This low frequency oscillator costs only £75 (Bench stands 1 gn. extra)

This reasonably-priced low frequency oscillator is extensively used in the aircraft industry and elsewhere as a convenient source of signals down to 1.15 c.p.s. for the testing and calibration of vibration recorders, servo systems etc. It is also widely used in medical research and clinical work for the calibration of biological amplifiers and recorders, and low frequency wave analysers.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>FREQUENCY RANGE</th>
<th>OUTPUT</th>
<th>INPUT</th>
<th>CONSTRUCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance capacity, with automatic amplitude control effective over the whole frequency range.</td>
<td>1.15 c.p.s. to 5,500 c.p.s.</td>
<td>Sine wave 50 volts peak to peak push-pull, with built-in attenuator.</td>
<td>200-250 volts, 40-60 c.p.s.</td>
<td>Standard 19&quot; rack mounting, but also suitable for bench use. Bench stands available.</td>
</tr>
</tbody>
</table>

NOTES. An incremental switch is fitted. Provision is made for mixing other signals with the output.

Immediate delivery from EDISWAN

RADIO DIVISION · THE EDISON SWAN ELECTRIC COMPANY LIMITED
Member of the A.E.I. Group of Companies
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JANUARY 1955

VOLUME 61 NO. 1
PRICE: TWO SHILLINGS

25. DAF96, DK96, DF96 and DL96, in ABC Receivers

The design of 25mA filament chains for ABC receivers is governed by the need to provide satisfactory conditions for the output valve. With the simple series chain of shunted filaments given in Fig. 1, the DL96 bias is derived mainly from the voltage drop across the other filaments. It is, therefore, highly dependent on the l.t. voltage. When the h.t. and l.t. batteries are new, the bias is about $3 \times 1.5V = 4.5V$, and the h.t. is 90V. Satisfactory operation will continue until the l.t. battery voltage has fallen to 1.1V per cell, when the bias will be 3.3V and the h.t. may be about 65V. If the l.t. battery is renewed at this stage, the bias will increase and the output will be reduced to a very low value. If, instead, the h.t. battery is renewed, the high h.t. voltage and low bias will produce an excessive cathode current in the DL96.

Tests in a receiver have shown extremes of 1.5mA and 5.0mA for the DL96 cathode current under these varied battery conditions. Separately renewable h.t. and l.t. batteries can thus be used only if the DL96 bias does not include the voltage drop across the other valves. This is achieved if the DL96 is placed at the earthy end of the filament chain, with bias taken solely from a resistor in the h.t. negative lead. But three difficulties arise: AGC provision is complicated; decoupling of the filaments will be difficult if the DAF96 is at the positive end of the chain; and, if the DL96 is the next valve in the chain to the DAF96, its filaments may act as a common cathode resistance—producing multivibrator action.

If the h.t. and l.t. negative lines are separated (Fig. 2), the DL96 cathode current is held, in a typical receiver, between 2.4mA and 5.0mA; but dependence on AGC is increased. (One resistor in Fig. 2 is shown dotted, as it has a high value and it does not greatly affect the operation of the circuit). High stability (3.0mA to 5.0mA) is achieved with the circuit shown in Fig. 3. There are two additional advantages: the DL96 cathode current falls as the l.t. voltage falls; and valves may be added to the chain without increasing the cathode current variation. But there are two disadvantages: the h.t. current flows through the l.t. battery and increases its consumption by about 30%; and the bias resistor has to produce the required bias plus $2 \times 1.4V$, therefore it must be a high-value close-tolerance component.

Similar stability, with the extra battery drain reduced from 30% to 12%, is given by the recommended circuit (Fig. 4), which provides satisfactory DL96 conditions at the cost of this smaller increase in l.t. battery consumption. This cost is adequately compensated by the ability of the circuit to work down to low voltages. Practical resistor values, for typical cathode currents, are shown in Fig. 4. Notes on the calculation of resistor values will be included in the reprint of this advertisement. Details of the requirements for mains operation have appeared in the Additional Notes to advertisement No. 23 in this series.

Reprints of "Valves, Tubes, and Circuits" (with Additional Notes) are obtainable without charge from the address below.

MULLARD LTD, Technical Service Department, Century House, Shaftesbury Avenue, W.C.2

MVM 311
A New Master?

IT must have sounded revolutionary to suggest, as we did last month, that the time had at last come to relieve the Post Office of some of its powers of control over radio. The present system has survived without basic change for over 50 years; we all tend to be conservative in these matters; the more surprising, therefore, that hardly any real objection has been raised against our proposals. Indeed, most of the criticisms have urged something more drastic, in some cases going so far as to say all executive and administrative power should be transferred to an independent body. Anyway, it seems clear that none of the radio interests are fully satisfied with the present position. Dissatisfaction has also been expressed in the House of Commons, where C. Ian Orr-Ewing said it would be wise to try to take the responsibility of frequency allocations from the Post Office and leave it to an independent body.

What kind of body should replace the G.P.O. as the controlling authority? When this kind of question crops up the Federal Communications Commission of the U.S.A. always comes to mind, and we have spent some time studying its history and constitution. The F.C.C. is "an independent Federal establishment" responsible to Congress. It is administered by seven Commissioners appointed by the President. Commissioners hold office normally for seven years. Not more than four Commissioners may be members of the same political party.

What does the F.C.C. do? Roughly, it exercises all the licensing and controlling functions over radio that come under the G.P.O. in this country. In addition, it regulates internal and external wire communications, but does not license U.S. Government stations. Frequency allocations for these are made by an inter-departmental committee with which the F.C.C., however, works in close collaboration. Technical functions of the F.C.C. include the maintenance of a laboratory dealing with such things as studying propagation and investigating interference; the operation of over 20 monitoring stations, the holding of technical examinations for operators and the inspection of stations. Administrative functions include the regulation of telegraph and telephone charges and the assumption of at least some responsibility for the content of broadcast programmes.

For the year 1951 (the latest for which a report is available) the F.C.C. was run by a total staff of 1,205 persons. The number of transmitters licensed numbered 425,000. For all this the cost was $6,600,000, which does not seem high, allowing for the vast size of the country and the large number of stations. It should also be remembered that much of the work of the F.C.C. is brought about by the intensely competitive nature of American radio. Taking everything into account, a safe guess is that a "B.C.C." would be far less costly than its American prototype.

Can the F.C.C. model be fitted with a right-hand drive for use in this country? We can see no insuperable difficulties, though we must admit some of the organizational problems involved are rather outside our province. For instance, which of the Ministers would replace the Postmaster-General in assuming responsibility in Parliament for radio matters? Not, we should hope, the head of any of those Ministries which are large users—and, it is to be feared, often prodigal users—of radio channels.

In the interest of economy the sale of broadcast receiving licences, the tracking-down of "pirates" and the investigation of interference with broadcast reception should remain in the hands of the Post Office. Such tasks as the allocation of channels and licensing of stations, monitoring, inspection and the examination and licensing of operators should be transferred to the new controlling body.

All but the most fervent revolutionaries are apt to have some doubts when a sweeping change is proposed. Is it worth while passing over from the known to the unknown? Our thoughts go back to a talk with an American visitor a year or two ago. After we had explained in some detail the way British radio was controlled, he said, "I see; near enough, then, F.C.C. is American for G.P.O." To make a change for the sake of a new set of initial letters would indeed be foolish, but there are in fact real differences. The G.P.O. is both an interested party and it is tied up with politics.
SPIRAL SCANNING
Simple Method for Industrial Television Equipment

When F. P. Hughes conducted his public search in the pages of *Wireless World* for the Simplest Possible Scan* he started with a point, proceeded to a line and ended with a Lissajous figure generated by two slightly different frequencies. With the wisdom that comes after the event one can now see that he missed out what is perhaps the simplest possible Lissajous figure—the circle. This has the advantage that the two sine waves applied to the x and y deflection systems of the c.r. tube are of the same frequency, although displaced 90° in phase. It is then only necessary to linearly modulate the amplitude of these two waves to produce a series of circles of increasing diameter which will completely fill in the tube face—in short, a spiral.

The spiral scan, of course, is not exactly new and has been used in oscillography for a good many years, but it is to the credit of the French firm Laboratoires Derveaux that they have successfully adapted it to television purposes. A description of the industrial television equipment they have developed on this principle is given in *Toute la Radio* for November, 1954. The scanning waveform, shown at (b) of the diagram, is a 15-kc/s sine wave modulated with a 50-c/s sawtooth (to produce the variation in circle diameter). One such signal is applied to the horizontal deflector coils of the camera tube and receiving c.r. tube and another one, 90° displaced in phase, to the vertical deflector coils. Each "tooth" of the sawtooth waveform contains 300 cycles of the 15-<i>kc</i>/s sine wave, so this means that one complete sweep of the spiral, from the centre of the tube to the outside, involves 300 revolutions of the spot. If the tube face is bisected by an imaginary line this gives the equivalent of 600 lines in a conventional raster.

Of course, the two components of the scanning waveform have to be kept in very strict phase and frequency relationship, so the 50-c/s sawtooth is produced by frequency dividing from the 15-<i>kc</i>/s source. Brightness modulation is applied to the receiving c.r. tube in the normal way. In addition it is necessary to apply a brightness correction waveform (of sawtooth form) to compensate for the fact that the spot has a lower "tracking" speed in the centre and the trace is consequently brighter there than at the outside of the spiral.

This variation in the speed of the spot, as it describes circles of increasing circumference, brings up an interesting point about definition. In the centre of the picture, where information is scanned and transmitted at low speed, the bandwidth required for the system is considerably less than at the outside, where the picture information is being scanned at high speed. In practice, using a fixed and limited bandwidth, this means that the definition will be higher in the centre than at the outside. However, Laboratoires Derveaux say that this is actually an advantage because the centre of interest of a television picture is generally in the centre of the tube.

In its utilization of time for the transmission of picture information the system is very efficient. Very little time is wasted on flyback (only one per "frame" instead of several hundreds) and none at all on transmitting sync pulses. The only synchronization that is necessary is to keep the transmitter and receiver 15-<i>kc</i>/s sine waves (which are derived from the same source) in correct phase relationship with each other. This adjustment is done by a simple phase-shifting network. Incorrect phasing merely results in the received picture being turned round out of the horizontal. Another incidental advantage of having no sync pulses is that if an r.f. carrier is used for transmission it can be modulated completely by the picture waveform.

The circular shape of the complete picture makes it unsuitable for domestic television, but this does not matter so much in industrial television. In fact it might be considered something of an advantage, in so far as it gives better utilization of lenses, pick-up tubes and cathode ray tubes, most of which are circular in form.

**STYLI BY THE MILLION**

**Mass Production of Sapphire Points**

For a gramophone pickup stylus to function satisfactorily it must be shaped to close limits to conform with the groove section of the particular type of record with which it is to be used. The first sapphire styli were produced by the same basic techniques as those used by precious stone cutters, which accounted for their high price.

To meet the enormously increased demand and at the same time to bring down prices, Sapphire Bearings, Ltd., in collaboration with the Union Carbide Corporation of America, have developed radically new manufacturing methods in which quality is maintained, but costs are much reduced.

The slicing of the synthetic sapphire "boule" and the production of the "rondel" or cylindrical shank follow normal practice, but the formation of the conical point is carried out on a centreless grinder

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*Wireless World, January 1955*
special design in which a sintered diamond grinding wheel revolving at 22,000 r.p.m. takes the place of the more usual lap, which must be continually re-dressed with diamond powder by skilled operatives.

After the formation of the cone, which is taken right up to a sharp point, the styli are subjected to a "tumbling" process in batches of 10,000 to 20,000 in a diamond powder medium. Details of this process are not disclosed, but the result is a symmetrical spherical point which will pass the closest examination.

Inspection probably accounts for the major part of the cost of these styli, and every one is examined for flaws and to check that its dimensions fall within prescribed limits. Binocular microscopes of the latest design and projection shadowgraphs are used for this purpose. A further inspection is made after the styli have been mounted in their shanks or pickup movements (some leading manufacturers entrust this work to the styli makers).

The surface finish of the sapphire after "tumbling" is of a high order and satisfies all ordinary require-

ments. An even higher polish can be obtained by fusion of the surface in an oxy-acetylene flame, and this "super" finish may be expected to give a correspondingly lower surface noise on records whose grooves are in mint condition.

Both standard and flame-polished types of stylus are available under the trade name of "Windsor" and cost 25s. 6d and 5s. 6d, respectively.

In a new factory to be opened next year it is expected that production will be at the rate of 20 million a year.

**Commercial Literature**

Radar Plotting Aid; the "Locanograph." An illustrated booklet explaining how it can be used in various ways, with worked examples, available from Marconi Marine, Chelmsford, Essex, price 4s. 6d.

Soldering Irons; a system involving many different types of crimped wire terminations, with special tools for attaching them, described in an illustrated brochure from Aeg-Nimonic, 2100 Paxton Street, Harrisburg, Pa., U.S.A.

Spring Alloy for high-temperature working (up to about 800° C), impervious to rust and corrosion. Leaflet giving the properties of Nimonic 90 from Henry Wiggin & Company, Wiggin Street, Birmingham, 16.

Tape Recording Accessories; foot switch for dictating; telephone pick-up device (attached by suction cup); stethoscope earphones; single-carriage headphones; a small crystal set mounted on a jack for reception of radio programmes. Leaflets from Truvox, 15 Lyon Road, Harrow, Middxex.

Low-voltage Stabilizer, with a range of 1-15V d.c. and 0-25A. Regulation: a load current of 2.5A causes a voltage drop not exceeding 5mV. Stability: a ±0.1 per cent mains voltage change causes an output change of less than ±5 mV. Specification on a leaflet from Servomeca Controls, Crowborough Hill, Jarvis Brook, Sussex.


Valve Retainers; booklet of tables giving the type of retainers needed for most valves in common use, from Electrothermal Engineering, 270 Neville Road, London, E.7. Distribution is restricted to equipment manufacturers.

Tape Recorders; transportable model in wooden cabinet, giving high-quality reproduction; a smaller portable model weighing 35 lb; a tape deck (used in both) with two speeds, 7µm and 4½m per second. Leaflets from Lee Products (Great Britain), Elpico House, Great Eastern Street, London, E.C.2.

R.F. High-voltage Generators for cathode-ray tube supplies and other purposes. Several models giving variable outputs over ranges between 5kV and 50kV. Output currents from 0.25mA to 1mA. An illustrated brochure from Teleonics (Communications), 196 Dawes Road, London, S.W.6.

Signal Strength Meter for television, consisting of r.f. amplifier, germanium diode and meter, with three ranges covering 0-10 mV altogether. Model supplied for each channel in Band I. Descriptive leaflet from Radio-Aids, 29 Market Street, Watford, Herts.

Nickel-Copper Alloy "Monel" with strong resistance to corrosion. Data sheet giving physical and mechanical properties from Henry Wiggin & Company, Wiggin Street, Birmingham, 16.

R.F. Tuner, 3-valve 4-waveband superhet, for feeding high-quality amplifiers. Output 1 volt maximum at infinite impedance. Also two new amplifiers, one for use with tape recorders. Leaflets from Lee Products, Elpico House, Great Eastern Street, London, E.C.2.

Electronic Manufacturing Facilities available in the Manchester area outlined in an illustrated booklet from the factory of F. C. Robinson & Partners at Councillor Lane, Cheadle, Cheshire.

Electronic Instruments for electrical, acoustic, radioactive, vibration, strain-gauge and electro-chemical measurements. An illustrated catalogue (in English) from the Danish company Bruel & Kjaer, available from the London office of Rocke International, 59 Union Street, London. S.E.1.

Component Storage Trays for assembly of electronic equipment in factories. Plastic mouldings designed suitably for interlocking, stacking and labelling. Leaflet from Precision Components (Barnet), 13, Byng Road, Barnet, Herts.
A Restrictive Practice?

VALVES and cathode-ray tubes are to come under the scrutiny of the Monopolies and Restrictive Practices Commission. The supply of these accessories is to be investigated by the Commission which has been asked to "report about both the facts of the matter and their bearing on the public interest."

Any person or organization wishing to offer evidence should write to the secretary of the Monopolies and Restrictive Practices Commission, 3, Cornwall Terrace, Regent's Park, London, N.W.1.

I.T.A. News

FREQUENCIES for the first three stations to be opened by the Independent Television Authority have now been announced. Birmingham will operate in Channel 8 (189.75 Mc/s vision, 186.25 Mc/s sound) and the transmitter for the London and Manchester areas in Channel 9 (194.75 Mc/s vision, 191.25 Mc/s sound). The frequencies of the London transmitter will be offset by 6.75 kc/s (vision) and 20 kc/s (sound).

Although Channels 8 and 9 were allocated to British stations in the Stockholm V.H.F. Broadcasting Plan the allocations were not made to transmitters in London, Manchester and Birmingham. It must, however, be remembered that the plan provides for the use of eight channels in Band III, only two of which will be available for television until such time as the present users of the band are accommodated elsewhere.

In addition to the appointment of P. A. T. Bevan as chief engineer (see Personalities) the I.T.A. has appointed Major-General D. A. L. Wade and Brigadier R. H. O. Coryton as assistants to the chief engineer. General Wade was, until recently, telecommunications attaché in Washington, and Brigadier Coryton chief signal officer, Northern Army Group.

Organizational, Personal and Industrial Notes and News

National Radio Show

THE period chosen for this year's Earls Court exhibition is approximately the same as last year—August 24th to September 3rd. The Radio Industry Council, which organizes the show with the co-operation of its constituent associations covering the various sections of the industry, is again arranging for a pre-view for overseas visitors and invited guests on August 23rd.

Television Society Exhibition

IN addition to some 30 manufacturers and research organizations, exhibitors at the Television Society's Exhibition will include a number of members. The exhibition, which will be held in the gymnasium, University College, Gower Street, London, W.C.1, on January 6th, 7th and 8th, is concerned with television research rather than domestic reception and amongst the equipment to be seen will be standards conversion gear for international television exchanges.

Admission on the first day (6-9 p.m.) is limited to members and the Press. Tickets for the other two days (noon to 9 p.m. and 10 a.m. to 7 p.m., respectively) are obtainable free from the society, 164, Shaftesbury Avenue, London, W.C.2.

Ambulance Radio

ACCORDING to figures given by the Minister of Health in reply to a question in the House of Commons, 20 of the 63 county health departments use mobile radio in the operation of their ambulance services. Of the 83 county boroughs, 42 have installed mobile radio equipment. It might be added that this is in spite of the fact that ambulances come under the "private mobile radio" category and have to pay £3 per annum for each transmitter, whereas fire services and police pay only £2 per annum for each fixed station irrespective of the number of mobile transmitters operating in the network.

Personalities

Professor G. W. O. Howe, D.Sc., M.I.E.E., has been awarded the Fellowship of the American Institute of Radio Engineers "for his pioneering work in radio and his outstanding contributions to engineering education."

Dr. Howe retired in 1946 from the James Watt chair of electrical engineering at Glasgow University, where he had been for 25 years, and was awarded an emeritus professorship. For fifteen years, he had been a consultant to the General Post Office in London and to the Post Office Research Station, forerunners of the National Physical Laboratory. He was also a consultant to the army and navy and to the Ministry of Aircraft Production during the war, and for ten years was a consultant to the War Office. In 1936 he was awarded the M.Inst.P. Prize by the Institution of Electrical Engineers, and in 1941 the IRE Gold Medal. He is a member of the Disciplinary Council of the U.S. National Academy of Sciences and a former president of the U.K. Physical Society.
years prior to going to the university he was lecturer and assistant professor at Imperial College, London. Dr. Howe has been technical editor of our sister journal Wireless Engineer for nearly 30 years. Incidentally a 75-page index to his editorials in Wireless Engineer from January, 1926, to May, 1954, has been prepared by Dr. A. J. Small of Glasgow University.*

T. E. Goldup, C.B.E., M.I.E.E., has also been awarded the Fellowship of the I.R.E. "for his pioneering achievements in the design and development of thermionic tubes and his contributions to the technical and administrative counsels of the British radio industry." He joined the research staff of the Royal Navy Signal School, Portsmouth, in 1914, where from 1918 to 1923 he was senior experimental officer. He is now a director of Millard's, which he joined in 1923 as an assistant in the valve laboratory.

Dr. A. G. Touch, M.A., D.Phil., the new director of electronics research and development at the Ministry of Supply, was a member of the Watson Watt radar team at Bawdesley research station from 1936 to 1940. For his contribution to the development of metre-wave AI and ASV he received an award from the Royal Commission on Awards to Inventors. Before joining the civil service he was at Clarendon Laboratory, Oxford. From 1941 to 1947 Dr. Touch was liaison officer with the British Joint Services Mission in Washington, where he was concerned with the development and production of airborne radio and radar equipment. For five years after his return from Washington he was superintendent, Armament and Instrument Experimental Unit, Marlisham Heath, Suffolk, and for the past two years has been deputy to the director, Air Comdre. W. G. Pretty, C.B.E., whom he is now succeeding. Air Comdre. Pretty was for two years in the Air Ministry directorate of signals, was deputy director (radar) at the Air Ministry and after a tour of duty as chief signals officer, Fighter Command, assumed the directorship at the Ministry of Supply, which he is now relinquishing. The new deputy director, electronics research and development (air) is Air Comdre. C. A. Bell.

John Clarricoats, G6CL, has completed 25 years as secretary of the Radio Society of Great Britain. To mark the occasion, the retiring president, A. O. Milne, made a presentation, for which over £150 was collected from members.

W. I. Fleck, Assoc.I.E.E., who is well known as the designer of the View Master television receiver and Soundmaster tape recorder, is to concentrate on printed circuitry for the Telegraph Condenser Company.

* Obtainable from Dr. Small, price 5s.

P. A. T. Bevan, B.Sc., M.I.E.E., whose appointment as chief engineer of the Independent Television Authority was announced early in December, was for 20 years with the B.B.C. where he had latterly been a senior member of the Planning and Installation Department of the Engineering Division. He graduated in engineering at Cardiff University and was for three years a graduate apprentice at the B.T.H. Rugby works. At the B.B.C. he has been mainly concerned with the development of v.h.f. television and sound transmitters. Mr. Bevan is the author of a number of papers, for one of which he received the I.E.E. Duddell premium and has, since 1949, been a member of the editorial advisory board of Wireless Engineer.

C. R. Jephcott, A.M.I.E.E., has been appointed engineer-in-charge of the B.B.C.'s temporary television transmitting station at North Hessary Tor, South Devon. He joined the corporation in 1935 at the Droitwich station, where six years later he became a senior maintenance engineer. In 1946 he transferred to the short-wave transmitter at Skelton, Cumberland, where he has been a senior maintenance engineer until taking up his new appointment.

S. W. Wain has retired from the position of deputy engineer-in-charge of the Post Office radio station, Leafield, which he has held since 1942. During his 34 years at the Post Office he has also served at Bodmin, Rugby and Portishead stations. He is succeeded at Leafield by E. G. H. Middleditch, who has been in the Post Office since 1923. Mr. Middleditch went to the engineer-in-chief's office at headquarters in 1935 and during the war...

PROVISIONAL field-strength contours for the two transmitters (S. Devon and N.E. Scotland) opened by the B.B.C. in December. The service contours (100μV/m) of the temporary stations are shown dotted. Scotland's temporary station is at Redmoss, near Aberdeen, some 25 miles from the permanent site at Meidrum. The station's horizontally polarized transmissions are radiated in Channel 4. The N. Hessary Tor mobile transmitter, which radiates in Channel 2 (carriers offset), is pictured on the opposite page.
SIR ANTHONY EDEN, guest of honour at the Radio Industry Council annual dinner, is seen talking to Sir Kenneth Clark, chairman of I.T.A. On his right is Sir Ian Jacob, director-general, B.B.C.

was given the task of providing emergency radio-telephone installations and mobile multi-channel R/T stations for the War Office.

Clifford Sanctuary, who has gone to Canada to take charge of the engineering side of the recently formed Decca Radar (Canada) company, has been associated with radar since he joined the Bawdsey research station in 1939. Two years later he joined the R.A.F. and was concerned with the installation of CH radar stations and OBOE. He joined the Decca Navigator Company in 1946 and transferred to the research labs of Decca Radar in 1951.

A. J. Brunker, B.Sc.(Eng.), A.M.I.E.E., who before joining E. K. Cole, Ltd., in 1947, was deputy director (radio production) at the Ministry of Supply, has become the company's chief engineer. He has relinquished the position of general export manager but retains his directorship in the subsidiary company, Ekco Electronics.

Walter M. York, who, as an executive director of E. K. Cole, already controls Ekco publicity and the company's heating division, will, in addition, now direct the export of radio, television, plastics and ciné equipment.

F. H. McCrea has been elected chairman of the Dublifier Condenser Company in succession to the late W. H. Goodman, who formed the original Dublifier company in 1912. Mr. McCrea has just completed 25 years service with the company and was appointed managing director in 1939, a position which he still holds.

G. Johnson, author of the article in this issue on a transistor d.c. amplifier, was concerned with the development of prototype gunnery radar at A.S.R.E. during the war, after which he was for a time senior inspecting officer at Ferranti's. In 1948 he became interested in electro-physiology and went to Hurstwood Park Hospital, Haywards Heath, to organize the new department of applied electro-physiology of which he is now in charge. He is honorary secretary of the Electrophysiological Technologists' Association and a council member of the EEG Society (electroencephalographic).

WHAT THEY SAY

Industry and P.O. Control.—"There is a strong door that shuts us out from discussions on frequency allocations."—G. Darley Smith speaking at the Radio Industry Council dinner.

Are we so Boring?—"I do not want to weary the House with a quotation from Wireless World ... "—C. R. Hobson, M.P., speaking in the House of Commons on November 23rd.

IN BRIEF

4,000,000 TV Licences.—Within the first few days of December the four-millionth television licence was issued. The number of television licences current in the United Kingdom at the end of November was 3,999,624, an increase of 157,956 during the month. The total number of receiving licences, including 250,256 for car receivers, was 13,794,195.

Television I.F.—The report on the choice of intermediate frequencies for television receivers prepared by the European Broadcasting Union, to which G. H. Russell referred in our July issue, is now available in English. The report, the full title of which is "The E.B.U. Enquiry Concerning the Choice of Intermediate Frequencies for Domestic Television Receivers and Related Questions," (Tech. 306-E) can be obtained from the Union Européenne de Radiodiffusion, 4, rue de la Vallée, Brussels, Belgium, price 70 Belgian francs, including postage.

R.S.G.B. Membership.—A regrettable but expected drop in membership as a result of the necessary increase in subscription rates is recorded in the annual report of the Radio Society of Great Britain. Comparative figures given in the report show a 13 per cent decrease during the year ended June 30th, 1954. The respective figures for 1953 and 1954 are 11,190 and 9,735.

U.S. Colour TV.—Over 130 stations in the U.S.A. are now equipped to rebroadcast network colour transmissions and, according to data given in Television Digest, of these will have three-colour film cameras by the end of January. A few stations are already equipped for live colour transmissions.

Solder Standard.—BS441:1954 "Rosin Cored Solder Wire, Activated and Non-Activated" is a revision of the standard "Cored-solder, Rosin Filled," published in 1932 and now includes methods for inspecting the rosin core. It costs 3s and is obtainable from British Standards Institution, 2, Park Street, London, W.1.

Component Testing.—Conditions and procedure for climatic and durability testing for components are given in BS211:1954 "Basic Climatic and Durability Tests for Components for Radio and Allied Electronic Equipment." Based upon the Radio Industry Council specification RIC11 and the Services specification RCS11, the standard describes tests which will form the basis of the tests to be included in individual standards for specific components. Price 5s.

The French Components Show will be held at the Port de Versailles, Paris, from March 11th to 15th.

Germany's Radio Show, which, like its British counterpart, covers sound and vision reception and gramophone reproduction, will be held from August 26th to September 4th in Düsseldorf.

Luxembourg TV.—The operators of Radio Luxembourg have been granted the monopoly of television in the Duchy. Commercial programmes will be radiated by the 819-line station on 189.26 Mc/s vision and 194.75 Mc/s sound when the service starts early this year.

Monte Carlo TV.—Using the French definition of 819 lines the Monte Carlo television transmitter has a directional aerial array which concentrates energy along a narrow stretch of the Riviera coast. Its sponsored programmes are receivable from San Remo, Italy, to St. Raphael, France.

E.B.U. Headquarters.—Having moved its receiving centre from the outer suburbs of Brussels to an interference-free site at Juribe-Masny (see W.W., September, 1953), the European Broadcasting Union has transferred its offices nearer the centre of the city. The new address is 4, rue de la Vallée, Brussels.

"Velocity of Radio Waves."—The velocity of light given in Dr. Smith-Rose's article (December, page 590) should, of course, have been 3 \times 10^8 km/sec.
A course of 20 lectures on the applications of Pulse Technique in communications, radar and computer circuits will be given on Tuesdays, beginning January 11th, from 7.30-9.0 at the Kingston Technical College, Fassett Road, Kingston-upon-Thames. The fee is 3 guineas.

The presentation of technical information is naturally of particular interest to Wireless World and we, therefore, draw readers' attention to the course of five weekly lectures on the Writing of Technical Reports at the Borough Polytechnic, Borough Road, London, S.E.1. The lecturer is G. W. Farr, and the course, for which the fee is one guinea, begins on January 20th at 6.30.

The one-full-day-per-week course on Band II (f.m.) and Band III (television) reception, which ran from September to the end of the year at the Northern Polytechnic, Holloway, London, N.7, will be repeated on Mondays from 9.30 to 4.30, commencing January 10th. The fee for the three-months course is £2.

The recent presentation of awards to trainees in Cossor's electronic engineering Apprenticeship Scheme afforded an opportunity to record that 112 student apprentices have entered the scheme since its inception in 1947.

BUSINESS NOTES

Aveley Electric, Ltd., of 44, Tottenham Court Road, London, W.1 (Tel.: Langham 7097), have been formed to act as representatives and agents for Rohde and Schwarz, of Munich, manufacturers of communication and laboratory measuring equipment. Eventually the company plans to manufacture some of the instruments in the Rohde and Schwarz range and a factory is under construction in Aveley, Essex. The directors are R. F. Parker, B.Sc., J. J. Brown, A.M. Brit.I.R.E., and C. A. Judd, A.C.A.

Mobile radio equipment has been supplied by Marconi's to the North of Scotland Hydro-Electric Board to facilitate the repair and maintenance of the new power transmission line which runs between Port Augustus and Speyside and is the highest in the U.K. The equipment has been installed in small buildings containing repair gear near the top of Corrieyairack Pass.

The General Electric Company, which, some months ago, installed mobile radio equipment for the rescue service of the N.W. Division of the National Coal Board, has now supplied similar installations for four other divisions.

It has been announced by Decca Radar that over 3,500 ships operated by more than 840 companies, navies and ministries throughout the world, have been equipped with Decca radar since the company started five years ago.

Learning a foreign language by "almost unconscious assimilation" with the aid of grammophone records is the principle of Assimil, which has been introduced into this country by E.M.I. Institutes. There are 20 double-sided records in the complete course, details of which are obtainable from 10, Pembridge Square, London, W.2.

A. K. Fans, Ltd., of 20, Upper Park Road, London, N.W.3 (Tel.: Primrose 5969), announce that A. W. Dean, who was with Marconi's, has joined the company and that they have taken over further factory space at 352, Clarelse Road, London, E.C.1.

The complete television studio and equipment which Pye installed at the recent British Trade Fair in Baghdad is to be purchased by the Iraq government and re-erected on a site belonging to the country's broadcasting authority. It is anticipated that initially the station will be used for educational purposes.

Underwater television equipment is being supplied by Pye which is FIT locating the wreck of the General Grant, sunk of the Lord Auckland Islands, south of New Zealand, in 1866 with a cargo of 91 tons of unrefined gold.

Medium- and short-wave transmitters, complete aerial systems and studio equipment are to be installed by Redifon at Piura for the Peruvian broadcasting organization Radio Nacional.

Cossor airfield control radar (Mark VI) has been installed at Zurich airport. A feature of this 450-kW surveillance radar equipment is the cancellation of permanent echoes, which is particularly important at Zurich where the Alps give heavy responses.

All-wave broadcast receiving equipment, gramophone amplifiers and loudspeakers are being supplied by Pye Make for 20 trailers being built at Lowestoft for the Soviet Union.

A $2.5M contract awarded to the General Electric Company for extensions to the telephone system of Haiti, in the Caribbean, includes the provision of v.h.f. radio relay equipment where the terrain makes the use of lines uneconomic.

Public address and intercom equipment has been installed by Hadley Sound Equipments, of Smethwick, at both the Renfrew (Glasgow) and Ringway (Manchester) airports.

Australian Agency:—The Sydney, N.S.W., firm of L. D. Beston (Aust.) Proprietary, Ltd., 387, Kent Street, would like to act as representatives of a U.K. manufacturer of television receiving aerials. Interested manufacturers should write directly to the company and are advised to send a copy of the correspondence to the U.K. Trade Commissioner, 39-49, Martin Place, Sydney, N.S.W.

Agency for a three-valve, all-dry, long- and medium-wave set made by a U.K. manufacturer not already represented in Ceylon is sought by Hentleys, Ltd., P.O. Box 670, Mackinnon Building, York Street, Colombo. Manufacturers should write direct to Hentleys but are invited to send copies of their correspondence to the U.K. Trade Commissioner, P.O. Box 745, Hong Kong Bank Building, Fort, Colombo.

NEW ADDRESSES

F. C. Robinson and Partners, manufacturers of electronic measuring and control equipment, have moved their head office and sales and service departments from Deansgate to 122, Seymour Grove, Old Trafford, Manchester, 16 (Tel.: Chorlton 5366). The factory is in Councillor Lane, Chadd, Cheshire.

Furzehill Laboratories have transferred their head office and sales and designs departments to 57, Clarendon Road, Watford (Tel.: Gadebrook 4686). The production and purchasing departments are still at the works in Shirley Road, Boreham Wood, Herts (Tel.: Elstree 1137).

The Rectifier Division of Standard Telephones and Cables has moved from Boreham Wood, Herts, to a new factory in Edinburgh Way, Harlow, Essex (Tel.: Harlow 26811).

The London district office and sales service depot of the Edison Swan Electric Company is now at 10-12, Euston Buildings, N.W.1 (Tel.: Euston 6972). The company's head office will remain at 155, Charing Cross Road, W.C.2.

The Manchester office of Elliott Brothers (London), Ltd., is now at 32, Deansgate, Manchester, 3 (Tel.: Blackfriars 7752).

A new branch office at 270, Corporation Street, Birmingham (Tel.: Central 6191), has been opened by the Telegraph Construction and Maintenance Company. The branch manager is J. H. Barham, Assoc.I.E.E.

Philips have opened new showrooms and a branch office at 47-49, Victoria Street, Bristol, Glos. (Tel.: Bristol 29307).

The address of the Middlesbrough district office of British Insulated Callender's Construction Company is now 55-57, Borough Road (Tel.: Middlesbrough 43644).
The pre-amplifier described in this article is intended primarily for use with the 10-watt amplifier described by the author in 1948, and its h.t. supply of approximately 20 mA at 300 V may be obtained from this power amplifier with complete freedom from motor-boating troubles. If desired, however, the pre-amplifier may be built with its own power pack, and may then be employed for feeding any high-quality power amplifier requiring a sine-wave input not exceeding 4 V r.m.s., at high impedance, for full output.

Separate input stages and gain controls are employed for the gramophone and microphone inputs, followed by a mixing circuit, making the pre-amplifier suitable for applications such as stage sound effects, recording, etc., where, for example, an effects record may be mixed in to provide a background to the spoken words of a play. If required, several microphone channels may be incorporated, whereas readers interested only in high-quality record reproduction may include only the gramophone channel.

The full output of 4 V r.m.s. may be obtained, with a total harmonic distortion not exceeding 0.1 per cent, for sine-wave signal inputs ranging from 1 mV to about 50 mV on the microphone channel, and from 20 mV to 1 volt on the gramophone channel. Full provision is made for recording-characteristic equalization, scratch filtering and microphone bass-cut, the writer's continuously adjustable tone-control circuit being employed, in addition to the above, to provide adjustable compensation to suit room acoustics, loudspeaker characteristics, etc.

The equipment as described uses Noval-based miniature valves; but certain other valves may be employed if desired, and the slight changes in circuit values then necessary are indicated below Fig. 1. The Noval type appears to be becoming established as the preferred series in British commercial practice, combining excellent electrical characteristics with conveniently small size and satisfactorily robust construction.

**Microphone Input Stage.**—Experience with high-quality ribbon microphones has shown that, for general purposes, the maximum gain available on microphone channels should be sufficient to enable the following amplifier to be fully loaded when a sine-wave signal of about 1 mV r.m.s. is applied to the input valve grid. An EF86 low-hum, low-microphony pentode, under the operating conditions employed in the present equipment, gives a gain of approximately 90 without negative feedback, and its harmonic distortion is less than 0.1 per cent provided the input does not exceed about 10 mV r.m.s.

However, even a low-sensitivity high-quality microphone may sometimes give a signal in excess of 10 mV—for example, when placed near to a piano or an orchestra—so that the distortion introduced by such a pentode stage will then be greater than 0.1 per cent.

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**Fig. 1.** Complete circuit of pre-amplifier. All resistors 1/4 watt ± 20%, except where otherwise specified. All capacitors (other than electrolytic) ± 20% except where otherwise specified. Mullard valve type EF86 may be directly replaced by Osram Z729; other alternatives require circuit changes as shown in the inset table.

**Table:**

<table>
<thead>
<tr>
<th>Circuit Values for Alternative Valve Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>MICROPHONE STAGE</td>
</tr>
<tr>
<td>VALVE</td>
</tr>
<tr>
<td>EF86</td>
</tr>
<tr>
<td>GRAMOPHONE STAGE</td>
</tr>
<tr>
<td>EF86</td>
</tr>
<tr>
<td>MIXER &amp; TONE-CONTROL STAGES</td>
</tr>
<tr>
<td>EF87A</td>
</tr>
<tr>
<td>OUTPUT STAGE</td>
</tr>
<tr>
<td>EF91</td>
</tr>
<tr>
<td>CV950</td>
</tr>
</tbody>
</table>

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Wireless World, January 1955
Pre-Amplifier

Versatile Design with Facilities for Mixing Several Inputs

By P. J. BAXANDALL, B.Sc.(Eng.)

unless the gain control is placed between the microphone and the grid. The disadvantage of having the gain control in this latter position is that the actual amplifier is operating at full gain all the time, resulting in unnecessarily high noise and hum levels under average conditions of use.

The problem is, therefore, to reduce the gain in such a way that low distortion is obtained without sacrificing signal-to-noise ratio, and the solution adopted in the present design is to place the gain-control potentiometer after the input stage and arrange that the valve may be switched to operate effectively as a triode instead of as a pentode when large signals are to be handled. Under triode conditions, an input of about 3 mV r.m.s. is required to give full output at the maximum-gain setting of the potentiometer, and the distortion does not exceed 0.1 per cent until the input reaches about 50 mV r.m.s. Thus, provided the switch is never used in the "pentode" position when sufficient gain can readily be obtained in the "triode" position, the distortion will never exceed 0.1 per cent for any value of input up to 50 mV—a value unlikely to be exceeded with a high-quality microphone.

The gain following the above input stage must be sufficient to give 4 V r.m.s. output from the pre-amplifier for a microphone stage output of 90 mV r.m.s.; with the mixing circuit employed, the noise level at the pre-amplifier output, with the input stages faded right down, is then approximately 70 db below 4 V r.m.s., which is highly satisfactory.

The above system has been adopted, instead of one of the feedback arrangements used in high-grade broadcasting equipment, for the following reasons—

(a) Shunt-feedback methods, if optimum signal-to-noise ratio is to be obtained, require the feedback circuit, microphone and input transformer to be designed to work in conjunction with one another, whereas in a versatile design, intended for amateur construction, it seems desirable to have an input circuit which will suit any available microphone with or without input transformer.

(b) Feedback obtained by inserting resistance in the cathode lead is liable to lead to unnecessarily high hum levels, unless a d.c. heater supply is used or other expensive precautions are taken.

(c) Circuits involving more than one stage, special feedback transformers, or ganged "tud-typ" potentiometers, are regarded as undesirably expensive for amateur use.

Though a single-knob gain-control system is certainly more convenient than the combination of potentiometer and switch used in the present design, it is thought that most amateurs will be prepared to sacrifice a small amount of simplicity of control in order to obtain a very high-grade performance economically.

In most circumstances the gain switch can be set, before commencing operations, to the position appropriate to the sensitivity of the microphone and the likely intensity of the sound, and it will not require altering during the performance. The gain-switching circuit has been so arranged, however, that no switch clicks are heard even if the switch is operated, as may occasionally be necessary, without first fading the input stage down. The switch (S1 in Fig. 1) must be of the make-before-break variety, to ensure that section S1B maintains a short circuit across the gain control during the whole of the time that section S1A is effecting the change-over from triode to pentode or vice versa.

On measuring the input capacitance of the microphone stage, including the input socket, values of approximately 30 pF and 70 pF were obtained under pentode and triode conditions respectively. The higher value under triode conditions is due to Miller effect, involving the screen-grid to control-grid capacitance. A capacitance of 70 pF, shunted across the secondary of a microphone transformer, will produce an appreciable effect on the high-frequency response only if the secondary impedance is well in excess of 50 kΩ; since such transformers are very rare, no trouble arising from input capacitance is likely to be experienced in practice.

A switch S2 is included (see Fig. 1) to enable various degrees of bass cut to be introduced on the microphone channel. This is a very desirable feature, par-

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TABLE 1

<table>
<thead>
<tr>
<th>Number of contact on switch S2</th>
<th>Approximate frequency for 3 db attenuation.</th>
<th>Approximate distance from ideal ribbon microphone for perfect bass compensation.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>50 c/s</td>
<td>3 ft</td>
</tr>
<tr>
<td>2</td>
<td>100 c/s</td>
<td>18 in</td>
</tr>
<tr>
<td>3</td>
<td>200 c/s</td>
<td>10 in</td>
</tr>
<tr>
<td>4</td>
<td>400 c/s</td>
<td>5 in</td>
</tr>
<tr>
<td>5</td>
<td>800 c/s</td>
<td>2.5 in</td>
</tr>
</tbody>
</table>

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Wireless World, January 1955
particularly when using a ribbon microphone under fairly close-speaking conditions, since the curved wave-front reaching the microphone then causes a considerable increase in the relative output at low frequencies. Table I on the preceding page gives, for each setting of the switch, the approximate frequency at which an attenuation of 3 db occurs, and the approximate distance from an ideal ribbon microphone at which the compensation for spherical wave propagation is theoretically perfect.

**Gramophone Input Stage.**—Equalization for recording characteristics is obtained by means of negative-feedback networks associated with V2 in Fig. 1, it being assumed that the pickup employed gives a constant output for constant stylus velocity at all frequencies.*

In the "LP" position of the switch S3, the measured response curve of the gramophone stage is as shown in Fig. 2 (broken-line curve), and is suitable for equalizing microgroove records of both British and American origin. A little extra bass lift may sometimes be required, however, particularly with R.C.A. records, but this can readily be applied by means of the main

* The best moving-iron, moving-coil and ribbon pickups approximate closely to this ideal.

![Fig. 2. Measured response curves for gramophone input stage (all components within 5% of values shown in Fig. 1).](image)

![Fig. 3. (a) Circuit used for gramophone bass equalization, omitting irrelevant details. (b) Frequency response obtained when Q=1.](image)

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**Practical Design Procedure:**

(i) Choose arbitrary value for $R_1$ (at least 100kΩ)
(ii) Make $R_2$ several times $R_1$
(iii) Determine $C_2$ from $-\frac{1}{C_2} = \frac{1}{2\pi f_1 R_2}$
(iv) Determine $C_1$ from $-\frac{1}{C_1} = \frac{1}{2\pi R_1} \left( \frac{1}{Q_{f_0}} - \frac{1}{f_1} \right)$
(v) Determine $R_4$ from $-\frac{1}{R_4} = \frac{R_2}{R_1 C_1 C_2 R_2} \left[ \frac{Q^2(C_R_1 + C_R_2)}{Q^2 R_1 C_2 R_2} - 1 \right]$  
(vi) Determine $R_3$ from $-\frac{1}{R_3} = \frac{R_2}{R_1 + R_4} \left[ \frac{V_{OUT}}{V_{IN}} \right]$ of H.F. at $f_1$

**Note:** The formulae apply accurately only when the actual valve gain is much higher than the value of $\frac{V_{OUT}}{V_{IN}}$ at $f_1$. In practice $R_1$ may be made higher than the calculated value, to compensate for finite valve gain.

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The full-line curves in Fig. 2 are obtained on the "78" setting of S3; fixed bass equalization, which is accurately the inverse of the E.M.I. recording characteristic, is provided, and the treble equalization is adjustable by means of a potentiometer. With the potentiometer at approximately 40 per cent rotation from the maximum-treble end, assuming a linear element, the treble attenuation is nominally correct for equalizing the high-frequency pre-emphasis on Decca "ffrr" records. Other settings may be used to give the best audible results with records of various makes and conditions.

It will be seen that the "78" bass-equalization curve shown in Fig. 2 rises at a rate approaching 6 db/octave down to about 35 c/s, below which it changes over fairly rapidly to a similar rate of fall. This latter feature, which provides a useful measure of turntable rumble filtering, is achieved by including two a.c. couplings in the feedback loop used for bass equalization, instead of only one as is more usually the case. The basic theory involved is the same as for the high-pass filter, and is considered later in this article. The practical design formulae are given in Fig. 3, which also shows the circuit freed from irrelevant details such as grid bias, screen supply, etc.

A low-pass filter, to be described later, is included in the last stage of the pre-amplifier, and will frequently be employed as a scratch filter when using the equipment for reproducing gramophone records only. When mixing a gramophone recording with live speech from a microphone, however, it is often preferable not to limit the frequency range of the microphone contribution, so that the low-pass filter cannot then be employed; but since conditions are not very critical when the gramophone channel is used merely to provide a background effect, scratch filtering is likely to be necessary only with 78 r.p.m. records and can be provided adequately well by means of the adjustable treble-cut control associated with the gramophone input stage. By placing the low-pass filter at the output end of the pre-amplifier, instead of the pre-amplifier input, the high-pass filter setting can be altered without also altering the bass equalization.
of making it part of the gramophone stage, it becomes available for use on radio programmes, the radio input being fed to the mixer circuit in a similar manner to the microphone and gramophone inputs. A further consideration is that if a crystal pickup is used, the gramophone input stage may be omitted altogether, a suitable passive equalizing network being connected between the pickup and the gramophone gain control; the low-pass filter is, however, still available under these conditions. (An alternative method of using a crystal pickup, such as the Cosmocord GP20 “Hi-g,” is to shunt the pickup with a series combination of two resistors, of values about 220 kΩ and 22 kΩ, the voltage drop across the 22 kΩ resistor being applied to the input of the gramophone stage shown in Fig. 1. The correct value of shunt resistance makes the crystal pickup have a response approximately the same as that of a moving-iron or moving-coil pickup.)

**Mixer Stage.**—An anode-follower or virtual-earth type of mixer is employed, because it possesses the following desirable features:

(a) The gain on one input channel is almost independent of the gain-control settings on the other input channels.

(b) The circuit is economical, enabling several inputs to be mixed with a single valve whilst also providing a useful amount of gain—just over four times in the present case.

(c) The non-linearity distortion is low, due to the negative feedback.

(d) The output impedance is low, also because of the negative feedback, making the circuit suitable for feeding the tone-control.

**Tone-control Stage.**—The tone-control circuit is almost exactly as previously published, but an EF86 valve is used in place of the high-slope valve originally specified, in order to secure reliable freedom from microphony and hum. The signal output from the tone-control valve, for a final output from the preamplifier of 4 V, is 400 mV; under these conditions, the non-linearity distortion introduced by the tone-control stage is much less than 0.1 per cent despite the low-slope valve employed.

With the switch S4 in the “open” position, the alternative treble-response curves, as shown dotted in Fig. 8 of the previous article, may be obtained. A resistor of 330 kΩ is connected to earth from each end of the treble-control potentiometer, to provide a d.c. return path from the grid to earth when S4 is opened—a requirement inadvertently overlooked when the original article was written, but soon pointed out by several readers! Whether this facility for obtaining the alternative response curves is included, is a matter for personal choice, and some constructors may prefer to omit it.

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**Fig. 4.** The constant-k, n-section low-pass filter shown at (a) has the same response (to both sine-waves and transients) as that given by circuits (b) and (c) in cascade, assuming that (c) does not appreciably load (b).
Output Stage.—The output stage provides a voltage gain of approximately 10, and has associated with it feedback circuits giving high-pass and low-pass filter characteristics.

The high-pass filter, which has a fixed cut-off frequency of about 30 c/s, reduces tendencies for the main amplifier and/or loudspeaker to be overloaded by sub-audio frequency inputs caused by turntable rumble, or, on the microphone channel, floor vibration and the effects of wind on the microphone. This filter also substantially reduces the amount of h.t. decoupling necessary for obtaining complete freedom from motor-boating troubles when the decoupling necessary for obtaining complete freedom from motor-boating troubles when the pre-amplifier is fed from the main amplifier h.t. supply. Full bass lift may, in fact, be applied at maximum gain settings without causing instability, though this combination is unlikely to be needed in normal use.

The low-pass filter, as already mentioned, is primarily for reducing scratch and distortion on the gramophone channel, and cut-off frequencies of 5 kc/s and 7.5 kc/s may be selected by means of switch S5, a third position of which cuts the filter out.

It is sometimes said that filters using resistors and capacitors only, in suitable feedback circuits, give better transient response than can be obtained with passive filters which include inductors. In general, however, this notion is quite incorrect, and any filter employing feedback principles may, in fact, be shown to be equivalent, in both frequency response and transient response, to a particular passive filter using inductors. The feedback filters employed in the present equipment are equivalent to, or “simulate,” simple constant-*k filters with one π (or T) section and resistive terminations, the rate of cut-off tending to 18 db/octave.

Considering first the low-pass filter, the basic circuit to be simulated is that shown in Fig. 4 (a), and the first fact utilized in deriving the equivalent feedback circuit is that the response of the basic circuit is exactly the same as that of the two circuits shown in Fig. 4 (b) and (c) in cascade, provided that the component values are correctly chosen and that circuit (c) does not appreciably load circuit (b). It is the normal practice to make R in Fig. 4 (a) equal to $\sqrt{L/C}$; to simulate this condition, the circuit of Fig. 4 (b) must series-resonate at the nominal cut-off frequency of the filter, with a Q of unity at resonance, and circuit (c) must have a response which is 3 db down at the cut-off frequency. Thus, provided a feedback circuit can be found, which has the same kind of response as the Fig. 4 (b) circuit, it is then only necessary to add a “sample lag,” as shown in Fig. 4 (c), to make it simulate the filter of Fig. 4 (a).

The main characteristics of the Fig. 4 (b) type of circuit are:

(a) Level response at low frequencies.
(b) A peak in the response near to the resonant frequency—unless the Q is very low.
(c) A rate of attenuation tending to 12 db/octave at frequencies well above resonance.

The above are also the main characteristics of a negative-feedback amplifier having two simple lags in the forward path, and it is actually found that the equation relating input and output voltages for such an amplifier is of exactly the same form as that for the Fig. 4 (b) circuit. Alternatively, one of the simple
diagram circuits may be used in place of the feedback amplifier, as shown in Fig. 4 (c).

* The latter condition may be satisfied by making circuit (c) of much higher impedance than circuit (b), or by interposing an isolating stage, such as a cathode follower, between the two circuits.

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**Fig. 5. Feedback circuits simulating the circuit of Fig. 4 (b).** The formulae apply accurately only when the actual valve gain is much higher than the gain given by the above circuits at low frequencies. The capacitor shown dotted above provides the additional lag required for simulating Fig. 4 (a) instead of Fig. 4 (b).
lags may be replaced by a Miller integrator, leading to the circuit shown in Fig. 5 (a); this arrangement has the advantage that its performance is almost independent of the actual valve gain, provided the latter is high enough. The necessity for a “floating” signal-input source may be avoided by employing the modified circuit shown in Fig. 5 (b). The capacitor shown dotted in Fig. 5 (b) provides the additional lag required for simulating the circuit of Fig. 4 (a) rather than that of Fig. 4 (b), and is placed before the valve (instead of after it) in order to enable the low output impedance of the feedback circuit to be utilized for feeding the cable connecting the preamplifier to the main amplifier—the cable capacitance may be as much as 200 pF without materially affecting the performance.

On referring to the complete circuit diagram, Fig. 1, it will be seen that the low-pass filter circuit of Fig. 5 (b) is that employed in the actual equipment, though a little effort may be needed to disentangle the low-pass filter from the high-pass filter, the latter being achieved by feedback round the same valve!

In the high-pass filter, a feedback circuit is used to simulate a series tuned circuit like that shown in Fig. 4 (b) but with L' and C' interchanged. This is followed by a circuit as shown in Fig. 4 (c) but with C'' and R'' interchanged, the combination of these circuits simulating a constant-k high-pass filter with a rate of attenuation tending to 18 db/octave below cut-off. The basic system used for simulating the series tuned circuit is shown in Fig. 6 (a), and involves a feedback loop having two a.c. couplings in the for-

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*The above method of providing the additional lag actually results in slight departures from the simple theory, because the extra capacitor affects, to some extent the operation of the other lag, involving C4; but perfectly satisfactory results may be obtained in practice by suitable choice of component values. Ref. (13) gives an ingenious solution of this complication.
ward path, the forward gain being stabilized by non-frequency-dependent internal feedback. The arrangement is the same in principle as that used for bass equalization and rumble-reduction in the gramophone stage, except that in the gramophone application the output is taken from the point “P.” The practical circuit evolved from Fig. 6 (a) is shown in Fig. 6 (b), in which irrelevant details have been omitted for clarity, and it will be seen that one of the time constants in the feedback loop comes before the valve and one after. Non-linearity distortion is considerably reduced by this means.

Fig. 7 gives the results of measurements on the complete output stage, with component values as shown in Fig. 1.

(To be continued)

REFERENCES


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**Dates for Your Wireless World Diary**

INDIVIDUAL announcements have already been made of the dates of many of this year’s exhibitions, but for the convenience of readers we give below a list of the principal shows in 1955.

**Television Society Exhibition**

*University College, Gower St., London, W.C.1.*

Jan. 6-8

**Components Show (R.E.C.M.F.)**

*Grosvenor House, Park Lane, London, W.1.*

April 19-21

**Physical Society Exhibition**

*New Royal Horticultural Hall, Westminster, London, S.W.1.*

April 25 & 28

**Association of Public Address Engineers Exhibition**

*Horseshoe Hotel, Tottenham Court Rd., London, W.1.*

April 27 & 28

**Northern Radio Show**

*City Hall, Manchester.*

May 4-14

**British Sound Recording Association Exhibition**

*Waldorf Hotel, Aldwych, London, W.C.2.*

May 21 & 22

**British Plastics Exhibition**

*National Hall, Olympia, London, W.14.*

June 1-11

**National Radio Show**

*Aug. 24-Sept. 3 Earls Court, Fulham, London, S.W.5.*

**Farnborough Air Show (S.B.A.C.)**

*Sept. 5-11 Farnborough, Hants.*

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**NEW ACOUSTICS LABORATORY**

A NEW wing has been added to the laboratory of Goodmans Industries, Ltd., at Wembley for research and development in the production of loudspeakers, microphones and other electro-acoustic devices.

The main feature of the new extension is an echo-free room with a volume of 4,500 cu ft lined with glass fibre wedges 8in square at the base and 3ft long. The whole room floats on rubber supports and although a main line railway is only 100ft away, structurally borne vibrations are negligible. The unusually deep lagging presents problems in the design of the door, which must, of course, be similarly treated. These problems have been solved by mounting the door on vertical guides and raising it electrically into a tower on the roof of the building when access to the room is required.

In addition to normal frequency response curves, measurements of "hang-over" transients are also made by a tone pulse technique, and this has proved useful in investigating cabinet as well as loudspeaker performance.

Auxiliary equipment includes a high-speed level recorder (1,000 db/sec), electrical and acoustical standards and instruments for measurement of compliance and other mechanical parameters.

The services of the laboratory are available to set manufacturers for testing prototype designs and ensuring that harmonious acoustic relations exist between loudspeaker and cabinet.

Goodmans Industries acoustics-laboratory, showing in the background the entrance to the echo-free chamber.
Education and Training

Can We be Satisfied with the Results?

By FRANCIS REECE

The tremendous demand for radio engineers and technicians is reflected in the many advertisements which appear not only in the technical press, but also in the lay press. There has been no easing of the shortage of manpower over the past ten years, and it may be assumed that this is a serious handicap to a fast developing industry.

Why is there such a shortage when the importance of technical education is so widely appreciated and public interest in technology in this country is greater than ever before?

It is popular to criticize the lethargy of the younger generation. Be that as it may, employers cannot complain at the number of young men who are sufficiently attracted towards employment in the radio field to embark upon long and arduous courses of instruction. In fact, there has been a very large increase in the number of candidates taking the examinations of the City and Guilds of London Institute, the Institution of Electrical Engineers, and the British Institution of Radio Engineers.

Whilst, however, large numbers of students undertake courses of study, comparatively few successfully complete the courses. Every technical college reports that at the end of each academic year a number of students give up their courses either because of their waning interest or an inability to assimilate the work. One London technical college has reported, for example, that 50 students started on the first year of an Ordinary National Certificate course, but by the end of the third year only 25 actually attempted the final examination leading to the award of the certificate. Of that 25, only 5 went on to attempt the Higher National Certificate. Similar figures have been given in respect of courses in preparation for the City and Guilds Full Technological Certificate and other examinations.

These facts are of supreme importance in estimating the future number of engineers, as distinct from technicians, likely to enter the radio industry. The bulk of the engineers already employed and certainly the majority of future engineers, will come from the technical colleges with a Higher National Certificate or having directly passed the examinations of the I.E.E. or the Brit.I.R.E.

A Popular Misconception

It is a popular misconception that engineers have necessarily to be university graduates. The majority of the engineering staff of any firm or Government organization have not had the advantage of a university education. Indeed, the number of graduates securing degrees in the appropriate engineering faculties could not possibly meet the present enormous demand for junior and senior development and research engineers. Moreover, the number of engineering degrees awarded in Great Britain has decreased in the last two years. Thus, in the main, industry must look to the technical colleges to provide the majority of men for whom there is at present such a demand.

It may be argued that much of the trouble lies in preliminary education. The minimum level of basic education laid down by the professional institutions is the Common Preliminary Examination conducted by the Engineering Joint Examination Board. This requires success in English, mathematics, elementary physics and a foreign language, and exemption is granted from it to the boy (or girl) who has obtained a pass in these subjects in the General Certificate of Education at the ordinary level.

Unfortunately, figures are not available to indicate how many grammar school boys enter the engineering profession, including the radio industry. Apart from this source many of the engineers of the future will receive their basic education in the secondary modern schools. It is, however, a deplorable fact that very few of these schools train their pupils for the General Certificate of Education even in two or three subjects.

Under the provision of the 1944 Education Act children not admitted to either grammar or secondary modern schools finish their education in the secondary technical schools. For the purpose of these notes such pupils need not enter into our reckoning, although doubtless many of them are ultimately engaged in engineering in an unskilled capacity or as craftsmen or mechanics. A few may have the tenacity to carry on with part-time studies to qualify for better positions.

Is Basic Education to Blame?

The bulk of students taking the Ordinary National Certificate or similar courses at a technical college come now from the secondary modern schools and have not had the advantage of a grammar school education. It may well be that this lack of basic education accounts for the large wastage now being experienced in second and subsequent years of technical college courses.

The question may, therefore, be asked as to whether the eight years working of the new Education Act is in any way responsible for the very high percentage of failures in the C. and G., I.E.E., and Brit.I.R.E. examinations. Whatever the reasons, the fact is that since the war the number of young students attracted to the radio engineering career has steadily increased. In 1953, for example, the C. and G. had a record entry of over 30,000 candidates for their various examinations in telecommunications. Of this number only 394 succeeded in obtaining an Intermediate Certificate, 139 were awarded a Final Certificate, and 67 obtained the Full Technological Certificate in Telecommunications Engineering (Radio).

Success in the Full Technological Certificate exami-
nation in telecommunications only secures partial exemption from the appropriate professional examinations of the I.E.E. and the Brit.I.R.E. The younger engineer usually looks forward to qualifying for membership of one of these professional bodies. Some consideration must therefore be given to the experience of these institutions in assessing the technical qualifications of their prospective members, whether by direct examination or by granting exemption.

According to the last annual report of the Brit.I.R.E. the results of its own examination are very disappointing. Whilst the number of entries is now over 1,000 a year, fewer than 6% of the candidates pass the graduateship examination.

The I.E.E. runs a different scheme of examination but it is sufficient for our purpose to consider the results of its Section B, which includes the optional subject of radio communication. The I.E.E. does not distinguish between candidates taking radio communication and the electricity supply subjects in its summary of results, but in 1953 it had 722 candidates writing the Section B subjects, of which only 152 succeeded. Thus, although the percentage of success may vary between the three examining bodies mentioned, the over-all result must be disappointing to both the entrants and those who are looking for an increased entry to the engineering ranks of the radio industry.

Varying Standards of Instruction

It is true, of course, that apprentices, trainees and others may meet the requirements of their individual firms by obtaining National Certificates. In 1953 over 7,500 Higher and Ordinary National Certificates (Electrical Engineering) were awarded, but figures are not available to show how many of these certificates were in respect of radio or telecommunication subjects. The pass standard required for National Certificates seems to be a little lower than that required for success in external examinations, but an important additional requirement is that the candidate's course work is also taken into account. Furthermore, the radio content of a course for the H.N.C. varies according to the college. There are all too few colleges in Great Britain able to offer a course leading to a Higher National Certificate in radio subjects. Indeed, the I.E.E. issued a memorandum in 1950 which stated that only 20 such colleges were offering approved courses in radio and telecommunications engineering (including line communication).

Courses in preparation for National Certificates or the examinations of the C. and G., I.E.E. or Brit.I.R.E. are the first steps which must be taken for qualification as an engineer by a candidate not having the advantage of a university education. Only from these sources can the industry recruit the type of engineer who, graduating through the technician and junior ranks, can undertake responsibility for development and production. Such experience must be coupled with proper training for ultimate employment in senior positions.

A Select Committee has recently issued a report in regard to the manpower requirement of the Royal Air Force. The shortage is particularly acute in the electronic field. Thus the Services now add their claim upon the too few people available to industry.

Surely the first step towards solving this problem is for the Ministry of Education, the C. and G. and the engineering institutions concerned, to make a detailed investigation as to the reasons for the poor results in their examinations and the National Certificates scheme. If the answer is that the calibre of the candidates is too low because of the inadequacy of basic education, then the Ministry of Education has it in its power to alter the application of the 1944 Education Act. The present writer suggests, however, that the failure lies not so much with basic education as with the inadequacy of subsequent technical instruction. Various reports, including one issued by the Parliamentary and Scientific Committee, have suggested that there is a shortage of properly qualified lecturers and that the colleges are handicapped in not possessing suitable equipment. There has also been little progress with the proposal that lecturers should have better opportunity to secure industrial experience with corresponding release of industrial engineers to undertake part-time teaching.

A further factor in trying to produce better results is the need to overcome the reluctance of some colleges to provide courses specifically designed for the radio engineer. Many of the existing syllabuses were drafted for the training of the electrical engineer. The addition of one subject in radio in the final year of a course for the H.N.C. is not generally thought to be sufficient to meet the needs of a rapidly expanding industry.

The third possibility is to consider whether the examining bodies demand too high a standard. Everyone would welcome these various bodies reconciling their differences of opinion. If they did so the technical colleges would be greatly helped in the arrangement of their courses. Concerted and agreed opinion would also influence training at the grammar school level.

Pros and Cons of Specialization

The C. and G. has always been primarily concerned with the training of the mechanic and technician. In more recent years, however, it has developed these interests to a more advanced level for the radio and telecommunications engineer. To this extent they are encouraging specialization.

On the other hand the I.E.E. does not fully subscribe to any degree of specialization, as will be seen from a perusal of its examination syllabus. This, however, does not necessarily account for its slightly better percentage of examination successes when compared with those recorded by the C. and G. and the Brit.I.R.E. In general the I.E.E. insists on a broader education in general engineering, with emphasis upon practical laboratory work.

Rather naturally perhaps the Brit.I.R.E. appears to subscribe to the policy of specialization. The tendency is to attach more importance to physics than would normally be followed in an O.N.C. course; possibly the main criticism of the Brit.I.R.E. is that it encourages specialization within two years of starting a general engineering course. This insistence upon specialization in depth might therefore account for the small percentage of successes in its graduateship examination.

In only one respect does the National Certificate examination scheme and the examinations of the two institutions agree—that of insisting upon some system of approved courses requiring actual attendance and the provision of suitable laboratory work. In the case of the C. and G. there is no insistence on the satisfactory completion of an approved course. The candi-
date alone decides when he will take the examination and the temptation to “have a go” may account for many of the failures. The Brit.I.R.E. appears to have realized that this factor contributes to the low percentages of success and is now insisting that candidates for the examination must provide evidence of supervised course work.

There is much discussion on the proper way of using an engineer once he has been recruited. The unskilled worker, the mechanic, and the technician are all needed by the industry. The future development, and the grasping of opportunities at hand in the radio industry, will be lost unless the engineer is recruited at the right age and with the requisite basic education.

It is not the function of this article to discuss the opportunities which are available to the properly trained young engineer. It is true that unfavourable comparison is very often made with the returns available elsewhere to unskilled labour. Nevertheless the interest of a comparatively new and growing art continues to attract large numbers of young men. The fact that they fail to achieve their goal must reflect on the education and training that they receive.

Education and training will continue to be a subject in which industry must take an increasing part. As employers, however, they are not alone in this responsibility for the same story of shortage of radio and electronic engineers is to be found in the Civil Service, the Navy, the Army, and the Air Force. Even the B.B.C., with its own internal system of training, is continually advertising vacancies for radio engineers.

Last year the Radio Industry Council published a most useful pamphlet “Careers in Radio and Electronics” dealing with the need and the opportunities for the young engineer in the radio industry. The booklet was a further indication of industry’s realization that it has a very important part to play in the training of the engineer of the future. Certainly, the opportunities available within the industry for “sandwich” courses and other methods of part-time study, coupled with experience, are a great advance upon the facilities available to the pre-war student.

The R.I.C. estimated that up to 3,000 engineers a year can be absorbed by the industry. No account was taken, however, of the demand for radio engineers outside the industry, and the developments already mentioned, including the Services’ requirement, probably means that at least double this number is required every year if all demands are to be reasonably satisfied. All the more reason, therefore, to ensure that available material is properly trained and not wasted. The first essential is to retain the interest of the student in the early years of his technical training. Unless this problem is tackled, the tendency must be for the younger man to take advantage of the opportunities in other fields, to the subsequent detriment of future development in the radio industry.

Can we, therefore, be satisfied with the results achieved by our present method of technical education?

### Radio Officers’ Training

#### Colleges Providing Courses

THE particulars included in the lists of further education establishments published in our September and October issues last year were provided by the Ministry of Education and included only those colleges, etc., which come under the direct control of the Ministry. They do not, therefore, include the privately operated wireless schools throughout the country which provide training for prospective radio officers. The following establishments in the United Kingdom are licensed by the P.M.G. to use transmitting equipment for instruction purposes.

**Bridlington**
- North Eastern School of Wireless Telegraphy, Radio House, Shaftesbury Road, Bridlington, Yorks.
- Grimsby Nautical School, Orwell Street, Grimsby, Lincs.
- Hull Municipal Technical College, Park Street, Hull, Yorks.
- Leamington Spa Midland Wireless School, 2, Myton Croft, Myton Road, Leamington, Warwick.
- Liverpool Riverside Technical College, Riversdale Road, Liverpool, 19.
- Wireless College, 6, Princes Road, Liverpool, 8.
- London British School of Telegraphy, 179, Clapham Road, London, S.W.9
- London Telegraph Training College, Morse House, 20, Penywern Road, Earl’s Court, London, S.W.5.
- Manchester Wireless Telegraph College, 25, John Dalton Street, Manchester.
- College of International Marine Radiotelegraphic Communication, Overseas House, Brook’s Bar, Manchester, 16.
- Plymouth Plymouth and Devonport Technical College, Tavistock Road, Plymouth, Devon.
- Preston Northern Counties Wireless School, 91, Lancaster Road, Preston, Lancs.
- Southampton The University, Southampton.
- Air Service Training School of Radio and Radar, Hamble, Hants.
- South Shields Marine School, Ocean Road, South Shields, Co. Durham.

**SCOTLAND**
- Aberdeen Marine Radio College, 56, Union Street, Aberdeen.
- Edinburgh Edinburgh Wireless College, 17, Gayfield Square, Edinburgh, 1, Midlothian.
- Leith Nautical College Leith, Edinburgh, 6, Midlothian.
- Glasgow Glasgow Wireless College, 26, Newton Place, Glasgow, C.3.
- Lanarks.
- Greenock Watt Memorial School, Dalrymple Street, Greenock, Renfrews.

**WALES**
- Cardiff Cardiff Wireless College, 1, Stuart Street, Docks, Cardiff, Glam.
- Colwyn Bay Wireless College, East Parade, Colwyn Bay, Denbighshire

**NORTHERN IRELAND**
- Belfast Marine Radio College, Urrington House, 2, Eglantine Avenue, Lisburn Road, Belfast.

**PUBLICATION DATE**

*Wireless World* will in future appear on the fourth Tuesday of the Month preceding that for which it is dated. The February issue will therefore be published on 25th January.
“Special Quality” Valves: Improvements in Electrical Characteristics as Well as in Reliability


In our company, we started work on reliable valves in early 1949 because of complaints about valve failures in an automatic pilot equipment. We then expanded our efforts in order to help our Radio Division to produce equipment which would successfully pass flight trials. The real impetus, however, was provided by the Services, who later in the same year placed large-scale development contracts for the design of reliable valves to be plug-in replacements for types on the Preferred List.

Our work showed that whilst human errors in manufacture played a part in producing failures, the basic valve designs needed attention. The major problem was that most valves had loose structures which gave rise to noise and characteristic instability, whilst some had structures of such dimensions that low frequency resonances were inevitable. Fig. 1 shows the proportions of noise output contributed by the various valve components.

Some manufacturers tended to take panic measures on the principle that if more structures were added to the valve structures then they would be bound to be more reliable, but our view has always been that a more scientific approach would pay dividends, even though it might take longer in actual time. Our philosophy was that before a valve design was considered suitable for production it had to be analysed for noise, and a resonance search test equipment designed by Dr. H. Moss proved invaluable for this purpose. Its disadvantage was that valves had to be made up first and then tested, but since then we have devised empirical formulae to forecast in advance whether the individual components would produce objectionable resonances. Thus this particular piece of test gear has now become a routine checking instrument only.

Cathode Poisoning

The most serious cause of valve failures, other than short life catastrophes, was found to be the evolution of gas, resulting in cathode poisoning. The cause of this was traced to frictional movement between the mica insulators and the valve envelope and components, and the elimination of this has been the most important contribution to valve longevity under conditions of vibration and shock.

The techniques used to overcome such troubles, and the results obtained, have already been described in Wireless World.† Work done on these mechanical improvements has also shown some very gratifying results with respect to the electrical characteristics. Not only has it been possible to produce redesigns which are electrically interchangeable with the existing types, but added advantages have been obtained in that there is a significant reduction in characteristic spread, a lower drift of characteristics in early life, reduced electrical noise and improved microphony performance. Fig. 2 shows a typical improvement in mutual conduction spread and Fig. 3 relates to the low frequency noise distribution.

In addition, it has been established that many of the theories held regarding valve instability are second-order effects compared with the advantages resulting from mechanically strengthening the valve structure. As an example, it has been possible to produce double triodes for d.c. amplifier work and Fig. 4 shows the improvement achieved on the type 6L58.

The successful elimination of early life catastrophic

* Brintam Engineering Division, Standard Telephones & Cables. This article makes use of some of the information and diagrams in a paper “Thermionic Valves of Improved Quality for Government and Industrial Purposes,” to be published in Proc. I.E.E.
Progress Report

Failures under vibration is shown in Fig. 5, which compares the 8D3 with the 6064 and also demonstrates the improvement which can be achieved by selective testing of ordinary commercial valves.

With normal static life testing we have used a method popular in the U.S.A. and based on a 500-hour life test. At the end of the run the average life of the group of valves is assessed by using the formula:

\[
\text{Average life percentage} = \frac{\text{Sum of life hours for all valves under test}}{x \text{ hours and number of valves started}} \times 100
\]

American specifications for the minimum acceptable life performance give a figure of 80 per cent for normal commercial valves and 95 per cent for the reliable types, while R.C.A. quote 97 per cent for their Red Series. Our figures on three of our “Trustworthy” types are 99.82 per cent, 99 per cent and 100 per cent respectively.

Having said something about the design of reliable valves, let us now look at the manufacturing problems.

An average valve has seven glass-to-metal seals and 35 welds, with over 800 separate and distinct manufacturing steps to convert the raw material into the finished product. The production engineer has the task of manufacturing mass-production quantities of such complex articles with the minimum variation of mechanical, chemical and human tolerances. The problems of reliability resolve themselves into greater efforts to control the materials, the processes and the operators' variability.

There are two schools of thought regarding the place in which special quality valves should be made. One advises an entirely separate location from the ordinary types, but much can be said in favour of their manufacture in the centre of the main assembly groups, so that with strong supervisory control the effect of the lessons learned will have a large psychological effect on the whole factory. This point is doubly important when it is realized that in the event of another war very large numbers of special quality valves will be demanded.

To obtain the high quality demanded it is necessary to have continuity of production over long periods and the corollary to this is that the diversity of valve types shall be limited as much as possible.

Mass-Production Outlook

Initially the assembly of “Trustworthy” valves was done on a time-work basis with no incentive towards speed. However, it was found that this was so alien to the mass-production outlook in valve manufacturing that a change was made to operate teams controlled by a quality control system working on each assembly position. It has now been possible to introduce an incentive scheme based on quality and quantity, and a study of the results has demonstrated that when an operator is given a simple sequence of jig-aided operations the work begins to flow at her natural rate with maximum efficiency.

The achievement of failure rates as low as 2 per cent per 1,000 hours is not dependent solely upon structural design and the control of the manufacturing unit. Good design and manufacturing controls combine to ensure that the manufacturing variations will be small and that there will be a few random faults or errors, but they cannot guarantee their complete elimination. It is imperative, therefore, that a form of valve testing shall be adopted which takes into account both “manufacturing variations” and “manufacturing errors.” The development of suitable testing procedures is very important, as it is easy to evolve a series of unwieldy tests which can make large-scale production impracticable.

So much for the problems involved in making reliable valves—but the matter does not end there. The contribution required from those who use valves is a very large and vital one. It is the very versatility of the valve which gives so much scope to the circuit designer's ingenuity. It may not be appreciated that the rate of failures of specific valves in different equipments can vary by a factor of 10. This can best be minimized by cooperative effort between the designers and the valve
Publication of a Code of Practice, CP.1005, on the correct usage of valves, should be learnt by heart by all designers, and is every bit as important in our sphere as the new Highway Code is intended to be to the road user.

It is obvious that electronic equipment in the future is likely to become more and more complex, and it is important that steps are taken to see that circuit complexity and unreliability do not become synonymous. The equipment designer must create and engineer his apparatus so that it becomes just a "black box" as far as the user is concerned. As an example, the telephone is a simple device to the user, yet we are all aware of the complexity of automatic telephone equipment. It is therefore increasingly important that equipment is designed conjointly with all component manufacturers and with adequate thought given to problems that will confront the user.

Now, what about the valve outlook—present, past and future?

Valves for the immediate future are taken care of by an adequate number of reliable miniature types. The past can best be dealt with by applying the testing techniques established for reliable valves to the domestic manufacture of the older types of valves, thereby eliminating the early life catastrophic failures due to unsatisfactory workmanship.

Further improvements in valve reliability must be at the expense of the present type of valveholder. Incompatibility between this and the valve pin positioning can cause failures in excess of the target achieved by the valves alone, and it is logical to adopt wired-in techniques which, in addition to reducing failures, can permit greater exploitation of the valve characteristics. There is a great need for bright circuit engineers to cast aside the chains of present circuit-technique thinking. They should regard these wired-in valves as new tools to be used on their own merits and in circuitry designed to use them to their full capabilities, so that the whole ratio of ironmongery to electronic circuitry is drastically changed. Some typical wired-in types are illustrated in Fig. 6.

As valve makers we dislike intensely the suggestion of unreliability which is cast at the electronics industry. One rarely hears such comments in the civil and mechanical engineering fields, but we are confident that we are on the brink of an era when electronics will have grown up and will have no more of this slur.

**NEWS FROM THE CLUBS**

**Kingston-on-Thames.**—The Osram 912 amplifier and G.E.C. metal-capse loudspeaker will be demonstrated at the meeting of the Kingston and District Amateur Radio Society at 7.45 on January 13th at Penryn House, Penryn Road, Kingston-on-Thames. Sec.: R. S. Babbs, 28, Grove Lane, Kingston-on-Thames, Surrey.

**Cleckheaton.**—The meeting of the Spen Valley and District Radio and Television Society on January 12th at 7.30 in the Temperance Hall, Cleckheaton, will be devoted to films. On the 25th members will meet the Bradford Radio Society in a quiz at Cambridge House, Bradford, Yorks. Sec.: N. Pride, 100, Raike Lane, Birstall, Nr. Leeds, Yorks.

**Coventry.**—At the meeting of the Coventry Amateur Radio Society at 7.30 on January 3rd at 9, Queens Road, Coventry, T. R. Theakston will speak on "Mathematics." Sec.: K. G. Lines, G3FOH, 142, Shorncliffe Road, Coventry, Warwicks.

*Wireless World, January 1955*
“Inexpensive 10-Watt Amplifier”

In his criticism in your November issue of the Baxandall type of amplifier your correspondent John Brighton underrates the benefits of negative feedback when applied to tetrodes and pentodes working into loudspeaker loads.

An increase in load impedance, such as occurs at high and low frequencies, will cause the “violent increase in third-harmonic distortion” mentioned only if the signal voltage is maintained constant, and occurs on account of the increased anode-voltage swing. When negative feedback is applied, even in small amount, the grid-voltage swing is automatically adjusted to maintain the output voltage reasonably constant against load variations, and the condition which would cause the sudden increase in third-harmonic distortion is prevented from arising. It is a fallacy to say that negative feedback can only reduce distortion to the same extent as the gain; where the feedback prevents an overload, as in this case, the reduction can be much greater for the cause of the distortion is, in fact, removed.

Apart from this consideration, of course, the quoted typical figure of 40 db for feedback would apply only for the correct load condition. An increase in load also causes a corresponding increase in loop gain, and on this account alone the picture would be brighter than that painted by Mr. Brighton.

Chislehurst, Kent.

D. J. R. MARTIN.

YOUR correspondent, John Brighton, in your November issue, raises again the hypothetical objection to the use of tetrodes in the output stage of a “quality” amplifier, but what, might we ask, does this alleged “violent” increase in third harmonic distortion really amount to in practice? Precious little!

The real reason why the Baxandall amplifier has not become popular is more likely to be owing to the fact that it requires 4 volts r.m.s. to give full output, which in many cases is inconveniently insensitive. A big point in its favour, however, distortion is prevented from arising. It is a fallacy to say that negative feedback can only reduce distortion to the same extent as the gain; where the feedback prevents an overload, as in this case, the reduction can be much greater for the cause of the distortion is, in fact, removed.

Despite protestations to the contrary, I do not think that this is quite so true of the Williamson. Constructors would be very well advised always to check performances with square waves as Baxandall suggests, and prepare themselves for some shocks.

Enfield, Middx.

J. K. WEBB.

JOHN BRIGHTON, in his letter published in the November issue, suggests that tetrodes are less desirable than triodes for use in the output stage of a high-quality loudspeaker amplifier employing negative feedback, because of increased third-harmonic distortion when the load impedance becomes reactive and/or higher in value than the nominally correct value.

The following experimental results have been obtained recently, on an amplifier which is the same as that described in my article in Wireless World, January, 1948, except for the use of a smaller and cheaper output transformer with a silicon-steel core.

With a 15-ohm load resistor connected to the output, a 500-c/s sine-wave input, of negligible third-harmonic content, was adjusted to give a mean power output of 10 watts; i.e., an output voltage of 12.2 volts r.m.s. With the input voltage kept constant, the value of the load resistor was then varied, and the effect on the third-harmonic distortion was as shown in the table.

An air-cored inductor, having a reactance of approximately 15 ohms at 500 c/s, was then connected across the amplifier output, and it was found that the third-harmonic distortion, at a level of 12.2 volts, was considerably less than with a 15-ohm resistive load. Reduced distortion was also obtained with a 16–F capacitance load.

The above results thus show that, with this amplifier, the distortion is not critically dependent on either the value or the phase angle of the load, and that an increase in load impedance actually causes a reduction in distortion.

What, then, is wrong with Mr. Brighton’s argument?

In the absence of feedback, it is perfectly true that an increase in the load impedance of a tetrode amplifier, with constant signal input, causes an increase in third-harmonic distortion. It should be noted, however, that there is also an increase in output voltage and an increase in gain.

When a large amount of voltage negative feedback is applied to a tetrode amplifier, on the other hand, an increase in load impedance causes almost no increase in output voltage, the feedback automatically reducing the signal applied to the grids of the output valves by the appropriate amount. Since this reduction in grid swing is accompanied by an increase in the forward gain of the feedback loop, i.e., more decibels of feedback are brought into play, it is hardly surprising that the third-harmonic distortion falls off as the load impedance is increased.

It would thus appear that Mr. Brighton has overlooked the beneficial effects of reduced grid swing and increased loop gain which automatically occur when there is a rise in the load impedance of a feedback amplifier using tetrodes.

Malvern.

P. J. BAXANDALL.

“Quality on V.H.F.”

I AM surprised and disappointed to learn from H. Bishop’s rejoinder (December issue) to your editorial that it is not the B.B.C.’s intention at least to transmit as many programmes as possible that justify high quality, with a full 15-kc/s frequency response. The B.B.C. apparently intends to use ordinary Post-Office music circuits for all its transmissions. These, I believe, are equalized only up to 8,500 c/s, and hence constitute a poor feeder for quality transmitters.

Mr. Bishop states that the better quality is brought about by the improved signal/noise ratio. I take it that the P.O. music circuits are better than the f.m. transmitters in this respect. However, surely the main advantage to be gained from a better signal/noise ratio is the wider dynamic range attainable. Even this, I suppose, will not be realized, as the programmes will be common to both f.m. and medium-wave transmitters, and the manual compression necessary for the latter is done at the studios. It is also unfortunate that this compression is more noticeable on f.m. as the now discernible concert hall atmosphere and microphone hiss rise and fall. The outlook certainly looks black for music lovers and quality enthusiasts, of which there must now be a great

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Wireless World, January 1955
LETTERS TO THE EDITOR

and quickly increasing number in the country—witness the expanding sales of "hi-fi" equipment and L.P.s; also the popularity of Mr. Briggs' lectures.

Surely a circuit equalized up to 15 kc/s could be provided from the local studios to the transmitters at a cost small compared to the cost of the transmitters themselves. A 15-kec/s line could also be provided to much-used concert halls—a small "hi-fi" network. After all, it is done for television, and up to 3 Mc/s, too, probably at a far greater cost than for 15 kc/s circuits.

Let us hope that, in years to come, a high-quality national network will enable, for example, Londoners to hear an Usher Hall concert with 15-kec/s bandwidth. However, why not start now with a few local circuits—why spoil the ship for a ha'porth of tar?

A. F. HARRISON.

Television Quality

I WOULD like to draw attention to the picture degradation that is evident in the regular B.B.C. television news and newsreel.

Bearing in mind the high standard of reproduction set by the previous newsreel, I feel that there can be little justification for the noticeably low picture quality, the snowstorm effect of innumerable scratches, spots and lines brought about by imperfect camera and development processes, and the unnecessarily large and often thrice-repeated cueing marks which could be easily replaced by other less obtrusive methods of cueing.

Perhaps quality is partly determined by the small gauge film techniques involved in producing a daily news film service and partly by the transcription equipment. It might be argued that no better equipment is available at present, but as far as the film is concerned there can be no excuse.

Instead of carrying on with the present feature, the B.B.C. might well consider reverting to the style and quality of the earlier newsreel until such time as they are in the position to operate with equipment and film processing techniques free from avoidable degradations.


G. T. CLACK.

"Some Electrical Theorems"

THE publication of this article by W. Tusting in the November issue of Wireless World recalls to mind a communication by Professor Williams* on a diagrammatic expression of the star-delta transformation.

It may be of interest that this expression can be simplified a little further if a change is made in labelling the impedances of a delta for which an equivalent star is required. The diagrammatic expression is then as shown in the accompanying diagrams.

The labelling of the delta will be recognized as corre-

* E. Williams; "Star Delta Theorem", Wireless Engineer, August, 1951, p. 258.

Mathematics

DO you not think, Sir, that the general tone of some of your articles tends to increase the non-mathematical reader's fear of mathematics? I have noticed repeatedly that "the mathematician" is regarded as some strange creature with a curious twist of mind quite beyond normal comprehension. For example, "Cathode Ray" spoke of the filter expert who disposed of the non-expert with a cash, as though it were something dreadfully obtuse and difficult, whereas in fact the use of mathematics renders the subject easier, not harder, if one takes the trouble to learn it. And if it is only a matter of using trouble; one does not need to be in any way extraordinary.

I see that Thomas Roddam has heard murmurings in the undergrowth about his use of maths. (This is hardly surprising, since a non-mathematical reader doesn't know what a polynomial is anyway, and isn't encouraged when he notes that it is a Tchebycheff variety!) Surely this is all the more reason for trying to debunk the supposed difficulty of maths, not to encourage such an attitude. It is with great pleasure, therefore, that one notes W. Tusting's attempt (November issue) to popularize the use of the better-known circuit theorems. But have they got "high sounding" names? Or is it just imaginary difficulty with the theorems themselves which makes the titles seem a supercilious affectation on the part of "the mathematicians"? I fear it is the latter.

Harefield, Middx.

F. V. BALE.

"Neon Timers"

IN your December issue B. T. Gilling advocates the use for photographic work of a timer which gives a constant interval irrespective of fluctuations in mains voltage. Surely this is not worth any bother and, in fact, the timer is better without it.

The visual light output of a normal filament main lamp is proportional to approximately the fourth power of the mains voltage. The effect on normal blue-sensitive bromide paper presumably varies with an even higher power. An ideal photographic timer would, therefore, reduce the interval by, say, 6 per cent for each 1 per cent increase in mains voltage. To do this it would be necessary to have the capacitor charging voltage only a few per cent higher than the neon striking voltage. This is probably impracticable, as the interval would also vary rapidly with small changes in component values, etc., but at least it is clear that for photographic work a stabilized h.t. supply actually makes the overall performance worse as well as making the unit more expensive. For black-and-white work a normal timer is sufficient and for colour work the enlarger bulb must be run from a constant voltage source; the same can be used for the timer.

Bristol, 6.

N. J. WADSWORTH.

WIRELESS WORLD, JANUARY 1955
R.S.G.B. Exhibition

Amateur and Commercial Equipment at the Eighth Annual Show

SINGLE-SIDEBAND techniques were again very much in evidence at the recent show organized by the Radio Society of Great Britain, and their bandwidth-saving properties came in for special mention by Harry Faulkner, C.M.G., who opened the exhibition. Mr. Faulkner, as a former Deputy Engineer-in-Chief of the Post Office, once had a great deal to do with international frequency allocations and he said that anything concerned with saving space in the ether came very close to his heart.

Two main methods of achieving single-sideband telephony transmission were actually represented. In one, known as the "filter" system, the audio signal is first modulated on to a low-frequency r.f. voltage and the unwanted sidebands resulting from the process are removed by a filter. The "carrier" is suppressed by the use of a balanced modulator. The remaining sidebands are then mixed with a high-frequency r.f. oscillation to produce the desired output frequency. In the other method, which seems to be more generally popular, the audio signal is first of all split into two components with a phase difference of 90° between them. An r.f. oscillation is similarly divided into two components and these are modulated respectively by the two a.f. signals and finally combined. The carrier again is suppressed by the use of balanced modulators, while the phases of the resulting sidebands are such that in the combined output one sideband is balanced out and the other is augmented. This method requires fewer stages but is perhaps more difficult to adjust.

One of the practical difficulties of the last-mentioned "phasing" method is in obtaining two a.f. outputs displaced 90° in phase, but one exhibitor was showing some small units designed for this purpose which are manufactured (on an amateur basis) and made available to other amateurs who feel unable to cope with the problem themselves.

Another branch of amateur work praised by Mr. Faulkner was the active experimentation which has been going on for some time in the 70-cm band. He said that as the professional radio people seemed rather reluctant to move into Band IV the amateurs would now be able to lead the way once again, as they did in the old days. There was, in fact, a good
deal of 70-cm transmitting and receiving equipment on show with some very fine examples of workmanship in “plumbing” and tuned-line techniques.

Mr. Faulkner was, however, referring more particularly to the amateur television transmissions in the 70-cm band. These were represented at the exhibition by a complete amateur television station with two cameras and a transmitter working on 436 Mc/s. The r.f. output (20 watts peak white) was being absorbed in a dummy load, and from this a probe supplied an input to a 70-cm converter, which represented the receiving side. The 45-Mc/s output from the converter was then “piped” to various standard television receivers distributed about the hall. Apart from the cameras, the video side of the transmitting equipment included the usual sync-pulse and waveform generators, a 3-camera mixer unit, a monoscope unit and c.r.t. monitors for checking the video waveform and the outgoing picture. The transmission standards were 202½ lines non-interlaced.

Transistor transmitters are apparently becoming quite popular. The transistors at present available, however, are somewhat limited in their operating frequencies, and most of the transmitters on show were for working on either 1.8 Mc/s or 3.5 Mc/s. In one notable exception, however, the designer had succeeded in making the transistor oscillate at 7 Mc/s. The tiny transmitter (shown on the Brimar stand) was crystal controlled and it used a new point transistor made by Brimar, Type TP2, which officially has a maximum operating frequency of 2 Mc/s. Other new transistors shown by Brimar were the TP1 point type, for switching applications up to 100 kc/s, and the TJ1, TJ2 and TJ3 junction types for audio applications.

Brimar also had some interesting new miniature valves suitable for Band IV receiving circuits. The 6AM4 is an earthed-grid triode on the B9A base suitable for amplification or mixing, while the 6AF4 is a B7G triode intended for use as an oscillator. Both will operate at frequencies up to 1,000 Mc/s. Suitable circuits for these valves have already been described in Wireless World.*

Apart from the home-constructed transmitters there were two new commercial equipments on view. Both were fairly compact table models, with band switching from about 3 to 30 Mc/s. The Labgear model gave a nominal output of 150 watts while the Panda equipment was for the lower power of 35 watts. Amongst the new “prefabricated” transmitting units shown by the Minimitter Company was an aerial matching unit, which permits the separate tuning of open-wire feeders, and a 33 ft steel mast which is hinged in the middle to allow adjustments to be made to the aerial on top.

A comprehensive range of cabinets shown by Philpott’s Metalworks included a portable instrument case for amateurs who like to give their home-constructed test gear a finished and professional appearance. The one on view, with a black crackle finish, measured approximately $8 \times 6 \times 4\frac{1}{2}$ in, but other sizes can be supplied. Miniature racks, complete with chassis and panels, were also displayed.

Magnetic Devices were showing a useful new relay which is almost identical in operation with the Post Office Type 3,000 relay but is somewhat smaller. The dimensions (above chassis) are $2\frac{1}{2}$ in high x lin wide x $1\frac{1}{2}$ in deep. A dust-proof can is provided. When fitted with a 10-kO coil the pull-in current is approximately 4 milliamps. An associated firm, Cathodeon Crystals, featured their quartz crystal units, which can now be supplied to order in as short a time as one week.


FIRMS SHOWING

Amos (Electronics), 45-49, High Street, Bletchley, Bucks.


Cosmocord, 700, Great Cambridge Road, Enfield, Middlesex.

English Electric Valve Co., Waterhouse Lane, Chelmsford, Essex.


Grundig (Great Britain), Kidbrooke Park Road, London, S.E.3.

Labgear (Cambridge), Willow Place, Cambridge.

Magnetic Devices, Exning Road, Newmarket, Cambs.


Panda Radio Company, 58, School Lane, Rochdale, Lancs.

Philpott’s Metalworks, Chapman Road, Loughborough.

Pye Telecommunications, Ditton Works, Newmarket Road, Cambridge.

Standard Telephones & Cables (Brimar), Footscray, Sidcup, Kent.

Taylor Electrical Instruments, Montrose Avenue, Slough, Bucks.
ELECTRONIC POSITIONING

Digital Methods for Automatic Control of Machine Tools

The idea of controlling machine tools by electronic mechanisms may not seem very startling to the average radio or electronics man, but it is creating quite a stir in the engineering world. Various systems are being tried out, some more advanced than others, but they all have the same ultimate end in view: to replace the human operator, working his lathe or drill or milling machine, by an electronic apparatus controlled by a continuous input of information from some kind of storage medium, such as a punched card or magnetic tape.

The scheme is really intended for manufacturing relatively small quantities of precision machined parts where the use of normal mass-production techniques would be somewhat inefficient. Exponents of the idea say that it will be more accurate than using human operators (because electronic mechanisms don't get tired) and that the machine tools will be used more efficiently: the machining operation is carried straight through at maximum speed and the control apparatus does not have to stop periodically to scratch its head, so to speak.

A fairly advanced system is shown schematically in Fig. 1. This has been devised by Ferranti's (at Edinburgh) for the automatic control of a milling machine, the work-table under the cutting tool being moved in accordance with information fed in from a magnetic tape. The whole system is based on the principle of specifying the contours of the part to be machined by a series of points, each having x and y co-ordinates from a given reference point. The x and y values are then used to move the work-table in two directions. This does not mean, however, that a human "programmer" has laboriously to put all this information on to the magnetic tape point by point. A digital computer is brought into play here, for most contours can be represented by mathematical expressions and it is only necessary to instruct the computer to calculate a straight line or a semi-circle or a parabola, as the case may be. Thus all that the human "programmer" has to do is to feed in information about the points of change on the contours (for example, where a straight line starts to bend round into a circle) and then the computer does the rest.

The real heart of the system, however (and the real subject of this article), is the mechanism by which the work-table is continuously positioned under the cutting tool. For precision machined parts this positioning has to be done to an accuracy of one ten-thousandth of an inch. The straightforward method of simply turning a calibrated lead-screw is therefore not good enough. With backlash in the work-table mechanism, one could never be sure that the work was actually being moved in accordance with the control information going into the lead-screw. The ideal method would be to measure the work itself as it was being cut and control the work-table movements accordingly. This, however, is somewhat difficult to do. In practice the best solution is to measure the movements of the work-table and use this information for controlling the positioning process.

The feedback type of mechanism by which this is achieved can be seen at the right-hand side of Fig. 1. The control system actually works on a digital, or step-by-step, principle because this enables it to be made as accurate as desired, according to the number of digits used. Thus a measurement or movement of 2.3075 inches can be represented more accurately in digits of one ten-thousandth of an inch than in digits of one thousandth of an inch, which would give either 2.307 or 2.308. Actually digits of one ten-thousandth of an inch are used. The actuating mechanism receives a train
of "command" pulses from the magnetic tape, each representing one digit. These cause the work-table to move and as a result the displacement measuring device produces a train of similar pulses representing ten-thousandths, which are fed back to the actuating mechanism. On the receipt of each "command" pulse the work-table moves in the required direction until a feedback pulse cancels the "command" pulse, when the movement stops. Thus the work-table can only move through the measured ten-thousandth of an inch and no further movement is possible until another "command" pulse arrives.

A similar digital servo system is used by Ferranti for positioning the work-table of a drilling machine (shown in the title picture). Here, however, there is no automatic control from magnetic tape. A human operator sets up the x and y co-ordinates of the hole to be drilled on a series of control knobs, then the machine proceeds to move the work-table until the required point is directly under the drilling bit. The work-table is driven by electric motors and, as before, its movement in each direction is measured by a device which produces a train of pulses, each pulse representing a displacement of one ten-thousandth of an inch. These pulses are counted by a decade counter until they have cancelled the number (in ten-thousandths) already set up on the control knobs by the operator. The "error signal" is then reduced to zero and the driving motors stop. There are five control knobs for setting up each dimension (x and y), the first for inches, the second for tenths, the third for hundredths and so on. Thus, if the operator sets the x dimension to, say, 5.7394 inches, this is the same as 57,394 ten-thousandths, and the decade counter has to count that number of digits before the cancellation occurs and the motor stops.

The electronic circuit which counts the pulses and finally cancels the original number makes use of the well-known Dekatron tube. For each dimension, x or y, there are five of these tubes in cascade, one for each decimal place of the number. The required number is set up on the five tubes by applying a negative voltage to a particular cathode on each one (this is done by the control knobs) so that the glow is initiated at this point. The arrival of pulses from the displacement measuring device then causes the glow to move, not in the normal clockwise forward direction, but backwards towards zero. In other words the incoming pulses are subtracted from the original number set up by the operator. This subtractive operation can be achieved quite simply because of the reversible properties of the Dekatron. It is only necessary to reverse the connections to the guide electrodes to cause the glow to be transferred in an anti-clockwise direction. Thus, when the incoming pulses have finally brought the original number down to zero the glow in the last tube transfers to the "zero" cathode and this produces an output signal which stops the work-table driving motor.

One of the most difficult problems from the practical engineering point of view is in producing a displacement measuring device capable of detecting a movement as small as a ten-thousandth of an inch. The two Ferranti machines use an optical system based on the interference pattern produced by two finely ruled gratings. Fig. 2 shows the general principle. A length of grating is fixed to the moving part of the work-table while another short length is fixed to the stationary part. The long grating therefore slides across the short one with the two surfaces almost in contact, and the pair are suitably aligned to produce an interference effect. A parallel beam of light is projected through the arrangement and when there is relative movement the interference effect modulates the intensity of the beam. One complete cycle of variation in intensity occurs for a movement equal to the pitch of the gratings, and from this it is possible to obtain two discrete electrical pulses per grating line. The gratings are ruled with 5,000 lines to the inch*, so that one pulse is produced for every ten-thousandth of an inch. By arranging two photocells as shown, so that the phase of the light variation is different in each, a two-phase electrical system is formed, and the phase rotation of this reveals in which direction the work-table is moving.

A rather different system of measuring displacement in digital form has been developed by Mullard. Measurements are made by referring to a standard marked off at intervals of a tenth of an inch with high accuracy. Such a standard can be produced in a tool-room by skilled craftsmen. An optical interpolation system is used for intermediate measurements, and the

interpolating scale is easy to make photographically.

The standard takes the form of a long rod cut with a screw thread of sawtooth form, the pitch being one-tenth of an inch. Part of the rod is cut away to reveal a cross-section of the thread as shown in Fig. 3. The vertical edges are then individually ground and lapped to form scale graduations 0.1in apart with an absolute positional accuracy of 0.00005in. The rod is fixed to the moving part of the machine and is made of hardened steel with the same coefficient of expansion as that of the machine.

The principle of the optical interpolation is shown in Fig. 3. An interpolating scale four inches long has 1,000 equidistant vertical opaque bars 0.002in wide, alternating with transparent bars of equal width. A lens forms an image of this grid across the teeth of the screw-thread, and a reduction factor of 40 is used to make the image fit exactly between two teeth.

Fig. 4 shows a typical relative position of the two scales. The optical image is fixed in space while the screw-thread scale is moving past it to the right. Regarding the left-hand edge of the image as a fixed reference point, the total displacement of the first edge of the screw-thread scale (marked *n*) is two tenths of an inch plus the fraction of a tenth *x*. The number of interpolation bars in *x* is the number of ten-thousandths of an inch in the fraction. To count these ten-thousandths electronically, the transparent bars in the scale are illuminated one by one by a line of light which moves behind it (Fig. 3). A photocell placed close behind the screw-thread scale then receives a succession of light pulses. As the sloping edge of the sawtooth is encountered by the moving light the pulses are reduced in amplitude until they finally disappear. Their sudden reappearance at the 0.2-in edge is the signal for them to be counted. This proceeds until the light reaches the left-hand end of the scale, when the total count is the fraction *x* of 1,000.

The scale is scanned repetitively by the line of light and the fraction *x* is determined afresh at each scan. In this way the system provides an output at regular intervals stating the position of the moving part of the machine. At the end of a scan the position is compared by means of a reversible counter with that set up initially by a human operator on six 10-position dials. The difference is then held and displayed on a meter until the end of the next scan, when a fresh value of the difference is available. The relative position is given within a definite limit, one ten-thousandth of an inch, since only whole numbers of interpolation scale bars are counted. However, the distance in which the count changes by one unit is less than 0.0001in, and the moving part of the machine can be set to these discrete positions with an even greater accuracy.

The reversible counter actually subtracts the measured dimension from the pre-determined dimension, and the difference displayed on the meter indicates whether the measured dimension is too long or too short and gives a rough indication of the magnitude of the error.

Both this Mullard machine and the Ferranti drill require a human operator to set up the controls in the first place—though, of course, no special skill is needed for such an operation. This could, however, be avoided by using a punched card system to supply the input information. The Ferranti drill would then be fully automatic and the Mullard machine could be made so by using the error signal (normally fed to the meter) to control motors which would drive the moving part of the machine until the error was reduced to zero.

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**THE DUST PROBLEM**

A New Device for Cleaning Gramophone Records

By CECIL E. WATTS

GRAMOPHONE records when examined under a microscope all have one thing in common; dust can be observed in nearly every inch of groove. As the reproducing stylus must surmount most of these particles small enough to rest in the angle of the groove, it is certain the groove loses control of the stylus many times a second, with a corresponding loss in accurate tracing. It may be reasoned that microscopic dust is mainly airborne and is light enough to be pushed aside. This is no doubt true of the larger masses; the smaller particles, such as those shown in the groove in Fig. 1, must obviously be trapped by the contour of the stylus. This fact, plus the increased surface noise, extra wear and tear of stylus and groove wall, clogging of stylus tip, etc., provide sufficient reason for more than casual attention to the dust problem, which becomes increasingly important as the quality of the reproducing system is improved.

The use of a brush or other pad, with or without cleaning fluids, has been the recommended treatment to date. If this operation is performed in bright sunlight a close examination usually shows the groove to be anything but clean, and certainly by the time the record is played it is again well charged.

Elementary logic points to the "instant of playing"

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Fig. 1. Photomicrograph of record grooves before cleaning.
as being the ideal moment to clean the record; in practice with an interval of a fraction of one revolution of the turntable between cleaning and playing. No doubt the various types of brush attachable to the pickup arm which have been designed in the past have been produced with this object in mind. Any such fitment applied to the modern ultra-lightweight pickup is, unfortunately, more than likely to affect its performance.

A separate arm seems essential to carry such a cleaning device, and these thoughts have been embodied in the "Dust Bug," a device which has in fact a lightweight plastic arm terminating in a small brush of nylon bristles, each of which is pointed so that the bottom of the groove may be thoroughly explored. The bristles also serve to track the arm across the record. A cylindrical plush pad (the "bug") is situated immediately behind the brush and collects the loosened particles.

The device is placed at the commencement of a record just before the pickup is lowered and cleans the record as it is played. A wipe with the dispenser cork of the cleaning fluid bottle cleans and charges the pad with the minute amount of fluid required to dissipate any electrostatic charge induced by the friction of the reproducing stylus or by previous polishing.

Most record cleaning fluids seem to serve equally well, the one favoured being a moderate concentration of ethylene glycol in distilled water, this being a trusted favourite for use in direct disc recording. One advantage of this form of cleaning is that the quantity of any anti-static or cleaning fluid is so minute that it is extremely unlikely that any trace remains in the groove even after prolonged use. This is well illustrated in Fig. 2 which depicts the last few seconds of "Petrouchka" (Decca LXT 2502) where the final "high C" on the trumpet disappears into the tape and other background noise.

Fig. 3 has been included to emphasize the necessity for using the cleaner each time a record is played.

![Automatic record cleaning accessory ("Dust Bug") with suction mounting for fixing to the motor board.](image)

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**Fig. 2.** Any residues remaining after cleaning are considerably less than the background noise modulation as seen in the four grooves on the left.

**Left: Fig. 3.** Dust particles, etc., collected by the plush pad (a) after the first use of the cleaner on a 12-inch l.p. record, (b) after a second playing immediately following the first, and (c) a third playing of the same record after being stored for a day in the maker's envelope.

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Wireless World, January 1955
ALL YOU NEED TO KNOW ABOUT RADIO

By "CATHODE RAY"

Technical Terms Used in the Underworld of Wireless

This particular season of the year is so full of things that there is grave danger of the necessities of life being crowded out by the luxuries. This page, for example, might receive less attention than usual, by reason of the prolonged concentration ordinarily demanded by it. As a concession to the flesh, therefore, I am this month bestowing a complete treatise on radio. It is so light that it can be assimilated even after the pudding, and yet so comprehensive that it is a good defence against the loss of dignity that is entailed by party games of the general knowledge sort. Originally presented free with the Christmas 1934 issue, it is now completely revised and enlarged.

Experience has shown that the whole of anything is equal to the sum of its parts. Know each part, and you know the whole. Samson himself might have struggled in vain to snap a bundle of firewood, but a child can take a stick at a time and break it. The reason why radio is found to be so difficult is that the student takes the whole bundle in his hand and expects to build Rome in a day. But when the loaf has been daintily sliced into separate grains of sand it soon (to put it metaphorically) makes a mighty ocean.

Each mysterious part of radio will now be clearly defined. This knowledge has hitherto been confined to a few experts; now, it is all revealed in language that everybody can understand. N.B.—You are warned that it is not considered suitable for children.

Band Pass. You don't suppose the musicians pay to get in, do you?

Band Spread. An effect closely associated with Self Capacity (q.v.).

Beat Frequency. Confidential information for avoiding a Lightning Arrester.

B.F. Source. According to Eton, Harrow. (And vice versa.)

Buffer Stage. Usually the last but one in the series. For a description, refer to W. Shakespeare (As You Like It, Act 2, Scene 7).

Cavity Resonance. A cause of unwanteed whispers, often existing at the Buffer Stage.

Condenser. High official of the B.B.C., whose duty is to fit the programmes in at all costs. His work is often in vain, and may be either fixed or moving. See also Padding Condenser.

Detector. Post Office official equipped with clever apparatus that responds to absence of licence.

Dissipation. See Featherweight Pick-up, Night Effect, Watt.

Earth. All natural wireless sets must be planted with the roots firmly underground, and well watered. A flower-pot is not recommended; it might be neglected during holidays. Portable sets are grown under a frame and need no earth.


Featherweight Pick-up. A form of Dissipation (q.v.).

Feedback. A concomitant of Instability (q.v.); also noticed just after Christmas and at other irregular seasons. The Pre-selector is particularly subject to it.

Gain Control. See OHMS Law.

Hand Capacity. A high-frequency phenomenon especially noticeable on leaving a hotel, whether equipped with wireless or not. It is believed that some form of direction-finder is used in the acceptor circuit, for screening; seldom avails to prevent one from being run to earth.

Harmonic Distortion. Well-known characteristic of music pupils and modern composers. In severe cases is known as Random Noise.

High Tension. A state which is liable to exist as a result of Key Clicks (q.v.).

Homing System. A device for cases of Instability (q.v.). In its more fully developed forms it can be used to suppress Key Clicks (q.v.).

Indoor Aerial. A device for foiling the Detector.

Insertion Loss. Money put in a fruit machine.

Instability. A variety of Night Effect (q.v.).

Key Clicks. Unwanted noises due to Instability.

Lightning Arrester. See Beat Frequency.

Microphonic Noises. Technical term for broadcast programmes.

Miller Effect. See Dust Core (if you can!).

Mutual Conductance, Tight Coupling, etc. These expressions are too romantic in character to be discussed in a prose publication. The subject is more suitable for an ode.

Night Effect. There are several varieties: one of them is usually most noticeable at the Output Stage; it is characterized by Instability, and, in severe cases, the seeing of two or more programmes at once. See also Homing System, Key Clicks, Dissipation. Another variety, which is common at a later stage, is also known as Variable-Mu. Still another (liable to be confused with the latter) is Threshold Howl (q.v.).

Noise Suppression. See Output Stage, Threshold Howl.

Non-linear Conductor. One that takes excessive stage gain.

OHMS Law. A law relating to Income Tax (or Remote Gain Control).

Output Stage. Generally coincides in time with severe outbreaks of Night Effect; usually about 10.30 p.m. Noise Suppression may have to be fitted at this stage.
Pinning Condenser. A negative condenser employed when a programme runs short.

Phase-change. Often observed at the detector or lightening arrester stage, or when a communication is received relating to OHMS Law.

Pre-selector. Scientific term for acquisitive junior member of a family. The pre-selector stage is reached at the age of about two years.

Primary Cell. One designed for first offenders.

Random Noise. See Harmonic Distortion.

Reaction. A common result of Dissipation. A pick-up may be needed.

Self Capacity. Characteristic typical of the Pre-selector.

Shunted Meter. Device for avoiding electric charge.

Skin Effect. Also known as parasitic oscillation.

Speech Choke. Would be very valuable, but is not permitted in this country, since it conflicts with the tradition of "freedom of speech."

Superhet. A very powerful type of receiver that brings in every station, and most of them twice. From the American super = very, and het = hot (e.g., "all het up").

Tape Recorder. A tailor’s assistant, who repeats everything back.

Thermal Agitation. Characteristic exhibited by a cat on hot bricks. See also Variable-Mu.

Threshold Howl. A form of interference peculiar to the weeks leading to Christmas. Is almost invariably followed by Hand Capacity.

Tracking. Operation of the Detector.

Trimmer. Another name for Condenser (q.v.).

Twin Feeder. The sort of thing one expects to see on “Inventors’ Club.”


Watt. A character who, in his youth, performed useful services in the kitchen, such as preventing kettle lids from flying off, so that his name became symbolic of energy. In later life, however, he seems to have fallen into evil ways, to judge from frequent references to Watt’s Dissipation.

Wavechange Switch. Despite the popularity of so-called continuous (or permanent) waves, this appliance meets with some application in the art of coiffure. Closely associated with step-up transformation.


By now you will, I am sure, need no further evidence that radio is a sordid and degrading occupation. Perhaps you would care to make it the subject of a New Year Resolution?

MAKING A GOOD RECORDING

Importance of Microphone Technique

ENCOURAGED by the high standard of quality which is readily obtainable from commercial gramophone records these days, many people have bought disc or tape recorders to make their own musical recordings, either for self-criticism or for the delectation of friends. After spending not inconsiderable sums on the best available equipment it is a common experience to find the first results disappointing.

In nearly every case the trouble can be traced to unsuitable acoustical surroundings or to faulty microphone technique, and can be remedied only by practice and experience. This point was emphasized by G. Elliott in a recent lecture on “The Art of Balance and Control in Recording Studios” to the British Sound Recording Association in London. Mr. Elliott, who has many outstanding recordings to his credit, including the “tugboat” effects record (Mercury Sound Recordings) said that while there was as yet no perfect microphone there were many very good ones, each with characteristic merits and shortcomings which could be deployed to make the most of any given situation.

Microphones were the tools of the recording “engineer”—microphones and his own ears, with could best be trained by listening to all and sundry sounds, first directly and then through a simple reproducing channel consisting of microphone(s), amplifier and a monitoring loudspeaker. Where possible the same loudspeaker should always be used in the same acoustical environment, and it was significant that broadcasting and recording organizations concerned with the interchange of recorded material had recently initiated moves for the standardization of monitoring conditions.

Mr. Elliott described several typical recording problems and illustrated with tape recordings the synthesis of a good recording of an orchestra from the outputs of a number of microphones, distributed among the players and in the body of the hall. It was evident that a single microphone failed to give that elusive quality of “presence,” so much esteemed by gramophiles.

An interesting point which emerged from Mr. Elliott’s talk was the increasing importance given by composers and arrangers of light music to “balance and control.” It was now becoming the practice to include in the score specific instructions for emphasis, and even the introduction of artificial reverberation over part of an individual musical phrase. The results are undoubtedly stimulating and the means by which they are obtained were, in the examples played by Mr. Elliott, completely hidden by the “art which conceals art.”

Extended-range L.F. Sine Wave Oscillator. The author asks us to correct a printer’s error in the second line of this article (page 596, December, 1954, issue); the range of 20-20,000 c/s should be regarded now as insufficient for exhaustive testing of high-fidelity amplifiers. He also points out that the 1-MH grid leak of the last valve should be returned to earth and not to cathode as shown.
TRANSISTOR D.C. AMPLIFIER

Stable Push-Pull Circuit for Low Level Operation

By G. Johnson*

A stable instrument constructed in the laboratory using a barrier-layer photocell in a photometer arrangement proved to be too insensitive for certain uses and an attempt was made to improve it by adding a d.c. amplifier between the photocell and the meter. It was desirable to make the instrument portable and independent of the mains, and the transistor appeared to offer advantages in these directions. Since the completed amplifier measures 3in x 1½in x 2in, including the power pack of two 1.5-V cells, and could be made smaller if desired, it fulfills both these requirements.

The main difficulty with d.c. transistor amplification is the extreme sensitivity to temperature variations. The collector current is approximately doubled for every 10°C rise in temperature. In this amplifier the problem was overcome by using a completely symmetrical push-pull circuit and arranging that any change in ambient temperature would equally affect both transistors.

Two Mullard OC71 p-n-p junction transistors are used in a simple earthed-emitter circuit with the 0-50µA meter connected between the collectors and the photocell with its attenuator connected between the bases. The voltage at the collectors is equalized by the load-balancing potentiometer, which acts as a set-zero control. The transistor temperatures are equalized by enclosing them in adjacent holes drilled in a small block of aluminium.

The power is derived from two Vidor V.0107 Batteries are on the back of the meter case. The control potentiometers can be seen immediately below the scale and their shafts protrude through the case on either side of the mechanical set zero.

Kalium cells which are of the same dimensions as the U7 pencil battery but are capable of providing up to 3,000 hours use at the average current drain of 200µA required in this amplifier. With this length of life it was at first thought unnecessary to include a battery switch, but this is essential for the purpose of setting the mechanical zero of the microammeter, which has been found to vary quite as much as the zero variations due to the d.c. amplifier itself.

The measured overall gain is approximately 30, giving the 7-inch meter a sensitivity of better than 0-2µA full scale. The overall noise produces a fluctuation on the needle which does not exceed plus or minus half a scale division, i.e., better than ±0.01µA. This very low figure is due to the fact that most of

Underside view of amplifier. The transistor leads can be seen emerging from holes in a Faxolin cover over the aluminium block. Controls are on the top of the case.

Right : Circuit of the transistor d.c. amplifier.

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the transistor noise is of too high a frequency for the meter needle to respond.

Following the satisfactory results obtained with this amplifier a second one was constructed, the potentiometers, amplifier, chassis, and batteries being mounted inside the case of a similar 0-500mA meter with the controls accessible underneath the edgewise scale. This has proved to be a very useful general-purpose meter, taking the place of the cumbersome mirror galvanometer and having a very much shorter time-constant. The instrument works equally well as a centre-zero galvanometer since the set-zero control can be used to bring the needle to any point on the scale for zero input to the amplifier.

INTERNATIONAL STANDARDIZATION

Summary of I.E.C. Discussions on Components

By G. DAVID REYNOLDS,* Ph.D., M.Sc., M.I.E.E.

As already recorded, the International Electrical Technical Commission held its Golden Jubilee meeting in Philadelphia in September. As in all international bodies the work of the I.E.C. is conducted by comparatively small committees representative of the countries participating. One of the sub-committees (12-3) deals exclusively with the standardization of radio and electronic components. This component committee has been working since 1950 on the international recommendations for standardizing methods of testing radio components and excellent progress has been made in spite of the fact that the full committee meets for only about eight days in each year. The radio industry and the Service establishments in this country had done a great deal of work, separately and jointly, on this subject before 1950 and this helped considerably in the rapid progress made internationally.

The meetings are not too formal and the committee works as a body of engineers with a common end in view and with a minimum of "politics." This year, at Philadelphia, thirteen nations took part and the co-operation and mutual understanding shown was even better than in past years. The British delegation to the components committee, of which I have been a member since 1950, is officially sponsored by the British Standards Institution and is paid for by the various associations in the radio industry.

In these notes a few items have been selected from the great mass of detailed discussion on every aspect of testing of capacitors and composition resistors at the Philadelphia meeting. They give some idea of the problems and difficulties met in reaching international agreement.

Capacitor and Resistor Standards

Draft standards for paper, ceramic, electrolytic and mica capacitors, for the colour coding of ceramic capacitors, and for carbon resistors, were discussed and brought near to completion. Work is now beginning on standards for high-stability composition resistors and carbon potentiometers and on the standardization of some of the principal dimensions of the components themselves.

The ceramic capacitor standard covers Type I capacitors, with moderate power factor and reasonably linear temperature coefficients. A standard series of values for the temperature coefficient has been agreed, and there are tolerances ranging from ±15 parts per million per degree centigrade for special purposes, to ±1,000 p.p.m./°C for general use. The capacitance values follow the E-series of preferred numbers (BS 2488), which is already used for carbon resistors.

The colour coding of ceramic capacitors has presented a very serious problem. There are at present several codes in existence with slight variations between them, and attempts to arrive at a standard code have proved very difficult. The code must cover temperature coefficient (one band or, sometimes, two), value (three bands using resistor code, with values in pF), and tolerance (one band). The principal difficulty is that there are only ten colours normally used while there are more than ten temperature coefficient groups, with their various tolerances, to put into the code. The latest I.E.C. proposal is for a five-band code except for the +100±30 p.p.m./°C, and the -3300±2500 p.p.m./°C coefficients which will need six bands. The code also covers two qualities of high-dielectric constant material (Type II).

The preparation of a series of standard values for electrolytic capacitors has also proved extremely difficult. In most European countries the "powers of two" series—2, 4, 8, 16, 32, 64—is used up to 64×10⁻⁶ F, but for higher values and for low voltages round values such as 10, 20, 25, 50, 60, 100, 150, 200, 250 are quite common.

For mechanical dimensions and tolerances in general, the R10 series of numbers adopted by the International Standardization Organization is widely used (BS 2045). Each term is obtained by multiplying the previous term by the tenth root of ten. The values are rounded to 1, 1.3, 1.6, 2.0, 2.5, 3.2, 4.0, 5.0, 6.3, 8.0, 10 etc. (Incidentally, the well-known resistor series is based on the twelfth root of ten.) At one stage it was suggested that the R10/3 series be used for electrolytic capacitors—i.e., every third item of the R10 series, making the values 1, 2, 4, 8, 16, 32, 130, 250, 500, 1,000—but this has not proved popular. The latest drastic proposal is 1, 2, 5, 10, 20, 50 etc., but this may not be the last word.

The agreement of standard voltages for electrolytic capacitors has proved equally difficult, and to meet the needs of all the representatives present a very long series has finally been adopted.

* Murphy Radio, Ltd.

Wireless World, January 1955

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Frame Flyback Suppression

Requirements and Circuity

By W. T. COCKING, M.I.E.E.

It is now a common practice to include frame flyback suppression circuits in television receivers. It has become common only in the last year or so, however, and many, if not most, existing sets do not contain them at all. The reason for this lies in the fact that the television signal itself is supposed to suppress any visible effect of the frame flyback. During the flyback period the signal is at or below black level and so the scanning spot is supposed to be extinguished and, therefore, invisible.

In practice, however, it is by no means rare for the flyback lines to show up on dark parts of the picture. It is often said that this occurs because the d.c. component of the signal is not fully retained in the receiver, but this is certainly not the only cause. If one starts initially with the receiver correctly adjusted on a picture of average mean brightness, the adjustment being such that good tone gradation is secured in the dark parts as well as the light parts, there should be no trace of the frame flyback even on quite black parts of the picture. If that condition is obtained and the mean brightness of the picture becomes less, the flyback lines will show if the d.c. component is not retained fully. A readjustment of the brightness control will then restore the proper conditions.

It does frequently happen, however, that with a picture of average mean brightness it is not possible to secure a complete absence of the frame flyback lines and at the same time to obtain good rendering of tonal values in dark parts of the picture. When brightness is adjusted so that the flyback lines just become invisible on a black part of the picture it is found that there is no tone gradation in dark regions. When brightness is adjusted for the best picture quality, the flyback lines show in the dark parts.

One possible, but not very likely, cause of this is the presence of an unwanted brightening pulse on the cathode-ray tube. In the frame timebase and deflection circuits pulses exist during the flyback period; in particular, there is a positive pulse of several hundred volts amplitude on the anode of the frame output valve. If, by stray coupling, this could reach the grid of the tube with an amplitude of only a volt or so it would have an appreciable effect. At the grid of the video stage it would have much more effect because of the gain of this stage.

Such effects are not very likely, however, because the grid of the c.r. tube is normally by-passed to chassis by a large capacitance and the video stage is usually well screened.

The unwanted appearance of the flyback lines is usually brought about by the curvature of the valve and tube characteristics. In an ideal system, the brightness of any point on the screen of the c.r. tube would be proportional to the brightness of the corresponding point in the scene being televised. The transmission system as a whole would be linear.

The tube characteristic, however, is not linear. It is rather like that of a valve and there is a considerable amount of curvature towards cut-off. A typical characteristic has the form sketched in Fig. 1. If the tube is biased so that black level corresponds to point A changes of signal near black level cause only small changes of brightness, whereas the same changes of signal near white level (point B) cause much larger changes of brightness.

If the linearity of the system is perfect except for the tube characteristic, therefore, tone gradations in dark parts of the picture are less well reproduced than they are in the light parts. A considerable improvement can be secured by reducing the tube bias so that black level comes at the point C. Black and white now correspond to C and D and the difference between the slopes of the curve at these points is much less. As a result, a better tonal range in the black region is secured.

However, “black” is no longer a complete cessation of light output from the tube. It is really a dark grey, but it does appear black by contrast with the bright parts of the picture.

It might be thought that the flyback, being at black level, would not be visible even under these conditions. However, it is and the reason is because the flyback trace is superimposed on the picture. In a black region of the picture, and especially towards the bottom of the picture, the screen is still emitting some light when the spot retraces it for the flyback and re-excites the screen. In such a region of the picture the screen is excited twice per scanning cycle where the flyback crosses it but only once per cycle elsewhere. Only when black corresponds to zero light output from the tube does this effect cease to occur.

It is, therefore, inevitable that the flyback lines shall be visible as long as the flyback signal is at
black level and black level is not a true black but only a relative back. In these days of bright pictures and the use of a good deal of ambient lighting, it is not often that a true black is permissible if a soot and whitewash effect is to be avoided. It becomes desirable, therefore, to suppress the signal on the tube during flyback by applying a pulse which drives the tube beyond cut-off.

Before going on to discuss the form of circuitry employed, it may be as well to deal with an objection that may be raised to the foregoing argument about the effect of the tube characteristic. Curvature of the tube characteristic means, in other terminology, that its "gamma" is not unity; it is actually about 2.2. In the transmitter, iconoscope-type tubes have a gamma of about 0.5 and so the camera tube and the receiving tube are complementary and produce an overall gamma of about unity. With other tubes gamma correction is employed.

It should happen, therefore, that the video signal is pre-distorted at the transmitter to correct for the curvature of the characteristic of the receiving tube. It thus appears that the argument based upon this curvature is a false one.

**Video Stage**

However, a similar curvature takes place in the video stage. Even if the transmitter pre-distortion corrects precisely for the tube curvature, therefore, the argument still holds for the curvature of the video stage. In practice, too, the pre-distortion cannot be precisely right for every receiving tube.

It is interesting to notice at this point that the effect of the video stage is quite different in modern receivers employing cathode feed to the tube than it was in early ones in which the video signal was fed to the grid. The video-stage characteristic is of the form sketched in Fig. 2 and when the signal is fed to the grid of the tube the valve is biased to point A. The video signal sweeping always negative with respect to A. The output then becomes more positive as the input becomes more negative for increasing brightness. The sync pulses and the dark regions of the video signal fall on the linear part of the valve curve and it is the white parts that come on to the curved portion. The result of video-stage curvature is thus to reduce the tonal range in the white parts of the picture.

When the video signal is applied in the modern way to the cathode of the c.r. tube, however, the video signal must be of the opposite polarity. The video valve must be biased to point B in Fig. 2, so that as the input increases positively for increasing brightness, the output must change negatively to carry the tube cathode negatively. As a result, it is now the sync pulses and dark parts of the picture signal that fall upon the curved part of the characteristic and the white parts that come in the linear region.

Video-stage curvature is not, of course, a necessary thing. It can be avoided by using a big enough valve and supplying it with enough current. Also, various correction circuits are possible. All these things cost money, however, and apart from the flyback lines the curvature does not have a very large effect upon the picture quality.

**Suppression Pulse**

Because of these effects, therefore, it has become the practice to apply a suppression pulse to the c.r. tube, the pulse being derived from the frame timebase. The ideal pulse would be a rectangular one of the same duration as the actual flyback of the spot. The amplitude of pulse required is not critical; it must be sufficient to extinguish the spot during flyback but not so great that it can cause any damage to the tube.

Tube makers generally set a limit of about 200 V to the maximum negative grid cathode voltage. At least one-half of this must be allowed for the brightness control and so it is probably undesirable that the pulse should exceed 50 V in amplitude. The minimum value for suppressing the spot is probably around 5 V. There is thus a good deal of latitude in the choice of amplitude. This is just as well because the ideal rectangular pulse is usually difficult to obtain.

The pulse can be applied to the control grid of the tube if it is negative-going, or to the cathode if it is positive-going. As the signal is applied to the cathode in most sets, applying a suppression pulse to the cathode as well involves mixing the two. It is simpler to apply the pulse to the grid if a negative pulse is as easily obtained as a positive.

The usual commercial practice is to take a pulse which appears naturally in some part of the frame timebase and to apply it to the tube through a simple RC shaping circuit. The resulting waveform is very far from the ideal one but, as the requirements are not stringent, a satisfactory result is secured.

On the anode of the frame output valve there appears a waveform of the kind shown in Fig. 3(a). It comprises a negative-going saw-tooth during the scan period and a positive-going pulse during the flyback. The total amplitude is rarely less than 100 V and is usually several hundred volts. The rise of voltage at the end of the scan is very rapid indeed.
and the subsequent fall during the flyback period is relatively slow and follows a more-or-less exponential law.

A RC coupling of differentiating type will remove the saw-tooth and leave a pulse wave as shown in Fig. 3(b). Such a wave can be applied to the cathode of the c.r. tube. The time constant of the coupling is commonly around 0.2 m sec and the suppression circuit is no more than a 0.002-μF capacitor in series with a 100-kΩ resistor connected between the tube cathode and the anode of the frame output valve.

The video circuits connected to the cathode affect the performance, of course, and because of their moderate impedance the pulse is considerably attenuated. The impedance is commonly around 5 kΩ and the attenuation is therefore some 20:1. A typical circuit of this type is sketched in Fig. 4.

Another common method is to differentiate the waveform across the timebase charging capacitor and apply it to the grid of the tube. The waveform is roughly like the one of Fig. 5(a) and differentiating it changes it to the form (b) which is much the same as that of Fig. 3(b), but inverted. All that this involves in many cases is a resistor in series with the lead from the grid of the tube to the brightness control and a capacitor between the tube grid and the charging capacitor of the timebase.

### Pulse Duration

In most sets, the flyback is governed mainly, if not entirely, by the output circuit of the frame time-base. The flyback of the saw-tooth generator itself can be quicker than the flyback in the output circuit. When this is the case it is unlikely to be satisfactory to take the suppression pulse from the saw-tooth generator. The pulse will be too short and will only suppress a part of the flyback.

Generally speaking, it is safer to take the pulse from the output circuit itself, for it is then necessarily related to the flyback on the tube. However, when the usual form of feedback circuit is used in the output stage the output flyback is fed back too and reacts on the input to modify the flyback there. As a result, there is a relation between the input and output flyback times and it can be quite satisfactory to take the pulse from the input; that is, from the charging capacitor.

The shape of the pulse obtained by simple means is far from ideal. The maximum amplitude is unnecessarily large; and the quick initial return and slow end to the pulse mean that it is difficult to secure full flyback suppression at the top of the picture without darkening the picture itself at the top. In practice, it seems easier to get a satisfactory performance than one would expect on theoretical grounds.

In a test with the Wireless World Television Receiver, Model 2, a 100-kΩ resistor was inserted in series with the grid lead of the tube and the grid connected through a 0.001-μF capacitor to the "hot" end of the frame deflector coils. The output transformer is normally connected to be phase-reversing so a negative pulse is secured. The pulse amplitude is about 10 V only but is adequate for quite good suppression.

### Transmitted Suppression Pulse

In recent months, the need for flyback suppression has been reduced by a change which has been introduced in the television waveform. This change amounts to the introduction of a small flyback suppression pulse in the video signal itself as transmitted. Before the alteration, the signal level immediately before and after the line sync pulses (the front and back porches) and on the tips of the inverse frame pulses was black, corresponding to 30 per cent of peak white signal. The present level is unchanged at 30 per cent but is now blacker than black, for the true black level of the picture itself has been altered to 35 per cent of peak white.

If the picture signal itself swings through 30 V between black and white the total video amplitude used to be 30/0.7 = 43 V, of which 13 V was sync-pulse amplitude. Now it must be 30/0.65 = 46 V of which 13.8 V is the sync-pulse amplitude and 2.2 V is the amplitude of the "suppression pulse."

The change is one which is helpful in preventing the flyback lines from showing whatever may be the actual cause of their tendency to appear. The pulse amplitude, however, is hardly sufficient to ensure the absence of the lines in all circumstances and it can hardly be increased in the transmission. Its presence does not remove the desirability of suppression circuits in the receiver, therefore, but it does make their design somewhat easier.
Transatlantic Telephone Cable

BOLD PROJECT CALLING FOR UNCONVENTIONAL AMPLIFIER DESIGN

In one of the books on which our youthful enthusiasm for electrical communication was fed there appeared a confident statement that, despite the great progress made in ocean telegraph cables, a transatlantic telephone cable was (for reasons stated) forever beyond the bounds of possibility. So it was an interesting experience to be sitting in the I.E.E. lecture theatre listening to details of a transatlantic telephone cable, laying of which is to begin next summer*. And this cable is to provide not just one telephone circuit, but 36 simultaneously.

Admittedly it is not yet an accomplished fact. To the conservative engineer, brought up on generous factors of safety, it may appear bold to the point of foolhardiness to put some £12,500,000 into a scheme that includes a sub-ocean link more than 10 times longer and much deeper than any yet in use, and in which the failure of any one of 312 valves or of thousands of associated components at the bottom of the sea will cut off all 36 lines at once, with no spare in reserve.

To the ordinary radio man with emphatic views on accessibility for servicing, the idea of sinking all those amplifiers at 40-mile intervals across the bed of the Atlantic, under anything up to 2½ miles depth of water, must appear more like a nightmare than a serious engineering project. To say that it was asking for trouble would seem to be a sublune understatement. Other aspects of the matter spring to mind: how does one supply the valves with the necessary power? And how, when something goes wrong, does one locate the fault? Yet notwithstanding its rather unpractical appearance, the whole thing has been gone into and accepted by the best British and American brains, the contract between the American telephone companies and the British Post Office was signed more than a year ago, and preparations for carrying out the work are far advanced.

Why offer such hostages to fortune, instead of extending the radio telephone system that has served the transatlantic route for 27 years? The answer to that, at least, can readily be appreciated by the radio man. There are in fact two transatlantic radio telephone systems: the original long-wave circuit between transmitters at Rugby and Rocky Point, and the short-wave system providing at present 16 circuits. Not only are there no spare frequency channels left for extending the service, but interference is making things increasingly difficult on the existing channels. Unlike broadcasting, v.h.f. channels are not available to fall back on, because their range is too limited. Even the present short-wave frequencies are not entirely suitable, because they are at the mercy of ionospheric disturbances which suspend communication in an unpredictable manner, so that quite often the inadequate long-wave link is the only one effectively serviceable.

Attenuation

The difficulty about a submarine cable is its attenuation, or loss of signal power with distance. Even with an open-air wire line there are limits to the distance before signals are reduced below noise level. A cable necessarily has solid dielectric, so the loss is greater. It increases with frequency, so the longer the cable the lower the maximum frequency that can be effectively transmitted. The first transatlantic cable was limited to something of the order of 1 c/s, so obviously only telegraphy was possible, and very slow telegraphy at that. New materials and techniques, especially Permalloy for continuous inductive loading, have enabled the bandwidth to be raised, in the very latest and best examples, to about 100 c/s. This is still far short of what is needed for a single speech channel, even if compressed by the device known as the Vocoder.

Ordinary underground telephone cables have an attenuation of the order of 1 db per mile at audio frequencies. At that figure, a 20-mile run reduces the power of the signal by 99

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* Information from the lecture, "A Transatlantic Telephone Cable" by M. J. Kelly, Sir Gordon Radley, G. W. Gilman and R. J. Halsey, has provided the basis for this article.

![Fig. 1. The route of the transatlantic telephone cable.](image-url)
per cent. This is not more than can easily be made up by a simple amplifier at the receiving end. But a 200-mile line having the same rate of attenuation would reduce the signal power to one hundred-thro-tilion; a loss that could not be made good, for although an amplifier with a power gain of $10^{10}$ could no doubt be made it would be futile, since it would be overloaded with its own noise, let alone any picked up by the line. Judge, then, of the impossibility of a transatlantic distance, which would reduce the signal power in the ratio $10^{-10}$, to say nothing of the distortion caused by unequal velocity with frequency.

Long-distance telephony of any kind is only made possible by inserting amplifiers—called by telephone engineers repeaters—at intervals along the route. Thus although the loss caused by a 200-mile line is too much to make up in one go at the end, there is not the slightest difficulty in keeping it up to strength if amplification is applied every 20 miles, or even 40 miles. But where the telephone line is at the bottom of the sea for such (or greater) distances, the difficulties are only too obvious. The idea of having floating battery-driven repeater stations moored at intervals across the Atlantic was looked into and, not surprisingly, abandoned as impracticable.

Submerged Repeaters

The first submerged repeater put into telephone service anywhere in the world is one belonging to the British Post Office laid between Anglesey and the Isle of Man in 1943. There are now 31 G.P.O. repeaters underneath the seas around the British Isles, and more are being installed. But all this experience does not necessarily provide a basis for a transatlantic system, for not only are these European cables much shorter but they are laid in relatively shallow water. Nevertheless, a 300-mile cable between Scotland and Scandinavia was designed and constructed deliberately with Atlantic requirements in view, for experience, and 16 repeaters of the same type are to be used in the 340-mile section of the transatlantic system linking Newfoundland with Nova Scotia (Clarencille to Sydney Mines; see Fig. 1).

Meanwhile the Americans, who for geographical reasons are not much interested in shallow-water routes of moderate distance, had been studying the problem of a sub-Atlantic repeater ab initio, and have evolved a rather different type. In 1950, two cables (113 and 125 miles long) using five submerged repeaters of this type at depths cable 20 feet to just over a mile were laid between Key West and Havana, and they have worked ever since without failure or deterioration. Fifty-two such repeaters are to be included in each of the two cables to be laid over the 2,000-mile route between Newfoundland (Clarencville) and Scotland (Oban).

A long-distance telephone cable providing only one communication circuit would not be an economic proposition. Multi-core cables, as used for local telephone circuits, are quite out of the question for submarine cables. Instead, a simple coaxial line is used, having sufficient frequency band width to take a number of separate speech channels. Single-sideband frequency changers are used to shift the 3,000-c/s wide speech band to higher frequency channels for transmission. So the transatlantic telephone cable problem is in fact much harder than it was when envisaged a generation or so ago and declared impossible, because it is required to transmit frequencies many times higher—and therefore many times more severely attenuated—than the highest speech frequencies. Hence the need for repeaters at fairly frequent intervals.

The net working bandwidth of the cable to be used for the main transatlantic link (Oban to Clarencille) extends from 20 to 164 kc/s, divided into 36 speech channels at 4 kc/s intervals (Fig. 2). Frequencies below 20 kc/s are to be used for one telephone channel and two telegraph channels for maintenance purposes, and 167-174 kc/s for certain test frequencies to be explained later. The second cable is not a spare; it is required for communication in the reverse direction. In the shorter Clarencille to Sydney Mines section the repeaters are much larger and enable that part of the cable (which is of the same type for both sections) to be used over a frequency band more than three times greater. This leaves room for no fewer than 60 speech channels in both directions, so only one cable is needed. Some of the extra channels

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Fig. 2. Allocation of the frequency bands transmitted by the cable.

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will be used for service between Newfoundland and the rest of Canada; the remainder will be spare.

The cable itself (Fig. 3) is built around a central copper conductor slightly thicker than 10 s.w.g., overwound with copper tape. The dielectric is Polythene—a valuable British contribution to cable technique—and the outer conductor is made up of six copper tapes, overwound with copper worm-resisting tape. Over this again is Telconax for screening, and steel armouring wired sandwiched between jute servings; overall diameter 1.21in. Near the shore ends, additional armour is used for extra protection.

Repeater Construction

Experience in laying cables had shown that unless great care was taken they were liable to be damaged, especially by kinking. Two things that conducted to kinking were irregularities in the cable itself and interruptions in the laying process. For these reasons the Americans decided to design the repeaters to be used for the main crossing as nearly uniform with the rest of the cable as possible; in particular, that they should be sufficiently flexible to pass through the cable-laying gear without interruption. The repeater finally evolved takes the form of a flexible bulge in the cable, 8ft long and 2.8in diameter, tapering down to the normal cable diameter over a distance of 20ft at each end. To design and produce a repeater in such a narrow space, with protection against ingress of moisture or collapse under sea water pressure up to 3 tons per sq in, yet at the same time to be flexible; to fulfill a stringent specification of gain from 23 db at 12 kc/s to 65 db at 108 kc/s; to be fed and tested from the shore; and to maintain its performance within close limits, without access for not less than about twenty years—that was a problem indeed.

The construction is certainly unconventional (Fig. 4). The valves and components constituting the amplifier are divided into 15 separate parcels, each contained in a cylinder 5in long and about 1.1in internal diameter. These cylinders, made of a plastic material similar to Perspex, are coupled together with short springs to form a system resembling a string of sausages. They are protected against the external pressure by two layers of overlapping steel cylinders each 5in long, over which is a layer of copper and then the usual armouring wires and jute. An elaborate system of seals is provided to prevent water penetrating the joints between this repeater housing and the cable proper. The tensile strength of the cable, which must be very considerable to stand the weight of several miles of itself from ship to sea bed, plus the laying stresses, has to be maintained throughout the repeater sections. Sufficient flexibility has been achieved to enable the repeaters to bend to a 3ft radius. To minimize risk of damage to the cables it is intended to lay the whole of the deep-water part of each (about 1,500 miles) in one operation. This length of cable weighs about 5,000 tons, and the only ship capable of doing the job is the British H.M.T.S. Monarch. It is hoped that the necessary twelve consecutive days of favourable North Atlantic weather will occur next summer, and again for laying the second cable the year after.

Amplifier Circuitry

Fig. 5 shows the circuit diagram of the American repeater. It is a 3-stage amplifier using pentodes of a type that is old enough to have been on continuous test for 13 years, and in which reliability, long life, and low anode voltage took precedence over high mutual conductance. The heaters are rated at 0.25 A 20V d.c., so the three in series require 60 V, which is also the anode voltage. Initially, however, they are to be under-run as shown. The power is fed along the signal wire; consequently transformers are needed to keep it out of the amplifier circuits, and chokes to keep the signals out of the power circuits (which in Fig. 5 are drawn in heavy line). A necessity in an amplifier to cover a frequency band of more than 144 kc/s without intermodulation, and at the same time to maintain a stable gain for years without adverse feedback. It is applied through a frequency-discriminating network to give the desired gain/frequency characteristic.

Two interesting details can be seen in the diagram. One is the quartz-crystal resonator shunted across the feedback circuit. Its effect virtually is to remove feedback at its resonant frequency. Each repeater has its crystal tuned to a different frequency, in the 167-174 kc/s band already mentioned. At that frequency its gain is much greater than at other frequencies, and, moreover, is much more dependable on valve characteristics. By measuring the transmission
Fig. 5. Amplifier circuit diagram of the American-type repeater. The power circuit is distinguished by heavy line and for clarity the heaters are shown separately above the valves to which they belong.

of the cable at the 52 different frequencies in the test band to which the crystals resonate it is possible to locate any repeater that is falling below standard. Not only so but each high-gain peak at crystal resonance causes an increase in amplifier noise at that frequency, which can be detected by a sharply-tuned receiver on shore; it is, therefore, a quick and simple matter to locate any repeater that has failed. One has only to note the test frequency at which the noise peak is missing. It might be supposed that an open-circuited heater would interrupt the power feed for the whole cable, rendering this test impossible; but the second interesting detail is the gas-discharge tube shunted across the heater chain of each amplifier. The normal voltage across its electrodes is insufficient to strike it, but if any heater chain becomes open-circuited the voltage rises and the diode conducts, re-establishing continuity. Since the amplifier would then, of course, be out of action, the noise peak at its particular frequency would be missing and the fault would thereby be located.

Besides the 55-V drop across the three heaters, there is another 20-V drop in the 40 miles of cable between one repeater and the next, so the total drop for the whole cable with its 52 repeaters is nearly 4,000 V. Half of this voltage is provided by a constant-current generator between one end of the cable and sea, and the other half by another generator of oppo-

Fig. 6—Block diagram of British-type repeater for the Newfoundland to Nova Scotia section of the cable. Filters $F_1$ and $F_2$ separate the power and signal currents, and filters $F_3$ and $F_4$ separate the East to West (high frequency) signals from the West to East (low frequency). BB are balanced bridges, and A is a pair of parallel-connected amplifiers.
site polarity, at the other end. No part of the cable, therefore, is at more than 2,000 V to sea.

Because a single fault in any part of any of the repeaters would affect all the telephone circuits at once, perhaps fatally, and repair by cable ship is a lengthy, expensive and hazardous business, the most extraordinary care is taken in selection and assembly of all components. The repeaters are manufactured by specially selected workers in air-conditioned rooms and surgical type of clothing.

The circuit diagram of the amplifier in the British type of repeater used in the Nova Scotia to Newfoundland section of the system is very similar to Fig. 5, but in other respects the design of repeater is quite different. Following the techniques successfully used by the G.P.O. on a smaller scale in Europe, no attempt has been made to confine the outlines of the repeater to a slight and gradual bulge capable of passing through the normal cable-laying machinery. It takes the form of a rigid cylinder 9ft long and 10½in diameter. Since this provides about ten times the internal volume of the flexible repeater, there is room not only for both "ways" and more channels but also a duplicate amplifier to improve the reliability. Moreover the components are not subject to such cramping dimensional restrictions. Fig. 3 shows that all the East to West channels are higher in frequency than the West to East; it is, therefore, possible to separate the two lots of channels en bloc by means of high-pass and low-pass filters as in Fig. 6, so enabling one amplifier (actually two amplifiers in parallel) to be used for both lots, rather in the manner of a bridge-connected rectifier unit. Another contribution to achievement of the wide frequency band is the use of modern high-performance valves (g_m = 6 mA/V²). A cure for the apparent gradual deterioration in mutual conductance, which is caused by the formation of a resistive barrier at the cathode, has been found by the G.P.O.

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**SHORT-WAVE CONDITIONS**

Predictions for January

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**THE full-line curves given here 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 January.**

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

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WIRELESS WORLD, JANUARY 1955.
A.M./F.M. Communications

Receiver

Review of Eddystone Model 770R, Covering 19 to 165 Mc/s

Nineteen valves, of which all but two are miniature, and three germanium crystal diodes are used in the new Eddystone Model 770R wide range, v.h.f. communications receiver. The types of these valves, their circuit positions and functions will be found in the valve table. This set is believed to be the only British-made receiver now available giving continuous tuning over such a wide v.h.f. range as 19 to 165 Mc/s. There are six ranges and the extent of each, together with some of the services likely to be found in the various bands, are outlined in the frequency tables on the following page.

The 770R has an i.f. of 5.2 Mc/s and provides for the reception of a.m. and f.m. telephony and c.w. telegraphy. No marked departures from well-tried techniques are attempted, but considerable ingenuity is evident in the planning of the circuit and range-changing mechanism of the front-end, comprising the r.f., mixer and oscillator stages. This is, of course, the real heart of a receiver of this kind and its general performance depends almost entirely on the design of this part of the set. Its very satisfactory behaviour on all ranges, but especially on the 114-to-165-Mc/s one, is a tribute to the design of the front-end unit.

The r.f., mixer and oscillator stages in the 770R are a single unit, and a good idea of the general arrangement can be seen in one of the illustrations. The set employs a six-position rotary-coil turret, three ganged split-stator capacitors, valve-holders and sundry small resistors and capacitors. The main feature of interest is that virtually no r.f. wiring is used in the whole unit; the positioning of the main items, such as coil turret, tuning capacitors and valveholders, is such that their interconnecting points fall so close together that the soldering tags alone form the wiring. Moreover, little real wiring is employed inside the coil turret itself. As shown in the

Valve Table

<table>
<thead>
<tr>
<th>Circuit Position</th>
<th>Type</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>V1</td>
<td>6AK5 EF95 (CV850)</td>
<td>Pentode r.f. amplifier.</td>
</tr>
<tr>
<td>V2</td>
<td>6AK5 EF95 (CV850)</td>
<td>Mixer</td>
</tr>
<tr>
<td>V3</td>
<td>6AK5 EF95 (CV850)</td>
<td>Oscillator.</td>
</tr>
<tr>
<td>V4-V7</td>
<td>6BA6 (CV454)</td>
<td>I.F. Amplifier</td>
</tr>
<tr>
<td>V8</td>
<td>6AU6 (CV2524)</td>
<td>F.M. limiter.</td>
</tr>
<tr>
<td>V9</td>
<td>6AL4 (CV140)</td>
<td>F.M. discriminator.</td>
</tr>
<tr>
<td>V10</td>
<td>6AL4 (CV140)</td>
<td>Noise limiter and a.g.c. &quot;S&quot; meter valve on a.m.</td>
</tr>
<tr>
<td>V11</td>
<td>6AU0 (CV2524)</td>
<td>Tuning indicator on f.m.</td>
</tr>
<tr>
<td>V12</td>
<td>6BA6 (CV454)</td>
<td>Beat frequency oscillator (BFO)</td>
</tr>
<tr>
<td>V13</td>
<td>6AU6 (CV2524)</td>
<td>Noise amplifier (muting).</td>
</tr>
<tr>
<td>V14</td>
<td>12AU7 (CV491)</td>
<td>Muting stage.</td>
</tr>
<tr>
<td>V15</td>
<td>12AU7 (CV491)</td>
<td>A.F. amplifier and phase inverter.</td>
</tr>
<tr>
<td>V16-17</td>
<td>6AM5 (CV136)</td>
<td>Push-pull output stage.</td>
</tr>
<tr>
<td>V18</td>
<td>VR150 30 (CV216)</td>
<td>Voltage stabilizer.</td>
</tr>
<tr>
<td>V19</td>
<td>524G (CV1851)</td>
<td>Full-wave h.t. rectifier.</td>
</tr>
<tr>
<td>CD1</td>
<td>Germanium</td>
<td>A.M. detector.</td>
</tr>
<tr>
<td>CD2-3</td>
<td>Germanium</td>
<td>Noise detectors (muting)</td>
</tr>
</tbody>
</table>

Right: Front-end unit of Eddystone 770R showing ganged capacitors, valveholders and (in rear) coil turret.

Wireless World, January 1955
illustration of two of the turret coil assemblies, the higher-frequency coils are self-supporting and are soldered direct to the inside extensions of the external contact studs. Any trimmers included have the shortest possible leads to their respective points.

Turret Mechanism

The actuating mechanism of a coil turret for v.h.f. use is a vitally important feature of its design, as it is most essential that at all times the turret comes to rest in exactly the same position on any one range. A fractional displacement would either add to or subtract from the total inductance in the circuit and cause changes in tuning of sufficient magnitude to render the range scales, if calibrated directly in frequency as they are in the 770R, quite useless. Moreover, as facilities are provided for accurately logging the tuning positions of stations, any unreliability in the turret positioning would become immediately apparent when a previously logged station's position is sought after changing ranges. Apart from small initial variations in tuning caused by oscillator drift (which cannot be entirely avoided by voltage stabilization alone), no abrupt changes in the tuning position of a station was noticed by going from range to range and back to the original. We looked for these effects most searchingly on the highest frequency range and, finding none, conclude that the coil turret mechanism is above reproach in this respect.

The tuning system of the 770R is the same basic type as used in other Eddystone communications receivers. It provides an overall reduction of 140 to 1, embodies a flywheel to counteract frictional drag of the gears, and gives a smooth and free action. It is heavy enough to carry the pointer some distance along the scales by spinning the knob sharply. The weight is nicely chosen and does not give the impression of taking charge of the tuning, as sometimes seems to occur when the flywheel is too heavy. The pointer is a long pendant one and embraces seven 12-in long horizontal scales, six of which are calibrated linearly in frequency; the seventh is the logging scale marked 0-2,500 and having 25 divisions. Each division represents one complete revolution of a subsidiary logging dial which is visible through an aperture in the top centre of the main dial. This dial has a 360-degree scale and is engraved 0-100. In effect it expands every scale to the equivalent of 32 ft. Quite small changes in frequency can thus be observed on the logging dial.

A.M. F.M. Arrangements

Owing to the rather high i.f. used (5.2 Mc/s) four i.f. stages have been included to satisfy the requirements of high sensitivity coupled with a wide band-

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FREQUENCY TABLE

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency coverage (excluding overlaps)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>114 to 165 Mc/s</td>
<td>Aircraft, amateurs.</td>
</tr>
<tr>
<td>2</td>
<td>78 to 114 Mc/s</td>
<td>F.M. broadcast, land mobile, aero nav aids.</td>
</tr>
<tr>
<td>3</td>
<td>54 to 78 Mc/s</td>
<td>Television, aero nav aids.</td>
</tr>
<tr>
<td>4</td>
<td>39 to 54 Mc/s</td>
<td>Television, U.S. amateurs.</td>
</tr>
<tr>
<td>5</td>
<td>27 to 39 Mc/s</td>
<td>Amateurs, aero nav aids, meteorological aids.</td>
</tr>
<tr>
<td>6</td>
<td>19 to 27 Mc/s</td>
<td>Broadcast, amateur, marine.</td>
</tr>
</tbody>
</table>

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Fig. 1. Last i.f., limiter and discriminator stages of the Eddystone 770R receiver.
width for f.m. reception. For f.m. there is in addition a limiter and a Foster-Seeley discriminator. For a.m. reception there are no fewer than 10 tuned circuits and a crystal diode detector. Some interesting features (see Fig. 1) can be found in that part of the circuit, which includes the last i.f. stage V7 limiter V8 and discriminator V9. The switches S₁₆ to S₃₆ are part of a larger switching system, which might be called the “services switch,” as it changes over from a.m. to f.m., adjusts bandwidth to suit each type of service and in the “CW” position switches on a BFO. S₈ and S₀₈ are for bandwidth adjustment of the i.f. amplifier at this point, the markings on S₈ indicating the four positions of the switching system; (1) CW, (2) AM, (3) NFM and (4) FM. NFM is narrow-band f.m. and is used for certain types of transmission for which the frequency deviation need not exceed ±15 kc/s compared to the ±75 kc/s of wide-band f.m.

In the top right-hand corner of the main dial is a small aperture disclosing a tuning indicator. It serves a twofold purpose; it functions as a single-strength meter for c.w. and a.m. transmissions, registering on the carrier level, and is used as a tuning indicator for f.m. It has a red-line centre zero on which the pointer is aligned for correct tuning on f.m. and a 0-9 “S”-scale for a.m. It is sometimes said that an f.m. signal can be tuned in correctly by adjusting for minimum background noise, but this region is generally far too broad for satisfactory tuning. The meter indicator of the 770R is very sensitive to small changes in tuning and enables the desired accuracy to be achieved in a simple manner.

Details of the circuit associated with this indicator are given in Fig. 2, which includes the switch S₄₆ for changing over the indicator’s functions from tuning indicator to “S” meter as required. It forms part of the main S₁ switching system. The remainder of the circuit is reasonably straightforward.

A push-pull output stage is used, preceded by a phase-splitter and a.f. amplifier. Negative feedback is employed. An output transformer provides matching for an external loudspeaker of 2.5 to 3 ohms; a loudspeaker is not included in the set. Provision is made for headphones and—unusual in a set of this kind—for a gramophone pickup.

One other circuit detail, which, however, is common to most commercial receivers, is a stand-by switch. It de-sensitizes the set in the stand-by position and also closes a pair of spare contacts to be used, if required, to control a nearby or remote transmitter via a relay.

Performance

The impression given by the set is that it has about as much sensitivity as can usefully be employed. The selectivity in the CW and AM positions is adequate for all v.h.f. requirements; and it must be judged on this basis. It leaves a little to be desired on the 19- to 27-Mc/s band, but these frequencies may be regarded as rather outside the normal scope of this receiver.

During our tests we dodged from range to range, noting station tuning positions and often coming back to them time and again; it was a form of monitoring and covered the whole v.h.f. range of the receiver. The set seems ideally suited for this type of work which could form one of its principal rôles.

The noise limiter suppresses ignition interference on a.m. transmissions quite effectively, but seems to cut rather deeply into the upper frequency response. Indeed, it forms a useful way of suppressing most of the set noise when the full gain is employed and especially so when the BFO is used, which, as seems inevitable, adds considerably to the general background noise. However, this is not peculiar to the 770R.

The following extracts from the maker’s specification serve to give some idea of the receiver’s qualities.

Sensitivity.—Better than 5 μV on all ranges for a 15-db signal/noise ratio and 50 mW output.

Selectivity.—CW and AM; 40 db down, 50 kc/s off resonance. Narrow band FM; 40 db, 80 kc/s away from resonance. Wide-band FM; 40 db down, 175 kc/s off resonance.

Noise Factor.—Not greater than 14 on Range 1, decreasing to less than 5 on Ranges 5 and 6.

Image Ratio.—Better than 20 db at 165 Mc/s and correspondingly greater at the lower frequencies.

Frequency Stability.—Drift less than 0.001 of 1 per cent, and less than 0.001 of 1 per cent for a 5-per cent change in mains voltage.

As the receiver covers the 21-, 28- and 145-Mc/s amateur bands it might have some appeal in this direction provided the price does not prove too great an obstacle.

The makers are Stratton and Co., Ltd., Eddystone Works, Alvechurch Road, West Heath, Birmingham, 31.

Two of the coil units removed from the turret.

Fig. 2. The f.m. tuning indicator and a.m. “S” meter are combined in one stage.

Wireless World, January 1955
Circuit Symbols

Differences Between American and British Standards

By "SYMBOL SIMON"

The June, 1954; issue of Proc.I.R.E. contains a list of graphical symbols—covering all electrical needs—which have been agreed with the American Standards Association.

In this country, the “heavy” and “light” engineering fields are catered for by two British Standards: B.S.108 and B.S.530 respectively. Perhaps we shall one day see a similar amalgamation of these two Standards; this would prevent inconsistencies between the two Standards, which, although few, are puzzling to a draughtsman who has to choose symbols from both lists for use on one drawing.

The I.R.E. list generally gives two sorts of symbols, “single-line,” i.e., simplified, somewhat similar to the British “block diagram,” and “complete”—on the lines of our circuit symbols. The supplement to B.S.530 on waveguides uses a similar arrangement.

Mention should first be made of two symbols which may confuse the British reader:

(a) The American open contact, as used on “power” diagrams (left), is very like our capacitor. (It must be remembered that Americans draw all lines of the same thickness.) Their closed contact (right) is rather like a British variable or pre-set capacitor which has lost the end of its shaft. They avoid confusion by giving their capacitors one curved plate (left). Possibly we could persuade them to change their open contact to our symbol used in Electric Traction diagrams by erasing half the horizontal lines (right). This change would remove any risk of confusion.

(b) Much less important. The American microphone (left) is similar to our buzzer (middle), whereas our microphone (right) has international agreement.

In passing, the British buzzer symbol is supposed to owe its origin to the practice (frowned on by the Post Office) of inverting the dome on a telephone bell to make it produce a quieter buzz. The American bell and buzzer are left and right respectively.

Apart from these contradictions, the symbols are generally self-evident, except, possibly, the plugs and sockets; for example, the socket (left) and plug (right), which are “pictures” of the modern connectors with rectangular pins.

A choice is given for the inductance symbol: the (British) “loop” symbol (right) or a “semi-circle” symbol (left), which is easier to draw and quite unambiguous. As an indication of the American preference between these two, it is interesting to note that the “semi-circle” symbol is used for an inductance in every case in the rest of the list. Perhaps we would do well to introduce this symbol in this country—it is already looked on with favour on the Continent.

The American “waveguide” symbols agree well with the “single-line” symbols in the supplement to B.S.530 mentioned above. This is not surprising, since an earlier draft of the American symbols was in the hands of the British “Services” committee which had its symbols on them and subsequently brought its decisions to the attention of the B.S.I.

To sum up, the list appears complete, and (with the few exceptions mentioned above) clearly intelligible to the British reader.

Millimetric Radar

What is believed to be the first millimetric radar surface movement indicator is to be installed at London Airport by the Ministry of Transport and Civil Aviation. It will provide the control staff with an accurate picture of the positions of aircraft and vehicles on the airfield and enable them to supervise movements under conditions of poor visibility more expeditiously than is possible with position reporting by radio telephone. Owing to the expanse of London Airport it should ease the flow of air traffic in and out under all conditions of visibility.

The equipment to be used is the new Decca 8-mm airfield surface movement indicator which employs a beam width of 23 min only and a pulse length of 0.05-sec, giving a radar picture of exceptional clarity as may be seen from the accompanying p.p.i. display showing the runways at London Airport. The slight masking of the picture in the upper right-hand corner is caused by a temporary obstruction which will be removed before the equipment is installed in its permanent quarters.

Talking of Test Gear...

A Cynic's View of Electronic Measuring Instruments

By A. J. REYNOLDS*

ONCE upon a time there was an engineer who, for want of a better name, shall be called Mr. P. H. Dee. Having made a great success of a research project at his university, working with apparatus made by himself and his assistants, he landed a highly paid job in industry (the sort in the small ads. section of W.W. at a salary at least twice what your firm pays), and looked forward to using some good professional apparatus. He was given an "X"-band development job and set about buying the necessary instruments. His first move was to study the advertisements in the technical press and the catalogues in the library. He picked out the eight most likely manufacturers and telephoned or wrote to them, and in due course finished up with four beautiful leaflets each describing an instrument allegedly suitable for his job. In this case, it was a fairly simple piece of waveguide apparatus, the main requirement being that it should achieve a reasonable degree of match. It was then that his bewilderment began, for he came up against the gentle art of "specification writing." It goes something like this, extracting the relevant passages from the manufacturers' leaflets:

Instrument A: VSWR 1.2 at 10,000 Mc/s.
Instrument B: Standing wave ratio < 0.8 at 10,000 Mc/s.
Instrument C: The degree of match achieved is better than 1 db.
Instrument D: The total reflected power is less than 1% over most of the band.

Now when converted to a common terminology all these mean almost the same thing, but it will be apparent to the keen student of Stephen Potter that the writer of leaflet D is a first-class lifeman. How much better his instrument sounds than if he had written:

VSWR 0.8 over the middle 51% of the band, falling to 0.55 at the extremes.

Having sorted all this out Mr. P. H. Dee found all the literature extremely silent on one most important point—that of the "handleability" of the instrument concerned.

Handleability can perhaps be defined as "possessing the quality that a given movement of the controls produces the expected response in the expected degree." The possession of this quality largely determines whether or not an instrument will meet with wide approval and enormous sales. All of us at some time have had to use a magic box where a meter has to be set to a datum line by means of a knob on the front. How infuriating it is when the slightest touch of the knob causes the meter needle to dash madly to one stop or the other! One can never regard with any affection an instrument which has such tricks in its repertoire.

One or two examples of eminently handleable instruments come to mind. In the field of the humble multi-range meter one particular example has this quality to a high degree. Since it was designed, well before the war, it has successfully fought off challenges from a variety of competitors, some of which required a small chain wrench to turn the knobs and some whose plug and socket range selection could only be adequately operated by an international cribbage-marker—not to mention those with nice easy range factors like 2.5 and 6, and figures of merit like 310 ohm/V. When the equipment designer specifies that the anode voltage of V1 is 275V measured with a 1,000-ohm/V meter, one notes that it reads 34.5V X 6 on one's 310-ohm/V meter, so this stage is obviously in order—or is it?

Attenuator Reaction

After the multi-range meter most people would agree that the signal generator is the next instrument to be purchased either for the average laboratory or service workshop. Here again the glossy leaflets are silent on the subject of handleability. It is easy to be misled by the paper specification into believing that generator A at half the price is just as good as generator B. Unfortunately, in instruments as in everything else, one gets just what one pays for (usually a little less). Most engineers have by now caught up with that old bogey of signal generators, spurious f.m., and in many cases the limits are included in the specification, but I have still to see attenuator reaction (that is, the effect of varying the attenuator on the emitted frequency) written into a specification. Yet this quality is by no means negligible in its effect on "handleability." The sequence goes something like...

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* Livingston Laboratories.
this. The indicating device at the end of the chain reads high, so the output from the generator is reduced by means of the attenuator until the pointer of the output meter is on the datum; this shifts the frequency so the generator is re-tuned to peak. The shift of frequency causes the output to drop, so the “Set Carrier” is advanced to its proper place. One then notices that the output meter is still a bit high and repeats the process.

Another quality of the signal generator rarely specified is the harmonic content of the r.f. signal. It may come as a surprise to hear that figures such as 25% second and third harmonic distortion are quite common in high-grade instruments. The everwidening bandwidths used to-day plus the use of feedback-type valve millivoltmeters as indicators make this point a matter of some importance. Before roundly condemning all signal generator manufacturers as scoundrels, remember that many of the best-known examples were designed in the 30’s days of bandwidths measured in small kc/s rather than large Mc/s, and that in these conditions the effect of r.f. harmonic distortion is small. 25% distortion only affects the level of the signal some 4%, and it is rarely that the level accuracy can be guaranteed to better than 10% for reasons quite unconnected with harmonic distortion.

In the last paragraph, passing mention was made of a now popular type of instrument, the valve millivoltmeter. Careful investigation is necessary before buying one of these. Apart from the usual points to watch such as zero stability and, in the case of the most sensitive types, noise on the lowest range, the form factor error is a variable and usually unspecified error that can affect the handling in many common applications. (Form factor being defined as the ratio of average voltage to peak voltage, that is, 1.11 for a sine wave.) One of these applications, the use of the instrument with a signal generator having a bad waveform, has been quoted above. These instruments are invariably calibrated in terms of r.m.s. volts and yet actually may be measuring peak voltage, half-wave average voltage, full-wave average, or a quantity that is not quite any of these. When fed from a distorting source, reading errors up to 50% are quite common between different instruments that agree extremely well on a pure sine wave.

Practically all the foregoing could be read as though my intention were to “debunk” the instrument industry, but this is not at all the case. The blame for many of the apparent shortcomings of instruments rests with the user who consistently demands an instrument having an enormously wide range of measurements.

We have grown so used to our micros and megas that we have lost a sense of wonder about such things. People look at a pulse displayed on an oscilloscope, for example, and say “the front edge is not too good—it is not much better than a twentieth, I suppose,” meaning, of course, that the rise time of the pulse in question is some 0.05/sec. Recently a well-known and well-liked pulse generator was being roundly criticized for daring to have a time jitter in the “free run” position of 0.05/sec! It may come as a surprise to those who have never stopped to think about it that 0.05/sec is to 1 sec as 1 sec is to 7 months, and yet people are now demanding presentation of an event lasting a fraction of a millisecond!

A somewhat similar state of affairs exists in other fields. Insulating materials having a loss angle (tan δ) of 0.0001 are in common use. For those not familiar with the expression “loss angle,” perhaps a word of explanation will not be amiss here. The perfect insulator when used as a dielectric material forms a capacitor that takes a current truly 90° ahead of the voltage in phase and hence has no loss. In practice, of course, this state never exists, and all practical capacitors have a small resistive component which modifies the resultant phase angle and represents the power dissipated in the dielectric. As, in the case of very small angles, the tangent is numerically equal to the angle; this figure is normally used to describe the merit of a particular dielectric material.

Those readers whose arithmetic is better than mine can, for amusement, calculate the missing dimensions in the accompanying vector diagram (left). Yet this quantity is regularly measured at 10 Mc/s or even 100 Mc/s.

Perhaps these two example have been sufficiently striking to help you to appreciate the magnitude of the task that faces the instrument designer these days. This task is made even more difficult by the demand for instruments having a wider and wider range. The ideal signal generator covers from 0.1 c/s to 50,000 Mc/s in one range; has an output of several watts which can be attenuated (without leakage, of course) to 0.01v; has internal f.m., a.m., p.c.m.; does not weigh more than 10lb or cost more than £100. It will then exhibit all the faults mentioned and have a few of its own. In general a narrow-range single-purpose instrument can be made to do its job supremely well, but, of course, the Sales Department can’t sell it as the customer will always buy a slightly worse one with a wider range.

**V.H.F. Valve Connector**

A NEW product of interest to users of v.h.f. equipment is an anode connector for transmitting valves such as the QQV06-40, 829, 832 and similar types with top anode pins. It is made of silver-plated brass, measures $\frac{3}{4} \times \frac{3}{4} \times \frac{1}{16}$in and while being massive enough to provide effective cooling of the anode pins adds little to the capacitance of the anode circuit.

Its construction and method of fitting are shown clearly in the illustration, which shows also the 6-BA tapped hole providing the means of connecting to the external anode circuit. Made by Power Controls, Ltd., Exning Road, Newmarket, Cambridge (one of the Pye group of companies) the price is provisionally 2s 3d each, but is subject to adjustment for quantities.
JANUARY MEETINGS

British Institution of Radio Engineers
London Section.—January 26th. “A Survey of Tuner Designs for Multi-Channel Television Reception” by D. J. Frewing and S. L. Fife at 6.30 at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

West Midlands Section.—January 12th. “Electronics in Materials Handling” by L. Landor Goodman (British Electrical Development Association) at 7.15 at the Wolverhampton and Staffs Technical College, Wiulluna Street, Wolverhampton.

North-Eastern Section.—January 12th. Address by the president, Rear-Admiral (L) Sir Philip Clarke, K.B.E., at 6.0 at Neville Hall, Westgate Road, Newcastle-upon-Tyne.

Merseyside Section.—January 6th. “Some Interesting Applications of Electronics to Photography” by D. M. Neale (Jiford, Ltd.) at 7.15 at the College of Technology, Oxford Street, Liverpool, 3.

North-Western Section.—January 6th. Discussion on “The Problems in the Design and Production of Car Radio” opened by G. L. Caiger (E. G. Cole) at 7.0 at the College of Technology, Sackville Street, Manchester.

South Wales Section.—January 12th. “Electronic Counting Devices” by Dr. F. H. Gage at 6.30 at the Glamorgan Technical College, Treforest.

Scottish Section.—January 10th. Discussion on “Band III Commercial Television” at 7.0 at the Institution of Engineers and Shipbuilders, Elm Bank Crescent, Glasgow, C.2.

January 20th. “Modern Ship-to-Shore Communication” by G. Macdonald (Marconi’s) at 7.0 at the Department of Natural Philosophy, the University, Edinburgh.

Radar Association

Incorporated Practical Radio Engineers
South Coast Section.—January 13th. “Some Practical Applications of Transistors” by R. A. L. Cole (S.T.C.) at 7.30 at the King Arnis Hotel, Castle Street, Christchurch.

North-West Section.—January 6th. “Cathode Ray Tubes” by a representative of the Edison Swan Electric Company at 7.30 at the Barley Mow Hotel, Turner Street, Manchester, 4.

East Midlands Section.—January 28th. “Electronics in the Radio and Electrical Industry” by C. Cowell (Fielden Electronics) at 7.15 at the Demonstration Theatre, Electricity Showrooms, Smithy Row, Nottingham.


Berks, Bucks & Oxon Section.—January 12th. “Visual Alignment” by J. E. Tomlin and G. Tomilake at 7.30 at the White Hart Hotel, St. Mary’s Butts, Reading.

JANUARY

Institution of Electrical Engineers


January 27th. Faraday lecture on “Courier to Carrier in Communications” by T. B. D. Terroni at 6.0 at the Demonstration Theatre, Nottingham.


North-Western Centre.—January 5th. “The Invention and Demonstration of the Telephone” by W. Lawrence at 6.45 at the Engineers’ Club, Albert Square, Manchester.

January 18th. Faraday lecture on “The City of Gold” by T. B. D. Terroni at 7.30 at the Free Trade Hall, Manchester.

South Midland Centre.—January 24th. “Some Applications of Telecommunications” by Col. C. E. Cruikshank at 6.0 at the James Watt Memorial Institute, Great Charles Street, Birmingham. (Joint meeting with Birmingham Section of Institution of P.O. Electrical Engineers.)


British Sound Recording Association
London.—January 21st. Demonstration of a high-fidelity reproducing chain by T. S. Livings, lecturer (Southern), at 7.0 at the Royal Society of Arts, John Adam Street, W.C.2.


Television Society

Radio Society of Great Britain

Institution of Production Engineers

Electro-Physiological Technologists’ Association
February 5th. Papers and demonstrations at 10.30 a.m. at the National Hospital, Queen Square, London, W.C.1.

Wireless World, January 1955
**TV Reception Freaks**

INTERFERENCE with television reception by continental sound broadcasting stations has been widespread in recent months. I expect you've had some of it; I certainly have. It naturally takes the form of faint, narrow, dark lines, sloping across the whole screen, now from left to right, now the other way. In severe cases these may give way to stationary vertical black bars, forming a sort of portcullis over the entire picture. But the most curious television freak I've yet come across is that. In the Netherlands it was permitted the Dutch are amongst the most charming and cultured people in the world. A pity that they've followed our bad example with the live chassis. Most of those who have written to me share my dislike of a.c./d.c. television and radio receivers; but if the present trend continues I fear that this will soon be the only kind obtainable.

**Reactivated C.R. Tubes**

IT WOULD BE interesting to know, though no one is ever likely to do so, how many television c.r. tubes are needlessly scrapped in the course of a year. Leaving out accounts the not inconsiderable number consigned to the rubbish dump by the kind of dealer who prescribes a new tube as the cure for ringing, or even for distorted sound, there are two common causes of failure which need not render a tube past redemption. The first of these is lost emission; and for this there are two possible remedies. One is to reactivate the cathode by raising it for a brief period to a temperature whether the people of that country are thereby branded as uncivilized! I didn't know that live chassis was permitted in the Netherlands, but I do know that the Dutch are one of the most charming and cultured people in the world. A pity that they've followed our bad example with the live chassis. Most of those who have written to me share my dislike of a.c./d.c. television and radio receivers; but if the present trend continues I fear that this will soon be the only kind obtainable.

**Shining 'Em Up**

DURING a stay in Devonshire, in the late unlaunched travesty of a summer, I was enormously impressed by the beautiful polish on the cabinet of my host's TV console. When I expressed my admiration he told me that it was due to a new kind of furniture polish which he'd been recommended to try a few months before. I brought some home and after giving it a thorough trial I feel that it is something of real value not only to owners of radio and television sets but to dealers and servicemen as well. "Topps," as it is called, is the easiest thing to use, as I found when I made my first experiment on a very old cabinet.

**Live-chassis Sets**

IT WAS stupid of me to suggest in these notes in the November issue that on d.c. all was well with a.c./d.c. receivers because they wouldn't work unless the mains connection was made the right way round. It must have been one of my absent-minded moments, for I know perfectly well that it's an even chance whether the live wire of most domestic d.c. systems is positive or negative to the earthed neutral. Apologies to readers and best thanks to A. B. Grief and others for pointing out the slip. A Dutch reader tells me that transformerless sets are used in Holland and asks if there are any plans to use them in this country. I'm afraid there aren't.
that has now rather given way to the number of channels to which they can be tuned: the man in the street feels at least a head taller if he can boast of his 13-channel receiver. One's always meeting or hearing of people hailing from remote parts of the country who, when buying sets this year, have chosen to put down an extra £5 or more to pay for Band III tuners for which they're unlikely to have the slightest use before the said sets are worn out. As they say in the North, "There's nowt so queer as folk."

Maintenance Schemes

THE OWNER of such a complex assembly of expensive bits and pieces as a television receiver is probably wise to take out a maintenance contract or insurance policy with a reputable firm. This does not apply so much to readers of Wireless World, who can do their own repairs, as to those less gifted folk who don't know the first thing about the "works." Still, even boffins can find, if they are unlucky, valve after valve packing up after the guarantee on them has expired. Only the other day I met one who was bewailing the failure of a 17-inch c.r. tube after a life of seven months; and, as you know, there are other vulnerable parts which can provide unpleasantly expensive surprises. There are many soundly and honestly run maintenance schemes; but there are, one fears, certain others in different parts of the country which are far from being anything of the kind. The existence of these is a blot on the radio trade and I sincerely hope that steps will be taken to stamp them out.

WIRELESS WORLD, JANUARY 1955

THE SILVER-DIAL RANGE OF CONTROL-KNOBS

A NEW Range of Instrument Knobs and Dials. Manufactured in the finest-grade polished Bakelite, with frosted aluminium "Silver-Dial" dials.

<table>
<thead>
<tr>
<th>List No.</th>
<th>Item</th>
<th>Dimensions, etc.</th>
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<td>K.410</td>
<td>Dial</td>
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<tr>
<td>K.410/P</td>
<td>Dial</td>
<td>ditto, not engraved</td>
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Further details available in the NEW 114-page Catalogue. Price £1/- post free. Ref. 194/WW.

BULGIN

Manufacturers of Radio and Electronic Components

A. F. BULGIN & CO. LTD., BYE-PASS RD., BARKING, ESSEX

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Render Unto Caesar

FAR be it from me to join issue with the mighty who have been arguing about the origin of the valve. But the noise of conflict certainly set me thinking as to what exactly is meant by the word "valve." The Greeks had a word for it, but it isn't necessary to go farther back than the Latin word volvere, meaning "to turn." In the days was well established as part of an entrance which had to be turned or moved round in order to get through it was called a valvula; in fact, Cicero himself used the word. The use of the word "valves" to describe the "leaves" of a folding door was not uncommon in Elizabethan days.

In 1615 the medical profession particularized the meaning of "valve" as a one-way door, using the word to describe those parts of the circulatory system which stop the blood regurgitating when the heart is not on its actual firing stroke. Forty-five years later it was used in engineering circles to describe an automatic one-way device inserted in a pipe through which water or air was flowing.

It seems obvious, therefore, that although literally there is no suggestion of unilateral conductivity in the word valve, its use as meaning a one-way device was well established three hundred years ago and so the expression "non-return valve" which we sometimes hear is tautological.

I have stated these facts at some length because attempts have been made in some quarters to say that de Forest and not Fleming patented the first real thermionic valve. Actually, of course, the addition of de Forest's grid to the existing thermionic valve turned Fleming's device into something else, namely, a thermionic relay.

A Vested Interest

MY ATTENTION has been drawn to a new question on the form which has to be filled in at the local post office if letters are to be redirected. This question demands to know the date of expiry of your sound or television licence.

Doubtless this question can be defended on the ground that it is merely a convenience to the P.M.G.'s clerical staff and also to the licence holder. But if this be so why does the post office not ask about the date of expiry of the dog licence, another annually renewable affair handled by the P.O.? The reason is, I think, that it is not so clearly understood what the P.M.G. has a vested interest in one but not in the other. The £1 or £3 wireless licence yields quite a healthy rake-off to the P.M.G. but he would not get more than a few coppers out of the humble 7s 6d dog licence.

Actually I believe I am right in saying he gets nothing at all but has to hand it all over to the local County Council, which is the authority responsible for licensing dogs. It is obvious, therefore, that the P.M.G. couldn't care less if we renew our dog licences or not.

How Many Microsquereas?

MORE than twenty years ago I published in these columns details of an appliance whereby a schoolmaster could put the administration of corporal punishment on a proper scientific basis so that there were "fair shares for all" in this matter.

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MORE than twenty years ago I published in these columns details of an appliance whereby a schoolmaster could put the administration of corporal punishment on a proper scientific basis so that there were "fair shares for all" in this matter.

The haphazard methods employed at that time are unfortunately still in use with the result that those at the tail end of the queue in a mass caning receive less than their just due owing to pedagogic fatigue.

As you will see from the sketch reproduced from W.W. for April 7th, 1933, the apparatus was simple, consisting merely of two beams of light projected on to photocells so that the rate at which the cane moved, and therefore, the force of the blow, was automatically calculated and shown on a large dial.

With the great advances in electronics which have been made in the past twenty years, the whole idea is now hopelessly out of date. Nowadays with modern technique it would be possible to dispense with the human element altogether and hand the delinquent schoolboy over to an electronic caner which would administrate justice scientifically after the schoolmaster had decided on the correct number of microsquereas which the culprit deserved. The unit of flagellation is, of course, named after the famous Dickensian character.

Needless to say the electronic caner would incorporate some of the features of the Ace computer and also the encephalograph so that it could first measure the boy's nervous reactions and then adjust the strength of its blows accordingly, as some boys feel pain more acutely than others. The machine could thus, in some cases, modify the schoolmaster's sentence by applying electronically calculated mercy to human justice.

Telepathy by V.H.F.

THE name of Maskelyne usually conjures up—surely le mot juste—visions of a woman being seen in half and it is a little odd to find that he well-known conjurer was one of the pioneers of radio. My attention has been drawn by the Rector of Ewhurst, Sussex, to an article in his parish magazine of over fifty years ago (July, 1901) in which he describes experiments successfully undertaken by the Maskelyne concern and the Rev. J. M. Bacon, M.A., in wireless communication between the earth and a balloon in flight.

From this it is obvious that wireless signalling between aircraft and ground followed very hard on the heels of ship and shore communication. These experiments were conducted in the summer of 1899 and in that same year the first wireless distress call was sent out by the East Geordie lightship.

Four years later Nevil Maskelyne was still engaged in wireless experiments. There was some acrimonious correspondence in The Times following his attempt in 1903 to obtain certain weaknesses in wireless tuning by transmitting signals which broke in upon the receiver which Fleming was demonstrating at the Royal Institute. This incident is recorded in the recently published biography of the late Sir Ambrose Fleming.*

It is difficult to say from the meagre information available whether the famous conjurer had a genuine scientific interest in radio or was merely seeking to use it as a stage stunt as is done to-day with tiny v.h.f. transmitters in music-hall "telepathic" turns.

In the old days of stage "telepathy" a clever and elaborate code either of words, vocal intonation or even body posture was used. Ship the stooge in the stalls to let the see on the stage know what he was holding in his hand. According to Dr. D. J. West, M.B., the experimental research officer to the Society of Psychical Research, the successful use of the code required long practice, and I can well believe it. In his recently published book, "Psychical Research To-day," he remarks that much simpler is the modern technique of using a small radio transmitter. Unfortunately, Dr. West gives no technical details, but obviously the stooge must use a midriff mike and be a ventriloquist in the literal meaning of that term.

---

* "The Inventor of the Valve," by Dr. J. T. MacGregor-Morris. (Television Society.)
Produced in response to a demand for a high sensitivity version of the world-famous Universal AvoMeter, this model incorporates the traditional design features of its predecessors, so highly valued for simplicity of operation and compact portability.

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It is of importance to note that this model incorporates the “AVO” automatic cut-out for protection against inadvertent overloads.

<table>
<thead>
<tr>
<th>D.C. Voltagre</th>
<th>D.C. Current</th>
<th>A.C. Voltage</th>
<th>A.C. Current</th>
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<tbody>
<tr>
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<td>50 μA</td>
<td>2.5 V</td>
<td>100 mA</td>
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<tr>
<td>100 V</td>
<td>250 μA</td>
<td>500 V</td>
<td>2.5 A</td>
</tr>
<tr>
<td>15 V</td>
<td>1 mA</td>
<td>1000 V</td>
<td>10 mA</td>
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<tr>
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<tr>
<td>25 V</td>
<td>10 A</td>
<td>25,000 V</td>
<td>20 A</td>
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</table>

Size 8½” × 7½” × 4½”
Weight 6½ lbs. (including leads)

£23 : 10s.

For your Valve Characteristic Meter or Valve Tester

Owing to the very large number of valves which have been issued within the last two years, no further amendments will be issued for the original “Avo” Valve Testing Manual. A new, completely revised and fully up-to-date Valve Data Manual is now available from the Company at 15/- post free.
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Designed for the measurement of any frequency in the range 10 c/s to 20 Mc/s with a basic accuracy of ± 1 part in 10⁶ ± 0.1, 1.0, or 10 c/s. Higher accuracies available if required. The unknown frequency is determined by counting the number of cycles that pass through a 'gate' open for a selectable time interval of 0.1, 1.0, or 10 seconds. The result is presented on eight panel mounted meters each scaled 0 to 9 and is in decimal notation. Full information available on request.

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The new Mullard QV1-150A is an external anode tetrode of exceptionally small dimensions, completely interchangeable with the popular American 4X-150A. It is forced-air cooled and will operate with excellent efficiency and power gain at frequencies as high as 500 Mc/s. Although the maximum d.c. anode voltage is 1.25kV, the performance of the QV1-150A is little reduced at half this figure and recommends it for both fixed and high power mobile transmitting equipments.

High permissible anode dissipation, high current density and very favourable ratio of mutual conductance to capacitance particularly suit this new tetrode for wide-band applications.

The modified loctal base of the QV1-150A is so arranged that, when equipped with its special socket, forced-air cooling is facilitated and coaxial or linear circuits may be used. Excellent circuit separation is achieved at U.H.F. by a disc-seal screen-grid connection located between anode and base which is by-passed to cathode by a capacitor built into the socket.

Further information on this and a wide range of other transmitting valves may be readily obtained from the address below.

### Typical Applications

<table>
<thead>
<tr>
<th>Typical Applications</th>
<th>Va (kV)</th>
<th>Pload (W)</th>
<th>f(Mc/s)</th>
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<tr>
<td>R.F. POWER AMPLIFIER</td>
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<td>Class &quot;C&quot; Telegraphy and F.M. Telephony</td>
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<td>165</td>
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<tr>
<td>Class &quot;C&quot; Anode Modulated</td>
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### HEATER

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<td>Vg2 max. 400 V</td>
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<td>pg2 max. 12 W</td>
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<tr>
<td>f max.</td>
<td>500 Mc/s</td>
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MULLARD LTD., COMMUNICATIONS & INDUSTRIAL VALVE DEPT. CENTURY HOUSE, SHAFTESBURY AVENUE, W.C.2.
An Ediswan Mazda aluminized picture tube gives a picture 60% brighter and more contrasty than is possible with an ordinary tube.

In addition, Ediswan aluminizing protects the screen from ion burn and, with the new Ediswan ion trap tetrode gun to protect the cathode, tube life is increased.

Ediswan production methods, which include the special in-line vacuumizing system, ensure a higher, more uniform standard of lasting efficiency. For complete satisfaction demonstrate and recommend Ediswan Mazda aluminized picture tubes.

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more contrast
extra tube life

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CURRENT RATING: 0.5 amp. (maximum).
Switching up to 29 positions (single-pole) per bank, or up to 30 positions per bank for 360° rotation.
Painton Winkler Switches can be supplied for either 'Make-before-Break' or 'Break-before-Make' operation.
Each switch has an adjustable stop device, by which the switch can be set to the number of positions required.
SINGLE, DOUBLE, THREE-POLE or FOUR-POLE.
1-6 BANKS OPERATED FROM A COMMON SHAFT.
The distinctive Painton knob type K21, with the 'adjustable skirt' feature has been specially designed to operate Painton Winkler Switches.
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This 7-channel Radio Link System has been designed for economy both in initial cost and maintenance demands. This has been achieved without sacrifice of essential facilities or relaxation of performance standards. Both Radio and Carrier equipment for the 7-channel terminal is housed in a single 6-foot cabinet as illustrated. The equipment is fully tropicalized and suitable for continuous unattended operation in all parts of the world.

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Radio Frequency Range 60–216 mc/s
Transmitter output Power 10 watts, or with Amplifier unit—50 watts
Baseband 7 Channels 0.3–23.4 kc/s
Maximum Deviation 50 kc/s
Receiver Bandwidth 6 db down at ±120 kc/s

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CAMBRIDGE ENGLAND
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MAGNETIC DEVICES LTD EXNING ROAD, NEWMARKET
## POWER RECTIFIERS & THYRATRONS

### POWER RECTIFIERS

<table>
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<tr>
<th>Type</th>
<th>Max Dimensions in m/m.</th>
<th>Filament</th>
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<th>Mean Anode Current</th>
<th>3 Phase F.W. Output</th>
<th>British Services Number</th>
<th>American Equivalent</th>
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<td>456</td>
<td>133</td>
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<td>19</td>
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<td>2.0(a)</td>
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<tr>
<td></td>
<td>AH.217</td>
<td>220</td>
<td>63</td>
<td>5.0</td>
<td>7.5</td>
<td>11,000</td>
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<td>1.25</td>
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<tr>
<td></td>
<td>AH.221</td>
<td>270</td>
<td>63</td>
<td>4.0</td>
<td>11</td>
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<td>4.7</td>
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<td>53</td>
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<td>270</td>
<td>63</td>
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<td>11,000</td>
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<td>AX.233</td>
<td>216</td>
<td>59</td>
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</table>

Note: (a) Filament Voltage in phase with anode current.
(b) Filament Voltage 60°–120° out of phase with anode current.
(c) AFH.220 is grid controlled with positive characteristics.

### THYRATRONS

<table>
<thead>
<tr>
<th>Type</th>
<th>Max Dimensions in m/m.</th>
<th>Filament</th>
<th>P.I. Voltage</th>
<th>Peak Forward Volts</th>
<th>Mean Current</th>
<th>Tube Drop</th>
<th>Peak Power Level (a)</th>
<th>British Services Number</th>
<th>American Equivalent</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Length</td>
<td>Dis.</td>
<td>Volts</td>
<td>Amps</td>
<td>Vols</td>
<td>Amps</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Xenon</td>
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<tr>
<td>Filled</td>
<td>AXK.212</td>
<td>54</td>
<td>19</td>
<td>6.3</td>
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<td>350</td>
<td>350</td>
<td>0.31</td>
<td>0.025</td>
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<td>AXK.203</td>
<td>176</td>
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<td>Hydrogen</td>
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<tr>
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<td>286</td>
<td>97</td>
<td>2.5</td>
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<td>16,000</td>
<td>16,000</td>
<td>16,000</td>
<td>300</td>
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<tr>
<td></td>
<td>FX.219</td>
<td>222</td>
<td>65</td>
<td>6.3</td>
<td>10.6</td>
<td>16,000</td>
<td>16,000</td>
<td>16,000</td>
<td>350</td>
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<td></td>
<td>FX.227</td>
<td>132</td>
<td>40</td>
<td>6.3</td>
<td>2.25</td>
<td>3,000</td>
<td>3,000</td>
<td>3,000</td>
<td>35</td>
</tr>
</tbody>
</table>

Note: (a) Product of Peak Forward Voltage, Peak Current and Pulse Repetition Frequency.
STAR FEATURES

★ Heats up from cold in 6 seconds—by a light thumb pressure on the switch ring.

★ When not in use, current is automatically switched off—thus greatly reducing wear of copper bit. Electricity consumption is correspondingly reduced.

★ It is 10" long, weighs 3½ ozs., can be used on 2.5 to 6.3-volt supply. 4-volt transformer normally supplied.

★ More powerful than conventional 150-watt irons and equally suitable for light wiring work or heavy soldering on chassis.

★ Simple to operate, ideal for precision work. Requires minimum maintenance at negligible cost. Shows lowest operating cost over a period.

★ Can be used from a car battery.

★ It is by far the most efficient and economical soldering iron ever designed for test bench and maintenance work.

STAR APPLICATIONS

Designed on an entirely new principle, this light-weight, versatile iron is eminently suitable for soldering operations in the RADIO, TELEVISION, ELECTRONIC and TELECOMMUNICATION industries, particularly for all SERVICE work. For general purpose work the Superspeed Iron is the ideal stand-by soldering tool.

Write for full particulars, including guarantee terms and free trial facilities, to the sole concessionaires in this country—

ENTHOVEN SOLDERS LIMITED
(Industrial Equipment Division), 89 Upper Thames St., London, E.C.4. Telephone: MANsion House 4533

LIST PRICES

Subject to trade discounts.

Superspeed Soldering Iron 39/6
Transformer (optional) 31/6
Replacement Element 1/-
Replacement Copper Bit 10s.
The Advance D1 Signal Generator has long been recognised as supreme in its sphere for accuracy, ease of operation and reliability. Now comes the D1/D—an up-to-the-minute successor—possessing all those proven qualities, but plus the advantage of being DIRECTLY CALIBRATED. Whilst the range of the D1/D (10 to 300 Mc/s) is only slightly less than the original D1, its characteristics, given below, prove the "D" series to be the finest V.H.F. instruments available in their price class.

- Frequency range 10 to 300 Mc/s
- Directly calibrated with an accuracy of plus/minus 1%
- Sine wave modulation 30% at 1,000 c/s
- Square wave modulation approx. 50/50 at 1,000 c/s
- Max. attenuation error at 300 Mc/s plus/minus 4 db
- Negligible stray field
- Light weight, only 34 lbs.

Full technical details available in Leaflet W26

Net Price in U.K. £97
An outstanding general purpose communication receiver

Justly acclaimed as Britain's finest post-war communication receiver the BRT 400 D is in widespread use by Military, Post and Telegraph and Broadcasting authorities throughout the world.

Combining first-class performance with a wide range of facilities, the BRT 400 D is equally suitable for both narrow-band telegraphy and wide-band telephony reception—with a very high standard of reliability.

It is available in either cabinet or rack mounting form, with a 500 kc/s crystal calibration unit as an optional extra. Normal operation is from an A.C. mains supply: an auxiliary power unit is available for 12 volt battery operation.

**S. E. C.**

**BRT 400D**

<table>
<thead>
<tr>
<th>BAND COVERAGE</th>
<th>SENSITIVITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.150—0.385 Mc/s</td>
<td>Better than 1.0 µV for 1.5 watts output, over the whole band.</td>
</tr>
<tr>
<td>0.510—30.0 Mc/s</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SIGNAL/NOISE RATIO</th>
<th>OVERALL FIDELITY</th>
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<tbody>
<tr>
<td>Standard input for 20 db:—</td>
<td>Less than 2 db down at 50 c/s</td>
</tr>
<tr>
<td>1.3—3.0 Mc/s</td>
<td>Less than 6 db down at 5,500 c/s</td>
</tr>
<tr>
<td>0.150—1.3 Mc/s</td>
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<tr>
<th>SELECTIVITY</th>
<th>A.G.C. CHARACTERISTICS</th>
</tr>
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<tbody>
<tr>
<td>Six switched bandwidths:—</td>
<td>Output constant within 3 db for 100 db change in signal input.</td>
</tr>
<tr>
<td>0.5 kc/s</td>
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</tr>
<tr>
<td>5.3 kc/s</td>
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<table>
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<tr>
<th>OUTPUT CIRCUITS</th>
<th>POWER SUPPLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>At 2.5 or 15 ohms</td>
<td>95—130 and 195—250 volts, 40/80 c/s. Also from 12 volt battery, using BRT 401 auxiliary power unit.</td>
</tr>
<tr>
<td>At 120 ohms</td>
<td></td>
</tr>
<tr>
<td>At 600 ohms</td>
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<table>
<thead>
<tr>
<th>POWER SUPPLY</th>
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<tbody>
<tr>
<td>2.5 watts</td>
<td></td>
</tr>
<tr>
<td>0.05 watts</td>
<td></td>
</tr>
<tr>
<td>0.2 watts</td>
<td></td>
</tr>
</tbody>
</table>

**SHORT SPECIFICATION**

**S. E. C.**

**BRT 400D**

For the full specification please send for a copy of publication BC2084.
NEW

LEARN THE PRACTICAL WAY — COURSES WITH EQUIPMENT

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SUBJECT(S) OF INTEREST

(We shall not worry you with personal visits)
THORN CONTRIBUTIONS TO
space & weight saving
IN EQUIPMENT DESIGN

The need for saving space and weight in modern electronic and panel control equipment is an ever present problem. The Atlas Midget panel bulb was designed with these difficulties particularly in mind. Tiny in size, simply and robustly constructed, its success is confirmed by type approval from the R.A.E., Farnborough, and S.R.D.E., Christchurch.

The development of the Atlas Midget panel bulb made possible the production of the Thorn Miniature Sealed Panel Lampholder, which has been developed specifically for the Armed Services. It is available with dimmer or indicator cap, and will withstand conditions of constant vibration and shock.

Brief details are given below, but further enquiries are invited.

THORN MINIATURE SEALED PANEL
LAMP HOLDERS

Overall length including contacts: 1.43 ins. Dia.: .75". Weights: with Indicator Cap 0.276 ozs., with Dimmer Cap 0.644 ozs. Conform to Radio Components Specs. (Prov.) 201. Humidity Class. H.1. Temperature category 40/100 (-40°C. to +100°C.). Pressure sealed to 20 lbs./square inch.

Completely weatherproof and will withstand conditions of constant vibration and shock. Rotation of the dimmer/joap controls the light output from bright to dim by means of an internal metal shutter. Developed originally for A.F.V.'s, Thorn Miniature Sealed Lampholders have many other obvious applications.

The holders are insulated from the panel which can vary from $\frac{1}{16}$ to $\frac{1}{8}$ thick. Thicker panels may be counterbored. Single hole mounting facilitates fitting. Rotation is prevented by flats on the body. The lamp can be replaced without breaking seals, by unscrewing cap.
For moulding, potting or sealing purposes, no resin can compare with ‘Araldite’. Added to remarkable electrical and mechanical qualities, it offers outstanding adhesion to metals, while shrinkage in setting is exceptionally low. ‘Araldite’ resists high temperatures, humidity and corrosive agents and fulfils the Services specification for sealing and potting electrical equipment.

Our illustrations are of three components from Pantak Ltd., Slough, makers of X-ray equipment. Such mouldings must combine high mechanical strength with the capacity to withstand high voltages. They exemplify the versatility of ‘Araldite’ epoxy resins.

These are the new Epoxies!

‘Araldite’ (regd.) epoxy resins are obtainable in the following forms:

- Hot and cold setting adhesives for metals and most other materials in common use.
- Casting Resins for the electrical, mechanical and chemical engineering industries.
- Surface Coating Resins for the paint industry and for the protection of metal surfaces.

Full details will be sent gladly on request.

Araldite epoxy casting resins

Aero Research Limited

This cable mounting elbow connector is the latest addition to our well-known range of plugs and sockets complying with R.C.S. 322.
For full details please write.
COSSOR
Model 1322

Telecheck and Marker Generator for Bands I and III

Model 1322 — used in conjunction with a cathode ray oscillograph — provides equipment for the display, measurement and correct adjustment of RF and IF response curves of television receivers. This entirely new instrument comprises a swept oscillator covering the Television BANDS I and III (5-75 Mc/s. and 155-255 Mc/s.) and a frequency marker oscillator so that precise calibration of the oscillograph display may be made; accuracy of the frequency of the marker pips being verified by reference to an internal crystal. The alignment oscillator is set to the video carrier to which the receiver is tuned and the sweep (either 1 Mc/s. or 10 Mc/s.) is automatically derived from the time base voltage of the display oscillograph. The response of the "strip" under test to the frequency band applied is then presented on the screen of the cathode ray tube. The RF output of Model 1322 is available at 75 ohms and is adjustable from a maximum of 40 millivolts to a minimum of 10 microvolts through a coarse and fine attenuator.

TELECHECK CONVERTER FOR BAND III

This adaptor provides owners of Model 1320 "Telecheck" with an extension of the frequency range of the original instrument into the BAND III television channel. Thus, alignment procedures adopted for BAND I RF/IF "strips" are available also for BAND III receivers. A selection of the desired BAND is made by means of a switch. Pattern generator facilities for picture time base linearity checks have been retained. Model 1321 Adaptor is designed for permanent attachment to the standard "Telecheck" providing a neat, light and compact unit. Mounting is effected by four screws and the inter-connecting wiring is carried in a single insulating sleeve.

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TRUCHORD reproducers are the result of extensive research carried out by electronic engineers who are specialists in the sphere of high fidelity record and radio reproduction. They have been built to give a general performance capable of satisfying even the most critical of music lovers at a price within the reach of all.

Truchord Corner Reproducer
A really High Fidelity corner loudspeaker unit with built-in amplifier. The cabinet is a corner reflex type sand filled baffle, in oak, mahogany or walnut veneer, fitted with high fidelity amplifier as used in the Truchord Model 50T, and 12in. Bakers Selhurst Auditorium loudspeaker. Price 36 gns. Corner loudspeaker and cabinet only, 21 gns.

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A high-fidelity unit ideal for record, radio or microphone reproduction. 10in. Goodmans high-flux Loudspeaker pick-up and microphone sockets incorporated. Provision for switched output to extension speaker. 3 ohm or 15 ohm imp. Polished mahogany cabinet. Size 18in. x 12in. x 12in. List price 26 gns. Available with built-in power pack for 6 v./12 v. battery operation. Price on application.

The Truchord "VERTU"
A high-fidelity radiogramophone at a moderate price. 5 valve three waveband superhet radio chassis with high-fidelity output stage, specially designed for L.P. records and giving faithful reproduction over the whole audible frequency range with no discernible distortion. Variable N.F.B. tone control. Collaro 3-speed auto-changer with high-fidelity Studio head. Handsome walnut veneer bass reflex cabinet with cream interior panels. Size 30in. x 30in. x 15in. List Price 54 gns.

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This outstanding instrument in the range of high-fidelity equipment incorporates: 5 valve push-pull amplifier unit with variable N.F.B. control. Separate bass and treble controls. Fitted with the Collaro 3 Special Units Changer and matched high-fidelity Studio heads. 10in. Wharfedale "Golden" loudspeaker or Bakers Selhurst 12in. Auditorium L.S. Handsome walnut veneer reflex cabinet with cream interior panels. List Price 165 gns. Also the "Octavia", 90 gns. Model 50 RC 73 gns. Model 50 RC/5 68 gns.

TRUCHORD LIMITED
82 GT. PORTLAND ST., LONDON, W.1.
Telephone: MUSEum 7674
**Hi Fi HIGH FIDELITY AMPLIFIER**

**MODEL PF91**

**28 GNS.**

**MODEL PF91A**

**12 GNS.**

(U.K. PRICES ONLY)

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**PF 91**

4 ft. extension cable available free of charge. 20 ft. extension cable available for 35/-.

- Built to proved mechanical and electrical engineering standards and suitable for continuous use even under tropical conditions.

- Frequency range substantially flat over entire audible range of 20—20,000 cycles per second, up to 12 watts output.

- Low noise level.

- The damping factor is variable from 35 to infinity to suit the loudspeaker used.

- Very low harmonic and intermodulation distortion.

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*Here is confirmation of our claims for this outstanding amplifier. Copies of the NATIONAL PHYSICAL LABORATORY REPORT and our comprehensive descriptive booklet on the PF91/91A are available on request from Pye Ltd., Box 49, Cambridge.*
All the designers sat on the problem..

The design department had dreamed up a super portable but the battery just wouldn’t go in. Unless specially designed batteries were ordered, the project would have to be quashed.

Designers of battery radio sets should note this dilemma. Time, effort (and money) are wasted if you prepare a design and then find you haven’t left room for the battery. Of course, Ever Ready can—and do—supply special units, but it’s so much simpler to call us in early so that your set is designed, if possible, to take one of our many standard batteries.

Dry Batteries for Radios

*If you have a design problem involving dry batteries, get in touch with us at Hercules Place, Holloway, London, N.7 Telephone: ARCHway 3030.
"Cyldon" Capacitors have a world-wide reputation for efficiency and dependability. We welcome enquiries for types not covered by our standard range. Our resources and experience are at your service.

Equipment Manufacturers and Wholesalers are invited to write for literature covering Cyldon "Teletuners" (Ref. T.V. 1953) and Cyldon Trimmers (Ref. T. 1951), together with details of our complete range of Variable Capacitors and list of Agents for Home and Overseas.

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Prompt delivery
Competitive Prices

LOW LOSS CERAMICS for the Electronic Industry

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become available to you
with these brilliant equipments

The SENSATIONAL

The Tape Recorder
for every home

The smallest lowest-priced Tape Recorder giving a full hour's playing time. Completely self-contained for recording. PLAYS BACK THROUGH ANY RADIO OR AMPLIFIER. At 26 gns. it represents unbeatable value.

26 GNS.
(Corr. & Packing 12½d.)

SPECIFICATION
☆ With single knob control for RECORD, PLAYBACK, REWIND and FAST FORWARD without unloading tape. ☆ "PLAYTIME" record and plays back with equal ease in any position, even upside down or on its side. ☆ Because it is scientifically developed and precision engineered, there is absolute minimum wow and flutter. ☆ Built-in 3-stage specially matched pre-amplifier with miniature MULLARD valves. ☆ Uniform frequency response between 60/8,000 c.p.s. ☆ Automatic erasure of unwanted recordings. ☆ Powered by specially designed motor. ☆ Balanced high fidelity twin track recording heads completely enclosed in handsome dress cover, affording complete protection against stray magnetic and electrostatic fields. ☆ Overall size 12½in. x 10in. x 1½in. Weight 10lb. ☆ Size of tape table only 11in. x 8¾in. ☆ For use on A.C. mains 220/250 v.

ACCESSORIES
High Fidelity crystal microphone 52s.- One Hour Spool of tape 20/-8. The "Playtime" is supplied complete and ready for use with above accessories for £31/4/6.

E. & G. MAIL ORDER SUPPLY CO.
The Radio Centre.
33 Tottenham Court Road. - London - W.1 - Tel: MUS 6667
SCALAMP FLUXMETER

Excellent design and the selection of the most suitable materials are combined to give this new FLUXMETER a truly outstanding performance. The drift rate with a search coil of 10 ohms or less is 0.1 per cent. A two speed “return-to-zero” control is fitted enabling measurements to be made with rapidity and ease. A spirit level and levelling feet facilitate setting-up and the automatic and manual coil clamps safeguard the suspension in transit. The illumination of the lamp bulb is effected either by an external 4-volt battery or by mains supply through the built-in transformer. Two search coils of mean diameter 1 cm and of area, turns of 10 or 100 sq. cm are available.

Please write for our descriptive leaflet quoting Cat. No. W.W. 8834

OUR NEW ILLUSTRATED CATALOGUE IS AVAILABLE ON REQUEST

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W. G. PYE & CO. LTD., GRANTA WORKS, CAMBRIDGE, ENGLAND

WO.55
These loudspeakers have been designed to provide minimum magnetic interference together with high acoustic efficiency. ELAC Elliptical and round loudspeakers are used in most of the leading Television and Radio receivers.

**PRICES INCLUDING P.T. FOR LOUDSPEAKERS LESS TRANSFORMER AS FROM NOV. 1st 1954.**

<table>
<thead>
<tr>
<th>Size</th>
<th>Description</th>
<th>Flux</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>7&quot; x 4&quot;</td>
<td>Elliptical</td>
<td>6,500 Gauss</td>
<td>21/10 PM. 6G</td>
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<tr>
<td>3 1/2&quot;</td>
<td>PM. 3G</td>
<td>6,500 Gauss</td>
<td>19/10 PM. 8D</td>
</tr>
<tr>
<td>5&quot;</td>
<td>PM. 5G</td>
<td>6,500 Gauss</td>
<td>20/6 PM. 10D</td>
</tr>
</tbody>
</table>

**ELECTRO ACOUSTIC INDUSTRIES LTD.**

Stamford Works, Broad Lane, Tottenham, N.15
the new

**Taylor**

**SIGNAL GENERATOR**

*For TELEVISION 240 Mc/s*

**Model 67A**

- Frequency range 100 Kc/s-240 Mc/s.
- Accuracy ± 1%.
- Attenuation continuously variable 100 dB. Total scale length 48in.
- Very effective R.F. screening.

**LIST PRICE £22.0.0** Prompt Delivery

**ELECTRONIC TEST METER**

**Model 171A**

- A robust valve voltmeter well suited for T.V. work and general laboratory use.
- A.C. 0-1 to 250 volts. 20 c/s to 200 Mc/s ± 2dB.
- 20 Megohms input resistance.
- D.C. 0-1 to 1,000 volts. 25 Kv. by optional probe.
- Resistance 0-1,000 megohms.
- Output 5 ranges –25 dB to +43 dB.

**LIST PRICE £26.10.0** Prompt Delivery

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**Other Taylor products include:**

- A selection of Multi-range Meters
- Cathode Ray Oscilloscopes, T.V. Sweep Oscillators, Valve Testers, Resistance and Capacity Bridges, Output Power Meters, R.C. Oscillators, Megohm meters, Insulation Testers, etc.

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LAB Storage Unit!

The LAB Continuous Storage Unit is widely acknowledged as the most efficient and convenient method of storing and selecting resistors. Now its usefulness is still further extended with the introduction of LAB pak'd 'Ceramicaps'. With the LAB Unit, research and experimental laboratories and small production groups have to hand immediately, a complete range of resistors and 'Ceramicaps', easily selected with card index simplicity from some 700 sorted and carded components. Empty cards are merely replaced with full ones from stock.

The LAB unit is supplied FREE with initial purchase to your specification. Standard assortments available. Each LAB Unit can be used to store one type of component exclusively, or quantities of the complete range of resistors and 'Ceramicaps'. Full details and illustrated list will be sent on application.

THE LAB CONTINUOUS STORAGE UNIT

★ Continuous Storage for Resistors and 'Ceramicaps'
★ Values separately carded
★ Finger-tip Selection

The Lab Continuous Storage Units are available from your normal source of supply, but more detailed information can be obtained from:

THE RADIO RESISTOR COMPANY LTD
50 ARBETY GARDENS • LONDON • N.W.8 • Telephone: Maida Vale 5522
DESIGNERS of compact and efficient tuned circuits and wave filters are making ever-increasing use of Mullard high Q inductance coils.

Based on Ferroxcube, the world's most advanced magnetic core material, these coils combine small size with an inductance of up to 30 henries over a wide frequency range. Furthermore, their convenient shape and self screening properties facilitate either individual mounting or stacking.

Full details of these and other high grade components now available from Mullard will be gladly supplied on request.

**Special Features**
- Small size
- Low hysteresis loss factor
- High value of inductance
- Low self capacitance
- Controllable air gap facilitating inductance adjustment
- Self screening
- Controlled temperature coefficient
- Operation over a wide frequency range
- Easily mounted

'Ticonal' permanent magnets, 'Magnadur' ceramic magnets, Ferroxcube magnetic cores.

**TYPICAL Q VALUES**

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**FREQ. Kc/s.**

Mullard

MULLARD LIMITED • COMPONENT DIVISION • CENTURY HOUSE • SHAFTESBURY AVENUE • LONDON • W.C.2 (MN450)
BICC Couplers and Cables are intended for the outdoor inter-connection of equipment, such as that mentioned above. Each application calls for composite trailing cables containing both R.F. units and other polythene insulated conductors.

BICC Polypole Mark III Couplers are available in two versions, designed for use with two standard types of BICC outdoor trailing cables. The Mark IIIA cable and coupler incorporates three coaxial circuits, and the Mark IIIB three screened twin circuits. In addition, both cables contain three triplets and 21 other conductors.

The couplers are permanently moulded to the ends of the cable in the factory. This technique provides a remarkably robust coupler which is virtually free from the hazards of conductor breakages near to, or within the coupler.

If you are interested in the uses of BICC Polypole Cable Couplers, we will be pleased to send you further information.

Note these important features:

1. The couplers are assembled with the conductors in tension to ensure that they each contribute their share of the total strength.
2. The cable itself is designed with a symmetrical cross section to provide the greatest reliability under severe handling.
3. Screwed lock rings provide forced engagement and withdrawal. The overall metal housing can also be easily replaced should it become damaged.
4. Polythene injection moulding permits a watertight assembly.
When a designer contemplates the input stage from a gramophone pickup he can (a) amplify and then compensate, (b) compensate before amplification, (c) compensate over the first stage by feedback.

No single method is acceptable over a wide range of impedances if the requirement is low distortion and low noise. His choice and the circuit impedances used will depend upon the output level of the pickup, its source impedance, its load impedance and its characteristic.

In the QUAD 11, the first stage circuit connections and their impedances are contained within a detachable plug unit. A range of units covers optimum design requirements for all types of pickups.

- ONLY THE QUAD 11 GIVES PERFECT MATCHING AND OPTIMUM INPUT CIRCUIT ARRANGEMENTS. ONE OF THE REASONS WHY THE QUAD 11 GIVES THE CLOSEST APPROACH TO THE ORIGINAL SOUND.
Three Versatile Instruments
FROM THE WAYNE KERR RANGE

V.H.F. Impedance Bridge Type B.801
For balanced and unbalanced measurement from 1-100 Mc/s.
Susceptance: Equivalent to ±230 pF.
Conductance: 0-100 mmho.
Accuracy: ±2%, ±0.5 pF.
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This is one of a range of bridges for use with external source and
detector for the measurement of aerials, cables, feeders, and a
variety of components and materials between 15 kc/s and 250 Mc/s.
Bridge sources and detectors are available for use between
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A moderately priced 50 c/s instrument with a very wide
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To measure the relative levels of the components
of a complex waveform over a range of 75 db
between 50 c/s and 20 kc/s. Input impedance 100K
unbalanced or >25KΩ balanced. In transportable
case as shown, or for standard 19" mounting.

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Our Chief Engineer, who is operating a Technical Guidance Service, is available daily, including Saturdays, from 10 a.m. to 6 p.m., and will deal with enquiries and the return of post. Our new Illustrated Catalogue and Supplement will be a great boon to those desiring high quality equipment for modest expenditure. Send two 2d. stamps for your copy now. It may well save you pounds.

CURRENT GARRARD PRODUCTS AVAILABLE FOR IMMEDIATE DELIVERY FROM STOCK AT PRESENT.

MODEL TA 3-speed unit, but with plug-in turnover head Type G.C.2, £10/15/-, or with Acos HGP 33 or 37 heads, £6/14/-, or with two separate high fidelity Acos HGP35 heads, £12/17/-. Unit less heads, £6/11/-. post 2/-.

MODEL TB as above, but with long pickup arm. Less heads, £6/11/-, post 2/-. Heads, £2/3 each, post 1/-. Post on heads 1/-. Unit with new turnover head, £7/9/6, with two separate Acos HGP35 heads, £10/5/-.


DECCA RECORD PLAYER. Model 349M comprising Garrard 3-speed unit Model TB with two Decca XMS heads, £35/-.

DECCA Model 349C, as above, but fitted Decca crystal heads, same price. Carr. 7/6.

BASS REFLEX CABINETS, fully finished in figured walnut, oak or mahogany to our own design and to match our Console Amplifier Cabinets, enabling the housing of a whole complete Carriage in a piece of furniture.

**SNIP NO. 1** GARRARD LATEST MODEL RC80M AUTO-CHANGER. Fitted with full-length Pickup Arm to take 3-pin plugs-in heads, manufactured end of Oct. 1954. PRICE LESS HEADS, £15/5/9/-. These extraordinarily versatile units can be supplied fitted with the following combinations of Pickup Heads at the following prices:

- With two Decca XMS 35/70 Magnetic Heads, £20/15/-.
- With two Decca Crystal Heads, £18/10/6/-. With Decca Crystal for L.P. and Garrard Miniature in Mag. Std., £16/17/9/-. With adaptor and two Acos HGP39-I Heads, £23/6/6/-. With adaptor and one Acos HGP39-I Head for L.P. and Garrard Miniature in Mag. Std. High Impedance for Std., £19/17/-.

**SNIP NO. 2** "MONARCH" 3-speed AUTO-CHANGER fitted with latest ACOS HGP37 turnover Pickup Head for Std. and L.P. Plays 12in., 10in., and 7in. records mixed in any order. Capacity 20 records. Operates on 100/125 and 200/250 v. A.C. 50/60 c/s. Unit plate measures 12in. x 10in. Height above plate required 5in.; depth below required 2in.


IMMEDIATE DELIVERY. Leave 2d.

BASS EXTRAVAGANCE 16 Gns., plus carriage 7/6.

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16, KINGS COLLEGE RD., ADELAIDE RD., LONDON, N.W.3. Phone: PRinmore 8314


**CONSOLE AMPLIFIER CABINETS** above, 35/- high, lifftop, lid with piano hinge, take Tape Deck, Gram Unit or Auto-changer, Amplifier, Pre-amplifier, and Radio Feeder Unit, finished medium walnut veneer. De Luxe version, 10 gns. carriage according. Other veneers 10/- extra.
OTHER PEOPLE'S AMPLIFIERS and Radio Feeder Units

If any reader should have his mind set on a high priced amplifier of another make but would like to save some money if possible, we should like to make the following clear-cut offer: If he buys one of our Symphony Amplifiers (Black or Deco version) and is not satisfied with it he may return it for full credit against any other Amplifier on the market. It should be emphasised at this stage that as Retailers we can supply any amplifier or Radio Tuner advertised in the "Wireless World" or "Gramophone".

HIGH FIDELITY LOUDSPEAKERS

We have made an extensive survey of the high-fidelity loudspeaker market and, after careful tests in our laboratory, we can recommend the following as representing the best value for money. The actual choice of a model is determined largely by the amount of money which can be allocated to this item, and we advise customers to get the best they can afford, as it is a very important item in the reproduction chain. The mounting of the speaker is just as important as the speaker itself, and for maximum results the speaker should be mounted in one of our Bass Reflex Cabinets (except the Axiom 150 which has its own cabinets). Advice freely given. If in town, call for a demonstration.

WHARFEDALE. Super 5, £6 13s. 3d. Super 8 CS (with cloth surround), £6 4s. 6d.; Super 8 CS AL (with aluminium speech coil), £6 13s. 3d.; Golden CS 10in., £8 6s. 7d.; W12 15s. 9d.; £9 15s.; Series 12 CS AL, £17 10s.; V15S, £17 19s.

GOODMANS: Axiom 101 Bin., £6 12s. 1d.; Axiom 102 Bin., £9 18s. 2d.; Axiom 150 Mark 2 12in. twin-cone model, £10 5s. 6d.; Audiom 60, £8 12. 6d.; Audiom 60S, special 35 c.p.s. bass-resonance model to act as bass unit in twin-speaker outfits, £8 12s. 6d. New model Orin £10 11s. 6d.; £10 15s.

WHITELEY (W.B.). Model HF 812, £3 5s. 6d.; HF 912, £3 9s. 6d.; HF 912S, £3 13s. 4d. These models are fitted with new universal impedance speechcoil, matching 7,5 and 15 ohms. Model HF 1214, £9 15s. 6d. (15 ohms only). Metal-cone Pressure-Unit, 15 ohms, £3 15s. 6d. Special Crossover Unit to match, £1 6s. 4d. recommended for use in twin-speaker outfit employing the HF 1012 or HF 1214 as bass speaker. G.E.C. New Model with metal cone 4 ohms impedance, £8 15s. Special matching transformer available to match this speaker to 15 ohms, 17s. 6d. Special octagonal cabinet in veneered walnut to G.E.C. specification for this speaker £19 10s.

TANNOW. Direct Diffuser model (12in.), £10, Duo-concentric model (12in.) with crossover, £17 10s. Duo-concentric, £3 10s. E.M.G. FILTER. An infinitely variable Steep-Cutting Filter for insertion in the loudspeaker circuit to reduce surface noise on 78's, "edge" on some L.P.'s and heterodyne whistles on radio. Price £6 10s.

WB. BASS REFLEX CONSOLE CABINET especially designed by Whiteley Electrical to house their HF 1012 10in. model together with the Pressure Unit and crossover. Both bass and treble units are housed inside the cabinet which measures 32in. high x 22in. wide x 16in. deep. The cabinet is supplied fully cut and ready veneered and polished and complete with speaker fabric in kit form for easy home assembly. Price £10 10s. incl. packing. Carriage according to area. This cabinet fitted with the two above-mentioned units gives very pleasing results. Illustrated leaflet on request. Recommended Bass speaker £3 17s. 6d. Pressure Tweeter and Crossover Unit, 5 gns.

GOODMANS CORNER CABINETS (left) for the AXIOM 150 Mark 2 manufactured by us to Messrs. Goodmans measurements. Height: 44in. Price: complete kit in plain board with lin, thick felt: £8 8s. Price ready built, 10 gns. Finished in figured walnut, 16 gns. Other veneers to order. Carriage extra according to area.

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We have carefully tested the few makes of F.M. Tuners on the market at present and are pleased to be able to recommend and supply the following:

CHAPMAN Model FM81. Tuneable Model with attractive fascia panel and dial. Will provide amazing degree of realism with complete absence of background noise when working with the N.R.S. No. 2 Symphony Amplifier or other high fidelity amplifier. Price £19. Call for a demonstration or send for leaflet.

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ELPICO Tape Deck as per"Impresario" Recorder, push-button controls, high-fidelity heads. Price 19 gns.

TAPE AMPLIFIER as per"Impresario" Recorder. Separate Treble and Bass controls, mean level indicator. Price 19 gns.

TRUVOX Tape Deck Mark III. Price 22 gns.

TAPE AMPLIFIER TYPE C, expressly designed by Truvox to work perfectly with their Deck 3-valve plus rectifier and Magic Eye level indicator. Price 16 gns.

Portable Cabinet to house the Truvox Deck and Tape Amplifier, 65 carr. paid. Radio Jack to inject local Radio Programmes into Tape Recorder or Amplifier. Price £3 19s. 11d., post 1s. 6d.

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Tubes: Swiss, Cottage or Chalk Farm

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CAPACITIES: 5 pf. to 0.5 mfd.
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HSA Type: with additional sealing for use in exceptional humidity conditions.
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ADCOLA SUPPLIES BIT SIZES 1/8" 1/6" 1/4"

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THE SPECIALIST TOOL FOR TV AND RADIO MAINTENANCE AND BENCH ASSEMBLY LINES

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1/8" Bit
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PROTECTIVE SHIELD
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INSTRUMENT MODEL
With Collet held 1/8" Bit
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British, U.S., Canadian Patents
Reg. Designs 86032, 86803, 873158, 871264

Stock volt ranges
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Since the Copenhagen Wavelength Convention in 1948 there has been rapid deterioration in the reception on both medium and long wave stations, until we arrive at a position where nearly 800 stations are transmitting on space that can only accommodate 250.

In July of last year the P.M.G. announced the B.B.C.'s scheme for a series of F.M. stations to overcome the present chaotic conditions. The B.B.C. are now transmitting F.M. programmes from Wrotham in Kent of unsurpassable quality with uncanny freedom from background noise. The F.M. service will shortly be extended to many parts of the country. The listener must now do his share by using equipment capable of doing justice to these high quality transmissions.

Armstrong announce the FM56 Tuner

CIRCUIT: A low noise triode R.F. stage is coupled to a high stability frequency changer. This is followed by two I.F. stages and a triple diode triode ratio detector and A.F. stage.

COVERAGE: 85 to 95 m.c.s.

OUTPUT: 3 volts r.m.s. max.

IMAGE REJECTION: 26 db

L.F. REJECTION: 60 db.

POWER SUPPLIES REQUIRED: 30 m.a. at 250 volts 6.3 v. 2 amps.

SIZE: Panel 9 1/2 x 5 1/2 cut-out required: 9in. x 4in.

PRICE: £21 0 0 (inc. tax).

Visit our Showrooms (address below). Weekdays 9—6 p.m. (Sats. until 5 p.m.). High Fidelity Demonstration on Thurs at 7 p.m. For further details write to Dept. W.J.


Developed for use in very high voltage—low current circuits, these rectifiers give approx. 600 volts output for each inch of length. The highly insulated tubular construction and the end tags for soldering enable them to be wired directly into circuit, whilst, providing adequate insulation is present, there is no limit to the number that may be connected in series. Below are tabulated some of the many types available in this range of:

WESTALITE

RECTIFIERS TYPE 36EHT & 36K

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<th>TYPE No.</th>
<th>PEAK INVERSE VOLTAGE</th>
<th>R.M.S. INPUT VOLTAGE</th>
<th>OUTPUT VOLTAGE</th>
<th>PEAK PULSE INPUT VOLTAGE</th>
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For further information on EHT rectifiers, write for Data Sheet No. 60 to Dept. W.W.I.

WESTINGHOUSE BRAKE & SIGNAL CO. LTD.
82 York Way, King's Cross, London, N.1
Telephone: TERminus 6432
The G.E.C. metal cone loudspeaker gives lifelike reproduction of any type of sound over a range of 9 octaves. This includes the entire musical fundamental range together with overtones which give tonal quality and character to the performance of each musical instrument.

The sound engineer will appreciate the simplification and improvement in performance which has been achieved by combining the following attributes in a single unit.

- Smooth response over a range of nine octaves with extremely good low frequency response
- Negligible inter-modulation
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£8.15.0 TAX PAID

For the Home Constructor
This is a professional instrument and must be used under the correct conditions to obtain the optimum results. Cabinets have been specially designed for use with this loudspeaker, details of which are available.

Metal Cone Loudspeaker

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The wide range of EGEN controls includes: Carbon Potentiometers Type 102 • Pre-set Resistors Type 104 • Miniature Carbon Potentiometers Type 105 and 115 • Sub-miniature Volume Controls Type III, 123 and 125 • T.V. aerial plug and socket • Pre-set potentiometers Type 126/127.

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The S. S. White Flexible Shaft Handbook which gives full information on the various aspects of Flexible Remote and Power Controls is obtainable upon request.

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in product design

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Never before has a Tape Unit of such advanced design been offered at the amazingly low figure of £18/10/- Precision engineered and exquisitely finished the Lane Mark VI represents unprecedented value in the realm of Tape Recording. Attractive discounts are available to quantity buyers. Note these special features.

- Three high grade motors.
- Single knob control electrically and mechanically interlocked.
- Drop-In tape loading.
- Automatic brakes.

- 2 speed. 7½in./sec. 3½in./sec.
- Speed change at turn of a key.
- Twin Track.

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Model VM853

- WIDE RANGE OF VOLTAGE MEASUREMENTS
- HIGHEST POSSIBLE INPUT RESISTANCE ON ALL RANGES
- MEASURES FROM D.C. TO U.H.F

On the lower D.C. ranges, this instrument approaches conditions of an electrostatic voltmeter and on A.C. ranges a measuring diode contained in an external probe, is provided. To minimize the effect of the metal body of the probe, the insulated terminal head can be replaced by a spike. All-range indicator consists of a 5-inch meter fitted with knife-edge pointer and mirror scale. Send for leaflet giving full specification.

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A range of 360 standard types available for "off the shelf" delivery in several different mounting styles including both open and hermetically sealed "C" cores.

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2400 RELAY

A Relay of noteworthy dimensions, designed in size and performance to suit present day electronic equipment. The new 2400 Relay is available with twin light duty or single heavy duty contacts.

When fitted with a 10,000 ohm coil, the pull-in is approximately 4 milli-amperes; contact pressure and clearance have not been sacrificed to achieve this sensitivity.

DIMENSIONS: Above chassis 2 1/2" high x 1" wide x 1 3/8" deep.

WEIGHT: 4 1/4 ounces.
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A new type of T.V. downlead has recently been introduced under the trade mark of “Aeraxial.” This cable has lower attenuation than solid types and yet is available at the same price (£/6. per yard). Other cables available include twin feeders (screened and unscreened) for 75 ohms and 300 ohm applications as well as 50 ohm and 18 dB, 24 dB and 36 dB and carries plug and socket ends. It may be instantly inserted in aerial downleads. Other accessories include plugs, couplers, lighting arrestors, brackets, etc.

Two valuable additions to the accessory range are the Part No. 166 coaxial plug and the Part No. 169 In-line attenuator. The plug is of three piece construction and is easily fitted to the semi-airspaced and standard types of coaxial cables. The In-line attenuator is available in five types, 6dB, 12dB, 18dB, 24dB and 36dB and carries plug and socket ends. It may be instantly inserted in aerial downlead. Other accessories include plugs, couplers, lighting arrestors, brackets, etc.

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Two valuable additions to the accessory range are the Part No. 166 coaxial plug and the Part No. 169 In-line attenuator. The plug is of three piece construction and is easily fitted to the semi-airspaced and standard types of coaxial cables. The In-line attenuator is available in five types, 6dB, 12dB, 18dB, 24dB and 36dB and carries plug and socket ends. It may be instantly inserted in aerial downlead. Other accessories include plugs, couplers, lighting arrestors, brackets, etc.

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Hall Electric Ltd., send Greetings and Good Wishes for 1955 to all their Overseas Customers and thank them again for their continued support.

During 1954 great strides have been made in electronic tube design, with the result that many new types have been produced. Most of these types are already in our stocks, which, we believe to be the most comprehensive available and now consists of over 1,200 types of both receiving and transmitting tubes. If you have not received our latest price and stock lists we will be pleased to supply same on request.

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HALTRON HOUSE, 49-55 LISSON GROVE,
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Tel.: Ambassador 1041 (5 lines) Cables: Hallocate, London
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FERROVOICE PLASTIC TAPE

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HIGH OUTPUT
LOW BACKGROUND NOISE
EASE OF ERASURE
HIGH TENSILE STRENGTH
NON-CURLING

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On the well-known universal Ferrovoice Spool
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300 ft 12/6

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Photograph of stamping by courtesy of Murphy Radio Ltd.

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The "ANTEX" is the original 'X' aerial, designed and patented by Antiference. Although widely imitated, it remains unsurpassed in performance, reliability and ease of installation. It is the only COMPLETELY pre-assembled 'X' aerial.

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**NEW SNAPACITOR DIELECTRIC**— The insulative capacitive coupling introduced by us to avoid metal to metal contact and the resultant corrosive effects, as well as absolute protection from the weather, now incorporates a completely new type of insulation which is not only tougher, but enables still higher capacity to be obtained with greater signal efficiency.

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**NEW "GATEGRIP" MAST BRACKET**— All Antiference aerials are designed for the greatest convenience of the rigger and their simplicity of erection has now been further improved by the introduction of a mast bracket that features fully retained spoke bolts that can be swung aside for insertion of the mast and swung back for tightening—enabling the rigger to have both hands free at all times.

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LOCKWOOD
Standard Loudspeaker Cabinet

This new 'LOCKWOOD' model has been manufactured to meet the demand for a cabinet of high quality, and in conjunction with various loudspeaker units and high fidelity apparatus is capable of giving reproduction of a very high order.

*A vented design developed from the Monitoring Loudspeaker Cabinet used by The British Broadcasting Corporation (BBC. PAT. 696,671), this enclosure is, we believe, the sensible approach to the problem of providing good quality in the home at a reasonable price.

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A brochure, free on request, fully explains this new model and why it is supplied ready to assemble.

EXPORT & TROPICAL MODELS AVAILABLE.
Trade enquiries invited.

DEMONSTRATIONS BY APPOINTMENT ONLY.
$100,000,000 is a lot of money by any standards! This is the amount which RCA has devoted to television research and development and from which the RCA compatible colour television system in the United States of America has emerged.

**IN INTRODUCING COLOUR, RCA** has developed many specialised items of equipment which can be made available to manufacturers preparing for the introduction of a British colour television service.

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An Associate Company of the Radio Corporation of America.
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No ceramics or mica are used in ORYX soldering instruments. Nothing to go wrong. Entirely designed and made in England for production line reliability and pin-point precision soldering

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<table>
<thead>
<tr>
<th>Model</th>
<th>Consumption</th>
<th>Voltage</th>
<th>Bit Diameter</th>
<th>Weight</th>
<th>Length</th>
<th>Price</th>
<th>Spare Bits</th>
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<tr>
<td>12</td>
<td>12 watts</td>
<td>6, 12, 24 or 50</td>
<td>3/16&quot; (4.8 mm)</td>
<td>0.5 oz</td>
<td>6 1/2&quot;</td>
<td>£1 5 0</td>
<td>2/-</td>
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<tr>
<td>11*</td>
<td>10 watts</td>
<td>6 only</td>
<td>5/32&quot; (4 mm)</td>
<td>0.5 oz</td>
<td>6&quot;</td>
<td>£1 15 0</td>
<td>7/6</td>
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<tr>
<td>9</td>
<td>8.3 watts</td>
<td>6, 12 &amp; 24</td>
<td>5/32&quot; (4 mm)</td>
<td>0.25 oz</td>
<td>6&quot;</td>
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<tr>
<td>6A</td>
<td>6 watts</td>
<td>6 only</td>
<td>3/32&quot; (2.4 mm)</td>
<td>0.25 oz</td>
<td>6&quot;</td>
<td>£1 5 0</td>
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<tr>
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<td>6 watts</td>
<td>6 only</td>
<td>1/16&quot; (1.6 mm)</td>
<td>0.25 oz</td>
<td>6&quot;</td>
<td>£1 5 0</td>
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</tr>
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*Special High Temperature Model: Fixed Bit

3 TOWER HILL - LONDON - EC3 Phone: ROyal 4439 Grams: (Overseas) "Antexlim, London" SUPPLIERS TO H.M. AND FOREIGN GOVERNMENTS, LEADING ELECTRONIC, HEARING AID, INSTRUMENT, RADAR, RADIO, TV AND ELECTRO MEDICAL MANUFACTURERS, HOSPITALS AND UNIVERSITIES THROUGHOUT THE WORLD.

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You can hear this outstanding Amplifier at your local High Fidelity Specialists or at our Showrooms at Holloway, which are open on weekdays from 9 a.m. to 6 p.m. (Saturdays until 5 p.m.). You are particularly invited to attend our special High Fidelity Demonstrations on Thursday evenings at 7 p.m. If you would like further particulars please write to us (Dept. W. 1.) for descriptive booklet.

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"RECORD NEWS" (November 1954) says:

"Its quality of reproduction is quite excellent, its power output more than adequate for all normal loudspeaker systems, its distortion infinitesimal and its frequency response leaves nothing to be desired. It can only be praised and recommended without reservation."
HIGH QUALITY
SOUND REPRODUCTION

A growing domestic market

The great advances which have been made in sound reproduction, notably in recordings, gramophone equipment and loudspeakers, have led to a growing public demand for high quality reproducing apparatus.

Mullard’s contribution to these trends has been the development of a range of audio valves of advanced design which meet the most exacting requirements of amplifier designers, and which are already used by leading amplifier manufacturers.

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A High Quality 10 watt Amplifier circuit using 5 of the latest audio valves was demonstrated by Mullard at the recent Radio Exhibition at Earls Court to a large and enthusiastic audience. This particular circuit is designed for easy construction at relatively low cost and will especially appeal to those enthusiasts who up to the moment have been unable to afford the higher cost of more elaborate equipment.

The circuit and the valves are fully described in Mullard publication MV8104 which is now being advertised. Manufacturers of components and complete equipment who may wish to utilise the circuit information or to offer components which conform with the specification are cordially invited to apply for full details. Arrangements have been made to check and approve prototypes and components if manufacturers wish to refer to the Mullard specification in their own literature and advertising.

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In all cases:

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* A single switched meter is provided for monitoring voltage and current.

Advanced design ensures superior performance. High grade components are used throughout and valves are conservatively rated for long life.

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Direct current power supplies may be cheaply and efficiently provided from alternating current mains by the use of G.E.C. selenium rectifiers. Maintenance costs are low as no moving parts are required. Efficiency may be as high as 80%. No damage is caused by very high overloads — up to 10 times overload may be applied for 2—3 seconds. The unit illustrated is rated at 28V 1000A but larger or smaller units are available to meet any requirements.
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★ Built as a musical instrument, sounds like a musical instrument.
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★ Indispensable for studio monitoring, or where definition and quality of reproduction is required.

LOWTHER
F.M. TUNER
Tunable over V.H.F. Band II. Quality reception guaranteed from Wrotham and other sites when ready.

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Plus purchase tax £7.6.4

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Fitted with sapphire stylus. £9/10/- (plus £3/3/3 P. Tax)
£5/10/- (plus £1/16/7 P. Tax)

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Illustrated are a few signal lamps taken from our wide range. The insulation of every Arcolectic signal lamp will resist a flash test of 1,500 volts A.C.
The S.L.90 illustrated here is a typical Arcolectic low voltage signal lampholder. It is designed to accept popular M.E.S. bulbs. The bulb is accessible from front or rear of panel. The domed plastic lens surrounded by a polished chrome bezel gives a most attractive panel appearance. This holder can be fixed in a single 3" hole.
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"SYNC. CANCELLED A.G.C."

Before it became necessary for television receiver designers to make provision for Band III reception, vision automatic gain control was, generally speaking, essential only in fringe area models. Long period signal fading, which A.G.C. combats, is normally severe only in fringe areas, although special circumstances can arise that make A.G.C. desirable in areas of good signal strength.

But now that alternative programmes are imminent, and most receivers are being designed for two band operation, vision A.G.C. has become necessary on standard as well as fringe models. The difference in strength between Band I and Band III signals may be found appreciable in many areas, and if viewers are to be saved major adjustments to sensitivity controls every time they switch from one band to the other vision A.G.C. is essential.

Vision A.G.C. Systems

Broadly speaking, there are three forms of vision A.G.C. that can be employed: mean level A.G.C., gated A.G.C. and "Sync. Cancelled A.G.C." Each of these circuits has its own special merits, depending upon the particular circumstances prevailing.

The mean level circuit is especially useful in fringe area conditions and is incorporated in the current "His Master's Voice" fringe models. It relies in its operation on the fact that in any series of pictures the average of black and white areas is reasonably proportional to the strength of the signal, and so an A.G.C. voltage can be derived relatively easily. Its value as a fringe circuit is enhanced by its ability to correct automatically the tonal quality of pictures containing an abnormally high proportion of black, as occurs, say, in transmission of night-time scenes.

Gated A.G.C. is a good circuit, but requires rather more components than the other systems. This circuit works on the principle that the amplitude of the "back porch" is directly proportional to the signal level. The video signal is applied to a valve which is rendered conducting by a "gating" pulse from one of the scanning circuits in the receiver. If the gating pulse is made to occur at the correct time and for the correct duration to be coincident with the back porch, then the valve conducts and measures the amplitude of the back porch, thereby providing an A.G.C. voltage.

"Sync. Cancelled A.G.C."

The third system, evolved by "His Master's Voice" engineers, is "Sync. Cancelled A.G.C.", which combines the advantages of the systems previously mentioned with simplicity, low cost and consistent performance in difficult, varying conditions. "Sync. Cancelled A.G.C." has been incorporated in the current "His Master's Voice" two-band "Highlight" receivers. The technique of the system consists very simply of measuring the amplitude of the sync. pulse, which is, of course, directly proportional to the signal strength. This is done in two steps. The peak of the inverted television signal (sync. pulses positive going) is clamped to a known reference voltage by a diode circuit, such as the grid-cathode of the sync. separator valve. The sync. pulses are then completely cancelled by pulses from the sync. separator valve, and the resultant signal is re-measured by peak detection of the A.G.C. diode. If the reference voltage is zero, then the output of the A.G.C. diode will be a negative voltage proportional to the sync. pulse amplitude. If the reference voltage is positive, then a negative A.G.C. output will not be produced until the signal has reached a prescribed amplitude. Since noise pulses are essentially in the same direction as picture signals, this circuit has the advantage that A.G.C. voltages are unaffected by interference.

"HIS MASTER'S VOICE"
This Coil Pack is for use with a 500 pF 2 Gang Condenser and covers the standard Long, Medium and Short Wavebands with the addition of the Band 50/160 metres, 1.85/6 Mc/s. This covers the Trawler Band, 105/160 metres, Shipping, 68/74 metres, Aeronautical 52/55 and 95/105 metres, and the 80 and 160 metre Amateur Bands.

The CP.3 IF comprises of Aerial and Oscillator coils wound on “Neosid” formers complete with iron dust tuning cores, Wavechange Switch and Mica Compression Trimmers mounted on an aluminium plate. Fixing is effected by an additional nut on the Wavechange Switch. The I.F. is 465 kc/s. For use with any standard frequency changer.

Retail Price: 49/- plus 16'4 P.T.—Total 65/4.

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It is the LOUDSPEAKER which re-creates the sound and it is the LOUDSPEAKER above all which must be BEYOND REPROACH.

We have loudspeakers for every purpose and set manufacturers are invited to collaborate with us on all problems relating to sound reproduction.

Model P44
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IN RESPONSE TO NUMEROUS REQUESTS FOR THE INCLUSION OF THE TRAWLER BAND ON OUR PRESENT RANGE OF SEVEN MINIATURE COIL PACKS WE NOW INCREASE THE RANGE TO EIGHT AND PRESENT THE FOUR WAVEBAND CP.3/F. FOR 500 pF. TUNING CONDENSER.

This Coil Pack is for use with a 500 pF. 2 Gang Condenser and covers the standard Long, Medium and Short Wavebands with the addition of the Band 50/160 metres, 1.85/6 Mc/s. This covers the Trawler Band, 105/160 metres, Shipping, 68/74 metres, Aeronautical 52/55 and 95/105 metres, and the 80 and 160 metre Amateur Bands.

The CP 3/F comprises of Aerial and Oscillator coils wound on “Neosid” formers complete with iron dust tuning cores, Wavechange Switch and Mica Compression Trimmers mounted on an aluminium plate. Fixing is effected by an additional nut on the Wavechange Switch. The I.F. is 465 kc/s. For use with any standard frequency changer.

Retail Price: 49/- plus 16/4 P.T.—Total 65/4.

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Denco (Clacton) Ltd. 357/9 Old Road, Clacton-on-Sea, Essex


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This Coil Pack is for use with a 500 pF. 2 Gang Condenser and covers the standard Long, Medium and Short Wavebands with the addition of the Band 50/160 metres, 1.85/6 Mc/s. This covers the Trawler Band, 105/160 metres, Shipping, 68/74 metres, Aeronautical 52/55 and 95/105 metres, and the 80 and 160 metre Amateur Bands.

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Retail Price: 49/- plus 16/4 P.T.—Total 65/4.

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SCIENTIFIC DATA PROVES WHY THE REVOLUTIONARY
WINDSOR FLAME FASHIONED STYLUS
IS ROUNDED TO THE POINT OF PERFECTION!

THE HARDEST
Under Knoop Hardness Test:
FLAME FASHIONED 2,300
Normal Sapphire 1,600

THE STRONGEST
Average Tensile Strength:
FLAME FASHIONED 102,000 lb./sq. in.
Normal Sapphire 67,000 lb./sq. in.

THE SMOOHEST
See the Brush analyser charts below.

1 Polished with Diamond. 2 Tumbled by Sapphire Bearings process. 3 Flame Fashioned by Sapphire Bearings.

Not even WINDSOR FLAME FASHIONED STYLI last for ever—
but they are the HARDEST, SMOOHEST, STRONGEST Styli ever made!

The Charts above are records from a Brush surface analyser, comprising a diamond point riding on the sapphire surface, so that the movement of the diamond point is transmitted through a piezo-electro crystal and an amplifier to a recording oscillograph. The magnification in the vertical direction is 40,000 and in the horizontal direction 16. In Fig. 1 the surface irregularities caused by diamond scoring occur at regular intervals and reach to 15 microns from the datum line. In Fig. 2 the irregularities are no higher than 2 microns. Fig. 3 shows the perfect smoothness of the flame fashioned surface.

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Highest quality reproduction from STANDARD and MICRO-GROOVE records.

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Incorporates the No. 500 Cartridge, and has the following features:
- Precision Cast Arm.
- Very low Vertical Inertia.
- Free-running lateral bearings.
- Single hole pedestal mounting adjustable to suit all turntables.
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(Sapphire Styli)

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75 ohm. TV DOWNLEAD CABLE
Nominal Attenuation at 50Mcs:-2.5dB/100ft.

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**High-Speed Oscilloscope**

**Type 830**

**Y PLATE AMPLIFIER:**
- Frequency Response:
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- Sensitivity:
  - 75 millivolts per cm.
- Rise-time:
  - 30 Millimicroseconds.

**TIME-BASE:**
- Range: 0.05 second to 1.5 microseconds.
- Operation: Triggered or repetitive.
- Expansion: Variable up to 5 times.
- Traverse:
  - A traverse control enables any portion of the expanded time-base to be viewed.

**E.H.T. VOLTAGES:**
- 1, 2 or 4 kV.

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*d Full details of this or any other Airmec instrument will be forwarded gladly upon request.*

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Tel: High Wycombe 2060
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WE SPECIALISE IN HIGH QUALITY TUNERS FOR USE WITH ANY OF THE WELL-KNOWN AMPLIFIERS

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IMPROVED VERSIONS ARE NOW IN LARGE SCALE PRODUCTION. A NUMBER OF MODIFICATIONS HAVE BEEN MADE TO THE CIRCUIT PROVIDING SUPERIOR PERFORMANCE AND HIGH EFFICIENCY.

Fundamental coverage 100 Kc/s—70 Mels. Calibration accuracy ± 2% on all bands. C.W. or M.C.W. and separate fixed A.F. output controls on front panel—attenuator, range switch, tuning, modulation On/Off and mains On/Off. Stout metal ease finished cream with leather handle—front panel black with natural lettering.

SGM.1 — MAINS OPERATED WITH DOUBLE WOUND IMPREGNATED TRANSFORMER.
SGB.1 — OPERATION BY STANDARD ALL-DRY BATTERIES.

ILLUSTRATED LEAFLET .......... 2d.
These really powerful units in compact form give quality and performance right out of proportion to their midget size and modest cost. Osmor "Q" Coilpacks have everything that only the highest degree of technical skill can ensure—extra selectivity, super sensitivity, adaptability. Size only 11 x 34 x 21 with variable iron-dust cores and polystyrene formers. Built-in trimmers. Tropically tested. Prealigned. Receiver-tested and guaranteed. Only 5 connections to make. All types for plates and battery superhet, and T.R.F. receivers. Ideal for the reliable construction of new sets, also for conversion of the 21 Receiver, TR.1196, Type 1B, Wartime Utility and others. Send today for particulars!

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### OSMOR STATION SEPARATOR

The Separator may easily be tuned to eliminate any one station within the ranges stated and fitting takes only a few seconds. Sharp tuning is effected by adjusting the brass screw provided.

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#### CHASSIS CUTTER

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<th>Type Hole Sizes</th>
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<td>1 lin. x 1lin.</td>
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<td>2 lin. x 1lin.</td>
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<td>3 lin. x 1lin.</td>
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<tr>
<td>4 lin. x 2lin.</td>
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De Luxe model by Neverlin, £4/15/-.

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45 pin screen. 4 in. Valve Heater. This Electrostatic Tube is recommended as eminently suitable for Television. £37/- plus 5/- Plg., carr. and ins. Data sheets supplied.

GRAMOPHONE PRE-AMPLIFIER

Power requirements 200-250 v., 2 ma., and 6 1/2 3a. This may be taken at existing radio.

All the components to build the above unit, 22/6, plus 1/6 pkg. and postage.

Famous Manufacturer’s Surplus of ANTI-INTERFERENCE AERIALS offered at a fraction of original cost

The aerial is designed for reception of long, medium and short waves, with any ordinary or communications receiver, having an input impedance greater than 1,000 ohms magnet with 150 ohm short waves. The installation discriminates against locally generated electrical interference, especially on the short wavebands. The equipment makes the installation of an 18 in flat-filament aerial which operates as a "T" aerial on medium and long waves. The aerial and receiver Transformers are intended for all interconnected with a 70 ohm coaxial cable.

COMPONENT PARTS

Aluminium Aerial Transformer Assembly. Comprising our own 21/6 rectangular transformers, Transformer dip. rubber mount, 6 in. x 6 in. brass screw, 4AB 1/4 in. brass nuts, 4AB 5/8 in. Screen clip. Transformer. Complete with insulators, clips, etc.; porcelain insulators 2 each, 60ft. insulated aerial wire, 50ft. screened coaxial down lead. Installation instruction leaflet included.

High grade Co-Axial Cable & Aerial Wire, 15/-, plus 1/6 pkg. and carr.

COMPLETE, 35/- plus 1/6 pkg. and carr.

LEAD BOLT CO-AXIAL CABLE & AERIAL WIRE, 15/-, plus 1/6 pkg. and carr.

QUALITY CRYSTAL PICK-UP ROTHERMEL TYPE U48 26/-

Pack 1/- Pack and Carr.

H. P. TERMS

Deposit £10.4.9 and 12 monthly payments of £2.17.7

SEPARATE UNITS CAN BE SUPPLIED AS LISTED BELOW—

Amplifier (built, wired and tested with Speaker). £4/15/-, plus postage and carriage 7/6.

Amplifier Kit (including Speaker). £11/10/- plus packing and carriage 5/.

Hire purchase terms, Deposit £3/13/9 and 12 monthly payments of £1/6/.

New Lane 2-speed Tape Unit Mark 6, £13/10/- plus packing and carriage 7/6.

Hire purchase terms, Deposit £4/12/6 and 12 monthly payments of £1/6/.

Post War Cabinet (reline covered). £4/19/6, plus postage and carriage 5/.

Microphone, £2/15/-, plus postage and carriage 1/.

Reel Scotch Boy Tape MC2-111 (1,200 ft.), £1/5/-, plus packing and carriage 1/.

Instruction Booklet, 2/6. Post free.
WILLIAMSON AMPLIFIER KIT 15 gns.
plus 7½ p. a. p.
H.P. Terms: De£ 5.5.0 & £2m'thy pm'tol£ 19/9
This Kit is absolutely complete and all components are guaranteed exactly to author's specification.

WILLIAMSON OUTPUT TRANSFORMER
Author's Specification 2.6 ohms secondary £4.4.0

MAIN TRANSFORMER SP425A
(Completely Shrouded)
This Transformer has an additional 6.3 v. 3A and is capable of supplying an extra 30 mA. for Preamplifier or Pre-amp output.

WILLIAMSON CHOKES
2H 150 mA. Fully shrouded... 19.6
3H 30mA. Fully shrouded... 11.9

3-BAND SUPERHET RECEIVER

DECCA MODEL 33A DUAL SPEED RECORD PLAYER
Includes crystal pick-up with stylius and a light-weight plastic sprung balanced arm. Heavy gauge pressed steel case with seven enamel finish in good quality for operation on A.G.C. mains 200/250 v. 50 c.p.s. Supplied complete with single head (either standard or long playing). £13.8.6
Extra Head can be supplied. Plus pkg. and carr. 5/-

PREMIER VARIABLE IMPEDANCE "MATCH TUBE" M.O.I5 OUTPUT TRANSFORMER
Designed to meet the demand for an efficient variable main Output Transformer (1) ratios (new 1:1 to 90:1 at all centers tapped and can be used to match any output valves either single or push-pull Class "A", "AB" or "B" to any low impedance speech coil or combination thereof. Primary Inductance 25 henries 15 watts audio 100 mA. Price 4½£.

LOUDSPEAKERS
ELAG—2½in. dia., Moving Coil, 15 ohm imp... 15/-.0
PELSB—5in. dia., Moving Coil, 9 ohm imp... 8/11
PELSB—8in. dia., Moving Coil 3 ohm imp... 18/-6
PELSB—5in. dia., Moving Magnet, 3 ohm imp... 18/-6
GOODRACE—12in. dia., Moving Coil, 15 ohm imp... 22/6
Plus ¥.25.0 packing and carriage £3/12/6
VITAVOX—12in. dia., Moving Coil, 15 ohm imp...
Plus ¥.15.0 packing and carriage £3/11/11

CRYSTAL MICROPHONE INSERTS
Ideal for tape recording and amplifiers. No Matching transformer required, 2½ ft. jack plugs.

PREMIER MAINS TRANSFORMERS
All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened.
SP175A. 50-0-50, 100 mA., 5 v. @ 2-3 a., 6.3 v. £5.15
SP425A. 350-0-350, 150 mA., 10 v. @ 2-3 a., 6.3 v. £2.21
SP500A. 350-0-350, 150 mA., 10 v. @ 2-3 a., 6.3 v. £3.30
SP501A. 500-0-500, 250 mA., 15 v. @ 2-3 a., 6.3 v. £4.30
SP605A. 450-0-450, 200 mA., 6 v. @ 2-3 a., 6.3 v. £4.40
SP606A. 500-0-500, 250 mA., 10 v. @ 2-3 a., 6.3 v. £5.50
SP607A. 1000-0-1000, 500 mA., 4 v. @ 1 a., 6.3 v. £10.10
SP608A. 200-0-200, 250 mA., 5 v. @ 2-3 a., 6.3 v. £2.10
SP609A. 200-0-200, 150 mA., 5 v. @ 2-3 a., 6.3 v. £2.20
SP610A. 250-0-250, 250 mA., 5 v. @ 2-3 a., 6.3 v. £2.30
SP625A. 250-0-250, 500 mA., 2 v. @ 2-3 a., 6.3 v. £2.50
SP630A. 200-0-200, 500 mA., 5 v. @ 2-3 a., 6.3 v. £2.60
E.M.T. TRANSFORMER, primary 210 x 230 v... £3/7/6
210 v., secondary 25 v. and 2 v... £3/12/3

E.M.T. TRANSFORMER, primary 210 x 230 v... £3/7/6
210 v., secondary 25 v. and 2 v... £3/12/3

Build these NEW PREMIER DESIGNS

4-WATT AMPLIFIER

Build your own 4-WATT AMPLIFIER

MAY RE BUILT FOR...
WIRELESS WORLD
WILLIAMSON OUTPUT TRANSFORMER £7.19.6
plus 7½ p. a. p.
W. 350-0-350, 150 mA., 10 v. @ 2-3 a., 6.3 v. £5.15
plus 2½ p. a. cart. £4.10.0

CRYSTAL MICROPHONE
One specially designed crystal microphone which can be safely used on A.C./D.C. amplifiers. High impedance No background noise, really natural tone. Ideal Mike for tape, wire and sound projectors, price up to £3.00.

MAINS NOISE ELIMINATOR KIT
Two specially designed chokes for smoothing condensers with circuit diagram. Cuts out all mains noise. Can be assembled inside existing receiver, 6/- plus 6d. pkg. and carr.

Germansfrii Crystal Diodes. G.E.C. wired end, 2/6d. -4/-

May be built for a Cure

Latest type Superhet Circuit using 4 valves and metal rectifiers for operation on 200/250 volts A.C. Waveband coverage—short 16-50 metres, medium 180-500 metres, and long 900-2000 metres. Valve line-up 6K8 freq. changer, 6K7, 1F, 6Q7 Detector AVC and first AF, 6V6 output. The attractive cabinet to house the Receiver size 12in. long, 6in. high, 14in. deep can be supplied in either WALNUT or IVORY BAKELITE or WOOD. INSTRUCTION BOOK 1/- (post free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components.

INSTRUCTION BOOK, 1/- (Post Free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components.
PREMIER RADIO COMPANY

SPECIAL OFFER

5-VALVE SUPERHET RADIO

RECEIVER

PRICE £10.19.6

In highly polished walnut cabinet. Built to high standards ensuring quality reception. Specifications:

VALVE LINE-UP: 9F7, 7F1, 7O8, 7S8, 7V4. 3 WAVEBANDS: Long, Medium and Short. CONTROL: Tuning, wave change, volume tone control using Gram Position on switch. Pick-up and Extension Speaker sockets incorporated. For use on 200/250v A.C. mains.

DIMENTIONS: Width, 16in. Height, 13½in. Depth 8in.


POWER SUPPLY UNIT

For above Incorporating output stage. Supplies an output of 250 volts at 80 mA. Suitable for the H1160 with the output stage. Sockets for connecting the Power Pack to the Receiver are included. The 6V6 output stage complete with Clarion transformer and 6in. speaker is built into the unit. Price £4.9. Packed in packing and carriage.

The two above Units together on Hire Purchase Terms: £6.1.14 deposit and 12 monthly payments of 14/5.

FUSE-FULL OUTPUT TRANSFORMERS. 2 x 6V6 into 225 ohms, 5/6. post free.

T.1144. BRAND NEW COMPLETE WITH VALVES £2.19.6 post and carriage 1/6.

METER RECTIFIERS. Miniature type with leads 1-1/2 in. 4/6. post paid.

AMPLIFIER TYPE AE1144. Battery operated 9 valves, type VR.31 and VR.33, 6/11, postage and carriage 1/6.

HEAVY DUTY POWER RESISTANCE. 17.5 ohms, 8 a., voltage handling 5 Amp long, 5½in. diameter, 15/10, postage and carriage 3/10.

HEAVY DUTY F.L. TRANSFORMER. Primary tapped 24 vs. 20 cycles, secondary 4.2 vs. 10 a. 4.2 vs. 10 k., 200v, postage and carriage 9/6.

ROTARY RESISTANCE. Wire wound heavy duty 14 ohms, 7/6, postage and carriage 1/7.

VACUUM PUMPS. For model makers etc. Ex-R.A.F Type 70-3M. £1.11. 2/6. postage and carriage 1/7.

COMPONENTS AVAILABLE FOR THE MULLARD AND OSRAM DESIGNS

FREQUENCY MODULATION

All components for the Denno F.M. Unit, less Valves £4-16-1. Packing and postage 1/6.

GARRARD S5 UNIT

Garrard rim drive 78 r.p.m. complete with magnetic pickup and turntable. £4-19-6. Packaging and packing 2/6.

All components supplied for our Radio and T.V. Designs are guaranteed for a period of 12 months (Valves carry the usual Maker’s 3 months’ guarantee).

LAMINATIONS IN BULK PROMPTLY

PROTOTYPES TOO!

We supply all types of Laminations in bulk promptly. All metals and specifications in most cases immediately available. All Silicon Iron Laminations are manufactured from Richard Thomas & Baldwin’s range of FerroSil Electrical Sheets. Nickel Iron Alloy Laminations are supplied in the Permalloy range of materials. We undertake the manufacture of special prototypes for customers’ new designs in the shortest possible time that size, type and circumstances permit.

Send us a sample or sketch of your requirements, together with the specification, which will receive immediate attention.

WE ARE SPECIALISTS IN BONDED LAMINATION PACKS.

ELECTRONIC LAMINATIONS LIMITED

Telephone No : Slough 25171/2

OXFORD AVENUE, SLOUGH, BUCKINGHAMSHIRE

LAMINATIONS

WE ARE SPECIALISTS IN BONDED LAMINATION PACKS.
A Monarch Automatic Record Changer is produced every 15 seconds throughout each day. This outstanding production achievement, which will be bettered in the very near future, is the first fruit of an extensive re-equipment programme recently laid down by B.S.R. Here the finest precision machinery, the most modern production methods and raw materials and labour of the highest standard are integrated to produce the world's finest autochanger. Here rigid stage by stage quality and accuracy control, and rigorous final testing determine the reliability and superlative performance the listener has come to expect of the Monarch. B.S.R. are today the world's largest producers of autochangers and players outside the U.S.A.

MONARCH
AUTOMATIC RECORD CHANGER

BIRMINGHAM SOUND REPRODUCERS LIMITED, OLD HILL, STAFFS
Wireless World
RADIO, TELEVISION, ELECTRONICS

JANUARY 1955

Managing Editor : HUGH S. POCOCK, M.I. E.E
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VOLUME 61 NO. 1
PRICE: TWO SHILLINGS
FORTY-FOURTH YEAR OF PUBLICATION

25. DAF96, DK96, DF96 and DL96, in ABC Receivers

The design of 25mA filament chains for ABC receivers is governed by the need to provide satisfactory conditions for the output valve. With the simple series chain of shunted filaments given in Fig. 1, the DL96 bias is derived mainly from the voltage drop across the other filaments. It is, therefore, highly dependent on the l.t. voltage. When the h.t. and l.t. batteries are new, the bias is about $3 \times 1.5V = 4.5V$, and the h.t. is 90V. Satisfactory operation will continue until the l.t. battery voltage has fallen to 1.1V per cell, when the bias will be 3.3V and the h.t. may be about 65V. If the l.t. battery is renewed at this stage, the bias will increase and the output will be reduced to a very low value. If, instead, the h.t. battery is renewed, the high h.t. voltage and low bias will produce an excessive cathode current in the DL96.

Tests in a receiver have shown extremes of 1.5mA and 5.0mA for the DL96 cathode current under these varied battery conditions. Separately renewable h.t. and l.t. batteries can thus be used only if the DL96 bias does not include the voltage drop across the other valves. This is achieved if the DL96 is placed at the earthy end of the filament chain, with bias taken solely from a resistor in the h.t. negative lead. But three difficulties arise: AGC provision is complicated; decoupling of the filaments will be difficult if the DAF96 is at the positive end of the chain; and, if the DL96 is the next valve in the chain to the DAF96, its filaments may act as a common cathode resistance — producing multivibrator action.

If the h.t. and l.t. negative lines are separated (Fig. 2), the DL96 cathode current is held, in a typical receiver, between 2.4mA and 5.0mA; but dependence on AGC is increased. (One resistor in Fig. 2 is shown dotted, as it has a high value and it does not greatly affect the operation of the circuit).

High stability (3.0mA to 5.0mA) is achieved with the circuit shown in Fig. 3. There are two additional advantages: the DL96 cathode current falls as the l.t. voltage falls; and valves may be added to the chain without increasing the cathode current variation. But there are two disadvantages: the h.t. current flows through the l.t. battery and increases its consumption by about 30%; and the bias resistor has to produce the required bias plus $2 \times 1.4V$, therefore it must be a high-value close-tolerance component.

Similar stability, with the extra battery drain reduced from 30% to 12%, is given by the recommended circuit (Fig. 4), which provides satisfactory DL96 conditions at the cost of this smaller increase in l.t. battery consumption. This cost is adequately compensated by the ability of the circuit to work down to low voltages. Practical resistor values, for typical cathode currents, are shown in Fig. 4. Notes on the calculation of resistor values will be included in the reprint of this advertisement. Details of the requirements for mains operation have appeared in the Additional Notes to advertisement No. 23 in this series.

Reprints of "Valves, Tubes, and Circuits" (with Additional Notes) are obtainable without charge from the address below.
... it is evident that BRIMAR high-grade cathode-ray tubes meet the most exacting specifications of television and electronic equipment manufacturers.

And detailed examination of the company's resources and experience in this field reveal that BRIMAR introduced:

- the first mass produced aluminised cathode-ray tube;
- the first flat faced tube;
- the first 14" rectangular tube;
- the first 17" rectangular tube;
- the first 21" rectangular tube;
- the first electro-static tube.

Research and development to anticipate and meet the changing demands of the radio and electronic industries are integrated with modern manufacturing techniques in the production of BRIMAR cathode-ray tubes.

Consult BRIMAR — the people who know — for your future equipment requirements

Standard Telephones and Cables Limited

FOOTSCRAY • SIDCUP • KENT Telephone: FOOTSCRAY 3333
Recording techniques have made such strides over the last two years that if you are to get the really superb reproduction made possible by the latest L.P. records you need one of the Acos "Hi-g" Pick-ups. These have been specially designed to meet the very exacting demands of the new records with their shallow groove and microscopic sound "track". This special design is necessary on two scores — firstly to do justice to the brilliant recording, and secondly to ensure the longest possible life from L.P. records. Such records are expensive; even a single playing with an unsuitable pick-up can cause irreparable harm.

If you want the best reproduction and value from your radiogram or record player and L.P. records ask your dealer (or post the coupon below) for details of the "plug-in" ACOS "Hi-g" Pick-ups — specially designed to replace existing pick-ups on most famous makes of record playing equipment. The cost? 32/6d. (plus 10/5d. P.T.)

ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

... always well ahead

To: COSMOCORD LIMITED, ENFIELD, MIDDLESEX.
Please send me details of ACOS "Hi-g" replacement pick-up heads

NAME
ADDRESS

WW
**NOTES**

New Service Areas

There seems to be a spate of new low-power television transmitters opening up all over the country from Redmoss near Aberdeen to Hessary Tor, near Princetown, Devon. Generally, the transmitters have a period of testing on low power from a low mast, followed by regular transmissions still on low power and low mast. After a pre-arranged period the transmitter is switched to its full power, using its high mast. The time lapse between low power and normal power may be six to nine months. A field strength contour of 100 μV/m on low power might reasonably be expected to become 500 μV/m when the transmitter is on full power. This really means that the power available at a receiving aerial will be 25 times as great as when the transmitter is on low power, Now 100 μV implies that an aerial, and 400ft. mast, Brighton is expected to get a good signal, but even then, there may be a few viewers within a short distance of the Truleigh Hill mast who will have become accustomed to a "swamp" signal and who will miss it.

The "Belling-Lee" mobile research unit has been in Brighton for a few days; our engineers were endeavouring to sort out fact from rumour: that there are bad spots not to be denied. The unit is continuing west into the Rowridge area investigating suspected difficult points, with particular attention to localities just north of the Downs; Perworth, Midhurst and Petersfield for example.

**Band I & Band III**

After the research unit's return from the South, it will be used in an investigation into a comparison of reception conditions between Band I and Band III, using the Sutton Coldfield transmissions as a basis. It may not be generally known that Sutton Coldfield is sending out a low power square wave signal on Band III. We will take the research unit to an open site and balance the Band I and Band III signals, and will then drive the unit around, behind hills, through woods, in built-up areas, etc., all the time watching and recording the effect on the two signals. We suspect that Band III will be more troublesome with reflections and shadowing, but we must be sure.

Science is truth, and we do want to approach this matter in a scientific manner eliminating guesswork. Our findings will be made available to the industry, and others will benefit from the thought, time and money expended on such a project. As we have manufactured more than half the total number of television aerials that have been erected, it is worth our while to do this work, in fact we feel it our duty to the industry.

During a very recent run around the coast in the region of Hastings and Rye, the writer was agreeably surprised to see the number of "Belling-Lee" aerials that were up, and that were looking really smart. In general they stand up well and do not lose their elements, and that is how we can give with each a three-year guarantee and insurance cover.

**TERMINAL BLOCK**

- bends, but will not break!

- This unique component is designed to provide great flexibility in both planes, thus enabling it to be secured to curves or irregular surfaces. It is moulded in P.V.C., which securely grips the terminal screws—they cannot fall out even if totally unscrewed from their inserts and the block mounted upside down.

The block is mechanically shock-proof and can easily be sub-divided with an ordinary knife into smaller groups of terminals. Fixing holes provided for each pair of terminals.

12-way strip, rated at 5 amp., but may be used at the designer's discretion up to 10 amp., or up to 2 kV peak working voltage between terminals or between terminals or chassis. Overall size, 5" x .750" x .625" high. Hole centres spaced .425".

**Advertisement of BELLING & LEE LTD.**

COSSOR ENGINEERS
MOVE THE ALPS

These two 40-mile range PPI photographs were taken on the Cossor Airfield Control Radar Mk. VI now installed at Zurich, Switzerland. That on the left is the normal radar display. The other PPI (right) shows clearly the effectiveness of the Cossor developed PERMANENT ECHO CANCELLATION circuits; the moving aircraft responses previously obscured are now revealed.

Mountainous terrain such as is found in Switzerland, with saturation ground returns, has hitherto been a nightmare for radar operators. Cossor engineers specialize in advanced development of this kind and have produced THE FINEST CONTROL RADAR—ACR MK. VI BY COSSOR.

COSSOR AIRFIELD SURVEILLANCE RADAR (ACR Mk. VI)
A view of the installation at the Zurich Airport.

COSSOR

- PERMANENT ECHO CANCELLATION
- C.R.D.F. SUPERIMPOSITION
- 60 MILES RANGE
- VIDEO MAPPING

THE COSSOR GROUP OF COMPANIES • Highbury Grove • London • N.S
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BEST PRODUCTS LTD • COSSOR (CANADA) LTD • BEAM INSTRUMENTS INC. (U.S.A.)
Marconi VHF FM Multi-Channel Terminal and Repeater Units

HM 100 AND 150 SERIES

Marconi VHF multi-channel systems provide reliable and economical communication. Up to 48 telephone channels can be provided simultaneously and some of these may be further sub-divided by VF telegraph channelling equipment to give either 18 or 24 telegraph channels. The equipment operates in conjunction with carrier apparatus which is the same as that already standardised for use on line systems. Such a radio system can operate over hundreds of miles by placing repeater units at suitable points along the route.

The HM 100 and 150 series of equipment will operate entirely unattended and change-over is automatic in duplicate systems.

All units can be easily withdrawn for inspection and maintenance.

Over 80 countries now have Marconi equipped telegraph and communication systems. Many of these are still giving trouble free service after more than 20 years in operation.

Lifeline of communication

MARCONI

COMPLETE COMMUNICATION SYSTEMS
Surveyed, planned, installed, maintained

MARCONI'S WIRELESS TELEGRAPH COMPANY LTD., CHELMSFORD, ESSEX

Partners in progress with The 'ENGLISH ELECTRIC' Company Ltd.
Progress Report

Increasing demand for SenTerCel selenium rectifiers, germanium devices and SenTerCel equipment is evidence that these products are meeting the exacting needs of industry.

"Standard's" policy of continually improving quality and increasing production is expressed in a bold plan to move its Rectifier Division to a new factory in Harlow, Essex.

This factory, the largest in Europe built solely for the production of metal rectifiers, has been designed specifically to provide the particular facilities essential to the manufacture of these products.

Standard Telephones and Cables Limited

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

RECTIFIER DIVISION: Edinburgh Way, Harlow, Essex

Telephone: Harlow 26811

Telegrams: Sentercel, Harlow
The amplifier, speaker and case, with detachable lid, measures 8½in. x 22½in. x 15½in. and weighs 30 lb.

**PRICE, complete with WEARITE TAPE DECK**  £84 0 0

**POWER SUPPLY UNIT** to work from 12 volt Battery with an output of 230 v., 120 watts. Suppressed for use with Tape Recorder. **PRICE** £18 0 0.

**3-WAY MIXER AND PEAK PROGRAMME METER**

For recording and large sound installations, etc.

One milliwatt output on 600 ohm line (.775V) for an input of 30 micro-volts on 7.5-30 ohm balanced input.

Output balanced or unbalanced by Internal switch. The meter reading is obtained by a valve voltmeter with 1 second time constant, which reads programme level, and responds to transient peaks.

Calibration in 2 db steps, to plus 12 db and minus 20 db referred to zero level. Special low field internal power pack supplies 8 valves including stabilising and selenium rectifier, consumption 23 watts.

Manufactured by

VORTEXION LIMITED, 257-263, The Broadway, Wimbledon, London, S.W.19

Telephones: LIberty 2814 and 6242-3

Parmeko make one thing only—transformers; and they make them well—naturally. Their ‘one man, one job’ team of technicians are experts—obviously. The single-purpose plant makes the best use of both time and money—automatically. Leading manufacturers of electronic and electrical equipment have been using Parmeko transformers for more than a quarter of a century. They must think them good—precisely.

PARMEKO of LEICESTER

MAKERS OF TRANSFORMERS FOR THE ELECTRONIC AND ELECTRICAL INDUSTRY.
LEARN THE PRACTICAL WAY

Specially prepared sets of radio parts with which we teach you, in your own home, the working of fundamental electronic circuits and bring you easily to the point when you can construct and service radio sets. Whether you are a student for an examination; starting a new hobby; intent upon a career in industry; or running your own business—these Practical Courses are intended for YOU—and may be yours at very moderate cost.

EASY TERMS FROM 15/- A MONTH

With these outfits, which you receive upon enrolment, you are instructed how to build basic Electronic Circuits (Amplifiers, Oscillators, Power Units, etc.) leading to complete Radio and Television Receiver Testing and Servicing.

BEGINNER'S RADIO OUTFITS — For carrying out basic practical work in Radio and Electronics, from first principles and leading to the design and building of simple Receivers.

TELEVISION Outfit No. 3 — With this equipment you are instructed in the design, construction, servicing and testing of a modern high-quality 15" Television Receiver.

OTHER COURSES WITH EQUIPMENT INCLUDE:

MECHANICS • ELECTRICITY
CHEMISTRY • PHOTOGRAPHY
CARPENTRY
ALSO DRAUGHTSMANSHIP • COMMERCIAL ART
AMATEUR S.W. RADIO • LANGUAGES • ETC.

E.M.I. INSTITUTES The only Postal College which is part of a world-wide Industrial Organisation
The lines of communication...

System Planners
Electronic Engineers
Designers and Manufacturers of
Aeronautical Broadcasting
Communication and Maritime Radio
Equipment, Television, Radar
and Navigational Aids on land,
at sea and in the air

...are in capable hands

MARCONI

MARCONI'S WIRELESS TELEGRAPH
COMPANY LIMITED • CHELMSFORD • ESSEX
**Six Advantages of the Clix Television Turret Tuner**

1. **Accurate switching.**
   The rotating drum of the Ediswan Clix Television Turret Tuner indexes accurately to any of twelve positions and re-sets precisely in these positions after switching. No question of mistuning after switching.

2. **All circuits are adjustable with the unit in position in a Television receiver.**
   Adjustable cores to all inductances are easily accessible with the tuner in position in a Television receiver.
   The tuner can, therefore, be set up or re-adjusted in its actual operating position.

3. **Additional tuned circuits may be added at any time without removing the Tuner from the receiver.**
   The Ediswan Clix tuner is designed so that additional coil segments can be added at any time while the tuner is in position in a receiver.
   To tune to another channel the serviceman merely clips into position additional coil segments, carrying correctly wound coils, and trims them by the adjustable cores provided.
   There is no need to dismantle the tuner or return it to the Factory for any part of this operation.

4. **Wiring reduced to an absolute minimum thereby eliminating stray capacities.**
   Stray capacities between wiring can lead to serious mistuning on the very high frequencies of Television Band 3. The Ediswan Clix Tuner is designed so that wiring is reduced to an absolute minimum and materials are specially selected to overcome the problems of drift and instability encountered on these frequencies.

5. **Easily accessible for servicing.**
   The 'L' section and 'U' section which form the Ediswan Clix tuner are easily parted without removing the drum. This gives easy access to the wiring on the 'L' plate for servicing purposes.

6. **Suitable for mounting in deep or shallow chassis.**
   Four 4BA tapped holes are provided for mounting the Ediswan Clix Turret Tuner. If required, suitable mounting brackets can be provided for use in shallow chassis.

Full technical information and prices on request.
Available to set manufacturers only

**EDISWAN CLIX**

THE EDISON SWAN ELECTRIC CO. LTD.
Member of the A.E.I. Group of Companies

WESTON
panel instruments

Both round and rectangular models of moving iron, moving coil, A.C. rectifier and H.F. thermocouple types are offered. In the range of rectangular instruments, which have been introduced to give the advantage of long, easily-read scales and to harmonize with rectangular panels, certain models are available with illuminated dials. Full particulars of types and ranges available are to be found in leaflets List Nos. W.1 and W.2, copies of which are available on request.

Larger instruments, both round and rectangular and for switchboard or panel mounting, are also available. These have scale lengths of 6' and 6½' respectively.

SANGAMO WESTON LIMITED
Enfield, Middx · Tel: ENField 3434 (6 lines) & 1242 (6 lines) Grams: Sanwest, Enfield
Scottish Factory: Port Glasgow, Renfrewshire. Port Glasgow 14111
Branches: London, CHAncery 4971 · Glasgow, Central 6308 · Manchester, Central 7904
Leeds, Leeds 30867 · Liverpool, Central 0230 · Wolverhampton, Wolverhampton 21912
Bristol, Bristol 2763 · Southampton, Soton 23328 · Brighton, Brighton 28497

Round models are housed in cases of 2", 2½", and 3½" diameter and have scale lengths of 7", 2½" and 2½" respectively.

Rectangular panel instruments are available with scale lengths of 2.5", 8.2", and 4.2". These offer the advantage of an increase in scale length of approximately 50% over their equivalent round models, for which they can be used as direct replacements using the same panel fixing holes.

SOUND SALES

PHASE INVERTER SPEAKER

For its size, this is one of the most attractive loudspeaker combinations I have yet come across. "the standard of reproduction obtainable must be heard to be believed." Not only is there a good, clean treble, well distributed by the diffusers on the front of cabinet; there is also a very firm, clear bass which extends below 30 c/s. Clarity is indeed the most noteworthy characteristic of this speaker. It was this quality that impressed itself on several visitors I had on the day when I was putting the speaker through its paces. That extra half octave above about 12 kc/s. and the corresponding one below about 30 c/s usually cost an awful lot of money. The range here is audible from below 30 up to above 13,000 c/s.

TECHNICAL REPORT by P. WILSON, M.A., of "THE GRAMOPHONE"

Price £14.10.0 complete with cabinet

OBTAINABLE FROM ALL LEADING STOCKISTS

SOUND SALES LIMITED
WEST STREET, FARNHAM, SURREY
Tel.: FARNHAM 6451 (2/3)
Sales up 300%! with the NEW LEAK TL/10 AMPLIFIER & "POINT-ONE" PRE-AMPLIFIER

and this is why

From long experience and by extreme attention to design details during development work on the pre-production models, we enable our labour force to achieve a high output per man-hour. The labour costs thus saved offset the increased costs incurred for high-grade materials, components and finishes, and this together with quantity production (made possible only by a world-wide market) explains how quality products may be sold at reasonable prices. The results obtainable with the new Leak TL/10 and "Point One" are indistinguishable from those obtained with the TL/12 model—a fact easily proved by an instantaneous changeover test. The new TL/10 has been used since its introduction in April last year, and these are some of the reasons why sales of the TL/10 and "Point One," since their introduction in April last year, are three times as great as for the famous TL/12 in the corresponding months of 1953—and why the size of our factory has been more than doubled to cope with this increased demand.

**TL/10 POWER AMPLIFIER**

This 10 watt amplifier maintains, in every respect, the world renowned Leak reputation for precision engineering, fine appearance and fastidious wiring.

**SPECIFICATION**

- **Circuitry**
  - A triple loop feedback circuit based on the famous TL/12.
  - The output transformer is the same size as in the TL/12.

- **Maximum power output:** 10 watts.
- **Frequency Response:** $\pm 1 \text{ db} \, 20 \text{ c/s} \text{ to } 20,000 \text{ c/s}$.
- **Harmonic Distortion:** 0.1%, 1,000 c/s, 7.5 watts output.
- **Feedback Magnitude:** 26 db, main 'oop.
- **Damping Factor:** 25.
- **Hum:** $-80 \text{ db}$ referred to 10 watts.

- **Loudspeaker Impedances:** 16 ohms, 8 ohms, and 4 ohms.

**"POINT ONE" PRE-AMPLIFIER**

The handsome gold escutcheon plate contributes to the elegant appearance, and blends with all woods.

- **Pickup**
  - The pre-amplifier will operate from any pickup generally available in the world.
  - A continuously variable input attenuator at the rear of the pre-amplifier permits the instantaneous use of crystal, moving-iron and moving-coil pickups.

- **Radio**
  - The radio input sockets at the rear permit the connection of the LEAK V.S. tuner unit.
  - An input attenuator is fitted. H.T. and filament supplies are available from the pre-amplifier.

- **Distortion**
  - Of the order of 0.1%.

- **Write for leaflet W**

H. J. LEAK & CO. LTD., BRUNEL ROAD, WESTWAY FACTORY ESTATE, ACTON, W.3

*Phone: SHEpherds Bush 1173/4/5

Telegrams: Sinusoidal, Ealux, London

Cables: Sinusoidal, London
CHASSIS ASSEMBLY

3 coils, 3 evahaps, scale covering standard, Long, Medium, and Short wave-band, scale pan, chassis punched for standard 5-valve superhet, puller driving lead, springs, etc., in set. Plastic side plate 12 1/2 x 7 x 1/2 in., screen plate 12 x 3 x 5/8 in. Price £10, plus 1/- post and packing. This is the one that fits our 37/6-5 table cabinet.

GLASS SCALES, 4/6-DOZEN

An exceptional bargain this month is our assorted parcel of glass scales. A most useful collection for the experimenter or other radio. We offer these scales, mostly in two or three colours for 4/-, plus 9d. post and packing. Limited quantity only.

EX-ROYAL NAVY SOUND POWERED TELEPHONE

These receive on batteries and will go for long periods without attention. Complete with grommet and speaker which gives a high pitched note, easily heard above any other noise. Also fitted with an indicator lamp which in quiet situations cannot be heard instead of the speaker, or where several headphones are used together. These are 143 x 10 x 7 1/2 in., wall mounting, designed for ship use, but equally suitable for home, office, ware-house, factory, garage, etc. Price £7 13/- each, plus 6d. carriage.

GRAMAFON AUTO-CHANGER

Latest type for all famous makers is invariably in stock at competitive prices.

TRANSFORMER 100 WATTS

These are transformers with a wound primary tapped 200, 250, 300, 400, but no secondary. There is ample window space, however, for the bar winding of the secondary to suit any requirements.

LIGHTWEIGHT REFLECTORS

Ideally suitable for all purposes where the least

reflection of electric illumination is required. The material is a special lightweight aluminum, highly polished. All are plated, standard lamp-holding.

STAR, 7 line dia. by 6 1/4 in. deep. Price £9 7/- each. Post, etc., 1/3.

SENSE, 11 line dia. by 1 in. deep. Price £3 13/- each. Post, etc., 1/3.

JUNIOR, 4 line dia. by 2 3/4 in. deep. Price £9 2/- each. Post, etc., 2/3.

BUD, 5 line dia. by 2 in. deep. For 230-volt lamps. Price £6 6/- each. Post, etc., 1/3.

BELL, 5 line dia. by 4 in. deep. Price £6 3/- each. Post, etc., 1/3.

DECCA CRYSTAL PICK-UP

A map for the connoisseur—turnover head suitable for all crystal tubes, 2/- per 2, plus 2/- post and packing.

G.E.C. METAL CONE SPEAKER

This fine speaker is coming to the front rapidly—price £5 15/-.

CONNECTING WIRE SNIP

P.V.C. insulated 25 gage. Suitable for underground or under water. Ideal also for towing around pipes to stop freezing or for unfreezing. Price 18/-.

EVERLASTING GRAPHHONE NEEDLES

Jewel (Nichol's) pointed, suit any type of pick up, position made—improves quality, eliminates vibrations, loud, soft, thinnest, 2/6

Coils, T.R.F. and Superhet

T.R.F. long and medium wave, 6/6. Superhet long, medium, and short wave, serial and coaxial coils, e.g., set of six coils with circuit, 10/-.
MAKE A CONVECTOR

Almost any metal case can be converted into a useful convector type electric heater if you see our porcelain mounted element (20 watt small size). Price 2/6, post free.

CAR STARTER/CHARGER KIT

All parts to build 6- and 12-volt charger which can be connected to a "flexi" battery and can enable one to start instantly. Kit comprising the following:

- Mains transformer 1/6
- 3-amp. rectifier 6
- Regulator Stud 6-inch 2/6
- Resistance Wire 2/6
- Resistance Former 2/6
- Mains on/off Switch 6
- G.-amp. Moving Coil Meter 1/6
- Constructional Data 6

or if bought all together price is 5/6. plus 2/ post and packing.

THE F.M. FEEDER UNIT

All the parts necessary to make the Denco F.M. Unit are now available. The unit gives an A.F. output suitable for feeding into at the pickup socket of any standard receiver. It fits into the space normally occupied by the aerial connector. Designed for use with Marconi, Associated and R.A.F. sets. Price 1/6, post free.

AMAZING LITTLE MAINS T.R.F.

using a twelve valve unit with high efficiency coils covers long and medium wave bands and has a powerful, white or tone, full audio spectrum, excellent volume, everything, £1/15/6 plus 2/- post. Constructional details clear for the parts, or available separately 1/6.

A HAPPY NEW YEAR TO YOU ALL. We take this opportunity to wish you Good Luck and Good Health. May 1955 be your best year yet.

LAST CHANCE TO SECURE THIS BARGAIN

Readers will remember that this fine receiver was offered last month at the lofty price of 4/6 and they have been going out very quickly. If you send immediately, however, you will probably be able to secure one. The set is a product of one of our famous manufacturers, has H.F. stage, tuning indicator, and all modern refinements. Covers 2 wavebands in covering short waves to 11 metres. Offered line valves and power pack, otherwise complete and unpacked price 5/6, carriage 7/6, post and return range valves.

THREE-SPEED GRAMPHONE MOTORS

The latest types complete with armature, crystal, or separate Hi-Fi magnet heads by famous makers are usually in stock at competitive prices.

ANOTHER CLEVELAND CHASSIS—THE "TREMENDO"

The first Cleveland chassis was good but this one is really superb. It has a 7-valve circuit with 6-watt output, fitted with Independent bias and treble control. It is similar in appearance to the famous "Organette" and is really an efficient R.F. circuit coupled to a high-fidelity amplifier. The chassis is made by the Cleveland Chassis Co. Ltd., Wembley, London, W.3. Price £1/10/6, carriage and packing 7/6. H.P. terms if required.

COMPLETE TOOL KITS—THE ELECTRICIAN'S

This is as illustrated and contains 58 fine tools arranged on 6 trays in a complete assortment. Price £1/10/6, post and packing.

AMPLIFIER AM1134a

This is a 5-stage intercom, and Tx pre-amplifier with transformers, etc. Easily modified as gram amplifier or dictaphone, etc. Complete with 2-g.w. valves, Q.F. and Trilode. Price only 6/-, plus 1/- post and packing. Circuit diagram, free with unit, or separately 1/6.

BARGAINS TO CLEAR

2-VOLT ACCUMULATORS

Made for the Forces by one of the most famous firms in the world, 11-amp. power pack, approx. 5 x 14 in., square in shape case, preceded only need filling with acid, 2/6 each, plus 6d. post and insurance.

PORTABLE CABINET

This is a modern, two-tone, bakelite with integral moulded handle. It is fitted with all other parts necessary to make a Mains or Battery portable. Note: All of these cases have slight imperfections; these are hardly noticeable, however, and will not impair the performance or safety of the set. Price 7/6 each and insurance 1/6.

REMOTE CONTROL

With only one pull of the lever, a signal can be sent anywhere in the house. Price 7/6, post 9d.

WAVE-CHANGE SWITCHES

One dozen assorted wave-change switches, ideal for Government-case and unused, post and packing 1/-.

NAIL INSULATORS

Suitable for aerials, fences, indoor aerials, etc., 3/- per dozen, post and packing 1/-.

E.P.E. LTD. SEE OVER
SELECTIONS FROM OUR RANGE OF CABINETS

EMPRESS CONSOLE
This cabinet is undoubtably a beautiful piece of furniture. It is elegantly veneered externally in figured walnut, internally in white sycamore. The radio section is raised to a convenient level but is not soldered or cut. The lower deck acts as the motor board, again is uncut, it measures 16 x 14 and has a clearance of 5in. from the lid. There is a compartment for the storage of recordings. Overall dimensions of this essentially modern cabinet are 3ft. wide, 2ft. 8in. high, and 1ft. 4in. deep. Price £10/15/-, carriage, etc., 12/-6.

THE 1955 CORNER CONSOLE
Designed for the man who wants something really impressive. A massive cabinet but being corner fitting is not out of place even in the modern small living room. Voted by one of our leading magazines as one of the finest pieces of furniture at the 1953 National Radio Show, Earls Court. Overall dimensions of this cabinet are: 47in. wide, 31in. deep (to corner), 50in. high. Note that in addition to the Superior 15 Television this cabinet will accommodate a radio unit with controls on the sloping panel at the top and a tape recorder, or a record player under the lid in the top. Price £11, plus 30/- carriage.

THE SUPERIOR 15 CONSOLE
Undoubtedly a very fine cabinet designed to house a very fine set. Handsome two-toned walnut finished and distinctive design, its modern lines blend with all furnishings. Cut out for 15in. tube and drilled or cut. The lower deck is uncut and its dimensions 16 x 14 and acts as the motor board, again is uncut so is suitable for user’s own equipment—clearance to motor board is 6in.—height of the cabinet to top of lid is 2ft. 6in. Price £10/17/6, carriage 12/6.

THE BUREAU
This is a really beautiful cabinet elegantly veneered in walnut and finely polished. The control board, revealed when the front is dropped down is ample for the larger than average radio chassis or amplifier and alongside there is a space for a tape recorder or automatic changer mechanism. Both the radio board and the control board are left uncut, suit your own equipment. Size approximately 30in. high, 32in. wide, and 16in. deep. Price 16 guineas, carriage 12/6.

THE CONTEMPORARY
Also in the modern trend is this very stylish contemporary console. Veneered in oak with contrasting mouldings, and is ideal for use with modern furniture or with other contemporary fittings or furnishings. The radio and motor board is uncut and its size, 30in. x 15in., provides ample room for all equipment. Price £8/15/-, carriage, etc., 12/6.

THE CONSOLE MK. II
A new design of a popular style—this is in two tone highly polished walnut veneer with nicely contrasting speaker fabric—the motor board, approximate size 30in. x 15in., is uncut so is suitable for user’s own equipment—clearance to motor board is 6in.—height of the cabinet to top of lid is 2ft. 6in. Price £10/17/6, carriage 12/6.

THE STATESMAN
An impressive costly looking cabinet—originally designed for projection T.V., but the projector screen can be removed very easily and the lid can be felt-lined to hide the marks. This simple modification makes the cabinet suitable for radiogram, amplifier, tape recorder, or reflex speaker—size 23in. wide, 22in. deep, and 37in. high. We have only a limited quantity of these cabinets left and we are offering them at £8/15/- each, plus 15/- carr., which is approximately half of their manufacturing cost. Also we have a small quantity slightly damaged but easily repairable—prices from £7/15/- downwards, plus 15/- carr.

THE ATTACHE CASE PORTABLE
This cabinet can be supplied with radio board or with board suitable for mobile pickup and loudspeaker. The board in either case is finished in the same style of material as the Cabinet proper, e.g., imitation crocodile and/or lizard skin in contrasting shades. Price £8/15/-, postage, etc., 3/6.

TABLE RADIOS
We have two styles of cabinet which will take our 15 x 5 x 2 chassis and dial assembly or our Windsor Superhet. The one illustrated is the Windsor De Luxe, price 49/-, carriage and packing 5/- . The Windsor Standard, also a very fine cabinet, is priced at 39/-, plus 3/6 carriage.

HIRE PURCHASE TERMS—Any cabinet costing £5 or more may be purchased by extended payments—deposit 15% or more—balance spread over 12 months.
THE INFRAY LAMP

The Infray Lamp is essentially a directional infra-red radiator. It emits rays in a conical fashion, the beam intensity being greatest near the lamp. The rays warm the object at which they are directed, but not the air through which they pass.

In addition to the medical and other functions of infra-red, the Infray Lamp is especially useful in cases where it is impossible, or uncommercial, to warm the atmosphere. Thus a person working in the open may be kept comfortably warm with three or four lamps placed at convenient positions. In other cases the infra-red lamp permits considerable economy of electricity. For instance, in the open, one lamp can be kept conveniently warm with one lamp costing only 4d per hour. It should always be kept in mind that a heat lamp does not heat the air, but only the object or persons which it is directed upon. The latter are heated directly by contact with the rays of infra-red, and indirectly by convection currents. No “cut” in ordinary sense is applied. A gramophone position is also possible.

THE CLEVELAND "WIDE-BAND" AMPLIFIER

Designed in conjunction with Truvox engineers this high-fidelity amplifier ensures that best possible results are obtained from the Truvox Mk. III as well as from other tape decks. Two good tape circuits are used—these have separate volume controls and so facilitate the mixing of programmes. They work up to a maximum gain of 2 kilowatt times 4 per hour to run, thus saving of electricity is really considerable. These figures are based upon sensitivity at one per cent per unit. In distortion where higher rates apply, then the saving would be even greater.

The Infray Lamp is invaluable to the farmer, poultry keeper and in fact to any breeder of animals. The young stock will benefit under the lamp for warmth and therefore are not likely to be suffocated by the mother.

AMPLIFIER FOR TAPE RECORDERS

The Cleveland "WIDE-BAND" Amplifier is fitted with independent bass and treble controls, connected through separate feed-back loops, so that no “cut” in the ordinary sense is applied. A gramophone position is also possible. Its frequency response is extremely wide and level being almost flat from 10 to 20,000 C.P.S.—three controls are provided and the whole tuning is very suitable for use with the Collins Studio and most other good pickups.

The Cleveland " ORGANTONE" is a 6-valve 3-wave band superhet covering long wave (1,080-1,875 metres), medium wave (187.5-545.5 metres) and short wave (1,020-1,875 metres), medium wave (187.5-545.5 metres) and short wave (1,020-1,875 metres). Built to a very stringent specification, it attains the highest level of performance, both with regard to sensitivity and fidelity. Oran-all glass miniature valves are employed throughout, and low loss ferrites are used in all aerial and oscillator sections together with permalloy tuned I.F. stages for an excellent signal to noise ratio. Pull A.V.C. is applied to cut frequency drift and I.F. stages, and particular care has been taken to ensure freedom from frequency drift.

The output stage utilizes variable negative feedback for tone control, and, but for standard pendule correction, no cut in the ordinary sense is applied. A gram position is provided on the wave change switch and reproduction of records is particularly good. An amply proportioned power transformer with a primary tapped for 110-220 volts gives complete isolation from the mains.

THE SELECTIVE FEED-BACK AMPLIFIER

Alternative to the £5 complete kit ready to work this amplifier is truly a high fidelity reproducer. Equal to amplifiers costing three or four times as much. The reason the price is so low is because we were able to buy the valves and materials at very keen prices.

The amplifier is fitted with independent bass and treble controls, connected through separate feed-back loops, so that no “cut” in the ordinary sense is applied. The price is £5 plus 7/6 carriage and packing. Alternatively the separate components can be supplied together with a booklet of instructions—price for every part is £4—carriage and packing 5s—booklet separately price ½d.

Ask to hear this amplifier when at our depot—you will be really amazed.

MINIATURE PORTABLE T.V.

THE ELPREQ MINIATURE TELEVISION

Uses standard conventional circuitry employing a total of 13 valves and 2 crystal diodes. The Cathode-ray tube used is a 241 in. Service type VCR—demonstrations gladly given.

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You can spend fifteen days with your friends, earning full
Regular Army pay and allowances. As a member of the
Army Emergency Reserve (Cat. IIA) you have no other duties
during the year. If a grave national emergency should arise,
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can be called out for overseas service only by Proclamation.
Volunteers are accepted from 18 years of age and engage-
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Miniature Polarised Relay.

Now in dust-proof heavy gauge anodised aluminium can and
miniature 5-pin base for plugging in, thus protecting the relay and
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DATA—A Sensitivity of 25 milli-watts
and capable of handling mains voltage on the
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A NEW HIGH FIDELITY CORNER DIFFUSION SPEAKER

Designed for small and medium sized halls and for use in homes where quality is a vital factor.
The lower registers are reproduced with exceptional smoothness assisted by the bass reflex action of the corner cabinet.
The high notes are brought out with brilliant clarity from the specially designed acoustic system.
The overall effect of this construction is to give life and extraordinary depth to the sound which thereby approaches a three dimensional quality and truly justifies the term "high fidelity."
The technical excellence of this instrument is matched by its artistic conception as a piece of stylish furniture finished in walnut veneers.

Maximum handling capacity: 12 watts
Speaker flux density: 10,000 lines
Impedance: 15 ohms
Height: 32 inches
Maximum width: 27 inches
Maximum depth: 18 inches
Net weight: 54 lbs.

Price:
CABINET Only (Pat. applied for)...... £26 0 0
SPECIAL SPEAKER TO MATCH...... £3 0 0
Plus Purchase Tax on Speaker...... 1 0 0

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Introduce A NEW HIGH FIDELITY CORNER DIFFUSION SPEAKER

This 10-watt amplifier maintains, in every respect, the world-renowned LEAK reputation for precision engineering, fine appearance, and fastidious wiring. The Pre-amplifier will operate from any well-known pick-up, whether crystal, moving iron or moving coil. Provision is made for Tape Recorder and Play back and, as an exclusive feature, readily accessible jacks are provided on the front panel for instantaneous use.

See maker's advt. p. 95 for full technical specification.
The total Cash Price for these Two Units is £28.7.0. Our NEW EASY TERMS are £3 Deposit with order and 14 monthly installments or £40 (carriage and crate free).
If you require FINEST QUALITY REPRODUCTION together with WORKMANSHIP of the HIGHEST ORDER your choice must be.

THE VERY LATEST
LEAK DYNAMIC PICK-UP complete with two detachable diamond heads and transformer is now available from stock. Cash price £20.19.9, or sent for £3 deposit and 10 monthly Payments of 40/-.
Post paid.

The L.R. SUPPLY COMPANY LTD.
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LEAK QUALITY EQUIPMENT for the Connoisseur

The amazing New "TL/10" AMPLIFIER and "POINT ONE" PRE-AMPLIFIER

SEN'T FOR 60/- DEPOSIT
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**DEMOBBED VALVES**

*Manual*

Giving equivalents of British and American Service and Cross Reference of Commercial Types with an Appendix of B.V.A. Equivalents and Comprehensive Price List. We have still some Valves left at very old Budget Rates (30%); which are actually sold at the old price. (10½ rate).

**PI FO**


12" Type $511 Electrostatic, same base as VCR 97-

$410.00-10.00 Carr. 41/6.

**TYANA TRIPLE THREE**

Small Soldering Iron Latest development. Complete with detachable bench stand, 19/6. Post 1/-.

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**TAYLOR METERS ON EASY TERMS**

For the Osram 912 Amplifier.

**QUALITY - RELIABILITY**

For the Mullard Amplifier.

For the Osram 912 Amplifier.

For the Williamson Amplifier.

C. R. Tube Isolation Transformers. Instrument Transformers, and all popular types.

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FRACTIONAL H.P. MOTOR UNITS

The DRAYTON R.Q. is a miniature capacitor induction type motor with a current consumption at 250 volts, 50 cycles of 0.09 amps pf. 0.9. It is available:

**RGG GEARLESS**

Running at 2,700 r.p.m. continuously or intermittently in either direction or continuously reversed.

**RGR GEARED**

For continuous or intermittent running or reversing at speeds from 27 mins. per rev. to 600 revs. per min., with or without self switching up to 2 1/3 r.p.m.

**RGH GEARED**

For high final shaft speeds for continuous or intermittent running, forward or reverse.

Send for List No. N 302-1

The Drayton Regulator & Instrument Co., Ltd., West Drayton, Middlesex

Transformers

**QUALITY - RELIABILITY**

For the Mullard Amplifier.

For the Osram 912 Amplifier.

For the Williamson Amplifier.

C. R. Tube Isolation Transformers. Instrument Transformers, and all popular types.

**ELIISON TRANSFORMERS LTD.**

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A NEW E.M.I. CENTIMETRIC VALVE

10 cms.
THREE BAND
KLYSTRON
2600-3700 Mc/s.

TYPE RK6112

This is a low voltage, reflex velocity modulated valve for use as a local oscillator in the 10 centimetre ("S") Band. It is of the plug-in type, with disc seals for resonator connection, and is indirectly heated.

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IS ONE OF OUR 1072 SERIES

It is robustly constructed and has excellent ventilation.

Front panels of 10 S.W.G. steel bolt to standard G.P.O. drillings and it is supplied with chassis runners and cast inset handles.

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S 742 (left) double cell type. R 572 (centre) double cell type, also available with built-in line transformer. R 474 (right) is our four cell type, the finest crystal microphone ever made.

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<tr>
<th>Output</th>
<th>List Price</th>
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</thead>
<tbody>
<tr>
<td>Output 12/15 Volts D.C. 1 Ampere.</td>
<td>9/-</td>
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<tr>
<td>Output 12/15 Volts D.C. 2.5 Ampere.</td>
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<tr>
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<tr>
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<td>£47.00</td>
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<tr>
<td>Treble Assembly</td>
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<tbody>
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</tr>
<tr>
<td>Transmitter ET4336</td>
<td>£110</td>
</tr>
<tr>
<td>Test Set TS13</td>
<td>£100</td>
</tr>
<tr>
<td>Frequency Meter TS175/U</td>
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</tr>
<tr>
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<thead>
<tr>
<th>Equipment</th>
<th>Price</th>
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</thead>
<tbody>
<tr>
<td>ET4336 Transmitter</td>
<td></td>
</tr>
<tr>
<td>SCR720C Search Radar, complete, also separate units and spare parts.</td>
<td></td>
</tr>
<tr>
<td>BC348 Receiver</td>
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<tr>
<td>ART13 Transmitter</td>
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We are able to offer amateur transmitters, foreign governments, boat owners, etc., the opportunity to obtain these fine units at what is probably less than one twentieth of their usual cost.

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We can also offer low cost conversions to 6 volt operation, 110/220v 50c operation or 24v operation. Send for details.

REMOTE CONTROL UNITS AND ACCESSORIES

Remote Control Units 15/- each, Moving Coil Headphones (Type F), 7/6 (for use with transmitter and/or Receiver). Carbon Microphone (No. 8) for use with Remote Control Units, 7/- Moving Coil Microphones (No. 7), 7/6 (for use with transmitter). 100 yard Coils Connector Cable (twin) on reel with plugs (both ends), 10/- GPO type one piece handset to replace headphones and microphone, 10/- Any of the above sent post paid.

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8ft. Whip with Base, 7/6. 9ft. Whip with Base, 10/-, 16ft. Whip with Base 12/6. 34ft. Rod Aerial with stay assembly, 30/- Base. Insulators, etc. *For those wishing to operate a loud-speaker instead of the moving coil headphones normally used, we can replace the RF pentode output valve with a GG6G audio pentode at no extra cost. We also supply the necessary simple conversion details.

RATHBONE TRADING CO.
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This is a 2-valve plus metal rectifier T.R.F. receiver with a valve line-up as follows: 6E7 (HF), 817 (Del.) and 6V6 (Output). The dial is Illuminated and when assembled the receiver presents a very attractive appearance. Coverage is for the Medium and Long Wave Bands. Operates on 200/250 volts A.C. Mains. Plus 1/2 Packing Carriage, Insur.

£5.10.0

MODEL 2 SUPERHET RECEIVER

This is a powerful midget 6-valve plus metal rectifier Superhet Receiver with a valve line-up as follows: 6A4, 847, 847, 6N6. The dial is Illuminated and coverage is for the Short Wave bands between 10-140 metres, the Medium Wave bands between 140-450 metres, and the Long Wave bands between 1,000-2,000 metres. Operates on 200/250 volts A.C. mains. Plus 1/2 Packing Carriage and Insur.

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T.R.F. RECEIVER

We can supply this Receiver ready built at 26/15/6. plus 3/8 p.c. carriage and insur. Assembled In existing receiver or separately as a Mired. Complete with circuit diagram. Extremely effective, cuts out all mains noise. Consisting of 2 specially designed chokes and 3 condensers.

NOTE: We would respectfully suggest to those interested in building this receiver that they send for our Instruction Booklet. Intending constructors can then judge for themselves how comprehensive this booklet is.

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- A 2-SPEED TWIN TRACK PORTABLE RECORDER.
- WILL PLAY THE NEW PRE-RECORDED TAPES.
- WILL TAKE ALL STANDARD REELS UP TO 1,200 FT.

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THE NEW TRUVOX Mk. IIIu TAPE DECK

- 2-SPEED TWIN TRACK RECORDING
- ACCURATELY MATCHED INPUT FOR ACOS CRYSTAL MICROPHONE
- ATTACHE CASE AS ILLUSTRATED

YOU CAN ASSEMBLE IT YOURSELF FOR £40

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- ATTACHE CASE AS ILLUSTRATED

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We have long delayed producing a tape recorder, both for the home constructor and as a complete unit, until we had completely satisfied ourselves that such a recorder would at least “equal the very best but cost far less.” THIS WE HAVE NOW DONE—we are using the NEW TRUVOX TAPE Mk. IIIu DECK (briefly described opposite) together with a really HIGH-QUALITY AMPLIFIER which was expressly designed to correctly operate with the Deck, thereby insuring clarity and reproduction to a very high standard. Push button control insures extreme simplicity of operation.

GUARANTEED FOR 12 MONTHS (B.V.A. VALVES 90 DAYS)

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(c) PORTABLE ATTACHE CASE
(d) ACOS CRYSTAL MIKE “33”
(e) REEL OF TAPE 1,200FT. (INCLUDING REEL)

Please include £1 when ordering (a), (b) or (c) for packing charge, this whole amount will be refunded if case is returned to us intact.

WE WILL SUPPLY ALL FIVE UNITS LISTED ABOVE, i.e., THE COMPLETE BUT UNASSEMBLED RECORDER, FOR £40 0 0. H.P. Terms: Deposit £10 and 12 monthly payments of £2 15 0 or in two parts as follows:—

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(b) ATTACHE CASE AS ILLUSTRATED

ACOS CRYSTAL MICROPHONE

NOTE: Please send 30/- to cover cost of packing, carriage and insurance. We will refund £1 if the packing-case is returned to us intact.

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THE "TELE-VIEWER"
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DESIGN OF A COMPLETE 12" SUPERHET T.V. RECEIVER

PERFECT PICTURE QUALITY
SIMPLE DIAGRAMS MAKE CONSTRUCTION EASY

PERFECT FRINGE AREA RECEPTION
BETTER RECEPTION AT HALF COMMERCIAL COST

Here are some of the features which combine to make this such a fine receiver:

A. The Superhet circuit easily tuned to any of the five channels, i.e., LONDON, SUTTON, COLDFIELD, HOLME MOSS, WENVOE and KIRK-OSHOTT.

B. A long wave, price £1/13/4. The above are supplied fully wired leaving only four connections to be made.

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D. The pre-set and light switch ensure a steady picture, free from bounce or flicker, even under the most adverse conditions the tube is able to display.

E. A really efficient video amplifier.

Rigid C.R.T. mounting enables entire receiver to be safely handled with ease of tuning.

The "WIDE ANGLE" TELE-VIEWER

A. A design which retains all the distinctive features of the 12" Television but with increased Time Base efficiency, producing 1½ to 6½ cm. E.H.T., with ample scanning power for C.R. Tubes up to 17".

B. The complete TELE-VISOR, including all Valves, can be built for only £28/16/4.

NOW AVAILABLE AT STERN'S

The DENCO M.T.O. Modulated Test Oscillator £3/15/-. (Plus 9/- carriage and ins.)

If Frequency range conforms to standard, it is available for £4/5/-.

The instructions include really detailed PRACTICAL LAYOUTS, WIRING DATA AND COMPONENT PRICE LIST, ALL COMPONENTS ARE AVAILABLE FOR INDIVIDUAL PURCHASE.

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For 6 or 12 volt 1 amp. rating £1/10/6

For 6 or 12 volt 2 amp. rating £2/10/6

(plus cost of speaker)

BRAND NEW C.R.T. MOUNTS

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£6/10/6

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£8/10/6

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Model H.F. 6-inch

£5/10/6

Model H.F. 8-inch

£8/10/6

Model H.F. 10-inch

£10/6/6

These speakers are of the very latest design and provide quality reproduction for the lower-price range, 3 or 15 ohm models are available.

WE CAN SUPPLY EX-STOCK

(a) The Tensive Tape Recorder complete £37/8/6

(b) The Trovez Tape Deck £32/10/6

(c) The Grundig Model H.F. Tape Recorder complete £68/6/0

Each is available on Hire, Purchase and descriptive leaflets are available on request R.A.S.
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Modernise your old Radiogram

COMPLETE RADIOGRAM EQUIPMENT—AT LOW COST

STERN'S DESIGN FOR HOME CONSTRUCTORS

The "SUPER-SIX"

A compact and highly efficient superhet Radio-Radiogram chassis of outstanding quality.

YOU CAN BUILD IT FOR £10/7/6

Including the OCTAL VALVE LINE-UP (£12/7/6 wth the miniature valves)

Incorporating the new B.V.A. Miniature Valve Line-up, this receiver is designed to the very latest specification and provision is made to incorporate either the standard Octal Valve Line-up or the new B.V.A. range of miniature valves. Great attention has been paid to the quality of the reproduction of both radio reception and Record playbacks, and excellent clarity of speech and music is obtained.

A few brief details:

- Covers 5 wavebands 18-50 metres, 190-550 and 800-2,000 metres.
- Employ 6 valves having PUSH-PULL for 5-6 watts output.
- Incorporates delayed A.V.C. on all bands for effective A.V.C.
- A 4 position Tone Control set on both Radio and Gram.
- Independent mains supply socket for a Record Player.
- Size of Assembled Chassis 12in. x 8in. x 8in. Dual aperture 8in. x 4in.
- For operation on A.C. mains 200-250 volts 50 cycles.

The INSTRUCTION and ASSEMBLY MANUAL is available for 2/-.

THREE COMPLETELY ASSEMBLED ALL-WAVE SUPERHET CHASSIS

Model B.3.P.P. A 6-valve 3-waveband Receiver with PUSH-PULL OUTPUT.

Model B.3.P.P./R.F. A 7-valve 3-waveband Receiver incorporating an R.F. stage with PUSH-PULL OUTPUT.

The Three Receivers are operated on A.C. mains 100/110 volts and 200/250 volts, and employ the very latest miniature valves. They were designed to the most modern specification grade, in order to have been given to quality of reproduction which gives excellent clarity of speech and music on both gram. and radio, making them the ideal replacement chassis for that "old Radiogram," etc.

Brief specifications: Model B.3.-Valve line-up, 6B9, 6AQ5, 6J5G, 6862, 6X4—waveband coverage short 16-50, medium 187-500, long 800-2,000 metres. Control (1) volume with switch; (2) tuning (broad tuning); (3) waveband selector; (4) Tone Control (operative on gram. and radio). Negative feedback is employed over the audio stage. Chassis size: 11 x 7 x 4in. High. Dial size 8 x 4in. Price complete and READY FOR USE, excluding speaker. £12/10/-

H.P. Terms £4/2/- deposit, 12 months at 17/6.

Model B.3.P.P. This model is the B.3 Receiver but incorporates two 6B9 in PUSH-PULL, resulting in a high output of 5-6 watts from push-pull.

Model B.3.P.P./R.F. This model is similar in appearance and has the same waveband coverage as the B.3 P.P. stage together with PUSH-PULL OUTPUT, employing a total of 7 valves with two type 6862 in Push-Pull. This makes for a really sensitive receiver with good quality reproduction. Price £18/15/-

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We can supply... COMPLETE KIT or ASSEMBLED CHASSIS FOR THE OSRAM 912 AMPLIFIER.

We supply... ASSEMBLED CHASSIS FOR THE MULLARD HIGH QUALITY AMPLIFIER.

A design by Mullard Ltd. of a quality 5 valve 10 watt Amplifier incorporating the latest Mullard valve line-up with two EL84 in push-pull.

PRICE COMPLETELY ASSEMBLED TO SPECIFICATION £18/10/-

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Price of complete kit £25/10/- (Plus 7/6 carr. and inc.)

We can supply... COMPLETE KIT or ASSEMBLED CHASSIS FOR THE MULLARD HIGH QUALITY AMPLIFIER

This 3 SPEED AUTOCHANGER is by a Famous Manufacturer and is offered for

£11/10/0 (Plus 7/6 Carr. & 1/- for delivery)

Hire Purchase Terms £2/17/6 Dep. and 12 months at 6/-

These units will autochange on all three speeds, 7in., 10in., and 12in.

They play MIXED Tem. 10in. and 33 records.

They have separate amplifier for L.P and 78 r.p.m., which are inserted into position by a simple switch.

Minimum backboard size required 16in. x 12in., with height above 6in., and height below backboard 3in. A bulk purchase enables us to offer these BRAND NEW UNITS at this exceptional price.

THE NEW ARMSTRONG F.C. 48

A high quality replacement Radio or Radiogram Chassis having provision for an F.M. Feeder Unit.

PRICE ASSEMBLED and READY FOR USE £23/18/0

(Plus 7/6 Carr. and Inc.)

H.P. Terms £5/15/- Deposit and 12 months at £1/15/6.

OUTSTANDING FEATURES INCLUDE--:

- A Valves including 2 double Triodes.
- 5 Watts output from 6BW6 valves. Drsy negative feedback is used resulting in negligible distortion and high damping factor.
- Provision for using F.M. adaptor to receive the present high quality transmissions from Wrotham and the new B.B.C. V.H.F. stations.
- An accessible socket for rear panel for connection of power supply for this unit.
- Independent control of BACK and TREBLE and cut with unique Thermometer visual indicator.
- Arm position on wavechange switch.
- 4 Wavebands Coverage 16-50, 50-120, 190-550, 1,000-2,000 metres.
- Large four-colour illuminated dial.

AN OUTSTANDING OFFER A BULK PURCHASE ENABLES US TO OFFER THIS "PUSH-PULL" 7 VALVE SUPERHET RECEIVER For only £12/19/6 (Carr. & Inc.)

H.P. — £3/6/6 Dep. 12 months at 18/6.

These receivers Model AWS-7 are made by a well known set of manufacturers and incorporate the latest Osram Valve Line-up of 6Z4, 6Z7, 6F27, 6F28, and 6F29 in Push-Pull for approx. 7 watts output. They cover 5 wavebands 18-50, 190-550 and 800-2,000, highs 600-1,000, and are for operation on A.C. mains 200-250 volts. A Grain position on the Wavechange switch.

They make an excellent replacement Radiogram Chassis having a P.C. connection for L.P and 78 r.p.m., which are inserted into position by a simple switch.

Price £25/11/0 (Plus 7/6 carr. and lug.)

We offer this receiver in 12 of 12 in. records.

THE NEW COLLARO 3-SPEED UNIT

* Special Redutions for Complete Equipment

PRICE COMPLETELY ASSEMBLED TO SPECIFICATION £18/4/0

H.P. Terms £4/12/- Deposit and 12 months at 17/6.

- A Non-Autochange 3 speed unit having the new lightweight STUDIO "O" CRYSTAL PICK UP.
- Will play 7 and 10in. and 12in. records.
- THE VERY LATEST MODEL.

THESE RECEIVERS ARE BRAND NEW AND FULLY GUARANTEED.

THESE RECEIVERS ARE BRAND NEW AND FULLY GUARANTEED.

WE CAN SUPPLY... COMPLETE KIT of ASSEMBLED CHASSIS FOR THE OSRAM 912 AMPLIFIER. Designed by General Electric Co.

A modern high quality 12 watt Amplifier for the HOME CONSTRUCTOR, having a Valve line-up of 126R, 269B, 270G and two 7706 in Push-Pull.

The Assembly Instructions include five "easy stage" diagrams and is available for £1/15/3.

We can supply... COMPLETE KIT or ASSEMBLED CHASSIS FOR THE MULLARD HIGH QUALITY AMPLIFIER.

A design by Mullard Ltd. of a quality 5 valve 10 watt Amplifier incorporating the latest Mullard valve line-up with two EL84 in push-pull.

PRICE COMPLETELY ASSEMBLED TO SPECIFICATION £18/10/-

H.P. Terms. Deposit £6/12/-, 12 months at £2/6/6.

Price of complete kit £25/10/- (Plus 7/6 carr. and inc.)

We supply... COMPLETE KIT or ASSEMBLED CHASSIS FOR THE MULLARD HIGH QUALITY AMPLIFIER.

SPECIAL REDUCTIONS FOR COMPLETE EQUIPMENT

SUMMARY—Select a RECEIVER CHASSIS and we will supply it TOGETHER WITH THE ABOVE 3-SPEED CHANGER AND AN 8-inch or 10-inch P.M. SPEAKER as follows:

£14/10/0 AUTOCHANGER WITH A SPEAKER AND—

- 12 of 10in. records.
- 15 of 7in. records.
- 15 of 10in. records.
- 12 of 12in. records.
- 12 of 11.5in. records.
- 12 of 12in. records.

An additional charge of 20/- is made in each case to cover Carriage and Insurance.

January, 1955 WIRELESS WORLD
"Hi-Fi" EQUIPMENT and KITS
TO SUIT ANY BUDGET

TWO COMPLETE "Hi-Fi" AMPLIFIER KITS

"STAGERS" HIGH QUALITY 8-10 WATT AMPLIFIER

Having a front panel which is very attractively finished in deep gold, and on which the controls are clearly identified. The ideal amplifier for general home use and for small halls, etc.

Price of COMPLETE KIT including Valves and Delivery £7/10/-
Deposit £5/10/- Carriage and Insurance 7/6 extra.

Designed for high quality reproduction up to an output level of 20 watts, having 99% in Push-Pull and incorporating negative feedback. It is suitable for use with all types of A.M. and F.M. Tuning Units. A.M. Tuning Unit, Remote Control and Record Player are available at additional cost.

Price of COMPLETE KIT including Valves and Delivery £11/10/-
Deposit £9/- Carriage and Insurance 7/6 extra.

"STAGERS" 12 Watt "HIGH FIDELITY" Push-Pull AMPLIFIER

A very high quality Unit constructed in deep gold with each control clearly identified on the front panel. A.M. Tuner, Remote Control and Record Player are available at additional cost.

Price of COMPLETE KIT including Valves and Delivery £16/12/-
Deposit £14/- Carriage and Insurance 15/6 extra.

The NEW "LEAK" TL/10 AMPLIFIER and "Point One" PRE-AMPLIFIER

This Amplifier has a maximum output of 10 watts with minimums in every respect. Separate Bass Boost and Treble Controls provide an excellent range of frequency correction, with a three band equalising circuit. A continuously variable input attenuator at the rear of the Pre-amp. provides the instantaneous use of equalisation networks in turning on and turning off. A very high quality Unit attractively finished in gold, and a Remote Control Pre-Amplifier is also available.

Price of COMPLETE KIT including Valves and Delivery £24/-
Deposit £20/- Carriage and Insurance 7/6 extra.

WILLIAMSON AMPLIFIERS by GODESELL

Three Amplifiers hardly need differing upon, it being sufficient to say that they have now won the acclaim of the industry as the accepted standard for quality reproduction by which all others are judged. Two Models are available:

MODEL G.W.18. Output 15 watts, maintains in every respect the high quality of tone reproduction established and fastidious wiring. The Pre-Amplifier will operate from any make or type of moving iron or moving coil pickup. A.M. Tuning Unit, Remote Control and Record Player are available at additional cost.

Price of COMPLETE KIT including Valves and Delivery £28/10/-
Deposit £25/- Carriage and Insurance 5/- extra.

MODEL G.W.12. This Model is a slightly lower H.T. voltage amplifier to produce 10 watt output, but otherwise is in every respect identical with the above Model.

Price of COMPLETE KIT including Valves and Delivery £27/10/-
Deposit £25/- Carriage and Insurance 5/- extra.

THEammaP. F.A. TONE CONTROL UNIT.

This Unit has established a reputation for excellence of reproduction and ability to give accurate gain for any type of pickup.

Price £20/-
Deposit £6/- Carriage and Insurance 5/- extra.

We have them in stock and will be pleased to demonstrate or send S.A.E. for illustrated and descriptive folder.

THE GODESELL "ULTRA LINEAR" M.A.S. AMPLIFIER

A "High Fidelity" Amplifier using a Triode connected push pull output stage providing 15 watts output. A.M. Tuning Unit, Remote Control and Record Player are available at additional cost.

Price £14/-
Deposit £12/- Carriage and Insurance 5/- extra.

THE LOW COST PRE-AMP. UNIT.

Recommended for this Amplifier is the model UK/977C. Its main features are adequate equalising for gramophone reproduction, separate controls of bass and treble and low pass filter. Feedback is used over each of four stages.

Price £12/-
Deposit £9/- Carriage and Insurance 5/- extra.

STERNO RADIO LTD.

124 WIRELESS WORLD

January, 1955

THE COMPLETE KIT IS AVAILABLE FOR £14/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £17/-

THE COMPLETE KIT IS AVAILABLE FOR £21/10/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £28/10/-

THE COMPLETE KIT IS AVAILABLE FOR £28/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £35/-

THE COMPLETE KIT IS AVAILABLE FOR £37/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £40/-

THE COMPLETE KIT IS AVAILABLE FOR £45/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £50/-

THE COMPLETE KIT IS AVAILABLE FOR £50/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £55/-

THE COMPLETE KIT IS AVAILABLE FOR £55/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £60/-

THE COMPLETE KIT IS AVAILABLE FOR £60/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £65/-

THE COMPLETE KIT IS AVAILABLE FOR £65/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £70/-

THE COMPLETE KIT IS AVAILABLE FOR £70/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £75/-

THE COMPLETE KIT IS AVAILABLE FOR £75/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £80/-

THE COMPLETE KIT IS AVAILABLE FOR £80/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £85/-

THE COMPLETE KIT IS AVAILABLE FOR £85/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £90/-

THE COMPLETE KIT IS AVAILABLE FOR £90/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £95/-

THE COMPLETE KIT IS AVAILABLE FOR £95/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £100/-

THE COMPLETE KIT IS AVAILABLE FOR £100/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £105/-

THE COMPLETE KIT IS AVAILABLE FOR £105/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £110/-

THE COMPLETE KIT IS AVAILABLE FOR £110/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £115/-

THE COMPLETE KIT IS AVAILABLE FOR £115/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £120/-

THE COMPLETE KIT IS AVAILABLE FOR £120/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £125/-

THE COMPLETE KIT IS AVAILABLE FOR £125/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £130/-

THE COMPLETE KIT IS AVAILABLE FOR £130/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £135/-

THE COMPLETE KIT IS AVAILABLE FOR £135/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £140/-

THE COMPLETE KIT IS AVAILABLE FOR £140/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £145/-

THE COMPLETE KIT IS AVAILABLE FOR £145/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £150/-

THE COMPLETE KIT IS AVAILABLE FOR £150/- (Deposit £5/-) AND THE COMPLETE UNIT ASSEMBLED AND READY FOR USE £155/-
CONSTRUCTORS SAY

"IT'S STILL THE BEST MAINS OR
BATTERY PORTABLE SET"

A 4-valve Superhet. Portable
receiver, giving approximately
12 monthly payments of £1 3s. 6d.
"Allday" battery. The set is designed so that the
whole set can be supplied at any time, and can
be added to at any time. The set supplied as an "Allday"
battery Superhet can be accommodated in the adopted
case illustrated (size 9in. x 4in. x 7in.). This
is attractively finished in light, neutral tone.
As a combined Mains/Battery Superhet Portable
a polished cabinet is available, comprising both
Main Unit and Batteries. Circuit incorporates delayed
A.V.C. and treble can be set to suit any conditions irrespective of the
volume output of the
main volume control.

A COMPLETE "CAR RADIO"
FOR THE HOME
CONSTRUCTOR
14in. x 12in. x 51/2in.
A design of a complete 5-VALVE
SUPERHET RECEIVER
playing an R.F. stage and
incorporating a separate
eliminator. Price 47s. 6d.
We can supply for an additional £1 1s. 6d.
the complete Receiver and Vender Pack
including a Metal Case, Valves, Drilled Chassis and 51/2 in. P.M. Speaker for £31 9s. 6d. (Carr. and two 1½oz. wires). On the Receiver Components for £21 9s. 6d.
Eliminator, £5 10s. Receiver. It is a new design employing new Components.
Send 5/6 for the complete set of ASSEMBLY INSTRUCTIONS, CIRCUITS and
PRACTICAL LAYOUTS, including a complete individual Component Price List.

SHAFTESBURY PORTABLE AMPLIFIER
Suitable for home use and small halls. Has installed
inputs for both Record Players and Microphone.
Also provides for the "mixing" and "loading" of
American and long-playing, and with any pick-up, the range of
tuneability and transference is
adequate for both Mains and Mains
or Mains/Carry. Circuit incorporates delayed
A.V.C. and pre-selective Audio Feedback. The set is completely in every detail and
includes ready-wound frame aerials, fully aligned I.F. traps and drilled chasis.
Overall size of assembled chassis 5in. x 4in. x 2in. This receiver as illustrated,
can be completely built for £21 9s. (plus Mains Unit if required). Send 1/6 for the fully descriptive Assembly Book which includes Practical LAYOUTS and complete Price List of Components. Attach copy available separately, 37s.

"PERSONAL SET" BATTERY ELIMINATOR
A complete kit of parts to build a Midget
Battery Eliminator, giving approximately
40 volts and 1.4 volts. This eliminator
is quite many and
approx. to 69 volts and 1.4 volts.
In addition we can offer a similar COMPLETE KIT to provide approx. 90 volts and
1.4 volts. Price of complete Kit with
both Mains Unit and Batteries. Circuit incorporates delayed
A.V.C. and treble can be set to suit any conditions irrespective of the
volume output of the
main volume control.

A BULK PURCHASE ENABLES THIS
SPECIAL PRICE REDUCTION
OF THE FAMOUS

THE "MINI TWO-THREE"
An "Allday" Battery Portable of
midget size, 6½in. x 4½in. x 3½in. designed to cover medium wave-
bands 100-550 metres, with use of
short trunk aerial.
The simple design of this Receiver is so arranged that either a 2-valve
set or a 3-valve (afterwards easily
can be converted to the 3-valve) can be made.
Comprises of a 7½F. balance circuit
and a high gain output
stage. Variable line up by TUNER, plus 2/6 carriage and
insurance.
Send 5/- for the assembly instructions, they include simple and
complete practical component layouts and diagrams which enable
the most inexperienced constructor to successfully build either set.

"CONSTRUCTORS!!
A NEW SUPERHET TRANSPORTABLE
THE SUPER THREE"

Designed for local station reception
without the use of an external aerial.
This design provides for a complete
Superhet Receiver incorporating a Frame
for "room to room" use, provision
is also made for a short external aerial.
If required, for the reception of Contin-
ental Broadcasts.
Briefly the features are as follows:-
• For use on A.C. Mains 200-250 volts.
• Complete set includes a Mains
Transformer and Chassis is NOT live to mains
so the Receiver can safely be used in the Kitchen, etc.
• Valve line up 6X9-437-T601, plus Metal Rectiflard.
• L.T. Transformer is supplied "pre-aligned" and thereby ensures extreme
simplicity of Tuning- in fact, most simple and most T.R. Receivers.
• Compact and easy to build single "point to point" practical diagrams are supplied
with a completely drilled chassis.
• The complete Receiver chassis can be built to cover the
Medium Wavebands only for £6 6s.
• Or to cover both Long and Medium Waves for
the attractive Polished Wood Cabinet 11¼in. wide
6½in. high and 6½in. deep illustrated above to
THE CONSTRUCTORS MANU-FACTURING PRICE £1 10s. 0d.
which shows the component prices, which are all available for separate purchase.

A DUAL-CHANNEL PRE-AMPLIFIER AND TUBE CONTROL UNIT
Attractively finished in "Old Gold" and providing full control of Bass and 
TREBLE in conjunction with a main volume control.
It can be used with any amplifier
and with any pick-up, the range of
frequency control provided by the unit is
sufficiently comprehensive for all types of pick-ups and all forms of
recording, i.e., English, American and long-pairing, without recourse to pick-up correction.
The extreme flexibility of the bass and treble control is such that the level of bass
and treble can be set to suit any conditions irrespective of the volume output of the
amplifier. Response characteristics are given in 12-valve amplifier units. The unit
measures only 9in. x 6in. x 4in., including self-contained power supply and can be
accommodated either on or away from the main amplifier, i.e., on the front panel
of a cabinet or any other position. Price including drilled chassis, valves 10G5N
and 7£32, and £3 10s. Complete assembly data are available separately for 5/6d. Completely
assembled and ready for use, £6 9s.

"MINI-TWIN" 1-VALVE BATTERY SET
A design of a simple 1-valve 2-stage Battery Receiver, giving excellent results on medium and long wavebands and having exceptionally low battery consumption.
Drilled chassis and practical diagrams make it the ideal
set for the beginner to build.
The complete chassis, including valve, can be built for
37s, plus 2/- (this, the attractive plastic case is £8, and suit able headphones, 1/- net).
The complete assembly instructions, layouts and a com-
ponent price list are available for 1/6.

A COMPLETELY ASSEMBLED
4 VALVE T.R.F. CHASSIS
Including a 5 ½ in. P.M.
TUBES and VALVES
£6 9s. (Plus 7½ 2oz. and 1½)
This receiver is the very
latest design and is for use
on A.C. or D.G. Mains. It
covers both Long and Medium
Wavebands and includes the modern BVA miniature valves.
The line up being 12BA6-12B1-12AT7-12AU7. It
incorporates Tuned Cuts, thus ensuring
maximum selectivity and sensitivity.
The overall size of the complete chassis
includes speaker is 10½in. x 4½in. x 5½in.
An attractive Cabinet size 11¼in. x 5½in. x 5½in. is
available for 10/- plus 2/6 carriage and insurance.
**ENORMOUS PURCHASE**

of "MEDRESCO" DEAF AIDS

We have purchased from the Ministry of Supply, as surpluses, thousands of "Medresco" Deaf Aids type OL 10. Some we have reassembled but all are in perfect working order.

**THE RADIO-MINDED AMATEUR** will at once see the possibilities of converting this unit into many interesting devices such as:

- MINIATURE RADIO RECEIVER—MODEL CONTROL EQUIPMENT—BABY ALARM—PRE-AMPLIFIER—INTERCOM TELEPHONE, etc., in addition to its original application.

**WE HAVE DEVELOPED TWO INTERESTING CONVERSIONS**

1. A Crystal Receiver incorporating a Germanium Diode, which may be built into the existing case (in place of the microphone). Loud headphone signals are thus obtained in any area where the merest whisper is heard on an ordinary crystal receiver. This circuit requires no alteration to the wiring.

2. Alternatively we offer a circuit describing conversion of the first stage into a Detector with reaction. This converts the unit into an O-V-2 (detector with two stages of amplification) receiver which is capable of receiving transmissions within an area of many hundreds of miles. Conversion details are for medium waves only, however, conversion to long or short waves would present no difficulties to the technically minded. This circuit, however, involves fairly intricate wiring (in view of the miniature components used) and, although only a few connections are involved, we do not recommend this conversion except to those fairly competent with a soldering iron.

A miniature loudspeaker may be operated (at low volume levels) from either of the above circuits; for this we recommend a 45 V. HT supply. *The crystal microphone is, of course, not required for the above conversions. Circuits supplied Free.*

**DISC-SEALER TRIODE**. (Lighthouse type GL446A (19E4).) Boxed. New. 25/.


**TRANSFORMER UNIT** Ex-TRI143A. Suitable for conversion to 2 metres. Circuit diagram and coil conversion details supplied free. Price less valves, 5/- post paid.

**AERIAL SECTIONS.** 12in. long, sleeved, for making up length desired, 5in. diam. Copper plated. 2/3 per doz. sections. Post paid.

**HEADBAND TORCHES.** (Leaves both hands free for awkward jobs.) M.E.S. holder, bulb and reflector, headband with rubber pad, battery box with 4ft. cable, all wired ready for use. Price 4/-. Needs 4½v. battery Vidor 110V or similar standard battery.

**MICROPHONES.** Electro-magnetic. 1½in. diam., fitted with switch. 1/9 post paid.

**HYDROMETERS.** Ball type No. 1 Portable. 6in. long, 1/6 post paid.

**STANDARD TELEPHONES.** Cold cathode triodes type G24/20, 10/-.

**ERICSSON COUNTER VALVES.** (De-eartron) type G.C.10,A, 10/-.

**METERDIALS.** Cossor type 343 ganging oscillator. £5/10/-.

**WOBBLATORS.** Cossor type 343 ganging oscillator. £5/10/-.

**BLOCK CONDENSERS.** 8 mid. 600 V.W.

**MOVING-COIL METERS.** Centre-Zero. 2in. square basic 750-0-750 microamps. (Originally air thermometer.) 4/6.

**TANNOR P.A. SPEAKERS.** 8 watt c.m.m. P.M. with re-entrant baffle mounted in wooden cabinet with line OP trans. Military surplus Cat. No. ZB11565, price 20/-. Enquiries invited for quantities.

**WIRELESS WORLD** JANUARY, 1955

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**QUANTITY ENQUIRIES**
welcomed from deaf aid
Consultants, Stockists, and Exporters.

**WE OFFER the "Medresco" units in** perfect working order (every one checked by experts) complete with Crystal Microphone and incorporating three Miniature Valves at the remarkably low price of **27'6**

*Price without Crystal Microphone 23/6.*

**ACCESSORIES**

- Miniature crystal earpiece complete with lead and plugs
  - Ever-Ready 1.5 V. L.T. battery (Type D 18) 8d.
  - Ever-Ready 30 V. H.T. battery (Type B 119) 4/3
  - Ever-Ready 45 V. H.T. battery (Type B 106) for greater gain and output.

**Conversion Accessories:**

1. Set of parts for Crystal Receiver 5/-
2. Set of parts for O.V.2 Receiver 6/-
3. Circuits for above conversions, supplied Free.
OUTSTANDING VALUE!

FEW ONLY LEFT!
BUY WITHOUT DELAY

COMPLETE 5 VALVE RADIO CHASSIS
BRAND NEW AND UNUSED, AC/DC Mains 200/250 volts

Completely wired and ready for use with the addition of a Speaker and Output Transformer.

Two controls only: Volume and Station switch.

Valves used: 10L9 freq changer, 10F9 or UF41 I.F. Amp, 10LD11 or UBC41 AVC and Det, 10P14 output, U404 or UF41 rect.

Circuit diagram supplied. Available separately at 1s. 6d. post free.

FULL RANGE OF 400 KC SAFE RADIO CHASSIS IN STOCK

THE OSRAM 912 AMPLIFIER KIT
All components in stock. chassis, Partridge trans., speakers, W/T, etc. Available separately.

THE BOOK, 3/6 post free.

THE MULLARD 10/12 AMPLIFIER KIT
All components, chassis and valves in stock. Available separately.

THE BOOK, 2/6 post free.

METAL RECTIFIERS
6 or 12 volt F.W. Bridge
2 amps 9/- 6 amps 21/-
4 amps 12/11 10 amp 32/6
6 volts 12 volts
1 amp 2/6 1 amp 3/11
1 amp 6/6 6/6

SUPERHET COIL PACKS
With Circuit
No. 1. L.M.S.G. Size: 4 1/2 x 2 1/2 in.
With jin. spindle, 19 1/2.
No. 2. M.S.S. Size: 4 1/2 x 3 in.
With jin. spindle, 16 1/2.
Both for use with 465 Kc/s. 1/ f.
PORTABLE RECORD PLAYERS
Single speed auto changer, with amplifier.
HIRE PURCHASE TERMS AVAILABLE ON CERTAIN ITEMS
Send for particular form. Please give details of the equipment required.

MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE
THE FAMOUS

**"TELE-KING"**

5 CHANNEL, 16 or 17in.

**WIDE ANGLE. LARGE SCREEN**

Do you know... this famous and well tried home constructor superhet TV set can now be built for £29 10/- including valves. Only tube and cabinet extra.

Every component can be supplied separately.

Full constructional data, wiring diagrams and circuits, post free, 6/-

WRITE NOW FOR OUR "TELE-KING" PRICE LIST. WE CAN SAVE YOU MONEY.

A MULTI CHANNEL TUNER FOR THE "TELE-KING" WILL BE AVAILABLE SHORTLY.

**ELECTROLYTIC CONDENSERS ALL BRAND NEW**

- 8 mfd. 450 v.w. 1/6
- 16 mfd. 350 v.w. 2/6
- 16 mfd. 500 v.w. 3/6
- 20 mfd. 500 v.w. 3/6
- 30 mfd. 450 v.w. 3/6
- 60 mfd. 350 v.w. 3/11
- 64 mfd. 450 v.w. 3/11
- 150 mfd. 350 v.w. 3/6
- 400 mfd. 350 v.w. 3/6
- 8 + 8 mfd. 450 v.w. 3/6
- 8 + 16 mfd. 450 v.w. 4/3
- 12 + 12 mfd. 350 v.w. 2/6
- 16 + 16 mfd. 350 v.w. 3/6
- 16 + 16 mfd. 450 v.w. 4/6
- 20 + 20 mfd. 275 v.w. 5/1
- 60 + 100 mfd. 350 v.w. 5/1
- 100 mfd. 450 v.w. 10/-
- 16 mfd. 350 v.w. 1/6
- 32 + 32 mfd. 450 v.w. 5/11
- MANY OTHER SINGLE AND MULTIPLE CONDENSERS

**HIGH VOLTAGE E.H.T. CONDENSERS**

- .1 + .1 mfd. 3.5 Kv. 5/11
- .1 mfd. 3.5 Kv. 1/6
- .001 mfd. 12.5 Kv. 7/6
- .001 mfd. 15 Kv. 10/-
- .0005 mfd. 10 Kv. 3/1
- .0005 mfd. 15 Kv. 6/6
- .004 mfd. 12.5 Kv. 5/-

**C.R.T. Neck Protectors 2/6.**

**SPECIAL T.V. CONDENSERS**

- 64 mfd. 450 v.w. 3/11
- 100 mfd. 450 v.w. 4/11
- 32 + 100 mfd. 450 v.w. 7/6
- 100 + 200 mfd. 350 v.w. 8/11

**DENCO F.M. FEEDER UNIT**

All components and valves in stock.

**VALVES & C.R. TUBES.**

Over 1000 available.

**METROSILS.**

10 Kv. 5/-

**BRIMSTORS, CZ.1 1/6 each, CZ.3 9d. each.**

**OUTPUT TRANSFORMERS**

- Midget Pentode... 3/6
- Standard pentode... 3/6
- Push-Pull 6V6... 9/6
- Multi Ratio, P.P... 12/6
- Heavy Duty, P.P... 14/11

H.P. TERMS. Deposit £3/10/- plus carriage charge. Balance plus charges spread over 12 months.

**THE ROTHESAY**

This cabinet is really the last word in outstanding contemporary design. Absolutely rigid construction throughout with the finest laminated woods, veneered in walnut, polished light, medium or dark shade. Fitted with gold anodised speaker grille. The C.R.T. aperture frame is detachable, supplied to suit any size tube to order. Full length doors if required can be supplied with the cabinet. Veneered both sides, and polished to match the cabinet, they will be mounted with full length piano hinges.

**NOTE THESE GENEROUS SIZES.**

Outside dim. 34in. high, 21in. wide, 21in. deep. Inside dim. 18in. wide, 19in. deep. Size of top 22in. x 21in. Thicknessalin.

**THE DE-LUXE**


An allowance of 4s. 6d. will be made if the mask is not required.

**WHY NOT CONVERT YOUR **

**TABLE RECEIVER TO A CONSOLE MODEL?**

Adaptor frames for fitting 9in. or 10in. C.R.T. tubes can be supplied if required.

**LASKY'S PRICE**

Carrige 1/2 extra

£8.10.0


**THE ROTHESAY SIZES.**

Outside dim. 34in. high, 21in. wide, 21in. deep. Inside dim. 18in. wide, 19in. deep. Size of top 22in. x 21in. Thicknessalin.

**THE DE-LUXE SIZES.**

Outsize 34in. high, 21in. wide, 21in. deep. Inside dim. 18in. wide, 19in. deep. Size of top 22in. x 21in. Thicknessalin.

The Rothesay cabinet with doors.

**LASKY'S PRICE**

Carrige 15/- extra

£9.19.6

**THE ROTHESAY CABINET.**

Have you seen Lasky's NEW BRANCH?

42 TOTTENHAM COURT ROAD, W.I.

Midway between Tottenham Court Road and Goodge Street Underground Stns.

Phone: MUS 2605. Hours: 9 a.m. to 6 p.m.

Immense stocks of all our usual lines plus everything for the Serviceman, "Ham" and Home Constructor.

Radio, Television, Hi-Fi, Electronics, P.A. Equipment, Recorders, etc.

Stockists of these famous products:- Wharfedale, Stentorian, Goodmans, Baker's, Leak, Cosmocord, Vitavox, Hunts, T.C.C., Dublifier, Garrard, Collaro, G.E.C., Wearite, Grundig, etc.

**MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE**
MANUFACTURERS’ SURPLUS TV COMPONENT BARGAINS

WIDE ANGLE 38mm.
Line E.H.T. trans., ferro-cube core. 9-16 kV. 25/-.
Scanning Coils, low imp. line frame. 25/-.
Frame Output Transformer 10/6.
Scanning Coils low imp. line and frame. 17/6.
Line blocking osc. transformer. 7/6.
Focus Magnets Ferroxdure 25/-.
P.M. Focus Magnets. Iron Cores. 19/-.
Dunaj Focalisers 29/6.
300 m/a. Smoothing choke 15/-.
Electromagnetic focus coil, with combined scan coils 25/6.

TELESCOPIC AERIAL MASTS
As previously advertised Complete. LASKY’S PRICE 25/-.
Carriage 2/6 extra.

CHOKES
40 m/a. 2/6 120 m/a. 7/3.
60 m/a. 2/6 200 m/a. 12/6.
80 m/a. 2/6 250 m/a. 14/-.

SPECIAL TRANSFORMER
Secondary tapped as follows: 3, 4, 5, 6, 8, 9, 10, 12, 15, 18, 20, 250 m/a.
Price 17/6.

CLOSED FIELD SPEAKERS
6 in. 18/6. 8 in. round and 6 in. elliptical. 19/11.

LASKY’S NEW AC/DC MIDGET AMPLIFIERS

* Push pull * Very high gain
4 valves: 2 UL41 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 AC/DC. Very easily converted to 230 volts. Supplied with circuit diagram and full details. Size: 9 x 4 x 4 in. Uses 2 metal rectifiers, 1 each RM2 and RM3. Ideal for ships’ record players, baby alarms, etc. Supplied complete, fully assembled and wired, with 4 valves. Highest quality miniature components used throughout. An auxiliary 60 m/a. output is fitted, for use with a radio feeder, etc.

INTERCOM UNITS
4-station operation. For use on A/C/D/C mains 200-250 volts. Complete, with 3 valves. Fitted in attractive plastic cabinet. MASTER UNIT £5/19/6.
Carriage 5/6 extra.
Extension Units, price 21/- each complete. Carriage 2/- each extra.

P.M. LOUDSPEAKERS
21 in. 16/-, 5 in. 16/6, 6 in. 16/6, 8 in. 18/6, 10 in. 19/11.

ENERGISED SPEAKERS
8 in. with O/T 600 ohm field, 15/6. 12 in. with O/T 600 ohm field, 15/6.
8 in. less O/T 1,200 ohm field, 14/6. 12 in. less O/T 1,200 ohm field, 14/6.

CO-AXIAL CABLE
75-80 ohms impedance. Single Core, per yard 1/6.
Twin Core, per yard 1/6.
Twin Balanced Feeder, per yard 6d.

CRYS TAL DIODES. Glass type, wire ends. 1/6 each.
Higher Grades available. Assorted for 30/-.

NOTE: Where postage charge is not stated, please add a reasonable amount to remittance to cover postage.

ALL MAIL ORDERS TO HARROW ROAD PLEAS
This cabinet is 110... Sorry but we close at 1.0 p.m. on Saturday.

Lamp transformer.

I lin.

24 VOLT ROTARY CONVERTER.

Quantity at 12/6 only, plus 2/6 P & P.

EL32, EF50, CV501. Type 600 al. standard

with full data for conversion to

I.F.T.’s coils, etc. In very good condition,

1 each, 8D2, 1502 and 401 -Six valve -

Mc/s.

Either receiver together with power pack.

This automatically records incoming telephone

in suction pad to base of telephone and plug

SPECIAL PURCHASE. We Can offer strictly

Truvox Deck. Truvox Telephone adaptor at

at 219/19/-.

We also have in stock Elpico new tape deck

programmes (in the case of tape recorder) of any of the

any two local stations, or to make recordings

amplifier to receive direct reception from

600/800 k, 450 -600 k, 300 -450 k, 200 -300 k,

500 -600 k, 400 -500 k, 300 -400 k, 200 -300 k,

Price 89/-6, plus 7/6 carriage and

REMOTE CONTROL UNITS

Dealers are invited for the above receivers.

These units are brand new, and suit both on sale.

15/- each. All

For full particulars please apply.

Model 6C2M I.D. -

Built into substantial steel cabinet mounted on easily removable resilient mountings. The instrument is fully taped

two wave bands -24-6 Mce (cassette 4 x 4(Mics 27.2

and 120 metres) switching by means of binary coded.

Transmitter output up to 1000 m.w. depending on type of aerial used, gives

ranges up to 35 miles on morse and 30 miles speech, in average country. Crammed

baskets provides a much wider range of aerials and will be available for a

Type, Complete, 27/6 only plus 2/6 P & P. A Bargain.

2-VOLT VIBRATOR PACK. Ex-W.D.

Victor, incorporating a built-in crystal microphone, fully adjustable to suit

Any one can be supplied at 69/- -.

The whole unit which measures only Olin. x

221/2 in. x 10 in. x 10 in. at 10/-.

Price 15/- plus 1/- P & P.

POWER PACK TYPE 501. For 200/500 v. at 15/- per pack

440/450 k, 330 -450 k, 220 -330 k.

Outputs 250 v at 80.8 m., 3.3 at 24 v.

Power pack is built into cabinet with power pack

8/6.

R.F. are in good condition, and complete, but tuning dial damaged.

These tubes are brand new, in original packing, and tested before despatch.

All

T.F.S. (with shunt)

Type CRD. Low resistance, live grey and red metal case.

Fused in and

1/6 P. & P. New condition.

W.B. RECTIFIER UNITS.

18, TOTTENHAM COURT ROAD, LONDON, W.1

Museum 5929/095.

All goods specially selected for quality and value. Prompt Service - Makers' guarantees - It will pay you

to visit our new retail shop premises. Member 50 s. only from Tottenham Court Road Post Office Savings

Hi-Fi PURCHASE

We are pleased to announce several new products, which we are offering at vastly reduced prices. All inquiries

over £10. Ask for details, mentioning what you are interested in.

22 SET POWER UNITS NO. 4M12 ZA14078 -

Complete with 4 by 12 V. 7 amp, 2 by 12 V. 8 amp.

60 mA. 2-12 v. 4 pin Mallory Vibrators, transformer, wattmeters, D.C. amp., 1 amp., milliammeter, etc., etc., in good condition.

Complete Instruments, 4 x £1.0 s., 5 x 8/-, Weight approx. 27/6, plus 5/- P & P.

VALVES. We have a very comprehensive stock of special purpose surplus valves at competitive prices.

All details and prices available from our Valve Price List.

L.T. RECTIFIER TYPE H. A newly manufactured range, guaranteed 12 months from date of purchase.

6 of 24 v. 1.5, F. W. bridge type... 69/-

8 of 24 v. 1.25, F. W. bridge type... 90/-

12 of 24 v. 0.8, F. W. bridge type...

150/-

CHARGER TRANSFORMERS. Input 230 v.

6/12 v. 9 a.

11/12 v. 6 a.

11/12 v. 4 a.

11/12 v. 6 a.

11/12 v. 3 a.

11/12 v. 6 a.

11/12 v. 4 a.

11/12 v. 6 a.

11/12 v. 4 a.

11/12 v. 6 a.

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11/12 v. 4 a.

11/12 v. 6 a.

11/12 v. 4 a.
F.M.!! (Frequency Modulation)

We are pleased to announce our complete kit for the "Deno" F.M. Feeder Unit.

This unit provides an A.F. output suitable for feeding into the audio section of a standard broadcast receiver where tedious output is available. Within an average 30 miles from a V.B.F. transmitter one F.M. stage should be adequate, but our complete Kit supplied includes all components and valves for an extra F.I.F. stage if necessary, or if the unit is used at greater distances.

Full constructional details, theoretical and practical, and point-to-point wiring diagram can be supplied for 2/6 post free, or by special arrangement, for 2/6. Kit right down to the last nut and bolt, at only 7/6, plus 2/6 packing and postage. This unit can be supplied if desired, ready assembled, aligned and tested, plus 2/6 post and postage.

It is hoped that we shall be pleased to allow this unit for constructors not possessing the necessary equipment, for a charge of 7/6. N.B.—Valve line-up is 6A6T, 12AB8, 26A8 and 6AK5 Change prices only when published. Great demonstrations at 18, Tottenham Court Road!!

SPECIAL PURCHASE

DRECO THREE-SPREAD-ARM UNITS

A superior quality single stereo motor complete with 10/3, tumtable and pick-up, in the two familiar Mag- setin plus-inches type Q and 6, fitted with die-cast stilts. Modern Dreh-cantilever type counter-balanced pick- up, with stripped alloy and fine tungsten. Suitable for any radiogoniometer or record reproducer, and is a substantial achievement of high-fidelity reproduction. Arranged with amplifiers specially designed for this purpose. Automatic stop and return feature for fine play. Base-stable measured 15/1 x 11/16. Height above table 12.13/2 in.

GARRARD 2000 KIT

Price £23/10/6, net. Plus 2/- carriage. Ideal for the beginner, or any who wish to experiment with a new type of equipment. We have a large stock for immediate delivery, + 2/- P & P.

THE SUPERIOR "FOUR" KIT.

Our new four-valve receiver. A.C. mains, 300/250 volts, 50 and 60 cycle. As with all our very successful "Economy Four" kit, this complete set is being demonstrated at the present time, and we can supply any to personal callers. A.C. mains 240/200 volts. Valve line-up is 6G6, 6G8T and 6H6. Charley ready drilled. Cabinet size, 11/2 x 15/8 x 9. Minimum depth at base, 5/16. £3, tapering to 9/16. at top. Sloping front. Very attractively finished in light walnut and peach. Each component brand new and tested prior to packing. Complete Instruction booklet with practical and theoretical diagrams is provided. Booklet available at 2/6, post free. Our price, complete kit, £25/10/6!! Plus 2/6 carriage and carriage. If preferred, we can supply Cabinet only, complete with tuning and button wiring diagrams, switch, dial, pointer, drum pulleys, drive sprocket, drive spring and knobs, at 4/- plus 2/6 packing and carriage.

If you order our receiver we shall be pleased to allow this unit for constructors not possessing the necessary equipment, for a charge of 7/6. N.B.—Valve line-up is 6A6T, 12AB8, 26A8 and 6AK5 Change prices only when published. Great demonstrations at 18, Tottenham Court Road!!

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Price £23/10/6, net. Plus 2/- carriage. Ideal for the beginner, or any who wish to experiment with a new type of equipment. We have a large stock for immediate delivery, + 2/- P & P.
SELENIUM RECTIFIERS

L.T. Types

H.T. Type H.W.

200 v. 40, 50 cm. 120/21.
0/12 v. a. h.w. 7/9.
F.F. Types

250 v. 50 ma.
0/12 v. 1 a. 4/11.
250 v. 80 ma. 7/9.
2/12 v. 1.5 a. 11/9.
350-350 v. 500 ma. 2/3.
250 v. 6 a. 7/11.
250 V. 12 a. 2/7.
450 V. 15 a. 17/6.
500 V. 25 a. 2/11.
600 V. 50 a. 17/6.
750 V. 100 a. 2/11.
1.000 V. 150 a. 2/9.
1250 V. 200 a. 7/9.
2500 V. 400 a. 17/8.

F.W. Bridge Types

ate outputs for 8 v. and 12 v. Fitted Meter and Fuses. Guaranteed months, 6/11.

700 ohms, TRIID, WIRE WOUND POTS: 20 ohms, 500

VOLUME CONTROLS with long spindles, AMPLIFIER OR CHARGER CASES.

25AF 25 v

HEAVY DUTY BATTERY CHARGER KIT

any type assembled and tested for 6/9 extra.

MAINs TRANSFORMERS

Primaries 200-250 v. 50 cm.

10v., 2 a., 5 v. 2 a. 3/9.
350-350 v. 400 ma. 2/3.
250-250 v. 50 ma. 17/7.
350-350 v. 50 ma. 2/3.
350-350 v. 60 ma. 3/3.
250-250 v. 100 ma. 17/6.
250-250 v. 100 ma. 2/3.

PRIMARIES: 0-9-15 v. 3 a., 16/9; 0-9-15 v. 4 a., 18/9; 0-10-15 v. 5 a., 22/9; 0-15-15 v. 6 a., 18/7.

AMPMETERS. Moving coil. G.E.C.

s, 0-5 amp., 2% scale, 11/9.

WIRE WOUND POTS: 20 ohms, 50 ohms, 5k, 25k, 50k, 100k, medium length spindles, 2/9, 220 ohms, medium 2/9, 10k, 20k, 50k, Preset type, 1/9, each.

AMMETERS. Moving coil. G.E.C.

25 mfd. 4000 v. Blocks


1 mfd. plus 1 mfd. 6000, large blocks


EG.O.V. AGGUMULATORS with non-spill vents

460 v. 1 a. 17/9.

EG.O.V. BLOCK PAPER CONDESERS

2 mfd. 800 v. 1/9.


8 mfd. 5000 v. 5/8.

10 mfd. 4000 v. 6/9.

15 mfd. 4000 v. 7/9.

25 mfd. 2500 v. 1/11.

EG.O.V. TRANSMITTER-RECEIVER TYPE TRIO, with all valves, only 47/4, plus carr. b.

M.E. SPEAKERS. All 2-3 ohms, 61in. Rollafeld 700 ohms, 11/8, 81in. R.A. field, 600 ohms, B.F. R.A. field, 1,000 ohms 2/9, 10in. R.A. field, 1,000 ohms 2/9, SPECIAL OFFER. Mains Trans. 200-550-50 c/s. Primary, Sec. 800-1000-1500 v. 2000-3000 v. 4, 5, 3 a., half shunted through diode, 21/6.


HEAVY DUTY BATTERY CHARGER KIT For special service, 250 v. 100 ao. D.C. output mains Transformer, 2, F.W. Metal Rectifiers, 2 variable rectifiers, 4 insulated terminals, 4 fuses and circuit. Total output 18 amps. Separate outputs for 6 v. and 12 v. Will make ideal Charger for Garage Cartage 15v. 6/19/5.

R.S.C. TRANSFORMERS

FULLY GUARANTEED, INTERLEAVED AND IMPREGNATED

Mains Transformers

Primaries 200-250 v. 50 cm.

6.3 v. 8 a. 8/11.
3.3 v. 8 a. 17/6.
10 v. 2 a. 7/6.
12 v. 3 a. or 24 v. 6.3 v. 2 a. 17/6.

CHARGER TRANSFORMERS

Primaries 200-550 v. 50 cm. 7/11 120 v. 40 ma., 5-6 v. 1 a. 14/9.

NOUPT OUTPUT TRANSFORMERS

Midget Battery Pedestal 60/1 for 534, etc.

Small Pedestal, 5000/1 to 31/4.
Standard Pedestal, 5000/2 to 31/4.
Standard Pedestal, 500, 450, 451, 491.
B.B.B Push-Pull.
Push-Pull 8 Watts 6V6 to 3 ohms
Push-Pull 10-12 Watts to match 6V6 to 4 ohm.
Push-Pull 20 Watts high quality uniquely wound 6L6, KT85, etc., 3 to 15/1.

SINING CHOKES

250 ma., 5, 500 ohms 11/9
100 ma., 10, 500 ohms 11/9
50 ma., 10, 500 ohms 11/9
50 ma., 50, 500 ohms 11/9
50 ma., 10, 500 ohms, Potted 10/9

R.F. GOV'T. MAINS TRANSFORMERS

All 250 v. 30/13, 50 ma.
8.4 v. 4/9.
48 v. 1 a.
0-11-25 v. 15 a.
35-11-25 v. 30 a.
16-18-25 v. 5 a.
7.7 v. C.T. 7 amps 4 times
460 v. 200 ma., 5.3 v. 3 a.
27/9.
9-12-30 v. 250 ma.
30-35-45 v. 150 ma.
9/17.
30-300-500 v. 80 ma., 5 v. 3 a.
2/17.
300-300-150 v. 100 ma. 150-610-150 v. 150 ma.
28/9.
400 v. C.T. 150 ma. 4 v. 6 a., 6 v. 6 a., 6.3 v. 4 a., 4 v. 3 a., 4 v. 3 a., 5 v., 5 v., 5 v., 5 v.
22/9.

EG.O.V. AUTO. TRANSFORMERS

250 ma., 10, 50 ohms 14/9.
275-295-315 v. 1,000, 30 a.
6/9.
400 v. 1500 ma., 5 volts 6 volts.
6/9.

R.C.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 c/a. To charge 6 v. accumahu at 2 amps, 25/9. To charge 6 v. or 12 v. battery at 2 a., 3/11. To charge 6 v. or 12 v. battery at 4 a. 49/9. ABOVE KITS CONSIST OF BLACK CRACKLE LOWED SHIELD CASE, MAINS TRANSFORMER, FULL WAVE METAL RECTIFIER, FUSES, FUSE-HOLDERS AND CIRCUIT. Any type assembled and tested for 6/9 extra.

CHASSIS

18 s.w.g. unalloyed aluminaium amplifier type 4/9.
12in. x 6in. x 3in. 8/11.
12in. x 6in. x 4in. 10/11.
14in. x 10in. x 5in. 7/11.
16in. x 10in. x 5in. 8/11.
18in. x 12in. x 5in. 9/11.
21in. x 12in. x 5in. 18/11.
21/2 in. x 12in. x 5in. 3/12.
18 s.w.g. aluminium, amplifier type, 4-sided.
18in. x 12in. x 5in. 7/12.
18in. x 12in. x 5in. 8/12.
18in. x 12in. x 5in. 9/12.
18in. x 12in. x 5in. 10/12.
R.S.C. HIGH FIDELITY 25 watt AMPLIFIER A4

A NEW DESIGN FOR 1955 HIGH GAIN "PULL PUSH" OUTPUT. BUILT-IN PRE-AMP. TONE CONTROL STAGES. INCLUDES 7 valves, sectionally wound output transformer, block paper reservoir condenser, and reliable small component. AN INPUT OF ONLY 20 millivolts IS REQUIRED FOR FULL OUTPUT, THIS MEANS THAT ANY TYPE OF MICROPHONE OR PICK-UP IS SUITABLE. Two separate inputs controlled by separate volume controls allow simultaneous use of "Mike" and Gram, or Tape and Radio, etc., etc. Individual controls for Bass and Treble "lift" and "cut." Six negative feedback loops giving total of 24 D.B. Frequency response ± 3 D.B. 30-20,000 c/s. H.P. Terms now on offer. To-point wiring diagrams, are supplied. EXTRA HIGH SENSITIVITY, HIGHEST QUALITY for Or assembled ready for use 50/- extra. Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. SUITABLE FOR SMALL HOMES OR LARGE HALLS, CLUBS, GARDEN PARTIES, LARGE HALLS, etc., etc. For ELECTRONIC ORUIN OR GUITAR. For STANDARD OR LONG PLAYING RECORDS. Size approx. 12in. x 9in. Weight 20 lb. Power consumption 175 watts. Outputs for 3 and 15 ohms speakers.. The kit is complete in every detail. Chassis is screen printed with all necessary footnotes for high quality, component parts in punched holes. The kit is complete in every detail. Chassis is screen printed with all necessary footnotes for high quality, component parts in punched holes. For mains input 200-250 v. 50 c/s. Supply of a Radio Feeder Unit, or Tape Deck preamplifier. A high gain amplifier enables speech and other sounds to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Ebony Bakelite cabinet is included. Main input 200-250 v. 50 c/s. M.T. line 300 v. CHASSIS VENEREERED WOOD OR BROWN BAKELITE CABINET. A high gain amplifier enables speech and other sounds to be heard at the master control. The unit is in kit form and point-to-point wiring diagrams are supplied. A walnut veneered wood or Ebony Bakelite cabinet is included. Main input 200-250 v. 50 c/s. M.T. line 300 v. This is not A.C./D.C. with "live" chassis but A.C. only with 400-600 v. Transist. Output is for 5-8 ohm speaker. We can supply a very suitable unit, unit by Rola at 27/9. Amplifier can be supplied ready for use for 25/- extra. Full descr ptive leaflet, yd.

R.S.C. A3 10 WATT "PUSH PULL" HIGH FIDELITY AMPLIFIER. With Self Contained Pre-amplifier and Tone Control. HUM LEVEL 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. R.S.C. A3 10 WATT "PUSH PULL" HIGH FIDELITY AMPLIFIER. With Self Contained Pre-amplifier and Tone Control. HUM LEVEL 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. Comparable with the very best designs. Hum level 66 D.B. down. Certified total harmonic distortion of only 0.35% measured at 10 watts. 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D. COHEN
RADIO AND TELEVISION COMPONENTS

Terms of Business: Cash with order. Despatch of goods within 3 days from receipt of order. Where post and packaging charges are not included, post and packaging charges are as follows: 1/6 up to 10/-, 2/- up to £1, and 2/6 up to £2. All enquiries, S.A.E., lists 5d. each.

SPECIAL NOTE: NO GOODS SENT WHERE CUSTOMS DECLARATION IS APPLICABLE

23 HIGH STREET (Uxbridge Road)

ACTON, W.3. Telephone: ACO'RN 5901

COMpletely BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-75 Mc/s, black crackle finished case and white panel. £19/16/- or 3/- deposit and 3 payments of £1. Post & Pkg. 4/- extra.

PATTERN GENERATOR

T.V. CONVERTER for the new commercial stations complete with 2 valves. Frequency—can be set to any channel within the 100-108 Mc/s band. L.F.—will work into any existing T.V. set designed to work between 42-48 Mc/s. Sensitivity—15-20 mg/s with any normal T.V. set. Input—arranged for 300 ohm coax. 80 ohm coax can be used with slight reduction. Circuit—tuned in a C.R. amplifier. Gain of the first stage, 20 dB. B.F. AMPLIFIER 16 dB. Required power supply of 200 v.D.C. at 3 mA. A.C. or D.C. 115/230 volt. Using inverter ensure complete freedom from unsignalised waves. 2 simple adjustments only.

EDN. TUBE: aluminised, heater cathode—short, 16 Kv. max. 5 v. heater complete with line and E.H.T. transformer 9V/100 with filament cord, line and width control, E.V.I. rect. winding trans. O.P. and coils, 120/- Per set.

Mains Transformer, chassis mounting, feet and voltage panel. Primaries 2,000 ohms 100 mA.

Mains Transformer, 300-500 75 mA. 6.3 v. 3.5 amp.

Mains Transformer, 300-500 75 mA. 6.3 v. 3.5 amp.

OUTPUT TRANSFORMERS: Standard type 3,000 ohms input. 6/3; 6/4 with extra feed back windings. 4/3. Minimum l.f. 2,000, 5,000 and 10,000 ohms. 6/3 1500, plus peak output.

FIRE BACK WOUNDINGS: 2/6.

PULL-BACK CONNECTING WIRE: As above.

STANDARD WAVE CHANGE SWITCH: 50 mfd. 350 v. 13/6.

PA Speaker, 1000 ohm field.

ONK. 65 mfd. 220 v. 3/6.

M.E. Speaker, 1000 ohm field.

M.E. Speaker, 1000 ohm field.

M.E. Speaker, 1000 ohm field.

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M.E. Speaker, 1000 ohm field.
This well-known cabinet of which thousands have been sold is ideal for every constructor. Complete with chassis, dial, backplate, cord drive, potentiometer, and drum. Price 2/6 each.

CHOKES
3Ω, 20Ω; 60 mA. Clamp
construction...
10Ω, 20Ω; 90 mA. Clamp
construction...
3Ω, 220 mA. 10/6 each. Fully
shielded...
18/6 each.

TRANSFORMERS FOR BATTERY
CHARGERS
300 v. Input Tapped 6-12 v.
amp.
230 v. Input Tapped 6-12 v.
amp. (Both with tap on Primary for 23 v.
Post light.)

LOUDSPEAKER CABINETS
Suitable for use as a projector
unit. Walnut finished cabinet
is attractive.

The attractive walnut finished cabinet
is available for 6/6 or 9/6 speaker
units. Metal meshed fret, complete
with back and rubber feet.

6/6.Jumping Measures
8/6.Jumping Measures
10/6.Jumping Measures

Price 1/6 each.

CARRYING CASE
Suitable for use as a projector or
recording case, size 181/2 x
x 11 in. depth, 5 in. front H.T.

This new attractive walnut finish
and chrome plated head, complete
with lead and jack plug, listed at 2/6. Our price...

Internal Diameter...

Depth sin.

Suitable for use as a projector
unit. Walnut finished cabinet
is attractive.

This new attractive walnut finish
and chrome plated head, complete
with lead and jack plug, listed at 2/6. Our price...

SPECIAL PURPOSE
HEADPHONES BY

S. G. BROWN, etc.

Clear resistance type 120 ohms...

CHASSIS

Amphenol Underfilled with Reinforced

内部填充，适用于以下情况。

6 m. in. x 61/2 mfd. 600 v.
6 in. x 10 mfd. 600 v.
8 in. x 10 mfd. 600 v.
10 in. x 10 mfd. 600 v.
16 in. x 10 mfd. 600 v.
16 in. x 10 mfd. 600 v.
20 in. x 10 mfd. 600 v.
25 in. x 10 mfd. 600 v.

This attractive walnut finished cabinet
is available for 6/6 or 9/6 speaker
units. Metal meshed fret, complete
with back and rubber feet.

6/6.Jumping Measures
8/6.Jumping Measures
10/6.Jumping Measures

Price 1/6 each.

DOUBLE TRIMMERS. 200/250 PF,
100/100; 100/100; 100/100; all 64 each.

TAYLOR SWITCHES. 3 pole 3 way.
1 gang, 1/2, 351/2, 5 gang, 3/4 each.

OCTAL PLUG AND SOCKET (attached).
1/each.

PRE-SET CONTROLS (carbon). 600Ω
1 ring (1); 1 lug (1): 5 cond. 1/6 each.

SENTINEL RECTIFIERS
RM1 28/6 each. RM2 4/6 each. RM3
56/6 each. RM4 8/6 each.

METAL RECTIFIERS
12 v. x 1, 12 v. x 1, 12 v. x 1, 12 v.
450 v. 1, 1/2, 18 1/2, 120 v. 1, 12 v.
300 v. 1, 450 v. 1, 1/2, 18 1/2.

FULL WAVE TYPES
12 v. x 1, 1/2, 12 v. x 1, 12 v.
230/250 v. 1, 12 v. x 1, 18 1/2.

WE INVITE YOU TO BUILD THIS PORTABLE FOR ONLY 6/6.

The COMPACT TELEVISION AMPLIFIER LTD.

Supplied complete with universal
mounting and backed in plate in
neutralized form, and complete
with all wiring instructions, and complete
of components. Available 25/6 each. Case
can be supplied separately. Available
in the following attractive colours:

# Brown
# Black

This new attractive walnut finish
and chrome plated head, complete
with lead and jack plug, listed at 2/6. Our price...

Inscriptions available:

“Regent” Hand Microphone.

“Eaton” Hand Microphone.

AERIAL Type 1T6 for Tubes with 35 mm. neck

Diameter 2'6 ea.

Type 2T6 for Tubes with 35 mm. neck

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Diameter 2'6 ea.

Type 2T6 for Tubes with 35 mm. neck

Diameter 2'6 ea.
WIRELESS WORLD

January, 1955

I.F. TRANSFORMERS

65 kHz Slit tuning Miniature Circular Grid, £9.10n. by Tri-force. Fine tuning by pot, 3 1/2" or smaller and good bandwidth. By Pre Radio. Two mounting holes. BRAND NEW.

G.R.T. BEATER ISOLATION TRANS. Ratio 1:2.55

Low leakage winding with 35% rec. boost, 2½ x 10/6. By Exalt.

BRENNSTOFF-Cl 3 4, SVE, CSIG 15 15 15 23/6.

CONDENSERS—New stock— no. 601, mfd. 6 kv. T.C.C. 1300 v. 200 v. 130 v. 100 v. 80 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v. 120 p.f. 100 v. 90 v. 80 v. 70 v. 60 v. 50 v. 40 v. 30 v. 25 v. 20 v. 16 v. 12 v. 9 v. 6 v. 5 v. 3 ½ v. 2 ½ v. 1 ¾ v. 1 v.
1 min. Piccadilly Tube Station.

FAIR PRICE TO THE TRADE

FOR ALL RADIO BARGAINS

Tube Station.

A.C.

2 way, brand new, 4/6 each.

standard

45/- each.

P.40 POWER PACKS.

make.

39'6 each.

wooden case complete with two test leads,

F/M., M/F, 25/-; 0-300 volts, Sin.

projection,

2in. square F,,M., M/coil, 7/6.

7/6 ; 20 20 amp., 2in. round F, M., 616 ; 0-30 amp.

R.F. 7 /6 each; 0-5 amp., 2fin. round F/M., R.F.,

M/A 2fin. round F/M, M/coil, 10/-; 0-20 volts,

M/A. 2in. square FIM., M/coil, 7/6 each.

0-150 m/a., 2in. square FIM., M/coil, 7/6; 0-200

ACCUMULATORS.

3 amp., 49/6 each.

50 cycle input. 250 x 250 volt 150 m/a., 4 volt

14 amp. 6.3 volt If amp., 10/6 each.

12/6 each.

boxed, fitted with 2in. 0-5 m/a., 11/C., meter,

PARTS.

and CV51 with VU39, SP6I, EA50 megacycles, brand new

METERS.

2in. size

that month. Supplied with clips and leads, brand new.

6/6 each.

amperes,

with 6 valves, 2 of EF39, 2 of EF36,

RECEIVERS TYPE T.R.1196.

we are the cheapest in the trade.

RELAYS.

Polarised

frequency 465

HEAVYDURY AUTO TRANSFORMERS.

of model makers, 10/6 each. Ditto fitted with blower, 12/6 each.

POLARISED

RELAYS.

tingle 0/50 micro amp. 62/6.

MIDNET REVERSIBLE MOTORS.

for operation on 4, 6, 12 or 24 volt D.C. Size

2in. x 1'in., spindle length 8in. x 8in. Ideal

for model makers, 10/6 each. Ditto new.

MIDNET POWER PACKS.

5314.

headpho

9d; 200/250

RECORD AMPLIFIERS.

Single ended 6V6 to 2 ohm, 3/6 each.

AMERICAN POWER RHEOSTATS.

8-ohm, 3.3 amp., 8/6; 6-ohm, 2.5 amp.,

7/6 each; 60 ohm, 1.3 amp., 7/6; 30 ohm,

0.74 amp., 7/6 each; 20 ohm, 120/180

RELAYS.

10/-; 9 henry 100,150 m/a., 7;6;

13'6; 15 henry 275 m/a., 10/6; 20 henry 120/180

10/6 each; 9 henry 100,150 m/a., 7;6/;

15 henry 80 m/a., 5,6.

amp., 0.74 amp., 7/6 each; 200 ohm, 0.3 amp.,

8 ohm, 3.3 amp., 9/6 each.

amp., 10/6.

amp., 10/6.

amp., 17/6;

amp., 24/6.

amp., 10/6.

amp., 12/6.

amp., 12/6.

amp., 17/6.

amp., 10/6.

amp., 12/6.

amp., 17/6.

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Selenium Metal Rectifiers (S.C.E.T. Type). Built to the closest tolerances for use in oscillators, transmitters and receiver units. All work fully guaranteed. Very good delivery. Your inquiries invited for large or small quantities.


Volts. Type | Volts | Volts | Price
---|---|---|---
243 | 6D | 245 | 8D
375 | 4A | 379 | 6A
550 | 2A | 556 | 4A
655 | 2A | 660 | 4A
755 | 2A | 765 | 4A
855 | 2A | 865 | 4A

1,000 OHMS H/R. Ear Pieces, 3,6 each, p.p. 9d.
15, condition, I5, p.p. 6d.

Unit ex-No. 19 Trans-receiver, 12, Type CV 1526, 21in., 4 v. filament, 3,000 v. anode, complete with Type VCR97, ex-Equip., in good order, 20, p.p. 3 6.

All work fully guaranteed.

No. 38 Walkie-Talkie Trans-receiver, in good condition, 20, p.p. 3 6.

Chromium Plated Extender Aerials. Min. length 12in. Max. length 48in. Suitable for car radio aerials, 8/6 each, p.p. 9d.

Cathode Ray Tubes

Type 3, new and unused, with base and screen, 42, p.p. 2 6.
Type VCR130 (ERC35). With screen and base, In new and unused condition.


2,000 OHMS H/R. Ear Pieces, 3/6 each, p.p. 9d.


Little Newport St., London, W.C.2.

BC410 Transmitters with speech amplifier, aerial tuning unit, etc. Brand New.

RCA Transmitters. Type ET-334. Complete with original speech amplifier and aerial tuning unit, etc. In good condition. Can be supplied with very large quantity of spares.

SELSYN TRANSMITTERS with speech amplifier, aerial tuning unit, etc. Brand New.

MULTI CHANNEL TRANSMITTER T-4/FRC, with modulators MD-1/FRC, 2 Mics to 18 ch. Each channel 40W. w. output.

T-C-S-4 EQUIPMENT complete with loading unit, remote control, microphone, etc. Brand New.

Magneto 10 Line U.C. Telephone Switch-Boards (complete).

Marconi Signal Generators Type TF 14G.

As new, checked.


Metal Rectifiers Type 1B, D.C. output 10 amps at 22, v. 220/250 v., 50 cts.

All above items in excellent working condition.

S.P.A. Sales, Address, Offices and Works BEAVOR LANE, HAMMERSMITH, LONDON, W.6 Telephone : RIV 80067
AMERICAN MINIATURE GEARED MOTORS

12-24 volts 2 amperes
A.C. / D.C. output
120 r.p.m.
175 lbf. ft. @ 3,000 r.p.m.

COPPER PLATED AERIAL RODS
Push-in sleeve joint, 3/4" per half-gross, 1½ per gross, P.P. ½.

SPECIAL PRICE OF £2 per thousand in ten thousand lots, plus carr.

ALL ORDERS & ENQUIRIES TO OUR EDGWARE ROAD BRANCH PLEASE. THIS IS OUR GREATEST SATURDAY.
HOURS 9-6. 8-1 THURSDAY.

169/171 EDGWARE ROAD, LONDON, W.2.
TEL: PAD 7851
AND
125 TOTTENHAM COURT ROAD, W.1.
TEL: EUS 4982

LIGHTWEIGHT UNSPILLABLE P. & G. 2-VOLT 7 AH. AT 10 HR. RATE ACCUMULATORS. Size 4½ x 2½. P.P. £1. EXIDE 10 volt 5 Ah. Glass accumulator, size 7 in. x 2½ in. x 5½ in. suitable for H.T. unit construction on models, etc. £2½. MINIATURE ACCUMULATORS made by Willard Co., .05 volt 0.5 Ah. Size 5/8 x 5/8. Note size and weights 3½ in. x 2½ in. x 5½ in., weight 5½ oz., 5½ p., or set of three 3½ in. and one 6½ in. same size but weight 4½ oz. in sealed metal container, £1, p. ½. Easily filled with hydrometric syringe.

EX-ARMY MEDICAL HYDROELECTRIC SYRINGES. Brand new. 1 c.c. with needle, 6½, p. 6d. 10 c.c. with needle, 7½, p. 6d. Extra needles, in 52½, p. 6d.

AMERICAN 6 VOLT 90 AH. IS PLATE CAR BATTERIES. Size 9½ in. x 9½ in. x 2½ in. Brand new In maker’s cases, £2½/16, carr. 7½.

PRICED AND GOLD STORAGE BATTERIES. 12 volt 75 Ah. Built in tank cases. Brand new, £4½/15, carr. 7½.

AMERICAN AIRCRAFT BATTERIES. 24 volt 11 Ah. by Willard. Brand size, £1/4, carr. 7½.

AMERICAN C.R. TUBES. 5 CPI. Brand new, 29½, carr. 2½. CRT Type NC 137, in packs, in cases, 3½, carr. 4½. R.F. UNITS, Type 24, 20-30 Mc/s, complete with valves, brand new, 15½, p. 2½. 1121 Tuning units, 8½, p. ½.

LOW WATTAGE IMMERSION HEATERS. Low wattage thermostats, for many small electrical appliances. 1,000 watt 10 Amp., £2/6. 1,200, £2/15. Built-in control. These sets are primarily intended for charging 12 volt batteries, but an A.C. output is also available. 120 volt, £2/20.

HIGH GRADE BLOCK CONDENSERS BY FAMOUS MANUFACTURERS. B. metric, in sets. 3-50 mfd. 24 volt, £4/6. 1,425 r.p.m. herausgegeben von 250, 1½ in. x 3 in. x 1½ in., weight 54 oz., 5½ p., plus returnable deposit of 1½. 1,000-1,500 g.p.h., £4/15. 15 amp. and 2.2 v. each, £4/15. Geared down to 1½ in. x 3 in. x 1½ in., 200-240 volt, 18 amps., 35½, carr. 4½.

HEAVY DUTY A.M. L.T. TRANSFORMERS. ROL GENERATOR CHARGING SETS. Originally designed for charging 12 volt batteries, but an A.C. output at about 300 cycles per second is also available. 15 volt, 2½ amperes, 7½, carr. 7½. 10 volt, 5 amperes, 7½, carr. 7½. The continuous D.C. rating is 3,000 watt, 200-250 volt, 5 amperes, complete with hand set and exhaustpipe, £22½. All condensers offered are brand new; postage on all orders 60 d. C., 7½.

...
**Quality Equipment Designers Ltd.**

**Complete kit £10-7-6**

PLUS 3/- Pic., Carr. & Ins.

Also, as usual: Chassis dimensions—12 x 8 x 2½. Circuit Diagram, etc., available especially at 1½. For operation on A.C. lamps 200/250 volts.

All components supplied in the circuit diagram. No price rise this year. Valves 3 months.

To those wishing to purchase this High Fidelity Amplifier really built and tested, we can offer it now at £11/12/6 plus 4½ for Pic., Carr., and Ins. (Please state whether for use with 3 ohm or 15 ohm speakers.)

**MAINS NOISE SUPPRESSOR UNIT**

A simple and effective method of cutting out mains noises. The kit consists of 3 specially designed chokes together with 3 condensers. The unit can be assembled in existence. No previous experience is needed.

4/11 COMPLETE WITH WIRING DIAGRAM £11, post, etc.

**W. B. STENTORIAN HI-LO HI FI LOUDSPEAKERS**

HF 10 Min. 3 watt.
HF 10 Min. 5 watt.
HF 10 Min. 7 watt.
HF 1012 Min. 10 watt.

Please state which will be required 1 ohm or 15 ohm.

All the above plus 2½ partition c, carriage, insurance.

**TERMS OF BUSINESS**

Cash with order or C.O.D. All orders for small items totalling over £2 post free unless otherwise stated.

To personal shoppers wishing to visit our premises ALIGHT AT HARRINGAY ARENA. OPEN FROM 9 a.m.-6 p.m. MONDAYS-SATURDAYS (EALY CLOSING WEDNESDAYS).

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**G2AK This Month's Bargains**

**G2AK T.V. POWER TRANS. By Parmeko. Pri. 200/250 v. E.H.T 4 kV. (RMS) 350/350 v. 250 ma. 6.3 v. 6 a. 4 v. 3 a. 4 v. for E.H.T. Rec. Wired to Holder. Beautiful job. 6½/6½, Carr. paid. P.E.M. ONLY. METERS. 2x12. flush mounting M.C. 100 ma. 0.10 ma. 0.30 ma. 1/2 a. 0.15 A. proi. thermo. 2x12. 7 ½. 0.9 A. hot-wire. 5/-.

TEST METER. 7 ranges 2 x 17 x 14 x 10 x 5 x 150 x 60 ma. 5,000 ohms. 25,000 ohms 2 x 11.2 in. dia. scale M.C. meter. Rotary selector switch. Black bakelite case. 6 x 4 x 4 fitted with removable lid, also provision for internal basis, ranges can be easily extended. Bargain price 30/-, plus 1/- post.

SPECIAL OFFER, AR88 SPARES. Cabinets, complete with base, feet and side strips. 64/- for 3 each. Pkg. and Carr. 5/-.

SET of 14 valves for "D" or "LF", model receivers.3½/- each. (Send 2d. STAMP FOR CATALOGUE).

Specially designed to give smooth silent movement. Complete with ball and plug. High quality, very sensitive. Chrome finish. List price 2 gns. Our price 2½/- Few only.

COPPER WIRE. 14G H.D. 140ft. 15½. 70ft. 7½. post and packing 2½/- Other lengths pro rata.

SPECIAL VALVE OFFER. 865A, 17½ each, or 30½/- pair. 807, 18½ each or 17½ pr. 621 A & 645, 60/- 7 ¾/½. £2 4/-.

STRAINED CABLE, complete. Choose any size or finish. Any size or finish. List price 2 gns. Our price 2½/- Few only.

SHAPED POLE MOTORS. For Tape Recorders, etc. Voltage tapping plate 200/250 v. 3½-name fixing. Our price 12½/6 ea. or 21½/- pr. Under £1.

Carriage paid up on all orders over £1 except where stated. Please give small amount for orders under £1.

Please print your name and address. All Mail Orders to—

**CHAS. H. YOUNG, G2AK Dept. C.W. 102 HOLLOWAY HEAD, BIRMINGHAM 1**

**Television - Radio - Record CABINETS MADE TO ORDER**

ANY SIZE OR FINISH

CALL OR SEND DRAWINGS FOR QUOTATION

**B. KOSKIE (DEPT. E.)**

72-76 Leather Lane, Holborn, E.C.1

Phone: CHAncey 6791/2
SEND STAMPS short.

Containing 4 EF50, 2 SP6I, 2 EA50, units are as new and tested before despatch. £4/10/-.

Junction Box and Aerial Rods in canvas bag. Freq. 150 mA.

All Meters are Brand New and in 30 mA.

10 mA.

5 mA.

1 mA.

500 uA.

20 A.

6 A.

5 A.

1 A.

20 v.

15 v. (50 c.)

6 v.

No. 38 "WALKIE-TALKIE" TRANSCEIVER, complete with Throat Mike, phones. No. 276, £1 6/-.

VOLTMETERS

R. C. M. 2m. Projection 10/-.

150 v. (25 c.) M. 2m. Flush 6/-.

250 v. M. 2m. Square 10/-.

300 v. M. 2m. Flush 15/-.

300 v. A. C. Projection 5m. Dial 15/-.

ANP-METERS

1 A. M. 3m. Projection 10/-.

1 A. T. C. M. 3m. Square 6/-.

3 A. T. C. M. 3m. Flush 8/-.

12 A. M. I. M. 4m. Projection 21/-.

17 A. M. I. M. 4m. Flush Win. 26/6.

30 A. M. I. M. 4m. Square 7/-.

MILLIAMMETERS

300 mA. M. C. 7m. Round 15/-.

1 mA. M. C. 2m. Flush 25/6.

1 mA. M. C. 3m. Deck Type 30/-.

5 mA. M. C. 2m. Round 7/-.

15 mA. M. C. 2m. Flush 10/-.

30 mA. M. C. 2m. Round 10/-.

50 mA. M. C. 2m. Flush 10/-.

100 mA. M. C. 2m. Round 10/-.

200 mA. M. C. 2m. Flush 10/-.

500 mA. M. C. 2m. Round 15/-.

1 mA. M. C. 2m. Meter Rect. 10/-.

M.C. = Moving Coil. M.I. = Moving Iron

T.-C. Thermostat-Compensated

All Meters are Brand New and in original cases.

No. 38 "WALKIE-TALKIE" TRANSCEIVER, complete with Throat Mike, phones, Junction Box and Aerial Rods in canvas bag. Price, range 7.4 to 9 Mcs. Range approx. 2 miles. All units are as new and tested before despatch. £8 10/-."

BOWTHORPE CONTINUITY METER

Dual scale 3-500 ohms and 100-200,000 ohms moving coil operated 94-mv. internal battery. Size 6in. x 3in. x 4in. Original price, £1 9/6d. Our price, brand new, £3 5/-."

INDICATOR UNIT TYPE 182A

Unit contains VR217 Cathode Ray tube, complete with Metal-screen, 3 EF50, 2 SP6I and 1 UG43 valves, 9 wire-wound volume controls and quantity of resistors and condensers. Reliable chassis for basis of television (full picture guaranteed) or Oscilloscope. Offered BRAND NEW (less relay) in original packing of television (full picture guaranteed) or Oscilloscope.

U.S.A. INDICATOR UNIT Type BC929A

Three Units are in absolutely new condition. Ideal for scope or send for full details.

EF50 (VR91A)

The selected EF50, Red Sylvania, original boxes 10/- each, 50/- for ten.

R.F. UNITS

Type 24 20-30 Mcs.

Switched Tuning.

With 3-SP6I

15/- EACH BRAND NEW

Type 25 45-55 Mcs.

Switched Tuning.

With 3-SP6I

19/- EACH BRAND NEW

T.V. PRE-AMPLIFIER FOR LONDON AND BIRM.

Hammar. Complete with ESA96. Ready to plug into your set, 276, £3 3/- 6d.

CRYSTAL MICROPHONE INSERTS

8/6 POST FREE

8/6 POST FREE

Ideal for tape recording and amplifiers. No matching transformer required.

PLEASE ADD POSTAGE. ARTICLES UP TO 10/-, 1/-; £1, 1 6/-, 2/-.
CONSTRUCTOR'S BARGAINS!

PLATE TRANSFORMERS FOR BC618 E TRANSmitter. Genuine brand new spaces for this famous American Transmitter. Primary 115 v. input. Secondary 2,000 volts and 2,500 volts, C.T. IN MAKER'S ORIGINAL CASES. ONLY £7/10/0 (carriage extra).

RF UNITS TYPE 26 and 27. For use with the R.1335 or any receiver with a 6.3 v. supply. These are the variable tuning units which use 2 x valves EF50 and 1 x EB34. Type 26 covers 65-50 M/c (5.6-7 metres) and Type 27 covers 85-65 M/c (3.5-3.0 metres). Complete with Bargain Brand NEW IN MAKER'S CARTONS. ONLY 35/- each.

w. 19/- 15 M/c. I.F. STRIP. Ready made for London Vision Channel. This 5-stage strip contains 6 valves EF50 and 1 x EB34. Complete with BRAND NEW IN MAKER's CARTONS. ONLY 70/- each.

COMMUNICATIONS RECEIVER R.1155

The famous ex-Bomber Command Receiver known to the world over to be supreme in its class. Covers 5 wave ranges: 18-5-7.5 M/c, 7.5-3.0 M/c, 1,500-600 kcs, 500-200 kcs. 200-100 kcs, and is easily and simply adapted for normal uses with full details being supplied. Aerial tested before despatch. BRAND NEW AND UNUSED IN MAKER'S TRANSIT CASES. ONLY 61/-19/6.

SLIGHTLY USED RECEIVERS. Grade I, also tested working before despatch. £9/19/6.

A.C. MAINS POWER PACK OUTPUT STAGE, in black metal case, enabling the receiver to be operated immediately by just plugging in, without any modification. Can be supplied as follows. WITH built-in 6juin. P.M. Speaker, £6/16/. LESS speaker, £6/10/0.

DEDUCT 10/6 IF PURCHASING RECEIVER AND POWER PACK TOGETHER. Please add carriage cost of 10/6 for receiver and 5/- for power pack.

POWER UNIT TYPE 3

Made for use with the R.1132A, this is a standard rack mounting job to match the receiver, and is for 200/250 v. 50-cycle outputs up to 100 v. D.C. 100 ma, and 6.3 v. 4 amps. Fitted with H.T. current meter and voltmeter, this is a first-class unit, and can be used for a variety of receivers. Used, but tested working before despatch. ONLY 90/- (carriage, etc., 5/-). Connecting cable with Jones Plugs for receiver and power unit, 10/-.

CLASS D WAVEMETER

Another small quantity has become available since our "sell out" a few months ago. A.G. receivers should act quite quickly. This is a really first-class crystal controlled wavemeter, which has been repeatedly reviewed and recommended in the "R.S.G.B." Bulletin. Covers 1.9-8.8 M/c, and is complete with 6 valves VR65. 1 of VR92, and 1 of VR53 or VR54. Mod. data supplied. ONLY 35/- (postage, etc., 5/-). Less valves, 25/- (postage 10d.).

AMERICAN LORAN INDICATOR UNIT APN.4

This unit recommended for use with 6.3 v. receivers and BRAND NEW IN MAKER'S CARTONS. ONLY £7/10/-.

GLOBE TUBE, etc., ONLY 8/-6.

MODULATOR TYPE 67. Contains fully smoothed normal A.C. Main's Power Pack, transformer being 345 v.-0-345 v. to 200 ma, 6.3 v. 3 a, 6.3 v. 4 a, 6.3 v. 5 a, 6.3 v. 6 a, and 6.3 v. 7 a. Used, but tested working before despatch. ONLY 70/- (carriage, etc., 5/-). 

TRANSFORMERS, EHT. Upright mounting.

EHT for VCR97 Tube 2,500 v. 5 ma, 2 v.-0-2 v. 1 a, 2 v.-0-2 v. 2 a, 37/6. EHT. 5,500 v. 5 ma, 2 v.-0-2 v. 1 a, 7/6. EHT. 7,000 v. 5 ma, 2 v.-0-2 v. 1 a, 8/6. EHT. 7,000 v. 5 ma, 4 v.-0-4 v. 1 a, 9/6. EHT. 7,000 v. 5 ma, 8 v.-0-8 v. 1 a, 10/6. EHT. 7,000 v. 5 ma, 16 v.-0-16 v. 1 a, 11/6. EHT. 7,000 v. 5 ma, 32 v.-0-32 v. 1 a, 12/6. EHT. 7,000 v. 5 ma, 64 v.-0-64 v. 1 a, 13/6. EHT. 7,000 v. 5 ma, 128 v.-0-128 v. 1 a, 14/6. EHT. 7,000 v. 5 ma, 256 v.-0-256 v. 1 a, 15/6. EHT. 7,000 v. 5 ma, 512 v.-0-512 v. 1 a, 16/6. EHT. 7,000 v. 5 ma, 1,024 v.-0-1,024 v. 1 a, 17/6. EHT. 7,000 v. 5 ma, 2,048 v.-0-2,048 v. 1 a, 18/6.

CABLE, CLEARANCE OFFER OF 23/6 twin polythene. Weatherproof, and suitable for outdoor use, 39/6 per 100 yard coil (carrige, etc., 3/6). S.A.E. for sample, trade enquires invited.

SPECIAL OFFER Ex-Admiralty L.T. TRANSFORMER. Normal mains input, output 4 v. 20 amps. C.T. New and unused. These have become damaged, but are still usable, the damage being confined to broken fixing lugs, and broken bakelite terminal panels. Formerly sold at 30/-, now offered at 17/6 (post., etc., 2/6).

ROTARY POWER UNIT, Type 87.

Ex-R.A.F. Input 24 v. Output 230 v. 65 ma, and 6.3 x 2 amps. Fully filtered, smoothed, and noise suppressed. Ideal for running radio on batteries or other 24 v. D.C. source. BRAND NEW. ONLY 15/- (postage, etc., 2/-).

INTERNATIONAL OCTAL PLUG Fits into I.O. valveholder, 2 1/2" (post. 3/6).

GANGED POTENTIOMETERS, Double 50K and double 1 meg, 7/6 each.

CERAMIC 2-WAY 3-BANK SWITCHES, 7/6 each.

Cash with order please, and print name and address clearly.

U.E.I. CORPORATION
Radio Corner, 138, Gray's Inn Road
(Open until 1 p.m. Saturdays. We are 2 mins. from Finsbury Park Station (Chancery Lane Line) and 5 mins. by tube from King's Cross)
OUR RANGE OF QUALITY EQUIPMENT IS MOST COMPREHENSIVE

Whether new or used, it is all guaranteed to be in perfect condition

See display in our new showroom (floor space over 500 sq. ft.)

BRITISH TEST EQUIPMENT

AVO Model 7 as NEW, £15. Model 40, £12. AC/DC/cons. £1/15. Rollet

panel valve testers. £12. Electronic test meter by AVO, £30. Wide range

signal generator, £22. AVO valve characteristic meter, £58. AVO signal


260A TV Wobbulator, as NEW, £30. Evershied Wee meegers 500 v.

£4. Bridge type and others in stock. Marconi: Signal generator types

TF144G, TF517, TF390/G. Valve voltmeters, output meters. Marconi

E9 valve testers, £12. AVO valve characteristic meter, £339, from £35.

Mullard Valve Tester, complete with cards, £65.

TRANSMITTERS

U.S.A. 1953 Harvey Wells, type TBS50. Phone CW. 80, 40, 20, 15, 10,

6 and 2 metres. Crystal Oscillator VFO switching. AS NEW. Less power

supply, £45. ELMAC transmitter 50 w. Phone or CW, VFO or crystal

control, 20, 11, 10 bands. Dual scale meter. less power supply mobile

or fixed, £50.

RECEIVERS

All receivers are in good working order and condition unless stated.


£68. SX42, 550-42 Mc's. £68. SX28, 550-42 Mc's. £63. SX2, 100-300

Mc's. £29. AC/DC portable battery 550-32 Mc's. £31. AC/DC 110-250 v.

£30. Also in stock SX30, 30 Mcs. £150, SX72A, 150-230 Mc's., £111. A

Marconi 12 v. radiotelephones. HRO receivers junior and senior

types with all coils and power supplies from £27, complete. National

MC190-BH1, MC90, MC91. National MC190, 3. 550-32 Mc's. Type

NEW, £85. Marconi CR100, 60 kc-45 Mc's. £22. £68. £50. £68. £675.

£35. £504. £23. £85. £23. £68. £11. £25. £32. £332. £36. £15.


Wireless World

January, 1955

Best Buy at Britain's

E.M.I. OUTPUT METER. Desk type incorporating a 2fin. 1 mA meter together with instrument rectifiers, etc. ranges 0-500 milli-watts and 0.5 watts and decibel scale. Brand new in original manufacturer's boxes with instructions. Price 35/-, post 1/6.

METER BARGAINS, ALL BRAND NEW 13 x 3 1/2in. 300 mA, 20 volt moving coil 2in. sq. pmt. mg. ... 7/6 3,500 volts moving coil 3fin. projection 10/- 150 milli-amp. 3in. sq. pmt. mg. ... 7/6 5 milli-amp. moving coil 2fin. sq. pmt. mg. ... 20/-. 20 amp. moving coil 2fin. 1fin. dia. 1mA, 2fin. barrel flush pmt. ... 2/6. 1 fin. 2fin. 2/6. 150 micro-amp. barrel. pmt. mg. scaled 0-1500 in 15 clear divisions. Only ... 4/6.

METAL RECTIFIERS. 1mA. Salford Instruments, 6/9, 2mA., S.T. C as used in E.M.I. Meter, 4/6. All are full wave bridge and brand new.

METAL RECTIFIERS. Heavy duty Selenium 10fin. long with 32fin. square. Plates are required for a full wave bridge giving 40 volts at 10 amps. Brand new and ridiculously cheap at only 57/6 per pair plus 2/6 post. R.M.4 250 volts 250 mA. Only 12/6. R.M.2, 4/3 each or 2 for 8/-, Selenium 300 volts 100 mA. Brand new, ex-W.D., 4/9 each.

X*TALs 465 kc/s S.T.C. jn. pins suitable for crystal glasses, IF checking, etc. Brand new, boxed, 1/8 each. 200 kc/s American G.E.C. jn. pins suitable for crystal calibrators, etc. Brand new, boxed, 1/8-10/- each. 100 kc/s jn. pin spacing. British, ex new units, 15/- each.

6 VOLT H.R.O. VIBRATOR PACK. Gives 165 volts at 80 mA, poetched D.C. Uses Mallory Vibrator, 6 x 5, heavy duty smoothing choke, etc. In black cased cabinets size 3fin. x 1fin. x 6fin. Brand new, ex W.D., 29/6.

POWER UNIT TYPE 285. A.C. mains input 230 volt 50 cps. Outputs E.M.T. 2 k.v., @ 5 m.A., H.T. 450 volts @ 200 m.A., L.T. 6.3 v. @ 17 amps, fully smoothed, 2 chokes, paper condensers, etc., complete with valves SV4G, VU120 and EF18. This was the ground power unit for the " Gee " equivalent calibrator and should be suitable for TV, etc. A REAL BARGAIN AT ONLY 69/6.

RACKS. 6.f.t. " U " channel P.O. type for 19fin. panel, heavy angle base. Price 7/6, plus carriage at cost.

MODULATOR TYPE 67. This unit is a pulse modulator with pulse width of 1, 2 and 5 micro seconds. The pulse amplitude is also variable. It is a particularly useful instrument as a heavy duty pulse power package suitable for 230 volt 50 cps. mains supply. The mains transformer outputs are 6.3 volts twice, 5 volts for the rectifier and the L.T. winding 345-345-345 volts. Also included are 5 SP6I; one 5416, 2 EB34, and 3 EA50. Size of case 18 x 9 x 7 inches. These units are brand new in original packing cases. Price 67/6 plus carriage at cost.

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INDICATOR TYPE 92A. Exactly the same as the 62 indicator unit but is 50 cycle revision. Double deck chassis, containing loads of components, 16 SP6I, 2 EB34, 4 E550, etc., Brand new condition (less VCR97). Only 45/- plus 7/6 carriage.

INDICATOR TYPE 92B. Indicators contains 3 EP50, 1 SU4G, 4 SP6I and a 64T. R.F. Type VCR 517, complete with 5u Metal-screen, 7 wire wound pots, with large assortment of resistors and condensers. Can be converted to Oscilloscope (as described in " Radio Constructor.") Circuit supplied. Tubes have no " Cut Off " and can be demonstrated to callers. Brand NEW (less relays). In original transit case, 87/6 plus 7/6 carriage.

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The PARTRIDGE Type P3064 8 Core

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£4:18s. For relevant technical data see Sheet No. 9.

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Wide range of surplus receivers, 2-300v, receivers and 250-500v, transistors, except
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SPECIALIZE in the manufacture of High Quality

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(010)

We now hold in stock a new Mullard amplifier-M.V.W. re-

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This superb "Jupeo" amplifier, type SB-10, which

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chassis, 15 watts output response 15 c/s to

4000 c/s. 4-valve design for 25, 18 db, 4 db, treble

18 db, treble lift 18 db, 6 db, cut 20 db; tone

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(015)

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(031)

SOUND sales A-Z Junior amplifier, control

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(1961)

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(771)

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(053)

R.F. units types 26 at 27/6, 25 at 15/-,

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amplifiers, pre-war condition, ideal

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Marconi variable attenuator, no. 1, 2, 3, £35; take £25; £350,

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(011)

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£9; constant voltage transformers, input 150-

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Description:

For more information, please visit their website.

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VALVE Production Engineer required to take charge of valve production section in an established works in N.W. London; must be experienced in practical control of transmitting and similar type valves and conversant with all processes. Also state experience, age, and salary required to Box 10750. [3636]

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250 S.F.D. 3" FLUSH MODEL 537

RECEIVER R1153

BRAND NEW. AERIAL TESTED in makers original transit case. Apply to get one from the best delivery we have heard from. The Maidstone Co., Ltd., Chertsey Street, London, S.E. 1. For further details or 1/3 for publication giving circuit diagram, etc. Offers available from EMW—according to condition.

BANKS: F.R.O. standard 16ins. panel, steel channel boxed, correctly drilled. Heavy angle base. Height, 15 ins. or 21 ins. £15.

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SLOW MOTION DIALS. 6ins. Scratched 0-100, reduction 260 to 1 or direct, hand rewind. £2 10/6 each. Same price, while they last, 6/6 each, post 11/0. [3927]


INSTRUMENT RECTIFIERS. A millisep., 776 c.s.e. £1 10/6. 8000 v. A.C. 10 cy. 5yls. Bush, moving coil, rectifier type, 30/-, post 11/-.

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RELAYS TYPE 3000 BUILT TO YOUR SPECIFICATION—EARLY DELIVERY—QUOTATION BY RETURN—PLEASE STATE RESISTANCE OF COIL AND REQUIRED AND CONTACT BUILD UP.

MICROAMMETERS


Electrical World
January, 1955

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MICROAMMETERS


Electrical World
January, 1955

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Waldorf, Mahogany or Oak, 30" wide, with enclosed expanded metal grille. 12" Speaker Model £10.00 8" Speaker Model £9.00
"Carried, paid GOODMANS & G.E.C.
Full range of cabinets for these speakers
You can see your cabinet being made in our cabinet-making workshop.
Cabinets made to order and made of
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ELECTRONIC ENGINEERS, Graduates and Junior, with a leaning towards technical writing, to undertake the preparation of instruction manuals, specifications, etc., for guided weapon systems. A working knowledge of pulse circuitry and microwave techniques required. Write to the General Electric Co., Ltd., Brown's Lane, Allesley, Coventry.

SALES representatives required by leading instrument and equipment manufacturer; good electrical and general engineering ability to actually book orders essential; territories London, Birmingham, Manchester, and South Shields. Apply giving full details of experience, age, salary required, to the Personnel Manager, The General Electric Co., Ltd., Brown's Lane, Allesley, Coventry.

ENGINEER or physicist required by large electronics manufacturer, Junior and Senior, for research and development work. Large electronics organisation. -Full details in strict confidence to Box 0564. [3941]

SENIOR electronic engineer required by radio manufacturers for research and development work. Experience important. Apply stating age, qualifications and salary required. -Full details in strict confidence to Box 0564. [3941]

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ENGINEER, 24 volts D.C., approx. 2 h.p., guaranteed in good working order, £50. C.I.F. Liverpool.

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All goods sent on 7 days approval against cash.

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HEAVY DUTY L.T. TRANSFORMERS suitable for rectifiers, soil testing, etc. Input 200/250 volts. Output a combination of 6, 12, 18, 24 volts at 20 amps. £6/15 each.

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Another Input as above. Output 0, 6, 12, 18, 24 volts at 30 amperes, 4/6 each.

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25 Watts - soldering
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200'220 volts, Length 9 in. excluding industries.

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Fidelia Standard 7-valve model

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10 Valve Radiogram

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Old Dan. Davis, an old man of only ninety-nine, reading right through Timespleat the Fidelia. I said to Dan: "Have you a son?" He said: "Yes, he's nineteen." I said: "Have you a daughter?" He said: "Yes, she's nineteen." I said: "Why do you call her Fidelia?" He said: "That's her name." I said: "Why do you call her Fidelia?" He said: "That's her name."

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Fidelia De Luxe 5-valve model with push-pull and output stage. Variable Selection, Separate Bass and Treble Control, Carbon button detector, 20,000 cycle audio response.

SITUATIONS VACANT

An opportunity occurs in progressive manufacturing department for an Engineer, aged 25-30, with electrical or electronic experience, obtained in research and development work on high frequency telecommunication cable and associated testing equipment. Salary will be commensurate with qualifications and experience.

= Apply giving full particulars to Box 73456

ENGLISH ELECTRIC VALVE Co. Ltd., have vacancies for young engineers to work on radio valve design and development. Applicants should be of degree standard, whereas experience of this type of work is desirable. All applications should be in writing. Only suitable candidates will be considered.

= Write, giving full details of education and employment, and salary required, to Personnel Manager, Box 5M/2548, A.K. Adve.

EX-SERVICE radio-radar mechanics. Leading company in the electronic field has vacancies for men in manufacture and testing of radio and radar equipment; opportunities occur in the quality control maintenance field for men who have had recent technical training in the theoretical knowledge of radio and radar equipment. Applicants should write, giving full details of their experience, etc., to Box 7569.

= RADIO and TV engineer with laboratory experience required by leading London firm of electrical engineering. Work is interesting in nature and is offered in connection with printed circuits. Applicants should be of degree standard, and have knowledge of electronic equipment essential.

= Write, giving full details of education and employment, and age and salary required, to Personnel Manager, Box 5M/2548, A.K. Adve.

Graduates with honours degrees in physics or in electrical engineering are required by the British Thomson-Houston Co. Ltd., Rugby, for research in the field of X-ray and electron-tube development. Some knowledge of electric circuits is desirable.

= Applicants should write to the Director of Research, giving their qualifications, age, and details of training and college, quoting the registration number DR.

= TRAINING by E.M.I. for Graduates with honours degrees in physics or in electronic engineering is open to students in the age group 20-25. Candidates must have been educated at Imperial College, London, or at a University outside the U.K., and have obtained a degree of not less than 2:1 in electronics or in physics.

= Write, giving full details of education and employment, and salary required, to Personnel Dept. (D/D), E.M.I. Factories, Ltd., Blyth Rd., Hayes, Middlesex.

= Technical assistants required for investigation work in connection with radio valve manufacture; applicants should possess at least B.Sc. degree in electrical engineering. Five-day week, modern welfare facilities, staff pension scheme, and five weeks' holiday a year. Excellent opportunities for men of degree standard to work in this new and well-equipped engineering department.

= Apply giving full particulars to Box 7677 (D/E), English Electric Factories, Ltd., Blyth Rd., Hayes, Middlesex.

= An opportunity occurs in a progressive manufacturing company for an Electrical Engineer to work in the design of electro-mechanical equipment. Applicants should be of degree standard, whereas experience of this type of work is desirable. All suitable candidates will be considered.

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Fidelia De Luxe 5-valve model with push-pull and output stage.

Fidelia 10-watt amplifier.

Full details on request. All models have three input stages, Variable Selection, Separate Bass and Treble Control, Carbon button detector, 20,000 cycle audio response.

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All details on request. All models have three input stages, Variable Selection, Separate Bass and Treble Control, Carbon button detector, 20,000 cycle audio response.

2 AMHURST ROAD, TELEPHONE CLIFFS, K. BRIBES.

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wanted for testing communications receivers and transmitters.

Apply with full particulars to:

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Electronic computing techniques are now being successfully applied to many accounting and statistical problems. There are excellent prospects with the expanding Production Development and Research Departments of the British Tabulating Machine Co. Ltd., Letchworth, Hertfordshire, for University Graduates and men of H.N.C. standard or higher with an interest in electronics and their application to computing machines. The Company will be pleased to hear from men seeking an opening in this field. Assistance with housing may be given to suitable applicants. Pension and Sick Pay Schemes are in operation. Enquiries should be addressed to Personnel Officer in the first instance.

THE PLESSEY COMPANY LIMITED

Invite applications for the position of CHIEF ENGINEER


Replies, which should give full details of qualifications and experience should be addressed for the attention of Mr. J. Rhys-Jones at the above address.

Situations Vacant

RADIO and television engineer—Applications from experienced men are invited by Selfridges, Ltd.; applicant must have current driving licence and good mechanical ability; sound general condition; good wages; staff canteen; discount on most personal shopping. Address Personnel Manager, Selfridges, Ltd., 500 Oxford St., London, W.1. (1934)

DECCA RADAR, Ltd. Require inspectors for control of electronic equipment. Applicants must have previous experience desirable; applicants must be capable of following electrical diagrams and able to point out to photog for checks; it is also desirable, but not essential, to have knowledge of I.E.D. (Intermediate Electronic Devices) for general assembly of electronic equipment. Apply immediately to the Personnel Officer, Decca Radar, Ltd., 20 Thorpe Rise, Northwood, Middx. (1934)

GRADUATES with honours degrees in physics or in electrical engineering are required by the British Tabulating Co. Ltd., Rugby, for research in the field of Thyratron development, some knowledge of electronics is desirable. Applicants should write to the Director of Research giving their age, qualifications and college, quoting the reference R. (1935)

HONOURS graduates in Physics or Electrical Engineering are required for advanced work in a Quartz Crystal Laboratory. The positions offered afford excellent opportunities for young men to specialize in the study of piezo-electric materials, from both the theoretical and practical viewpoints. An interest in mathematics and electronics would be an advantage for this work. HOUSES can be made available to successful applicants. APPLY in writing to the Superintendent, National Telephone and Cables, Ltd., Crystal Division, Industrial Estate East, Harlow, Essex. (1935)

RADIO technicians required by International Aeradio Ltd., for overseas service: permanent and pensionable positions, inclusive salary from £694 per annum to £1,735 per annum, tax free according to marital status; free accommodation: kit allowance; free air fares; generous U.K. leave; invalidity pension for widows and children to whom replies only will be sent please write quoting RT to Personnel Officer, 40 Park St., London, W.1. (1935)

SENIOR and junior development engineers are required for responsible work in radio and television development laboratories, applicants for senior position should be able to understand and develop with minimum supervision; excellent conditions and salary available for applicant accepted. Apply in first case to Personnel Manager (Dept. R.D.), R. & H. Massey, Ltd., 58, Wakefield Ave., Hull. (1936)

DEVELOPMENT engineer required by leading firm of electrical component manufacturers in N.W. London for work in connection with development of printed circuits and application to production; must have good knowledge of radio and TV techniques; salary £500 plus. Write, stating full details of education, practical experience and salary required, to Personnel Manager, Box 0121. (1936)

TEST engineers required to assist in the production of a variety of precision electronic laboratory instruments. The laboratory department experience is essential (preferably in connection with electronic measuring instruments); salaries in the range of £450-£575 p.a. according to qualifications and experience. Apply, stating full details to the Personnel Manager, Pye, Sunley House, E.C.4. (1936)

ELECTRONIC engineers required to assist in the development of prototype high grade telecommunication equipment. Applicants to possess fundamental knowledge of radio and television to be capable of producing own component layouts and wiring to a high standard. Pension scheme. Write, stating age, experience and salary required, to Chinab, Television Ltd., Worsley Bridge, Lower Byndenham, S.E.9. (1935)

Australian radio manufacturer of repete requires first class television production and design engineer. Excellent prospects, passage paid, good salary, excellent facilities for applicants. Apply, with photographs and testimonials to Mr. J. Younger, interviews Jan/Feb., London. (1934)

Nelson Research Laboratories, Stafford, have a vacancy for their electronic test section for an experienced man for initial training in the maintenance of precision electronic and recording equipment. Applicants to possess fundamental knowledge of electronics and radio to be capable of producing own component layouts and wiring to a high standard. Write, stating age, education and salary required, to Personnel Manager, The Telegraph, W.C.3, quoting Ref. 6/40C. (1936)

Testing engineers required for interesting work in connection with radar, television film projectors, camera tubes, microphone links and similar electronic equipment; applicants must have theoretical and practical knowledge of electronics backed by practical experience in S.M. Forces or experience in professional positions and superannuation scheme; single lodging accommodation available. Apply, giving full details of salary to the Personnel Dept. (CE/21), E.M.I., Ltd., Hayes, Middlesex. (1937)
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Applications are invited for Senior Electronic Engineers having experience on research or design relating to the development of the sub-miniature components, or microwave electronic equipment. Knowledge of physics and electronic devices is desirable. Applicants must be able to work efficiently and effectively with other electronic engineers and in close co-operation with draughtsmen and draughtswomen. Positions are of a permanent nature for engineers able equally to take part in the design of new products and to work on design and development of electronic units for servo control work.

**LABORATORY ASSISTANTS AND JUNIOR ELECTRONIC ENGINEERS**

Required for a number of posts in the Research and Development Laboratories of a leading manufacturer of microwave and electrical equipment. Experience, initiative and adaptability required. The work is interesting and rewarding for the junior posts and of a permanent nature for engineers able equally to take part in the design of new products and to work on the design and development of electronic units for servo control work.

**ENGINEERS!**

Whatever your age or experience, you need read "ENGINEERING OPPORTUNITIES!" Full details of the easiest way to pass A.I.E.E. B.A.I.C.E. & A.H.E.L.E. etc. in Electrical, etc. Select your B.I.E.T. pass to suit your own requirements. B.I.E.T. Post office box 5, London W.1.

**SITUATIONS VACANT**

Electronic or electrical engineers, between the ages of 25 and 35 years, of degree standard is required to take charge of the engineering department in a factory engaged in the manufacture of frequency control equipment. The successful candidate will be responsible for the design and specification of all new parts in addition to the routine engineering problems. The position offers a wide scope for a person possessing the necessary technical qualifications and initiative to expand the work along numerous channels.

HOUSES can be made available to successful applicants. Apply writing to the Superintendent, Standard Telephones and Cables, Ltd., Crystal Factory, Industrial Estate East, Harlow, Essex.

**MICROWAVE Engineers reqd. for research and development work at Petaluma, Calif. Applicants should have a broad background with experience of microwave equipment. Two vacancies exist, each requiring a good degree in Electrical Engineering. Applicants should write with full details to Personnel Dept. (ED/203) of the Eng. Dept., Raytheon Mfg. Co., [address].

SCIENCE graduates in physics or chemistry are required for a number of posts in the Research and Development Laboratories of a leading manufacturer of microwave and electrical equipment. Experience, initiative and adaptability are required for this work. Working away from base for periods of a few days may be necessary. Any previous experience of a similar nature would be an advantage. (Ref. 76)

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SITUATIONS VACANT

RADIO technology technique required to manage the design and development of a complete radio communications system for a large industrial concern. The successful applicant will be responsible for the management of the project and its control, contact with clients and other departments within the organisation and the general direction of radio servicing technical staff. Supervisory and administrative experience desirable but not essential. Please write giving details of experience and qualifications, etc. in writing to the Managing Director, Decca Radar Ltd., Malvern, Worcestershire.

SITUATIONS WANTED

M. MICHAEL. RADIO, Slough, Bucks. Recent experience in electronic engineering to be engaged on Goverment work, including radio amplifiers and associated equipment. Applications are invited in writing to the Chief Engineer, M. Michael, Road, Slough, Bucks. 011-83-3301.

ELECTRONICS installation and service engineer required for work in factory and industrial control. Six months commercial experience essential. Joiners will be considered. Please write, stating age, qualifications and experience, to the Personnel Manager, E. K. Cohn, St. George's Road, Southend-on-Sea.

TECHNICAL assistants required for interest- ing and progressively expanding research laboratory. MULLARD Research Laboratories: applicants must have technical degree in electronic circuitry and in possession of the highest degree of proficiency in their particular field. A substantial educational background is re- quired as standard, ex-service candidates will be considered: excepted conditions of employment: salary £95 per annum, £120 and above. Please apply to the Personnel Officer, Mullard Research Laboratories, Camberley, Surrey.

SITUATIONS VACANT

RADIO service technician required to manage the servicing and repair section of a large motor firm in Wolverhampton. The successful applicant will have a thorough knowledge of radio and servicing experience essential. Preference will be given to a candidate with a R.C.A. licence. Applicants are invited to write fully to the Chief Engineer, RFC 200, Wolverhampton.

M. IC. Instruments, Ltd., have an immediate requirement for a Technical Literature (Telecommunications) Sales Engineer. A thorough technical knowledge of radio engineering qualifications and/or experience in radio servicing is an essential. Applications are invited from experienced candidates, the duties are varied and interesting and the successful applicant will be given an opportunity to take a leading position in a well-established company. —Apply Mr. P. B. Lewis, M.Inst.E., Longbridge, Birmingham 12.

SITUATIONS WANTED

M. W. Electronics, Ltd., have an immediate requirement for a Sales Engineer to handle the sales of the company's range of television and radio equipment. Applicants should preferably have technical diploma or equivalent qualification and should be interested in the electronics industry. A new branch is opening in Southend Southend-on-Sea and applicants are invited to write, stating age, qualifications and experience, to the Personnel Manager, R. A. C. Electronics, Ltd., 292 High Street, Southend-on-Sea.

SITUATIONS WANTED

M. N. Co., Ltd., Queens Engineering Works, Bedford. Application for the post of Sales Manager, requires a candidate with a minimum of five years experience in the field of industrial electronic equipment. Preference will be given to candidates with a technical degree, who have a strong background in technical sales. Applicants are invited to write, stating age, qualifications and experience, to the Personnel Manager, M. N. Co., Ltd., Queens Engineering Works, Bedford.

SITUATIONS WANTED

M. N. Co., Ltd., require a Sales Engineer in the Midlands. The successful applicant will have a minimum of three years experience in the field of industrial electronic equipment. A knowledge of the electronics industry is required. Applicants are invited to write, stating age, qualifications and experience, to the Personnel Manager, M. N. Co., Ltd., Queens Engineering Works, Bedford.

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FERRANTI LIMITED, EDMUNDBURGH  

—FLIGHT TRIALS DIVISION—  

APPLICATIONS ARE INVITED FOR  

ELECTRONIC ENGINEER for interesting work in their Flight Trials division. Applicants will be engaged on trials to evaluate the technical and operational performance of fire control and navigation equipment and systems. Opportunities are available to degree or equivalent standard with a minimum of three years experience. Ref. No. B.R./TID. 

RADAR SPECIALIST for E.E. I or equivalent standard. Experience with Ex Radar Officers and Senior N.C.O.'s is invited to apply for either or both vacancies. The appointments are pensionable and offer excellent career prospects and working conditions in or attached to our new laboratories. Applications or application form, quoting appropriate reference number to the 

PERSONNEL OFFICER,  
Ferranti Limited, Ferry Road, Edinburgh, S.
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The increasingly high voltages encountered in television receivers and allied equipment demand outstanding features in condenser design to ensure dependability and long service life.

The 'Visconol' process — exclusive to T.C.C. — gives maximum stability to the dielectric and enables it to withstand sharp-front, short-time surges. The leakage-path between high and low potential terminals is the maximum possible and flash-over is virtually eliminated.

The fact that T.C.C. 'Visconol Cathodray' condensers are consistently used in leading equipments is indisputable proof that in every respect they are completely reliable under the most stringent conditions of operation.

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<tr>
<th>Max. Working Voltages (at 60 C)</th>
<th>Cap. in µF</th>
<th>T.C.C. Type No.</th>
<th>Max. Height above Chassis</th>
<th>Max. Diameter</th>
<th>Mounting Stud Diameter</th>
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<td>CP59ROO</td>
<td>2 3/4&quot;</td>
<td>1 3/4&quot;</td>
<td>O.B.A.</td>
<td>10/-</td>
</tr>
</tbody>
</table>

Details of complete range available on request

THE TELEGRAPH CONDENSER CO. LTD
RADIO DIVISION
NORTH ACTON - LONDON - W.3 Tel: ACORN 0061

SPECIALISTS IN CONDENSERS SINCE 1906
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RADIO & T/V SERVICE ENGINEERS' 1 LB. REELS

This special economy pack for Service Engineers contains approx. 167 ft. of 18 s.w.g. Ersin Multicore Solder. Reels 15/- each (subject)

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SIZE 1 CARTONS (5/- SUBJECT) Available in 4 specifications as below.

<table>
<thead>
<tr>
<th>Catalogue Ref. No.</th>
<th>Alloy</th>
<th>Tinc</th>
<th>S.W.G.</th>
<th>App. Length per carton</th>
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</thead>
<tbody>
<tr>
<td>C 16014</td>
<td>60/40</td>
<td>14</td>
<td>21 feet</td>
<td></td>
</tr>
<tr>
<td>C 16018</td>
<td>60/40</td>
<td>18</td>
<td>55 feet</td>
<td></td>
</tr>
<tr>
<td>C 14013</td>
<td>40/60</td>
<td>13</td>
<td>19 feet</td>
<td></td>
</tr>
<tr>
<td>C 14016</td>
<td>40/60</td>
<td>16</td>
<td>38 feet</td>
<td></td>
</tr>
</tbody>
</table>

SOLDER RINGS
Ersin and Arax Multicore butt-jointed solder rings in diameters from 1/2" and in gauges from 10—22 s.w.g. (according to diameters) are available at no extra cost.

7 LB. REELS

Ersin Multicore 5-core Solder is supplied in 6 alloys and 9 gauges on 7 lb. reels for factory use. Prices on application.

TAPE SOLDER

Multicore Tape Solder needs only a match to make a sound joint. On 1/2 cards and, for factory use, on 34 lb. reels in widths from 3/8—1 and thicknesses from .005".

ULTRA FINE GAUGES
Ersin Multicore Solder can now be supplied in 22 s.w.g. on 1 lb. reels and in even gauges between 24 and 34 s.w.g. on 3 lb. reels in 60/40 and 40/60 alloys. All gauges have 5 cores of Ersin Flux.

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LIQUID AND JELLY FLUX

Ersin Flux in liquid form is available for dipping purposes. Ask for Multicore High Viscosity Red Jelly when a flux of greater adherence is required. Size 12 tins 4/6 each (subject).

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for every soldering need

Ersin Multicore 5-core Solder is so fast that you can often save money by using an alloy of lower tin content. The 5 cores of extra-active Ersin Flux guarantee a continuous flux stream which cleans even the most heavily oxidised surfaces at great speed and reduces the surface tension of the molten solder, causing it to wet metals rapidly. The activating agent in Ersin Flux is completely volatilised during the soldering process and the residue is pure rosin—non-corrosive, non-sticky and impervious to moisture.

If you have any soldering problems the Multicore Technical Service Department will be pleased to assist in finding the most suitable and economical solder for your particular application.

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