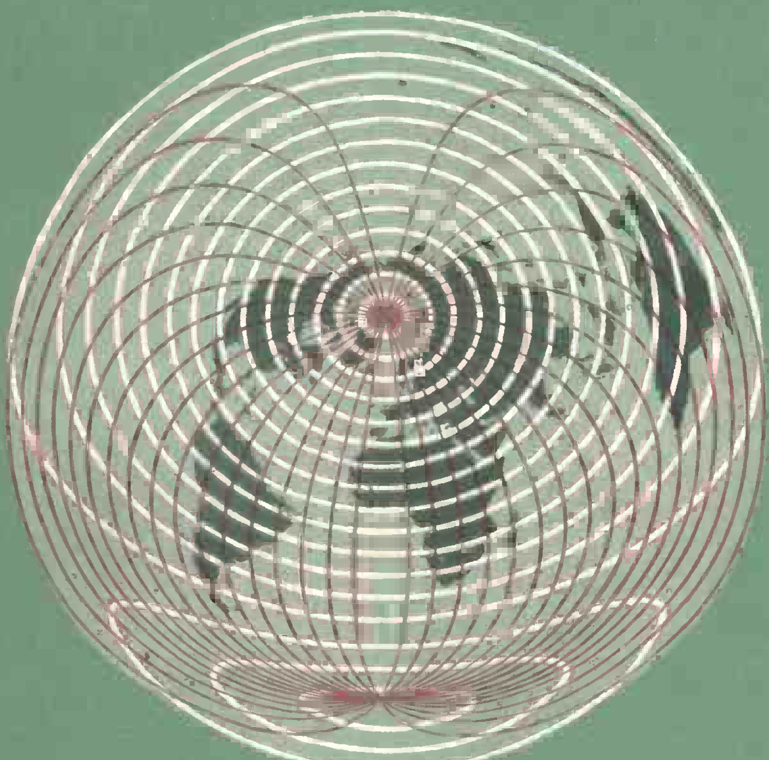
JULY 1960 TWO SHILLINGS

Wireless World

ELECTRONICS

Radio · Television



FIFTIETH YEAR OF PUBLICATION

BICC

polypole couplers

for Pye microwave TV links

Robust, reliable and lightweight BICC Polypole Couplers and Multicore Cables are used exclusively by PYE as part of the standard equipment for their transportable long range television links.

BICC design and manufacture Polypole Coupler Systems to meet special requirements. These systems cover a wide variety of types and sizes of cable, terminated with moulded-on couplers.

Further information is contained in Publication No. TD TPC5 — available on request.

BRITISH INSULATED CALLENDER'S CABLES LIMITED 21 BLOOMSBURY STREET LONDON WC1

97

Wireless World

ELECTRONICS, RADIO, TELEVISION

JULY 1960

Managing Editor:

HUGH S. POCOCK, M.I.E.E.

Editor:

F. L. DEVEREUX, B.Sc.

Assistant Editors:

H. W. BARNARD

T. E. IVALL

VOLUME 66 No 7.

PRICE: TWO SHILLINGS

FIFTIETH YEAR
OF PUBLICATION

Offices: Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager, or Publisher, as appropriate

PUBLISHED MONTHLY (4th Monday of preceding month) by ILIFFE & SONS., LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* " Ethaworld, Sedist, London." *Annual Subscriptions. Home and Overseas,* £1 15s. 0d. *Canada and U.S.A.,* $5.00. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6, *Telephone:* Digby 9-1197.

JULY 1960
Vol. 66 No. 7

Wireless World

Line Standards

IN 1956 the Postmaster General of the day asked the Television Advisory Committee amongst other things to say whether the existing 405-line standards were likely to remain adequate for all purposes for the next 25 years and if there was any reason why the United Kingdom should not adopt 625 lines for Bands IV and V if it were recommended by the C.C.I.R. as the European standard.

To the first question the Committee in its 1960 Report* has given an unequivocal no, on the grounds that a "definite" improvement in picture quality is possible with 625 lines (assuming also an equivalent increase in channel width) and that with the trend towards increasing picture size the line structure will be less visible with 625 than with 405 lines. A direct answer to the second question is avoided and the response takes the form of an inversion and a recommendation that 625 lines *should* be adopted, not only for Bands IV and V but ultimately for Bands I and III also.

Although the evidence for a case *against* 625 lines is included in the Report it is scattered and unco-ordinated, and before the growing compulsion towards a change of standard reaches the proportions of a general obsession, we think that the case for the retention of 405 lines should be made with at least equal emphasis. Briefly it is that the 405-line standard is already capable of giving better picture quality and higher definition than is at present realizable *on the viewer's screen*, and that any improvement which might be obtained from 625 is marginal and not worth the 15 years or more of disruption, the cost of duplicating services and the dual standards receivers which would be necessary to effect a change. When finally Band I and III stations were converted to 625 lines and the last 405-line-only receiver had become obsolete we should finish up with nation-wide dual standards receivers in which the 405 section would be redundant, and for our trouble we should have a slightly better picture but at least one national programme less than we could have enjoyed if we had stuck to 405 lines and 5Mc/s channel spacing.

How much better than 405 would the picture quality of 625 be *in the home on the average commercial receiver?* In our opinion, after seeing both British and Continental performance, not much. But if you do not accept our opinion read the report† of the Working Party of the Technical Sub-Committee of the T.A.C. which says (p.139) ". . . This is not very positive evidence for either the 405-line or 625-line pictures in Band V, but it indicates that the 625-line pictures are not worse than their 405-line counterparts and they are perhaps very slightly better." These tests were made with 7Mc/s channel and 5Mc/s video bandwidth. With the proposed 8Mc/s and 6.75Mc/s respectively the difference in quality would undoubtedly be more "definite," but still, we think, marginal. Such differences as exist can be easily and much more economically accommodated by intelligent camera work and minor adjustments of viewing distance.

Visibility of lines on the larger screens is undoubtedly the strongest argument so far advanced against 405 lines, but the average assessment of observers in the field tests† is Grade 3 (definitely perceptible, but not disturbing) for 405 lines as against Grade 2 (just perceptible) for 625 lines. But there are less expensive ways of overcoming "lininess" than turning the whole broadcasting system into bedlam—at the receiver, for example, by the use of an elliptical scanning spot or "spot-wobble." Some people prefer to see the lines, taking them as an indication of a "sharp" picture, and have been known to switch off spot-wobble in sets in which it is provided. It is entirely a matter of personal opinion.

That a 405-line and 5Mc/s channel standard would put us in an invidious position in our international relations and upset European plans for the general adoption of 625 lines and 8Mc/s channels is not necessarily true. It may be a necessary expedient on the Continent where national boundaries are contiguous, but on this side of the Channel we have the advantage of geographical isolation, particularly on Bands IV and V where, as the field test report confirms, propagation is more difficult and (p.15) "the limits of a Band V service area are somewhat more precisely defined than those of a Band I service." Mutual interference with other European stations is much more likely on Bands I and III. Why then should we have prematurely committed ourselves to 8Mc/s spacing on the higher frequencies, while reserving the right to transmit for an indeterminate period with 5Mc/s spacing on the lower and more easily propagating bands? It would have been much better to forgo "tidymindedness" and to take advantage of our insular position to make the best use of the available bandwidth in providing more alternative programmes, at the same time safeguarding our neighbours' interests by careful attention to aerial directivity in stations near the south and east coasts.

Summarizing the case against a change to 625 we can say that (i) the value to the viewer in terms of picture quality would be negligible; (ii) there are cheaper and easier ways of overcoming "lininess" if it is thought to be objectionable; (iii) a third programme with national coverage would no longer be possible in Band III; (iv) if Bands IV and V were eventually brought into service, more programmes could be established earlier and at less cost with 405 than with 625 lines.

* Report of the Television Advisory Committee 1960, H.M. Stationery Office. Price 1s.

† "Television Field Trials of 405-line and 625-line Systems in the U.H.F. and V.H.F. Bands 1957-1958." Published by the B.B.C. Price 20s.

Instruments, Electronics and Automation

THE I.E.A. EXHIBITION AS SEEN BY THE TECHNICAL STAFF OF *WIRELESS WORLD*

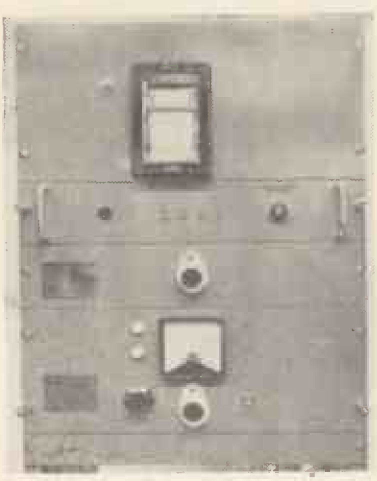
AN ELECTRONICS exhibition is probably the only place where one would find accessories so remotely connected as television aerials and hydraulic valves. On this occasion the great diversity of the show at Olympia was partly due to the inclusion of many radio and electronic component manufacturers (there being no R.E.C.M.F. exhibition this year). Such variety inevitably meant a much larger exhibition than the one held in 1958, and both the Grand and National Halls were occupied. Technical interest, too, was greater—particularly in the field of automatic control, where there were more complete systems to be seen in addition to the isolated bits of apparatus used in these systems.

INDUSTRIAL ELECTRONICS

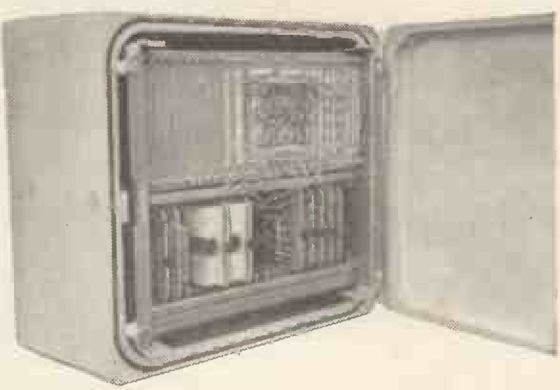
Process Control Systems.—Most of the automatic control equipments on view were intended for continuous-process operations, as, for example, the continuous adjustment of properties of liquids flowing in pipes. This type of application allows the general principle of the servomechanism to be used. A monitoring transducer measures the required property of the material concerned and the measured value is compared with the required value to produce an error signal, which is used to actuate a control device to correct any deviation. An example of this straightforward technique was a temperature controller for electric furnaces, shown, rather appropriately, by the Phœnix Telephone and Electric Works. The input signal is derived from a thermocouple and from a reference signal given by a potential divider connected across a Zener diode voltage source. The difference output from the thermocouple and reference source is amplified by magnetic amplifiers and used to control a saturable reactor which in turn controls the supply of electrical power to the furnace. The feature of this system is that it avoids the use of mechanical contacts which have to be periodically serviced.

In such systems the control signal is usually directly proportional to the amplitude of the error signal. There are certain processes, however, which require the control signal to be a more complex function of the error signal. For example, in some plants a measured deviation in the form of a sudden step might, if fed back as a correcting signal, cause "hunting" in the process control system. It might be necessary, therefore, to integrate the sudden step into the form of a slowly rising control voltage. In many of the controllers on view there were, in fact, facilities for providing these special functions—usually integration and differentiation (to give a control signal depending on the rate-of-change of the error signal). These, in addition to the normal proportional control, give what are commonly known as "three-term" controllers. As an example, Evershed demonstrated a three-term controller being used to control automatically the concentration of mixtures of liquids on the basis of conductivity measurements. The measuring transducer produces an electrical signal proportional to conductivity, and a resistance network gives the difference between this value and the desired value (set manually by a potentiometer from a voltage source). The difference signal then passes through an amplifier system in which its amplitude can be manually set and its waveform modified by adjustable integrating and differentiating circuits — to emerge as a signal which controls the rate of operation of one of the pumps contributing to the mixture of liquids.

An integrating circuit was used for giving a delay effect on the control signal in an interesting equipment shown by Haynes & Haynes on the Lancashire Dynamo stand. This was for controlling the wall thickness of plastic tube during extrusion. Variations of wall thickness are used to regulate the speed of the motor which drives the "haul off" conveyor system for the plastic tube. The measuring transducer is a capacitor with its two plates not parallel but inclined to each other so that a section of the plastic tube can pass between them. The tube wall, therefore, provides part of the capacitor's dielectric and any variations in wall thickness alter the capacitance. This transducer is connected in series with another capacitor of equal value to a 3-Mc/s oscillator, and an output signal is taken from between the two



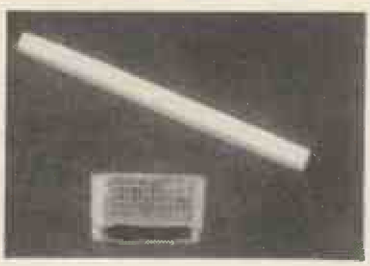
Phoenix Telephone temperature control equipment.



De Havilland "Anatrol" analogue computer for process control.

capacitors. The result is a bridge arrangement in which any unbalance between the two capacitors (due to wall thickness variation) is indicated by the amplitude of the output signal, while the direction of unbalance (increase or decrease of thickness) is indicated by the phase of the output signal relative to a reference signal from the oscillator. These changes are detected and passed to the integrating circuit, the output of which is used to control the variable-speed drive of the plastic tube conveyer.

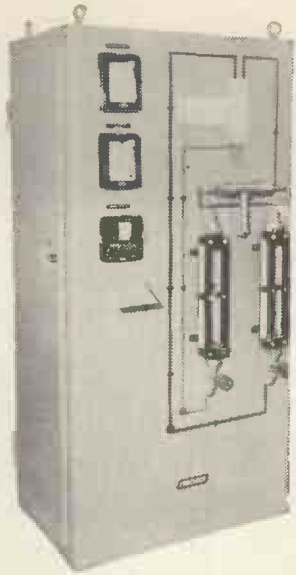
Data Processing.—One could not go very far in the exhibition without seeing some equipment or other for the transmission or conversion of information—for telemetering, communications, computation, or the "logging" of data from transducers in industrial plants. A particularly impressive example was a large equipment shown by Bristol Aircraft for converting tape recordings, obtained from the receiving end of a 24-channel time-multiplex telemetering system, into the form of data on punched cards. By this means the weeks of work normally required for analysing the telemetered information could be reduced to a single day. An electronic analogue-to-digital converter, also shown by Bristol, had the unusual feature of giving a digital output which was corrected for any non-linearity, drift or gain variations in the analogue transducer



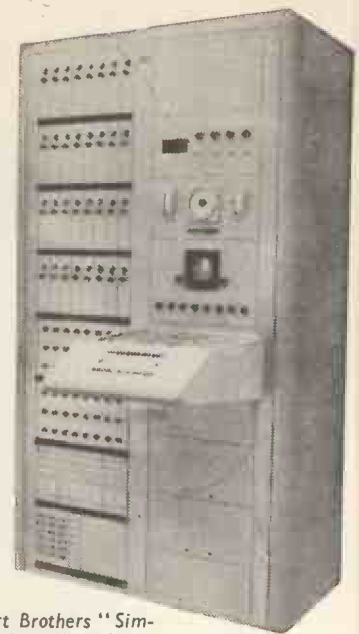
Texas Instruments solid-circuit binary adder, compared in size with a safety match.

system providing the input. This correction is achieved by supplying to the converter, along with the analogue input, reference voltages which are a calibration of the analogue signal and are subject to the same unknown variations. The converter works on the well-established principle of comparing the analogue input with a succession of fixed voltages; when equality is reached the action stops and a binary counter registers the number of comparison steps which have been taken. In the Bristol Aircraft system these fixed voltages are provided by the reference voltages mentioned above, so that the unwanted variations in the transducer system are automatically compensated.

Another type of error correction was a feature of many of the telegraph and digital data transmission



Evershed equipment with three-term controller for controlling mixture of liquids.



Short Brothers "Simlac Minor" analogue computer.

systems on view. In general, the method consists of transmitting extra digits along with the normal information. These give a special pattern to each of the characters or numbers transmitted so that any mutilations of the signal in transit can be automatically recognized at the receiving end. Great interest was attracted by a G.P.O. demonstration of this principle in which the number of errors detected and the number of characters transmitted were "clocked-up" on counters. In general such correction techniques can reduce the normal error rate of about 1 in 40,000 characters to about 1 in 10^6 characters.

Turning to the computation side of data processing, one of the most interesting exhibits relating to the design of computers was a working binary adder constructed from semiconductor solid-circuits. Demonstrated by Texas Instruments, it consisted of a group of tiny flat plates of silicon, measuring $\frac{1}{4}$in by $\frac{1}{8}$in, each of which was an integrated circuit element formed by diffusion, etching and deposition techniques. Four types of solid circuit elements were used: (1) voltage inverters, each consisting of a transistor, a diode and resistors, (2) diode gates for AND and OR operations, (3) a bi-stable circuit, containing transistors, diodes, resistors and capacitors, for delay purposes, and (4) a diode gate to provide the correct drive for the bi-stable circuit. Interconnections were made with the aid of printed conductors and the whole adder was well spread out for display purposes. In practice, however, the individual circuit elements are packed together face to face into a tiny cube—the incredibly small size of which can be seen from the illustration on this page. The saving in volume over an equivalent adder using conventional semiconductor devices is of the order of 100 : 1, according to Texas.

Semiconductor circuit elements are now the standard thing for all new digital computing systems, and one particularly interesting example was a digital machine shown by Elliott-Automation, designed for incorporation in process control loops in industrial plant. The machine is called the "Optimat," because it is not a straightforward computer but a device for seeking the optimum performance point within a specified regime of operation of the plant. It does this by making trial-and-error incremental variations in the control signals to the plant until the plant conditions meet the specification (which is laid down in the programme to the machine). In this way optimum performance can be obtained even against the influence of uncontrolled parameters in the operation of the plant. The logical elements, established already under the name "Minilog," are transistor and diode circuits mounted on printed circuit cards which in turn are wired in groups on to larger boards carrying plugs for insertion into a chassis.

For simpler process control applications the analogue computer is particularly suitable, since the control and monitoring signals to and from the plant are necessarily analogue signals. An example at the exhibition was the "Anatrol" anologue computer, developed by de Havilland, which was shown as a means of solving equations necessary to keep the composition of a blended product at some specified value. As

Electromethods Series 5100 miniature chart recorder, showing 2in diameter chart.

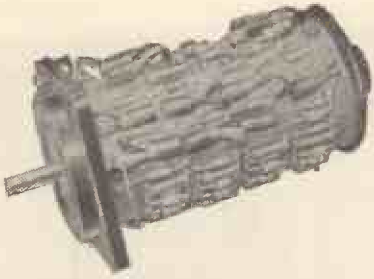
in the "Optimat," the circuitry was based on semiconductor devices.

An analogue computer with some unusual facilities was the "Simlac Minor" shown by Short Brothers & Harland. It has a push-button selection system which enables the d.c. amplifiers and passive circuit elements to be selected and connected to various measuring instruments and also allows the coefficient potentiometers to be automatically set up, by servo control, to an accuracy of 0.1%. A novel "patch-cord" system gives flexibility of interconnection between the units while using the minimum number of cords and avoiding the need for the cords to cross. The computer is actually a small general-purpose machine and uses 32 d.c. amplifiers.

Information Recovery from difficult-to-get-at places is common in these days of "sputniks"; however, many examples are far nearer at hand than an orbiting artificial satellite—the inside of a continuous paint-stoving oven, for instance, or the face of a piston in a running internal-combustion engine.

Shown on the D.S.I.R. stand was a small telemetry transmitter designed to fit inside the piston of an engine. Developed by the British Internal Combustion Engine Research Association, recourse to telemetry was made because the number of slip rings and wiping contacts required could have resulted in false signals and would have been difficult to maintain. The single-transistor transmitter operates at about 2Mc/s, feeding an aerial which projects into the crankcase. A thermistor sensing element on the face of the piston modulates directly the frequency of the transmitter. To withstand the high temperatures built up, and the oil present, the unit is encapsulated. A silicon transistor is used.

Another approach was illustrated by Electromethods, with their series 5100 recorder. This a miniature ($6\frac{1}{2} \times 4\frac{3}{4} \times 3\frac{1}{2}$in) instrument using a clockwork-driven chart of pressure sensitive paper only two inches in diameter. A self-balancing bridge



Ericsson "Rotapulse" transducer for automatic weighing.

system is used, balance being achieved between the input and a slide wire whose moving contact is coupled to the stylus marking the chart. Periodically the input signal is removed automatically and a second servo system re-balances the zero of the bridge.

For applications such as monitoring the temperature throughout a stoving oven, the whole recorder, complete with its battery pack, can be put inside a vacuum flask with leads connected to an external resistance thermometer. When used for potential recording the sensitivity is such that signals of 10mV or so may be registered. For use with a resistance sensing element, accuracy figures quoted were $\pm 2\%$ of f.s.d. and variation of zero and sensitivity $\pm 0.25\%$.

Weighing Automatically materials into bins or sacks is a typical example of how automation can reduce the physical labour of a task, and at the same time cut down clerical work with its opportunities for error. The adaptation of an ordinary weighing machine, too, brings in a common problem—the sensing of rotation without the imposition of a significant load on the apparatus. The general principle is that the rotation of the scale pointer is sensed and converted to pulses, which are counted and registered on a reversible decimal stepping display. Preset circuits allow the rate of delivery of the material to be reduced as the correct weight is approached and cut off when the weight is correct. A converter may be fitted, for instance, to operate a teleprinter which would record the weight.

Microcell, in their Type 171 machine, use a radially striped disc coupled to the pointer spindle and another stationary grating. Light shining through the gratings is thus modulated by the passage of the rotating grating, and picked up by photocells. To allow for other than critical damping of the weighing machine, the sense of rotation must be discovered so that the counter can be "instructed" whether to add on or take off pulses. This is done by using two photocells with 90° angular separation.

The Rotapulse transducer, shown by Ericsson, is also primarily an optical system: it is offered as an entirely separate unit with low-friction bearings (less than 0.05oz/in torque is required). Four quadrantally positioned phototransistors are used, and with the 250 and 249 segments on the gratings 1,000 pulses are given for each revolution of the spindle. The pulse-forming circuits are transistorized and are built on a flexible printed-wiring board which is wrapped round the rotating mechanism.

A selsyn transmitter is coupled to the weighing-machine pointer in the E.M.I. "Emiway" equipment. This transmits the rotary motion to the remote equipment where analogue to digital conversion is achieved by a coded disc driven by the synchronous receiver motor. The control unit provides for the checking of the machine zero, two reduced rates of feed and the starting of the print-out operation. The accuracy achieved is better than one part in 2000 in 360°, or 0.1% of f.s.d.

Industrial Television.—When direct viewing through windows or by means of large mirrors is impracticable, stereoscopic television may well provide a solution, for instance, when handling radioactive substances behind screening. To give a true solid image two pictures must be presented, one to each eye, from the positions and angles of view that would be occupied by the eyes if they were observing the scene to be transmitted.

E.M.I. were showing a stereo TV system using two small cameras with automatic adjustment of the angle subtended to the subject by the eyes, achieved by coupling to the optical focus control. Display was on two c.r.ts, the images being combined by a half-silvered mirror and the tubes were covered with orthogonally-set sheets of optical polarizing medium. The wearing of similarly polarized spectacles separated the pictures at the eyes.

Pye, however, were showing stereo TV with only one camera, amplifying chain and c.r.t. This was achieved by the use of mirrors to produce the left and right views on halves of the

Stereoscopic television camera showing optical system for producing left- and right-eye views (Pye).

sensitive area on the camera tube. The monitor thus displays side by side the two images, which are directed into the appropriate eyes by an optical system similar to that used on the camera. Of course, the solid picture produced is of only half the area of a "flat" picture, but this is of no importance for industrial purposes.

E.M.I. were demonstrating their new colour camera which uses three vidicon tubes and a novel optical system. The optical system utilizes supplementary lenses in the lens turret to give varying fields of view. Inside the camera the light is split into its red, green and blue components by mirrors and filters, and then individually focused on to the tubes by separate lenses. The smearing of moving objects so often seen with vidicon pick-up tubes has been reduced considerably by the use of new short-lag tubes.

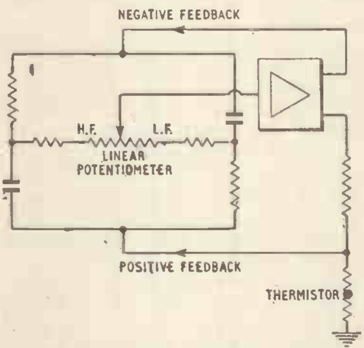
The camera is designed to operate on 625, 525 and 405 line systems. This was a general trend noted throughout the exhibition; for instance, Thorn were showing a picture monitor and waveform generator capable of being switched between these standards and Epsylon, in their range of industrial television equipment also cater for quick changing from one standard to another. The Epsylon equipment incorporates a picture monitoring circuit which adjusts automatically the potential fed to the camera tube for a 50:1 variation in light intensity.

Unit Construction seems to be the main trend in industrial control and automation equipment. The aim of this, of course, is to have available a number of standard blocks, such as amplifiers, counters, timers and power units, which can be fitted together to suit practically any requirement. This must reduce the "electronic" interest of the system, but it must be remembered that the prime requirement for industrial equipment is that it should, in the event of a fault, remain unserviceable for the minimum possible time. The best method of fulfilling this requirement is the use of standard plug-in "blocks," so that only a small number of spares need be kept. This approach was exemplified by, for instance, Mullard, with their Combi-elements and Norbits, Fox Yarborough and Lancashire Dynamo, who were also exhibiting a unit rack assembly developed for naval use. This uses a novel cooling method. Instead of the usual extractor fan and inlet filter drawing air through the actual apparatus, cooling is achieved by mounting heat-producing components on a spring-loaded metal plate. When the unit is forced fully home this plate is pressed into intimate contact with the machined walls of the closed "cell" in which the unit is held. The cell walls are of extruded light alloy, carrying internal finned ducts through which air is drawn. In this way efficient air-cooling is achieved without the fire danger caused by forced-draught cooling of racks of open equipment.

Power-supply units have become more or less standard in their design, but one novelty seen on the stand of International Electronics was a transistor-stabilized 300-V 500-mA unit. Normally transistors are not used for h.t. stabilization because of the danger of damage should the supply be short circuited. However, by designing the error-amplifier so that, in the event of a short circuit, the output transistors are switched hard on, and by including a current-limiting resistor in the unstabilized side of the supply, the dissipation in the transistors can be kept low enough to ensure safety while the output fuse blows. Naturally, the use of transistors achieves a considerable saving in weight and bulk.

MEASURING INSTRUMENTS

Sine Wave Oscillators.—In a transistorized oscillator shown by R.R.E., constant output (within ± 0.1 dB), low distortion (<0.1%) and a wide frequency range (10 to 1) are obtained by means of a basically simple circuit (see diagram) in which a single linear potentiometer controls the oscillation frequency. This potentiometer is connected between two simple CR leading and lagging phase-shift networks



Basic circuit of new R.R.E. oscillator.

so that the phase of the amplifier input can be varied. Oscillations are produced at the frequency at which the input phase is the same as the positive feedback output phase. (In the circuit diagram the "upper" resistor and capacitor should have a higher impedance than the corresponding "lower.") Three transistors are used in the amplifier circuit. If a linear potentiometer is used, the oscillation frequency varies nearly logarithmically with the spindle angle except near the beginning and end of the potentiometer element. A linear potentiometer also gives a more uniform scale graduation spacing than is usually obtained with a logarithmic potentiometer. This is because a logarithmic potentiometer normally approximates to the ideal logarithmic curve in three straight line segments, so that at the two joins of these segments a sudden change in the scale graduation spacing is produced.

An unusual method of sine wave generation is used in the Marconi TF1382 low-frequency (down to 0.0033c/s) sine, square and ramp waveform generator. The latter (ramp) waveform is that basically produced in this generator. This waveform is then shaped in a Zener diode circuit to produce sine waves with a distortion of less than 5%. Square waves are also produced from the triangular waveform *via* a bistable circuit.

A tone-burst generator was shown by Ferguson. When fed with a sine-wave input this produces sine waves in bursts whose individual duration and repetition rate can be varied, each burst containing an integral number of sine waves. Such a generator is useful for testing audio amplifiers, since its output provides a simple approximation to the high peak-to-mean power ratio conditions of music and speech. When an amplifier is fed with such bursts its output-stage operating point corresponds more closely with that obtained in practical use than does the operating point obtained with a high-power continuous sine-wave input. Marginal instability is also easier to detect when the high-power signal is cut off at the end of each burst. To obtain such bursts the sine-wave input is gated on and off, the gating being controlled from the sine-wave input so that only an integral number of sine waves is produced in each burst.

Oscilloscopes.—Transistorized instruments were shown by Microcell and Tektronix(L). An unusual feature of the latter instrument is that the flyback trace is suppressed by feeding a suitable signal to a separate deflection plate system in the c.r.t. so that these plates intercept the beam. Intensity modulation of the beam is also possible.

A cathode-ray tube containing a set of deflection plates forming the capacitive elements in a lumped L-C line (travelling-wave deflection) is

Agents in U.K. for foreign instruments: (C L), Claude Lyons Ltd., Valley Works, Hoddesdon, Herts; (G & G), Griffin & George (Sales), Ltd., Ealing Road, Alperton, Wembley, Middx.; (L), Livingston Laboratories, Ltd., Retcar Street, London, N.19; (N & T), Nash & Thompson Ltd., Hook Rise, Tolworth, Surbiton, Surrey; (R H C), R. H. Cole (Overseas), Ltd., 2 Caxton Street, London, S.W.1.

used to obtain a response up to as high as 100Mc/s in the Tektronix(L) Type 585.

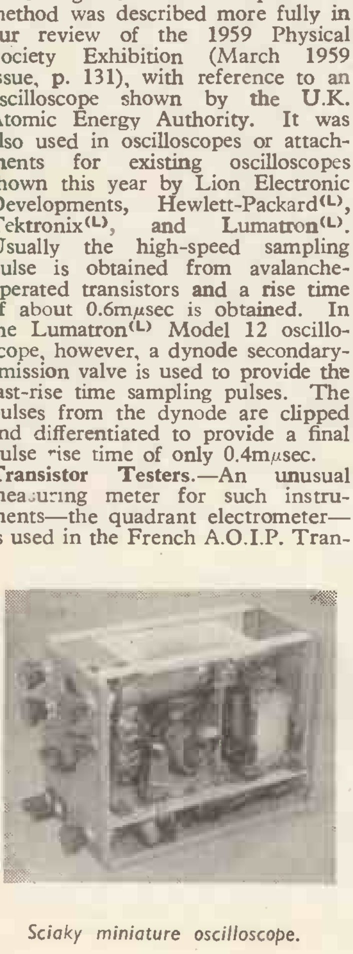
A very small ($5in \times 3\frac{3}{4}in \times 6\frac{1}{4}in$) oscilloscope was shown by Sciaky Electric Welding Machines. A single EF91 is used for the time base and a second EF91 as the d.c. Y-amplifier. The response extends to 300kc/s at a sensitivity of 700mV/cm.

An unusual feature of the oscilloscopes shown by the East-German VEB Funkwerk Kopenick(G & G) is that no internal Y-amplifiers are provided, separate units being available for this purpose.

Switching between as many as five inputs is an unusual facility possible with the Czech Krizik(N & T) K552 oscilloscope. The inputs are switched on and off in turn either by a 100kc/s multivibrator, or alternatively, for viewing high-frequency waveforms, in synchronism with the timebase.

The frequency range of an oscilloscope for recurrent waveforms can effectively be greatly extended by using very fast rise-time pulses to sample various portions of a recurrent waveform, the sampled pulses being stored and amplified in the relatively much larger time between the taking of successive samples. This method was described more fully in our review of the 1959 Physical Society Exhibition (March 1959 issue, p. 131), with reference to an oscilloscope shown by the U.K. Atomic Energy Authority. It was also used in oscilloscopes or attachments for existing oscilloscopes shown this year by Lion Electronic Developments, Hewlett-Packard(L), Tektronix(L), and Lumatron(L). Usually the high-speed sampling pulse is obtained from avalanche-operated transistors and a rise time of about 0.6mμsec is obtained. In the Lumatron(L) Model 12 oscilloscope, however, a dynode secondary-emission valve is used to provide the fast-rise time sampling pulses. The pulses from the dynode are clipped and differentiated to provide a final pulse rise time of only 0.4mμsec.

Transistor Testers.—An unusual measuring meter for such instruments—the quadrant electrometer—is used in the French A.O.I.P. Transistormeter. Input and output resistances, leakage currents and gains can be measured by this instrument. All measurements are referred to measurements of collector current changes. These are carried out by first charging both pairs of quadrants to a voltage proportional to the collector current. One pair of quadrants is then kept at this potential by a high-insulation capacitor, while the other pair is brought to a new potential proportional to the changed collector current. The electrometer deflection is then proportional to the change in collector current. One advantage of this system of measurement is that the initial conditions are stored so that any change can be accurately measured after an interval of time.



Sciaky miniature oscilloscope.

Features of the new Microcell Type 156 are the use of a wide-range (1kc/s-10Mc/s) oscillator as signal source, and a differential valve-voltmeter as indicator. This type of indicator eliminates errors due to spurious voltages developed across the resistive networks. Cut-off frequencies, amplification factors, leakage currents and turnover voltages can be measured with this instrument.

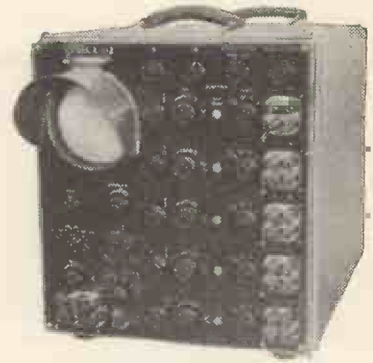
An instrument for service departments—the Type 105C—was shown by Labgear. This can measure current gains and collector leakage currents and turnover voltages.

Collector voltage/collector current characteristics at up to five different base or emitter input currents can be simultaneously presented visually on the Dobbie McInnes Transigraph TG104 oscilloscope. Current gains, output impedances and optimum operating conditions can then be readily determined.

Grid-dip Meters were shown by Grundig Instruments and the Czech firm Kovo(N & T) (Tesla BM342). These consist simply of a calibrated oscillator whose grid current can be measured. They can then be used as an absorbtion resonance-frequency indicator (minimum grid current) or as a signal source. Alternatively, the oscillator valve can be connected as a diode and the instrument used as an absorption wavemeter (maximum current).

Frequency Response curve tracers usually display simply the output variation so that inaccuracies and complications are produced if the input source varies. However, in the Siemens(RHC) ratio tracing receiver Type Rel 3K217c the input is used to alter the gain of the output amplifier so that input variations of up to 10dB are compensated for to within 0.3dB. The amplified output traced on the c.r.t. screen is then proportional (within 0.3dB) to the response.

Voltage Measurement.—A precision (0.05% accuracy) r.m.s. decade voltmeter—the D-930-A—was shown by Muirhead. In this instrument the



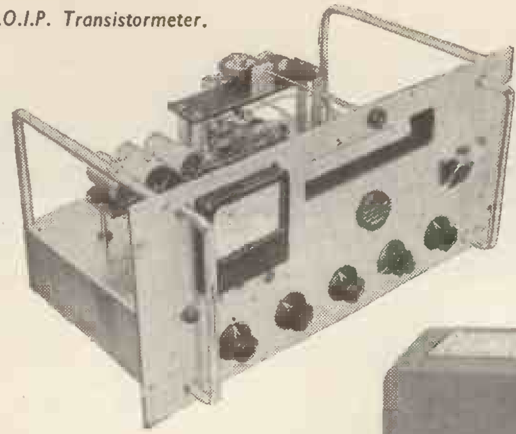
Kovo Krizik (N & T) five-channel oscilloscope.

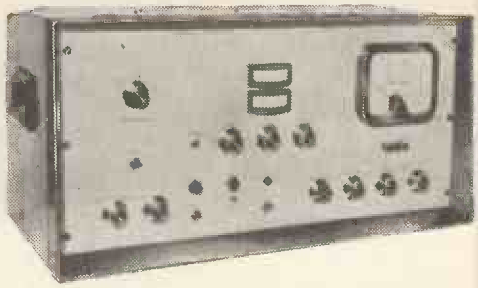
unknown voltage is fed via the range switch to an a.c. amplifier followed by a decade attenuator and second a.c. amplifier. The output of this second a.c. amplifier is fed to a Wheatstone resistor bridge in which a lamp forms one arm. Since the resistance of this lamp depends on the electrical heating power developed in it, the bridge balance is determined by the r.m.s. value of the input. The point at which the bridge balances is first standardized against the direct voltage from three Weston reference cells. This voltage is then reduced by about 80%, and the bridge rebalanced by adding an internally supplied a.c. voltage. This standardizes the a.c. voltage. This voltage is then attenuated and fed to the input of the voltmeter to standardize the a.c. amplifier gains. In the Marconi TF1377 suppressed-zero voltmeter potentials are measured by balancing them off against the output of a potentiometer fed from a standard voltage—the potentiometer setting being shown on a three-digit indicator. Residual unbalance voltages and thus voltage changes can be measured by means of a differential valve voltmeter.

Both the amplitude and phase of a voltage can be measured by a simple device shown by F. C. Robinson and Partners. In this instrument current is fed from the mains, or from any 15W, 15-Ω output impedance amplifier, through a standard potentiometer P_1 in series with the primary of a mutual inductance. Across the secondary of this inductance is connected a second potentiometer P_2. The voltages developed across the two potentiometers P_1 and P_2 are then 90 degrees out of phase. The phase and amplitude of an unknown voltage can then be measured by balancing this voltage off against the outputs of the potentiometers P_1 and P_2.

Wires carrying alternating current can be detected without having to make any contact with them by picking up the electrostatic field produced by the current in the Everett Edgcumbe "Metrac" live

A.O.I.P. Transistormeter.





Microcell transistor test set.

Everett Edgcumbe "Metrac" live line indicator.

Tektronix (L) transistor oscilloscope.

line indicators. These instruments have been developed for use with high-voltage cables and are amply sensitive enough to detect live wires at the standard safe working distance which, for example, is 8½ft for 11kV.

An interesting circuit is used in the Southern Instruments E.R.I.C. Universal Electronic Multimeter which can measure both direct voltages and currents. This circuit is direct-coupled throughput and consists of three cascaded pairs of balanced cathode-coupled amplifiers (the first pair using electrometer valves) followed by a pair of cathode-follower outputs. In use, one of the two inputs is cross-connected to one of the outputs, a different input being connected according to whether voltage or current is being measured. If, in addition, a standard resistor is connected between the other input and output, the impedance between the two inputs is then very low (voltage drop <5mV) so that direct currents are conveniently measured between the two inputs. On the other hand, with the standard resistor disconnected, the impedance between the unconnected input and output is extremely high so that direct voltages are conveniently measured between this input and output. Input voltages can also be stored on a 0.15μF polystyrene capacitor (producing an input impedance of $10^{13}\Omega$) so that a reading can be taken after the probe has been removed from the test point. Resistances can also be measured with this instrument.

Current Measurement.—An unusual photo-electronic chopper technique is used in the prototype Nanoammeter shown by the French firm A.O.I.P. Here the unknown d.c. input is passed through a photoresistor on which a light is shone. This light is periodically interrupted by a mechanical movement so that the photo-resistance is periodically altered. The d.c. input is thus partially converted into a.c. which is then amplified and measured.

Direct currents can be measured down to 3mA full scale without interrupting the circuit under test in the Hewlett-Packard Model 428A clip-on d.c. milliammeter. In this instrument the magnetic field produced by the current in a probe of magnetic material which is clipped round the current-carrying conductor is measured by a fluxgate technique. In this technique an a.c. signal passed through a coil wound on the probe drives this probe into magnetic saturation on alternate half cycles. The additional field due to the current makes the magnetization curve of the probe slightly asymmetrical with respect to zero field and induction. This results in a second harmonic output being produced in a second coil wound on the probe. This second harmonic output is detected and measured. Interfering effects produced by uniform direct fields (such as the earth's field) can be arranged to cancel out by using the fact that the fields on opposite sides of a current-carrying conductor are in opposite directions. The probe is also magnetically shielded against external a.c. or d.c. fields. An advantage of this method of measuring current is that no resistance and very little inductance (<0.5μH) are introduced into the circuit being measured.

Power Measurement.—In the Burndept BE281 powers can be measured at frequencies up to 1,000Mc/s by feeding them to a 50-Ω coaxial resistor (made up of a carbon film on a cylindrical ceramic core) which is mounted along the axis of exponential cavity to provide broad-band matching. The r.f. voltage developed across a portion of the resistor is rectified and measured. This purely electrical method of measurement gives a much faster response than is obtained when r.f. is measured by using it to produce a heating effect (as in a bolometer).

L, C, R Measurement.—When high-loss reactive components are measured using bridges, the measurements of the reactive and resistive parts of the component usually influence each other so much that many adjustments are needed to obtain a balance point. Two general methods of considerably reducing the number of such adjustments required were seen. In capacitor bridges shown by Rank Cintel and Winston Electronics phase-sensitive detectors are employed so that the resistive and relative out-of-balance voltages (which differ in phase by 90°) can be separately detected and zeroed. In the General Radio(C L) Type 1650-A L, C, R bridge, the resistive and reactive adjustments are mechanically connected by friction clutches such that, when the resistive adjustment is altered, the reactive adjustment is also altered so as to keep the ratio of the resistive and reactive parts constant; but, when the reactive adjustment is altered, the resistive adjustment is not affected.

In capacitance meters shown by E. C. Robinson & Partners and the Czech firm kovo(N & T) (Tesla Model BM271) measurements are made by placing the unknown capacity in a resonant circuit which also contains a calibrated variable capacity. By keeping the resonant frequency fixed by adjusting the calibrated variable capacity, the effect of the unknown capacity can be measured. In the Tesla BM271 the resonant circuit is placed across the output of a fixed-frequency oscillator and adjusted to resonate at the oscillator frequency by maximizing the voltage developed across the circuit. By also adjusting this voltage to a fixed value by means of a variable resistor placed across the unknown capacitor, the loss of the capacitor can be similarly measured. This variable resistor consists of a thermionic diode with a by-passed variable resistor in series with it; this arrangement providing a resistance which is sufficiently non-inductive for use up to 30Mc/s. In the F. C. Robinson and Partners Picofarad Meter the resonant circuit forms part of an oscillator and the resonance is adjusted to a fixed frequency by listening to the audio beats produced with another fixed-frequency oscillator in a loudspeaker. Since the oscillator frequencies are at 1.5Mc/s, such beats produce a very exact indication of correct frequency adjustment.

A very simple method of measuring inductors and capacitors used in radio or television receivers is used in the East-German V.E.B. Werk für Fernmeldewesen[(G & G)] LCM1. An oscillator with a cathode-follower output stage provides an alternating current which is passed through the component. The voltage developed across the component is then a sufficiently accurate indication of the component reactance, since the resistive loss in components used in radio or television receivers is generally small.

Robinson & Partners Picofarad Meter.

PARTS AND MATERIALS

Strip Wiring is formed from flat copper strips a few thousandths of an inch thick, supported and insulated from each other and external contact by plastics films.

Technograph have been making flexible "printed" wiring for several years, including, for instance, resistive elements on a rubber compound (for the de-icing of aircraft control surfaces), and strain gauges on various films such as Terylene. Their latest strip-wiring cable consists of copper conductors sandwiched between two layers of 0.001-in Melinex film. The Melinex softens sufficiently to be stripped from the copper at about 160°C, so leaving free the ends of the conductors, for connection. T.C.C. introduced a flat-strip cable, called Flexistrip, at the exhibition: in their cable the copper strips are moulded into polythene, and an overall jacket of Melinex is then applied. Possibly the most startling thing about strip cables is their flexibility—Flexistrip, for instance, passes the DEF5000 test, which involves no fewer than 20,000 flexings, and is normally applied to tinsel-braid cables.

Connectors for strip-wiring could take practically any form; for instance, it could be soldered directly to a printed-wiring board, or be fitted with eyelets. However, any method requiring individual handling of each wire to achieve a disconnection is not likely to be acceptable where many connections are required. Thus several connectors have made their appearance, each quite different in principle.

Belling and Lee were showing an experimental moulded housing to fit on to either circuit-board connectors or a small piece of board, so forming a socket and plug which can be attached to the cable. The housing itself has three slots through which the cable is passed, to form a cable grip. The ends of the strip are pierced and soldered onto lugs projecting from the socket or plug board and the housing, which has a snap-on cover, can incorporate a finger-release locking clip.

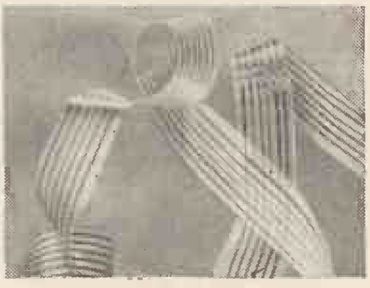
N.S.F. have a modified form of their Varicon interconnection tags, which, when mounted on a printed-wiring board, form both "plug" and "socket" contacts. The modified tag carries on its rear a toothed portion under which the end of the unstripped cable is trapped. On mounting the tags, the teeth cut through the insulation and enter the conductor, so making contact. Slots punched in the board could provide a cable grip. For quick assembly Varicon can be supplied in strips of thermoplastic material, which, after fixing the tags to the board, is warmed and removed.

Continental Connectors, a division of Ultra, were showing a fitting like an ordinary circuit-board socket. However, it accepts only a very thin section—the end of a flexible strip cable, in fact, with the conductors cleaned of insulation and folded back over the cable. For very flexible cables which would not be rigid enough for direct plugging in, a thin piece of board could be used as a supporting member, with the stripped strip conductors folded over the edge of the board. Again, slots in the board could provide for a cable grip and retaining mechanism.

Connection to Printed-wiring boards is made without the use of solder by a new technique shown by Belling and Lee. Known as Prestincert, it depends upon the discovery that a disc or peg can, with the aid of a die and press, be punched into sheets of insulating material or metal without first making a hole for it. Knurling the edges of the insert prevents rotation, and the die can peen over the penetrating end, so forming a strong fixing. For component connection the peg is formed into a lug with a soldering terminal at the top and an oversize collar that seats firmly on the board. A slot, cut diagonally into the peg across a diameter, takes the component lead: on punching, the lead is squeezed into intimate contact with the board and the insert, the excess wire being sheared off. Also insulation on the wire is stripped automatically.

Printed Power resistors, shown by Technograph, consist of a meandered resistive track on an insulating coating on a metal panel. This may then be fixed to another metal plate, possibly the chassis of a piece of apparatus, for dissipation of heat at ratings up to 10W/in². The resistance values and ratings on one of the panels displayed suggested that it was intended for use as the mains-dropping resistors in a television receiver, so we arrive at the paradox of having to put back the chassis to act as a cooling fin for the contact-cooled h.t. rectifier and mains dropper, after eliminating it by the use of printed-wiring panels!

Capacitor Construction has for several years remained largely unchanged, except for the entry to the field of plastics-film dielectrics. However, a development shown by Dubilier may well challenge the ubiquitous wax and paper capacitors. The Dubilier "Blue-cap" employs a paper dielectric, but instead of wax, a synthetic-resin impregnant is used. The absence of wax or oil in the manufacturing process makes possible hermetic sealing in a plastics sleeve without danger of moisture penetration at the lead-in wires. The sleeve material has a high melting point and is designed to withstand any normal soldering operations.



Flat-strip cable, by Technograph.

Another novel construction was shown by Hunts, in their WF49 "Duolectric" capacitors. These are housed in aluminium cans and occupy roughly a third of the volume of the equivalent rating of waxed-paper types. To achieve this reduction polyester film has been used as the dielectric; but to avoid the relatively high cost of metallized film a sandwich construction of plain film with metallized paper electrodes has been employed. The largest Duolectric capacitor (2μF, 1kV) is only $3\times1\frac{1}{4}$in.

Work on tantalum electrolytic capacitors has resulted in the elimination of liquid sulphuric acid as the electrolyte; the effects of a burst or leaking capacitor containing this can only too easily be imagined. Hunts have developed a chemically inert electrolyte for use in slug-type capacitors, which are, for extra safety, contained in two cans, one inside the other. Dubilier have a range using a solid layer of semiconductor material as the "electrolyte" and a sprayed-zinc coating is used for the second electrode. Other types (Dubilier and Hunts) utilize a construction similar to that of the common "dry" aluminium electrolytic capacitor.

Push-button TV Tuners have many advantages in simplicity of operation; for instance, it is not necessary, as it is with some rotary types, to clank through several unused channels, possibly moving inadvertently the fine tuner as well. A.B. Metal Products had on show a new four-channel push-button unit using a frame-grid cascode triode and triode pentode in the common circuit arrangement. In place of the rotary turret, however, was a push-button mechanism for selecting two Band-I and two Band-III channels. When a button is depressed it allows the appropriate coil strip to rise under spring pressure and engage with several double-leaf contacts projecting from "busbars" joined to the rest of the circuit. A feature of the new tuner is that separate preset fine-tuning controls for each channel are put into circuit by an extra contact on the coil strip.

Wire-less Transformers or, more correctly, piezoelectric transformers, were shown by Brush. These depend for their operation on the mechanical excitation of ceramics such as lead titanate zirconate either by another section of the same ceramic or by the magneto-strictive effect in a ferrite carrying a winding. Demonstrated was one of bar form, used to light a small neon sign needing about 1mA at 2kV. The low-potential part of the bar was excited by 10V applied from an oscillator connected across its "thickness." Here the impedance is relatively low, but by polarizing the other half of the $\lambda/2$-long bar along its length it can be made to oscillate in the lengthways mode, which corresponds to a high impedance between the ends of the $\lambda/4$ section. Thus, by attaching wires to the ends of this bar a high potential at low current may be extracted.

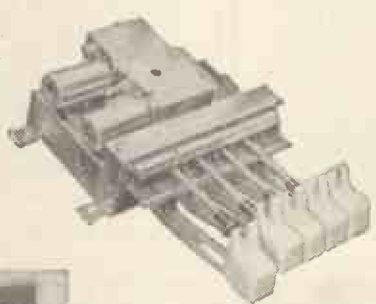
The efficiency of the ceramic-to-ceramic transformer shown was of the order of 50%; but, by driving the lengthways-mode "crystal" from a magneto-strictive transducer cemented to it, greater power can be fed in to the bar, with a consequent increase in both efficiency and output, which may be made as high as 40kV.

Semiconductor Devices.—High-frequency transistors at economical prices is the aim of the alloy diffusion method of manufacture developed by Mullard, and a whole range of new p-n-p types based on this principle was on view. Briefly, the technique uses a wafer of p-type germanium to form the collector, and on one face of this two metal pellets are placed side by side to form the emitter and base. During heat treatment n-type impurities diffuse into the germanium wafer from both pellets to produce an extremely thin base layer between the emitter and base electrodes. At the same time, p-type impurities diffuse relatively slowly out of the emitter pellet only and produce a small p-type layer around this pellet, confined within the n-type base layer. The high-frequency properties are obtained mainly as a result of the extremely thin base layer (about 5 microns) and partly because the graded distribution of impurities gives an accelerating field which reduces the transit time of the current carriers through the base even further.

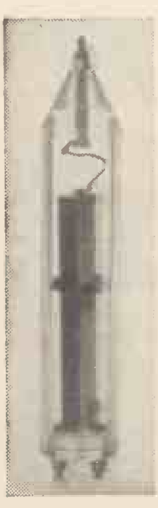
In addition to the established OC170 and OC171 made by this technique, Mullard showed two low-noise transistors for v.h.f. communications which give power gains of 10dB at frequencies of 100Mc/s and 200Mc/s respectively. There was also a switching transistor for use in computers operating with p.r.fs up to 10Mc/s, and a type for driving ferrite core stores which was capable of producing 0.5A output pulses with rise times of less than 40 nanoseconds. A p-n-p-n four-layer switching device made by the same technique had an impedance ratio for its "on" and "off" states of higher than 3 million to one, while an avalanche switching transistor was capable of producing 50mA pulses with a rise time of 1 nanosecond (10^{-9}).

Other manufacturers are using the "mesa" construction and the drift-field technique for their high-frequency transistors. A.E.I., for example, had two new mesa transistors, XA161 and XA162, with minimum cut-off frequencies of 25Mc/s and 35Mc/s respectively, and three drift types, XA141, XA142 and XA143, with minimum cut-off frequencies of 20Mc/s, 40Mc/s and 60Mc/s respectively. This firm has also introduced four power transistors for industrial applications. Two of them, XC155 and XC156, have peak current ratings of 10A and collector-base voltage ratings of 80 and 100 volts respectively. The other two, XC141 and XC142, have peak current ratings of 3A and collector-base voltage ratings of 40V and 60V.

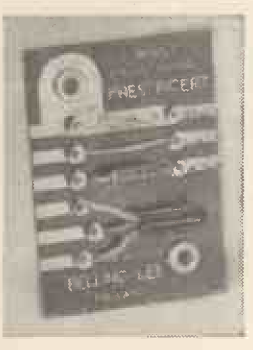
In the field of power control, as distinct from power amplification, the silicon-controlled rectifier is rapidly invading the domain of the industrial thyratron and other large devices. It enables several kilowatts of power to be controlled by a few milliwatts. Examples were shown by Westinghouse and International Rectifier. On the Westinghouse stand an impressive demonstration was given of a 10kW tungsten-lamp sign being turned on and off by two silicon controlled rectifiers connected, in inverse parallel, between the a.c. supply and the load. The r.m.s. output voltage was varied by controlling the proportion of each half cycle for which the rectifiers were conducting.



Above: Four-channel push-button TV tuner (A.B. Metal Products). Fifth button actuates on/off switch and six-button version can switch in separate f.m. tuner.



Left: Brush 2-kV piezoelectric transformer.



Left: Demonstration circuit board with components connected by the Belling-Lee "Prestincert" principle.

T.A.C. REPORT

TECHNICAL FEASIBILITY OF ALTERNATIVE PLANS FOR TV DEVELOPMENT

SINCE the Television Advisory Committee was reconstructed in 1952, under the chairmanship of Admiral Sir Charles Daniel,* it has issued several reports but the most eagerly awaited was that published on June 1st.† Although the broad terms of reference of the committee are "To advise the Postmaster General on the development of television and sound broadcasting at frequencies above 30 megacycles per second and related matters, including competitive television services and television for public showing in cinemas and elsewhere," the committee was asked in March 1956 specifically "for advice on fundamental technical problems of television development." In particular the members were asked whether they would

(a) recommend whether the existing 405-line standards were likely to remain adequate for all purposes for the next 25 years;

(b) say whether there was any reason why the United Kingdom should not adopt 625 lines for Bands IV and V in this country, if it were recommended by the International Radio Consultative Committee (C.C.I.R.) as the European standard;

(c) make recommendations regarding the general principles of a compatible colour system for operation, initially at least only in Bands IV and V;

(d) recommend the best technical means of transmitting the colour signals associated with (c) above, bearing in mind that these need not necessarily be in the same frequency band as the monochrome signals;

(e) take note of, and report on, any proposals by the B.B.C. or I.T.A. for adding colour to transmissions within Bands I and III; and

(f) give their views as to the technical advantages to be gained from the use of higher standards in Bands I and III, if the possibility of extension of television into Bands IV and V were to be disregarded, and taking into account the improvement in receiver and other apparatus that may be expected in the next 25 years.

It is in answer to these specific questions that the present report was presented to the P.M.G.

Because of the widespread interest in the report Mr. Bevins promised Members of Parliament that it would be published. It is, however, stated in the foreword, and the P.M.G. has personally stressed the fact, that the Government has reached no decision as to which of the possible alternatives should be adopted. Furthermore, if any changes in line standards were to be decided upon, they would require to be made in accordance with a long-term phased programme which should take account of the interests of the viewers, the broadcasting organizations, and the radio industry. The committee has emphasized that 405-line services would need to be continued for many years so that there would be no question of 405-line receivers becoming prematurely obsolescent.

It will be appreciated that although the questions posed are technical, there are political and economic factors which enter very largely into the picture. For example:

(a) the number, nature and coverage of the television programmes to be provided;

(b) the method and time-table by which the new standards should be introduced;

(c) the costs of introducing the new standards and the way in which they could be met.

These are, however, mostly outside the committee's terms of reference and the purpose of the report is solely to give the Government the technical information it needs to formulate policy.

Over the past two or three years various technical studies, including propagation tests in Bands IV and V, 625-line test transmissions from a Band V transmitter at Crystal Palace and colour transmissions on 405 lines, have been undertaken by the T.A.C.'s Technical Sub-Committee‡ in collaboration with the D.S.I.R., the radio industry, Post Office and broadcasting organizations.

How Many Programmes?

As is shown in Table I, Bands I and III, if fully exploited on the present 405-line standard, could provide three programmes—two with at least 98% coverage and one with a coverage of over 95%.

Tests have shown that an acceptable television service could be provided in Bands IV and V. Nevertheless, the service area of a transmitter operating in these bands would be more restricted than for the lower bands and more irregular, particularly in mountainous or hilly terrain, and to give a nation-wide service a greater number of transmitters would therefore be needed. The report states that whereas some 20 stations are required in each of the lower bands to provide upwards of

* See Appendix I for list of present members.

† Report of the Television Advisory Committee, 1960, *Stationery Office*. 1s.

‡ See Appendix II for list of present members.

TABLE I

		No. of channels for operation on		No. of channels per national programme		No. of programmes which could be provided using	
Band	Range (Mc/s)	405 lines 5 Mc/s channels	625 lines 8 Mc/s channels	No.	for estimated population coverage	405 lines and 5 Mc/s channels	625 lines and 8 Mc/s channels
I	41—68	5	3	5	98%	2 (98%) & 1(95—98%)	2(95—98%)
III	174—216	8	5				
IV	470—582*	22	14	12/13	95%	3(98%) or 4(95%) & 1(70%)	2(98%) or 2(95%) & 1(90%)
V	606—800*	38	24	17/18	98%		

*As amended at the Geneva Conference, 1959.

98% population coverage, possibly four or five times as many stations would be needed in Bands IV and V to give 95% coverage.

Because of the undoubted advantages of the v.h.f. bands over the u.h.f. bands for television, the Committee sought advice whether any broadening of Band III was practicable within the foreseeable future. The Radio Industry Council, too, feel strongly that any extension of television up to four national or near-national programmes should, if at all possible, be accommodated within Band I and an extended Band III. Both the Committee and the R.I.C. were, however, informed "that the pressure in the v.h.f. portion of the spectrum is immense, and that the Government must hold a balance between desirable broadcasting development and the requirements on these frequencies for other services." That being so, at this stage no hope can be held out that additional frequencies could be made available in the v.h.f. bands for television purposes. Any extension of television must, therefore, be made in the u.h.f. bands.

It is stated in the report, although this may not have been previously generally known, that the T.A.C. advised the P.M.G. early last year that the U.K. delegation attending the C.C.I.R. meeting at Los Angeles (April, 1959) should be empowered to say that "in the interests of frequency planning the United Kingdom would adopt an 8Mc/s channel in Bands IV and V, if Europe generally adopts this, and further that if the United Kingdom should decide to adopt 625-line standards in those Bands a 6Mc/s video bandwidth would be used."

405-line Standard Inadequate

The Committee states that good as the 405-line picture may be for the size of screens now in general use they do not think the 405-line system will be adequate for the next 25 years.

As will be seen from Table II the majority of European countries as well as some in the western hemisphere and Australasia have adopted 625 lines. In field trials in Band V a comparison was made of 405-line and 625-line pictures. The results showed that the overall assessment of the 625-line pictures was not significantly different from that of 405-line although in areas of comparatively high field strength the 625-line pictures generally received a slightly higher assessment. The Technical Sub-Committee felt that the fact that there was not a significant difference in the overall assessment of picture quality was due partly to the nature of the trials and partly to the restriction of the video bandwidth of the 625-line system to 5Mc/s. They considered, however, with one dissentient, that with further development of this system using a 6Mc/s video bandwidth and receivers with improved noise factors 625-line pictures, particularly on larger screens, would show a definite superiority. Following further international discussion the Sub-Committee considered that there would be technical advantages and no loss in picture quality in restricting the video bandwidth to 5.5Mc/s and increasing the width of the vestigial side-band from 0.75Mc/s to 1.25Mc/s.

Assuming it to be the Government's policy to develop television beyond the capacity of the present two bands, the committee points out that the introduction of Bands IV and V will provide the last opportunity of improving the standards of definition. They recommend the use of 625-line with an

TABLE II

	Adopted in		Channel width
405-line	United Kingdom Ireland		5 Mc/s
525-line	Bermuda Brazil Canada Colombia Cuba Dominican Rep. El Salvador Guatemala Iran Korea	Japan Mexico Nicaragua Panama Peru Philippines Puerto Rico Saudi Arabia Thailand Uruguay U.S.A.	6 Mc/s
625-line	Argentine† Australia Austria Belgium Bulgaria* Cyprus Czechoslovakia* Denmark Egypt Finland E. Germany W. Germany Hungary* Iraq Italy	Lebanon Netherlands New Zealand Nigeria Norway Poland* Portugal Rumania* Spain Sweden Switzerland Turkey U.S.S.R.* Venezuela† Yugoslavia	7 Mc/s (*8-Mc/s; † 6-Mc/s channel)
819-line	Algeria France Belgium	Monaco Morocco Luxembourg	} 13 Mc/s 7 Mc/s

8Mc/s channel in these bands and ultimately in Bands I and III. It is pointed out that the maintenance of 405-line operation here would show the United Kingdom to a disadvantage in Eurovision as standard convertors degrade picture quality, particularly for conversion to a higher standard, and this would have its effect in selling United Kingdom programme material to the rest of Europe.

On the question of colour the members of the committee state "we are of the opinion that present technical and economic limitations make it undesirable to introduce a colour television system in the near future. We will report further on the technical details of colour television standards as soon as we are in a position to do so."

APPENDIX I

Present members of T.A.C.

Admiral Sir Charles Daniel, chairman.
B. St. J. Trend (Treasury).
D. W. G. L. Haviland (Ministry of Aviation).
W. A. Wolverson (Post Office).
H. Carleton Greene (B.B.C.).
Sir Robert Fraser (I.T.A.).
G. Darnley Smith } (Radio Industry).
C. O. Stanley
Sir Edward Herbert.
Lord Aberconway.
Sir Walter Puckey.
J. L. Judd (Post Office), secretary.

APPENDIX II

Present members of Technical Sub-Committee

A. H. Mumford (Post Office), chairman.
Sir Harold Bishop (B.B.C.), deputy chairman.
Capt. C. F. Booth (Post Office).
A B. Howe (B.B.C.).
P. A. T. Bevan (I.T.A.).
T. C. Macnamara (Associated Television).
Dr. L. F. Broadway (E.M.I.).
K. I. Jones (Ferguson).
E. P. Wethey (K.B.).
V. J. Cooper (Marconi's).
Dr. R. L. Smith-Rose (D.S.I.R.).
T. M. C. Lance (Rank-Cintel).
C. W. Sowton (Post Office), secretary.

WORLD OF WIRELESS

I.T.A. Plans

FUTURE plans for the extension of the coverage provided by the I.T.A. stations include five new transmitters to be opened next year and further stations the following year. As has already been announced, the Authority is also increasing the height of the masts at Croydon (which with its new aerial will then have an e.r.p. of 200kW) and at Black Hill and Lichfield.

The first three stations, to be brought into service next spring, are the dual transmitters in the south-west—Stockland Hill, Devon (channel 9) and Caradon Hill, Cornwall (12)—and Caldbeck, near Carlisle (11). Towards the end of 1961 a high-powered transmitter will be opened in Kincardineshire, Scotland, on channel 9 and a low-power transmitter at Selkirk, the channel for which has not yet been announced.

Stations planned for 1962 are for Inverness-shire, West Wales, Londonderry and the Channel Islands if the provisions of the Television Act are extended to cover the Islands.

Receiver Production

THE sale of 17-inch television receivers continues to dominate the home market and in 1959 represented 91% of the 2.75M receivers sold. The previous year's figure was 83% of the 2M sets sold. The sale of 21-inch sets rose from about 100,000 in 1958 to 165,000 last year—the percentage of the total sales being 5 and 6 respectively. The demand for 14-inch sets continues to decline.

Receiver exports for 1959, valued at £3,247,000, declined by 8% compared with the previous year. Sweden, for the second successive year, heads the list of receiver importers with a total of £298,796 of which all but £5,000 was for television receivers. Nigeria is second in the list with a value of £248,531, but little of this was for television—the country's first TV stations opened last October. The second highest importer of television receivers was Eire with £101,934 worth.

These figures are given in the annual report of the British Radio Equipment Manufacturers' Association.

Inst.P. and Phys. Soc. Amalgamate

PROPOSALS for the amalgamation of the Institute of Physics and the Physical Society have been a frequent topic of discussion and now a new body under the name "The Institute of Physics and The Physical Society" has been incorporated.

The Physical Society was founded in 1874 and on the initiative of that Society the Institute of Physics was founded 45 years later. The original scheme for the Institute envisaged a kind of federation of societies interested in physics.

Broadly speaking, the scientific meetings and publications of the Institute were confined to applied physics, while those of the Society were concerned more with pure physics. As, however, over the past 20 years or so, the boundary between these two aspects became less defined, there has been increasing overlap in the activities of the two bodies and in their membership.

The three Institute of Physics grades of membership—fellow, associate and graduate—will continue under the new organization but there will also be fellows of the Physical Society.

The first president of the amalgamated body is Sir John Cockcroft.

Birthday Honours

AMONG the recipients of awards in the Queen's Birthday Honours list are the following:—

Knighthood

Dr. Gordon B. B. M. Sutherland, F.R.S., Director, National Physical Laboratory.

Dr. Basil F. J. Schonland, C.B.E., F.R.S., Director, Research Group, U.K. Atomic Energy Authority.

K.B.E.

Dr. Robert Cockburn, C.B., O.B.E., Chief Scientist, Ministry of Aviation.

C.B.

Major-General E. S. Cole, C.B.E., Director of Telecommunications, War Office.

Dr. J. S. McPetrie, Director-General of Electronics Research and Development, Ministry of Aviation.

C.B.E.

Dr. T. E. Allibone, F.R.S., Director, A.E.I. Research Laboratory, Aldermaston.

Dr. R. A. Smith, Chief Scientific Officer, Royal Radar Establishment.

O.B.E.

F. W. Bates, Works Director, Kelvin and Hughes.

Dr. L. F. Broadway, Head of E.M.I. Research Laboratories.

R. J. Clayton, Manager, G.E.C. Applied Electronics Laboratories.

Dr. A. L. Cullen, Professor of Electrical Engineering, University of Sheffield.

F. J. D. Taylor, M.B.E., Staff Engineer, Post Office Research Station.

M.B.E.

F. H. Austen, General Manager, Rediffusion (South East), Ltd.

W. F. Coleman, Deputy Director of Broadcasting (Engineering), Ghana.

W. G. Dickson, Wireless Communications Superintendent, Ministry of Home Affairs for Northern Ireland.

C. A. Green, lately Communications Officer, Office of the U.K. Commissioner for Singapore and Commissioner-General for South-East Asia.

C. H. Pope, Radio Supervisor, War Office.

B.E.M.

Miss S. Holloway, Communications Officer, Birdlip Radio Station, Ministry of Aviation.

Jubilee Lectures.—To mark the 25th anniversary of the formation of the company, Ultra Electric (Holdings), Ltd., is organizing a series of lectures, the first of which will be in the Recital Room of the Royal Festival Hall, London, on September 14th. The speaker will be Professor Arthur Porter, Dean of Electrical Engineering at the University of Saskatchewan, whose subject will be "The evolution of instrumentation." On October 19th, also at the Royal Festival Hall, G. W. A. Dummer, Superintendent of Components Research, Development and Testing at R.R.E., will review the latest developments in components.

D.S.I.R. Grants for Radio Astronomy.—In addition to continued support for the Manchester University's Jodrell Bank experimental station with three grants totalling £187,000, it is stated in the D.S.I.R.'s 1959 Report that it has awarded nearly £40,000 to Professor M. Ryle for the development of new techniques and equipment at Cambridge University. Professor Ryle's work will be aimed at new methods of constructing and improving radio-telescopes and new automatic systems of data-recording for automatic computation.

Disc Production.—Figures issued by the Board of Trade show that in the first four months of this year the production of 45 r.p.m. records increased by 41% compared with last year (17.3M against 12.3M) and 33⅓ r.p.m. discs by 22% (5.5M against 4.5M). During the same period 63% fewer 78 r.p.m. discs were produced (1.5M compared with 4.1M a year ago).

Licences.—During April the number of combined television-sound licences in the U.K. increased by 98,932 bringing the total to 10,568,685. Sound-only licences totalled 4,484,063, including 432,790 for car radio. In West Germany (including West Berlin) the number of sound radio licences showed a decrease for the first time during the first four months of the year—15,617,338 compared with 15,899,447 on January 1st. During the same period combined television-sound licences increased from 3,385,003 to 3,883,145.

St. Dunstan's has re-established a scientific committee to study the whole field of sensory reading and guiding devices. This is announced in the charity's latest report. Members of the committee are: Air Commodore G. Bentley Dacre (chairman); Dr. A. M. Uttley, superintendent, control mechanisms and electronics division, N.P.L.; Dr. H. B. Barlow, King's College, Cambridge; Dr. R. L. Beurle, English Electric Valve Co.; Dr. D. E. Broadbent, director of applied psychology research unit of the Medical Research Council, Cambridge, and Lord Fraser of Lonsdale.

Anglesey Radio, the new Post Office coast radio station at Amlwch opened by the P.M.G. on May 23rd, has taken over all the coast station services previously provided by Seaforth Radio, which it replaces.

"Broadcast Entertainment by Wire."—We regret that, due to a printer's error, the name Teleng, Ltd., was misspelt in the acknowledgments on page 214 of the May issue.

Potential-indicating Lamps.—Acru's fluorescent-green indicator lamps require a minimum striking potential of 160V, not 7 160V as stated on p. 301 of our June issue.

Biological Engineering Society is the name of a new group which was formed in June. The society has a distinct bias towards electronics and is intended to bring together doctors, physiologists, electronic engineers, mechanical engineers and physicists to further the applications of engineering to biological and medical problems. The president is Dr. R. Woolmer of the Royal College of Surgeons, and the acting secretary is Dr. A. Nightingale, Physics Laboratory, St. Thomas' Hospital, London, S.E.1.

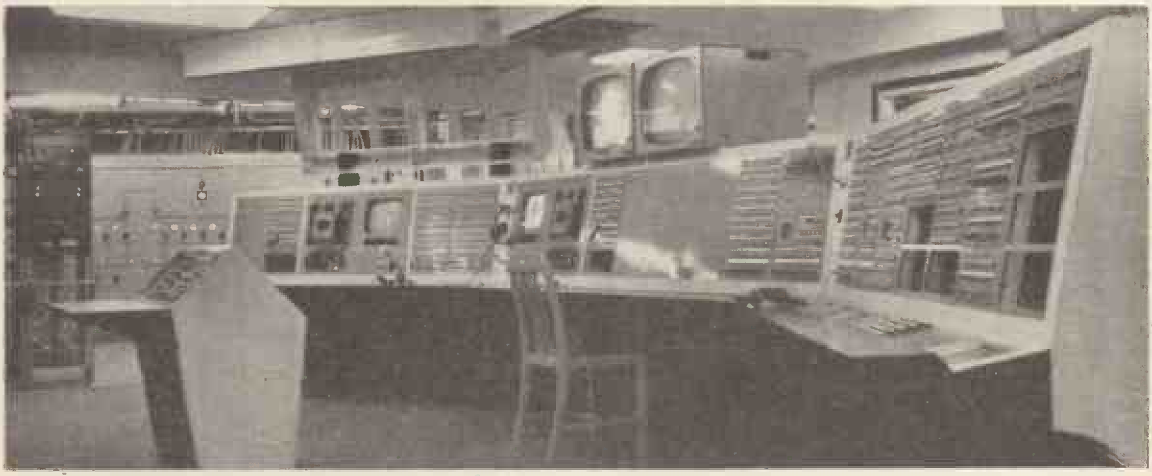
Control Engineering.—A short course providing an introduction to control engineering theory and practice is being conducted by the Loughborough College of Technology from July 18th to 29th. A leaflet, obtainable from the college, gives details of the course. The fee for the course and full residence is 35 gn.

Non-Destructive Testing.—A conference on the "Theory and practice of ultrasonic inspection" is to be held at the Queens Hotel, Cheltenham, from September 22nd to 24th. The arrangements are being made jointly by the Institute of Physics' Non-Destructive Testing Group, the Society of Non-Destructive Examination and the Non-Destructive Testing Society of Great Britain. Details can be obtained from the conference secretary, I. M. Barnes, Materials Laboratory, de Havilland Propellers Ltd., Hatfield, Herts.

Air Traffic Control.—The Guild of Air Traffic Control Officers is to hold its third A.T.C. Convention at Bournemouth on October 18th and 19th. Details are obtainable from the Guild at 118, Mount Street, London, W.1.

Electronic telephone exchanges is the subject of a conference being organized by the I.E.E. for November 22nd to 24th. It is hoped it will provide an opportunity for the interchange of information and experiences of the construction and operation of fully electronic exchanges both in this country and overseas. Further details and a form of registration may be obtained on application to the I.E.E., Savoy Place, London, W.C.2.

"Television Explained."—First published in 1947 under the authorship of W. E. Miller, managing editor of the *Wireless and Electrical Trader,* this book is now in its 7th edition. It includes a new chapter on combined television and f.m. sound receivers. Both this edition and the preceding one were revised by E. A. W. Spreadbury, associate editor of the *Trader.* It is obtainable from our Publishers, price 12s 6d.



FOCAL POINT of the B.B.C. Television Centre, Wood Lane, London, W.12. All sound and vision signals from the nine studios and the telecine and videotape machines are fed to this Central Apparatus Room for distribution. The first transmission from the centre is on June 29th.

Audio Manufacturers' Group of the British Radio Equipment Manufacturers' Association has elected the following member firms (whose representatives names are in parentheses) to form the management committee: A.E.I. Sound Equipment (L. R. Metcalfe); Beam-Echo (H. M. Rahmer); E. K. Cole (J. A. Catchpole); Clarke & Smith (Major J. F. E. Clarke); Electric Audio Reproducers (L. Stone); Gramophone Co. (H. S. Futter); Grampian Reproducers (J. E. Morley); Jason (G. G. Blundell); Lowther (D. M. Chave) and Trix (D. A. Lyons). The Committee has re-elected Major J. F. E. Clarke as chairman and elected D. M. Chave vice-chairman in succession to D. A. Lyons.

Autumn Audio Fair.—The venue for this year's Autumn Audio Fair is to be the Palace Hotel, Southport, Lancs. It is being organized by Audio Fairs Ltd., 22 Orchard Street, London, W.1, and will be held on October 7th, 8th and 9th.

R.I. Club.—The report presented at the annual general meeting of the Radio Industries Club on May 31st recorded a membership of the "parent" club of 996. The membership of the seven affiliated clubs in the provinces is 1,330. F. W. Perks, chairman of Radio Industry Exhibitions Ltd. and immediate past chairman of B.R.E.M.A., is the new president of the club.

Radio Ball.—This annual function organized by the Radio Industries Club during the National Radio Show will be held at Grosvenor House, Park Lane, London, W.1, on August 26th.

I.E.E.—More meetings were held by the Electronics and Communications Section of the I.E.E. than all three other sections of the Institution. The Electronics and Communications Section also has the largest membership (6,171) of any specialized section. During the year ended in March, the Institution membership increased by 1,678 to 46,222. Student members increased by 592 to 4,689 and graduates by 530 to 14,545.

Personalities

Lord Halsbury has been appointed a Governor of the B.B.C. until 1962 in succession to **Sir Edward C. Benthall,** who has resigned. Lord Halsbury was managing director of the National Research Development Corporation for ten years until his retirement in March, 1959. He is now chairman of International Rectifier Co. (G.B.) Ltd., which was formed by the International Rectifier Corporation of the U.S. and the Lancashire Dynamo Company, and also of L.C.E. Ltd. recently formed jointly by G. & E. Bradley (a subsidiary of Joseph Lucas) and Collins Radio Co. of America.

Alan Wolstencroft is the new Director of Radio Services in the Post Office in succession to **W. A. Wolverson,** who, as announced in our last issue, has become a Deputy Director General. Mr. Wolstencroft, who is 46, joined the Post Office in 1936. He was closely associated with the preparations for the setting-up of the Independent Television Authority in 1954 and was in fact its first secretary for a year.

M. L. Jofeh, O.B.E., A.M.I.E.E., manager of the industrial division of Sperry Gyroscope Co., which he joined in 1947, has been appointed an additional director. For several years he headed the engineering unit at the company's Stonehouse, Glos., factory, but in 1954 returned to Brentford as deputy chief engineer. He was appointed chief engineer in 1957 and, with the reorganization of the company in January last year, became manager of the industrial division in which is concentrated the company's interests in industrial control engineering. For eleven years before joining Sperry Mr. Jofeh was in the research laboratories of Cossor.

John D. Clare, M.Sc., A.M.I.E.E., has succeeded **Air Commodore H. B. Wrigley,** C.B.E., as Director of Guided Weapons Research and Development (Air) in the Ministry of Aviation. Born in 1920 and educated at Birmingham University, Mr. Clare was employed throughout the war in the development laboratory of the G.E.C., Coventry. From 1945 to 1950 he was a senior engineer with Sobell Industries. He then entered the Civil Service at what is now the Royal Radar Establishment, and was for five years section leader responsible for the centimetric receiver system on new fin control "radar" and low-altitude guided weapons. Since 1955 he has been superintendent of the surface-to-air guided weapons department.

J. D. Clare

R. I. Kinross

R. I. Kinross, M.I.E.E., managing director of Rediffusion Research, Ltd., is the new president of the Society of Relay Engineers. He was for nine years with E.M.I. and for a year with Philco before the war. During the war he served in the Royal Corps of Signals and was seconded to Military Intelligence. He joined Rediffusion after the war as chief engineer of a region, and subsequently took charge of the company's Development Department. He has been managing director of Rediffusion Research and a director of Television Research since 1958. **R. P. Gabriel,** B.Sc., M.I.E.E., A.M.Brit.I.R.E., the new vice-president of the Society of Relay Engineers, is chief engineer of Rediffusion.

P. W. Faulkner, O.B.E., has joined Rank-Xerox Ltd. as deputy managing director. He joined Plessey in 1952 and for some time was general manager of the company's commercial and metallurgical division at Towcester, Northants. He has been a director of the Plessey International Co. and also an executive director of the Plessey Co. for several years.

J. W. Soulsby, chief radio officer in the British India Steam Navigation Company's vessel *Uganda*, has been re-elected chairman of the Radio Officers' Union for the sixth consecutive year. He joined the Marconi Marine Co. at the age of 18 in 1918. **W. S. Armstrong** is again vice-chairman. It is his fourth term of office. Mr. Armstrong, who is 47, was with the Marconi Company's marine staff until 1947, when he was appointed to the staff of the Inspectors and Technical Employees' Section of the Union.

J. Sykes, M.I.E.E., M.Brit.I.R.E., M.I.N., has left the Ministry of Aviation, in which he was superintendent of the civil aviation communications centre at Croydon Airport, and is setting up as a consultant specializing in technical training and recruitment schemes. He has been with the Ministry and its predecessors for 25 years. Mr. Sykes, whose address is Red Lion Court, Stalbridge, Dorset, serves on the City and Guilds Advisory Committee on Telecommunication Engineering, and the membership committee of the Brit.I.R.E.

P. T. H. Dannahy, A.M.Brit.I.R.E., has joined Radio and Allied Industries Ltd., manufacturers of Sobell and McMichael receivers, as chief radio engineer. He was chief engineer and production manager with Peto-Scott Electrical Instruments until 1945, when he joined the Ferguson Radio Corporation as chief radio engineer.

P. T. H. Dannahy

E. David Parchment, who joined Leevers-Rich Equipment last August as technical sales manager, has been appointed a director in place of **G. W. Parkes**, who has resigned from the directorate of the company. Mr. Parchment was for many years with the Decca Record Co. and subsequently was sales director of Epsilon Sales and Services Ltd.

W. E. C. Varley, Assoc.I.E.E., A.M.Brit.I.R.E., has been appointed by the B.B.C. Superintendent Engineer, Transmitters, in succession to **E. F. Wheeler**, O.B.E., D.L.C., M.I.E.E., who has retired after 17 years in the post and 36 years' service with the Corporation. Mr. Varley joined the Corporation in 1933. During 1943 and 1944 he was chief broadcasting engineer at the Allied Forces Headquarters in North Africa.

M. H. Hall, M.B.E., has become Assistant Superintendent Engineer, B.B.C. London Television Studios, in succession to **H. Walker**, O.B.E., A.M.I.E.E., who is retiring. Mr. Walker joined the B.B.C. in 1931. He was appointed engineer-in-charge of the Alexandra Palace television station in 1950 and since 1953 has been Assistant Superintendent Engineer, London Television Studios. Mr. Hall joined the Corporation in 1927. In 1950 he was appointed engineer-in-charge of the B.B.C. Television Studios at Lime Grove.

W. D. Hatcher, B.Sc.(Eng.), A.M.Brit.I.R.E., who succeeds Mr. Hall as Engineer-in-Charge, London Television Studios, joined the B.B.C. in 1931. During the war he was concerned with the design and equipment of the B.B.C.'s high-power short-wave transmitting stations.

C. Powell, contributor of the article "Radio Aids to Hydrography" in this issue, has been with the Decca Navigator Co. since 1946. He is now in charge of the company's technical information department, but was initially concerned with applications of the Navigator for surveying and originated the two-range Decca technique. Mr. Powell's industrial career began in 1934 when he was personal assistant to P. K. Turner, of Hartley-Turner Radio. For part of the war he was attached to the Army Operational Research Group.

J. H. Mitchell, B.Sc., Ph.D., M.I.E.E., has been appointed to succeed **G. D. Christie** as chairman of the board of directors of Associated Transistors Ltd., which is operated jointly by Automatic Telephone & Electric Co., English Electric, and Ericsson Telephones. Dr. Mitchell, who is director of research of Ericsson Telephones, which he joined in 1947, was at the Bawdsey Research Station in 1936 and for his radar contributions he received an award from the Royal Commission on Awards to Inventors. Mr. Christie, who is a director of A.T. & E., remains a member of the board of Associated Transistors Ltd.

D. M. MacKay, B.Sc., Ph.D., who is in the Wheatstone Physics Laboratory, King's College, London University, has been appointed to the Research Chair in Communication founded by Granada Television in the University College of North Staffordshire.

Wing Commander A. R. Gilding, newly appointed assistant technical secretary of the Electronic Engineering Association, was until recently in charge of the branch of the Air Ministry responsible for airborne radio servicing policy and some aspects of new airborne equipments. Throughout his career in the R.A.F., which he began in 1927 as an aircraft apprentice, Wing Commander Gilding specialized in communications and radar. For two years before being posted to the Air Ministry in 1954, he was at N.A.T.O. headquarters, Oslo.

OBITUARY

Rupert Browne, O.B.E., B.Sc., who, owing to ill-health, resigned from the secretaryship of the Radio Industry Council in 1957, died on May 21st. Born in 1897 and trained as a chemist, Rupert Browne graduated at London University. In 1924 he joined the staff of the National Association of Radio Manufacturers and then, when the Radio Manufacturers' Association was formed, he joined that organization. When in 1945 the Radio Industry Council was born out of the R.M.A. he became its secretary. He was appointed an O.B.E. for his work on a war-time committee, under the chairmanship of Lord Hankey, devising and working a scheme, in collaboration with others in the radio industry, for the training of radio engineers for the Services.

F. G. Robb, A.M.I.E.E., chief of Marconi's Test Division from 1948 until his retirement five years ago, died on May 14th. He was with the company for 36 years except for a period during the last war, when he was seconded to the Admiralty, where he became chief of radar test. He was for some years in the company's design and development section, where at one time he worked on the development of transmitters for the Marconi-Franklin short-wave beam system.

John A. J. Cooper, sales director of Leevers-Rich Equipment since 1954, died on May 16th at the age of 67. After service with the War Department, Mr. Cooper joined the B.B.C. in 1928 and became senior recording engineer in the engineering division.

Philatelists among our readers will be interested in this series of six stamps recently issued by the Czechoslovak Postal Authorities commemorating International pioneers of wireless. They are Tesla (Yugoslavian); Popov (Russian); Branly (French); Marconi (Italian); Hertz (German); and Armstrong (American). Each stamp includes a portrait of the pioneer and an illustration depicting an aspect of his work.

E

News from the Industry

Relay Exchanges Ltd., record a group trading profit during 1959 of £3,583,311, compared with £2,515,988 the previous year. After deducting over £2M for depreciation and provision for renewal of equipment and £128,182 for taxation, the year's net profit was just over £1M. Sudsidiaries of Relay Exchanges include 16 radio and television relay companies, six Rentaset renting companies, four retail concerns and three manufacturing companies including Goodmans Industries.

Simms Motor and Electronics Corporation have announced a group trading profit for the past year of £1,037,690 before taxation, compared with the previous year's £632,072. Taxation absorbed £548,200 in 1959 and £366,000 the year before. Reference is made in the directors' report to the activities of N.S.F., which in terms of output and profit ranks second in the group, and to the recent acquisition of Cawkell Research and Electronics.

Pye closed-circuit television has been installed in a new plant of the Dunlop Rubber Co. at Fort Dunlop, Birmingham, to facilitate the examination of tyres being tested at speeds of up to 500 m.p.h. Each of the two cameras has two lenses. A calibration grid is electronically superimposed on the television display in the control room from which the cameras are remotely operated.

The Chloride Electrical Storage Co. has opened new central research and development laboratories at Fletcher Avenue, Clifton, Swinton, Manchester, for fundamental research into the physics of electrochemical couples, including fuel cells, and into the problems of extending life and reducing weight and cost in conventional types of cell. The laboratories have a floor space of 41,500 square feet and there is a staff of 180, including 40 qualified specialists.

Du Mont Agents.—Aveley Electric Ltd., of Ayron Road, Aveley Industrial Estate, South Ockendon, Essex, have been appointed U.K. agents for all products of the Allen B. Du Mont Laboratories Inc., of the U.S.A. The Du Mont range of equipment includes the new 425 digital-readout high-frequency oscilloscope, oscilloscope recording cameras and photo-multipliers.

Ferranti announce that they are engaged in the development of another radar fire control system, **Airpass II**. The original Airpass was shown publicly for the first time at the S.B.A.C. show at Farnborough last September. Airpass II will provide the following facilities:—air-to-air radar search and automatic tracking, computer-controlled approach for blind or visual attacks, and radar-assisted attacks against surface targets.

Britec Ltd., of 17 Charing Cross Road, London, W.C.2 (Tel.: Whitehall 3070), have been appointed distributing agents for Elesta cold-cathode tubes and electronic controls manufactured in Switzerland.

Marconi's are supplying a 50-kW 50-cm airfield control radar, Type S264, with two moving-coil display units and ancillaries, for the Royal Radar Establishment airfield at Pershore, Worcestershire.

R.C.A.—Dr. H. R. L. Lamont, director of R.C.A. European technical relations, has moved his office from Pall Mall to 36 Berkeley Square, London, W.1 (Tel.: Grosvenor 1217).

A new factory for the production of selenium rectifiers and silicon diodes was opened at Oxted, Surrey, on May 25th by the International Rectifier Company (Great Britain) Ltd., which is jointly owned by Metal Industries Ltd. (through its acquisition of Lancashire Dynamo Construction) and the International Rectifier Corporation, of Los Angeles.

Grundig in N. Ireland.—A new company, Grundig Works Ltd., is being formed in Belfast to operate a factory in Dunmurry on the outskirts of the city. The factory, which is planned to begin operation in September, will initially produce one model tape recorder, but eventually other equipment will be made. All products made at the factory will be distributed throughout the U.K. by Grundig (Great Britain) Ltd. The directors of Grundig Works include Max Grundig (founder of the organization), three others from the parent company and G. S. Taylor, chairman and managing director of Grundig (G.B.) and of Wolsey Electronics.

Nash & Thompson Ltd., Hook Rise, Tolworth, Surbiton, Surrey, have been given approval as a Part III Test House (including testing under environmental conditions) by the Director General of Inspection for Functional and Performance Testing of Electronic Components. The company's environmental and electronic testing laboratories have been in existence for over six years and have been approved as a Test House by the Air Registration Board for some time. Any firm or organization may submit components for testing to a specification and a Certificate of Test will then be issued stating that the tests have been carried out in accordance with the requirements of the Air Registration Board or Director General of Inspection.

E.M.I. Electronics Ltd. have supplied the vision equipment and have carried out the "technical" wiring and installation at Associated Rediffusion's new Studio 5, opened recently at Wembley, Middx. They are also supplying 15 cameras for the television studios being constructed at Teddington, Middx. for A.B.C. Television.

Marconi's have been awarded the contract for the supply and installation of the vision and sound transmitters for the new I.T.A. station at Caldbeck to serve the Carlisle area. In addition to the duplicated transmitters and ancillary equipment, Marconi's are supplying the mast and horizontally polarized sixteen-stack quadrant aerial which will give a vision e.r.p. in the direction of maximum propagation of over 100kW.

EXPORT NEWS

Midas range of magnetic tape data recording equipment developed by Royston Instruments Ltd., of Byfleet, Surrey, is to be marketed in the Western Hemisphere and Australasia by Lockheed Aircraft Services Ltd., of Ontario, California.

The Italian hydrofoil, *Freccia dell Adriatico*, which operates a passenger service between Trieste and Venice (a distance of 80 miles) at an average speed of 40-45 knots, carries Kelvin Hughes marine radar type 14/9. Kelvin Hughes have also received orders for radar for Italian-built hydrofoils for operation in Norway and Finland.

Poland.—Three Marconi Mark IV television cameras and ancillary equipment have been ordered for the Warsaw studios of the Katowice station which was equipped by Marconi's. Polish television operates on the 625-line, 8Mc/s standard.

Brazil.—The complete studio and transmission equipment for a new television station at Recife, Brazil, costing in the region of £250,000, has been supplied by Marconi's.

India.—G. S. Dhingra, director of Union Radio & Appliances Private Ltd., of 72 Janpath, New Delhi, will be visiting the U.K. in July to negotiate with firms interested in collaborating in the manufacture in India of components such as fixed and variable resistors and capacitors, loudspeakers and switches.

Wire Broadcasting in Holland

PLANS FOR DISTRIBUTING TELEVISION OVER THE EXISTING SOUND NETWORK

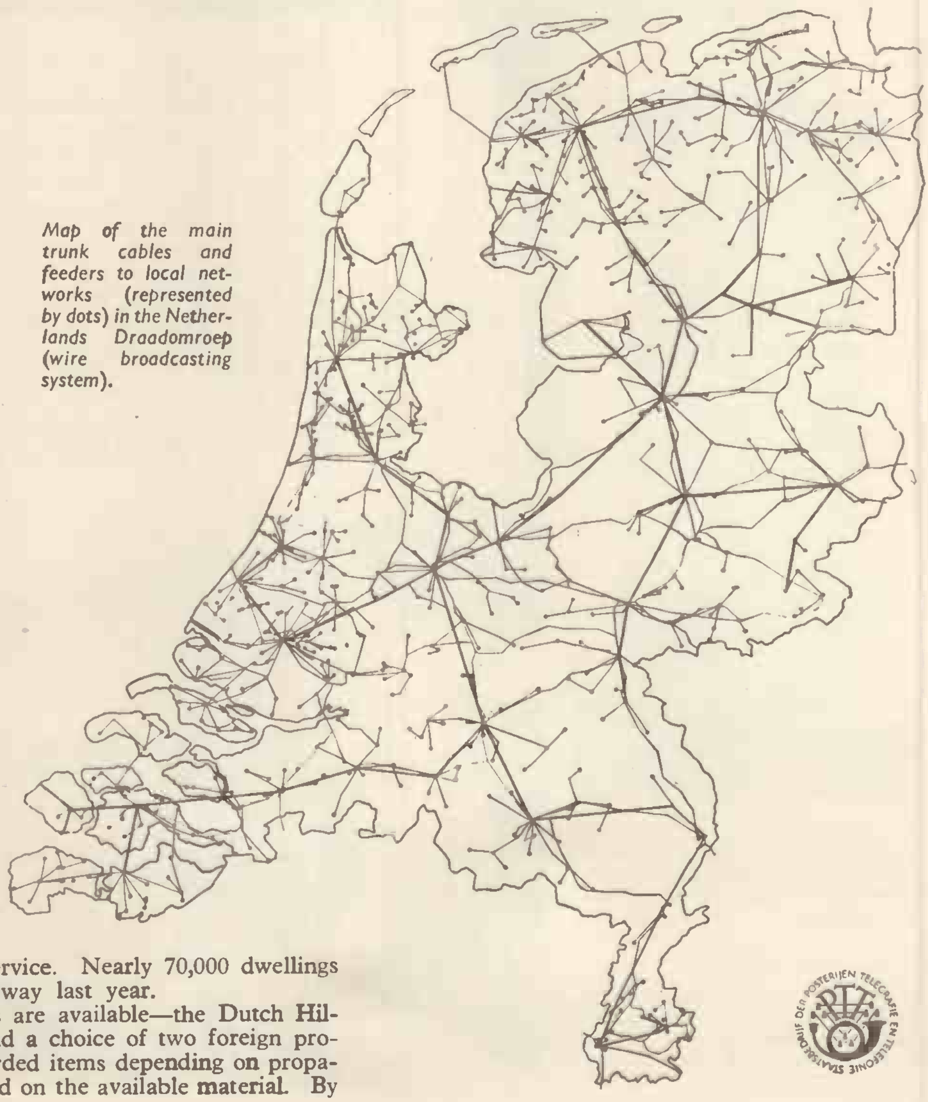
ALTHOUGH Holland is a relatively small country it has always held a high reputation for its contributions to art, science and the social services. In broadcasting its radio stations led the way in Europe in the early days, and today it enjoys one of the most efficient and widely disseminated wire distribution systems in the world.

This is run by the postal telegraph and telephone authorities, the Netherlands PTT, which was made responsible during the war for control of several independent networks and has since continued to develop and extend an integrated system.

The accompanying map gives some indication of the coverage (1959) of the main trunk cables and branches. Points on the map represent one or more power amplifiers feeding local "networks" of anything up to 1,800 houses. The total number of subscribers in Holland is about 500,000 in a population of 11 millions (1 in 22) whereas in Great Britain the ratio is 1 in 50 (1M in a population of 50M). All new housing estates in Holland are now wired in advance for telephone and broadcast relay services, without any obligation on the tenants to become subscribers. Terminal outlets are embedded in the wall plaster and covered by a flush-fitting cover, which is easily replaced by a control panel with stepped volume control and selector switch if the occupants of the house or flat elect to take the relay service. Nearly 70,000 dwellings were fitted in this way last year.

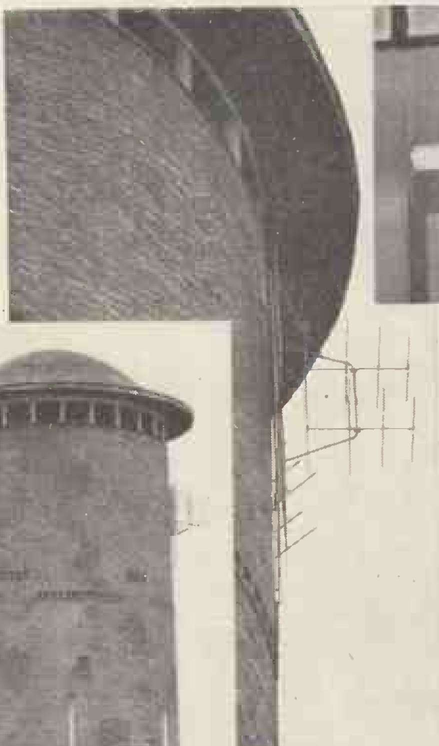
Four programmes are available—the Dutch Hilversum I and II and a choice of two foreign programmes or of recorded items depending on propagating conditions and on the available material. By mutual arrangement with the Belgian authorities, any of their programmes may be selected by remote control and passed direct from Brussels to Rotterdam by land line. Programmes from other countries are picked up by special receivers placed at favourable sites on the borders of Holland. The receivers for the three B.B.C. services are installed in a water tower at Domburg on the island of Walcheren and normally give an acceptable signal/noise ratio from Wrotham (130 miles) or Norwich.

Special care is taken to provide high quality of reproduction and a frequency response of 40c/s to 10kc/s ± 2dB is guaranteed in all parts of the system. Local distribution amplifiers are housed



Map of the main trunk cables and feeders to local networks (represented by dots) in the Netherlands Draadomroep (wire broadcasting system).

in kiosks which are visited regularly each month by technical staff in a van specially fitted with the instruments necessary for a thorough check of performance. The audio power available at the subscribers' outputs is of the order of ½ watt which provides an acoustic level sufficient for most people's needs if a loudspeaker of reasonable efficiency is used. Although the authorities do not supply more complicated reproducing equipment, guidance is given for those who may wish to use existing receivers or add high-quality power amplifiers.

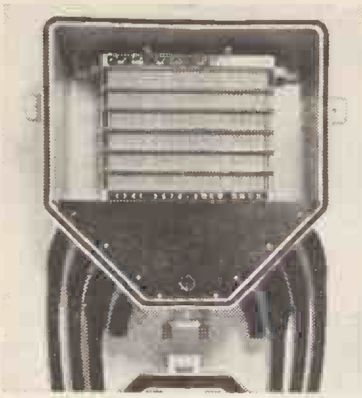


At present there is no regular wire distribution of television in Holland, but a thorough investigation has been made* of the feasibility of using the existing sound broadcasting cables at high frequencies. It has been found that the polythene-insulated, unscreened cables with four pairs, each twisted with different pitches have a good performance at frequencies up to 10Mc/s and that the older paper insulated cables can also be used satisfactorily. The polythene cables used in Holland appear to suffer less from increased attenuation—about 10 to 15% under adverse conditions compared with over 30% for similar types used elsewhere. The average loss per kilometre is between 23 and 57dB at the chosen vision carrier frequency of 7Mc/s depending on the

* See for example " Some Problems Concerning the Experimental Wire Television Service as Realised in the Netherlands," by A. P. Bolle, *Het PTT Bedrijf*, Vol. IX, No. 3, November 1959.

Above: The receiving station for English programmes is situated at the top of the water tower at Domburg in the island of Walcheren.

Right: Control centre at Rotterdam, where programmes are selected and monitored. Level indicators for each of the four programmes are at the back of the control desk.



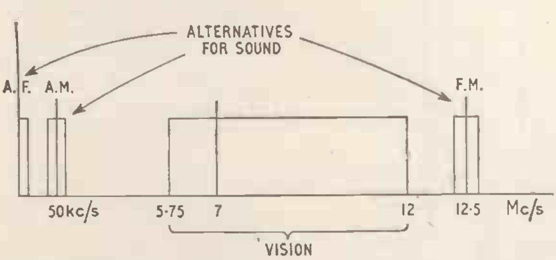
Above: Distribution box for subscribers' lines. Television and/or sound signals can be applied to any subscriber by the insertion of the appropriate resistive or inductive elements which are encapsulated in foamed polyster resin.

Right: A mobile laboratory visits each network amplifier once a month for a thorough check of performance.

type of cable under consideration. The cross-view between pairs at a distance of 2km is better than 40dB. With a sending level of 3 volts peak-to-peak the maximum radiated field at a distance of 3 metres is $200\mu V/m$. Interference picked up on the unscreened cable would be of longitudinal character and experience has shown that its magnitude is unlikely to cause trouble unless the signal level falls below 20mV.

The characteristic impedance of the cables at r.f. is of the order of 100 ohms and careful matching at all junctions is necessary to avoid reflections and "ghosts." The ratio of the special transformers used at these points varies according to the number of subscribers which may be up to as many as 16. The impedance "seen" at the secondary is about 1.5 ohm and as each subscriber's loading is of the order 5,000 to 10,000 ohms decoupling is very effective. Separation of sound and vision takes place after the subscriber's selector switch by simple series inductors and capacitors.

By using a vision carrier of 7Mc/s with a complete upper sideband and vestigial lower sideband it is possible to legislate for the use of existing receivers by changing the oscillator frequency and to keep the f.m. sound signal at the normal spacing of 5.5Mc/s, i.e., at 12.5Mc/s. Alternatively, if special simplified television receivers become available for use with the wire system it is proposed to provide the sound accompaniment as a double sideband a.m. signal on a 50kc/s carrier. This is preferable to sending the sound at audio frequency as it enables the original four sound-only programmes still to be distributed. Although the initiation of a regular wire television service in Holland still awaits official sanction and possibly the backing of private enterprise to provide the recommended special receiving equipment, the technical problems of transmission have been solved.



Spectrum of the proposed television transmissions with possible alternatives for the sound accompaniment.

Through the courtesy of the Netherlands PTT *Wireless World* was able recently to witness test transmissions of alternative television programmes over standard four-pair cables carrying the regular sound programmes. The two television signals were using synchronized carriers on adjacent pairs of an experimental circuit installed at the Leidschendam research laboratories. Excellent picture quality was obtained and there was no trace of interference from either sound or the alternative vision programme, even when the modulation of one vision carrier was switched off and the raster examined at full gain.

Similar tests carried out over a period of a year with the collaboration of subscribers in a district of the Hague have proved the reliability of the system in the field. Only one live television programme is at present available in Holland, but satisfactory tests of cross-view were made with the alternative programme supplied by a pattern generator. It was also confirmed that the effect of any external interference picked up by the unscreened feeders is negligible.

European Television Stations

Europe's 680 or more television stations in Bands I, III and IV are tabulated geographically and in order of frequency in the 5th edition of the list of TV stations produced by the Technical Centre of the European Broadcasting Union. A chart showing the stations in each of the channels is included in the publication, which is obtainable from the E.B.U., 32 avenue Albert Lancaster, Brussels 18, Belgium. The list and its supplements costs 50 Belgian francs.

High-gain Video Amplifier*

FURTHER NOTES ON VERSIONS FOR GRID OR CATHODE MODULATION

By R. G. YOUNG

IT is very gratifying to learn from the Editor that there has been a widespread interest in, and requests for, further practical details of a circuit which I should have thought would have been of merely limited interest. Evidently many folk still prefer to make their own television receivers, even in these mass-produced days and in spite of the trouble in getting parts. You almost need a licence to get 110° scanning coils!

The circuit was evolved after many efforts to overcome i.f. instability, bearing in mind that "fringe-area" operation was required. The instability manifested itself partly by bad streaking after bright objects—this was particularly so in scenes containing venetian blinds or staircases. The other effect was a black edge on bright objects, due to overshoot; this was not quite so bad, but looked terrible on Test Card C.

It seemed to me that the trouble arose from excessive signal levels appearing at the detector diode. The only answer could be to get more video-frequency amplification, and this circuit was the result after much trial-and-error experimentation with various arrangements.

It seems a little complicated, but it goes into a space 5in × 2½in quite comfortably (see Fig. 1). I put both cathode-bypass capacitors on top of the chassis where they were easy to get at, as a change of 20% in value produces an appreciable difference in the picture, and can make or mar results. It appears that if the first cathode-bypass capacitor is too high in value, a "ring" at about 2Mc/s is caused and too high a capacitance in the second amplifier cathode circuit causes a less-severe ring at about 1Mc/s.

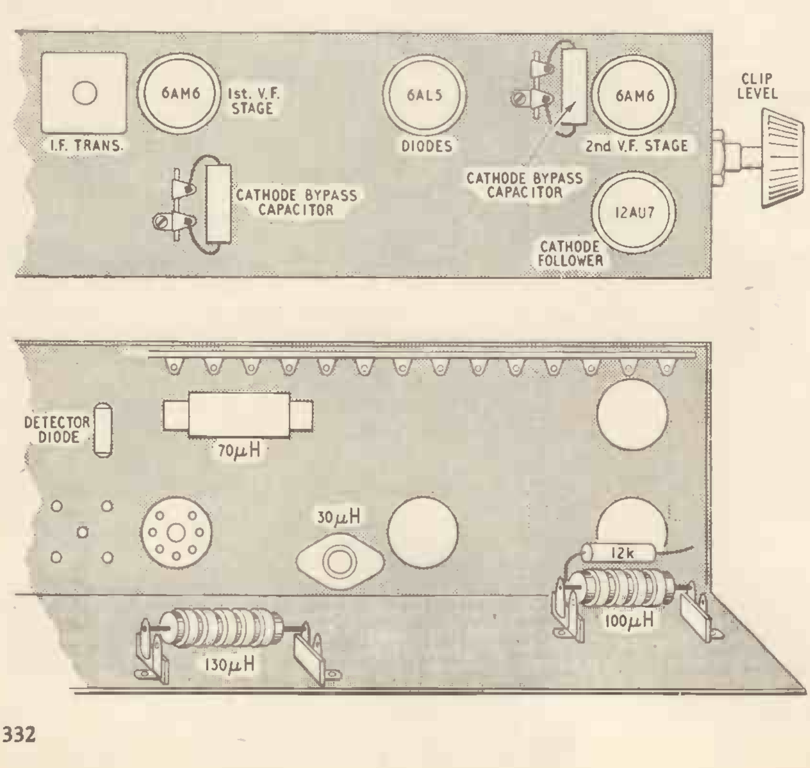
In the original version definition was quite satisfactory with a wideband i.f. amplifier; but it is possible that the circuit might be used with an i.f. amplifier having a narrower pass-band, in extreme fringe conditions. In this case a choke in the second v.f. stage anode circuit can improve the picture.

Fig. 2 is the final result. Shown here is the use of a thermionic diode for the detector—some readers may prefer it—and it does make the polarity quite clear.

If space is very limited a triode-pentode of the ECF82 type can be used for the second amplifier and cathode follower with, however, a loss both of gain and peak-to-peak output (about 30%). Some may wish to eliminate the cathode follower altogether. To do this would mean using a lower-value anode resistor in the second v.f. stage, as the stray capacitance of the c.r.t. and synchronizing separator would then become important. The effect would then be to reduce the available output (peak-to-peak). It could be done, but I do not recommend such a radical change, just to save a single triode; better to use a triode-pentode. Further information about the use of cathode followers in v.f. amplifiers was given in a Mullard technical advertisement (*Wireless World* for August, 1955, p. 90†).

It may be desired to use the amplifier in a receiver designed for grid modulation of the c.r.t. Several changes are needed in addition to the

Fig. 1. Top and under-side views of 5 x 2½-in chassis layout used for cathode-modulating version of amplifier. Leads must be kept short and stray coupling avoided.



* See "Letters to the Editor," p. 294, *Wireless World*, June 1960.

† This is an abridged version of a paper published in *Mullard Technical Communications* No. 12 (May 1955), p. 42.

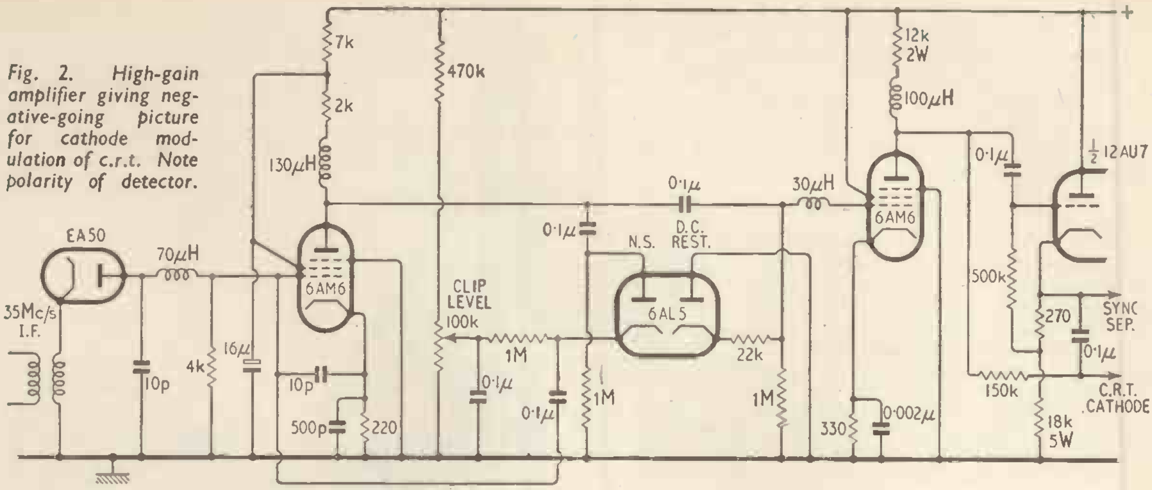


Fig. 2. High-gain amplifier giving negative-going picture for cathode modulation of c.r.t. Note polarity of detector.

changes in polarity. The d.c. restorer becomes superfluous as the second v.f. stage grid will do the same job, by reducing the cathode bias. The purpose of the "safety circuit" round the cathode follower in Fig. 2 is to ensure that, in the event of a valve failure, the c.r.t. beam is cut off. For grid modulation of the tube this is achieved when the feed is taken directly from the cathode follower, so this safety circuit is not necessary. The modified circuit is shown in Fig. 3.

There now remains to be supplied data on choke winding. The coils of 70μH and 30μH are close-wound solenoids, and the 130μH and 100μH inductors employ pile-wound sections. Details are shown in Fig. 4. All the coils were checked on an inductance (audio-frequency) bridge: it would be wise to adopt this procedure because surprising variations in inductance can occur with hand-wound coils.

It must be remembered, too, that when one of these circuits is used to replace the existing video amplifier in a receiver, some adjustment to the brilliance-control network may be necessary to achieve proper range of control.

In conclusion, one unexpected bonus from the use of this circuit is the apparent reduction of "snow"

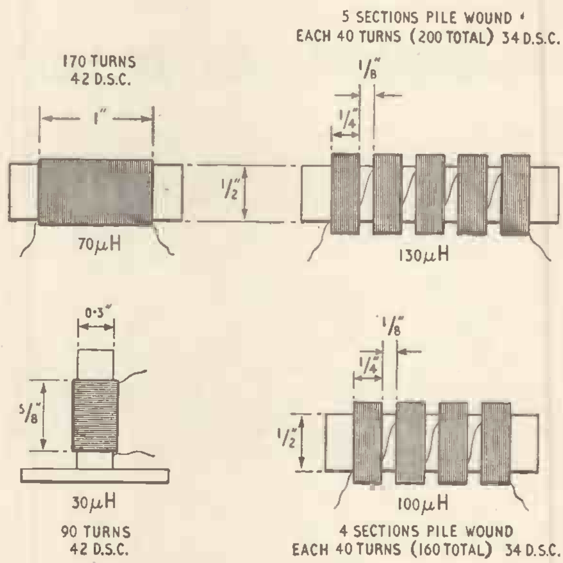


Fig. 4. Coil-winding details (wire gauges given are s.w.g.).

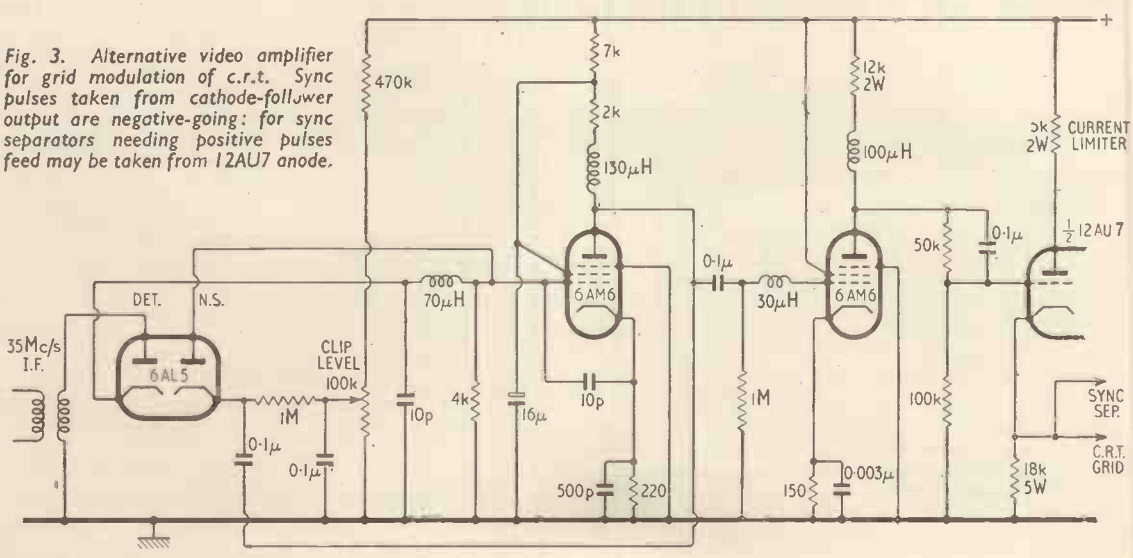


Fig. 3. Alternative video amplifier for grid modulation of c.r.t. Sync pulses taken from cathode-follower output are negative-going: for sync separators needing positive pulses feed may be taken from 12AU7 anode.

on the picture; just why that is, I do not attempt to explain, but just mention it in passing.

Several readers have asked for recommendations of diode type. This is quite unimportant; I have tried Mullard OA10, G.E.C. GEX34 and "unknown" (surplus) types and could perceive no difference in the image obtained.

APPENDIX

For use at i.f. below 35-38Mc/s the filtering is not really satisfactory. As the circuit stands, a small amount of an i.f. below say, 20Mc/s, could appear in the output. This might not cause trouble in all cases, but it would be advisable to connect a 70-μH choke in series with the cathode follower output when using a low i.f.

Where ½-in diameter formers are not available 0.3-in diameter can be used. For the 130-μH and 100-μH coils use wire gauge and spacing as shown in Fig. 4 but increase each section to 65 turns. The 70-μH coil would be sectionally wound with similar dimensions to the 100-μH choke, but each section would contain 50 turns.

Birmingham-London TV Link

SO that programmes, rehearsals and advertisements originating at A.TV Alpha Studios, Aston Road, Birmingham, can be seen at Associated Television's headquarters in London, Pye Telecommunications Ltd. have installed for A.TV a 7Gc/s, 135-mile-long link for both sound and vision. Three automatic repeater stations are used at Meriden, Cold Ashby and Barkway and the terminals are on the C.M.L. building in Birmingham and at Highgate, London.

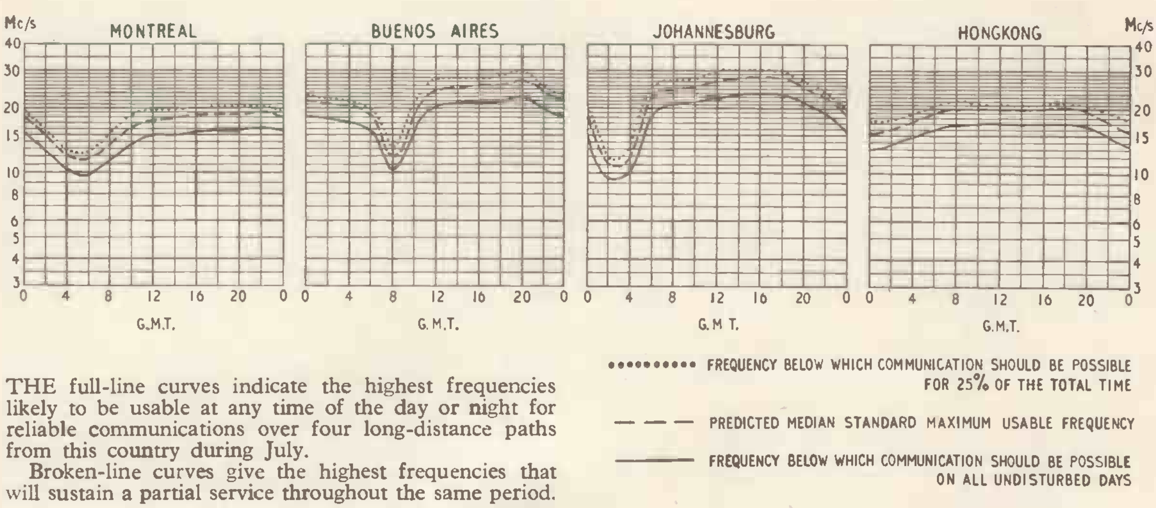
A feature of the Barkway repeater, which has a tower over 200ft high, is the use of passive reflectors on the tower with the microwave transmitter and receiver aerial "dishes" mounted horizontally only a few feet above the ground. Normally both the transmitter and receiver would have to be placed at the top of the tower, or long waveguides would be necessary to feed the aerials, so a considerable saving in both initial and maintenance costs has been made possible by the use of this technique of "mirroring" at the top of the tower the aerials at ground level.

Plane passive reflector on mast reflects to next repeater becm from aerial at ground level.

Faults occurring at any station are automatically indicated on the London control board by telemetry circuits operating over a 450-Mc/s control link. Authority to install and operate the system was granted by the General Post Office, who have recently made available a band of microwave frequencies for such operations.

SHORT-WAVE CONDITIONS

Prediction for July



THE full-line curves indicate the highest frequencies likely to be usable at any time of the day or night for reliable communications over four long-distance paths from this country during July.

Broken-line curves give the highest frequencies that will sustain a partial service throughout the same period.

General view of the four huge reflectors at Thule, Greenland

BMEWS

American Long-range Radar Warning System

ALTHOUGH primarily a defence project for N. America the ballistic missile early warning system (BMEWS for short) is of more than passing interest to us in the U.K. first for its technical features and secondly because one of the three "forward bases" is to be in this country. Under an agreement between the U.S.A. and the U.K. we are co-operating in setting up and operating a radar tracking station on Fylingdales Moor, Yorkshire. The technical equipment for the station is being provided by the U.S. but the station will be commanded and operated by the R.A.F. The other two bases are at Thule, Greenland, and Clear, Alaska, and all three will be linked by duplicated communication channels, using cables, tropospheric scatter and microwave radio links, to the control centre of the North American Air Defence Command (NORAD) at Colorado Springs, Colorado.

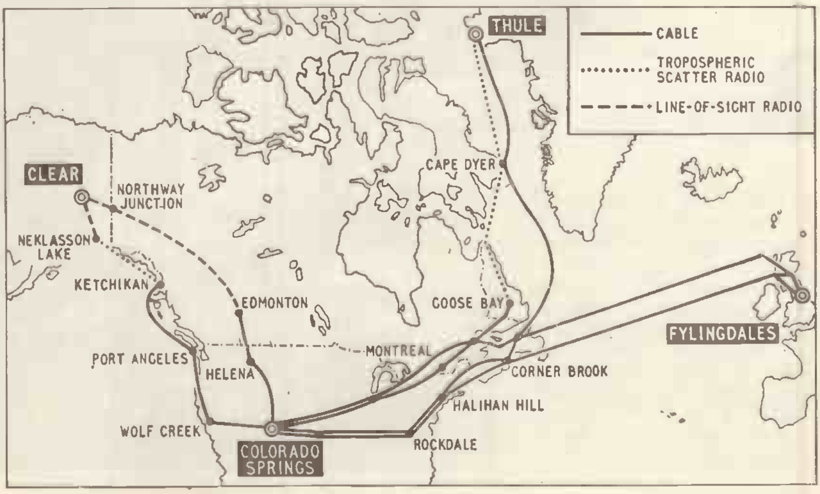
The first base to be completed is at Thule which is planned to come into operation later this year. At this site there are four large rectangular reflectors each measuring 400 feet long and 165 feet high. These are for the pulsed-Doppler detection radar and together they will give a total azimuth coverage of 150 degrees.

Pulsed transmissions, fed into each reflector from horns on its nearby transmitter building, form two stationary horizontal fans at different elevations. Prediction of the probable land fall of a missile will be obtained by extrapolating its path from the range, azimuth, bearing and time sequence data recorded as it passes through the fans. Three similar reflectors, giving a coverage of over 100 degrees are being installed at Clear, Alaska, which is scheduled to come into operation some time next year.

At Thule there will also be a dual purpose tracking radar the paraboloid of which will be housed in a specially treated plastic sphere 140 feet in diameter. It is this type of radar which will be installed in this country. At Fylingdales there will be three of these radomes capable of both detecting and tracking missiles and they will provide azimuth coverage of over 100 degrees.

The paraboloid and its pedestal weigh over 150 tons. The radome of the prototype tracking radar at the R.C.A. establishment at Moorestown, New Jersey, was assembled from 1,646 hexagonal sections

Communication routes linking the three radar bases with the BMEWS control centre in Colorado. It will be seen that all links are duplicated.



each section consisting of a 6in thick "biscuit" of resin-impregnated paper between fibre glass walls.

At Thule station staff are protected against possible radiation hazards by the provision of screened passages linking all buildings on the one mile-square site.

The three stations when completed will have an overall range of some 3,000 nautical miles, which is ten times that of the DEW (Distant Early Warning) line which was established across the North American continent some time ago.

Reliability of the whole system is of paramount importance. To ensure continuous operation all equipment is duplicated and there is an elaborate system of checking and monitoring installed.

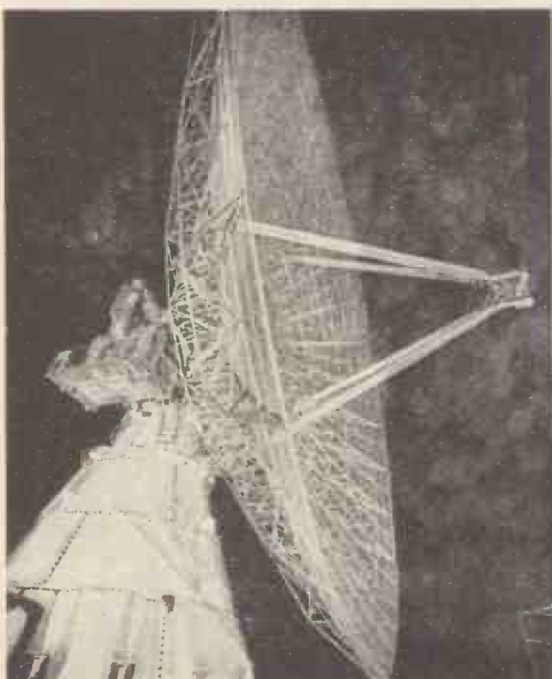
Some idea of the magnitude of the whole BMEWS project can be gained from the following statistics given by the American Department of Defense. Although R.C.A. is the "prime contractor" for the project with Western Electric responsible for the communications network, there are 2,900 sub-contractors. The permanent staff at Thule when it becomes operational will be about 1,000 and at Clear about 600.

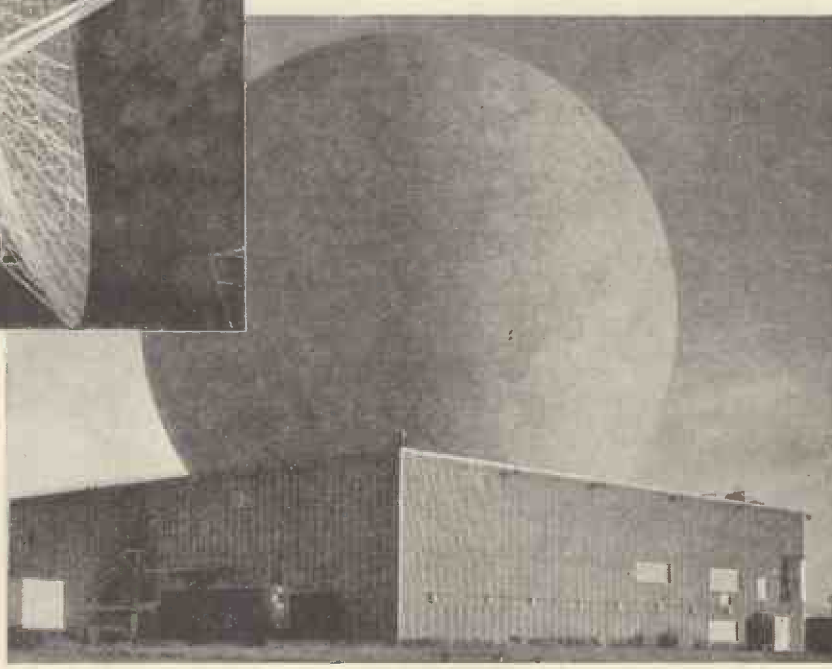
The estimated cost of the whole project is over $950M; about half this sum being for the Thule site.

High-power klystrons for the BMEWS project.

The cost to the U.S. Air Force of the Fylingdales site is $114M.

At the Thule site power during the construction of the station and subsequently for the operation of the system is supplied by a U.S. Navy generator ship—incidentally, the heat dissipated by the generating equipment keeps ice from forming in the basin in which the vessel is anchored.





Scanner of the tracking radar inside its 140-foot radome. Note the sectional construction of the sphere. On the right is the prototype radome housing the tracking radar atop its transmitter-computer building at the R.C.A. experimental establishment at Moorestown, New Jersey. The buildings and radome to be built at Fylingdales, Yorkshire, will be of similar construction.

BETTER CIRCUIT DIAGRAMS

By PATRICK HALLIDAY

SHOULD WE ADOPT CONTINENTAL CONVENTIONS ?

ASK any service or maintenance engineer which part of a service manual is the most important: infallibly the answer will be "the circuit diagram." Without it the engineer is like a sailor without a chart; with it—no matter how little other information may be available—the skilled man will be prepared to tackle the most complex unit. But do British equipment manufacturers always make their main circuit diagrams as clear and as informative as possible? Here the answer will be no less certain—in many, too many, cases an unequivocal "no."

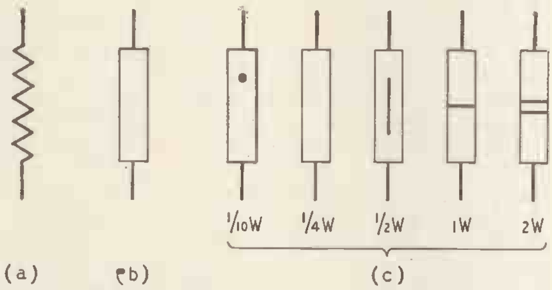


Fig. 1. The "common or garden" fixed resistor, (a) as cultivated in Britain, (b) the less elegant but equally distinctive Continental variety, (c) a Continental bunch, complete with wattage coding.

For more than a decade, drawing offices have had as their guide British Standard 530:1948, "Graphical Symbols for Telecommunications," together with a series of supplements, now six in number. Even the most casual inspection of the circuit diagrams actually used in maintenance manuals by British electronic firms will show, by the great diversity of styles, that so far this Standard is accepted fully by only a small percentage of draughtsmen—or at least of those who determine the house styles. But are the circuit diagrams, even when drawn in accordance with B.S. 530, as informative as they might be? And do they not represent far too much wasted time and effort in the drawing offices? It is illuminating to compare traditional British circuit conventions and symbols with those now coming generally into favour on the Continent, more especially in Austria and Germany. The best European circuit diagrams (and it must be admitted immediately that there are many very bad ones) may look strange and unattractive at first to British eyes, but they offer substantial advantages both to those who must pay for their production and to the ultimate user, once he has familiarized himself with their codes and circuit symbols.

In British practice, the resistor—possibly the most common of all components—requires upwards of nine separate lines (see Fig. 1 (a))—and over-enthusiastic draughtsmen, proud of their ability to produce a mathematically correct zig-zag, not infrequently extend them to as many as seventeen or eighteen bends. If the wattage reading of the resistor is to be indicated, it must be written out alongside the symbol, adding time and clutter to the diagram. The unadorned rectangular box of the Continental diagram, Fig. 1 (b), is not only simpler to produce (particularly with a stencil), but opens the way to providing wattage information with a minimum of effort. Fig. 1 (c) shows a commonly used code which can quickly be added to the box, reproduces well and requires no extra space.

Fixed capacitors or condensers (for, despite all the efforts of the powers that be, the old term still marches gaily on) are drawn basically similar the world over (Fig. 2 (a)); but the overseas draughtsman seems much more inclined to throw in additional information for good measure. In the United States, it is common practice to indicate the correct connection for the "earthy" side (outer foil) by using a curved line on one side: Fig. 2 (b). On the Continent, the correct voltage rating is often indicated by means of simple codes; a representative code is shown in Fig. 2 (c). The objection may be made that, when reproduced by printing processes, small dots may appear or disappear accidentally; in practice this would seem to be no more bothersome than the many other potential sources of error.

The widespread Continental adoption of the nanofarad unit of capacitance (1nF=1000 pF or 10^{-9} farad) is yet another valuable aid in cutting down

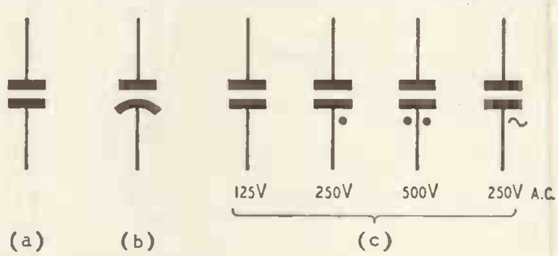


Fig. 2. How the familiar two-line capacitor symbol can be adapted to provide additional information: (a) standard; (b) indication of outer foil connection; (c) a representative voltage rating code as used on the Continent.

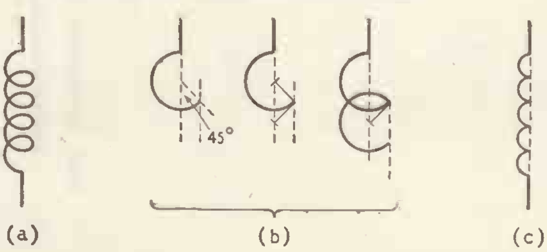


Fig. 3. Coils may look like (a), but to draw this symbol accurately is not simple—one way is shown in (b) which is not so quickly accomplished as the straightforward half-circles (c) now widely used on the Continent and in the United States

drawing time and circuit clutter when showing component values on circuit diagrams rather than relegating them to a separate component list—a practice which, though leading sometimes to overcrowding of the diagram, is generally popular with service and maintenance engineers, especially where the complete wattage or voltage specification can be given. More and more drawings for service manuals, British and foreign, now include on the main diagram the valve pin numbers and typical check voltages, as well as component values. With the nanofarad, such values as 0·003 μF, 0·02 μF need be shown only as 3n, 20n, retaining μ for values of 0·1 μF and above. Incidentally, why do so many firms persist—despite paragraph 36 of B.S.530—in adding μ, F or H after every value? It is a long time now since even the Royal Navy abandoned its beloved jars of capacitance.

Then there is the question of inductive components. Here Continental and American practice scores on production time, if for no other reason. Fig. 3 (a) shows the traditional British symbol for all forms of inductors. To produce this accurately on the drawing board requires a procedure along the lines indicated in Fig. 3(b). Compare this with the symbol now finding increasing favour on the Continent and in the United States—Fig. 3(c)—which is just a series of half circles but which is every bit as distinctive as the traditional symbol (often, in fact, clearer when reproduced on a small printing block which may cause the small loops of the British symbol to fill in).

Audio-frequency and mains transformers take a considerable time to draw accurately with the loop system of Fig. 4(a), particularly by draughtsmen whose ambition it appears to be to include almost as many symbolic turns as there are real ones. The Continental style, Fig. 4(b) may look a little uglier at first—but how much easier to produce! And immediately distinguishable from other types of transformers.

To come down to earth (or chassis) on the Continent requires only one small line—Fig. 5(a)—compared with our four (Fig. 5 (b)). Indeed the main chassis line is frequently omitted altogether, again simplifying production, though—to some British eyes—often resulting in a rather untidy and difficult to follow circuit diagram.

The sum total of the time spent in British drawing

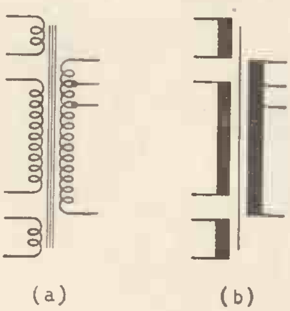


Fig. 4. Will export orders wait while your drawing office painstakingly produces the mains transformer (a)? Your European rival may beat you to it with the simply produced (b).

Fig. 5 The single line of (a) takes less time to draw than the four lines of (b).

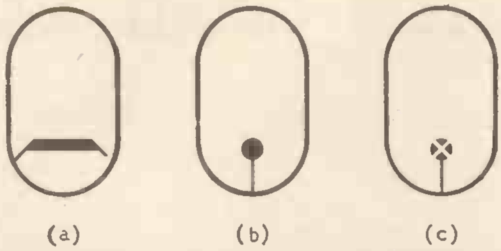


Fig. 6. Sketch (a) may seem a distinctive cathode, but (b) is quicker to draw, and in the form (c) provides additional information.

offices in producing carefully shaped valve cathodes (Fig. 6(a)) in accordance with British Standards—sensibly not done, one notices, by *Wireless World*—would surely make any organization and methods man come down heavily in favour of the Continental short-cut (Fig. 6(b)). A useful additional feature of this symbol is that it can easily be adapted to indicate that a particular cathode is common to other parts of a multiple valve (Fig. 6(c)).

One should perhaps not be too hard on British traditional conventions: in the best examples the circuit diagrams look good, are easy to follow, and keep many draughtsmen contentedly exercising their skill—even if so many of the lines they draw are unnecessary and add nothing to the information conveyed to the user. But keep those Time and Motion Study people out of the drawing offices, or many firms may finish up—despite B.S. 530—adopting some at least of the Continental practices.

CLUB NEWS

A mobile rally is being organized jointly by a number of clubs in the southern counties for July 17th. It will be held at Beaulieu Motor Museum, near Southampton. Control stations G31VP/A (1980kc/s) and G2HIF/A/(144.13Mc/s) will be operating from 10.30 a.m. Programmes of the Southern Counties Mobile Rally, costing 6d, are available from R. Bassett, 42 Northam Avenue, Shirley, Southampton.

Prestatyn.—Meetings of the Flintshire Radio Society are now held at the Ffrith Hotel, Ffrith, Prestatyn, at 7.30. At the meeting on July 4th, T. A. P. Colledge, of the G.P.O., will talk on subscriber trunk dialling. On the 25th the club is holding a 160-metre d.f. hunt.

Tunbridge Wells.—The second of a series of talks on 2-metre operation will be given to members of the West Kent Amateur Radio Society by the president, W. H. Allen (G2UJ), on July 22nd. The club meets on alternate Fridays at 7.30 at Culverden House, St. John's, Tunbridge Wells.

"The Eyes of the Few"

THE many *Wireless World* readers who served in the wartime R.D.F. system (radar to newcomers) would be well advised to take this book* on holiday with them. If, like the author—Daphne Carne, *née* Griffiths—they spent 1940 in the active Kent and Sussex sector, they may find it almost unbearably nostalgic. Unpretentiously told, this account of the experiences of a W.A.A.F. R.D.F. Operator is vivid and exciting. Those who were not there to see for themselves should find it not only entertaining and at times moving but also informative concerning an essential and none-too-well publicized part in the saving of the world from Nazi domination.

M. G. S.

*P. R. Macmillan Ltd. 15/-. pp. 238. 14 illustrations.

B.B.C. SATELLITE STATIONS

THE coverage of the present 23 B.B.C. television stations is about 98.8% of the population, though this figure includes people in some areas where reception is, at times, subject to severe interference. When the 14 stations (marked stage 1 on the map below) announced last year, come into service by March, 1962, a further 200,000 people will come within the service area and about a million will have an improved service. The P.M.G. has now given "approval in principle" to the second stage of the B.B.C.'s plans for extending and improving television coverage. This provides for a further 10 satellite stations, which, when completed early in 1964, will bring television to about another 100,000 people and improve the service for a further 400,000.

Plans have also been announced for extending the v.h.f. sound service. The coverage of the existing 20 stations, most of them providing a three-programme service, is a little over 97% of the population. Stage 1 of the v.h.f. satellite scheme (see above map) which is also scheduled to be completed by 1962, adds a further 10 stations bringing the service to a further 640,000 people. The 11 satellites to be erected by 1964 under Stage 2 will bring the service to another 350,000 people.

Pickup Design

By J. WALTON*

RELATIVE IMPORTANCE OF VARIOUS FACTORS

VARIOUS excellent articles have appeared from time to time on one or more of the factors mentioned here, so that it is not proposed to enter deeply into these factors in themselves, but rather to try to indicate their relative importance.

This is attempted as a result of observing how such articles sometimes cause those who do not have the facilities or time to make quantitative comparisons to attend to a particular feature in a manner that is disproportionate to its overall effect on the performance of the gramophone.

Pickup Arm Length and Stylus Tip Radius

I am starting with "tracking error" since this seems to be a common source of care and of a desire for longer pickup arms in systems with a far greater source of distortion, namely the size of stylus tip employed.

Now if we accept the maxim that a chain is as strong as its weakest link, and we also wish to play the last ten minutes or so of our precious l.p. records, then we must consider the fact that the size of the stylus tip is the factor causing the greatest distortion in *any* type of gramophone pickup.

The distortion due to tracking error is given by H. G. Baerwald[1] as

$$\eta_2 = \frac{V\alpha}{u} \times 100$$

where η_2 is the percentage second harmonic distortion, V the peak recorded velocity, α the tracking error in radians and u the groove speed.

Let us then consider a moderately large signal at the *inside* of the record where tracking error will do its worst: say 5 cm/sec r.m.s. lateral velocity when the diameter is 4¾in on a record rotating at 33⅓ r.p.m., and a tracking error of 4 degrees. Then the groove velocity

$$u = \frac{4\cdot75 \times 3\cdot14 \times 2\cdot54 \times 100}{3 \times 60}$$

$$= 21 \text{ cm/sec}$$

so that $$\eta_2 = \frac{5 \times 1\cdot41}{21} \times \frac{4}{57} \times 100$$

$$= 2\cdot3\%$$

which, after correcting for the recording characteristic,

$$\approx \mathbf{1\cdot3\%} \text{ (second harmonic)}$$

Now, according to H. E. Roys[2], the main component of the lateral tracing distortion is given by

$$V_{D3} = \frac{3(\pi r f)^2 V^3}{4u^4}$$

where V_{D3} is the third harmonic distortion velocity, r the stylus tip radius and f the frequency.

And, if V_{D3} is small, this is approximately equivalent to

$$\eta_3 = \frac{3\,(\pi r f V)^2 \times 100}{4u^4}$$

where η_3 is the percentage third harmonic distortion.

Take the same signal of 5 cm/sec and the smallest available stylus radius of 0·0005in (which according to usual manufacturing tolerances is likely to be nearer 0·0006in). Since the distortion here depends on frequency, we will take a moderate 3kc/s.

Then $$\eta_3 = 75\pi^2 \times \frac{(0\cdot0006 \times 2\cdot54 \times 3000 \times 5 \times 1\cdot41)^2}{21^4}$$

$$= 4\%$$

which, after correcting for the recording characteristic,

$$= \mathbf{1\cdot6\%} \text{ (third harmonic)}$$

i.e. with 5 cm/sec r.m.s. velocity at 3kc/s, the distortions from a 4-degree tracking error and from a nominally ½-thou stylus are about the same.

Moreover, we may say that below such figures where tracking and tracing distortions are equal they are both of little importance for practical hi-fi purposes.

Distortion figures above this point, however, are attained at an enormously greater rate in the case of tracing distortion than in the case of tracking error distortion.

For instance by the time one "reaches" even 10cm/sec at 4kc/s, we get 12% tracing distortion and 2·6% tracking-error distortion, even for a nominally ½-thou tip, and a nominally 0·0007-in tip gives 20% tracing distortion. However, I must say that where the values calculated are *extremely* large, they are not *so* large by measurement.

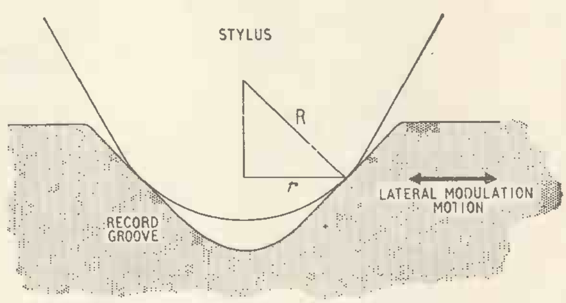


Fig. 1. "Effective stylus tip radius" (r) for lateral modulation.

Since an 8-in arm can give a 2½-degree tracking accuracy, and certainly better than 4 degrees even with manufacturing tolerances, there would appear to be no advantage in exceeding 8in unless the stylus tip radius can also be reduced to well below 0·0005in.

Whilst considering tracing distortion, I would like clarification upon whether or not the change in the effective stylus tip radius with modulation adds another variable to the equations. Lateral modulation motion would appear to me to give

* Decca Record Co. Ltd.

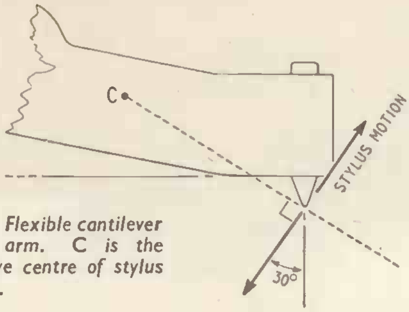


Fig. 2. Flexible cantilever stylus arm. C is the effective centre of stylus motion.

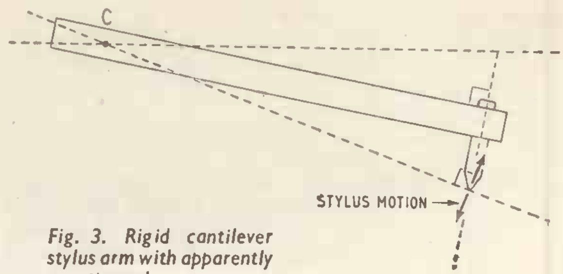


Fig. 3. Rigid cantilever stylus arm with apparently negative rake.

significance to the dimension r (see Fig. 1) which I call the "effective stylus tip radius." This is $1/\sqrt{2}$ times the actual radius R for a 90 degree unmodulated groove, but is modified to a higher value by the pinch effect.

Thus the effective stylus tip radius would appear to me to be an extra variable in the lateral case, but not in the stereo case of a 45 degree movement. However, the effective tip radius is the larger (equalling the actual radius) for stereo, and this must be a factor giving greater distortion in stereo reproduction, unless, of course, the correspondingly smaller actual tip radius is used.

I would conclude this section by saying that since only lighter tracking-weight pickups allow of smaller stylus radii on account of their effect on wear, a gramophone pickup must primarily be assessed on its genuine tracking weight and tip radius.

Needle Trail, Vertical Tracking and Stereo

Again, if the effect of tracking error was serious, we should be in greater trouble with *vertical* tracking errors in stereo pickups than has actually appeared to happen, since a difference of 23 degrees of "vertical" tracking angle occurs between the cutterheads of one manufacturer and another, to say nothing of differences between different pickups, and a further 15 degrees change between the top and bottom records in a changer.

It is not my intention to belittle these discrepancies. On the contrary, I am at present trying to correct the vertical motion of a flexible transmission arm similar to that described in the April 1959 issue of *Wireless World* (p. 182). Since the whole stylus arm flexes here, an effective centre of rotation can be found which determines the instantaneous direction of motion of the stylus tip.

For the arrangement shown in Fig. 2; as used in a typical mono head, the "vertical" motion is at 30 degrees to the vertical. This is unimportant in the mono case since the actual forward movement due to the lift produced by pinch effect is too minute to add any significant further tracing errors, but the departure from vertical motion must be very much reduced in a stereo pickup.

Let me take this opportunity of discussing the effective centre of rotation in relation to cantilever stylus arms in general, and needle trail in particular.

Any normal cantilever arm will have an effective centre for the stylus motion, and not only will this govern the direction of "vertical" motion of the stylus, but it will also give the effective trail of that stylus.

Now it has long been considered advantageous to have a small amount of needle trail, and some cantilever styli have been criticised on this basis when the rondel has been mounted with an apparently "negative rake" (as in Fig. 3). But surely the original purpose of "positive rake" as it was applied to the older type of needle (as in Fig. 4(a)) was to ensure that any forward drag at the stylus tip did not cause the stylus to dig further into the groove (as in Fig. 4(b)) with a cumulative effect upon this drag and its resultant digging.

The cantilever shown in Fig. 3 is, however, completely exonerated if its flexing centre is at C as shown, for it then has in fact an effective positive rake of about 70 degrees. This does not, however, exonerate the cantilever from having a 20 degrees to vertical "vertical" motion if it is to be used for stereo.

Vertical Compliance and Tracking

It could be imagined that the "hill and dale" aspect of stereo where there is no restriction in the vertical *downward* direction could lead to a condition where the groove receded from the stylus at a more rapid rate than that at which the compliance could cause the stylus mass to follow. It might be thought also that mechanical resistance to motion of the stylus arm could give an even more stringent tracking condition, and that all these problems were something not encountered in lateral recording in which two groove walls "direct" the stylus.

It can be shown, however, that there is no essential difference between the lateral and vertical cases, since not only are the groove walls at 45 degrees to both the vertical and horizontal, but also the friction, particularly at low tracking weights, is too low to make any appreciable difference between the lateral force required to make the stylus ride up out of the groove and the vertical force required to make the stylus leave the groove in a frictionless manner as in the "hill and dale" case.

Consider Fig. 5. For static equilibrium the upward reaction force F on the stylus tip of mass m must equal the tracking weight, and m must also be subject to an equal downward force F. If the groove is *suddenly* lowered then the acceleration α of the

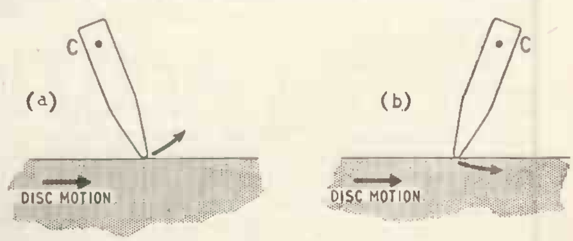


Fig. 4. Older-type styli with positive (a) and negative (b) rakes.

stylus tip mass m is given by $\alpha = F/m$. Thus the acceleration is not dependent upon the compliance but on the tracking weight and stylus mass, provided that the displacement of the stylus is too small to appreciably alter F.

In fact the groove displacement at 8 kc/s and a peak recorded velocity of 22 cm/sec is $22 \div (2\pi \times 8000) =$ **0.00044 cm.** Now consider a 1-gm pickup with an effective stylus tip mass of ½ mgm and a compliance of 25×10^{-6} cm/dyne. The static displacement of the stylus as the pickup is placed on the record is **0.025 cm.** Thus the above condition that the groove displacement be too small to appreciably alter the 1 gm force on the stylus is fulfilled. The stylus acceleration is thus 2000g, which is nearly twice that of the groove ($2\pi \times 8000 \times 22$ cm/sec$^2 \approx 1100$ g), and the tracking possibilities thus remains as for lateral modulation.

Mr. R. W. Bayliff in as yet unpublished work relating to the Decca stereo pickup has pointed out that a *stiffer* vertical movement can give a greater tracking capability, for a given effective stylus tip mass and tracking weight, in that portion of the upper middle register where the vertical compliance

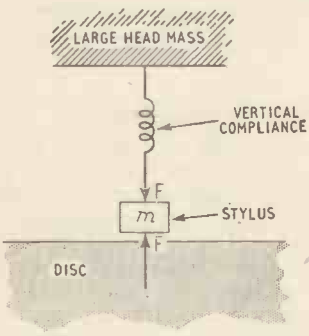


Fig. 5. Stylus tip mass (m) in static equilibrium. F is equal to the tracking weight.

resonates with the effective tip mass. But this does not alter the main argument, nor that a *greater* compliance gives a greater tracking possibility at all frequencies below this resonance and that a lower tip mass gives better tracking above this resonance.

If resistance is now introduced into the stylus arm, this will have its greatest effect at maximum velocity (zero acceleration with a sine wave) and have no effect at zero velocity (maximum acceleration). Thus the vertical tracking condition is as before, and provided that the maximum force due to resistance is not greater than that due to stylus inertia or cantilever stiffness then no additional tracking weight is required.

It might be said, however, that to cope with a peculiar case where the effects of maximum velocity, acceleration and displacement all occurred together, then a tracking force corresponding to the sum total would be required.

There would also appear to be the possibility of an integration of upward signal impulses by the momentum of the head so as to require extra tracking weight thereabouts. This of course applies also in lateral recording in the form of integration of impulses not only of vertical pinch effect movements but also of extra forward drag due to modulation, this integration being converted into side thrust that tends to push the stylus out of the groove so as also to require extra tracking weight. However, due to

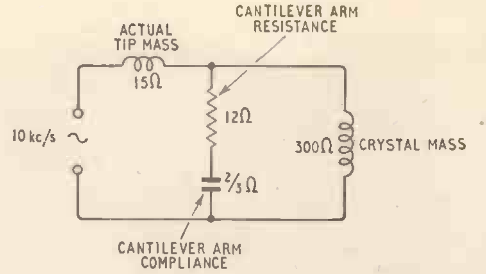


Fig. 6. Simplified mechanical impedance analogue of a flexible cantilever arm pickup. Typical impedance values at 10kc/s are shown.

the pickup arm geometry, the side thrust here will only be about one-fifth of the forward drag. Thus although the stylus arm resistance may be limited in magnitude to, and entirely out of phase with, the other factors of mechanical impedance for sine wave motion, then even in that motion, the resistance and impedance could conceivably have a combined effect in their integrated sum.

And we could probably continue " in ever decreasing circles " discussing this and that smaller and smaller points, but the problems of producing a high-fidelity stereo pickup do not, I think, yet warrant this.

Groove Speed and Record Wear

Since most record deformation normally takes place at points of maximum acceleration or displacement, it would appear therefore that the inclusion of a substantial amount of resistance in the stylus arm will not decrease the life of a record.

I might mention that the increase with age of the resistance of p.v.c. must be taken into account in most of the pickups in use. This increasing resistance may also alter the effective stylus impedance at high frequencies as shown by Fig. 6.

When considering record wear in a theoretical way we have usually started from Hertz's equations for a static indenter in the elastic range, and a conception of record wear is then evolved around the " mean pressure " under the indenter (thus the pressure is assumed to be inversely proportional to the square of the stylus radius). Now not only does this assume a direct relation between mean pressure and wear, and so does not take into account any wear due to the greater impact of a larger stylus radius in a smaller groove curvature (i.e. under conditions of high tracing distortion) but it does not even take into account the linear speed of travel of the stylus in an unmodulated groove.

I hope to be able to present some experimental results in the near future on these last aspects and their general relation to the gramophone record. Results so far obtained indicate that recourse to lower turntable speeds would be severely detrimental not only to quality (distortion varying inversely as the fourth power of the groove speed) but also to record life, and that other means of gaining playing time are both possible and preferable.

REFERENCES

1 *Jour. Soc. Motion Picture and Television Engineers*, Vol. 37, Nov. 1941, p. 591.

2 *R.C.A. Review*, Vol. 10, June 1949, p. 254.

Ohm's Law and Negative Resistance

—AND THE LAW THAT KIRCHHOFF FORGOT TO INVENT

By "CATHODE RAY"

SPECTATORS of the recent duel between D. L. Clay and myself in the correspondence columns no doubt noted with interest Mr. Clay's shrewd thrust with my own weapon dated August 1953. To alter the metaphor, he used my own voice to pronounce me dimmer than a beginner. Must I accept this unflattering assessment, or alternatively eat my 1953 words? The dilemma is unattractive. Being a generous opponent, however, Mr. Clay invited further explanation. This course (assuming the Editor is equally generous with space) I elect to adopt. Quite apart from the obvious possibilities of a verbal smokescreen for evasive action, further explanation appears to be justified for the following reasons. With youth now at the helm, what Cathode Ray said in 1953 must seem almost as far-off as what Gladstone said in 1888. Next, in a misguided attempt to be brief, what I said (or didn't say) in last February's issue evidently left room for Mr. Clay—and maybe others—to find obscurities and contradictions. And the whole thing has convinced me that Ohm's law is even more treacherous than I thought, and that is saying a lot.

First of all (summarizing the 1953 contribution) we must say what we mean by "Ohm's law." My guess is that what most people mean is

$$I = \frac{E}{R}$$

(or its equivalent, $E = IR$ or $R = E/I$) in which E is the e.m.f. in volts required to drive a current I amperes through a resistance R ohms. Though undoubtedly a useful piece of information, this would have looked very strange indeed to Dr. Ohm, who would have been at a loss to account for his name being attached to it, since volts and amperes had not been invented in his lifetime and the ohm was a unit of wine, equal to about 40 gallons and therefore presumably beyond the means of a struggling teacher. Even the concepts of e.m.f. and resistance would have been novel to him. So much so that it is not easy for us, saturated in "Ohm's law," to follow just what it was that Ohm discovered. Put into modern terms, it seems to have been that the ratio of e.m.f across a conductor to current through it (i.e., its resistance) does not vary with the amount of current, provided the temperature is constant.

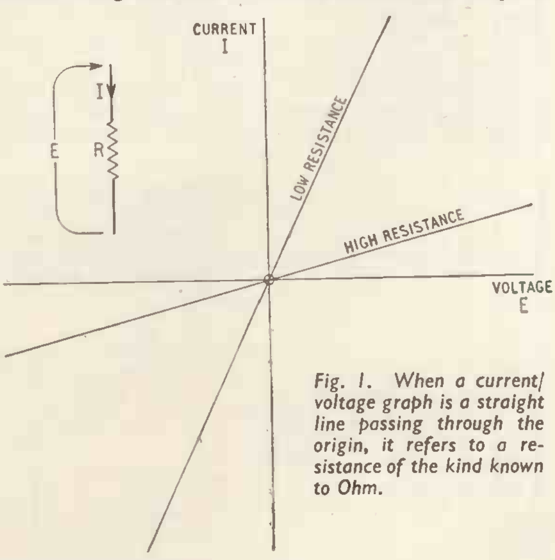


Fig. 1. When a current/voltage graph is a straight line passing through the origin, it refers to a resistance of the kind known to Ohm.

Note that *our* "Ohm's law"—$R = E/I$—says nothing of the kind. For all it knows, R may be variable. In these days of semiconductors it often is. But Ohm's experiments were carried out on metal wires, and the constancy of their resistance has been confirmed within very much closer limits than were possible with his crude apparatus.

It is probably too late to make "Ohm's law" mean what Ohm meant, which is true for metals but not for semiconductors or insulators. We call metallic resistances "ohmic" or "linear" (because their current/voltage graphs are straight lines passing through the origin). But "Ohm's law" in present-day usage is simply a convenient formula, relying on a system of units Ohm never knew, and true for any kind of conductor, linear or otherwise. It can also be regarded as a definition of resistance.

However, the thing is not quite as simple as that, because *sometimes* "Ohm's law" must be understood to imply the "law of Ohm" (as we may call what Ohm meant). For instance, an elementary exam paper might say "The current through a 500-Ω resistor is 0.3A; use Ohm's law to find the voltage across it." This obviously means the well-known formula, and it would make no difference to the answer if the resistor disobeyed the "law of Ohm." But if the question were "When 150V is applied to a resistor the current is 0.3A, what is with 40V?" one would have to assume the resistor obeyed the "law of Ohm" to be able to answer it at all. A knowledge of the system of units used is unnecessary, whereas the answer to the first question would depend on the units (e.g., it could be 150V, 0.15kV, 15,000,000,000 e.m.c.g.s. units, or 0.5004 e.s.c.g.s. unit).

There are some other circumstances to be understood. Ohm's experiments were carried out with d.c., and that is generally taken for granted in connection with "Ohm's law" too. Fig 1 shows current/voltage graphs for two resistances, which can both be recognized as ohmic by their straightness. It doesn't matter how much e.m.f. is applied (so long as the temperature is not altered appreciably); its ratio to the current gives the same resistance every time. Reversing E (i.e., multiplying it by -1) reverses I too, so we have the continuations towards the bottom left.

Fig. 2, which is the sort of result we might get with

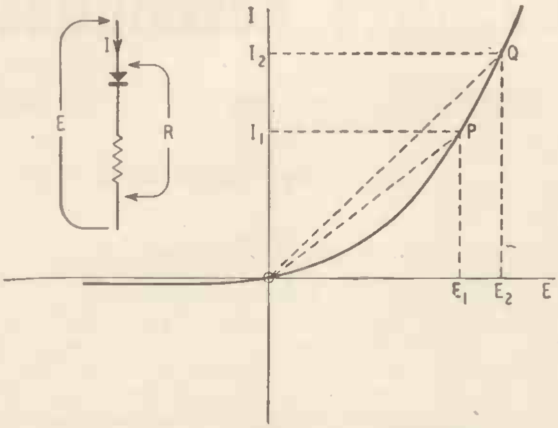


Fig. 2. Many circuit elements now in common use have resistances that do not follow the pattern of Fig. 1. Though non-linear to d.c., they may be at least approximately linear to a.c. within limits, as for example P to Q here.

an ohmic resistor in series with a germanium rectifier, is quite different. E_1/I_1 gives one value of resistance, which anyone ignorant of non-ohmic resistances would assume to be representable by the dotted line OP. Increasing the voltage to E_2 causes a disproportionate current increase to I_2, so the calculated resistance E_2/I_2, represented by OQ, is less. Neither of them is the resistance most likely to interest us in this more sophisticated era, when E might consist of a steady voltage half-way between E_1 and E_2, plus an alternating voltage with peak value $(E_2-E_1)/2$. The latter would alternate between E_1 and E_2, and the corresponding part of the current would alternate between I_1 and I_2. So far as this current is concerned, the resistance (being represented by the nearly straight line PQ passing through the *a.c.* origin) is almost ohmic, and less than either of the d.c. values. It is known as the a.c. or incremental resistance. The poor beginner is usually left to guess from the context whether "resistance" means the d.c. or the a.c. kind.

The next complication is that the circuit may contain reactance. In point of fact, it is bound to; but what I mean is that the reactance may be enough to have an appreciable effect on the amount of a.c. flowing. Now there are various ways of handling this. A common one in elementary textbooks is to produce the following (or something equivalent) as "Ohm's law for A.C.":

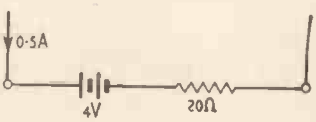
$$I = \frac{E}{\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}}$$

Having now gone on record as accepting, however reluctantly, "Ohm's law" as meaning "I=E/R", I will no doubt be exposing myself to attack from Mr. Clay if I object to the above on the ground of its being outside the experience of Dr. Ohm. In self-defence I might claim that it is wildly remote from his experience. But my main objection is that it brings in a new principle. To teach beginners that reactance is just a special kind of resistance that applies only to a.c. (as some books do) may make it look easier at first but is likely to make things more difficult later on. I would be inclined to emphasize that reactance is something quite different from resistance, even though it is reckoned in ohms and mixed up with it in impedance. The reason is that resistance is essentially something that takes any electrical energy it can lay its hand on as an outright gift, whereas reactance accepts it only as a short-term loan, scrupulously paying it back in full within a single a.c. cycle. (Idea for a chapter title in Cathode Ray's Monster Nursery Book of Electrical Theory—"The Story of the Bad Mr. R and the Good Mr. X." Including, of course, "Pat-a-cake, pat-a-cake, Vector's Man; Turn it through half pi and mark it with 'j'"). Anyway, just now resistance is enough to be thinking about, without complicating the issue with reactance.

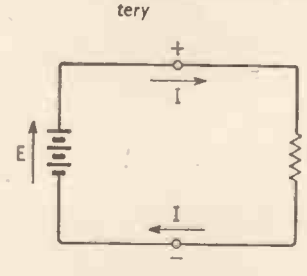
For we are coming to the bit that was turned against me. I said (in 1953) "that it is no good trying to apply Ohm's law to a circuit containing an e.m.f.—at least, not without allowing for the e.m.f. If E=IR were applied to find the voltage between the terminals [in Fig. 3 here] the answer would be $0.5\times20=10$. But the measured voltage would be 14. The reason for this discrepancy is obvious, and even a beginner would have to be rather dim to fall into the trap." So I suppose it really was asking for trouble to offer (in 1960) the diagram reproduced here as Fig. 4, and, having requested the audience to look between the terminals eastwards to see a positive resistance R, proceed to turn them around facing the battery and suggest that it appears to be a negative resistance—even with the proviso "not an ohmic one in this case!". Being more modest than you might think, I had not imagined the possibility of anyone following my utterances with such attention as to be able instantly to quote any of them made within at least the last seven years. I hope it will be a lesson to me.

Mr. Clay—for none other than he is the prodigy alluded to—skilfully turned aside my defensive stroke (which was to ask what gave him the idea that I was applying "Ohm's law" to Fig. 4) by a thrust cunningly disguised as an apology. He said he was sorry he had incorrectly assumed I had used "Ohm's law" to show that a generator is equivalent to a negative resistance, but it was the only way he knew of obtaining a value of resistance from a voltage and current. And to increase my discomfiture he added that he also assumed "non-ohmic" meant "non-linear," but, as the current did not affect the voltage in any way, perhaps "non-resistive" would have been better.

"Touché," I believe, is the appropriate expression. Not that I concede having said anything actually wrong, but an explanation which left room for such



Left: Fig. 3. In measuring the real d.c. resistance between the terminals, one would have to exclude the 4-V battery



Right: Fig. 4. This is the controversial diagram. Is it legitimate to regard the battery as a negative resistance?

comments can't have been a very good (i.e., foolproof) explanation of negative resistance. The fault was not in what I said but in what in my haste I didn't say to guard readers against the treacheries of "Ohm's law."

So let us begin with Fig. 4 again. Looking at what we have between the terminals on the right-hand side, we recognize exactly the situation we met in Fig. 1. We measure the voltage between the terminals, and find it to be equal to E. We also find a current I flowing from the positive to the negative terminal, which is conventionally the same direction. So the current has the same sign (+ or −, depending on which terminal we choose as our reference) as the voltage. We therefore have the data for plotting the two points P and P′ in Fig. 5. If we had the opportunity to vary E we would be able to plot more points, which (assuming R to be "ohmic," in the sense already defined) would all fall on the sloping straight line marked "R."

Now let us about-turn and consider the same pair of terminals from the opposite direction. Performing the same two measurements, we would find the

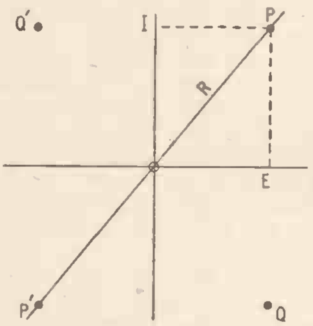


Fig. 5. P and P′ are points on a current/voltage graph of R in Fig. 4. Q and Q′ are points measured in the same way on E.

direction of the current reversed relative to the voltage, so the results would have to be represented in Fig. 5 by Q and Q′. Since P and P′ represented R, Q and Q′ must represent −R. That is what I meant by saying that the battery was equivalent to a negative resistance. The logic of the conclusion seems inescapable. Moreover, the positive resistance R is a dissipator of power; its opposite or negative should therefore be a source of an equal amount of power, and that is precisely what the battery is. And, just as according to Kirchhoff's Second Law the total voltage around a circuit (reckoning a current-carrying resistance as a negative voltage source) must be zero, in an alternative view

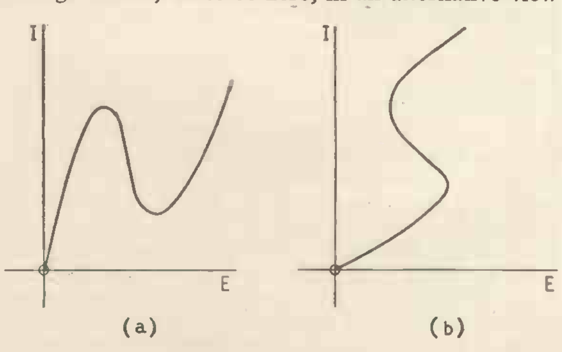


Fig. 6. Two types of current/voltage curve showing negative resistance.

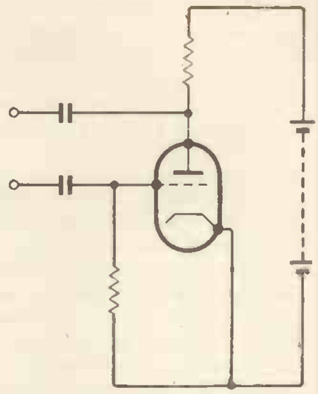


Fig. 7. A practical "negative resistor."

the total resistance around a circuit (reckoning a voltage source as a negative resistance) must be zero. And, just as the negative voltage source in Kirchhoff's law is a rather peculiar one, depending entirely on the current, so my negative resistance is (as Mr. Clay pointed out) an analogously peculiar one. If we had the opportunity to vary R, the additional points would not lie on the straight line joining Q′ to Q. They would, of course, be on vertical lines through Q′ and Q. That was why I warned readers not to expect an ohmic resistance. And since this is only an extreme case of the sort of thing we found in Fig. 2, I am sticking to that, rather than Mr. Clay's "non-resistive." For the equivalent negative resistance of the battery is found by "Ohm's law," in just the way he is used to. But I ought to have warned him (and less knowledgeable readers) that an *equivalent* resistance is one calculated by applying "Ohm's law" without regard for the rule (needed for finding *real* resistances) about excluding sources of e.m.f. For example, the equivalent or apparent resistance between the terminals in Fig. 3 is $14/0.5 = 28\Omega$. The 4-V battery absorbs the same power and has the same voltage across its terminals as an 8-Ω resistor *at that current.* In fact, unless one was allowed to vary the current one could not distinguish between the battery and a resistor by any electrical test.

Just as the source of current-opposing e.m.f. in Fig. 3 is thus equivalent to a positive resistance, the source of current-assisting e.m.f. in Fig. 4 is equivalent to a negative resistance, as I hope all can now see. The point I was trying to make in this way is that a negative resistance is in effect a power source. I did not intend to convey that all negative resistances vary with current in the same way as the battery in Fig. 4 does. Practical negative resistances are negative over only a limited range of current and voltage, and fall into the two classes shown in Fig. 6, distinguished for obvious reasons as "N" and "S" types. Because of this limited range they are of interest chiefly as regards a.c. (Compare Fig. 2.) Certain valves and semiconductor devices* have characteristic curves of one or other of these types. Similar effects can be produced artificially by positive feedback in an amplifier. For instance, an a.c. negative resistance is found between the terminals in Fig. 7, and a tuned circuit connected to them is set into oscillation thereby, provided that its positive resistance isn't enough to make the total resistance positive.

* A new example is coming up for attention next month.

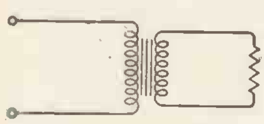
Mr. Clay and perhaps spectators around the ring may be thinking—even openly saying—that in order to get myself out of an awkward position I have been making up the rules as I go along. In 1953 I said any fool can see that one mustn't include e.m.fs when applying "Ohm's law," and in 1960 I said of course that is only for "real" resistances; for "equivalent" resistances one can. Where is there a rule about there being different sorts of resistance?

The British Standard definition of resistance (B.S.205:1943, No. 1276) says "That property of a body by virtue of which it resists the flow of electricity through it, causing a dissipation of electrical energy as heat. It is equal to the constant difference of potential applied to the ends of the body divided by the current which it produces when the body has no e.m.f. acting therein."

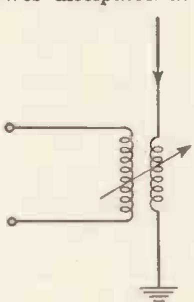
That is not only resistance in the strictly real sense, but is confined to d.c.—note the *constant* d. of p. That obviously doesn't get us very far in these days, but lower down (No. 1283) there is a definition of "effective resistance":

"Of a circuit element with alternating current. The component of the terminal voltage in phase with the current divided by the current. The power dissipated in heat divided by the square of the current."

This is really two definitions, defining quite different things. The second one agrees with No. 1276, and in fact could be substituted for it as an a.c./d.c. definition. For the power P in a d.c. resistance is given by EI, and dividing that by I^2 leaves E/I, which is "Ohm's law" again. I am assuming that the definers meant strictly the power dissipated as



Above: Fig. 8. What is the a.c. resistance between the terminals?



Right: Fig. 9. And what is the resistance between these terminals?

heat *in the circuit element* referred to. That is rather an important point, as we see if we consider Fig. 8. What is the "circuit element" to which the terminals are connected? The primary winding? The whole transformer? Or the transformer and its load regarded as one element?

With any reasonably efficient transformer, the heat dissipated in the primary, or even the whole transformer, should be small. Most of the power fed in at the terminals would be dissipated in the load resistance. But if that is reckoned as a separate circuit element, its heat mustn't be counted. Its effect on the circuit between the terminals *is solely as an e.m.f.*—the e.m.f. induced in the primary by current flowing in the secondary circuit, which depends mainly on the load resistance. However, if the whole of Fig. 8 is deemed to be "a circuit element," then this e.m.f. is a purely internal arrangement for distributing the dissipation, and the definition is of the strict kind.

Note that heat is also dissipated in the iron core, because currents are induced therein, and in the insulation because of charging currents between wires, and extra "skin-effect" heat in the wires because of e.m.fs induced in them. It would be hopeless to try to find the a.c. resistance of the whole thing accurately by counting up the ohms due to all these different effects; hence the idea of doing it in one by measuring the power and dividing it by the current squared. This gives the single resistance that would run away with the same power when the same current was flowing.

How do we measure this power? Since the definition refers to power dissipated as heat, we are committed to a calorimeter measurement, which is a messy, time-consuming and (except perhaps in the N.P.L.) inaccurate business. So we are strongly attracted to the first No. 1283 definition, which allows us to measure the electrical power fed in. In this circuit it would give the right answer. But not everywhere. Consider Fig. 9. Here, if the thing is doing its stuff, most of the power is radiated. To make the two definitions agree it would then be necessary to stretch the "circuit element" to include the entire universe, which seems rather far-fetched. Or, in case the heavy old electrical engineers who composed this definition begin to murmur that of course they didn't mean this new-fangled wireless telegraphy, we can quickly silence them by passing on to the example of an a.c. circuit feeding an electric motor. The second No. 1283 definition would include only the power dissipated as heat in the motor, which should be quite small; the second would include also all the mechanical power developed by the said motor, which could be many times greater.

These are only a few of the recognized varieties of resistance, more of which are defined in B.S.204.

To sum up: It seems that in its strictest sense the resistance of any circuit or part of a circuit concerns the power dissipated as heat therein. Measuring amounts of heat is something we definitely don't want to do. With d.c. we can avoid it by using "Ohm's law," provided we carry out a preliminary frisking to make sure the thing being measured has no concealed e.m.fs. With a.c. we measure the current in phase with the applied e.m.f., but if we exclude all e.m.fs we will find ourselves excluding almost everything but standard resistors. Most often, we want to include at least all the losses, whether they come into our circuit as e.m.fs or not. We *may* want to include all permanent departures of power, such as radio waves, light, sound, etc.

No doubt it was naughty of me—even with the praiseworthy object of reducing the thing to ultimate simplicity—to begin with a d.c. circuit, Fig. 4, without explaining unmistakably that this was just as a step towards the a.c. circuits of commerce, in which "equivalent" and "effective" resistances are established conventions. Another point is that even with a.c. resistance, counting effects brought in by e.m.fs, these e.m.fs usually bear some relationship to the input current, whereas E in Fig 4 is completely independent, like the battery in Fig. 3 (apart from its internal resistance). As I have shown, the principle involved here is not fundamental, but it would have been better to have pointed out that the battery didn't behave like a practical negative resistor if the current was varied. I hope, however, that it has been justified by the bringing to light of Kirchhoff's hitherto unknown Third Law.

LETTERS TO THE EDITOR

The Editor does not necessarily endorse the opinions expressed by his correspondents

Demonstrating Electron-spin Resonance

FOLLOWING the description[1] by G. B. Clayton of a demonstration apparatus for electron-spin magnetic resonance absorption, readers may like to know of a simple modification to the circuit which enables a satisfactory estimate of the magnetogyric ratio, γ, to be made. The time required for the observation is such that it may easily be carried out in the course of a lecture, thus adding greatly to the value of the demonstration.

γ is given by the relation $2\pi f = \omega = \gamma B$ and it is the ratio of the magnetic moment to the angular momentum of the electron, not the reciprocal of this ratio as given in the article. f is the frequency of the radio-frequency oscillator, B the magnetic flux density at the sample. If f is expressed in Mc/s and B in weber/m^2 we have

$$\gamma = (2\pi f/B) \times 10^6 \text{ coulombs/kgm}$$

The frequency, f, may be measured in a convincing manner by means of a short-wave wireless receiver. A characteristic purring tone will be heard, representing a pair of absorption pulses repeated at 100 c/s.

For the measurement of the resonance value, B, of the magnetic flux density an ammeter (reading r.m.s. current) is inserted in series with the Helmholtz coils and some provision is made for varying the current continuously. This can most conveniently be done by use of a " Variac." but failing that a rheostat will do. As the current is reduced the trace on the oscilloscope screen shrinks until, for a certain value, i, of the r.m.s. current, the extremes of the trace coincide with the peaks of the absorption line. Then the field, B, is given by

$$B = 4\pi \times 10^{-7} \times (8N/5\sqrt{5}R) \times \sqrt{2}\,i \text{ weber/m}^2$$

where N is the number of turns on each coil and R is the radius of the coils in metres.

The resulting value of γ may be compared with the known value of the charge-to-mass ratio, e/m, for the free electron, namely 1.76×10^{11} coulomb/kgm, since for the unpaired electrons in diphenyl picryl hydrazyl at frequencies above 5 Mc/s,

$$\gamma = e/m$$

to a very good approximation[3].

In an actual demonstration, with an oscillator frequency of about 24 Mc/s, I obtained

$$\gamma = 1.7 \times 10^{11} \text{ coulomb/kgm.}$$

The oscillator[2] was found to work very well at this frequency without the capacitors C_1 and C_2, adjustment of the amplitude being made by varying C_0.

The University, Edinburgh. A. G. A. RAE

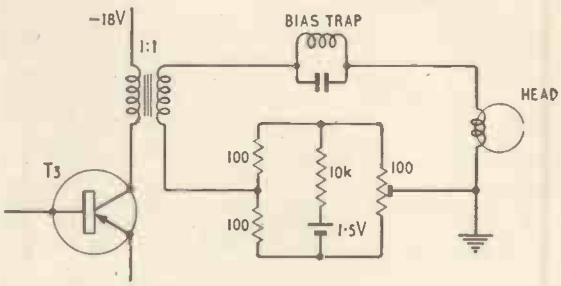
[1] *Wireless World*, Feb., 1960, p. 68.
[2] *Wireless World*, Feb., 1960, p. 70, Fig. 8.
[3] Garstens, Singer and Ryan, *Phys. Rev.* Vol. 96 (1954), p. 53.

Transistor Tape Recorder Amplifier

I HAVE just read Mr. Blick's article in your April issue and I congratulate him on an elegant solution to the problem of the recording amplifier.

Although the leakage of modern electrolytic capacitors is reasonably low, the small residual magnetization of the head would be enough to introduce noise in the recording process and harmonic distortion in the playback process. A solution which avoids this is to use a double-wound transformer in place of the reactor L, in Mr. Blick's Fig. 1. The recording head directly connected across the secondary eliminates the leakage current although not, of course, switching transients.

It is probably worth while for high-quality work including a variable direct e.m.f. in the secondary circuit



(see accompanying diagram) and to adjust this for minimum noise when playing a virgin tape. This is also the condition for minimum distortion.

Salisbury Polytechnic, S. Rhodesia. PHILIP F. RIDLER

Deeper Amplitude Modulation

MR. BLANCHARD (June issue) is no doubt correct in his facts and I have myself noticed all the effects, including the distortion. Increased percentage modulation and clipping also reduce the dynamic range, which is also observable. Furthermore, the operation of the a.g.c. system in normal sets will be affected by the increased modulation and is likely to reduce even further the dynamic range.

The practical result, in my view, would be unfortunate as it would be the fashioning of another nail ready for the coffin for medium- and long-wave amplitude modulation.

No medium- or long-wave service hinders international contacts and aids the spread of extremist nationalism but on a purely personal level I, and presumably Mr. Blanchard, find the Continental broadcasts more entertaining than those of the B.B.C. or else why roam the ether? If we really want entertainment why surrender to the evidently ever-selfish motorists?

London, N.W.11. L. STREATFIELD

V.H.F./F.M. Car Radio

R. V. TAYLOR'S article in the June issue on v.h.f./f.m. reception in a car was interesting, but having experimented extensively with this myself, and decided that it was not the answer unless operating only in small areas relatively near to a transmitter, perhaps my remarks would be of interest.

I first started some eighteen months ago, exactly as Mr. Taylor suggests, by using a standard commercial tuner feeding into the a.f. and power pack unit of an ordinary car radio. The alterations necessary to do this were very simple, consisting merely of re-wiring the valve heater. The adjustable car-radio whip aerial was set at 2½ feet, and was in what was then the normal position for such an aerial—on the offside front wing.

One of the first things I discovered was the need for far better interference suppression on the car than was ever necessary for good medium- and long-wave reception, the main trouble coming from the voltage regulation. After quite a lot of trouble, this was cured, as were other sundry crackles coming from unbonded parts of the car, although generator whine was never quite eliminated. Surprisingly enough, the ignition gave no trouble at all! When all this had been done, I found that the level of interference from other traffic was too high for comfort, but, of course, nothing could be done about it. However, the receiver worked fairly well, and was used for some time to find out whether the service area of the v.h.f. transmissions was large enough to warrant making up a receiver with better amplitude limiting. It was found with this tuner that the area within which the v.h.f. programme was of use (i.e., little fading or interference) was only a circle of about 20 miles radius. Outside this radius, in towns, flutter and distortion were much in evidence, although in the country reception was naturally better, but outside 30 miles reception was pretty poor anywhere, except, of course, on the tops of hills. Modifications were made to the tuner to improve limiting, but this only gave an increase of the good usable range to 25 miles, and the maximum usable range to 40 miles. If circles of these radii are drawn round the major transmitters on a map, the large gaps in coverage will be noted. Of course, these radii take no account of the topography, so that ranges in some directions may be better than others, but this will not materially affect the overall result.

The sensitivity of the tuner was not in question, it being possible to hear Sutton Coldfield on the South Coast, although the signal was quite useless for entertainment.

Another difficulty was that of tuning accurately, which had to be done if maximum a.m. rejection was to be achieved. Since it was obviously impossible to use visual indicators of any sort, tuning had to be done by ear, and with the slight fading experienced even in the best areas of coverage, this was quite difficult. In fact, I usually found it best to stop the car and then tune accurately.

Several Continental journeys were made with the v.h.f. tuner installed, and the situation there was even worse, due to the widespread use of low-power repeater stations. These had an effective range of about only 10 miles and when travelling on a motor-road this meant that it was necessary to re-tune (if a new station were available, that is!) every 15-20 minutes.

All these factors contrast very unfavourably with medium- and long-wave reception, about the only advantage v.h.f. having over these for car use being that when a good signal is obtainable, it is free from interference from other transmitters. The fact that better quality is to be obtained from v.h.f. is not significant for mobile reception, unless listening is confined to periods when the car is stationary—hardly mobile reception! Fading on medium waves is not a problem until ranges of 100-150 miles are reached, and then only at night, and so there are no gaps in the B.B.C. coverage of the U.K. If one can tolerate a little noise, it is possible to listen to Home or Light programmes while holidaying on the Continent, which certainly cannot be done with v.h.f. And tuning is far easier with a.m. than with f.m. if it has to be done aurally.

For these reasons I took the v.h.f. tuner out of the car some months ago, and reverted to the usual frequencies, with a certain amount of relief. Experiment with v.h.f./f.m. in a car by all means, but I don't think it's nearly as much use there as it is at home!

Tangmere, Sussex. W. BLANCHARD

WHILST many of the considerations involved have been dealt with adequately in Mr. R. V. Taylor's article, this cannot be said of the treatment of interference generated by the vehicle itself. However effective the a.m. interference rejection of the sets may be, the remainder of the set must be very prone to interference conveyed by the power supply lead and probably interference radiated from the ignition system and other electrical components of the vehicle. Mr. Taylor makes no mention of this and from long experience of this I can say that it is a very difficult problem.

Mr. Taylor is also, probably unintentionally, misleading regarding the B.B.C. v.h.f./f.m. coverage. At chimney-pot height what he says regarding the field strength laid down by the B.B.C. transmitters is no doubt true, but it is certainly not true of the field strength at car radio aerial height. It is, for instance, quite impossible to get an adequate signal on the road between London and Birmingham, and the same applies in many other places, and a thorough survey of this has shown that for a satisfactory car radio set, it is necessary, however effective may be the v.h.f./f.m. car radio, for medium- and long-wave a.m. reception facilities to be provided as well.

Pinner, Middlesex. W. CROSSLAND

Power Transformer Design

IN his article on small power transformer design (June issue) Mr. Saull seems to have made an error in his example of a practical design. In step (*c*) he uses a figure of 216 T/in² for the LT1 winding whereas Table II shows that 17 s.w.g. enamelled copper wire winds 289 T/in². Consequently the remainder of his calculations for the example are wrong.

Using the figure shown in Table II the LT1 winding will occupy 0.125 sq in, making the total for the two l.t. windings 0.24 sq in. The remaining space for the h.t. winding is then 0.39 sq in, from which it is found in step (*e*) that the T/in² is 9,168. The nearest wire gauge from Table II is therefore 34 s.w.g., having a current carrying capacity of 66.5 mA. In consequence this winding will have a slightly lower copper loss, resulting in a small improvement in regulation and efficiency.

St. Leonards-on-Sea, Sussex. W. E. THOMPSON

MAY I comment upon a statement by Mr. D. Saull in his article (June issue) "Power Transformer Design"?

Whilst not disputing that for mechanical reasons it may be preferable to wind the heavier gauge windings of a transformer first, an improved voltage regulation is not necessarily obtained for this winding arrangement.

The voltage regulation is a function of the sum of the primary resistance, R_p, referred to the secondary terminals, and the secondary resistance, R_s, that is, the effective secondary voltage drop = $I_s (R_p/n^2 + R_s)$ where $n = I_s/I_p$ = turns ratio.

The shorter mean length of turn of the secondary winding will reduce R_s, however the resultant longer mean length of turn of the primary winding will increase R_p, and, for equal primary and secondary winding areas, the effective secondary voltage drop will be unchanged.

Weymouth. A. D. WAITE

The author replies:

Mr. W. E. Thompson is perfectly correct; I apologise for the error quoted by him which came about through misreading the comprehensive wire tables that I normally use when transformer designing. These tables include single and double silk and cotton covered wire, in addition to enamelled wire. The turns/in² I quoted for 17 s.w.g. wire was 216 which is, of course, for double-cotton-covered wires. As Mr. Thompson points out, I should have used 289 turns/in² in my example.

It is refreshing to see that Mr. Thompson has read my article with a discriminating mind and eye and is not prepared to accept all he sees in print without first agreeing. I like to see this quality in a reader—it keeps up the standard of technical literature. Once again, sorry for my error Mr. Thompson!

The point brought up by Mr. A. D. Waite is, I believe, a controversial one amongst transformer designers. Some say the winding sequence should be h.t. winding, primary winding, and l.t. windings on the outside; others say a winding sequence of primary winding first, followed by the h.t. windings, and finally the l.t. windings on the outside; a third group, which I support, believe that the best results are obtained by winding the l.t. windings on first, the h.t. windings last, and positioning the primary in the centre of the transformer.

In support of the windings sequence I have chosen I will make these points—it is up to the reader to make his final choice.

(1) The purpose of my article was to produce a quick method of design; one that contained a minimum of variables; one that the design engineer could " get into " without too much preliminary digesting—otherwise he might just as well read a standard text book on transformer design.

(2) Positioning the primary between the l.t. and the h.t. windings, and consequently more to the centre of the lamination window, gives a smaller flux gradient across the window area. This results in a lower leakage inductance—consistent with the growing requirements of power supplies for transistorized, or partly transistorized, equipment.

(3) For design simplicity, the l.t. windings are required to carry current densities up to 2,000 A/sq in. A winding on the extreme inside is approximately half the length of one of the extreme outside, hence approximately half the resistance. However, if the primary is in the centre its resistance will not alter a great deal if moved slightly inwards or outwards. Primary current is a function of secondary wattage and, with small power transformers, the l.t. windings are responsible for the lion's share.

H.t. windings are operated at lower current densities, and in the smaller variety of power transformers, their resultant primary wattage is the lamb's share.

Heating effects are also a consideration: I^2R, if R is small, is half the answer that would have resulted if R became 2R. L.t. windings placed near to the core will lose heat, through the large surface area of the laminations, quicker than directly from a smaller surface area in contact with air, had the l.t. windings been placed on the extreme outside.

Now reflected resistance, $n = \sqrt{R_1/R_2}$, only holds good at 100% efficiency. With 86% efficiency, which is an average for small power transformers, not all of the secondary resistance is reflected into the primary winding!

We haven't discussed leakage currents between windings when the transformer is connected in circuit. These currents produce a chemical effect resulting in the enamel coating on the wire and other insulation deteriorating, an important factor in long-term installations such as instrumentation equipment used in atomic power stations.

My article was based on simplicity and therefore generalized. It contained a little error—perhaps inexcusable, but I have, I hope, tried to lead the engineer to the meat, cutting away the fat; and I say, " Brother, put these turns on and you will produce a transformer that is reasonable. You might be able to improve on it—but if time is money to you—I think that you will find it acceptable."

D. SAULL

Wire Broadcasting

IN your article in the May issue describing the TV relay equipment you mentioned Capt. P. P. Eckersley's experimental sound relay where the electric light supply mains were used for programme transmission. Some years before Capt. Eckersley's experiments I applied to the Post Office, in association with Charles Melhuish, at that time proprietor of the Crapstone and Yelverton Electricity Supply Co., for permission to install on the company's supply a Multi-Programme Broadcast Relay using an h.f. carrier modulated by a number of lower frequency sub-carriers each accommodating a separate radio programme. Our plans were well advanced including the special mains spacing and h.f.c. arrangements required, and one of the receivers even included a form of a.g.c. which varied the gain by altering the h.t. voltage. It was not very effective!

Although we had the support of the late Sir Arthur de Freece then living at Dunster, our plans were turned down by the Post Office as they were held to infringe the B.B.C. monopoly. I bring this to your notice as, although there may have been previous proposals along these lines, of which I am not aware, ours did precede Capt. Eckersley's.

Haverfordwest. K. F. PONTTING-BAKER

Radio Telescope

" UNBIASED " by " Free Grid," in your May 1960 issue, finds the name radio telescope inadequate and confusing and suggests that an entirely new word should be given to this instrument. I quite agree with him and since he has asked your readers to help in this matter, I would suggest " electronic cosmoscope " or " radio cosmoscope."

Mombasa, Kenya. K. C. FOLEY

Medical Electronics

THE third International Conference on Medical Electronics opens at Olympia on July 21st for a week. Some 100 papers will be presented at this conference which is being organized by the Electronics and Communications Section of the I.E.E. in association with the International Federation for Medical Electronics.

About 80 exhibitors are participating in the exhibition which is being held at Olympia throughout the conference. In the following list of exhibitors we have indicated the country of origin of those from overseas. The exhibition will be open daily from 9.30 to 6.0; admission is 3s 6d.

A.E.I.
Air-Shields (*U.S.A.*)
Allen & Hanburys
Alvar-Electronic (*France*)
Amplivox
Antares (*France*)
Ateliers de Construction Beaudouin (*France*)
Atlas-Werke (*W. Germany*)
Atomic Weapons Res. Estab.
Bailey, I. G., & Co.
Barr & Stroud
Becker, J. (*Holland*)
Belling & Lee
Bird Oxygen Co. (*U.S.A.*)
Chiba Electric Works (*Japan*)
Coulter Electronics
Cox, Stanley
Dawe Instruments
Disa Elektronic (*Denmark*)
Ekco Electronics
Electronic & X-Ray Applications
Electronic Industries Assoc. (*Japan*)
Electronic Machine Co.
Elektrolaboratoriet (*Denmark*)
Elema-Schonander (*Sweden*)
Elga Products
Endometrics
English Electric Valve Co.
Etudes et Constructions Electro-Medicales (*France*)
Faraday Electronic Insts.
Frieseke & Hoepfner (*W. Germany*)
Fukuda Electro Co. (*Japan*)
Fukuda Medical Electric Co. (*Japan*)
G.H.S. Electronics
Godart & Miinhardt
Godart-Miinhardt (*Holland*)
Heiwa Electronic Institute (*Japan*)
Hellige & Co. (*W. Germany*)
Heywood & Co.
Hilger & Watts
Hitachi (*Japan*)
Infra Red Development Co.
Japan Radio Co. (*Japan*)
Leitz, E. (Instruments)
Leitz, E. (*W. Germany*)
Leland Instruments
Marconi Instruments
Medische Apparaten (*Holland*)
Mullard Equipment
Multitone Electric Co.
Nagard
New Electronic Products
Nikkoh Electronic Instrument Co. (*Japan*)
Nippon Electric Co. (*Japan*)
Nuclear Enterprises (G.B.)
Officine Toscane Elettromeccaniche (*Italy*)
Offner Electronics (*U.S.A.*)
Ossa (*Switzerland*)
Picker International Corp. (*U.S.A.*)
Purtschert, M. J., & Co. (*Switzerland*)
R.C.A. Great Britain
S.S. Electronics
Sanborn Co. (*U.S.A.*)
San'ei Instrument Co. (*Japan*)
Sanyei Manfg. Co. (*Japan*)
Saunders-Roe & Nuclear Enterprises
Schwarzer, F. (*W. Germany*)
Selig Electromagnetics
Shimazu Seisakusho (*Japan*)
Siemens-Reiniger-Werke (*W. Germany*)
Sierex
South London Electrical Equipment Co.
Telco (*France*)
Telefunken (*W. Germany*)
Tinsley & Co.
Tokyo Shibaura Electric Co. (*Japan*)
Dr. Ing. J. F. Tonnies (*W. Germany*)
Townson & Mercer
Winston Electronics

Electronics in Israel

STEADY GROWTH EXEMPLIFIED AT THE RECENT EXHIBITION IN TEL AVIV

By R. DANZIGER, M.Brit.I.R.E.

THE first Electronics Exhibition was held recently in Tel Aviv and was organized by the IEMA (Israel Electronics Manufacturers Association) and the trade schools. Since its modest start in 1950 the electronics industry has increased the value of its annual output from 350,000 to 8,000,000 IL (Israel Pounds).

The 1960 exhibition was the first of what is intended to be a series of annual events. The main part of the show was devoted to domestic radio receivers which ranged from tiny transistorized sets through car radios to elaborate "hi-fi" equipment for rooms with special acoustic arrangements. Wood was still the favourite material for the Continental styled cabinets of most makers with plastic materials being the exception. Some firms showed prototypes of their future production programme including TV sets, stereo amplifiers, tape recorders and d.c. record players.

An important part of the exhibition was the components show. Except for valves, transistors and certain types of condensers and resistors all parts are manufactured in Israel. A wide range of components was shown including piano-type waveband switches, polystyrene condensers, several types of variable condensers, many types of loudspeakers and tweeters and a wide range of all types of transformers and coils.

Perhaps the most interesting part of the show was that devoted to the professional exhibits. Whilst the manufacture of professional electronics equipment is still at its beginning, it is backed by considerable know-how. Outstanding in this section were electronic fire alarms and counters made by ELCO (Ramat Gan), printed circuits, epoxy castings and pulse equipment by Israel Electronics Co. (Rishon Lezion) and quartz crystals by Tadir (Holon). All being up to a high standard both in respect of specification and finish. Other items in the professional section included timers, miniature pulse transformers, measuring gear, electro-medical equipment, loud hailers and of course a large variety of office and industrial intercommunication systems.

In addition to the commercial exhibits one wing of the show was devoted to training aids and the work of the students of the trade schools. There are seven major trade schools in Israel with 4-year courses in electronics. They have a combined capacity for 500 students and turn out about 200 qualified technicians per year. The demand for places at those schools is considerable and stiff entrance examinations are held, resulting eventually in a high standard of training. The exhibits in this section included many student-built equipments such as oscillators, amplifiers, transmitters, etc., but also more advanced equipment such as u.h.f. waveguides, pulse-shaping circuits nicely demonstrated by means of several oscilloscopes, and even a radio-controlled model aeroplane.

The most sophisticated equipments were shown by the two leading academic teaching institutions, The Hebrew University, Jerusalem, and the Technion, Haifa. They exhibited an analogue computor, pulse generators, coincidence plug-in units and even a 24-channel pulse height analyser.

One leaves the exhibition with the definite impression that the local electronics industry has left the "music box" stage for good and is embarking on a serious domestic and professional production programme in the electronics field.

The exhibition, with a floor space of 500m^2, comprised 27 stands and was open for four days (4 hours per day) during which time the number of visitors was of the order of 2,000.

Radio Aids to Hydrography

DECCA TWO-RANGE AND LAMBDA POSITION-FIXING SYSTEMS

*By C. POWELL**

This article describes the latest version of one of the radio aids to survey at sea. The aid is used extensively throughout the British Commonwealth and in ships of the Royal Navy

"THE science of Hydrography", says the Admiralty textbook on that subject, "originated in the need for the production of maps specially designed for the use of the mariner. . . . During the nineteenth century nearly every specialised maritime country founded a department for the sole purposes of dealing with the issue and publication of charts and for the coordination and execution of marine surveys, and immense progress has been achieved in the production of charts"[1]. An important contribution to that progress, since the Second World War, has been made by radio position-fixing systems, and these are now accepted as standard surveying equipment in hydrographic work.

A radio position-fixing system can be used to fix the position of the survey ship, so that observations can be assigned to their correct geographical positions; to hold the ship on the survey tracks, and to navigate the ship to the survey area with the minimum delay and wasted steaming. It can be used when haze or mist prevent shore marks from being used for fixing and running lines by the classical methods; also at distances such that shore marks are beyond the limit of visibility. This has brought radio aids into the field of oceanographic surveying, involving ship-to-shore distances of several hundred miles. A widely-used radio aid to surveying at sea is Two-range Decca; as this is derived from the Decca Navigator[2, 3] some aspects of the latter should be noted.

Decca Navigator.—Decca employs unmodulated c.w. transmissions occupying spot frequencies in the 70-130 kc/s band. At these frequencies, the attenuation of the surface wave is sufficiently small to permit use of the system by ships at distances greatly exceeding that of the "radio horizon" and the stability of propagation condition during the hours of daylight, coupled with the potentialities of the phase-comparison method of obtaining a position line, make possible a degree of accuracy appropriate to most hydrographic-survey requirements. A chain of Decca stations normally comprises a central master with two or three outlying slave stations disposed about it. The slave transmissions are phase-locked to the master and the basic function of the receiver carried by each user of the system is to compare the phase of the master transmission with that of each slave. The phase differences are displayed on three pointer-type phasemeters, known as Decometers (one for each master/slave combination) and each reading locates the user on one of a family of hyperbolic constant phase-difference lines focussed on the master station and the appropriate slave. A position fix is given by the intersection of two such position-lines: on board ship the readings are usually plotted manually on a chart overprinted with correspondingly-numbered Decca-grid lines. In aircraft, and in certain special-duty ships, the fix is continuously displayed on an automatic plotter (Flight Log[4] or Track Plotter) which provides a pictorial presentation of position by a pen, representing the user vehicle, moving across a map.

Two-range Decca.—Soon after its commercial introduction in 1946, the Decca Navigator became established as an aid to hydrographic surveying by use of the permanent European coverage as it then existed, supplemented by mobile chains in Greenland, Sweden and the Persian Gulf. In 1950, however, there arose an operational requirement which the conventional Decca station layout could not meet; a survey organization operating in the Antarctic required a radio position-fixing system having the characteristics of Decca; but using only two shore stations instead of three because three suitably-disposed and habitable sites could not be found in the area of the proposed survey. As a solution the survey department of the Decca Navigator Company proposed a layout in which the two slave stations would remain on the shore, the master being installed on the survey ship together with the receiver. While confining the use of the chain to a single ship at a time, this arrangement overcame the siting difficulty and also introduced other advantages, notably the fact that the Decometers now indicated the direct distances to the shore stations rather than the distance-differences of the conventional system.

The ensuing development of the Two-range system into an operational hydrographic-survey tool was undertaken in close co-operation between the Hydrographic Department of the Royal Navy, the Admiralty Signal and Radar Establishment (now the Admiralty Surface Weapons Establishment) and the manufacturers.

Principles of Two-range System

The layout of a Two-range chain is shown diagrammatically in Fig. 1. The master transmitter on the ship radiates a c.w. signal of frequency $12f$ where f is approximately 14 kc/s. As all the radiated and phase-comparison frequencies are harmonically related, as in conventional Decca, it is more convenient to refer to them in a harmonic notation rather than in numerical terms. The "red" slave station ashore receives the master transmission and radiates a signal of frequency $8f$, in a manner such that the slave and master signals have a constant phase relationship at the common multiplied-up frequency value of $24f$; a stable pattern of constant-phase-difference lines is therefore generated about

*Decca Navigator Co. Ltd.

the two stations (broken lines in Fig. 1) this pattern being identical with that which would be produced if signals frequency 24*f* (about 340 kc/s) were actually radiated from master and slave. In the shipborne receiver the signals are received and multiplied for phase comparison at 24*f*, and the phase-difference meter (Decometer) makes one rotation if the ship-to-slave distance alters by one phase-difference cycle or "lane". Along the line between master and slave, the lanes recur at uniform intervals each equal to half a wavelength at the comparison frequency, and the lane pattern that the ship uses therefore takes the form of a family of concentric circles centred on the slave station. At 24*f*, the lanewidth is roughly 420 metres and the Decometer, which can be read to less than half-a-hundredth of a revolution, will therefore respond to a change of a metre or two in the ship's distance from the slave. A similar process takes place in the "green" co-ordinate (9*f* slave frequency) at a common comparison frequency of 36*f*, giving in this case a lanewidth rather less than 300 metres as shown in the accompanying table.

Each Decometer embodies a lane-counting pointer geared down from the phasemeter rotor, together with a subsidiary indicator driven through a further stage of gearing and recording groups of lanes ("zones") passed through. Assuming a value for the speed of propagation of electromagnetic radiation, these readings can be converted into distance units: this is generally done by plotting them on a chart overprinted with the two patterns of circular position lines, numbered to correspond with the Decometer readings and drawn at constant radial intervals of one or more lanewidths. A "two-range" fix of the ship's position with respect to the shore stations is given by the intersection point of the two circles (interpolating between the lines on the chart as required) indicated by the meter readings.

If a second receiver were placed close to, say, the red-slave station, the red Decometer reading of this receiver would show no change even if the ship

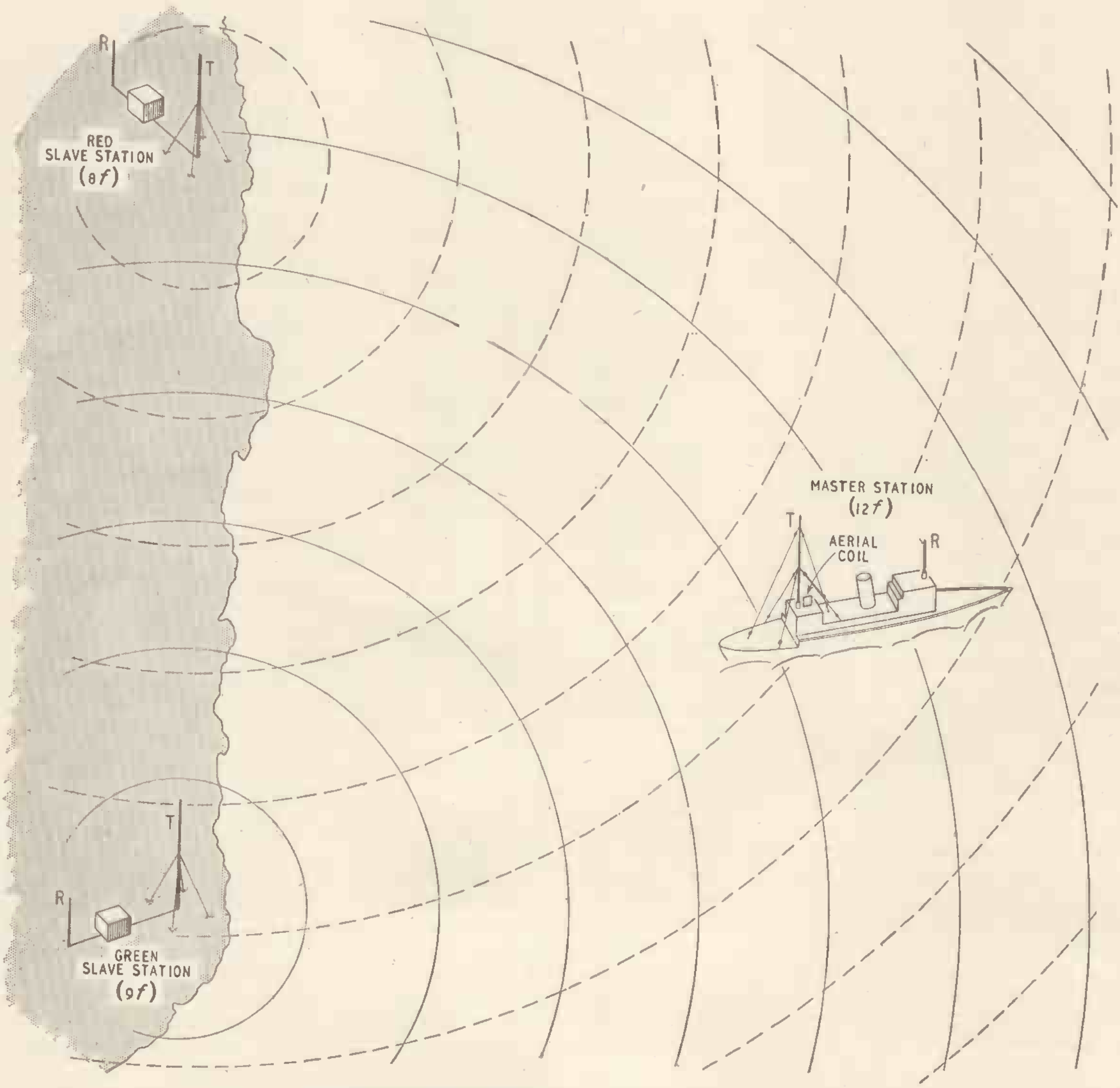


Fig. 1. Diagram of layout of Two-range Decca Hydrographic-survey system.

TABLE
Typical values for frequency and lane width

Function	**Carrier Frequencies**		**Phase Comparison Frequencies**		**Lane Width**
	kc/s	**harmonic**	**kc/s**	**harmonic**	**(v=299,650 km/sec) metres**
Master	177.6	$12f$	—	—	—
Master Identification (Lambda system only)	162.8	$11f$	—	—	—
Green	133.2	$9f$	532.8	$36f$	281.2
Red	118.4	$8f$	355.2	$24f$	421.8

Note: All frequencies are harmonically related to a non-transmitted fundamental value f.

altered her position by several hundred miles; this is because the slave station's function is to radiate a signal having a constant phase relationship with the incoming master transmission. The shipborne Decometer indicating the master/slave phase difference is, however, sensitive to any change in the ship-to-shore distance, as this alters the length of the transmission paths from the master to the slave and back without a corresponding change in the direct path from the master to the ship receiver.

If maximum accuracy is to be secured from the system, corrections have to be applied for the non-uniform speed of propagation of radio waves in the groundwave mode and for fixed phase shifts. The full expression for measurement of the distance between the ship and a slave station therefore becomes:

$$d = (\lambda c f/2)(\phi - \alpha - \psi)$$

where d is the distance from the "electrical centre" of the ship to the mid-point between the receiving and transmitting aerials at the slave station, $\lambda c f/2$ is the lanewidth in metres for the appropriate pattern, assuming free-space velocity, ϕ is the observed Decometer reading (whole lane number plus fraction), α is the "locking constant," and ψ is a correction to the free-space value of the speed of propagation.

The exact location of the electrical centre of the ship in the above formula is found by calibration at a known distance and on a number of different headings. The locking constant is the name given to the overall phase shift due to the close proximity of the receiver to the master transmitter (placing the former in the "induction field") and, at the slave station, a possible fixed displacement from the nominal zero phase-difference condition that is assumed to exist between the received master signal and the outgoing slave transmission. The value of the locking constant for each pattern is found at the start of a survey by observations at exactly known distances from the slaves, and is thereafter subtracted from all observed Decometer readings.

The quantity ψ refers to the dependence of the effective speed of propagation upon the nature of the medium over which the signals are transmitted—an aspect of the groundwave mode of propagation which is of fundamental importance when the transit time of low-frequency signals forms the basis of position or distance determination. This phase lag with distance results from absorption of energy by an imperfectly conducting earth* and Fig. 2 shows a practical set of phase-lag correction curves for the red and green patterns. The increase in the correction value at short ranges is the result of the complex field existing around the transmitter, and the increase beyond 100 km or thereabouts is the effect of the phase lag. The mean speed of propagation resulting from the phase lag varies widely with the electrical characteristics of the medium over which the signals are transmitted; e.g., the sum of experience so far with Two-range Decca points to a mean velocity of 299,650 km/sec over seawater transmission paths, while a corresponding figure for land paths of the lowest soil conductivity yet encountered (of the order of $\sigma = 5 \times 10^{-15}$ e.m.u.) amounts to about 298,400 km/sec. If no steps were taken to correct for this variation, an uncertainty of 1 part in 240 could exist in the range determination (assuming the possibility of a Two-range chain being operated over land as well as over sea) which would render the system completely unacceptable as a survey instrument. Fortunately it is possible to apply corrections for different path conductivities; also for paths of mixed conductivity such as the case where a large island or promontory intervenes between the ship and the shore.

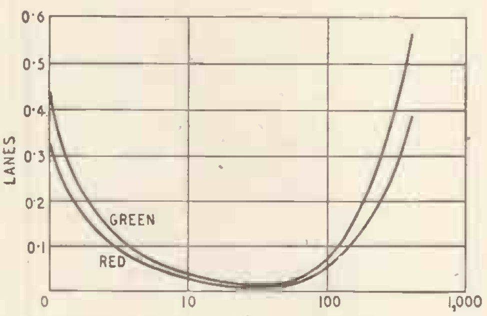


Fig. 2. Phase correction (expressed in lanes) for seawater transmission path.

Application of the corrections shown in Fig. 2 for transmissions over seawater leaves, with present knowledge, a residual uncertainty amounting only to one or two parts in ten thousand. The curves were constructed on a theoretical basis, but have been confirmed by observations with the conventional Decca system as well as with the Two-range version at distances up to about 200 km: beyond this distance it is hoped to obtain practical

* This has been the subject of theoretical work, notably by Sommerfeld, Bremmer and Norton, which is described in detail in a paper by A. B. Schneider[5]. Extensive work has also been carried out by Dr. B. G. Pressey and his associates at the Radio Research Station (D.S.I.R.).

confirmation from trials specially designed for this purpose. Here we encounter a familiar problem in the practical deployment of modern radio aids to surveying and navigation: to check the radio aid satisfactorily it is necessary to know distances and positions with an accuracy several times greater than that of which the aid itself is capable, and this is liable to tax present survey resources to the utmost. For example, if the correct value of ψ over seawater could be determined experimentally without error, the Two-range technique should then be capable of measuring, say, the distance from a point on the north coast of East Anglia to a point near Aberdeen with an accuracy of one or two parts in 50,000, yet this is not far short of the accuracy with which the actual distance between the two points in question can be stated from present survey knowledge.

Random Errors.—The phase errors so far described can be partly or wholly corrected. Rather more important are errors of a random character, which may be due to instability associated with wave propagation or with instrumental variations, or both. From sunset until sunrise at all seasons, and also during daylight in winter, random variations due to skywave interference start to become detectable at ship-to-shore distances of about 40 miles, and thereafter increase in magnitude with range. The actual survey operations requiring accurate fixing are, therefore, generally confined to daytime, but this does not apply to incidental manœuvres such as journeys between different survey areas, which call for a lower degree of accuracy than the survey itself. Typical random-error contours for the use of the system by day are indicated in Fig. 3. In practice, the overall accuracy of Two-range Decca has been such as to permit plotting of the results at a chart scale of 1:70,000 (about one inch per nautical mile) without the errors or variations due to the system itself being detectable at this map scale.

A geometrical characteristic of the Two-range layout is the relatively large proportion of the coverage, compared with a hyperbolic system having the same distance between the slave stations, within which a high fix accuracy can be obtained. The angle of cut between the two circular position-line patterns is good (i.e., near 90°) over a wide area, and the layout is favourable in that there is no lane expansion such as occurs when similar equipment is operated as a hyperbolic chain.

Referencing.—A potential source of error in the receiver itself arises from the differential phase shifts between the master and slave channels. To check and correct these, the receiver incorporates a reference source, whose output is a 0.5μsec pulse having a recurrence frequency equal to the fundamental value f, to which all the transmitted and phase-comparison frequencies in the system are harmonically related. Applying this pulse to the input of the receiver, each channel extracts its harmonic frequency. As the harmonics are related to a common fundamental, the two Decometers would read zero if there were no differential phase shifts in the channels. If a reading other than zero is observed, a compensating phase shift is applied so that a zero reading is restored.

Frequencies.—The transmissions are of the pure continuous-wave type with no modulation. This characteristic enables receiver bandwidths of a few c/s to be employed, which in turn secures the required performance from transmissions of low radiated power. The shipborne master transmitter installation radiates approximately two watts and the slave stations (in the standard version of the system) approximately four watts. The use of low-power transmissions having no modulation sidebands minimises the problems of frequency allocation and of mutual interference with other services.

Those familiar with conventional Decca will have noticed from the table that a different harmonic relationship for the transmitted frequencies is used

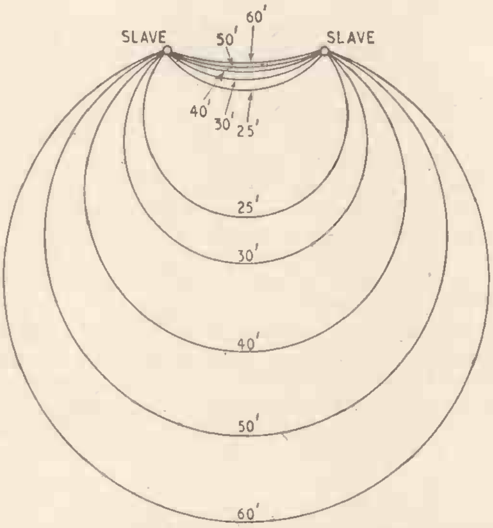


Fig. 3. Fixing-accuracy contours in feet for summer daylight operation. Contours are drawn for a 0.01 lane deviation.

in the Two-range version of the system, the master frequency having twice the normal harmonic value. This is in order to secure maximum strength of radiated signal from a shipborne aerial mast which is necessarily of restricted size. On the frigate-type survey ships of the R.N. Hydrographic Service, for example, the height of the mast is limited by the available staying radius to about 45 feet. Early Two-range chains used a master frequency 6f, i.e., a spot value between 85 and 90 kc/s, which resulted in a radiated power of approximately one-third of a watt for an input to the aerial of 350 watts. By doubling the frequency an approximately eight-fold gain in radiated power for the same input is achieved, and this has permitted operation in tropical regions, where the noise level is high, at distances well in excess of 150 miles.

Equipment.—Briefly reviewing the items of equipment comprising a Two-range Decca chain, the shipborne master installation consists of a duplicated unit containing a stable crystal oscillator which provides the source of the master signal, feeding a 350-watt c.w. transmitter. The 45-foot tubular transmitting aerial mast (Fig. 4) is base-insulated and is supported at three heights by stays insulated at their lower ends.

The shipborne receiver is generally installed in or near the chart room and uses a standard Decca receiving aerial which is a vertical fibreglass tube containing a length of insulated wire. The receiver

(*Continued on page* 355)

is of the Decca "survey" type which is capable of use with either the hyperbolic or the Two-range layout, the latter necessitating two small adjustments: a reduction in the gain of the master channel because of the proximity of the master transmitter, and a reversal of the sense of Decometer rotation so that the readings increase instead of decrease with distance from the slave station. The Decometers are supplemented, when necessary, by the Track Plotter which is the marine counterpart of the Flight Log. Ashore, each slave station comprises, in duplicate, a "control unit" which contains the oscillator forming the signal source, together with the equipment for phase-locking the outgoing slave transmission to the received master signal. The second "standby" control unit, as it compares the phase of the master and slave transmissions and displays their phase difference, acts as an independent monitor of the phase pattern. The transmitter is similar to that used at the master, and a similar transmitting aerial system is employed except that, in general, its height is approximately twice that of the shipborne mast.

Lane Ambiguity.—From a practical point of view, Two-range Decca as so far described has a serious limitation in the form of a high degree of pattern ambiguity. From the above table it will be seen that typical lanewidths for the two co-ordinates are about 420 and 280 metres respectively, which means that before starting work, or after an interruption, the user must know his distance from the red shore station to better than ± 210 metres and from the green to better than ± 140 metres. At moderate ranges this has not given rise to any serious difficulty; the ship usually starts from a known point in any case, appropriate plotting procedures can reveal the development of a whole-lane error should this occur and, if the journey to a check point where the lane values are known should have to be made this may not be a major undertaking when surveying within a small area. At distances greater than about 100 miles from the stations, however, the lane ambiguity becomes an increasingly serious problem, and some form of lane identification, such as is provided on all the permanent Decca navigational chains, would greatly improve the system. The conventional Decca lane-identification method does not lend itself to use with mobile transmitting equipment where light weight and compactness are paramount, but a modified technique known as the "Lambda" method (Low-AMBiguity DeccA) which overcomes this difficulty has recently been evolved and is incorporated in a new Decca survey system based on the Two-range principle.

Lane Identification in the Lambda System

In essence, any lane-identification system consists in superimposing upon the ambiguous lanes a coarse pattern in which one "lane" or phase-difference cycle embraces a number of the fine lanes. Thus, if a pattern resulting from phase comparison at a frequency $1f$, using the previous notation, is superimposed upon the $24f$ red pattern, a phasemeter responding to the coarse pattern would make one revolution for 24 red lanes passed through, and would indicate the correct red lane number for the ship's position in a group of 24. Similarly, a $1f$ pattern will identify the correct green ($36f$) lane out of a group of 36. As there will be many more than 24

Fig. 4. British Naval Survey Ship equipped with Two-range Decca showing tubular aerial mast for transmission of the master signal.

or 36 lanes in the total fine patterns, some ambiguity will still remain; but, remembering that the "$1f$" lanes are about 10km wide measured along the master-to-slave line, this requires only that the user should know his distance from the slave station initially to ± 5km in order to be able to make use of the coarse patterns for setting correctly the Decometers. In practice, this remaining degree of ambiguity causes no difficulty since the ship's position can be found accurately enough by an astronomical fix or other standard practice.

Since it is out of the question actually to transmit $1f$ (14kc/s) from the stations, this frequency must be extracted from them by other means. In the Lambda system, the shipborne receiver obtains a $1f$ master signal direct from the appropriate circuit in the master-transmitter control unit. For the receiver to obtain a $1f$ signal from the slave stations, which normally transmit $8f$ and $9f$ for red and green respectively, the slave frequencies are momentarily counter-changed so that, given a means of "memorising" the original phases of the signals, a $1f$ beat note can be derived from each station. Comparing the $1f$ transmission thus obtained from the slave with the $1f$ signal from the master results in the generation of the $1f$ phase pattern necessary for lane identification.

Lane identification is initiated in the Lambda system by stopping the $12f$ transmission from the ship and replacing it, for about 1.3 sec, by an $11f$ signal. This triggers the changeover of frequencies at the slave stations and provides the slave with a "notching" datum, to be described later.

A locked-oscillator technique is used at the shipborne receiver to extract the required 1f beat note from each slave station. (Fig. 6(b)). At the receiver on board, the 8f and 9f locked oscillators preserve the phase of the signals that normally control them, and 1f beat notes are extracted for each slave by mixing the oscillator outputs with the signals received during lane identification. The phase difference between the master and each slave at the frequency 1f is displayed by a sector-shaped pointer on the coarse Decometers (lower dials in Fig. 5). If the lane-identification pointer moves so as to enclose the lane-counting pointer, the latter is reading correctly. If this does not occur, the lane-counting pointer is reset manually to the position indicated. After the one-second lane identification transmissions the normal transmissions are resumed until the user again decides to check or identify the lanes. The actual indications are "frozen" for several seconds, for ease of reading.

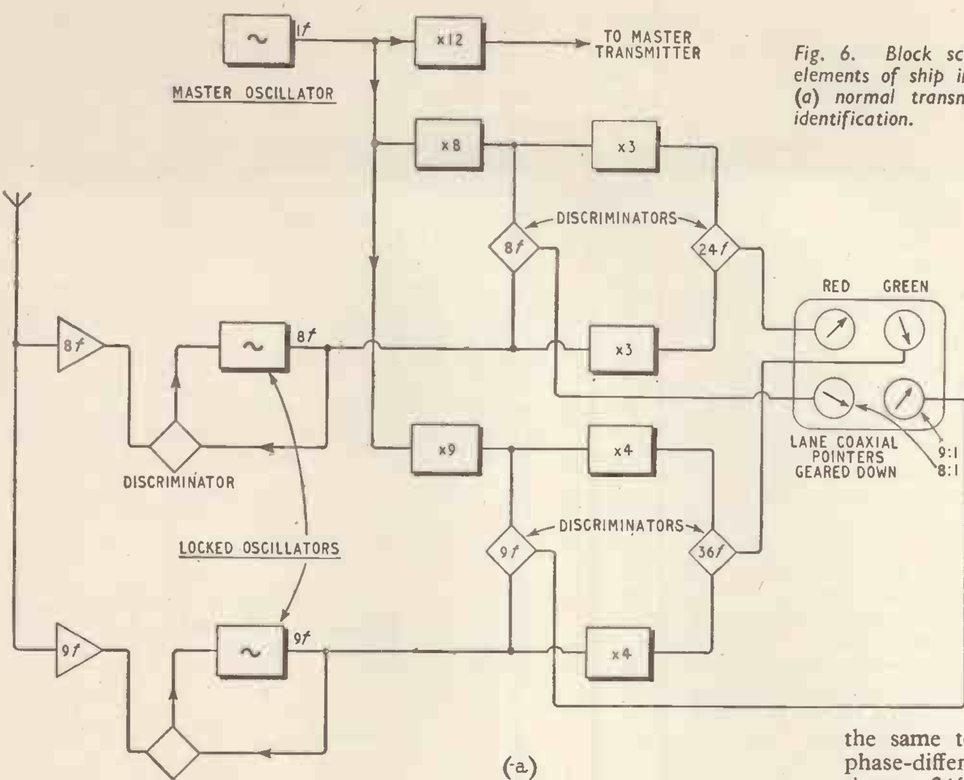
Lambda Lane Patterns.—In a system designed for oceanographic surveying several hundred miles from land, every possible precaution must be taken to ensure continuity of operation. The ambiguity which the lane-identification system is designed to resolve should be made less severe, if this is feasible, and the possibility of a whole lane error occurring should be reduced to the absolute minimum. Accordingly, in the Lambda system the basic patterns are produced by comparing phase at the frequency of the slave transmission without multiplication. This results in a greater discrimination against noise interference than when frequency multiplication takes place, leading to a greater range for a given probability of lane loss. At the same time the lanes thus generated by phase comparison at the relatively low slave frequency are correspondingly wider and less ambiguous.

The basic Decometers (the two lower dials on the display unit shown in Fig. 5) respond to these slave-frequency patterns and the movements are so geared to the lane-counting pointers that the latter make one revolution per zone, i.e., one revolution for 8 red slave-frequency lanes and 9 green slave-frequency lanes. On turning manually the red meter with the reset button, therefore, it will be found that the lane pointer can take up any one of eight equally spaced positions around the dial. The lane-identification pointer is coaxial with the lane-counting pointer, so that the basic function of the former is to indicate which of these eight positions is the correct one, i.e., to identify the correct slave-frequency lane within a zone of 8 or 9 such lanes for red and green respectively. As already mentioned, a rough fix serves to tell the user which zone of each pattern he is in. The individual zones are counted, as in normal Decca practice, by additional dials appropriately geared to the lane-counting pointers.

Unhappily, technological achievements do not include the extraction of something from nothing, and owing to its wide lanes the system as described so far would be three times less sensitive to a change in the distance from the ship to the red slave station than the earlier version of Two-range Decca, and four times less sensitive in the green co-ordinate. To remedy this, narrower lanes are interpolated between the slave-frequency lanes simply by carrying out a further phase-comparison at a higher frequency. This requires further frequency-multiplication in the receiver, together with additional discriminators and a pair of fine Decometers, as shown in the block diagram of Fig. 6 (a). The fine meters, which are the upper pair on the display unit, make one revolution per 24f (red) and 36f (green) lanes, and thus restore the pattern sensitivity to the same level as that of the previous system. Except in the strictly arithmetical sense, no extra ambiguity is introduced by this measure; the lower Decometers have scales marked in fine-lane units and can be read to a fraction of a fine lane, and a glance at the upper meters which are calibrated in hundredths furnishes the second digit. In effect, therefore, the upper meters operate simply as expanded scales for the coarse meters, and present no individual setting-up problem apart from the necessity that they should periodically be "referenced" to zero together with all the other meter movements in the system.

"Notching."—Reverting to the generation of slave-frequency lanes, it will be realized that these contain an additional ambiguity of their own, which is true of any Decca pattern in which phase is compared at a frequency lower than one or both of the radio transmissions involved; this is the result of frequency-division which, even if it does not take place literally in a dividing circuit, is nonetheless carried out in effect when slave-frequency lanes are produced. Here we need consider only the phase relationship between a slave station such as the red (frequency 8f) and the 12f master transmission to which it is phase-locked. Granted that the phase-control circuit at the red slave holds the outgoing 8f signal at zero phase difference with an 8f signal derived from the master, it can do this for three different relationships between the 8f and 12f master signals. In other words, the 4f frequency corre-

Fig. 5. Display unit of Lambda-type installation. Upper meters indicate fine pattern readings (comparison frequencies 24f and 36f). Whole lanes and lane identification are given by lower dials.



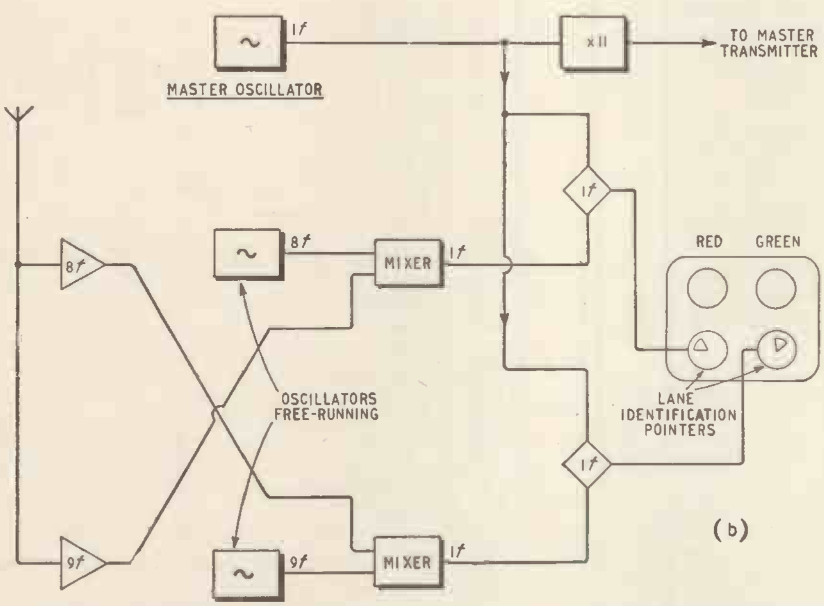


Fig. 6. Block schematic of main elements of ship installation during (a) normal transmission, (b) lane identification.

sponding to division of the 12*f* by 3 can start on any 12*f* cycle it likes without affecting the phase comparison at 8*f*, but for every one such cycle giving the correct pattern phasing, there are two which produce pattern errors of either one- or two-thirds of an 8*f* lane. These "notch" errors, as they are called, are equivalent to shifts of one or two fine (24*f*) red lanes respectively, so that if nothing were done about them the 8*f* pattern that we have gone to so much trouble to generate would have exactly the same total number of phase-difference ambiguities as a 24*f* pattern, despite the relatively wide slave-frequency lanes. Further, if there is a potential notch error in counting down 12*f* to 8*f*, there must also be a greater uncertainty in extracting 1*f* signals from the various stations for lane-identification purposes in the manner already described. In practice, all such ambiguities are dealt with by the single notch-correcting facility embodied in the equipment.

Ship Installation.—Fig. 6(a) is a rudimentary block diagram of the receiver in its normal state (i.e., in the absence of lane-identification transmissions). The master transmitter circuits, other than the output stages, are incorporated in the same box as the receiver, and the 1*f* oscillator which forms the basis of the master transmission also provides the receiver with its master phase datum. For the latter reason, there is no notch ambiguity problem at the receiver, since the slave-frequency master signals required by the receiver are derived direct by selecting the eighth and ninth harmonic from the pulse output of the 1*f* oscillator, and no uncertainty therefore exists as to the relationship of these signals with the 12*f* transmitted signal which is also derived directly from the same oscillator.

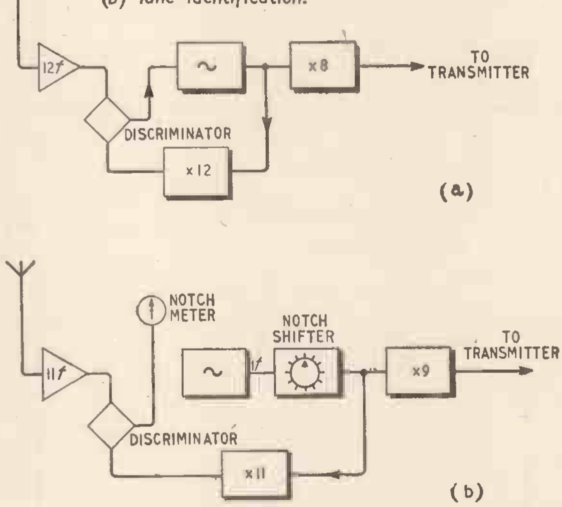
The functioning of the two receiving channels by which the shipborne equipment obtains the red and green slave signals depends upon the use of locked oscillators; that is to say, stable crystal oscillators in temperature-controlled "ovens" whose outputs are compared in frequency and phase with the received slave signals and locked to them by servo loops involving phase discriminators and reactance circuits. The oscillator outputs therefore provide noise-free replicas of the incoming signals, an arrangement which decreases the effective bandwidth of the receiver, as well as furnishing the phase memory required by the method of lane identification shown in Fig. 6(b).

Slave Stations.—Figure 7 shows the essentials of a slave station. The signal source is an oscillator of frequency $1f$ which is locked at its twelfth harmonic to the incoming $12f$ master signal. The equipment is identical at the two slave stations; if we assume that it is switched to operate as a "red" slave, the eighth harmonic of the basic $1f$ oscillator is amplified and transmitted continuously, except during lane identification. The locking of the slave to the master, upon which the generation of a stable pattern of position line circles depends, is carried out in two stages. The incoming master signal, having been passed through a two-stage crystal filter also in the "oven," is amplified and phase-compared with the twelfth harmonic of the slave's oscillator. The discriminator output controls the phase of the oscillator to keep the $12f$ signals phase-locked. The second stage of phase-locking (not shown in the diagram) is between the radiated output from the aerial and the input to the transmitter. The $8f$ output of the oscillator passes to the transmitter through a reactance stage. This is controlled, in turn, from an $8f$ phase discriminator, in which the drive and radiated $8f$ signals are phase-compared, to keep the radiated signal locked to the drive signal, irrespective of capacity changes in the transmitting aerial. This whole arrangement is duplicated at $9f$ so that the slave transmission at that frequency during lane identification shall be similarly phase-stable with respect to the master.

Elimination of the notch ambiguities is simply a matter of ensuring that the slave $1f$ oscillator has the correct phase relationship with the master $1f$ oscillator and this relationship is displayed to the slave-station operator every time the ship initiates a lane-identification transmission. The "notch meter" indicates the phase-difference between the $11f$ signal from the master (i.e., the eleventh harmonic of the master oscillator) and the eleventh harmonic of the slave oscillator. The latter is sufficiently stable for it still to be considered as locked to the interrupted $12f$ master signal, so that the twelfth harmonics of the two oscillators are already in phase; if the eleventh harmonics are seen by the notch meter to be also in phase the master and slave oscillator outputs will have the correct (i.e., zero) phase relationship at their fundamental frequency. If one of the eleven other possible readings is observed, a 12-position notch control, which operates a phase-shifting network, is turned a sufficient number of clicks in the appropriate direction to bring the eleventh harmonic of the oscillator into the right phase. The use of a click device on the phase control simplifies the setting up process as correction can then be made after the lane-identification period ($\approx$ 1 sec) has finished. When the meter reads zero, the whole system is correctly notched, i.e., the slave transmissions have the correct phase relationship with the master at the fundamental frequency $1f$ and hence also at the transmitted harmonic frequencies. The probability of a notch error developing during a day's work has been shown to be extremely remote. However, to enable the slave operator to check the notch in the event of an interruption in transmission, provision is made for him to request the ship to initiate a lane-identification transmission. The signal takes the form of a momentary phase shift in the slave transmission which is too rapid to introduce a Decometer error, but which serves to trigger a "slave-call" lamp on the receiver display unit.

On the survey ship, the receiver and the input sections of the master transmitter are now housed in a bulkhead-mounted container similar in size to that of the familiar Decca Navigator Mark 5 shipborne

Fig. 7. Simplified block schematic of slave-station control system during (a) normal transmission, (b) lane identification.



set; the transmitter itself and the aerial system are disposed in the same way as before (Figs. 1 and 4). The slave stations are stowed on board the ship in transit, and are then taken ashore in small boats or helicopters and set up for the duration of the survey. To assist stowage and transport, the units are housed in standardised boxes of the type used for Army signals equipment: hydrographic surveys are in the nature of military operations, and every possible effort has to be made to ensure mobility as well as reliability in the equipment that the modern surveyor employs.

REFERENCES

1 Admiralty Manual of Hydrographic Surveying (1948 edition).

2 O'Brien, W. J. Radio Navigational Aids. *Journal of Brit. I.R.E.*, Vol. 7, 1947, p. 215.

3 Powell, C. The Decca Navigator for Ship and Aircraft Use. *Proceedings of the I.E.E.*, Vol. 105, Part B, Supplement No. 9, 1958.

4 Roberts, G. E. The Design and Development of the Decca Flight Log. *Journal of Brit. I.R.E.*, Vol. 12, No. 2, February 1952.

5 Schneider, A. B. Phase Variations with Range of the Ground Wave Signal from C. W. Transmitters in the 70-140 Kc/s Band. *Journal of the Brit. I.R.E.*, Vol. 12, No. 3, March 1952, p. 181.

Elements of Electronic Circuits

15.—THE "BOOTSTRAP" TIMEBASE

By J. M. PETERS, B.Sc. (Eng.), A.M.I.E.E., A.M.Brit.I.R.E.

A TIMEBASE circuit which uses both positive and negative feedback is shown in Fig. 1. Known commonly as a "bootstrap" timebase, it comprises:—(i) A switch, consisting of a triode V1 operated by a negative-going square pulse, shunting the timebase capacitor C. (ii) A charging resistor, R, across which a constant potential is maintained. (iii) A triode, V2, connected as a cathode-follower amplifier, i.e., with current negative feedback, and developing unity gain. (iv) A capacitor, C_1, providing positive feedback to V2, the feedback voltage being developed across the timebase charging resistor R.

The operation of the circuit is as follows. An initial quiescent state is assumed with V1 conducting and V1 anode at a low potential. A negative-going square wave cuts off V1, and the timebase capacitor C starts to charge via R. If point X in Fig. 1 had been connected to a fixed h.t. potential C would have charged in an exponential fashion. To provide *linear* charging we endeavour to keep the potential across R constant so that the current through it is constant also. In other words, the waveform generated at Y must also appear at X. (Hence the description "bootstrap" timebase—derived from the notion of pulling oneself up by one's bootstraps.)

This type of action is achieved in the following way. The V2 stage is arranged to have approximately unity gain by operating it as a cathode follower. The timebase waveform developed at Y, if applied to V2 grid, therefore appears in phase at V2 cathode. We now connect the cathode of V2 via C_1 to point X, which (by cathode follower action) will follow the potential of Y. Thus, by positive feedback via C_1, a constant potential can be maintained across R, through which the timebase capacitor C is being charged. As a result C charges linearly.

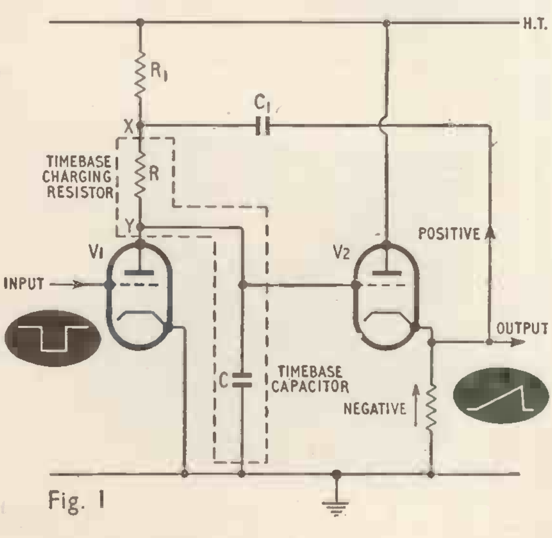


Fig. 1

The potential levels during the quiescent period are maintained by C_1 and R_1. Capacitor C_1 does not discharge appreciably during the period of the sweep provided that:

(a) the value of C_1 is very much greater than C;

(b) the time constant C_1R_1 is large compared with the duration of the sweep. Voltage changes across C_1 during the sweep must be small, otherwise the voltage across R will not be constant, thus causing non-linearity;

(c) the time constant C_1R is also large compared with the duration of the sweep.

Ideally the voltage across R should be exactly constant, but this cannot be attained in practice on account of the gain of V2 departing from unity. With a gain of less than 1 the voltage at X lags slightly on that at Y, the current through R falls slightly and the timebase sweep voltage becomes non-linear.

During the quiescent period (i.e., absence of input voltage at V1 grid) current flows through R_1, R and V1 to earth. During the period of the sweep, the current through R remains constant but the decrease in current through R_1 is made up by that flowing through C_1.

B.S.R.A. Constructors' Competition

THIS year's competition, held in conjunction with the annual dinner of the British Sound Recording Association, was notable for the exceptionally high standard reached by all the competitors, not only in design but in the workmanship and finish of the sound recording and reproducing equipment shown.

The President's Trophy was awarded to L. Widger, A.M.I.E.E., for a fully automatic system of sound accompaniment for a cine film in which commentary from tape and background music from discs are blended through mechanically-operated faders by notch cues on the film and conducting strips on the magnetic tape. The system includes means of precise speed control of the film and facilities for recording the combined sound effects on a single tape if required.

A neat v.h.f./f.m. receiver with pulse-counter-type discriminator won the *Wireless World* prize. This was designed by R. N. Baldock, B.Sc., in cylindrical form (2in diameter × 8in long) for mounting behind existing panels where space may be limited. Another tuner, with a similar discriminator, also of very compact design was entered by A. Robinson and was runner-up in the section for non-members of the Association.

A. J. Harper was awarded the Guy Fountain Prize with a neat turntable and pickup mounting incorporating an unusually smooth pickup lowering mechanism, most of which is below the motor board.

A prize for non-members of B.S.R.A. has been donated by *Hi Fi News* and was won this year by J. T. Gilbert for a stereo tape recorder using a modified commercial mono deck and with an unusually wide range of facilities, including dual level indicators and a built-in oscillator for balance adjustments.

Manufacturers' Products

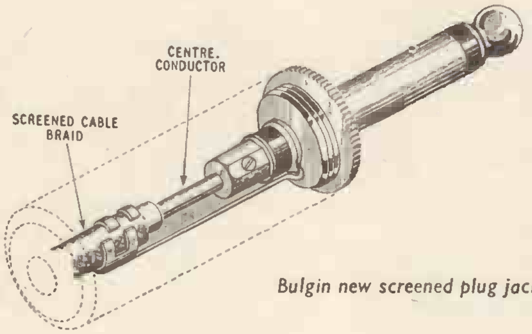
NEW ELECTRONIC EQUIPMENT AND ACCESSORIES

Screened Jack Plug

A FULLY screened telephone or microphone plug with standard ¼-in-diameter shank, has been introduced by A. F. Bulgin and Co. Ltd., Bye-Pass Road, Barking, Essex, primarily for use with tape recorders, but it has also applications wherever screened concentric or co-axial cables are terminated in a plug of this kind. It takes cables up to 7/32-in outside diameter and the screw-on metal cover, which is electrically connected to the shank electrode of the plug, is available with either polished chrome (P538) or 22ct gold plate (P539) finish. The price is 4s 6d in either finish.

No soldering is required, the centre conductor of the cable is secured by a grub screw to a terminal block and the screened sheath is gripped in a claw-like clamp, which serves also to take any strain on the cable.

A companion 6-mm model, for use with "Continental" equipment, is available also.



Bulgin new screened plug jack.

Flexible Wood-veneer Strips

THE processed forms of wood—from plywood to veneered chipboard—have very definite advantages for the construction of equipment and loudspeaker cabinets; but, if it is desired to "finish" as polished wood, inferior or complicated construction of the edge joints often has to be adopted to cover the multi-layer or chip nature of the material. To avoid the need for difficult construction Flexible Veneers Ltd. offer the ¾-in-wide Agastrip and Agatape paper-backed, flexible-veneer edging strips in light oak, mahogany and walnut. Agastrips are supplied in four- and ten-yard-long coils with the grain across the strip and with along-the-strip grain in 3-ft lengths. These have to be glued on; but the self-adhesive Agatape (19½-in lengthwise-grain strips) has only to be pressed on to the clean, dust-free surface.

The address of Flexible Veneers Ltd is: Cobbs Court Buildings, Carter Lane, London, E.C.4.

Transistorized Public-address Amplifier

WITH the new WS Electronics "Lilliput" amplifier a maximum output power of 12W r.m.s. into an impedance of 3 or 15Ω may be obtained from an input of 2mV r.m.s. at 30Ω impedance. The average current consumption when amplifying speech to maximum power output is about 1.5A (at 12V d.c.). The amplifier may be operated from 12, 24 or 28V d.c. supplies. Fuses in the amplifier protect the battery supply against being shorted out and also prevent the transistors being damaged by the application of a reversed voltage. The weight of the "Lilliput" amplifier is 5lb and its size 6½in by 4in by 4in. It costs £19 10s and is manufactured by W.S. Electronics Ltd., of Brunel Road, East Acton, London, W.3.

WS Electronics "Lilliput" transistor public-address amplifier.

High-resistance Kilovoltmeter

THE E.I.R. Instruments kilovoltmeter has a sensitivity of 250kΩ/V and indicates over the ranges 0 to 100V, 0 to 20kV (direct only) and 0 to 300MΩ on a 4-in scale. Using a 100-μA basic movement, the 4-μA f.s.d. sensitivity is achieved by the use of a cathode-follower current amplifier. This has a high-value cathode resistor, thus stabilizing the meter against mains-supply variations and the effective grid-to-earth resistance is 25MΩ, corresponding to the 100-V range. To change to the 20kV range a 5-GΩ (5,000MΩ) series resistor mounted in an insulated tube is used: this resistor is a single unit of a special type rated at 30kV. To measure resistance the unknown resistor forms a potential divider from h.t. with the input resistance of the meter.

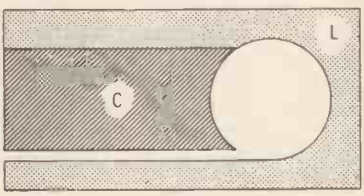
Capable of operating from 110 or 200 to 250-V a.c. supplies the meter is available in several forms (skeleton for incorporation in equipment, wooden or metal case, with or without megohm range) and it costs between £20 and £23.

Manufacturers: E.I.R. Instruments Ltd., 329 Kilburn Lane, London, W.9.

100-V and 25-kV meter has sensitivity of 250kΩ/V.

Technical Notebook

Industrial R.F. Generators usually employ large tank circuits in which the losses have to be kept to a minimum. This implies the use of a high-Q circuit with a small value of tuning capacitance; but then the variable reactance imposed by the work may " pull " their frequency outside the set limits. A large tank-circuit capacitance can overcome this effect by swamping the imposed variations, but the losses in a circuit of normal construction are then increased. In *Mullard Technical Communications*, Vol. 5, No. 41, F. Dittrich describes the design of "laminated circuits," the aim of which is to combine the inductive and capacitive components of the tuned circuit, at the same time avoiding joints and sharp corners in the path of current flow. The tuned circuit is made up from a set of plates of the form shown in the sketch, stacked and spaced, alternate plates being reversed to make the cross-hatched portions overlap from alternate edges and form the capacitance. This forms a parallel-plate capacitor with an integral single-turn inductor

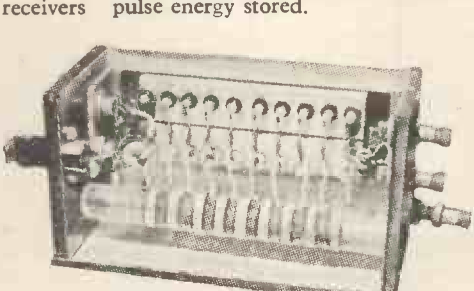


—the inductor being split into many sections so that each section carries only the circulating current associated with its own capacitor plate. Another advantage is that, outside the cross-hatched area on the sketch, adjacent plates are at the same r.f. potential so that metallic spacers and bolts may be used for assembly.

Adjacent-Channel Interference due to multiplex signals may not be so great in practice as simple theoretical considerations would indicate, according to a letter from L. B. Arguimbau published in *Proc. I.R.E.* for August 1959. Measurements on two commercial v.h.f./f.m. receivers were made—one nominally broad-band and the other nominally narrow-band. In both cases there was little change in adjacent-channel interference when an ordinary f.m. signal was replaced by an f.m. signal which included a sub-carrier such that the maximum total deviation was increased (although at the same time the main-carrier deviation was reduced and the amplitude of the added sub-carrier was made less than that of the main carrier). The reason for this small change in adjacent-channel interference with increasing deviation is probably due to the fact that in any practical receiver the response outside the passband does not fall off immediately to zero. In this latter simple theoretical case where the response outside the passband does immediately fal off to zero, if the deviation of a signal normally just outside the passband is increased, the interference, of course, increases from zero to some finite value, so that the proportionate increase in adjacent-channel interference is theoretically infinite.

Drop-outs and Noise due to imperfections in the tape are problems besetting any type of magnetic-tape recording, but for digital work either can result in false information. Many precautions are thus taken to reduce the effect of these distortions. The Telegraph Construction & Maintenance Company have attacked the root of the problem by, surprisingly enough, returning to the *Blattnerphone* idea, replacing the oxide-coated tape by 0.001-in thick Vicalloy. This material is a malleable and ductile permanent-magnet alloy with a saturation flux density of about 12,000 gauss. It is claimed that, due to the lower incidence of drop-outs and noise, much more information can be packed on the tape, so saving space in compact instrumentation.

Pulse Shortener developed by the Admiralty Surface Weapons Establishment uses variable-capacitance diodes as the capacitors in a lumped-constant transmission line. To shorten a pulse the bias on the diodes is altered so as to decrease their capacitance as the pulse is travelling down the line. This decrease in the diode capacitance produces an increase in the velocity of propagation down the line. Since the pulse continues to occupy the same physical length of line, this increase in the pulse velocity decreases the pulse period. Decreasing the diode capacitances also increases the pulse energy stored.



RANDOM RADIATIONS

By "DIALLIST"

It's Worked in New Zealand

A READER in New Zealand tells me that the term radiotrician, which I mentioned in the April issue, is in fairly common use in his country, but the official word is serviceman. Official? Yes, in New Zealand it is illegal for anyone who has not served a specified term as a trainee and subsequently passed an official examination to undertake the servicing of any mains-operated electronic equipment. Having served his time and passed the exam, he is registered as a serviceman and receives his certificate of competence. To become a trainee, a man must obtain a "permit to assist" a certificated tradesman for so many years, after which he can present himself as a candidate for the exam. We have, of course, in this country the R.T.R.A. exams and certificates in both sound radio and television servicing; but it isn't agin the law to undertake such work if you haven't got these certificates. Whether or not it should be is a moot point. I wonder what readers think about it?

Wire or Wireless?

WHICH, I wonder, will win the race to provide better television and v.h.f. sound reception in places where they're not now too good? Stage 2 of the B.B.C.'s expansion programme is scheduled for completion by March 1964 and the additional 21 satellites will bring in an important number of new viewers and listeners, as well as improving reception for many thousands more. But the piped services people are getting on fast with the job of providing strong "clean" signals in places where they're now weak, or interference-ridden, or both. Myself, I'm rather inclined to believe that piping is the only certain way of providing good services in built-up areas in which interference, ghosting and so on are bad. But it probably would be uneconomic to extend it to remote country districts and it's the villages and isolated houses that satellite transmitters and translators can do most to help.

V.H.F. DX

FROM Aylesbury comes further news of successful long-distance reception on the very high frequencies. The reader who sends it tells me that in the four years in which he's been at it he has logged all bar one of the B.B.C.'s v.h.f. stations. He has also logged nearly 60 European stations, including thirty-six in Italy. He points out how heavily the v.h.f. DX-er scores over his medium-wave opposite number. On the very high frequencies good, clear reception of Continental stations can be obtained; but that's too often far from being the case on the crowded medium- and long-wave bands.

The Dry Cell Problem

IN the May issue of *Wireless World* I mentioned the possibility of serious damage through the puncturing of one or more cells of a partly run down dry battery left in a transistor receiver, a hearing aid, or an ohm-meter. Several suggestions for making things safe have come along; wrap the battery with Sellotape or with insulating tape, or place it in a polythene bag in the set and should it spring a leak, throw it away bag and all. So long as there's room for a wrapped battery and provided you can contrive watertight exits for the connecting leads, any of these should answer. But the real answer is surely that dry batteries meant for use in such apparatus should be made up of leakproof cells. They cost a bit more, but in my view it's jolly well worth it, for I have never known a leakproof cell of good make to belie its name, even though badly treated. Just to see what would happen, I once kept a trio of run-down leakproof cells on the shelf for a whole year. They weren't leaking when I threw them away.

V.H.F. and Polarization

AS you know, the B.B.C.'s v.h.f. sound transmissions are horizontally polarized and I have been surprised to find that with an horizontal dipole I have often picked up vertically polarized signals sent out by non-broadcasting stations. This so intrigued me that one day I tried the experiment of changing my aerial from the horizontal to the vertical position. Reception from the local broadcasting station wasn't so good; but I *did* get a signal of some kind with the dipole in any position between the horizontal and the vertical. A friend who often listens to European v.h.f. stations tells me that with his horizontal Band III dipole he is frequently able to receive vertically polarized transmissions—or at any rate, transmissions emanating from vertical aerials—from other countries. It must be, I suppose, that as they journey these very short waves tend to twist a little.

Electron Beam Welding

SINCE writing the note in the June issue on electron beam welding and cutting I have learned that the originator of the technique in Europe was J. A. Stohr, of the French Atomic Energy Authority. I am interested to learn also that Edwards High Vacuum Ltd. have obtained a licence to manufacture in this country vacuum welding equipment using an electron bombardment heat source. Edwards also kindly sent me a reprint of a paper on the subject presented by two members of their research staff, M. E. Harper and E. G. Nunn, at a recent meeting of the Institute of Welding.

Getting Down to It

THE striking and animated picture entitled "TV," which attracted so much attention at this year's Royal Academy Exhibition, might well have had a sub-title "How not to watch it," for nearly every method of obtaining a poor picture and straining the eyes is being practised by the viewers. To begin with, the receiver is on the floor, which means that except for the children and the dog, who are themselves on the carpet, everyone must look right down at the screen—a most uncomfortable business and hard on the eyesight. The children, poor mites, have their eyes within inches of the screen. Despite the fact that they're already so close to the set all the grown-up viewers are leaning forward. It's a question of artistic licence, I suppose.

Without the Book

AMAZING—isn't it?—what a mess a ham-handed fellow who tries to adjust a television receiver can make of things. I don't mean by taking the back off and poking about inside but just by messing with the external controls. A friend of mine recently acquired a first-rate set, capable of showing an excellent picture, which was put in and adjusted by his dealer. When I dropped in a few days later to see how it was doing I found that it was showing just about as bad a picture as you can imagine. Surely the dealer hadn't left it like that, I suggested. No, I was told, it wasn't quite like that: but the owner thought that he could make it just a tiny bit better, so he tried his hand. No, he hadn't bothered about the instruction book; just tried altering one knob's setting after another. Afraid he hadn't made much of a job of it; could I be so kind . . .?

UNBIASED

By FREE GRID

Radar in 1896?

IF I were to state that radar was invented before radio communication, it would probably result in strong letters of protest being sent to the Editor. Yet this is stated almost daily in the popular Press and even, I'm sorry to say, in some so-called technical journals.

The writers do not make this statement directly but they certainly do in effect when they tell us, for instance, that radar was used at Jodrell Bank to switch on and off the transmitter of one of the American space probes. We also often hear that "radar waves" are used to control guided missiles, and to destroy American rockets in mid-flight when it has been found necessary owing to something having failed to work out according to plan.

This grievous perversion of the word radar is obviously due to the fact that these offending writers imagine it to mean control at a distance or, in other words, telearchics. To some extent this is the fault of people in responsible positions who coined the expression "secondary radar" to describe what was really a special application of telearchics. No doubt the expression secondary radar is highly convenient for those who know what they are talking about but it was bound to cause confusion and trouble among the less well-informed who at once proceeded to apply the term radar to any other application of telearchics.

Now if we are going to allow the word radar to be used as a synonym for telearchics we must, to be logical, be prepared to admit that radar was invented before radio communication. A moment's thought will make this clear.

Everybody will admit that before it was possible to establish radio communication, Marconi and others had to find some means of causing incoming radio waves to waggle the diaphragms of a pair of headphones or trigger off a local source of power to operate the armature of a morse inker. In other words, telearchics, which is loosely and falsely called radar-control by certain writers, had to precede radio communication, as is made abundantly clear in Marconi's patent specification of June, 1896.

However, telearchics—and therefore wrongly so-called radar—was established long before 1896. I have been reading a book published in 1917 and written by B. F. Meissner, of the U.S. Navy. It is mainly about the control of torpedoes by telearchics—which the author calls teledynamics or radiodynamics.

In this book Meissner stresses that the first instance of the electrical control of mechanisms from a distance was when Le Sage, of Geneva, established his electrostatic telegraph nearly two centuries ago in 1774. Its wireless counterpart—using the word wireless in its literal sense—was in 1838, when Steinheil obtained deflections of a galvanometer needle over a distance of fifty feet by means of earth currents.

I will cap this by pointing out that in 600 B.C., Thales of Miletus demonstrated wireless control at a distance when he caused amber to attract pieces of paper. Obviously, even in pre-electrical days, telearchics always preceded communication, for no matter whether we receive a message aurally or visually, it is first necessary for the incoming signals to waggle our eardrums or agitate our retinæ.

Music Hath Charms . . .

EVERBODY has heard of Congreve's famous words:—

> "Music hath charms to soothe a savage breast,
> To soften rocks, or bend a knotted oak,",

and it is for this reason that in days of old, young men used to serenade their lady loves, and try to soften their hard hearts by fiddling beneath their bedroom windows. This technique is, of course, exactly the same as that employed by a snake charmer who can, by a suitable tune, bend the most savage serpent to his will.

In the jargon of present-day psychological science, this musical mesmerizing of a maiden would be called conditioning her to accept a proposal.

I hear that this old technique has been adopted by some go-ahead dentists to soothe their patients and "condition" them to accept pain. So far I have only heard of it being employed in the case of a young lady of my acquaintance, but it may be used on some men also, for certain of our sex are undoubtedly as susceptible to the strains of Orpheus' lute as were any of the other beasts of the field.

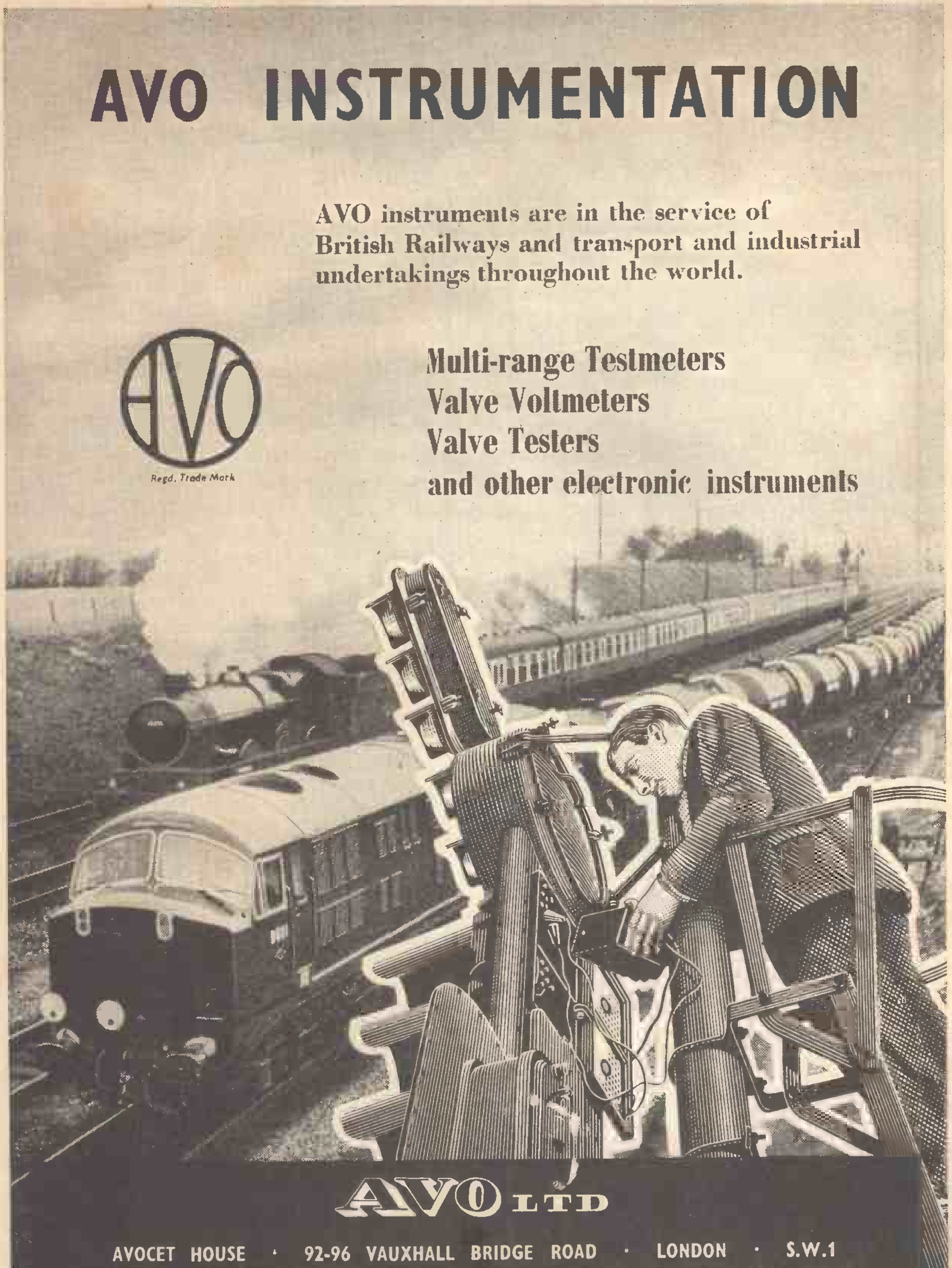
The lady who supplied me with the information, told me her dentist used the very latest technique in supplying the mesmerizing music. He had installed a modern stereophonic system which ground out a scherzo as his drill ground into her carious cavity.

I am wondering if the choice of music is always left to the dentist's professional judgment or whether the patient can have a say in the matter. A scherzo is, of course, a light, quick and animated movement; in fact, just the sort of movement the patient herself would make when the drill lighted on a nerve.

The whole thing is thus reminiscent of the technique of the ancient Chinese dentist who, so Marco Polo would have us believe, used to employ thumbscrews on the patient when extracting a tooth. The idea was, of course, that the pain of the thumbscrews acted as a counter-irritant to the oral pain inflicted by the dentist. The thumbscrew agony was so excruciating that the dental pain paled into insignificance.

That being so, I think that if I had my choice, I would pick as my counter irritant something by Bartok or Hindemith as I cannot think of anything more painful than being forced to listen to their efforts. Modernists will naturally not agree with me and would probably choose Bach or Beethoven as their counter irritants. But for a tooth extraction, of course, nothing would be so effective as the Eton boating song with the swinging melody which accompanies the words "we all pull together."

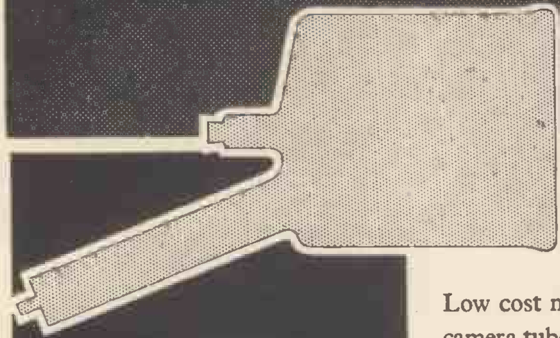
Counter-irritant to oral pain



An Esso Photograph
G24

Illustration by courtesy of British Railwa s

Industrial



for your plans tomorrow

Mullard

Low cost monitors, precision oscilloscope tubes, image converters and camera tubes—all are available from Mullard. Some of these tubes from the current range of over forty basic types of industrial display device are shown opposite. Whatever your interest in industrial cathode ray tubes and other display devices, it will pay you to have a word with Mullard. Not only does the current range include tubes for all sorts of applications — research and development is intensive and well advanced in a number of new fields, some of them being described below:

✻ Display storage tubes

Advanced development is now in progress on both bi-stable and half-tone storage tubes. The bi-stable tubes are electrostatically deflected and are intended for use in infinite persistence oscillograph applications. The half-tone tubes are magnetically deflected and provide a bright flicker-free display with controllable persistence characteristics. Uses for these half-tone tubes include radar displays where ambient light levels are high and equipment for the display of information received on slow-scan narrow bandwidth systems.

✻ Information storage tubes

Tubes are being developed which provide electronic writing and reading facilities for use in information processing systems. Of particular interest is a single-gun tube capable of storing a high resolution television picture for purposes of standards conversion, or processing for band-width compression. In the radar field it has applications in systems employing true-motion display or moving target indication.

✻ Solid State display devices

Among the solid state devices under active investigation is a light amplifier which utilises a combination of electroluminescent and photoconductive principles. Other devices in this sphere of activity include solid state image convertors and multi-element devices.

✻ Transparent Phosphors

In applications where the ambient light is extremely strong it is possible, in some instances, to maintain contrast by using display tubes with transparent phosphors. Experimental tubes show that although the brilliance of the trace is naturally less than that of a normal tube, only negligible ambient light is reflected from the transparent tube screen, and an effective display is obtained.

✻ Scan Magnification

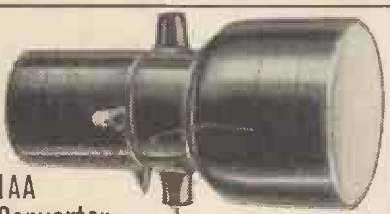
Deflection sensitivities of both magnetic and electrostatic industrial and radar tubes of conventional design can, under certain conditions, be increased by factors of 10 times by the use of magnetic and electrostatic lens systems of scan magnification. Substantial progress is being made at the Mullard Research Laboratories in the complex problems which must be resolved before this attractive system becomes a practical proposition.

display devices

...and your needs today

AW17-20 Television Camera Viewfinder

This high quality viewfinder and monitor tube has a 6½-inch diagonal *rectangular* screen. Compared with earlier 5-inch round tubes, the rectangular screen of the AW17-20 provides nearly twice the useful screen area for an increase of only 20% of the face plate area.



ME1201AA Image Converter

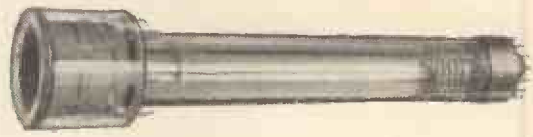
One of the most important applications of the image converter is as an electronic shutter in high speed photography. With the grid controlled ME1201AA, exposures as short as a thousand-millionth of a second are possible.

MM13-10 High Brightness Radar Tube

At high altitudes ambient light is strong, and for easy viewing, radar tubes are made with a very high brightness. The MM13-10 is a five-inch magnetic tube specially designed for such applications.

DH10-78 Helical P.D.A. Tube

The DH10-78 is a 4-inch diameter flat faced instrument tube which employs a helical post deflection acceleration system. The characteristics have been carefully determined to suit it for a wide variety of applications ranging from simple inexpensive oscilloscopes to precision laboratory apparatus.



5820 Television Camera Tube

The 5820 is a 3-inch image orthicon tube with an exceptionally high sensitivity and a spectral response approaching that of the human eye. It is a direct equivalent of the American tube of the same type number.

AW36-48 Studio Monitor Tube

The high-brightness and definition of this 14-inch tube are of particular value in television studio monitors. Deflection is magnetic and focus electrostatic.

DH3-91 Waveform Monitor Tube

One of the simplest and most economical systems of waveform monitoring is provided by the DH3-91. This is an inexpensive one-inch tube that in most equipment can be operated from existing H.T. lines.

Mullard

GOVERNMENT AND INDUSTRIAL VALVE DIVISION

Mullard Ltd., Mullard House, Torrington Place, London, WC1. Telephone: LANgham 6633

MVT770a

CELESTION

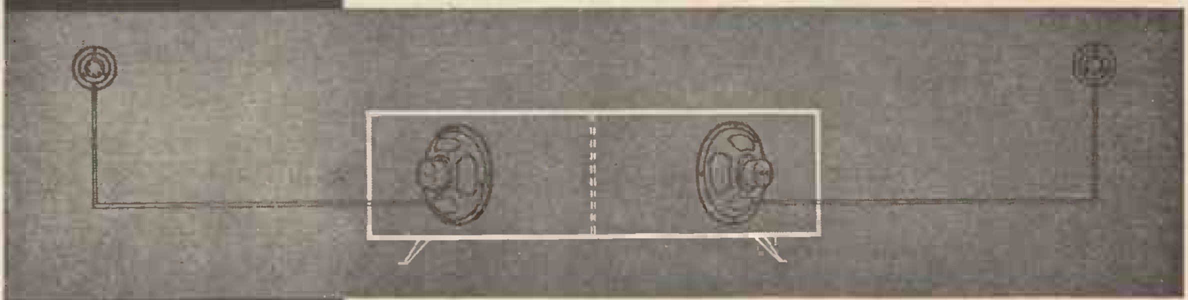
MODEL G44/1300

FULL WIDTH STEREOPHONIC

LOUDSPEAKER SYSTEM

The complete answer to the demand for a reasonably priced high quality speaker system for the reproduction of stereophonic recordings in the home.

Utilising two very small pressure type direct radiator units for the higher frequencies and two 12in. reproducers for the lower, the equipment covers a response which is substantially level from 35-15,000 c/s. with true stereophonic effect.



The price for two HF.1300 and two G.44 units, complete with enclosure details is:—

£18:10:0

HIGH-NOTE PRESSURE TYPE UNITS

Designed and developed in CELESTION Laboratories this class of unit has been manufactured for special purposes over the past five years. A new unit, Model HF.1300, has been introduced for the new stereophonic system and its smooth response and wide dispersion ensure an exceptionally high standard of reproduction of the higher frequencies.

LOW-NOTE REPRODUCER G—44

This new 12in. Loudspeaker has been designed specially to work in conjunction with the HF.1300. A skilfully balanced voice coil and cone assembly with correct cone edge termination result in a level and clean low frequency response.

COMPLETE SYSTEM

The system uses only one enclosure, 15in. high x 42in. wide x 18in. deep, having a central dividing partition with one G.44 unit mounted at each end. The enclosure should then be positioned near the centre and against one wall so that the speakers are facing outwards and are about 2ft. 6in. from the floor.

The two HF.1300 units should then be placed near the corners of the room, one on each side of the enclosure and approximately 4 feet above the floor. The width of sound will very nearly correspond to the distance between these two units. No elaborate cross-over networks are required and the system is completed by a 12 Mfd. capacitor in series with each high note unit.

Designed and developed by CELESTION

Celestion Ltd., THAMES DITTON : SURREY

Telephone: EMBerbrook 3402/6

Printed Circuit Counter Panels

A complete range of transistorized counter panels of common size, fixing method and electrical connexion, designed to provide a flexible unit system whereby any special requirements in the counting or data processing fields can be quickly built up.

A fully illustrated brochure giving complete performance and specification figures for every panel in the range is available on request.

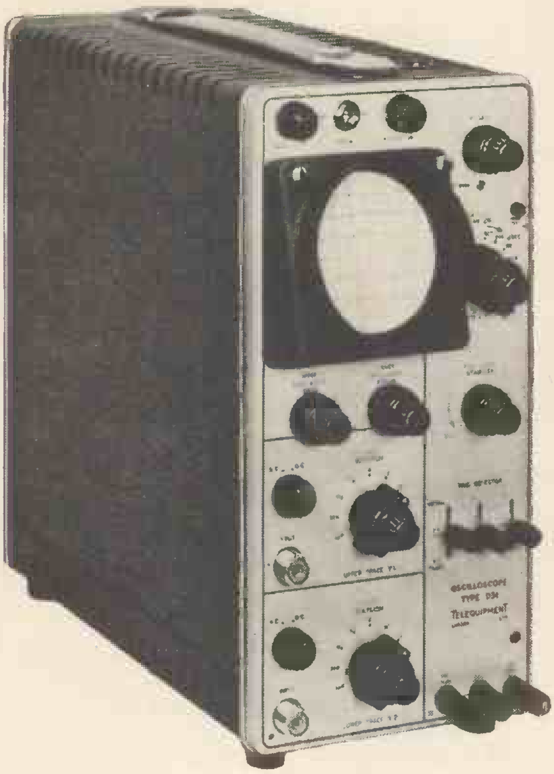
50kc/s Scaler
1Mc/s Scaler
Input Amplifier
Gate Unit
10kc/s Oscillator
1Mc/s Oscillator
Power Unit
50kc/s Read-out Scaler
1Mc/s Read-out Scaler
4 Channel Output Unit
Read-out Unit
Meter Display Unit
Lamp Display Unit
Numerical Indicator Tube
Shift Register Stage
Shift Register Driver

CINTEL
INSTRUMENT *Division*

RANK CINTEL LIMITED
Worsley Bridge Road · London · SE 26
HIther Green 4600

Sales and Servicing Agents: Atkins, Robertson & Whiteford Ltd. Industrial Estate, Thornliebank, Glasgow; McKellen Automation Ltd., 122 Seymour Grove, Old Trafford, Manchester, 16; Hawnt & Co. Ltd., 59 Moor St. Birmingham, 4.

D31 double beam Serviscope . . . a logical development of the original, highly successful S.31 single beam Serviscope. Though weighing only 26 lbs. in its rugged steel case, the D.31 has capabilities greater than many more elaborate instruments, plus many improved features which make for wider application, more accurate measurements and simpler operation.



D.C. amplifiers and slow speed time base (down to 5 sec/cm if necessary) are eminently suitable for servo work and similar applications. Fast rise time (.06 μsec) and high writing speed (10 cm/μsec at maximum expansion) are essential for any work dealing with fast pulses or TV waveforms. The unique triggering arrangements enable complex waveforms to be examined in detail with complete accuracy of synchronisation. At this moment D.31 is in use in the diverse fields of computer development and servicing, radar equipment, telemetering applications, closed circuit and broadcast TV, automatic telephone equipment—in fact in any field where a double beam oscilloscope is essential.

The D.31 costs £95

TELEQUIPMENT

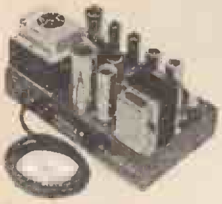
TELEQUIPMENT LTD., 313 Chase Road, Southgate, London, N.14. *Telephone: FOX LANE 1166*

See our full range of Kits at the NORTHERN ELECTRONICS EXHIBITION

Heathkit DAYSTROM

COLLEGE OF SCIENCE & TECHNOLOGY, MANCHESTER JULY 7—13

HI-FI MONAURAL AMPLIFIER KIT Model MA-12



A compact high fidelity power amplifier (including auxiliary power supply). 12 watts output. Wide frequency range and low distortion. A variable sensitivity control is fitted enabling it to be used with an existing amplifier in a stereophonic system. Other applications include sound reinforcing systems, transmitter modulators, for use with tape recorders, and general purpose laboratory amplifier. **£9.19.6**

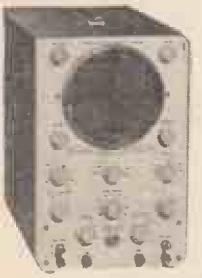
STEREO CONTROL UNIT KIT Model USC-1

Incorporates all worthwhile features for high fidelity stereo and mono. Push-button selection, accurately matched ganged controls to ± 1dB. Negative feedback rumble and variable low-pass filters. Printed circuit boards. Accepts inputs from most tape heads and any stereo or mono pick-up. **£17.19.6**

"CHEPSTOW" EQUIPMENT CABINET KIT

Specially designed for those whose floor space is at a premium. Will house Record Player, FM Tuner, Stereo Amplifier and additional power amplifiers where needed. An upper deck is available for the self-powered stereo amplifiers to ensure maximum heat dissipation. Veneered and left in white for finishing to personal taste. Overall dimensions are 35" x 18" x 33" high. **£10.10.0**

5in. OSCILLOSCOPE KIT Model O-12U

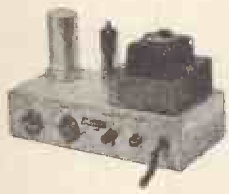


Laboratory quality at utility oscilloscope price and ease of assembly make this kit of outstanding value. Vertical frequency response 3 c/s to 5 Mc/s., +1.5 dB. −5 dB., sensitivity 10 mV. per cm. at 1 kc. Horizontal frequency 1 c/s. to over 400 kc/s. (± 1 dB. up to 200 kc.). The Heath patented sweep circuit functions from 10 c/s to 500 kc. in five ranges giving five times the usual sweep of other 'scopes. In addition it has exceedingly short re-trace and rise in times and electronically stabilised power supply. Included is a 48-page instructional Manual. **£34.15.0**

BALUN COIL UNIT KIT Model B-1U

Useful transmitter accessory. Will match unbalanced co-axial lines, used on most modern transmitters, to balanced lines of either 75 or 300Ω impedance. **£4.4.6**

POWER SUPPLY UNIT KIT Model MGP-1



Compact, general purpose unit suitable for FM Tuners, Tape Recording Amplifiers and general Laboratory use. Input 100/120V, 200/250V, 40-60 c/s. Output 6.3 V 2.5A A.C.; 200, 250, 270V. 120 mA. max D.C. **£4.9.0**

HI-FI STEREO AMPLIFIER KIT Model S-88

Gives 16 w. output (8 per channel with 0.1 per cent. distortion at 6 w. per channel). It has ganged controls, STEREO/MONAURAL gram, radio and tape recorder inputs and push-button selection as well as many other first class features well above its price range. In two-tone grey metal cabinet with a golden surround and fittings. Also ultra-linear push-pull output. **£25.5.6**

Basic sensitivity 10 mV. (2 mV. available 20/- extra).

DUAL-WAVE TRANSISTOR RADIO KIT Model UJR-1

This sensitive headphone set is a fine introduction to electronics for any youngster. Operated by a small torch battery. **£2.16.6**

ELECTRONIC SWITCH KIT (Oscilloscope Trace Doubler) Model S-3U

This extremely useful, low priced device will extend the use of your single-beam oscilloscope for duties otherwise only in the province of the double-beam tube.

In short, at a nominal cost, the Heathkit model S-3U will give you the advantages of a double (or other multiple) beam 'scope, while retaining all the advantages of your present single-beam instrument.

Hitherto an electronic switch of this nature, permitting the simultaneous observation of two signals on the screen of a single-beam C.R.T. oscilloscope, has cost nearly as much as the 'scope itself. **£9.18.6**

MULTIMETER KIT Model MM-1U

Provides wide voltage, current, resistance and dB ranges to cover hundreds of applications. Sensitivity 20,000 ohms/volt D.C. and 5,000 ohms/volt A.C. Ranges: 0-1.5V to 1,500V A.C. and D.C.; 150μA. to 15A D.C.; 0.2Ω to 20 MΩ. 4½in. 50 μA meter. **£11.8.6**

TRANSISTOR PORTABLE KIT Model UXR-1

Presented in elegant real hide case with tasteful gold relief. Can be assembled in 4 to 6 hours, and you have a set in the top flight of the 20-23 guinea class. Prealigned I.F. transformers, printed circuit and a 7in. x 4in. high-flux speaker. **£15.18.6**

DECADE CAPACITOR KIT Model DC-1U

Capacity values 100μμF to 0.111μF in 100μμF steps. Precision silver-mica capacitors and minimum loss ceramic wafer switches ensure high accuracy. **£5.18.6**

AUDIO WATTMETER KIT

Model AW-1U. Up to 25W continuous 50 W intermittent. **£13.18.6**

RESISTANCE-CAPACITANCE BRIDGE KIT Model C-3U

Measures capacity 10pF to 1,000μF, resistance 100Ω to 5 megohms and power factor. 5-450 v. test voltages. Safety switch provided. **£7.19.6**

2¾in. SERVICE 'SCOPE KIT Model OS-1

Light, compact, portable, for service engineers. Printed circuit board for easy construction. Wt. 10½ lb. Size 5in. x 8in. x 14½ in long. **£18.19.6**

VARIABLE FREQUENCY OSCILLATOR KIT Model VF-1U

For all Amateur Bands, 160-10 metres. Ideal for Heathkit DX-40U and similar transmitters. **£10.12.0**

Price less valves £8/19/6

● Deferred Terms ●
available on all orders above £10.

DAYSTROM LTD.

DEPT. W.W.7, GLOUCESTER, ENGLAND

A member of the Daystrom Group. *MANUFACTURERS OF THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS*

thoroughly **Heathkit** DAYSTROM ***dependable***

COTSWOLD SPEAKER SYSTEM KIT

This acoustically designed enclosure measures 26 x 23 x 15½in. and houses a special 12in. bass speaker with 2in. speech coil, elliptical middle speaker together with a pressure unit to cover the full frequency range of 30-20,000 c/s. Its polar distribution makes it ideal for really Hi-Fi Stereo. Delivered complete with speakers, cross-over unit, level control, Tygan grille cloth, etc. Left "in the white" for finish to personal taste, all parts are pre-cut and drilled for ease of assembly. **£19.18.6**

HI-FI F.M. TUNER

Tuning range 88-108 Mc/s. Flywheel tuning. Attractive Plastic Front Panel in two-tone grey with golden trim, surround and motif. Thermometer type visual tuning indicator. Pre-aligned I.F. transformers (eliminates adjustment). Three I.F. Stages. Wide-band low distortion. Ratio Detector. Complete R.F. Unit, wired, tested and pre-aligned (ready for mounting to chassis). Printed Circuit for I.F. Amplifiers and Ratio Detector, for ease of assembly. No alignment necessary after assembling. Built-in power supply. Output sockets for stereophonic adaptor (for stereo transmission when available).

TUNER UNIT Model FMT-4U (incl. 16/11 P.T.) £3 2 0 with 10.7 Mc/s. I.F. output.

I.F. AMPLIFIER Model FMA-4U complete with case and valves £10 10 6

Sold separately .... Total £13 12 6

★ FREE ON REQUEST ★

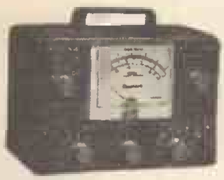
A copy of our NEW (British) Heathkit Catalogue. Prices include free delivery in U.K.

CAPACITANCE METER KIT Model CM-1U

This Direct-Reading Capacitance Meter is a very low priced, time-saving instrument which is so useful that it should be part of the general equipment of every electronic laboratory and production line. Easily built in a few hours. 0–100 $\mu\mu$F, 0–1,000 $\mu\mu$F, 0–0.01 μF, 0–0.1 μF. The meter has 4½in. scale and can be used by an unskilled operator after a few minutes' instruction. **£14.10.0**

STEREO-HEAD BOOSTER KIT Model USP-1

Hi-Fi Stereo Pre-Amplifier for low-output Hi-Fi P.U.s. Input 2 mV. to 20 mV. Output adjustable from 20 mV. to 2 V. 40–20,000 c/s. Also suitable as low-noise R.C.-Coupled high-gain monaural amplifier **£5.19.6**



AUDIO SIGNAL GENERATOR KIT Model AG-9U

10 c/s. to 100 kc/s., switch selected. Distortion less than 0.1%. 10 v. sine wave output metered in volts and dB's........................ **£19.3.0**

● Deferred Terms available on orders over £10 ●

HI-FI SPEAKER SYSTEM KIT Model SSU-1

Ducted-port bass reflex cabinet, "in the white." Frequency response to 40–16,000 c/s. Power rating 25 watts. Matched speaker units 8in. high flux (12,000 lines) with hyperbolic cone and 4in. wide angle dispersion type for higher frequencies. With legs £11/12/6........................ **£10.5.6**

Please tick the items in which you are interested and we will send you full details.

	S-88	Hi-Fi Stereo Amplifier Kit		UJR-1	Dual-Wave Transistor Radio Kit
	S-33	6-Watts Stereo Amplifier Kit		S-3U	Electronic Switch Kit
	UXR-1	Transistor Portable Kit		309-CU	R.F. Probe Kit
	DX-40U	"Ham" Transmitter Kit		DX-100U	Amateur Transmitter Kit
	O-12U	5in. Oscilloscope Kit		—	Matched Hi-Fi Stereo Kit
	V-7A	Valve Voltmeter Kit		RP-1U	Transcription Record Player
	SSU-1	Hi-Fi Speaker System Kit		—	Gloucester Stereo Cabinet Kit
	AG-9U	Audio Signal Generator Kit		—	Cotswold Speaker System Kit
	C-3U	Resistance-Capacitance Bridge Kit		—	"Chepstow" Equipment Cabinet Kit
	VF-1U	Variable Frequency Oscillator Kit		—	Hi-Fi F.M. Tuner
	USP-1	Stereo-Head Booster Kit		CM-1U	Capacitance Meter Kit
	USC-1	Stereo Control Unit Kit		MA-12	Hi-Fi Monaural Amplifier Kit
	OS-1	2½in. Service Oscilloscope Kit		MM-1U	Multimeter Kit
	B-1U	Balun Coil Unit Kit		—	Tape Deck "Packaged deals"
	DC-1U	Decade Capacitor Kit		AW-1U	Audio Wattmeter Kit
	MGP-1	Power Supply Unit Kit		AV-3U	Audio Valve Millivoltmeter Kit

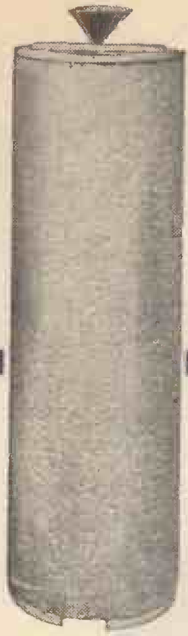
NAME ....ADDRESS ....

(In CAPITAL letters please).. W.W.7

DAYSTROM LTD.

DEPT. W.W.7, GLOUCESTER, ENGLAND

THE WORLD'S LARGEST-SELLING ELECTRONIC KIT-SETS



UNUSUAL SINGLE SPEAKER SYSTEM

A CONCRETE COLUMN

An inexpensive column speaker constructed from a concrete pipe and fitted with an 8/145 unit attracted much interest and admiration at the London Audio Fair because of its clean open sound.

The absence of cabinet resonance produces bass of unusual crispness normally associated with larger and more expensive speakers.

A complete kit of wooden fixtures including absorbent wadding and diffusing cone are available at a price of £3 15s. 0d. Full details free on request. Suitable concrete pipes can be purchased from builders' merchants at about 12/6. Recommended unit type 8/145 £6 19s. 11d. inc. P.T.

W3 THREE SPEAKER SYSTEM

Where a ready-to-use complete speaker system is required the W.3 in its handsome cabinet is always a popular choice.

BASS L.F. output is produced by a special 12in. unit type WLS/12 fitted with a heavy cone and a new type of suspension which permits large linear excursions and gives a low fundamental resonance of 25-30 c/s.

TREBLE The upper registers are handled by 5in. and 3in. units connected in parallel via a quarter section 1 kc/s. dividing network, with an extra series capacitor to protect the small speaker. The volume controls permit adjustment of midrange and treble to give tone control and facilitate balancing speakers on stereo.

Cabinet size 28in. x 14in. x 12in.
Weight 48 lb. complete. Impedance 15 ohms.
Maximum input 15 watts.
Effective frequency range 30–20,000 c/s.

The elegant cabinet is available in a choice of walnut, oak or mahogany veneers. Also available in white-wood, price £36/10/-. Tropical model made with resin-bonded plywood can be supplied at £2 extra.

Descriptive leaflet free on request. **Price £39.10.0 complete, tax free**

Wharfedale
WIRELESS WORKS LTD
IDLE BRADFORD YORKS

Telephone: Idle 1235/6 Telegrams: 'Wharfdel,' Idle, Bradford

R-C Oscillator Type TF 1101

A compact general-purpose oscillator giving a low-distortion output of ⅔ watt max. into 600 ohms. Frequency range 20 c/s to 200 kc/s. Output level indicated by panel-meter and calibrated attenuator. A band-pass filter provides for a 1-kc/s output of very low distortion.

Audio Tester Type TF 894A

The TF 894A covers from 50 c/s to 27 kc/s. It comprises a heterodyne oscillator and 0- to 50-dB, 600-ohm attenuator combined with a three-range a.c. voltmeter which is available for external use. Output: 2 watts maximum at 600, 15, and 3 ohms. Voltmeter ranges: 80, 8, and 4 volts full-scale.

A.F. Power Meter Type TF 893A

A wide-range absorption-type power meter for use in the frequency range 20 c/s to 35 kc/s. The power measurement range is 20 μW to 10 watts and the input impedance can be set to any of 48 different values between 2.5 ohms and 20 kΩ.

Distortion Factor Meter Type TF 142F

Measures total spurious content, up to 30 kc/s, of inputs within the fundamental frequency range 100 c/s to 8 kc/s. Distortion measurement range: 0.05 to 50%. The input can be at any level between 500 mV and 500 volts.

A.F. Power Meter Type TF 1347

A sensitive, accurate, direct-reading instrument. Its ten power ranges, covering 10 μW to 6 W, and 5½-inch meter provide excellent discrimination. Impedance range: 2.5Ω to 20kΩ in 11 steps. Frequency characteristic substantially flat from 50 c/s to 20 kc/s.

Wave Analyser Type TF 455E

Gives amplitude and frequency of individual components of either audio signals or the modulation envelopes of r.f. signals up to 500 Mc/s. Its a.f. range is 20 c/s to 16 kc/s and its amplitude measurement range is 30 μV to 300 volts.

PRECISION AUDIO MEASUREMENT

calls for

Measurements of audio performance to modern standards call for the very best in test equipment. Marconi's offer an unrivalled range of instruments to meet the most exacting requirements at every stage in the design-production cycle. From first evaluation of laboratory models to final testing in the factory, and maintenance in the field, there is a Marconi instrument to meet the need.
For full details write for leaflets G172.

MARCONI INSTRUMENTS

AM & FM SIGNAL GENERATORS · AUDIO & VIDEO OSCILLATORS
DISTORTION METERS · DEVIATION METERS · Q METERS & BRIDGES
FREQUENCY METERS · POWER METERS · TRANSMISSION MONITORS
VOLTMETERS · OSCILLOSCOPES, SPECTRUM & RESPONSE ANALYSERS

Please address enquiries to
MARCONI INSTRUMENTS LTD., at your nearest office:
London and the South; Marconi House, Strand, London, W.C.2.
Telephone: COVent Garden 1234
Midlands: Marconi House, 24 The Parade, Leamington Spa. Telephone: 1408
North: 23/25 Station Square, Harrogate. Telephone: 67455

Export Department: Marconi Instruments Ltd., St. Albans, Herts. Telephone: St. Albans 56161

TC 172

Stentorian

HIGH FIDELITY AT REALISTIC COST

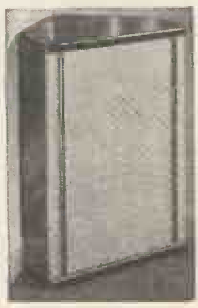
The items illustrated are representative of the wide range of W.B. Hi-Fi equipment. A noteworthy recent addition is the "Stentereo" Stereophonic Speaker System embodying many novel features. Our experience in sound reproduction covers 33 years: such a background is a guarantee of quality. Full details of all W.B. products will gladly be sent on request.

W.B.8 Amplifier £19.19.0.

W.B.8S Stereo Amplifier £23.15.0

W.B.8S Stereo Control Unit £22.15.0

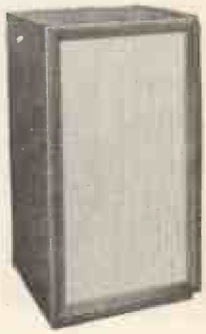
Stentorian Cambric Cone Hi-Fi Units.
The famous H.F.1016 at £7.12.3.
Other types from £1.2.6.



Ready-to-assemble cabinets in polished walnut from £5.10.0 to £16.16.0.

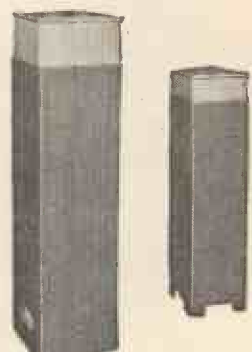
"PRELUDE" ready-to-assemble cabinets in striped sapele from £9.19.6 to £13.13.0.

Tweeter Units from 33/3 to £12.12.0.



Prelude Horn-Loaded Cabinet £19.0.0.
H.F.817 Speaker £10.16.6.

T.359 Cone Tweeter Unit 33/3.



COLUMN LOUDSPEAKERS
Cabinet for H.F.816 Unit £18.18.0.
Cabinet for H.F.610 Unit £9.19.6.

Stentorian Extension Speakers from 60/-.

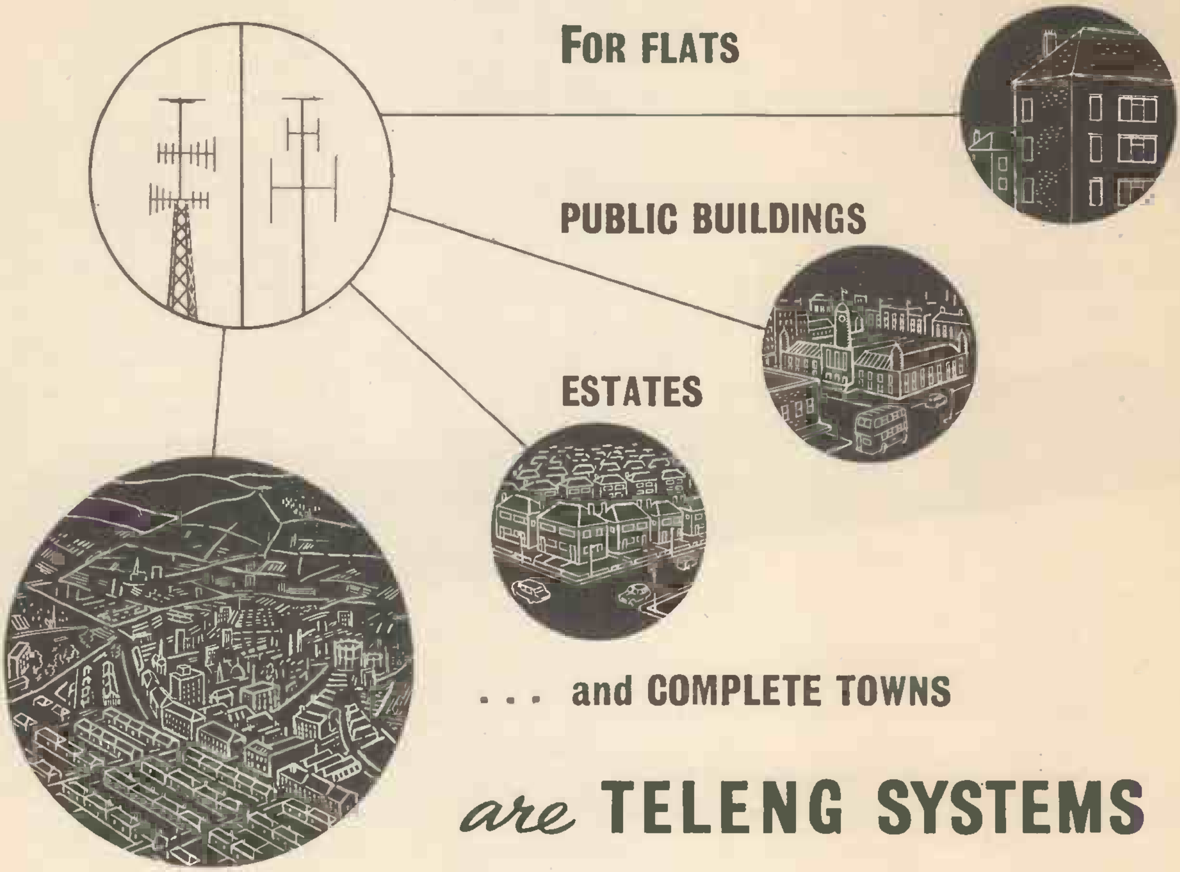
W.B.121

WHITELEY ELECTRICAL RADIO CO. LTD · MANSFIELD · NOTTS

Telephone: MANSFIELD 1762-5

Demonstrations at our London Office (109 Kingsway, W.C.2.) every Saturday from 9 a.m. to 12 noon.

More and More T/V - F/M RELAY and COMMUNAL AERIAL SYSTEMS



are TELENG SYSTEMS

Teleng's many YEARS of successful practical experience is at your service for the installation of complete systems serving any channels, any size of area coverage, and any number of outlets for standard receivers.

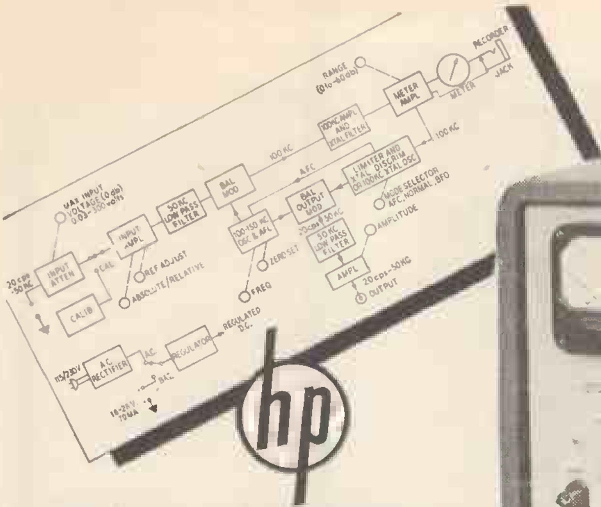
Teleng Equipment is built to the highest public service standards, gives known performance and utmost reliability, fully obeying Post Office Engineering Department requirements and insurance dictates for absolute safety to connectees.

Full system planning and quotations are given without obligation.

this is why MORE and MORE DEALERS

Consult TELENG

TELENG LIMITED, TELENG WORKS, CHURCH ROAD, HAROLD WOOD, ROMFORD, ESSEX.
Ingrebourne 42901



HEWLETT PACKARD 302A WAVE ANALYZER

ADVANTAGES: **No calibration or stabilization needed • Direct readings; accurate • Measures frequencies 20 cps to 50 KC • Completely transistorized • Battery or ac powered • Hum free • Low power consumption • No warm-up needed • Very sharp acceptance circuits • AFC • Also frequency restorer circuit • Compact, rugged, versatile.**

New Model 302A Wave Analyzer represents a significant improvement in wave analyzer design. Completely transistorized, sophisticated in design, highly selective, free of tedious calibration and stabilization before use—these are but a few of the important convenience and accuracy features in the new 302A. Other exceptional features are low power consumption (in the order of 3 watts), provision for battery operation (18 to 28 volts) as well as ac line power, and elimination of warm-up time.

SPECIFICATIONS:—

Frequency Range: 20 cps to 50 KC.

Frequency Calibration: Linear graduation 1 division per 10 cycles. Accuracy ± (1% × 5) c/s.

Voltage Range: 3μv to 300v.
Ranges provided by an input attenuator switch and a meter range switch in steps of 1 : 3 or 10 db. Meter range is indicated by a dial mechanically linked to input attenuator. An absolute-relative switch, in conjunction with a variable 10 db control is provided for adjustment of intermediate values.

Warm-Up Time: None.

Voltage Accuracy: ±5% of full scale value.

Residual Modulation Products and Hum Voltage: Greater than 75 db down.

Intermediate Frequency Rejection: Intermediate frequency present in input signal rejected by at least 75 db.

Selectivity: ±3½ cycle bw—at least 3 db down.
±25 cycle bw—at least 50 db down.
±70 cycle bw—at least 80 db down.
beyond ±70 cycle bw—at least 80 db down.

Input Impedance: Determined by setting of input attenuator: 100,000 ohms on 4 most sensitive ranges, 1 megohm on remaining ranges.

Selected Frequency Output: 1v open circuit at output terminal for full scale meter deflection. Output level control provided. Frequency response ±1 db. 20 cps to 50 KC. Output impedance approximately 600 ohms.

B.F.O. Output: 1v open circuit at output terminals. Output level control provided. Frequency response ±1 db, 20 cps to 50 KC. Output impedance approximately 600 ohms.

Automatic Frequency Control: Range of frequency holding is ±100 cycles minimum.

Power: 115/230v ±10%, 50/1600 cycles, 3 watts (approx.) Terminals provided for powering instrument from external battery source. Battery supply range 28v to 18v.

Weight: Net 43 lbs. Shipping 63 lbs. (cabinet mount). Net 35 lbs. Shipping 55 lbs. (rack mount).

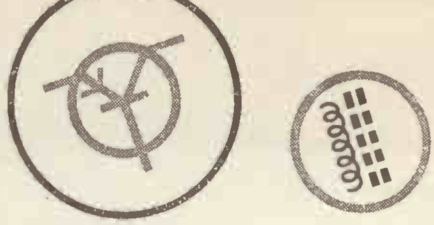
Dimensions: Cabinet Mount: 20¾" wide; 12½" high; 14½" deep. Rack Mount: 19" wide; 10½" high; 13½" deep.

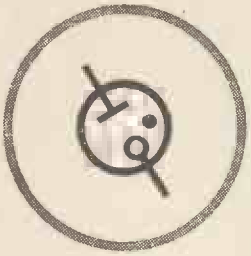
Price: Delivered U.K. and exclusive of duty—where payable
£718 (cabinet mount)
£712 (rack mount)

Continuous progress in design may affect the above specification which is therefore subject to change without notice.

LIVINGSTON LABORATORIES LTD.

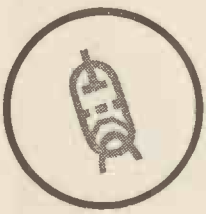
RETCAR STREET · LONDON · N.19 Telephone ARChway 6251

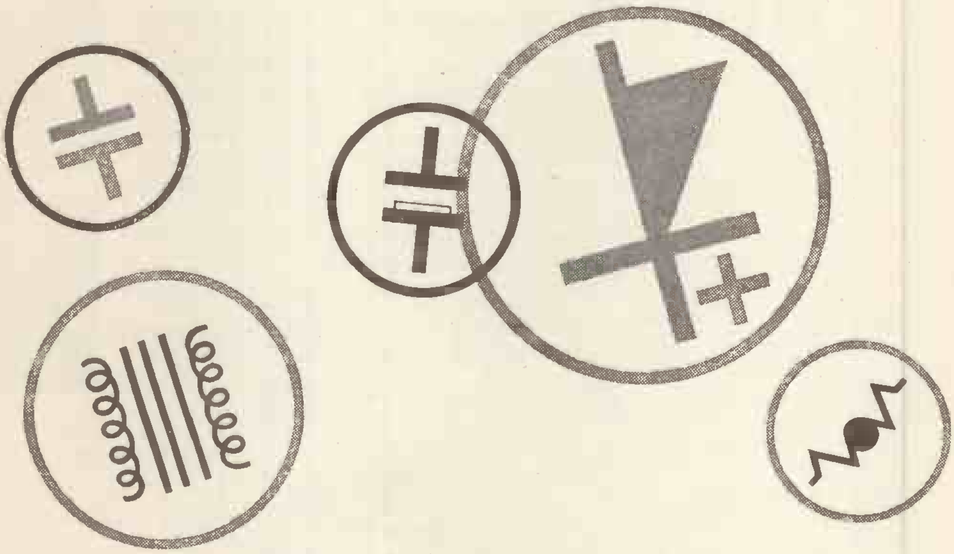




RELIABLE PERFORMANCE
demands
STC COMPONENTS

The standard of reliability of STC components is set by the vital roles of the navigation and communications equipments in which many of them are used. The consequent employment of top grade materials and high degrees of skill and care in manufacture ensures that all users of STC components may have the fullest confidence in them.





YOU CAN RELY ON STC COMPONENTS

Brimar Teletubes · Brimar Valves · Brimistors · Capacitors · Contact Cooled Rectifiers · Ferrites · Germanium Diodes · Germanium Photocells · Hermetic Seals · High Stability Resistors · Magnetic Materials · Quartz Crystals · Relays · Special Valves · Selenium Rectifiers · Silicon Rectifiers · Silistors · Suppressors · Transistors · Thermistors · Transformers · Zener Diodes

Get to know the range of STC Components—write for booklet M/103 which lists all components and their relevant technical literature.

STC COMPONENTS GROUP

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London W.C.2.

COMPONENTS GROUP · FOOTSCRAY · SIDCUP · KENT

60/3M

RTB

ALPHASIL—*the modern core material*

The inset curves illustrate the superior magnetic properties of Alphasil cold-reduced grain oriented silicon steel over those of a typical hot-rolled grade (Ferrosil 80). Alphasil has a maximum permeability four times that of the hot-rolled transformer sheet and its core losses are approximately one-third. Initial and Incremental permeability, stacking factor and ductility are considerably better than those of hot-rolled sheet.

Alphasil ·013″ thick is produced in coil 30 inches wide, and can be supplied slit to narrower widths by arrangement.

TABLE OF WATTS LOSSES

	Frequency cycles/second	*Guaranteed max. total losses at B. Max. 15 Kilogauss*
ALPHASIL 44	50	·62 watts/lb.
ALPHASIL 40	50	·56 watts/lb.
ALPHASIL 37	50	·51 watts/lb.
ALPHASIL 33	50	·46 watts/lb.

ABOVE—A 4,000-lb. coil of 30″ wide x ·013″ thick, ready for despatch.
RIGHT—Core-loss testing of Alphasil by the 'double-lap' Epstein method.

Thin Alphasil for high frequency work is also available in coil in ·004″ thick in widths up to 5½ inches, and in ·002″ thick, in widths up to 4½ inches.

	Frequency cycles/second	*Guaranteed max. total losses*
ALPHASIL ·004HF	400	8·00 watts/lb. at B Max 15 Kilogauss
ALPHASIL ·002HF	8,000	9·50 watts/lb. at B Max 2 Kilogauss

Full technical data will be supplied on request

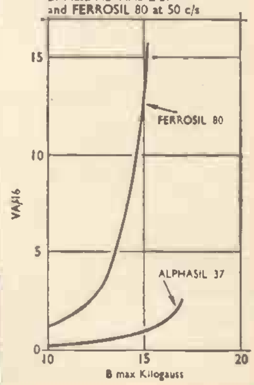
RICHARD THOMAS & BALDWINS LTD

Enquiries for sheet and strip to be addressed to RICHARD THOMAS & BALDWINS (SALES) LTD., WILDEN, STOURPORT-ON-SEVERN, WORCS.

Enquiries for laminations to be forwarded to RICHARD THOMAS & BALDWINS LTD., COOKLEY WORKS, BRIERLEY HILL, STAFFS.

Our Cookley Works is one of the largest in Europe specializing in the manufacture of laminations for the electrical industry.

Curves of RMS VA/lb against B. max. ALPHASIL 37 and FERROSIL 80 at 50 c/s



gm=47mA/V

with the 3A/167M Triode

The 3A/167M is a high performance, long life triode, which has been designed to satisfy the particularly stringent requirements of repeater applications. There is, however, a much wider field of applications fully described in a new Application Report. Send for a copy. The number is MS/109.

Applications include:

WIDE BAND AMPLIFICATION

LOW NOISE AMPLIFICATION

V.H.F. CASCODE AMPLIFICATION

PULSE AMPLIFICATION

LOW DISTORTION AMPLIFICATION

LOW NOISE TRIODE MIXING

CATHODE FOLLOWER CIRCUITS

COMPONENTS GROUP

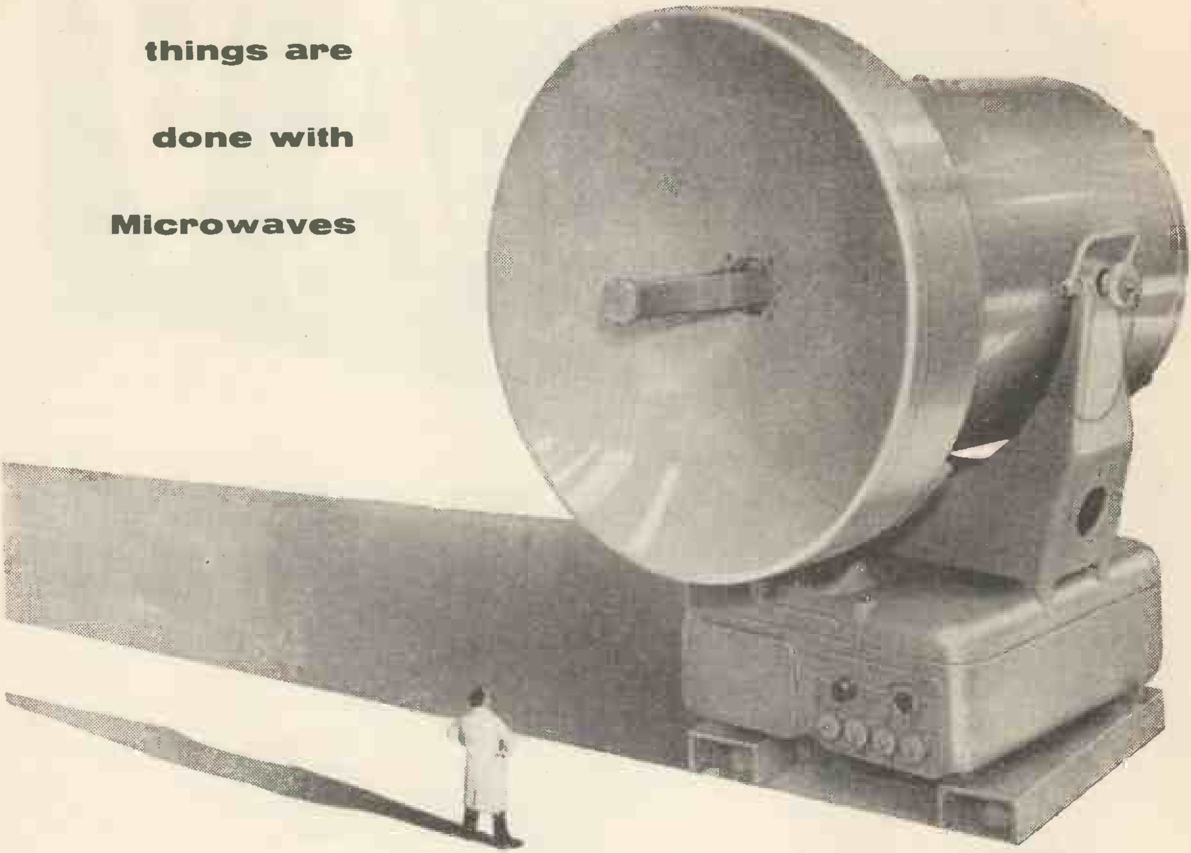
60/3MS

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London W.C.2

VALVE DIVISION: FOOTSCRAY · SIDCUP · KENT

Where great things are done with Microwaves



RADAR: Fire Control · Navigation of Aircraft and Small Ships · Automatic Landing · Missile Guidance and Transponders • **COMMUNICATIONS:** Multichannel Radio Links for telemetering Data and Speech **VALVES:** Klystrons and Magnetrons for 35/GCS and 75/GCS bands · Monitor Diodes for 1/GCS to 35/GCS **INSTRUMENTS:** Comprehensive Waveguide measuring circuits covering 6 to 75/GCS • **RESEARCH:** Outstanding Research and Development of the latest techniques.

ELLIOTT

COMMUNICATIONS DIVISION · RADAR DIVISION · VALVE DIVISION
MICROWAVE & ELECTRONIC INSTRUMENTS DIVISION · RADAR RESEARCH LABORATORY

ELLIOTT BROTHERS (LONDON) LTD

Elstree Way, Borehamwood, Hertfordshire · Elstree 2040
Airport Works, Rochester, Kent · Chatham 4/4400

EA *A MEMBER OF THE ELLIOTT-AUTOMATION GROUP*

ensure CONSISTENT magnetic characteristics

with STC

permalloys & permendur

PERMALLOY 'C'
for highest initial permeability, useful for wide-band frequency transformers, current transformers, chokes, relays and magnetic shielding.

PERMALLOY 'B'
has lower initial permeability than Permalloy 'C' but has a higher value of flux density. It is suitable for use where high permeability to an alternating field superimposed upon a steady polarising field is required.

PERMALLOY 'D'
for very high resistivity withouc undue lowering of the maximum flux density. Variation of permeability with frequency is small. Ideal for H.F. applications.

PERMALLOY 'F'
very rectangular hysteresis loop with a rententivity of at least 95% of its saturation value; high flux density and low coercive force. Ideal for saturable reactors, magnetic amplifiers, digital computers, memory devices, etc.

V-PERMENDUR
for high permeability with a very high value of maximum flux density. Finds special application for use as high quality receiver diaphrams, also motor generators and servo-mechanisms in aircraft where weight and volume are important factors.

PHYSICAL PROPERTIES AND GENERAL MAGNETIC CHARACTERISTICS

	Permalloy 'B'	Permalloy 'C'	Permalloy 'D'	Permalloy 'F'	V-Permendur
Specific Gravity	8.3	8.8	8.15	8.4	8.2
Electrical resistivity—microhms per cm cube	55	60	90	26	26
Initial permeability μ_0	2 000 to 4 000	15 000 to 40 000	1 800 to 3 000	400 to 1 000	700 to 1 000
Maximum permeability μ_{max}	15 000 to 40 000	50 000 to 150 000	12 000 to 20 000	200 000 to 400 000	3 000 to 6 000
Magnetising force for μ_{max}-oersteds	0.20 to 0.40	0.025 to 0.04	0.2 to 0.5	0.03 to 0.10	2.0 to 6.0
Maximum flux density-gauss	16 000	8 000	13 000	14 000	24 000
Coercive force in oersteds for B_{max} = 5 000 gauss	0.16	0.03	0.15	0.05*	2.3†
Remanence in gauss for B_{max} = 5 000 gauss	4 000	3 500	3 500	13 000*	16 000†
Hysteresis loss in ergs/cc/cycle for B_{max} = 5 000 gauss	160	40	200	220*	12 500†
Total loss in watts/lb for B_{max} = 5 000 gauss 50 c/s 0.015 in. sheet	0.11	0.04	0.2	0.3*	4†

* for B_{max} = 14 000 gauss † for B_{max} = 20 000 gauss

Write for Technical Data Sheets :—

STC COMPONENTS GROUP

Standard Telephones and Cables Limited

Registered Office: Connaught House, Aldwych, London, W.C.2

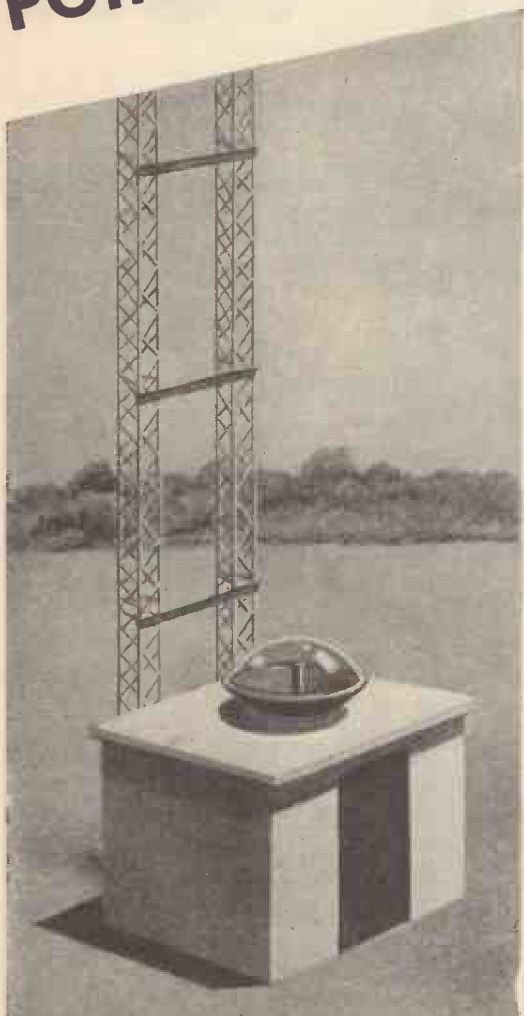
MAGNETIC MATERIALS SALES DEPT: EDINBURGH WAY · HARLOW · ESSEX

60/1MM

AS SUPPLIED TO:

Associated Television Ltd.
Scottish Television Ltd.
Tyne-Tees Television Ltd.
Central Rediffusion Services Ltd.
Portuguese Television Service.
Atomic Weapons Research Establishment.
Southern Television Corporation, Adelaide, Australia.
and many other users.

POINT TO POINT



MICROWAVE LINKS

This Pye microwave television link Type PTC M1000 is suitable for use with the N.T.S.C., C.C.I.R. or the British 405-line systems. A sub-carrier f.m. music link circuit is incorporated. The normal frequency range is 6575 to 7425 Mc/s but models can be supplied to cover the range of 5925 to 6425 Mc/s. The r.f. power output is 1 watt. Wave guide or passive reflector installations available. Transportable link equipment is also available.

Please write for full details.

PYE MICROWAVE LINKS

PYE TELECOMMUNICATIONS LIMITED : NEWMARKET ROAD : CAMBRIDGE
Telephone: Teversham 3131 Telegrams: Pyetelecom, Cambridge

TA 41

GM 6012

Broadband Millivoltmeter, type GM 6012

Frequency range: 2 c/s - 1 Mc/s
Measuring range: 1 mV (f.s.d.) - 300 V in 12 steps
dB scale: -80 dB up to +52 dB (0 dB = 1 mW into 600 Ω).
Input impedance: 4 MΩ in parallel with 20 μμF (up to 3 V)
10 MΩ in parallel with 10 μμF (in the other ranges).
Overall accuracy with respect to full scale:
within ± 2,5%, 5 c/s 100 kc/s
within ± 5%; 2 c/s - 1 Mc/s
Pre-deflection: < 100 μV

High Frequency Millivoltmeter, type GM 6014

	Without pre-attenuator	With pre-attenuator
Frequency range:	1 kc/s - 30 Mc/s	10 kc/s - 30 Mc/s
Measuring range:	1 mV (f.s.d.) - 300 mV in 6 steps	100 mV (f.s.d.) - 30 V in 6 steps
dB scale:	-80 dB up to -8 dB	-40 dB up to +32 dB
Damping at 1 kc/s	1 MΩ	50 MΩ
1 Mc/s:	700 kΩ	10 MΩ
30 Mc/s:	50 kΩ	2 MΩ
Input capacitance:	7 μμF	2 μμF

Pre-deflection: Compensated by electrical zero setting
Variations of the frequency characteristics:
< 5% over the whole range, with respect to the response at the frequency of the calibration voltages.
Overall accuracy: < 3% with respect to full scale and with reference to the frequency characteristic.

meters

DC Microvoltmeter, type GM 6020

	Input I	Input II
Measuring range:	100 μV (f.s.d.) 10 V in 11 steps	10 mV (f.s.d.) 1000 V in 11 steps
Input impedance:	1 MΩ (± 1.5%) in parallel with 20μμF	100 MΩ (± 1.5%) in parallel with 10 μμF

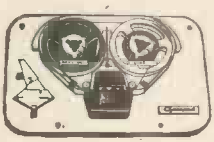
Overall accuracy with respect to full scale: 3%
Pre-deflection: < 5 μV
Drift: < 1 μV per hour after 1 hour of warming-up
Automatic polarity indication doubles the effective scale length with respect to centre-zero instruments.
DC currents may be measured directly with this instrument due to the high accuracy of the input resistance.
Measuring range: 100 μμA (f.s.d.) - 10 μA
Accuracy: < 3.5%

GM 6014

instruments: quality ***tools*** for industry and research

PHILIPS

fit Garrard for Good....



MAGAZINE TAPE DECK

Unique design plus magazine loading makes tape recording and play back easy and good. No threading, anchoring or spilling of tape. Tape can be stopped at any point, magazines removed and replaced later.

MODEL 4 HF

A high quality single Record Player elegantly styled and carefully designed to provide maximum reliability with fidelity of reproduction. Fitted with TPA 12 Pick-Up Arm

And now the latest unit to bear the Garrard name—Model 210 Record Player and Automatic Record Changer. Elegantly styled to match in with modern equipment design. Produced with the same engineering skill that characterises everything in the Garrard range.

★ **MODEL 210**

Plays any number of records up to eight, either 7in., 10in. or 12in. at 16⅔, 33⅓, 45 and 78 r.p.m. 10in. and 12in. of the same speed can be mixed in any order. May also be played manually.

MODEL TPA 12

Transcription Pick-Up Arm designed for monaural and stereophonic record reproduction. It is an instrument of the highest quality with its modern styling finished in Ivory, Chrome and Red. Fitted with M.P.M.4 Plug-in moulding which accepts most cartridges, it is the companion to the Model 301 Transcription Motor.

....and always

GARRARD ENGINEERING & MANUFACTURING CO. LTD.

Factory and Registered Office: NEWCASTLE STREET, SWINDON, WILTSHIRE

Telephone: SWINDON 5381 (5 lines) TELEX 44-271

GARRARD SWINDON TRADE REG. MARK

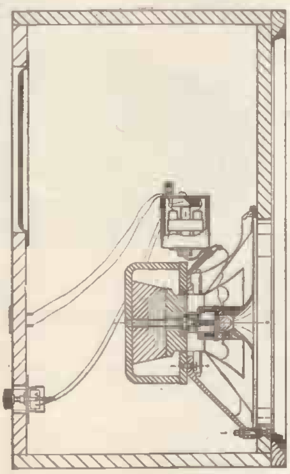
GOODMANS

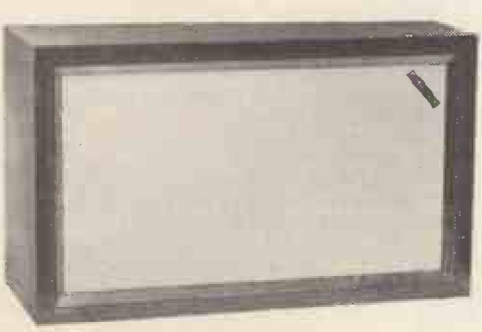
PIONEERS OF COMPACT LOUDSPEAKER SYSTEMS

There was once a time when Full Range High Fidelity reproduction from a Loudspeaker housed in a *small* enclosure was considered impracticable—the text books said so and this appeared to be confirmed by experimental work.

The first real break-through came before the war—from GOODMANS—with the introduction of a high compliance twin-cone unit mounted in a totally enclosed 18″ cube. After the war, development was taken up again and complete multiple Loudspeaker Systems were developed for use specifically in very small enclosure volumes. Again GOODMANS led the market. Then the research and development effort was directed to overcome the remaining disadvantages; complexity, low efficiency, high cost. The result was Model A.L/120—incorporating all the valuable experience gained over many years as well as the latest developments in enclosure loading, diaphragm design, high frequency radiation, magnet design, to say nothing of advanced methods of precision manufacture.

This achievement is best judged and appreciated by ear; the actual description of the A.L/120 is as follows:—Frequency range 35 c/s to 20,000 c/s with a maximum power handling capacity of 15 Watts. Overall enclosure size—24″ x 11½″ x 14¼″. Enclosure loading—Acoustical Resistance (GOODMANS Patent No. 790997 [British]). Drive unit: 12″ Triaxial unit comprising *three concentrically mounted radiating elements,* each designed to specialise in low distortion reproduction of one part of the overall scale; bass, middle, treble; and integrated on to a common axis to approach the ideal of the "point source" radiator with its freedom from phase interference between the separate units. Bass radiation is from a large diaphragm with plastic treated high compliance suspension, with mechanical crossover to a moulded high stability mid-range radiator; and finally electrical crossover (twin ½-section L.C. network 12 db/octave) to a high precision horn loaded high frequency pressure unit, with separate L-pad balance control.





Model A.L/100 also follows these lines in most respects, except that it employs a two element drive unit and provides smooth coverage from 35 c/s to 15,000 c/s., with a power handling capacity of 12 Watts.

THESE LOUDSPEAKER SYSTEMS ARE DESIGNED AND BUILT WITH GREAT CARE TO BRING *TRUE* HIGH FIDELITY INTO YOUR HOME—COMPACTLY, ELEGANTLY, EXCITINGLY.

WRITE *NOW* FOR ILLUSTRATED BROCHURE.

A.L/120 . . . Price £29. 10. 0
as illustrated

A.L/100 . . . Price £23. 10. 0

Both models available in walnut or mahogany finish.

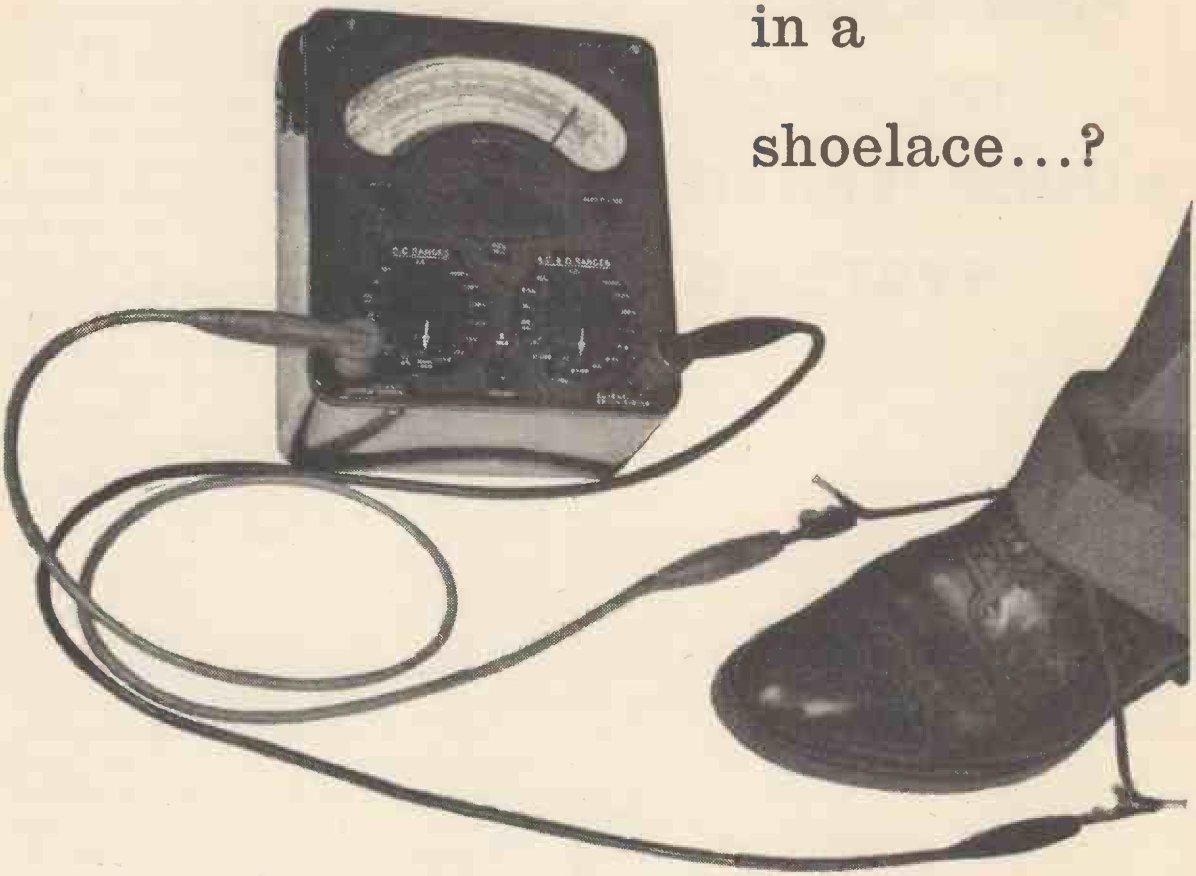
G34WW

GOODMANS INDUSTRIES LIMITED, Axiom Works, Wembley, Middx.

Tel.: WEMbley 1200 (8 lines) Grams: Goodaxiom, Wembley, England.

In every sense the greatest range—in every country the greatest name.

how many ohms in a shoelace...?



Fanciful? No, because as our photograph proves, a shoelace can be made electrically conducting by impregnating it with "dag"* colloidal graphite.

Unrealistic? As a practical proposition the shoelace test is just that; as a simple illustration of a fundamental idea we think it is effective enough.

Over-simplified? Perhaps, yet thousands of cars are fitted with a non-metallic conducting braid which has much in common with a shoelace impregnated with colloidal graphite.

A non-conducting material can be made conductive by treating it with "dag" colloidal graphite, either by impregnation (surface coating or dipping after manufacture) or incorporation (addition during manufacture).

Furthermore, you can impart any or all of the many other characteristics of colloidal graphite: low friction and "parting" properties, resistance to heat and wear, chemical inertness.

** Registered trade mark of Acheson Industries (Europe) Ltd: licensed user—Acheson Colloids Ltd.*

Acheson Colloids LIMITED

P.O. BOX 12 · PRINCE ROCK · PLYMOUTH · DEVON

(a subsidiary of Acheson Industries (Europe) Limited)

Manufacturers of dispersions of colloidal graphite, molybdenum disulphide, silver, glass vermiculite in suitable carrier liquids including oil, water, white spirit, alcohol and toluene.

If your problem is basically how to make plastics, natural or synthetic fibres, leather, cloth, paper or wood electrically conducting, then you should get in touch with us.

ACHESON

Also Acheson Colloids Company, Port Huron, Michigan, U.S.A. and Acheson Colloiden N.V. Scheemda (Gr.) Netherlands

Another outstanding new Ediswan valve

with a CV4000 specification

The EDISWAN S2P20 (CV4097)
Filamentary Beam Tetrode

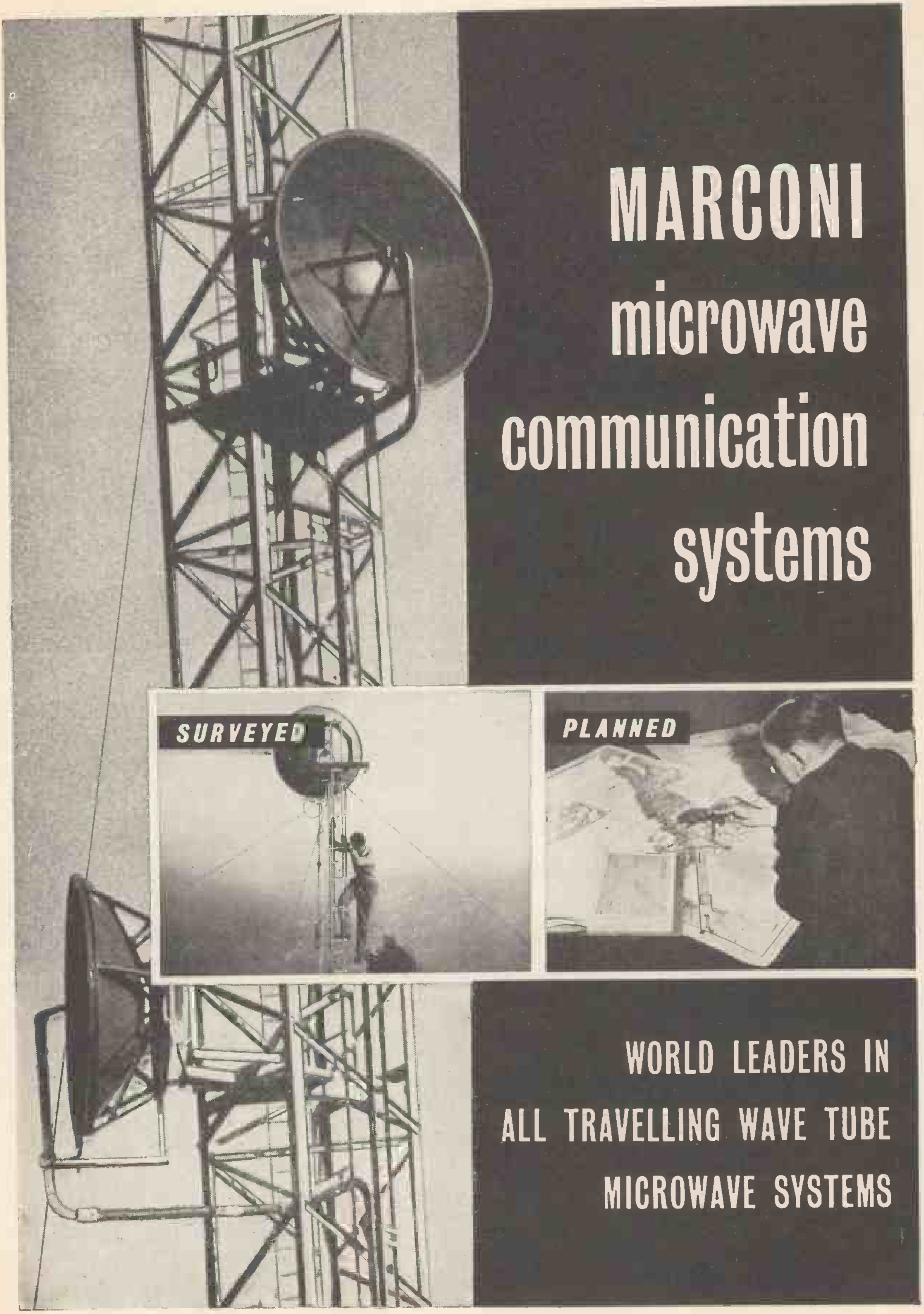
Here is a new special quality Filamentary Beam Tetrode with a really low anode voltage, for use as an RF Power Amplifier at frequencies up to 100 Mc/s.
Instantaneous filament heating enables the valve to be switched off during non-duty periods, which makes it particularly suitable for use in battery operated portable equipment. Its specially rugged construction enables the valve to withstand continuous vibration at 2.5 g and a short duration shock of 500 g.

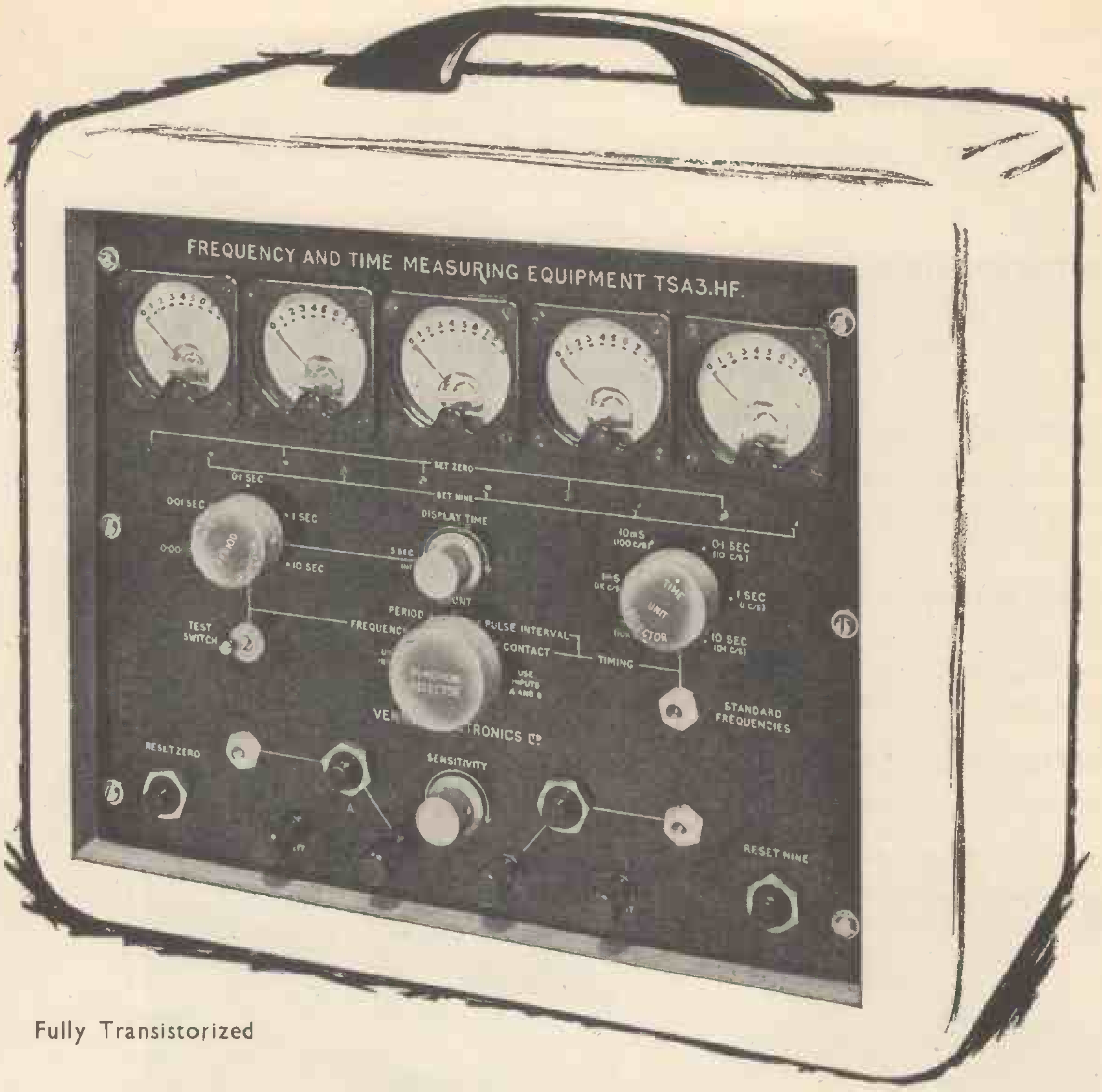
MAIN PARAMETERS ARE AS FOLLOWS:—

V_f	**Filament Voltage (volts)**	**2.5 or 5.0**
P_f	**Filament Power (watts)**	**1.15**
$V_{a(max)}$	**Anode Voltage, maximum (volts)**	**150**
$V_{g2(max)}$	**Screen Voltage, maximum (volts)**	**150**
g_m	**Mutual Conductance (mA/V)**	**4.3**
$P_{a(max)}$	**Anode Dissipation, maximum (watts)**	**5.0**

AEI

Associated Electrical Industries Limited
Radio and Electronic Components Division
Industrial Valves and Cathode Ray Tubes Department
155 Charing Cross Road, London, W.C.2.
Telephone: GERrard 8660 Telegrams: Sieswan Westcent London
CRC 16/11


MARCONI
microwave
communication
systems
SURVEYED
PLANNED
WORLD LEADERS IN
ALL TRAVELLING WAVE TUBE
MICROWAVE SYSTEMS



Fully Transistorized

RADIO TUBES
EXPORT ONLY

3000 types of both receiving and transmitting tubes **in stock**
In addition, a comprehensive range of crystals and some types of transistors and trustworthy tubes are available.

PRICE AND STOCK LISTS ON APPLICATION

Your specific enquiries for special types to CV. JAN and MIL specifications are invited.

Our organisation is Air Registration Board approved,

HALTRON

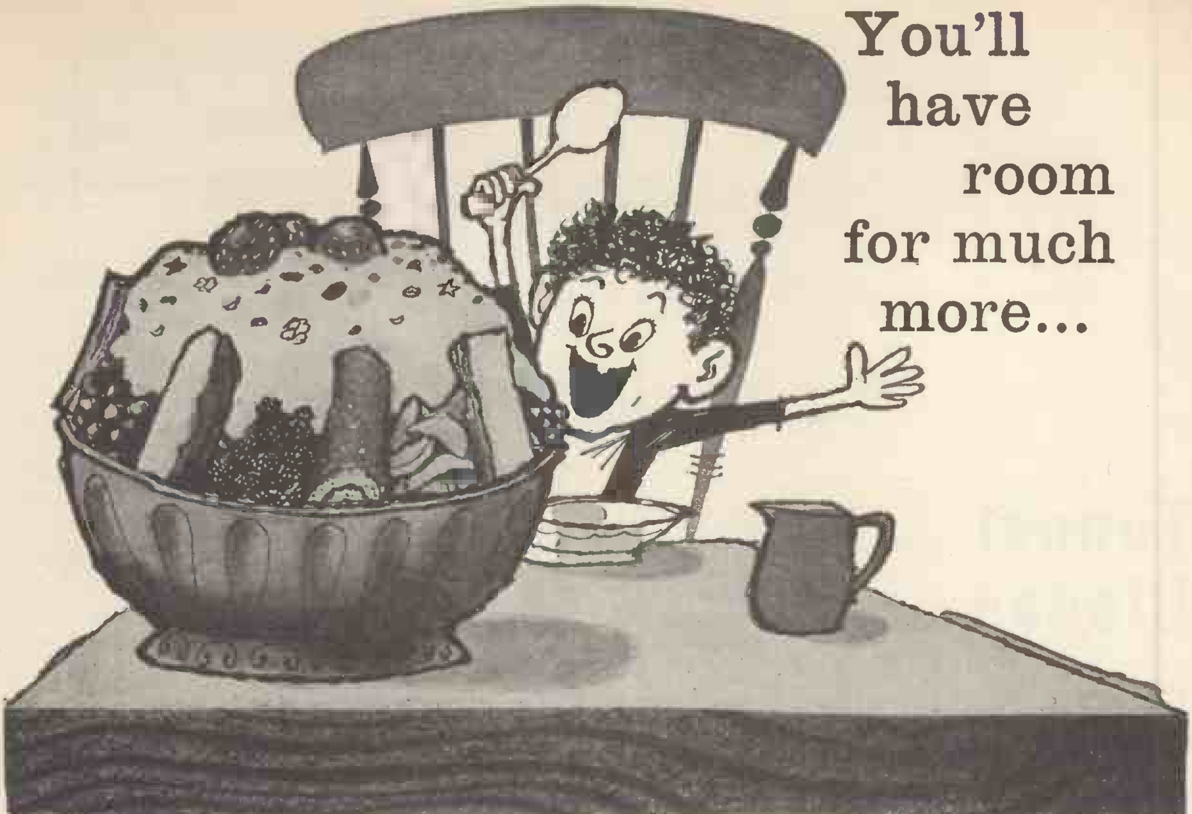
HALL ELECTRIC LTD

HALTRON HOUSE, ANGLERS LANE, LONDON N.W.5.

Tel.: Gulliver 8531 (10 lines) Telex 2-2573 Cables: "Hallectric London"

HALTRON

You'll have room for much more...



... with the A.T.E. Series TAA Telegraph Terminal Equipment

This unit is specially built to be as compact as possible, giving you room for much more equipment without overcrowding. The unit, comprising an electronic distributor and an operating head, is equipped with two tape readers arranged to operate alternately for continuous transmission of messages. The space taken is kept to a minimum because the operating head measures only 6½" in width.

Equipments are available to operate with conventional point to point, synchronous and semi or fully automatic switching systems.

Special features are:—

a. Automatic transmission of:—
 1. Station call sign and serial number before any message.
 2. Start of message and end of message preambles when operating in conjunction with automatic switching system.
 3. Error signal and end of message preamble in the event of a mistake in the tape message being discovered by an operator.
 4. A 100 character test message.
 5. A routine message of up to 48 characters.
 6. Station call sign and serial number at pre-determined intervals while no traffic is being handled.

b. Speeds 45.5, 50, 75 bauds selected by means of a switch, together with a spare position for an optional speed.

c. 7, 7½ or 8 unit code.

d. Stopping a transmission and re-starting at the point when a transmission was interrupted, or at any point without starting a new preamble. In the case of a tape, this facility may be used to repeat, or omit a particular portion of the message.

e. Transmitting the test message direct from the distributor.

Operating Head
Dimensions 6½" x 22" x 9" (16.5 cm x 56 cm x 23 cm). Weight 31 lbs. (19.1 Kg).

Electronic Distributor
Dimensions 19" x 8¼" x 3½" (48 cm x 21 cm x 9 cm). Weight 23 lbs. (10.7 Kg).

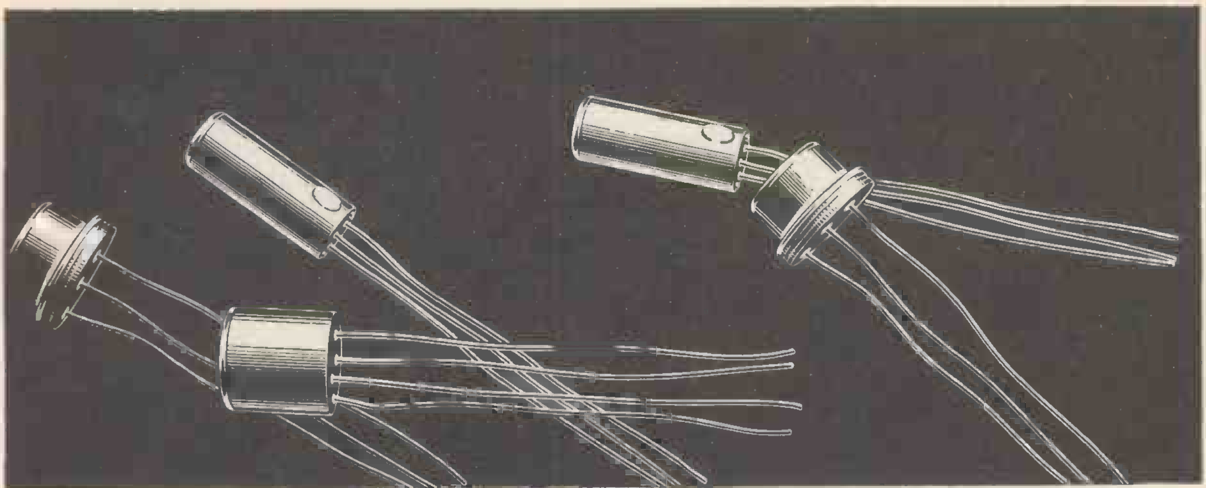
ATE

AUTOMATIC TELEPHONE & ELECTRIC CO. LTD.

STROWGER HOUSE, ARUNDEL STREET, LONDON, W.C.2.
Telephone: TEMple Bar 9262. Strowger Works, Liverpool 7.

AT14991


VOLTAGE
SELECTOR
AMPLIFIER 1
METER
AMPLIFIER 2
MILLIVOLTMETER
TYPE 264



The germanium alloy diffusion technique—proved by Mullard in the quantity production of OC170 and OC171 r.f. transistors—has been intensively developed to provide transistors for a much broader range of applications. In many new industrial fields equipment designers will be able to specify Mullard "alloy diffused" when they need high performance transistors and when economies must be borne in mind.

Specific types of industrial transistors outlined here are successively being put into production. Sample quantities are becoming available — watch Mullard announcements in the coming months for full details.

MULLARD LIMITED
SEMICONDUCTOR DIVISION
MULLARD HOUSE
TORRINGTON PLACE, LONDON, W.C.1
TELEPHONE: LANGHAM 6633

* V.H.F. Communications Transistors

Here is the most direct development of the highly successful OC170 and OC171—a new Mullard low noise transistor for 100 Mc/s r.f. amplifier stages in professional communications equipments. Power gain is greater than 10 dB and noise less than 6 dB at 100 Mc/s. This is being followed by another transistor with the same performance at twice the frequency which is also intended for use in V.H.F. communications receivers.

* Extremely High Speed Logic Transistors

The alloy diffusion technique can be used to provide logic transistors for operation at a p.r.f. of 10 Mc/s which will fully 'bottom'. An especially sophisticated transistor is being made available to meet all the requirements of the logic circuits for the next generation of high speed computers. This transistor will have a f_1 greater than 300 Mc/s at 10mA, a low bottoming voltage and a very rapid turn-off time. Already available is a favourably priced logic computing transistor with a frequency cut-off greater than 40 Mc/s, a maximum collector current of 25 mA and a maximum voltage of 40 V.

* Fast, High Current Core Driver Transistor

A new core driver transistor is to be introduced shortly for high speed storage in conjunction with the new high performance logic transistors. This has a collector current of 750 mA and a very fast rise time—f_1 is greater than 60 Mc/s.

The high frequency and power characteristics of this transistor also suit it for carrier telephony and transmitting equipment where an output of three watts at 8 Mc/s can be obtained, or up to one watt at higher frequencies.

* PNPN Switching Transistor

A wider view of the potentialities of the alloy diffusion technique has led to the development of a four layer pnpn device. This is a three terminal germanium transistor with a negative resistance characteristic which can be operated as a high speed electronic switch. After being switched "on", the transistor automatically remains bottomed until it is switched off. This characteristic makes the device particularly suited for use as a speech path cross-point in automatic telephone exchanges.

Extremely simple arrangements can be devised for astable, monostable and bistable circuits. Maximum ratings are in the region of 35 volts and 25 mA. The on/off (or series: parallel) impedance ratio is three million to one.

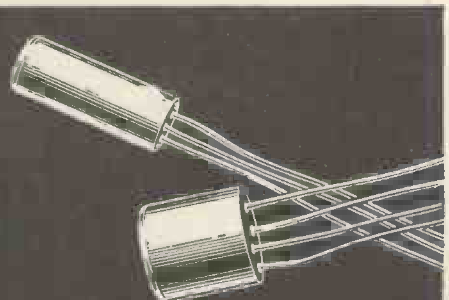
* Special Avalanche Transistor

A more specialised alloy diffusion development, but one which is invaluable for some applications such as high speed sampling oscilloscopes, is a device which does not function by normal transistor action but which utilises the "avalanche" phenomenon.

This transisotor works over a limited current region, but has a high gain and an exceptionally fast rise time of the order of a millimicrosecond. Its pulse current is as high as 50 mA which represents a remarkable current rate of rise of 50 amps per microsecond.

Mullard

industrial semiconductors



MIS 22a

meter menu

Anders Electronics supply meters very much "*à la carte.*" It is the speciality of the house to provide non-standard—often quite exceptional—meters of all types without delay.

Avo, Crompton, E.A.C., Elliott, Pullin, Taylor, Turner, Weir, Weston, and other makes : Moving iron, moving-coil, thermo couple, electrostatic : Square, circular (flush or projecting), rectangular or industrial : Any required range, calibrated to B.S.89 : Catering for any number—from individual meters to large parties.

Standard range from stock.
Special meters 7-14 days.

Meters, Electronic and Test equipment to individual specifications

Anders electronics LTD

103 Hampstead Road, London, N.W.1.
Tel.: EUSton 1639

Contractors to G.P.O. and Government Departments
DGI/Ministry of Aviation approved

NOW WHAT CAN WE TELL YOU THAT YOU WOULDN'T KNOW?

As a reader of this paper, you'll already be well aware of the importance of the British National Radio and Television Show. You'll know that unfailingly, year after year, it's an event that mustn't be missed. You'll know what to expect—eagerly.

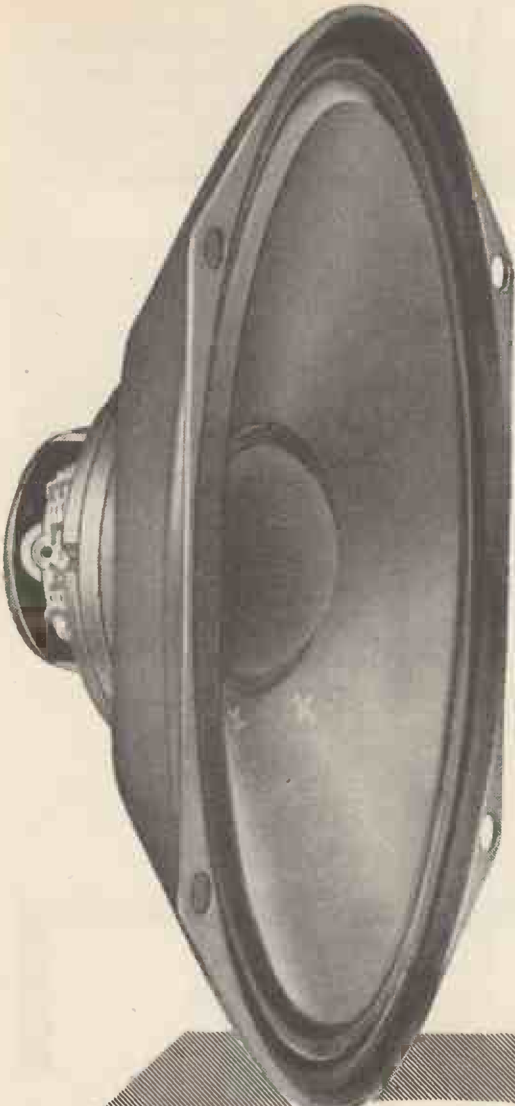
They'll be developments of tremendous interest to you . . . in Radio and Television . . . in sound reproduction and recording techniques . . . in broadcasting and studio equipment . . . in telecommunications and electronics for the G.P.O. and Defence Services, and incidentally you'll know that you're going to enjoy yourself more than ever before.

And you'll be right.

THE RADIO AND TELEVISION SHOW

EARLS COURT · LONDON

AUGUST 24 TO SEPTEMBER 3



New 5"x3" ELAC elliptical speaker

MODEL 35G (3 ohms) **6,500** gauss **20/6**—P.T. 6/7
MODEL 35C (3 ohms) **8,500** gauss **24/-**—P.T. 7/8

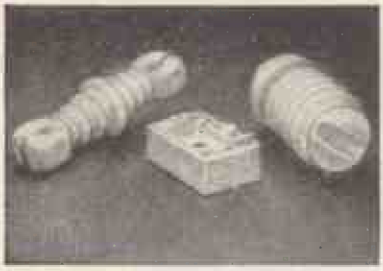
THE IDEAL UNIT FOR TRANSISTOR PORTABLES

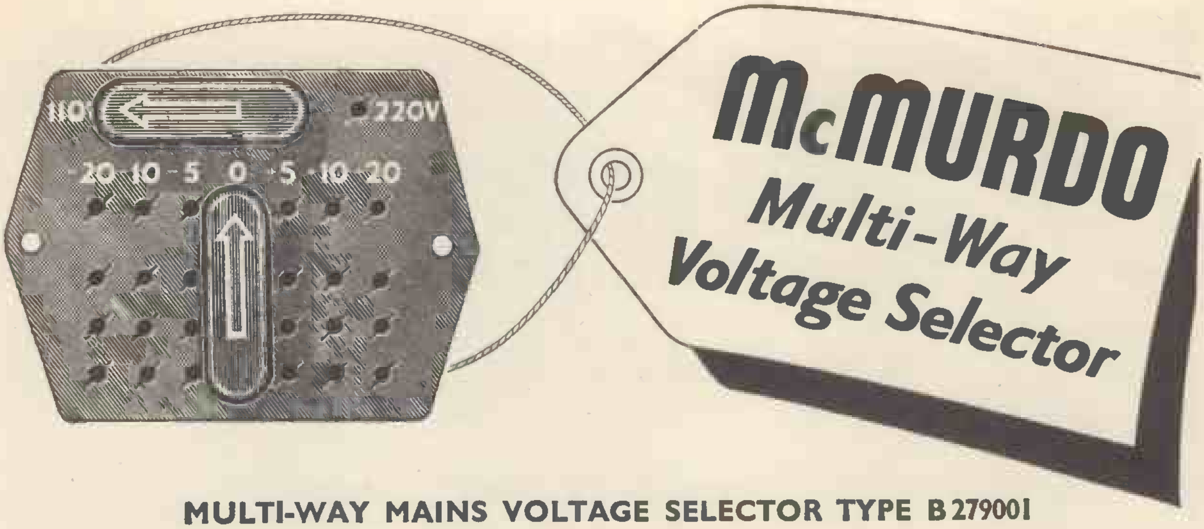
The outstanding feature of this unit is its excellent performance in relation to its size. While providing a better space factor than a typical 4in. round unit, it also shows a considerable improvement in overall response and sensitivity. Both models can be supplied covering a wide range of voice-coil impedances and response characteristics to meet the special needs of the set designer.

Nominal frequency response:
150 cycles—8,000 cycles.

ELAC

ELECTRO ACOUSTIC INDUSTRIES LTD.
Stamford Works, Broad Lane, Tottenham N.15. *Tel: Tottenham 0505/9*





MULTI-WAY MAINS VOLTAGE SELECTOR TYPE B279001

14 POSITIONS! 90, 100, 105, 110, 115, 120, 130, 200, 210, 215, 220, 225, 230, 240 VOLTS.

BLACK P.F. MOULDING.

Send for full details including circuit information to :—

THE McMURDO INSTRUMENT CO. LTD · ASHTEAD · SURREY · Tel: ASHTEAD 3401

5649

Phœnix

EYELETTING and light PUNCHING MACHINES

AUTOPHOENIX No. 6A. A new and improved air-operated machine for the automatic insertion and closing of eyelets. The deep throat, high vertical gap and projecting base make this an ideal machine for the eyeletting of components in radio chassis even in the closest corners and, of course, for spinnings. cylinders and plastic mouldings. It can be supplied with built-in air compressor.

We manufacture a large range of hand and automatic Eyeletting and Piercing Machines and also stock eyelets which we can supply in small or large quantities.
Full illustrated brochure of the "Phoenix" machines, write for leaflet W.W.2.

HUNTON LTD.

PHOENIX WORKS, 114-116 EUSTON ROAD, LONDON, N.W.1

Tel.: EUSton 1477 (3 lines) Grams.: Untonexh, London


TRANSFORMERS CHOKES
PLUGS SOCKETS
SWITCHES
RESISTORS
ARDENTE
ARDENTE
ARDENTE
Miniature Electronic Components
FULL TECHNICAL DATA UPON REQUEST
AMPLIFIERS
POTENTIOMETERS
ARDENTE ACOUSTIC LABORATORIES LTD
8-12 MINERVA ROAD : LONDON : NW10
Phone: ELGAR 3923 (6 lines) Telegrams: HAILER, LONDON
A.1.


TAKE YOUR PICK
Our wide range of capacitors, incorporating all the latest developments, are described fully in these new leaflets . . .
SEND NOW for COPIES
DALY has succeeded in maintaining full capacity values and working voltages in more compact designs, specially suited to ultra modern equipment :—
PHOTO-FLASH EQUIPMENT • DEAF AIDS
PRIVATE TELEPHONE INSTALLATIONS
AMPLIFIERS • D.C. POWER UNITS
TRANSISTOR EQUIPMENT
MAGNETISATION EQUIPMENT
TEST GEAR
Electrolytic Capacitors
MOTOR STARTING
Electrolytic Capacitors for PHOTO-FLASH Equipment
Electrolytic Capacitors
For use in connection with ELECTRONIC APPARATUS and TELECOMMUNICATIONS
DALY (condensers) LTD.
MINIATURE ELECTROLYTIC CONDENSERS
DALY
ELECTROLYTIC CAPACITORS
Condenser Specialists for over 20 years.
DALY (Condensers) LTD., WEST LODGE WORKS,
THE GREEN, EALING, LONDON, W.5. Phone: Ealing 3127-8-9. Cables: Dalcyon, London

INTERCHANGEABILITY

of the 5 different sized bits with the 1 Precision Iron, creates the most versatile soldering tool yet produced. Bit sizes of .040in., 3/32in., 5/32in., 3/16in. and 3/16in. heavy duty complete the range.

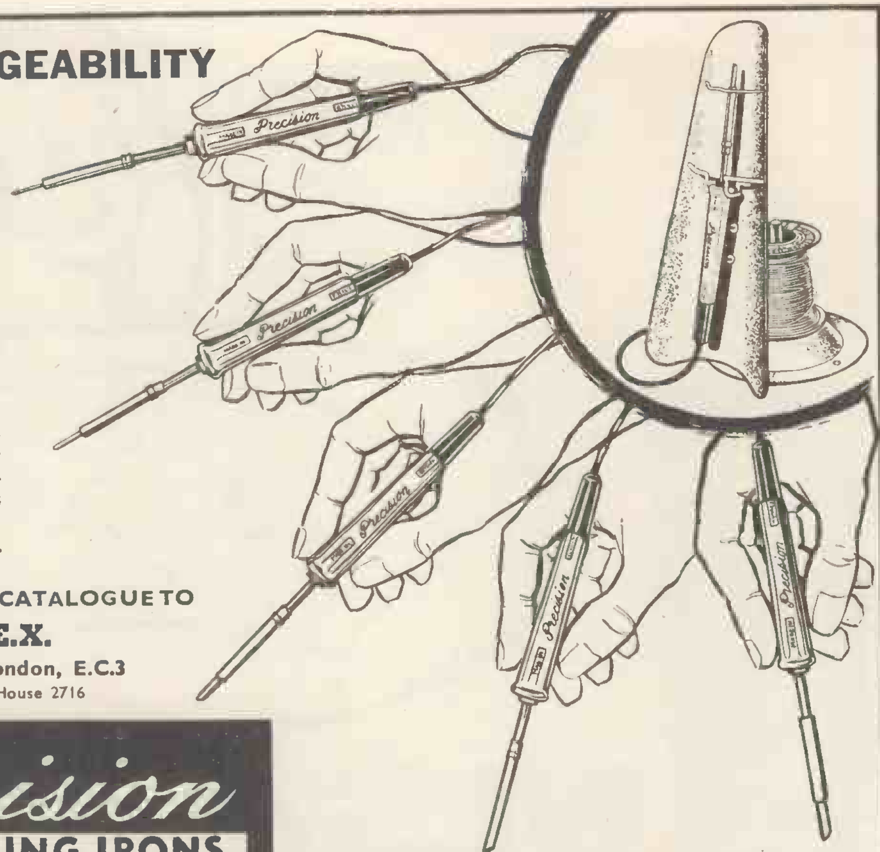
FINGERTIP CONTROL, sharp, regulated heat, ensures a quicker better job. Model C.240 (230/240 volts) illustrated, is available from the usual wholesalers or direct from the manufacturers at 29/6 (complete with one bit). Other models for voltages ranging from 6 to 230 volts also available.

Stands as illustrated at 12/6.
[ALL PRICES SUBJECT]

SEND FOR DETAILED CATALOGUE TO

A.N.T.E.X.

7/8 Idol Lane, London, E.C.3
Phone: Mansion House 2716



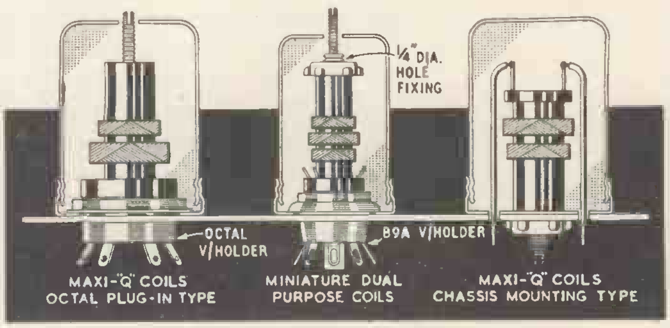
Precision SOLDERING IRONS

MAXI~Q REGD.

"WE COULD BLIND YOU WITH SCIENCE"

on the technical superiority of our coils but are sure you would prefer us just to say "WE GUARANTEE THEM"!

Coverage from 3.8 to 2,000 metres in 7 ranges—Each coil is packed in an aluminium container which may be used as a screening can for the coil itself—Brass threaded adjustable iron cores—Colour coded moulded polystyrene formers—Chassis/Plug-in Technical Bulletin, DTB.1 1/6—Dual Purpose Technical Bulletin, DTB.4 1/6—Colour Code Identified Coils: BLUE Signal Grid Coil with Aerial Coupling winding—YELLOW Signal Grid Coil with intervalve coupling winding — GREEN Grid Coil with reaction and coupling windings—RED Superhet Oscillator for I.F. of 465 Kc/s—WHITE Superhet Oscillator for 1.6 Mc/s. Prices range from 4/1 to 4/9 each. Five Colour Glass Scale, Back Plate, Pointer, Pulleys and Cord for use with 315 pF tuning condensers. Coverage (1) 150-400 Kc/s.; (2) 530-1,600 Kc/s.; (3) 1.5-4 Mc/s.; (4) 4-12 Mc/s; (5) 10-30 Mc/s; Price 15/-.



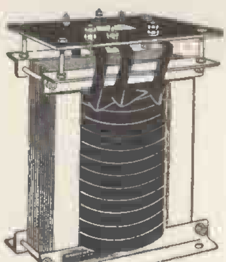
GENERAL CATALOGUE covering full range of components send 1/4d. in stamps or P.O. PLEASE SEND S.A.E. WITH ALL ENQUIRIES.

DENCO (CLACTON) LTD. (Dept. W.W.), 357/9 Old Road, Clacton-on-Sea, Essex

WORKS HOLIDAY—Goods cannot be despatched from 27.7.60 to 7.8.60

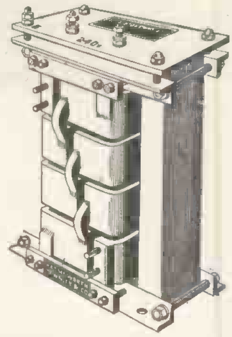
TRANSFORMERS

All for 240 V Input. Other Supply Voltages as Required
CONTINUOUS RATING. Short Rating Transformers also available



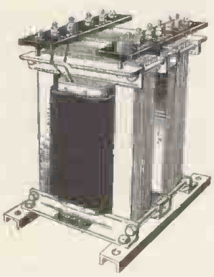
5 V	80 A	£8
4 V	100 A	£8
60 V	7 A	£8
110–120 V	4 A	£9
12 V	40 A	£8
18 V	30 A	£9
17 V	40 A	£9
24 V	30 A	£10
30 V	25 A	£10
55 V	15 A	£10
5 V	140 A	£11
110–120 V	10 A	£15
40 V	25 A	£15
5 V	300 A	£20
5 V	200 A	£24
6–12 V	50 A	£10
12 V	60 A	£10
12 V	100 A	£16
50 V	60 A	£25
10–15–25 V	100 A	£26
10–20–30 V	100 A	£33
110 V centre tapped	25 A	£28
6–12–18–24–30 V	12 A	£11

5 V	5,000 A	£110
2.5 V	5,000 A	£64
4 V	5,000 A	£94
2 V	10,000 A	£98
3.5 V	20,000 A	£127
2 V	30,000 A	£130
10 V	2,000 A	£103
10 V	1,000 A	£59
10 V	900 A	£55
10 V	500 A	£38
10 V	300 A	£28
20 V	800 A	£80
20 V	3,000 A	£150
5 V	1,000 A	£39
22 V	1,000 A	£90



TRANSDUCTORS

SATURABLE REACTORS



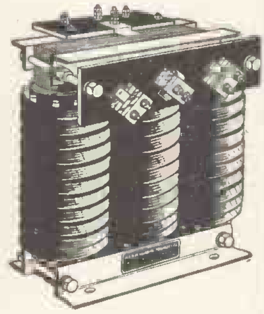
Saturable Reactors for controlling AC loads from .5kVA to 300kVA. Available for all standard AC supply voltages, single-phase and three-phase. Standard DC control volts; 12, 24, 36, 110 and 240 V.

THREE-PHASE TRANSFORMERS

Input 400/440 V.

40 V	50 A	3-phase	£40
230 V	50 A	3-phase	£78
110 V	100 A	3-phase	£90
4 V	5,000 A	3-phase	£130

These and other Transformers can be supplied for 3-phase, 6-phase and 12-phase Rectifiers.



VOLTMOBILE VOLTAGE SELECTOR AUTO-TRANSFORMERS

Range: From 1.6% to 100% of Supply Volts in 64 steps of 1.6%.
ON LOAD SWITCHING.

VOLTMOBILES can be used by themselves or in the primary of another transformer to give very fine changes of output. Overvoltage available as extra.

Single Phase Units	240 V	440 V
30 A	£37	£48
60 A	£67	£79
100 A	£99	£119

D-CMOBILE RECTIFIER SETS

For 240 V A.C. The larger outputs are available for 3-phase supply.
Full load DC Volts and Amps are stated.
Prices are without Meters and Regulators.

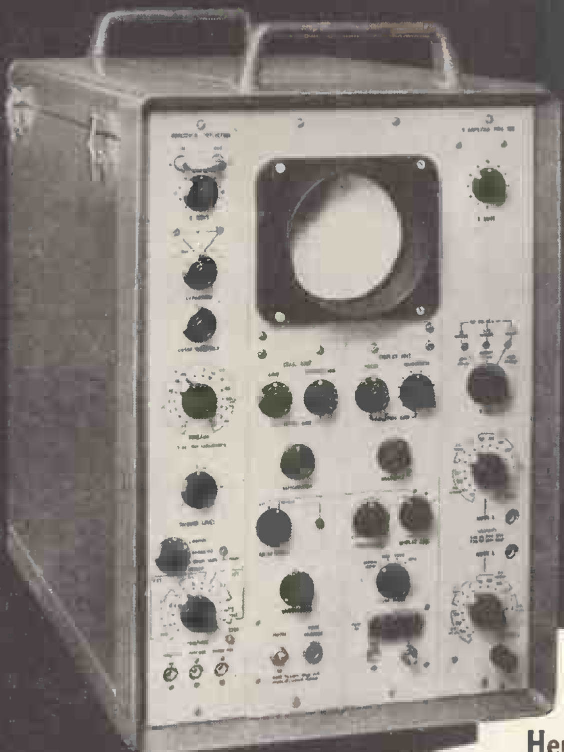
6 V	15 A	£14
12 V	10 A	£15
12 V	20 A	£19
12 V	30 A	£25
12 V	60 A	£35
12 V	105 A	£55
12 V	210 A	£71
12 V	1,000 A	£185
24 V	12 A	£23
24 V	20 A	£27
24 V	30 A	£33
24 V	60 A	£41
24 V	105 A	£70
24 V	200 A	£86
24 V	750 A	£262
36 V	10 A	£26

36 V	20 A	£32
36 V	40 A	£42
36 V	60 A	£55
110 V	5 A	£32
110 V	10 A	£42
110 V	15 A	£53
110 V	20 A	£67
110 V	25 A	£84
220 V	130 mA	£15
250 V	6 A	£49
250 V	10 A	£70
250 V	15 A	£89
250 V	20 A	£110
1,200 V	225 mA	£30

Built in to order—Ammeters—Voltmeters—Rheostats—Stabilising Circuits—Chokes—Variacs.

SPECIFIC ENQUIRIES are invited for Transformers and Rectifiers. We specialize in HEAVY CURRENT EQUIPMENT.

HARMSWORTH, TOWNLEY & CO.
2 JORDAN STREET, MANCHESTER 15. CENTRAL 5069



Consider the advantages of the Remscope

Here is an oscilloscope that:

* will store fast transient signals and display them for up to 2 hours.
* gives a choice of long persistence display or variable persistence.
* can include a trace shifter to facilitate comparison of several signals at once.
* eliminates the clutter and delay of photography (as well as the cost).

Data

Size: 23½in x 14½in x 24in
Screen: 10 cm diameter.
Resolution: 40 lines/cm
Writing speed (stored): 2-4 cm/μs
Sensitivity: 5 mV/cm (max.)
Bandwidth: 0-4 Mc/s
Time base velocity: 3cm/μs 0.1cm/s
Erasure time: <1 second

With its English Electric E702A cathode-ray tube and crystal controlled time markers, the Remscope is an accurate and reliable instrument that is also designed for easy servicing and adjustment.

If you use 'scopes . . . or are thinking of using them . . . for any kind of waveform study, from computer outputs to mechanical testing, consider the advantages of the Remscope.

We will be glad to arrange a demonstration for you.

Send now for full details of this outstanding instrument.

. . the fastest storage oscilloscope in the world . .

CAWKELL SOUTHALL ENGLAND

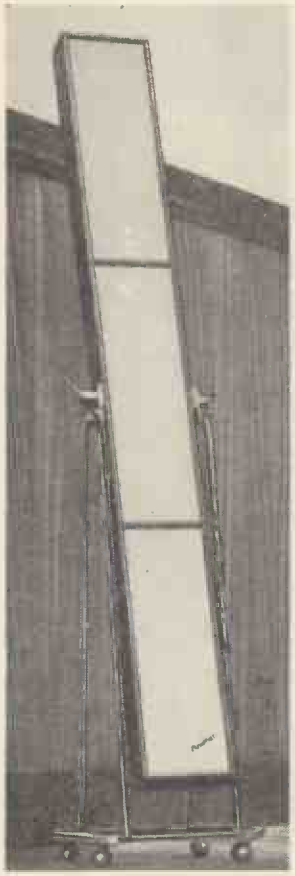
CAWKELL RESEARCH & ELECTRONICS LTD

One of the Simms Group of Companies

Scotts Road, Southall, Middx. Southall 3702/5881

Export Managers: Applied Research (Instruments) Ltd., Emefco House, Bell Street, Reigate, Surrey

SOUND



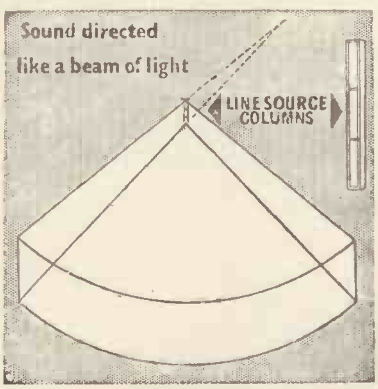
directed like a beam of light....

This is one of the Pamphonic Line Source Loudspeakers in the Portsmouth Guildhall. Only two are needed to cover the whole auditorium! The special stand enables the loudspeaker to be moved and tilted to cover the varying seating arrangements ... sound being directed like a beam of light. This unique Pamphonic sound system can operate under difficult conditions and still give perfect results where other systems fail.

Pamphonic

LINE SOURCE LOUDSPEAKERS

Greater power economy with no extra expensive fitting costs. Used extensively by Municipal Authorities for many Public Buildings and by the B.B.C. Special robust all-metal weather-proof models are available for out-door sound coverage.



PAMPHONIC REPRODUCERS LTD

17 Stratton Street, London, W.1. Telephone: GROsvenor 1926

DaP760WW

RELAYS?

OVEN CONTROL LIQUID CONTROL PHOTO ELECTRIC CELLS PULSE CIRCUITS ETC

Everything points to

DEPENDABLE

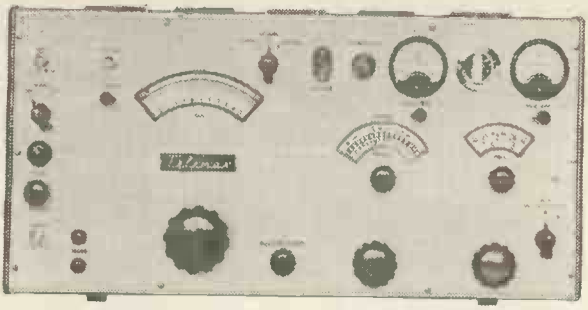
Our wide range of relays have one thing in common—they are manufactured to the highest standards. Whether your need is for Automation, Transistor, Type 3000 or Type 600 Relays, you can leave your specifications in our hands with confidence.
Prototypes can be delivered in 1/7 days, and quotations for quantities and special orders given on request to our engineering department, which is always available for advice on special problems.

Please send your enquiries to:

DEPENDABLE RELAY CO LTD

8a Ainger Road Camden Town London NW3 *Telephone: PRImrose 8161*

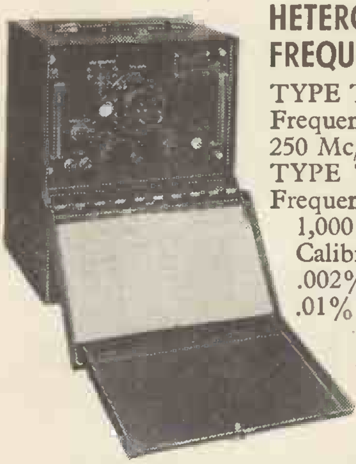
TELEMECHANICS INTRODUCES



A NEW TELEMAX FREQUENCY METER—TYPE T.D.1

PARTLY TRANSISTORISED

RANGE:
AS A GENERATOR: 0-3,000 Mc/S
AS A FREQUENCY METER: 1 Kc/s—3,000 Mc/s
ACCURACY: 2 PARTS IN $10^{\cdot 8}$
DIGITAL UNIT STAGE—
OPERATING AMBIENT TEMPERATURE RANGE:—40°C TO +40°C



HETERODYNE FREQUENCY METER

TYPE T74
Frequency range: 20 to 250 Mc/s.
TYPE T75
Frequency range: 85 to 1,000 Mc/s.
Calibration accuracy: .002% at 25°C. (or .01% between −20°C. to +70°C.).

Crystal controlled, portable heterodyne-type FREQUENCY METERS used for field testing and measurement of pulsed, modulated, or C.W.R.F. transmitters, receivers and signal generators. Mains operated power unit available as optional extra and designed to fit into the battery compartment.
Reconditioned and calibration checked BC.221 frequency meters available; range 125 Kc/s. to 20 Mc/s.

HIGH VOLTAGE INSULATION TEST SET

TYPE E115
Output voltage range: 1 Kv. to 15 Kv. D.C. (continuously variable).
Accuracy of voltage measurement: ±2%.
Measurable current range: 1 Microamp to 100 Microamp.
Accuracy of current measurement: ±1½%.
Measurable resistance range: 10M. ohms to 15KM. ohm.
Short circuit current at 15 Kv.: 200 Microamp max.
Facilitates theme asurement of insulation resistance of high voltage cables, components, etc., at normal working voltage and location of faults such as tracking, flash-over, ionisation, corona discharge, etc.
Supplies a metred source of high voltage power for temporary set-ups using cathode ray tubes, electronic flash tubes, electron photo multipliers GEIGER MULLER tubes, etc.

Telephone:
TOTTON, HANTS 3666

Telemax
INSTRUMENT

Cables: TELESET
TOTTON, SOUTHAMPTON

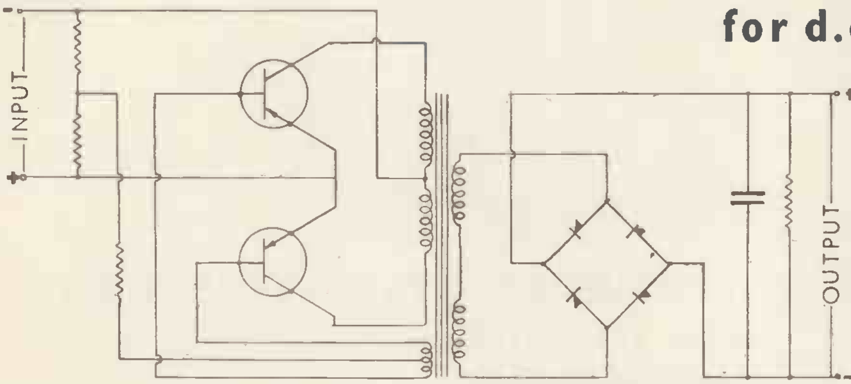
Complete specifications on application to

SOLE MANUFACTURERS:— **TELEMECHANICS LTD.**
(INSTRUMENT DIVISION, DEPT. W.W.9)

TELEMAX WORKS, BROKENFORD LANE, TOTTON, SOUTHAMPTON, ENGLAND

FORTIPHONE TRANSFORMERS

for d.c. CONVERTERS



Transformers suitable for use in the circuits described in the recently published G.E.C. Application Reports on d.c. converters are now included in our standard range.

TYPICAL SPECIFICATIONS

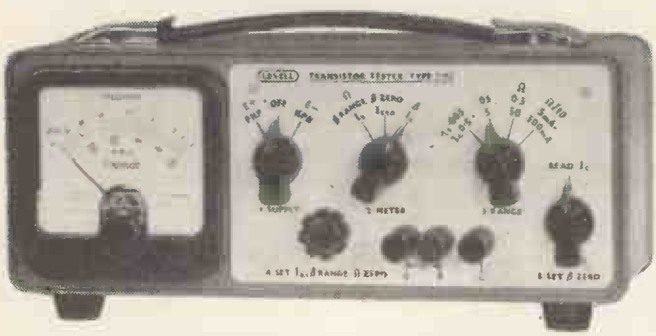
INPUT	OUTPUT	RATING
6 V	100 V	1, 1.5, 2, 3 or 4 WATT
6 V	200 V	
6 V	400 V	
6 V	800 V	
12-18 V	250 V	50 WATT

FORTIPHONE TRANSFORMER DIVISION (DEPT. 5) 92 MIDDLESEX ST. LONDON E.I.

LEVELL PORTABLE INSTRUMENTS

TRANSISTOR TESTER

TYPE TM5



Measures the current gains of PNP and NPN transistors, the values of resistances, and the leakage currents of diodes, transistors and low voltage electrolytic condensers.

Collector Current Ranges: 0.5, 5, 50, 500 mA.

Current Gain Ranges: 100, 250, 500.

Resistance Ranges: 0-50kΩ, 0-500kΩ.

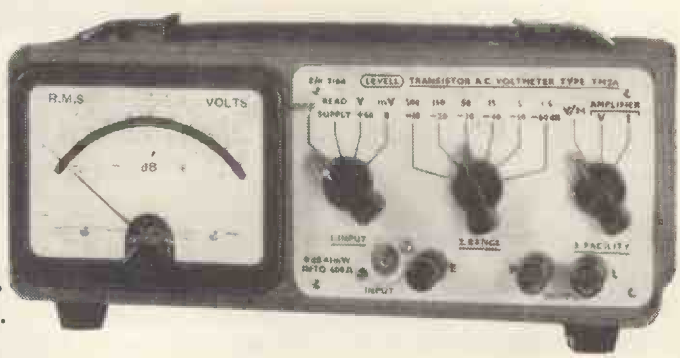
Price with batteries: **£17.0.0**

A.C. MILLIVOLTMETER

TYPE TM2A

Measures 50μV to 500V on 12 ranges. Response $\pm$ 0.1dB from 30 c/s. to 30 kc/s. High input impedance. Output for C.R.O. Gain up to 80 dB available with 2 V. output Low noise level. Low microphony. No hum.

Price with batteries: **£36.0.0**



LEVELL ELECTRONICS LTD.
10-12, St. Albans Road, Barnet, Herts.
Telephone: BARnet 5028

Make contacts better than clean with ELECTROLUBE

BRAND LUBRICANT

Electrolube lubricant is a carbon-free fluid of low electrical resistance which combines mechanical lubricating properties with unique electrical properties, reducing friction and wear and virtually eliminating arcing and corona. In its electrical applications it provides conductive efficiency between contacts which is *better* than clean metal.

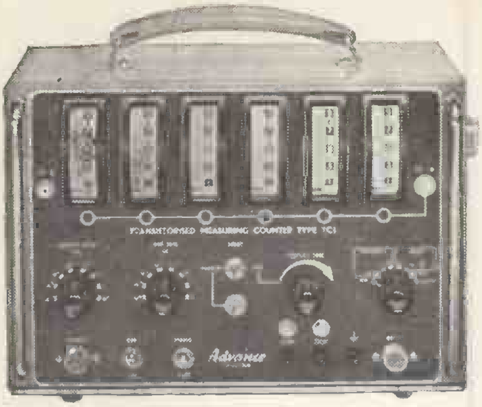
- **In high-gain communications circuits a sensitivity increase of several dB can be achieved.**
- **High contact efficiency is maintained throughout the working life of the instrument.**
- **Electrolube lubricant ensures sustained maximum performance in high-speed switching and relay circuits.**
- **Electrolube lubricant is particularly applicable to heavy duty contacts such as in controllers, commutators and slip rings, in motors and generators, in welding and electroplating, and on collector rails.**

Electrolube Grade No. 1 contains a volatile solvent which not only dissolves films of mineral oil and grease, and loosens tarnish, corrosion and dirt, but also acts as a carrier for the even distribution and penetration of the lubricant. Electrolube Grade No. 2 is the undiluted lubricant for use on chemically clean surfaces. Chemically inert, Electrolube lubricant gives very long service under all conditions. Both grades available in nylon "Snorkel" dispenser from wholesalers only. Write today for full details.

These specially designed Electrolube nylon dispensers, both bottle and pen, embody a retractable "Snorkel" tube giving a 4-inch reach, and providing controlled, drop by drop, application only at the points required.

ELECTROLUBE LTD
16 BERKELEY STREET, LONDON W.1
Tel: HYDe Park 0501

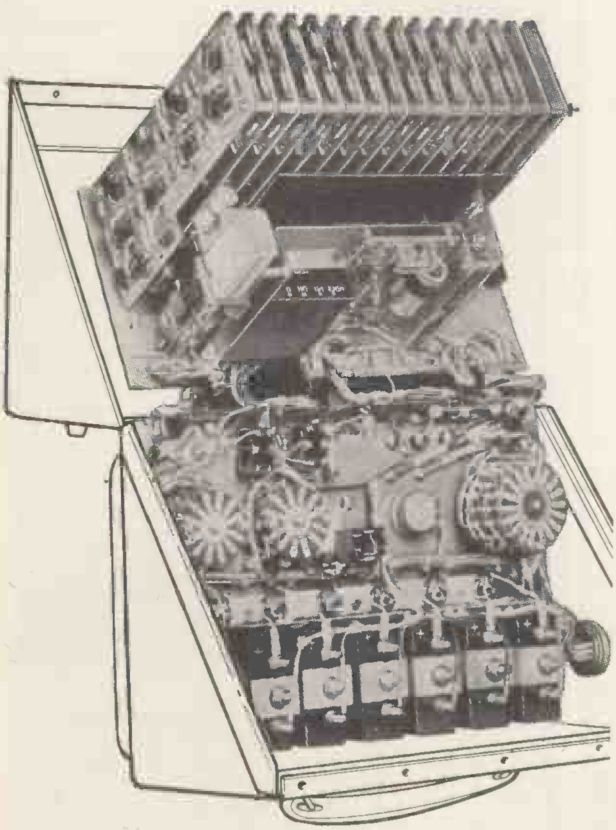
Advance TC1



1Mc/s TRANSISTORISED COUNTER

it's the inside that counts

. . . in this case up to 1 Mc/s. And the inside of the Advance time and frequency measuring counter type TC1 is rather exceptional. Over 145 transistors and 21 printed circuit boards have been combined in an advanced design to provide the full facilities and high performance expected of a first grade laboratory instrument.



Nett Price in U.K. **£335**

Leaflet Y101 will be forwarded on request.

SIX FIGURE DISPLAY	accurate to ±1 count
FREQUENCY MEASUREMENT	from 10 to 1,000,000 c/s
TIME MEASUREMENT	from 1 μsec. to 2,777 hours
★ PERIOD MEASUREMENT	1 or 10 periods of input wave-form down to 10 c/s
RANDOM COUNTING	totalling over any period
OUTPUT TIMING PULSES	from 10^{-1} to 10^6 p.p.s.
INTERNAL STANDARD	oven controlled 1 Mc/s crystal
STABILITY	±1 part in 10^6 at 25°C
SELF-CHECK FACILITIES	to internal crystal standard
FREQUENCY MEASURING PERIOD	0·1, 1·0 or 10 seconds
REPETITION OF COUNT	manual or automatic
POWER CONSUMPTION	3 W (battery), 14 VA (mains)
DIMENSIONS	length 12in., height 9in., depth 6in., weight 12 lb.

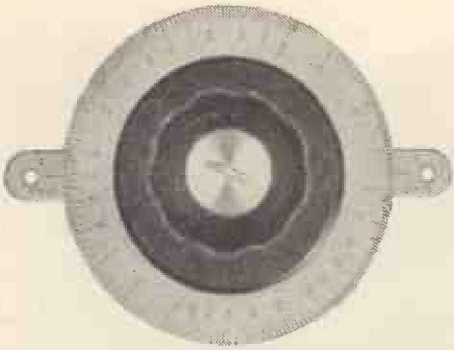
★ **AND NOW—Virtually to d.c. with V.L.F. Converter type C.A.1.**

Advance COMPONENTS LIMITED

INSTRUMENTS DIVISION

ROEBUCK ROAD • HAINAULT • ILFORD • ESSEX • TELEPHONE : HAINAULT 4444

TT-1Ab



accuracy and stability for vision circuit testing

For the really effective testing of vision circuits the Video Oscillator Type 022B provides an input signal that is exceptionally accurate and stable.

The accuracy of calibration is, in fact, 1% over the frequency band 10 kc/s to 10 Mc/s, whilst the amplitude remains constant to within ± ½ dB throughout this frequency range and is independent of variations in mains voltage and range setting. Thus the necessity for resetting the reference level no longer exists, and instead a means of measuring the load impedance by the reading on the output voltmeter is provided.

The total harmonic content of the output waveform of this high quality oscillator is less than 1%. These standards of performance in a compact, portable item of equipment explain why the Wayne Kerr Video Oscillator Type O22B is so widely used by the G.P.O., B.B.C. and throughout the television industry.

The Wayne Kerr Video Oscillator is fully described in Information Service Leaflet DO 22B, copies of which are available on request.

THE WAYNE KERR LABORATORIES LTD.,
Sales and Service,
44 Coombe Road,
New Malden, Surrey.
Tel: MALden 2202

WAYNE KERR
Video Oscillator O22B

M. R. SUPPLIES, LTD.

(Established 1935)

We offer only first-class material at the most attractive prices and with prompt delivery. Careful packing. Satisfaction assured. Prices nett.

SYNCHRONOUS TIMERS (by well-known British maker—brand new). Good news for those who applied too late for first supply—a limited new delivery now available. 200/250 v. 50 c. Providing any " on " period between 5 mins. and 8 hours, switching " off " at the end of the set period. Made for electric cookers and suitable for many other purposes—tape recorders, immersion heaters, etc. Capacity 25 amps., fitted neon indicator. Housing 6in. sq., by 3¼in. £4/12/6 (despatch 3/-).

ROTARY INSTRUMENT SWITCHES (positive stud type). 1-pole, 9-way, 3-amp. A.C. switching, 2½in. dia., ¼in. shaft, 5/6 (des. 9d.).

SUPERB INSTRUMENT OFFER. Brand new portable laboratory Voltmeters by famous British makers, first-grade m/iron A.C./D.C. 0/160 volts with 8in. mirror scale. Basic meter 10 mA. deflection—easily converted for mains measurements. In wooden case 9½ × 8½ × 3¼in. with carrying handle. Current list price approx., £14. Limited supply in sealed cartons ex-Govt. at only £5/15/- each (des. 3/6).

OPERATION COUNTERS (mechanical). Continuous rotary action, counting up to 6,000 with 1/10th indicator. One rev. per digit. Counting forwards and backwards. Size 3¼ × 1½in. sq., 29/6 (despatch 1/-).

SUPPLY METERS (Kilowatt hour), 200/250 v. 50 c/s. Usual 5-index dial reading from 1/100th unit. Loading 5 amps. L.R. (suitable for 10 amp. load). These are Brand New, at zero. simple to install. 39/6 (despatch 3/6).

UNISELECTOR SWITCHES. New miniature model. Two banks of ten plus home contacts. 30 onms coil (24 v.), 22/6 (despatch 2/-).

SHADED POLE MOTORS. 200/250 v. A.C. (Scophony), 1,200 r.p.m. Suitable for fans, stirrers, etc., quiet running—no interference. 4in. long by 2½in. dia. Shaft proj. 1in., ¼in. dia. 21/- (despatch 1/6).

SYNCHRONOUS ELECTRIC CLOCK MOVEMENTS. 200/250 v. 50 c/s. Fitted with spindles for hours, minutes and seconds hands. Self-starting, central hole fixing. Dia. 2¼in., depth behind dial only 1in. Very latest model. With dust cover, 29/6 (despatch 1/6). Sets of three hands to fit, in good style, for 5/7in. dial, 2/6 set, or 8/10in. dial., 3/6 set.

SYNCHRONOUS TIMER MOTORS (Sangamo). 200/250 v. 50 c/s. Self-starting, 2in. dia. by 1¾in. deep, 1 r.p.m., 1 r.p.h. and 12 r.p.h., any one 37/6 (des. 1/-). Also high torque model (G.E.C.) 6 r.p.m., 57/6 (des. 1/-). These are suitable for display turntables.

SYNCHRONOUS TIME SWITCHES. (Sangamo) for accurate pre-set switching operations on 200/250 v. 50 c/s. Providing up to 3 on-off operations per 24 hours at any chosen times, with day-omitting device (use optional). Capacity 20 amps. Compactly housed 4in. dia., 3¼in. deep. With full instructions. £5/8/6 (despatch 2/6). Also Smith's Relyon Twin-circuit model, 20-amp. switching, £7/8/- (des. 2/6).

EXTRACTOR FANS. A very popular line. Well-made units at much lower than normal prices. 200/250 v. A.C. induction motor, silent running, no interference. With mounting frame and back grille, ready for easy installation. With 8in. impeller (10in. overall dia.), 200 C.F.M., £5/5/-. 10in. impeller (12in. overall). 240 C.F.M., £5/12/6. Also minor model, 6in. overall dia., 75 C.F.M., £4/12/6 (despatch any one 3/-).

COMPLETE SEWING MACHINE MOTOR OUTFITS. No better job obtainable at any price. 200/250 v. A.C./D.C. Fitted latest radio/T.V. suppressors. Comprising motor with fixing bracket, foot control and switch, needle light with switch, belt, etc., and instructions for easy fixing to ANY machine. The complete outfit still £6/15/- (despatch 3/-).

M. R. SUPPLIES, Ltd., 68 New Oxford Street, London, W.C.1
(Telephone: MUSeum 2958)

Quartz Crystals of any shape and size cut and ground precisely to specification and coated, if required, with Gold, Silver or Aluminium, etc.

BROOKES CRYSTALS LTD
Suppliers to Ministry of Supply, Home Office, B.B.C., etc.
LASSELL STREET, GREENWICH, S.E.10
Phone: Greenwich 1828
Grams: Xtals, London, S.E 10 *Cables:* Xtals, London

COSSOR INSTRUMENTS

THE NEW SYMBOL OF SUPREMACY IN THE INTERNATIONAL FIELD OF ELECTRONIC INSTRUMENTATION

This new trade-mark symbolises the Cossor approach to your problems —you will see it on a wide variety of instruments: signal generators, L C R bridges, voltmeters, amplifiers, transducers, transistor testers, and a host of other equipment of advanced design, as well as oscilloscopes. It is your assurance of a flexible outlook brought to your problems, and of objective technical advice. It is the badge of an after-sales service equally concerned with you in the successful solution of your problems by Cossor instruments.

It is your invitation to come to Cossor for the best possible electronic tools and service.

COSSOR INSTRUMENTS

Cossor Instruments Ltd

COSSOR HOUSE, HIGHBURY GROVE, LONDON, N.5, ENGLAND
Telephone: CANonbury 1234 (33 lines). Telegrams: Cossor, Norphone, London. Cables: Cossor, London. Code: "Bentley's Second"

Watch that WOW!

with the Gaumont-Kalee FLUTTER METER

Gaumont-Kalee Fluttermeter Type 1740

Accurate measurement of sound equipment speed deviations

The Flutter Meter measures those components which are commonly described as "Wow" and "Flutter" resulting from speed variations in sound recorders and reproducers. This instrument is equally suitable for use with machines employing perforated film, tape, wire or disc records.

Type 1740 is of entirely new design. More compact, lighter in weight and costing considerably less than earlier Gaumont-Kalee Flutter Meters, but with the same high performance and facilities.

Dimensions: Height 10¼" 26.04 cm. Width 12¼" 31.12 cm. Depth 14¼" 36.47 cm.
Nett Weight: 29lb. 13.15 Kilos.

Brief Technical Data

Operating carrier frequency 3,000 c.p.s. ±5%
Minimum Input signal 50 mV R.M.S.
Input. Impedance 1 Megohm.
Input amplifier bandwidth —3db at 2,500 and 3,500 c.p.s.
Effective limiter range ±10dB.
Meter scaling—"Peak wow" 0 to ±1% (centre zero).
"Wow" and "Flutter" 0 to 1% and 0 to 0.2% R.M.S.
Crossover frequency 20 c.p.s.
"Flutter" meter response—3db at crossover. —3dB at 200 c.p.s.
"Wow" meter response —3dB at crossover. —1dB at 0.5 c.p.s.
C.R.O. output frequency response level down to zero frequency—3dB at 200 c.p.s.
3,000 c.p.s. oscillator output level 5V R.M.S. into 0.5 Megohm 100 mV R.M.S. into 500 ohms.
Accuracy: Meter presentations ±2% f.s.d.
Power consumption 35 watts.
Mains 100/150v. and 200/250v.
Single phase 45/60 c.p.s.

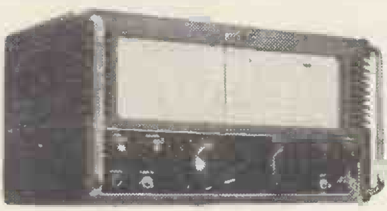
Important users of Gaumont-Kalee Flutter Meters include:

B.B.C. Television and Research, Collaro.
Commission Superioreure Technique, Paris.
Commonwealth of Australia, Melbourne.
Compagnia Commerciale di Cinematografia, Milan.
Dept. Posts and Telegraph, Dublin.
Egyptian State Broadcasting.
E.M.I. Research Laboratories.
Garrard Engineering and Manufacturing Co.Ltd.
Magnavox Corporation of U.S.A.
Marconi Wireless.
Ministry of Supply.
Ministry of Transport and Civil Aviation (U.K.).
Mullard.
N.V. Philips' Gloeilampenfabrieken, Holland and Denmark.
N.Z. Broadcasting System.
Post Office Research Department.
R.C.A. Photophone Ltd.
Southern Instruments Ltd.
Truvox Ltd.
Vortexion.
Westrex Co. Ltd.
Wright & Weaire Ltd., and users in India, Poland and Kong Kong.

Write for full details to:

RANK PRECISION INDUSTRIES LTD
G.B-KALEE DIVISION (STUDIO), WOODGER RD., LONDON, W.12, ENGLAND
Tel: SHEpherds Bush 2050. Cables: RANKPRESTU, LONDON

EDDYSTONE COMMUNICATION RECEIVERS



Model 840A illustrated

HIRE PURCHASE TERMS

Model No.	Cash Price	Deposit	12 Monthly Payments	24 Monthly Payments
870	£33	£6/12/-	£2/6/8	£1/5/4
840	£55	£11/-/-	£3/18/10	£2/2/2
888A	£110	£22/-/-	£7/17/8	£4/4/4
680X	£140	£28/-/-	£10/-/8	£5/7/4

Carriage paid per passenger train.

These sets are the choice of the discerning professional and amateur users. Descriptive literature gladly forwarded.

The Eddystone Specialists

H.P. RADIO SERVICES LTD.

51 COUNTY ROAD, LIVERPOOL, 4

Telephone: AINTREE 1445 *ESTAB. 1935*

AT LAST, FOR ONLY £1!

A really efficient Fan for use in Electronic Equipment

This is what the Electronics world has been waiting for! At extremely low cost air-stirring and extraction can be easily achieved.
Also in production we have Low-Speed Motors from 8 r.p.m. to 40 r.p.m. Price and further details on application to:

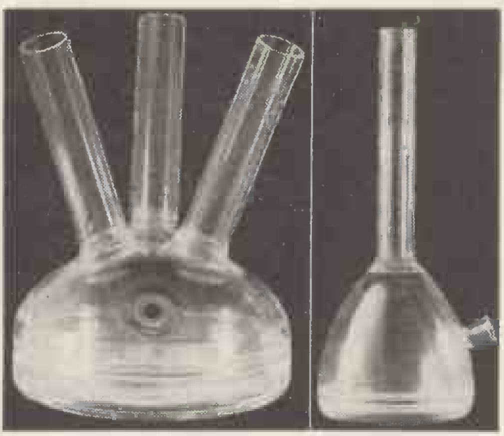
KENURE, HOLT ELECTRONICS LTD.
BOYN VALLEY RD., MAIDENHEAD, BERKSHIRE
Telephone: Maidenhead 5331-2

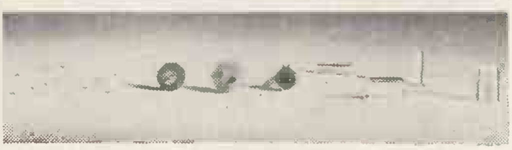
WE ALSO HAVE SUB-CONTRACT FACILITIES FOR ELECTRONIC WIRING AND ARE FULLY A.I.D. APPROVED

The answer
to your special glass problems

SOVIREL'S six basic glasses for valves, tubes and semi-conductors

Code	Current Name	Sealing to	Principal uses
S 746 03	SO 14	FeNiCo Alloys (Nilo K, Kovar, Therlo etc)	Power and transmitting valves Camera and Storage Tubes Spécial Tubes
S 747 01	7056	FeNiCo Alloys (Nilo K, Kovar, Therlo etc)	All uses where halogen-free Glass required Optical face plates
S 732 01	SOLIDEX	Tungsten	X- Ray-Tubes -Spécial Lamp Bulbs
S 740 01	B 40	Tungsten	Power Valves -Spécial Lamp Bulbs
S 750 01	MO	Molybdenum	X-Ray Tubes
S 190 01	G 12	Dumet Chrome Iron Alloys	Cathode-Ray Tubes





GLASS ENVELOPES AND TUBING FOR

a) Special cathode Ray Tubes
b) Camera Tubes, Storage and Display
c) X - Ray Tubes
d) Power and Transmitting Valves

BULBS FOR LIGHTING PURPOSES

a) Bulbs for Mercury Vapor Lamps
b) Bulbs for Projection Lamps

GLASS COMPONENTS FOR SEMI-CONDUCTORS

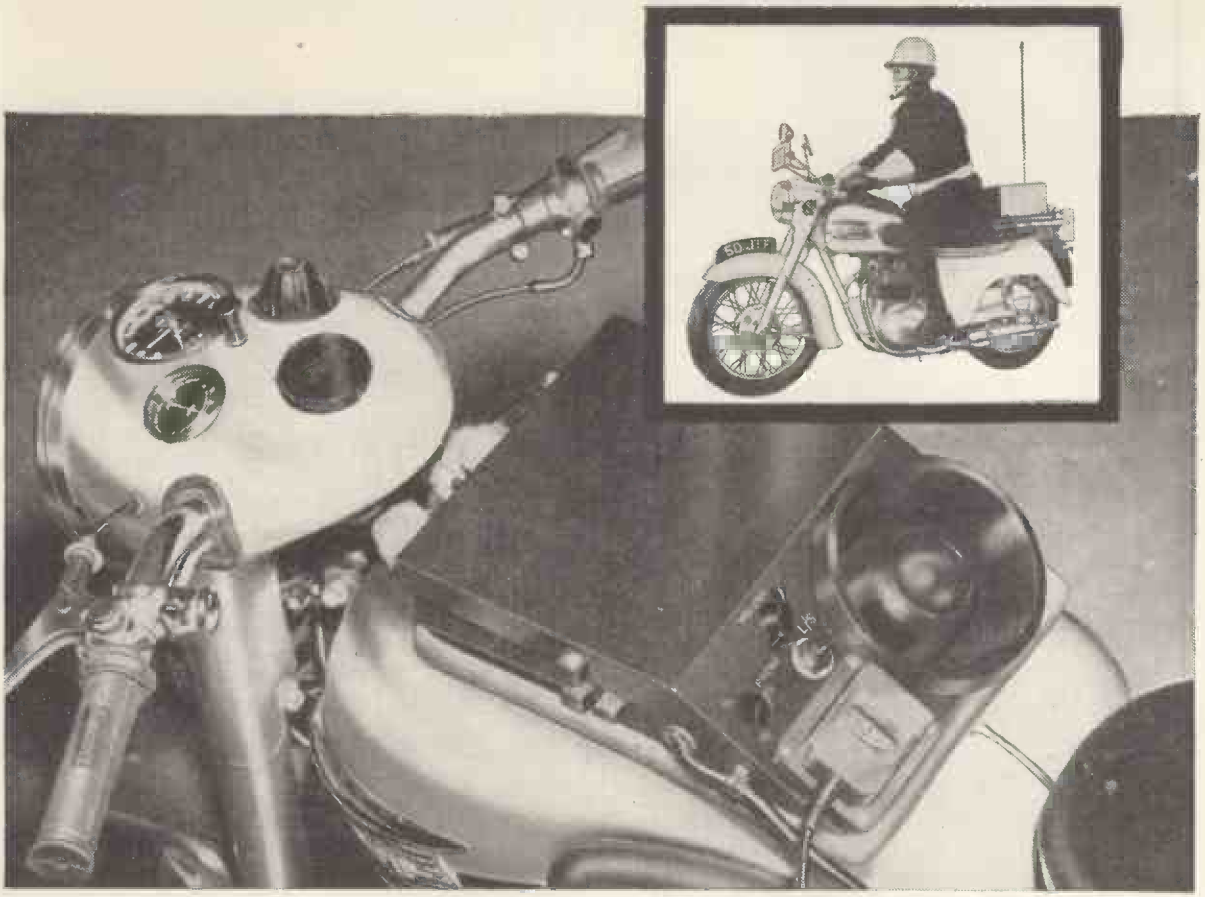
a) Diodes : cut, beads and envelopes
b) Transistors : all glass enclosures
sintered glass bases and beads
c) Rectifiers : beads

BULBS FOR CATHODE RAY TUBES

Agent For United Kingdom
UNIVER - Maurice CHEVALLIER
Napier House - 24-27 high-Holborn
LONDON W.C. 1 ANGLETERRE

SOVIREL

27, RUE DE LA MICHODIÈRE - PARIS-2e - RIC. 52-25



TRANSISTORISED

MOTORCYCLE

VHF

RADIO

by

G.E.C.

This phase modulated, 2 channel transmitter/receiver—the LANCON—is a completely new design incorporating many unique features particularly suitable for motor-cycle patrols, and large numbers are already in service for the Lancashire County Constabulary.

Features include:

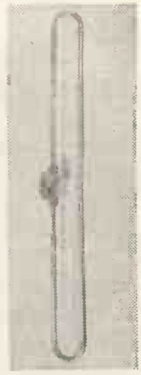
- A transmitter power of 10 *watts* and a frequency range of 80-100 *Mc/s.*
- The low consumption of 4·5 *watts* by the receiver in conjunction with a device for switching off the transmitter filaments automatically eliminates the necessity for external charging of the motor-cycle battery.
- Two-way communication whilst travelling at any speed is the standard method of operation.
- There is no necessity for the rider to remove his hands from the handlebars to operate the radio equipment.
- Two-way range is equal to that of the best car V.H.F. radio equipment obtainable.
- Micro-telephone unit in headgear provides privacy of communication and eliminates need for windscreen.
- The design of the equipment and aerial is such that the handling characteristics of the motor-cycle are unaffected.
- Special magnetic 'snatch' disconnects headgear unit in event of accident.
- Equipment is completely watertight and dust-proof.

PIONEERS OF V.H.F. RADIO IN THE UNITED KINGDOM

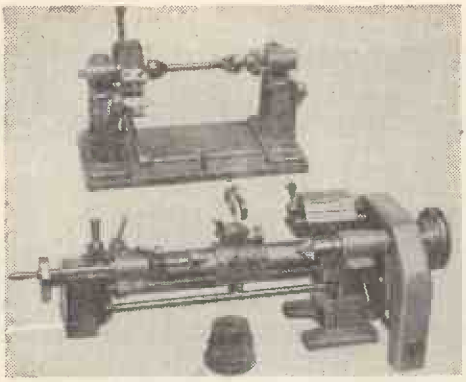
For further information please write to:

THE GENERAL ELECTRIC CO LTD OF ENGLAND
Radio Communications Division, Ford Street, Coventry, England

Smee's G.E.C. 57A.



... with Trigger-Action Spring-Loaded Clips
PRESS TRIGGER TO OPEN
RELEASE TO GRIP



MODEL 'E' SEMI - AUTOMATIC COIL WINDING MACHINES

Model 'E' is a new addition to the famous range of Eta Coil Winding Machines. It will wind coils 6in. x 6in. also may be arranged to wind Flat Resistance Strips up to 6in. long.
A large diameter Lead-screw gives the feed great accuracy and runs in Ball-Races. The reverse is manual and only One Gear needs changing for the alteration to feed.
A Heavy Duty Revolution Counter with Five Figures and Reset.
The machine is heavily built and will wind much larger wires if required. Price on application.

ETA TOOL CO. LTD.

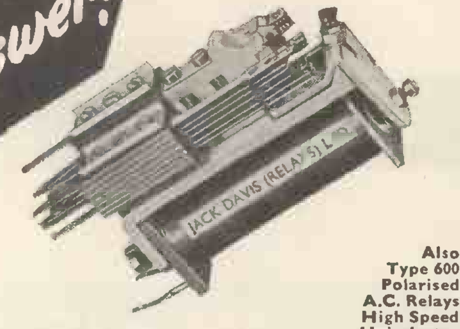
29a WELFORD ROAD, LEICESTER.

Phone: Leicester 56386 *Grams: Leicester 56386.*

Is this the Answer?

P.O. Type 3000

The most versatile relay available today.
Coils up to 120,000Ω
Spring Set Insulation up to 5KV



Also
Type 600
Polarised
A.C. Relays
High Speed
Uniselector
Key Switches
Latching Relays
Magnetic Counters
Miniature Sealed Relays

Are you aware of the variety of contact build-ups we can assemble? Your problem may not be as bad as it seems if you take advantage of our wide experience in the unlimited use of this adaptable product.

- Quotation by return.
- Prototypes within 48 hours
- Good delivery guaranteed.

Consult the Specialists!

Jack Davis (Relays) Ltd.

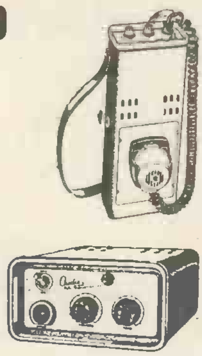
(DEPT. W.) TUDOR PLACE, LONDON, W.1
TELEPHONES: MUSEUM 7960 LANGHAM 4821

TRANSISTORISED POWER AMPLIFIERS

PORTABLE, MOBILE, MAINS

FOR ALL RADIO, AMPLIFIER & SOUND INSTALLATIONS

ENQUIRIES:—



Audix

STANSTED, ESSEX. *STANSTED 3132*

A.C. SOLENOID TYPE SCM.

9/10ths
FULL SIZE

Continuous 3 ozs. at [illegible]
Instantaneous to [illegible]
Larger sizes obtainable.

Also—Transformers to
7kVA 3 phase.

R. A. WEBBER LTD.

18 FOREST ROAD, KINGSWOOD, BRISTOL. Phone: 67-4065

P.A. Operators, SOUND engineers, or anyone with the PROBLEM of what to try for price, performance and reliability MUST see and hear:—

AMPERIAL

Whether it be the full 7-valve 40-watt version at **£42.10.0**, or the 25-watt ultra-linear job at **£27.15.0**, all agree it is unbeatable.

Full details of whole range by return.

E. K. ELECTRONICS, Brotherton, Knottingley, Yorks.

Wireless World

ELECTRONICS, RADIO, TELEVISION

JULY 1960

Managing Editor:

HUGH S. POCOCK, M.I.E.E.

Editor:

F. L. DEVEREUX, B.Sc.

Assistant Editors:

H. W. BARNARD

T. E. IVALL

VOLUME 66 No 7.

PRICE: TWO SHILLINGS

FIFTIETH YEAR OF PUBLICATION

Offices: Dorset House, Stamford Street, London, S.E.1

Please address to Editor, Advertisement Manager, or Publisher, as appropriate

PUBLISHED MONTHLY (4th Monday of preceding month) by ILIFFE & SONS., LTD., Dorset House, Stamford Street, London, S.E.1. *Telephone:* Waterloo 3333 (65 lines). *Telegrams:* " Ethaworld, Sedist, London." *Annual Subscriptions. Home and Overseas,* £1 15s. 0d. *Canada and U.S.A.*, $5.00. Second-class mail privileges authorised at New York, N.Y. BRANCH OFFICES: *BIRMINGHAM:* King Edward House, New Street, 2. *Telephone:* Midland 7191. *COVENTRY:* 8-10, Corporation Street. *Telephone:* Coventry 25210. *GLASGOW:* 62, Buchanan Street, C.1. *Telephone:* Central 1265-6. *MANCHESTER:* 260, Deansgate, 3. *Telephone:* Blackfriars 4412. NEW YORK OFFICE: *U.S.A.:* 111, Broadway, 6, *Telephone:* Digby 9-1197.

FOR COMPLETE DATA

ON MULLARD VALVES, TUBES,

SEMICONDUCTORS

AND COMPONENTS

COMPREHENSIVE TECHNICAL HANDBOOK SERVICE

The Mullard Technical Handbook has long been established as the comprehensive reference work for all those needing full data on Mullard Valves, Tubes and Semiconductors.

It has now been replanned; a volume on Electronic and Magnetic Components has been added and Volume 1A incorporated in enlarged Volumes 1 and 3.

The Handbook Service includes the supply of any or all of the loose leaf volumes listed below, plus the automatic issue of revised and supplementary sheets as and when published.

Mullard Limited,
T.S.D. Data and
Publications Section,
Mullard House,
Torrington Place,
London, W.C.1

VOLUME 1 Receiving and Amplifying Valves and Television Picture Tubes recommended for use in current and new equipment, and Special Quality Receiving Valves.

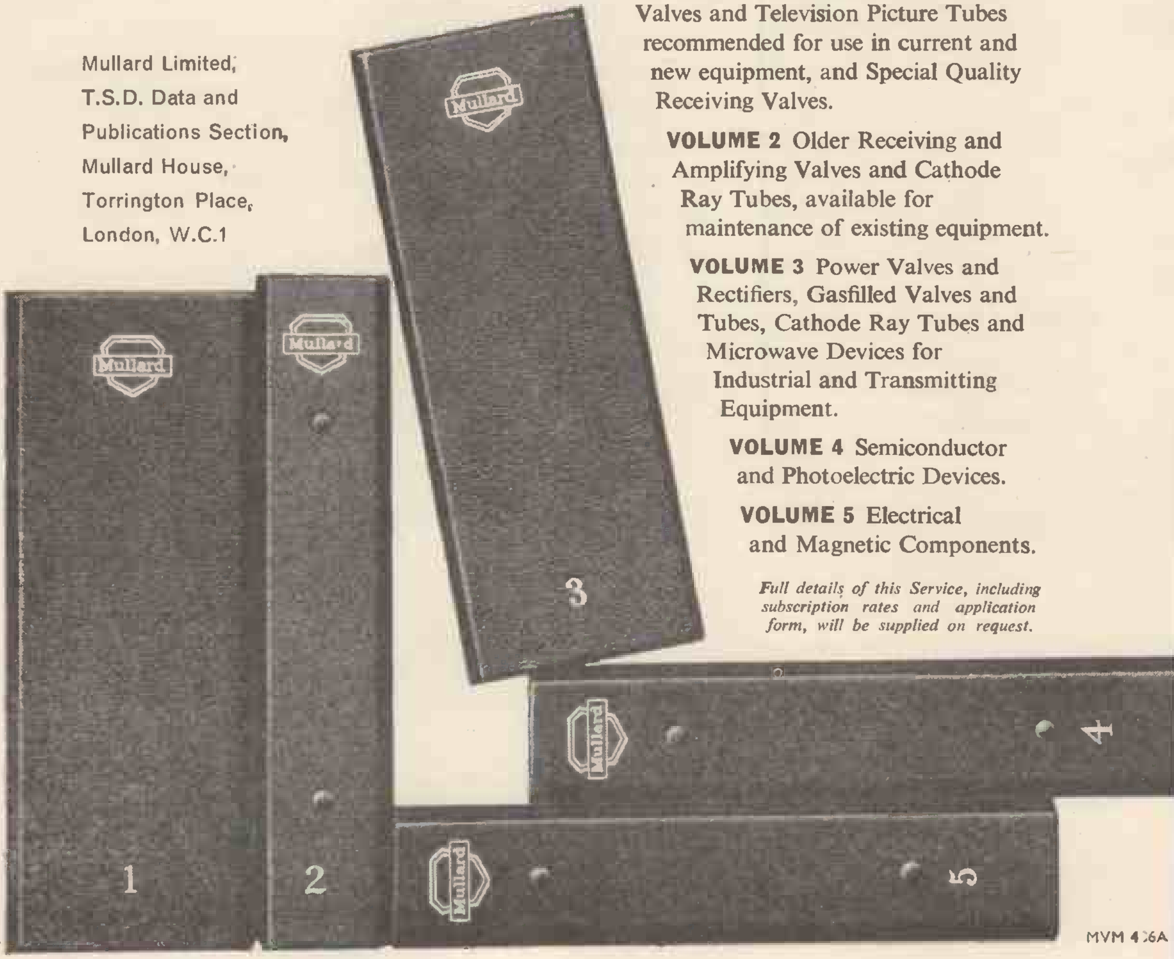
VOLUME 2 Older Receiving and Amplifying Valves and Cathode Ray Tubes, available for maintenance of existing equipment.

VOLUME 3 Power Valves and Rectifiers, Gasfilled Valves and Tubes, Cathode Ray Tubes and Microwave Devices for Industrial and Transmitting Equipment.

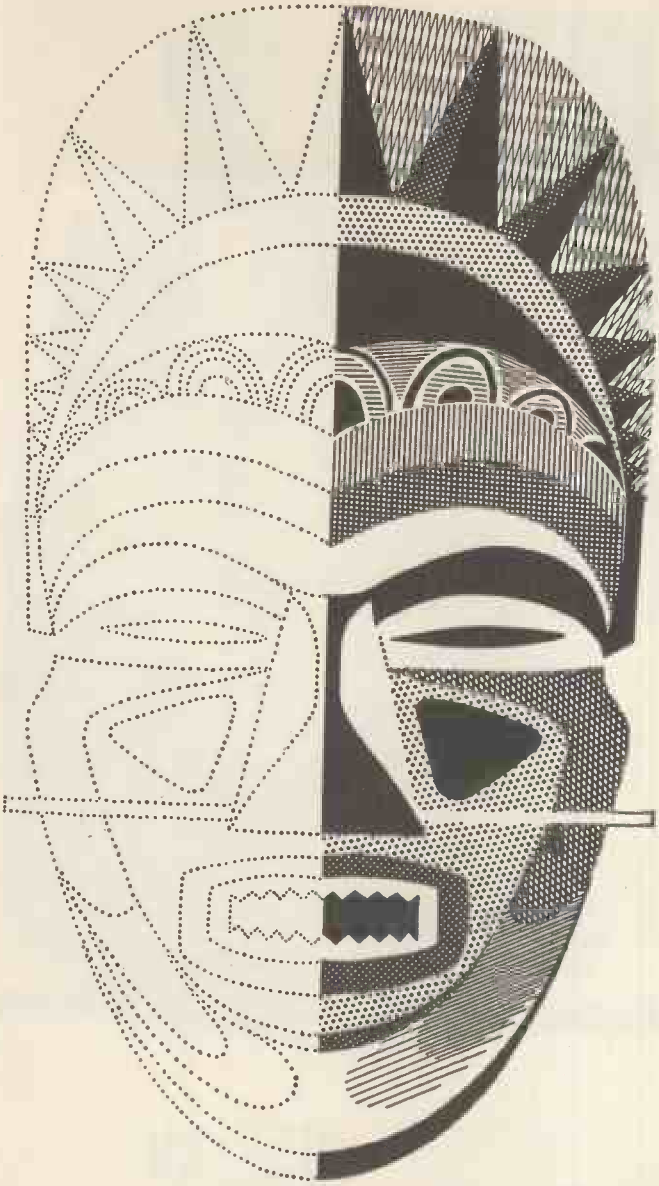
VOLUME 4 Semiconductor and Photoelectric Devices.

VOLUME 5 Electrical and Magnetic Components.

Full details of this Service, including subscription rates and application form, will be supplied on request.



MVM 4?6A



"BELLING-LEE" NOTES

No. 18 *of a series*

Fusing, part 2

A Fuse is a device for opening a circuit by means of a conductor which is designed to melt when an excessive current flows. Properly speaking, the term covers the complete device including any housing. The active part of the fuse, which breaks the circuit, is the Fuse-element. This may be an open wire bridging two terminals, or it may be supported on a carrier or enclosed in a cartridge, the element and its immediate container being called a Fuse-link.

One must never lose sight of the fact that a fuse is a thermal device; melting of the element occurs when its temperature is raised to the characteristic level of the material of which it is made. The melting point is a precise physical property of a metal or alloy and the amount of heat energy required to raise a given mass of it to the melting point is therefore a precise quantity under any specific set of conditions. However, any variation of these conditions such as alteration of the temperature differential, or of the heat losses, will alter the quantity of heat required to produce melting, and in relation to a fuse-element this means that its performance will be affected. Thus, a fuse-element made of a material which melts at 250° C. will require appreciably less applied heat to blow it in the tropics than at the north pole or, put another way, if a fuse-element is chosen to give adequate protection to an equipment at the equator, it may not satisfactorily protect the equipment in mid-winter in northern Alaska where it might take appreciably longer to operate under the same degree of fault current. Equally, a fuse-element running in a zone of unusually high temperature, e.g., inside an enclosure where considerable heat is developed, may interrupt the circuit without any electrical fault having occurred.

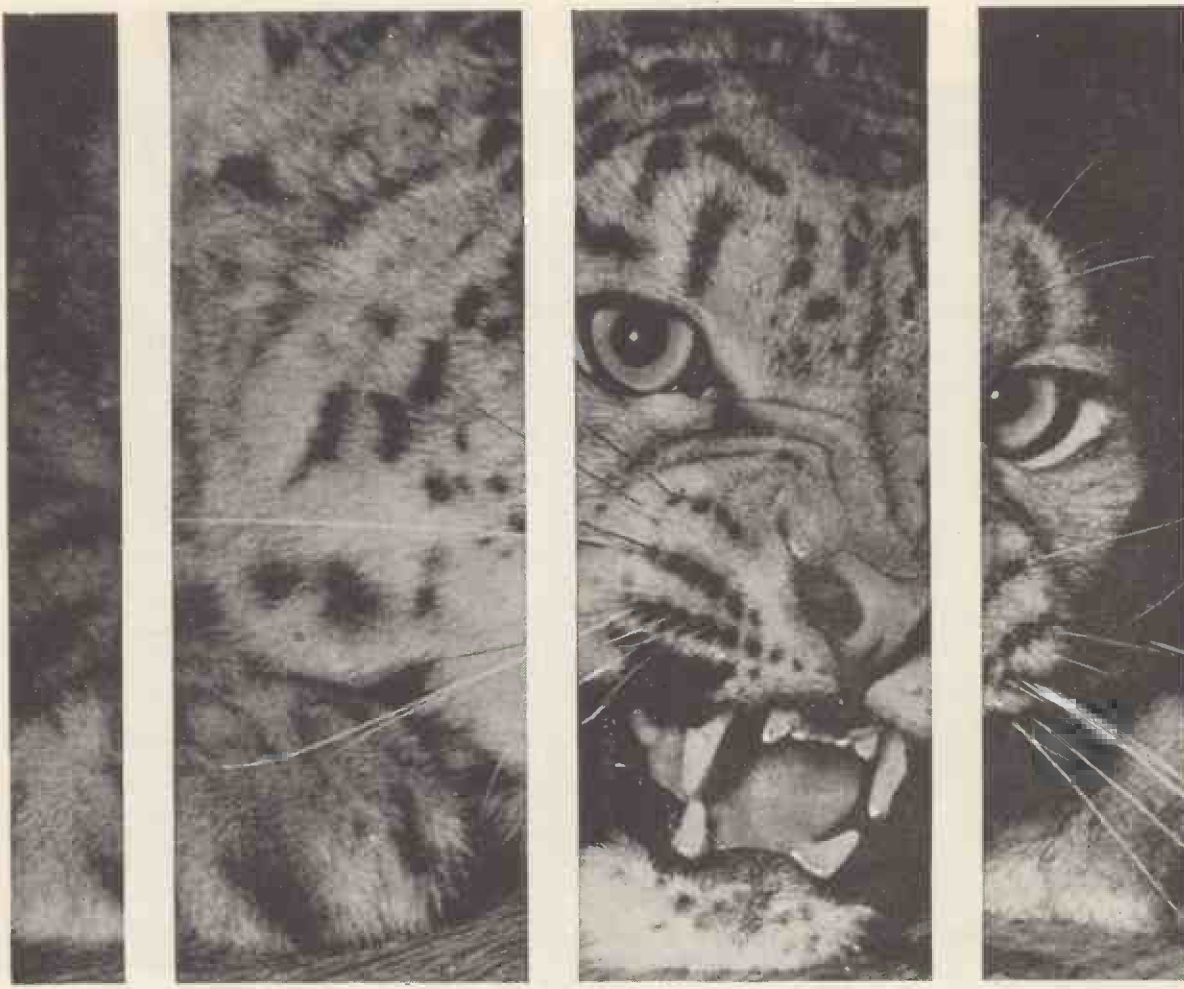
There are other practical considerations associated with thermal effects. The element in an unfilled cartridge fuse-link is usually designed to be supported at the ends only, clear of the walls of the tube. However, if such a fuse-link is badly made so that the element rests on the inside of the bore, some heat will be conducted away by the tube wall, which means that additional energy will be needed to replace this; i.e., protection will be less satisfactory than the designer intended. A similar effect can occur if the element is slack, even if it is not actually touching the inside of the tube under normal running conditions. As soon as excess current commences to flow, the expansion of the element as the temperature rises may cause it to sag against the cartridge wall, and this will slow down the rate of temperature climb, and delay fusion and opening of the circuit. This is one of the reasons why "Belling-Lee" do not enclose identity labels inside glass cartridge fuse-links, since there is a risk of them touching the elements and altering the blowing characteristic. (Another practical reason is that the very action of blowing usually so disfigures the label as to render it unidentifiable! We think it preferable to stamp the rating indelibly on the end caps, since even marking the glass is rendered ineffectual if the tube becomes broken.)

The position of mounting, and the connections to a fuse also introduce thermal effects which can affect performance. When mounted vertically, heat generated at the bottom of the element helps to raise the temperature at the upper end, and accelerates blowing. Poor contact resistance at the ends of a fuse-link can lead to the development of considerable heat, and it is not uncommon for a high rating fuse-link mounted in a faulty carrier to blow prematurely, or for the soldered connection between element and caps to melt. The use of a fuse-link of higher rating than its carrier can produce a similar failure due to overheating of the carrier, and the fact that a carrier accepts a fuse-link does not necessarily mean that they are intended to work together. The connecting links between a fuse and the circuit can also have a bearing on the performance, for together with the terminals they form a heat sink, and excessive cooling due to the use of too generous conductors can retard the rate of action of the element and impair the protection.

For all these reasons the design and testing of fuse-links are related to closely specified operational conditions which are well known to circuit designers, and fuse-link types and ratings in an installation should not be altered indiscriminately.

(To be continued)

Advertisement of
BELLING & LEE LTD.
Great Cambridge Road, Enfield, Middx.



CONTROLLED POWER

New G.E.C. Silicon Controlled Rectifier now available

The SCR96 silicon controlled rectifier is a three-junction semiconductor device developed and manufactured by G.E.C. for use in power control and power switching applications requiring blocking voltages up to 200V and load currents up to 10A. Series and parallel circuits may be used for higher power applications.

Type	Maximum Continuous P.I.V. (V)	Maximum Transient P.I.V. (5ms)* (V)	Maximum average current† (A)	Peak one-cycle surge current (A)	Maximum average gate power (W)	Average gate current to fire (mA)	Typical turn-on time‡ (μs)	Typical turn-off time‡ (μs)
SCR961	25	35	10	120	0.5	20	2	15
SCR962	50	75						
SCR963	100	150						
SCR964	150	225						
SCR965	200	300						

* For zero or negative gate voltages † Depends on cooling system and conduction angle. ‡ Value depends on circuit.

G.E.C. **SEMICONDUCTORS**

For full information please write (or in London area phone TEMple Bar 8000 Ext. 10) to

THE GENERAL ELECTRIC CO. LTD., SEMICONDUCTOR DIVISION, SCHOOL STREET, HAZEL GROVE, STOCKPORT, CHESHIRE.

Aspects of design 24

FM RATIO DETECTOR (PART I)

This is the twenty-fourth of a series of special features dealing with advanced problems in television and radio circuit design to be published by The Ediswan Mazda Applications Laboratory. We will be pleased to deal with any questions arising from this or other articles, the twenty-fifth of which will appear in the August 1960 issue.

The ratio detector is a circuit used for the detection of frequency modulated signals, and, by suitable design, it can be made insensitive to unwanted amplitude modulation of the signal. The frequency modulation is detected by making use of the phase differences between the voltages across the primary and across each half of the centre tapped secondary circuit of a double tuned transformer as in the normal phase discriminator. Typical detector circuits are shown in Figs. 1 and 2.

The rectified currents in the diodes D1 and D2 are varied by the deviation of the signal frequency from its central value and the difference between these currents, flowing through the output audio load R_L, produces the required audio output signal. The diodes conduct at the peaks of the input signal, allowing the stabilising capacitor C_1 to be charged to a voltage dependent on the signal strength. The stabilising capacitor and its associated parallel resistance R_1 have a sufficiently long time constant to resist any rapid change of potential. Hence, if the input signal increases, the current flowing into the capacitor rapidly increases, and this adds very considerably to the load on the tuned circuits, consequently reducing their gain. Similarly, a reduction of signal causes a reduction of loading and an increase in gain. By this means, rapid variations in the signal strength (i.e. amplitude modulation) are considerably reduced.

There is a limit to the amount of downward modulation (i.e. temporary reduction of signal) which can be handled by a ratio detector. At some value of modulation, depending on the particular circuit used, both diodes are biased beyond cut-off and the circuit fails to function as an FM detector. From tests carried out on FM receivers, under widely varied conditions of reception, it is generally considered that an acceptable design has an AM-FM rejection ratio not less than 35 dB (see below for method of measurement), and that the FM detector should handle a downward amplitude modulation of 40%.

The stabilising capacitor in itself cannot entirely eliminate the effects of amplitude modulation, and various methods are used to reduce the unwanted output by producing an antiphase component. Some methods principally affect the balanced component, i.e. the AM component which is dependent on the frequency deviation, and others the unbalanced component, i.e. the AM component which is independent of frequency deviation. To obtain good AM rejection a combination of methods may be necessary.

A well designed ratio detector should meet the following requirements:—

1. The load resistance across the diodes must be low enough to reduce the average working Q to a value at which the circuit can handle the maximum likely amount of downward modulation. In general the working Q should be about a quarter of the unloaded Q.
2. The coupling between primary and secondary should be less than critical coupling at the working Q.
3. The ratio of tertiary voltage V_3 to the half secondary voltage V_2 should be nearly unity.
4. The FM detector characteristic must be linear over a frequency band which will handle a deviation of ± 75 kc/s plus any drift in the receiver oscillator.
5. The stabilising capacitor value must be large enough to maintain limiting action at the lowest audio frequency. This is particularly important in an unbalanced circuit where one side of the load resistance is "earthy" and the voltage across the stabilising capacitor appears in the audio output.
6. The AM rejection ratio should not be unduly dependent on the level of the signal input, and any method of improving the performance figure must cater for the spread in production tolerances of all the circuit components, including valves or crystal diodes.

MEASUREMENT OF AM REJECTION RATIO

The unwanted AM audio signal depends in general on the amount by which the carrier frequency differs from the centre frequency of the discriminator curve. Thus, if the amplitude and frequency modulated signals are applied individually, the measured ratio will be very dependent on the alignment of the discriminator circuit. For this reason a better assessment of the ability to discriminate against AM is made by using a signal which is simultaneously amplitude and frequency modulated, but using different modulation frequencies to enable the signals to be separated after detection. As the output from the AM may contain appreciable harmonics, it is advisable to use a lower frequency for the frequency modulation, and to separate the audio modulation output by means of a high pass audio filter.

Suitable conditions are achieved by using 30% frequency modulation (i.e. ± 22.5 kc/s deviation) at 50 c.p.s. and 30% amplitude modulation at 400 c.p.s.

The rejection ratio is then given by

$$\frac{\text{rms audio output produced by FM}}{\text{rms audio output produced by AM}}$$

expressed in dB where suitable correction is made for the insertion loss of the audio filter network used in the measurement.

If the unwanted AM output is known to be mainly due to an unbalanced component, the rejection ratio can be satisfactorily obtained by measuring the audio output using amplitude and frequency modulation separately applied.

TYPES OF RATIO DETECTORS

Two basic types of ratio detector circuits are shown in the illustrations, and obviously there are a number of ways in which their individual features may be combined. Fig. 1 uses a separate tertiary winding tightly coupled to the primary circuit, and a bifilar secondary winding to obtain a good electrical centre tap on the secondary circuit. The diode load is balanced to earth. AM rejection is improved by a suitable choice of values for resistors R_2 and R_3. Fig. 2 uses a tap on the primary winding instead of a separate tertiary winding, and a capacitor tap on the secondary winding. The use of a capacity tap avoids the necessity of using a bifilar winding in the secondary circuit. The circuit, in addition, uses an unbalanced diode load, and AM rejection can be improved by a suitable choice for R_4 and C_2. The unbalanced circuit is essential if the diodes in a triple diode triode valve are used in an FM detector.

In the next issue, details will be given of a ratio detector circuit based on Fig. 2 which is designed to give a consistently good AM rejection performance.

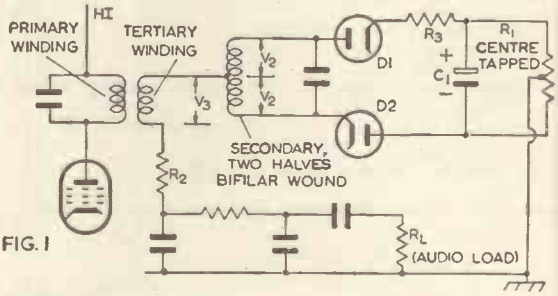


FIG. 1

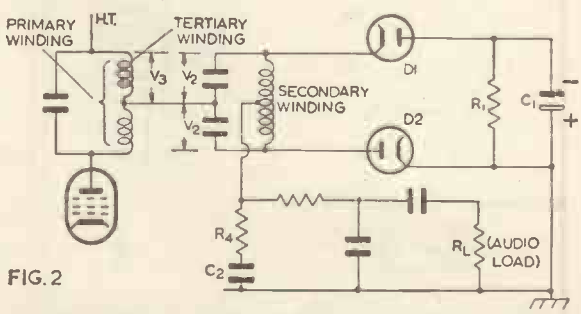


FIG. 2

NEW VERY HIGH SLOPE SCREENED HF PENTODE

EDISWAN MAZDA 6F24

The 6F24 has a slope of 15 mA/V at 10 mA anode current and a high "Figure of Merit," both results achieved by incorporating the new frame grid technique. This new screened HF Pentode enables improved performance to be obtained as an IF amplifier in a.c. or a.c./d.c. television receivers.

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.3

TENTATIVE RATINGS AND DATA

Maximum Design Centre Ratings

Anode Dissipation (watts)	$p_{a(max)}$	2·5*
Screen Dissipation (watts)	$p_{g2(max)}$	0.8*
Anode Voltage (volts)	$V_{a(max)}$	250
Screen Voltage (volts)	$V_{g2(max)}$	250
Heater to Cathode Voltage (volts rms)	$V_{h-k(max)rms}$	150†
Control Grid to Cathode Resistance (megohms)	$R_{g1-k(max)}$	0.6‡

*With grid to cathode resistance not exceeding 10 kΩ.
†From cathode to higher potential heater pin.
‡With $p_{a(max)} = 2$ W; $p_{g2(max)} = 0.5$ W; and assuming a common anode and screen decoupling resistance < 2.2 kΩ ±10%.

Inter-Electrode Capacitances (pF)§

Input Capacitance	c_{in}	8.8
Output Capacitance	c_{out}	2.6
Grid 1 to Anode	c_{g1-a}	0.006
Grid 1 to Grid 3	c_{g1-g3}	0.1
Grid 1 to Grid 2	c_{g1-g2}	2.0
Grid 1 to Cathode	c_{g1-k}	6.2
Grid 2 to Anode	c_{g2-a}	0.15
Grid 3 to Anode	c_{g3-a}	0.47

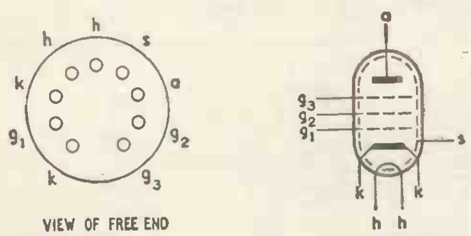
§Measured in fully shielded socket, without can.

TYPICAL OPERATION

Anode Voltage (volts)	V_a	170
Screen Voltage (volts)	V_{g2}	170
Self Bias Resistance (ohms)	R_k	150
Anode Current (mA)	I_a	10
Screen Current (mA)	I_{g2}	2.7
Mutual Conductance (mA/V)	g_m	15
Inner Amplification Factor (g_1 to g_2)	μ_{g1-g2}	65
Equivalent Grid Noise Resistance (ohms)	R_{eq}	370
Input Loss at 38 Mc/s (Pins 1 and 3 strapped) (kΩ)	$r_{g1-k(w)}$	8.5
Working Input Capacity** Measured at 38 Mc/s (pF)	$c_{in(w)}$	13.7
Change in Input Capacity produced by biasing valve to cut-off. Measured at 38 Mc/s (pF)	$\Delta c_{in(w)}$	3.4
Figure of Merit†† (Valve only) (Mc/s)		375
Effective Figure of Merit (Valve and Circuit) (Mc/s)		220

**Inter-electrode capacity with holder capacity balanced out.
††Given by $\dfrac{g_m \times 10^3}{2\pi\sqrt{c_{in(w)}\, c_{out}}}$ see "Aspects of Design" No. 1 for further details. (Wireless World July 1958.)

Base: BA9 (Noval) **Mounting Position:** Unrestricted

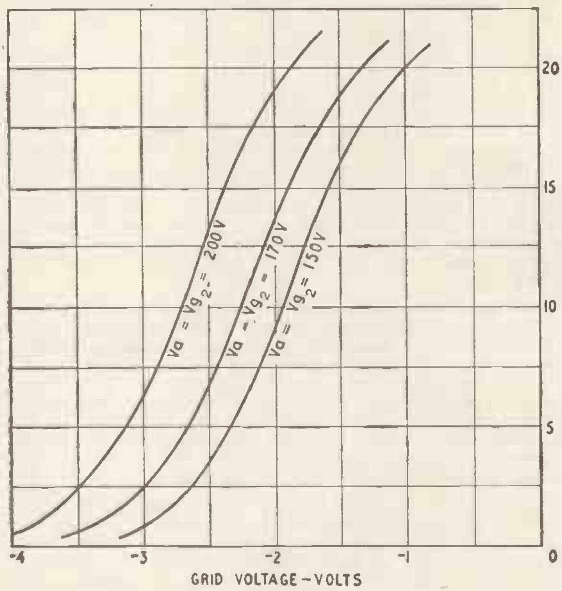


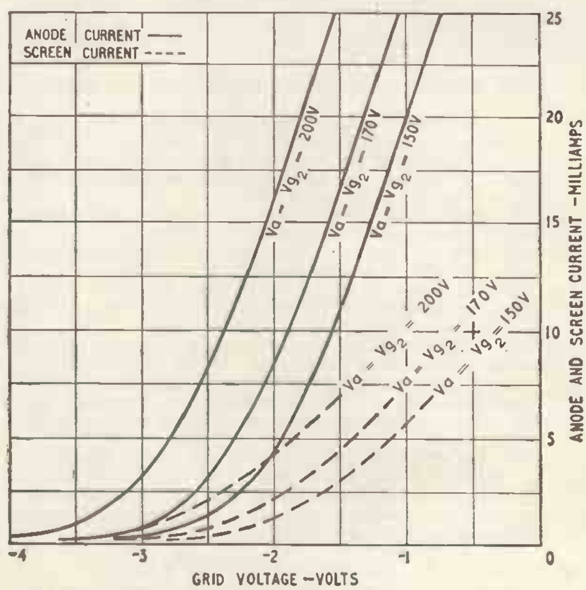
VIEW OF FREE END

Maximum Dimensions (mm)

Overall Length	56
Seated Height	49
Diameter	22.2

Tentative Characteristic Curves of Ediswan Mazda Valve Type 6F24

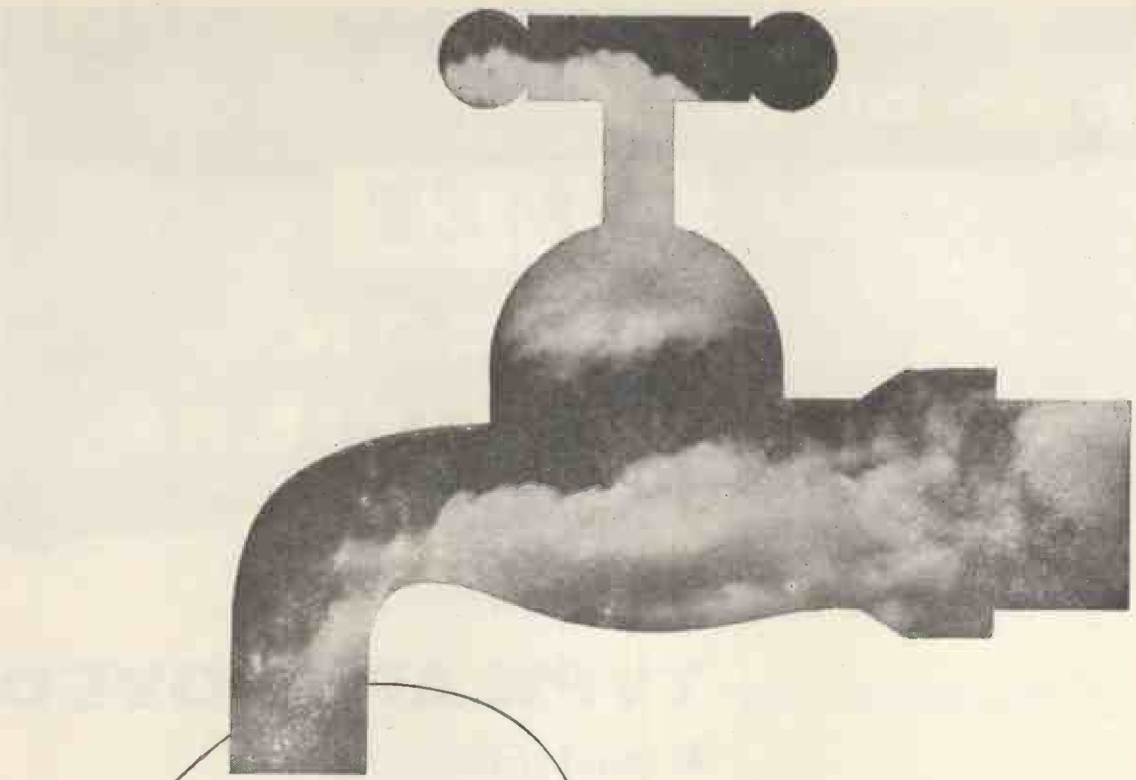




Associated Electrical Industries Ltd
Radio and Electronic Components Division
Technical Service Department
155 Charing Cross Road, London, W.C.2
Tel: GERrard 8660. Grams: Sleswan, Westcent, London

EDISWAN
MAZDA

CRC15/57



NOW! WEATHER INFORMATION FOR THE PILOT ON TAP BY TELEPRINTER

THE MARCONI AD308 TRANSISTORISED AIRBORNE TELEPRINTER RECEIVER

AD308 provides automatic teleprinting of continuously broadcast weather information whenever the pilot needs it.

AD308 high selectivity receiver and low noise ferrite loop aerial gives continuous reception across the North Atlantic.

AD308 using narrow band L.F. reception clears the HF band for vital ATC communications.

AD308 being automatic, radically reduces the flight deck work load.

AD308 light weight receiver is contained in a short ½ A.T.R. case and weighs only 9 lbs (4.1 Kgs).

MARCONI

AIRPORT AND AIRCRAFT RADIO SYSTEMS

* *Fitted in B.O.A.C's. fleet of Boeing 707's*

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED · CHELMSFORD · ESSEX · ENGLAND

A2

Train at home in your spare time

LEARN RADIO & T.V. SERVICING

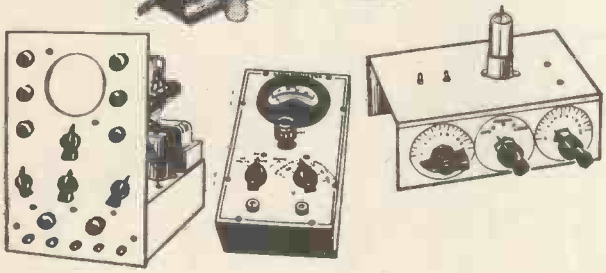
this new, easy, practical way!

YOUR OWN... BUSINESS... CAREER... OR FASCINATING HOBBY

Electronics is rapidly becoming a great new industry with far reaching applications into every field of modern activity.
You can learn all the essentials of this new science at home in your spare time and turn your knowledge to good purpose!
Now is your chance to set up your own business and be your own boss!

RADIOSTRUCTOR EQUIPMENT COURSES MAKE LEARNING SO SIMPLE

You learn by building actual equipment with the big kits of components and parts which we send you. You advance by simple steps using high quality equipment and performing a whole series of interesting and instructive experiments—there are no complicated mathematics! Instruction manuals and our teaching staff employ the latest techniques for showing clearly how radio works in a practical and interesting manner; in fact, you really have fun whilst learning!
And you end by possessing a first-rate piece of home equipment with the full knowledge of how it operates, *and* how to maintain it afterwards. In fact, for those wanting help with their radio career training, to set up their own full or part-time servicing business, or the hobbyist, this new and instructional system is exactly what is needed and it can be provided at very moderate cost with payments available. Post the coupon now, for full details. There is no obligation of any kind.



• No Mathematics • Easy Terms Available • All Test Equipment Supplied • Personal Tuition • Finest Equipment

RADIOSTRUCTOR

BRITAIN'S LEADING RADIO TRAINING ORGANISATION

POST TODAY FOR FREE brochure

To RADIOSTRUCTOR, (Dept. G66)
40 RUSSELL STREET, READING, BERKS.

Please send Brochure without obligation to:

Name ____________________

Address ____________________

____

BLOCK CAPS PLEASE

825 *We do not employ representatives* 7.60

F

we can get you out of a wide band problem

And if you're in a rage over rectifiers or in a diode of despair—don't worry. We'll get you out of that too. (Why, we've made some of our customers actually beam at tetrodes!) It's because we've experienced over 40 years bottling up valves—Tx, Rx, rf, audio, hard, soft, gov't., special—that problems like this no longer hold any terrors for us. Also, we've everything on the research and production side you could possibly wish for. So the next time you're enveloped in a valve problem, let us know.

TYPE	gm (mA/V)	Ca — all less g1 (pF)	Cg1 — all less a (pF)	Pa (pF)
Z319	19	3	8	2.5
Z759	15	3	13	5
417A	25	0.35	6.5	4
R5559	25	5	12	4.5
A2674	32	3.5	15	4.5

Many other types, for all applications—Let us know what you're interested in and we will be pleased to send you details.

G.E.C. valves are obtainable from

THE M-O VALVE CO. LTD

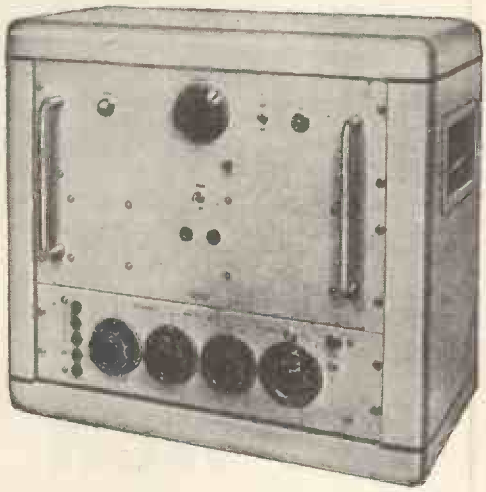
BROOK GREEN · HAMMERSMITH · LONDON W.6.

A subsidiary of the General Electric Co. Ltd

Model W.V.A.

Vortexion quality equipment

120/200 WATT AMPLIFIER



Will deliver 120 watts continuous signal and over 200 watts peak Audio. It is completely stable with any type of load and may be used to drive motors or other devices to over 120 watts at frequencies from 20,000 down to 30 cps in standard form or other frequencies to order. The distortion is less than 0.2% and the noise level −95 dB. A floating series parallel output is provided for 100-120 V. or 200-250 V. and this cool running amplifier occupies 12¼ inches of standard rack space by 11 inches deep. Weight 60lb.

TAPE RECORDERS

The W.V.A. tape recorder now has provision for Stereo plug in heads to enable this recorder to replay Stereo. The regular models are retained with additions and improvements. Our high standard which has made these recorders famous has been maintained, resulting in their being chosen for the foremost musical centre in this country.

30/50 WATT AMPLIFIER

Gives 30 watts continuous signal and 50 watts peak Audio. With voice coil feedback distortion is under 0.1% and when arranged for tertiary feedback and 100 volt line it is under 0.15%. The hum and noise is better than −85 dB referred to 30 watt.

It is available in our standard steel case with Baxendale tone controls and up to 4 mixed inputs, which may be balanced line 30 ohm microphones or equalised P.U.s to choice.

ELECTRONIC MIXER/AMPLIFIER

This high fidelity 10/15 watt Ultra Linear Amplifier has a built-in mixer and Baxendale tone controls. The standard model has 4 inputs, two for balanced 30 ohm microphones, one for pick-up C.C.I.R. compensated and one for tape or radio input. Alternative or additional inputs are available to special order. A feed direct out from the mixer is standard and output impedances of 4-8-16 ohms or 100 volt line are to choice. All inputs and outputs are at the rear and it has been designed for cool continuous operation either on 19 x 7in. rack panel form or in standard ventilated steel case.

Size 18 x 7½ x 9½in. deep.

Price of standard model **£49.**

Also 3-way mixers and Peak Programme Meters.

4-way mixers.

12-way mixers, and 2 x 5-way stereo mixers with outputs for echo chambers, etc. Details on request.

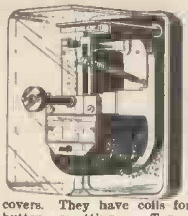
Full details and prices of the above on request

VORTEXION LIMITED, 257-263 The Broadway, Wimbledon, London, S.W.19

Telephones: LIBerty 2814 and 6242-3 Telegrams: "Vortexion, Wimble, London."


SPACE for things to come

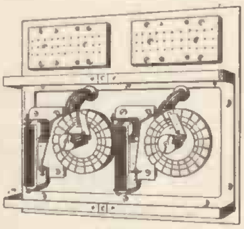
OVERCURRENT RELAY



Beautifully made by the famous American Westinghouse Company. These are the surface mounting through panel type with clear Pyrex glass covers. They have coils for remote push-button resetting. Type A—calibrated for currents between .1 and .4 amps. Type B—calibrated for currents between .5 and 2 amps. Price, unused and perfect, **£3/17/6** each.

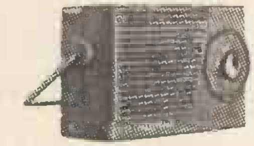
Motorised Gear Pump

Will build up tremendous pressure for operating hydraulic rams, lifts and similar equipment. Geared to 24-volt D.C. motor, but this can be operated off A.C. mains through step down transformer. **£17/10/-** each.



Motorised Rotary Switches

Ministry Ref. No. AP57579, this is a motor-driven switch, the driving motor being a synchronous type for working on 110 volts 50 cycles. The two switches have 20 positions each and are enclosed by a Perspex fronted lid, separately operated relays providing interlocks. Sale price **27/6** each. Carr. 3/6.



Transistor Set Cabinet

Very modern cream cabinet, size 5½ × 3 × 1½ in. with chrome handle, tuning knob and scale. Price **8/6**, plus 1/6 postage and packing.

Heavy Duty Thyratron

Heater 5 volt 20 amp. Peak anode 16,000 volts. Peak plate current 120 amps. Unused, perfect condition. **£5.**

High Voltage Rectifiers

CV19 63 kV., Peak 800 mA	£4 17 6
CV1504 60 kV., Peak 1200 mA.	£5 17 6
CV74 40 kV., Peak 600 mA.	£2 17 6
CV1508 8 kV., Peak 1000 mA.	£1 17 6
CV1111 14 kV., Peak 350 mA.	7 6

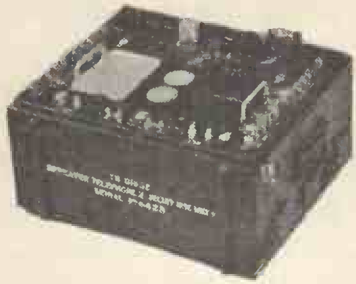
Magnetron

American and British makes. Several types in stock. New and unused, for example, American type 725A. Price **£5/10/-.**

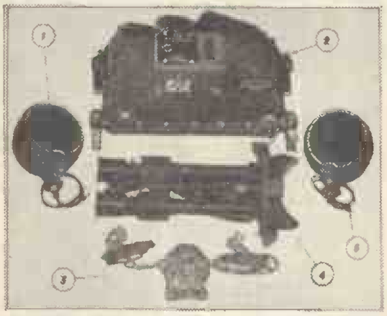
Klystrons

Several types in stock. For example, American type 714AB. Price **30/-.**

TELEPHONE REPEATER No.1, MARK I



This equipment is for amplifying telephone signals in both directions of traffic and also to remedy line distortion of speech. It is intended for use with two wire or four wire circuits, has four amplifiers and is in fact two quite independent repeaters mounted on the same panel and having a common power supply. The power supply may be operated from a 12-volt car battery or from standard A.C. mains. The units are absolutely new in original packing complete with spares and instructional manual. Price **£20** each.



TABBY EQUIPMENT COMPLETE

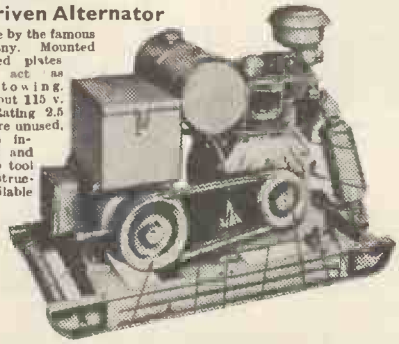
Complete equipment for seeing in the dark, as fitted to Army vehicles for night driving, etc. Complete working equipment comprises: 2 Infra Red Radiators, adjustable binoculars, powerpack for 6 or 12 volts, control units and interconnection cables. Original cost, probably around £100. Unused and in perfect order—**£6/19/6** or **10/-** deposit and 15 fortnightly payments of **10/-.**

Klystron Receiver

Partly stripped but containing valuable Klystron with tuning mechanism and a host of spares including condensers (paper and mica), transformers, relay bobbins, pot. meters, resistors, delay line, coils, coil formers, knobs, pye sockets, trimmers, valve holders, a very useful chassis and case size approx. 15 × 9 × 7½in. and hundreds of other useful sundries. Price only **19/6** plus 7/6 carriage and packing.

Petrol Driven Alternator

American made by the famous ONAN Company. Mounted on heavy bed plates which also act as skids for towing. Generator output 115 v. 60 cycles. Rating 2.5 K.W. These are unused, complete with instruction book and spares, but no tool kit. **£45.** Instruction books available separately, price **10/-.**



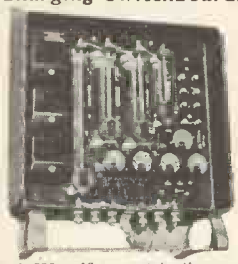
Dimmer or Regulator

Total resistance 1,000 ohms maximum current of .59 amps. This is a beautiful unit which uses a 32-position stud switch. Resistance is divided into 31 sections each approx. 30 ohms. In ventilated metal case, size approx. 7in. × 7in. × 5½in. with wall mounting brackets and large control knob, **27/6**, plus 2/6 post and insurance.

Cine Cameras

16 mm. motorised (24 VAC) for 16 frames per second, contains fine f/8.5 triple anastigmatic lens and spool to carry 25ft. of film — probable cost around £150, brand new and in sealed carton **£6/10/-** or **20/-** deposit and 13 fortnightly payments of **10/-**, post and insurance 3/6.

Charging Switchboards



Type A. 550 w. 18 v.—contains three reverse current relays, one voltmeter rated 25 v. f.s.d., one main ammeter rated 40 amps. f.s.d., one secondary ammeter rated 15 amps. f.s.d. and two secondary meters rated 20 amps. f.s.d., one 2 ohm variable resistor, one 11 ohm variable resistor and two 1.2 ohm varible resistors. Complete in metal case 2ft. 6in. × 2ft. 8in. approx. Price **£2/15/-**, carriage and ins. 15/-.

Type B. 1260 w. 50v., .12 amps.—contains one 14 ohm variable resistor and four 1 ohm variable resistors, one main ammeter rated at 40 amps. f.s.d., four secondary meters rated at 20 amps. f.s.d. and one voltmeter rated at 50 volts, and two reverse current relays. Complete in metal case—size approximately 2ft. 6in. × 2ft. 8in. Price **£4/15/-**, carriage 15/-.

Connecting Leads for these switchboards with Nifam plugs **30/-** each.

W.D. Circuit Details

Diagrams and other information extracted from official manuals. All **1/6** per copy. 12 for **15/-.**

A.1134	R.109
BC.348	HRO Receiver
BC.312	R28/ARC5
R.103A	R1116/A
BC.342	RA-1B
RA-1B	AR88D
R-208	AN/APA-1
R-1155	78
R-1124A	76
R-1132A/R-1481	R.T.18
R-1147	CAY-46-AAM-RADAR
R-1224A	
R-1082	A.S.B.-3
R-1355	Indicator 62A
B.C.1206-A/B	Indicator A.S.B.3
B-455-A (or -B)	Indicator 62
B-454-A (or -B)	Indicator 6K
B-453-N-A (or -B)	R.F. unit 24
Transmitter T1154	R.F. unit 25
Fifty-eight walkie talkie	R.F. unit 26
	R.F. unit 27
Frequency meter B.C.221	Wireless set No. 12
	Demobbed valves

ELECTRONIC PRECISION EQUIPMENT, LTD.

post orders are dealt with from Eastbourne, so for prompt attention please post your orders to 66 Grove Road, Eastbourne, marked Department 2. Callers may use any one of the Companies below:

Electronics (Croydon) Ltd., 266 London Road, Croydon.
Phone: CRO. 6558.
Half day, Wednesday.

Electronics (Finsbury Park) Ltd., 29 Stroud Green Road, Finsbury Park N.4.
Phone: ARChway 1049.
Half day, Thursday.

Electronics (Manor Park) Ltd., 520 High Street North, Manor Park, E.12.
Phone: ILFord 1011.
Half day, Thursday.

Electronics (Ruislip) Ltd., 42-46 Windmill Hill, Ruislip, Middx
Phone: RUISLIP 5780.
Half day, Wednesday.

LASKY'S RADIO

4-SPEED MIXER AUTO-CHANGERS

Brand new in maker's cartons
B.S.R. UA12. Wired for STEREO, complete with stereo cartridge. Post 5/- **£8.19.6**

B.S.R. Type UA8, complete with latest B.S.R. "ful-fi." Post 5/- **£6.19.6**
Ditto, wired for Stereo and with Stereo cartridge, £7/19/6.

COLLARO. Complete with Studio crystal p.u. and sapphire stylus. LIST £13/17/-.
LASKY'S PRICE Post 3/6 **£7.19.6**
STEREO version £8/19/6.

GARRARD

Model 121. Mk. II	£10 10 0
121, Mk. II STEREO	£11 10 0
121, Mk. II, with mon-aural and Stereo heads	£12 10 0
RC.88......................	£12 19 6
RC.88, STEREO	£13 19 6

SINGLE PLAYERS

Auto start and stop. Complete with pick-up and crystal cartridge.

COLLARO 4/564	£6 9 6
GARRARD 4SP	£6 19 6
GARRARD TA Mk. II, wired for STEREO, plug-in head	£8 9 0
E.M.I. 4 spd., wired for STEREO and fitted Acos stereo T.O. cartridge	£6 19 6

Post on all above 5/-

B.S.R. TU9, non-auto Turntable and separate Pick-up ... £4 9 6
Post 3/6

COLLARO JUNIOR 4-speed motor and separate pick-up with cartridge styli £3 15 0
Post free

MICROPHONES

The DIANA. A high quality moving coil microphone with unique magnetised table base. Response 30-15,000 c.p.s. Ideal for tape recorders. LIST 4 GNS.
LASKY'S PRICE **55/-** Post free.

ACOS CRYSTAL STICK MIKE, type MIC.39/1, complete with cable. Listed at £5/5/-.
LASKY'S PRICE Post free **39/6**
Desk Stand 1/6 extra

ACOS type 33/1. Crystal hand or table Mike, 29/6. Post 1/6.

RIBBON MIKE on table stand. Famous make, high impedance.
LASKY'S PRICE Post 3/6 **£6.19.6**

TEST METER BARGAIN

"ALFA" MULTI-RANGE. A.C. and D.C. 3,333 ohms per volt. Ohms ranges to 2 megs. Volts A.C. and D.C. up to 1,200. Overall size: 5¼ × 3⅜ × 1⅞in.
LASKY'S PRICE Including Leads. Post 2/- **89/6**

PICK-UP CARTRIDGES

ACOS type **HGP.59** or **HGP.37** turnover crystal cartridge with L.P. and standard styli. List 39/7
LASKY'S PRICE 18/- Post free.

ACOS type 73-1A STEREO. List 52/6.
LASKY'S PRICE 29/6 Post 1/-.

H.P. TERMS AVAILABLE
on certain goods.
Call or write stating your requirements.

BUILD THIS FINE 3-SPEED TRANSISTOR RECORD PLAYER

FOR **£9.19.6** Carr. 7/6

6-volt operation. For all L.P. and standard records. Complete parcel comprises:—

AMPLIFIER. 300 milliwatts output, using two OC71 and two OC72 transistors. Fully assembled. 79/6. Knobs 3/6 extra.

LOUDSPEAKER. 30 ohms, 7 × 4in. elliptical Speaker matched to amplifier. 25/-.

3-SPEED TURNTABLE with rubber mat and speed adjustment, complete with t.o. crystal cartridge and two sapphire styli. 79/6.

CARRYING CASE as illustrated, handsome two-tone finish, size 17in. deep, 14in. wide, 5⅜in. high. 49/6.

Batteries extra. All components available separately. Build this modern Record Player for £££s less than an equivalent ready-built Player.

FOR YOUR HOLIDAYS!

BUILD THE COSSOR "TRAVELLER'S FRIEND"

4-Transistor POCKET SUPERHET

Uses 9 v. PP4 battery. Covers 190-550 metres. Output 30MW. All components including 4 transistors. OC44, OC45, OC45, OC72, two OA70 diodes, two AGC systems, 2¼in. M.C. speaker, Ferrite slab aerial, etc., leatherette case, size 6 × 3¼ × 1⅞in. Printed Circuit and easy-to follow instructions.
LASKY'S PRICE Post 2/6 **£7.19.6**
Originally nearly £20
All components available separately.

The COSSOR BATTERY ELIMINATOR converts your all-dry portable to mains 200-250 v. New in maker's carton. List 63/-.
LASKY'S PRICE 37/6
Post 1/6

COSSOR 3-watt AUDIO AMPLIFIER KIT including 2 speakers. In maker's cartons. List £9/15/-.
LASKY'S PRICE £5.19.6
Post 2/6

TRANSISTORS

P.N.P. Junction Types

AUDIO, yellow/green spot, each 5/-. **R.F.,** yellow/red spot, each 7/9. **TS1.** For all audio applications, 3/6. Post 6d. Special prices for quantities.

OC44 15/-; OC45 15/-; OC70 8/6; OC71 8/6: OC72 15/- (Matched Pair 30/-); OC73 14/-: OC16 54/-.

EDISWAN MAZDA TRANSISTORS. The very latest types. XB/102 10/-; XB103 10/-; XC/101 12/6: XA/101 15/-; XA/102 17/6.

"GOLDTOP POWER" TRANSISTORS

All types in stock. Example:—
V15/10P. Ideal for output stage of car radio, will give approx. 3 watts operating from 12 v. Each 15/- post free.
Suitable Output Transformer for above. correct ratio, matched to 3 ohms. 9/6. Post 1/-.
Driver Transformer 9/6. Post 1/-.

CRYSTAL DIODES. General Purpose GEX00, each 1/-. Per doz. 9/-.
All other types in stock.

Send for Lasky's
COMPONENTS CATALOGUE
OVER 100 PAGES
SIZE 8½in. x 5½in.
COPIOUSLY ILLUSTRATED
Price **2/-** Post 6d.
Our latest 12-page "BARGAIN BULLETIN" free with each copy or available separately by post, price 6d.

C.R. TUBE BARGAINS

NEW AND UNUSED

FERRANTI, 9in. type T9/3. 4 v. heater, triode, octal base, standard deflection. LIST 9 GNS.
LASKY'S PRICE Carr. & Insur. 12/6 **49/6**

FERRANTI, 12in., types T12/44 and T12/54.
LIST £12. **LASKY'S PRICE** Carr. & Insur. 12/6 **59/6**

FERRANTI 17in. type TR17/10, 6.3 v. .3 amp. heater. Brand new and unused
LASKY'S PRICE Carr. and Insur. 12/6 **£6.19.6**

17in. 90 degrees C.R. TUBES
Seconds but in perfect working order and guaranteed. £4/19/6.
Carr. and insur. 12/6

RE-GUNNED C.R. TUBES
GUARANTEED FOR 12 MONTHS

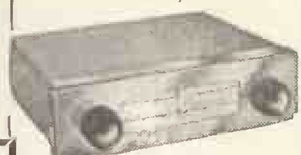
Type	Price	Carr. & Ins.
12in. round	£6 10 0	....12/6
14in. rect.	£6 10 0	....12/6
15in. & 16. round	£6 19 6	....12/6
17in. rect.	£6 19 6	....12/6
21in. rect.	£7 19 6	....21/-

12-CHANNEL TURRET TUNERS

Buy now free of Pur. Tax. Large selection, many by famous makers such as Cyldon, Brayhead, Plessey, Cossor, etc. all I.Fs. Brand new and unused. Write for quotation on model you require
Listed at 7 Gns.
LASKY'S PRICE from **39/6**

LASKY'S CAR RADIO

CAN BE BUILT ABSOLUTELY COMPLETE
FOR £12.10.0
Post 3/6.



★ Small size. Will fit any car
★ 12 volt operation
★ New Hybrid circuit
★ Transistor output
★ New Type Brimar valves
★ No Vibrator, 12volt H.T. & L.T.
★ T.C.C. Printed Circuit and Condensers
★ Tuned R.F. stage
★ Medium and long waves
★ Permeability tuning
★ 7in. × 4in. elliptical speaker.

Instruction Booklet giving full details, illustrations, dimensions, circuit diagram and shopping list, price 2/6 post free (returned if you order).

Please address MAIL ORDERS and enquiries to EDGWARE ROAD

TWO ADDRESSES FOR PERSONAL CALLERS

207 EDGWARE ROAD, LONDON, W.2
Few yards Praed Street
PADdington 3271/2

42 TOTTENHAM COURT ROAD, W.1
Nearest Station: Goodge Street
MUSeum 2605

Both Addresses OPEN ALL DAY SATURDAY
Close Thurs. 1 p.m.

electronic and nucleonic equipment

Frazar & Hansen Ltd., internationally known since 1834, presents many leading U. S. A. manufactured test instruments and components, including nuclear instrumentation, radiation detectors, microwave and transistorized electronic devices, aluminum microwave and relay towers, AM transmitters, high speed pulse generators, signal generators, spectrum analyzers, and transistorized power supplies. Write for information.

FRAZAR & HANSEN Ltd.

301 Clay Street • San Francisco, Calif., U.S.A.

Low Price 4-Digit Voltmeter

Model V64. Ranges from ±9.999/99.99/500.0 volts. Snap-out type readout ±(0.01% of reading or 1 digit) accuracy, 1 second average balancing time, front panel sensitivity control, manual ranging and polarity. Used for quality control, calibration laboratories, production line testing and receiving inspection. Dimensions: 5¼in. high, 15½in. deep, for 19in. rack mounting. For 110–220 volts, 50/60 cycles.

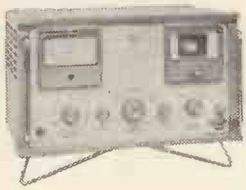
NON LINEAR SYSTEMS, INC.

Portable Alpha Counter

Model PAC-IS. Alpha Counter-Scintillation Type. Designed for surveying alpha contamination over a wide range of activity levels and under wide temperature variations. Consists of a probe, a single conductor 36 inch shielded cable, and rate meter. All units waterproof. Controls and scale selector, etc., are conveniently grouped around handle and can be operated by one finger of the carrying hand even when wearing protective gloves.

EBERLINE INSTRUMENT CORP.

New Frequency Selective Voltmeter



Model 125A. Both an A.C. voltmeter covering 3 to 600 kc. in one band and an A.C. VTVM with flat response (±0.2 db) from 1 to 600 kc. Selectivity settings of 250 cps and 2.5 kc. Measures voltages from −90 to +32 dbm within ± 1 db; frequencies ±1 kc. to 100 kc., and ± 2 kc between 100 and 600 kc. As a flat A.C. VTVM, it has a range of −30 to +32 dbm. 40in. precision frequency scale.

SIERRA ELECTRONIC CORP.

BENTLEY ACOUSTIC CORPORATION LIMITED

The Valve Specialists

38 CHALCOT ROAD, LONDON, N.W.1

Telephone: PRIMROSE 9090

Nearest Underground: Chalk Farm

EXPRESS POSTAL SERVICE! ALL ORDERS DESPATCHED SAME DAY AS RECEIVED.
TELEPHONE AND TELEGRAM ORDERS FOR CASH ON DELIVERY SERVICE ACCEPTED UP TO 3.30 P.M.

OA2 ..17/6
OB2 ..17/6
OZ4 .. 5/-
1A5 .. 6/-
1A7GT 12/-
1C5 ..12/6
1D5 .. 9/-
1D6 ..10/6
1H5GT 10/6
1L4 .. 4/6
1LD5 .. 5/-
1LN5 .. 5/-
1N5GT 10/6
1R5 .. 6/6
1S4 .. 9/-
1S5 .. 6/-
1T4 .. 4/6
1U4 .. 12/6
1U5 .. 6/-
2X2 .. 4/6
3A4 .. 6/-
3A5 ..10/6
3B7 ..12/6
3D6 .. 5/-
3Q4 .. 7/6
3Q5GT 9/6
3S4 .. 7/-
3V4 .. 7/6
5R4GY 17/6
5U4G 6/6
5V4G 10/-
5Y3GT 6/6
5Z3 ..12/6
5Z4G 9/-
6A8G 9/-
6AB8 9/-
6AC7 4/-
6AG5 5/6
6AK5 8/-
6AL5 4/-
6AM6 4/6
6AQ5 7/6
6AT6 7/-
6AU6 10/-
6AV6 12/8

6B8G .. 4/6
6BA6 .. 7/6
6BE6 .. 6/-
6BG6G 23/3
6BH6 8/-
6BJ6 6/-
6BQ7A 15/-
6BR7 15/-
6BW6 8/6
6BW7 7/-
6BX6 7/-
6C4 .. 5/-
6C5G 6/6
6CD6G 36/6
6CH6 9/-
6E5 ..12/6
6F1 ..26/6
6F6G .. 7/-
6F12 4/6
6F13 ..11/6
6F23 10/6
6F33 .. 7/6
6G6 .. 6/6
6H6GT 3/-
6J5G .. 5/-
6J6 .. 5/6
6J7G ..6/-
6K6GT 8/-
6K7G 5/-
6K8G 6/6
6K25 19/11
6L1 ..23/3
6L6G 8/-
6L7GT 7/6
6L18 13/-
6L19 23/3
6LD20 15/11
6N7 .. 8/-
6P25 12/6
6P28 26/6
6Q7G 6/6
6R7G 10/-
6SA7GT 8/6
6SL7GT 6/6
6SN7GT 5/6

6SQ7GT 9/-
6U4GT 12/6
6U5G 7/6
6V6G 7/-
6V6GTG 8/-
6X4 5/-
6X5GT 6/-
6/30L2 10/-
7B6 ..21/3
7B7 .. 8/6
7C5 .. 8/-
7C6 .. 8/-
7D6 ..10/6
7H7 .. 8/-
7S7 .. 9/6
7Y4 .. 7/6
8D3 .. 4/6
9BW6 15/3
10C1 ..12/-
10C2 26/6
10F1 26/6
10F9 ..10/6
10LD3 8/6
10LD11 15/11
10P13 15/-
10P14 19/3
12A6 5/-
12AC6 15/3
12AD6 17/3
12AE6 13/11
12AH8 12/6
12AT6 7/6
12AT7 6/-
12AU6 23/3
12AU7 6/6
12AV6 12/8
12AX7 7/6
12BA6 8/-
12BE6 9/-
12BH7 21/3
12J7GT 9/6
12K5 17/11
12K7GT 5/6
12K8GT 14/-

12Q7GT 5/-
12SA7 8/6
12SK7 6/-
12SQ7 11/6
12SO7 8/6
14S7 27/10
19AQ5 10/6
19BG6G 23/3
20D1 ..15/3
20F2 ..26/6
20L1 ..26/6
20P1 ..26/6
20P3 ..23/3
20P5 ..23/3
25A6G 10/6
25L6GT 10/-
25Z4G 9/6
25Z5 9/6
25Z6G 10/-
27SU 19/11
28D7 ..7/-
30C1 .. 8/-
30F5 7/-
30FL1 10/-
30L1 .. 8/-
30P12 .. 7/6
30P16 7/6
30PL1 11/6
35A5 21/3
35L6GT 9/6
35W4 7/6
35Z3 10/6
35Z5GT 9/-
43 ....10/-
50C5 12/6
50CD6G 36/6
35Z4GT 6/-
50L6GT 9/6
53KU 19/11
72 .... 4/6
78 .... 6/6
80 .... 9/-
83 ....15/-
83V ..12/6

85A2 ..15/-
150B2 15/-
185BT 33/2
185BTA 33/2
807 .. 7/6
4033L 12/6
5763 ..12/6
AC6PEN 7/6
ATP4 .. 5/-
AZ31 10/-
AZ41 13/11
B36 15/-
BL63 7/6
CBL31 23/3
CCH35 23/3
CL33 19/3
CV63 10/6
CY1 18/7
CY31 16/7
D1 .. 3/-
D15 ..10/6
D43 ..17/3
D77 .. 4/-
DAF91 6/-
DAF96 8/6
DD41 13/11
DF66 15/-
DF70 15/-
DF91 4/6
DF96 8/6
DF97 .. 9/-
DH63 6/6
DH76 5/-
DH77 7/-
DK40 21/3
DK91 6/6
DK92 9/-
DK96 8/6
DL66 15/-
DL68 15/-
DL92 7/-
DL94 7/6
DL96 8/6
DL810 10/6

DM70 7/6
EA50 2/
EA76 9/6
EABC80 9/-
EAC91 4/6
EAF42 9/-
EB34 2/6
EB41 .. 8/6
EB91 4/-
EBC33 5/-
EBC41 8/6
EBC81 8/-
EBF80 9/-
EBF83 13/11
EBF89 9/6
ELB21 23/3
EBL31 23/3
EC52 5/6
EC54 6/-
EC70 12/6
EC92 13/3
ECC31 15/-
ECC32 5/6
ECC33 8/6
ECC34 24/7
ECC35 8/6
ECC81 6/-
ECC82 6/6
ECC83 7/6
ECC84 9/-
ECC85 8/6
ECC88 23/11
ECF80 10/6
ECF82 10/6
ECH21 23/3
ECH35 9/6
ECH42 9/-
ECH81 9/-
ECH83 13/11
ECL80 9/-
ECL82 10/6
ECL83 19/3
EF22 14/-

EF36 4/-
EF37A 8/-
EF39 5/6
EF40 15/-
EF41 9/-
EF42 10/6
EF50(A) 7/-
EF50(E) 5/-
EF54 5/-
EF73 10/6
EF80 7/-
EF85 7/-
EF86 10/6
EF89 9/-
EF91 4/6
EF92 4/6
EF97 13/3
EK32 8/6
EL32 5/-
EL33 12/6
EL34 15/-
EL38 26/6
EL41 9/-
EL42 10/6
EL81 12/6
EL84 7/6
EL85 13/11
EL91 5/-
EL95 10/6
EM34 9/6
EM71 23/3
EM80 9/-
EM81 9/-
EM84 10/6
EN31 37/-
EY51 9/-
EY83 16/7
EY86 9/-
EZ40 7/-
EZ41 7/-
EZ80 7/-
EZ81 7/-
FC4 15/-
GZ30 9/-
GZ32 10/-

GZ33 19/11
GZ34 14/-
HABC80 13/6
HL23 15/3
HVR2 20/-
HVR2A 6/-
KT2 5/-
KT33C 10/-
KT36 29/10
KT41 12/6
KT44 12/6
KT61 12/6
KT63 7/-
KT66 15/-
KTW61 6/6
KTW62 7/6
KTW63 6/6
KTZ41 8/-
KTZ63 7/6
L63 .. 6/-
MU14 8/-
MX40 15/-
N37 19/11
N78 19/11
N108 19/11
N308 20/7
N339 15/-
PABC80 13/11
PCC84 8/-
PCC85 9/6
PCC88 23/11
PCC89 11/6
PCF80 8/-
PCF82 10/6
PCL82 10/-
PCL83 11/6
PCL84 12/6
PEN45 19/6
PEN46 7/6
PEN383 23/3
PL33 11/3
PL36 12/-

PL38 26/6
PL81 10/6
PL82 7/6
PL83 9/-
PL84 12/8
PL820 18/7
PM24M 21/3
PX4 10/6
PX25 59/8
PY31 16/7
PY32 11/6
PY80 7/6
PY81 8/6
PY82 7/-
PY83 8/6
PZ30 19/11
QP21 7/-
QP25 14/6
QS150/15 10/6
R12 .. 9/-
R18 ..14/-
R19 ..19/11
SD6 ..12/-
SP41 .. 3/6
SP61 .. 3/6
SU25 ..26/6
SU61 9/-
T41 ..23/3
TDD4 12/6
TP22 ..15/-
TP25 15/-
TY86F 13/3
U12/14 8/6
U16 ..10/-
U18/20 8/6
U19 ..36/-
U22 .. 8/-
U24 ..29/10
U25 17/11
U26 ..10/-
U31 .. 9/6
U33 ..26/6
U35 ..26/6
U37 ..26/6

U43 .. 9/-
U45 .. 9/-
U50 .. 6/6
U52 .. 6/6
U76 .. 6/-
U107 16/7
U191 16/7
U251 14/-
U281 19/11
U282 22/7
U301 23/3
U329 14/-
U339 16/7
U404 8/6
U801 29/10
UABC80 9/-
UAF42 9/6
UB41 12/-
UBC41 8/6
UBC81 11/4
UBF80 9/-
UBF89 9/6
UBL21 23/3
UCC84 14/7
UCC85 9/-
UCF80 16/7
UCH42 9/6
UCH81 9/6
UCL82 11/6
UCL83 19/3
UF41 9/-
UF42 12/6
UF80 10/6
UF85 9/-
UF86 17/11
UF89 9/-
UL41 9/-
UL44 26/6
UL46 14/6
UL84 8/6
UM4 17/3
UM80 15/3
URIC 9/-
UU8 26/6

UU9 7/6
UYIN 18/7
UY21 13/11
UY41 7/6
UY85 7/-
VM84B 15/-
VP4 15/-
VP4B 23/3
VP23 6/6
VP41 6/-
VR105 8/-
VR150 7/6
VT501 5/-
VU39 8/-
W76 5/6
W77 4/6
W81M 6/-
X31 ..26/6
X41 ..15/-
X61 ..12/6
X63 .. 9/-
X65 ..12/6
X66 ..12/6
X76M 14/-
X78 .. 21/3
X79 ..21/3
XD(1.5) 6/6
XFG1 18/-
XFY12 9/6
XFY34 17/6
XH(1.5) 6/6
Y63 .. 7/6
Z63 .. 7/6
Z66 .. 17/6
Z77 4/6

Transistors and Diodes
CG1C 4/-
CG4E 4/-
CG6E 4/-
CG10E 4/-
CG12E 4/-
GET103 12/6
GEX33 4/-

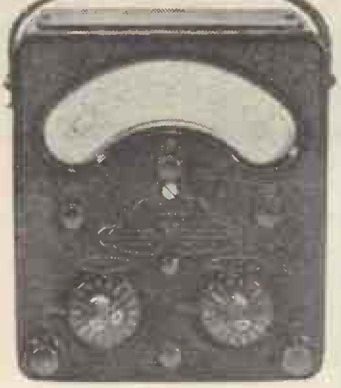
GEX34 4/-
GEX35 4/-
GEX36 10/-
GEX64 11/6
GEX66 13/-
OA2 .. 4/-
OA5 .. 4/-
OA70 4/-
OA79 4/-
OA81 4/-
OA210 25/-
OA211 40/-
OC16 54/-
OC19 54/-
OC28 20/-
OC35 20/-
OC44 26/-
OC45 23/-
OC65 22/6
OC66 25/-
OC70 14/-
OC71 14/-
OC72 17/-
OC73 20/-
OC75 20/-
OC77 20/-
OC78 17/-
OC81 18/-
OC170 35/-
OC200 54/-
OC203 58/-
XA101 23/-
XA102 26/-
XA103 15/-
XA104 18/-
XB102 10/-
XB103 14/-
XB104 10/-
XC101 16/-

New Type Surplus
H.F. 5/-
L.F. 5/-

Terms of business:—Cash with order or C.O.D. only. Post/Packing charges 6d. per item. Orders over £3, post free. C.O.D. 2/6 extra. Any parcel insured against damage in transit for 6d. extra. We are open for personal shoppers. Mon.-Fri. 8.30-5.30. Sats. 8.30-1 p.m.

Latest catalogue of over 1,000 different valves, also metal rectifiers, volume controls, electrolytic condensers, transistors, germanium diodes, valve holders, and Hivac miniature valves, with full terms of business, price 6d.

All valves boxed, fully guaranteed, and new manufacturers' stocks or government stores surplus. First-grade goods only., no seconds or rejects. Please enquire for any type not listed. S.A.E. please.



AVOMETER MODEL D.

£8.19.6 (*P. & P. 3/6*)

D.C. Volts	A.C. Volts	D.C. Current	A.C. Current
150 mV.	7.5 V.	15 m/A.	75 m/A.
500 mV.	15 V.	30 m/A.	150 m/A.
1.5 V.	75 V.	150 m/A.	750 m/A.
3 V.	150 V.	300 m/A.	1.5 Amps.
15 V.	300 V.	1.5 Amps.	7.5 Amps.
30 V.	600 V.	3 Amps.	15 Amps.
150 V.	750 V.	15 Amps.	
300 V.	1.5 KV.	30 Amps.	Resistance
750 V.			0-1000 ohms.
1.5 KV.			0-10 K ohms.

Thoroughly overhauled. Complete with batteries and instructions. An extremely robust meter at a very reasonable price.

SELENIUM BRIDGE RECTIFIERS. Funnel cooled. A.C. input 45 v. RM5. D.C. output 30 v. 10 amps. BRAND NEW. Boxed. 45/-. Post 3/6.

MARCONI IMPEDANCE BRIDGE Type TF373. Measures, L, C & R at 1,000 cycles. Accuracy 1%. 0–100H; 0–100uF; 0–1MΩ each in 5 ranges. Power Factor and "Q." First-class condition, £35, carr. paid.

6-VOLT VIBRATOR PACKS. HRO type, 180 v. D.C., 65 m/amps. BRAND NEW. **29/6**, post 3/6. Type PU2, 200 v. D.C. 100 m/amps., with OZ4 rectifier. **BRAND NEW, 25/-** Post FREE.

ADMIRALTY HT TRANSFORMERS Pri 230 v. 50 c/s. Secs. 620-550-375-0-375-550-620 v. (620 and 550 v. 200 m/amps., 375 v. 250 m/amps.), plus two 5 v. 3 amp. rectifier windings. Total rating 278 VA. Upright mtg. Wt. 25 lb. Made 1953. **BRAND NEW.** Original boxes. 45/-. Carr. 5/-.

INSTRUMENT TRANSFORMERS. 230 v. A.C. input. Outputs 0-65-130-195 v. 85 m/amps., 6.3 v. 5 amps., 6.3 v. 0.3 amps. Shrouded. Size 3¼ × 3¼ × 3¾in. high. 15/-, post FREE.

AR88D MAINS TRANSFORMERS. Input 110–240 v. Output 345–0–345 v. 125 m/amps., 6.4 v., 4.5 amps., 5 v. 2 amps. 4¾ × 4¼ × 5¼in. high. Wt. 12 lb. Potted. Tag ends. RCA BRAND NEW. Boxed. 29/6, post 3/6.

"C" CORE TRANSFORMERS. Pri. 230 v. 50 c.p.s. 510-0-510 at 275 mA. 375-0-375 at 83 mA. 6.3 v. at 9 A. 6.3 v. at 2A (twice), 6.3 v. at 1A (twice), 6.3 v. at 1.5A, 6.3 v. at 0.5A, 5 v. at 3A. 6¾ × 6 × 7½in. high. Weight 25 lb. Removed from equipment but in perfect condition, 52/6. Carr. 5/6.

SANGAMO-WESTON VOLTMETERS S61. Dual range 0–5 and 0–100 v. D.C. FSD 1 m/A. 3in. scale. Recent manufacture. Ideal for schools. Complete in super quality canvas carrying case, with test prods and leads. **BRAND NEW.** Boxed. **27/6.** Post 2/6.

MARCONI CR100

Completely overhauled. In perfect working order. LOOK LIKE NEW. **£21.**
Later model with Noise Limiter, **£25.**
Carr. Eng. and Wales 30/-. Send S.A.E. for full details.

RCA AR-88 SPEAKERS

A high quality 3 ohm unit fitted into heavy gauge black crackled steel cabinet, size 10¼ × 11½ × 6in. Fitted with rubber feet and 6ft. lead. Ideal for extension speaker. CR 100, etc. In original cartons. BRAND NEW. 45/-. Post 3/6.

MINIATURE 373 IF STRIPS. For FM tuner described in "Practical Wireless." Complete with 3 of EF91, 2 of EF92 and 1 of EB91. A fresh release enables us to offer these once again. BRAND NEW. Complete reprint of conversion instructions and circuit supplied free. 35/-. OR less valves, 12/6. Post, either, 2/6.

LOUD HAILER EQUIPMENT

IDEAL FOR CROWD CONTROL, FACTORIES, FETES, ETC. CONSISTS OF 4 SPEAKER UNITS AND CONTROL UNIT. COMPLETE WITH MICROPHONE, HEADPHONES AND SPARES. OPERATES FROM 12 VOLTS D.C. (OR 6 VOLTS D.C. WITH SLIGHTLY REDUCED OUTPUT), CONSUMING ONLY 3 AMPS. OUTPUT POWER 8 WATTS. ALL TESTED AND WORKING, BUT SLIGHTLY SOILED. A GENUINE BARGAIN. **£4/19/6.** CARRIAGE 25/6.

SIGNAL GENERATOR TYPE 54. Marconi 762A. Frequency 430 to 610 Mc/s. Square or Pulse Int. Mod., provision for Ext. Mod. Attenuation range +10 to −100 dB. Directly calibrated dials. As new, £35, carr. paid.

COMMUNICATIONS RECEIVERS R-1155B. A first class 10 valve Communication receiver, covering 75 Kc/s. to 18 Mc/s. (16.2–4,000 m.) in 5 bands. The large scale and superior dual ratio slow-motion drive make tuning easy, and the R.F. stage and 2 I.F. stages ensure world-wide reception. All the receivers we sell have been thoroughly overhauled, completely re-aligned, and are in first class working order, ONLY **£9/19/6.**

A.C. MAINS POWER PACK OUTPUT STAGE. In handsome black-crackled steel cabinet to match the R-1155. Fitted with RCA 8in. speaker. Just PLUG IN and switch on! Only the finest quality components are used, and we guarantee OUR power packs for 6 months. ONLY **£6/10/-.** Deduct 10/- when purchasing receiver and power unit together. Send S.A.E. for further details, or 1/3 for 14 page illustrated booklet giving technical data and circuits etc. (FREE with each receiver.) Add 10/6 carriage for receiver, 5/- for power unit.

T.C.C. VISCONOL CONDENSERS. 8 mfd. 800 v. D.C. wkg. at 71 deg. C. CP152V. Size 3 × 1¾ × 5in. high. **BRAND NEW.** Boxed. 8/6 each, post paid.

MINIATURE RELAYS (ALL BRAND NEW and BOXED)

G.E.C. sealed, wire ends, 670 2M2B H/D M1095	8/6
G.E.C. sealed, wire ends, 670Ω, 2 H/D makes, M1099	15/-
G.E.C. sealed, wire ends, 670Ω, 4 c/overs, platinum, M1092	19/6
G.E.C. sealed, wire ends, 5,000Ω, 2 c/overs, platinum, M1052	17/6
Siemens High Speed, 1K+1KΩ, 1 c/over	10/6

MORE METER BARGAINS

Range	Type	Size		Price
25 Microamp.	D.C. M/C	2½in.	Flush Circ. Scale "Rontgens"	69/6
25 Microamp.	D.C. M/C	2½in.	Proj. Circ. Scale "Rontgens"	59/6
50 Microamp.	D.C. M/C	3½in.	Flush Circ. Scale "Tolerance"	79/6
50 Microamp.	D.C. M/C	2½in.	Flush Circ. Scaled 0-100 v.	59/6
100 Microamp.	D.C. M/C	3½in.	Flush Circ. Scale 0-50/0-1,000 v.	62/6
100 Microamp.	D.C. M/C	2½in.	Flush Square	42/6
1 Milliamp.	D.C. M/C	3½in.	Flush Circular	50/-
1 Milliamp.	D.C. M/C	3½in.	Flush Squ. Scaled 0-250 v.	69/6
200 Milliamp.	D.C. M/C	2½in.	Flush Circular	10/6
3 Amp.	Thermocouple	2in.	Projecting Circular	6/9
1 Amp.	Thermocouple	2in.	Projecting Circular	6/9
300 Volts	A.C. M/I	6in.	Flush Circular. Made 1955	79/6
300 Volts	A.C. M/I	2½in.	Flush Circular	25/-
500 Volts	A.C. M/I	2½in.	Flush Circular	25/-
40 Amperes	D.C. M/C	2in.	Flush Circular	7/6

METAL RECTIFIERS. Full wave bridge. BRAND NEW. Salford 1 mA. 8/6, 5 mA. 8/6. STC 2 mA. 5/6.

SIGNAL GENERATOR TF390G. These are complete with A.C. mains power pack and incorporate a 2½in. 50 micro-amp. meter for carrier level mounting. There are 4 ranges, 1.6–2.4 Mc/s., 8–16 Mc/s., 16–32 Mc/s., and 32–60 Mc/s. They are less their original calibration charts so guidance readings only are provided. In first class mechanical and working condition. £4/19/6. Carriage 10/6.

CHARLES BRITAIN (Radio) LTD.

11 UPPER SAINT MARTIN'S LANE
LONDON, W.C.2 *TEMple Bar 0545*

One minute from Leicester Sq. Station. (Up Cranbourne St.)
Shop Hours: 9-6 p.m. (9–1 p.m. Thursday.) Open all day Saturday

G.E.C. SELECTEST DIII

This testmeter has exactly the same ranges as the Avo "D." The scale is even larger. Those we offer are in first class condition, completely overhauled and carefully tested prior to despatch. Complete with battery, test leads and instructions. **£7/10/-.** P. & P. 3/6.

ELECTROSTATIC METER. Dia. 6½in. reads 5–18.5 Kv. Manufactured 1953. Contained in wooden case 10 × 10 × 9in. high. **£9/19/6.** Post paid.

SANGAMO-WESTON ANALYSER E772. A useful multi-range meter. Thoroughly overhauled and in perfect working order. For full details see previous adverts. **£7/10/-.** Carr. 4/6.

MARCONI TF987/1 NOISE GENERATORS. Range 100 Kc/s. to 200 Mc/s. Determines noise factor of AM and FM receivers. Fully stabilised H.T. supply A.C. mains operation. Brand new and in original boxes. £15. Carr. 7/6.
MARCONI TF.340 OUTPUT METERS. Perfect working order, **£9/19/6.** Carr. 7/6.

HEAVY DUTY SLIDER RESISTORS. 1.25Ω 20 A., 12/6, post 3/6. 1Ω 12 A., 8/6. **ZENITH ADJUSTABLE** 25 Ω 4 A., 8/6. Post 2/6.
PRECISION RESISTORS. 1 Megohm. 1% 1 watt wire wound, Ex-U.S.A. BRAND NEW. **10/6** per dozen.

D.C./A.C. CONVERTERS. Input 12 v. D.C. Output 230 v. 50 c/s. A.C. at 135 watts. Fitted with 0–300 v. A.C. 2½in. meter and slider resistor for voltage adjustment. In stout wooden carrying case with lid. Perfect working order. **£9/19/6.** Carr. 10/6.
24 v. Input 230 v. A.C. 50 c/s. 100 watts output. In grey metal case. BRAND NEW. **92/6.** Carr. 7/6.

RADIATION METERS. Portable dose-rate meter, containing modern type rectangular 50 micro-amp. meter, CVX494 electrometer valve, etc. BRAND NEW. In canvas carrying case, £3/19/6. Post 2/6.
For details of other equipment, see our previous adverts.

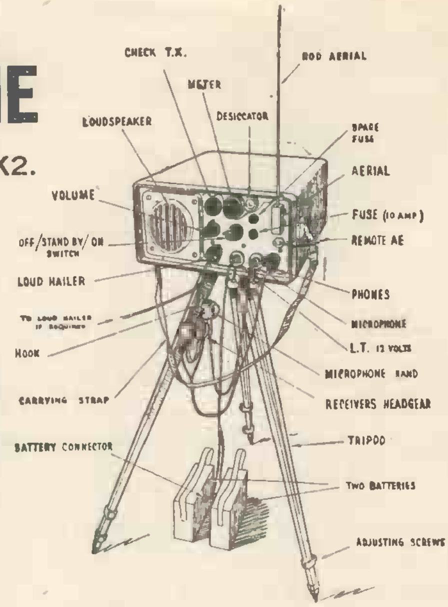
MOVING COIL PHONES. Finest quality Canadian with chamois ear-muffs and leather-covered headband. With lead and jack plug. Noise excluding and supremely comfortable. **19/6.** Post 1/6.
MATCHING TRANSFORMER (for Hi impedance) i.e. for HRO, CR100, etc., with standard jack plug, **4/6.**
MIKE/HEADSET, all moving coil. As used on 19 set. BRAND NEW. **12/6.** Post 2/-.

FERRANTI VOLTMETERS N5.
0–300 volts, 25–100 c/s. Moving iron, 6in. scale. Fl. mtg. Hermetically sealed, grade IN. Made 1955. BRAND NEW. Boxed. **79/6.** Post 3/6.

Portable/Mobile

V.H.F RADIO TELEPHONE

TYPE W.S B44 MK2.



EXPORT ONLY

CRYSTAL CONTROLLED 60-95mc/s.

A modern 14-valve superhet receiver and AM transmitter using current series of B7g valves. Valve line-up: 2–CV136/7D9, 1–CV137/EAC91, 7–CV138/EF91, 4–CV416/6F17. Robust cast aluminium case includes 5in. loudspeaker. Internal vibrator pack (synchronous type) provides operation from 12-volt accumulators or vehicle or boat 12-volt supply, in fixed or mobile use. Available, less crystals and accessories, but with connecting plugs, ex-stock. Accessories and crystals for specified frequencies in the range 60–95 Mc/s can be supplied to order at extra cost.

Each unit is fully tested and in good condition. Price (including packing FOB London), £20 each. Special quotation for quantities up to 500 sets.

50 MICRO AMP MOVING COIL METERS

(Brand New & Boxed)

Made on Government Contract by Famous British Maker

3½in. Square—800 ohms resistance. 4 Scales operated by lever " Set-zero "—" 0–3 "—" 0–30 "—" 0–300." Easily coupled to rotary range switch by cord or lever. Ideally suitable for transistor tester, output meter, volt-milliameter.

A RANGE OF METER BOXES

Completely finished and enamelled, with all screws, sockets, etc., designed to take one or two meters and with provision for controls, caters for all kinds of applications of this meter.

Boxes to take one Meter, small 5/6, medium 7/6, large 10/6. Two Meters, small 9/6, large 15/6.

Circuits for many applications—free.

Complete with data and circuits

ONE METER **19'6** (*plus post 6d in U.K.*)

TWO METERS **35'-** (*plus post 1/- in U.K.*)

TEST GEAR COMPONENTS (LONDON) LTD

15 ARCANY ROAD, SOUTH OCKENDON, ESSEX *TEL: SOUTH OCKENDON 2610*

Each Model incorporates the highly successful HF/TR3 Amplifier (described opposite), thus ensuring truly "Hi-Fi" record and playback facilities.

All prices quoted provide for the COMPLETE RECORDER including CRYSTAL MICROPHONE and 1-200ft. Spool of Tape.

There are no "better value for money" Tape Recorders on the market—if you can't call and hear them send S.A.E. for fully descriptive leaflets.

Stern's "fidelity" TAPE RECORDERS

BEFORE YOU BUY—YOU SHOULD HEAR THESE RECORDERS—THEY ARE COMPARABLE TO THE MUCH HIGHER PRICED MODELS

MODEL CR3/S. Incorporates the new COLLARO "STUDIO" TWIN TRACK 3-speed Deck **£41.0.0**
H.P. Terms: Deposit £8/4/- and 12 months of £3/0/2.

MODEL CR3/T. Incorporates the very popular 3-speed COLLARO Mk. IV "TRANSCRIPTOR" Deck, which has both upper and lower tape tracks **£49.10.0**
H.P. Terms: Deposit £9/18/- and 12 months of £3/12/7.

MODEL TR3/Mk. VI. Incorporates the New TRUVOX Mk. VI TWIN TRACK 2-speed Tape Deck **£49.10.0**
H.P. Terms: Deposit £9/18/- and 12 months of £3/12/7.

Model HF/GR2

and NOW — WE INTRODUCE

TWO UNITS METICULOUSLY MATCHED TO CORRECTLY OPERATE

THE NEW GARRARD "MAGAZINE" TAPE DECK

- **MODEL HF/G2P TAPE PREAMPLIFIER**
- **MODEL HF/G2A TAPE AMPLIFIER**

Based on the very successful MULLARD tape DESIGNS, incorporating only HIGH GRADE COMPONENTS and MULLARD VALVES.

Both Units form an entirely new "Easy to handle" presentation, each is completely self contained with power supply, Loudspeaker (Amplifier HF/G2A only) and all INPUT and OUTPUT sockets being incorporated on the chassis, which itself is constructed to allow for direct attachment to the tape deck (as shown in illustration). Thus the tape deck with the Amplifier (or Preamplifier) fixed to it form ONE COMPLETELY SELF-CONTAINED WORKING UNIT which requires only screwing into a Cabinet and Connecting to the Mains supply.

Model HF/G2A Amplifier

A Complete Tape Amplifier—Incorporating . . .

- Magic Eye Level Indicator
- Volume Control.
- Superimpose Switch.
- Effective Tone Control.
- Monitoring Facilities.
- Extension Loudspeaker Socket.
- Inputs for recording from Mike, Gram. and Radio Tuner.
- Incorporates Loudspeaker and Power Supply on Chassis.

Model HF/G2P Preamplifier

Forms the Ideal "Link" to add High Quality Tape Recording facilities to existing Audio Installations, such as our MULLARD RANGE of Amplifiers and also admirably suitable to operate through the Pick-up Sockets of most Radio Receivers.

It incorporates:

- Magic Eye Level Indicator and Control.
- Superimpose Switch.
- Inputs for recording from Mike, Gram. and Radio.

BOTH UNITS CARRY MESSRS. GARRARD'S FULL RECOMMENDATION.

As is usual with GARRARD products this Tape Deck is a Precision Engineered Unit of Excellent quality operating two tracks at 3¾in./sec. speed. It is the "Easiest to Handle" Tape Deck, having only two controls and incorporates the new instantaneous Tape loading Magazine which makes tape loading as simple as putting on a Record.

Model HF/G2A-D

WE OFFER AS FOLLOWS:

(a) MODEL HF/G2R PORTABLE TAPE RECORDER. Includes spool of L.P. tape and crystal microphone. H.P. TERMS: Deposit £6/12/-, 12 monthly payments £2/8/5. **£33.0.0**

(b) MODEL HF/G2A/D, comprising AMPLIFIER and TAPE DECK. Includes spool of L.P. tape and loudspeaker. H.P. TERMS: Deposit £5/10/-, 12 monthly payments £2/0/4. **£27.10.0**

(c) ASSEMBLED and TESTED AMPLIFIER MODEL HF/G2A. H.P. TERMS: Deposit £3, 12 monthly payments £1/2/-. **£15.0.0**

(d) MODEL HF/G2PP PORTABLE PREAMPLIFIER. Complete in portable case (like HF/G2R). H.P. TERMS: Deposit £6. 12 monthly payments £2/14/-. **£30.0.0**

(e) MODEL HF/G2P-D comprising PREAMPLIFIER and TAPE DECK. Includes spool of L.P. tape. H.P. TERMS: Deposit £5/4/-, 12 monthly payments £1/18/2. **£26.0.0**

(f) ASSEMBLED & TESTED PREAMPLIFIER MODEL HF/G2P. H.P. TERMS: Deposit £2/16/-, 12 monthly payments £1/0/6. **£14.0.0**

! ! RADIOGRAM CHASSIS ! !

ARMSTRONG MODEL A F 208 .... **£23.2.0**
Complete AM/FM chassis. Separate Bass and Treble controls.

ARMSTRONG "STEREO" TWELVE **£37.16.0**
The most complete AM/FM stereo chassis yet produced.

ARMSTRONG "JUBILEE" **£29.8.0**
An AM/FM chassis with nine valves and with push-pull output stage providing 6 watts.

ARMSTRONG AM/FM "STEREO 44" **£28.7.0**
Provision is made for Stereo and Monaural playback from pick-up or

RADIO TUNING UNITS

The JASON "MERCURY" Mk. II Switched FM Tuner
Choice of 4 stations plus I.T.V. and B.B.C. T.V. sound transmissions.
PRICES: KIT OF PARTS £10/10/-. ASSEMBLED **£14.10.0**

DULCI MODEL FMT/2 .... **£24.13.4**
A complete self-powered FM Tuner incorporating auto. freq. control.

ARMSTRONG "S.T.3." AM/FM Tuning Units **£27.6.0**
A self-powered tuner covering VHF, medium and long wavebands with automatic frequency control on VHF.

DULCI "H4/T" AM/FM Tuning Units **£25.15.2**
A 4-waveband self-powered tuner covering the FM transmission plus the long, medium and short wavebands.

NEW HIRE PURCHASE TERMS are available on all above. Illustrated leaflets available—send S.A.E. (Carr. and Ins. 5/- extra).

THE "ADD-A-DECK"

incorporating the

NEW B.S.R. "MONARDECK"

and MATCHED PREAMPLIFIER

£17.17.0 Deposit £3/12/-. 12 months £1/6/2 (plus 7/6 carr. and ins.)

Designed to operate through the Pick-up Sockets of the standard RADIO RECEIVER through which first-class results are obtained. It consists of a single speed Twin Track Tape Deck, incorporating matched Preamplifier, and operates at 3¾in./sec. speed. It uses 5in. Tape Spools, thus providing up to 1½ hours' playing time on L.P. Tapes or 1 hour on the standard 6in. Tape Spools.

The equipment is supplied fully tested and completely assembled on an attractive wood plinth. It can therefore be "dropped" directly into an existing cabinet and only requires connections to the mains supply and the Pick-up Sockets, for which purposes "floating" leads are incorporated on the Preamplifier.

STERN'S MK. II "fidelity" F.M. TUNING UNIT

(Plus 5/- carr. and ins.) **£14.5.0**

HIRE PURCHASE: Deposit PRICE £2/17/- and 12 months at £1/0/11. Incorporates the latest MULLARD PERMEABILITY TUNING HEART and the corresponding MULLARD VALVE LINE UP comprising ECC85, 2 type EF85s (or EF89s), EM84, Tuning Indicator, plus 2 type O.A. 79s Germanium Diodes. A really first-class Tuner very attractively presented and comparable to many offered at much higher prices. Power consumption is only 1.5 amps at 6.3 volts and 25 m.a. at 250 volts.

! HOME CONSTRUCTORS

YOU CAN BUILD THIS TUNING UNIT FOR ONLY .... **£10.10.0** (Plus 5/- carr. and ins.)

Send S.A.E. for descriptive leaflet, or Assembly Manual for 1/6.

STERN'S 12 VOLT CAR RADIO *incorporating* . . .

PRINTED CIRCUIT and POWER TRANSISTOR

A versatile design covering both LONG and MEDIUM WAVEBANDS, incorporating Transistor Output thus having very low battery consumption. Is operated direct off 12 volt car battery. We offer it on the UNIT ASSEMBLY BASIS . . . consisting of THREE SEPARATE, FULLY WIRED, ALIGNED AND TESTED UNITS ALL FOR Only 12 solder joints are required to finish the complete receiver. **£15.0.0**
Send 1/6 for manual containing complete data.

STERN RADIO LTD. DEPT. W. 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

Stern's "fidelity" TAPE EQUIPMENT

A SELECTION OF HIGH FIDELITY PORTABLE TAPE PRE-AMPLIFIERS

Adds "Hi-Fi" Tape Recording to your existing Audio Installation.

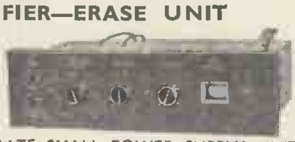
IN ALL MODELS WE INCORPORATE THE TYPE "C" PRE-AMPLIFIER

and offer it complete in portable case with . . .

(a) The new "COLLARO" STUDIO 3 speed Deck. Deposit: £7/6/-. 12 months £2/13/6 .... **£36.10.0**
(b) The COLLARO Mk. IV "Transcriptor" 3 Speed Deck. Deposit: £8/6/-. 12 months £3/0/11 .... **£41.10.0**
(c) The new TRUVOX Mk. VI Tape Deck. Deposit: £8/14/-. 12 months £3/3/10 .... **£43.10.0**
(d) The BRENELL Mk. V 3 Speed Deck. Deposit: £10/6/-. 12 months £3/15/7 .... **£51.10.0**
(e) The WEARITE MODEL 4A Tape Deck. Deposit: £12/4/-. 12 months £4/9/5 .... **£61.0.0**

STERN'S MULLARD TYPE "C" TAPE PRE-AMPLIFIER—ERASE UNIT

INCORPORATING THE NEW FERROXCUBE POT CORE PUSH-PULL OSCILLATOR and 3 SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR.



PRICES . . . INCLUDING SEPARATE SMALL POWER SUPPLY UNIT
COMPLETE KIT OF PARTS **£14.0.0** ASSEMBLED AND TESTED **£17.0.0**
Deposit £3/8/- and 12 months of £1/4/11. Assembled unit only.
ALSO AVAILABLE EXCLUDING POWER SUPPLY UNIT FOR
£11.15.0 and **£14.10.0** respectively. (Carr. and Ins. 5/- extra)
Send S.A.E. for leaflet or 2/6 for Complete Assembly Manual.
WHEN ORDERING PLEASE STATE MAKE OF TAPE DECK TO BE USED
We present this "Hi-Fi" Pre-amplifier strictly to Mullard's specification etc., incorporating ONLY NEW HIGH GRADE COMPONENTS and the SPECIFIED NEW MULLARD VALVES. It comprises a COMPLETELY SELF-CONTAINED UNIT, all components and valves being contained in a well ventilated Box—Chassis neatly finished in Hammered gold with a very attractively engraved PERSPEX FRONT PANEL.

FOR PERMANENT HIGH FIDELITY INSTALLATIONS WE ALSO OFFER (excluding Case) the following

(a) The COLLARO "STUDIO" TAPE DECK and our Mullard Type "C" PE-AMPLIFIER and Power Unit Assembled and Tested **£32.10.0**
H.P. Terms: Deposit £6/10/- and 12 months at £2/7/8
(b) As above but TYPE "C" PRE-AMPLIFIER supplied as complete Kit of Parts **£29.0.0**
(c) The COLLARO Mk. IV TAPE DECK and the MULLARD Type "C" Pre-amplifier and Power Unit assembled, tested **£35.0.0**
H.P. Deposit £7 and 12 months £2/11/4.
(d) As in (a) above but the Type "C" supplied as COMPLETE KIT OF PARTS **£32.0.0**
(e) The TRUVOX Mk. VI TAPE DECK and the assembled Type "C" Pre-amplifier and Power Unit **£40.0.0**
H.P. Deposit £8 and 12 months £2/18/8.
(f) As above but the Type "C" supplied as complete KIT OF PARTS **£36.10.0**
(g) The BRENELL Mk. V Deck and the assembled Type "C" PRE-AMPLIFIER and POWER UNIT **£46.0.0**
(h) As above, but the Type "C" supplied as complete KIT OF PARTS **£43.0.0**
(i) The WEARITE 4A DECK with Type "C" assembled and tested **£56.0.0**
H.P. Deposit £11/4/- and 12 months £4/2/1.
(Carriage and Insurance on above quotes 10/- extra)

STERN RADIO LTD.

DEPT. W 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

THE FINEST RANGE OF TAPE EQUIPMENT FOR THE HOME CONSTRUCTOR

YOU CAN BUILD A COMPLETE HIGH QUALITY TAPE RECORDER for £36.0.0

H.P. TERMS . . . Deposit £7/4/-, 12 months £2/12/10
FOR THIS WE SUPPLY:—
COMPLETE KIT OF PARTS TO BUILD THE HF/TR3 TAPE AMPLIFIER.
THE NEW COLLARO "STUDIO" TAPE DECK.
PORTABLE CARRYING CASE (as illustrated).
ROLA/CELESTION 10in. x 6in. P.M. LOUDSPEAKER.
ACOS CRYSTAL MICROPHONE 1200ft. SPOOL E.M.I. TAPE.

Alternatively for those who prefer another type of TAPE DECK we will supply precisely as above—but IN PLACE of the COLLARO "STUDIO" DECK—WE INCLUDE:—
(a) The Mk. IV COLLARO "TRANSCRIPTOR" DECK . . . H.P. TERMS . . . Deposit £8, 12 monthly payments of £2/18/2 (£1 extra if we are required to wire up the Transcriptor Switch Banks). **£39.15.0**
(b) The new TRUVOX Mk. VI DECK **£45.0.0**
H.P. TERMS: Deposit £9, 12 months of £3/6/- (Carr. and Ins. on all above is 12/6 extra).

For constructors with their own Cabinet—WE OFFER:—
(a) COMPLETE KIT to build the HF/TR3 Amplifier, together with the COLLARO "STUDIO" DECK...... **£28.0.0**
(b) As above but HF/TR3 ASSEMBLED and TESTED........ **£31.10.0**
H.P. TERMS: Deposit £6/6/-, 12 months of £2/6/2.
(c) COMPLETE KIT to build the HF/TR3 together with the Mk. IV COLLARO "TRANSCRIPTOR" DECK (£1 extra if we are required to wire up Deck Banks) **£30.15.0**
(d) As above but HF/TR3 ASSEMBLED and TESTED........ **£34.10.0**
H.P. Terms: Deposit £7, 12 months at £2/10/5.
(£1 extra if we are tl wire up Deck Switch Banks)
(e) COMPLETE KIT to build the HF/TR3 together with the NEW TRUVOX Mk. VI TAPE DECK........ **£36.0.0**
(f) As above but HF/TR3 ASSEMBLED and TESTED........ **£39.10.0**
H.P. Terms: Deposit £7/18/-, 12 months of £2/17/11.
(g) COMPLETE KIT to build the HF/TR3 AMPLIFIER with the BRENELL Mk. V TAPE DECK........ **£41.10.0**
(h) As above but HF/TR3 ASSEMBLED and TESTED........ **£45.0.0**
H.P. Terms: Deposit £9, 12 months of £3/6/-.
(i) THE ASSEMBLED and TESTED HF/TR3 AMPLIFIER with the WEARITE MODEL 4A DECK, incorporates Wearite Head Lift Transformer, etc........ **£55.0.0**
H.P. TERMS: Deposit £11, 12 months of £4/0/8.
(Carriage and Insurance on each above is 10/- extra).

Attractive PORTABLE CASE is available to accommodate the TRUVOX or COLLARO TAPE DECKS and we offer it together with ROLA/CELESTION 10×6in. LOUDSPEAKER—ACOS CRYSTAL MICROPHONE—and 1200ft. SPOOL E.M.I. TAPE—ALL FOR **£9.0.0**
(Carriage and Insurance 5/- extra).

WE HAVE THE NEW 2-SPEED TWIN TRACK TRUVOX Mk. VI Tape Deck in stock £26.5.0 Deposit £5/5/- 12 months £1/18/6
It incorporates PRECISION REV. COUNTER and PAUSE CONTROL and fully maintains the general high standard of all Truvox equipment. The very popular COLLARO Tape Decks and the BRENELL Mk. V Decks are also available.

THE MODEL HF/TR3 TAPE AMPLIFIER

Incorporating *3-SPEED TREBLE EQUALISATION by means of the latest FERROXCUBE POT CORE INDUCTOR*

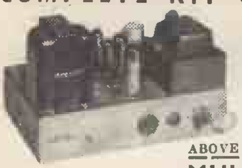
PRICE for COMPLETE KIT OF PARTS **£12/15/-**
FULLY ASSEMBLED AND TTESTED **£16/10/-**
HIRE PURCHASE: Deposit £3/6/6 and 12 months at £1/4/2. A very high quality amplifier based on the very successful Type "A" design completed in the MULLARD LABORATORIES. ONLY NEW HIGH-GRADE COMPONENTS are incorporated including MULLARD VALVES and a GILSON OUTPUT TRANSFORMER . . . other features are: Magic Eye Recording Head Indicator—Effective Tone Control—Monitoring and Extension Speaker Sockets—has own Power Supply and can be used as independent Amplifier for direct reproduction of Gram. Records or from Radio Tuner. Overall size 11 x 6 x 6in.—Truvox—Collaro—or Brenell—please specify which. Send S.A.E. for leaflet or 2/6 for Assembly Manual.

PLEASE ENCLOSE S.A.E. WITH ALL CORRESPONDENCE

STERN'S MULLARD DESIGNS

COMPLETE KIT OF PARTS

Designed by MULLARD—presented by STERNS strictly to specification



MULLARD "5-10" MAIN AMPLIFIER

For use with the MULLARD 2-stage pre-amplifier with which an undistorted power output of up to 10 watts is obtained. We supply SPECIFIED COMPONENTS AND NEW MULLARD VALVES including PARMEKO MAINS TRANSFORMER and choice of the latest Ultra-linear PARMEKO or the PARTRIDGE Output Transformer.
Price: COMPLETE KIT (Parmeko O/put Trans.)...... **£10.0.0**

Alternatively we supply ASSEMBLED AND TESTED **£11.10.0**

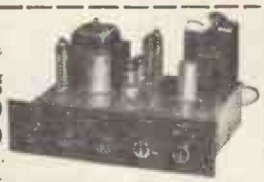
ABOVE INCORPORATING PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

MULLARD'S PRE-AMPLIFIER TONE CONTROL UNIT

Employing two EF86 valves and designed to operate with the Mullard MAIN AMPLIFIER, but also perfectly suitable for other makes.
Supplied strictly to MULLARD SPECIFICATION and incorporating:
- Equalisation for the latest R.I.A.A. characteristics.
- Input for Crystal Pick-ups and variable reluctance magnetic types.
- Input (a) Direct from High Imp. Tape Head. (b) From a Tape Amplifier or Pre-Amplifier.
- Sensitive Microphone Channel
- Wide range BASS and TREBLE Controls.

Price: COMPLETE KIT OF PARTS **£6.6.0** Alternatively we supply ASSEMBLED AND TESTED **£8.0.0**

COMPLETE MULLARD 5-10 AMPLIFIER



The popular and very successful complete "5-10" incorporating Control Unit providing up to 10 watts high quality reproduction.
Specified components and new MULLARD VALVES are supplied including PARMEKO MAINS TRANSFORMERS and choice of the latest PARMEKO or PARTRIDGE ULTRA Linear Output Transformers.
Price: COMPLETE KIT. Parmeko Transformer **£11.10.0**

Alternatively we supply ASSEMBLED AND TESTED.. **£13.10.0**
Hire Purchase (Assembled Amp. only). Deposit £2/14/-, 12 months at 19/10.
ABOVE incorporating PARTRIDGE OUTPUT TRANSFORMER £1/6/- extra.

COMPLETE MULLARD 3-3

A VERY HIGH QUALITY AMPLIFIER DEVELOPED FROM THE VERY POPULAR 3-VALVE 3-WATT AMPLIFIER DESIGNED IN THE MULLARD LABORATORIES.

Price for COMPLETE KIT OF PARTS **£7.10.0**
(Plus 6/6 carriage and insurance).
Alternatively supplied ASSEMBLED AND FULLY TESTED (Plus 6/6 carriage and insurance) **£8.19.6**

H.P. TERMS: Deposit £2 and 8 monthly payments of £1.

Our kit is complete to the MULLARD specification including supply of specified components, valves and PARMEKO OUTPUT TRANSFORMER. We also include switched inputs for 78 and L.P. records plus a Radio position. Extra power to drive a Radio Tuning Unit is also available.

COMPLETE STEREO AMPLIFIER

A thoroughly recommended design that very effectively meets the many requests for a low priced but good quality DUAL CHANNEL STEREOPHONIC AMPLIFIER.
Price: COMPLETE KIT OF PARTS **£8.10.0**

Alternatively ASSEMBLED AND TESTED.. **£10.10.0**

Two Mullard ECL82 Triode Pentode Valves are incorporated in the design, they form a "CLASS A" single ended output stage in each channel. The input sensitivity is 300 m/volts, therefore when used with most STEREO Crystal Pick-ups, or Radio Tuning Units, an output of 2 watts per channel is achieved, or similarly when switched to MONAURAL Pick-up position a combined output of 4 watts is produced.

SPECIAL CASH ONLY OFFER ! !

This very attractive PORTABLE AMPLIFIER CASE together with a good quality GRAM AMPLIFIER and a matched P.M. SPEAKER. ALL FOR ONLY (plus 7/6 carr. and ins.). **£8.7.6** The Amplifier consists of a 2-stage design incorporating the 3 modern BVA valves and has separate BASS and TREBLE CONTROLS. The Portable Case will also accommodate almost any make of Autochanger and is attractively finished in Grey Colour Rexine—WE ALSO SUPPLY SEPARATELY:—

(a) The 2-stage (plus Rectifier) AMPLIFIER £4 2 6
(b) The PORTABLE CARRYING CASE £3 17 6
(c) 6½in. P.M. SPEAKER........ 18 9 (Carriage and Insurance 4/- extra).

"Hi-Fi" LOUDSPEAKERS

WE HAVE IN STOCK A COMPLETE RANGE BY
GOODMANS WHARFEDALE
W. B. STENTORIAN
ILLUSTRATED AND PRICED LEAFLETS ON REQUEST

! ! HOME CONSTRUCTORS ! !

A RANGE OF "EASY TO ASSEMBLE" PREFABRICATED CABINETS
Designed by the W.B. "STENTORIAN" COMPANY for "Hi-Fi" Loudspeaker systems or to accommodate high quality equipment. The acoustically designed Bass Reflex Cabinets containing the very successful "Stentorian" Speakers give really first-class reproduction and are well recommended. Models are also available to accommodate high-quality Amplifiers, Pre-amplifiers, Tuning Units, Record Players, etc. All models are very easily assembled, in fact only a screwdriver is required.
Fully illustrated leaflets are available including complete specifications of the various STENTORIAN LOUDSPEAKERS. Please enclose S.A.E.

Please enclose S.A.E. if ILLUSTRATED and DESCRIPTIVE LEAFLETS are required . . . alternatively the COMPLETE ASSEMBLY MANUALS containing component Price List and practical Drawings, etc., are available at 1/6 each.

SPECIAL PRICE REDUCTIONS

(c) The COMPLETE KIT OF PARTS to build both the "5-10" Main Amplifier and the 2-Stage Pre-Amplifier Control Unit...........	£15.15.0
(d) The "5-10" and the 2-Stage Pre-Amplifier both Assembled and Tested	£18.18.0
H.P. TERMS: Deposit £3/16/- and 12 months of £1/7/8.	
(e) The COMPLETE KIT OF PARTS to build the Dual Channel "3-3" Amplifier and the Dual Channel Pre-Amplifier Control Unit	£21.10.0
(f) The Dual Channel "3-3" Amplifier and the Dual Channel Pre-Amplifier Control Unit both Assembled and Tested	£25.0.0
H.P. TERMS: Deposit £5 and 12 months of £1/16/8.	
(g) The COMPLETE KIT OF PARTS to build one "5-10" Main Amplifier (Parmeko Transformer) and the Dual Channel Pre-Amplifier Control Unit	£21.10.0
(h) One "5-10" Amplifier (Parmeko Transformer) and the Dual Channel Pre-Amplifier both Assembled and Tested	£25.0.0
H.P. TERMS: Deposit £5 and 12 months of £1/16/8.	
(i) COMPLETE KIT OF PARTS to build Two "5-10" Main Amplifiers (incorporating Parmeko Output Transformers) and the Dual Channel Pre-Amplifier Control Unit	£31.0.0
(j) Two "5-10" Amplifiers (Parmeko Output Transformers) and the Dual Channel Pre-Amplifier Control Unit both Assembled and Tested	£36.0.0
H.P. TERMS: Deposit £7/4/- and 12 months of £2/12/-. Carriage and insurance 7/6 extra..	

Prices quoted are subject to £1/6/- extra for Partridge Trans.

STEREO 3-3 MAIN AMPLIFIER

Comprises two "3-3" MAIN AMPLIFIERS on one chassis and is designed to operate with our DUAL CHANNEL PRE-AMPLIFIER for both STEREOPHONIC or MONAURAL operation.
Price: COMPLETE KIT OF PARTS **£10.0.0**
Alternatively ASSEMBLED AND TESTED **£11.15.0**
H.P. Terms: Deposit £2/7/-, 12 months at 17/4.
Its output power is 6 watts (3 watts per channel) and together with our PRE-AMPLIFIER provides a first-class STEREO installation.

STEREO DUAL CHANNEL PRE-AMPLIFIER

This model incorporates two 2-valve Pre-Amplifiers (described above) combined into a Single Unit enabling it to be used for both STEREOPHONIC and MONAURAL operation. It is designed primarily to operate with our range of MULLARD MAIN AMPLIFIERS but will also operate equally well with any make of Amplifiers requiring an input of 250 m/v.

Price: COMPLETE KIT OF PARTS .. **£12.10.0** Alternatively ASSEMBLED and TESTED **£15.0.0**
H.P. Terms: £3 Deposit and 12 months of £1/2/-.
Perfectly suitable for MONAURAL only operation, with one "3-3" or one "5-10" MAIN Amplifier to which the second Main Amplifier can at any time be added thus very easily providing for both STEREO or MONAURAL reproduction.
Recommended combination for STEREO operation.
(a) The DUAL CHANNEL PRE-AMPLIFIER together with the Dual "3-3" MAIN AMPLIFIER.
(b) The DUAL CHANNEL PRE-AMPLIFIER together with two "5-10" MAIN AMPLIFIERS. Assembly Manual is available for 3/- or send S.A.E. for Descriptive Leaflet. When ordering please advise MAKE and MODEL OF AMPLIFIER in use.

! ! RECORD PLAYERS ! !

The LATEST MODELS are in Stock. Many at REDUCED PRICES!!!
Send S.A.E. for ILLUSTRATED LEAFLET

B.S.R. MONARCH UA8 4-spd. Mixer Autochanger with Crystal Pick-up	£6.19.6
The COLLARO "CONQUEST" 4-spd. Autochanger, Studio "O" Pick-up.	£7.10.0
The latest COLLARO "CONTINENTAL" 4-speed MIXER Autochanger. Studio "C" Pick-up	£8.10.0
The NEW COLLARO model RP594, 4-speed Single Record Player, Studio Cartridge	£9.18.9
The COLLARO 4-speed Single Record Player, incorporating the Studio "O" Pick-up	£6. 9.6
THE NEW B.S.R. model UA12 is in stock. A 4-"SPEED" MIXER AUTOCHANGER	£8. 7.6
UA12 is also available incorporating the B.S.R. STEREO Pick-up, plays L.P. and 78 records	£10.10.0
GARRARD RC210 4-speed Autochanger fitted with latest Crystal Pick-up	£10.10.0
The latest GARRARD TRANSCRIPTION MOTOR "301" with Stroboscopically marked turntable	£23.18.4
The new GARRARD Model 4HF High Quality Single Record Player fitted with the latest T.P.A. 12 Pick-up arm and G.C.S. Crystal Cartridge	£18. 7.6
GARRARD Model TA/Mk. II Single Record Player fitted with high output Crystal Pick-up, detachable head	£8.10.0

HIRE PURCHASE TERMS available on all units £8/19/6 and over
Carriage and insurance on each above 5/- extra.

STERN RADIO LTD. DEPT. W. 109 FLEET ST., LONDON, E.C.4
Telephone: FLEET STREET 5812/3/4

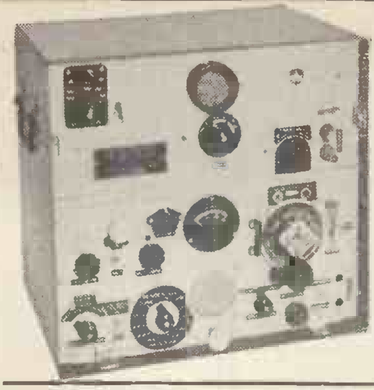
R1155 RECEIVERS

The famous Bomber Command Receiver known the world over to be supreme in its class. Covers 5 wave ranges: 18.5-7.5 Mc/s., 7.5-3.0 Mc/s., 1,500-600 kc/s., 500-200 kc/s., 200-75 kc/s., and is easily and simply adapted for normal mains use, full details being supplied. All sets thoroughly tested and in perfect working order before despatch, and on demonstration to callers. Fitted with latest type Super Slow Motion tuning assembly. Have had some use, but are in excellent condition. ONLY £9/19/6.

A.C. MAINS POWER PACK OUTPUT STAGE in black, metal case to match receiver, enabling it to be operated immediately, by just plugging in, without any modification. Fitted with 8in. P.M. Speaker £6/10/-. DEDUCT 10/-. IF PURCHASING RECEIVER AND POWER PACK TOGETHER.

Send S.A.E. for illustrated leaflet, or 1/3 for 14-page booklet which gives technical information, circuits, etc., and is supplied free with each receiver. Add carriage 10/6 for Receiver, 5/- for Power Unit.

RCA RECEIVERS AR88D. Thoroughly re-conditioned and in perfect working order. Cover 500 kc/s.-31Mc/s. ONLY £60 (carriage etc., 25/-).

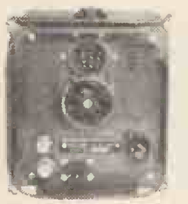


CANADIAN RECEIVER No. 52

A magnificent 10 valve Receiver covering 1.75-16.0 Mc/s. (19-170 metres) in 3 switched bands. Has built-in 3 valve Crystal Calibrator employing dual 100/1,000 kc/s. Crystal to provide marker check points at 10-100-1,000 kc/s. Other refinements include Valve-check Voltmeter, Internal 3in. Speaker, R.F. and A.F. Gain Controls, Noise Limiter, B.F.O. Switch, Heterodyne Pitch Control, choice of Wide or Narrow Bandwidth, Speaker or Headphones and Manual or Automatic Volume Control on both C.W. or R.T. There are Fast and Slow Tuning Controls, with additional Oscillator Control for Fine adjustment. In steel carrying case as illustrated, size 15in. × 12in. × 15in. First class condition, thoroughly checked and tested, and in perfect working order before despatch. Circuit supplied. Voltages required 12 volts L.T. and 160 volts H.T. ONLY £11/19/6 (carriage etc. 15/-).

A suitable Power Pack, for use on 110-250 volts A.C. or 12 volts D.C., can be supplied (less outer case) for 60/-, plus 5/- carriage.

CRYSTAL CALIBRATOR No. 10



A superb Crystal Controlled Wavemeter just released by the Ministry of Supply. Has directly calibrated dial for nominal coverage of 1.5-10.0 Mc/s. but may actually be used from 500 kc/s. up to 30 Mc/s. Complete with 500 kc/s. Crystal 2 valves type 1T4, 1 or 1R5 and 1 of CV286 (Neon Stabiliser), and Instruction Book. Size 7in. × 7½in. × 4in., weight 5lb. Used but in first class condition. ONLY £2/19/6. Carr. 3/6.

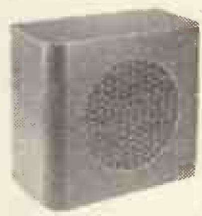
DOUBLE BEAM OSCILLOSCOPE TUBES

Type CV 1596 equivalent to Cossor 09D as used in oscilloscopes by Cossor (339 series). Hartley and Erskine (13 series). Listed at £12/10/-.

Our price £2/19/6 (carriage 5/6)

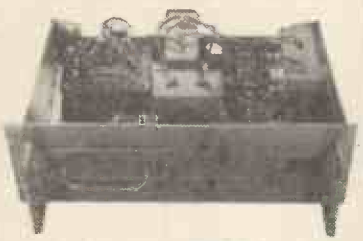
Brand New in makers' crates.

RCA 8in. P.M. SPEAKER



In heavy black crackled metal case, designed for use with AR 88 Receiver, or any set with 3 ohms Output. BRAND NEW IN MAKERS' CARTONS. ONLY 45/- (Post 3/6).

POWER UNITS TYPE 234



Primary 200/250 v. 50 cycles. Outputs of 250 v. 100 mA., and 6.3 v. 4 amps. Fitted double smoothing. For normal rack mounting (or bench use) having grey front panel size 19in. × 7in. BRAND NEW. Only 59/6.

ALSO POWER UNIT TYPE 3. Specification as above, but has two meters mounted on front panel to read H.T. Current, and Voltage. BRAND NEW. ONLY 79/6 (Carriage on either unit 7/6).

12 VOLTS AMERICAN DYNAMOTOR. Delivers 220 volts at 100 mills. Size 5½ × 3½in. diameter. Ideal for running Radio and Electric Shaver, etc., from car battery. ONLY 32/6.

MARCONI SIGNAL GENERATOR TF 144G/7. Coverage 85 kc/s.-2.5 Mc/s. and 8 Mc/s.-70 Mc/s. Complete, and in AS NEW CONDITION. ONLY £95.

W 1191A WAVEMETER

Crystal controlled heterodyne frequency meter covering 100 kc/s. to 20 Mc/s. in 8 switched bands and is virtually the British BC221. Power requirements 2 v. L.T. and 40-60 volts H.T. Complete with Calibration Book, Crystal, Operating Valves and full set of spares. BRAND NEW IN ORIGINAL TRANSIT CASES. ONLY £9/19/6 (carriage 15/-).

CANADIAN MOVING COIL PHONES. Low-resistance, fitted noise-excluding chamois ear muffs, and leather covered head-band. Lead terminates to jack plug. BRAND NEW. ONLY 19/6 (Post 1/6).

CARRYING CASES, solid leather, BRAND NEW. Internal dimensions 8¾in. H. × 8¾in. W. × 4¾in. D. Fitted lock and key, and shoulder strap. Ideal for Test Instrument, Camera and accessories, etc. ONLY 35/- (postage 2/-).

BC 342 RECEIVERS. A few only of these famous American sets covering 1.15-18.0 Mc/s. in six bands. Internal 115v. A.C. Mains pack. A super receiver in first class condition and perfect working order. ONLY £25 (carriage 15/-).

AMPLIFIER N24

Utilises 4 valves, 1 each 5Z4G, 6V6G, 6J7G, 6J5G and high quality components such as "C" Core Transformers and Block Paper Smoothing Condensers. A.C. Mains Pack for nominal 110 × 230 volts. Provision for 600 ohms or High Impedance Input. Output to 600 ohm Line. For normal use only requires changing Output Transformer. Output approximately 4 watts. Designed for Standard Rack Mounting, having grey front panel size 19in. × 7in. All connections to rear panel, front having "On/Off" Switch. Gain Control, Indicator Light. Fuses and Valves Inspection Panel. BRAND NEW IN MAKER'S PACKING. ONLY £4/9/6 (carriage 10/6).

EHT TRANSFORMERS. 7 kV. (Rect.) with 2 v. 1 a., 89/6. 2.5 kV. (Rect.), with 2-0-2 v. 1.1 a., 2-0-2 v. 2a., (for VCR 97 tube, etc.). 47/6 (postage 2/- per trans.).

SELECTEST TESTMETER D111

Manufactured by General Electric Co., and has exactly the same ranges as the Avometer D, but with a rather larger mirror scale, Size 9in. × 7in. × 5in., with carrying strap. Thoroughly overhauled and in perfect order, with batteries and instructions. A real "snip" while they last. ONLY £7/10/- (postage, etc., 3/6).

UNIVERSAL AVOMETER 34 RANGE MODEL D

Ex-Air Ministry, but thoroughly reconditioned and checked. Supplied with internal batteries and instructions. Covers ranges as follows:

D.C. VOLTS	A.C. VOLTS	D.C. Current	A.C. Current
150 mV.	7.5 v.	15 mA.	75 mA.
300 mV.	15 v.	30 mA.	150 mA.
1.5 v.	75 v.	150 mA.	750 mA.
3 v.	150 v.	300 mA.	1.5 amp.
15 v.	300 v.	1.5 amp.	7.5 amp.
30 v.	600 v.	3 amp.	15 amp.
150 v.	750 v.	15 amp.	
300 v.	1,500 v.	30 amp.	Resistance
750 v.			1,000 Ω
1,500 v.			10,000 Ω

ONLY £8/19/6 (Postage, etc., 3/6).

Cash with order please, and print name and address clearly

PLEASE ADD POSTAGE OR CARRIAGE COSTS ON *ALL* ITEMS

HARRIS ELECTRONICS (LONDON) LTD.

Radio Corner, 138 Gray's Inn Road, London, W.C.1. Phone: TERMINUS 7937

Open until 1 p.m. Saturdays. We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross.

R.S.C. HI-FI TAPE RECORDER KIT

OR DEPOSIT £5/7/6, and 12 monthly payments of 42/-. Cash price if settled in 3 months.

Build a high quality recorder in the £70 class for only **25½ GNS.** Carr. 17/6.

Can be assembled in ½ to 1 hour.

MERELY CONNECT AMPLIFIER TO DECK AND ASSEMBLE IN CABINET. INCORPORATING THE LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. THE LINEAR LT45X HIGH QUALITY FULLY ASSEMBLED TAPE AMPLIFIER. A HIGH FLUX 7×4in. LOUDSPEAKER, Reel of Best Quality TAPE, Spare Tape Spool, a Portable Cabinet, size approx. 16×13×9in., finished in two-tone rexine, and connection diagram for wiring amplifier to transcriptor.

FEATURES INCLUDE

★ 3 SPEEDS. ★ FREQUENCY RESPONSE 50-11,000 c.p.s. ★ SWITCHED NEGATIVE FEEDBACK EQUALIZATION FOR EACH SPEED. ★ OUTPUT 4 WATTS. ★ MAGIC EYE RECORDING LEVEL INDICATOR. ★ 3 MOTORS. Fast rewind. ★ TAPE MEASURING AND CALIBRATING DEVICE. ★ TAKES FULL 7in. DIAMETER REELS OF TAPE. ★ NEGLIGIBLE HUM. ★ ENTIRELY EFFECTIVE AUTOMATIC ERASURE.

Full descriptive leaflet supplied on receipt of S.A.E.

HI-FI 10 WATT AMPLIFIERS

BRAND NEW BUT IN SLIGHTLY SOILED CONDITION **£5-19-9** Carr. 7/6

A REMARKABLE OPPORTUNITY

Push-pull output. Latest high efficiency Mullard valves. Dual separately controlled inputs, for mike and gram. Separate bass and treble controls. High sensitivity. Output for 15 ohm loudspeaker. Guaranteed, tested, and in perfect working order.

VALVES! Full range at really competitive prices All guaranteed!

SUPERHET RADIO FEEDER UNIT

Design of a high quality Radio Tuner Unit (specially suitable for use with any of our Amplifires). A Triode Heptode F/charger is used. Pentode I.F. and double Diode Second Detector, delayed A.V.C. is arranged so that A.V.C. distortion is avoided. The W. Ch. Sw. incorporates Gram-position. Controls are Tuning, W. Ch. and Vol. Output will load most Amplifiers requiring 500 mV. input depending on Ae location. Only 250 v. 15 mA. H.T. and L.T. of 6.3 v. 1 amp. required from amplifier. Size of unit approx. 9-6-7in. high. Send S.A.E. for illustrated leaflet. Total building cost is £4/15/-. Point-to-Point wiring diagrams and instructions 2/6.

METERS

0-50 micro-ammeters, 2⅞in. scale, scaled 0-100. 39/6.

0-500 micro-amp., 3½in. scale, scaled in decibels. 59/6.

Ferranti Multimeters, D.C. and A.C., complete in carrying case, 59/6.

Meter Rectifiers 0-5 mA. 11/9.

ACOS HI-FI CRYSTAL 'MIKES'

Mic 40 hand or Desk type

25/9 (Listed 45/-)

39-1 Stick type

39/6 (Listed 5 Gns.)

Limited number.

R.S.C. BATTERY TO MAINS CONVERSION UNITS

Type BM1. An all-dry battery eliminator. Size 5½×4½×2in. approx. Completely replaces batteries supply 1.4 v. and 90 v. where A.C. mains 200-250 v. 50 c/s. is available. Suitable for all battery portable receivers requiring 1.4 v. and 90 v. This includes latest low consumption types. Complete kit with diagram 39/9 or ready for use 46/9.

Type BM2. Size 8×5½×2½in. Supplies 120 v. 90 v. and 60 v., 40 mA. and 2 v. 0.4 v. to 1 amp., fully smoothed. THEREBY COMPLETELY REPLACING BOTH H.T. BATTERIES AND H.T. 2 v. ACCUMULATORS when connected to A.C. mains supply 200-250 v. 50 c/s. SUITABLE FOR ALL BATTERY RECEIVERS normally using 2 v. accumulator.

Complete kit with diagrams and instructions. 49/9 or ready for use 59/6.

BUILD A PORTABLE BATTERY OPERATED RECORD PLAYER FOR ONLY £6/19/6. Portable Cabinet, Garrard 45 r.p.m. motor and pick-up unit, all parts for transistor amplifier, and circuit diagrams. Parts sold separately.

PARMEKO RE-ENTRANT LOUDSPEAKERS. Horn type for factory or outdoor use. Highly efficient, will handle up to 10 watts. Matching 15 ohms or 200 ohms. Brand New. Boxed. 59/6. Carr. 5/6.
R.C.A. RE-ENTRANT LOUDSPEAKERS, 20 watts with tapped transformer giving matching for 3, 15, or 600 ohms. Only 6 Gns.

THE SKY FOUR T.R.F. RECEIVER

A design of a 3 valve 200-250 v. A.C. mains L. and M. wave T.R.F. receiver with selenium rectifier. For inclusion in cabinet illustrated or walnut veneered type. It employs valves 6K7, SP61, 6F6 and is specially designed for simplicity in wiring. Sensitivity and quality are well up to standard. Point-to-Point wiring diagram. Instructions and parts list 1/9. This receiver can be built for a maximum of £4/19/6 including cabinet. Available in brown or cream bakelite or veneered walnut.

EXTENSION SPEAKERS. Handsome walnut veneered cabinets. All standard 2-3 ohms. 6½in. 29/9; 8in. 35/9.

R.S.C. A12 STEREO AMPLIFIER KIT

4 GNS. Carr. and packing 7/6.

A complete kit of parts to construct a good quality 3 + 3 watt (total 6 watt) stereo amplifier providing really life-like reproduction. Suitable for use with all stereo pick-up heads at present available. Ganged volume and tone controls. Preset balance control. Outputs for matching 2-3 ohm speakers. For 200-250 v. A.C. mains. Astonishing value.

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS

HF1012, 10 watts, 15 ohms (or 3 ohm) speech coil. Where a really good quality speaker at a low price is required, we highly recommend this unit with an amazing performance. £4/10/9. Please state whether 3 ohm or 15 ohm required.

SELENIUM RECTIFIERS

We can quote special prices for quantities of 12 to 10,000 of most types. Special types made to order.

L.T. Types	
2/6 v. ½ a. h.w.	1/9
6/12 v. 1 a. h.w.	2/9
Following F.W. (Bridge)	
6/12 v. 1 a.	3/11
6/12 v. 2 a.	6/11
6/12 v. 3 a.	9/9
6/12 v. 4 a.	12/3
6/12 v. 5 a.	14/6
6/12 v. 6 a.	15/6
6/12 v. 10 a.	25/9
6/12 v. 15 a.	35/9

H.T. Types H.W.	
120 v. 40 mA.	3/9
250 v. 50 mA.	3/11
250 v. 60 mA.	4/11
250 v. 80 mA.	6/11
250 v. 250 mA.	12/9
Contact Cooled	
50 v. 80 mA.	6/11
250 v. 75 mA.	8/11
F.W. (Bridge)	

JACK PLUGS. Standard type complete with 4ft. screened lead. 1/11 each.
JUNCTION TRANSISTORS. R.F. Type, 11/6. Audio type, 5/9. Power type Goltop V15/10P 2 watts, 17/9. OC71, 10/-. OC72 17/-. XB102 10/-. XB104 10/-. XA101, OC44, XA102 17/6, and many other types.
RECORDING HEADS. Baird Record Playback and Erase (Housed in one container), 9/6 pr.

All Battery Chargers and Kits for 200-230-250 v. 50 c/s. A.C. Mains

HEAVY DUTY CHARGER KIT

6/12 v. variable charge rate up to 6 amps. Consisting of Mains Trans., F.W. (Bridge) Selenium Rectifier, 0-7 amp. meter, multi-position switch with knob, fuses, fuse-holders, panels, plugs, and circuit. Only 59/6. Post 4/6.

TANNOY RE-ENTRANT LOUDSPEAKERS. 8 watt
7.5 ohms 22/9
Or a pair for .. 2 Gns.

ASSEMBLED CHARGERS

6 v. 1 a.	19/9
6 v. 2 a.	29/9
6/12 v. 1 a.	29/9
6/12 v. 2 a.	38/9
6/12 v. 4 a.	56/9

Above ready for use with mains and output leads. Cases well ventilated and finished in stoved blue hammer. Carr. & pkg. 3/6.

CHARGER TRANSFORMERS

200-230-250 v. 50 c/s.

0-9-15 v. 1½ a.	12/9
0-9-15 v. 2½ a.	15/9
0-9-15 v. 3 a.	16/9
0-9-15 v. 5 a.	19/9
0-9-15 v. 6 a.	23/9

BATTERY CHARGER KITS

Consisting of Mains Transformer F.W. Bridge, Metal Rectifier well ventilated steel case. Fuses, fuse-holders, grommets, panels and circuit. Carr. 2/9 extra.

6 v. or 12 v. 1 amp.	24/9
As above, with ammeter	32/9
6 v. 2 amps.	25/9
6 v. or 12 v. 2 amps.	31/6
6 v. or 12 v. 2 amps. (inclusive of ammeter)	42/9
6 v. or 12 v. 4 amps.	53/9
6 v. or 12 v. 4 amps. with variable charge rate selector and ammeter	59/9

CHARGER AMMETERS

0-1.5 amp., 0-3 amp., 0-4 amp., 0-7 amp., 0-25 amp., 0-60 amp. 8/9

ASSEMBLED CHARGER

6 v. or 12 v. 2 amps. Fitted Ammeter and selector plug for 6 v. or 12 v. Louvred metal case, finished attractive hammer blue. Ready for use with mains and output leads. Double Fused. Only **49/9** Carr. 3/9.

As above, but for 3 amp. charging. Only 59/6. Carr. 3/9

ASSEMBLED 6 v. or 12 v. 4 amps.

Fitted Ammeter and variable charge selector. Also selector plug for 6 v. or 12 v. charging. Double fused. Well ventilated steel case with blue hammer finish. Ready for use with mains and output leads. Carr. 5/-. Or Deposit 13/3 and 5 monthly payments of 13/3. **69/9**

As above, but for 6 amp. charging 4 GNS. Carr. 5/-. Or Deposit 16/- and 5 monthly payments of 16/-. The 6 amp. model only is slightly store soiled and is being offered at well below usual price.

VIBRATORS. Oak and Wearite, synchronous 7-pin, 2 v 7/9, 6 v. 8/3, 12 v. 4-pin non-synchronous 7/9.

2 v. 16 A.H. EX. GOVT. ACCUMULATORS. New Boxed. Only 5/6 each, 3 for 15/-, plus 3/6 carr.

EX. GOVT. MAINS TRANSFORMERS

All 200-250 v. 50 c/s. input.

Pr. 0-110-200-230-250 v., 275-0-275 v. 100 mA., 6.3 v 7 a., 5 v. 3 a.	22/9
250 v. 60 mA., 6.3 v. 2 a.	10/11
300-0-300 v. 60 mA. 6.3 v. 2 a.	11/9
265-0-265 v. 150 mA., 6.3 v. 11 a., 5 v. 3 a., 5 v. 3 a.	29/11
350-0-350 v. 100 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
0-24-26-28 v. 15 amps. A.C. conservative Govt. rating (marked with D.C. rating after rectification) 69/9. Carr. 15/-. 0-10-20-25 v. 24 a. (Govt. rating) 79/6. Carr. 15/-. AUTO 500 watts 0-215-220-225-230-235-240 v.	29/9
Carr. 7/6. 50 watts, 0-110/120/230/250 v.	8/11

D.C. SUPPLY KITS. Suitable for electric trains. Consists of mains trans. 200-250 v. 50 c.p.s.; 12 v. 1 amp. selenium rect. (F.W. Bridge); 2 fuseholders, 2 fuses, change direction switch, variable speed regulator, partially drilled steel case and circuit. Very limited number, 33/9.

EX. GOVT. SMOOTHING CHOKES
200 mA., 3-5 H., 50 ohms. Parmeko 8/9; 100 mA., 5 H., 100 ohms 3/11; 150 mA., 10 H., 50 ohms 9/9; 80 mA., 20 H., 900 ohms 5/9; 120 mA., 12 H., 100 ohms 8/9; 50 mA., 50 H., 1,000 ohms 6/9; 100 mA., 10 H., 100 ohms 6/9; 60 mA., 5-10 H., 250 ohms 2/11.

EX. GOVT. CASES. Well ventilated, black crackle finished, undrilled cover. Size 14×10×8½in. high. IDEAL FOR BATTERY CHARGER OR INSTRUMENT CASE. COVER COULD BE USED FOR AMPLIFIER. Only 9/9, plus 2/9 post.

WAYNE KERR SIGNAL GENERATORS. Type CT53. 3.9 to 300 megacycles. Suitable for aligning V.H.F. Radio or T.V. receivers. Output 1 micro-volt to 10 milli-volts. Worth approx. £100. Limited number at 19 Gns., with charts.

P.M. SPEAKERS. 2-3 ohm 2½in. Perdio 21/9. 5in. Goodmans 17/9. 7×4in. R.A. Elliptical 19/9. 6½in. Rola 19/9 8in. Rola 19/9. 8in. Goodmans 25/9. 8×6in. Elac with high flux magnet 25/9. 10in. R.A. 28/9. 10×6in. Elliptical Goodmans 29/9. 12in. R.A. 29/11. 12in. R.A. 3 or 15 ohms. 10 watts, 12,000 lines, 59/6.

TWEETERS, 4in. Plessy, 3 ohms, 18/9. R.A. 15 ohms 25/9

R.S.C. A10 ULTRA LINEAR 30 WATT AMPLIFIER

HIGH FIDELITY PUSH-PULL UNIT EMPLOYING SIX VALVES. EF86, EF86, ECC83, 807, 807, GZ34. Tone Control Pre-Amp. stages are incorporated. Sensitivity is extremely high, Only 12 millivolt minimum input is required for full output. THIS ENSURES THE SUITABILITY OF ANY TYPE OR MAKE OF MICROPHONE OR PICK-UP. Separate Bass and Treble controls give both "lift" and "cut" with ample tone correction for long playing records. An extra input with associated vol. control is provided so that two separate inputs such as "mike" and gram, etc., etc., can be simultaneously applied for mixing purpose. AN OUTPUT SOCKET WITH PLUG IS INCLUDED FOR SUPPLY OF 300 v. 20 mA. and 6·3 v. 1.5 A. FOR A RADIO FEEDER UNIT. Price in kit form with easy-to-follow wiring diagrams.

ONLY **11 Gns.** Carr. 10/-. Or Factory built with 12 months' guarantee £13/19/6. TERMS ON ASSEMBLED UNITS. DEPOSIT 31/9 and 9 monthly payments of 31/9.

Cover as illustrated 18/9 extra. Type 807 output valves are used with High Quality Sectionally wound output transformer specially designed for Ultra Linear operation. Negative feedback of 20 D.B. in main loop. CERTIFIED PERFORMANCE FIGURES ARE EQUAL TO MOST EXPENSIVE UNITS AVAILABLE. Frequency response ± 3 D.B. 30-20,000 c/cs. Tone Controls ± 12 D.B. at 50 c/cs. ± 12 D.B. to − 6 D.B. at 12,000 c/cs., hum and noise 70 D.B. down. Good quality reliable components used, Chassis finished blue hammer. Overall size 12 x 9 x 9in. approx. Power consumption 150 watts. For A.C. mains 200-250 v. 50 c/s. Outputs for 3 and 15 ohm speakers. EQUALLY SUITABLE FOR THE CONNOISSEUR OR FOR LARGE HALLS, CLUBS OR OUTSIDE FUNCTIONS, IDEAL FOR USE WITH MUSICAL INSTRUMENTS SUCH AS STRING BASS, ELECTRONIC ORGAN, GUITAR, etc. FOR DANCE BANDS, GARRISON THEATRES, etc., etc. We can supply Microphones, Speakers, etc., at keen cash prices or on terms with amplifiers. EXPORT ENQUIRIES INVITED.

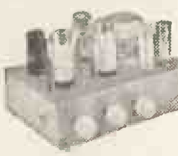
FULL RANGE OF LINEAR HIGH FIDELITY AMPLIFIERS ALWAYS IN STOCK.

LINEAR L45 MINIATURE 4/5 W. QUALITY AMPLIFIER. Suitable for use with any record playing unit and most microphones. Negative feedback 12 D.B. Bass and Treble controls. For A.C. mains input of 200-250 v. 50 c.p.s. Output for 2/3 ohm speaker. Three miniature Mullard valves. Size only 6 x 5 x 5½in. high. Chassis fully isolated from mains Guaranteed 12 months. Only **£5/19/6** Or Deposit 22/- and 5 monthly payments of 22/-. Send S.A.E. for leaflet.

GL3A MINIATURE 3 WATT GRAM AMPLIFIER
For 200-250 v. 50 c.p.s. A.C. mains. Overall size only 11½ x 2½ x 2½in. Fitted Vol. and Tone Controls with mains switch. Designed for use with any kind of single player or record changing unit. Output for 2-3 ohm speaker. Guaranteed 12 months. Only 59/6.

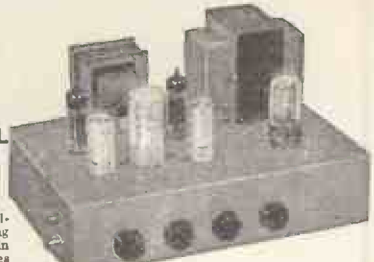
R.S.C. A7 3-4 WATT QUALITY AMPLIFIER. Spec. exactly as A5 below with exception of output voltage. Complete kit of parts, diagrams and instructions £3/15/-, carr. 3/6.

R.S.C. A5 4-5 WATT HIGH GAIN AMPLIFIER
A highly sensitive 4-valve quality amplifier for the home, small club, etc. Only 50 millivolts input is required for full output so that it is suitable for use with the latest high-fidelity pick-up heads in addition to all other types of pick-ups and practically all mikes. Separate Bass and Treble controls are provided. These give full long playing record equalisation. Hum-level is negligible being 71 D.B. down. 15 D.B. of negative feedback is used. H.T. of 300 v. 25 mA. and L.T. of 6.3 v. 1.5 a. is available for the supply of a Radio Feeder Unit or Tape Deck pre-amplifier. For A.C. mains input of 200-250 v. 50 c/s. Output for 2-3 ohm speaker. Chassis is not alive. Kit is complete in every detail and includes fully punched chassis (with baseplate) with the blue hammer finish, and point-to-point wiring diagrams and instructions. Exceptional value at only £4/15/- or assembled ready for use 25/- extra, plus 3/6 carriage. Or Deposit 22/- and five monthly payments of 22/- for assembled unit.



HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES



Two input sockets with associated controls allow mixing of "mike" and gram. as in A.10. High sensitivity. Includes 5 valves: ECC83, ECC83, EL84, EL84, 5Y3. High quality sectionally wound output transformer specially designed for Ultra Linear operation, and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut." Frequency response ± 3 D.B. 30-30,000 c/cs. Six negative feedback loops. Hum level 60 D.B. down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and type of pick-ups and microphones. Comparable with the very best designs. For STANDARD or LONG PLAYING RECORDS. For MUSICAL INSTRUMENTS such as STRING BASS, GUITARS, etc. OUTPUT SOCKET with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a RADIO FEEDER UNIT. Size approx.: 12.9-7in. For A.C. mains 200-250 v. 50 c/cs. Output for 3 and 15 ohm speakers. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. (Or factory built 45/- extra). ONLY **8 Gns.** Carr. 10/-.
If required louvred metal cover with 2 carrying handles can be supplied for 18/9. TERMS ON ASSEMBLED UNITS. DEPOSIT 24/3, and 9 monthly payments of 24/3. Send S.A.E. for illustrated leaflet detailing Ready-to-assemble Cabinets, Speakers, Microphones, etc. with cash and credit terms.

R.S.C. PORTABLE GUITAR AMPLIFIER

JUNIOR 5 WATT. High Quality Output. Separate Bass and Treble "cut" and "boost" controls Sensitivity 15 mv. High Flux 8in. l/speaker. Input sockets for Radio/Tape or Gram Pick-up and Mike /Instrument Pick-up. Handsome strongly made cabinet (size approx. 14 x 14 x 7in.). Finished in satin walnut and fitted carrying handle.
£8/19/6 Carr. 7/6. Or Deposit £1 and 9 monthly payments £1.
Send S.A.E. for leaflet.

SENIOR 10 WATTS. High Fidelity Push-Pull output. Separate Bass and Treble "cut" and "boost" controls. Twin separately controlled high gain inputs so that two instruments such as Guitar and String Bass can be used at the same time. Two Loudspeakers are incorporated, a 12in. P.M. for Bass notes, and 1 7 x 4in. elliptical for Treble. Cabinet is well made and finished satin walnut. Size approx. 18 x 18 x 8in. 15 Gns. Plus 10/- carr. TERMS. DEPOSIT. 34/9. and 9 monthly payments 34/9. Both models for 200-250 v. A.C. mains.

STAAR GALAXY 4-SPEED MIXER AUTO-CHANGERS. Brand new, cartoned. Turnover sapphire styli. Many exclusive features. Unique design motor virtually free from rumble For 200/250 v. A.C mains. Limited number tested and guaranteed, £5/19/6. Carr. 4/6.

COLLARO CONQUEST 4-SPEED AUTO-CHANGERS. With studio pick-up with turnover head. BRAND NEW. Cartoned. Latest model. For 200-250 v. A.C. mains. £7/19/6. Carr. 4/6.

B.S.R. MONARCH AUTO-CHANGERS. Type UA8, 4 speed T/O Pick-up with sapphire stylus £7/19/6. Carr. 4/6.

COLLARO JUNIOR. 4-speed Single Players with HiFi T/O crystal pick-up head, £3/19/6.

LOUDSPEAKERS IN POLISHED WALNUT FINISHED CABINET. Gauss 12,000 lines. Speech coil 3 ohms or 15 ohms. Only £4/19/6. Carr. 5/-. TERMS: DEPOSIT 11/- and 9 monthly payments of 11/-.

12in. 20 WATT 15,000 line l/speakers 15 ohms, in Cabinet finished as above. Size 18 x 18 x 8in. £7/19/6 or Deposit 17/9 and 9 monthly payments of 17/9.

R.S.C. TRANSFORMERS

Fully Guaranteed. Interleaved and impregnated.

MAINS TRANSFORMERS. Primaries 200-250-250 v. 50 c/s.

FULLY SHROUDED UPRIGHT MOUNTING

250-0-250 v. 60 mA., 6.3 v. 2 a., 5 v. 2 a.	17/6
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	25/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	33/9
425-0-425 v. 200 mA., 6.3 v. 4 a., c.t. 5 v. 3 a.	49/9

TOP SHROUDED DROP-THROUGH TYPE

260-0-260 v. 70 mA., 6.3 v. 2 a., 5 v. 2 a.	16/9
350-0-350 v. 80 mA., 6.3 v. 2 a., 5 v. 2 a.	18/9
250-0-250 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
300-0-300 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
300-0-300 v. 130 mA., 6.3 v. 4 a., c.t., 6.3 v. 1 a., suitable for Mullard 510 Amplifier	29/9
350-0-350 v. 100 mA., 6.3 v. 4 a., 5 v. 3 a.	23/9
350-0-350 v. 150 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9

FRAMED DROP-THROUGH TYPE

250-0-250 v. 100 mA. 6.3 v. 2 a.	19/9
300-0-300 150 mA., 6.3 v. 3 a., 5 v. 3 a.	27/9

ELIMINATOR TRANSFORMERS. Primaries 200-250 v. 50 c/s.

120 v. 40 mA., 5-0-5 v. 1 a.	14/9
90 v. 15 mA., 6-0-6 v. 250 mA.	9/11

FILAMENT TRANSFORMERS. Primaries 200-250 v. 50 c/s.

6.3 v. 1.5 a.	5/9	12 v. 1 a.	7/9
6.3 v. 2 a.	7/6	6.3 v. 3 a.	8/11
0-4-6.3 v. 2 a.	7/9	6.3 v. 6 a.	17/6

OUTPUT TRANSFORMER

Midget Battery Pentode 66:1 for 3S4, etc.	3/9
Small Pentode 5,000Ω to 3Ω	3/9
Standard Pentode 5,000Ω to 3Ω	5/9
Standard Pentode 8,000Ω to 3Ω	5/9
Push-pull 8 watts 6V6 to 3 ohms	8/9
Push-pull 8 watts EL84s to 15 ohms	8/9
Push-pull 10-12 watts 6V6 to 3 or 15Ω	16/9
Push-pull 10-12 watts to match 6V6 to 3-5-8 or 15Ω	17/9
Push-pull EL84 to 3 or 15 ohms	17/9
Push-pull Ultra Linear for Mullard 510	27/9
Push-pull 15-18 watts, sectionally wound, 6L6, KT66, etc., for 3 or 15 ohms	23/9
Push-pull 20 watt high-quality sectionally wound, 6L6, KT66, etc., to 3 or 15Ω	47/9

SMOOTHING CHOKES

250 mA., 5 H., 100Ω	11/9	80 mA. 10 H., 350Ω	5/6
150mA., 7-10H, 250Ω	11/9	60 mA., 10 H., 400Ω	4/11
100mA., 10 H., 200Ω	8/9	1 amp. 0.5Ω L.T. type	6/6

PARMEKO MAINS TRANSFORMERS. Fully shrouded

450-0-450 v. 120 mA., 6.3 v. 4 a., 5 v. 3 a.	29/9
500-0-500 v 120 mA., 6.3 v. 4 a., 5 v. 3 a.	31/9

ACOS HGP59 Hi-Fi Crystal Cartridges. (Turnover type with sapphire stylus). Standard replacement for Garrard and Collaro. Only 19/9. B.S.R. Ful-Fi 19/9. Garrard GC2 19/9.

ACOS HIGH FIDELITY PICKUPS. GP54 with HGP59/52 Cartridge. Turnover sapphire styli, cream finish. Limited number at approx. half price. Only 29/11.

PLESSEY DUAL CONCENTRIC 12in. P.M. SPEAKERS

(15 ohms), consisting of a high quality 12in. speaker of orthodox design supporting a small elliptical speaker ready wired with choke and condensers to act as tweeter. This high fidelity unit is highly recommended for use with our A11 or any similar amplifier. Rating is 10 watts. Gauss 12,000 lines. Price only £5/17/6 Or Deposit 13/6 and 9 monthly payments of 13/6.

R.S.C. MANCHESTER, LEEDS & BRADFORD

(LEEDS) LTD.

Open to callers at the following branches:—
5-7 County (Mecca) Arcade, Leeds. 1.
54-56 Morley Street (above Alhambra), Bradford.
8-10 Brown Street (Market St.), Manchester, 2.

TERMS: C.W.O. or C.O.D. No C.O.D under £1. Postage 1/9 extra on all orders under £2, 2/9 extra under £5 unless carriage stated. Trade supplied. Post orders to Mail Order Dept. 29-31 Moorfield Road, Leeds, 12.

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having Heater/Cathode short circuit and for C.R. Tubes with failing emission. Full instructions supplied.

Type A. Low Leakage windings. Optional Boost 25% and 50%. Tapped mains primaries:

2 volt	12/6 each
4 volt	12/6 each
6.3 volt	12/6 each
10.8 volt	12/6 each
13.3 volt	12/6 each

OUR LATEST SUPERIOR PRODUCT. Type A2. High Quality. Low capacity, 10/15 pf. Optional boost 25%, 50%, 75%. 16/- each

Type B. Mains input. Low capacity. Multi Output 2, 4, 6.3, 10 and 13 volts. Optional boost 25% and 50%. Suitable for all Cathode Ray Tubes, 21/-.

RESISTORS. All preferred values. 20% 10 ohms to 10 meg., ¼ w., 4d.; ½ w., 4d.; 1 w., 6d.; 1½ w., 8d. 2 w. 1/-. HIGH STABILITY. ½ w., 1%, 2/-. Preferred values 100Ω to 10 meg., Ditto 5% 9d., 100Ω to 5 meg.

5 watt, 10 watt, 15 watt WIRE-WOUND RESISTORS 25 ohms—10,000 ohms. 1/3, 1/6, 2/-

15,000 ohms.—50,000 ohms, 5 w., 1/9; 10 w. 2/3

WIRE-WOUND POTS, 3 w. Pre-set Min. T.V. type Knurled Slotted knob, All values 25 ohms to 25K., 3/- ea., 30 K., 50 K., 4/-. Ditto, ½ w. Carbon Track 30 K. to 2 Meg., 3/-.

WIRE-WOUND POTS, 4 w. Standard size Pots, long Spindle High Grade. All values 100 ohms to 50 K., 6/6; 100 K. 7/6. W/W EXT. SPEAKER CONTROL 10Ω, 3/-.

O/P TRANSFORMERS. Heavy duty 50 mA., 4/6. Multi-ratio push-pull, 7/6. Miniature 3V4, etc., 4/6. Hygrade Push-pull 10 watts, 15/6. MULLARD "510" 6k or 8k 30/-. L.F. CHOKES 15/10H 60/65 mA., 5/-. 10H 85 mA., 10/6. 10H 150 mA., 14/-.

MAINS TRANSFORMERS 200/250 v. A.C.

STANDARD 250-0-250, 80 mA., 6.3 v. 3.5 a. tapped 4 v. 4 a. Rectifier 6.3 v. 1 a., tapped 5 v. or 4 v. 2 a. Ditto 350-0-350	22/6
MINIATURE 220 v. 20 mA., 6.3 v. 1 a.	10/6
MIDGET, 250 v. 45 mA., 6.3 v. 2 a.	15/6
SMALL, 220-0-220 50 mA. 6.3 v. 2 A.	17/6
STANDARD, 250-0-250, 65 mA., 6.3 v. 3.5 a.	17/6
HEATER TRANS., 6.3 v. 1½ a., 7/6; 3 amp.	10/6
GENERAL PURPOSE LOW VOLTAGE. Outputs 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 24 and 30 v. at 2 A.	22/6

ALADDIN FORMERS and cores, ¼in., 8d.; ⅜in., 10d.
0.3in. FORMERS 5937 or 8 and Cans TV1 or 2, ⅜in. sq. × 2½in. or ⅜in. sq. × 1½in., 2/- with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6 : 1, 2/3.
SOLON. Midget Soldering Iron, 230 v. 25 w., 24/-.
REMPLOY INSTRUMENT IRON. 230 v. 25 w., 17/6.
MAINS DROPPERS. 3 × 1½in. Adj. Sliders, .3 amp. 1,000 ohms 4/3. .2 amps. 4/3. .1 amp. 2,000 ohms., 5/-.
LINE CORD. .3 amp., 60 ohms per foot, .2 amp., 100 ohms per foot, 2 way, 6d. per foot, 3 way 7d. per foot.

CRYSTAL MIKE INSERT by Acos 6/6

Precision engineered. Size only ⅞ × 1 3/16 in.

ACOS CRYSTAL STICK MIKE 39-1. Bargain 37/6.

MIKE TRANSF. 50 : 1, 3/9 ea.; 100 : 1 Potted 10/6.
LOUDSPEAKERS P.M. 3 OHM. 5in. Rola, 17/6.
6in. × 4in. Rola, 18/-. 7in. × 4in. R.A., 21/-.
10in. × 6in. Rola, 27/6. 8in. Plessey, 19/6.
6½in. Rola, 18/6. 8in. Rola, 21/-. 10in. R.A., 30/-.
HI-FI TWEETERS, 4in. 25/-. 12in. Plessey, 30/-.
12in. Baker 15 wt. 3 ohm. and 15 ohm models, 105/-.
12in. Baker foam suspension 15 w. 15 ohm, £8.
12in. 15 ohm Plessey 10 wt., 45/-.

I.F. TRANSFORMERS 7/6 pair

465 kc/s. slug tuning miniature can 2½ × 1 × 1in. High Q and good bandwidth. By Pye Radio. Data sheet supplied.

Wearite M800 I.F. Miniature 465 kc/s., 12/6 pair.
Weymouth I.F. Standard size 465 kc/s., 12/6 pair.

CRYSTAL DIODE G.E.C., 2/-. GEX34, 4/-. 40 Circuits, 3/-.
H.R. HEADPHONES. 4,000 ohms, brand new, 15/- pair.
SWITCH CLEANER Fluid, squirt spout, 4/3 tin.
TWIN GANG CONDENSERS. 365 pf. Miniature, 1½in. × 1½in. × 1⅜in., 10/-. .0005 Standard with trimmers, 9/-; less trimmers, 8/-. Midget 7/6; Single 50 pf., 2/6; 100 pf., 150 pf., 7/-. Solid dielectric 100, 300, 500 pf., 3/6.
VALVE HOLDERS. Pax. int. Oct., 4d. EF50, EA50, 6d. B12A, CRT. 1/3. Eng. and Amer. 4, 5, 6, 7 pin, 1/-.
MOULDED Mazda or Int. Oct. 6d. B7G, B8A, B8G, B9A, 9d. B7G with can, 1/6; B12A, 1/3. B9A with can, 1/9.
CERAMIC, EF50, B7G, B9A, Oct., 1/-; B7G, B9A Cans, 1/-.
SPEAKER FRET. Gold Cloth 17in. × 25in., 5/-, 25in. × 35in., 10/-. Tygan 54in. wide, 10/- ft. 27in. wide, 5/- ft. Samples, S.A.E.

WAVECHANGE SWITCHES

2 p. 2-way, 3 p. 2-way; short spindle	2/6
5 p. 4-way, 2 wafer, or 3 p. 11-w. 3 wafer long spindle	6/6
2 p. 6-way, or 4 p. 2-way, or 4 p. 3-way, long spindle	3/6
3 p. 4-way, or 1 p. 12-way, long spindle	3/6

Wave change "MAKITS" 1 wafer, 8/6; 2 wafer, 12/6; 3 wafer 16/-; 4 wafer 19/6; 5 wafer 23/-; 6 wafer 26/6.
TOGGLE SWITCHES. S.P., 2/-; D.P., 3/6; D.P.D.T., 4/-;
MORSE KEYS, good quality, 2/6.
SUB-MINIATURE ELECTROLYTICS (15 v.), 1, 2, 4, 5, 8, 25, 50 mfd., 100 mfd., 3/- each.

EDISWAN TRANSISTORS JUNCTION TYPE P.N.P.

AUDIO XB102, for amplifiers and output stages up to 250 milliwatts in push-pull. PRICE 10/-

R.F. XA104 frequency changer up to 4 Mc/s. 18/-
XA103 IF amp. etc. up to 2 Mc/s. 15/-

Mullard OC44, 26/-. OC45 23/-.

RCS "REGENT" 4 VALVE

"96" RANGE VALVES

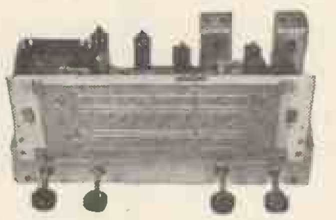
KIT PRICE £6. 6. 0.

Carr. 4/-.

PRINTED CIRCUIT BATTERY PORTABLE KIT

Medium and long wave. Powerful output from 6in. high Flux Speaker. T.C.C. Printed circuit and condensers. All components of finest quality clearly identified for assembly with full instructions. Osmor Ferrite Aerial and Coils, Rexine covered attache case type cabinet. Size 12in. x 8in. x 4in. Batteries used B126 (L5512) and AD35 (L5040), 10/- extra. Details and instructions 1/9 (free with kit). Mains Unit ready made for above 39/6. Same size as batteries, sold separately.

1960 RADIOGRAM CHASSIS



THREE WAVEBANDS
S.W. 16 m.—50 m.
M.W. 200 m.—500 m.
L.W. 800 m.—2,000 m.

FIVE VALVES
LATEST MULLARD
ECH81, EF89, EBC81, EL84, EZ80

12-month Guarantee. A.C. 200/250 v., 4-way switch. Short-Medium-Long-Gram. A.V.C. and Negative Feedback, 4.2 watts. Chassis 13½in. × 5½in. × 2¼in. Glass Dial Size 10 × 4½in. horizontal or vertical. Two Pilot Lamps. Four Knobs. Walnut or Ivory. Aligned and calibrated. Chassis isolated from mains.

BRAND NEW £9. 10. 0. Carr. 4/6

TERMS: Deposit £5/5/- and 5 monthly payments of £1.
MATCHED SPEAKERS 8in. 17/6; 10in. 25/-; 12in. 30/-.

RECORD PLAYER BARGAINS

4 Speed Autochangers, B.S.R., U.A.8	£6 19 6
Collaro Conquest	£7 19 6
Garrard Model 210	£10 10 0
4 speed Single Players, EMI	£6 19 6
Garrard TA Mk. II	£8 8 0
Garrard 4 HF	£17 19 6

All post free

THE HI-GAIN BAND 3 PRE-AMP

Cascode circuit using Valve ECC84. 17db gain. Kit 29/6 less power; or 49/6 with power pack. Plans only 6d. Also Band I version same prices. (PCC84 Valve if preferred)

TELETRON POCKET RADIO KIT
Transidyne Superhet Six 6" × 4" × 1½"

T.C.C. Printed Circiut, internal Ferrite aerial, Rola loudspeaker push-pull output. All parts, cabinet, 6 Ediswan transistors, GEX34 diode. Details 9d. **£9.9.0**

VOLUME CONTROLS Midget size: Long spindle. Guaranteed 1 year. All values. 5 K. ohms up to 2 Meg. No switch 3/-. D.P. Sw. 4/9. Linear or Log Tracks.

80 ohm Cable Coaxial Semi-air spaced, ¼in. dia. Ideal Band III 6d. yd. Losses cut 50% Post 1d. per yard extra. FRINGE QUALITY AIRSPACED .... 1/- yd

COAXIAL PLUGS .... 1/-   LEAD SOCKETS 2/-
PANEL SOCKETS .... 1/-   OUTLET BOXES 4/6
BALANCED TWIN FEEDER per yd. 6d., 80Ω or 300
TWIN SCREENED BALANCED FEEDER 1/6 yd., 80 ohm.

ALUMINIUM CHASSIS. 18 s.w.g. Plain, undrilled with 4 sides, riveted corners and lattice fixing holes, with 2½in. sides 7 × 4in. 4/6; 9 × 7in., 5/9; 11 × 7in., 6/9; 13 × 9in., 8/6; 14 × 11in., 10/6; 15 × 14in., 12/6 and 18 × 16 × 3in., 16/6.

BLACK CRACKLE PAINT. Air drying, 3/- tin.
P.V.C. CONN. WIRE, coloured, single or stranded, 2d. yd.
NEON MAINS TESTER SCREWDRIVERS, 5/-.
CORED SOLDER RADIOGRADE, 4d. yd., ½lb., 2/6.
PAXOLIN 1/16in. × 8in. × 10in., 1/6. ION TRAPS 5/-.

P.V.C. PLASTIC RECORDING TAPE

Long Play	7in. reel, 1,800ft.	32/6
	5¾in. reel, 1,200ft.	22/6
	5in. reel, 850ft.	19/6
	3in. reel, 225ft.	7/6
Standard	7in. Reel, 1,200ft.	21/-
	5in. reel, 600ft.	15/-

"Instant" Bulk Tape Eraser and Head Defluxer, 200/250 v. A.C., 27/6. Leaflet, S.A.E.

RECTIFIERS, RM1, 5/-; RM2, 6/-; RM3, 8/-; RM4, 16/-; RM5, 20/-; FC31, 27/6; 14A86, 17/6; 14A100, 25/-.
MINIATURE CONTACT COOLED RECTIFIERS. 250 v. 50 mA., 7/6; 60 mA., 8/6; 85 mA., 9/6; 200 mA., 21/-; 300 mA., 27/6; Full Wave 250 v. 120 mA., 15/-.
COILS. Wearite "P" type, 3/- each. Osmor Midget "Q" type adj. dust core from 4/- each. All ranges.
TELETRON. L. and M. T.R.F. with reaction, 3/6.
FERRITE ROD AERIALS. M.W., 8/9; M. & L., 12/6.
T.R.F. COILS. A/HF, 7/- pair. H.F. CHOKES, 2/6.

JASON F.M. TUNER COIL SET. 26/-. H.F. coil aerial coil, Oscillator coil, two I.F. transformers 10.7 Mc/s., Detector transformer and heater chokes. Circuit and component book using four 6AM6, 2/6. Complete kit FMT1 with Jason Calibrated dial and 4 valves, £6/5/-. With new Jason Cabinet, FMT2, 30/- extra.

CONDENSERS. New Stock. .001 mfd. 7kV. T.C.C., 5/6; 20 kV., 9/6. .1 mfd. 7kV, 9/6. 100pf. to 500 pf. Micas, 6d. Tubular 500 v. 0.001 to 0.05 mfd., 9d.; 0.1, 1/-; 0.25, 1/6; 0.5, 1/9; 0.1/350 v., 9d.; 0.1/1,000 v., 1/9; 0.1 mfd. 2,000 v., 3/6; 0.001 mfd., 2,000 v., 1/9.
CERAMIC CONDS. 500 v. 0.3 pf. to 0.01 mfd., 9d.
SILVER MICA CONDENSERS. 10% 5 pf. to 500 pf., 1/-; 600 pf. to 3,000 pf., 1/3.
CLOSE TOLERANCE (1± pf.) 1.5 pf. to 47 pf., 1/6. DITTO 1% 50 pf. to 815 pf., 1/9; 1,000 pf. to 2,000 pf., 2/-.
TRIMMERS. Ceramic, 30, 50, 70 pf., 9d., 100 pf., 150 pf. 1/3. 250 pf., 1/6. 600 pf., 750 pf., 1/9. Phillips, 1/- ea.

NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350 v.	2/-	50/350 v.	5/6	8/500 v.	3/-
2/350 v.	2/3	100/25 v.	3/-	16/500 v.	4/-
4/450 v.	2/3	250/25 v.	3/-	32/350 v.	4/-
8/450 v.	2/3	500/12 v.	3/-	100/270 v.	5/6
8/500 v.	2/9	8+8/450 v.	4/6	2,500/3 v.	4/-
16/450 v.	3/6	8+8/500 v.	5/-	5,000/6 v.	5/-
16/500 v.	4/-	8+16/450 v.	5/-	8+16/500 v.	7/-
32/450 v.	5/6	8+16/500 v.	5/6	32+32/450 v.	6/6
25/25 v.	1/9	16+16/450 v.	5/6	50+50/350 v.	7/-
50/25 v.	2/-	16+16/500 v.	6/-	64+120/350 v.	11/6
50/50 v.	2/-	32+32/350 v.	4/6	100+200/275 v.	12/6

FULL WAVE BRIDGE/SELENIUM RECTIFIERS. 2.6 or 12 v. 1½ amp., 8/9; 2 a., 11/3; 4 a., 17/6; 6 a., 22/6.
CHARGER TRANSFORMERS. Tapped input 200/250 v. for charging at 2, 6 or 12 v., 1½ a., 15/6; 2 a., 17/6; 4 a. 22/6. Charger circuit free. AMPMETERS, 4 a., and 5 a., 13/6.

NEW and boxed VALVES 90 day-guarantee

1R5	7/6	6L6G	10/6	EA50	1/6	EY51	9/6
1S5	7/6	6N7M	6/6	EABC80	8/6	EY86	10/-
1T4	6/-	6Q7G	7/6	EB91	6/-	HABC80	12/6
2X2	3/6	6SA7M	6/-	EBC33	8/6	HVR2A	6/6
3S4	7/6	6SJ7M	6/6	EBC41	8/6	MU14	9/-
3V4	7/6	6SN7	6/6	EBF80	10/-	P61	3/6
5U4	7/6	6V6G	6/6	ECC84	9/6	PCC84	9/6
5Y3	7/6	6X4	7/6	ECF80	9/6	PCF80	9/6
5Z4	9/6	6X5	6/6	ECH42	10/6	PCL82	11/6
6AM6	5/-	12A6	7/6	ECL80	10/6	PEN25	6/6
6BE6	7/6	12AT7	8/-	ECL82	10/6	PL82	10/6
6BH6	9/6	12AU7	8/-	EF39	5/6	PY80	7/6
6BW6	9/6	12AX7	8/-	EF41	9/6	PY81	9/6
6D6	6/-	12BA6	8/6	EF50	5/6	PY82	7/6
6FG6	7/6	12BE6	8/6	EF80	8/-	SP61	3/6
6H6GT	3/6	12K7	6/6	EF86	14/6	UBC41	9/6
6J5	5/6	12Q7	6/6	EF92	5/6	UCH42	9/6
6J6	5/6	35L6	9/6	EL32	5/-	UF41	9/6
6J7G	6/6	35Z4	7/6	EL41	9/6	UL41	9/6
6K6GT	6/6	80	9/6	EL84	8/6	UY41	8/-
6K7G	5/-	807	5/6	EZ40	7/6	U22	8/-
6K8G	7/6	954	1/6	EZ80	7/6	U52	7/6

RADIO COMPONENT SPECIALISTS

48 HOUR MAIL ORDER

337 WHITEHORSE RD. WEST CROYDON

POSTAL SERVICE 1/-, OVER £2 FREE. C.O.D. 1/6 (EXPORT C.W.O. POST EXTRA) Wed. 1 p.m.

THO. 1665 Buses 133 or 68

HARVERSON SURPLUS CO LTD

Phone: CHErrywood 3985/6/7 83, HIGH STREET, MERTON, S.W.19. Phone: CHErrywood 3985/6/7

The world famous E.M.I. Angel Transcription P.U.

SPECIFICATION

Physical
Length $15\frac{7}{8}$ inches (40.32 cms.).
Height $2\frac{1}{2}$ inches (6.41 cms.)
With $2\frac{3}{8}$ inches (6.03 cms.)
Centre of base to stylus tip 12" inches (30.72 cms) Approx. overall.

Stylus
A diamond stylus is fitted to the $33\frac{1}{3}$/45 r.p.m. head supplied

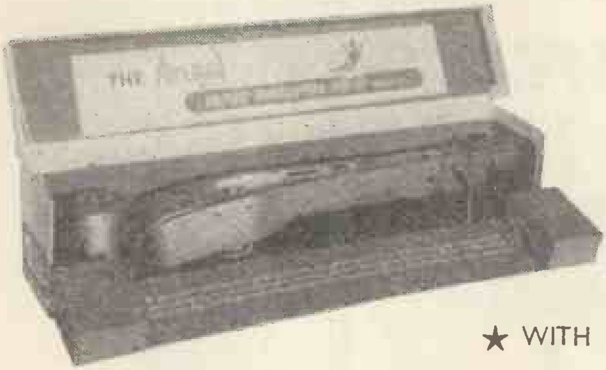
Head Impedance
1 ohm (measured at 1,000 c.p.s.).

Frequency Response
For a constant recorded velocity the frequency response is sensibly level within the following limits: with micro-groove stylus 20—16,500 c.p.s. With standard stylus 20—20,000 c.p.s.

Distortion
Measured at 400 c.p.s., the total harmonic distortion is less than 5% for a recording level of +20 db referred to 1 cm./sec. r.m.s. transverse velocity.

Sensitivity
50 mV at secondary of transformer provided from a recording level of +10 db referred to 1 cm./sec. r.m.s. velocity.

Weight at Stylus Point
Variable from 3—10 grammes as required.



★ (MODEL 17A)

A PICKUP FOR THE CONNOISSEUR ORIGINALLY PRICED AT £17/10/-. WE CAN OFFER THE LAST REMAINING FEW AT

£4 . 19 . 6

PLUS P. & P. 5/-.

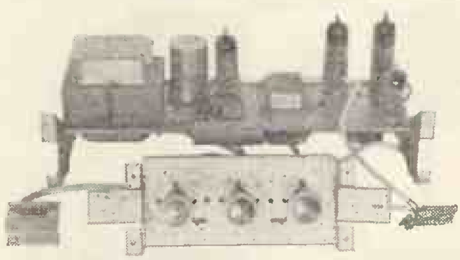
★ WITH DIAMOND STYLUS

SPECIAL OFFER FOR 1 MONTH ONLY

8 WATT Push Pull MONAURAL AMPLIFIER

By well-known manufacturer—employing four Mullard valves: ECC.83, 2 EL.84 and EZ.80. Bass, treble and volume on remote panel. Elegant knobs. **OUR PRICE**—Plus P. & P. 4/6. **£5.18.6**

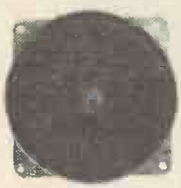
Also a few Stereo left.



PLESSEY TWEETER

This well-known Plessey 3 ohm Tweeter at our amazing price of . . .

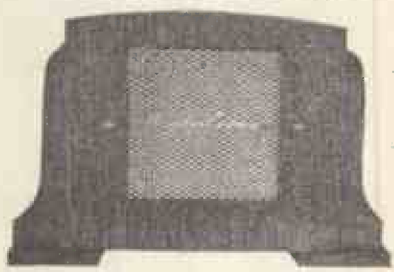
12/6 TAX PAID
Plus P. & P. 1/6.



SPECIAL OFFER FOR 1 MONTH ONLY

Ex. Speaker, 5in. Goodman unit. Cabinet 8" x 6" x 2". Complete, includ-lead lead. P. & P. 2/-.

18/6



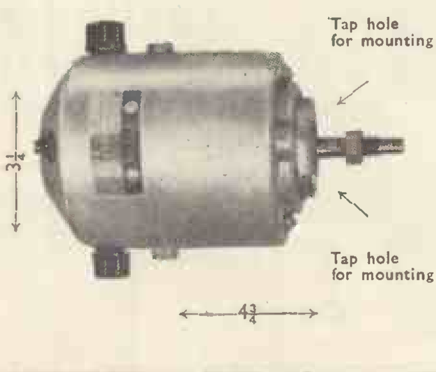
AMAZING SCOOP

Cossor 10in. Tubes 108K. Brand New, boxed and guaranteed. Manufacturer's Surplus. Equiv. HMV3/16

15/- each
Plus P. & P. 12/6.

DIAMOND STYLUS

Cost £8/15/-. Brand new.
78 AT **£2.0.0**
$33\frac{1}{3}$-45 AT **£4.0.0**
P. & P. 1/6.



NOT GOVT. SURPLUS

$\frac{1}{6}$ H.P. 220-250 A.C. motor, ideal for lathe, coil winder, drill, saw motor, etc. Don't miss it. Dimensions: $6\frac{1}{2}$ x $3\frac{1}{2}$

30/- P. & P. 2/3.

NOTICE

WHY NOT VISIT OUR NEW SHOWROOM. LARGEST WALK AROUND IN LONDON. 1 min. South Wimbledon Tube.

HARVERSON
83 HIGH ST., MERTON, SURREY.
COME AND SEE US.

VISIT OUR FULLY EQUIPPED
HI-FI SHOWROOM
AT TOTTENHAM COURT ROAD FOR DEMONSTRATIONS OF THE LATEST
HI-FIDELITY EQUIPMENT
BY ALL LEADING MANUFACTURERS

We stock equipment of Quality by all leading makers: i.e., Leak, Quad, Armstrong, Dulci, Ferrograph, Reflectograph, Vortexion, Linear, Wharfedale, Grundig, Goodmans, W.B., Rogers, Garrard, Lenco, B.T.H., Pamphonic, Simon, Brenell, Collaro, Telefunken, Fi-Cord, etc., etc. A full range of high quality cabinets to suit all purposes is on show, i.e., "RECORD HOUSING," "W.B.," "A.D.," etc. Enquire about our interesting part-exchange scheme for personal callers. H.P. Available.

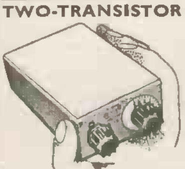
CLYNE RADIO ELECTRONIC ORGAN
Readers will no doubt be pleased to know that our working model of this amazing organ for home construction, may now be heard and seen, at our Hi-Fi Showroom in Tottenham Court Road, W.1 For the benefit of constructors all components, keyboards, chokes, etc., are available ready made. Full constructional details are available in book form at 15/- plus 1/6 p. and p. We shall be happy to forward a complete price list on receipt of a stamp. Please address all organ enquiries for the attention of Mr. L. Roche

SUPER MAGNETIC RECORDING TAPE SPECIAL ! ! ! *Trade enquiries invited*
First delivery Famous American Ferrodynamics Acetate Base High Quality Recording Tape. An enthusiast's "must." Brand new (NOT SUB-STANDARD), 5in. 600ft. 16/-, 5in. 900ft. 18/6, 5¾in. 1,200ft. 23/6, 7in. 1,200ft. 25/-, 7in. 1,800ft. 35/-. Professional quality "MYLAR" Du Pont 5in. 1,200ft. 37/6. 7in. 1,800ft. 44/-. 7in. 2,400ft. 60/-, each on plastic spool. P. free.

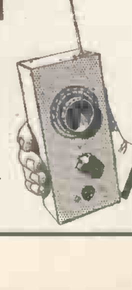
DECCA PORTABLE AMPLIFIER. As supplied in famous DECCA-MATIC III. Complete with small cream knobs. Full range tone and volume controls. Employs ECL82 valve. Size 3 x 3½ x 8¾in. Only 59/6 plus 2/6 P.&P
SPECIAL CELESTION 8 x 6in. elliptical high flux loudspeaker 30/- plus 1/- P. & P. to fit.
VERY ATTACTIVE PORTABLE CABINET in two-tone rexine covering for accommodating the above items and ancillary equipment. 75/- plus 5/- P. & P.
Note. If the above three items are purchased together they will be supplied at the special inclusive price of £7/2/6 plus 6/6 P. & P.

EXTRA SPECIAL OFFER ! !
A small three-valve **PORTABLE RECORD-PLAYER AMPLIFIER** mounted on baffle 12 x 7in., with High Flux 6½in. Loudspeaker. Valve line-up ECC83, EL84, EZ80. Incorporates separate bass and treble controls. Max. output 3 watts. Will match all types of high impedance pick-up. Ready to use, £5/12/6. P. & P. 3/6.
NEW STYLE CABINET finished in two-tone Leatherette. Will accommodate above Amplifier and Baffle without modification, also most types of Ancillary Equipment. Overall size 18 x 13½ x 8½in. Fitted with carrying handle, £3/9/6 plus 5/- P. & P.
NOTE. If both items purchased together they will be supplied at a special inclusive price £8/7/6 plus 6/6 P. & P.

TWO-TRANSISTOR PERSONAL PORTABLE. This is an amazing little receiver with built-in aerial, and small enough to be held in the palm of the hand. Medium wave reception at wonderful volume. Supplied with drilled chassis and colour coded components. Easily assembled with the aid of the easy-to-follow assembly instructions provided. Total cost of all necessary components, including transistors, Deaf-aid type earpiece, wiring wire and even solder. **ONLY 69/6** or complete with single standard High Resistance earphone at ONLY 62/6. Plus 1/6 P. & P. Parts price list and Easy Lay-out Plan s 2/- post free.



SUPER PERSONAL PORTABLE. A wonderful little set that you can take anywhere. Ideal for camping, picnics, etc. Detachable aerial rod supplied. Covers Medium waveband 200-500 metres. Can be built in approx. 1 hour. All necessary components available at the following SPECIAL INCLUSIVE PRICES: 1-valve version **ONLY 35/-**. Super 2-valve version **ONLY 41/-**. Plus 2/- P. & P. Send for point-to-point wiring diagram and parts price list 2/- post free. Extra for use with the above DLR5 balanced armature headphones, 7/6 pair.



RECORD PLAYERS
Full range at usual competitive prices. Interesting H.P. facilities

COLLARO JUNIOR

4-speed turntable and pick-up complete with crystal cartridge and sapphire styli.
SPECIAL OFFER at only 75/- plus 2/6 P. & P. Or **TURNTABLE** and **MOTOR** only at 52/6 plus 2/6 P. & P. **PICK-UP** only at 27/6 plus 1/6 P. & P.

B.S.R. TU9. 4-speed single-record unit with separate lightweight pick-up fitted with T.C.8H. crystal insert and sapphire styli. An ideal unit for a small portable gramophone. Brand new and fully guaranteed. SPECIAL PRICE: 75/- plus 2/6 P. & P. or motor and turntable only at 42/6 plus 2/6 P.&P. or Pick-up only at 27/6 plus 1/6 P.&P.

E.M.I. 4-SPEED STEREO SINGLE RECORD UNIT. Complete with Stereo Head and Sapphire Styli Brand New and Fully Guaranteed. **ONLY £6/19/6** plus 3/6 P. & P.

GARRARD RC120/4H. 4-speed autochanger with GC2 Insert. Brand New, fully guaranteed. £8/19/6. P. & P. 3/6.

JUST ARRIVED!
LATEST B.S.R. UA14. 4-speed. Attractive appearance. Wired for stereo. Fully guaranteed. £7/19/6, plus 3/6 P. & P.

B.S.R. UA8 MONARCH. 4-speed Mixer Autochanger complete with turnover crystal insert and Sapphire Styli. Few only, now at £6/19/6 plus 3/6 P. & P. Brand new and fully guaranteed.

THE LATEST COLLARO "CONQUEST." 4-speed autochanger in cream with Studio "O" insert. Brand new, fully guaranteed, £7/19/6 plus P. & P. 3/6.

B.S.R. UA8 STEREO/MONAURAL. Few only at £7/19/6, plus 3/6 P. & P. Brand new. Guaranteed.

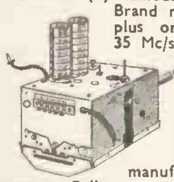
No. 38 AFV WALKIE-TALKIE. A wonderful offer. This famous trans-receiver unit, with relay operated SEND/RECEIVE switch covering 7.4–9 Mc/s band, range approx. 5 miles. Good condition. ONLY 22/6 plus 2/6 P. & P. per unit (less accessories). Quantity export inquiries welcomed.

— TRANSISTORS ! ! ! —
SURPLUS P.N.P.
RED SPOT (Audio/Experimental Application) .... 5/- ea.
WHITE SPOT, R.F. up to 2.5 Mc/s .... 5/- ea.
Attractive discounts for bulk purchases. The above is a selection only. Full range in stock by all leading manufacturers. Let us have your enquiries.
(ALL POST FREE)

FRUSTRATED EXPORT Not repeatable! L., M. and S.W. SUPER-HET RECEIVER. Manufactured by McCarthy for export. At present for operation on 6 volts, but conversion details supplied free.

Valve line-up: 6K8G, 6K7G, 6Q7C, 6F6G, 6X5G and 6 volt 4-pin non-synchronous vibrator. 8in. P.M. Speaker, 4 watts output, P.U. socket Ext. L.S. socket, etc. Tone control. Fitted in polished wood cabinet, size 21¾in. x 10½in. x 10½in. These cabinets are slightly soiled owing to storage, but each is guaranteed unused, in serviceable condition, tested prior to despatch. Price £5/19/6 only plus P. & P. 7/6, plus 27/6 for A.C. Mains Conversion Components if required. **OUTSTANDING BUY !**

12 CHANNEL TV TURRET TUNER (By famous manufacturer). Brand new, **NOT** surplus or ex-equipment. 35 Mc/s. **I.F. PCC 84** and **PCF 80** valves. Complete with coils: Band I Channels 1 to 5. Band III Channels 8 to 11. In manufacturers original carton. Fully guaranteed at only 39/6 plus 2/6 P. & P.



AMPLIVOX HEADSET SPECIAL (not surplus). As used in up-to-date ships, aircraft, etc. Excellent quality super lightweight, low impedance, magnetic headphones complete with button microphone attached and plastic ear moulds. Absolutely brand new. 45/- pair. Plus 1/6 P. & P.

ACOS MIC 39-1. Crystal stick microphone. List price 5 gns. Our price 39/6 plus 1/6 P. & P.
MIC40. General purpose crystal microphone with desk stand. Our price 25/- only plus 1/6 P. & P.

LATEST COLLARO STUDIO TAPE TRANSCRIPTOR. 3 motors, 3 speeds, 1⅞, 3¾, 7½ i.p.s., takes 7in. spools. Push-button controls, £15/15/- plus 5/- P. & P. Usual H.P. facilities.

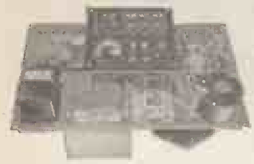
TAPE RECORDER AMPLIFIER for use with Collaro Studio Transcriptor. Size 11¼ x 5 x 3in. Uses 3 valves, magic eye, contact cooled metal rectifier. Incorporates mike/gram/radio inputs, ext. l.s. jack, superimposing switch, £12/12/-. Complete with matching knobs (Gold/Black). Circuit etc. Post 3/6.

LATEST B.S.R. "MONARDECK." Single speed Tape Deck. Takes 5¾in. spools—3¾ i.p.s. At £9/19/6 only plus 5/- P. & P.

CLYNE RADIO LTD.
THE COMPONENT SPECIALISTS
162 Holloway Road, London, N.7.
99 Cheapside, London, E.C.2.
18 Tottenham Court Road, London, W.1.

Get Finest Value from IRONGATE—England's Leading Equipment Wholesalers
Bulk Buying means LOWEST PRICES. All Equipment is in TIP-TOP condition

VOLTAGE REGULATOR—115v.



Relay and motorised Variac control. Suitable for hand or automatic control. Mains Input Range 100/120 v. Separate meters for input and output reading. Contains complete overload cut-out (switch type) and sensitive 4in. moving coil (meter reading type). Handling capacity 8 amps. £35. Delivered Free.

ATTRACTIVE INSTRUMENT CABINET

LIMITED QUANTITY ONLY

7ft. x 2ft. grey enamel finish. For housing and protecting equipment. Standard 19in. rack mounting (heavy angle side channels). Sliding ball-bearing runners. 2 door (front and back) position action locking chrome handles. Carr. 30/-. **£26.10.0**

WORLD FAMOUS TELEPHONES

"F" TYPE IN ATTRACTIVE CASE

The best portable telephone ever made. With a range of up to 5 miles is ideal for FACTORIES, BUILDING SITES, FARMS, CIVIL ENGINEERING PROJECTS, OUTSIDE BROADCAST UNITS AND OFFICES. **2 perfect sets (SUPERIOR QUALITY)** in individual carrying cases, complete with long life batteries, bells, magneto and 100ft. telephone cable.

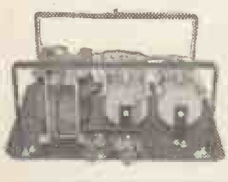
£7.10.0 per pair. Carr. 7/-.

TELE "F" HIGH POWER as above, but complete, with amplifier, £6/10/- each. Carr. 12/6

D3 STRANDED TELEPHONE CABLE. New Mile Drum 85/-. Carr. 17/6.

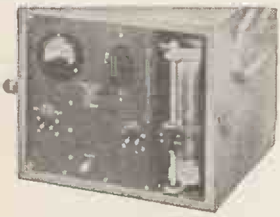
ENGLAND'S LARGEST STOCKS OF TELEPHONE EQUIPMENT

G.E.C. L.T. SUPPLY UNIT



OUTPUT: 24 volts, 10 amps. D.C. INPUT: 200/250 volts A.C. New and in original cases.

£13.10.0 Carr. 9/6.



ROTARY CONVERTORS. 12 v. D.C. input. 230 volts A.C., 150 watts, 50 cycles output. Housed in wooden case and fitted with voltage control slider resistance switch, plugs and A.C. mains voltage output check meter. Supplied in perfect condition, individually tested, £9/19/6 each. P. & P. 10/-.

HEAVY DUTY 20 AMP. L.T. SUPPLY UNIT

by **S.T.C.**

Normal cost over £100

Essential equipment for Electronic Engineering, research laboratories, schools. Ideal for battery charging, etc. Guaranteed for 20 amps.
Output: D.C. Variable up to **20 amps.** and **24 v.** or trickle charge 125/350/700 ampere hours.
Input: A.C. 100/260 volts 45/65 cycles.
Size: 16 x 24 x 32in. high.
In attractive Grey Cabinet. **£22-10-0** ex Warehouse
(Circ. diags. and instru. loaned for 10/- deposit).

CONSTANT VOLTAGE TRANSFORMERS

FERRANTI 7½-KVA MOVING COIL
Stabilized output voltage in the range 200-250 v. Plug-board tappings. The selected output voltage is constant with ±½% at all loads 0 to 30/87½ amps. when the supply voltage is varying over the range +8% to −12%.

- Frequency compensated 45·55 and 54·66 c/s.
- Excellent output wave-form.
- Can be used as a variable transformer.
- Unused. Complete with spares and instruction book at a fraction of the normal cost, only £65.
- **A.C. MAINS STABILIZER.**

AUTO TRANSFORMERS

3KVA Air Cooled (100% under-rated).
GUARANTEED 230/250 tapped, 12 amps.
6 KVA 105/120 tapped, 28.5 amps.
Made by well-known manufacturer and housed in strong metal case. Weight: 2 cwt. Brand new, in original maker's cases.
PRICE £15.0.0 Carr. 25/-.

EXPORT ONLY

Just released by the Ministry of Supply, **"88" SETS.** Manufactured by E. K. Cole. The latest miniature Walkie Talkie—3,000 available. **£10** each.

"22" SETS ALSO—300 available only. New condition **£10** each.

Enquiries are invited for Bulk supply at reducing low prices.

Greater-than-ever-Values

BARGAIN DISPOSALS

26B RECTIFIER UNITS. £10 each. Carr. 17/6.
80 REPERFORATORS 7TR £20 each. Carr. 30/-.

1,000,000 YARDS !! SCREENED WIRE FLEX FOR ONLY 3d. per yard

For Immediate Delivery—priced far below cost.
Specification: Close braided 14/.0048 in. Covered .024 p.v.c. Tinned Copper. Screened. Assorted colours. Applications: Microphone leads, pick-up beads, etc.
ON MAKER'S REELS.
220 yd. REELS (min. quantity), 55/-. P. & P. 5/-. TEN REELS £25. Carr. Paid.

SUPER POWER AMPLIFIER

Multiple Speaker System

Output: 30 to 60 watts. Valves: Four 6L6, Parallel Push-Pull.
Input: 200-250 volts.
Leads, hand microphone, plugs and spares included. In robust wooden transit case 17½ x 15¾ x 21¼in. **Will take up to 20 Speakers.**
£22/10/- Carr. 17/6.
Speakers 18/6 each extra. 3/6 carr.

P.A. SYSTEM (EX GOVT.)

Complete with amplifier unit, 4 speakers, microphone, headphones and all spares packed in wooden cases. 6 or 12 volts D.C. handling capacity 8 watts. Ideal for cars, boats, factories, etc. **£7/10/0.** Carr. 30/-

AERIAL MASTS

IMPROVED TYPE 50 MK.II 36ft. HIGH

Kits comprise—six 2¼in. dia. Tubular Steel Sections of 6ft. length, top-section and base Pickets, Guys and Fittings. **YOU** can purchase this normally expensive MAST for a fraction of its cost. Please add £1 for (returnable) wooden carrying case. The MAST is particularly suitable to take aerials for Tx., Rx. F.M. and TV. (especially **COMMERCIAL**) and has many other uses. Extra 6ft. sections can be supplied at 17/6 per section.
£8.10.0 only Carr. 15/6

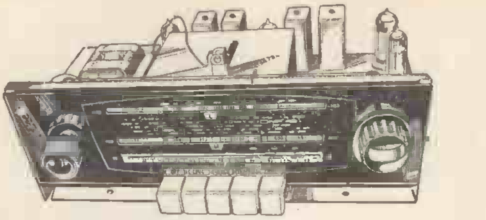
U.S.A. Type 45ft. TELECOM AERIAL MAST. (7 sections, 6ft. 8in. x 2¼in., guys, etc.). This entirely complete set in carrying case 12½ Gns. Carr. 17/6. Or 2 sets for **£25.** Carr. extra. *British Manufacture only.*

ARMY TYPE 32ft. MASTS similar to above but 10 1in. screw-sections, suitable for permanent lightweight installation. Kit in canvas bag, £3/15/-. Carr. 7/6.

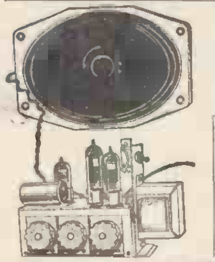
Limited Quantity
36ft. TELESCOPE MASTS
Finest quality brass. Non-rusting. Base diameter 2½in. Complete with hand-winding winch for easy, rapid extension; and cable-wire bracing stays. One of the best masts ever produced. Winds down to 9ft. **£35** each. Carr. £1/10

Irongate (M.O.) COMPANY
Dept.(WW9), 2, IRONGATE WHARF ROAD, PRAED STREET, LONDON W.2
PADDINGTON 2231/2/3

BRAND NEW AM/FM (V.H.F.) CHASSIS AT £13.6.8. (P. & P. 10/-)



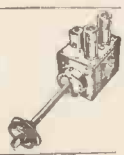
Why buy a F.M. Tuner at the same price?
Tapped input 220-225 v. and 226-250 v. A.C. ONLY.
Chassis size 15 × 6¾ × 5½in. high. New manufacture.
Dial 14½ × 4in. in gold and black.
Pick-up. Extension Speaker, Ae., E., and Dipole sockets. Five "piano" push buttons—OFF, L.W., M.W., F.M. and Gram. Aligned and tested.
With all valves & O.P. Transformer, Tone-control fitted.
Covers 1,000-1,900 M.; 200-500 M.; 88-99 Mc/s.
Valves EZ80 rect., ECH81, EF89, EABC80, EL84, ECC85. Speaker and Cabinet to fit chassis, **47/6.**
10 × 6in. ELLIPTICAL SPEAKER, **20/-.**
TERMS:—(Chassis) **£4/16/8** down—10/- carr.—and 6 Monthly Payments of **30/-**, or with Cabinet and Speaker **£5/9/2** down and 7 Monthly Payments of **32/-**.



3-VALVE AMPLIFIER (INCL. RECT.)

Capable of giving 6 watts. Mains and output transformers. Valves ECC81, EL84 and Rect. 3 Controls. volume, bass and treble. On/Off switch. Fully guaranteed. Chassis size 6½ × 3 × 2½in.; with 7 × 4in. elliptical speaker or 6½in. round (Goodmans); state which.
ONLY **67/-**, (3/- P. & P.).

STUPENDOUS OFFER! 13-CHANNEL TUNER



I.F. 34-38 Mc/s. complete with valves PCF80 and PCC84 Removed from chassis but in working order.
15/- (2/6 P. & P.) Knobs 2/6 extra. Some tuners less valves **7/6.**

50 SILVERED MICA AND CERAMIC CONDENSERS, **10/-**. 50 RESISTORS, 5/- ALL NEW.

NEW WAXED TUBULARS, 350 v. or above, 3 of each. .001, .002, .005, .01, .02 .05, .1 mF. Total 21 for **4/6.** post paid.

NEW ITA AND BBC TUNER

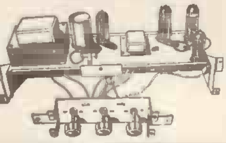
By well-known manufacturer for superhet TVs with 35-38 Mc/s. I.F. For all areas; covers all 13 channels. Switch gives BBC and two ITA selections. Suits G.E.C. sets BT4543, 4544, 5146, 5147, 5543, 5642 and 6641 without alteration. Easily adapted as aerial convertor. and instructions can be provided free. Has ITA and BBC co-axial sockets and separate gain controls.
WITH VALVES PCF80 and PCC84. **22/6** (P. & P. 3/-).
Some without valves at only **12/6** (P. & P. 3/-).

GRAMOPHONE AMPLIFIER

with 5in. SPEAKER. On Fabric-covered Baffle 12½in. × 5in. Mains and Output Transformers. Metal Rectifier. ECL82 Valve. Tone and Volume Controls. On/Off switch. Plenty of Volume. Fully Guaranteed. Two Knobs supplied. Ready to play. Useful for Stereo. ONLY **57/-**, post 3/-.

PUSH-PULL AMPLIFIER £5.10.0

(3/6 P. & P.)

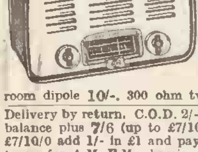


Brand new by famous manufacturer. 200-240 A.C. mains. Bass, treble and vol. controls flying panel. With valves EZ80, ECC83 and 2-EL84 giving full 8 w. Chassis 12 × 3¼ × 3½in. With o.p. trans. for 2-3 ohm speaker.

FULLY BUILT BATTERY OPERATED TRANSISTOR RECORD PLAYER FOR £7.19.6

(3/6 P. & P.)

Built and tested. Cossor printed circuit 4-transistor amplifier: Garrard 45 r.p.m. battery player type BA1; speed control: Cabinet size 11 × 9 × 5in.; less than 8½lb. Requires two Ever Ready AD28 batts. State colour—red/cream or blue/cream.



LISTEN WITHOUT INTERFERENCE

Fully built V.H.F./F.M. Set. Wired, aligned and tested. Six Mullard valves, 88-98 M/cs. Metal (Blue and grey) cabinet 12 x 7¼ x 6in. ONLY **£8/8/-** (4/- carr.). Cheap room dipole **10/-**. 300 ohm twin feeder, 6d. yd. With 12 months' guarantee.

Delivery by return. C.O.D. 2/- extra. Terms: Cash with order or one-third down and balance plus **7/6** (up to £7/10/0) in four equal monthly payments. Balance over £7/10/0 add 1/- in £1 and pay in not more than 6 monthly payments. See special terms for A.M.-F.M. chassis. All new goods unless stated. Send 6d. for 16-page catalogue.

GLADSTONE RADIO 58A HIGH ST., CAMBERLEY, SURREY. Tel. 22791
or callers to 3 Church Road, Bristol 5 Tel. 51207 (Camberley closed Sat.)
247, New Road, Copnor, Portsmouth, Hants.
(Portsmouth and Bristol closed Wednesday afternoon)

BENSON'S BETTER BARGAINS

TRANSFORMERS, potted, " C " core; Input 230 v. Outputs:—6.3 v., 0.3 A. (1 A. actual), twice, **8/6;** Outputs:—510-0-510 v. 275 mA, 375-0-375 v. 83 mA, 5 v. 3 A., 6.3 v. 7 times (17 A.), **45/-.** **CONDENSERS,** block, paper; 8 mfd. 250 Vw. **4/-;** 600 Vw. **6/-;** 4 mfd. 2 kVw. **7/6;** 600 Vw. **3/6.** Switch fuse splitter, DP. 15 A. **15/-.** Panel fuseholders, **1/3;** Panel Lampholders (indicators), **1/6.** **POWER UNITS.** Input A.C. 115/250 v. Outputs: D.C. 330 v., 120 mA. and 6.3 v. A.C. twice. Potted trans. and LF choke, new (post 3/6), **30/-.** **MONITOR 56,** triggered oscilloscope, comprising **Indicator 248** and **Power Unit 675.** Valves VCR138a, 3/EF50, 2/ECC33, 5/EF55, EF37A, 6V6, 3/EA50 and 2/5U4G, VU120A. Two units each 12 × 9 × 18in., black finish. 230 v. A.C. input, with 18-way cable and mains cable and circuit. Cathode probe unit extra, **17/6, £8/10/-** (Rail 20/-)' **INDICATORS, Type 101** with VCR530 and 2/EB91, 2/EF91, 2/R10, new cond., **30/-** (post 7/-). **Type 1** with VCRX263, 2/EF52, 5/6J6, 1/6V6, 1/EY51, 2/EB91, 3/EF91, RF EHT Generator and 28 kc/s, xtal, **45/-** (Rail 7/6) **HEADPHONES,** CLR, **7/6.** **CR100** Noise Limiter assemblies, with valve, **3/6.** **NEW M.C. METERS,** 3½in. round flush, 50μA, **70/-;** 200μA, centre zero, **50/-;** 1 mA, centre zero, **45/-;** 1 mA, **55/-;** 2½in. 1 mA, **22/6;** 2in. 300 mA, each **8/6.** 2½in. M.I. 20 v. A.C., **8/6;** 300 v. A.C. 2½in., **15/-.** **VIBRATORS,** Mallory G634C 12 v. 4-pin, **7/6;** 6 v. 5-pin reversible, **7/6.** **R1155B,** good condition, tested with handbook. **£7/10/-** (Rail 10/-). **DRIVES:** slow-motion Admiralty 200:1 ratio, scaled 0-100, **5/6.** **R1155 S.M.** " N " type, new, **10/6.** **VIBRAPAK,** 6 v. D.C. to 250 v. 60 mA, smoothed case, **22/6.** **12 v. to 250 v. 60 mA, 21/-** (p.p. 3/6). **DYNAMOTORS** (post 3/6). 12 v. to 250 v. 65 **mA, 11/6;** 6 v. to 250 v. 60 **mA, 11/6.** **ROTARY CONVERTERS.** Input 24 v. D.C. Output 50 v., 4 a., 50 c/s., **40/-** (Rail 7/6). **CATHODE RAY TUBES.** New: VCR 139A or VCR 138, each **30/-;** Potentiometers, miniature wirewound, 6Ω, 100Ω, 600Ω, 1k and 2k, each, **1/-.** **CHOKES,** LF 10H 200 mA, **8/6;** 100H 60 mA., **8/6,** **9H** 100 mA, **5/6;** Potted 10H 100 mA, **7/6;** " C," 5H 400 mA, **10/6,** 10H 250 mA, **12/6;** 10H 50 mA, **6/-.** **R.F.27,** good cond., **18/-** (p.p. 3/6). **METAL RECTIFIERS,** 240 v. 100 mA., **4/-;** 240 v. 30 mA. **3/6;** 600 v. 30 mA. **5/6;** 240 v. 80 mA. **5/6;** 1,000 v. 30 mA, **7/6,** 350 v. 2 a, **20/-.** **Mic. Inserts,** G.P.O. carbin, **2/6.** **CONTROLS Camera** Type 35; a timing device, new **10/6.** (post 3/6), **COMMAND** Receivers, medium-wave (520-1,500 kc/s), 6 valves; new, **97/6;** used **82/6.** Conversion data for above to CAR RADIO, **12** v., with circuit, **1/6.** **RELAYS,** potted, small, 1,700+1,700Ω, hi-speed SP c/o, **10/6.** 2,500Ω 2 make, **6/-.** **TEST SET 263,** 9280-9480 mc/s. with waveguides, 50μA and **1.5** mA, meters, **£5/10/-** (Carr. 10/-).

LIST AND ENQUIRIES S.A.E. please. Terms, C.W.O. **Postage extra.** Immediate despatch.

Callers & Post: **W. A. BENSON (WW), 136 Rathbone Road, Liverpool, 15.**
Callers: *SEF* 6853
SUPERADIO (Whitechapel) Ltd., 116 Whitechapel, Liverpool, 2. *ROY* 1130

Second, revised edition of a comprehensive appraisal by internationa experts on one of the most important plastics materials.

POLYTHENE

THE TECHNOLOGY AND USES OF ETHYLENE POLYMER

Edited by

A. Renfrew, Director ICI Plastics Division
Phillip Morgan, Editor " British Plastics"

Acknowledged to be the standard, authoritative text boo in its field, this new edition has been virtually rewritte with added chapters to keep up-to-date with the ne developments in polythene manufacture and application

Experts from the United States, Germany and Grea Britain have contributed to this authoritative book fo technologists in the plastics industry and other industrie where polythene is used.

If required the book may be had on 14 days' approv

165s. net by post 167s. Over 870p. inc. 93 art plate **from leading booksellers.**

A 'British Plastics' book published by Iliffe & Sons Lt

DORSET HOUSE STAMFORD STREET LONDON S.E.

Special Offer!

HIGH QUALITY RECORDING TAPE

By Famous Manufacturers

Stand. Play, 1,200ft., 7in. reel .... 22/6 (P. & P. 1/6)
Stand. Play, 600ft., 5in. reel .... 16/6 (P. & P. 1/-)
Long play, 1,800ft., 7in. reel .... 32/6 (P. & P. 1/6)
Long play, 1,200ft., 5¾in. reel .... 25/- (P. & P. 1/-)
Double play, 2,400ft., 7in. reel ...... 65/- (P. & P. 1/6)

ALL BOXED AND GUARANTEED NEW STOCK

New additions to GOODMANS speaker range

Latest release of two 10" units

AXIOM 110 - £5. 10 watts 40-1500c/s

AXIOM 112 - £8 10s. 12 watts 40-15000c/s

also the new Triaxiette Super 8in. Unit £13/10/-.

The well-known 8in. Axiette (£6/12/-) and the 12in. Audiom 60 (£9/12/-) as recommended for two speaker systems, are still available, ex stock.

RECOMMENDED RECORD PLAYER BARGAIN

E.M.I.—4-speed Single Player Unit, fitted with latest stereo and monaural Xtal cartridge and dual sapphire styli. Auto stop and start. A fidelity unit and bargain buy at only £6/19/6 (carr. and insurance 3/6).

SINGLE PLAYERS: BSR (TU9), with Ful-Fi P.U., 90/-; GARRARD (4SP), £6/17/6; GARRARD TA Mk. II with plug-in GC8 Xtal head £7/19/6. carr. and insurance 3/6.

AUTOCHANGERS: BSR (UA8), £6/19/6. BSR UA8 fitted with Stereo/Monaural cartridge, £7/19/6; COLLARO Conquest £7/19/6; GARRARD (RC121 4D, Mk. II). plug-in head, stereo adapted, 10 gns. Stereo head £2 extra.

RECORD PLAYER CABINETS

Contemporary styled, rexine covered cabinet in two-tone fawn and brown, or mottled red with white polka dot. Size 18½ × 13½ × ht. 8½in., fitted with all accessories, including baffle board and anodised metal fret. Space available for all modern amplifiers and autochangers, etc. Uncut record player mounting board 14 × 13in. supplied.

Cabinet Price £3/3/-. Carr. and Ins. 3/6.

2-VALVE 2-WATT AMPLIFIER

Twin stage ECL82 with vol. and neg. feedback. Tone controls AC 200/250 v. with double-wound Mains trans. Complete with knobs, etc., ready wired to fit above cabinet.

£2/17/6 P. & P. 1/-.

6in. Speaker and matching trans., 22/-. P. & P. 1/6.

NEW BOXED VALVES ALL GUARANTEED

1R5, 1T4	7/6	EABC80	9/6	EZ81	7/6
1S5	7/6	ECC84	10/6	MU14	9/6
3S4, 3V4	8/-	ECF80	11/6	PCC84	10/6
5Z4	9/6	ECH42	10/6	PCF80	10/6
6K7	5/6	ECL80	10/6	PCL83	12/6
6K8	8/6	EF80	9/6	PL81	12/6
6Q7	8/6	EF86	13/6	PL82	9/6
6V6	7/6	EF91	8/6	PL83	11/6
DAF96	9/-	EL41	10/6	PY80	7/6
DF96	9/-	EL84	9/6	PY81	9/6
DK96	9/-	EY51	10/-	PY82	7/6
DL96	9/-	EY86	10/-	U25	12/6

Send for list of more valve bargains.

SPECIAL PRICE PER SET
1R5, 1T4, 1S5, or 3S4 or 3V4, 27/6
DK96, DF96, DAF96, DL96, 35/-
6K8, 6K7 6Q7, 6V6, 5Z4 or 6X5, 35/-

COAX 80 OHM CABLE.

Stand ¼in. diam. Low Loss Semi-Air Spaced Aeraxial. Top grade cable—not to be confused with inferior types.

Special Reduced Prices

20 yds. 12/6, p. & p. 1/6; 60 yds. 32/6, p. & p. 2/-; 40 yds. 22/6, p. & p. 2/6. All other lengths 8d. per yard. Coax Plugs 1/-, Sockets 1/-, Couplers 1/3, Cable End Sockets 1/6, Outlet Boxes 4/6.

TRANSISTORS

Bulk Purchase—Brand New

OA70 .... 3/-
OC70 .... 8/6
OC72 (XC101) 10/6
OC45 (XA101) 14/6
OC44 (XA102) 16/6

All branded BVA Types. First Grade.

NOW! TheTouRiSt Portable

4 valve. Med. & L.W., L'tweight battery Radio. Size only 8in. × 5½in. × 4in. Weight 3½lb. with battery:— P. & P.

Complete receiver component kit 57/6 1/6
Set 4 miniature valves (96 series) 35/- 9d.
5in. Speaker & O/put Trans. ... 21/- 1/6
Cabinet Dial and Knobs, etc... 22/6 2/-

Latest superhet circuitry delayed AVC and A.F. Neg. feedback.

Complete kit—BARGAIN—only £6.10.0, post free

Terrific performance— Remarkable size— Staggering Value

Send for Booklet NOW: 1/6 post free.

JASON FM TUNER UNITS (87-105 Mc/s)

Designer-approved kits of parts for these quality and highly popular tuners available as follows.

STANDARD MODEL (FMT)—as previously extensively advertised. COMPLETE KIT, 5 gns., post free. Set of 4 spec. valves, 30/-, post free.

LATEST MODEL (FMT2)—attractively presented shelf mounting unit to enclosed Metal Cabinet with Built-in Power Supply.

COMPLETE KIT, £7, p. & p. 3/6. Set of 5 spec. valves, 39/6.

NEW JASON COMPREHENSIVE F.M. HANDBOOK, 2/6 post free. 48hr. Alignment Service, 7/6, p. & p. 3/6.

MULLARD "3-3" AMPLIFIER

Quality built to Mullard's specification, with special sectionalised O/P Trans.

Complete kit with front panel only £6/19/6. P. & P. 3/6.

C.R.T. Heater Isolation Transformers

New improved types—mains prim. 200/250 v. tapped

All Isolation Transformers now supplied with alternative *no boost, plus* 25% and *plus* 50% boost taps at no extra charge.

2V. 2A type.... 12/6 (P. & P. 1/6)
6.3V. .6A type.. 12/6 (P. & P. 1/6)
10.5V. .3A type 12/6 (P. & P. 1/6)
13V. .3A type .. 12/6 (P. & P. 1/6)

Small size and tag terminated for easy fitting. Other voltages available.

RE-GUNNED TV TUBES NEW REDUCED PRICES

... and now 12 months guarantee !

All tubes rebuilt with new heater, cathode and gun assembly — reconditioned virtually as new.

12in. £6, 14in. £7, 17in. £8/10/-, etc.

10/- part exchange allowance on old tube

Carr. and ins. 10/-. Comprehensive stocks—quick delivery.

CONDENSERS—Silver Mica. All pref values, 2 pf. to 1,000 pf., 6d. each. Ditto ceramics 9d. each. Tubulars 450 v. T.C.C. etc., .001 mfd.-01 and .1/350 v., 9d. each. .02-1/500 v., 1/- each. .25 Hunts 1/6, .5 T.C.C. 1/9. .001 6 kv. 5/6. .001 20 kv. 9/6.

RESISTORS—FULL RANGE 10 ohms—10 megohms 20%, ¼ w. and ½ w. 3d., 1 w. 5d. (Midget type modern rating), 1 w. 6d., 2 w. 9d., 10% Hi-stab. ¼ w., 5d., ½ w., 7d., 5% ½ w., 9d., 1% HI-STAB, ½ w. 1/6 (10-100 ohms 2/-).

PRE-SET W/W POTS. T/V Type, 25 ohms—50 K ohms 3/-. 50K—2 Meg. (Carbon 3/-).

SPEAKER FRET—Expanded Bronze anodised metal 8 × 8in. 2/3; 12 × 8in. 3/-; 12 × 12in. 4/6; 12 × 16in. 6/-; 24 × 12in. 9/-; 36 × 12in. 13/6, etc., etc.

TYGAN FRET (Contemporary pat.), 12 × 12in. 2/-; 12 × 18in. 3/-; 12 × 24in. 4/-, etc.

LOUDSPEAKERS—P.M. 3 ohms. 2½in. Elac 17/6. 3½in. Goodmans 18/6; 5in. Rola, 17/6. 6in. Elac, 18/6; 7 × 4in. Goodmans Elliptical. 18/6; 8in. Rola, 20/-; 10in. R. and A., 25/-; 10in. W.B.-HF1012. 99/9. 12in. Plessey 15 ohms with 6/4L. Tweeter and Cross Over Filter, 97/6.

Electrolytics All Types New Stock

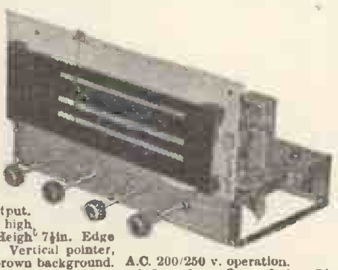
TUBULAR		CAN TYPES	
25/25 v. 50/12 v.	1/9	8+8/450 v.	4/6
50/50 v. 100/25v.	2/-	32+32/275 v.	4/6
8/450 v.	2/3	50+50/350 v.	6/6
16+16/450 v.	5/6	60+250/275 v.	12/6
32+32/450 v.	6/6	100+200/275 v.	12/6

Comprehensive range in stock.

VOLUME CONTROLS—10K—2 Megohms. ALL LONG SPINDLES, MOCCANITE MIDGET TYPE. 1⅛in. diam. Guar. 1 yr. LOG or LIN Ratios less Sw., 3/-. D.P. Sw., 4/6. Twin gang controls ¼ Meg., ½ Meg., 1 Meg. less Sw., each. 8/9.

7 VALVE AM/FM RADIOGRAM CHASSIS

Valve Line-up: ECC85, ECH81, EF89, EABC80, EL84, EM81, EX80.



Three Waveband and Switched Gram positions. Med. 200-500 m., Long 1,000-2,000 m., VHF/FM 88-95 Mc/s. Philip's Continental Tuning insert with permeability tuning on FM and combined AM/FM IF transformers. 460 Kc/s and 10.7 Mc/s. Dust core tuning all coils. Latest circuitry including AVC and Neg. Feedback. Three watt output. Sensitivity and reproduction of a very high standard. Chassis size 13½ × 6½in. Height 7½in. Edge Illuminated glass dial 11½ × 3½in. Vertical pointer. Horizontal station names. Gold on brown background. A.C. 200/250 v. operation.

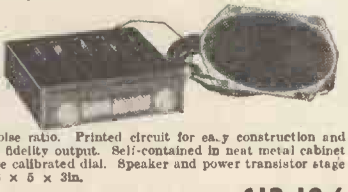
***Aligned and tested ready for use.* £13.10.0** *Carr. & Ins. 5/-*

Complete with 4 Knobs—walnut or ivory to choice.
Three ohm P.M. speaker only required. Recommended quality speakers.
8in. Goodmans special cone.................. 21/6
10in. Rola (Heavy Duty)..................... 30/-
Post & Pkg. 1/6.

As previously announced fresh supplies are now being received, but we regret some slight delay may be experienced in fulfilling orders for this popular item.

2 WAVEBAND CAR RADIO KIT

12 v. operation Med. & Long Waves



Modern development of the famous Brimar Hybrid vibratorless car radio circuit. Five latest type Brimar low voltage valves and power transistor. R.F. stage and permeability pre-aligned Cyldon Tuner Unit provide extremely good sensitivity and signal noise ratio. Printed circuit for easy construction and 7 × 4in. elliptical speaker for fidelity output. Self-contained in neat metal cabinet 8 × 7 × 2½in., with attractive calibrated dial. Speaker and power transistor stage mounted separately approx. 8 × 5 × 3in.

Recommended Buy *Complete Kit Bargain Price* **£12.19.6**

Instruction booklet and parts list available, 3/6 post free. P. & P. 3/6.

ONLY A FEW ITEMS ARE LISTED FROM OUR COMPREHENSIVE STOCK. WRITE NOW FOR FULL BARGAIN LISTS, 3d.

Terms: C.W.O. or C.O.D. post and packing up to ½lb. 7d.; 1lb. 1/1; 3lb. 1/6; 5lb. 2/-; 10lb. 2/9.

RADIO COMPONENT SPECIALISTS

70 BRIGSTOCK RD., THORNTON HEATH, SURREY

Established 1946. Tel.: THO 2188. Hours: 9 a.m.—6 p.m. 1 p.m. Wednesday

Tubes

HIGHEST QUALITY—NEW LOW PRICES
Carr. & Ins. 12/6 GUARANTEED

MOST MULLARD, MAZDA, COSSOR, EMITRON, EMI-SCOPE, BRIMAR, FERRANTI TYPES PROCESSED IN OUR OWN FACTORY.
New Mullard, Mazda & U.S.A. guns used.
NEW 108K 39/- (Equiv. 3/16)

	6 Months REVACUUMED	12 Months REGUNNED	12 Months NEW TYPES
9/10in.	£2- 0-0	£3-10-0	Mw 31/74 £4-10-0
12in.	£2-10-0	£4-10-0	
14in.	£3- 0-0	£5- 0-0	Mw 36/24 £7-10-0
15/17in.	£3-10-0	£5-15-0	
21in.	£4-10-0	£6-15-0	Mw 43/64 £8-10-0

PM SPEAKERS
Top Makes Guaranteed
6in. 8in. 8/- 5in. 7×4 11/- 10in. 10×6 13/-

TRANSISTORS: RED SPOT 4/6
I.F., L.F. and Output up to 800 kc/s. 48/- doz. WHITE SPOT. R.F. and I.F. 2.5 Mc/s., 6/6, 69/- per dozen.

CO-AXIAL CABLE
Semi-air spaced, low loss. 50 yard drums 22/6, carr. 2/-. 6 drums 125/-, carr. 5/-.

B.S.R. TAPE DECKS £9/10/-
COLLARO
B.S.R. Monarch £6 15 0
COLLARO CONQUEST £6 19 0

13 CHANNEL TV's
TABLE MODELS, FAMOUS MAKES.
Absolutely complete

These sets are unequalled in value due to huge purchase direct from source. They are untested and are not guaranteed to be in working order. CARR., ETC., 15/-.

12" — £3.19
14" — £6.19
17" — £9.19

ALSO 12" 5 CH. TV's 55/-

C.R.T's ECR30 15/-; 5FP7 12/6; ECR35 9/-; VCR97 12/6.

4-SPEED RECORD PLAYERS
Latest Turntable, together with light-weight Staar Galaxy dual sapphire crystal turnover pick-up head. Amazing value (Pick-up only 19/-.) £3/10/-. Carr. 3/-.

RECTIFIERS:
For Chargers selenium, full wave bridge, 12 volt 3·4 amps., 9/6. 250 v. 80 mA., 5/-. RM1, 6/6; RM2, 8/-; RM3, 9/-; RM4, 15/6; RM5, 21/-; 14A86, 17/-; 14A97, 23/-; 14A100, 25/-.

100 RESISTORS 7/-
100 CONDENSERS 10/-
A must. A well balanced assortment of miniature silver mica and ceramic condensers. 3-10,000 PF. List value over £5.

ALL DRY PORTABLES
Famous Stella shoulder strap, super polka dot finish. Economy valves, lightweight. Listed £13/2/6. Truly an unrepeatable snip £7/19/-. Manufacturers' sealed carton.

INSTRUMENT C.R.T.'s

Carriage and packing: 3·5in. 4/-; 6in. 4/6; 9in. 5/-; 12in. 7/6.

CV601 (5BP1—5in.) 25/-
CV718 (5FP7—5in.) 15/-
CV965 (3in.) 7/6
CV1596 (091—4in.) 9/6
CV1869 (12T01A—12in.) 25/-
CV2108 (9M06A—9in.) 19/-
CV2108 (E4504—6in.) 12/6

VCR97 (ECR60—6in.) 14/-
VCR138 (ECR35—3½in.) 15/-
VCR139A (ECR30—3in.) 9/6
VCR517 (6in.) 11/-
VCR517A (6in.) 12/6
SPECIAL—CV2244 (4in.) Flat-faced Projection type tube 15/-

VALVES BY RETURN OF POST

10% DISCOUNT SPECIAL OFFER TO PURCHASERS of any SIX VALVES marked in black type (15% in dozens). Post: 1 valve, 6d., 2-11, 1/-.

NEW LOW PRICES GUARANTEED 3 MONTHS

FREE TRANSIT INSURANCE. All valves are new or of fully guaranteed ex-Government or ex-equipment origin. Satisfaction or Money Back Guarantee on goods if returned unused within 14 days.

OZ4	5/6	6AM6	3/6	6J7G	5/6	6X2	8/9	12C8	8/6	35Z5GT	8/6	DAC32	9/9	ECC34	9/-	EL84	7/-	N78	15/-	SU2150A	4/6	UCL82	11/3
1A5GT	5/-	6AQ5	6/-	6J7GT	7/9	6X4	5/6	12E1	12/6	42	7/6	DAF91	5/3	ECC35	6/9	EL91	4/9	N108	18/-	T41	7/6	UCL83	13/6
1A7GT	11/9	6AT6	7/-	6J8	8/6	6X5G	5/6	12J5GT	3/6	43	7/6	DAF96	7/9	ECC81	5/9	EM34	8/6	N152	10/6	TH30C	12/6	UF41	8/6
1C5GT	9/9	6AU6	7/9	6K6GT	6/6	6X5GT	6/-	12K7GT	5/6	50C5	9/6	DF33	9/9	ECC82	6/6	EM80	9/3	P41	4/6	U14	8/-	UF42	6/9
1D5	9/6	6B7	9/6	6K7	5/9	7A7	10/6	12K8GT	11/6	50CD6G	19/-	DF91	4/-	ECC83	7/-	EM81	9/3	P61	2/3	U18	8/6	UF80	9/-
1D6	9/9	6B8G	3/6	6K7G	2/3	7B5	12/6	12K8	12/6	50L6GT	9/3	DF96	7/9	ECC84	8/9	EM84	9/9	PABC80	11/-	U22	6/9	UF85	9/-
1H5GT	9/9	6BA6	6/-	6K7GT	5/-	7B6	9/6	12Q7GT	5/6	53KU	10/6	DH63	6/9	ECC85	8/3	EM85	10/6	PCC84	7/6	U24	15/-	UF86	14/6
1L4	3/6	6BE6	6/-	6K8	10/-	7B7	7/3	12SG7	6/-	54KU	8/9	DH76	5/6	ECF80	9/9	EN31	16/-	PCC85	9/3	U25	13/6	UF89	7/3
1LD5	3/6	6BG6G	12/6	6K8G	5/6	7C5	7/6	12SJ7	5/6	61SPT	11/-	DH77	7/-	ECF82	9/9	EY51		PCC88	19/-	U26	11/-	UL41	7/6
1LN5	4/6	6BH6	6/-	6K8GT	10/-	7C6	7/3	12SK7	5/6	75	8/-	DK32	11/9	ECH21	14/-	SMALL	8/9	PCC89	13/9	U31	7/3	UL44	12/6
1N5GT	9/9	6BJ6	6/-	6K25	7/6	7E7	9/6	12SN7GT	8/6	77	6/6	DK91	6/-	ECH35	9/6	EY86	8/-	PCF80	7/6	U33	13/-	UL46	9/9
1R5	6/-	6BR7	9/3	6L1	12/6	7H7	7/6	12Y4	9/6	78	7/6	DK92	8/6	ECH42	8/6	EZ35	6/-	PCF82	7/6	U35	8/9	UL84	7/9
1S4	8/6	6BW6	7/9	6L6	9/9	7K7	8/-	14S7	14/9	80	6/6	DK96	7/9	ECH81	8/3	EZ40	6/9	PCL82	8/6	U37	26/6	UM80	9/6
1S5	5/3	6BW7	6/6	6L6G	7/6	7Q7	9/6	19AQ5	7/6	83	9/6	DL33	8/9	ECL80	7/6	EZ41	7/3	PCL83	11/6	U43	8/9	UU6	12/6
1T4	4/-	6BX6	5/3	6L7	9/-	7R7	10/6	19BG6G	15/-	90AV	4/6	DL35	9/9	ECL82	10/-	EZ80	6/3	PCL84	9/9	U50	6/-	UU7	9/6
2D21	4/6	6C4	3/6	6L7G	7/6	7S7	9/6	20D1	9/6	11726	10/6	DL82	9/6	ECL83	14/6	EZ81	7/-	PEN25	4/6	U52	5/-	UU8	25/-
3A4	5/6	6C5	5/6	6L18	9/-	7V7	7/9	20F2	9/6	185BT	16/-	DL91	8/9	EF22	12/-	GT1C	7/-	PEN45	7/3	U76	5/6	UY1N	11/-
3A5	9/6	6C6	4/9	6L19	12/6	7Y4	7/-	20L1	13/6	723A	29/-	DL92	6/-	EF36	3/3	GZ32	8/9	PEN46	5/3	U78	5/6	UY21	11/6
3Q4	7/3	6C9	9/6	6LD3	8/6	7Z4	7/6	20P1	11/6	807A	5/-	DL94	7/-	EF39	4/3	GZ34	12/6	PL33	9/-	U107	11/-	UY41	6/6
3Q5GT	8/9	6CD6G	18/6	6LD12	7/6	8D3	3/6	20P3	12/6	807E	3/9	DL96	7/9	EF40	13/6	GZ37	10/6	PL36	11/-	U191	9/6	UY85	6/9
3S4	6/-	6CH6	9/3	6LD20	8/6	10C1	11/-	20P4	17/-	808	15/-	EA50	9d.	EF41	8/6	HL41DD	9/6	PL38	14/6	U281	9/6	VR105/30	
3V4	7/-	6D1	9d.	6N7	6/6	10C2	13/6	20P5	16/-	954	2/-	EABC80	7/6	EF42	7/6	HVR2	7/6	PL81	9/9	U282	15/-		7/-
5R4G	9/6	6D2	3/9	6P1	14/-	10C14	9/-	25A6G	8/-	955	3/9	EAC91	4/9	EF50-BR	2/-	KL35	7/9	PL82	7/6	U301	14/-	VR150/30	
5U4G	5/-	6D3	12/6	6P25	9/-	10F1	6/9	25L6G	6/9	956	2/9	EAF42	8/6	EF50-USA		KT32	6/9	PL83	7/6	U309	12/6		5/6
5V4G	9/6	6D6	4/9	6P28	12/6	10F9	10/3	25L6GT	9/-	5763	10/-	EB34	1/6		2/6	KT33C	6/6	PL84	11/-	U329	12/6	W61M	11/-
5Y3G	6/-	6F1	5/9	6Q7G	6/9	10L14	8/-	25Y5G	9/-	9001	4/-	EB41	7/-	EF54	3/3	KT36	9/-	PM84	9/9	U339	11/-	W76	5/6
5Y3GT	6/6	6F6G	6/3	6Q7GT	9/3	10LD3	8/3	25Z4G	7/3	9002	4/9	EB91	3/9	EF80	5/3	KT44	9/6	PX25	16/-	U404	6/6	W77	4/9
5Y4G	11/-	6F6M	7/-	6R7G	7/6	10LD12	8/9	25Z5	8/-	9003	4/-	EBC3	9/-	EF85	7/-	KT45	8/6	PY31	8/3	U801	18/-	W81	5/9
5Z4	11/-	6F12	3/6	6SA7	5/9	10P13	9/6	25Z6	9/-	ATP4	2/9	EBC33	5/-	EF86	10/3	KT61	9/-	PY32	10/6	UABC80	8/9	X61M	12/6
5Z4G	8/6	6F13	6/9	6SG7	4/9	10P14	9/6	27SU	16/-	AZ31	9/-	EBC41	8/6	EF89	8/-	KT63	6/6	PY80	7/-	UAF42	9/-	X63	9/6
5Z4GT	11/-	6F14	9/6	6SH7	4/6	10P18	8/-	30C1	7/6	B36	8/6	EBC81	7/9	EF91	3/6	KT66	12/6	PY81	6/6	UB41	8/-	X65	11/-
6A7	10/-	6F15	9/6	6SJ7	5/-	12A6	5/3	30F5	7/-	B65	4/9	EBF80	8/6	EF92	4/9	KT76	9/6	PY82	6/9	UBC41	8/3	X66	11/-
6A8G	9/6	6F16	8/6	6SK7	5/3	12AH7	6/9	30FL1	9/6	CBL31	21/-	EBF89	8/6	EF95	6/9	KT81	14/-	PY83	8/-	UBC81	10/-	X76M	9/6
6A8GT	13/6	6F33	6/9	6SL7GT	6/-	12AH8	9/9	30L1	7/9	OCH35	7/6	EBL21	14/-	EK32	7/9	KTW61	5/6	PZ30	12/-	UBF89	8/6	X78	14/6
6AB8	8/3	6G6	3/-	6SN7GT	4/9	12AT6	7/9	30P4	12/6	CL33	18/-	EBL31	21/-	EL32	4/6	KTW63	4/9	R18	12/6	UBL21	14/6	X79	16/6
6AC7	4/3	6H6	2/-	6SQ7	6/3	12AT7	5/9	30P12	8/-	CY31	9/9	EC52	3/9	EL33	9/-	KTZ63	5/6	R19	12/6	UCC84	14/6	Y63	6/3
6AG5	4/3	6J5	4/3	6SS7	5/-	12AU7	6/6	30P16	7/9	D63	1/6	EC90	3/6	EL35	8/6	L63	2/9	SD6	9/-	UCC85	8/-	Z63	5/3
6AG7	8/-	6J5G	2/9	6U4GT	10/6	12AX7	7/-	30PL1	10/6	D77	3/9	EC91	4/6	EL37	11/6	LN152	7/6	SF6	3/9	UCF80	16/-	Z66	9/6
6AK5	6/9	6J5GT	3/9	6U5G	6/3	12BA6	8/-	35L6GT	9/-	D152	6/6	ECC31	9/6	EL38	12/6	LZ319	7/6	SP41	2/6	UCH21	14/6	Z77	3/6
6AL5	3/9	6J6	4/-	6V6G	5/6	12BE6	8/9	35W4	6/9	DA30	12/6	ECC32	4/-	EL41	8/6	MU14	8/-	SP61	2/6	UCH42	7/9	Z152	5/3
6AM5	4/6	6J7	7/9	6V6GT	6/6	12BH7	10/6	35Z4GT	5/6	DA90	2/6	ECC33	4/9	EL42	9/6	N37	11/-	SU25	15/-	UCH81	8/6	Z719	5/3

COMBINED SERVICES VALVES

Large stocks of special purpose and industrial types available ex stock. We list a proportion of the types available below, and will be pleased to submit our keenest quotations.

CV2	CV59	CV125	CV304	CV511	CV626	CV706	CV973	CV1050	CV1133	CV1190	CV1288	CV1434	CV1759	CV1944	CV2739
6	63	127	303	522	639	709	977	1052	1135	1196	1289	1439	1765	1945	2742
8	64	133	312	525	640	716	980	1053	1136	1207	1293	1442	1788	1951	2769
12	66	138	315	540	641	720	982	1054	1137	1216	1295	1443	1794	1963	2810
13	67	140	338	543	644	721	984	1062	1141	1221	1307	1444	1805	1988	2840
15	72	173	360	555	646	722	991	1069	1144	1223	1322	1453	1812	1990	2874
18	82	185	368	571	647	723	992	1072	1145	1234	1324	1458	1835	1991	2967
21	85	188	392	577	648	727	993	1076	1152	1236	1325	1480	1841	1993	3579
22	86	199	395	581	649	797	1001	1082	1155	1240	1327	1488	1850	2101	3594
25	87	202	405	594	656	801	1019	1088	1160	1241	1331	1491	1852	2215	3595
34	90	208	416	604	659	802	1020	1090	1163	1249	1335	1501	1853	2216	3601
35	94	209	424	608	663	819	1022	1091	1166	1250	1355	1510	1857	2312	3621
43	100	216	428	610	664	848	1025	1103	1167	1260	1401	1569	1859	2547	3693
45	101	222	454	611	667	849	1028	1106	1171	1267	1402	1574	1878	2568	3747
50	102	223	465	612	683	897	1035	1107	1172	1272	1403	1577	1885	2663	3797
52	103	233	487	615	690	916	1037	1113	1174	1274	1408	1582	1896	2666	3799
54	112	248	490	616	697	922	1043	1118	1177	1278	1409	1587	1931	2701	3830
56B	114	265	493	621	700	968	1044	1119	1180	1283	1429	1587	1931	2701	3830
57	121	278	509	623	702	970	1045	1127	1183	1286	1432	1756	1935	2706	3886

List of 1000 Special Offers 6d. Callers always welcome. **POST:** 2lbs. 1/6, 4 lbs. 2/-, 7lbs. 2/9, 15 lbs 3/6. No C.O.D.

TECHNICAL TRADING CO., 350-352 FRATTON RD., PORTSMOUTH

Electronics (FLEET ST.) Ltd

DEPT. B
152/3 FLEET ST., LONDON E.C.4
Telephone: FLE 2833
Business hours: Weekdays 9-6. Saturdays 9-1

STOCKISTS FOR THE FOLLOWING

AMPLIFIERS, STEREO AND MONAURAL, BY:
VERDIK, QUAD, ARMSTRONG, LEAK, ROGERS, W.B., DULCI, etc.

V.H.F. TUNERS BY:
ARMSTRONG, T.S.L., LEAK, DULCI, QUAD, ROGERS, etc.

HI-FI SPEAKERS BY:
GOODMAN, W.B., PLESSEY, T.S.L., WHARFEDALE, G.E.C., LORENZ, etc.

DEFINITELY THE LAST FEW

At this drastically reduced price. The famous R.C.A. orthophonic amplifier. 12-20 watt output. **Distortion:** harmonic less than .1% at 10 watts/700 c.p.s. **Noise Level:** 85 D.B. below rated output. **Frequency Response:** within .2 D.B., 20/25,000 c.p.s., within .5 D.B., 10/60,000 c.p.s. **Feedback:** 40 D.B. total. **Output Impedance:** 3.4 ohms, 7 ohms and 15 ohms. **Spare Power:** 395 v./-5 M.A. and 6.3 v. 2.5 amps. for pre-amp, radio tuner and tape amp. **A.C. Input:** 100/150 v. and 200/250 v. **Valve Line-up:** two EF86, two KT66, one GZ32. **Dimensions:** 16¼ x 8 x 7½in. **Weight:** 32lb. Complete with circuit and instructions £18/19/6 plus 10/- crating and carriage.

THE JUNIOR RCA 5-8 WATT PUSH/PULL AMPLIFIER

A compact Amplifier complete with plug-in Power Pack, valve line-up HY90, 2-19AQ5 and 12AX7, separate bass and treble control, suitable for Speakers of 15 ohms impedance and two 3-ohm tappings for Tweeters. For use on A.C. mains. tapping 115-150 and 210-250 can also be supplied with Power Pack suitable for AC/DC mains. PRICE COMPLETE WITH ESCUTCHEON AND KNOBS, £6/19/6, 3/3 post and pkg.

THE VERDIK "QUALITY TEN"

10 watt push-pull ultra linear hi-fi amplifier with hi gain pre-amp. Mic., radio, gram and tape inputs, bass and treble controls. Beautifully finished. Control panel in gold lettering on grey green. Fully guaranteed. Original price 23 gns. Our price £14/19/6. P. & P. 7/6.

SPECIAL OFFER

2 valve 3 watt printed circuit amplifier made by famous manufacturer, completely assembled, needs output T x F and speaker, at the very low price of 39/6, plus 2/6 post and pkg.

BRAND NEW AND GUARANTEED

7in. reels of 1,200ft. P.V.C. base tape, **21/-**, plus 1/6 post and pkg.
5in. reels of 600ft. P.V.C. base tape, **14/6**, plus 1/6 post and pkg.
4in. reels of 300ft. P.V.C. base tape, **9/6**, plus 1/- post and pkg.
7in. reels of 1,800ft. L.P. P.V.C. base tape, **32/6**, plus 1/6 post and pkg.
5¾in. reels of 1,200ft. P.V.C. base tape, **25/-**, plus 1/6 post and pkg.
Brand new E.M.I. 7in. take-up spools in polythene bag, **3/9** each post free, 6 for **20/-**.
The New American Audio Tape with plastic base. Also supplied in green or blue at no extra cost.
3in. reel 150ft. ... 6/- 4in. reel 300ft.... 10/6
5in. reel 600ft. ... 18/- 7in. reel 1,200ft.... 30/-
Post and packing 1/- per spool.

HI-FIDELITY TAPE HEADS

Made by famous manufacturer. Brand new. Upper or lower track, record/play-back, high impedance giving up to 12,000 c.p.s. at 7½ I.P.S. output 5 m/volts at 1 KC at 7½ I.P.S. Erase heads low impedance.
Only **39/6** per pair. Post 1/-. *State upper or lower track.*

THE NEW "INSTANT" BULK TAPE ERASER
Can erase a spool of magnetic tape in a few seconds. Demagnetises oxide deposits on tape heads. Only **27/6**, post free.

THE NEW TAPE EDITING BLOCK. For standard ¼in. mag. tapes. Can be fixed to tape deck. Only 7/6, 6d. post and pkg. The new Acos telephone adaptor can be attached to any recorder. **21/-** post free.

BIGGEST SCOOP OF THE YEAR

Due to Huge Purchases of the Famous

AVANTIC BEAM-ECHO EQUIPMENT

We can offer the following Hi-Fi Amplifiers brand new in sealed cartons.

DL7-35 POWER AMPLIFIER. 54 watt output peak, intermod distortion .7% at 20w. output, freq. response 5c/s to 30 K/cs ± .0 DB. Load imp. 4, 8 or 16 ohms., switch selected; hum and noise level—85DB relative to 20w. output. Multi voltage input. Makers price 30 gns. **OUR PRICE £34.** 12/6 packing and carr.

SPA21 STEREO AMPLIFIER. Combined twin channel power amp. and pre-amp. unit. Designed for stereo or monaural reproduction. Direct operation from magnetic p/up and hi impedance tape replay head. 25 w. peak output each channel. Frequency response 40 c/s—15 K/cs. ± 1 DB. Loudspeaker 4, 8 and 16 ohms. Tape output, 50m/v. Continuously variable bass and treble controls. Volume and loudness control. Inputs for tuner, tape, p/ups etc. Manufacturers price £48/10/0. **OUR PRICE £29/10/0.** Carriage and packing 12/6.

VHF/FM/MW RADIO TUNER BM611. Shelf styled to match with any of the other Avantic units. Using 8 valves plus rectifier, A.F.C. control, Foster Seeley discriminator ensuring drift-free performance, magic eye tuning on both bands, 88-108 M/cs. Makers price £40. **OUR PRICE £25.** Plus 7/6 post and packing.

STEREO AMPLIFIER. Combined twin channel amplifier and pre-amp control unit. P/pull output, for each channel. 10 watts peak each channel, loudspeaker imp. 4, 8 and 16 ohms. Tape output 100 M/V. Multi voltages, continuously variable bass and treble controls. Stereo balance control, stereo reverse and phase reverse. Makers price 28 gns. **OUR PRICE 19 gns.** Carriage and packing 7/6.

PL6-21 AMPLIFIER AND PRE-AMP. Combined unit. Compactly designed and fully enclosed. Ideal for shelf mounting for monaural reproduction. 30 watt peak power. Intermed distortion 1% at 10w., output impedance 4, 8 and 16 ohms. Radio, tape, p/up, etc. inputs. Separate bass and treble controls. High and low pass filter. **Our price £19/19/0.** Carriage and packing 7/6.

ANOTHER SNIP FOR TAPE RECORDER CONSTRUCTORS

The new Collaro studio tape deck using 3 motors, 3 speeds at 1⅞, 3¾ and 7½ I.P.S., will take 7in. spools, push button controls, **£12/19/6**, 5/- post and pkg. Well designed tape recorder amplifier (not a kit) for the studio deck, incorporating Mic/Gram/Radio inputs, ext. loudspeaker, super imposing switch, with matching knobs, separately mounted mains transformer. Frequency response 60-10K/c 3DB at 7.5 I.P.S., magic eye level indicator. Using ECC83, ECL82 and EM85 and Metal rectifier. Assembly instructions. The 2 units, **£25/10/-** complete Crating and insurance, 17/6. Suitable Acos mic. 40 for above, 25/-.

ANOTHER OF OUR AMAZING SCOOPS

A snip for the Constructor

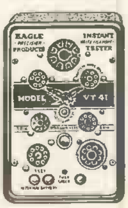
Build this Cossor Pocket 4-Transistor Superhet Receiver. Circuit description: 4 transistors (OC44, OC45, OC45, OC72), two OA70 diodes, two AGC systems, coverage 190-550 metres. Power output 30 m/ws. Ferrite slab aerial, 2¼in. moving coil speaker, printed circuit, attractive tuning control knob, leatherette case 6 x 3¾ x 1¾in. All components including theoretical and point-to-point diagram for easy construction.
ONLY £7/19/6. Post & Pkg. 2/6. All parts available separately.
9 v. PP4 battery 2/-. Maker's original price nearly £20.

BRAND NEW TV TUBES, CHEAPER THAN REBUILDS

All brand new in famous maker's cartons. (1) 17in. rectangular aluminized 6.3 HRTS. .3A current; max. anode voltage 16 kV. Usual price £17/5/-. **OUR PRICE £7/19/6.** Crating and carr. 15/-.
(2) 14in. rectangular Tube, 6.3 heaters; .3 amp. current; max. anode 14kV; ion trap; external conducting coating; B12A base. **£7/9/6.** Crating and carriage 12/6.
(3) Ferranti T12/44 12in. magnetic white fluorescence; 4 v. heater; max. anode 10 kV. As used in many TV receivers. Original price £17/15/-. **OUR PRICE £2/19/6.** Crating and carr. 12/6.
(4) Ferranti 9in. Tube, round white fluorescence, 4 v. heater, max. anode voltage 7 kV. **OUR PRICE £2/5/-.** Crating and carr. 11/6

SOMETHING NEW FOR THE SERVICE MAN!

THE POCKET VALVE FILAMENT TESTER



Battery operated, it gives instant check on radio and TV valves, pilot lamps, fuses, continuity of circuit; also built-in 7 and 9 pin valve straightener. The ideal precision instrument for service engineer or amateur constructor. Finished in grey hammer case with gold panel. Fully guaranteed and ready for use. **OUR PRICE 30/-.** Post and packing 2/-.

SOMETHING NEW FOR THE CONSTRUCTOR

Etch your own printed circuits; complete kit with instructions comprising 3 laminate sheets, copper faced etching bath, 4 bottles, etchant, resist solvent and cleanser and brush. **19/6** complete. P. & Pkg. 1/6.

PORTABLE BATTERY ELIMINATOR

Housed in two containers which are to replace AD35 and B126 Batteries. 37/6, Plus 2/- P. & P. Only suitable for use with Dk96 Series valves.

A SELECTION OF P.A. SYSTEM EQUIPMENT FOR INDOOR OR OUTDOOR USE

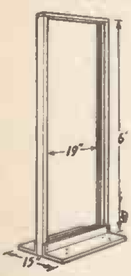
VORTEXION PORTABLE AMPLIFIER
A first-class amplifier for 200/250v.A.C. or 12v. D.C. operation. 12 watt push-pull output matched to 7.5, 15, 250 or 500 ohms. Incorporates inputs for mike and gram, volume control and bass and treble control. Good working order. **ONLY £9/19/6.** Carr. 10/6.

NEW AND UNUSED ACCUMULATORS

12 v. 25 A.H. (as on left) 45/-. Carr. 7/6. Ideal for use with above Amplifier

2 v. 100 A.H. 75 actual (ex Govt.), with carrying handle. Size 6½ x 6½ x 3½in., 15/- each. Carr. 3/6. **2 v. 16 A.H.**, as above. 7½ x 4 x 2in., 5/- each. P. & P. 2/-. 6 for 24/-. P. & P. 10/-. 2 v. 14 **A.H.**, as above (less handle). 7 x 2½ x 2½in., 5/- each. P. & P. 2/-. 6 for 24/-. P. & P. 10/-.

ROTARY CONVERTER. 24 v. D.C. to 230 v. A.C. 50 cycles, 150 watts. Brand new and unused. £8/10/-. Carr. 7/6. Ditto. 100 watts £6/9/6. Carr. 7/6.
ROTARY CONVERTER. Ex-Govt. 12 v. D.C. input 230 v. A.C. output 50 cycles at 135 watts. Complete in carrying case with lid. Voltage control, sliding resistance, mains switch and 0-300 v. A.C. flush meter. In good condition £10. Carr. 10/-.
Motor only, without case, etc. Brand new and unused, £8/10/-. Carr. 5/-.



G.P.O. RACKS

19in. Heavy duty, all steel Standard drilling.
5ft. 6in. angle uprights. **£3/10/-.** Carr. 15/-.
6ft. channel uprights (as illustrated) **£5.** Carr. 15/-.
7ft. channel uprights. **£6.** Carr. 15/-.
19in.x14in. PANEL SHELF in 14 s.w.g. steel. Suitable for above racks. 15/-. P. & P. 5/-.

HEAVY DUTY—ALL STEEL

TRIPOD STANDS

Adjustable every 6in. to approx. 9ft. 6in. when fully extended. (Folds up to only 4ft. 6in. for storage). Suitable for outdoor speakers, public address systems, floodlighting, etc., etc.

OUR PRICE **£3.10.0** Carr. 5/-.

These stands are ideal for our RE-ENTRANT LOUD HAILER as described above.

HAND MICROPHONE. Electro-dynamic. Suitable for use with our Portable Amplifier With built-in on/off switch and rubber mouthpiece for outdoor work. 30/-. P. & P. 2/-.

TWO SPECIAL ITEMS

WESTALITE RECTIFIER UNIT. Type 925. A.C. input 200/250 v. or 440/440 v. 50/60 cycles, 3 phase. D.C. output 13–0–13 v. by 1 volt steps to 16–0–16 v. at 120 amps. Metered, switched and fused throughout. Brand new and unused. **£75** ex-stores.

WESTALITE TRANSFORMER RECTIFIER. Oil filled. Primary 380–440 v. 50 cycles. 3 phase. Supply 20 v. D.C. at 200 amps (conservative rating). Complete with original control panel. Perfect condition, unused. **£150** ex-stores.

MARCONI SIGNAL GENERATOR. TYPE TF517-F/1. Covering 10–18 Mc/s. 33–58 Mc/s. 150–300 Mc/s. In very good condition. Complete with full technical data and instructions. Unrepeatable at only £12/10/-. Carr. 20/-.

MARCONI SIGNAL GENERATOR TYPE TF390G. for 200–250 v. A.C. mains input. Frequency range 4–16 Mc/s. and 32–100 Mc/s. indirect calibration. Output 1μV to 100 M/V. 400 c/s internal modulation. In good order. Only £12/10/-. Carr. 20/-.

BRAND NEW CRYSTAL CALIBRATOR No. 10 .(Battery powered 1.4 v. valves.) Complete with full working instructions, circuit diagram, carrying haversack, connecting lead and spare valves. Frequency range: 1.5 to 10 Mc/s. (nominal) but can actually be used up to 30 Mc/s. Weight 5lb. Size 7in. x 7½in. x 4in. A miniature B.C.221 in every respect. A must for every laboratory, etc. ONLY £4/19/6. P. & P. 2/6.

MULLARD BRIDGE. Type GM. 4140/1 Mains operated from 100–250 v. A.C. Will test resistances from 0.1 ohm to 10 megohms and condensers from 10pf. to 10mfd. Good condition and complete with instruction booklet. **£6/19/6.** P. & P. 2/6.

RECORDING TAPES. Super quality P.V.C. 1,800ft. L.P. 7in. spools, 30/-; 1,200ft. Std. 7in. 19/-; Empty 7in. spools 3/9 each. Send S.A.E. for Tape Bargain List.

EVERSHED AND VIGNOLES MEGGER CIRCUIT TESTER (low reading ohm meter). 2 ranges. 0-3, 0-30 ohms. The perfect meter for continuity and polarity testing, complete with test leads and ready to use. Brand new. Only £4/17/6. P. & P. 3/-.

BRIDGE MEGGERS. Evershed and Vignoles. Series 2 in perfect condition. 250 v. **£22.** Carr. paid. Leather case available at 20/- extra.

TELEPHONE SETS (TELE "F") Housed in Bakelite cases, complete with built-in ringing generators and batteries. Ideal between two or more positions up to practically any distance. Tested before despatched. ONLY 70/-. P. & P. 3/6. 2 sent for £6/10/-. Carr. paid.
TELEPHONE CABLE. Twin one-mile drums (Don 8), £5. Carr. 20/-. Single one-mile drums (Don 3), 50/-. Carr. 7/6.

6 kV/A. AUTO-TRANSFORMER. 230/110 v. 50 cycles (fully tapped primary and secondary). Capable of 25% over actual rating. Brand new and unused, £18. Carr. 20/-. Also **3 kV/A** as above, £12/10/-. Carr. 20/-.

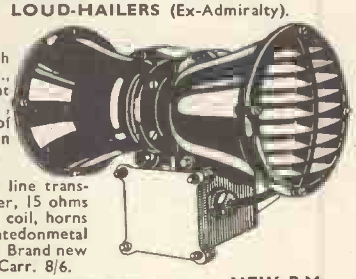
20 kV/A AUTO-TRANSFORMER. 230/115 v. 50–60 cycles, by Jefferies Transformer Co., U.S.A. Perfect condition, £20. Carr. £1.

Limited Quantity Only ! !

TRANSMITTER TYPE T.1945
As used for Air-Sea Rescue. This transmitter is a non-directional sono-buoy. The freq. band of 62.9 Mc/s to 71.7 Mc/s is divided into 12 channels spaced 800 kc/s apart, each buoy being set up to one of the channels. (Most channels available.) H.T. power supply is from 3-45 v. batteries, L.T. 1.5 v. Absolutely brand new and complete in tropically sealed packing (less batteries).
HOME AND EXPORT ENQUIRIES INVITED

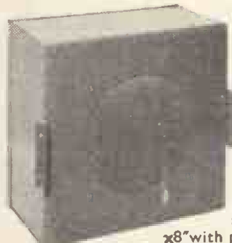
RE-ENTRANT LOUD HAILERS
(Ex-Govt.)
Heavy duty 20 watts all-metal 15 ohms. Diameter. 15in., length 15in. (approx) good condition **£6/10/-.** Carr. 10/-.
Ditto. Brand new, £8. Carr. 10/-.

PARMEKO TWIN BAKELITE LOUD-HAILERS (Ex-Admiralty).



Length 15 in., Height 9 in., dia. of horn 8½in.

With line transformer, 15 ohms voice coil, horns mountedonmetal base. Brand new **£3.** Carr. 8/6.



NEW P.M. HEAVYDUTY SPEAKERS
Complete with O.P. trans, in all steel blue-grey double grilled cabinet.
6in. 30/-
8in. 32/6
Carr. 3/6 each

10inch Speaker in wooden cabinet, size approx. 14"x16" x8" with padded interior and volume control. 50/-. Carr. 3/6.

FLARE HORN. 30in. x 12in. x 26in. long. Driven by Heavy duty 3 ohm P.M. Speaker. Ideal for music, etc. £7/10/0. Carr. 10/-.

EXPONENTIAL HORNS
by famous manufacturer of P.A. systems.

15 watt, 30in. long, 20in. square flare, 15 ohms speech coil. Good condition, **£7/10/6.** Carr. 10/-.

VITAVOX PRESSURE UNITS TYPE N. Heavy Duty. Special quality. 20 watts P.M. Brand new **80/-.** Carr. 5/-.

BAKER'S SELHURST SPEAKERS
12in. P.M. 15 ohms 15 watts, 30–14,000 c.p.s. Our price £4/10/-.
"AUDITORIUM" 12in. 15ohms, 12 watts, 35–16,000 c.p.s. Flux density 14,500. OUR PRICE £7/10/-.
"SUPER HI-FI 25" 12in., 15 ohms, 25 watts 25–20,000 c.p.s. Flux density 17,600. OUR PRICE £9/9/-. All are brand new and full descriptive specification is available.

TRUVOX/TANNOY LOUD-HAILERS
With 180 ohm line transformer and condenser. Impedance 7½ ohms, handling capacity 8 watts. Complete in slope-front wooden case. Brand new 25/. Carr. 4/6.

GEE BROS. (RADIO) LTD.
15 LITTLE NEWPORT STREET, LONDON, W.C.2. *GER. 6794/1453*
ADJOINING LEICESTER SQ. TUBE STATION—Open 9-6 Weekdays. 9-1 Sat.

EDDY'S (NOTTM) LTD

172 ALFRETON ROAD NOTTINGHAM

1L4	3/6	6SG7M	4/9	ECH42	8/3
1R5	6/-	6SH7M	4/3	ECL80	7/6
1S5	5/11	6SJ7M	5/11	ECL82	9/11
1T4	3/11	6SN7GT	4/3	EF36	3/-
3Q5GT	8/6	6X4	5/11	EF40	13/3
3S4	6/3	6X5G	4/11	EF41	8/3
3V4	7/-	12AH7GT	6/6	EF42	7/3
5U4G	5/-	12K7	5/3	EF86	10/-
6AG5	4/-	12Q7	5/3	EF91	3/6
6AL5	3/9	25Z4G	7/6	EL41	8/3
6AM6	3/6	35W4	6/6	EL42	9/3
6AT6	6/11	35Z4	5/3	EL84	6/6
6B8G	2/11	807B	3/6	EY51	8/6
6BA6	5/11	954	1/6	EY86	7/11
6BE6	5/11	955	3/6	EZ80	6/-
6BG6G	12/3	956	2/6	GT1C	6/11
6BJ6	5/6	9001	3/11	P61	2/-
6BW6	8/6	9004	3/11	PCC84	7/3
6C4	3/3	9006	3/11	PCF80	7/3
6C6	4/-	AZ1	12/6	PCL82	11/3
6CH6	9/-	DAF96	7/9	PEN36C	8/6
6D2	3/6	DF96	7/9	PL81	9/-
6F1	6/6	DH77	6/3	PL82	7/3
6F6G	6/-	DK96	7/9	PL83	7/3
6H6	1/11	DL96	7/9	PY80	6/11
6J5G	2/6	DM70	7/6	PY81	6/-
6J5GT	3/6	EB41	6/11	PY82	6/6
6J5M	4/6	ECC40	19/11	UB41	7/11
6J6	3/11	ECC81	5/3	UBC41	7/6
6J7G	5/-	ECC82	5/11	UCH42	7/6
6K7G	1/11	ECC83	6/11	UF41	8/-
6K7M	7/6	ECC84	8/11	UF42	7/3
6K8G	5/6	ECC85	7/11	UL41	7/3
6L6G	7/3	ECF80	9/6	UY41	6/3
6SA7M	5/9	ECF82	9/6		

Guaranteed New or Surplus Valves—By Return Post

SPECIAL OFFER!

CAR RADIO KITS

Seven Transistors. Long and Medium Waves 2 Watts output. R.F. Stage and automatic gain control. Complete Kit with cabinet **10½ gns.** Speaker extra **17/11.** P. & P. 5/-. Please state voltage. Size 7¾ x 7¼ x 2½in.

VIBRATORS. 12 volt 4 pin, 4/11. Post 1/-.

GERMANIUM DIODES 8d. each, 7/- doz. Post 6d.

CONDENSERS. Tubular Wire End (not ex. govt.). 8 mfd. 450 v. 1/9, 8-8 450 v. 2/6, 16 mfd. 450 v. 2/9, 16-16 450 v. 3/9, 32 mfd. 450 v. 3/9, 32-32 350 v. 4/-. Post 1/-.

TRANSISTORS. Red spot 3/11, white spot 4/11. Post 6d.

NIFE ACCUMULATORS. Midget single unit. Size 3 x 2¾ x ⅞in. 8 amp. hrs. 1.25 volts. Weight 13 ozs., 1/11 each. Post and Packing 1/6. One only. Add 9d. each cell.

Any parcel insured against damage in transit for only 6d. extra per order. All uninsured parcels at customers' risk. Postage and packing 6d. per valve extra. Over £3 free. C.O.D. or C.W.O. only. C.O.D. charge 3/- extra.

S.A.E. with all enquiries.

BRING YOUR DUODE RIGHT UP TO DATE

Now is the time for all who own older **Barker and Duode Units** to have them brought right up to 1960 standards.

No **Barker or Duode** unit is ever entirely dead so long as its magnet system is intact. This principle applies to all models made since 1947. At a very reasonable cost a new 1960 frame, cone and drive assembly with foam suspension is fitted, the magnet checked, re-magnetised if necessary, and the whole tested to the latest standards.

Why not use this unique, economical service—or if you still do not own a **Duode**, send for details of the new models.

DUODE LTD.

24 Dingwall Road, Croydon, Surrey

More than meets the eye

It looks good but there is more in it than meets the eye—enough to make the discerning purchaser feel that he must have Savage Massicore regardless.

Generous design—no compromises on quality—conscientious workmanship—that is what you get when you buy a Massicore Transformer.

MASSICORE SAVAGE

SAVAGE TRANSFORMERS LIMITED

NURSTEED ROAD, DEVIZES, WILTS.

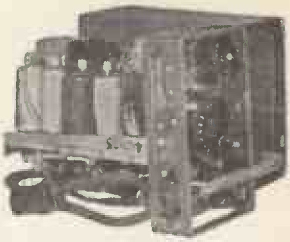
Telephone: Devizes 932

SOUTHERN RADIO'S SPECIAL BARGAINS

TRANSMITTER - RECEIVER

TYPE 38 MK II

★ WALKIE-TALKIE



Complete in Metal Carrying Case. 9in. × 6¾in. × 4in. Weight 6lb. Frequency 7.3 to 9 Mc/s. Five valves, £1/2/6. Post paid.

These TX-Rs are in NEW CONDITION, but owing to demand they are not tested by us and carry no guarantee, but should prove SERVICEABLE.

ATTACHMENTS for Type "38" Trans-receivers. ALL BRAND NEW. Headphones **15/6**; Throat Microphones **4/6**; Junction Boxes **2/6**; Aerials, No. 1 **2/6**; No. 2 **5/-**; Webbing **4/-**; Haversacks **5/-**; Valves—A.R.P. 12 **4/6**; A.T.P.4 **3/6**; Set of FIVE VALVES **19/-** the set.

SPECIAL OFFER No. 2:
"38," as above, complete with set of external attachments, **42/6,** post paid.

SPECIAL OFFER No. 3:
Transmitter-Receiver "38" Mk. II. Brand new with complete set of external attachments including Webbing, Haversacks and Valves **57/6** post paid. Fully guaranteed.

CONDENSERS. 100 assorted Mica; Tubular, etc., 15/-. NEW.

CONTACTOR TIME SWITCHES. 2 impulses per sec., in case, **11/6.**

REMOTE CONTACTOR. For use with above, 7/6.

LUFBRA HOLE CUTTERS. Adjustable ¾in. to 3¼in. For Metal, Plastics, etc., 7/-.

MAGNETS. Strong Bar type, 2×½in., **1/6** each.

MORSE TAPPERS. Midget type **2/9**; Standard, 3/6; Heavy type on base, **5/6.** ALL BRAND NEW

MORSE PRACTICE SET. TAPPER with BUZZER on base. Complete with battery, **12/6.** BRAND NEW.

PACKARD-BELL AMPLIFIERS. Complete. BRAND NEW, with valves, relay, etc., etc., **17/6** each.

QUARTZ CRYSTALS. Types F.T.241 and F.T.243. 2-pin ½in. spacing. Frequencies between 5,675 kc/s. and 8,650 kc/s. (F.T.243), 20 Mc/s. and 38.8 Mc/s. (F.T. 241, 54th Harmonic), 4/- each. ALL BRAND NEW. TWELVE ASSORTED CRYSTALS, **45/-.** Holders for both types, 1/- each. Customers ordering 12 crystals can be supplied with lists of frequencies available for their choice.

RECORDING BLANKS. Brand new. "Emidisc." Ready for cutting. 13in. **6/-** each or 15 complete in metal case **£4.**

RESISTANCES. 100 assorted useful values. New wire end **12/6.** NEW.

SPECIAL OFFER. 12 ASSORTED METERS. Slightly damaged. Mainly broken cases (perfect movements). Including 3 BRAND NEW Aircraft Instruments. 12 for **45/-.**

STAR IDENTIFIERS. Type 1 A-N Covers both Hemispheres, **5/6.**

T1154 TRANSMITTERS. Complete in transit case. New condition, **£2/5/-.**

TEST METERS D.C. PORTABLE 0-5,000 ohms 0-6mA 0-1.5v and 3v. In case 3¾in × 3¾in × 2½in. Voltage range can easily be extended by addition of resistances to suit individual requirements. BRAND NEW, **12/6.**

ATTACHMENTS for "18" Transreceivers. ALL BRAND NEW. Headphones **15/6**; Hand Microphone **12/6**; Aerials **5/-**; Set of 6 Valves **30/-.**

TRANSPARENT MAP CASES. Plastic 14in.×10¾in. Ideal for Maps, Display, etc., **5/6.**

Post or carr. extra. Full list Radio Books, etc., 3d

SOUTHERN RADIO SUPPLY, LTD.

11, LITTLE NEWPORT STREET, LONDON, W.C.2. GERrard 6653

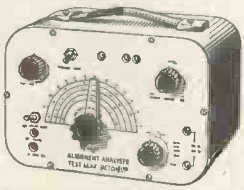
DOUBLE BEAM 'SCOPE'

For D.C. & A.C. APPLICATIONS

Engineered to precision standards, this high-grade instrument is made available at the lowest possible price, incorporating the essential features usually associated with luxury instruments. This "SCOPE" will appeal particularly to Service Engineers and Amateurs. A high gain, extremely stable differential Y-Amplifier (30 mV/C.M.). Provides ample sensitivity with A.C. or D.C. inputs. Especially suitable for measurement of transistor operating conditions where maintenance of D.C. levels is of paramount importance. Push-pull X amplifier. Flyback suppression; Internal Time-base Scan Waveform available for external use; pulse/output available for checking T.V. Line O/P Transformers, etc.; Provision for external X 1/P and CRT. Brightness Modulation. A.C. mains 200/250 v. £19/19/- plus P. & P. 7/6, or 50/- deposit, plus P. & P. 7/6 and 12 monthly payments of 33/4.

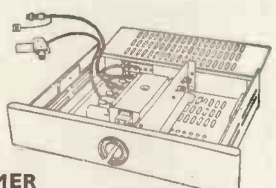
FULL 12 MONTHS' GUARANTEE INCLUDING VALVES AND TUBE

ALIGNMENT ANALYSER TYPE MC12



A.C. MAINS, 200/250 volts. Provides:—"WOBBULATOR" (SWEPT FREQUENCY) OPERATION, for FM/TV alignment linear frequency sweep up to 12 Mc/s. From 400 Kc/s.—80 Mc/s. CAPACITANCE MEASUREMENT. Two ranges provided 0—60 pf. and 0—120 pf. SPECIAL FACILITY enables true resonant frequency of any tuned circuit I.F. transformer, etc., to be rapidly determined. Cash price £6/19/6 and 5/- P. & P. H.P. terms 25/- deposit and 5/- P. & P. and 6 monthly payments of 21/6.

CHANNEL TUNER



Will tune to all Band I and Band III stations. BRAND NEW by famous manufacturer. Complete with P.C.C. 84 and P.C.F. 80 valves (in series). I.F. 16-19 or 33-38. Also can be modified as an aerial converter (instructions supplied.)
Complete with knobs.

22/6 Plus 3/6 P. & P.

HEATER TRANSFORMER

To suit the above, 200-250 v., 6/- Plus 1/6 P. & P.

B.S.R. MONARCH UA8 with FUL-FI HEAD

4-speed plays 10 records 12in., 10in., or 7in. at 16, 33, 45 or 78 r.p.m. Intermixes 7in., 10in. and 12in. records of the same speed. Has manual play position; colour brown. Dimensions: 12½in. × 10¼in. Space required above baseboard 4⅝in., below baseboard 2½in. Fitted with Ful-Fi turnover crystal head. £6/19/6. Plus 5/- P. & P.

STEREO HEAD £7/19/6 Plus 5/- P. & P.

LINE E.H.T. TRANSFORMER

With built-in line and width control. 14 KV. Scan coil, 90° deflection, on ferrite yokes. Frame O.P. transformer 500 pf. 18 KV. smoothing condenser. Can be used for 14in., 17in. or 21in. tubes. Complete with circuit diagram. **29/6** Plus 4/- P. & P.

FOCUS MAGNET suitable for the above (state tube), 10/-. 2/6 P. & P.

MAINS TRANSFORMERS

All with tapped primaries 200-250 volts.

0-160, 180, 200 v., 60 ma., 6.3 v. 2 amps., 10/6 280-0-280, 80 ma., 6.3 v., 2 amp., 6.3 v., 1 amp., 10/6. 350-0-350, 70 ma., 6.3 v. 1 amp., 6.3 v. 2 amp., 10/6. 250-0-250, 70 ma., 6.3 v., 2 amp., 10/6. Postage and packing on the above 3/-.

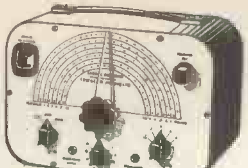
WOLSEY 3-ELEMENT FOLDED DIPOLE

I.T.V. Aerial less mounting bracket for external use, complete with 12 yds. of coaxial cable. 15/-; 4 element, 17/6; P. & P. on above, 3/6.

BATTERY RECORD PLAYER AND AMPLIFIER

Incorporating 45 r.p.m. "Starr" motor "Acos" crystal pick-up, 3 transistor push-pull amplifier complete with transistors. Output 500 milliwatts, 49/6 plus 3/6 P. & P

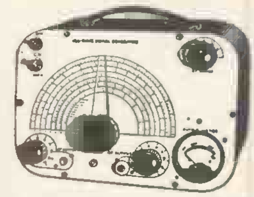
SIGNAL GENERATOR



£6/19/6

Covering 100 Kc/s.-100 Mc/s. on fundamentals and 100 Mc/s. to 200 Mc/s. on harmonics. Metal case 10in. × 6½in. × 5¼in., grey hammer finish. Incorporating three miniature valves and Metal Rectifier. A.C. Mains 200/250 v. Internal Modulation of 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F., output continuously variable 100 millivolts C.W. and mod. switch, variable A.F. output. Incorporating magic-eye as output indicator. Accuracy plus or minus 2%.
Or 25/- deposit and 6 monthly payments of 21/6. Post & Packing 5/- extra.

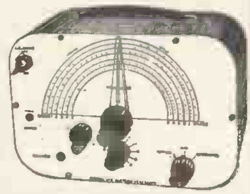
SIGNAL GENERATOR



Coverage 120 Kc/s—230 Kc/s., 300 Kc/s.—900 Kc/s., 900 Kc/s.—2.75 Kc/s., 2.75 Mc/s.—8.5 Mc/s., 8 Mc/s.—28 Mc/s., 16 Mc/s.—56 Mc/s., 24 Mc/s. 84 Mc/s. Metal case 10in. × 6½in. × 4¼in. Size of scale 6½in. × 3½in. 2 valves and rectifier A.C. mains 230-250 v. Internal modulation of 400 c.p.s. to a depth of 30 per cent., modulated or unmodulated R.F., Output continuously variable. 100 millivolts C.W. and mod. switch variable A.F. output and moving coil output meter. Grey hammer finish case and white panel. Accuracy plus or minus 2%. **£4/19/6** Or 25/- deposit and 4 monthly payments 21/6. P. & P. 5/- extra.

SIGNAL & PATTERN GENERATOR

£6/19/6 P. & P. 5/-.



Or 25/- deposit. P. & P. 5/- and 6 monthly payments of 21/6.
Coverage 7.6 Mc/s.-210 Mc/s. in five bands, all on fundamentals, slow motion tuning audio output. 8 vertical and horizontal bars, logging scale. In grey hammer finished case with carrying handle. Accuracy ±1% A.C. mains 200-250 v.

F.M. TUNER UNIT

By famous German manufacturer. Coverage 88—100 Mc/s. Complete with ECC85. Size 4in. × 2in. × 2in.

25/- Plus P. & P. 1/6. Circuit diagram free with unit. **1/-**

10.7 Mc/s. I.F. and Discriminator Coil 4/- pair

3-TRANSISTOR POCKET RADIO

Plus GERMANIUM DIODE ON PRINTED CIRCUIT

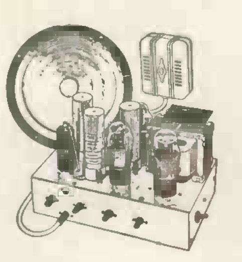
Size 3¼" × 4" × ⅞"

Incorporating Ferrite Rod Aerial. Tuneable over medium and long waves.

Kit of parts. **39/6** Plus 1/6 P. & P.

Circuit diagram 1/6 free with kit.

8 WATT PUSH-PULL AMPLIFIER



COMPLETE WITH CRYSTAL MIKE AND 8in. LOUDSPEAKER

A.C. mains 200/250 v. Size 10½in. × 6½in. × 2½in. Incorporating 6 valves. H.F. pen., 2 triodes, 2 output pens., and rectifier. For use with all makes and types of pick-up and mike. Negative feed-back. Two inputs, mike and gram., and controls for same. Separate controls for Bass and Treble lift. Response flat from 40 cycles to 15 Kc/s. ±2 db; 4 db down to 20 Kc/s. Output 8 watts at 5%, total distortion. Noise level 40 db down, all hum. Output transformer tapped for 3 and 15 ohm speech coils. For use with Std. or L.P. records, musical instruments such as Guitars, etc.

£4.19.6 Plus P & P. 7/6

Or £1 deposit, plus P. & P. 7/6 and 4 monthly payments of 23/-.

PORTABLE AMPLIFIER on printed circuit for A.C. Mains 200/250 v. Size 4in. × 3in., with tone and volume control. Valves: ECL82 and EZ80. 39/6. P. & P. 2/6.

BUILT POWER SUPPLY UNIT, A.C. Mains 200-250 v., D.C. output, 250 v. at 75 ma., also 6.3 v. 2 amp. heater winding, 21/-. Plus 3/6 P. & P.

RADIO AND T.V. COMPONENTS (ACTON) LTD.

23, ACTON HIGH STREET, LONDON, W.3

GOODS NOT DESPATCHED OUTSIDE U.K. ALL ENQUIRIES S.A.E. TERMS OF BUSINESS C.W.O.

UNITED COMPONENTS LTD.

Design and Manufacturing Organisation

for

R.G.D. - REGENTONE - ARGOSY

Invite applications from Electronics Engineers for Senior and Junior positions in expanding design teams engaged on the following work:

- Television Receiver Design.
- Radio Receiver Design.
- Transistor Applications for Radio and T.V. Receivers.
- Test Equipment Engineering.
- Instrument Standardising.
- Component Testing.
- Technical Clerk.

These appointments offer unrivalled scope for personal advancement. Excellent working conditions with every facility required for top quality work. Salaries are excellent, normal working hours short and a pension and life insurance scheme is operated by the company. All applications will be regarded as strictly confidential.

Write to: **Technical Director,**
United Components Ltd.,
Eastern Avenue West, Romford, Essex.

THE

ENGLISH ELECTRIC VALVE COMPANY

Chelmsford - - Essex

require a

VALVE ENGINEER

with a particular interest in the Vacuum Condenser field. A wide experience in the valve industry is essential including knowledge of high voltage, vacuum physics and X-ray techniques.

It will be an advantage for the successful applicant to be acquainted with the working principles of mechanical engineering in order to appreciate prototype and production manufacturing problems as they occur.

Replies should be sent to **Dept. C.P.S., Marconi House, 336/7, Strand, London, W.C.2,** quoting reference No. WW 1506F.

EARN what you're really worth!

You've got ability—everyone has. But are you making the most use of it—to earn what you're really worth? If not, let ICS training develop your ability and help you to a better job, with more security!

Take the right course now . . .

Advertising & Selling
General Advertising
Sales Management
Exams.: Joint Inter., A.A. and I.P.A. Finals, I.S.M.A., U.C.T.A.

Architecture and Building
Clerk of Works
Building Construction
Exams.: R.I.B.A. (Inter.) R.I.C.S., I.Q.S., Inter., Final & Dip. in Working Up, L.I.O.B.

Art
Commercial Illustrating.
Oils and Water-Colours.

Commercial Training
Bookkeeping
Computer Programming
Office Training Bookk'ping
Exams.: I.C.W.A., C.I.S., C.C.S., A.C.C.A., Inst. Bk-keepers.

Draughtsmanship (State Branch)
Drawing Office Practice
Mechanical Drawing
Maths. & Machine Drawing

Farming and Horticulture
Pig and Poultry Keeping
Flower and Veg. Growing
Smallholding
Exam.: R.H.S. General

Fire Engineering
Instn. of Fire Engineers.

General Education
Good English
Exams.: G.C.E. Subjects at Ordinary or Advanced Level

Management
Industrial Mangmt., Office Mangmt. Personnel Mangmt.
Exams.: Br. Inst. of Mangmt. Inter., Final and Cert. in Foremanship

Mechanical Engineering
Wide range of subjects incl: Workshop Practice, Diesel Engines, Refrigeration & Welding. Engineering Maths., Production Eng.
Exams.: I.Mech.E., Soc. of Engrs., Cert. in Foremanship

Motor Engineering
Motor Mechanics
Running and Maintenance

Photography
The Amateur Photographer
Exam.: P.D.A.

Radio, T.V. and Electronic Engineering
Basic Electronics
Radio Engineering
Indust. Electronics & T.V.
Radio Servicing
T.V. Servicing and Eng.
Practical Radio (with kits)
Electricians
Exams.: Brit.I.R.E., Soc. of Engrs., C. & G. Certs. for Telecom Technicians, Radio Amateurs, Radio Servicing (RTEB)

Writing for Profit
Short Story Writing
Journalism

And Many Other Courses

. . . and fill in this coupon

INTERNATIONAL CORRESPONDENCE SCHOOLS, (Dept. 222Q), Intertext House, Parkgate Rd., London, S.W.11.

Please send FREE book on ....

Name .... Age ....

Address ....

....

Occupation 7.60

TELEVISION ENGINEERS

WANTED FOR GENEVA OFFICE

TV FIELD ENGINEERS . . .

RCA International Division has openings for qualified graduate engineers with several years experience in installation and maintenance of TV Studio and/or transmitting equipment. Position affords opportunity for extensive travel in Western Europe, pleasant living conditions in Geneva, Switzerland, good salary, expense account while travelling, liberal company benefits. Send resumé.

Attn.: J. P. RILEY
RCA International
13, quai de l'Ile
GENEVA/Switzerland
Cable: VIDICO GENEVE

SMITHS *Radiomobile*

BRITAIN'S CAR RADIO SPECIALISTS INVITE APPLICATIONS FOR THESE POSTS

ASSISTANT FOREMAN

Experience of car radio application and maintenance desirable but not absolutely essential. This progressive appointment is in the Service Department.

EXPERIENCED SERVICE ENGINEERS

These appointments hold out very definite prospects of advancement for the right individuals.

Applications giving full details of career to date should be addressed to:

THE STAFF MANAGER, S. SMITH & SONS (ENGLAND) LTD., CRICKLEWOOD, LONDON, N.W.2 quoting ref. SM245

UNICAM INSTRUMENTS LTD.

This company specialises in the production of high quality optical instruments for use in spectrum analysis and has an international reputation as a leader in this field. At all stages of manufacture the best standards of workmanship are needed.

We have vacancies for men with electronic experience for testing. Radar and radio technicians with fault finding experience would be suitable.

If you have the kind of background which you think would fit you for this interesting work in a pleasant University City, please let us have full details of your qualifications and experience.

Write to:—

The Works Manager,
Unicam Instruments Ltd.,
Arbury Works, Cambridge
quoting reference E.S.26.

VACANCIES FOR RESEARCH AND DEVELOPMENT CRAFTSMEN IN GOVERNMENT SERVICE AT CHELTENHAM

Experience in one or more of the following:

(1) Maintenance of radio communication receivers.
(2) Sub-assembly lay out, wiring and testing of radio type chassis.
(3) Cabling, wiring and adjustment of telephone type equipment.
(4) Fault finding in and maintenance of electronic apparatus.
(5) Maintenance of teleprinter or cypher machines and associated telegraph equipment.

Opportunities for permanent and pensionable posts. Five-day week; good working conditions; single accommodation available.

Apply in writing for further particulars to:—

Personnel Officer,
G.C.H.Q. (3/RDC),
53, Clarence Street,
Cheltenham, Glos.

RADIO TECHNICIANS IN CIVIL AVIATION

Men aged 19 or over or interesting work providing and maintaining aeronautical telecommunications and electronic navigational aids at aerodromes and radio stations in the U.K. Fundamental knowledge of radio or radar with some practical experience essential; training provided on special types of equipment. Salary according to age and station, approx. £670 at age 25 rising to £795. Prospects of permanent pensionable posts. Good opportunities for those who obtain O.N.C. in Elec. Eng. and certain C. and G. Certificates for promotion to posts with maximum salaries of £875, £1,035 and £1,260. Apply to the Ministry of Aviation (ESB1/RT), Berkeley Square House, London, W.1, or to any Employment Exchange (quoting Order No. Westminster 3552).

Southampton County Borough

Education Committee

Southampton Technical College

COMMUNICATION ENGINEERING AND ELECTRONICS

The Electrical Engineering Department offers a three years' full-time course in Communication Engineering and Electronics, leading to a College Diploma. The Final Examinations are assessed by the British Institution of Radio Engineers for exemption from their Graduateship Examination. Details of the course, fees, etc., from the Registrar, Southampton Technical College, St. Mary Street, Southampton.

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

Instrument Mechanics (Physical and Electronic) and Instrument Electricians

We have vacancies for men experienced in fault diagnosis, repair and calibration of a wide range of instruments used in nuclear reactors, radiation laboratories and chemical plant operation. The work is interesting and involves working with instruments using pulse techniques, wide band low noise amplifiers, pulse amplitude analysers, counting circuits, television, and industrial instruments for the measurement of flow, pressure and temperature.

Men with appropriate experience in H.M. Forces or with industrial experience of radar, television, radio or industrial instrumentation are invited to write for further information.

The rate of pay is £12.12.0d. for a 44-hour, 5-day week. Housing will be available for married men. Promotion prospects are good and there is a superannuation scheme.

Application forms and further information can be obtained from:

Recruitment Officer,
Dounreay Experimental Reactor Establishment,
Thurso, Caithness, Scotland.

INDUSTRIAL ELECTRONIC ENGINEERING

Appointments with a progressive organisation operating in a rapidly expanding field are available for Equipment Designers in the following categories:

1. Engineering of Standard Products, including Mechanical Design, circuit layout and preparation of descriptive information.
2. Circuit Designers conversant with the design and operation of Industrial Electronic equipment.
3. Control System Designers having primarily an Electrical Engineering background, but capable of adapting established circuit designs to suit specific applications.

Positions are available at Junior and Senior levels and your application should state the preferred category together with details of education and previous experience.

All applications will be treated in strict confidence and should be addressed for the attention of the Chief Designer.

LANCASHIRE DYNAMO ELECTRONIC PRODUCTS LIMITED,
Rugeley, Staffs.

A. V. ROE & CO. LIMITED

have vacancies for

RADIO ENGINEERS

in the

FLIGHT DEVELOPMENT SECTION

AT WOODFORD, CHESHIRE.

Position 1

Applicants should have a recognised Engineering Training—a minimum of 5 years' experience in installation and maintenance of aircraft radio and radar systems—sufficient aircraft experience an advantage (and ex-Service radio/radar technical training would be suitable).

Position 2

Applicants to assist in aerial development work—a minimum of 3 years' experience of R.F. measurement techniques preferably associated with aerial systems—suitably academically qualified.

Applications should be made quoting Ref. R133/W, and giving full particulars of age, training and experience to:

The Personnel Manager,
A. V. ROE & CO. LIMITED,
Greengate, Middleton, Manchester

NORTHERN POLYTECHNIC
Holloway, N.7. North 1686

DEPARTMENT OF PHYSICS
Session 1960/61

COURSES IN APPLIED PHYSICS

DIPLOMA COURSE

In the PHYSICS AND TECHNOLOGY OF ELECTRONICS SANDWICH COURSE leading to the Diploma in Technology (Dip. Tech.). and Graduateship of the Institute of Physics (Grad. Inst. P.)

PART-TIME COURSE leading to Graduateship of the Institute of Physics.

NATIONAL CERTIFICATES IN APPLIED PHYSICS

Ordinary National Certificate. Course available to students of 16 and over.

Higher National Certificate. Course available to students with O.N.C., or with suitable passes in G.C.E.

Students taking the H.N.C. course at the Northern Polytechnic can proceed to complete the College Diploma course and qualify in this way for Grad. Inst. P.

Enquiries should be addressed to The Head of the Department of Physics.

COSSOR RADAR AND ELECTRONICS LIMITED

require

RADAR AND NAV. AID SYSTEMS ENGINEERS:
To undertake the initial systems design of new projects and to co-ordinate the design work through to the production stage.

SENIOR DESIGN ENGINEERS:
To be responsible for sections concerned with the design of major items of electronic equipment.

DESIGN ENGINEERS:
To be responsible for the design of electronic equipment, especially in the following fields:—

3.1 Radar Displays
3.2 Microwave components and receiver/transmitters
3.3 Data processing

MECHANICAL ENGINEERS:
Experience in the design of electronic equipment for use by the Services is essential.
Engineers with the necessary experience and qualifications are invited to write to:

The Personnel Manager,
Cossor Radar & Electronics Limited,
Elizabeth Way,
Harlow, Essex.

Housing arrangements can be made for selected applicants.

CENTRAL ELECTRICITY GENERATING BOARD

RESEARCH AND DEVELOPMENT DEPARTMENT

APPLICATIONS BRANCH (MECHANICAL)

ELECTRONICS DESIGN ENGINEER

required in the Rig Design Section to be located at **Guildford Power Station.**

A knowledge of electronics circuitry is of advantage, but it is essential that the engineer appointed be fully competent to carry out the engineering design of electronic equipment to given circuit designs and provide detailed information to draughtsmen preparing manufacturing drawings. The equipment to be designed includes that required for electronic instrumentation of experimental apparatus of many kinds, but the principal responsibility will be for equipment to be developed for automatic control applied to power stations and the grid distribution system. This equipment must be designed to the high standards appropriate to power station practice.

Applicants should have several years of relevant experience and proof of capability for independent work, with qualifications of at least H.N.C. or membership of a recognised institution.

The starting salary will be within the range £1,195-£1,775 p.a., or £1,090-£1,300 p.a., according to duties and responsibilities.

Applications stating age, qualifications, experience, present position and salary, to the Personnel Officer, 24-30, Holborn, London, E.C.1, as soon as possible. Envelopes should be marked "Confidential Ref. WW/196."

FREE TO AMBITIOUS ENGINEERS

— THE LATEST EDITION OF ENGINEERING OPPORTUNITIES

Have you sent for your copy?

ENGINEERING OPPORTUNITIES is a highly informative 156-page guide to the best paid engineering posts. It tells you how you can quickly prepare at home for a recognised engineering qualification and outlines a wonderful range of modern Home Study Courses in all branches of Engineering. This unique book also gives full details of the Practical Radio & Electronics Courses, administered by our Specialist Electronics Training Division—the *B.I.E.T. School of Electronics,* explains the benefits of our Employment Dept. and shows you how to qualify for five years promotion in one year.

We definitely Guarantee
"NO PASS—NO FEE"

Whatever your age or experience, you cannot afford to miss reading this famous book. If you are earning less than £20 a week, send for your copy of "ENGINEERING OPPORTUNITIES" today—FREE.

WHICH IS YOUR PET SUBJECT?

Mechanical Eng.,
Electrical Eng.,
Civil Engineering,
Radio Engineering,
Automobile Eng.,
Aeronautical Eng.,
Production Eng.,
Building, Plastics,
Draughtsmanship,
Television, etc.

GET SOME LETTERS AFTER YOUR NAME!

A.M.I.Mech.E.
A.M.I.C.E.
A.M.I.Prod.E.
A.M.I.M.I.
L.I.O.B.
A.F.R.Ae.S.
B.Sc.
A.M.Brit.I.R.E.
City & Guilds
Gen. Cert. of Education
Etc., etc.

PRACTICAL EQUIPMENT

Basic Practical and Theoretic Courses for beginners in Radio, T.V., Electronics, Etc., A.M.Brit.I.R.E. City & Guilds Radio Amateurs' Exam.
R.T.E.B. Certificate
P.M.G. Certificate
Practical Radio
Radio & Television Servicing
Practical Electronics
Electronics Engineering
Automation

INCLUDING TOOLS!

The specialist Electronics Division of B.I.E.T.(incorporating E.M.I. Institutes) NOW offers you a real laboratory training at home with practical equipment. Ask for details.

B.I.E.T. SCHOOL OF ELECTRONICS

POST COUPON NOW!

Please send me your FREE 156-page "ENGINEERING OPPORTUNITIES"
(Write if you prefer not to cut page)

NAME ....

ADDRESS ....

....

....

SUBJECT OR EXAM THAT INTERESTS ME ....

BRITISH INSTITUTE OF ENGINEERING TECHNOLOGY *(Incorporating E.M.I. Institutes)*
(Dept. SE/22), 29 Wright's Lane, London, W.8

THE B.I.E.T. IS THE LEADING ORGANISATION OF ITS KIND IN THE WORLD

NEW ZEALAND—AIR DEPARTMENT

RADAR TECHNICIANS—N.Z. CIVIL AVIATION ADMINISTRATION

Salary: Up to £910 a year depending on qualifications and experience with further prospects of advancement to established positions.

Location: Wellington Airport or Dunedin Airport.

Qualifications Desired: Recent experience in the maintenance of S. and X band ground radar equipment together with 1st Class P.M.G. Certificate or City and Guilds Radio 2 and Tels 2 Certificates or equivalent qualification.

Duties: Operation and maintenance of Precision Approach and Surveillance Radar installations.

Training: Appointees will be required to undergo approximately three months' training in the United Kingdom on full salary, in the operation and maintenance of radar equipment of the type installed in New Zealand.

Sea passages to New Zealand for the appointees and their families, if any, will be arranged and paid for by the Department. In addition, an allowance will be made towards the cost of transporting personal effects.

Enquiries, mentioning this publication and quoting Reference No. B11/6/5, should be addressed to the High Commissioner for New Zealand, 415 Strand, London, W.C.2. Further details and application forms will then be supplied. Completed applications must be lodged in London not later than 22nd July, 1960.

Plessey

Radio & Television Development Engineers and Draughtsmen

The Laboratories of the Domestic Equipment Division of the Company are concerned with the development of the complete range of domestic radio and television.

The high standard of design and development engineering achieved has resulted in increased demands for the services of the laboratories. This, in turn, has created a number of vacancies at all levels of staff connected with:—

TELEVISION RECEIVERS · RADIO RECEIVERS
CAR RADIO & TAPE RECORDERS

The Company's policy is to secure the best men available, pay them well and give them every opportunity for individual advancement.

If you feel that you have the necessary ability to work on any of the above equipments and that you can show evidence of reasonable success in the fields of development engineering on domestic radio and television or mechanical design, we will be pleased to receive details of your qualifications and experience which should be addressed for the attention of the Personnel Manager.

The Plessey Company Ltd., Vicarage Lane, Ilford, Essex

MARCONI TYPE TF-885A VIDEO OSCILLATORS

Frequency Range 25 c/s. to 5 mc/s. for sinewave output and 50 c/s. to 150 kc/s. for squarewave output, covered in two bands; max. output 1 W. into 1000Ω sinewave and 30 V. peak squarewave. Distortion better than 3% at full power. Fully calibrated attenuator. Mains operation.
PRICE, fully rebuilt to the original specification and guaranteed £150 0 0
Ditto model TF885, older version of the above £115 0 0
Packing and carriage £2 10

CT-49 ABSORPTION AUDIO FREQUENCY METER

Variable Capacitor tuned L-C Resonant Circuit. Detector and Valve Voltmeter Stage. Microammeter resonance indicator. Range 450 c/s. to 22.0 kc/s. in four directly calibrated bands. Power required: dry batteries 1.5 V. and 22.5 V.
PRICE, fully overhauled and guaranteed £22 0 0
Packing and carriage.......... 15 0

MARCONI PRECISION HETERODYNE WAVEMETER TYPE TF-783

Range 3 to 15 mc/s. on fundamentals, extendable to at least 30 mc/s. by using harmonics. Accuracy better than 0.005%. Crystal reference oscillator giving check points every 20 and 200 kc/s. Mains operation.
PRICE, fully overhauled and guaranteed, £75. Packing and carriage, £1.

CINTEL R-C OSCILLATOR AND AUTOMATIC FREQUENCY MONITOR

Oscillator output from 10 c/s. to 100 kc/s. with an accuracy of ±0.5%. Automatic Frequency Monitor will count the actual oscillations within a pre-set period of time, viz.: 0.1, 1 or 10 sec. displaying the result on five digital meters. Basic accuracy of the counter is .005%. Mains operation.
PRICE, fully overhauled and guaranteed, £220. Packing and carriage £5.

SPECIAL UHF AND EHF RECEIVERS

AN/APR-4 Search Receivers. Frequency Range 40 to 2,000 mc/s. Panoramic Adaptors type RDO available.
AN/APR-5 Search Receivers. 1,000-6,000 mc/s.
R-1294 Receivers, 500-3,000 mc/s.
R-1619 Receivers. 1,250-5,000 mc/s.
Prices and details on application.

INSULATION TESTERS

EVERSHED SERIES 1 MEGGER INSULATION TESTERS. 500 volts, 40 megohms, secondhand, fully overhauled and guaranteed £25 0 0
Packing and carriage 15 0
EVERSHED SERIES 2 BRIDGE MEGGERS, 500 volts, 100 megohms, with built-in four decade resistance box and ratio arms of .01-.1-1.0-10-100; Selector for Bridge, Megohms and Varley measurements. Unused and fully guaranteed.......... £65 0 0
Packing and carriage £1 0 0
EVERSHED SERIES 2 MEGGER INSULATION TESTERS, 1,000 volts, 200 megohms in leather cases, brand new £45 0 0
Packing and carriage.......... 15 0

MARCONI TYPE TF-373D IMPEDANCE BRIDGES

1,000 c/s. Impedance Bridge giving the following ranges: 5μH to 100H; 5pF. to 100μF; 0.05Ω to 1 megohm; "Q"—.1-100; Condenser Loss—.001 to 1.0; Accuracy ±1% except extreme of ranges for C, L, R. Power Supplies: 200-250 V., 40-100 c/s.
PRICE, fully overhauled to the original specification and guaranteed £65 0 0
Packing and carriage £1 0 0

"S" BAND AND "X" BAND SIGNAL GENERATORS

TS-14. 3,200-3,370 mc/s.; Power Measuring Range 20-200 mW.; R.F. output pulsed at variable width, phase and repetition rate. Fully overhauled and guaranteed. £85 0 0
TS-13, 9305-9445 mc/s.; R.F. output C.W. or pulsed at variable width, phase and repetition rate. Peak pulsed power output 50μW. Fully overhauled and guaranteed. £115 0 0
Packing and carriage £1 0 0

MARCONI WIDE RANGE BEAT FREQUENCY OSCILLATORS

TF195L4, 50 c/s.-150 kc/s.; Max. output 2 W.; Calibrated Attenuator 3μV-3 V. Fully overhauled to the original specification and guaranteed .. £65 0 0
TF-195M5, 50 c/s., 0-200 kc/s.; Max. output 2 W.; Calibrated Attenuator 1μV.-10 V.; Fully overhauled to the original specification and guaranteed £75 0 0
Packing and carriage.......... £1 10 0

PEN RECORDERS

EVERSHED SINGLE PEN, SWITCHBOARD PATTERN Centre Zero 2.5-0-2.5 mA. D.C., 6in. Chart; Synchronous Chart Drive, 230 V. A.C. at 3in. per minute.
Fully overhauled and guaranteed £50 0 0
EVERSHED TWIN PEN SWITCHBOARD PATTERN, 5 mA. D.C. each movement; 6in. Chart; Synchronous Chart Drive, 230 V. A.C. at ½in. per minute.
Fully overhauled and guaranteed £65 0 0
ELLIOTT SINGLE PEN SWITCHBOARD PATTERN. 5 mA. D.C., 6in. Chart, Synchronous Chart Drive 230 V. A.C. at 3in. per minute.
Completely rebuilt and guaranteed £50 0 0
Other ranges and speeds can be supplied if required.
EVERSHED SINGLE PEN SWITCHBOARD PATTERN 5mA D.C., 6in. Chart; Synchronous Chart Drive at 12in. per minute, completely rebuilt........ £50 0 0
Ditto with operation pen, energised by closing external contacts £55 0 0
Packing and carriage £1 per recorder.

MAGNETRONS

4J50, 9,345-9,405 mc/s.; heater 7-13 V.; Peak anode volts 22 kV.; Peak output power 225 KW. Forced air cooling £35 0 0
5J30, 375 mc/s., 2.2 V. heater, peak anode volts 2.5 kV.; Peak output 150 W. Liquid cooled £2 0 0

TYPE 101 SIGNAL GENERATOR

Frequency Range 400-650 mc/s.; Output +7.5 to +11 db. above 1 μw. Output Impedance 72Ω. Internal Squarewave modulation. Power Supplies 230 V. 50 c/s. Fully overhauled and guaranteed, with output calibration and frequency Charts.......... £55 0 0
Packing and carriage £1 0 0

Charges for packing and delivery are quoted for England, Scotland and Wales only.

Z. & I. AERO SERVICES LTD.

14 South Wharf Road, London, W.2. Telephone: AMBassador 0151/2

ELECTRICAL & WIRELESS SUPPLY CO.

69, CHURCH ROAD, MOSELEY, BIRMINGHAM 13
Cables: ELEWICO, BIRMINGHAM

Suppliers of American Wireless Communication Equipment for Aircraft such as **BENDIX V.O.R. Type MN-85** VHF 280 crystal-controlled channels radio system incorporating both navigation and communication facilities operating in the frequency range of 108, 0 to 135, 9 mc/s.

RCA Type 710A Signal Generator. Frequency range 370 to 560 mc/s. Direct calibration. Accuracy ½%. Output voltage 1μV to 90 mV. Output impedance 50 ohms.

TCS Remote Control Units Type 23270A.
TS-98AP Voltage Dividers.
AMERICAN AIRCRAFT CAMERAS FAIRCHILD Types **K24, K22, K20, K19B, K17B, K8A-B** and **GUN CAMERAS** the most recent type **AN/N-9** and **G.S.A.P.**

AMERICAN FLIGHT INSTRUMENTS such as Air speed, Climb, Fuel, Temperature, Pressure, Horizon, Turn & Slip Indicators, FUEL FLOW AMPLIFIERS, CONTROL DIRECTIONAL GYROS, etc., etc. AMERICAN AIRCRAFT RELAYS by Leach, Cutler-Hammer, also DELCO FUEL PUMP MOTORS, etc., etc.

SOUTHERN TECHNICAL SUPPLIES

TRANSFORMERS FOR ALL MULLARD AMPLIFIERS

OUTPUT TRANSFORMERS (Secondaries for 3.75 and 15 ohms)
T.44. 5-10 amp. ultra linear, 8,000 ohm. 43% tappings 30/-. P/P. 2/-.
T.162. 5-10 amp. and Osram 912, 6,600 ohm. 20% tappings, 30/-. P/P. 2/-.
T.100. 5-10 amp. LOW loading, 6,000 ohm., 28/-. P/P. 2/-.
T.142. 7 watt stereo amp., 9,000 ohm. 20% tappings, 26/-. P/P. 2/-.
T.140. 3 watt amp., type A tape amp.. 3 watt stereo, 5,000 ohm, 12/-. P/P. 1/6.
MAINS TRANSFORMERS (Primaries 240-220-200; 0-10 v. 50 c/s).
T.55. 5-10 amp. and tuner, 300-0-300 v., 120 mA., 6.3 v. 2.5 a., 6T., 6.3 v. 2.5 a., 6.3 v. 1 a., 32/-. P/P. 2/6.
T.56. 5-10 amp. 300-0-300 v. 100 mA. 6.3 v. 2.5 a., cT. 6.3 v. 1 a., 27/-. P/P. 2/6.
T.101. Two 5-10 amp. Low loading. 300-0-300 v., 150 mA., 6.3 v. 4 a., cT., 6.3 v. 1 a., 34/-. P/P. 2/9.
T.143. 7 watt stereo 250-0-250 v., 150 mA., 6.3 v. 4 a. cT., 6.3 v. 1 a., 33/-. P/P. 2/9.
T.141. 3 watt, 300-0-300 v., 60 mA., 6.3 v. 1 a., cT., 6.3 v. 1 a., 22/-. P/P. 2/-.
T.163. 2 watt stereo 250-0-250 v., 80 mA., 6.3 v. 2 a. cT., 6.3 v. 1 a., 25/-. P/P. 2/6.
T.A. Trans. and Rectifier. 270 v. D.C. 100 mA., 6.3 v. cT., 3 a., 32/-. P/P. 2/-.
T.B. Trans. and Rectifier. 270 v. D.C. 60 mA.; 6.3 v. cT., 2 a., 25/-. P/P. 2/-.
All transformers fully guaranteed, all shrouded fully except T140 and TB. Write for our fully illustrated catalogue, with all data.
SPECIAL OFFERS T44 and T55, 59/-; T143 and two T142's, 82/-. P/P. 3/6 on both.
Mullard's latest Publication detailing the complete range, "CIRCUITS FOR AUDIO AMPLIFIERS," 8/6. P/P. 1/-.
SOUTHERN TECHNICAL SUPPLIES, 83, Station Road, Portslade, Sussex

SCOOP!

RES/CAP BRIDGE
KewLab Bridge Kit Type 108

Measures 1 ohm to 10 Megohms and 10 pf to 1000 mF. Power Factor Measurement. Leakage test. Directly Calibrated. Balance indication by magic eye. Mains operated. In grey metal cabinet 10" x 7" x 4½". This Kit is absolutely complete—valves, case, panel, all components down to screws and solder—nothing else to buy. Comprehensive wiring and assembly instructions. List Price £6.10.0. Special Introductory Offer at £5.19.6 for one month only.

Sole U.K. Distributor—

GRAYSHAW INSTRUMENTS
126 Sandgate High Street, Folkestone, Kent.
Tel.: Folkestone 78618

VALVE BASES (Stems)

in Lead and Hard Glass

VALVE SLEEVES

QUARTZ CRYSTAL CONTAINERS

We specialise in short runs to customers' specifications. We invite your enquiries, also for other Glass Parts for the Electronics Industry.

DAY-IMPEX LIMITED

Progress Works, Brunel Road
Eastwood Industrial Estate, Southend-on-Sea, Essex
Telephone: EASTWOOD 525296/7

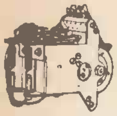
Z. & I. AERO SERVICES LTD.

Head Office: 14 South Wharf Road, London, W.2

RETAIL BRANCH (personal callers only): 85 TOTTENHAM COURT ROAD, W.2

Tel.: AMBassador 0151/2 Cables: ZAERO, LONDON

Please send all enquiries, correspondence and Mail Orders to Head Office



RATCHET MOTORS, 12 v.

1 Amp. (Impulse Motors) 5.75 ohms .... 3/6 each
Packing and postage 1/6

WESTINGHOUSE POLARIZED RELAY TYPE D164816. Enclosed polarized relay; reed type permalloy armature. 1 C.O. 500 mA contacts. Two 1450Ω Coils and one 90Ω Damping winding. With windings in series soaking current is 2.6mA and operating 0.4mA. 9-pin base. Complete with base .... p.p 3/- 25/-

EXTRA SENSITIVE RELAYS

SIGMA 4C1 (or equiv.), high speed, 1B 500mA. contact, 5000Ω winding; operating current 4mA. Secondhand .... p.p. 1/6 5/6

SIGMA 51132-1 SEALED RELAY. 1 C.O. .2A Contacts, 16,000Ω coil; operating current 0.3-0.8 mA. 1½in. × 1½in. × 3in., 5-lug connections p.p 2/- 25/-

LEACH RELAYS

Type	Coil	Volts	Contacts		Price	p.p.
1015-12	95Ω	12 V.	1 C.O.	2 Amps.	3/6	1/6
1015-24	375Ω	24 V.	1 C.O.	2 Amps.	3/6	1/6
1220DE	95Ω	24 V.	1M.	5 Amps.	7/6	1/6
1257	160Ω	24 V.	2 C.O.	12.5 Amps.	7/6	1/6
1326	A.C.	115 V.	1M1B	5 Amps.	12/6	2/6
1702MX	A.C.	115 V.	1 B.	5 Amps.	10/6	2/-
2026W	160Ω	28 V.	2M2B	5 Amps.	7/6	1/6

AMERICAN TELEPHONE RELAYS

STANDARD TYPE:—
Clare A-18258, 12 V. 200Ω 1 C.O. 1 Amps. Contacts, slow release p.p. 1/6 4/9
Ditto secondhand .... p.p. 1/6 3/-
Clare B40830, 24 V. 6500Ω 1M1B 1 Amp. Contacts .... p.p. 1/6 4/9
Clare G21935, 24 V. Twin winding 140Ω and 1300Ω, 2M2B, slow release .... p.p. 1/6 7/6
D847371, 24 V. 3000Ω 1 C.O. 1 Amp. Contacts, slow make .... p.p. 1/6 4/9
Clare D73051, 27 V. 3000Ω 1M1B 1 Amp. Contacts .... p.p. 1/6 4/9

SHORT TYPE:—
Clare B65369, 12 V. 125Ω 1M1B 1 Amp. Contacts .... p.p. 1/6 4/9
Clare A18259, 12 V. 150Ω 2 C.O. 1B, 1 Amp. Contacts, secondhand .... p.p. 1/6 3/6

P.O. RELAYS TYPE 3000, 1000Ω Coil, 6 C.O. contacts, unused, removed from equipment p.p. 2/- 6/-

MIDGET 12 V. RELAYS, 1 normally open contact (1 make), 2 Amps. 75Ω coil: operating current 90mA. Secondhand. 1¼in. × 1in. × 1¼in. p.p. 1/- 1/6

METERS

50μA D.C.M.C. 1¼in. round panel mounted, miniature, black scale, calibrated 0-5, sealed .. 35/-
200μA D.C. M.C.:—
2in. Round Flush Mtd. 32/6
2½in. Rd. Flush Mtd. 35/-
2½in. Sq. Flush Mtd. 35/-
500μA FSD D.C. M.C. Calibrated 0-10 (even scale) and marked "Level," 2½in. square, manufactured by SIFAM 35/-
500-0-500μA. D.C. M.C. 3½in. Rd. Fl. Mtd., calibrated 50-0-50 yards per sec., secondhand 22/-
1 mA. D.C. M.C. 2in. Rd. Fl. Mtd., enclosed in steel square box 2½in. × 2½in. with lead 20/-
1 mA. D.C. M.C. 2½in. Rd. Fl., calibrated 0-100 .. 17/6
100 mA. D.C. M.C. 2½in. Rd. Fl. Ferranti 12/6
200 mA. D.C. M.C. 2in. round flush mounted, black scale 17/6
500-0-500 mA. D.C. M.C. 2½in. Rd. Fl. Mtd. 12/-
5-0-5 Amps. D.C. M.C. 2½in. Rd. Fl. Charge-Discharge Meter 17/6
10 Volts A.C. M.I. 2in. Rd. Fl. Mtd., sealed 17/6
30-0-30 V. D.C. M.C. 2½in. Rd. Fl. Mtd. 12/6
18-36 V. D.C. M.C. Suppressed Zero 2in. Rd. Fl. Mtd. Calibrated every .5 V. 25/-
150 V. A.C. M.I. 2in. Rd. Fl. Mtd., Black Scale 17/6
150 V. A.C. M.I. 2½in. Rd. Fl. Mtd. Black Scale 20/-
150 V. D.C. M.C. Cal. 300/900 V., 2in. Rd. Fl. Mtd. scaled. 1,000 o.p.v. 17/6
300 V. A.C. M.I. 2½in. Rd. Fl. Mtd. 20/-

Packing and postage 1/6 per meter.
Please send S.A.E. for full list of meters.

BRAND NEW AMERICAN BLOCK CAPACITORS

0.25μF 4000V Sprague, Stud Terminals, 2½in. × 3¾in. × 8½in. .... p.p. 3/6 12/6
0.5μF, G.E.: 1000V 3/-; 1500V 4/6. P.p. 1/6.
1μF: 400V 3/6; 600V Bathtub 2/-; 600V 4/-. P.p. 1/6.
1μF: 800V 5/-; 1500V 6/-; 2000V 8/6. P.p. 2/-.
1μF 18700V G.E. Stud Terminals, 5in. × 14in. × 19½in. .... p.p. 10/- 80/-
2μF: 400V 3/6; 600V Bathtub 3/-; 600V Tubular 2/6; 600V 3/-. P.p. 1/6.
2μF: 1000V Stud Terminals 1in. × 1¾in. × 4¾in. p.p. 2/6 6/-
3μF: 250V 2/-; 600V Tubular 3/-. P.p. 1/6.
4μF: 220VAC 4/6; 600V 5/6; 600V Tubular 5/-. P.p. 1/6.
4μF: 1500V Stud Terminals 1¼in. × 3¾in. × 4¾in. p.p. 2/- 8/-
4μF 4000V G.E. Stud Terminals 4½in. × 3¾in. × 12in. p.p. 3/- 25/-
8μF: 600V 6/6; 1500V 10/-. P.p. 2/-.
10μF: 350V 7/6; 600V 8/-. P.p. 2/-.
VACUUM CAPACITORS 50μμF 32kV p.p. 3/6 40/-
ELECTROLYTIC CAPACITORS, T.C.C.:—
"Micropack" 4μF 350V Pk Wkg...... p.p. 3d. 1/9
"Lectropack" 8-8μF. Can not isolated 450V Pk Wkg .... p.p. 3d. 3/6

VENNER 8-day clockwork time switches. 24-hour dial with one make and one break. 1 amp. 230V contacts. Second hand, good condition, complete with winding key .... p.p. 2/- 27/6

ROTARY TRANSFORMERS (DYNAMOTORS)

Type	Input	Output		Price	P.P.
DY1/ARR2X	14 v.	250 v.	50 mA.	35/-	2/6
ML4312-35	24 v.	130 v.	26 mA.	12/-	2/6
DY5/ARR3	24 v.	180 v.	100 mA.	25/-	3/6
3638	24 v.	220 v.	60 mA.	18/6	2/6
DM416	24 v.	330 v.	170 mA.	40/-	5/-
DY19A	28 v.	400 v.	400 mA.	35/-	5/-
DY85	24 v.	600 v.	174 mA.	35/-	5/-

TESTED AND GUARANTEED VALVES

OAG4	3/-	6K7	6/-	76	8/-
OC3/VR105	5/6	6L6GAY	7/6	83V	9/-
OD3/VR150	6/6	6SA7GT/G	7/6	532A	5/-
1A3	3/-	6SC7	6/-	559	4/-
1L4	3/6	6SG7	6/-	705A	15/-
1R4/1294	8/-	6SH7	4/6	717A	5/-
1S5	7/-	6SJ7	6/-	808	12/6
1U5	7/-	6SK7	3/6	832	15/-
1V (6Z3)	4/-	6SK7GT	5/-	866A	10/-
1S5	7/-	6SL7GT	6/6	956	2/-
2C26	2/-	6SN7GT	5/-	957	2/-
2X2, 2X2A	4/-	6SQ7	6/-	2050	7/6
3D6	4/-	6887	6/-	5647	17/-
3S4	7/-	6V6G	5/6	5678	7/-
4B28	12/6	6X5GT	6/-	5787	12/6
5U4G	6/6	7AG7	5/-	5829	7/-
5Z3	7/-	7E5/1201	6/-	5899A	10/-
6AC7	4/6	12A6	5/-	6073	4/6
6AG5	3/6	12A8, GT	5/-	6130	17/6
6AG7	6/-	12AT7	6/-	7193	2/-
6AK5	5/-	12AU7	6/-	9001	4/6
6AL5(EB91)	4/-	12AX7	7/-	9002	5/6
6AM5(EL91)	5/-	12C8	5/-	9003	6/6
6AM6(EF91)	4/6	12H6	2/-	9006	3/-
6AR6	5/6	12J5GT	1/6	ARP34	4/6
6AT6	7/6	12SG7	2/6	ARTH2	7/-
6B8	6/-	12SH7	2/-	AC/HL	3/6
6C4	2/6	1 doz.	15/-	AW3	4/-
6C5G	4/-	12SK7	4/-	EAC91	4/-
6C6	4/6	12SQ7	7/6	EF50	1/6
6G6G	2/6	12SR7	5/-	EF92	6/6
6H6WGT	2/6	25Z6	7/-	SP61	2/6
6J5	4/6	28D7	5/-	TT11	3/-
6J5G	4/-	42	8/-	TT15	35/-
6J6	4/-	53A	3/-	VR92	1/-

Please add 2/6 in £ for packing and postage.
Please write for full price list of valves and tubes.

P.O. BUZZERS

Post Office Buzzers model T Mk. I. Minimum operating voltage 3 volt. PRICE (p.p. 1/6) 4/6

D.C. MOTORS

24 V. D.C. Miniature Motor, approx. 1/50 H.P. 1¼in. barrel × 2½in. long, two shaft extensions ¾in. and 5/32in. .... p.p. 2/6 12/6

24 V. D.C. 1/5 H.P. (1 minute rating), 3,800 r.p.m. Pinion shaft, 64 D.P., 2½in. dia. × 4in. long p.p. 2/6 12/6

COMMUNICATION RECEIVERS

All Receivers are available on H.P. Terms. Please write for details.

R.C.A. AR-88LF	£80 0 0
R.C.A. AR-88D	£85 0 0
HALLICRAFTER S-27	£65 0 0
BC-342 (1.5-18 mc/s)..............	£42 0 0

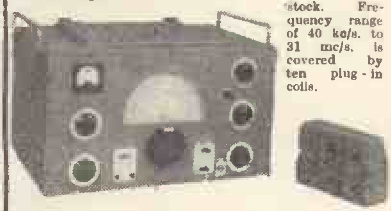
All the above are fully overhauled, tuned and adjusted in accordance with the original specification and fully guaranteed for six months.

MARCONI CR-100, good condition, tested and in guaranteed working order £25 0 0

These can also be overhauled to Laboratory Standard. Please write for details.

AVAILABLE AGAIN
EDDYSTONE 358X RECEIVERS

We have again a limited number of these receivers in stock. Frequency range of 40 kc/s. to 31 mc/s. is covered by ten plug-in coils.



PRICE, in perfect condition, complete with ten coils and mains Power Pack.......................... £15 0 0
Packing and carriage £1 0 0

V.H.F. RECEIVER UNITS BC-624

(part of SCR-522 Transmitter-Receiver)

4 Crystal controlled channels, 100-156 Mc/s. (3.0-1.93 metres). Valves 9003 R.F. stage; 9003 Mixer; Three I.F. stages 12SG7; Det/AVC/Audio 12C8; Second Audio 12J5GT; Oscillator 12AH7GT; Harmonic Generator 9002; Harmonic Amplifier 9003; Audio Squelch—other section of 12AH-7GT. High and Low Impedance output.
PRICE, complete with valves, with description and circuit diagram, but without squelch relay 25/-, p.p. 5/-. PRICE, chassis only, less valves, 7/6, p.p. 3/6.

ALSO LIMITED QUANITTY ONLY:

TRANSMITTER UNITS BC-625

(part of SCR-522 Radio Set)

Valves: Speech Amplifier 6887; Push-Pull Modulator (two 12A6); Oscillator 6G6G; 1st Harmonic Ampl. 12A6; 2nd Harmonic Ampl. 832; Power Ampl. 832. Output 8 watts.

PRICE, complete with valves, description and circuit diagram .... p.p. 5/- 22/6
Price, chassis only, less valves ...... p.p. 3/6 7/6
Descriptions and circuits available at 8d. each.

WESTINGHOUSE SELENIUM RECTIFIER POWER UNITS

Input 115/230 V., fully smoothed and fused. Output adjustable from 80 to 140 V. D.C. by means of fine and coarse tap switches in the secondary winding. Max mum current 400 mA. continuous. Dimensions: 17¼in. × 10½in. deep × 3½in. high .... p.p. 7/6 49/-

CATHODE RAY TUBES

Type	Val.	Va2	Vg1	Defl.	Price
2AP1	250 V.	1000 V.	60 V.	E-S	25/-
5FP7	340 V.	1500 V.	45 V.	E-M	12/6
5SP7	430 V.	1500 V. (twin gun tube)	45 V.	E-S	140/-
7BP7A	7000 V.	—	70 V.	E-M	60/-

Packing and postage 5/- per tube.

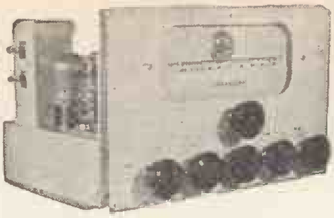
STEEL C.R. TUBE SCREENS

Suitable for 3PB1 and other 3in. tubes, brand new, with rubber lining and mounting foot .... p.p. 1/- 5/-

Packing and carriage charges are quoted for England, Scotland and Wales only.

We urgently require Frequency Meters BC-221, Communication Receiver R1359 and other high class Communications and Test Equipment.

Fidelia



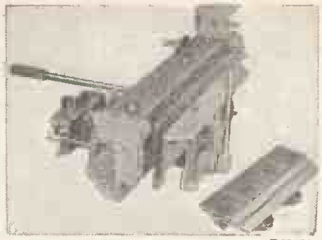
Our present range includes:
Fidelia Major AM/FM tuner unit with pre-amp., tone controls, etc., R.F. stage on all wavebands, variable selectivity, etc. Price £27/4/-, or with the Major amplifier, £42/14/-.
Fidelia Imperial, VHF tuner. Price £15/5/-, or with pre-amp. and tone controls, £19.
Fidelia Preciton, switched VHF tuner. Price £14/6/-, or with pre-amp. and tone controls. £19.
Fidelia Major amplifier, £18.

Full details willingly on request. (6d. for postage is appreciated.)

ELECTRO Acoustic DEVELOPMENTS
2 AMHURST ROAD TELSCOMBE CLIFFS
Nr. Brighton, SUSSEX.
Tel.: Peacehaven 3156

MORE and MORE RESEARCH UNITS are finding A.A. BENDERS invaluable

SO WILL YOU



RX-20

This UNIQUE BENDER

Quickly and Accurately Forms

Angles, Channels, Sections, Boxes, Lids, Trays, Chassis Brackets, Clamps, Clips, Shrouds, etc.

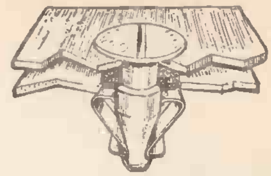
The RO-20 and RXX-26 are becoming "essential equipment" for Electronics, Radio, T.V. and General Research work. Many now prefer the RZ-26.

The RO-20 is similar in general design and finish to the RX-20 shown above, but is lighter and less expensive.

For 6-page Folder write to :—

A. A. TOOLS (w)
197a Whiteacre Rd., Ashton-u-Lyne

ODDIE FASTENERS



THE FASTENER WITH ENDLESS APPLICATIONS – SIMPLE – POSITIVE SELF-LOCKING. MADE IN A VARIETY OF TYPES AND SIZES. SPECIAL FASTENERS TO SUIT CUSTOMERS' REQUIREMENTS. WIDELY USED IN THE RADIO INDUSTRY.

Illustrated brochure and other information will gladly be sent on request.

DEPT. "W.W."

Oddie, Bradbury & Cull Ltd., Southampton

Tel.: 55883 Cables: Fasteners, Southampton

BARGAIN OFFER
surplus

White Spot R.F. Transistors

at 4/6 each. *POST FREE*

Our Component Lists for 3d. Stamp
Money Back Guarantee on all Items

NEO MAIL ORDER SUPPLIES
2A MAXWELL RD., PORTSMOUTH

AMERICAN

COMPONENTS - VALVES
TEST EQUIPMENT

PHONE-WHITEHALL 4856

DALE ELECTRONICS
109 Jermyn Street, London
S.W.1

A.D

LOUDSPEAKER ENCLOSURES AND AMPLIFIER CONSOLE CABINETS

A. DAVIES & CO. (Cabinet Makers)
3 PARKHILL PLACE (off Parkhill Road), LONDON, N.W.3. GULLIVER 5775
Few minutes walk Belsize Park Underground

SERVO & ELECTRONIC SALES LTD.

COMMUNICATION RECEIVERS, Type R.107, 1.2 to 17.5 M/cs, in 3 ranges, 9 valves, superhet, 3 kc/s or 7.5 kc/s bandwidth, 100-250 v. 50 c.p.s. or 12 v. D.C. supply. Sensitivity 2-6μV in excellent condition, £14/10/-, plus carr. 25/-. Type R.206, 15 kc/s to 30 Mc/s. continuous in 9 ranges, 15 valves superhet, 0.7, 2.5 or 8 kc/s. bandwidth 100-250 v. 50 c.p.s. or 12 v. D.C. supply. Sensitivity 2-4μV a superlative receiver in excellent condition, £30, plus carr. 35/-. **TANTALUM ELECTROLYTICS**, 10μF 6 v., 10/- (P.P. 6d.). **TR1986 TX RX XSTL CONTROLLED**, 124-156 Mc/s, tip-top condition, with instructions, £8/15/- (P.P. 12/6). **CONNECTING LEADS**, fitted Pye skt. each end, brand new, useful stocks for Labs., separately packed 6ft. 5/-, 9ft. 5/6, 13ft. 6/6, 20ft. 8/- (P.P. 2/-). **SIGNAL GENERATOR T49**, £10 (P.P. 10/-). **GERMANIUM DIODES**, new, guaranteed not rejects. GEX34 2/-, GEX35 2/6, GEX55 55/1 5/-. **SILICON DIODES**, GJ6M 10/-, Z810A 12/6, ZR20 15/6 (P.P. 6d.). **ALTERNATOR SETS IN STOCK FOR** 400, 1,100 and 2,000 c.p.s. Write for details. **PYROMETERS**, direct reading, from 24 remote positions, 0-350°C, fitted cold junction thermos, £12/10/- each. **TINSLEY GALVANOMETERS** 885.45, 50 mm. per μA., £10/10/- each. New **INDICATOR UNIT APW 9922A**, 1-VCR97, 3-VR91, 2-VR54, 1-CV1285, 1-VT61, mumetal shield, focus and brill. controls, 8 pots, ideal for 'scope conversion or CRT display unit. New with cct, 37/6 (carr. 5/-). **CARPENTER POLARISED RELAYS**, each-side-stable type, operate at 0.25 v. 2.2 mA., 27/6 (P.P. 1/-). **S.T.C. MIN. RELAYS**, 4186ED, 17/6 (P.P. 1/-). **MEGGERS**, 500 v. Ser. II, completely reconditioned and guaranteed, £21 (carr. 7/6). **MAINS/BATTERY POWER UNIT L332**, 12 v. D.C. or 110-250 v. A.C. in, 12.6 v. 2 a., 250 v. 75 mA. D.C. out, 19in. rack mtg. with cct, 37/6 (P.P. 5/-). **DRAYTON TYPE RQ MOTORS**, 37 r.p.m. 230 v. A.C., 75/- (P.P. 4/-). **CAPACITANCE/RESISTANCE UNITS**, 2 RES. ARMS 1-4, 332 ohms, 2 cap arms 0.001-4,332μF with data sheet, 17/6 (P.P. 3/6). **TELE "F" SETS**, £6 pr. (P.P. 12/-). **SOUND POWERED TELEPHONE SETS**, wall mounting, 75/- pr. (P.P. 15/-). **P.O. RELAYS T3000** 3.950 plus 3.950 w. S.P.C.O., 6.500 W. D.P.C.O., 4,000 w. S.P.C.O. 250 w. 6 pcs., 10/- ea. (P.P. 1/-). **ELECTROLYTIC VOLTMETERS** 1.5 kV. 2½in. flush, 25/- ea. (P.P. 1/6). **SYNCHRO. C.T.s AND SERVO MOTORS FOR 400 cps. optn. SARAH AIR/SEA RESCUE POWER UNITS and RECEIVERS, ELLIOTT AUTO PILOT SPARES**, also available, together with our normal range of **MAGSLIPS, SELSYNS, IPOTS**, etc., and all components for electrical computation and control.

Post orders to: 1, Hopton Pde., Streatham High Rd., London, S.W.16.

Callers to: 43, High St., Orpington, Kent. Tels.: Orpington 31066 and Streatham 6165. TERMS: nett C.W.O. or monthly approved accounts.

P. A. MARRIOTT & CO., LTD.

Specialists in the manufacture of Magnetic Recording Heads.

SUNLEIGH WORKS, SUNLEIGH ROAD, ALPERTON, WEMBLEY, MIDDX. WEM 7493

Q.C.C.

YOU are invited to apply for a copy of our illustrated brochure and price list which gives full details of our wide range of

QUARTZ CRYSTAL UNITS

which are renowned for their

Accuracy & Reliability

THE QUARTZ CRYSTAL CO. LTD.

Q.C.C. Works, Wellington Crescent, New Malden, Surrey.
Telephones : *MALden 0334 & 2988*

TAPE RECORDER SOUND HEADS

Monaural.	R/P & Erase.
2 Track Stereo.	R/P & Erase.
4 ,, ,,	R/P & Erase.

HOME & EXPORT

Full specifications, technical data, with samples available to the Trade on request :—

BRADMATIC PRODUCTIONS LTD
124, ALBERT ROAD
BIRMINGHAM, 21
ENGLAND

Wireless World Classified Advertisements

Rate 9/- for 2 lines or less and 4/6 for every additional one or part thereof average lines 6 words. Box Numbers 2 words plus 1/-. (Address replies: Box 0000 c/o "Wireless World," Dorset House, Stamford St., London, S.E.1.) Trade Discount details available on application. Press Day August 1960 issue, Thursday, June 30th, 1960. No responsibility accepted for errors.

WARNING

Readers are warned that Government surplus components and valves which may be offered for sale through our displayed or classified columns carry no manufacturers' guarantee: Many of these items will have been designed for special purposes making them unsuitable for civilian use, or many have deteriorated as a result of the conditions under which they have been stored. We cannot undertake to deal with any complaints regarding any such items purchased.

RECEIVERS AND AMPLIFIERS SURPLUS AND SECONDHAND

HRO Rx's, etc., AR88, CR100, BRT400, G209, S640, etc., etc., in stock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0053

FOR SALE.—Collins communication receiver 51J2, excellent condition, 100% accuracy, in table top case, 230/110v., A.C. mains.—Offers in writing to A. Benyon, 47, Alexandra Ave., Sutton, Surrey. [9133

WHEN in the Midlands you must visit our new walk-round bargain stores at 15, Church St., Wolverhampton; always available, ex-Government surplus receivers, test sets, valves and components of every description; also secondhand radio sets, T.V. sets, tape recorders, record players and suchlike equipment. YOUR welcome assured at Walton's Wireless Stores, 15, Church St., Wolverhampton. Tel. 22039. [0147

LOUDSPEAKERS SURPLUS AND SECONDHAND

WHARFEDALE 3-speaker corner enclosure, sand filled, overall height 48in, width 34in, consisting of W15FS, W10, Super 3 and crossover unit; beautiful hand made walnut cabinet.—Tel. Archway 0945. [9106

NEW TEST EQUIPMENT

HEATHKITS can now be seen in London and purchased on easy terms; free brochure.—Direct TV Replacements, Ltd., 138, Lewisham Way, S.E.14. Tideway 6666. [9118

HETERODYNE frequency meters, BC221 125kc/s-20mc/s, £30; TS174 20mc/s-250mc/s TS175A, 85mc/s-1,000mc/s, brand new receivers, Eddystone 358X, 40kc/s-32mc/s, £16/10; Hallicrafter's R-44/ARR5 27mc/s-145mc/s A.M./F.M., £25; AN/APR-4 38mc/s-4,000mc/s Receiver-indicators APN-9s, etc.—R. V. Wright, 4a, Nepal Ave., Atherton, Manchester. [0019

TEST EQUIPMENT—SURPLUS AND SECONDHAND

FREQUENCY meter B.C.221, with calibration charts, £60; valves.—Box 0109. [9126

SIGNAL generators, oscilloscopes, output meters, wave voltmeters, frequency meters, multi-range meters, etc., etc., in stock.—R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0056

TEST EQUIPMENT WANTED

WANTED, the following Nagard equipment: Model DT.103 double-gun oscilloscope, Type 2502 electrometer stage, Type 2701 pre-amplifier; alternative similar equipment would be considered.—Full details and prices to, Snowdon, Windsor Grove, Ramsey, Isle of Man. [9115

OSCILLATORS required urgently, 3 B.S.R. type LO 800B beat frequency oscillators, ranges 0-600 c/s-0-16 Kc/s, or 0-750 c/s-0-25 Kc/s; output 5 watt impedance load 3-15-4,000 ohms; similar instruments will be considered whether new or reconditioned.—Write Box E.165, c/o Streets, 110, Old Broad St., E.C.2. [9127

NEW COMPONENTS

CRYSTAL microphone inserts with exceptionally high output. (Cosmocord Mic 6.) Guaranteed newly made and boxed, 15/6 post free.—Radio-Aids, Ltd., Dept. W.29, Market Street, Watford, Herts. [0213

LINE output transformers and scan coils for most makes, exact replacements from 45/- new or 25/- used, send s.a.e. for imm. quote, telephone orders sent same day c.o.d.—T.C.S. Ltd., 28, Brockley Cross, S.E.4. Tideway 5394, and at 112, Camberwell Rd., S.E.5. Rodney 7917. [0334

COMPONENTS—SURPLUS AND SECONDHAND

I.T.V. converters, Stirling, Aerialite, 55/1 P.P.—O.D.B., 25, Ramshead Approach, Leeds 14. [9139

CATALOGUE No. 14 Government surplus and model radio control, over 500 illustrated items, 2/- (refunded on purchase), p.p. 6d.—Arthur Sallis Radio Control, Ltd., 93 (C), North Rd., Brighton. [0193

COMPONENTS—SURPLUS AND SECONDHAND

VARIABLE resistances (potentiometers), min. carbon ¼watt, 100,000 ohms, ¼ spin×¼in; ref. ZA.2808/PC81257 for No. 19 T/R new cond. qty., 4,000 at 6d for the lot; qty. 200 Grelco M12 (12-way), new terminal blocks, 1/6 each for the lot.—Rodwell, Ltd., 232, Lavender Hill, Enfield, Middx. Enfield 7878. [9112

NEW GRAMOPHONE AND SOUND EQUIPMENT

TAPE recorders; Ferrograph, Vortexion, Brenell, Telefunken, Reflectograph, & Fi Cord. TAPE Decks: Wearite, Brenell, Truvox, Bradmatic. Amplifiers & Tuners: Quad, Leak, R.C.A., Dynatron, Dulci & Chapman. Microphones: Reslo, Lustraphone, Gramplan & Telefunken. All tapes & accessories. Specialists in Audio Service & Sound Recording. HIRE purchase facilities available. LAMBDA RECORD COMPANY, Ltd., 95, Liverpool Road, Liverpool, 23. Great Crosby 4012. [9014

CINE-VOX disc recording mechanisms for L.P. or standard operation from 30gns.-56gns.; also complete tape-disc or direct channels from 50gns.-112gns. DEMONSTRATIONS can be arranged in London.—For full details write to K.T.S., Ltd., "Coplow," Park Rd., Braunton, N. Devon. Callers by appointment only. [0210

BRAND new, selling off bargains in High Fidelity equipment and Tape Recorders; send s.a.e. for list.—The High Fidelity Centre, 61, West St., Dorking, Surrey. [9128

GLASGOW.—Recorders bought, sold, exchanged, cameras, etc., exchanged for recorders, or vice versa.—Victor Morris, 406, Argyle St., Glasgow. C.2. [0201

"EROICA" RECORDING STUDIOS (Est. 1949).—For the better class tape recorders for industry, research, music and private use; Ferrograph, Brenell, etc.; complete recording service; music for industry, tape/disc.—31, Peel St., Eccles, Manchester. Eccles 1624. Studio Director Thurlow Smith, A.R.M.C.M. [0122

GRAMOPHONE AND SOUND EQUIPMENT—SURPLUS AND SECONDHAND

TELEFUNKEN M23 small studio recorder, new condition; demonstration London; £118.—Box 0264. [9151

GRAMOPHONE AND SOUND EQUIPMENT—WANTED

WANTED, Grampian disk (feedback) cutter-heads and amplifiers, latest types.—Box 0262. [9150

TAPE RECORDING, ETC.

RENDEZVOUS RECORDS offer comprehensive 78/LP tape to disc recording facilities. —Leaflet from 19, Blackfriars St., Manchester, 3. [8829

TAPE to disc recording: Microgroove LP from 27/6, 78 r.p.m. from 11/-, also 45 r.p.m.; 48-hour service; s.a.e. for comprehensive leaflet to.—A. D. Marsh, "Deroy" Sound Service, Little Place, Moss Delph Lane, Aughton, Ormskirk, Lancs. Aughton Green 3102. [8931

TAPE/DISC/TAPE transfer editing, copying; if quality and durability matter (especially with L.P.s from your precious tapes), consult Britain's oldest transfer service; every new tape recorder is supplied with a 2-year service guarantee; latest American tapes (25 to 35 per cent saving); now available.—Sound News Productions, 10, Clifford St., London, W.1. Reg. 2745. [0192

VALVES

VALVE cartons by return at keen prices; send 1/- for all samples and list.—J. & A., Boxmakers, 75a, Godwin St., Bradford 1. [0172

RECLAIMED valves, tested and perfect, huge stocks, modern and obsolete, all one price, 5/- plus 6d postage each; delivery by return.—Lewis, 46, Woodford Ave., Gants Hill, Ilford, Essex. [9131

VALVES WANTED

NEW valves wanted, any quantity, best cash price by return.—Stan Willetts, 43, Spoon Lane, West Bromwich, Staffs. Tel. Wes. 2392. [8547

ALL types of valves, British or American, transmitting and receiving; keenest cash prices paid. What have you to offer?—Write or call Lowe Bros., 9a, Diana Place, Euston Rd., N.W.1. Tel. Euston 1636-7. [9124

WANTED, EXCHANGE, ETC.

A PROMPT cash offer for your surplus brand new valves, speakers, components, test instruments, etc.—R.H.S., 155, Swan Arcade, Bradford, 1. [0190

WANTED, all types of communications receivers and test equipment.—Details to R. T. & I. Service, Ashville Old Hall, Ashville Rd., London, E.11. Ley. 4986. [0163

WANTED in bulk radio and telephone parts, ex-Army under ZA & YA references.—Rodwell, Ltd., 232, Lavender Hill, Enfield, Middx. (Enfield 7878.) [9111

URGENTLY wanted, manuals or instruction books, data, etc., on American or British Army, Navy or Air Force radio and electrical equipment.—Harris, 93, Wardour St., W.1. Gerrard 2504. [8880

EXCLUSIVE OFFERS

★ Dowty High Speed Registers	£6 0
★ Avo Geiger Counters	£16 10
★ 20 kVA 115/230 v. Auto Transformers	£20 0
★ American Teletype Tables	£4 0
★ 50 watt Rack Mounting Power Amplifiers 200/250 v. A.C.	£1 15
★ Precision Mains Filters	10
★ 150ft. Aerial Masts 6in. dia., steel tubular	£95 0
★ 15 kVA Constant Current Transformers	£85 0
★ Trylon Lattice Ladder Towers, 50ft. high	£60 0
★ 85ft. 2½in. dia. Steel Tubular Masts	£50 0
★ R.201 Triple Diversity Receivers	£125 0
★ Ferranti 7KVA Automatic Voltage Regulators	£35 0
★ T-1131 Transmitters	£35 0
★ Creed 8B Tape Teleprinters, new	£35 0
★ 7ft. RCA Cabinets for 19in. panels	£12 10
★ Westinghouse 30 kV., 100 mA., Cabinet Rectifiers variable from 2 kV.	£75 0
★ 25ft. Self-supporting Plymold Tripod Masts	£5 0
★ AN/TRC-1 Aerial Arrays	£7 0
★ AM-8/TRA-1 250 watt Amplifiers	£8 0
★ RA-87 Teletype Rectifiers	£7 10
★ REC-30 Teletype Rectifiers	£12 10
★ AN/FMD-1 Rawin	£80 0
★ DFG-24 Direction Finders	£27 0
★ TCJ Transmitters, 400 watts	£30 0
★ RCA 5-element Yagi Arrays, 420 Mc/s.	£3 0
★ 75ft. Plywood Masts, 9in. dia.	£35 0
★ RCA 25-watt Projector Speakers	£14 0
★ RCA Twin Channel Broadcasting Control	£185 0
★ E.H.T. Power Supply, 3 Kv. 0.5 amp. in cubicle	£25 0
★ Standard Business Machines, Video type Tape Recorders, 3in. tape	£250 0
★ 12in. Bowl Deck Insulators	£3 0
★ Power Supply Units, 1,200 v. 200 m/a.	£6 0
★ E.H.T. Power Supply, 7,500 v. 3.5amps. in cubicles	£250 0
★ E.H.T. Power Supply, 1,600 v. 5 amps. in cubicle	£130 0
★ Sola 2 kW, Constant Voltage Transformers	£16 0

AERIAL EQUIPMENT. Whips, Beams and Microwave. Poles and Masts up to 150ft., 70 different types in stock.

RECEIVERS from 15 Kc/s to 650 Mc/s, 60 kinds available.

TRANSMITTERS, 50 types, Mobile and fixed up to 2 kilowatts.

CABINETS and RACKS. American and British, open and closed, 30 patterns from 12in. to 9ft.

POWER SUPPLIES. Over 100 varieties giving up to 30,000 volts from standard and off standard inputs.

TRANSFORMERS. 300 patterns in stock of all sizes to 20 kVA for power and 5 KW for Radio, Audio and Modulation up to 2 kW also, lists available.

TELEGRAPH and TELEPHONE APPARATUS of all kinds include Printers and Perforators for Morse, 5, 6, 7 unit code also Transmitters and Converters and Carrier and Channelling equipment. Filters, Repeaters and Power supplies for all the above in British and American versions.

40-page List of over 1,000 items in stock available—keep one by you.

RELAYS and CHOKES. 12 tons of American post-war just arrived—a pleasure to use and look at—ask for special list—others in stock include Miniature, Polarised Post Office, aircraft, Control and Starting Relays. Chokes, open and potted, vary from one inch mu metal to 100-amp. power types—list available.

NUCLEAR GEAR—includes Scalers, Counters, Registers, Ratemeters, Dosimeters, Probes, Monitors, etc. Special list on request.

TEST EQUIPMENT. 200 different items of British and American test gear and hundreds of types of Meters available.

We have a large quantity of "bits and pieces" we cannot list—please send us your requirements as we can probably help—all enquiries answered.

P. HARRIS
ORGANFORD - DORSET
WESTBOURNE 65051

WANTED, EXCHANGE, ETC

WANTED, good quality communication RYS tape recorders, test equipment, domestic radios, record players, amplifiers, valves, components, etc., estab. 18 years.—Call, send or 'phone Ger. 4638, Miller's Radio, 38a, Newport Court, Leicester Square, W.C.2. [8563

PROMPT cash for the purchase of surplus stocks of televisions, tape recorders, radios, amplifiers and domestic electrical appliances of every description, substantial funds available.—Spears, 14, Watling St., Shudehill, Manchester. Deansgate 7705 (3 lines). Bankers: Midland Bank, Ltd. [0216

REPAIRS AND SERVICE

BOULTON'S OF BRADFORD.

LOUDSPEAKER, pressure unit, and microphone repairs, D.C.B. cone assemblies and field coils in cartons, service and satisfaction guaranteed. —D. C. Boulton, 134, Thornton Rd., Bradford, 1. Tel. 22838. [0171

MAINS transformers wound to any specification.

MOTOR rewinds and complete overhauls; first-class workmanship; fully guaranteed. F.M. ELECTRIC Co., Ltd., Potters Bldgs., Warser Gate, Nottingham. Est. 1917. Tel. 54898. [0113

WE undertake the manufacture of transformers singly or in quantities to any specification; all work guaranteed for 12 months.
LADBROKE Transformer Co., Ltd., 820a, Harrow Rd., London, N.W.10. Tel. Ladbroke 0914. [0222

TRANSFORMERS to any specification. Singles, rewinds, small or large batches; quick and efficient service, competitive prices, estimates by return of post from:
MESSRS. Newman & Son 1, Grove Crescent, South Woodford, E.18. [0330

TRANSFORMERS.—Suppliers to B.B.C., I.T.A., and leading radio manufacturers, single or long runs, prompt delivery, home and export, rewinds to all makes.
FORREST (TRANSFORMERS), Ltd., Shirley, Solihull, Warwicks. Tel. Shi. 2483. [0128

SPEAKER repairs, cones fitted fields and clock coils wound, guaranteed satisfaction, prompt service.—L. S. Repair Services, Pluckley, Ashford, Kent. [0223

MISCELLANEOUS

SPECIAL bargain list; send 2d stamp.—Porter's Radio, 30-31, College St., Worcester. [9130

METALWORK, all types cabinets, chassis, racks, etc., to your own specification, capacity available for small milling and capstan work up to 1in bar.
PHILPOTT'S METAL WORKS, Ltd., Chapman St., Loughborough. [0208

WORK WANTED

PROTOTYPE Wireman requires work at home, anything considered.—Box 0181. [9138

CAPACITY AVAILABLE

RADIO components made to order.—Bel Sound Products, Marlborough Yard, N.19. [0185

ELECTRONICS engineers to the industry. Production with 100% inspection.
RADIO-AIDS, Ltd., 29, Market Street, Watford (25988), Herts. [0214

SMALL London manufacturer has capacity available for experimental or production high vacuum electronic devices.—Box 8924. [9108

NEWLY formed electrical/electronic firm have capacity available for manufacture in electro-mechanical and electronic fields.—Box 8784. [9098

CONSULTANT and development engineer, own laboratory, audio, magnetic recording, etc., well known name in this field.—Tel. Buc. 9315, or write Box 0252. [9147

HIGHLY competitive quotations given for all your prototype and production requirements.—Newlyn Electronics, Ltd., The Fradgan, Newlyn, Penzance. Tel. Penzance 2462. [9120

ELECTRONIC instruments and devices made to your requirements; design work undertaken; special application and "one only" orders welcomed; quotations gladly given. Why not discuss your problem with us?—Vacuum Electronic, Ltd., 35, Sackville St., W.1. Regent 6404. [9125

CONSULTANTS

MR. J. Sykes, M.I.E.E., M.Brit.I.R.E., M.I.N., has left the Ministry of Aviation to set up as a consultant specialising in engineering staff selection and recruitment, promotion board referee; technical training schemes inaugurated and supervised.—Head Office, Red Lion Court, Stalbridge, Dorset. Tel. Stalbridge 498. [9116

SITUATIONS VACANT

SENIOR engineer required to work in Applications section of valve development laboratory.
MINIMUM qualification H.N.C. Previous experience in testing and designing test gear for medium and high power radio transmitting valves, and experience with R.F. heating.
APPLY to Personnel Department, Associated Electrical Industries, Ltd., Cosmos Works, Brimsdown, Enfield, Middx. [9102

Ersin MULTICORE
SAVBIT SOLDER

Savbit for the small user

The popular Size 1 Carton is now supplied in 3 specifications: 53 ft. of 18 s.w.g. 30 ft. of 16 s.w.g. or 20 ft. of 14 s.w.g. 5/- each (subject).

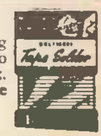
Home Constructors Pack

Contains 19 ft. of 18 s.w.g. 60/40 alloy wound on a reel or, for soldering printed circuits, 40 ft. of 22 s.w.g. 60/40 alloy also wound on a reel. 2/6 each (subject).

Size 2 Carton

Contains 3 ft. of 40/60 Ersin Multicore 5-Core Solder—enough for about 200 average joints. The low price ensures a quick turnover. 6d.

Tape Solder Card

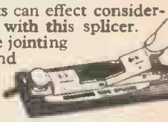


A real tin/lead solder containing cores of Ersin Flux. Needs no soldering iron or extra flux. Sufficient solder for 100 average joints. 1/-.

Bib Wire Stripper and Cutter

This efficient tool strips insulation, cuts wires cleanly and splits plastic twin flex. It is adjustable to most wire thicknesses. 3/6 each (subject).

Bib Recording Tape Splicer



Recording enthusiasts can effect considerable tape economies with this splicer. It makes the accurate jointing of tape so simple and quick that every scrap can be used. 18/6 each (subject).

Send stamped addressed envelope for free Copy of folder "How to Edit Tape Recordings".

See also MULTICORE advertisement on back cover

If you have any difficulty obtaining any of these items, they will be sent post free.

MULTICORE SOLDERS LIMITED, HEMEL HEMPSTEAD, HERTS

ENCLOSURES, EQUIPMENT & CABINETS by STAMFORD

THE ESSEX stereo cabinet. Sizes 36in. by 36in. by 16in. deep, motor board 15in. by 14in. Separate reflex enclosures incorporating the Wharfedale acoustic filter. Record storage. Recommended for any 8in. units. Price £19/19/-, or £3 deposit and 9 payments of 40/6 monthly or 18 payments of 21/8 monthly.

EQUIPMENT	Cash Price			Hire Purchase	
AMPLIFIERS	£	s	d	Deposit	18 Mths.
Rogers Cadet	17	10	0	52/6	19/1
Leak TL/12	31	10	0	94/6	34/2
STEREO					
Jason J2-10/Mark III	37	10	0	112/6	40/9
Quad 22 Control	25	0	0	75/-	27/2
Leak 20 and Control ..	51	9	9	154/6	55/8
TUNERS					
Quad FM	28	17	6	87/-	31/4
Chapman FM85	28	17	6	87/-	30/9
CHASSIS					
Armstrong Jubilee ..	29	8	0	88/-	31/10
Armstrong Stereo 44 ..	28	7	0	85/-	30/10
SPEAKERS					
Axiom 300	11	5	9	33/6	11/5
Golden 10in. FSB	8	6	7	25/-	9/-
MOTORS					
Collaro 4T/200	18	12	0	55/6	20/4
Connoisseur Type B ..	27	16	1	82/6	30/3
Garrard 4 HF	18	9	9	55/6	20/1
Garrard 301	22	7	3	67/-	24/3
Connoisseur 2 speed ..	16	13	1	50/-	18/2

Write for our Hi-Fidelity Equipment List of Complete Systems and Stereophonic Cabinets.

WE SPECIALISE in supplying and fitting any equipment currently available.
No fitting charge.
DEMONSTRATIONS AT OUR WEYMOUTH TERRACE SHOWROOMS

Goodmans speaker system **completely** fitted and wired.

THE SHERWOOD DESIGN

Stage (I). With Axiom 300 12in. twin cone speakers. Price £30/17/6, or £4/10/- deposit and 18 payments of £1/13/9 monthly.
Stage (II). With Audiom 60 Bass unit plus Trebax 5K/20XL tweeter attenuator and crossover. Price £35/17/6, or £5/7/6 deposit and 18 payments of £1/19/- monthly.
Stage (III). With Audiom 60 Bass unit, Midax 650 mid range unit. Trebax 5K/20XL tweeter crossover and attenuators. Price £54/17/6 or £8/4/6 deposit and 18 payments of £2/19/8 monthly.

Products supplied in Oak Walnut and Mahogany Veneers finished to shade required. Delivery 12/6.

Write for our illustrated catalogue or visit our Hi-Fidelity Showrooms at:
84/86/98 Weymouth Terrace, off Hackney Road, LONDON, E.2. Telephone: SHO 5003
Showroom hours: Monday-Saturday, 9.30 to 5.30. Late night Wednesday 7 p.m.
Directions: No. 6 bus from Liverpool Street Station to the Odeon, Hackney Rd. Walk back two turnings.

A. L. STAMFORD LTD. (DEPT. C4)

SITUATIONS VACANT

RADIO maintenance technician.
POLICE Department, Government of Northern Rhodesia, requires a radio maintenance technician on agreement for one tour of 3 years with prospect pensionable employment. Salary according to experience in scale £745 rising to £1,260 a year. Prospects of promotion to telecommunications officer (maximum salary £1,315) and chief telecommunications officer (maximum salary £1,490). Married accommodation with heavy furniture available immediately at sub-economic rent, e.g., on salary of £745 rent is £45 a year. Free passages. Liberal leave on full salary. Candidates should be between 22 and 35 years, of good physique, and possessing maths. and physics at G.C.E. "O" level standard. They should have sound knowledge of installation and maintenance of modern low and medium power V.H.F. static and mobile equipment, H.F. transmitters and receivers including S.S.B. and petrol generator and diesel electric sets. Knowledge of installation and maintenance of teleprinters an advantage.—Write to The Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, qualifications and experience, and quote M2A/50829/WF. [9104

INSTRUCTOR (Telecommunications) Sierra Leone Government Technical Education Department.
APPLICATIONS are invited for the above post from candidates between the ages of 22 and 45 years possessing either:—
(a) FULL Technological Certificate in Telecommunications, specialising in radio transmission; or
(b) C. & G. Teachers' Certificate in a technical subject; or
(c) UNITED Kingdom Ministry of Education Certificate as well as specialist qualification.
SALARY for candidates possessing qualification (a) in scale (including Inducement Addition) £960 rising to £1,528 a year; for candidates possessing qualification (b) or (c) in scale (including Inducement Addition) £966 rising to £1,666 a year. Commencing point in salary scale will depend on age, qualifications and experience.
APPOINTMENT will be on contract for three tours of 10/12 months in first instance. Gratuity at rate of 15% of total salary drawn. Outfit allowance £60. Children's allowance £48-£288 a year. Free passages. Liberal leave on full salary.
SUCCESSFUL candidate will be required to teach telecommunications subjects to trade apprentices up to C. & G. standard.
WRITE to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, qualifications and experience and quote M2A/50686/WF. [9152

MEN with a knowledge of the basic principles of radio and radar are required in the Meteorological Office.
AFTER short initial training, those appointed will maintain and operate radio and radar equipment, including facsimile apparatus; opportunities to serve overseas and in the United Kingdom; starting salary for radio (Meteorological) technician, London, £690 at 25 or over, rising annually to £820, subject to deductions for each year below age 25; provincial salary £40 to £50 lower; good promotion prospects, overtime, allowances, night duty, etc.—Apply to Meteorological Office (M.O.10 R/M/T), Victory House, London, W.C.2. [9134

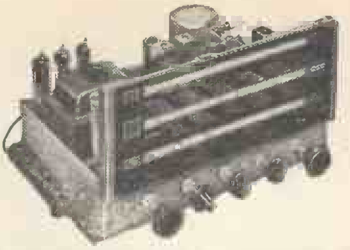
PART-TIME advertising and office manager required by London hi-fi dealers; age immaterial; experience important.—Box 6676. [0133

THE Scientific Civil Service needs men and women for pensionable posts as (a) senior scientific officers and (b) scientific officers in all major scientific fields, including:
PHYSICS
ENGINEERING
CHEMISTRY
METEOROLOGY
MATHEMATICS and
BIOLOGY.
SOME particular vacancies include physicists/electrical engineers for research in the application of servo-control for machine tools, physical chemists, chemists for research in high polymers, botanist for study of bryophyta, physiologist for work at the Institute of Aviation Medicine, mineralogist to work on meteorites (petrologist with sound knowledge of physics preferred), and zoologists to specialise in the taxonomy of the porifera and in serological and other histo-chemical techniques applicable in zoology and anthropology.
QUALIFICATIONS: normally first or second class honours degree in science, mathematics or engineering, or equivalent attainment; additionally, for (a), at least 3 years' relevant (e.g., post-graduate) experience; normal age limits: (a) between 26 and 32, (b) between 21 and 29, with extension for regular Forces service and Overseas Civil Service; selection by interview; London salaries (men): (a) £1,233-£1,460, (b) £655-£1,150; provision for starting pay above minimum; promotion prospects.—Write Civil Service Commission, 17, North Audley St., London, W.1. for application form, quoting (a) S/53/60, (b) S/52/60. [9145

ELECTRICAL test personnel are required by Tannoy Products, Ltd., Sound Equipment Designers and Engineers; good all-round knowledge and previous experience essential.—Apply Tannoy Products, Ltd., Norwood Rd., S.E.27. [9148

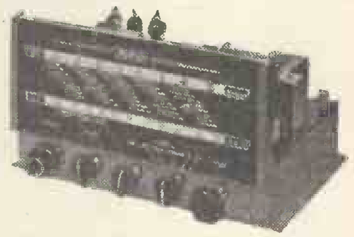
Armstrong

JUBILEE CHASSIS 28 GNS



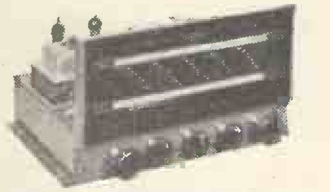
An AM/FM chassis with nine valves and two diodes with push-pull output stage providing 6 watts. Full VHF, medium and long wavebands with automatic frequency control on FM and ferrite aerial on AM. Tape record and playback facilities.

STEREO 44 CHASSIS 27 GNS



A stereo and monaural chassis providing 8 watts output, 4 watts on each channel, and covering the full VHF and medium wavebands. Stereo and monaural inputs for tape playback and all types of crystal pick-ups and outputs for stereo and monaural tape recording. Separate bass and treble ganged controls together with dual volume control for ease of balancing.

AF208 CHASSIS 22 GNS



An AM/FM chassis providing 5 watts output and covering the full VHF and medium wavebands. Tape record and playback facilities, separate bass and treble controls. Although an economically priced chassis, this has the same superior finish and quality components as our more expensive models.

The use of more expensive loudspeakers would justify your considering our more expensive combined chassis, the STEREO-TWELVE, 36 gns.

Post this coupon or write for descriptive literature or call at our Holloway showroom for full demonstration. Open 9-5.30 weekdays, 9-5 Sats.

NAME ....

ADDRESS ....

.... WJYC

ARMSTRONG WIRELESS & TELEVISION CO. LTD.

Warlters Road, London, N.7

Telephone: NORth 3213

SOLDERING EQUIPMENT BY LITESOLD

REGD. TRADE MARK

PRECISION SOLDERING INSTRUMENTS for the ELECTRONICS INDUSTRY

- Comprehensive range
- Robust and Reliable
- Light weight
- Rapid heating
- Bit sizes 3/32in. to 3/8in.
- 'PERMABIT' or Copper bits
- All voltage ranges 6/7v. to 230-250v.
- Prices from 19/6.

Illustrated is the 25w. 3/16in. replaceable bit model with safety shield.

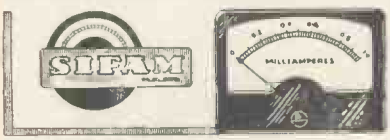
British and Foreign Patents. Registered designs. Suppliers to H.M. and Foreign Governments. Agents throughout the world.

Brochure No. S.5 sent free on request.

Sole proprietors and manufacturers:

LIGHT SOLDERING DEVELOPMENTS LTD.
28 Sydenham Road, Croydon, Surrey
Phone: CROydon 8589 Grams: Litesold Croydon

Instrumentation at its best . . .



SIFAM ELECTRICAL INSTRUMENT CO. LTD.
LEIGH COURT - TORQUAY - Telephone 4547/8

LYONS RADIO LTD.

MODULATION INDICATORS (Ex Govt.). These are battery-operated Test Sets, designed to measure depth of modulation of signal between 2.4 and 6.25 Mc/s. Housed in neat metal cases 11½ × 7¼ × 6¼in. Fitted with 2¾in. dia., 0/500 microammeter, 1 mA. meter rectifier, triode valve, etc. These Units could also serve as an excellent basis for a first-class Valve Voltmeter at an exceptionally low PRICE, ONLY 35/-, post 3/6.

POWER UNITS, TYPE 325. As fitted in many Marconi Test Instruments, chassis 7¾in. long × 4½in., extends from back of front panel which is 10 × 5in. Fitted with fuse holders, on/off switch, pilot light holder, etc. Input 200/250 v. 50 c.p.s. A.C. mains output approx. 220 v. D.C. (unsmoothed) at 75 mA. and 6.3 v. at 3 A. and 4 v. 2 A. for rectifier valve MU12 or equiv. In good working order. PRICE ONLY 17/6, post 3/6. Rectifier valve 8/6. Smoothing easily added, details supplied if requested.

CATHODE RAY TUBES. Type VCR97, as new in original crates. Tested and guaranteed. PRICE ONLY 27/6, carriage 2/6.

I.F.F. UNITS. Contain a wealth of useful components, including relays, 10 valves (6—6SH7, 2—7193, 2—6H6) and a rotary converter rated at 18 v. D.C. input for 480 v. D.C. output. With 12 v. D.C. input the output is of the order of 250 v. D.C. at 80 mA. One end of converter is fitted with blower fan and gear box to other end. Both can easily be removed, if desired. Two driving shafts protrude from gear box and rotate at approx. 4 and 16 r.p.m. for 12 v. input and about half this speed from 6 v. input. An especially good buy for experimenter and model maker. PRICE ONLY 27/6, carriage 5/-.

3 GOLDHAWK ROAD, (Dept. M.W.)
SHEPHERD'S BUSH, LONDON, W.12
Telephone: Shepherd's Bush 1729

SITUATIONS VACANT

PART-TIME electronic engineers for L.P. disc cutting, installation work, technical advising, wanted in London.—Box 6677. [0134

ROYAL Marsden Hospital. Radiotherapy Department, Megavoltage Therapy, technical supervisor.
THE new branch of this hospital being built near Sutton in Surrey will be equipped with two different 4 million volt linear accelerators, a cobalt 60-unit and a 2 MeV. Van de Graaff generator.
APPLICATIONS are invited from suitably qualified persons to assist in the installation and to be responsible with his assistants for the subsequent running and maintenance of these machines; applicants should have had some practical experience in electrical or electronic engineering and be interested in the design and construction of measuring instruments and ancillary equipment for use with this apparatus.
SALARY according to qualifications and experience within the scale £1,140 to £1,550 plus London weighting.
APPLICATIONS, quoting two referees, to be sent as soon as possible to the House Governor, Royal Marsden Hospital, Fulham Rd., S.W.3. [9156

SALES engineer required for well-established public company distributing world-famous components to radio and electronic industries; technical background and good personality essential.—Apply, Box 0059. [9117

RADIO service engineer for bench work in Bermuda, familiarity with transistor radios and American television techniques advantageous; salary commensurate with ability.—Riihiluoma's, Hamilton, Bermuda. [9113

SENIOR Engineer required for Relay Service in Bideford; permanent position for the right man; accommodation arranged.—Bideford Relay, Ltd., 29, Bridgeland Street, Bideford, North Devon. [9135

TELEVISION bench and field engineers required at all times for vacancies in most parts of the British Isles; permanent positions with highest salaries plus bonus for suitable applicants; 5½-day week.—Box 1757. [0251

LICENSED radio engineers and mechanics required for aircraft maintenance and installation work in U.K.—Apply Chief Engineer, Dan-Air Engineering, Ltd., Lasham Airfield, Nr. Alton, Hants. Telephone Herriard 282-3. [9103

RADIO mechanics.—Permanent and pensionable vacancies exist for young men experienced in the assembly, installation and testing of HF and VHF telecommunications equipment, preferably in connection with aviation ground services.
STAFF will be based at the Engineering Division of the Company, address below, but their main duties will take place overseas for varying periods installing telecommunications equipment. Whilst overseas a generous daily allowance is paid.
EX-SERVICES personnel of fully skilled categories are particularly welcome to apply.
APPLICATIONS to the Personnel Officer, International Aeradio, Ltd., Hayes Rd., Southall, Middlesex. [0263

TECHNICAL assistant with knowledge of radio, communications or P.A. practice, able to make up complete equipment from basic requirements.—Apply Personnel Manager, Phœnix Telephone & Electric Works, Ltd., The Hyde, Hendon, N.W.9. [9155

LOUIS NEWMARK, Ltd., leading company in the design of auto pilots for helicopters, are expanding their facilities at their Development Laboratories at New Addington, Croydon, and have the following vacancies to be filled immediately.
ENGINEERS and Assistant Engineers with degree or H.N.C. and experience in the field of light electrical engineering, electronics, electro mechanical devices or semi-conductors, to work on the development, installation and flight testing of automatic pilots.
SALARY commensurate with experience; pension scheme.—Apply in writing, giving full particulars to Personnel Officer, Louis Newmark, Ltd., Prefect Works, Purley Way, Croydon, Surrey, or 'phone Mr. Barkham, Lodge Hill 3441. [0333

ELECTRONICS inspector, with experience of trouble shooting in electronic and transistor circuitry; some experience in light servo mechanisms would be an advantage.—Apply Bryans Aeroquipment, Ltd., Willow Lane, Mitcham Junction, Surrey. [0314

JUNIOR wireless telegraphy operator required by Falkland Islands Government for service at Government wireless station, South Georgia, on agreement for 1 tour of 24-30 months in first instance; salary in scale £420 rising to £520 a year; free passages; liberal leave on full salary.
CANDIDATES, preferably single, must be able to transmit and receive morse at 25 words a minute and should be familiar with H.F. and M.F. transmitters and receivers; P.M.C. certificate and/or ability to read reports in International Meteorological Code an advantage.—Write to the Crown Agents, 4, Millbank, London, S.W.1. State age, name in block letters, qualifications and experience, and quote M2A/51018/WF. [9114

LONDON CENTRAL RADIO STORES

WESTERN ELECTRIC EXTENDING TELEPHONES with single earpiece and headband, complete with screw-fixing table stand. Approx. 22in. extension. Brand New, boxed. 32/6.
B29 RECEIVERS, fully valved, untested £5. for callers only.
PARABOLIC MIRRORS, 20-inch in good condition, £5, for callers only.
PROJECTION LAMPS, Pre-focus 100 v. 300 w. in new condition, 8/6.
PROJECTION LAMPS, 3-pin 110 v. 500 w., in new condition, 10/6.
TIME SWITCHES, VENNER. 8-day clockwork, 230 v. 1 A. Thoroughly reconditioned and guaranteed, £2/2/- including post and packing.
SOUND-POWERED BREAST MIKE AND HEAD-SET. No Batteries needed, 15/-.
CARBON TELEPHONE HANDSETS, New. 12/6.
SOUND-POWERED INSERTS. Suitable for Transistor Sets, New, 3/9.
AVO UNIVERSAL TEST METERS. Reconditioned as new. In perfect working order. Model 40 £10/10/- Model Z, £9/9/-.
HIGH-SPEED ELECTRO-MAGNETIC COUNTERS. Ex-Govt. 0-9,999. 25/50 v. D.C. Size 4 × 1 × 1in. Single coil 2,300Ω or single coil 500Ω, 18/6.
VENNER TIME SWITCHES, for switching on/off lighting and power. Reconditioned as new. In iron-clad cases, 10 amp., 75/-; 15 amp., 85/-; 20 amp., £5/5/-.
TELEPHONE DIALS. 0-9. Suitable for inter-office and factory installations. With fixing mount, fitted with connecting tags, 21/-.
3-OHM P.M. SPEAKERS. In good working order, 10in., 27/6; 8in. 9/6; 6in. 9/6; 5in. 11/6.
ELECTRICITY SLOT METERS (1/- in slot) for A.C. mains. Fixed tariff to your requirements. Suitable for hotels, etc. 10 A., 84/-; 15 A., 94/-; 20 A., 104/-. Other amperages available. Reconditioned as new.
QUARTERLY ELECTRIC CHECK METERS. Reconditioned as new. 10 A., 42/6; 15 A., 52/6; 20 A., 57/6. Other amperages available.
BALANCED ARMATURE HEADPHONES. Suitable for crystal sets, 12/6.
HAND BEARING MARCHING COMPASSES, 14/6.
MOVING COIL HAND MIKE. Type 7, 7/6.

All prices include carriage

23 LISLE ST. (GER.2969) LONDON, W.C.2
Closed Thursday 1 p.m. Open all day Saturday

TANNOY

The leading name in sound affairs
WEST NORWOOD SE27
Tel: Gipsy Hill 1131 (7 lines)

RESISTANCE WIRES

EUREKA-CONSTANTAN
Most Gauges Available
NICKEL-CHROME MANGANIN

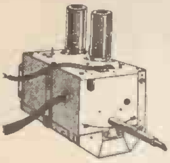
COPPER WIRE

ENAMELLED, TINNED, LITZ, COTTON AND SILK COVERED
SMALL ORDERS PROMPTLY DESPATCHED
B.A. SCREWS, NUTS, WASHERS, soldering tags, eyelets and rivets, EBONITE and BAKELITE PANELS.
TUFNOL ROD, PAXOLIN TYPE COIL FORMERS AND TUBES, ALL DIAMETERS
SEND STAMP FOR LIST TRADE SUPPLIED

POST RADIO SUPPLIES
33 Bourne Gardens, London, E.4
Phone: CLIssold 4688

SOUTH SUPPLIES
(ELECTRICAL LTD.)

95, OLD KENT ROAD, LONDON, S.E.1
90, HIGH STREET, EDGWARE, MIDDX.
124, JUNCTION ROAD, LONDON, N.19



12-CHANNEL TURRET TUNER

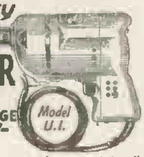
BRAND NEW. Fitted with coils 1 to 5 and 8 to 9. 34/38 Mc/s. Complete with P.C.F. 80 and P.C.C. 84 Valves. Manufacturer's price £7/7/–.

OUR PRICE **33/-** Carriage Paid.

'CYLDON' TURRET TUNER

Same specification as above but with channels 1 to 5 and 8 to 11. BRAND NEW, £2/5/–. Plus 2/6 P. & P.

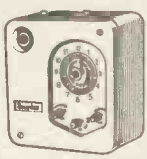
LIMITED QUANTITY
BRAND NEW
BLACK & DECKER
¼" ELECTRIC DRILLS



£4·18·6 CARRIAGE ETC. 3/-

Fraction of Maker's price, complete with flex and chuck key and in maker's sealed cartons. Full instructions and full maker's guarantee. Drill polishes and takes ALL B. & D. Home Workshops Tools including Hedge Trimmer. TV suppressed. A.C./D.C. 235/250 v. We can supply all B. & D. home workshop tools to fit this drill.

ELECTRIC CLOCK, AUTO COOKER TIMER & TIME SWITCH



BRAND NEW. Modernise and add pounds to the value of your electric cooker. Ideal for automatic cooking, or any heat or current control, Complete with handsome electric clock. 200/250V. 30 Amp. Full fitting instructions. Plus 2/6 P. & P. OUR PRICE **£3.17.6**

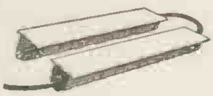
Battery operated PORTABLE GRAM

78 r.p.m. Aural sound box with sapphire needle. "Starr" motor operates on 2 flat 4½V. batteries, 300 records per battery. List £5/5/–.
OUR PRICE **39/6** Plus 2/6 P. & P.
Ex-liquidator's stock.

B.T.H. FAN MOTOR

7 watts. 200/250 V. A.C. **32/6**
Plus 2/6 P. & P.

TANK IMMERSION HEATER



Complete with separate Thermostat. 200/250 V. Famous make. Ideal Frost prevention. Photo developing trays etc. List £3/0/0.
TO CLEAR **22/6** Plus 2/6 P. & P.

SPECIAL BRAND NEW
KODAK CAMERAS
Ex Liquidators Stock

Cresta Mk. II. List £2/0/8. Our price £1/9/6. 2/– P. & P.
Junior II. List £5/3/–. Our price £3/10/–. 2/– P. & P.
Bantam Colorsnap. List £9/11/–. Our price £7/10/–. 2/– P. & P.
Brownie 127. Brand new. List £1/5/6. Our Price 19/6. Plus 2/– P. & P.

CAR AERIALS

2 section telescopic, heavy chromium plated, solid plated base. Side, wing or roof. Originally 27/6. OUR PRICE 19/6. P. & P. 2/6.

SITUATIONS VACANT

ENGINEER for planning public address systems, qualifications H.N.C. with practical experience in electronic laboratory and/or factory production essential; salary according to qualifications and experience.—Pamphonic Reproducers, 8, Dalston Gdns., Stanmore, Middx. Wor. 0226. [0312

COILWINDING. Senior engineer required to take charge of design small audio transformers. Knowledge of current transistor practice an advantage. Excellent prospects. Applicant would be required to work at Rickmansworth.—Full details to Colne Electric, Ltd., Bury Lane, Rickmansworth. [9099

TELESURANCE, Ltd., require young man for technical work on R.F. relay systems; sound practical relay or T.V. servicing experience essential; must possess clean driving licence and be prepared to travel; attractive conditions offered and car provided.—Apply to 14, Windmill St., London, W.1. (Ref. REP.) [9157

LONDON Chartered Patent Agents require graduate in electrical engineering for training with a view to qualifying as a patent agent; interesting work with good prospects for a professional career.—Write, giving details of age, qualifications, etc., to Box DA2054, c/o Whites, Ltd., 72, Fleet St., London, E.C.4. [9132

JUNIOR Electronic Development Engineer, familiar with general industrial electronics and with a working knowledge of sheet metal and light engineering practise; salary scale £650-£800 depending on ability; staff position, pension scheme, sick club, holidays honoured.—Write Grundy & Partners, Ltd., 3, The Causeway, Teddington, Middlesex. [9142

OVERSEAS Oil Exploration Company with world-wide seismic parties offers permanent career to electronic technicians. Work consists in maintaining and operating electronic recording equipment under field conditions. Live generally in camp Qualification: H.N.C. or equivalent essential, with practical experience in electronics. Home leave every two years.—Box No. 5829. [0331

VACANCY for trainee Cyclotron Operator for medical radioisotope production, age under 40, applicant should have experience in maintenance of electronics or Post-Office telephone equipment or high vacuum plant.—Apply stating age and full details of experience to Senior Cyclotron Engineer, Medical Research Council, Hammersmith Hospital, Ducane Rd., London, W.12. [9110

PHILIPS ELECTRICAL, Ltd. (Medical X-ray Division) require an Engineer for the service and installation of X-ray equipment; candidates with O.N.C. (Electrical) or Electronics experience would be considered.—Applications, with full details, should be addressed to the Personnel Officer (Medical X-ray Division), 45, Nightingale Lane, Balham, S.W.12. [9141

UNIVERSITY OF ABERDEEN.—Technician required for Medical Physics Laboratory, Foresterhill; some experience as electronics mechanic desired; National Certificate in Electrical Engineering or Applied Physics an advantage; wage on age scale to £615 at 28, with supplement by relevant qualifications.—Apply in writing by 30th June, 1960, to the Secretary, Marischal College, Aberdeen. [9123

TEST engineers.—Applications are invited from test engineers with previous industrial experience of testing radio communications, receivers and transmitters; successful applicants will be offered positions on the company's permanent staff; starting salaries commensurate with qualifications and experience.—Apply in writing, giving full details, to Personnel Officer, Redifon, Ltd., Broomhill Rd., S.W.18. [0252

TAPE-RECORDING equipment service engineer is required for the tape-production department of E.M.I., Ltd.; experience in tracing faults in audio electronic equipment is essential, although preference will be given to engineers who have gained their experience in the tape recording field; age 25-35 years.—Please write, giving full details and quoting Ref. SS/7/3, to Personnel Manager, E.M.I., Ltd., Hayes, Middlesex. [9119

MEDICAL RESEARCH COUNCIL have a vacancy for an Electronics Technician to assist in the maintenance and construction of electronic equipment at their Environmental Radiation Research Unit, Leeds. Experience as a radar fitter in the R.A.F. would be suitable qualification. Salary within the range £595 to £720 or £710 to £870, depending on qualifications, age, and experience. Applications, giving details of previous experience and the names of two referees should be sent to The Secretary, Department of Medical Physics, University of Leeds, The General Infirmary, Leeds, 1. [9137

INTERNATIONAL AERADIO, Ltd., has periodic vacancies overseas for Radio Technicians, City and Guilds Intermediate Telecoms. an advantage but not essential if applicant has considerable experience installation/maintenance H.F./V.H.F. low/medium power comms. Equipment: applications ex-service personnel of fully skilled categories welcomed; posts are permanent and pensionable; normally accommodation is provided with tax free emoluments equated to local conditions; additional marriage and child allowances; free air passages and insurance; kit allowance; generous U.K. leave; apply in writing.—Personnel Manager, 40, Park St., W.1. [0262

LEWIS have the CABINET for YOU

EXTENSIVE RANGE OF CABINETS FROM £4-7-6

THE CONTEMPORARY
Price £11.11.0

This beautifully designed Contemporary Cabinet can be supplied in Oak, Walnut or Mahogany veneer and has a waxed semi-matt finish. This cabinet can be fitted with any of the latest Hi-Fi units.

THE CONTINENTAL
Price £29.10.0

This elegant Cabinet is the finest in our range of those designed in the continental style. Solidly constructed and finished in Oak, Walnut or Mahogany veneers. (Dark, medium or light, high gloss or satin finish available.)

TWO NEW LEWIS CATALOGUES:—

FREE!

The Cabinet Catalogue

The Equipment Comparator Catalogue

(Designed to assist your choice of cabinet and equipment.)
Please send me details of your two new catalogues

Name ....

Address ....

BLOCK CAPITALS PLEASE WW70

LEWIS radio

120 GREEN LANES, PALMERS GREEN, LONDON, N.13 (Near the Cock Tavern).
Telephone: BOWes Park 1155/6

INTRODUCTION TO

Laplace Transforms

FOR RADIO AND ELECTRONIC ENGINEERS

by **W. D. DAY**
Grad.I.E.E., A.M.Brit.I.R.E

a simple explanation of an essential tool for solving radio & electronic problems

32s. 6d. POSTAGE 1/-

FM SIMPLIFIED by M. S. Kiver. 45/-. Postage 1/6.
TRANSISTOR PROJECTS. Gernsback Lib. Pub. 23/-. Postage 1/-.
THE RADIO AMATEUR'S HANDBOOK by ARRL. 1960 ed. 32/6. Postage 2/-.
ENCYCLOPEDIA ON CATHODE-RAY OSCILLOSCOPES AND THEIR USES by J. F. Rider and S. D. Uslan. £10/10. Postage free.
SERVICING TRANSISTOR RADIOS by L. D'Airo. 23/-. Postage 1/-.
MARINE RADIO FOR PLEASURE CRAFT by H. McKay. 23/-. Postage 1/-.
RADIO VALVE DATA. 6th ed. Compiled by "W. W." 5/-. Postage 9d.
NEW 1960 CATALOGUE 1/-.

THE MODERN BOOK CO.

BRITAIN'S LARGEST STOCKISTS of British and American Technical Books

19-23 PRAED STREET LONDON, W.2

Phone: PADdington 4185
Open 6 days 9-6 p.m.

METER REPAIRS

All makes of Single and Multi-range instruments repaired and recalibrated.

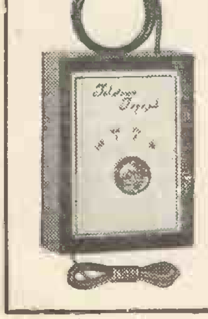
★ *Prompt Service*
★ *All work guaranteed*
★ *Priority for urgent orders.*

Competitive prices for repairs to all types of instruments. Contracts a speciality.

New meters supplied from stock (2" to 6") and complete equipment manufactured to specification.

Call, write or phone for details to:

E.I.R. INSTRUMENTS LIMITED
329 Kilburn Lane London, W.9 *Tel: LAD 4168*



TELETRON TAPEJAK

The first Transistorized Radio Tuner, specially designed for use with Tape Recorders.

★ High Sensitivity.
★ Twin tuned circuits.
★ Pre-setting for MW.Programmes
★ Fixed tuned for 1500M.

Price...... £5 9 0

THE TELETRON CO. LTD.
112B, Station Rd., London, E.4.
SIL. 0836.

SITUATIONS VACANT

ELECTRONIC maintenance personnel required for shift duties in an expanding Steelworks; applicants should have a thorough knowledge of Electronic principles, and experience in fault finding; a basic knowledge of control systems for A.C. and D.C. motors would be an advantage but not essential; this is a permanent weekly staff appointment and an excellent contributory pension scheme is operated.
APPLICATIONS should be addressed to the Labour Manager, Samuel Fox & Company, Limited, Stocksbridge Works, Nr. Sheffield. [9136

AUDIO frequency engineers for work on sound recording and reproducing equipment and kindred projects for T.V. 35 and 16mm films; experience with transistors an asset; salary according to age and experience; pension scheme, staff canteen, 5-day week.—Applications in writing, giving details of education and experience, should be forwarded to Personnel Officer, Rank Precision Industries, Ltd., Woodger Rd., Shepherds Bush, W.12. [9121

SENIOR Electronic Engineer to lead design team for audio-frequency amplifiers up to 10kW frequency, range 5c/s to 10kc/s; qualifications degree or H.N.C. with not less than five years' in development laboratory; experience of broadcast relay systems, P.A. and acoustics desirable; permanent position in expanding concern for man aged 30-45; salary according to qualifications and experience.—Pamphonic Reproducers, 8, Dalston Gdns., Stanmore, Middx. Wor. 0226. [0311

CIRCUIT Designers and Circuit Laboratory Engineers required for design and testing of automatic telephone exchange systems and other similar projects. Candidates should have had previous experience of this work and preferably have at least an O.N.C. or an intermediate grouped C. & G. certificate. Knowledge of Crossbar Switching or totalisators would be an advantage. Good salary paid to selected applicants. Pension scheme after qualifying period.
WRITE giving full details of qualifications and experience to the Personnel Manager, Ericsson Telephones, Limited, Beeston, Nottingham, quoting Ref. DA/1. [0160

TELEVISION engineers who possess sound theoretical knowledge, and some years of practical experience are invited to apply for permanent, pensionable positions with well established rental company in Middlesex and Surrey; there are vacancies for field and workshop engineers; three weeks' annual holiday is given; excellent conditions and equipment; top rates of pay.—Telephone Mr. Powditch, Puratone Rental Service, Kingston 9468 for immediate appointment. [0313

AIRCRAFT radio maintenance engineers required for overhauls and repairs in approved radio section of Department of Flight. A.R.M.E. licence an advantage. Good working conditions, generous holidays, staff superannuation and sick pay scheme. Commencing wage between £9/17/8 and £11/17/8 depending on experience, increasing to £13/4/8 with prospects of further advancement. 42-hour week of five days.—Application forms from Chief Clerk, the College of Aeronautics, Cranfield, Bletchley, Bucks. [9100

BRITISH RELAY WIRELESS, Ltd., have vacancies for engineers to carry out the installation and maintenance of television and audio relay main repeater stations in the London area. Applicants should have reached a technical standard equivalent to City and Guilds Intermediate Certificate with suitable practical experience.—Applicants should write, giving details of experience and qualifications, to The London Area Engineer, British Relay Wireless, Ltd., 9-13, Camberwell Rd., London, S.E.5. [9105

ELECTRONIC engineers, Ekco Electronics, Ltd., Southend-on-Sea, Essex, have vacancies for electronics engineers, based at Southend for installation and service laboratory duties; work is in connection with industrial nucleonic systems, nucleonic counting equipment and general nucleonic instrumentation; permanent progressive posts in expanding organisation; requirements, good theoretical electronic background, preferably with fault-finding experience; salary commensurate with ability.—Please write, stating age, qualifications and experience, to Personnel Manager. [9149

ACOS microphones, pick-ups, magneto-resistors, electro-magnetic transducers and other electro-acoustic devices. We are seeking lively and forward looking engineers to carry out advanced and progressive design and development work in these and other interesting related fields. Previous experience in the art not vital, but good theoretical and practical background training and experience in light current engineering essential. High starting salary. Usual hours, holidays, pension scheme, etc.—Apply to Chief Engineer, Cosmocord, Ltd., Eleanor Cross Road, Waltham Cross, Herts. [9101

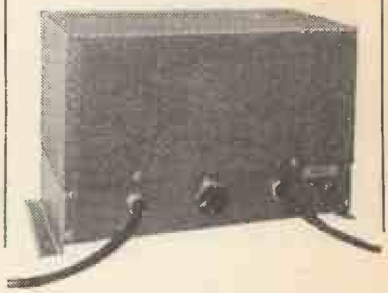
APPLICATIONS are invited for posts as technical assistants at £861 p.a., and junior trainees, within a company specialising in Videotape recording and telerecording facilities; high technical qualifications are not essential but a knowledge of electronics and a keen desire to learn will be considered an advantage.—Applications should be addressed to the Technical Manager, Alpha Television Services (London), Ltd., 18, Ogle St., London, W.1. [9107

CLEAN AND SILENT

D.C. to A.C.

UP TO 100 WATTS

WITH THE NEW FELGATE ELECTRONIC INVERTER



NO MOVING PARTS
FREQUENCY CONTROL

Manufactured by

RADIO MAILING LIMITED

STUDLAND HALL, STUDLAND STREET, LONDON, W.6.

T.V. TUBES

12-MONTH GUARANTEE

12", 14", 17".......... **£5. 10. 0**
21".............. **£7. 10. 0**

YOUR OLD TUBE REQUIRED

C.W.O. 10/- CARRIAGE

JACK PEARSON
77, HIGH STREET, BLACKHEATH, BIRMINGHAM

MORSE CODE TRAINING

Get your Radio Operator's Licence the easy way!

CANDLER has taught **MORSE CODE** by correspondence for **50 years.**
On Land, Sea and in the Air and in every Continent, you will find first-class Radio Operators who have learnt their profession or excelled as Amateurs the CANDLER WAY. *Write for the Candler "Book of Facts" without obligation and see for yourself how fascinating the Candler Method of teaching the Morse Code can prove. You may if you wish pay as you learn.*

CANDLER SYSTEM CO.
(55W) 52b ABINGDON RD., LONDON, W.8
Candler System Co., Denver, Colorado, U.S.A.

SITUATIONS VACANT

MINISTRY OF AVIATION require electrical engineers (assistant signals officers) for aviation telecommunications and electronic navigational aids; min. age 23, 1st or 2nd class degree in physics or engineering or A.M.I.E.E. or A.F.R.Ae.S. (candidates with parts I, II and III of A.M.I.E.E. or parts I and II of A.F.R.Ae.S. or equiv., or of very high professional attainment without these quals. considered); salary £690 (age 23) to £1,125 (age 34) max. £1,300; slightly lower outside London and for women.—Further details and forms from Ministry of Labour, Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D.161/OA. [0315

NATIONAL ENGINEERING LABORATORY (D.S.I.R.), East Kilbride, Glasgow, requires experimental officer/asst. E.O.s, for development of electronic instrumentation for use in research on plasticity and lubrication; experience in electronics or telecommunications essential. Quals.: G.C.E. "A" level in two science or science and maths. subject or equiv., over 22, pass degree, H.N.C. in electrical engineering or equiv. generally expected. Salary range: A.E.O. (men) £382 10s (age 18)—£830; E.O. (min. age 26) £954—£1,166.—Forms from Ministry of Labour, Technical and Scientific Register (K), 26, King St., London, S.W.1, quoting D.330/0A. Closing date 11th July, 1960. [9122

GOVERNMENT OF NORTHERN IRELAND. Wireless Technician (Male). Applications invited for pensionable post in Ministry of Home Affairs; candidates must be British subjects ordinarily resident in United Kingdom; Qualifications—good general education; sound theoretical and practical knowledge of Radio Engineering and some years' experience in maintenance of radio equipment. Preference for ex-Servicemen. Salary scale—£525 (age 21)—£640 (age 25 and over)—£795; successful candidate with special qualifications or experience may enter at salary above minimum. Application forms, obtainable from Secretary, Civil Service Commission, Stormont, Belfast, must be returned by 8th July, 1960. [0518

PATENT examiners and patent officers.—Pensionable posts for men or women for work on the examination of patent applications, age at least 21 and under 29 (36 for examiners), with extension for regular Forces service and overseas civil service; qualifications: normally first or second class honours degree in physics, chemistry, engineering or mathematics, or equivalent attainment, or professional qualification, e.g., A.M.I.C.E., A.M.I.-Mech.E., A.M.I.E.E., A.R.I.C.; London salary (men) £655-£1,460; provision for starting pay above minimum; promotion prospects.—Write Civil Service Commission, 17, North Audley St., London, W.1, for application forms, quoting S/128/60, and stating date of birth. [9143

ALUMINIUM LABORATORIES, Ltd. (The Research and Technical Organisation of the International ALCAN Group of Companies) require a Physicist having a good working knowledge of basic electronic techniques, or an Electronics Engineer with a sound knowledge of physics, to work on instrumentation problems associated with the production of aluminium sheet, extrusions and castings, every opportunity will be given to the successful candidate to exercise initiative in carrying out his work, which will include the development and application of new measuring techniques; a university degree or an equivalent qualification would be an advantage, as would experience in research or development work.—For further details please apply to the Personnel Officer, Southam Rd., Banbury, Oxon. [9109

ASSISTANTS (scientific).—Pensionable posts for men or women at least 17½ and normally under 26 on 1.1.60 with appropriate educational or technical qualifications (normally G.C.E. with passes at O or A level in 4 distinct subjects including English language and a scientific or mathematical subject, or O.N.C. or equivalent qualifications) and at least 2 years' experience in either (i) engineering or physical sciences, or (ii) chemistry, biochemistry or metallurgy, or (iii) biological sciences, or (iv) geology, meteorology, or skilled work in laboratory crafts such as glass-blowing: starting salary (men, London) from £347/10 (at 17½) to £550 (at 25 or over); maximum (London) £715; promotion prospects; 5-day week generally.—Write Civil Service Commission, 17, North Audley St., London, W.1, for application form, quoting S/59/60. [9146

THE Scientific Civil Service needs men and women for pensionable posts as (a) experimental officers, and (b) assistant experimental officers in mathematics, physics, meteorology, chemistry, metallurgy, biological sciences, engineering, miscellaneous (geology, library and technical information services); candidates must, on 31.12.60, be at least 26 and normally under 31 for (a), and at least 18 and normally under 28 for (b); qualifications should normally include H.S.C. or G.C.E. or equivalent, or H.N.C. or university degree; provisional admission if taking examinations in 1960: men's salary scale (London) (a) £1,005-£1,233; (b) £397/10 (at 18) to £710 (26 or over) rising to £880; promotion prospects; further education facilities.—Write Civil Service Commission, 17, North Audley St., London, W.1, for application form, quoting S/94-95/60. [9144

SITUATIONS VACANT

ELECTRONICS Engineer required to control modern automatic printers; duties will be to set up and service a bank of printers; a knowledge of photography is virtually essential and some experience of photo-electrical control equipment.—Box 0276. [9159

RADIO PROTECTION SERVICE (Ministry of Health and Medical Research Council, Clifton Avenue, Belmont, Sutton, Surrey, requires a Technician to work in the Electronics Laboratory; the work is mainly concerned with the construction and maintenance of electronic equipment used in the measurement of radio-active materials, e.g., scalers, linear amplifiers, pulse height analysers; applicants must have experience in wiring from circuit diagrams and maintenance of electronic equipment; salary £595 to £720 p.a. plus £20-£30 p.a. London Weighting; 5-day week; 3 weeks' leave per year.
APPLICATIONS, with the name and address of 2 referees, to the Directors at the above address. [9129

IONOSPHERIC Assistants required by Falkland Islands Dependencies Survey for service in the Antarctic for 2 years. Salary at a basic rate of £500 a year with extra allowances for qualification and experience. Officers appointed will be required to undergo course of training before leaving U.K. in October/November. Whilst in the Antarctic everything is provided free of charge including clothing, cigarettes, etc. Liberal leave on full salary. While on duty in U.K. an extra allowance of £150 a year is paid before departure and £200 a year on return. Candidates must have knowledge of radar and radio with some maintenance experience. The appointment will be made with the advice of the DSIR Radio Research Station.—Write to the Crown Agents, 4, Millbank, London, S.W.1. Stae age, name in block letters, qualifications and experience and quote M3C/52985/WF. [9140

TECHNICAL TRAINING

LEARN Radio and Electronics the New Practical Way! Very latest system of experimenting with and building radio apparatus—"as you learn"—Free brochure from Dept. W.W.10, Radiostructor, 40, Russell Street, Reading, Berks. [0241

CITY & GUILDS (electrical, etc.) on "No Pass—No Fee" terms; over 95% successes. —For details of modern courses in all branches of electrical engineering, applied electronics, automation, etc., send for our 148-page Handbook—free and post free.—B.I.E.T. (Dept. 388A), 29, Wright's Lane, London, W.8. [0017

TUITION

FULL-TIME courses for P.M.G. Certificates, C.G.L.I., Telecommunications and Radar Maintenance Certificates.—Information from College of Technology, Hull. [0111

WIRELESS.—See the World as a radio officer in the Merchant Navy; short training period, low fees, scholarships, etc., available boarding and day students; stamp for prospectus.—Wireless College, Colwyn Bay. [0018

RADIO and TV servicing, all aspects from basic principles, guaranteed coaching for City & Guilds, R.T.E.B. Cert., Brit.I.R.E., etc. Study at home under highly qualified tutors. No books to buy.—Write for free prospectus stating subject, to I.C.S., Intertext House, Parkgate Rd. (Dept. 442A), London, S.W.11. [0033

"HOW and Why" of Radio and Electronics made easy by a new, no-maths, Practical Way. Postal instructions based on hosts of experiments and equipment building carried out at home. New Courses bring enjoyment as well as knowledge of this fascinating subject.—Free brochure from Dept. W.W.12 Radiostructor, 40 Russell Street, Reading, Berks. [0240

TV and Radio—A.M.Brit.I.R.E., City and Guilds, R.T.E.B. Cert., etc., on "No Pass —No Fee" terms, over 95% successes.—For details of exams. and home training courses (including practical apparatus) in all branches of radio, T.V. and electronics, write for 148-page Handbook—free—B.I.E.T. (Dept. 397A), 29, Wright's Lane, London, W.8. [0016

A.M.I.Mech.E., A.M.Brit.I.R.E., City & Guilds, G.C.E., etc., bring high pay and security: "No Pass—No Fee" terms; over 95% successes.—For details of exams. and courses in all branches of engineering, building, electronics, etc., write for 148-page Handbook—free.—B.I.E.T. (Dept. 387B), 29, Wright's Lane, London, W.8. [0118

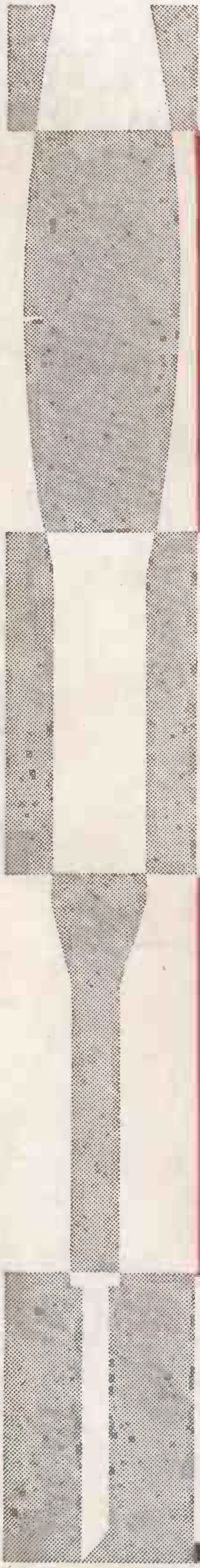
INCORPORATED Practical Radio Engineers home study courses of radio and T.V. engineering are recognised by the trade as outstanding and authoritative; moderate fees to a limited number of students only; syllabus of instructional text is free; the Practical Radio Engineer journal, sample only 2/-; 6,000 alignment peaks for superhets 5/9; membership and entry conditions booklet 1/- all post free, from the Secretary, I.P.R.E., 20, Fairfield Rd., London, N.8. [0088

PATENTS

THE Proprietor of Patent No. 744239 for "An Improved Aerial," desires to secure commercial exploitation by Licence or otherwise, in the United Kingdom.—Replies to Haseltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. [9153

INDEX TO ADVERTISERS

Printed in Great Britain for the Publishers, ILIFFE & SONS LTD., Dorset House, Stamford St., London, S.E.1, by CORNWALL PRESS LTD., Paris Garden, London, S.E.1. *Wireless World* can be obtained abroad from the following: AUSTRALIA and NEW ZEALAND: Gordon & Gotch, Ltd. INDIA: A. H. Wheeler & Co. CANADA: The Wm. Dawson Subscription Service, Ltd.; Gordon & Gotch, Ltd. SOUTH AFRICA: Central News Agency, Ltd., William Dawson & Sons (S.A.), Ltd. UNITED STATES: Eastern News Co., 306 West 11th Street, New York 14.



ERSIN MULTICORE SAVBIT 5 CORE SOLDER

A FIRST CLASS JOINT

Quicker than you can say it!

Ersin Multicore Savbit Solder has been tested and proved on the production lines of leading manufacturers throughout the world. They find that its continued use is cutting costs by lengthening the life of copper soldering iron bits. Savbit contains a small percentage of copper which, by preventing the absorption of copper from the bit itself, prolongs bit life by up to ten times. And by keeping bits in good condition, Savbit increases soldering efficiency.

Laboratory engineers and technicians are invited to write on their company's letter heading for the latest edition of Modern Solders, containing 24 pages of technical information.

Made under sole British Licence of patent No. 721,881.

SAVBIT FOR INDUSTRY

Ersin Multicore Savbit Solder containing 5 cores of non-corrosive flux is supplied to factories at bulk prices on 7 lb. reels. The popular 16 and 18 s.w.g. diameters are suitable for most soldering processes. Supplies are also available on 1 lb. reels.

SAVBIT FOR THE ENGINEER

Approximately 170 ft. of 18 s.w.g. Savbit solder is supplied on a convenient 1 lb. reel packed in a carton. Price 15/- per reel (subject).

SAVBIT FOR THE HOME

The Size 1 Carton contains approximately 53 ft. of 18 s.w.g. Savbit solder. Also supplied in 14 and 16 s.w.g. sizes. Price 5/- per carton (subject). There is also a home constructor's pack of 60/40 Alloy at 2/6 per reel (subject).

MULTICORE SOLDERS LIMITED · MULTICORE WORKS · HEMEL HEMPSTEAD · HERTS

Telephone: BOXMOOR 3636