 68 to 88, 156 to 174 and 450 to 470 Mc/s bands, available with up to eight channels, and with 2 W audio output.

The model for use on 50- or 25-kc/s channelling, operates from a 6, 12 or 24 V d.c. supply. The power supplies, audio and i.f. stages are transistorized, while valves are used for the r.f. stages.

The set is compact (4 by 10 by 13 in.), boot mounted and splash-proof; has waterproof connectors and is rigidly constructed in a diecast casing which will withstand rough handling. The current drain on a 12-V supply is 700 mA on receive, 1·5 A on standby and 5·5 A on transmit.—*Storno-Southern Ltd., Private Box No. 4, Camberley, Surrey.*

For further information circle 31 on Service Card

32. High Power Welding Ignitrons

National Electronics Inc. have announced what they consider to be an important advance in welding ignitrons. These ignitrons, which are marketed in this country by Walmore Electronics, are capable of handling two-thirds more current than conventional ignitrons of the same size.

Important features of these units are: (1) reduced 'side-wall' arcing, allowing higher currents; (2) increased anode radiation area, giving lower anode operating temperature; (3) closer anode/mercury pool spacing to produce lower arc drop; and (4) high-efficiency, self-flushing copper cooling coils to allow long averaging time.

Two groups of tubes are now available. The NL 1081 (illustrated) comprises two tubes in inverse parallel connection giving a maximum demand current of 2,000 A at 500 V r.m.s. and up to 5% duty. Maximum average anode current is 75 A. In the NL 1082 two tubes give maximum demand current of 4,000 A r.m.s.—*Walmore Electronics Ltd., 11-15 Betterton Street, Drury Lane, London, W.C.2.*

For further information circle 32 on Service Card

33. Photomultiplier Tube

An addition to its growing range of 'squirrel cage' photomultiplier tubes, the type 9663, is announced by E.M.I. Electronics. This tube is sensitive to radiation through its side wall, which is made of ultra-violet transmitting glass. The opaque photo-cathode is of bismuth silver, giving a spectral coverage from approximately 2,000 to 8,000 Å. The high gain and low dark current which are achieved in this tube make it particularly suitable for low-level u.v. and visible radiation spectrometers.

The 9663 tube has a B14B pressed glass base for which a matching p.t.f.e. socket is available. It can also be supplied overcapped with a small shell sub-magnal 11-pin base when it will operate in place of the RCA 1P28.—*E.M.I. Electronics Ltd., Hayes, Middlesex.*

For further information circle 33 on Service Card

34. Pygmy Power Plug-In Relay

D. Robinson & Co. announce that they are importing from the Taiko Organisation of Japan a power relay which they term the 'K' type. It is of standard pygmy plug-in form and is available in two versions: the K2 which has an octal base and two change-over contacts, and the K3 which has an 11-pin base and three change-over contacts.

Made to a performance and test specification laid down by the distributors, these relays are claimed to be of the highest quality. The price is very low: 17s. 9d. each, delivery free, for both the 2- and 3-pole types (for quantities of 12 or more).

The standard coil supply is 175/250 V, 50/60 c/s, although units can be supplied for all other normal voltages with an operating range of ±15% on a.c. or d.c. The contacts are rated at 5 A, 250 V a.c. and the relay will withstand an ambient temperature of 140 °F, the clear plastic cover not softening below 200 °F. The contact pressure exceeds 20 gm even on the back contacts and the life expectancy is about 7½ million mechanical operations.—*D. Robinson & Co. Ltd., 5/7 Church Road, Richmond, Surrey.*

For further information circle 34 on Service Card

35. Direct Writing Recorder

A portable two-channel rectilinear direct-writing recorder which provides channels 80 mm wide at frequencies beyond 35 c/s is announced by Brush Instruments.

Designated Brush Recorder Mark 280, the unit is intended for uses beyond the normal range of conventional direct-writing recorders. Possible applications include spectrophotometry, chromatography, dif-

fusion, shock and vibration, and process quality assurance studies as well as many aspects of medical and laboratory analysis.

Dynamic writing speed (frequency × amplitude) is claimed to be more than ten times greater than previously achieved on channels of 80 mm width. The recorder is designed to combine the high accuracy and resolution provided by wide channels with the portability, flexibility, and ruggedness needed for field use.

The Mark 280 incorporates a pen-position feedback servo system which ensures both static and dynamic accuracy of ½%, full scale. Included are solid-state drive amplifiers and preamplifiers for each channel, affording a sensitivity of 0·5 mV per chart division and an input range up to 250 V. Inputs are floating and guarded with an input impedance of 1 MΩ.

Writing method is by forced fluid and trace presentation is rectilinear. In addition to two analogue channels, two 3-position event channels are provided and a third event channel may be incorporated.

Chart speeds are controlled by push-buttons. Amplifier controls on the front panel include ten-step attenuation, variable gain and pen centering. Pen limiters, adjustable for amplitude, are provided for each channel. Models with calibrated zero suppression are available.

The recorder weighs 76 lb, is equipped with a carrying handle and may be operated in any position. A lightweight tubular-frame cart, available as accessory, permits the recorder to be tilted to any convenient angle.—*Aveley Electric Limited, South Ockendon, Essex.*

For further information circle 35 on Service Card

36. Transistorized Voltage Stabilizer

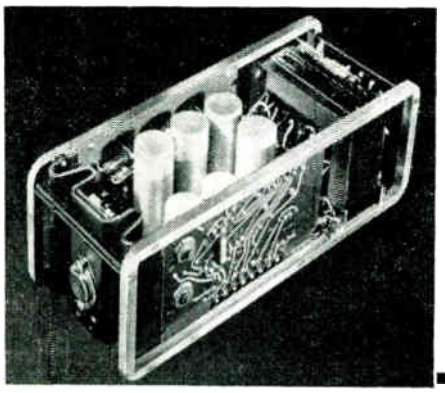
The first of a series of transistorized d.c. voltage stabilizers has been introduced by Philips. It has an output voltage that can be pre-set in the range of 1 to 30 V, and the maximum current rating at 24 V is 1·3 A.

A differential amplifier ensures that with mains fluctuations of ±10% the output does not change by more than 0·1% of its nominal value. The internal resistance is less than 0·01 Ω, and ripple is only 1 mV. Permissible ambient operating temperatures are up to 45 °C.

The stabilizer is available as a chassis unit for building into other equipment. It can also be supplied as a rack-mounting unit with mains switch and indicator lamp on a panel at the front and a socket board at the back. A cabinet version is also listed. The type number is PE4862.—*Research and Control Instruments Ltd., Instrument House, 207 King's Cross Road, London, W.C.1.*

For further information circle 36 on Service Card

EQUIPMENT review



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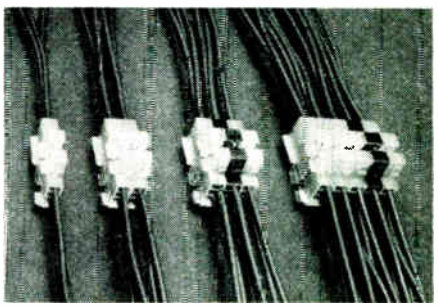

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37. Voltage Tunable Magnetrons

A new range of voltage tunable magnetrons recently introduced by Eimac, are intended for applications in microwave oscillators.

Some of the interesting features of these magnetrons are: efficiency of 50% or better, linear electronic tuning characteristic, low noise, wide tuning range with reasonably flat power characteristic, and rugged, ceramic/metal construction.

Types are now available to cover the frequency range from 200 to 3,000 Mc/s and at power levels from 20 mW to 35 watts.—*Walmore Electronics Limited, 11-15 Betterton Street, Drury Lane, London, W.C.2.*

For further information circle 37 on Service Card

38. Modular Connector

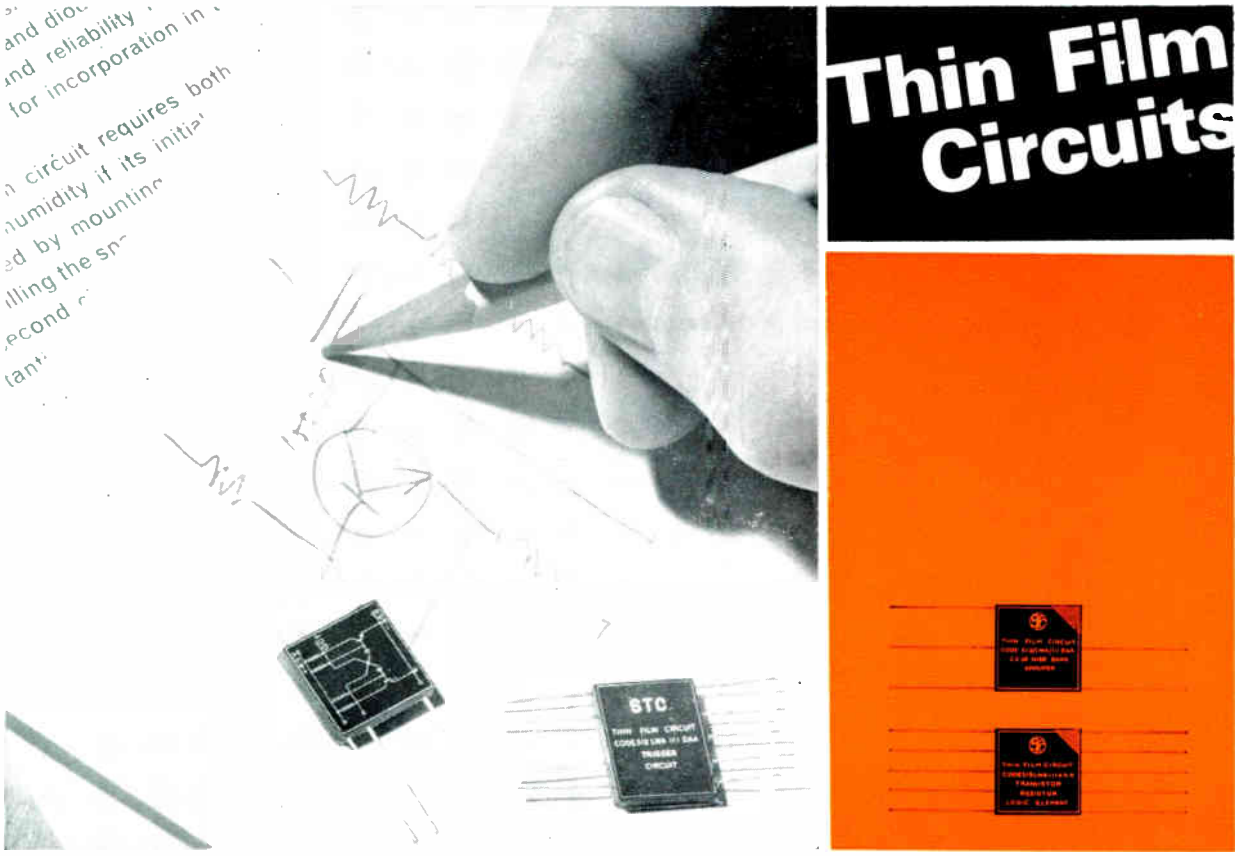
A modular connector, which can be rapidly adapted for any multi-circuit configuration, has been introduced by A-MP.

Called the 'Fastin-Faston' modular connector, it is basically a three-way connector consisting of two mouldings with tab and receptacle contacts. The contacts are crimped to wire and then hand-inserted into the mouldings. A locking lance on the contacts assures positive contact retention in the moulding.

Multiple circuit configurations are obtained by coupling the required number of connectors. Connectors snap together with finger tip pressure at two points and are held secure against shock and vibration through a tongue and groove device in the mouldings. Up to five modular connectors can be stacked up, making a fifteen-way connector with each circuit capable of carrying up to 15 A.

Completed connectors can be either panel mounted or left free-hanging. Contacts can be crimped to wire by matching A-MP auto-machine tooling at rates of up to 3,000 per hour, or by hand tools for smaller production runs Mouldings are available in ten colours for circuit identification purposes. A further advantage of this connector is that it simplifies inventory problems where a number of multi-way connectors are used, as only one size moulding need be stocked.—*Aircraft-Marine Products (Great Britain) Ltd., Amplo House, 87-89 Saffron Hill, London, E.C.1.*

For further information circle 38 on Service Card



CUSTOM-BUILT OR READY-MADE STC Thin Film Circuits are now available ready-made or manufactured to order. Custom-built circuits are being developed, produced and delivered at extremely short notice. Six ready-made circuits are immediately available; among them, Amplifiers, Logic Networks, Trigger Circuits & Multivibrators. All STC Thin Film Circuits are manufactured under Full Quality Control; subjected to STC Quality Assurance Testing. For full information write, 'phone or Telex to: Components Group, Capacitor Division, Standard Telephones & Cables Limited, Footscray, Sidcup, Kent. Telephone Footscray 3333; Telex 21836.

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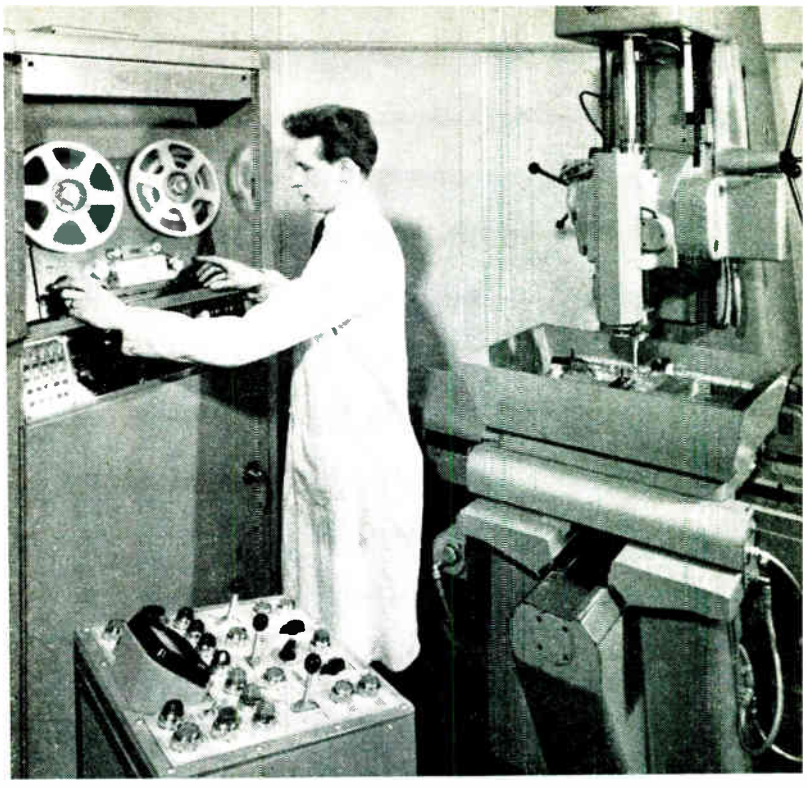
63 16MC

The use of continuous control of a jig-boring and milling machine is described in this article. As well as explaining how it functions, the article gives an example of the magnitude of cost reduction which has been achieved by its use.

CONTINUOUSLY CONTROLLED MACHINE TOOL

By J. N. MUIR, B.Sc.(Eng.)*



The jig-borer with the control console and tape deck

IN order to meet the demands for air navigation computers, the Aviation Division of S. Smith & Sons Ltd. has installed a Newall 1,520 CC jig boring and milling machine, fitted with A.E.I. continuous path control. This machine has been engaged on production work since its installation 18 months ago and during the last twelve months has been working double shifts.

The Machine

The machine, a general view of which appears in one of the photographs, is basically a standard 1,520 which has been modified for continuous-control purposes by the addition of individual servo drives for each motion. For position measurement an A.E.I. Helixyn has been fitted to each axis.

A 2-h.p. motor is fitted to the spindle and 12 speeds are available, from 60 to 3,000 r.p.m. The traverses of the machine are 15 in. × 10 in. × 5 in. vertical movement, and the continuous-control system provides for speeds up to 25 in./minute for the horizontal motions and 15 in./minute for the vertical motion. In addition a full set of manual controls is provided; these allow for milling speeds which are infinitely variable between 0·6 in./minute and 20 in./minute for the horizontal motions, and 0·25 in./minute to 8 in./minute for the vertical motion. Joysticks are provided for each motion to enable the workpiece to be manoeuvred into the correct position for machining, each joystick giving three speeds forward and reverse; i.e., inching speed, medium speed and rapid traverse.

Helixyn Measuring Bar

The design and manufacture of a precision measuring system for a machine tool may be carried out in two basic ways.

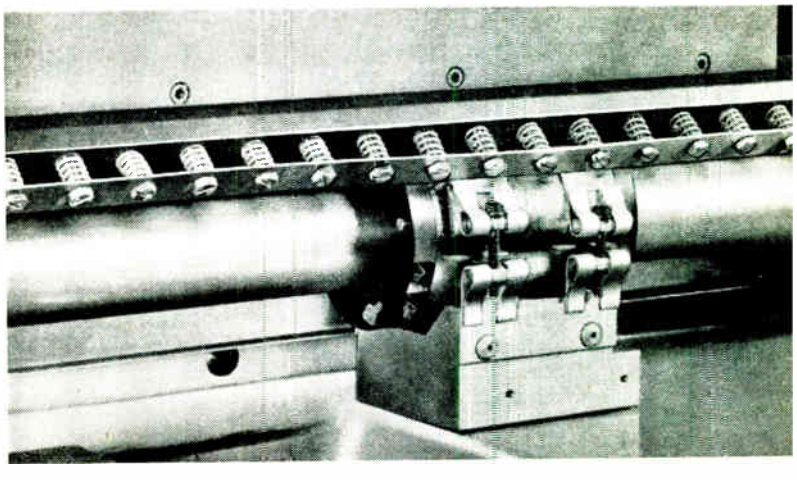
In the first method, the measuring system is made to the highest possible accuracy, reliance being placed on careful design to ensure that there is only a minimum loss of accuracy resulting from the fitting of the measuring system to the machine. The second method of making a precision machine tool measuring system is to make a system with high repeatability, but low intrinsic accuracy, and to adjust the measuring system using suitably accurate standards on the machine.

In the A.E.I. Helixyn measuring bar, the principle of which is explained later, a combination of both approaches has resulted in a robust high accuracy measuring system which is easy to install and to adjust. The Helixyn bar is held to an accuracy of 0·0005 in. per foot during manufacture and during the installation a cam correction strip is adjusted to bring the accuracy of the equipment to the desired level. In the case of this equipment the Helixyn bars have been set to achieve an accuracy of ±0·0001 in. over the working area of the machine tool, by setting them up against a reference line standard.

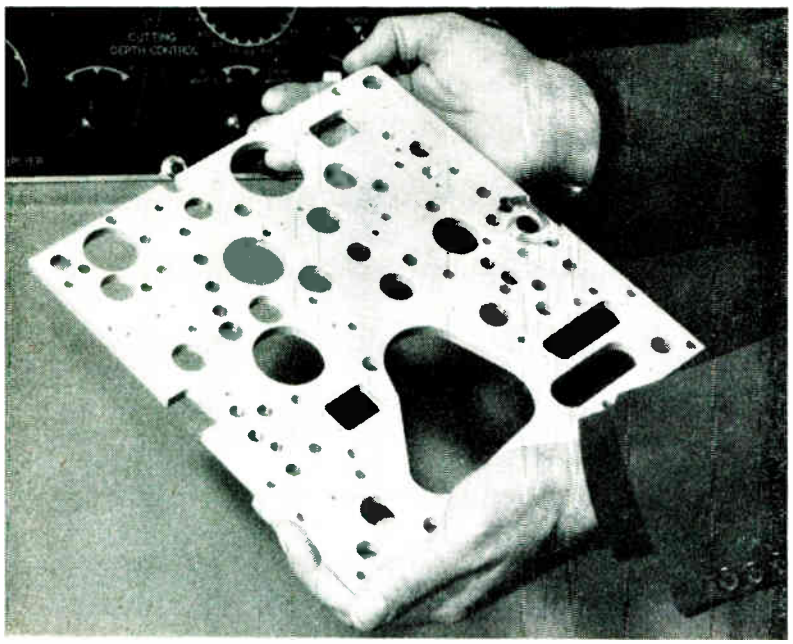
One of the photographs shows a close-up of a Helixyn mounted on the machine, together with its cam strip.

If the accuracy of the control system is to be utilized, the machine tool must be inherently capable of comparable

One of the Helixyns with its cam strip

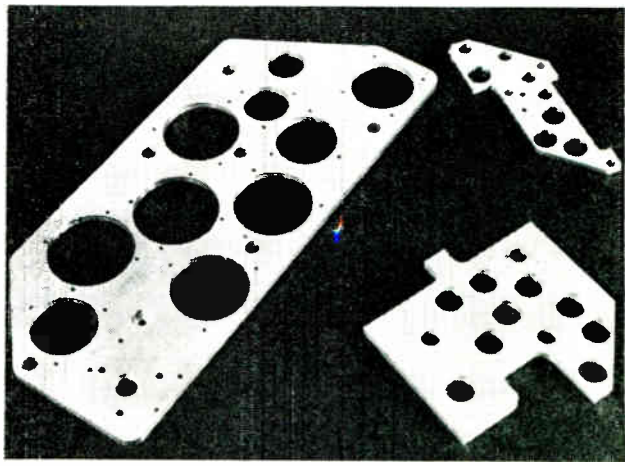


* Associated Electrical Industries Ltd., Electronic Apparatus Division.



A typical example of jig-boring work. The machine has reduced the production cost of 100 plates from £4,000 to £1,800 and the time from 3,000 hours to 800 hours

Further examples of the work of the machine



accuracy. In particular, the axes of the machine must be perpendicular (orthogonal) to one another, and the motion of each axis must be accurately constrained, to give high repeatability.

As the measuring system is finally adjusted in situ on the machine tool, some residual machine tool errors are automatically eliminated.

Machining Facilities

The control system provides for simultaneous full control of the speed and position of all three axes of the machine. The user is thus able to undertake any combination of continuous-path milling and jig boring without any restrictions on the size or shape of the workpiece, apart from those imposed by the limitations of machining itself and the size and power of the machine tool. Thus the machine is well suited to the manufacture of cams and gearbox plates, as required in this application.

The machine has been engaged full time on production work which has consisted mostly of boring and profiling aluminium gearbox frames. The boring and profiling are carried out on the same fixture, without the workpiece being removed from the machine. This ensures that there is no loss of accuracy between the bored holes and the profile.

On workpieces of this type the bored holes are of primary importance and the profiled surface is not necessarily so critical. Another type of work carried out has been the manufacture of cams, and in this case the form of the profile and its position relative to that of the spigot are equally important.

Much of the work lends itself to being machined two or three at a time; i.e., two or three plates are clamped together and machined as one, with considerable saving in production times and costs.

Relative Machining Costs

An example, typical of the jig boring type of work done, is illustrated. About 90 per cent of the 100 holes in the plate are bored, the remainder being drilled. The bored holes have a tolerance of ±0·0004 in. on centre co-ordinates and 0·0004 in. on diameter.

An estimate of the relative costs of making these plates by conventional machining and with the continuously controlled machine is as follows

Conventional Machining

Bought out cost of jig-bored plate	£40 each
Time to machine one plate	30 hours
Total cost for 100 plates	£4,000
Total time to make 100 plates	3,000 hours.

Continuous Control Machining

Manufacturing time per plate	7 hours
Manufacturing cost per plate	£16
Planning and tape service costs	£200
Total manufacturing cost for 100 plates	£1,800
Planning time	100 hours
Total manufacturing time for 100 plates	800 hours.

Thus with the continuously-controlled machine there is a saving of £2,200 and 1,200 hours of manufacturing time.

Other examples of the work carried out are shown in another photograph. The desired accuracy was the same in each case and similar savings in time and cost were achieved.

Since no special fixtures are required for these jobs the set up time is short and small batch quantities may be made, interspersed with other jobs, as required. In this way the machine is able to supply many varying components for a complete job without the user paying the penalty of breaking down the set-up, which may frequently greatly increase the total cost of each item in a conventional machining system.

The Control System

The control system has been designed on the basis of minimum planning by the user. Since the quantity of information necessary to control the machine tool is very great, this entails a very great expansion of the original information supplied by the planner. This expansion is provided by the A.E.I. tape service through the medium of a special-purpose computer.

As may be seen in the block diagram in Fig. 1, the information from the planning sheet is punched on to standard 5-hole paper tape. The information on this paper

tape is further expanded by a general-purpose computer before being fed into the special-purpose computer which produces the ¼-in. wide magnetic tape, which is returned to the user to control his machine. On this magnetic tape is written all the information necessary to control the three axes of the machine together with the necessary auxiliary information.

Auxiliary Information Channels

In addition to the position information for the three axes of the machine, the magnetic tape carries extra information for additional machining facilities and also for the control of the tape itself.

The standard facilities provide for the compulsory and optional stops in a machining programme.

A compulsory stop will bring the machine tool to a smooth halt, after which the magnetic tape will cease to run. An optional stop is similar but the operator may, if he wishes, over-ride it by means of a switch on the controller. If he chooses to over-ride it, the stop becomes a two-second pause and the tape does not stop. Once the tape has stopped, the operator may restart it by means of the appropriate push-button, the tape and machine tool motions being automatically held in synchronism.

This optional stop facility is included to allow the operator to stop and to examine the workpiece, or change a tool if desired. During a stop, planned or optional, the machine tool slides may be manually traversed to a position which allows ready access to the workpiece.

With the aid of a Datum Set meter, fitted to the operator's console, the slide may be re-positioned and machining continued with no loss of accuracy.

In addition, there are seven other auxiliary instruction channels on the tape which may be selected by the planner. These may be used to control a variety of functions related to machining, such as the supply of coolant, or may be used to assist in the planning. This latter course has been adopted in this equipment, and the functions controlled are 'Interchange axes X and Z', 'Interchange axes Y and Z', 'Lock X', 'Lock Y' and 'Lock Z'.

The lock functions, as the name implies, provide a control signal which may be used to control slideway clamps on certain machines. This particular machine, however, is not fitted with these clamps.

The axis interchange functions simplify the planning of certain workpieces.

The equipment is also provided with a Mirror Image switch, controlled by the operator. This has the effect of reversing the direction of measurement of the axis which is mirrored, thus allowing for the production of left and right-handed workpieces from the same piece of magnetic tape.

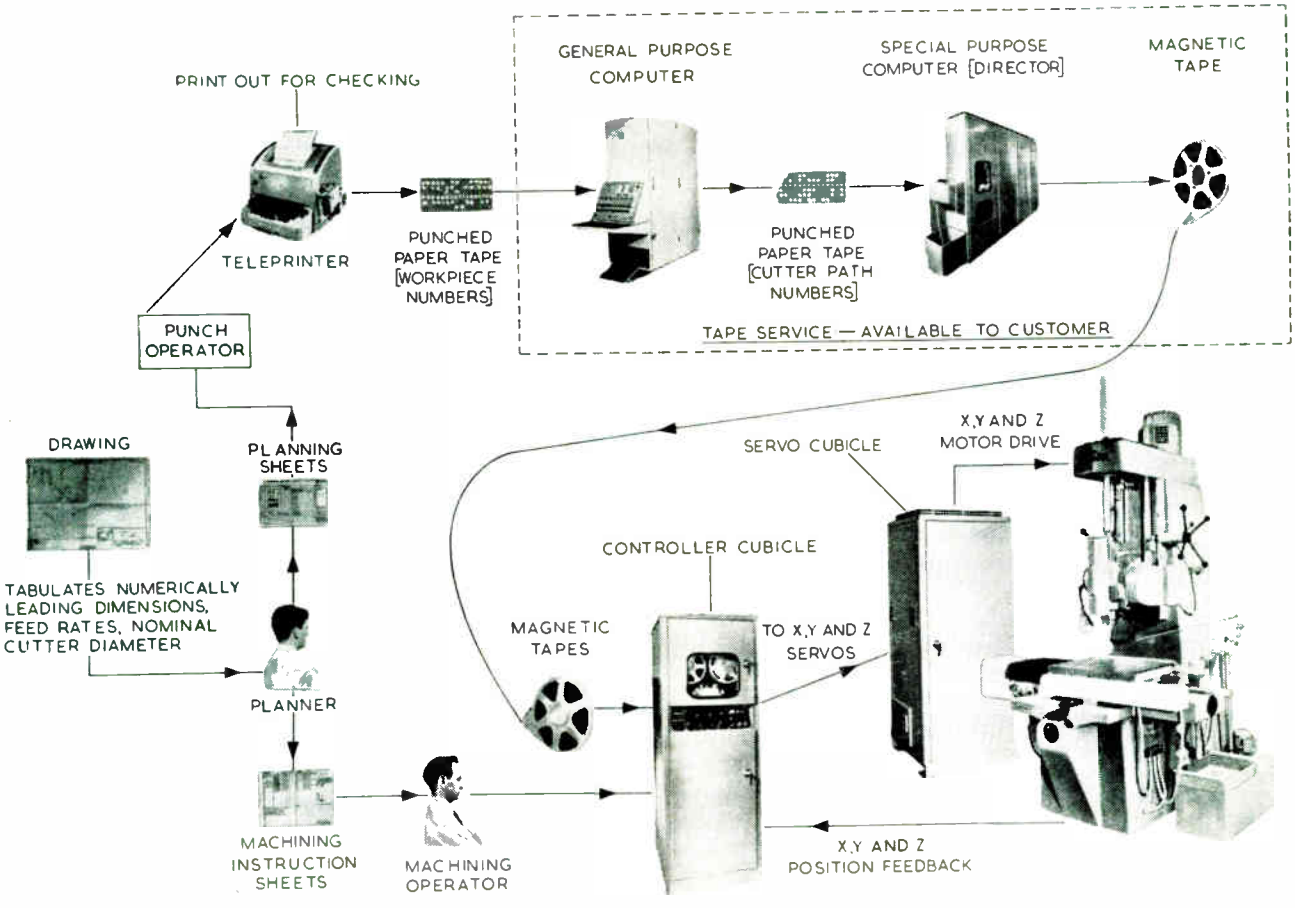
Cutter Radius Compensation

One feature of the control system which is of particular interest to the user is the cutting depth compensation.

The controls for this compensation are provided on the controller, and allow the operator to vary the effective cutter radius by an amount up to ± 0·038 in. A photograph shows a close-up view of the controls.

This compensation may be applied in a variety of ways. For example, the actual diameter of a cutter may differ from the diameter chosen by the planner, owing to the cutter having been re-ground. Or, in the case of the most accurate work, it will often be found that the effective, or cutting, diameter of the cutter will be different from its measured diameter. If the cutter is mounted eccentrically it will cut larger than its measured diameter, but if the

Fig. 1. Block diagram giving an overall picture of the system



material to be machined is hard or the cutter diameter is small, the deflection of the tool will result in the cutter appearing to be of smaller diameter than its measured value.

In either case, compensation may readily be made by the operator. This control also proves useful in doing a roughing cut, leaving on a precisely known amount of metal for the finishing cut. This has a very beneficial effect on the final accuracy.

The Planner's Role

The object of the planner is to produce two documents which between them define the way in which a given workpiece is to be machined. The first is the planning sheet, which describes the path of the cutter, and the second is the machine instruction sheet which carries the instructions to the operator relating to such things as setting up instructions, clamp positions, cutter size and type for each operation, etc. The operator will also have the usual drawing of the part to be made.

The planner has, for guidance, a Machine Data Card which contains, in standard form, information particular to the machine, relating to such things as the maximum feed rates, the maximum acceleration, etc., which depends on the desired accuracy, and the extent of slide travel.

In planning a workpiece, the movements of the tool must be divided up into a series of programme steps consisting of straight lines or arcs of circles between points specified in Cartesian co-ordinates. In writing a complete programme it is necessary to state the tool diameter, the maximum XY-plane feed rate and the maximum acceleration. Thereafter each individual programme step is accompanied by an instruction digit which specifies the type of motion required, e.g., straight line, minor arc of circle, planned stop, etc. In addition, the X and Y co-ordinates for the end of the programme step, the radius of curvature of the tool path, where applicable, and the change of Z co-ordinate and feed rate, where applicable, must also be specified.

If the information on the drawing is not in a form which readily allows the planner to divide the movements of the tool into simple programme steps, as for example, a profile specified in a few points requiring a smooth curve passing through these points, an interpolation routine is used at the A.E.I. tape centre to generate the straight lines and arcs of circles required to represent the desired curve to the accuracy specified by the planner. This block of information is inserted into the system for recording on the magnetic tape at the appropriate point in the programme.

Types of Planning

In planning the cutting of a profile, the planner uses the co-ordinates of the workpiece. The computation for the offset, required to allow for the tool radius, is automatically carried out in the preparation of the magnetic tape. The cutting-depth control is then able to compensate for all normal departures in the cutter diameter from the nominal diameter, or to allow for roughing and finishing cuts to be made by replaying the same piece of magnetic tape.

If, however, it is required to drill a series of holes, the planner writes down the programme steps to do this in terms of tool centres which he again takes from the drawing. In this tool centre form of planning, the cutting depth control is rendered inoperative thus preventing holes being drilled in the wrong place as a result of the application of cutting depth compensation.

The planning is carried out in close co-ordination with the machining, in order that the maximum benefit can be obtained from the new techniques. The result has been a very satisfactory output from the small production team involved.

Helixyn Operation

The Helixyn measuring system consists of two parts, the bar and the sleeve. The bar consists essentially of a fibreglass shell bonded to a steel core. The steel provides the dimensional stability and a coefficient of expansion which matches the machine tool. The fibreglass acts as an insulator in which three spirals of copper wire are wound in the form of a three-start thread.

The sleeve consists of the inverse of the bar, namely a steel shell with a fibreglass tube on the inside. Four spirals of copper wire are wound on the inside of the sleeve in the form of a four-start thread. The four conductors of the sleeve are connected as interleaved pairs which are fed with pulses of voltage from the secondaries of two transformers, called the sine and cosine transformers.

The ratio of the two voltages corresponds to the tangent or cotangent of an angle which represents the position along the axis of the Helixyn. The magnitude of the tangent or cotangent is restricted to 1.

What happens may at first be a little difficult to visualize. Consider two of the four sleeve windings. They are fed in push-pull from a transformer. Thus, at a time when the turns of one winding are positive those of the other are negative. Alternate wires on the sleeve are consequently positive and negative along it.

An electric field exists between the wires and at a little distance from the sleeve its distribution is sinusoidal. Positive and negative maxima occur opposite the turns of a pair of wires with nulls midway between turns.

The other pair of windings on the sleeve is identical but is fed from a separate transformer in space phase quadrature to the first pair. The two pairs of windings produce a combined field, the pattern of which can be moved along the sleeve by altering the relative amplitudes of the voltages fed to the windings.

There is a radial clearance of approximately 0·025 in. between the bar and the sleeve, and at this distance the electric field set up by the sine and cosine voltages is sinusoidal. The bar is the pick-off device which, by capacitive coupling with the windings on the sleeve, senses the position of the electric field along the sleeve.

Two of the bar conductors are connected to the primary of a misalignment transformer and the third one is earthed.

The pitch of the bar and sleeve windings is 0·1024 in. which is therefore the cycle length of the measuring system. The Helixyn sleeve is approximately 40 pitches long which has the effect of averaging out errors in the position of individual turns.

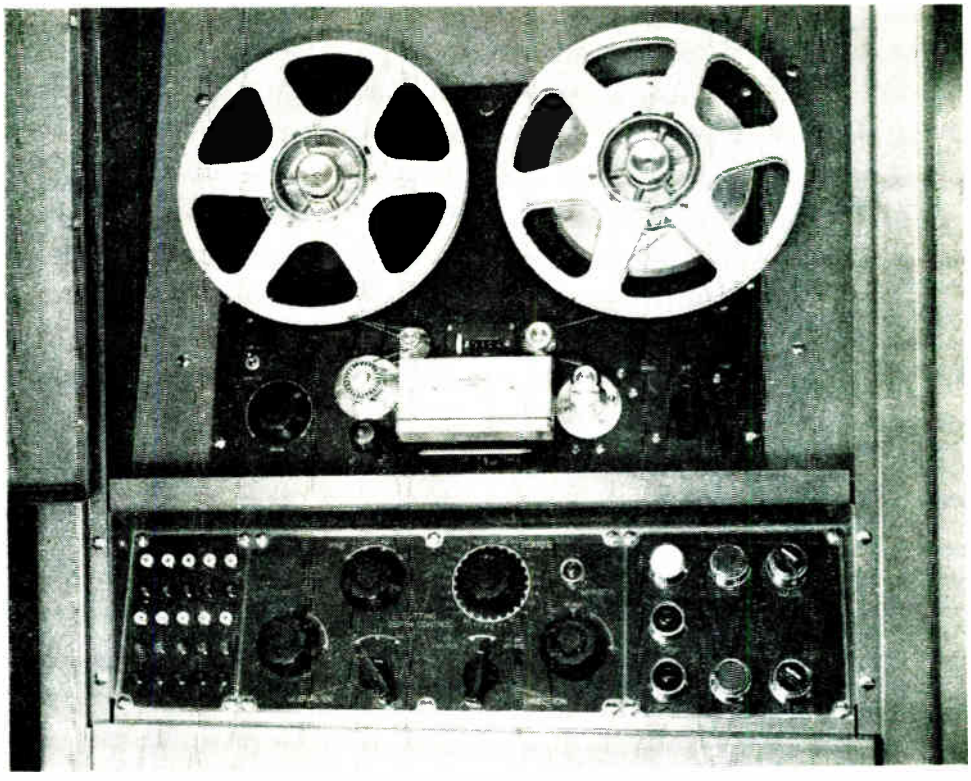
The sine and cosine voltages applied to the sleeve are produced by a digital-to-analogue translator which employs precision resistors to control the relative values of the sine and cosine voltages.

The control of the position information along the Helixyn is divided into two parts.

The position information in the Helixyn cycle is divided into 1,024 steps, spaced 0·0001 in. This division is carried out in two stages. The first stage consists of dividing the cycle into 8 equal parts, and the second of dividing each $\frac{1}{8}$ of a cycle into 128 equal parts. This latter division is carried out by seven high-speed relays controlled by the information written on the tape. These relays switch the precision resistors to control the precise ratio of the voltages applied to the sine and cosine windings. Three more high-speed relays control respectively the sign of the instantaneous sine and cosine voltages and the interchange of the sine and cosine channels.

Thus by the use of 10 relays it is possible to divide the cycle into 1,024 parts.

Since the Helixyn must be capable of reading position



Close-up of controls and tape deck

while in motion, the misalignment signal from the bar is interrogated for a short period of time only.

The Helixyns belonging to each motion of the machine tool are interrogated approximately 60 times per second, and each misalignment signal is demodulated and stored in a capacitor between successive interrogations to provide a smooth d.c. signal for the servo drive.

The Controller

The equipment divides naturally into two parts, the one dealing with the interpretation of the magnetic tape and the handling of the position information, and the other the servo drives.

The position information is written in the form of pulses on standard $\frac{1}{4}$-in. wide magnetic tape. Four tracks are used, three carrying information, the fourth one being the parity track.

The information written on the tape contains, in sequence, the auxiliary instruction information, the Z-axis position information, the X-axis tool radius compensation information, the X-axis position information, the Y-axis tool radius compensation information and the Y-axis position informa-

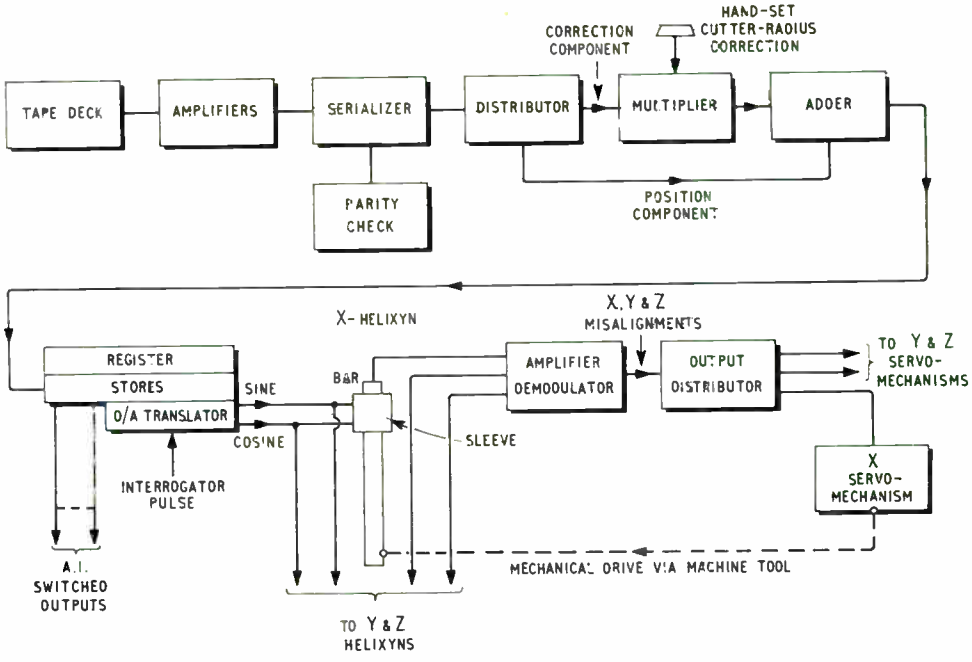


Fig. 2. Block diagram of the control system

tion. Such a complete block of information is called a 'packet', and 57 packets are recorded each second.

The controller works on the principle of time sharing: that is, the information for each axis is handled in turn, which results in a saving in the amount of apparatus necessary.

A block diagram is shown in Fig. 2. The information read in from the magnetic tape, where four heads are reading in parallel, needs to be put into serial form in order that it may be processed. The X- and Y-axes tool radius compensation information is fed to a multiplier controlled by the cutting depth controls on the control panel.

This multiplier increases the length of the compensation vectors in both the X- and Y-axes according to the amount of correction set in by the operator. The sign of the compensation vector is determined first by the shape of the curve being machined, the information on the tape including a sign vector to indicate whether the cutter is on the inside or outside of the curve; and secondly, by the operator selecting compensation away from or towards the workpiece.

The compensation vectors are added to the respective position information and passed on to the digital-to-analogue translator.

Meanwhile, the parity of the incoming tape information is continually checked. In the event of the parity being incorrect, the output from the Helixyn demodulator is inhibited, and the output to the servo-mechanism is maintained at the previous value thus preventing any disturbance to the servo-drive. If successive packets show incorrect parity the equipment is shut down.

Servo Drives

A range of servo drives is available, electric or hydraulic depending on the power required. In this particular installation the servo drives are electric, direct armature control of $\frac{1}{4}$ h.p. d.c. motors being employed. Full reversing control is obtained by controlling the width of current pulses supplied to the armature. Alternate pulses are of opposite polarity and the control circuits are so arranged that as the widths of the pulses of one polarity are increased, the widths of the pulses of the opposite polarity are reduced.

The use of d.c. amplifiers in the control circuits has been avoided in order to reduce the drift of the servo drives to a minimum. Their place has been taken by transistor chopper amplifiers. The stability of the servo drives contributes to the accuracy achieved by the equipment.

While the equipment is running under tape control the position error is continuously monitored. If this exceeds a pre-set amount, the equipment is shut down to prevent damage to the workpiece or the cutter.

In conclusion, the writer wishes to acknowledge the assistance given him by S. Smith & Sons Ltd., in the preparation of this article.

Nelas Gas Laser

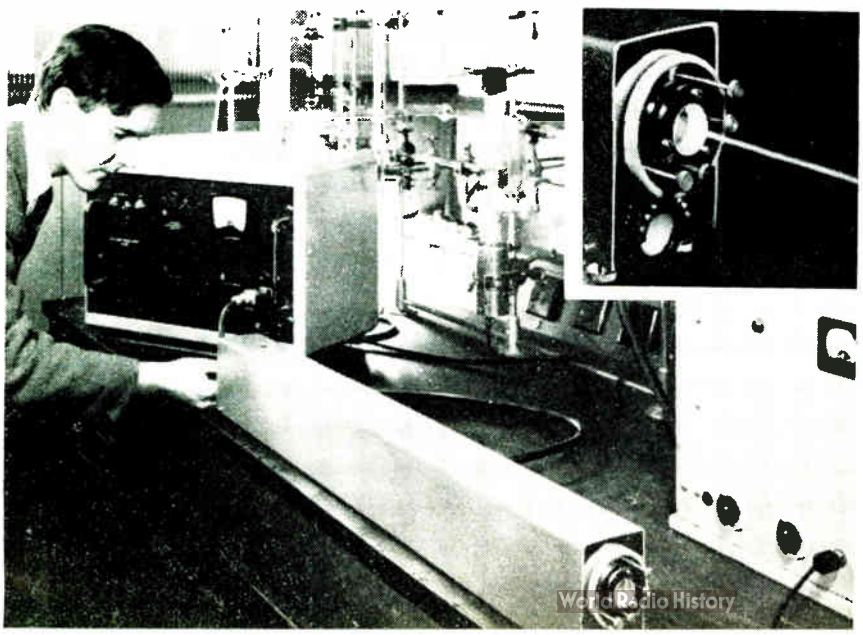
Following production of the Nelas ruby laser, International Research & Development Co. and Thermal Syndicate have now developed a mixed gas laser, known as 'Nelas gas laser model G1'. This continuous action laser is primarily intended for research and teaching purposes.

The 115-cm long tube is of transparent Vitreosil, and is fitted with high optical quality Spectrosil synthetic fused silica end windows. These windows are sealed to the main tube by a thermal adhesion technique to prevent distortion. Each window is optically polished and accurately aligned at the Brewster angle for 0·6328 μ to decrease loss by reflection and to permit a higher light gain per pass; this results in a higher power output. The tube is normally filled with a 7 : 1 helium : neon mixture at about 1 mm pressure.

The gas laser tube is mounted between confocal, spherical mirrors which can be supplied for operation at wavelengths of 0·6328, 1·1538 or 3·3900 μ. The output with the mirrors supplied is greater than 10 mW. The power supply has been specifically designed for use with lasers and the power input being adjustable from 0 to 200 W allows satisfactory operation of short prism laser tubes, the normal model G1 head, or experimental tubes up to $2\frac{1}{2}$ m long.

If required, hemispherical mirror configurations or heads for plane parallel operation can be supplied in place of the model G1 head. Tubes filled with other gases and/or special mirror coatings for other wavelengths can also be supplied. The price of the standard equipment is £525 net ex-works.

For further information circle 43 on Service Card



One of the scientists responsible for the development of the Nelas gas laser making final tests on a prototype. To the left is the power supply and in the background part of a gas filling plant. Inset: the emergent beam

SPECIAL TYPES OF VIDICON CAMERA TUBES

By A. C. DAWE,
B.Sc.(Eng.), A.C.G.I., A.M.I.E.E.*

Vidicon camera tubes are obtainable in standard, high-resolution, ultra-violet, infra-red and storage types. This article explains the characteristics of the special types and indicates some of the applications for which their use is advantageous.

High-resolution vidicon, type 9677

THE range of applications of a standard industrial television channel can be readily increased by fitting a special vidicon camera tube selected according to the type of application. One-inch vidicon tubes are available with (a) improved electron optics to give considerably increased resolution, particularly in the corners, (b) sensitivity extending into the ultra-violet, (c) sensitivity extending into the infra-red, (d) fibre-optic faceplates and (e) a long memory to record flash pictures or for scan conversion applications. Nearly all vidicon tubes have 6·3-volt heaters although recent designs require a lower heater current than normal so that a balancing resistor may be required in a camera employing a series-heater chain. Pin connections are standardized where possible although some tubes employ extra electrodes.

High-Resolution Vidicon, Type 9677

The standard vidicon has an ion trap mesh mounted parallel to the target and internally connected to the wall anode. In the past, to obtain increased resolution the wall anode (and mesh) were operated at voltages of 750 and more. However, over twice the normal scanning and focus currents are required and mesh microphony and corner shading become troublesome. In the new E.M.I. 9677 tube the ion-trap mesh is insulated from the wall anode and is connected to pin 3 on the base (this pin is normally unused except in split wall anode tubes when it is used as the part of the wall anode adjacent to the gun).

Fig. 1 shows the effect the mesh potential has on modulation equivalent to 375 television lines at the centre of the target (375 television lines is equivalent to 500 vertical lines across the picture width as the aspect ratio is 4 : 3. This represents a frequency of about 5 Mc/s on a 625-line system). When the mesh and wall anode are at the same voltage (as in a standard vidicon) there is a sudden dip in the curve of from 1 to 3 dB. This dip is caused by the accumulation of heavy positive ions in the wall anode space. With the mesh a few volts removed from the wall anode potential an electric field gradient is set up in the wall anode space and ions are extracted. The removal of the ions has another advantage in addition to the increased resolution as the tube can now be operated at high beam current without loss of focus (also gas patterns are avoided in tubes with a poor vacuum). It is normally a simple matter to operate the tube in a standard camera under these conditions by connecting the mesh (pin 3) to the limiter (pin 5), which is usually 20 volts positive to the wall anode. If the limiter is not well decoupled then it is advisable to add some decoupling to the mesh supply. With the mesh at a fixed voltage there is negligible rotation of the picture as the tube is swung in and out of electrical focus by variation of the wall anode voltage.

The top half of Fig. 2 shows an electric field plot and electron trajectory in a standard vidicon; the lower half shows a similar plot for the separate mesh tube operated with 280 volts on the wall anode and 430 volts on the mesh in E.M.I. studio scanning coils. With this ratio of voltage it will be seen that the beam passes through the ion trap mesh orthogonally so that excellent beam landing is obtained all over the target. This results in very uniform sensitivity and shading and holds for target voltages even

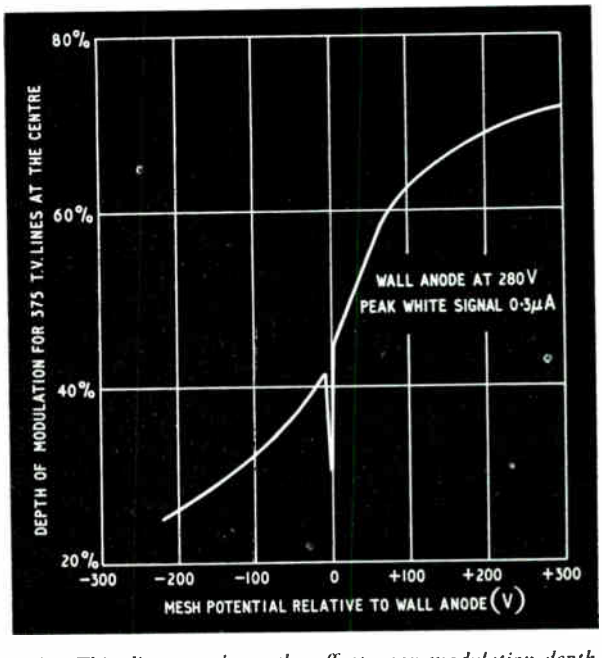


Fig. 1. This diagram shows the effect upon modulation depth of the relative mesh potential of a high-resolution vidicon

* E.M.I. Electronics Ltd.

below one volt: it also results in the best corner resolution for a given wall anode voltage. Because the beam passes through the mesh orthogonally, it does not bend away from the tube axis when decelerating in the mesh-to-target space and some scan amplitude is lost unless the scanning currents are increased by about 20 per cent. It should be noted that the ratio of voltage between mesh and wall anode to give ideal beam landing depends to some extent on the coil design but is usually in the range 1·3 to 1·5. Typical modulation curves are shown in Fig. 3. The current taken by the mesh is negligible and if the extra voltage is supplied by a small battery the life will be shelf life of the battery.

The resolution of the tube can be improved still further by increasing the wall anode and mesh voltages in the same proportion, to avoid beam landing errors. The modulation at 375 television lines with 800 volts on the mesh is over 70 per cent at the centre and 35 per cent at the corners. On refocusing the corners the modulation there rises to 55 per cent. This can be corrected by the use of dynamic focus applied to the wall anode, the separate mesh effectively shielding the signal plate. Since the complete length of the wall anode can be used for dynamic focus, a mere 12 volts of waveform is necessary. The scanning currents required with 500 volts on the wall anode and 800 volts on the mesh are 70 per cent greater than for a standard tube operating at 280 volts on the wall anode.

The vertical definition of a camera tube is very important as it cannot be improved by aperture correction. When operated at 280 volts on the wall anode (mesh at 430 volts) the 9677 can complete a black/white edge in less than 2 lines on a 625-line system. The increased horizontal resolution may be used to give either improved resolution if there is no bandwidth limitation or a better signal-to-noise ratio by a reduction of aperture correction. The ability to run at high beam currents enables the tube to handle large overload signals and makes the camera particularly simple to operate. The 9677 vidicon has a 6·3-volt 95-mA heater and is, therefore, equally suitable for transistorized cameras.

Ultra-Violet Vidicon

The separate mesh vidicon type 9677 is also available with a quartz faceplate and special target material for operation with high sensitivity in the ultra-violet regions as the 9677UV. Fig. 4 shows the special response curve and it will be seen that the response reaches 2,300 Å and is 50 per cent at 2,500 Å. The sensitivity extends through the blue and green region but falls off rapidly towards the red so that there is negligible response beyond 6,000 Å. Unlike a standard vidicon, this tube has a linear response to light (i.e., unity gamma) so that the sensitivities given in Fig. 4 hold for a range of signal currents. The lag is somewhat greater than that of a standard tube and is shortest at high signal current (0·3 μA); the lag is however short enough for most uses, including the major one of ultra-violet microscopy.

The ultra-violet microscope has two main uses, the first, to give higher magnifications by using light of shorter wavelength and second, to obtain good contrast pictures of cells without the necessity of staining. This means that living cells can be observed, which is possible because at 2,800 A proteins absorb strongly, while at 2,500 Å nucleic acid absorbs strongly. When the 9677UV is used in conjunction with a simple student microscope fitted with quartz objectives and condenser, excellent images of living cells at a total magnification of 3,000 times can be displayed on a 14-in. television screen. The intensity of illumination from a medium pressure mercury lamp and simple monochromatory is adequate even with the glycerine immersion objective of numerical aperture 1·25 and it is possible to

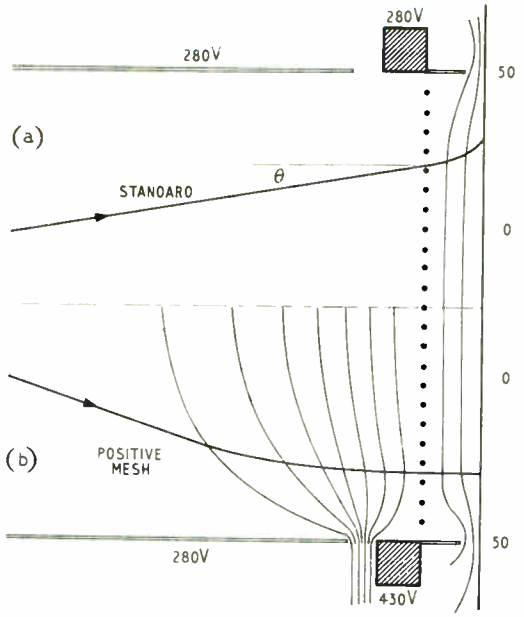


Fig. 2. Electron trajectories and electric-field plot for standard (a) and positive mesh (b) vidicons

Fig. 3. Modulation curves of the 9677 high-resolution tubes at various voltages and of the standard 10667 tube

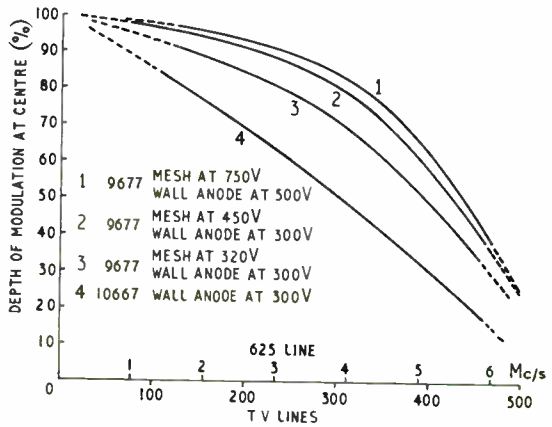
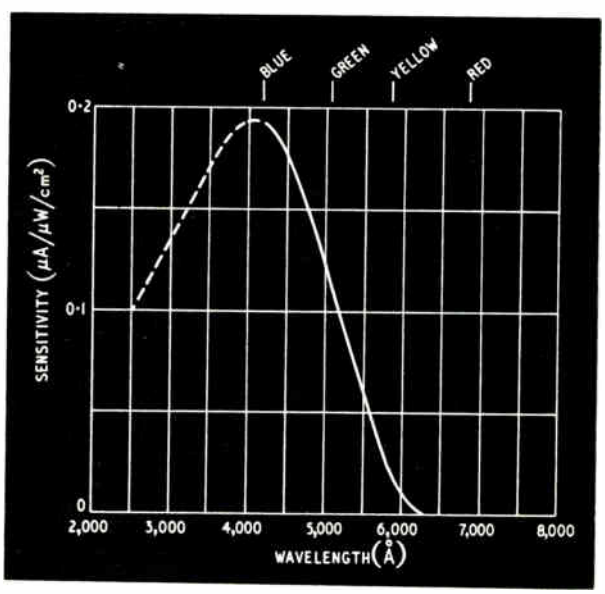


Fig. 4. Relative spectral response of the ultra-violet vidicon



obtain good quality photographs of the screen using a 35-mm camera with exposures as short as 1/25 sec. The great advantage of this system is that it enables microscopy to be carried out as easily with ultra-violet as with visible light. Focusing presents no problem and there are no special mechanical requirements.

When using the highest magnification possible in the ultra-violet the intensity of illumination required may well cause damage to living cells and therefore the exposure time must be reduced to the minimum and for this reason the very high ultra-violet sensitivity of the 9677UV is of great importance.

The 9677UV vidicon is frequently employed in other applications because it has a negligible response to red light. For example, in the inspection of red-hot ingots for surface defects the ingot is illuminated with blue light from a mercury vapour lamp. The red glare from the hot ingot makes a standard vidicon tube useless for this purpose.

Infra-Red Sensitive Vidicon

Fig. 5 shows the spectral response curve of a standard vidicon and of the infra-red sensitive vidicon type 10667IR. It will be seen that the response of a standard tube becomes negligible at about 7,700 Å while that of the infra-red vidicon has a response out to 10,000 Å (i.e., 1 micron). The longest wavelength seen by the average human eye is about 7,000 Å. As a comparison, photographic infra-red film has a long wavelength cut-off of about 8,800 Å, but special photographic plates can be made which extend out to 15,000 Å. The target of the 10667IR tube is a sensitive layer and has a typical sensitivity of 0·0011 $\mu A/\mu W/cm^2$ at 8,500 Å for a signal of 0·15 μA and a dark current of 0·05 μA. In quoting these sensitivities it is essential to state the signal current as this tube has a gamma of 0·6 similar to a standard tube in the normal region. The scanned area of the target is standard at $\frac{1}{2}$ in. × $\frac{3}{4}$ in. or approximately 1 cm^2.

This tube may be operated at normal signal currents of about 0·25 μA but it is usually required to operate at high sensitivity and typical conditions would be 0·15 μA peak signal with 0·05 μA dark current requiring a target voltage of about 25 V.

The most obvious use for this tube is the observation of subjects by infra-red illumination in the absence of visible light. This type of application is frequently required for the observation of nocturnal animals, hospital patients, photographic dark rooms, security purposes, etc. The infra-red illumination is most easily obtained from a suitable tungsten filament lamp fitted with an infra-red filter such as the Kodak Wratten 87. This filter gives good results with the 10667IR tube although it is still possible to see the outline of the filament through the filter. However, this is rarely a disadvantage and if necessary a filter with a longer wavelength cut-off may be used, although in this case a higher wattage lamp is required for comparable results. It is difficult to illuminate uniformly large areas by infra-red so that to observe nocturnal animals in their natural state the infra-red spot light technique is normally employed. However, caesium-vapour lamps are available which give a high proportion of their energy at 8,521 Å and 8,944 Å, both these wavelengths being suitable for the E.M.I. 10667IR vidicon.

It is sometimes suggested that the 10667IR tube should be used to penetrate fog. Unfortunately, the near infra-red is effectively stopped by water droplets in mist and fog, although there is some penetration by wavelengths of 6 microns and above. However, the tube is effective in penetrating heat haze for long distance viewing, in the same manner as an infra-red film. In this type of application a suitable optical filter is fitted over the camera lens. The strong infra-red reflection from chlorophyll in green vegetation often helps to enhance the contrast ratio of the scene.

The tube may be used to observe hot bodies by their infra-red radiation. A weak response is obtained in the dark from a body at 450 °C and a reasonable response at 500 °C with a very strong response at 550 °C. If temperatures of this order need to be monitored, the 10667IR tube will rapidly indicate temperature variations, for example in a catalyst bed. Infra-red tubes employing other types of target have been developed which have a long wavelength cut-off in the region of $1\frac{1}{2}$ to 2 microns. However, such tubes are very difficult to produce and rather expensive. The 10667IR vidicon has a 0·6-amp heater, although it is expected that this type of target will become available in the 9677 tube as the 9677IR.

Fibre-Optic Faceplate Vidicon

It is sometimes necessary to couple a vidicon tube very efficiently to a picture source with a 1 to 1 magnification. Typical examples would be coupling to the output phosphor of an image intensifier or to a flexible bundle of optical fibres used for endoscopy. To meet these particular requirements the 9677 type of tube is available with a fibre optic window as the E.M.I. type 9686. The scanned area of the target is standard at $\frac{1}{2}$ in. × $\frac{3}{4}$ in. and there are about 2,100 fibres per picture width. When tested with a test

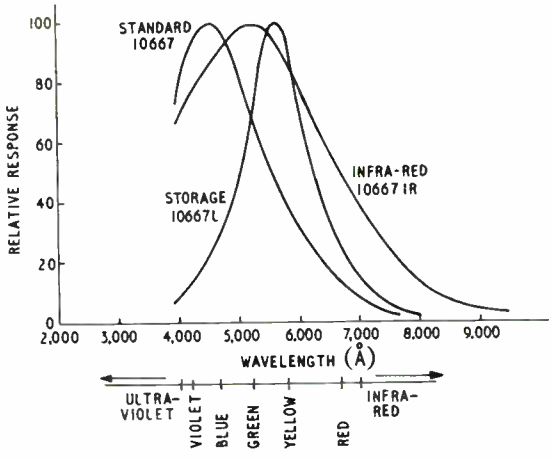


Fig. 5. Spectral responses of the standard, infra-red and storage vidicons

chart and lens focused to give an image on the front face of the window, the limiting resolution is about 1,000 lines per picture width (i.e., 750 television lines resolution). When the tube is coupled to a picture producing tube which is also fitted with a fibre optic output window, the two fibre optic windows are brought into intimate contact and adjusted slightly in position to obtain the strongest signal. Under these conditions the limiting resolution is somewhat less than 750 television lines. However, the need for focusing is removed and efficiency of light transferred from one tube to the other is over 80 per cent. The tube was described in more detail in the August 1963 issue of *Industrial Electronics*, page 576.

It has been proposed that this tube should be used in satellite astronomy for the production of hard ultra-violet images by means of a suitable phosphor deposited on the outer surface of the fibre optic window.

Storage Vidicon

Vidicon camera tubes suffer from a short term memory or lag which gives a blurred effect to fast movement. This

lag is reduced as the illumination is increased. In the E.M.I. storage vidicon 10667I the lag has been considerably lengthened so that a moving bright object against a dark background can leave a trail which is visible for from 1–3 minutes, depending upon the operating conditions. The spectral response of this special target is shown in Fig. 5. The gamma is 0·6.

The storage time of the 10667I has been achieved by lengthening the normal photoconductive lag, so that the photoconductive target takes an appreciable time to return to the insulating state after the illumination is removed, and by giving the target a high capacitance so that the capacitive discharge lag is increased. This also has the effect of increasing the build-up time for the output signal to reach full amplitude, but this does not prevent signals being fed rapidly into the tube. When the illumination is suddenly removed from the target, the signal decays rapidly at first, followed by an approximately hyperbolic decay.

The tube is frequently employed in radar p.p.i-to-television scan converters. In a simple installation the television camera is focused directly on to the fluoride cathode-ray tube of the plan-position indicator, which may also be observed by the radar operator. In more elaborate systems a separate p.p.i. cathode-ray tube is reserved for the camera so that the radar display controls can be set to give the best television pictures. Sometimes a green willemite phosphor is employed in the p.p.i. cathode-ray tube. This is often used in oscilloscope tubes, is very efficient and matches the colour response of the vidicon fairly well. Typical observed aircraft trails are 1–3 minutes in length.

The tube may also be used to display strobe flash pictures. This allows short term inspection of moving objects. The scene being viewed is illuminated by the simple electronic flash, precautions being taken to avoid light entering the camera at any other time. The detail in the half tones of the television picture fades in about 12 seconds but it is not necessary to wait until the complete image has erased before taking a second picture as the bright flash effectively erases the remains of the stored image. Pictures have been satisfactorily recorded with a flash duration of 30 μsec.

Thanks are due to the directors of Electric and Musical Industries Ltd. for permission to publish this article.

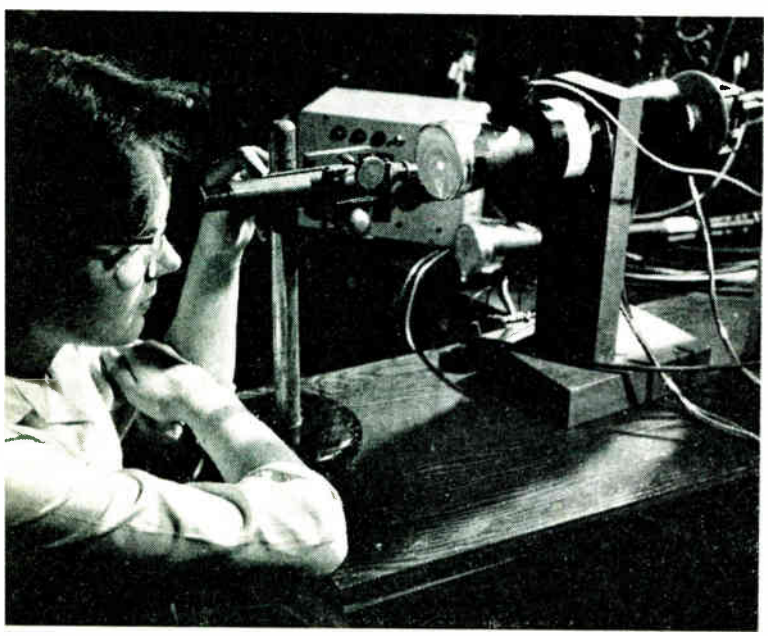
High Resolution Cathode-Ray Tubes

An increasing number of applications of cathode-ray tubes to radar, film scanning and read-out systems require the spot size to be reduced so that more detailed information can be accurately displayed on the face of the tube. Work at the Hirst Research Centre of The General Electric Co. Ltd., Wembley, Middlesex, has produced improvements in the design of the electron gun, together with advances in the deposition of small particle, fine-texture, fluorescent screens, thereby making it possible to obtain spot sizes less than 0·001-in. diameter. The spot size is sensibly independent of tube brightness and the fine-texture of the screen produces a low level of screen 'noise'. Phosphor particles of about 1 micron diameter are used.

The electron gun is a special triode gun. Focusing and deflection of the beam are achieved by the usual electromagnetic fields.

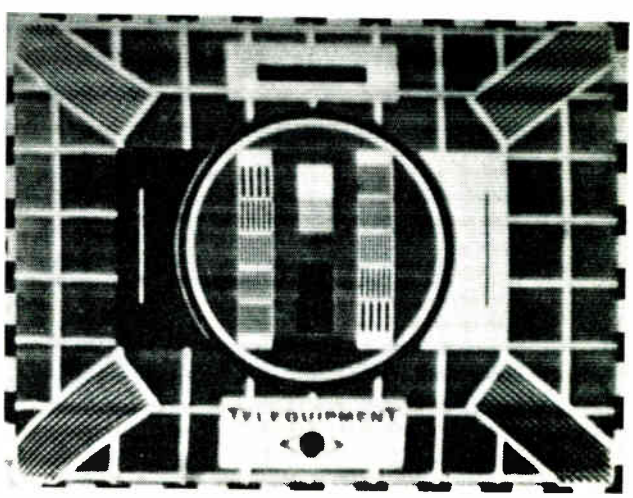
The small angle of the beam issuing from the electron gun allows the focusing field to be located at a greater distance from the gun, thus enabling the lens to operate at a small magnification ratio.

The tube performance is such that in a test card 'C' pattern, less than $\frac{1}{2}$in. wide derived from a monoscope picture generating equipment, the 3-Mc/s bars are clearly resolved.



(Left) This shows the test card 'C' pattern being examined

(Below) A photographic enlargement of a test card 'C' pattern less than $\frac{1}{2}$-in. wide. (The 3-Mc/s bars are clearly discernible on the original print, but the blockmaking process has caused deterioration)



APPLICATIONS ILLUSTRATED

Electronic Counters

1

AN electronic counter is primarily a system for comparing an unknown signal frequency or time interval with a known signal frequency.

These few words describe simply what promises to be the most widely used electronic 'tool' in industry.

From the user's point of view a counter is an instrument with various controls that requires an input of electrical impulses which are counted and displayed by the machine. This immediately suggests that such a device can only be used for the simple counting of objects as they flow past a given point. This is not true.

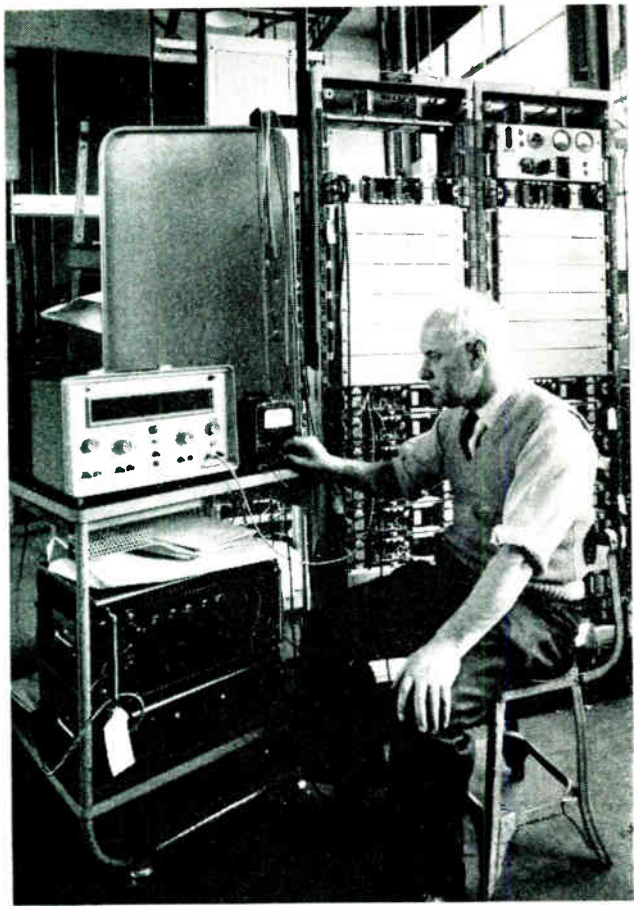
With suitable input 'converters' electronic counters can be used for measurements of all kinds including length, weight, temperature, rotational speed, viscosity, acceleration, time periods, batch quantities, etc.

When counting objects on a moving belt the input 'converter' would probably be a photocell with a light projector. These are arranged in such a manner that the objects break the light beam falling on the photocell and cause an electrical pulse to be generated and counted.

With a more elaborate input 'converter' the measurement of the length of objects could be made. For instance, for length measurement of continuous strip a white mark on one of the rollers over which the strip rolls could be used to reflect a light beam, once per revolution on to a photocell. From the resultant pulses and knowing the diameter of the roller the length can be determined. By using a counter timer the period taken for a known mass to fall through a liquid can be measured. This indicates the viscosity of the liquid.

These are but a few examples of the applications of counters. Illustrated here are other examples. The Advance TC1A timer counter is being used in the Production Test Department of Ericsson Telephones to count accurately the frequency of signals being used to test equipment.

For further information circle 44 on Service Card



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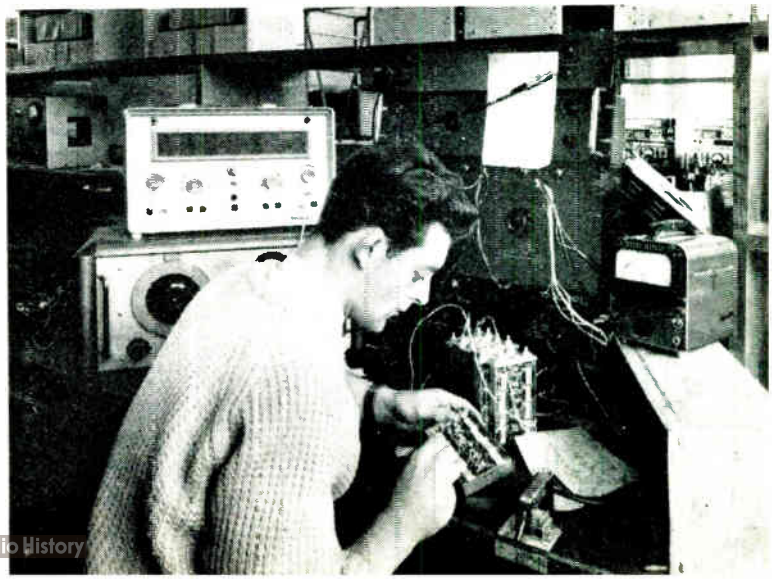


2

1. *Checking a batch of electronic filters for use in line communications with aid of a counter*

2. *Here individual filters are being tested*

3. *Testing 12-channel telegraph terminal racks which are for use in Zanzibar*

Charts are given for designing current-carrying strip conductors for producing magnetic fields of known amplitude and uniformity. For high-frequency applications, the strip impedance is introduced as an additional design parameter.

STRIP CONDUCTORS

By T. H. BEEFORTH, B.A.*

THE current-carrying strip conductor is often used as a means for producing magnetic fields. For instance, matrices of thin magnetic films, as might be used in computer stores, will be driven by strip conductors lying over the films. Although it is relatively straightforward to determine the magnetic field produced by a given strip,[1] the designer is primarily concerned with the converse problem: what strip dimensions should be used to give a certain field amplitude and uniformity?

Design of such conductors by normal analytical methods may prove tedious and for this reason charts have been prepared which enable suitable strip dimensions to be obtained simply and rapidly.

It is usually the component of magnetic field lying in a given plane parallel to the conducting strips which is of interest, and the analysis below refers only to this parallel component.

It may readily be shown that the component of magnetic field parallel to the plane of a thin strip conductor is

$$H_Q = \frac{1}{5S}\left\{\tan^{-1}\left(\frac{RS}{R^2 - S^2/4 + B^2/4}\right)\right\} \quad \text{oersteds per ampere}$$

where, as shown in Fig. 1, R and $B/2$ refer to the co-ordinates of Q, the point under consideration, and S is the strip width (all dimensions being in centimetres).

As B increases from zero, so H_Q will steadily decrease and the value of B at which H_Q has fallen to a fraction P of the maximum value H_{max} (where $B = 0$), is found by solving the equation:

$$\frac{1}{5S}\left\{\tan^{-1}\left(\frac{RS}{R^2 - S^2/4 + B^2/4}\right)\right\} = \frac{P}{5S}\left\{\tan^{-1}\left(\frac{RS}{R^2 - S^2/4}\right)\right\}$$

i.e., $$B^2 = S^2 - 4R^2 + 4RS \cot\left\{P \tan^{-1}\left(\frac{RS}{R^2 - S^2/4}\right)\right\}$$

The values of B will then define that region in which the magnetic field does not fall below a fraction P of its maximum value.

Solutions of this equation for a range of values of R, S and

* Mullard Research Laboratories.

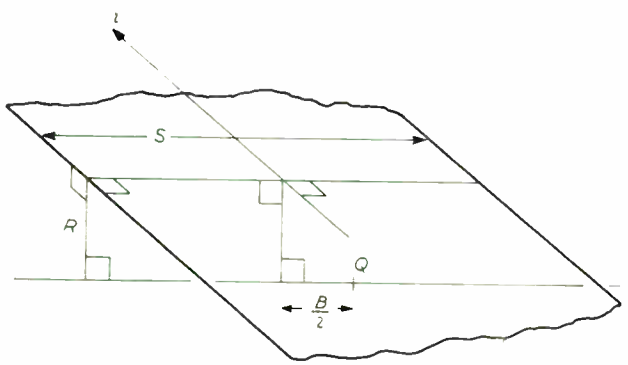


Fig. 1. Diagram of strip configuration

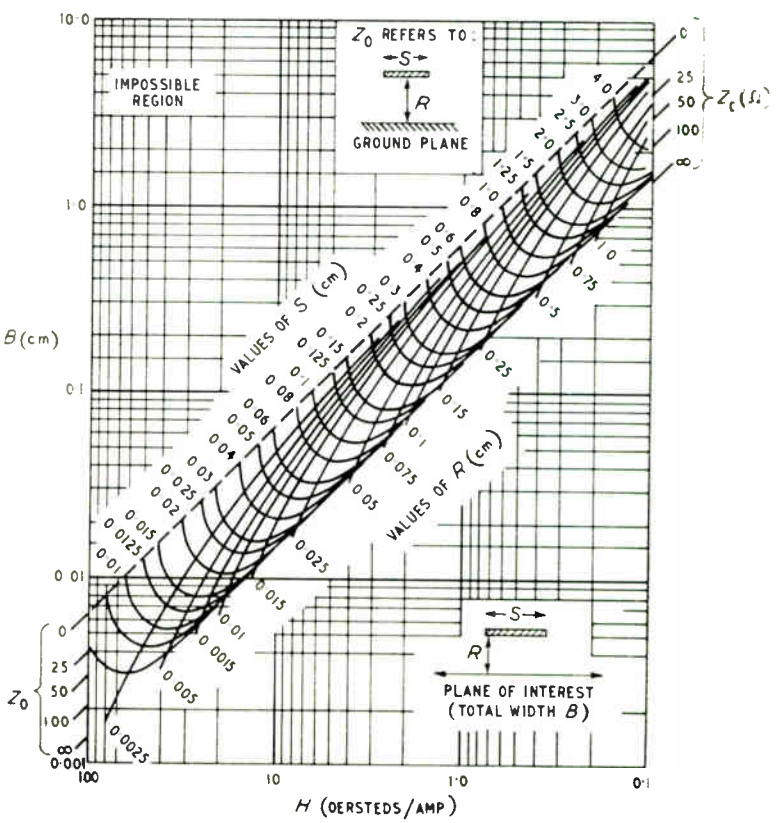


Fig. 2. Chart for design of single strip conductors for 90% field uniformity

FOR MAGNETIC FIELD GENERATION

P may conveniently be found by using a computer. The results, showing the relation between R, S, H_{max} and B, are given in Figs. 2 ($P = 0{\cdot}9$) and 3 ($P = 0{\cdot}75$).

High Frequency Considerations

If a conducting strip is used in conjunction with a ground plane at a distance R, then at high frequencies the characteristic impedance of the system is

$$Z_0 = \frac{120\pi\,(R/S)}{1 + (R/S)} \text{ ohms } (S \geqslant R)$$

Since Z_0 is a function of only one variable, R/S, straight lines may be constructed on Figs. 2 and 3 to represent strip configurations having constant impedance.

Although the charts refer primarily to the characteristic impedance of a strip and ground plane, it is nevertheless possible to find an approximate value for another common arrangement, namely, two identical strips, width S and separation R, without a ground plane. At low values of R/S the impedance on the charts will be approximately the same as that of two identical strips, but as R/S approaches unity so the impedance of a two-strip system will be about twice that found from the charts.

Use of the Charts

The charts may be used to determine the performance of a given strip conductor (i.e., known width and spacing). However, their main value is in the design of strip conductors to fulfil specific requirements.

Design of strip conductors almost invariably starts from two of the following three parameters:

(i) the maximum field rating; i.e., H_{max} in oersteds/ampere;
(ii) the characteristic impedance of the line assembly, Z_0; or
(iii) the region B, over which the field must be uniform to a known degree.

For high-frequency applications it is often B and Z_0 that take precedence. The corresponding strip dimensions and

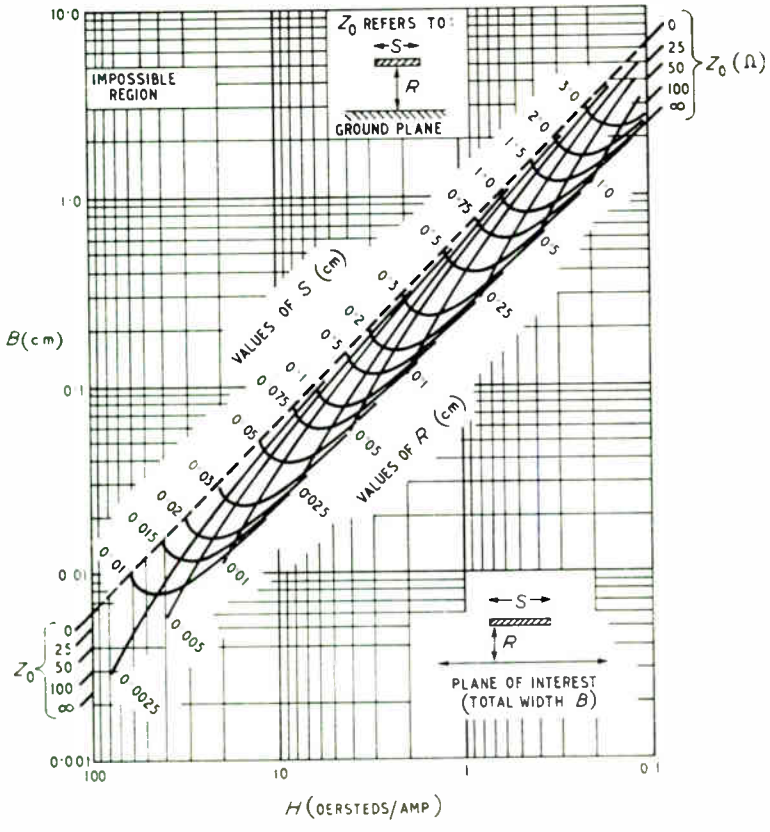
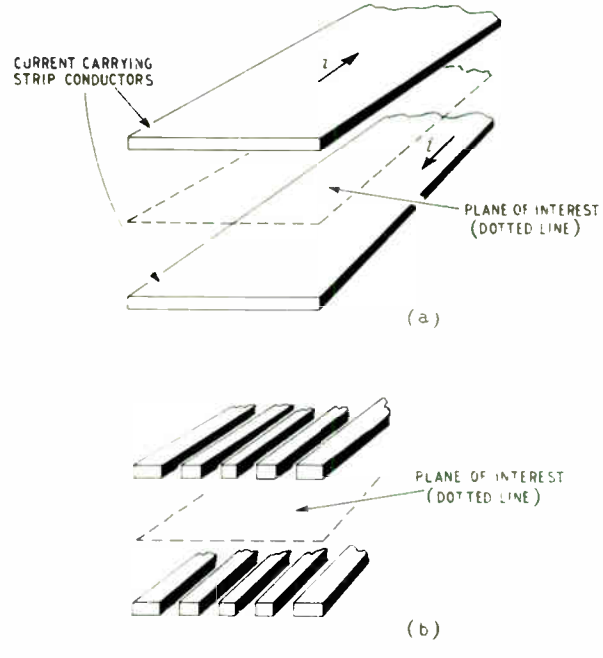


Fig. 3. Chart for design of single strip conductors for 75% field uniformity

Fig. 4. Complex systems of conductors



resultant field strength are then immediately given by Figs. 2 or 3.

However, in many other applications, including all those relating to direct currents where Z_0 becomes meaningless, it will be B and H_{max} that determine the design.

The charts then show the value of strip width S, and separation R necessary to obtain the desired field amplitude H_{max}, with either 90% uniformity (Fig. 2) or 75% uniformity (Fig. 3) over a given region B.

There are two areas on the graphs which the R and S curves do not cover. The upper region shows simultaneous values of B and H_{max} which cannot be produced by any single strip conductor; hence the description 'impossible region'. The lower section of the graph arises since with any specific value of separation R there is a non-zero lower limit to B even when the strip width S tends to zero.

When the demands for B and H_{max} fall in this lower section, it is because these are impossibly conservative and increased values of B and H_{max} cannot be avoided.

More Complex Systems

The charts refer to a single conducting strip and show the magnetic field strength in a particular direction. Hence H_{max} is a scalar quantity. This simplifies the problem of complex systems since the total field strength may be found by straightforward addition of the individual contributions.

Common systems involving more than one conductor include two conductors with the region of interest lying in between, Fig. 4(a), and also the use of slotted conductors, Fig. 4(b).

The design of 'two-conductor' systems will be a duplication of the single conductor described above. There is no a priori reason for the individual R, S and H_{max} to be the same, and design of such strips may, if necessary, be carried out separately.

Slotting of the conducting strip is usually carried out to achieve higher simultaneous values of H_{max} and B, with a given R, than would otherwise be possible. However, there is a limit to this process, and it can be shown that values of B and H_{max} lying in the 'impossible region' will always be unobtainable.

Reference

[1] N. D. Richards, M. J. W. Taylor and G. Winsor, *Industrial Electronics*, November 1962.

International Telemetering Exhibition

THE emphasis upon military and space activity which characterized the papers presented at the recent International Telemetering Conference was reflected in the associated exhibition which was held at the London Hilton Hotel. Much of the highly specialized equipment on display had no obvious industrial application. However, with so much research and development being undertaken in the field of telemetry, some commercial 'fall-out' is inevitable, and there were two exhibits of particular interest to the industrial user.

The E.M.I. U.10 24-channel sender

In keeping with the current trend to use telemetry for data-transmission links in non-military and commercial applications, E.M.I. Electronics has developed the U10 sender. The input capability of this 24-channel sender embraces any time variant voltage input within the frequency range d.c. to 8 kc/s and includes forms of pulse-code modulation. Multichannel working may be achieved by time division multiplex of the channels. The transmission takes the form of an f.m./a.m. signal in which a voltage input causes frequency modulation of a sub-carrier. This, in turn, amplitude modulates a v.h.f. carrier.

The sender consists of two units, a modulator/converter unit and a v.h.f. oscillator. The modulator accepts a voltage input varying between the limits of ± 3 V which produces a sub-carrier signal, the frequency of which varies between the limits of 130 and 160 kc/s. The linearity of the relationship between input voltage and output frequency is better than $3\frac{1}{2}$%. The input is fed to a reactance-valve circuit which controls the frequency of a tuned-grid oscillator and the output is taken through an electron-coupled stage to the v.h.f. oscillator. The input resistance is 100 kΩ.

Current consumption from a 13-V supply is about 1 A and a built-in d.c./d.c. converter provides the h.t. voltage for the v.h.f. oscillator. This latter takes the form of a single valve Colpitts oscillator with pre-set inductive feedback. The power output is 0·5 W mean over a frequency range of 430 to 460 Mc/s into an aerial load impedance of 50 Ω. Although the sender is ideally suited to applications such as meteorological rockets where simplicity and low cost are of importance, it obviously has terrestrial uses, e.g.,

The Marconi tabular display in a desk-mounting unit, showing a format envisaged for power station data presentation

the remote monitoring of inaccessible or dangerous industrial processes.

One of the major problems with modern high-speed data processing and computing installations, particularly those having to operate in real time, is the difficulty of integrating the human operator into the system. In the simpler systems, display lamps of various forms have been used but these have a very limited application. In most cases it has been necessary to provide some form of electric typewriter or printer. These latter do, of course, provide a permanent record but this frequently becomes an embarrassment when information is only required momentarily, or when some parameters need monitoring continuously. Large quantities of paper will be produced and almost all of it discarded very quickly.

The Marconi tabular display system has been designed to overcome these problems by replacing electromechanical printers with alpha-numeric characters and symbols written at high speed on a cathode-ray tube. These symbols can be arranged into any convenient format and can be changed almost instantaneously under the control of a computer or, more simply, from paper tape or keyboard control. A continuous dynamic display is therefore available to the operator to enable him to assess the state of the controlled system and to make decisions where necessary with no delay for printing or code interpretation. Push buttons can be used to select completely new formats as rapidly as required, and, if a computer is used, the number of formats is limited only by the available storage. Essential instructions and alarms can be displayed on a separate c.r. tube.

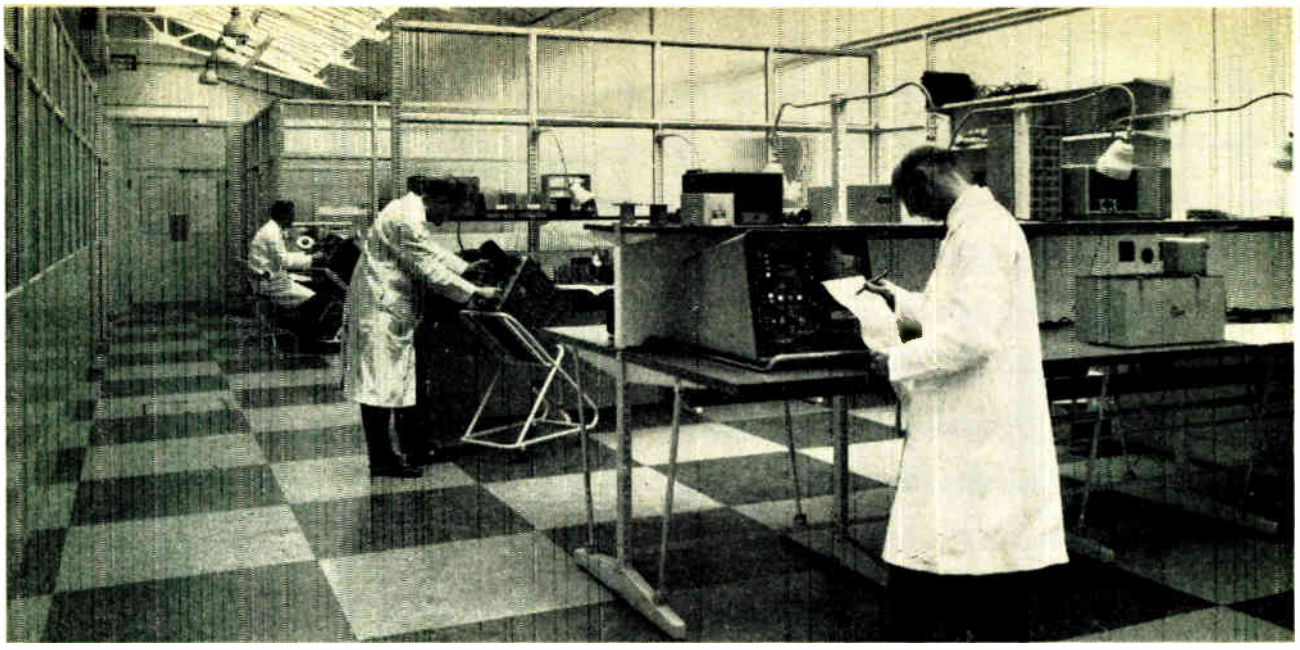
The symbols are written on the screen by deflecting the electron beam to the position where the character is required, and then applying an additional, fast, low-amplitude deflection to trace out the actual symbol. The positioning of the beam and the generation of the symbols are controlled by digital information held in a ferrite-core store. Six-bit words are read from the store at 20-μsec intervals and decoded for symbol generation and display format control.

When a word indicating a line number is detected, the beam is deflected to the beginning of the required line and a cancellation deflection system is started which produces a horizontal line of dots across the screen, spaced in time by 20 μsec; these dots are the centre points of the symbols and are normally blanked off. Meanwhile, words read from the store are decoded and fed to the symbol waveform generator which produces X and Y deflection waveforms to deflect the beam from each dot to form a symbol. These waveforms are produced in eighteen 1-μsec elements, each of which generates a short straight line which may be at any of sixteen angles. These line segments are arranged to form a large variety of symbols and the standard equipment provides a total of 50, which may be written in three sizes.

The deflection waveforms can be routed to as many as twelve display tubes simultaneously, and bright-up control information, read from the store at the beginning of each line, initiates bright-up only on those tubes where the specific line is required. The store holds 4,096 words, and, allowing for instruction words, it is possible to operate twelve displays each having a different format averaging about 330 symbols, or a smaller number of displays with more symbols on each.

The basic cycle time of the store is 5 μsec for one read/write operation. Since symbols are displayed at 20-μsec intervals, a period is available between display readouts which is used to read in new information. This information may be either a 20-bit word with 6 bits defining a symbol, 12 bits specifying the store location into which the symbol should be written and 2 bits for control functions (when associated with a computer); or just a 6-bit word defining a symbol. In this latter case, the word is written into a store address defined by a cycling address counter, which is clocked on as each new 6-bit word is read in. Using the random access facility, it is therefore possible to modify individual symbols held in arbitrary store locations or to write sequentially into any area of the store.

When information is being transferred from a computer, words can be accepted with or without addresses at 20-μsec intervals or at any slower rate that the computer can provide. Thus characters can be read out at the rate of 50,000 per sec and a complete display can be changed in about 80 msec.



Part of the new research and development laboratories of Savage & Parsons Ltd., Watford, Herts, which will be available on a contract basis to other firms as well as Government contract and Savage & Parsons' own development work in the fields of precision electro-mechanical and instrument research. The laboratories, which include electronic test bays (right), drawing office, machine room, clean room, and offices separated by a new partitioning system, are self-contained for security sealing

For further information circle 46 on Service Card

Space Power from the Sun

The world's first orbiting solar reflector is expected to be launched into space towards the end of this year. This shot, the first of a series by the United States Air Force, is part of a programme to concentrate heat from the sun to generate electricity in satellites.

The outstanding advantage of this solar reflector development is that a single energy converter—a liquid metal cell or closed cycle engine—replaces the multitude of expensive solar cells which at present encumber almost every object launched into space.

Key to the success of the project is a four-foot diameter Fresnel mirror fabricated by the Allison Division of General Motors. Looking more like an outsize gramophone record than the conventional deeply-curved search-light or shaving-mirror shape that is normally used to concentrate light or heat, the almost-flat Fresnel reflector comprises a series of precisely-located concentric rings. Made in this fashion, it can be folded into a compact package for launching into space.

The mirror must be highly polished and extremely accurate in form, but weight limitations restrict its thickness to 0·005 in. Perhaps logically, therefore, it is made by exactly the same process as the accurate 'stampers' from which gramophone records are mass-produced. A polished and precise 'master' is first prepared and specially treated to make it conductive but non-adherent to other metals. A layer of strong, corrosion-resistant nickel is then plated on to the surface and built up to the required thickness. The electroformed layer is finally pulled off the mandrel as a perfect replica.

Polycarbonate Capacitors

A metallized-polycarbonate, stripped lacquer film capacitor, developed by engineers at Bell Telephone Laboratories, has low-loss characteristics approaching those of present polystyrene or mica capacitors, is many times smaller, and can be operated over a wide temperature range. The polycarbonate resin, a polymerized carbonic acid ester of a bisphenol, is applied in a chloroform solution to a support of polyethylene terephthalate, and dried by passing it near a set of infra-red lamps. A thin aluminium film coating is deposited on the resin by vacuum metallizing, the material slit to the desired width, and the 0·12 mil metallized polycarbonate lacquer film stripped from the backing. To support the fragile film during winding, the supply rolls are kept in contact with the mandrel. The terminals are then 'sprayed' to the ends and leads are attached. Finally, the capacitor is hermetically sealed in a metal container ($\frac{5}{16}$ in. diameter by $1\frac{1}{8}$ in. long for a 1 μF capacitor), electrically 'cleared' of internal short circuits and tested.

These 50-V, low-loss capacitors are suitable for use with transistors and where small size and high capacitance-to-volume ratio are essential. They can be operated over a temperature range from −78 °C to 125 °C. They have a low temperature coefficient of capacitance ($\pm$50 p.p.m./°C), and are self-healing, i.e., they have the ability to isolate faults in the lacquer film or areas damaged by excess voltage. Since the capacitors retain only a small residual charge (0·005% to 0·009%), they are suitable for use in analogue computers.

27-oz TV Camera

Westinghouse have developed what is believed to be the lightest and smallest television camera ever built. Using a one-inch electrostatic vidicon tube, the unit is about as long as a two-cell torch: without the lens, the 27-oz camera is $7\frac{1}{2}$ in. long, 2 in. wide and $3\frac{1}{4}$ in. deep; it requires 50 cu in. of space and a power supply of 4 W. Tighter packaging may reduce the size still more, perhaps as much as 50%. There are 197 components in the camera, including 36 molecular electronic blocks which perform such functions as amplification, sync generation and scanning.

Built as an experimental model of an advanced unit for use in space or military systems, the camera is not designed for commercial applications. For demonstration purposes it has a built-in transmitter capable of sending a picture 150 ft to a nearby receiver, whereas in practice it would be connected to telemetry equipment aboard a spacecraft through coaxial cables. A slow-scanning capability can be incorporated to reduce telemetry bandwidth requirements; this can be achieved without any increase in power consumption.

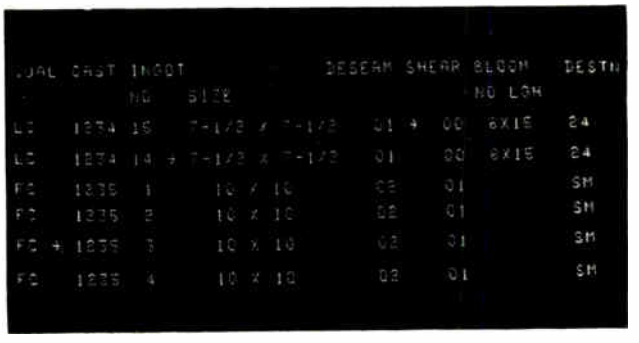
The picture produced by the Westinghouse camera compares favourably with a high quality home television picture. The camera includes a 'binary countdown synchronizing generator' to produce standard interlaced scanning of 525 lines at 30 frames per second and a circuit to give dynamic picture focus.

Correspondence

Output Devices for Industrial Computer Systems

Sir,—I have just read with interest the article in your July issue by J. F. Roth. He summarizes the section on Visual Display in these words:—

'One aspect of a visual display system which is evident from this example (referring to an illuminated number display in a steel mill) is its inflexibility. The display is normally designed for a particular use and if this changes or if a different information content is required the modifications could well be extensive.'



I would like to dispute these points as the Marconi Tabular Display System is anything but inflexible.

Information is presented on a cathode-ray tube in alphanumeric form, which is easily and quickly assimilated by an operator. Any character from a total selection of 50 may be presented at any position on the tube face. The rate of writing is 50,000 characters/second. A single back-up cabinet will feed 12 displays each showing a different format, any of which may be altered in whole, or in part, down to the limit of one character, without interference to the rest. The display may have an 8½, 14 or 21-in. screen or a three-colour projected picture 6 ft square may be used. Data may be fed into the system directly from a computer, from magnetic or paper tape or from a manual keyboard, making this an ideal system for integration with a control complex in which a computer will be fitted at a later date.

I enclose a photograph taken directly from the screen of an 8½-in. display. It shows the extreme clarity of the symbols and the format for use in a steel mill to give information to operators on the mill floor.

A control system using an English Electric KDN.2 computer and the Marconi Tabular Display system is at present being installed in the Park Gate Iron and Steel Works.

ALAN HARTLEY-SMITH.

Data Handling Projects Group,
Radar Division,
The Marconi Co. Ltd.,
Chelmsford.

The author replies:—

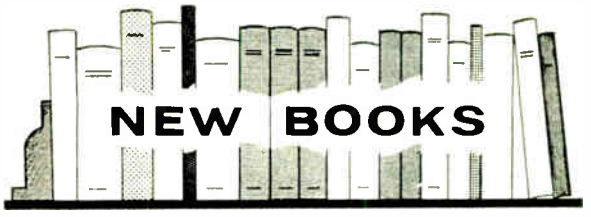
Sir,—I am not quite certain of the object of Mr. Alan Hartley-Smith's letter. In the article in question c.r.t. display systems were not considered and therefore there is no cause for Mr. Smith to dispute a point I did not make. The extract he quotes, which in fact never purported to be a summary, must be considered in relation to its context and not in isolation.

However, if he intended to point out that there is another form of display system which I did not mention, then I would be pleased to agree with him. But then he seems far more intent on proclaiming the characteristics of one manufacturer's system giving a thumbnail specification covering, understandably, its attractive features. However, there is always the other side of the picture which with c.r.t. display systems includes such mundane aspects as the cost, running into tens of thousands of pounds and, not least, the problems of organizing and presenting the data for display which Mr. Smith rather glosses over. This latter problem is most acute where the display has to be updated in part or the information moved to another section of the screen. For example a common use of a c.r.t. display is to show a list of activities. When one has been completed the information is deleted, the remaining information is shifted up, and the next activity added at the bottom. To achieve this sequence it is necessary to have immediately available all the data on the display so that its disposition can be altered within the very short time period that can be allowed. A digital computer can perform the required functions, but this is adding a large amount of additional hardware. However, the full capacity of the computer would not in general be exclusively required for this purpose, but a large proportion of its immediate access store must be reserved for display data storage.

Although the correspondence columns of this journal are hardly the place to conduct a *Which?* survey on the best buy, seeing that Mr. Smith has extolled the virtues of one system, I feel that I may be forgiven for mentioning that amongst the other manufacturers of c.r.t. display systems is the Airspace Control Division of Elliott Bros. who utilize these systems extensively for Air Traffic Control applications. One of the salient features of this display system is that the storage problems discussed above have been provided for by integrating the computer with the display control unit and using a screen which although having a long after-glow can be very rapidly cleared when the data is to be changed.

J. F. ROTH.

Elliott Bros. (London) Ltd.,
Borehamwood, Herts.



Electronic Devices and Networks

Edited by E. E. ZEPLER, Ph.D., M.Brit.I.R.E., and S. W. PUNNETT, B.Sc. Pp. 217 + vi. Blackie & Son Ltd., 5 Fitzhardinge Street, Portman Square, London, W.1. Price 35s.

The chapters of this book are:—electron theory, network theory, vacuum valves, gas-filled valves, transistor characteristics, transistor circuits, noise and the complete measuring system. Put baldly in this way the subjects chosen for successive chapters look a little odd. However, the content of the chapters is by no means always what one expects.

Thus 'network theory' starts with Ohm's law and discusses resistance, inductance and capacitance. Impedance concepts follow, circuit theorems, transients, and a.c. steady-state response. Transformers are covered as well as coupled tuned circuits, and the chapter ends with transmission lines and wave propagation. This is both more elementary at the start and more advanced at the end than most people would expect to find under the heading 'network theory'.

In some of the other chapters, too, the scope is wider than their titles indicate and the contents page would have given a clearer indication of the ground covered if the book had been broken up with a much greater number of chapters, but leaving the actual content just the same. This is, perhaps, a minor point for the user of the book will soon learn his way about it. It may, however, discourage some potential users from referring to it.

The treatment is generally good, although some readers will find it abbreviated. In spite of the elementary parts, the book is hardly one for the beginner. Quite a bit of prior knowledge is desirable if understanding is to be reasonably easy.

Basic Junction Devices and Circuits

By ROY H. MATTSON. Pp. 460 + xii. John Wiley & Sons Ltd., Glen House, Stag Place, London, S.W.1. Price 72s.

The 13 chapters of this book cover more or less the usual ground of a transistor book. The first three cover the necessary basic physics, semiconductor materials and junction devices. There is then a chapter with the misleading title of Circuit Review. It is misleading because it does not deal at all with specific circuits but rather with methods of circuit analysis and especially with circuits containing active devices.

The next chapter, on the transistor, is a long one for it deals not only with transistor characteristics but biasing problems and the effect of temperature. Small-signal equivalent circuits are then covered and the choice of operating point is dealt with. A chapter on the transistor as a switch follows. Apart from a final chapter on switching applications and junction devices and their applications, the rest of the book deals with amplifier design including, of course, feedback amplifiers.

Among the appendixes is one giving the rules of matrix algebra, which makes it appear that matrices are frequently used in the book. In fact, however, one has to search hard to find any example of their use. Mathematics are freely used but they rarely amount to more than the ordinary algebra of circuit analysis.

Hall-Effect Instrumentation

By BARRON KEMP. Pp. 128. Howard W. Sams & Co., Inc., Indianapolis 6, Indiana, U.S.A. Price $4.95.

This is an elementary and non-mathematical book which enumerates the properties of Hall-effect elements and explains a great many of their applications.

Microwave Systems Fundamentals

By F. JONATHAN MIVEC. Pp. 288. Howard W. Sams & Co. Inc., Indianapolis 6, Indiana, U.S.A. Price $5.95.

A Laboratory Manual for Principles of Electricity and Electronics

By E. C. HALLIDAY, B.Sc.(Eng.), and B. P. MORRIS, B.Sc., A.M.Brit.I.R.E. Pp. 100 + xi. The English Universities Press Ltd., 102 Newgate Street, London, E.C.1. Price 9s. 6d.

The book gives 35 elementary experiments mainly with electricity, but includes a few dealing with electronics. There is a brief description of the principles involved and of procedure.

Manufacturers' Literature

Long-Range Proximity Detectors. This 6-page publication, RCD141, describes a range of electronic proximity detectors and their control units. These have been designed as compact and reliable devices which overcome some of the disadvantages of conventional detection systems such as microswitches or h.f. balanced-bridge detectors.
G.E.C. (Engineering) Ltd., Electrical Engineering Works, Witton, Birmingham, 6.

For further information circle 47 on Service Card

Transistorized Microlimit Wire Gauge. A device which provides simplified, out-of-contact dimensional measurement of products manufactured in continuous form is described in this 4-page leaflet. Insulated wire or extruded shapes from 0·001 in. to 0·75 in. diameter are handled by this gauge.
Daystrom Ltd., Bristol Road, Gloucester.

For further information circle 48 on Service Card

Scientific Instruments: Oscilloscopes and Cameras. This short form catalogue, No. 129, lists the current range of oscilloscopes, scope cameras, pulse generators and probes which are produced by Du Mont Laboratories. Distributed in the U.K. by
Aveley Electric Ltd., South Ockendon, Essex.

For further information circle 49 on Service Card

Cold Cathode Trigger Tubes. In this 36-page booklet details are given on the characteristics, operation and application of Ericsson tubes.
Ericsson Telephones Ltd., Tube Division, Beeston, Nottingham.

For further information circle 50 on Service Card

Smoke Density Integrator. A 4-page leaflet which briefly describes the Torry Brown system for the measurement and control of smoke density.
A. G. Brown & Co., Lower Mills, Busby, Clarkston, Glasgow.

For further information circle 51 on Service Card

Evershed Remote Weighing Indicator. A series of servo-driven indicators, type RAM, is described in this 4-page publication No. SS61.
Evershed and Vignoles Ltd., Devonshire Works, Dukes Avenue, London, W.4.

For further information circle 52 on Service Card

Telcon Thermostatic Bimetals. Provided in this 18-page brochure (publication TM1/863) are fundamental design data, property tables and useful information on the fabrication of Telcon bimetals.
Telcon Metals Ltd., P.O. Box No. 12, Manor Royal, Crawley, Sussex.

For further information circle 53 on Service Card

'Teflon' Products for the Electronic Industry. Published by Habia of Sweden, this lists the 'Teflon' products of Hammarby Bakelit Industri AB. They include insulated wires and cables, tubing and impregnated glass cloth and laminates. Distributed in the U.K. by
John Tullis & Son Ltd., Tullibody, Alloa, Scotland.

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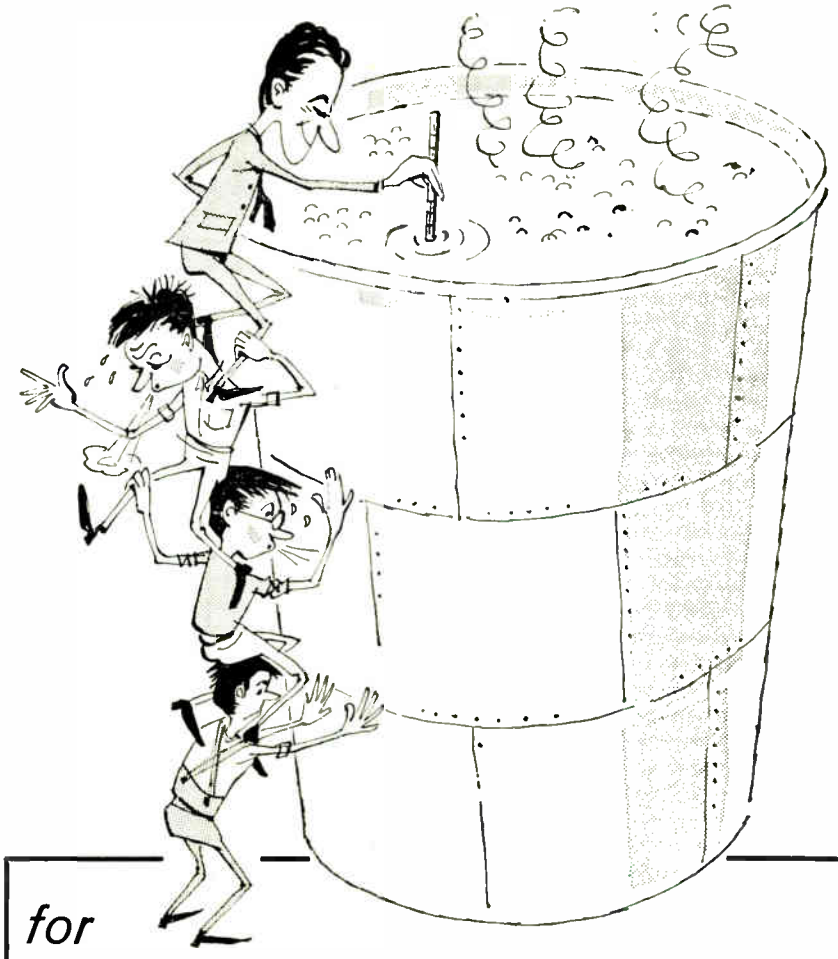

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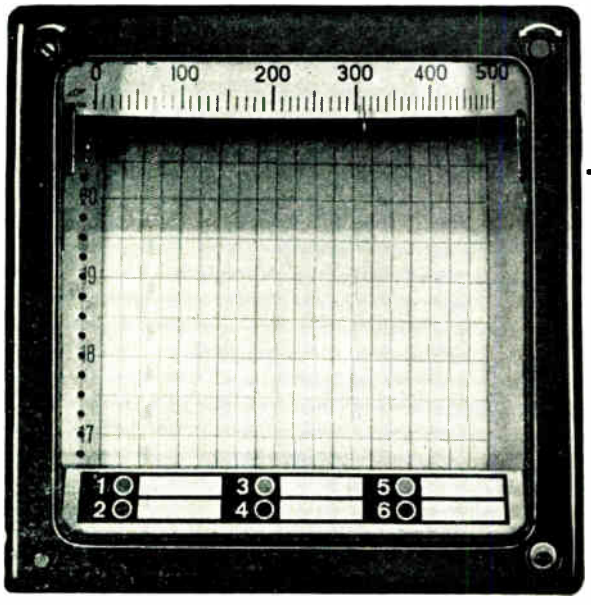

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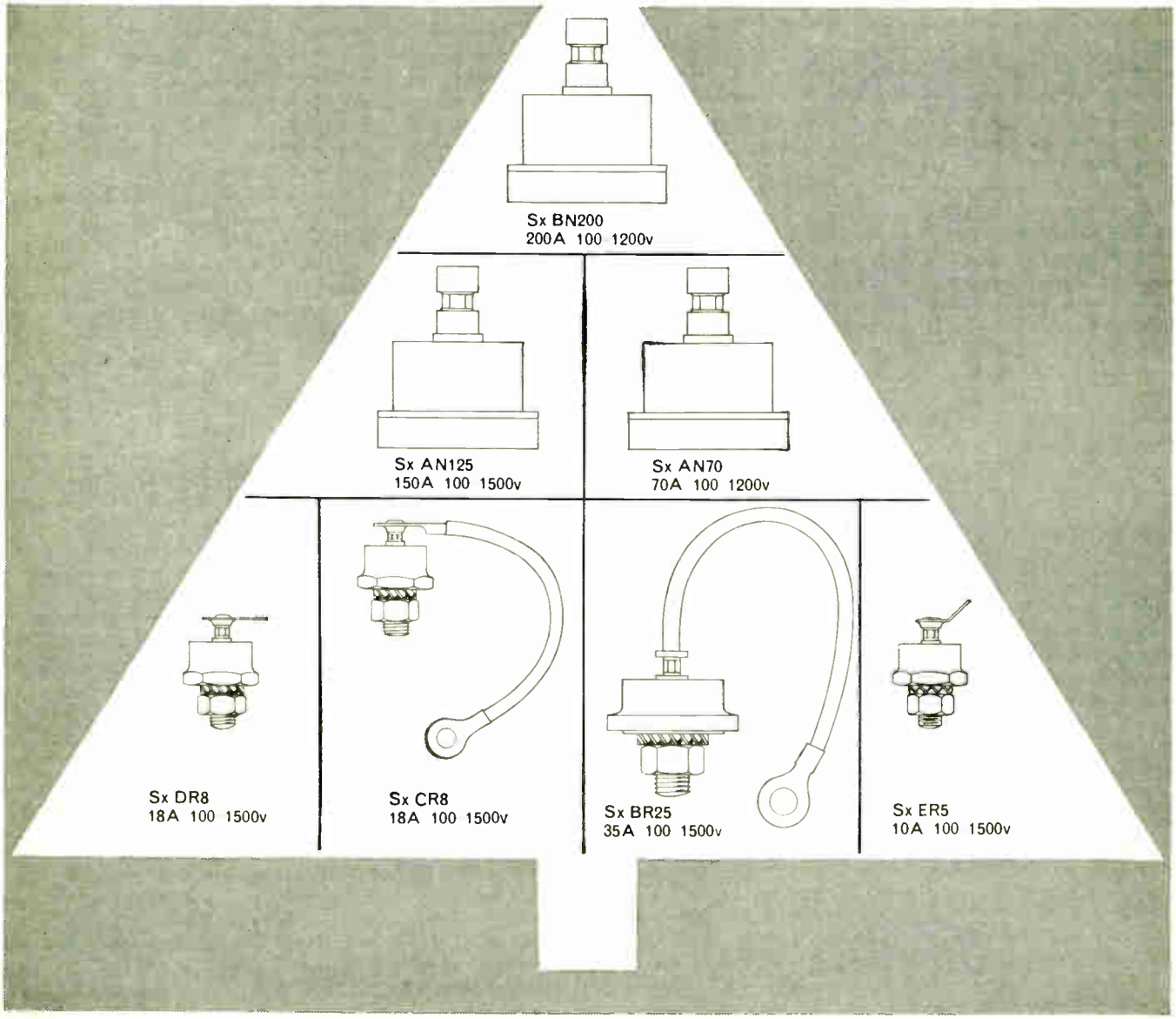

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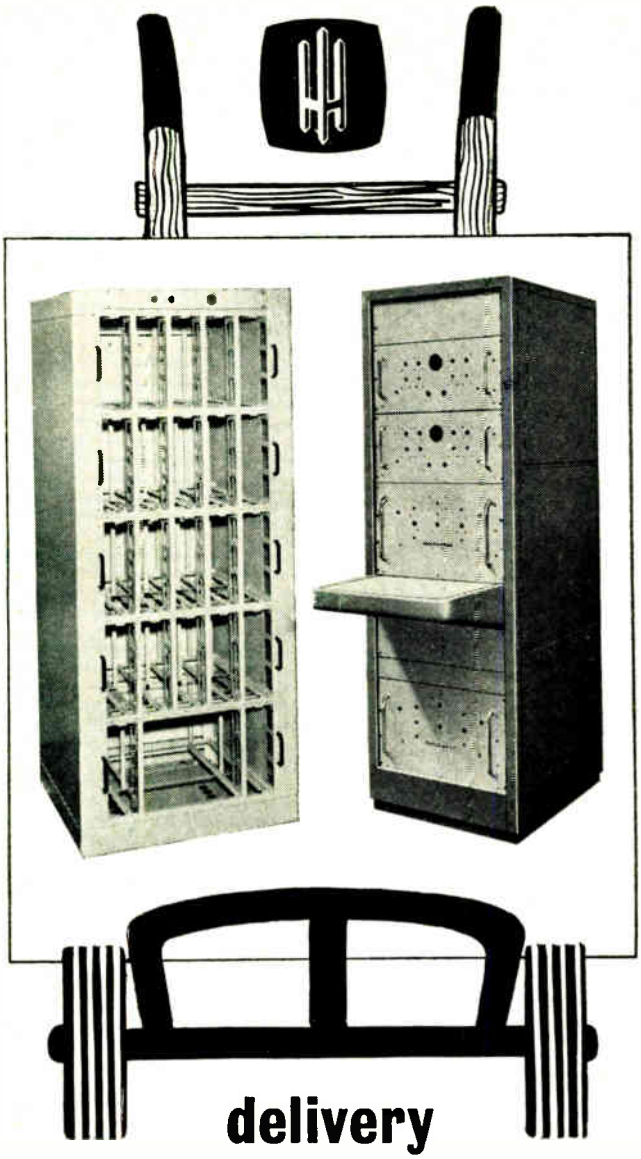

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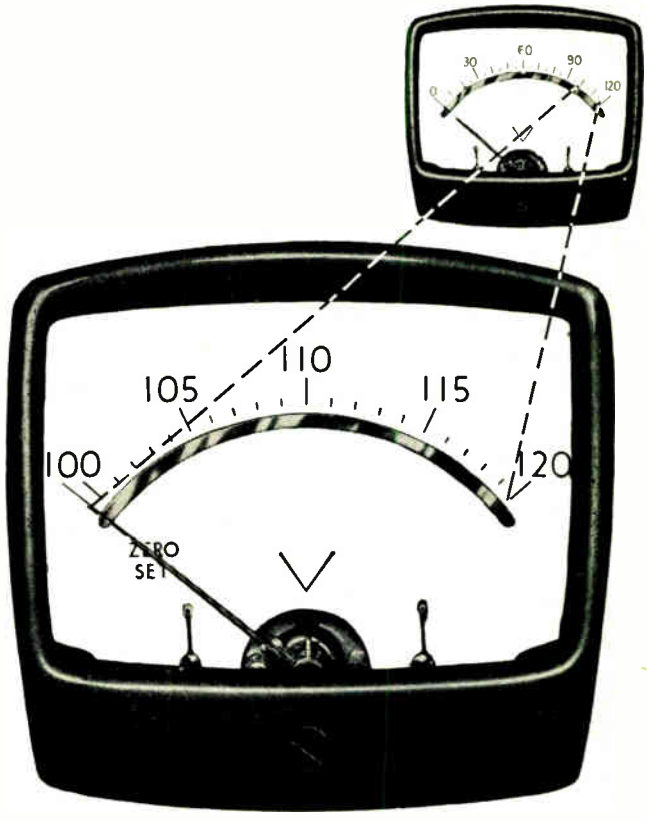

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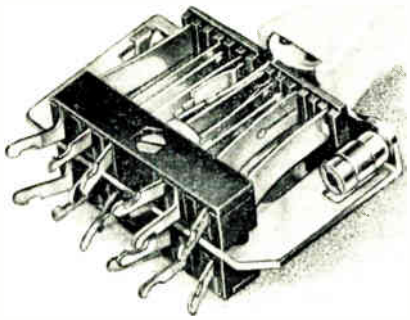

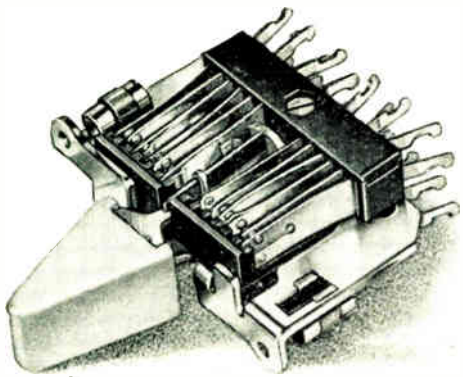

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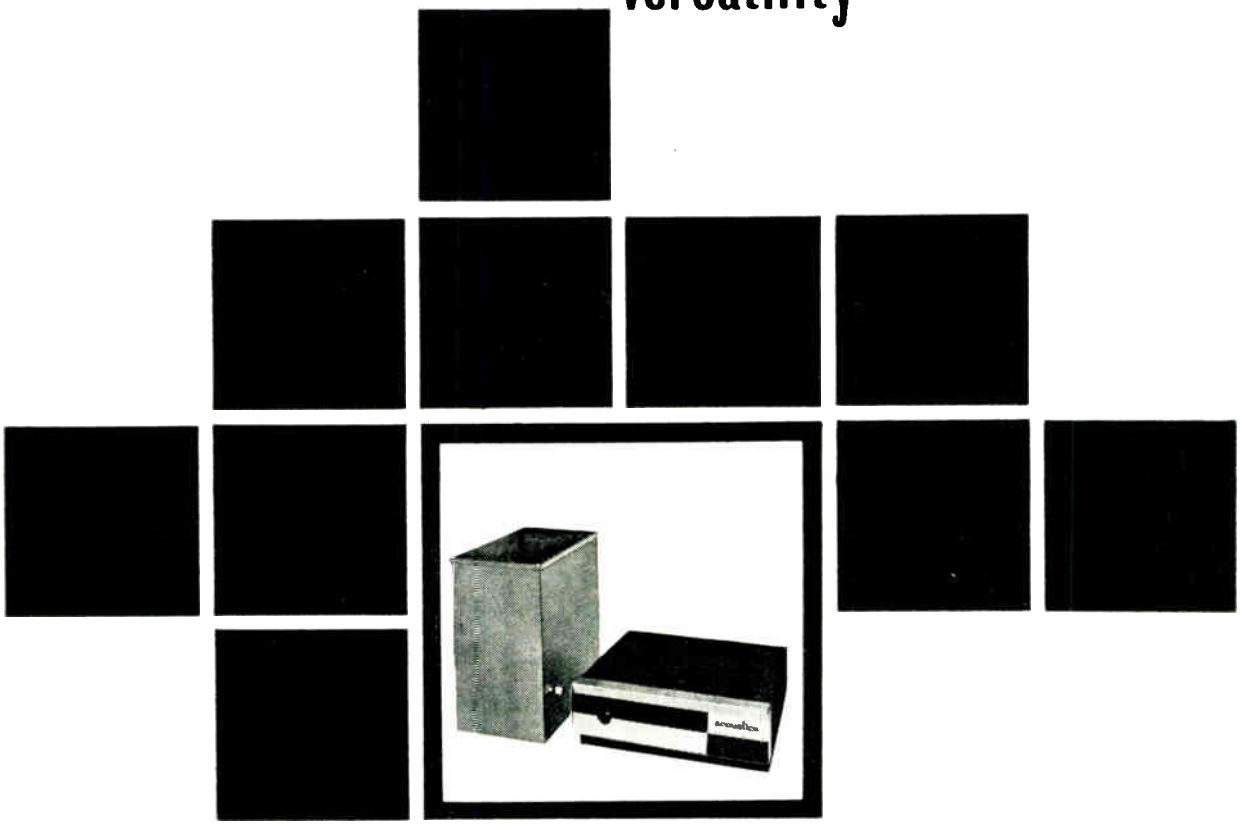

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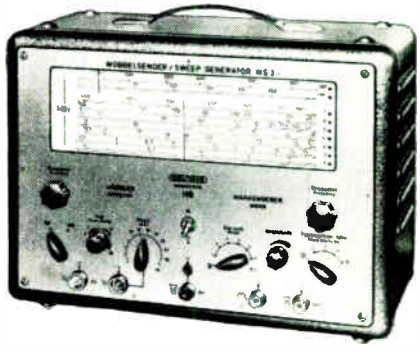

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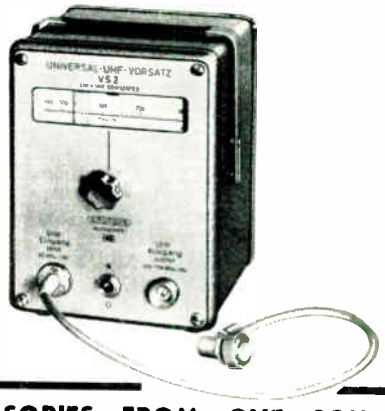

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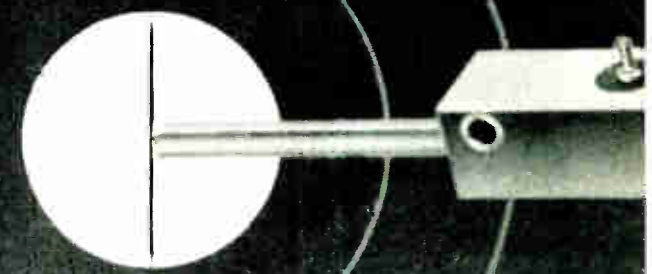

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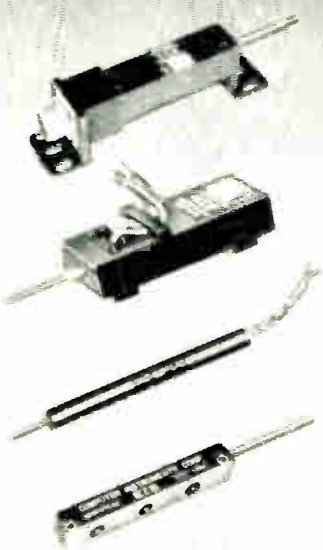

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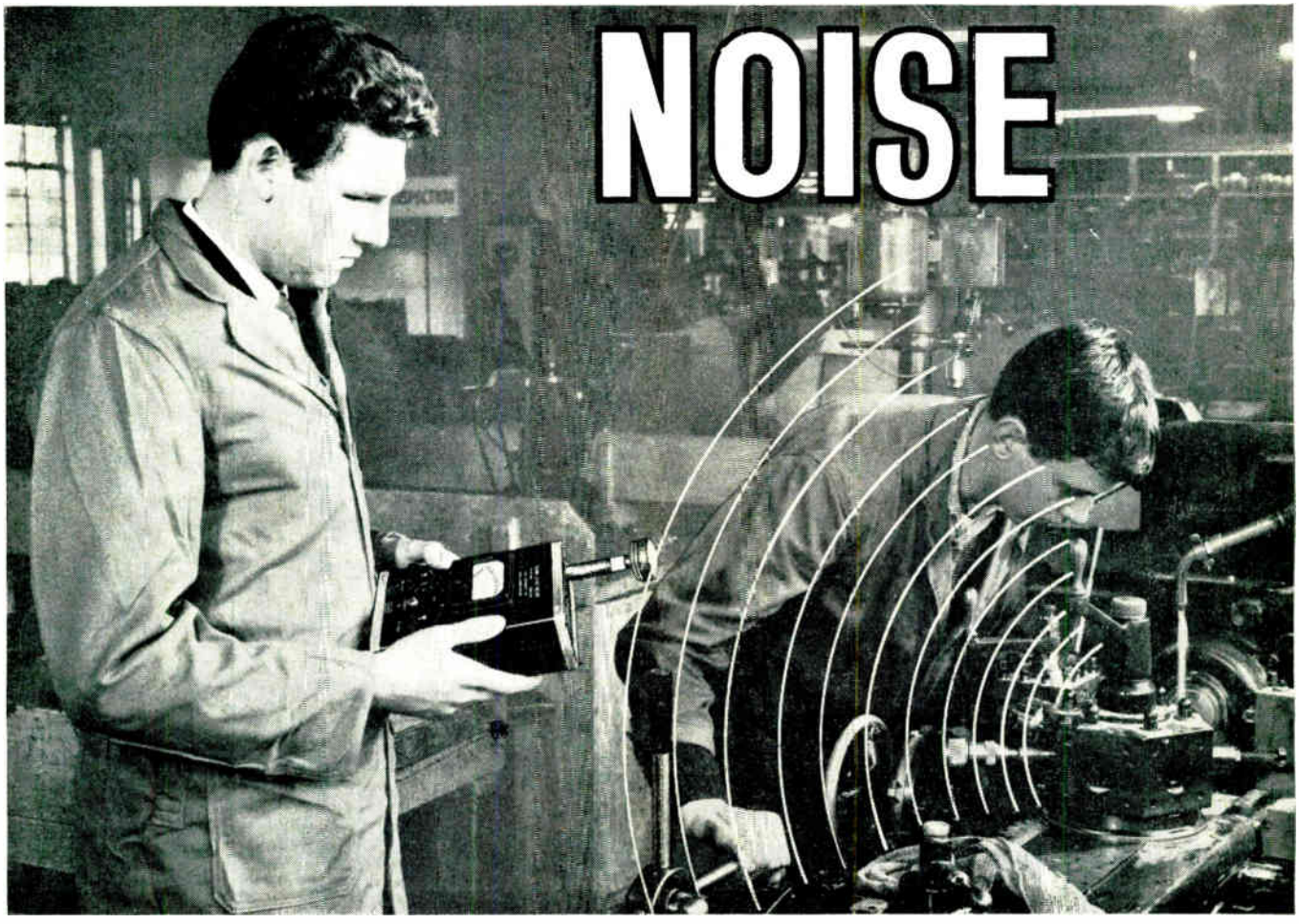

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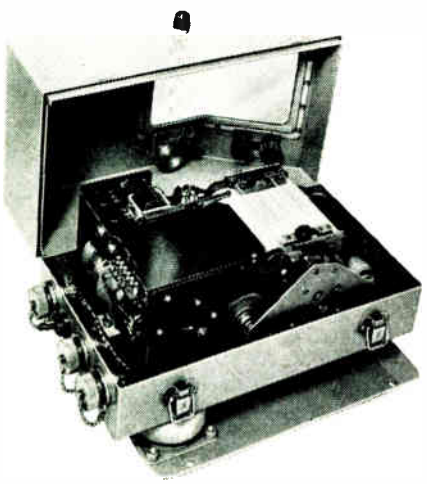

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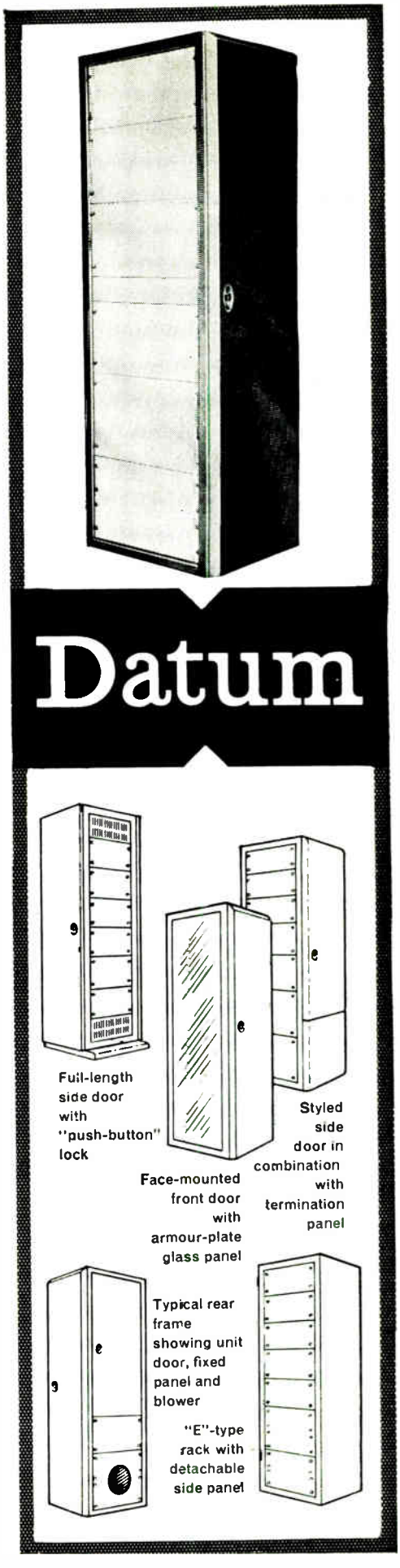

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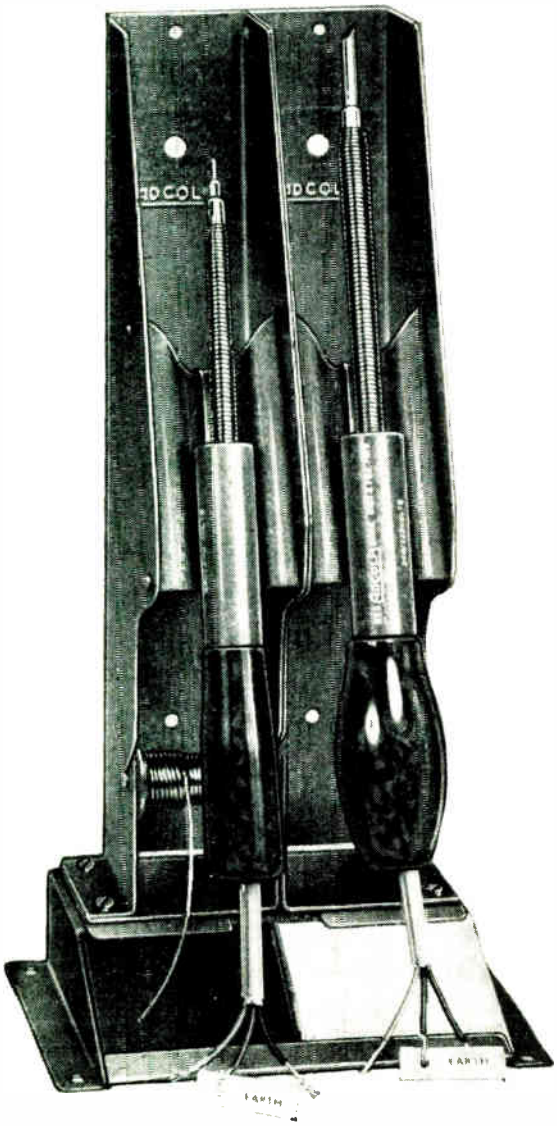

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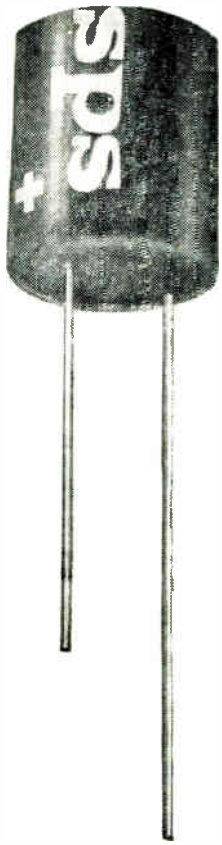

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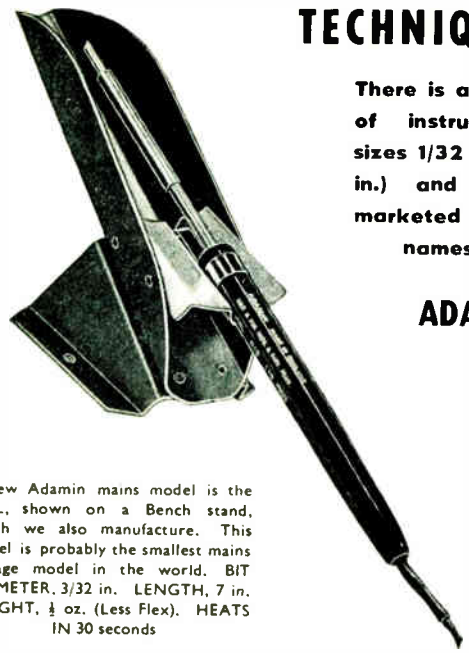

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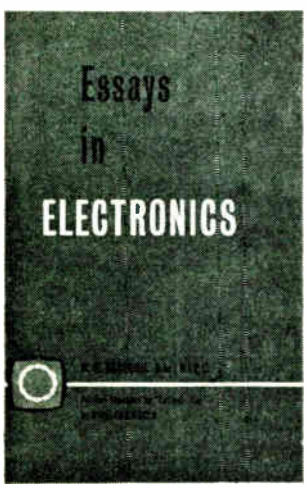

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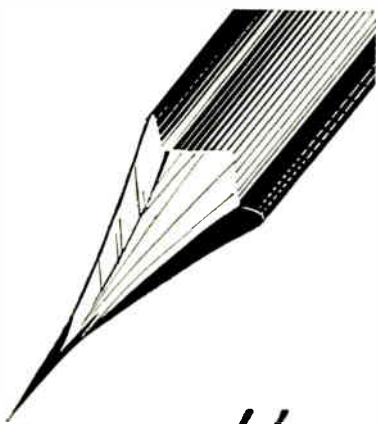

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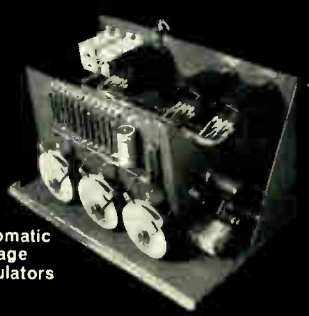

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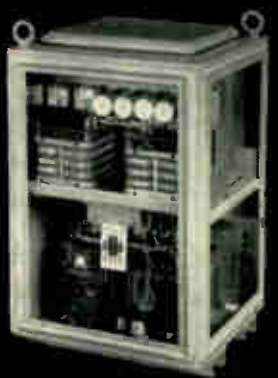

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