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BRITISH INSULATED CALLENDER'S CABLES LIMITED
21 BLOOMSBURY STREET, LONDON, W.C.1
Wireless World
RADIO, ELECTRONICS, TELEVISION

Managing Editor:
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OCTOBER 1955

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FORTY-FIFTH YEAR
OF PUBLICATION

The need for efficient timebases for 90° picture tubes was mentioned in "Valves, Tubes, and Circuits" No. 33 (a reprint is available). The line timebase shown above is for use with the Mullard MW53-80 21-inch, 90° tube, operating at 16kV e.h.t. The h.t. drain of 19W is little more than that of a typical 70° scanning system.

The change from 70° to 90° necessitates, for scanning coils of a given length, an energy increase of \((\sin 45°/\sin 35°)^2 = 1.5\) times. The sensitivity of the coils is reduced because their magnetic length must be shortened to avoid corner cutting (partial compensation is obtained by extending the coils up the flare of the tube). And, for the larger picture area, the e.h.t. voltage must be increased if the beam current is not to be excessive.

For given values of scanning coil energy, booster diode conduction period, e.h.t. voltage, flyback time, and peak pentode anode current, there is an optimum h.t. line voltage for highest circuit efficiency. Thus for a given h.t. line voltage there is an optimum value of peak pentode anode current. In a conventional 70° circuit a resistor in the cathode lead of the output pentode, commonly dissipating 1.5W, is used to reduce the h.t. potential. Its removal increases the scanning coil current and peak anode current and voltage. If the peak anode current is corrected by alteration of the turns ratio of the diode and pentode windings, the h.t. drain is unchanged and the output to the scanning coils is increased. The resulting excessive peak voltages on the booster diode and output pentode are counteracted by tuning the leakage inductance of the e.h.t. overwind (points 6 to 7) to approximately the third harmonic of the flyback oscillation. This does not lengthen the flyback; and it helps to eliminate ringing at the start of the scan. Energy flows, during flyback, from the primary to the leakage inductance of the overwind and then back to the primary. The tuning is not critical.

The scanning coil connections (points 3 and 4) are equidistant respectively from points 1 and 5, which are at a.c. earth during scan. Ringing voltages at points 3 and 4 are equal and of the same polarity, therefore the ringing current through the coils is zero. The series width coil and the linearity coil are in opposite ends of the scanning coil feeds in order to disturb this balance as little as possible. Operating conditions for the circuit will be included in the reprint of this advertisement. They should be closely reproduced in the interests of maximum valve life. The reprint will also include a frame timebase circuit.

Reprints of all advertisements in this series are available without charge from the address given below.

MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, London, W.C.2
In our last issue we expressed doubts whether the new Post Office regulations, which came into force on September 1st, would in fact have any significant effect in reducing the prevailing intolerably high level of man-made interference with radio reception. These fears were strengthened by statements made by the Postmaster-General at a conference held shortly after our last issue appeared.

Administrative complexity is only one of the difficulties. According to the P.M.-G.'s own admission "these regulations can only be enforced through very elaborate legal processes, which are laid down in the Wireless Telegraphy Act." That sounds to us like an under-statement. Take the regulations affecting small motors. They seem clear enough; all users are required to restrict conducted and radiated interference to limits that are precisely laid down. But it is not really so simple as that; in fact, the user of a motor producing strong interference does not feel the weight of the regulations until several steps have been taken. First the Post Office must have a complaint from a neighbour who is suffering from the interference; then the complaint must be investigated and traced to its source by P.O. officials; finally a notice must be served on the owner of the offending motor requiring him to fit suppressors. Failing a complaint, the owner need do nothing; put rather crudely, he commits no offence until he is caught—or, more accurately, until he refuses to obey an order requiring him to fit a suppressor. And in the majority of cases, the complaint needed to set in motion the complex P.O. machinery will be lacking.

Unfortunately, the history of compulsory interference suppression has been a long story of "too little and too late." The P.M.-G. was given the powers—admittedly somewhat limited—to take active steps by the Act of 1949, but did nothing until 1953, when regulations for ignition suppression came into force. These regulations were somewhat half-hearted, and in any case were out of date when they were issued. They did not cover broadcasting Band III, in which arrangements had already been made to start an alternative television service. The truth of the matter seems to be that the present procedure is too slow and cumbersome for a rapidly growing art like ours. Before the P.M.-G. can act he must be advised by a committee faced with the difficult tasks of reconciling strongly conflicting interests and, harder still, of laying down precise limits of interference on data that is never complete or fully up to date. Wireless World is increasingly in sympathy with those who contend that anti-interference legislation should be on a simpler basis, requiring merely the observance of "reasonable precautions."

Although the latest regulations may be ineffective, they may at least serve to draw attention to the general subject of interference, and so have an indirectly beneficial effect. To coincide with them, the British Standards Institution has just issued two booklets. The first is a revised edition of "Components and Filter Units for Radio Interference Suppression" (BS615:1955; 6s). An important feature of this publication is that it deals at length with capacitor requirements and tests. All too often, unsuitable capacitors have been used and, naturally enough, frequent breakdowns have prejudiced makers and users of electrical appliances against suppressors in general.

The second B.S.I. publication is "General Aspects of Radio Interference Suppression" (CP1006:1955; 10s). This is intended as a working guide for radio and electrical dealers and their service technicians on the fitting of suppressors. For this purpose it constitutes a very useful and detailed survey of accepted good practice in dealing with the usual sources of interference.

We are glad to see that in the CP1006 booklet a fair amount of space is given to the question of receiving aerials, even though this subject might be thought irrelevant. Without being entirely defeatist over the powers of the Post Office to protect its broadcast receiver licencees, it is as well to remember that "Heaven helps those who help themselves." Is there not a thought in this for broadcast receiver manufacturers? Although the public now refuse to put up good aerials for a.m. sound reception, they will do so for television; they might be persuaded to do the same for v.h.f. sound.
**GERMAN**

Correspondents' Impressions of Broadcast Receivers and Test Equipment at the Düsseldorf Exhibition

While the British radio show was in progress at Earls Court, another exhibition, larger and more varied, was taking place on the bank of the Rhine at Düsseldorf. A tour of the stands, and conversations with the helpful and enthusiastic attendants, soon showed that real development had taken place in German vision and sound radio since the last exhibition in 1953.

Owing to the post-war lack of medium-wave channels the German v.h.f. service in Band II has expanded more rapidly than in Great Britain, and trends in Germany may well influence future design here.

All German receivers must now be approved by the Post Office as sufficiently free from radiation, and the cheap designs of the immediate post-war years have disappeared. The v.h.f. input circuit used in nearly all receivers consists of a neutralized triode r.f. amplifier followed by a self-oscillating triode frequency-changer. Further, to reduce radiation, the output from the r.f. amplifier is coupled into the frequency-changer grid circuit at a tapping point of low oscillator voltage.

Ratio detectors are now used in all receivers, often with germanium rectifiers. The standard i.f. of 10.7 Mc/s is used except in combined sound/television receivers, which have an i.f. of 5.5 Mc/s, the TV sound being produced by the difference-frequency principle to be mentioned later.

**Multiple Loudspeakers.**—There is great interest in high-quality reproduction, resulting from the introduction of v.h.f. and of high-quality records. Most receivers, including table models, have more than one loudspeaker, spaced round the front and sides of the cabinet. The intention is to diffuse the sound into the room, and also, with the larger assemblies, to give a three-dimensional effect. Six loudspeakers are used in some radio-gramophones, including electrostatic types for the higher frequency range.

Practically no receivers are without a v.h.f. range. Most cover v.h.f., medium and long waves, or v.h.f., short, medium and long waves. Interest in medium-wave reception, despite the heavy interference on many German frequencies, is shown by the fitting in some receivers of ferrite rod aerials, rotatable by a control knob on the front panel.

The German television standard is 625 lines and f.m. sound. The total channel width is 7 Mc/s, and the separation between sound and vision carrier-frequencies is 5.5 Mc/s. This higher definition system probably accounts for the larger screen sizes popular in Germany, the tendency being to concentrate on 17-in and 21-in tubes, while two models with 27-in tubes were on show, the picture tubes being American. Certainly the larger screens could be comfortably viewed at a distance at which the lines would have been prominent on the 405-line standard.

**Television Receiver Design.**—German television is transmitted on a number of channels in Bands I and III, and turret tuners are generally fitted. Many receivers use cascade r.f. amplifiers and careful screening is used to prevent oscillator radiation. A common wide-band i.f. amplifier is employed for both sound and vision. It appears that earlier designs using a separate i.f. chain for sound had given trouble because of oscillator drift on Band III which caused detuning and distortion of the f.m. sound. The difference-frequency system is now commonly used, by which the sound and vision i.f.s are amplified together and applied together to a diode detector. The products of rectification include the video frequency signal, and the beat frequency of 5.5 Mc/s between the sound and vision carriers. This frequency of 5.5 Mc/s, which is dependant only on the difference between the sound and vision r.f. carrier frequencies, is filtered out and fed into the f.m. sound circuits.

At the moment there are rather fewer than 200,000 television receivers in use in Germany, and a rapid increase is expected. The German manufacturers are also very interested in the export market, and at least two firms had on show a 4-standard receiver which would receive 819- or 625-line systems, with positive or negative vision modulation, a.m. or f.m. sound, to suit the several systems of Northern France, Holland and Belgium.

Internal rotatable aerials are fitted in these receivers. They consist of a butterfly-shape of metal foil on an insulated disc about 20in across, mounted under the top of the cabinet with a small projection backwards for rotation; with the cascode r.f. stage they appear to give very satisfactory reception in regions of good field-strength. However, I noticed that the German Post Office stand featured a display stressing the
desirability of an external aerial to combat interference.

Band IV Television.—It is expected that Bands I and III will be fully occupied by television within two years, and plans are already being made for operation in Band IV. Several television receivers have space ready for a Band IV convertor, and in at least one receiver, one position of the turret switches the cascode r.f. stage and the pentode mixer to straightforward operation at the i.f. Thus, when a Band IV convertor is fitted, a high-gain low-noise i.f. amplifier will be available.

There was a larger variety of radio-gramophones and tape-recorders than at Earls Court, including massive instruments that include both functions. However, the only item of particular technical interest was the Tefillon.

Tefillon recordings are in the form of a spiral groove on an endless belt or tape of flexible plastic, rather less than one inch wide. A special diamond pickup head is employed and the tape speed is 19 cm/sec. The maximum duration of the recordings is four hours. Any desired part of the recording may be selected by moving the pickup head across the tape, and no rewinding is required.

A comprehensive display of v.h.f. aerials was on show, particularly for Band III. At one stand an enquiry whether they had much demand for the erection of Band I aerials elicited the reply, "Nein, Gott sei dank!" But, if they did not like working on large Band I aerials, they did try to meet any requirement on Band III. Yagis with up to ten elements are available with a bandwidth of one channel (7 Mc/s), in vertically stacked pairs to reduce interference from below, and side-by-side to reject reflections from the side. Vertically stacked dipoles backed by a reflector plane of wires are available for locations with strong interference or reflections from behind, and these aerials have the advantage of a wide bandwidth.

TEST AND MEASURING GEAR

THOUGH the Düsseldorf show was predominantly a display of domestic broadcast receivers, many of the foremost German instrument firms were represented. One of the senior firms in the German instrument industry is Rhede & Schwarz, whose products are now becoming known in this country. In quality of workmanship their gear is equal to anything made anywhere in the world, and their range includes instruments rarely encountered in other catalogues.

Amongst them are a variety of signal generators covering the v.h.f. range with disc seal triode valves and going right through the microwave region with klystron generators. In fact, signal generator coverage can be given from 1 Mc/s to 20,000 Mc/s with varying types of modulation. Other items seldom seen in Britain were field-strength measuring sets covering the range up to 1,000 Mc/s and a calibration receiver of instrument quality in the same frequency band with an aerial system for which remote drive for orientation is provided. V.H.F. impedance and power measuring devices were also well represented. The general impression of the firm is one of immense technical competence.

Medium-priced Equipment.—A smaller firm and one less known to most of us is Klement. Here prices are below the dizzy heights of Rhede & Schwarz, and the equipment, while still very well made and finished, has not quite the same air of haute couture. Technically the range is most interesting and the majority of the exhibits fit neatly into gaps in the British manufacturers' ranges. The most ambitious instrument is a factory production limit bridge which automatically sorts capacitors into five tolerance groupings at the rate of 2,600 an hour. A close relation to this is an automatic balancing 1-Mc/s capacitance bridge which also measures small phase defect angles. The Klement range proceeds through a variety of television wobbulators with built-in markers, display and pattern generators and a rather fine flying spot scanner, to equipment with more appeal to the servicing technician. Foremost here is a television field-strength meter covering 40-225 Mc/s with a voltage range of 5 µv-100mV/metre. This, while being comparatively low in price, has sufficient performance to make it suitable for many other uses.

Another of the big names in German test gear is Siemens and Halske of Munich. Their exhibits were confined to a few oscilloscopes on the Siemens radio stand, although their range is probably the most comprehensive in Germany, particularly in the audio and carrier telephony frequency range.

There was a large number of firms showing such things as multi-range meters, valve testers and comprehensive service kits—little attaché cases containing a meter, a small generator, an oscilloscope and a range of trimming tools. Most of the instruments shown in this category have British-made equivalents.

V.H.F. Signal Generators.—In view of the leeway that Germany had to make up after the war in the v.h.f. and microwave fields, the number of instruments available compared with the variety in this country is most surprising. The early start with an f.m. broadcasting system, on the other hand, is well reflected by the comparatively wide choice of f.m. signal generators. The general standard of manufacture and finish is at least as good as our own and in one or two cases rivals the best available here. Prices vary enormously from the expected in both directions, but tend on average to be high. Deliveries are rather better than we normally expect over here.

Represented on the Telefunken stand were Hienz Gunther Neuwirth with a range of f.m. signal generators. A few of these are already in use here and are highly thought of. One of them, the MS4/U, covers the useful frequency range of 4-250 Mc/s on fundamentals and is one of the best liked examples of that rare breed, the professional quality f.m. signal generator.

Diversity of Standards.—One disadvantage of buying German instruments in this country lies in the different standards used. The standard r.f. output impedance, for example, is 60 Ω and, although easy enough to pad up, is rather a nuisance, while the standard r.f. plug is yet another to add to one's already large collection of conversion leads or adaptors. All instruments have frequency calibrations in Hertz or...
MHZ (where fortunately the conversion factor is simple!) but many have controls marked in nepers, which is not so good. To set against these drawbacks it should be said that the German manufacturers are far more willing to meet one’s requests for detail changes than are the majority of British firms.

The general conclusion would seem to be that we are much better served by our own industry in the choice of everyday instruments such as valve voltmeters and audio oscillators, but that the German technician has a much greater chance of buying an instrument for a rather unusual measurement or in an “unpopular” frequency band.

I.T.A. London Transmitter

Signals radiated from the new commercial television station at Beulah Hill, Croydon, are on exactly the same standards as the B.B.C. transmissions, but the method of producing them is somewhat different because of the much higher frequency (194.75Mc/s vision). Coaxial line techniques are used for the r.f. amplifiers, and the valves are mounted inside vertical cylinders looking rather like drain-pipes which constitute the tuned circuit elements. The r.f. section of the vision transmitter actually comprises a crystal drive unit, two triode r.f. amplifiers working in earthed grid circuits, a tetrode modulated amplifier and a final triode amplifier which handles the modulated signal and gives an output of 10kW peak. The valves are air-cooled.

On the video side, the incoming signal from the studios, after passing through various amplifying, control and correction circuits, goes to the modulator, where the actual process of modulation is done on the grid of the tetrode r.f. amplifier by a cathode follower output stage. The black level of the signal is maintained constant by means of a feedback circuit which monitors the amplitude of the transmitted sync pulses (at a point in the aerial feeder) and uses this information for correction purposes.

The outputs from the 10-kW vision transmitter and the 2½-kW sound transmitter are fed to a combining unit in the transmitter hall which also contains a vestigial sideband filter to give the correct characteristics. From there the signals go by feeder to the eight-stack aerial array, which is mounted on a mast at a height of 175ft and has sufficient gain to give an effective radiated power (on vision) of 60kW. The height of the transmitter site itself is actually 375ft.

Marconi’s, in collaboration with I.T.A. engineers, have designed the transmitter, and it is actually the prototype equipment which they have installed because of the extremely short time available to do the job—seven months since February. A standard production model will follow later. Film scanning equipment made by Cintel has also been put in, to provide local programme material if there is a failure of the video signal coming from the studios.

Commercial Television Studios

When advertisers are paying several hundred pounds a minute for “spots” on commercial television the need for split-second timing of programmes is of paramount importance. The facilities needed to achieve this are perhaps the most outstanding feature of the equipment which Marconi’s have installed at the Wembley studio centre of Associated-Rediffusion (the Monday-to-Friday programme producing company in London). The process of switching from camera to camera, for example, is all done by relays under the control of a bank of push-buttons, and the person in charge of “vision mixing” has to develop much the same kind of skill as a typist or calculating machine operator. Moreover, because of the large number of filmed inserts used in programmes, it has been necessary to provide the “vision mixer” with a very rapid means of bringing in the film-scanning equipment, and this is done by a remote control system, again worked by push-buttons.

Such is the precision demanded for changing programmes on time that apparently the human operator is not to be relied on, and eventually the job will be done automatically by a time switch!

In the same room as the main film scanners (made by E.M.I.) is another equipment (R.C.A.) in which either films, slides or caption cards can be scanned by a small Vidicon camera. A whole succession of caption cards (or even solid objects) can be fed through it automatically on a belt, like cartridges going into a machine-gun, while the slides are presented in succession on rotating discs—the complete mechanism...

The control desk at the station, with the actual transmitter seen through the window.
being again under remote control. Further speed of operation is achieved with yet another remote control system for raising and lowering studio lamps on telescopic mountings, while on the sound side the gramophone turntables have optical calibration systems which enable the pick-up to be lowered straight into a groove selected beforehand.

Image orthicon cameras are used throughout (incorporating the improved 4½-in pick-up tube described in our May, 1954, issue) and with these it has been possible to utilize fluorescent lighting a good deal.

Another important feature of the Wembley establishment is its structural planning and layout. The four studios (five eventually) are arranged on either side of a long, central section built in three storeys which contains all the control rooms and, in fact, the entire technical installation and its staff. This technical “nerve centre” is therefore kept very compact and isolated from the programme production activities, but at the same time is well placed to see what is going on.

### Distributing I.T.A. Programmes

When the B.B.C. extended its television service to the provinces the Post Office established a control centre in London to look after the complicated network of lines, cables and radio links connecting the various studios, o.b. points, and the transmitting stations. Through this centre, located in the Museum telephone exchange buildings, passes practically all the B.B.C.’s television programmes. With the inauguration of the I.T.A.’s service its programmes will also pass through this centre.

A further network of lines and cables connecting the studios of the new programme companies and the London transmitting station has, therefore, been built up and some idea of the complexity of this new network can be obtained from the accompanying schematic drawing. It does not, however, give quite an exact picture as some of the links consist of multiple cables containing either coaxial tubes or balanced pairs. The system of transmission over the cables will be either a modulated carrier centred on about 6 Mc/s or the actual video signal. Where the carrier system is used, as shown by the twin-line connecting links in the diagram, the lower sideband only will be transmitted with complete suppression of the carrier. The bandwidth of the system is 3 to 7 Mc/s.

The microwave relay system set up to carry the B.B.C.’s television programme to the Midlands before the coaxial cable was laid, and which was described in the December, 1949, *Wireless World*, is being renovated and brought up to date so that it can be used when the I.T.A. opens its Midlands station.

*Schematic drawing of the G.P.O. programme distribution system planned for the I.T.A.*

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*Wireless World, October 1955*  
471
**WORLD OF WIRELESS**

**450-Mc/s Band for Mobile Radio • American TV Stations • V.H.F. Broadcasting • S.O.S. Alarm Signal**

**U.H.F. Mobile Radio**

THE Ministry of Transport and Civil Aviation has been asked to vacate at an early date part of the 420-460 Mc/s band (at present used for radio altimeters) as it is needed for private mobile radio and other services. Initially the top 10 Mc/s only are to be used for mobile radio.

At the Atlantic City conference this band was allocated, so far as the European region was concerned, to aeronautical radio-navigational aids and amateurs, priority being given to the first. It has, however, always been understood that the radio-altimeter service would be transferred to bands around 2,000 and 4,000 Mc/s when suitable equipment became available.

So far as amateurs are concerned, the Radio Society of Great Britain recently stated that it anticipated that eventually in this country the band 425-440 Mc/s would become an exclusive amateur allocation, whilst the 5 Mc/s below and 10 Mc/s above would be shared with other services.

**U.S. Broadcasting Stations**

ACCORDING to figures issued by the Federal Communications Commission there were 3,665 broadcasting stations operating in the United States at the end of July. Of this number 2,719 were medium-wave a.m. stations, 499 f.m. transmitters, 437 commercial television and 10 educational television stations. It is worth noting that 109 of the television stations are operating in the u.h.f. band (above 470 Mc/s) and that a further 119 of the 180 under construction will also operate in this band.

According to Tele-Tech, although only a handful of the commercial television stations can originate their own colour programmes, the majority of the 364 network stations operating in 241 cities are equipped to relay colour transmissions.

Applications for permission to build a further 209 a.m., 11 f.m. and 157 television stations were outstanding at the end of July.

**Wrotham on Full Power**

ALL three v.h.f. transmitters at Wrotham are now working on full power, the e.r.p. of each being 120 kW. During August the second half of the Home Service transmitter together with the aerial combining units were installed and the setting up of the final aerial arrangements completed.

The completion of the installation means a 3 db increase in the effective radiated power of the Light and Third Programme transmitters and a 6 db increase for the Home Service.

If present plans materialize, the stations at Pontop Pike (Co. Durham), Divis (Northern Ireland) and Meldrum (Aberdeenshire) will be brought into service by the end of this year. The three transmitters at each of the stations will have an effective radiated power of 60 kW.

**Marine Distress Calls**

AN internationally recommended alarm signal to improve the distress service on 2,182 kc/s is being introduced in this country. The signal consists of two tones (2,200 and 1,300 c/s) transmitted alternately each quarter of a second for up to one minute before the distress call. The first two British coast stations to be equipped with electronic equipment for generating and receiving the alarm were North Foreland and Niton which introduced the signal on August 16th when some French coast stations also started using it.

The alarm signal, which on vessels may initially be generated by means of a whistle, can be readily distinguished through heavy interference and can be used to actuate receiving equipment.

**Authors' Awards**

THE annual award of premiums to authors of papers published during the year in its Journal is announced by the British Institution of Radio Engineers.

The Institution's premier award, the Clerk Maxwell premium (value 20 gns) is to be presented at the annual general meeting on October 26th to F. N. H. Robinson, a research fellow at the Clarendon Laboratory, Oxford, for his paper "Microwave shot noise in electron beams and the minimum noise factor of travelling wave tubes and klystrons."

Dr. T. B. Tomlinson, formerly at the University of Southampton and now at the G.E.C., receives the Heinrich Hertz premium (20 gns) for "Partition components of flicker noise." The premium is awarded for the most outstanding paper dealing with the mathematical or physical aspects of radio.

For his paper "Problems of television cameras and camera tubes" L. H. Bedford (Marconi's) receives the 15-gn Louis Sterling premium awarded for the most outstanding paper on television technique.

The 15-gn Brabazon premium (awarded for a contribution on electronic or radio aids to aircraft safety) is shared by J. W. Jenkins, J. H. Evans, G. A. G. Wallace and D. Chambers, of Cossor, for "A high-definition general-purpose radar."

For his paper "Some factors in the engineering design of v.h.f. multi-channel telephone equipment" W. T. Brown, of British Telecommunications Research, receives the 10-gn Marconi premium (an engineering award); Dr. G. N. Patchett, of Bradford Technical College, receives the 10-gn Leslie McMichael premium (awarded for a paper on improvements in the technique of broadcast or television reception) for his contribution "A critical review of synchronizing separators with particular reference to correct interlacing"; and R. W. Walker, King's College, Newcastle-upon-Tyne, the 10-gn Students' premium for his paper "An electronic random selector."

The second award of the Sir J. C. Bose premium for a contribution by an Indian goes to S. Deb (Institute of Radio Physics and Electronics, Calcutta University) for "Decay of emission from an oxide-coated cathode due to adsorption of matter liberated from the anode."

The Institute has also awarded 20-guinea premiums for five papers read at the Industrial Electronics Convention held in Oxford in July last year.

Wireless World, October 1955
PERSONALITIES

Sir Robert Watson-Watt, F.R.S., has been appointed president and chairman of the board of Logistics Research, of Redondo Beach, Cal., U.S.A., manufacturers of electronics from the age of 49. Sir Robert has been in North America for some time and was appointed adviser on radar and electronics to the Canadian Defence Research Board in 1952.

Sir Leslie Nichols, K.C.M.G., M.I.E.E., is relinquishing, at his own request, the chairmanship of Cable & Wireless, Limited, in January next; he is 60. A regular staff officer from the age of 49, Sir Leslie retired with the rank of Major-General shortly before his appointment to the board of Cable & Wireless in 1947. During the last war he served as chief signal officer in various theatres of war and after the invasion of Europe became deputy chief signal officer to General Eisenhower at S.H.A.E.F.

Captain Geoffrey C. F. Whitaker, R.N., has relinquished his appointment as assistant captain-superintendent of the Admiralty Signal and Radar Establishment, which he has held since 1952, and has become fleet electrical officer on the staff of the Flag Officer Commodore-in-Chief. Captain Whitaker, who had previously been at A.S.R.E. for two years, has served exclusively in the research and development field in his shore appointments since the war. He has been Admiralty representative on the I.E.E. Radio Section Committee since 1952, on which he is continuing to serve. As announced last month, he is succeeded at A.S.R.E. by Captain G. C. Turner.

Dr. David G. Tucker, since 1950 in the Royal Naval Scientific Service at H.M. Underwater Detection Establishment, Portland, has been appointed to the chair of electrical engineering at the University of Birmingham. Professor Tucker, who is 41, joined the Post Office research station, Dollis Hill, in 1934 where, in 1946, he was appointed head of the transmission measurements research group. He received his doctorate of science in 1948 from London University, where he obtained his Ph.D. and B.Sc, degrees. Twelve of his many contributions to the technical press have appeared in our sister journal Wireless Engineer.

Colonel A. H. Read, at present telecommunications attaché at the British Embassy in Washington, has been awarded the Marconi Commemorative Medal of Service by the American Veteran Wireless Operators' Association. He was for 32 years in the Post Office and was at one time inspector of wireless telegraphy. At the time of his retirement from the Post Office last year he was director of overseas telecommunications.

J. D. Crages, M.Sc., Ph.D., F.Inst.P., has been appointed to the Robert Rankin Chair of Electronic Engineering in the University of Liverpool, where he was formerly reader of electronic engineering.

During a tour of the United States, which he is beginning early in October, P. D. Collings-Wells, B.Sc. (Eng.), of Goodmans Industries, Ltd., will deliver a lecture on "Standards of acceptance for high-fidelity loudspeakers" at the New York Convention of the Audio Engineering Society. He will also lecture to branches of the Society. One of the objects of the tour is to promote discussions on which it is hoped will ultimately lead to the formation of a set of standards governing minimum performance requirements for high-quality loudspeakers.

Appointments to fill the post of engineer-in-charge at two of the new B.B.C. television stations are announced. J. J. Allen goes to the Channel Islands station at Les Platos, Jersey, which is now nearing completion, and W. F. Balfour is appointed to Meldrum, Aberdeenshire. Mr. Allen joined the engineering equipment department of the B.B.C. in 1939 and since 1953 has been in the planning and installation department. Mr. Balfour has been with the Corporation since 1934, when he joined the staff at the Washford, Somerset, station as assistant maintenance engineer. He was previously at the G.P.O. station at Portishead. Since 1950 he has been engineer-in-charge at the studio centre and transmitter in Aberdeen, for which he will continue to be responsible. The former is also announced. The new appointments are: E. F. Bowden as engineer-in-charge of the short-wave transmitter at Skelton, Cumberland, in succession to S. A. Williams, who has retired. Mr. Bowden, who joined the London staff in 1926, has been assistant engineer-in-charge at Skelton since 1945, having previously held the same position at the Rampisham, Dorset, short-wave station.

W. T. White, who has been with the Ferguson organization for more than 25 years and is now general works manager of the electronics division, and C. E. Payne, chief engineer of the division since 1945, have been appointed to the Board of the Ferguson Radio Corporation. S. T. Holmes, publicity manager of the Thorn group (which includes Ferguson), has also been made a director of the Corporation.

Christopher E. G. Bailey, M.A., M.I.E.E., has been appointed technical director of Solartron Electronic Business Machines, Ltd., and will act in a general advisory capacity on research and development work to the Solartron Electronic Group, of Thames Ditton, Surrey. He has been a consultant to the Group for some time and was largely responsible for the design and development of the Solartron radar simulator. He read physics at Balliol College, Oxford, where he was an exhibitioner, after which he joined the Gramophone Co. in 1928 for three years. He has since then been on the staffs of a number of radio companies, including Philips in Holland. He is 49.

A. T. Bardens, A.M.I.E.E., M.Brit.I.R.E., until recently engineer-in-charge, Radio Hong Kong, has joined Overseas Rediffusion, Ltd., as a senior engineer for appointment abroad. He was previously with Cable & Wireless and held various technical posts during 28 years in overseas services. Radio Hong Kong operates one short-wave and two medium-wave stations.

OBITUARY

Harold L. Kirke, who retired from the position of assistant chief engineer of the B.B.C. in 1952 owing to ill health, died on August 25th at the age of 60. He joined Marconi's in 1920 and was closely associated with the setting up of the Writtle experimental broadcasting station in 1922. He went to the B.B.C. in 1924 and in the following year was appointed head of the development department which later became the research department. Mr. Kirke was assistant chief engineer for two years before his enforced retirement. He was appointed C.B.E. in 1947.

OUR AUTHORS

R. E. Wyke, contributor of the article in this issue on small power valves, has been with the M.O. Valve Co., where he is now in charge of design and development, for over 20 years. Since the war he has been concerned with government work on improving valve reliability.

Herbert J. Fraser, who in this issue describes a simple circuit for reducing hum in receivers, has been on the engineering staff of Amalgamated Wireless Valve Co. Pty., Ltd., Australia since 1944. He has of late been concerned with production engineering of transmitting...
and special valves and on the development of electronic equipment for valve production and testing. He received a diploma in radio engineering from the Marconi School of Wireless, Sydney, in 1944. He is 32.

**WHAT THEY SAY**

Subscription Television.—"It may not be generally known that the wired television systems we have developed have been designed so as to enable subscribers to receive additional programmes for an extra payment —through a coin box or otherwise. This method of subscription television, if introduced, will have the great advantage over any radio method of subscription television in that it will not be necessary to employ radio channels wastefully for the benefit of a limited part of the population."—J. S. Wills, chairman and managing director of Broadcast Relay Service, Limited.

Bonanza.—"If we made no profits whatever from selling [domestic] radio and television sets, we would still make sufficient profits in the other parts of our business to maintain our present dividends."—Pye Limited, report for 1954/55.

**NEWS IN BRIEF**

During July Receiving Licences for television increased by 49,161 and licences for car sets by 4,893 but "sound only" licences decreased by 22,227. Licences current in the U.K. at the end of the month were "sound" 9,061,008, television 4,725,583 and car radio 280,803.

The spring meeting of the Physical Society will be devoted to the subject of Semi-conductors. It is being organized by the B.T.H. Company and will be held at Ashorne Hill, near Leamington, from April 10th to 12th. The meeting is open to non-members on payment of a fee of 10s, but accommodation is limited to 150. Application forms are obtainable from the Physical Society, 1, Lowther Gardens, Prince Consort Road, London, S.W.7.

Elsewhere in this issue is a contribution from a Swedish correspondent on Long-Distance TV Reception. We have also heard from Invicta Radio, Limited, that a correspondent in Portugal who has been experimenting with a 1948 Invicta set has received B.B.C. transmissions on a number of occasions recently.

"Free Grid's" reference last month to the need for Communal Television Aerials to avoid the unsightly forest of aerials springing up in populous areas finds an echo in an announcement from Burntisland, in Fife, where each block of 39 houses is to have a communal aerial.

Is it the First? The Post Office has granted the Post of London Authority permission to install a point-to-point radio-telephone link between its Police Headquarters on the north bank of the Thames and its main transmitting station at Shooter's Hill, south of the Thames, previously linked by cable. Normally the Post Office stipulates one end of a private radio-telephone link must be mobile.

Science Museum Amateur Station.—An amateur radio station is to be set up in one of the demonstration rooms adjacent to the Communications Galleries at the Science Museum, South Kensington, London, S.W.7. The station is being designed by the Radio Society of Great Britain in collaboration with Gerald Garratt (G5CS) who is deputy keeper in charge of the Communications Department at the Museum. The station will be operated daily by transmitting members of the staff headed by G. Voller (G3JUL) who is assistant in the Communications Department.

Films on Loan.—Club secretaries may like to know that there are a number of electronics and electrical films which can be borrowed free of charge from the Central Film Library of the Central Office of Information, Government Building, Bromyard Avenue, Acton, London, W.3. Among those recently added to the list are "The Electronic Microscope" (18 minutes) and "Electric Induction Heating" (23 minutes). Both were sponsored by Metropolitan-Vickers. Also available under the same scheme are three films on capacitors, inductors and ammeters and voltmeters, sponsored by the Electrical Development Association.

At the commencement of his European tour, William Stern, manager of the international division of Brush Electronics Corporation, of Cleveland, Ohio, visited B. & K. Laboratories, in London. Mr. Stern announced that Brush are now growing Quartz Crystals. Although the manufacturing cost is about three times that of natural quartz, the quartz crystal is substantially pure whereas only 10 per cent of the natural mineral is usable.

Tickets for the exhibition "Silicones for Industry," which is being held in Leeds (September 26th to 30th), can be obtained from Midland Silicones Limited, 19, Upper Brook Street, London, W.1. The exhibition, which covers the history, production and application of silicones, is being held at the Leeds Church Institute, 5, Albion Place, from 10.0 to 6.0.

Cable and Wireless, Limited, have acquired a new headquarters building at 110-124, Theobalds Road, London, W.C.1, which will be known as Mercury House. It will be opened towards the end of the year. The company plans for the company to find new offices arises from the continued growth of the Post Office's London Telegraph Station in Electra House, Victoria Embankment.

For some time British Road Services have been operating experimental radio-telephone services for the parcels collecting vans working in the Bristol, Birmingham, Leicester and Liverpool areas. A similar service (using equipment supplied by Pye Telecommunications) is now being operated in the London area. The fixed station (working on 85.925 Mc/s) is at the B.R.S. depot at Waterden Road, Stratford, E.15. The mobile sets operate on 72.425 Mc/s.

**COMMERCIAL TELEVISION'S first studio**—the Granville Theatre, Waltham Green, South London—was converted for Associated-Rediffusion (the London Monday to Friday programme contractors) by Central Rediffusion Services Ltd. This control room, equipped with Marconi gear, is installed beneath the stalls.

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www.americanradiohistory.com
U.S.S.R. Television.—Another television station has been brought into service by the U.S.S.R. The new transmitter at Tallinn, Estonia, which has an e.r.p. of 100 kW, radiates on 59.25 Mc/s (vision) and 65.75 Mc/s (sound). This is the fourth major station in the Union, the others being at Moscow, Lenigrad and Kiev. There are also in addition a number of low-power stations in operation.

Amateur Courses.—In addition to those centres mentioned last month (page 443) as providing courses in preparation for the radio amateur examination, we have also been notified of the following:—Swarthmore Adult Education Centre, Woodhouse, Square, Leeds (Fridays), organizes the Leeds Amateur Radio Society, and the Central Evening Institute of Further Education at St. Thomas's School, Granville Street, Birmingham (Mondays). The Leeds course, which covers two years, started on September 23rd and that in Birmingham on September 12th. The fee for each is 15s.

A new electronics laboratory has been opened at the North Gloucestershire Technical College, Cheltenham, where, in addition to the higher and ordinary National Certificate courses, they are running an introductory and an advanced electronic engineering course.

Geoffrey Parr, the well-known secretary of the Television Society, is giving a course of six lectures on Writing Technical Reports at the Borough Polytechnic, Borough Road, London, S.E.1, on Thursdays at 6.30, commencing on October 20th. The fee is 10s.

The production of Films for Television will be covered in a course of seven lectures arranged by the British Kinematograph Society. Commencing on October 14th at 7.45 at 2, St. Brice's Hill, London, W.C.2, the course, for which the fee for non-members is 2gns, covers basic principles of television and cinematography, lighting, sound recording and film scanning. Full particulars are available from the B.K.S., 164, Shaftesbury Avenue, London, W.C.2.

Reference is made in the annual report of the Ministry of Labour and National Service to the Technical and Scientific Register, which is kept by the Appointments Service of the Ministry. During 1954 a total of 1,800 vacancies were filled from the register. At the end of the year there were nearly 4,000 names on the register.

I.E.E. Students.—The new officers of the London Students Section of the I.E.E. are: chairman, M. H. F. Collins (B.T.-H.); vice-chairman, K. W. E. Gravett (Post Office Research Station); hon. secretary, E. L. Jones (Edison Swan).

BUSINESS NOTES

Sylvania-Thorn C.R.T. Project.—Sylvania Electric Products, of the U.S.A., and Thorn Electrical Industries, who have already made arrangements for the joint development of colour tubes in this country, have now negotiated for the setting up of a joint concern for the large-scale manufacture of monochrome tubes in the U.K. Production is unlikely to start before the end of next year. It is stated that it is improbable that the firm will be members of the British Radio Valve Manufacturers' Association.

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Shafﬁshire Bearings, Limited, has recently taken possession of a new factory at Bletchley, Bucks, which, with its 15 automatic sapphire-point grinding machines, is claimed to be the largest sapphire engineering factory in the world. The company, which produces the Windsor "flame-faceted" sapphire-tipped gramophone stylus, began business with one machine in East London in 1952.

International Aerial, Limited, have been appointed consultants on communications to the Antarctic Aerial Survey Expedition to the Grahamland Peninsula which is being undertaken by Hunting Aerosurveys, Limited, for the Falkland Islands Dependencies. Besides advising on the equipment required for the Expedition I.A.L. are providing the staff to install and maintain it.

Ultra Electric, Limited, is to build a new factory covering about 120,000 square feet at Gosport, Hants, for the production of television receivers. The company, which began 35 years ago in one room in East-Central London, already has manufacturing floor space of some 175,000 square feet. A considerable area of the present factory space is devoted to the production of electronic equipment including the homing device, Sarah.

Ekco search radar for the detection of dangerous storm clouds is being used by the British Overseas Airways Corporation for the route-proving flights of the Britannia aircraft. This 3-cm equipment, with which clouds are detectable at a distance of up to 120 miles, will also be installed on the fleet of Britannias which the B.O.A.C. will operate. A second Britannia flight simulator, which provides facilities for the entire flight crew to be trained on the ground, has been ordered from Redifon, Limited, by the British Overseas Airways Corporation.

Granada TV Network, Limited, programme contractors for the Monday-to-Friday service from the Lancashire station of I.T.A., are setting up the Granada Television Centre in Manchester. Marconi's are supplying five television colour television equipment and control room gear for the centre.

Decca Radar, Limited, is to supply new radar equipment "incorporating special features to meet the operational requirements of naval vessels" for ships of the Royal Navy.

R.C.A. Photophone, Ltd., has moved its offices and works from Shepherds Bush to Lincoln Way, Windmill Road, Sunbury-on-Thames, Middx. (Tel. Sunbury-on-Thames 3101.)

Simplex-Ampro, Ltd., manufacturers of ciné sound and vision equipment, have recently opened a service department at their offices at 167-169, Wardour Street, London, W.1.

OVERSEAS TRADE

Venezuela is to equip four of her main civil and military airfields with Decca Type 424 airfield control radar. Two Decca Type 41 storm warning radars have also been purchased to assist in the preparation of aviation weather forecasts.

Two examples of equipment for the control of guided missiles will be shown by the General Electric Company on their stand at the British Trade Fair, Copenhagen, (September 29th-October 16th) whereas they will also be exhibiting communications equipment and accessories.

Three vessels being built in Lübeck, Germany, for the Scindia Steam Navigation Company, of India, are to be equipped with Marconi radio communication and navigational equipment.

Radio equipment selected by the Council of Industrial Design for showing at the German Industries Exhibition, Berlin (September 24th-October 9th), includes Decca’s Decallan record reproducer, Ekco’s “Stroller” mains/battery portable, a Ferranti 17-in console television receiver and Imhof’s “Trollygram” incorporating a Pye amplifier and Collaro transcription unit.

Forty-six air navigation beacons and communications transmitters have been ordered from Redifon, Ltd., by India’s civil aviation department. Thirty similar radio installations have already been supplied by Redifon for use at Indian airfields.

A contract awarded to Marconi’s by the Iranian Ministry of Posts, Telegraphs and Telegraphs calls for the supply and installation of dual diversity receiving equipment for the country’s external radio-telephony and telegraphy service.

Jorge J. Larach y CIA., San Pedro Sula, Republic of Honduras, have informed the British Legation at Tegucigalpa that they are interested in importing British broadcast receivers.
Radio Show Review

THIS YEAR'S TRENDS IN VISION AND SOUND
BROADCAST RECEIVERS—AND SOME HIGHLIGHTS

In the following pages the technical staff of "Wireless World" reports on tendencies in design in those branches of radio most fully represented at the National Radio Exhibition. At this year's show, interest centred on receivers for television and V.H.F. sound broadcasting. A survey of aviation radio equipment shown at the Farnborough Exhibition appears after this review.

However much television sets may differ from one another in detail they are rapidly becoming standardized in their basic form. Nearly all sets now have a multi-channel tuner for Bands I and III which includes a cascode r.f. stage and a triode-pentode frequency-changer. There are usually two, but sometimes three, i.f. stages in the vision channel and one or two in the sound, the intermediate frequencies being 34.65 Mc/s and 38.15 Mc/s, the new standards, or very close to them. There are diodes for detection and interference-limiting, one or two video stages and one or two audio stages. For the rest, there is a main sync separator and usually a line and frame pulse separator, the timebases and the power supply.

Timebase circuitry is more nearly standardized than anything else. The use of flyback e.h.t. and h.t. boost is universal and it is remarkable how detailed improvements in design have enabled the output to be increased. Tube sizes and operating voltages are steadily increasing and yet can still be scanned and the voltages obtained from what is basically the same circuit.

The improved performance comes about through a gradual reduction of losses. It is fundamental that in essence scanning does not require power, but it does need energy. The whole point of modern circuits is that the energy supplied to the deflector coil can be largely recovered. The only power needed is to supply the unavoidable losses in the copper of coils, the iron of cores, the anode dissipation of valves and, of course, the e.h.t. Improvements in the detailed design of deflector coils, transformers and valves have reduced the losses and enabled a considerable improvement in performance to be secured.

The use of ferrite cores for transformers and deflector coils is now quite general and the auto-transformer is preferred to the double-wound transformer. Several firms, however, adopt the so-called direct-drive circuit in which the transformer as a coupling element to the deflector coils is eliminated. A transformer for e.h.t. is still needed, however, and its primary serves as an energy store to permit h.t. boost to be obtained.

A typical circuit of this nature is shown in Fig. 1. The two parts of the line deflector coil are L1 and L2, with the linearity control L3 connected between them. This operates in the now usual manner by controlling the degree of saturation of a ferrite-cored coil by a permanent magnet. The width control operates by introducing loss in the circuit to reduce the width below the maximum possible. With an h.t. line of 215 V full scan of a 17-in tube at 11.75 kV
is obtained. The supply voltage for the output valve is 590 V, so that the boost obtained from the energy-recovery circuit amounts to 175 V.

A supply for the first anode of the tetrode tube is obtained from a tapping on the deflector coil via a non-linear resistance R.

As a contrast, the auto-transformer type of circuit is shown in Fig. 2. With an h.t. line of 200 V a 17-in. tube operating at 14 kV can be scanned, the mean anode current of the driving valve being 100 mA, so that the power input is only 20 W. A boost of 250 V is obtained. The deflector coils are L₁ and L₂, and linearity is controlled by the saturation of L₃. The width control is L₄.

The drive for the output valve is a saw tooth form and in the case of both Figs. 1 and 2 is obtained with one extra valve which forms with the output valve a multivibrator. This is, however, hardly a general practice and a separate saw tooth generator is more usual. Ekco use a blocking oscillator, while Michael adopt a multivibrator for which a triode-pentode is used.

On the frame side, energy recovery is not practicable and the power needed is much less because of the relatively slow repetition rate. The output valve is a pentode with some form of negative feedback for linearizing the circuit. The saw tooth generator is generally a multivibrator, although sometimes a blocking oscillator is used and occasionally a thyratron.

The increased use of the double-triode or triode-pentode as a multivibrator both in line and frame sawtooth generators is quite marked this year.

Synchronizing methods remain much the same. The line timebase is usually locked by a pulse from the main sync separator and there is some form of frame pulse separator in the feed to this timebase. A slight increase in the use of flywheel sync is evident. Bush, for example, now include it in all the new models. A well-known form is used with a phase-discriminator comprising a pair of diodes fed in push-pull with differentiated sync pulses and in parallel with a saw tooth from the line output circuit. The integrated output is applied as bias to the grid of one valve of the multivibrator line-sawtooth generator.

Kolster-Brandes use quite a different arrangement in which a sawtooth from the blocking oscillator is mixed with the sync pulses and applied to a cathode-follower type detector.

On the frame side there is very little uniformity in the methods adopted for separating the frame and line pulses. The integrator, usually combined in some way with diodes, is still a favourite, mainly because it tends to make the frame synchronizing less likely to be affected by noise and interference than some other methods. Bush adopt a simple arrangement which is virtually a double integrator with a biased diode for the resistance element of the second section. This gives this section a short charging time constant and a slow discharge time constant.

The short time-constant integrator fed through a diode and with a second limiting diode is still quite often used, but G.E.C. adopt a differentiator with diode limiter. One thing is quite certain: designers are by no means agreed on the best way of achieving frame synchronization.

Video stages are, in the main, unaltered. Most sets have one pentode. However, there is a slight tendency evident to follow the video amplifier by a cathode-follower. When this is done the two valves are combined in one envelope as a triode-pentode. There are two reasons for this. It enables a lower output impedance to be obtained which is useful in certain a.g.c. circuits. It will be remembered that Pye adopted a cathode-follower output stage some years ago for this reason. However, it also increases the video gain. This is rather unexpected for the
cathode-follower is noted for giving under unity gain. The point is that by removing the tube capacitance from the video coupling the video stage gain can be so increased that it more than offsets the cathode-follower loss.

One change this year is an increase in the number of sets fitted with a.g.c. This is one result of the advent of alternative programmes but is also desirable to minimize fading and it can help to reduce aircraft flutter. It is, of course, doubtful whether a.g.c. will be effective enough to prevent some adjustment of contrast being desirable when a change from one station to another is made, but at least it does reduce the amount of adjustment needed.

True gated a.g.c. systems, which do not affect the black level, are still in the minority. Most operate by utilizing the mean bias voltage developed on the grid of the sync separator. This results in a tendency for the system to keep the mean brightness of the picture constant, which is equivalent, apart from the gain-control action, to reducing the d.c. component of the signal.

It is, however, very rare for the d.c. component to be fully retained and most designers consider it desirable to remove a considerable part of it. This is a very debatable matter on which strong views are held on both sides and one in which, if one may judge by the trend of practice, the supporters of the d.c. component are losing ground.

Kolster-Brandes use a constant mean-level system, but employ a separate diode to develop the control voltage. It is applied to two of the three i.f. valves and, delayed, to the r.f. stage. The amount of i.f. stage bias is limited. As a result, on weak signals the control operates chiefly on the i.f. stages to keep the signal-to-noise ratio at a maximum. On moderate signals it functions on both i.f. and r.f. stages, while on strong signals, the i.f. gain is reduced to a fixed minimum and further control is effective only on the r.f. stage to avoid overloading.

A further refinement is the interconnection of the vision and sound channel a.g.c. systems so that if the vision transmitter ceases to operate the sound signal takes charge and prevents the vision-channel gain from rising unduly.

G.E.C., on the other hand, use a very simple arrangement in the BT2889. This is sketched in Fig. 3. The sync separator grid leak is split into two parts $R_1$ and $R_2$. The a.g.c. voltage is taken from the junction. The diode is biased through $R_1$ from the potentiometer $R$, forming the contrast control. Until the signal is strong enough for the sync separator grid current to exceed the current through $R_2$, determined by the setting of $R_1$, the diode $D$ conducts and short-circuits the a.g.c. voltage. When the signal exceeds this the diode becomes non-conductive and an a.g.c. voltage dependent on the mean sync separator current through $R$, becomes available. This is filtered by RC and applied to the r.f. grid. A manual i.f. gain control is provided.

Bushe use a similar arrangement in which a fraction of the sync-separator voltage is applied via a contrast-control potentiometer to the r.f. stage and one i.f. stage.

By no means all designers are convinced of the need for a.g.c. and quite a lot of sets do not have it. Any need for contrast re-adjustment when switching from one station to another is avoided by switching pre-set manual gain controls. Murphy do this. The r.f. stage has two cathode-bias resistances, labeled sensitivity, one of which is switched into circuit for Band I and the other for Band III, and adjusted to equalize the signals on the two bands.

Gated a.g.c. systems, with which the black level can be fully retained, are less often used. Ultra still employ the frame-gated system described in last year's report and in their fringe-area models G.E.C. use a line-gated system. Ecko have adopted a line-gating circuit the essentials of which are shown in
Fig. 4. Positive-going pulses from a tapping on the line timebase output transformer are applied to \( D_1 \) through the differentiating circuit \( C, R \), the resistance also providing a bias for \( D_1 \) and acting as a contrast control. The pulses are also applied through \( R, C \) to the anode of the video stage to black out the line flyback.

Because of the differentiation in \( C, R \), each pulse after \( C \) is followed by a negative-going pulse coinciding with the back porch of the video signal, which is at black level. This negative pulse makes \( D_1 \) conduct, and being coupled to \( D_2 \) through \( C \), it pulls down the cathode of \( D_2 \) and makes this diode conduct also. In effect, therefore, \( C \) becomes connected via both diodes between the video anode and the input capacitance \( C \) of the a.g.c. filter, so that \( C \) is charged to the potential of the video anode, which is dependent on the prevailing black level, less the voltage to which \( C \) is charged. This last voltage is dependent on the settings of \( R_i \) and \( R \) which govern the precise conduction conditions of \( D_1 \) and \( D_2 \).

On sound, a.g.c. is almost invariably used and differs in no way from the conventional method of purely sound sets.

One result of the adoption, already noted, of the standard intermediate frequency of 34.65 Mc/s for the vision channel is an increase in the number of sound rejection circuits. This is probably the only objection to this frequency which otherwise has many advantages. In some sets every i.f. coupling now has at least one trap, for the sound signal of the adjacent channel must be considered as well as that belonging to the picture.

As an example, the McMichael sets have two traps in the second i.f.-detector coupling, which is basically a coupled pair. The traps are tapped coils capacitively coupled to the filter coils. The secondary trap is for own sound and the primary trap for adjacent sound rejection. Between the two i.f. valves there is another coupled pair each with traps tuned to own sound rejection, the primary trap acting also as a sound channel pick-out circuit.

There are two i.f. stages with three coupled pairs, three traps tuned for own and one for adjacent channel sound rejection. One i.f. stage is common to both sound and vision channels. A 6-dB bandwidth of about 2.7 Mc/s is claimed with 40-dB sound-channel rejection.

The precise forms of the intervalve couplings and traps vary very much. There is undoubtedly a marked tendency to use coupled pairs of circuits as intervalve couplings instead of stagger-tuned single circuits. Designers’ preferences in the matter of traps fall into two main groups as illustrated in Fig. 5. The shunt trap at (a) usually has a 3-pF coupling capacitor with which the inductive reactance of LC resonates to form a “short-circuit” across \( L \). In (b) the trap is in series with \( L \), and the input capacitance of the valve; rejection occurs at parallel resonance when LC has a high impedance and tends to isolate \( L \) from the valve.

Other methods are used. The trap may be coupled to the main coils or it may be used as a top-end coupling element between the primary and secondary of the intervalve coupling.

As said earlier, the basic arrangement of the tuner is virtually a standardized one and is very much the same as in last year’s two-band sets. Nearly all sets are now two-band, of course, but in spite of the standardization of the basic circuit there is great variation in detail, especially in the method of station selection.

The basic circuit is that of a double triode as a cascode r.f. stage with a triode-pentode as frequency

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Valradio turret tuner which is available for conversions.

Fig. 4. Ekco line-frequency gated a.g.c. circuit.

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Fig. 5. Typical forms of sound-channel rejectors.
In the cascode stage the first operates as an earthed-cathode stage and the second as an earthed grid. Invariably the anode of the first is connected to the cathode of the second through a small coil tuning with the valve capacitances to the upper end of Band III. This is to increase the gain at the highest frequencies where it would otherwise fall off.

The input is a single tuned circuit and there is often an i.f. trap in the feeder connections. The first triode is often, but not always, neutralized by a capacitance bridge circuit. The second triode is nearly always coupled to the pentode through a coupled pair of tuned circuits.

The oscillator is invariably a Colpitts. The coupling to the mixer grid varies somewhat. Often the oscillator coil is wound on the same former as the two intervalve coils so that the coupling is by mutual inductance. However, capacitance coupling is used nearly as often.

The main differences between tuners are in the arrangements for station selection. The turret tuner is probably the favourite but some other systems run it close. In the turret completely separate coils are provided for each channel and mounted in a revolving framework or turret. Each set of coils has its contact studs which press against contact springs when the turret is rotated.

A clicker mechanism stops the turret and holds it in the proper position and usually 12 positions are fitted so that 12 channels can be provided for. Usually, the coils for all these channels are not fitted and the set is supplied with coils for two or three channels only, appropriate to the area in which the set will be used. It is not envisaged that in the near future any receiver will be able to receive more than three channels. Additional coils are readily fitted, however, for they clip into the turret without soldering.

As will appear later this policy has the advantage of enabling a television set to be readily combined with f.m. sound reception, since some of the vacant turret positions can be used for Band II.

The second major method of station selection is by the so-called incremental-inductance tuner. In this, wafer switches are used, usually with 12 positions, and the coils are connected in series around the switch plate which short-circuits the unwanted ones. There is a small coil tuning to the highest frequency channel at one end of the chain; each switch step then adds a minute amount of inductance to change the tuning one channel at a time. Then a relatively big step is added to bring the tuning to Channel 5 and further smallish steps follow until Channel 1 is reached.

With this method all coils must be provided and alignment must always start with the highest-frequency channel and proceed in turn to the lowest.

A third system is to provide one set of Band I coils and another for Band III with a switch changing over from one to the other. Each set of coils is arranged to cover the whole of each of its bands, sometimes with composite metal and dust-iron cores. Some makers, G.E.C. for example, provide two such sets of coils for Band III and a three-way switch. The coils are then preset for any one Band I and any two Band III stations and the user has switch selection among three channels.

Others gang the cores and make them a user control. Bush do this, but provide the panel control with a clicker mechanism so that it moves the cores in preset jumps. At the appropriate place the band change-over switch is operated automatically. So far as the user is concerned the control is like that of a tuner, but the internal mechanism is quite different.

In addition to the stepped movement for station selection the cores can be moved continuously over a small range by another panel control. This is for fine tuning and is provided mainly to permit the correction of any oscillator drift. Such a control is provided on all sets but with the other kinds of tuner it is usually in the form of a very small variable capacitance between the oscillator grid and earth.

A fair number of television sets this year permit reception of the f.m. sound transmissions on Band II. All the English Electric models, for instance, can be obtained with or without Band II. The television set rather lends itself to this, for its "front end" is already of a v.h.f. type and if it has a turret tuner it needs only Band II coils in the "blank" positions.

(Continued on page 481)
The sound i.f. amplifier is of ample bandwidth and the main addition is an f.m. discriminator.

The arrangement used by Ekco is shown in Fig. 6. V, is the second sound i.f. stage and feeds a discriminator with a double-diode D., D. ratio detector. For a.m. sound the two switches are changed over, disconnecting the ratio detector reservoir capacitance and altering the i.f. output point. The usual a.m. noise limiter D. is also brought into circuit.

Other linked switches alter the connections of the a.g.c. circuit and disconnect certain valve heaters on f.m., but the switching is all basically simple.

During the last year the 14-in tube has been the most popular size. Such sets are still widespread, but are somewhat outnumbered by the 17-in, and there are now quite a lot of sets with 21-in tubes. The 12-in appears to be on the way out, for only two or three models of the normal kind were on view. Murphy, however, showed a new 12-in design which might be called a transportable. It is extremely compact and has a carrying handle; it is intended for easy moving from room to room.

Ekco showed a mains/battery portable television set with a telescopic aerial and a 9-in tube. It weighs 30 lb and measures 10½ in by 13 in by 15 in. It covers Bands I, II and III, and operates from a 12-V car battery.

One aspect of Band III which has not so far been mentioned is how owners of Band I sets are catered for. There are very many such sets, and most set makers have a range of converters for their own earlier models. A range is needed because of the varying requirements of different sets.

Some converters are merely attachments which feed into the aerial socket on the receiver and leave it quite unaltered; others are similar, but draw their power from the receiver and so require internal alterations to be made. Still others are virtually new front ends. The H.M.V., for instance, has a complete Band I and Band III tuner; the r.f. and frequency-changer valves are removed from the receiver and plugs fitted in place of them, so providing the power for the converter and feeding into the i.f. amplifier.

Except for some very old models, it may be taken that conversion is possible and a suitable converter is usually available from the makers of the set. There are, however, a number of general-purpose converters. The Pam has preset tuning and operates to convert a Band III signal to the local Band I frequency. It has its own power supply, and it is noteworthy that a four-section filter is included in the i.f. output in an endeavour to separate the frequencies generated by the two oscillators, the one in the converter and the one in the set.

Channel Electronics also have a range of converters and pre-amplifiers, the latter being intended for fringe areas. There is a Band III model comprising a cascode r.f. stage and power unit. Spencer-West is another firm in this field, and, in addition to converters and pre-amplifiers, has a range of mast-head amplifiers and distribution amplifiers for Bands I, II and III.

TELEVISION AERIALS

DURING the past twelve months the Band I—Band III aerial situation seems to have crystallized into a definite shape. The pilot transmitter installed and operated by Belling-Lee in South London no doubt had something to do with that, as it provided a genuine signal for testing drawing-board designs. So far as the main body of television aerials is concerned they seem to fall into three main classes; addition elements for adapting on existing aerial for Band III reception; dual-band aerials designed for optimum performance on both bands and separate Band III aerials which are either used independently, or, with small modifications, assembled with a Band I aerial and sharing the same pole and feeder.

The Band III aerial adaptors take various forms, but the most common is a short quarter-wavelength rod with a clamp or snap-on adaptor for fixing to each half-dipole rod of the Band I aerial. The usual place of fitting is one each side of the insulator with the open ends pointing outwards and either lying parallel to the parent dipole or set at an angle. Some makers use twin rods for each add-on unit and either fit them like a "V" (Telerection) or parallel like prongs of a fork (Labgear).

An unusual adaptor kit has been evolved by Belling-Lee; it consists of two rods insulated from the Band I dipole and straddling the centre insulator and extending some distance along and parallel to the parent dipole. These have the effect of electrically breaking up the Band I dipole into two quarter-wavelength sections—the exposed ends of the rod—separated by a form of transmission line. The two phantom quarter-wavelength aerials are in effect both connected to the feeder via a phasing and matching transformer section and the signals received are additive and improve reception on Band III to the extent of 2 dB. Another Belling-Lee adaptor kit, intended for use with an existing Band I dipole, takes the form of an extension arm carrying a Band III folded dipole and a director with phasing bars leading back to the Band I dipole's insulator for connection to the feeder. The Band I dipole behaves as a reflector on Band III and as a single dipole aerial on Band I. It is similar to the Band III section of one of their dual-band aerials.

In most cases the Band I aerial has no detrimental effect on the performance on Band III, on the contrary, in some designs it enhances the performance. Under certain conditions, however, one case being when the Band I dipole happens to be an exact odd number of half-wavelengths long at the alternative Band III frequencies, fitting adaptor units to the centre of such a dipole will not give a satisfactory performance on Band III. The Band I dipole (and Channel 4 with Channels 8 and 9 as the alternative is a case in point) being exactly ½ wavelengths long on the high band itself functions as an harmonic aerial reasonably well matched to the low-impedance feeder, but its polar diagram, or response pattern, is unsuitable for television purposes; its response is largely from high single directions and greatly influenced by the position in which it may be fitted and on height above ground.

Murphy V230 12-in table model.

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In order to overcome this the Band III rods are usually fitted about a half-wavelength (Band III channel) away from the centre insulator on each side with their open ends pointing inwards. The exposed centre section of the Band I rod is then half a wavelength long overall, as the adaptors are generally each a quarter wavelength long. The adaptor rods, in conjunction with the portions of the dipole adjacent to them, behave as a quarter-wavelength sections of transmission line, which, being shorted at the outer ends, presents an infinitely high impedance at the inner ends. The original Band I dipole now looks like a shorter half-wave dipole supported at its end by two high-impedance sections of transmission line, or by insulators. It thus functions as a plain dipole.

The same principle can be applied to convert a Band I dipole into a form of director and is indeed so done by Antiference when adapting their Antex "X" for Band III use. The dipole element of the Antex has adaptor units fitted close in to the centre and pointing outwards; the director element has then fitted near the ends of the rods and pointing inwards.

The 1½-wavelength harmonic relationship of a Channel 4 Band I aerial to Channels 8 and 9 in Band III is actually utilized advantageously by Belling-Lee in the design of two dual-band aerials for use in the Midlands. Its simplest form is an angle rod, rather like a wide "V" turned on its side, with arms vertical and the open end pointing towards the transmitting station. Being 1½ wavelengths long on Band III it is a satisfactory match to a 70-ohm feeder and the forward inclination of the rods apparently so modifies the forward response pattern that only one lobe is evident, resembling that of an "H" aerial system but with a little more back response. Being a uni-directional aerial it shows a gain of about 3 dB on Band III compared with a plain dipole. On Band I the performance is apparently unaffected by the shape. There is a companion model consisting of two similar angle rods mounted on a cross arm and both connected to the feeder to produce in-phase operation. The gain is 3 dB on Band I and 7 dB on Band III.

Another dual-band aerial operating as an harmonic system on Band III is the Aerialite "Duband" consisting of a Channel 4 Unex (X-type) with the addition of two "V"-shaped directors turned horizontal with the open ends pointing towards the transmitting station. The forward inclination of the aerial portion of the Unex presumably suppresses any spurious high-angle responses, leaving one forward lobe only in the polar diagram.

Band I aerials intended for use also on Band III, and which are not an exact number of odd half wavelengths long at the high band, have, as a rule, separate Band III elements incorporated in the construction. A striking example is the Wolsey Band I/Band III series of in-line aerials. Various models were shown, but taking a plain Band I dipole as the basic pattern the Band III part of the aerial consists of a backward inclined folded dipole sprouting from the Band I dipole's insulator and having similarly inclined directors and a reflector. A 30° angle between folded dipole and Band I dipole is said to give the best all-round results. Companion models based on "H" Band I aerials are also included.

A most unusual form of dual-band aerial has been evolved by Antiference. Basically it consists of a Band I dipole with the feeder connected in the usual way at its centre. Placed close to it, but in no way electrically connected, is a plain Band III dipole. With a certain critical spacing between the two rods and also critical adjustment of length of the shorter element, Band III signals can be received just as satisfactorily on the Band I dipole of the combination as on a separate Band III dipole. Antiference call it "electronic coupling" and in practical form it consists of either a plain low-band dipole, or "H" aerial, with a forward extension boom carrying a close-spaced Band III plain dipole with various numbers of directors in front according to the Band III performance required.

When none of the elements in a dual-band aerial serves any function on both bands it might be more in keeping with rational classification to call them compound aerials; composite or combined would serve just as well. Numerous examples of this pattern were shown at the exhibition and their main feature of interest lies in the methods employed to connect them up to a single feeder cable. As separate aerial systems they have little individual interest as the majority follow a common form with folded dipole, one reflector and any number of directors up to about 12.

They can, however, develop into quite elaborate affairs, the Belling-Lee Type L916/6 being an outstanding example. This has an "H" for Band I, and,
disposed on either side, a six-element Band III system (see sketch). The two Band III aerials are spaced laterally for best broadside working and minimum mutual interaction and the feeder points of all three aerials are directly connected (that is to say, there is no combining unit) by sections of transmission line functioning as impedance matching and phasing transformers. The gain on Band III is 9 dB.

Sometimes provision is made in the design of the compound aerial independently to orientate the two aerial systems as the B.B.C. and I.T.A. transmitters are not likely to be always co-sited. Another very good reason for allowing independent setting of the two aerials, even where the two transmitters are in a straight line from the receiver, is that it might be necessary to offset one or the other in order to suppress a troublesome reflection.

One method of achieving this is to mount the high-band system on a short arm projecting sideways from the cross arm of the Band I aerial, a favoured form of assembly in the Aerialite 804 to 807 series of composite aerials. Another is to fix the Band III section to the pole a little below the Band I aerial, the fitting being such that the two systems can have different directivities. The combining filters, cross-over networks or diplexer units, as they are variously called, which are fitted to most of the combined aerial assemblies, consist of a high- and a low-pass filter fitted in a small weatherproof box and placed so that each system can be connected to it by short lengths of coaxial cable. Its function is to enable the feeder to "see" its own characteristic impedance at the aerial termination whichever band is being employed so that correct matching is obtained under all conditions. Printed circuit elements are coming into favour for this type of filter as some of the inductors are so small that this form of construction is ideal for exact reproduction. Capacitors are printed where it is practical to do so. Several specimens of printed circuit plates for this purpose were shown on the T.C.C. stand.

Units for keeping unwanted signals in the aerial from reaching the receiver have been developed by Labgear. They are housed in neat boxes and are interposed between the receiver and the coaxial cable. They take the form of high- and low-pass filters according to the type of rejection required. For example, the Type E5028 suppresses all signals below about 38 Mc/s; the E5031 cuts off at 70 Mc/s and suppresses all signals of higher frequency. One of each kind connected in series provides a band-pass filter allowing all Band I signals to pass freely to the

set but suppresses everything below 38 Mc/s and above 70 Mc/s.

There is an i.f. rejector effective between 30 and 40 Mc/s and another which is believed to be quite unique in its operation. It has been designed for dual-band aerials (and receivers) and consists of two high-pass filters and one low-pass arranged to give complete rejection of all signals outside the two television bands. It has 18 capacitors, 15 inductors, some of which are only a fraction of a microhenry, and employs a printed circuit inductor element. This
composite filter cuts off below 40 Mc/s, passes 40 to 70 Mc/s, cuts off from 70 to 150 Mc/s and again lets through at 150 Mc/s and over. This gives protection to i.f. interference around 38 Mc/s, to break-through of police, business radio, amateur transmissions and f.m. The attenuation is 40 dB or better over the rejection regions with very low insertion loss over the working bands. It is known as the Type E5038.

The number of separate Band III aerials now available is legion; they are all of fairly uniform design with folded dipoles and anything up to 12 or more parasitic elements all of which, with the exception of one reflector, are directors. Aerial gains range from about 5 dB to about 14 dB as broadside arrays figure among them.

One that is different to the majority has been evolved by J-Beam Aerials; it consists of a skeleton slot mounted horizontally and flanked on each side by a multi-element yagi so arranged that the short ends of the slot serve as the aerial element of each yagi. The coaxial feeder is joined into the centre of the skeleton slot via a "delta" type matching transformer and it is claimed that this form of construction ensures accurate matching and imparts wide-band characteristics to the system.

**SOUND RECEIVERS AND REPRODUCERS**

THE establishment by the B.B.C. of a full three-programme service from the v.h.f. station at Wrotham has had a profound effect on the structure of the sound receiver market. After a slow and what appeared to be in some quarters a reluctant start, the industry has now responded handsomely to the demand created by the increasing number of listeners in S.E. England who have made it their business to investigate the combined advantages of v.h.f. and frequency modulation. Most new sound broadcast receivers are being fitted with a v.h.f. range and there are so many of these new models that they already equal in number the older short-, medium- and long-wave sets still retained in the manufacturers' catalogues. Until v.h.f. spreads into the Regions we cannot expect to see the phenomenon of the tail wagging the dog: only three or four receivers for v.h.f. only were on show and about as many adaptors for feeding into the pickup terminals of existing sets. The combined "T.V./F.M." receiver discussed in the preceding section is another development which, so far as numbers go, can only be said to have a promising future.

Examination of the circuits of a representative selection of this year's sound receivers shows a preference for a double triode as the "front end" of the v.h.f./f.m. section. The first half functions as an earthed-grid r.f. amplifier, the input being injected into the cathode circuit (Fig. 7(a)), while the second half is a mixer-oscillator.

In most sets the input transformer is designed to match a 300-ohm loaded dipole fixed to the inside of the cabinet and there is usually a primary tap for a 75 to 80-ohm coaxial cable in case an outdoor aerial system is necessary at the fringe of the service area. It is common practice to include a wave trap in the cathode circuit (Fig. 8(a)) to reject interference at intermediate frequency which may be picked up by the aerial.

![Composite filter setup](image-url)
One of the chief anxieties of the v.h.f. set designer is, or should be, to prevent oscillator radiation from the aerial. The first line of defence is in the coupling between the oscillator and the preceding r.f. stage, but this does not always prove to be sufficient, and many of the triode r.f. circuits make use of a combination of the earthed-grid and earthed-cathode connection. At first sight this appears to throw away the advantage of the screening effect of the earthed grid, but as this is never complete there may be more to be gained by a compromise. By connecting the aerial secondary coil between grid and cathode and returning a tapping point to earth a bridge is formed with the valve anode-grid and anode-cathode capacitances which can be balanced to the extent of providing a higher barrier to oscillator r.f. than the fully earthed grid alone (Fig. 7(b) and (c)). Incidental advantages of the modified earthed-grid circuit are less negative feedback with more gain and a higher output impedance.

The balanced inter-stage coupling between the r.f. and oscillator/mixer valves (Fig. 8(a)), is by now well known. Again, a bridge network is formed which includes the grid-cathode capacitance of the oscillator valve and the r.f. is injected between earth and a null point in the oscillator grid circuit (Fig. 8(b)). This may be a tapping on the coil or the junction of a split tuning capacitance.

About half the set makers favour ganged permeability tuning for the r.f. and oscillator circuits and half employ special condenser gangs with low-capacitance sections for the v.h.f. range.

When the primary of the first i.f. transformer in the anode circuit of the triode mixer is tuned to resonance the feedback through the anode-grid capacitance of the valve is negative at the intermediate frequency. This reduces the output impedance of the valve and throws heavy damping on the i.f. transformer. Positive feedback is necessary to offset this effect, and the means of applying it are many and various. The simplest and most popular method (Fig. 9(a)) is to feed both r.f. and mixer stages from a common "decoupling" resistor and to permit some feedback by using a bypass capacitor of lower than normal value. The feedback path to the mixer grid is via the r.f. anode circuit and interstage coupling, which will be capacitive at intermediate frequency. If all goes well the feedback will be positive and can be controlled by the value of the bypass capacitor.

McMichael FM55 and Murphy A242 receivers both make use of elaborations of this basic feedback method designed to give greater stability of performance. Cossor in the Model 523 apply inductive feedback directly from the cathode of the mixer to a tertiary winding on the first i.f. transformer (Fig. 9(b)).

If a pentode mixer is used no feedback is required as the output impedance is inherently high and the anode-grid capacitance small. Bush (VHF54), G.E.C. (BC5842) and Pye (Fenman II) are using pentodes not only as mixer-oscillators but in the r.f. stage too. It can be claimed that suppression of the oscillator radiation at least comparable to the balanced triode can be achieved with less circuit elaboration, and that higher gains are possible. The pentode costs more and is fundamentally a noisier valve than a triode, but in practice it is doubtful if the difference would be noticeable within the station service area. Whatever the final outcome, the ancient pentode-triode controversy seems to have shifted its battle ground from the output to the input stages of the receiver.

In receivers covering all broadcast wavelengths the heptode section of the frequency changer used on
longer wavelengths is employed as the first i.f. amplifier when the set is switched to v.h.f. This and subsequent i.f. stages have the primaries of 10.7 Mc/s and 465 kc/s transformers connected in series in their anode circuits. Some makers switch at least the first primary windings when changing from "f.m." to "a.m." but many designers are content to accept the small series reactance of the 10.7 Mc/s circuits at 465 kc/s and dispense with switching altogether.

Much of the sound reproducing equipment described in a recent review (July issue, pp. 312-316) was shown to the general public for the first time at Earls Court. Individual new items not previously recorded include the Goodmans Axiom 80 loudspeaker with cantilever-suspended, free-edged cone and a new range of Goodmans cabinets of comparatively small volume, made possible by the use of acoustically damped vents.

The growing interest in tape recording is reflected in a number of new recorders and reproducers, one of the most interesting technically being the "Reflectograph" with transistors in the early stages of the amplifier. At the low levels available from the magnetic tape at low frequencies, mains hum is a serious problem and the absence of heater current in the pre-amplifier is a distinct advantage.

Another firm (Specto) is in production with a twin-track reproducer for H.M.V. "Stereosonic" tape records. It is equalized to C.C.I.R. standards and is designed to work with two Tannoy Dual Concentric loudspeakers.

In the Portogram TR/100 console tape recorder, space is provided for a v.h.f. tuner and a gramophone turntable, as well as storage of disc and tape records. All public interest in good quality of sound reproduction continues to expand and all demonstration rooms were packed. Many set manufacturers are following the German vogue for what is termed "3D" reproduction. This usually involves the use of more than one loudspeaker inside the cabinet and various

"Spectone" reproducer for "Stereosonic" tape records.

Above: Portogram TR/100 console tape recorder, with space for v.h.f. tuner and record player.

Left: Goodmans "Axiom 80" loudspeaker.

Trixette record player (A611) with twin-speaker wide-angle sound distribution.
apertures in the sides and back to disperse the sound output. Many people find the result more pleasing than the relatively narrow beam radiated at middle and high frequencies from the conventional single-cone loudspeaker.

"High-fidelity," which means wide-range frequency response with the minimum distortion, is no longer the hobby of the few, whose needs were supplied by a handful of small firms. The big companies now find that there is sufficient business to justify a serious attack on this market. Development teams have been allocated to the production of new amplifiers, radio feeder units and loudspeakers, and these have demonstrated to keen audiences with the skilled showmanship which is the dominant feature of the Radio Show.

VALVES AND CATHODE-RAY TUBES

FOLLOWING the general acceptance of 21-inch cathode-ray tubes in television receivers, the latest trend in design has been to shorten the length of the tube by increasing the normal 70° scanning angle to something like 90°. The examples of this reported last year have now been joined by two more 21-in tubes, from G.E.C. and Mullard respectively. Both operate with about 16kV on the anode, for which the grid cut-off voltage is between -40V and -80V, and they have 6.3V, 0.3A heaters and external conducting coatings. The G.E.C. tube, however, has a triode gun while the Mullard is a tetrode.

Of course, this increase in scanning angle brings with it considerable problems in design. In the first place, the small change from 70° to 90° demands a somewhat disproportionate increase in scanning power of about 50 per cent. Within the tube itself the electron beam is liable to be interrupted by the glass wall at maximum deflection, producing corner cutting of the picture. In addition, with the approximately flat faces now being used, the beam strikes the screen at increasingly acute angles towards the edges and so has a tendency to be defocused there.

These troubles have to be overcome partly by the design of the external deflection system and partly by the electrostatics of the internal electrode structure. In the Mullard tetrode gun, for example, an extra electrode at about cathode potential is used to obtain optimum uniformity of focus over the whole screen, and it appears that this uniformity is achieved at the expense of "spot smallness" in the centre. The desired condition is produced when the extra electrode is zero or slightly negative with respect to the cathode. If the voltage on it is increased the spot size in the centre of the screen is certainly reduced, but inferior focusing is obtained at the edges. However, the necessary sacrifice in "spot smallness" at the centre is largely offset by the reduction obtained in the length of the tube: this causes the magnification of the focusing "lens" to be less than with a normal-length tube, so that the image formed on the screen (i.e. the spot) of the electron cross-over point in the gun is smaller than usual.

In the triode gun of the G.E.C. tube the improvement in uniformity of focusing is obtained by a conical section at the cathode end of the long anode cylinder (see illustration). This works by eliminating the bulging equipotential lines of electrostatic field which in normal anode structures have a divergent effect on the electron rays of the beam. The criterion in all such systems, however, is that the beam diameter should be as small as possible within the deflector coils.

Generally speaking the reduction in length achieved by the increase from 70° to 90° scanning angles is about 3 inches and this is quite a help in the mechanical design of the big 21-in sets. It seems, however, that there is still scope for the same method of reducing length on the popular 17-in tube, and G.E.C. have been trying it out on an experimental basis. It will be remembered that their first introduction of the 90° scanning angle was in a tube as small as 12 inches. The experimental 17-in tube is similar to their existing type 7401A except that it has the 90° angle instead of 70°.

Small tubes are, of course, in the minority nowadays, but a new 12-in type was shown by Ediswan, the CRM124. This incorporated the improved type of ion-trap developed by Ediswan which traps positive ions as well as the negative ones by means of a slanting electrostatic lens formed between the first and final anodes. Ediswan also have a new 14-in rectangular tube, the CRM143, which has similar characteristics to the CRM124.

Aluminizing now seems to be a common feature of

Conical part of anode in G.E.C. 21-inch 90° c.r. tube for obtaining uniformity of beam focus.

Experimental G.E.C. 17-inch c.r. tube with 90° deflection angle.
almost all cathode-ray tubes. The main reasons for it are well known, but it has other advantages which are perhaps not so familiar. In manufacture, for example, it has been found that the variations in screen brightness from tube to tube do not have such a wide range, or "spread," when aluminizing is used, so that fewer of the aluminized tubes are likely to be rejected as being outside the required limits than the non-aluminized types. In addition, aluminizing overcomes the effect known as "mottling" on the non-aluminized screens.

No significant developments in receiving valve design have taken place since our review in June this year (page 277), except that Ediswan and Ferranti were showing their versions of the Band-III "front end" types which have now become so familiar. A new "magic eye" tuning indicator, the Brimar EM85, however, was notable, for having a screen which is viewed through the side of the bulb. It is suitable for f.m. receivers and can be mounted on a travelling cursor on the tuning system. Incidentally, Brimar have recently produced a new Brimistor current-limiting element, the CZ10, for use as a protective device in the filament circuits of mains/battery receivers using the latest 25 mA valves.

In transmitting valves, English Electric have extended their range of travelling-wave tubes to include 13 different types, N1001 to N1013. These valves are notable for their ability to amplify over bandwidths up to 1,000 Mc/s. Ediswan had a new radiation-cooled triode, the ES1001, designed for use in industrial heating equipment. Its maximum anode dissipation is 1 kW at 40 Mc/s. This firm were also showing their "Vapotron" industrial valve (characterized by a water-vapour cooling system) which is now known as the ESV892. A new "packaged" magnetron for the 3-cm band made by Mullard operates in the frequency range 9345-9405 Mc/s and has a peak output power of 250 kW. Maximum anode voltage and current are 23 kW and 27.5 A respectively. Mullard also had a new transmitting tetrode of all-glass construction, the QY3-65, with a maximum operating frequency of 250 Mc/s and an anode dissipation rated at 65 watts. It can be used as an r.f. driver, power amplifier, power oscillator or as an a.f. power amplifier.

Amongst transistors the most interesting exhibit was a development-model power transistor made by Mullard, the OC15. Two of these in a Class B type

(Continued on page 489)
of audio output stage will give an output of 10 watts, working from a 12-volt accumulator, the peak collector current per transistor being about 2 A. The OCL is arranged simply in a helix, one in a hermetically sealed can which has to be bolted to the metal chassis to conduct the heat away. Its equivalent-circuit resistances are: emitter, 0.25Ω; base, 5Ω; collector 20 kΩ. With earth-emitter operation the emitter cutoff current at a collector voltage of 6 V is -2.5 mA, while the current gain is about 25. The illustration gives some idea of the power capabilities of the device.

For high-frequency operation, and particularly in pulse circuits, G.E.C. were showing the EWS51 point transistor. Used as a pulse amplifier, its speed of response is such that if the rise time of the input waveform is 0.05 μsec the rise time of the output waveform is less than 0.15 μsec. In a typical application the current gain (alpha) falls to 0.7 of its l.f. value at 4 Mc/′s. To achieve this performance the spacing between the metal whiskers on the germanium surface has to be extremely small and is, in fact, about 0.001 in.

Since transistors are somewhat unrewarding in their external appearance, it was interesting to learn from G.E.C. something about the internal construction of their latest junction types, EWS53, EWS58 and EWS59. The small germanium wafer is actually mounted on a frame made of nickel. The base lead is connected directly to the wafer while the collector and emitter leads are joined to small indium beads on opposite faces of it. The three leads are taken through a glass bead which is set in a copper thimble, and the whole device is hermetically sealed inside a small gold-plated copper can.

Germanium has already proved its worth in power rectification, and an example of this at the Show was a new germanium power rectifier shown by S.T.C., the R60A. Four of these extremely small units arranged in a bridge circuit with a 250-V a.c. input will give a d.c. output current of 500 mA. With half-wave rectification into a resistive load, a 250-V input will produce 250 mA of d.c. Westinghouse have extended the range of their contact-cooled metal rectifiers, which are also notable for their small size, and the smallest, which gives an output of 280 V, 20 mA, measures only about 1 in × 1 in.

**EXHIBITION SIDELIGHTS**

**THE** telephone answering machine, shown by Pye Telecommunications, is intended for use in the absence of the subscriber and permits the caller to record a message. The device is started by "ringing" signals from the Post Office line, which are rectified and then used to operate a relay switching system. This actuates a delay circuit, which, after 10 seconds, causes an announcement on a continuous length of magnetic tape to be played back to the caller, inviting him to record his message. At the end of the announcement a hole in the tape is used to start the main tape recording unit. While this is running the input from the telephone line is monitored and when the caller has finished speaking the machine "listens" for a final six seconds then switches off and clears the line. The monitoring circuit is designed to recognize the receipt of dialling tone, which can occur when a call from an automatic exchange is terminated. A total of one hour of recorded messages can be accom-

modated on the main tape, and the machine will handle input levels from +6 dB to +35 dB relative to a milliwatt.

The general idea of "coin-in-the-slot" television as a way of collecting rental or hire - purchase payments on receivers, has become quite well known by now, but at this Radio Show an actual machine for the purpose was exhibited by Ediswan. It is, in fact, a coin-operated time switch designed to interrupt an electric circuit at the end of a pre-paid length of time, which may be hours or weeks. The insertion of a coin sets a register to show the amount of viewing time which has been paid for, and connects the electricity supply to the set. A self-starting synchronous motor driving a cam through a train of gears provides the timing mechanism and this switches off the supply at the end of the pre-paid time. As in electricity slot meters, the machine can be "stoked up" with several coins for a long continuous run.

Another exhibit of some interest shown by Ediswan was a prototype transistor amplifier for electro-physiological work which is capable of driving a recording pen directly. It has sufficient amplification to give a pen deflection of 1 cm, peak-to-peak, with an input of 100 mV, while the maximum possible deflection is 1.5 cm peak-to-peak. The frequency response is substantially flat from zero to 15 kc/s. Small dry cells provide the sole power supply, so that the amplifier has the great advantage of portability, as well as small size, compared with conventional valve equipments used for this type of work. A complete miniature portable recording unit, incorporating the amplifier, is under development.

Transistor circuits were also a feature of the Mulward display, and in addition to several audio amplifiers and output stages (one of which is mentioned under

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*Wireless World, October 1955*
Circuit of Mullard transistor d.c. converter giving 10 kV e.h.t. from a 12-V battery.

"Valves and C.R. Tubes") there were demonstrations of transistor d.c. converters for producing h.t. and e.h.t. voltages from l.t. supplies. These made use of the fact that the junction transistor in a suitable circuit has characteristics very close to those of an ideal switch. The transistor is used in a simple relaxation oscillator circuit, interrupting the input from an l.t. battery. Energy is stored in the inductance of a coupling transformer (see diagram) during the "on" period, while in the "off" period it is delivered at an increased voltage to the output circuit. Simple rectifiers or more complex voltage multipliers are used in the output circuit, depending on the voltage required.

Very good conversion efficiency is obtainable at power levels ranging from a few milliwatts to several watts. The operating conditions are such that the transistor is "bottomed" when it is "on," and as a result the efficiency is quite high, the figures for the six converters on view ranging from 55% to 80%. The voltage outputs of the six circuits ranged from 30 V (using a 1.2-1.5-V battery) to 10 kV (using a 12-V battery).

A rather unusual piece of radio apparatus on the Royal Air Force stand was the "Sonobuoy" used by aircraft for locating ships and submarines. It is a miniature automatic transmitter in a canister which is dropped into the sea by parachute. A hydrophone dangling below the sea surface at the end of a 30-ft wire picks up any engine sounds, which are relayed by the transmitter back to the aircraft. The transmitter, which is powered by Kalium dry batteries and a 2-V accumulator, consists of an electron-coupled oscillator with three doublers and an output stage, producing an r.f. output of about 300 mW in the lower v.h.f. region. The oscillator is frequency-modulated by a reactance valve, which is driven through two a.f. stages from the hydrophone; this is a magnetostriiction device and has an underwater range of about 3 miles. The transmitter signals can be picked up at a distance of about 10 miles. Also on the R.A.F. stand was a sectioned rocket, containing radio equipment for guidance and telemetering, as used in guided missile design.
Ediswan P.T.F.E. valveholders.

To demonstrate that all the channels of their 13-channel television receivers really do work, Pye had an elaborate closed-circuit picture generating system with 13 cameras and 13 transmitters, all operating on different frequencies, feeding into a group of 13 receivers, each of which displayed a different picture. The cameras were the small Pye industrial models using 1-in diameter photo-conductive pick-up tubes, and each had its own waveform generating unit. The transmitters (13 for sound and 13 for vision) were simple crystal-controlled oscillators with frequency multipliers to produce the required channel frequencies in Bands I and III. A control room was equipped with a push-button monitoring system and enabled any video camera output to be fed to any transmitter; sound was also added at this point.

An electronic machine for sorting coins of two different alloys, originally developed for the Royal Mint, was shown by Teledictor in the "Electronics and Careers" section. The mixed coins are loaded into a rotary hopper which feeds them one by one through a gap in an iron-cored inductor, and the effect they have on the magnetic flux is used in the electronic circuit as an indication of their composition. If the flux variation is indicative of cupro-nickel the coin is allowed to fall straight into an appropriate box. A silver alloy, however, causes a signal to be fed to an electromagnetic actuator, which deflects the falling coin into another box. The sight of the machine rattling through half-crowns at the rate of 8 per second is quite impressive.

BRITISH AIRCRAFT RADIO

Highlights of the Equipment Seen at this Year's Air Show

MODERN commercial and military aircraft now carry such a vast amount of radio and radar equipment that size and weight have become vitally important. Miniaturization has ceased to be an adequate description and sub-miniaturization is taking its place. This, at least, was one of the impressions gained from the air show held recently at Farnborough by the Society of British Aircraft Constructors.

One example of this trend was the new Marconi sub-miniature direction finder (Model AD722) covering 200 to 1,750 kc/s. A significant factor in the reduction in size and weight of this equipment is the dispensing with a power supply unit, the set being operated (included h.t.) entirely from the aircraft's 28-volt d.c. system.

The direction finder is a modern version of the Bellini-Tosi system with two fixed crossed loop aerials, the modern flavour being given by the use of dust-iron cores and by enclosing the loops in a sealed unit only ½in thick so that it can be mounted on the outside of the aircraft without affecting the "drag." The loops connect to a goniometer embodied in a direct-reading panel-mounting indicator giving continuous bearing information.

Another aid to navigation in the air is VOR (very high frequency omni-range) and Marconi's have this year introduced a new receiver embodying both VOR and ILS facilities, or at least for part of the ILS. It is the model AD704 and represents another example of weight reduction by streamlining several facilities in one set; the AD704 also serves as a communications receiver over the range 108 to 136 Mc/s. The set is used for receiving the localizer signals of ILS but to complete the ILS equipment two other units, the AD706 and A708, are required, these being the glide path and marker receivers.

Standard Telephones were showing also a new complete airborne VOR/ILS receiver, the SR32/33, capable of receiving any one of 100 pre-set frequencies in the 108- to 118-Mc/s band and any one of 20 spot frequencies in the 300- to 325-Mc/s band and also one spot frequency on 75 Mc/s. These together cover localizer, glide path and marker facilities.

Indications are that a new u.h.f. radio-telephone band is coming into use for ground-to-air communications. It is 225 to 400 Mc/s and the 175 Mc/s available provide 1,750 channels of 100-kc/s bandwidth.
Plessey were showing the ground equipment in rack form and of quite massive construction. The fact that it is entirely weatherproof with all units sealed no doubt gives this impression. Two transmitters are available, one a single-channel set, crystal controlled and allowing full remote control, and the other a multi-channel set which, while making available the whole 1,750 channels by mixing the harmonic outputs of some 32 crystals, provides on immediate call and by remote control 12 pre-selected channels. Normal r.f. power output is 10 watts but the addition of an r.f. amplifier and its power supply unit raises the available r.f. power to 150 watts.

A small airborne set for use in the new u.h.f. band is the Burndred BE234 working on a single spot frequency between 238 and 248 Mc/s with facilities for emergency working on the international distress frequency of 243 Mc/s. The use of an overtone crystal enables the working frequency to be reached by a frequency multiplication of 12. The output of the transmitter is 2.5 watts and amplitude modulation is employed. The self-contained receiver is a double superhet with a first i.f. on about 20 Mc/s and the second on 2 Mc/s.

A further example of equipment for this new band was an automatic ground direction finder shown by Standard Telephones. It is the Type FGRIX-1340 and provides remote selection of 10 spot frequencies in the band 225 to 400 Mc/s. Bearings are displayed on a cathode-ray indicator. It employs a fixed vertical aerial mounted in the centre of a rotating fibreglass cylinder carrying a reflector. This imparts a rotating cardioid response to the system which in effect is tantamount to modulating any received signal by a sinewave of a frequency equivalent to the speed of rotation, in this case 40 c/s. Bearing information is obtained by comparing the instantaneous phase of the 40-c/s modulation of the signal with a 40-c/s sinewave generated by an alternator embodied in the base of the spinning cylinder.

The c.r. indicator includes a switch which displays instantly when required the reciprocal of the bearing with magnetic correction (the QDM) for passing back by R/T to the aircraft.

Another system of direction finding demonstrated on the airfield by Standard Telephones was one to which has been given the title Commutated Antenna Direction Finding (CADF) because it operates by sampling in sequence the signals picked up on a ring of vertical aerials by one receiver, mixing them with the same signal picked up by a nearby single aerial and on comparison in a suitable discriminator a sinewave output at the frequency of the aerial commutating cycle is obtained. The phase of this signal varies with bearing and the actual bearing is obtained by comparison with a reference signal derived from the commutating system. Although demonstrated on v.h.f. signals it is equally applicable to u.h.f. and to h.f.

Heavy storm clouds are a potential source of danger to aircraft and generally avoided wherever possible, or when sufficient warning of their presence is available under conditions of poor visibility. Ekco airborne search radar was developed especially to give this early warning and this year a new version was shown having a longer range, 120 miles as compared with 40 to 50 miles of the early set. It also embodies a discriminating feature in that cores within the clouds of heavy air turbulence are emphasized on the P.P.I. display.

Pye were showing the ground equipment of a new ILS (instrument landing system). Its special features are long-range localizer transmitter, high accuracy and automatic monitoring of the whole equipment from a centrally disposed control console. Two localizer transmitters are used; they operate in the 108-112-Mc/s band, each gives 50 watts out-
put and each feeds dipoles in the localizer aerial system. They are separately modulated and the approach path is determined in the air by comparing the amplitudes of the two modulating signals, the resultant information being passed to a combined approach and glide path indicator. The localizer aerial is directional, giving a beam width of ±70° centred on the approach to the runway.

Glide path transmitters are of 20 watts output, operate in the 328- to 355-Mc/s band and feed into vertically stacked aerials. Different modulating tones are used and again comparison of their amplitudes gives the glide angle. There are three marker beacons in the system on 75 Mc/s.

Other ground nav aids shown this year comprised a new ground beacon and airborne apparatus by means of which aircraft can fix their own position. It is known as "Tacan," operates between 962 and 1214 Mc/s and was shown by Standard Telephones. It is an interrogator-responder system and has a range of 200 miles.

Decca had a new medium-range surveillance radar, the Type MR75, working on 3.2 cm and having an operational range of 75 miles on large, and 45 miles on small, aircraft. It is said to fill the gap between the more elaborate long-range surveillance radars and short-range approach control radars. The aerial is a 14-ft horizontal mesh-covered system fed by a horn and rotating at 10 r.p.m. The equipment, except the display unit, is housed in a single cabinet 2ft 6in square at the base and 5ft 6in high. Several display units, located up to 2,000 yards away, can be used with one equipment and aerial system.

For long-distance point-to-point ground communications relating to routine movements of aircraft and operational instructions, radio telegraphy, or its modern counterpart the teleprinter, has no rivals yet. Frequency-shift signalling is the well-established system for rapid and accurate handling of large volumes of radio traffic and equipment for this purpose was well in evidence.

Redifon had a frequency-shift receiving adaptor (Type AFS10) designed especially for simplified operation. One of its principal features is the ability to accept signals whose carrier frequency may drift as much as 2.75 kc/s above or below the nominal frequency. It is intended for use with the Redifon R50M communications receiver, but will function with any other good set of this type covering frequencies between 445 and 470 kc/s. Another feature is that it provides the 80-0-80 volts required for operating the teleprinters (two) and radio telephony can be employed as an alternative service. Plessey were showing frequency-shift adaptors for use with suitable existing communications receivers, also complete dual-channel f.s.k. receiving terminals and for the radio link 100-watt and 1-kw h.f. transmitters.

Medium-frequency ground beacons still play an important part in air navigation in all parts of the world, but perhaps their importance is realized less in Europe where v.h.f. is so prominent than in the more remote parts. For use under the most arduous conditions, Redifon have a robust m.f. ground beacon transmitter (Type T1918) giving 300 watts output over the range 110 kc/s to 1500 kc/s in four tuning bands. It is made up of three separate units designed for easy separation and transportation by air, or other means. They can be stacked for operation either vertically or used side by side, as in a vehicle. Units are sealed and the transmitter will work in 18in of water. A special feature is the provision for use of radio telegraphy and telephony, should the need arise.

A most interesting development was seen on the Ultra stand. It is described as a "sea cell" and is intended for operating the "Sarah" rescue beacon equipment in emergency inflatable dinghies. The cell is normally dry, or inert, but on immersion in sea water becomes active and will operate "Sarah" for 100 hours continuously, or for about 4 days. The output is 1.3 volts and the h.t. supply for the equipment is provided by a small vibrator unit. The overall size is 3½ × 4½ × 4in. Another Ultra exhibit was an aircraft "station" intercommunication box (UA118/A) operated entirely by transistors. This new box is about half the size and three-quarters the weight of the equivalent valve-operated model.

Wireless World, October 1955
Radio Equipment Firms at the Farnborough Show

Bell and Caledonian Ltd., Great Cambridge Road, Enfield, Middlesex.
Burneside Ltd., West Street, Erith, Kent.
Canadian Marconi Company, 2442 Trenton Avenue, Montreal 16, Canada. (Agents: Marconi’s Wireless Telegraph Co. Ltd., Chelmsford.)
The Decca Navigator Co. Ltd., 247 Burlington Road, New Malden, Surrey.
Decca Radar Ltd., 1-3 Brixton Road, London, S.W.9.

While on the subject of power supplies there were some interesting, but not entirely new, lightweight secondary cells, shown by Venner Accumulators. They are silver-zinc accumulators and the smallest shown, while weighing only 3 oz and measuring 3/4" x 1 1/4" x 1 1/4", is capable of giving a 10-A continuous discharge. Its rating is 0.75 amhr. Silver-zinc accumulators give a nominal voltage of 1.5 and are approximately 1 1/2 to 1/6 the size and weight of most lead-acid accumulators of comparable performance. The ampere-hour efficiency is 90 to 95%.

Other components seen which have been developed especially for use in aircraft radio equipment were double- and quadruple-voltage Westalite metal rectifiers for h.t. use. They are, of course, considerably smaller and lighter than normal types; the price paid is a slightly higher forward resistance, but this is of little consequence. The quadruple-voltage types will withstand a peak inverse of 80 volts per plate compared to 24.3 volts for the standard pattern. Contact-cooled rectifiers relying on conduction rather than convection for dissipating the heat are new this year; they are fairly thin and flat with as much contact surface area as possible and the normal way of fitting is on the equipment chassis. All these were shown by Westinghouse.

A number of items of test equipment especially applicable for testing and maintaining aircraft radio and radar equipments were shown by Marconi Instruments. One was the TF801B, 10- to 500-Mc/s signal generator, another the TF1020/1 direct-reading r.f. power output meter covering 0-100 watts at frequencies up to 250 Mc/s and there was a micro-wave test set, TF890A, for checking characteristics of transmitters, receivers and aerial systems in the 3-cm band. It embodies a cavity wave meter covering 900 to 9680 Mc/s.

Wayne Kerr had a test set, the Type 740, which is designed especially for functional tests of airborne and v.h.f. transmitters, receivers and intercom units in an aircraft. It can be used by semi-skilled persons and by rotation of a switch and observation of a meter scaled “pass” or “reject” most of the equipment can be quickly checked over. Detailed investigation of “reject” equipment can then be undertaken by the skilled staff. The gear is reasonably small and light and quite easily operated in confined spaces.

TELEVISION IN AUSTRALIA

PROVISION has been made for both commercial and Government-operated stations in Australia and licences have already been granted for four commercial stations—two in Sydney and two in Melbourne. British equipment worth £0.25M has now been ordered for the first two Government-operated stations. They are due to come into service towards the end of next year.

Some months ago, the Australian Broadcasting Control Board issued a report on the standards to be adopted for television in the Commonwealth. The system agreed upon is 625 lines, with frequency-modulated sound. Ten 7-Mc/s channels between 49 and 216 Mc/s are being made available for the operation of the service and the Board, with the concurrence of manufacturers, suggests that from the outset receivers should be tunable to all ten channels. It is also suggested that receivers should be capable of economic adaptation to provide for the u.h.f. bands (500 to 855 Mc/s) which will eventually be used.

Standardized intermediate frequencies are to be employed for all receivers used in the Commonwealth; they are: sound 30.5 Mc/s and vision 36 Mc/s. These frequencies must be adhered to within ±0.25 Mc/s and the oscillator frequency must be above the channel frequency. Beat oscillator radiation must be kept to less than 50 µV/m at 100 feet in the lowest three channels, 100 µV/m at 50 feet in channels 4 and 5 and 150 µV/m in the top five channels.

The transmitters for the Government-operated stations, which are to be erected in Sydney and Melbourne, are to be provided by Marconi’s, through their associates Amalgamated Wireless (Australia), Limited. The installation at each station will consist of an 18-kW vision and 4-kW sound transmitter, 5-kW and 1-kW stand-by transmitters, ancillary equipment and an 8-stack aerial array. A sound and vision radio link is also being provided between the two stations.

Wayne Kerr portable test set Type 740.
Simple Hum-Reducing Circuit for Radio Receivers

The economic design of a.c. operated radio receivers requires low hum output from the loudspeaker for low values of filter capacitance in the power supply. If the receiver has two a.f. stages and the grid bias for the second stage is obtained from a resistor in the common negative h.t. supply line, the use of hum cancellation at the grid of the second amplifier is commonly used to lower the cost of the filter components for a given level of hum output. It can be shown that if the resistor $R_x$ is added to the otherwise conventional circuit of Fig. 1, a further reduction in hum output or in filter cost is obtained.

The equivalent circuit for hum potentials at the grid of $V_2$ (Fig. 1) is shown in Fig. 2 which can be represented by the equivalent bridge circuit of Fig. 3. Minimum hum at the grid of $V_2$ will be obtained when this bridge circuit is balanced.

It can be shown that at balance the following relations hold.

(a) Resistive balance:

$$R_x = \frac{R_2 R_3}{R_4} - \frac{R_a}{R_4} - \frac{X_c a \cdot X_c a}{r_a} \ldots (1)$$

(b) Capacitive balance:

$$C_a = C_n \cdot \frac{R_4}{R_2} \left( \frac{1}{r_a} \right) \ldots (2)$$

where $X_c a \cdot X_c a$ = reactance of $C_a$ and $C_n$ at the hum frequency considered and $r_a$ = anode resistance of $V_2$.

In a practical circuit it is found that the second term on the right-hand side of Equ. (1) is negligible and $R_x \ll r_a$.

Hence equations (1) and (2) become

$$R_x = R_2 \frac{R_3}{R_4} \ldots \ldots \ldots \ldots \ldots \ldots (3)$$

$$C_a = C_n \cdot \frac{R_4}{R_2} \left( \frac{r_a}{R_3 + r_a} \right) \ldots \ldots (4)$$

Because the bridge balance does not depend upon frequency it can be balanced for all hum-frequency components. The resistive balance is independent of capacitive balance and in particular it does not depend upon the value of $C_a$ which will be the main variable if $C_a$ is an electrolytic capacitor.

Experimental results were taken on a receiver with the end circuit of Fig. 1 with the following values of components:

- $R_a = 80 \text{k} \Omega$
- $R_1 = 2.5 \text{k} \Omega$
- $R_2 = 220 \Omega$
- $R_3 = 270 \text{k} \Omega$
- $R_4 = 470 \text{k} \Omega$
- $C_1 = C_2 = 16 \mu F$
- $C_3 = 0.02 \mu F$
- $R_x = 100 \Omega$

($C_n$ and $R_2$ were adjusted for minimum hum.)

The hum voltage measured across the secondary of the output transformer $T_1$ for $R_x = 0$ was $-46 \text{ dB}$ (arbitrary reference level) and $-63 \text{ dB}$ for $R_x = 100 \Omega$. $R_x$ differs from the value (126 $\Omega$) calculated

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By HERBERT J. FRASER, A.M.I.E.E.*

* Amalgamated Wireless Valve Co. Pty. Ltd., Sydney, Australia.
from Eqn. (3) because other sources of hum, such as that due to anode and screen voltages, have not been considered in the simple theory. The value $R_3$ required for circuits including negative feedback from the secondary of $T_1$ to the grid of $V_1$ has been found to be much less than that predicted by Eqn. (3).

The bridge balance is not particularly critical. Table 1 shows the hum output when the bridge was first adjusted for minimum hum ($-63$ dB) and each component listed was varied by $\pm 25\%$.

**TABLE 1**

<table>
<thead>
<tr>
<th>Component</th>
<th>+25%</th>
<th>-25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_a$</td>
<td>-51.5</td>
<td>-47</td>
</tr>
<tr>
<td>$R_3$</td>
<td>-51</td>
<td>-57.5</td>
</tr>
<tr>
<td>$R_5$</td>
<td>-55</td>
<td>-59</td>
</tr>
<tr>
<td>$R_4$</td>
<td>-54.5</td>
<td>-55</td>
</tr>
<tr>
<td>$C_2$</td>
<td>-53</td>
<td>-53</td>
</tr>
<tr>
<td>$C_3$</td>
<td>-57.5</td>
<td>-50</td>
</tr>
<tr>
<td>$r_a$</td>
<td>-</td>
<td>-54.5</td>
</tr>
</tbody>
</table>

It is seen that despite these large changes in components the hum is not higher in any case than the minimum hum obtainable for $R_a = 0$. In practice resistive balance can be held to close limits as it depends only upon the three fixed resistors $R_3, R_5, R_4$ and it represents a distinct advantage in hum reduction even if the bridge is not accurately balanced capacitively.

**APPENDIX**

To derive the balance conditions for Fig. 3, the three delta components comprised by $R_3, R_5, R_a - jX_a$ are replaced by their star equivalent obtained by means of the star-delta theorem; the circuit then takes the form shown in Fig. 4, in which $Z = r_a + R_5 + R_a - jX_{c2}$. Only two of the star elements enter into the balance condition which is, by the ordinary bridge relation,

$$R_a = R_3 (R_x - jX_{c2})/Z$$

Expanding, and equating real and imaginary parts separately, we get

$$R_x = R_3 R_4 X_{c2} X_{c3} R_2$$

$$X_{c2} = X_{c3} R_2 \left(1 + \frac{R_3 + R_4}{R_a}\right)$$

whence $C_2 = C_3 R_a / \left(1 + \frac{R_3 + R_4}{R_a}\right)$


**I.T.A. MIDLAND STATION: TEST TRANSMISSIONS**

SOME idea of the anticipated coverage of the I.T.A. Midland transmitter at Lichfield will be gained from this map on which has been superimposed the authority’s estimated 2-mV/m contour (dotted) outside which is the 0.5-mV/m area (shaded).

Work has already begun on the site on which Marconi’s will be erecting a 450-ft self-supporting mast and aerial system. The site is 500ft above sea level.

The transmitting equipment for the station, which will operate in Channel 8 (189.75 Mc/s, vision, and 186.25 Mc/s, sound) with an e.r.p. of 144 kW, is being supplied to Pye.

Belling and Lee have been asked to radiate a test signal from a temporary low-power transmitter on the site, as they did from Croydon, and it is hoped that regular transmissions will begin on October 10th. The proposed schedule for transmissions using a similar test card to that radiated from London (with the same call sign, G9AED) is: Monday to Friday 9.30-12.30, 2.0-5.30, and 7.30-8.30; Saturday 10.0-1.0.

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496 WIRELESS WORLD, OCTOBER 1955
Letters to the Editor

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

Band III Convertors

A NUMBER of advertisers in your September issue offer convertors for the reception of the I.T.A. Band III transmissions on Band I receivers. All assert their units are suitable for any type of receiver without internal modification; some say categorically they will work with either "straight" or superheterodyne receivers. These statements are apparently aimed largely at home constructors.

Now the majority of "straight" sets in the London area have been fitted with the upper sideband of the Alexandra Palace transmitter to make sound rejection simple. As the I.T.A. transmitter will be sending out vestigial sideband (lower sideband only) straightforward conversion will not work. Either separate sound and vision convertors will have to be fitted or the existing receiver returned to the lower sideband. This latter course would be preferable in case the B.B.C. decide to change over to single-sideband when they move to Crystal Palace. In other words, many of those who attempt to fit convertors will have to buy an I.T.A. announcement of returning and adding sound rejectors in order to cut their losses.

Unfortunately, the Belling-Lee experimental Band III transmissions from their Croydon station have contributed, quite inadvertently, to this problem, since both upper and lower sidebands have been radiated. People who have bought and fitted convertors have received the test card satisfactorily and are temporarly happy. I fear some of them are in for a rude awakening when the I.T.A. station starts up in earnest.

Thornhill Heath, Surrey.

H. BANHAM.

F.M. at Sea

I AM glad you have drawn attention in your September issue to the Parliamentary announcement by the Postmaster General; in view of the sad history of marine v.h.f., it is not surprising that it was "tucked away."

The whole story of marine v.h.f. since its inception after the war, has been a long one of restriction, frustration and confusion. The Office of Marine Administration and I would like to reconstruct it in the hope that the same mistakes do not occur in future.

At Atlantic City, 1947, an extraordinary resolution was hurriedly passed in the last few days making f.m. compulsory in Region II (America) and strongly recommending it in Regions I and II (the rest of the world). There had been no experience of commercial marine v.h.f. prior to this and the decision ignored the vital factor that a.m. was standard for all aeronautical services. In May, 1949, the G.P.O., pointing out the important advantages of using a.m., decided to reverse the Atlantic City policy and to standardize on a.m. for Commonwealth marine services. The G.P.O. must have realized the far-reaching consequences of this reversal and should have given all concerned the opportunity of reviewing it once again at some future date. Indeed, once the decision was made it should have been supported actively and effectively in Britain and throughout the world.

After the adoption of a clearly defined policy, my company felt it was safe to enter the market and give full support to the G.P.O. and between 1950 and 1953 great strides were made in Great Britain and throughout the rest of the world in fitting ships and vessels with British equipment.

As these strides were continued, we began to sense opposition and obstruction to our plans to further the G.P.O.'s stated policy. Although continually pressed, the G.P.O. refused to establish further Public Correspondence schemes beyond the initial Thames Radio Service. The G.P.O. would not discuss with us ways and means of opening up additional v.h.f. channels for ship-to-shore communications with liners. Our export salesmen began to hear rumours from abroad that the G.P.O. were thinking about changing back to f.m. Although in 1951 Mr. Ness Edwards, then P.M.G., announced in the House that Great Britain would continue to support a.m. for international standards, we were left in no doubt that the G.P.O. were considering a so-called face in January, 1953, when the G.P.O. asked the radio industry what its attitude would be to a change to f.m. As Britain's largest suppliers we vigorously opposed this change, as we felt that Britain was being "pressurized" from America to use an inferior marine system and we owed allegiance to our numerous marine customers who, with us, had supported the G.P.O.'s agreed 1949 policy.

The net result of these G.P.O. actions has been the stagnation of marine v.h.f. since 1953, with the consequent damage to our business and complete cessation of exports of marine v.h.f. whilst the shipowner has been deprived of a new and important form of communication for safety and business purposes.

We ask ourselves, therefore, if we should now support the G.P.O.'s changed policy for f.m. Past history tells us "No" but if the new P.M.G. can restore confidence and show sincerity by positive action, we would be the first to support him. The positive action he can take is three-fold.

1. To agree quickly a reasonable international marine v.h.f. specification with sufficient working frequencies and narrower channel spacing.

2. To announce the intention of setting up a number of public marine v.h.f. stations to conform to the new f.m. standards within a specified period.

3. To state that a.m. to present standards can continue to be used on private marine channels.

Pye Marine, Ltd.

R. I. T. FALKNER.

Tape Bookmark

R. G. WICKER states in his letter (your September issue) that he uses a 2-c/s signal for "finding the place" on magnetic tapes. A simpler method of imposing a signal is by means of a permanent magnet, which, if applied close to the tape, gives a very strong audible pulse on fast wind-on or rewind, even although not in contact with the head. Also this uses very little tape.

The essence of our tape selector mechanism (Wireless World, April) lies in its simplicity and ability to work whether the tape is moving at high speeds or at the playback speed. We had considered the idea of applying a signal to the tape but the complexity involved outweighs the advantages of this technique although the home constructor with space to spare may prefer this method.


R. PRICE

R. A. FREWER.

In your August editorial, you reviewed ways and means of precise location of individual recordings on a length of magnetic tape. The problem is undoubtedly an irritating one for which no simple and elegant solution has yet been found.

The conventional type of indicator usually provided on a tape recorder is far too crude to give anything like precise location. If a device of this general character is to be used, then the revolution counter is definitely superior, yet its accuracy is inevitably prejudiced by changes in tape length due to humidity and temperature and by changes in winding tension. The idea of recording a sub-audible note on the tape for registering purposes fails, as you rightly point out, because the playback head is normally inoperative during...
LETTERS TO THE EDITOR

fast wind and rewind. If a procedure of this kind were seriously contemplated, it might be as easy to obtain the necessary signals at the start and finish of a recording by interruptions, possibly coded, of the h.f. bias current. Any frequency transformation or the like which might be found to the ratio detector certainly is simplicity itself (to align), yet the distortion introduced by the S.B. line when the programme source is anywhere but London produces a marked deterioration although the stated limits

of distortion for a single link are only 0.6% at 1,000 c/s and 5% at 100 c/s (I say "only," but one shudders to think of the possibilities—at the actuality, often enough—when a programme comes from a distant region via perhaps four or five links!) Whatever may appear on paper, distortion in the ratio detector does not appear too significant in practice.

Similarly, one gets excellent results from commercial gramophone records although the distortion of the whole channel measured from the input of the cutter amplifier to the output of the pickup can scarcely be less than several per cent at much a purer signal level than is significant that one never sees measured results published. And it is customary to adjust tape recorders for from 2% to 5% distortion at maximum level, yet we happily use these machines to record f.m. transmissions and replay them through his real ears as a means through which to educate him. We find that a number of our boys are very keen indeed on amateur radio and we have planned a scheme of work around this topic which will strengthen the English, mathematics, science, geography, etc., of the pupils, following it as a living, active, and practical aspect of radio itself. It will be clear, then, that our aim is in no way vocational, but is directed to improving the pupil's general education.

Our difficulty is equipment. As most people know educational funds for such purposes are very limited indeed. If any of your readers have components, valves and accessories, meters and test gear, old receivers, materials, etc., lying idle, we should be most grateful for them. They may rest assured that such gifts, however small, would be most gratefully received and put to the fullest possible use.

Radio in Schools

YOUR readers may be interested to know that we are including amateur radio as one of the subjects a child may opt to do in this school.

Our reasons are as follows. Once the basic subjects have been adequately covered, we believe that a child may best be helped to grow into a mature and responsible adult by using his real interests as a means through which to educate him. We find that a number of our boys are very keen indeed on amateur radio and we have planned a scheme of work around this topic which will strengthen the English, mathematics, science, geography, etc., of the pupils, following it as a living, active, and practical aspect of radio itself. It will be clear, then, that our aim is in no way vocational, but is directed to improving the pupil's general education.

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Headsman,
Holmer Green County School,
High Wycombe, Bucks.

Transistor Letter Symbol

SHORTLY after you published my letter in the July issue I was sternly informed that "The American use V for valves as we do." Checking what American literature I have in hand, I find that Audio Engineering uses V, Terman uses T, and Begun uses VT.

Of course, "tube" has the virtue of being more general than "valve," covering things like c.r.t.s and photocells and thereby giving a logical reason for using T for both valves and transistors. My correspondent demands that T should be kept for transformers but it seems perfectly satisfactory to put mutual inductances in the list of inductors, as is already done with r.f. transformers.

Prestwich, Manchester.

V. MAYS.

F.M. Receiver Design

S. W. AMOS' and G. G. Johnstone's reply (August issue) to their critic J. K. Carter demands further comment, as it is quite wrong.

Even if a single conventional moving-coil speaker were the form of transducer in general use in the sort of high-quality equipment to which an f.m. feeder is likely to be added, it would remain a fact that distortions in successive parts—be it the driver, the amplifier or the loudspeaker—do not add up, to the detriment of the overall quality. That frequency-divided multiple units may reduce the audible effects of speaker distortion to a very low level is well enough known to need no elaboration. The designer of one unconventional moving-coil speaker used as a single unit has claimed* that by its use an increment of distortion from 0.1% to 0.4% in the amplifier can be heard, and certainly this speaker does not itself introduce audibly significant intermodulation. So the loudspeaker is not a universal offender.

However, Mr. Carter's commentary really bugs the question "What sort of distortion?" As "Cathode Ray" has been ably pointing out in your pages, an unqualified percentage figure is not a true measure of distortion once we start considering sound rather than an abstract waveform.

Despite the alleged 3% distortion, f.m. reception via a ratio detector shows, under favourable conditions, less audible distortion than any other source readily available (I have not yet heard a unit using the Foster-Seely circuit, and the ratio detector certainly is simplicity itself to align), yet the distortion introduced by the S.B. line when the programme source is anywhere but London produces a marked deterioration although the stated limits

* F. H. Brittain, "Metal Cone Loudspeaker," W.W., Jan. '53.

WIRELESS WORLD, OCTOBER 1955
Transistor Equivalent Circuits

4.—Conclusion

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

W e have now derived several basic equivalent circuits for the transistor and it might be thought that the subject is exhausted. This is not so, however, for there is one important effect that we have so far ignored and another that we have stressed so little that it may well be overlooked, although we have actually taken account of it.

Before discussing these matters, however, we propose to digress a little from our main theme of equivalent circuits to consider some of their applications. The valve, as is well known, has a moderate to high output impedance and an input impedance so high that it can often be ignored. The lowest output impedance normally found is about 500 Ω, for a large power triode; the highest is several megohms, for an r.f. pentode. Unless positive grid drive is used, the input resistance is tens of megohms or more, except at very high radio frequencies.

With a junction transistor, on the other hand, the output resistance is high, being around 1–2 MΩ, but the input resistance is low, perhaps 500 to 2 kΩ. This has a big influence on circuit design. Figures for voltage or current amplification can have little meaning unless the impedances are also stated, and it is often better to express amplification in terms of power.

In order to obtain maximum power gain, it is essential to match the output resistance of one stage to the input resistance of the next by means of a step-down transformer. Now the input resistance of a stage depends upon the load resistance of that stage and the output resistance depends upon the internal resistance of the stage or other device which drives it. The general solution for the optimum conditions in a multi-stage transistor amplifier can thus be quite complicated.

Except in the early stages, where the signal levels are very small, this condition of matched impedances is not very satisfactory, however, because too much non-linearity distortion occurs. Hitherto, we have treated the transistor on the basis of a linear approximation to its characteristics. Just as in the case of the valve, this becomes rather inaccurate at high signal levels and it becomes necessary to determine the proper conditions by a graphical construction.

We need not go into this in detail here, for the procedure is identical with that for the valve. Basically, one takes a set of collector voltage–current curves for the transistor and by trial and error determines the optimum load for it for maximum power output and minimum distortion, taking care not to exceed the maximum ratings for peak voltage, peak current and mean power. One then obtains a figure for the peak current input at base or emitter, according to the form of connection being employed.

For the output stage, it often pays to use the earthed-base connection, for the collector characteristic curves are straighter and more evenly spaced than in the earthed-emitter connection.

The procedure so far is exactly like that for a valve, save that the input is expressed as a peak current instead of a peak voltage. There is now, however, a difference, for the input characteristics are not linear and must be taken into account. Strictly, one must have a set of input voltage–current curves and draw a load line upon them to represent the resistance of the input circuit and determine its proper value for minimum distortion. Very commonly, however, the input distortion may be much greater than the output and may preclude the possibility of impedance matching.

In order to make the distortion negligible, it is often necessary to feed a transistor from a source having a resistance high compared with the input resistance. This means operating in a mismatched condition with a consequent loss of amplification. Resistance-capacitance coupling may then entail relatively little further loss of amplification and may well make for a lighter and more compact amplifier even if it does entail the use of more transistors.

SUMMARY: In this concluding article of the series, some elementary aspects of transistor amplifiers are considered. The question of frequency response is touched upon and the applicability of the d.c. equivalent circuit to the designing of circuits for stabilizing the operating point is pointed out.

Whatever form of coupling is used, it is essential to know the input resistance and some other characteristics. In Fig. 1 is shown the T form of equivalent circuit for an earthed-base transistor; \( R_1 \) and \( R_2 \) are the resistances of the input and output circuits respectively.

First of all, ignore \( R_1 \) and let \( v_s \) be a signal voltage applied between emitter and base; \( R_d \) is connected and \( v_o \) is the output voltage developed across \( R_2 \) by \( i_e \) flowing in it. The equations are:

\[
\begin{align*}
v_e & = i_e (r_e + r_b) - i_r s \ \\ i_e \cdot i_r & = i_e (r_b + r_e + R_2) - i_r s
\end{align*}
\]

From (2) we get straightaway

\[
i_e = i_r = \frac{r_b + R_2}{r_b + r_e + R_2} = i_e A_e
\]

where \( A_e \) is the current amplification.

Inserting this result in (1),

\[
v_o = i_e (r_o + r_e - A_e r_b)
\]

The input resistance is defined as

\[
r_{in} = \frac{v_o}{i_e} = r_s + r_b (1 - A_e)
\]

Wireless World, October 1955
The voltage amplification is

\[ A_v = \frac{v_o}{v_i} = \frac{i R_2}{i R_1} = A_e \frac{R_2}{r_{in}} \]  \hspace{1cm} (5)

To determine the output impedance, we imagine \( R_3 \) of Fig. 1 to be disconnected and \( R_1 \) connected while \( v_i \) becomes an externally-applied driving voltage. If \( i_r \) is of opposite polarity to that shown, the directions of the currents and the polarity of \( i_r x \) are all unaltered. The equations then become:

\[ v_o = i_r (r_e + r_b) - i_x (r_e + r_m) \]  \hspace{1cm} (6)

\[ 0 = i_x (r_e + r_1 + r_e) - i_x b \]  \hspace{1cm} (7)

whence

\[ r_{out} = \frac{v_o}{i_o} = r_e + r_b - \frac{r_b + r_m}{r_b + r_m} \]  \hspace{1cm} (8)

By a similar procedure, using the two-generator equivalent circuit, the relations can be obtained in terms of \( r_{in}, r_{22}, r_1 \) and \( \alpha \). They are all listed in Table I with the formulae for the earthed-emitter connection also.

At this stage, it is desirable to quote some practical values so that we may be familiar with the orders of magnitude of the quantities involved. In Part 3, we quoted the following figures for a junction transistor:

\[ r_{11} = 785 \Omega, \quad r_{22} = 1.5 \text{ M} \Omega, \quad \alpha = 0.97, \quad \beta = 0.956 \text{ for the earthed-base connection.} \]

These became \( r_{11} = 785 \Omega, \quad r_{22} = 30 \text{ k} \Omega, \quad \alpha = 48.5, \quad \beta = 0.0446 \text{ for the earthed-emitter connection.} \)

Suppose that the load resistance \( R_3 \) is 100 kΩ. Applying the relations of Table I, first for earthed-base connection, we get:

\[ A_e = 0.97, \quad \frac{1.5}{1.6} = 0.91 \]

\[ r_{in} = 785(1 - 0.91 \times 0.956) = 102 \Omega \]

For the earthed-emitter connection, we have:

\[ A_e = 48.5, \quad \frac{30}{130} = 0.2 \]

\[ r_{in} = 785\left(1 - 0.91 \times 0.0446\right) = 1,775 \Omega \]

If the source resistance \( R_1 \) is also 100 kΩ the output resistances in the two cases are:

\[ r_{out} = 1.5\left(1 - 0.97 \times 0.956\right) = 0.785 \frac{100.785}{100} \approx 1.5 \text{ M} \Omega \text{ (earthed-base)} \]

\[ r_{out} = 30\left(1 + 48.5 \times 0.0446\right) = 0.675 \frac{100.785}{100} \approx 30.3 \text{ k} \Omega \text{ (earthed emitter)} \]

**Two-stage Amplifier**

Consider now a two-stage amplifier, such as that sketched in Fig. 2(a). The complete equivalent circuit has the form (b) and seems quite complex. However, it can be further reduced to the form (c) for which the only assumption is that the reactance of the coupling capacitor \( C \) is negligibly small at the frequencies under consideration. Apart from this, the only changes are the substitution of the input resistance of each stage for the feedback generator \( b i_{21} r_{11} \) or \( b i_{12} r_{21} \), and slope resistance \( r_{11} \) or \( r_{22} \).

Consider the inter-transistor coupling. The load on \( V_1 \) comprises \( R_1 \) and \( r_{in} \) in parallel. We have seen that for an earthed-base transistor \( r_{in} \) is of the order of 100Ω only and, for an earthed-emitter transistor, \( r_{22} \) is about 30 kΩ. Even if \( R_1 \) and \( R' \) in parallel have a value of no more than 1 kΩ, the combined value in shunt with \( r_{in} \) will only be about 10% less than \( r_{in} \) by itself. Approximately, therefore, the load on \( V_1 \) is merely \( r_{in} \) and the current amplification of \( V_1 \) is very little less than the current amplification factor \( \alpha \).

Generally speaking, with junction transistors in RC coupling, the load impedance of one stage is very nearly the input resistance of the next and this is low compared with the resistance \( r_{22} \), so that the current amplification \( A_e \) is very nearly the current amplification factor \( \alpha \), or \( \beta \), as the case may be. In working out a preliminary design, therefore, only three simple steps are necessary:

1. Choose the output load \( R_2 \) for the required power output and determine the input current \( i_{21} \) for this output stage. Usually this must be done graphically from the characteristic curves, since distortion is important here.

2. The preceding stages will each have a current gain of nearly the current amplification factor. So the input current to the first stage is nearly \( i_{r1} \) divided by the product of the individual current amplification factors. In earthed-base connection \( \alpha \) is less than unity and this arrangement is consequently useless for current amplification with RC-coupled junction transistors. The earthed-emitter connection must be used.

3. Compute the input resistance of the first stage. Under these conditions it is very nearly \( r_{in} = \frac{r_{11}}{1 + \alpha} \).

The input circuit must then be designed so that the signal source can feed into this impedance efficiently. This will often entail the use of a transformer. Conditions with the point-contact transistor are very

---

**TABLE I**

<table>
<thead>
<tr>
<th>Earthed-Base Transistor</th>
<th>Earthed-Emitter Transistor</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current amplification</strong></td>
<td><strong>Current amplification</strong></td>
</tr>
<tr>
<td>( i_2 = A_v = \frac{\alpha r_{22}}{r_{22} + R_3} )</td>
<td>( i_2 = A_v = \frac{\rho_2}{r_2 + R_2} )</td>
</tr>
<tr>
<td>Voltage amplification</td>
<td>Voltage amplification</td>
</tr>
<tr>
<td>( v_o = A_e = \frac{R_2}{r_{in}} )</td>
<td>( v_o = A_e = \frac{R_2}{r_{in}} )</td>
</tr>
<tr>
<td><strong>Input resistance</strong></td>
<td><strong>Input resistance</strong></td>
</tr>
<tr>
<td>( v_i = i_{in} = r_{in}(1 - \beta A_e) = r_i + r_e(1 - A_e) )</td>
<td>( v_i = \rho_{in} = r_{in} + r_e(1 + A_e) )</td>
</tr>
<tr>
<td><strong>Output resistance</strong></td>
<td><strong>Output resistance</strong></td>
</tr>
<tr>
<td>( v_o = i_{out} = r_{out} \left(1 + \frac{\alpha \beta r_{11}}{r_{11} + R_1}\right) )</td>
<td>( v_o = i_{out} = r_{out} \left(1 + \frac{\rho_{11}}{r_{11} + R_1}\right) )</td>
</tr>
</tbody>
</table>

where \( R_1 \) and \( R_2 \) are the external base and collector circuit resistances respectively.
different from those with the junction type. Krugman quotes \( r_{11} = 250 \Omega \), \( r_{12} = 100 \Omega \), \( r_{21} = 24 \, k\Omega \), \( r_{22} = 12 \, k\Omega \). From Table 2 of Part 3, \( r_{12} = r_5 \) and \( r_{21} = r_m + r_{12} = r_m + r_9 \). \( r_{22} = r_9 + r_{11} = r_9 + r_r \). Therefore, from Table 1 of Part 3, \( r_{21}/r_{22} = 24/12 = 2 \) and \( \beta = r_{12}/r_{11} = 100/25 = 0.4 \).

In the earthed-base connection, with a load \( R_L \) of 24 k\( \Omega \), we have

\[
A_v = \frac{2}{12 + 24} = 0.66
\]

\[
r_{\text{in}} = 250(1 - 0.66 \times 0.4) = 183.3 \, \Omega
\]

This is a condition which might appertain to an output stage. For a previous stage the load cannot exceed \( r_{\text{in}} = 183.3 \, \Omega \) unless a transformer is used. This is small compared with \( r_{22} \) and the current amplification is nearly 2; it is \( 2 \times 12 = 18 \) = 1.98.

Unlike the junction transistor, therefore, a point-contact transistor will give a small current gain in the earthed-base connection.

The output resistance depends on the value of the source resistance. If this is very small, \( r_{\text{out}} \) tends to \( r_{22}(1 - x\beta) = 24(1 - 0.8) = 4.8 \, k\Omega \) in the example considered. If it is very large, \( r_{\text{out}} \) tends to \( r_{22} = 24 \, k\Omega \). In this case, therefore, the output resistance must lie within the limits of 4.8 k\( \Omega \) and 24 k\( \Omega \) and, with practical values of source resistance, it is likely to be in the range 6–10 k\( \Omega \). Whatever the values of \( R_L \) and \( R_0 \), the input and output resistances are always positive.

Let us now consider the point-contact transistor in the earthed-emitter connection. From Table 1, Part 3, \( \rho_{11} = 11.85 \, k\Omega \), \( \rho_{22} = 8.15 \, k\Omega \), \( a = -2 \), \( b = 0.6 \) and so, taking \( R_1 = R_2 = 20 \, k\Omega \), we get

\[
A_v = -\frac{2 \times -11.85}{8.15} = 2.9
\]

\[
r_{\text{in}} = 250(1 + 0.6 \times 2.9) = 685 \, \Omega
\]

\[
r_{\text{out}} = -11.85(1 - 2 \times 0.6 \times \frac{250}{20,250}) \approx -12 \, k\Omega
\]

The input resistance is positive but very small, while the output resistance is negative.

**Point-Contact Characteristics**

From Table 1, for the extreme limits of zero and infinity for \( R_L \), the current amplification varies from \( a \) to zero. With zero load, it equals the current amplification factor of the transistor and is negative. Since \( \rho_{22} \) is negative as \( \rho_{22} \) is increased \( A_v \) remains negative but increases rapidly to infinity when \( R_L = \rho_{22} \). For any higher value of \( R_L \) the amplification falls and becomes positive, which means that the output current reverses in phase as \( R_L \) passes through the value \( \rho_{22} \).

The input resistance is \( \rho_{11}(1 + bA_v) \). With \( R_L = 0 \), \( A_v = a \) and \( A_v \) is negative. If, as is normally the case, \( ab \) is a number greater than unity, the input resistance is negative. It becomes infinite when \( A_v \) becomes infinite and for higher values of \( R_L \) it is positive and reaches the value \( \rho_{22} \) when the load is infinite. This critical condition of infinite input resistance occurs when

\[
R_{11} = -\rho_{22}
\]

The output resistance when \( R_L \) is infinite is \( \rho_{22}(1 + ab) \) and is positive and low in value. As \( R_L \) is increased, \( \rho_{22} \), falls and passes through zero when

\[
-1 = \frac{ab\rho_{11}}{\rho_{11} + R_L}
\]

or \( R_L = -\rho_{11}(1 + ab) \). For the transistor we have considered, this value is

\[
R_L = -250(1 - 2 \times 0.6) = -250 \times -0.2 = 50 \, \Omega
\]

For higher values of \( R_L \) the output resistance increases in value and becomes negative.

If the input and output resistances of a point-contact transistor are both to be positive, it must be operated
with a source resistance $R_s$ of less than $-\frac{1}{2}(1 + ab)$ and a load resistance $R_L$ of greater than $-\frac{1}{2}$. It is not usually convenient to observe these limits and this is a major reason why the point-contact transistor is not much used in the earthed-emitter condition.

This is not the place to go into the reasons why the point-contact transistor can have negative input and output resistances in the earthed-emitter connection. We merely note the fact, which is one that makes it necessary to be very careful how one uses this kind of transistor in this circuit. The fact, however, can be put to good use for as a consequence of it the point-contact transistor is well suited for use as an oscillator and in switching circuits.

High Frequencies

Returning now to transistor amplifiers generally, there is one matter which we have, so far, ignored completely. We have treated the transistor constants as being pure resistances. In practice, they have reactive elements; in other words, the voltages and currents are not precisely in phase.

The main effect at low and moderate frequencies is to the current amplification. As the frequency is raised, the magnitude of $\alpha$ falls and there is a phase angle between $I_t$ and $V_t$. It is not uncommon, although very approximate, to allow for the effect by writing:

$$\alpha = \frac{\alpha_0}{1 - j\omega f_m}$$

where $\alpha_0$ is the low-frequency current amplification factor as previously defined and previously designated by $\alpha$. The frequency under consideration is represented by $f_m$ while $f_m$ is the frequency for which the magnitude of $\alpha$ is $1/\sqrt{2}$ of its low-frequency value. For some of the older transistors, the value of $f_m$ was only a few kilocycles but, in the newer junction types, it is often 1 Mc/s or so. With these, the change of $\alpha$ through the a.f. range is negligible. This may not be so in the earthed-emitter circuit, however.

To a good approximation:

$$\alpha = \frac{\alpha_0}{1 - \frac{f_m}{\omega}} = \frac{\alpha_0}{1 - \frac{f_m}{\omega}}$$

The cut-off frequency is $1 - \frac{f_m}{\omega}$ times that for earthed-base operation. As $\alpha_0$ is around 0.95 for a junction transistor, $1 - \frac{f_m}{\omega}$ is around 0.05 and the cut-off frequency is only about one-twentieth. In earthed-emitter operation, therefore, the change of amplification factor with frequency is much more important and may have to be considered even at a.f.

The effect of frequency upon the operation of a transistor is sometimes taken into account by elaborating the equivalent circuit by the addition of capacitances. So far, all attempts to do this seem approximate. We feel that a representation has not yet been devised which is both sufficiently accurate and sufficiently simple to be of much practical use. For audio frequencies, and with modern transistors, frequency effects are usually small and can be ignored. At high frequencies, some guidance is obtainable from the value of $f_m$ but, apart from this, the approach must be largely experimental.

Turning now to another matter, we said at the beginning that there was one thing which we have stressed so little that it may well have been overlooked, although we have actually taken account of it. This is the collector current with zero emitter current, normally designated by $I_{o2}$. If we refer to the d.c. equivalent circuit for the earthed-base transistor Fig. 2, Part 3, and to the characteristics of Fig. 3, Part 3, we see that we have designated as $I_1$, the collector current for zero emitter current and in Fig. 2(f) we took account of this by the battery $E'_c$.

The current flowing with $I_1 = 0$ is $E'_c - I_2 R_2$ when $V_2 = 0$ and this equals $I'_2$, of Fig. 3 and the $I_2$ of conventional nomenclature. From now on we adopt this convention and so $E'_c = I_2 R_2$ and the d.c. equivalent circuit of Fig. 2(f), Part 3, is applicable.

The practical importance of $I_2$ is that it varies a great deal with temperature and, in transistor circuit design, it is necessary to arrange the circuit so that its variation has a minimum effect upon the operating conditions. To this end, d.c. feedback is quite often employed. The use of the d.c. equivalent circuit in one or other of its many possible forms facilitates the design of such circuits. The aim is to devise a circuit in which $I_2 = 0$ or $V_2$ and $I_{o2}$ are substantially independent of the value of $I_{o1}$.

It may be objected that the d.c. equivalent circuit is not of much use for this purpose because it depends upon a linear approximation to the transistor characteristic and so can be reasonably accurate only over a small range. The whole purpose of a stability circuit, however, is to keep the operating point substantially constant and therefore within the range of validity of the linear approximation. We cannot safely use the d.c. equivalent circuit to calculate the performance of a poorly stabilized circuit, but we can do for a well-stabilized one. We can, therefore, use it as an aid in devising such a circuit. It will only be invalid if we do not succeed in finding one, and that is not of much importance.

In this series of articles, we have but touched upon the fringe of transistor circuitry, but it is hoped that they have served their purpose which is, by the analogy with the valve, to give the newcomer to the transistor some familiarity with the equivalent circuits and to endow them with some meaning.

We have not, for instance, dealt at all with the earthed-collector circuit. This bears the same relation to the earthed-emitter circuit as the cathode-follower bears to the ordinary valve amplifier. It is, in fact, a transistor "cathode" follower. It can, therefore, be treated in an analogous manner.

Violation of Amateur Bands

THE continued presence in exclusive amateur bands of commercial and broadcast stations is criticized in the July issue of the R.S.G.B. Bulletin, in which the present position in each of the bands is briefly surveyed. The hope is expressed that with the lessening of world tension there will be a reduction in the number of propaganda broadcasts which have been cluttering up the 7-Mc/s band for the past ten years—"broadcasts which we suspect have no listening public other than the diplomatic mission across the road. The "noisesome pestilences" in the 14-Mc/s band, allocated exclusively to amateurs throughout the world, are the jamming stations which "appear to idle for hours on odd frequencies in the band ready to pounce on victims which come up outside the band."

The writer castigates the British Government, which, although a signatory to the Atlantic City and Buenos Aires conventions, is "just as much to blame for breaking international agreements as are countries behind the Iron Curtain."
Dry-Cell Reactivator

Recharging with Partially Rectified Alternating Current

By R. W. HALLOWS, M.A.(Cantab.), M.I.E.E.

An article of mine on the possible means of reactivating dry cells published some time ago in Wireless World has since brought me a great deal of interesting correspondence from many parts of the world. Research work on this fascinating and rather important problem has already led to several solutions, each satisfactory up to a point, of which practical use is being made commercially. In some United States towns, for example, meter-readers hand in at the end of the day’s work the flashlamps with which they are provided. The batteries are placed overnight in the racks of large reactivators and next morning each man draws a flashlamp containing a “rejuvenated” battery, which can be relied upon to give him all the light that he needs throughout the day.

It is, in fact, recognized that cells can readily be reactivated, provided that certain conditions are complied with. Nothing can be done with a cell whose can is punctured, or with one which has suffered a slow decline in e.m.f. through long use, through evaporation of the water in the electrolyte, or through standing idle on the shelf. It is widely accepted that the e.m.f. of a “run-down” cell, otherwise in good condition, can be restored by passing a suitable reverse current through it, if (a) the period of service has been short—say, not more than one or two days; (b) the e.m.f. has not fallen below about 0.9 V; and (c) the reactivating current is applied without delay.

If such conditions are fulfilled, apparatus as simple as an ordinary trickle-charger will enable a cell of good quality to be given from eight to fifteen or more new leases of life. There are, though, certain serious “snags.” The first is that unless the reverse current is limited to something quite small and the reactivating process made a long, slow one, the cell is apt to become very hot. It may even burst, with rather devastating results! The second drawback is that after reactivation the open-circuit e.m.f. may be 2.4 V, or even rather more. Though the e.m.f. falls quickly under load to a normal value, it is to begin with undesirably high for, say, the filaments of the sub-miniature valves used in hearing aids.

A successful method of dry-cell reactivation has been developed in Holland by Mynheer Beer, who was kind enough to send me some time ago some of his apparatus for test purposes. This reactivator, the Elektrophoor, has been produced commercially in a considerable number of forms: special patterns are available for reactivating the combined h.t. and l.t. batteries of hearing aids and “all-dry” wireless sets, cycle-lamp batteries and a variety of flashlamp batteries. As I make a good deal of use of a flashlamp using three “U2”-sized cells, the Type E4 Elektrophoor, specially designed to deal with batteries of


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seen that when the Elektrophoor is dealing with a partly run-down cell its output is what may be described as "very dirty d.c." The net direct e.m.f. works out at approximately 4.7 V.

The lamp glows when the apparatus is connected up and switched on. A value for the effective current flowing may thus be obtained by using a similar lamp in a circuit containing a battery, a rheostat and a 0-500 milliammeter, the rheostat being adjusted until the brilliance of the two lamps is matched. As a check, the lamps are changed over and another reading is taken. The current is found in this way to vary, according to the condition of the cell under charge, between about 0.135 and 0.16 A.

Laboratory tests gave results very similar to those obtained with a simple trickle-charger, so far as the life of the cells was concerned: discharged through 6 ohms per cell for 3 hours a day and then immediately put into the reactivator they had a useful life from nine to seventeen times as long as that of untreated cells.

Two important differences were, however, noted. In the first place, the open-circuit e.m.f. of cells immediately after reactivation was never undesirably high, for it averaged 1.55-1.6 V. Secondly, no cell was found to become hot during reactivation.

Further tests showed that it was not essential to put cells on charge as soon as possible after their period under load. Three cells which had been used intermittently for over three months without ever being reactivated were placed in the Elektrophoor and given an all-night charge. Their average e.m.f. was 1.22 V on open circuit. Next morning all showed e.m.fs in the neighbourhood of 1.5 V. They were put into a flashlamp and a night in the reactivator whenever they seemed to need it has kept them at work ever since.

The only differences between the Elektrophoor circuit and that which I used previously with an ordinary trickle charger are the addition of the flashlamp and of the resistor shunting the rectifier. The purpose of the lamp is presumably to limit the charging current. All that the resistor can do is to allow some alternating current to by-pass the rectifier.

I do not pretend to know why this a.c. improves the reactivation. It may give a kind of electro-chemical shake-up to the cell and so assist the processes of depolarization and of re-deposition of zinc on the inner surface of the can. Be that as it may, one certainly finds on breaking open a cell which has been reactivated in this way that the zinc is more evenly and smoothly re-deposited and is in a less pasty and lumpy state than when reactivation has been done without the shunt resistor across the rectifier.

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**Long-range Television Reception**

AT ONE time the reception of television pictures over distances of several hundred miles was considered just a freak, but now, to judge from various reports, it is becoming a consistent freak. One gets the impression that if one cannot view opera from Milan or ballet from Moscow as a matter of course every evening it is only for the lack of a few hundred lines on the screen and a few extra elements on the aerial—not through any fault of the waves themselves!

However, the Continental viewers with their common standards are in a much better position for this international eaves-dropping than we are. Some of the most remarkable results in recent months have been obtained by a couple of Swedes, B. Pettersson and I. Sandblom, from the town of Skillingaryd in southern Sweden. Using a 17-inch 625-line German receiver by Nord-Mende of Bremen and an ordinary dipole aerial, they received their first long-distance picture on 1st June, 1954—from Russia. Since then, with a more elaborate aerial array, they have been picking up programmes from Italy, Switzerland, Russia, Czechoslovakia, Germany, Denmark and Holland, not to mention the Swedish experimental transmitter and some unidentified stations. The screen pictures on the opposite page have all been obtained this year.

On the European channels 2 and 3 (48 and 55 Mc/s vision) good reception has been obtained with a...
single aerial array, while for channel 4 (62Mc/s vision) an 8-element stacked array is used. A telescopic mast raises the assembly about 40ft above the roof of the house, giving a height above ground of about 65ft, and there is a mechanical system for rotating the aerial to point it in any desired direction.

Experience has shown, apparently, that receiving conditions are poor during warm periods and best at changes between high and low barometric pressures. During 1955 reception has been somewhat inferior to that in 1954. Of all the stations they have picked up, Pettersson and Sandblom regard the Italian and Russian ones as the most reliable, while others prove more or less capricious. An outstanding day was 22nd May, 1955, when Italy came in “just like a local programme.” Later on in June, with two receivers operating, they saw test-cards from Switzerland and Italy simultaneously. British transmissions have sometimes broken through the Italian and Russian programmes, but, of course, being on 405 lines, they could not be displayed on the screen.
MORE ABOUT

FOURIER

Analyzing Waveforms into their
Various Harmonics

By “CATHODE RAY”

ONE can hardly take an intelligent interest in any of the technicalities embraced by Wireless World without some acquaintance with Fourier’s theorem—the one that says all kinds of waveforms can be analyzed into or built up from pure sine waves having frequencies that are whole-number multiples of the fundamental frequency of the wave. Last month we took almost nothing for granted and set about an inquiry as to why sine waves have such a unique status among waveforms. Though we didn’t succeed in establishing that they are absolutely compulsory, we found that there are good reasons for their privileged position in the scheme of things. For instance, while there might conceivably be other ways of reckoning frequency, such ways would stand no chance at all against the accepted practice of reckoning the frequencies of waves as the frequencies of their Fourier fundamental sine waves.

It is easy enough to demonstrate on paper that adding together a fundamental and one or two harmonic sine waves produces waves of other shapes, and then to say that all waves of those shapes can be analyzed into sine waves. But what about sundry waveforms that are produced, say, by a valve oscillator? The oscillator doesn’t know that it is generating a lot of harmonic sine waves; it is only one oscillator, after all—not a legion of them. Then do those harmonic sine waves predicted by Fourier exist really, or only in the mathematician’s imagination? It is particularly difficult to believe that waveforms like those in Fig. 1(a) can be made up entirely from smooth sine waves (b). Doubts like this must have been in the mind of a radar trainee during the war, who had been taught that when a square wave is applied across a CR circuit having a short time-constant, the waveform across R consists of sharp peaks (Fig. 2). The explanation of this phenomenon was of course given him in terms of exponential charging or—without a hint of Fourier. But having on another occasion heard about the Fourier principle, he put the two things together and inquired whether, if the square wave really consisted of sine waves, as was said, these sine waves when applied to the CR circuit would come out in such a way as to make the peaked wave.

I don’t know what was going on in the fellow’s mind, but it may have been something like this: “The shape of the pointed waveform comes from the charging of the condenser—I can see that all right—and sine waves don’t come into it at all. Even if it is true, as they say, that the square wave is made up of sine waves (it doesn’t look like it) and the peaked wave too (looks even less like it), the change from one to the other has nothing to do with sine waves that I can see. This just shows that the Fourier idea doesn’t stand up to things like this, which work on other principles. It’ll be fun to catch out old—with it”!

But I would rather give him credit for quite exceptional intelligence, first for putting together two different lines of instruction—instead of just taking them as given—and secondly for devising a “critical test” of the Fourier principle. Anyway, the instructor was so impressed that he retired to his room for a few hours to perform the tedious job of drawing the fundamental and harmonics up to the 15th, to represent the infinite series needed to make a perfect square wave, then redrawing them all with the attenuation and phase shift that each individually would suffer in the CR circuit, and finally putting these all together. The result bore an unmistakable likeness* to the peaked waveform arrived at by the entirely different route of charging-capacitor theory, and effectively dispelled any feeling there may have been that the Fourier idea only works within limits and cannot be relied upon in cases like this, which old Fourier himself perhaps never envisaged even in bad dreams.

And although last month I may have shaken confidence a bit by suggesting that even the reception of a distorted r.f. transmission on harmonic frequencies cannot be taken as complete proof that it actually has these frequencies (it all depends on how you define “frequency”!), the universe is so made that obvious frequency-selectors like tuned circuits fit in perfectly with the Fourier idea of frequency. So we are not really going to forsake the normal practice of relating frequency to sine waves. That being granted, the reality of the Fourier harmonics can hardly be doubted. They can be tuned in, one by one. And think of multivibrators!

Fourier Analysis

So for the rest of the time let us accept Fourier unreservedly and consider the relationship between some of the more important waveforms and the sine waves into which they can be analyzed. I nearly said “sine waves of which they are made,” but thought that might tend to confuse. One has only to think of the devices actually used to generate (for example) square waves to realize that they do not do so by generating innumerable sine waves and then putting them together, even though square waves could be produced that way if one had an infinite number of sine-wave generators. So it would be more correct to say “sine waves of which they could be made.” A square table top could be made entirely of pieces shaped like Fig. 3(a), by putting them together as at (b). But it would not usually be made that way. Whether it was or not, however, it could always be divided into such pieces.

Now although it is easy enough to put together any desired number of harmonics sine waves, having any desired amplitudes and phases, and so construct an infinite variety of waveform, it is not so obvious how one sets about analyzing any given waveform into its harmonics. If the waveform exists physically as a voltage or current, there are such instruments as wave analysers for measuring the harmonics. These instruments read the amplitudes of the various harmonics, but not usually their phases—which are necessary in order to tell anyone how to reconstitute...

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* To be seen in Wireless World Dec. 1945, p. 360.
the original waveform from its ingredients. Then
there are various ways of analysing a waveform drawn
on paper. Neither of these procedures gives perfectly
accurate specifications for perfect square waves,
pulses, triangles, etc. But these specifications can be
calculated mathematically.

The starting point is the complete general Fourier
series consisting of all harmonics from 1 (the funda-
mental) up to infinity. Of course, we don’t write them
all out, or there would be no time for anything else!
The first few will do, just to indicate what symbols
one is intending to use. At this stage the only thing
that is known is the ratio of each frequency to the
fundamental. Taking the fundamental as 1, the
frequencies continue as 2, 3, 4, 5, 6 etc., as we all
know.

The first step is to find the actual frequency of
the fundamental. That is done by noting the
“period”—the shortest time that includes the whole
waveform. Every equal interval of time that follows
will then (if it must be in order to come within
the scope of Fourier, the thing is truly periodic)
consist of an identical repetition of the same waveform.
Call the period T seconds. Then the fundamental
frequency is 1/T c/s, usually denoted by f. When,
by examining the waveform, we have found what T is,
the value of f follows.

Specifying Phases

So now we definitely know all the frequencies, but
neither the amplitudes nor the phases. For the mean-
while we shall just have to write a letter, such as A1,
to denote the peak value of the fundamental. Remem-
bering last month’s findings, we now have the mathe-
matical formula for the fundamental sine wave:
A1 sin 2πft, usually abbreviated to A1 sin ωt.
But what about phase? Right up till now I have
been rather loosely talking about “sine waves”,
without regard to phase, so cosine waves (which are
just the same thing beginning quarter of a cycle ahead)
have equally been included. But now we must be
more strict and remember that a sine wave is one that
starts from zero as in Fig. 4(a), whereas a cosine wave
starts from maximum as at (b). But of course a wave
might start at any stage in its cycle; i.e., in any phase.
There are two ways of specifying the phase. One is
to work throughout in sines (or in cosines) and specify
the starting handicap or phase difference as an angle.
For example, a cosine wave ωt can be written as
sin (ωt + 90°), or more usually sin (ωt + π/2), π/2
being a right angle in radians, the mathematical units
of angle. The general expression, covering any phase
difference, φ, is sin (ωt + φ).

The other method is to analyse A sin (ωt + φ)
into, say, a sin ωt + b cos ωt. As we saw last month,
adding together any two waves of sine shape but
different phase gives a wave of sine shape and (in
general) a phase different from that of either of the
component parts. We can, in fact, by mixing sine and
cos waves in the right proportions, get a wave of any
desired phase and amplitude. It is pretty obvious,
for example, that if the sine and cos have equal ampli-
itudes (a = b) the result has its peak half-way between
those in Fig. 4; namely, 45° from the start. And in
case it looks as if this method only avails for angles
from 0° to 90°, let us remember that either a or b or
both can be negative, so all four quadrants are covered.
The full expression for the fundamental term now
appears as either A1 sin (ωt + φ) or as a1 sin ωt + b1
cos ωt. The frequency of the next, the second har-
monic, we know to be exactly twice as great, so we
can write its specification as A2 sin (2ωt + φ) or
as a2 sin 2ωt + b2 cos 2ωt. And so on. After the third,
the scheme of symbols is clear enough for anyone to
grasp, so it is sufficient to indicate the whole series as
a1 sin ωt + b1 cos ωt + a2 sin 2ωt + b2 cos 2ωt +
a3 sin 3ωt + b3 cos 3ωt + . . . or of course the alter-
native in (ωt + φ) style.

Obviously the phases of all the component harmonics
will depend on where the whole waveform is reckoned
to start. Usually we are free to start anywhere we
like, and those who know the ropes take care to fix
the start where it will ease the subsequent calculations
—preferably where it will make either the sin or the
cos lot drop out completely, all the a’s (or all the b’s)
being zero. This is not always possible, but those for

which it is include most of the important "ideal" waveforms.

Anybody who already knows all about Fourier and is reading this merely to see what kind of a mess I'll make of it will no doubt be aching to point out that I've omitted something. There should really be a zero-frequency term, \( a_0 \). I have been assuming that what we are to analyse is a purely "a.c." waveform; but to cover all contingencies we had better include the \( a_0 \) (which, because it doesn't alternate, requires no sin to be attached).

Wave Multiplication

So far, the only thing we have done on our particular waveform to be analysed—as distinct from finding suitable expression for the general Fourier series, which covers every possible waveform—is to find its frequency, which is dead easy once we know how long each cycle takes to occur. Before we can progress with the more difficult job of finding the values of \( a_1, a_2, a_3, \ldots \), and of the \( b_1, b_2, b_3, \ldots \), we must get hold of the idea of multiplying one sine (or cosine) by another. (To keep our feet on the ground, we should remember that this is what is actually done in a hexode or other "multiplicative" frequency changer; the output is proportional to the signal input voltage multiplied by the mutual conductance \( g_{m1} \); and since the oscillator, which generates a sine wave, varies \( g_{m3} \), the valve in effect multiplies one sine wave by another.)

If we multiply \( \sin \theta \) by \( \sin \theta \), to give what is written as \( \sin^2 \theta \), we find it comes entirely on the positive side of the line. At the positive peak, \( 1 \times 1 = 1 \). At the negative peak \( -1 \times -1 = 1 \). Plotting the whole curve, as in Fig 5 (where the dotted line is the original sine wave), we see that it is like a half-size sine wave stood up on the base line. Its average value over a whole cycle, as can easily be proved if the graph doesn't show it clearly enough, is \( \frac{1}{2} \). The same applies to \( \cos \theta \). If now we try multiplying a sin or cos by a sin or cos of a different frequency, we find that the average over a complete cycle of both always comes to nought. By "a complete cycle of both," I mean the interval between two successive occasions when they have the same phase relationship. For instance, if one of them has one third the frequency of the other, Fig. 6 shows one complete cycle. The important thing to notice is that the second half, from \( b \) to \( c \), is exactly the same as the first half, \( a \) to \( b \), except that it is upside down. So even if the average from \( a \) to \( b \) comes to something, it will be exactly cancelled out by the average from \( b \) to \( c \). And obviously what holds for one complete cycle holds for a continuous train of complete cycles.

Whatever the ratio of one frequency to the other, there is always some kind of symmetry with respect to the base line, causing the average to be zero. The only exception is, as we have seen, the ratio \( 1:1 \). And even then an average value only exists when sin is multiplied by sin or cos by cos, but not when sin is multiplied by cos. In Fig. 7, where a single cycle of each is plotted, the half from \( b \) to \( c \) is an inversion of a mirror image of \( a \) to \( b \), so again the product cancels out.

The significance of all this may begin to appear if we consider what happens when we multiply the whole general Fourier series by the sine of any of the frequencies involved, and average the result over one cycle of the fundamental frequency. The average for all the cos terms is zero, for a start. So is the average for all the sin terms except the one having the same frequency as the multiplier. Suppose, for instance, we had multiplied by \( \sin \omega t \). Then the only Fourier term that would give any average would be \( a_1 \sin \omega t \), and since the average of \( \sin^2 \omega t \) over a cycle is \( \frac{1}{2} \), the average of \( \sin^2 \omega t \) would be \( \frac{1}{2} \).

The procedure, then, for analysing a waveform is first to express it as a mathematical formula. Fourier tells us that this formula is equal to his general series, so what we have to do is find the values of \( a_1, b_1, \ldots \), etc., in the series. First multiply the formula by \( \sin \omega t \), where \( \omega = 2\pi \) times the fundamental frequency of the waveform, and take the average over one fundamental cycle. This average being \( a_1/2 \), \( a_1 \) must be double the average. Then repeat the process for \( \cos \omega t \) by multiplying the formula by \( \cos 2\omega t \); and so on. Having finished all the sin terms one does the cos terms. The result is the particular Fourier series equal to the particular waveform analysed.

An Example

People who are new to this will no doubt be seeing some difficulties. How does one express a waveform as a mathematical formula? And how does one calculate the average? The short answer, of course, is learn the appropriate mathematics.

But rather than dismiss the class in such an unsatisfied state, I will finish with an example. None other than the good old square wave, Fig. 8(a). How does one express it mathematically? The first half-cycle is easy; it is \( v \) (the instantaneous value) = \( V \) (the peak value). But we have to average over a whole cycle, and the second half-cycle follows a different formula, \( v = -V \).

![Fig. 5. The full line is a sine-squared curve, resulting from multiplying the values represented by the dotted sine wave by the same.](image1)

![Fig. 6. One complete cycle of a combination consisting of two waves, one of them three times the frequency of the other. The average value of the two multiplied together is nil.](image2)

![Fig. 7. The average value of \( \sin \times \cos \) is also nil. as can be seen by comparing the two halves of the cycle, \( a-b \) and \( b-c \).](image3)
There are various ways of getting over this. An ingenious one is to tackle a saw-tooth, Fig. 9(a), in which v falls at a steady rate of \( V \theta / \pi \) throughout the cycle, and then add it to the result obtained for a different saw-tooth (b), which when added to the first makes up the required square wave. Perhaps you would like to have a go at this afterwards; and in case the second saw-tooth seems to offer the same difficulty as the square wave I would point out that the averaging should be done over the whole cycle from \(-\pi\) to \(+\pi\).

Another and simpler method is to average over the two half-cycles of Fig. 8(a) separately and add them together. First of all we note that the combined average of the wave as it stands, which is the "d.c." term, \( A_0 \), is nil, since it has equal positive and negative halves. Next, to get the value of \( a_1 \), in the fundamental sine term \( a_1 \sin \omega t \), we multiply the waveform by \( \sin \omega t \), or \( \sin \theta \) as it appears on the graph. The result is shown, against a dotted framework of the original square wave, in Fig. 8(b). In the second half, the negative values of \( \sin \theta \) are multiplied by \( V \), so are positive, exactly as in the first. The effect of multiplying the sine wave by the square wave is, as it were, to rectify it. Now we know (or jolly well ought to) that the average value of a rectified sine wave of peak value \( V \) is \( 2V/\pi \), or 0.637V. The value of \( a_1 \) is, as we saw, twice the average, so in this case is \( 4V/\pi \).

To get \( a_2 \), we must multiply the square wave by \( \sin 2 \omega t \) or \( \sin 2\theta \). The result is shown at (c). Obviously the positive and negative half-cycles cancel out and the average is nil, so \( a_2 = 0 \). The same goes for all the even terms, so we can concentrate on the odd ones. In (d), out of the six half-cycles, four cancel one another out; the remaining two make up an average which is one third what it was in (b), and consequently \( a_3 = 4V/3\pi \). Continuing on the same principle shows \( a_4 = 4V/5\pi \), \( a_5 = 4V/7\pi \), and so on.

### The Full Recipe

Lastly we come to the cos terms. They can quickly be disposed of, for (e) shows that the average of the fundamental is nil; and one can easily see that the same applies to all the harmonics. So only the sin terms survive, and their values are \( 4V/\pi \) times the amplitude of the square wave, divided by the number of the harmonic. The Fourier recipe for a square wave having amplitude \( V \) is therefore

\[
\frac{4V}{\pi} \left( \sin \omega t + \frac{\sin 3 \omega t}{3} + \frac{\sin 5 \omega t}{5} + \frac{\sin 7 \omega t}{7} + \ldots \right)
\]

The process of multiplying a sine wave by a square wave and taking the average is just what is done physically in the wave analyser described by M. G. Scroggie in the August issue; even when the beat oscillator gives a sine wave it has nearly the same effect on the rectifiers in the modulator as a square wave, and this is why that type of analyser responds not only to the fundamental frequency of the beat oscillator, but also (to one-third the extent) to three times that frequency, and so on. This Fourier business is a fascinating and useful pursuit, and one I can recommend for further attention.

I'm not going to spin out the space with recipes for all the other stock wave shapes, because they are given in many reference books, including Radio Designer's Handbook (4th edition), Chapter 6, Sec-
tion 8. But to anticipate indignant shouts to the effect that in choosing the square wave I was cheating, because I was able to use a well-known result in evaluating the average, whereas the average of a sine wave multiplied by (for example) a truncated pyramid wave is emphatically not something one is expected to be able to pull out of the mental store on demand, I must point out that the well-known result, and the less well known, and the totally unknown, are all obtained by means of the integral calculus. As I said before, the short—and in fact only complete—answer is to learn the appropriate mathematics.

Books on Servicing

HAVING dealt with the time-bases and their associated circuits in the first volume of "Television Receiver Servicing," in his second volume E. A. W. Spreadbury covers the remaining sections of a receiver—video stage, tuning circuits, power supplies and aerials. In writing the volumes the author, who is technical editor of Wireless and Electrical Trader and an examiner for the practical tests for the R.T.E.B. Television Servicing Certificate, had in mind the sections, power supplies and the remaining principles used.

This 308-page volume, with 176 diagrams and illustrations, is published by the Trader Publishing Company, Dorset House, Stamford Street, London, S.E.1, price 21s (postage 8d).

The latest in the series of booklets published by the Central Youth Employment Executive on the choice of careers covers radio and television servicing.* Within its 36 pages are briefly outlined the training required by and the opportunities open to those who take up servicing as a career. It covers not only the type of servicing undertaken in retail shops but also the opportunities for service technicians in industry.

To whet the appetite of the keen youngster a typical circuit diagram of a superhet is given with a key to the components used. It is a pity however, that some of the symbols in the key are so archaic and bear little likeness to the modern, W.W.-style symbols used in the circuit.

* "Radio and Television Servicing" H.M.S.O. Is. 6d.

Education and Training

WITH the opening of the scholastic year, we have been notified of a large number of colleges at which courses in radio and allied subjects are being provided. A bulletin of part-time courses in higher technology being held in London and the Home Counties is obtainable from the Regional Advisory Council for Higher Technological Education, Tavistock Square, London, W.C.1, price Is 6d. Among the subjects covered are colour television, f.m., digital computers, microwave theory, pulse techniques, semi-conductors and servo-mechanisms.

New full-time servicing courses are being provided by the Northern Polytechnic, Holloway, London, N.7, where in addition to the standard courses in telecommunications there are also evening classes in v.h.f. sound and vision techniques and electronic computers. The prospectuses from the South-East London Technical College, Lewisham Way, S.E.4, and the Norwood Technical College, London, S.E.27, also include special lectures in addition to established courses. At the South-East London T.C. a course of five lectures on the principles and practice of frequency modulation is to be given on Tuesday evenings from November 22nd.

A one-year evening course on linear servo-mechanisms is among a number of specialized courses available at the Battersea Polytechnic, London, S.W.11. It will be held on Monday evenings from October 3rd (fee £2).

Thirty lectures on the theory of microwave circuits (suitable for graduates in physics, mathematics or electrical engineering) will be given on Wednesday evenings at the Battersea Polytechnic, commencing on October 12th (fee 4 gns).

A series of 22 lectures (fee £2 10s.) on the fundamental principles of pulse techniques will again be given at the Borough Polytechnic, London, S.E.1, on Monday evenings from October 3rd. The Borough's evening course on transistors is this year being divided into two—basic principles (8 lectures) and special applications (10 lectures). The first course starts on October 18th and the second on January 12th. The fee for each is 25s.

A course of six lectures in linear network synthesis will be given at the College of Technology, Manchester, on Tuesday and Wednesday evenings, beginning November 1st (fee 25s).

SHORT-WAVE CONDITIONS Predictions for October

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 October.

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

The Problem of Channel Allocation

FROM A CORRESPONDENT

It seems to be common ground that all broadcasting authorities favour colour television systems which, like the American N.T.S.C. system, provide for the transmission of the colour information by means of sub-carriers. These sub-carriers may be one or two in number and may be modulated in various manners, either by the primary colour signals themselves or by various derived signals. In some systems they are situated within the vision-carrier band used by the corresponding monochrome system, whereas in other systems they are outside these bands. However, they all have in common the feature of giving rise to additional r.f. signals which are a priori capable of causing interference to other stations, whether monochrome or, in the same or adjacent channels, or of being interfered with by these stations.

This is a particularly significant consideration and it is one which may indeed preclude the broadcasting of colour television in Bands I and III within the framework of the Stockholm Plans. In other words, if the stations provided for at Stockholm in 1952 should simply begin to radiate programmes in colour it is probable that the interference protection afforded by the Plans will not be maintained and they will no longer be respected. The matter was raised recently at a study group meeting of the International Radio Consultative Committee at Brussels and was the subject of much discussion by the delegates. It became evident, however, that a decision would have to await the results of practical experiments.

Protection Between Stations

In considering the Stockholm Plans for Bands I and III one sees that they do not consist of a regular pattern of evenly-spaced channels of equal width. Because the Plans have to accommodate stations using no fewer than six different transmission standards it was a priori impossible to arrange their sound and vision carrier frequencies in any way which would ensure that there were standard frequency differences between the carriers of stations sharing a channel or between those of stations in adjacent channels. Consequently, the frequency differences between, for instance, a particular vision carrier and a carrier of another station may have almost any random value. The protection considered necessary, and this is of course one of the fundamentals of the Plans, had therefore to be verified for every pair of stations individually. By protection is meant in this context the ratio of the field-strength of the carrier of the station being considered to that of an unwanted carrier, measured at the least favourable point on the contour of the "field-strength to be protected" of the station being considered. The numerical values of the "protection ratio" and the "field-strength to be protected" are basic characteristics of the Plans.

In view of the difficulty, then, which was experienced at Stockholm in working out the Plans for the relatively less complex case of monochrome stations, it seems extremely improbable, in the light of the data at present available, that the Plans for Bands I and III can remain workable for colour television.

There seem to be two alternatives facing the authorities. The first is to convene in the fairly near future another conference with the task of working out a new series of plans which would supersede the Stockholm Plans and might cover also Bands IV and V (to which the Stockholm Plans do not refer at all). The second is to retain and put into effect the Stockholm Plans as they stand for monochrome television, and to convene, when the necessary technical data has been accumulated, an international conference to assign channels in Bands IV and V for colour-television stations. The second solution has many supporters because, in the European context, it could virtually dispose of the compatibility problem. The basis of that problem is the reluctance to render obsolete the receivers already in the hands of the public. It would seem to be practicable, when colour transmissions begin in Bands IV and V, for the luminance signal only to be radiated by the corresponding Band-I and Band-III stations.

Need for a Common Standard

One of the major difficulties encountered in working out the Stockholm Plans was, as already mentioned, that arising from the adoption of different transmission standards by the various countries. It is rather doubtful whether European plans for Bands IV and V for colour television could gain international agreement as long as the differences persist. The rational solution therefore appears to consist in securing, first of all, agreement on common transmission standards for colour television in the European area. This possibility was often postulated at the Brussels meeting, mainly as being necessary to permit the effective relaying of colour programmes from country to country. It is generally recognised that the higher production costs of colour television will make the "Eurovision" idea even more necessary than it is at present for monochrome television, and it is doubtful whether it would be possible to "convert" colour transmissions from one standard to another by any system analogous to that used at present for monochrome. It would seem, however, that quite apart from this programme-exchange consideration, the adoption of a common standard, at any rate for certain parameters, is necessary before the channel-allocation plans can be established.

Suppose, then, that a single system for colour television has been adopted by the European countries and that it has been decided to plan for colour transmission in Bands IV and V—how is the compatibility question affected? The point is that as there is at present no regular programme transmission in Bands IV and V in Europe (with the exception of one low-power experimental station in the German Federal Republic) there are no receivers in the hands of the public. Transmissions in these bands can therefore be of programmes different from those being radiated in Bands I and III, or the same, whichever best suits the situation in the individual countries. There is, of
course, no reason why the programmes should be in colour, at any rate at the start, provided that they conform with the colour standards. Where the same programme is radiated by the Band I and Band-III stations, however, it would be necessary to convert the luminance signal to the appropriate standard, as the "European" colour standard would probably not be compatible with any of the existing standards. Thus conversion process, however, should be possible by the system used at present.

Now the Brussels study group meeting did not come to any decision on these points; indeed, it stated that no decision could be taken until more information had been collected; but it did do two things which should make the decisions easier and surer in due course. One was to write to all the governments concerned, asking them to consider the matter very carefully and very urgently, and above all not to make any decision on the national scale which would preclude the future establishment of a common European standard for colour television. The other was to set up a committee of experts with the task of reporting on the different systems and standards of colour television that are in existence and under consideration. The intention is that a complete study of the problem shall have been made in time to submit fully documented proposals to the next plenary meeting of the C.C.I.R., which is planned to be held in Warsaw next summer.

At the same time, the European Broadcasting Union, of which all the television services at present forming the European network (or expected to join it in the near future) are members, has appointed a small working party to report upon the situation at its next General Assembly (which will take place in Rome in October) so that the necessary action may be taken to find a solution acceptable to the members as an entity. Perhaps these broadcasting authorities are more interested in the attainment of a unique standard for European colour television for its programme-exchange implications than its influence upon the possibility of establishing a channel-allocation plan. But although the causes may differ the desired objective is the same, and the E.B.U. undoubtedly intends to bring the common viewpoint of the Mullard $5$-valve, $0$-watt amplifier and two $48$, preamplifier designs to go with this amplifier. It is interesting to note, by the way, that the E.B.U. recognises the influence of the manufacturers in the establishment of national transmission standards and fears that, unless suitable action is taken on the international plane, each country will tend to adopt colour-television standards compatible with its existing monochrome system.

This, it contends, is neither necessary nor, in the wider view, desirable.

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**BOOKS RECEIVED**


An Automatic Counter for the Measurement of Impulsive Interference by J. Miedzincki, B.Sc. Details of a device for counting the number of switching operations in an electrical appliance and the number of occasions on which the radio interference exceeds a prescribed value. E.R.A. Technical Report M/T114. Pp. 24; Figs. 2. The Electrical Research and Development Association, Thornicroft Manor, Dorking Road, Leatherhead, Surrey.


High Quality Sound Reproduction. Booklet based on Wireless World articles describing a 20-watt power amplifier, a pre-amplifier and a v.h.f. tuning unit, with additional point-to-point wiring diagrams, dimensioned chassis drilling plans, etc. Includes further notes on the Mullard $5$-valve, $0$-watt amplifier and two pre-amplifier designs to go with this amplifier. Pp. 48, profusely illustrated. Price 3s. 6d. Mullard, Ltd., Century House, Shaftesbury Avenue, London, W.C.2.


Small Power Valves
Design of Electrode Systems for Particular Applications

By R. E. WYKE*

At one time a few basic pentodes or beam tetrodes were used as general-purpose power valves, but of recent years a number of different types have been designed and manufactured for such uses as scanning cathode-ray tubes, current and voltage stabilizing, pulse modulation and so on. At the same time considerable improvements have been made in the more conventional types of low frequency amplifier valves. These improvements have been, in general, a reflection of the reduction in size which has taken place in almost all valve designs during the past ten years and, so far as the larger types are concerned, the reduction in cathode heating power made possible by increased use of the oxide-coated cathode.

The size of the lower-powered valves has been reduced by the use of the familiar pressed-glass base technique, and in both these and in valves of larger powers the introduction of new electrode materials and processing methods has permitted an increase in electrode loading. For example, except in the case of series stabilizers, all power valves require for efficient operation that at some time during the duty cycle the anode current shall be almost or completely cut off by the application of a negative voltage to the control grid. Should this grid itself emit, electrons will reach the anode to form a part of the anode current, which will be practically independent of the grid voltage. This effect, known as grid emission, occurs whenever the grid itself becomes excessively hot. To prevent this, the grids of power valves are often cooled by the use of large cross-section supports and by welding radiating fins to the ends of these support wires. If, however, the electron work function of the grid material is increased, its maximum safe operating temperature can be raised and the grid itself reduced in size. One of the modern methods of doing this is by gold-plating the grid wires. Emitting material from the cathode, deposited during processing on to such a surface, has a high work function and in consequence the safe operating temperatures of the grid can be increased by as much as 50%.

Although at first sight the desired characteristics for all types of power valves of comparable wattage rating are similar, they do in fact differ considerably, so that, apart from the control-grid characteristic mentioned above and the need for a high anode loading, they have little in common. Fig. 1 and Table 1 show typical operating conditions for various types of power valves using a similar cathode.

Stabilizers.—There are two classes of valves here, one suitable for use as series stabilizers and the other for use as shunt stabilizers. The former are used in series with the load and must themselves absorb as little power as possible. They must be essentially low-impedance devices; and, for this reason, pentodes, either used as such or triode-connected, are frequently adopted. However, of recent years several low-impedance triodes specially designed for series stabilizer use have become available. The low-impedance requirement entails the use of close electrode spacing, and since a good grid control characteristic is of no great importance the grid wire spacing is made as wide as mechanical rigidity will allow, so that such valves have very low amplification factors, usually between 2 and 5.

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* M. O. Valve Company

![Fig. 1. Typical operating conditions of voltage (above) and current (below) for various types of power valves: (a) pulse modulator, (b) line output valve, and (c) class B amplifier. Volts and current are not to scale.](image-url)
d.c. conditions the anode current of the series stabilizer is almost constant throughout operation. It is therefore unique among power valves in that its cathode need not supply a peak current greatly in excess of the mean current, and the cathode temperature of this class is often lower than that of other valves of a similar size and mean cathode current rating. In fact, the efficiency of the modern coated cathode is such that the ultimate loading of the series stabilizer is usually determined by the temperature of the anode or valve envelope rather than by the available emission.

Since ease of valve production is largely set by the mechanical strength of the electrode structure, there is a lower limit of anode impedance below which it is hardly economic to go, and the valve designer has to accept the limitations imposed by small-clearance electrodes. This has led to the efficient series stabilizer usually having a cathode current rating of about 150mA, and although valves are made to handle much larger currents they usually consist of a multiplicity of these small units arranged in parallel within a common envelope. It is unlikely that a valve capable of handling high currents with a single electrode system will become available for some time to come, and it is probable that the most efficient and economic way of stabilizing such currents will be by the use of a number of small mass-produced valves in parallel. A basic circuit of a typical series stabilizer unit is shown in Fig. 2.

Up to now shunt stabilizers have not been widely used in this country, but the increasingly high voltages needed for television and equipment such as radiation monitors will lead to their greater application in the future. The shunt stabilizer is essentially a high-impedance device, usually operating at a high anode voltage. Triodes are generally used and valves specially designed for this purpose often have cathode and grid structures similar to those in cathode-ray tubes. Single valves are invariably used.

Pulse Modulators.—A pulse modulator is required to amplify voltage pulses from an earlier stage and to feed them into the drive circuit of a larger output valve. The load will be a coupling transformer and will be highly inductive. The operating voltage of the output valve may be quite high, often some thousands of volts, and this high d.c. voltage will have to be held off by the modulator during the quiescent part of the duty cycle. When the drive is applied the grid of the modulator is taken up to a high positive value and the peak anode current is very large. At the same time the voltage dropped across the load causes the anode voltage to fall to quite a low value. As soon as the drive is removed the anode current and voltage return to their original value, the inductive load often causing the voltage to "overshoot" by a large amount unless an inverse diode is fitted. The electrical requirements of a pulse modulator are, then, that it shall operate at a high anode voltage, have a low impedance (otherwise the power loss when driven would be excessive), and be capable of a high cathode emission. Since the anode current must be zero during the quiescent period (when the anode voltage is very high), the valve must have a good grid control.

Obviously these conditions can only be met by the use of a tetrode or pentode. The cathode current density during operation is high, so that suppression of secondary electrons from the anode readily occurs and conventional forms of suppression by a third grid or beam plates are often unnecessary. The high cathode emission required is usually obtained by operating the cathode at an increased temperature. This, coupled with the fact that during the bulk of its duty cycle the pulse modulator is non-conducting, causes a fairly rapid increase in cathode interface resistance, so that the life of such valves is usually appreciably shorter than that of other valve types of a comparable mean power rating.

When the length of pulse handled is extremely short, less than a microsecond, the rate of rise and fall of anode current is so high that the valve is effectively handling a high frequency signal. Under these circumstances the valve inter-electrode capacitances must be kept low if distortions of pulse shape during amplification are to be avoided.

Line Output Valves.—To a very limited extent the characteristic requirements of the line output valve are
similar to those of the pulse modulator. Both valves require a low impedance while passing current and a very high impedance during the non-conducting portion of the duty cycle. Here the similarity ends. The line output valve works at a fairly high mean anode current with a peak/mean current ratio of about 3:1 only; the anode voltage rises to a high value for only an extremely short time during each cycle of operation and may then overshoot negative with respect to the cathode. The drive is such that the grid voltage does not reach a high positive value with respect to the cathode, so that the suppression of grid emission does not present too difficult a problem as the grid dissipation is small. On the other hand, the screen dissipation tends to be quite high, often approaching that of the anode itself, and careful attention has to be given to the prevention of screen emission. As in any output valve, currents to the anode which are not modulated by the control grid will cause loss of output. In the case of the line output valve, emission from either control or screen grid, being thermal in character, will cause a gradual loss of scanning width as the valve warms up.

The fact that variations in output are being constantly monitored visually by the user make it advisable for line output valves to be rated far more conservatively than, say, audio output valves, where output is usually readily adjusted by means of a volume control and has the added grace that the ear is far more tolerant of distortion than is the eye.

Low Frequency Amplifier Valves.—These form the largest class of small power valves. They are used for the output stages of domestic receivers, public-address and high-quality sound reproduction equipment, speech reinforcement systems, servo motor control systems and countless other applications. Valves used in domestic radio sets invariably follow the fashionable design pattern of the day so as to suit mass-production requirements in both the valve and the receiver factories. For example, if a new base or bulb shape is introduced, within a very short time a complete new range of valves, often having a similar performance to previous ranges, will become available in the “new look.” This means that many valves are used in equipment before they have had time to establish themselves as sound commercial products and before their users have had time to understand their particular peculiarities. The resulting unreliability, which is by no means peculiar to radio valves, is all too familiar to both radio dealers and the general public alike.

When the equipment has to give a public service, as with public-address or radio relay systems, reliability of operation is of extreme importance. The service must not have repeated breakdowns or its popularity will suffer. A valve type which has a consistently good life will give a service in which replacements can be made on a routine basis and not as a result of failure during operation. Economy is of importance, but more in consideration of replacement and servicing costs than in initial outlay. Consequently makers of such equipment have used known and trusted valve types of proved reliability for years on end and have been understandingly reluctant to risk their reputations by introducing valves of a more modern design. The designs of many of the valves used in public-address equipment to-day are approaching twenty years old; a long time indeed in the electronics industry!

Recent Trends.—During the post-war years valve manufacturers have been cautiously trying to improve established types and incorporating improvements only after very extensive life testing covering many thousands of hours under operating conditions. These improvements have taken two main forms.

In the first case valves have been wholly or partially redesigned to make them easier to produce or to avoid the continued use of obsolete components which may, during the course of several years, have become peculiar to one particular valve type. An example of such redesigning is shown in Fig. 3. In this case a well-known valve, first made some twenty years ago, has been completely redesigned. A more robust filament system, having fewer loops of heavier material, is used. New grid-treatment processes allow the grid to operate safely at a higher temperature than hitherto so that its size can be decreased and the anode loading, which greatly influences grid temperature, can be increased. The consequent use of a lighter anode structure has allowed the designer to dispense with the rather clumsy system of anode supports previously used, and the whole valve is more suitable for modern manufacturing technique with its emphasis on economy in the use of materials and man power. A slight reduction in overall size has followed, but this was not a prime intention in the redesign.

In this case the new valve is a direct replacement for the old and retains the same type number. In the second case an entirely new valve may be introduced which is not essentially a plug-in replacement for the original type but which will, it is hoped, be used when new equipment is designed; or with minor circuit modifications will replace it in existing equipment. This has been done when the existing valve has features which make it unsuitable for modern usage. For example, a certain small class-B output triode has a thoriated tungsten filament. The inherent fragility of this type of filament and its extreme sensitivity to operating voltage make it unsuitable for use in mobile equipments or industrial applications where there may be some vibration present or where the mains voltage may fluctuate wildly. Consequently, a new valve has been developed which, while having the same operating characteristics as the original, is more suitable for

Fig. 4. Radiograph of two triodes having anode dissipations of 2-40 watts. The valve on the right (DA 41) is the older filament type while the one on the left (DA 42) has an oxide-coated cathode and is suitable for mass production.

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modern requirements. The thoriated tungsten filament system has been replaced by an indirectly heated oxide-coated cathode, with consequent saving in cathode heating power. Since the grid of a valve having such a cathode has to work at a lower temperature than that of one having a thoriated tungsten filament, the grid of the new valve has larger diameter support wires, welded-on radiators, and is specially processed to avoid grid emission. The original anode, which was machined out of solid carbon, has been replaced by a fabricated metal structure and mica insulators are used instead of the ceramic ones. The temperature of the glass foot tube has been reduced by fitting a polished metal reflector between it and the electrode system. Fig. 4 is a radiograph showing the essential constructional differences of the two valves, while Table 2 gives a list of the materials used for their electrodes.

Economy in operation is influencing valve design to an increasing degree. The use of high-impedance valves in push-pull class-B operation is becoming more popular when power outputs of 30 watts or over are required. Such valves operate when quiescent at zero grid voltage and require no bias supplies, although, of course, a low-impedance driving stage is needed. High peak anode currents are obtained by driving the grid well positive with respect to the cathode so that a high power output can be achieved without the use of excessively high anode voltage. The efficiency of circuit arrangements of this type can be as high as 66%.

TABLE 2

<table>
<thead>
<tr>
<th></th>
<th>DA41</th>
<th>DA42</th>
</tr>
</thead>
<tbody>
<tr>
<td>anode</td>
<td>carbon</td>
<td>carbon-coated tungsten mica</td>
</tr>
<tr>
<td>grid winding wire</td>
<td>molybdenum</td>
<td>nickel</td>
</tr>
<tr>
<td>grid support rods</td>
<td>molybdenum</td>
<td>gold-plated molybdenum copper</td>
</tr>
<tr>
<td>cathode</td>
<td>thoriated tung. wire</td>
<td>oxide-coated tungsten mica</td>
</tr>
<tr>
<td>heater</td>
<td>--</td>
<td>alumina-coated tungsten mica</td>
</tr>
<tr>
<td>insulators</td>
<td>ceramic</td>
<td></td>
</tr>
</tbody>
</table>

and a pair of valves of the type shown in Fig. 4 can give an output of 175 watts at about 5% distortion for a total input of 275 watts. Since this type of circuit calls essentially for high-impedance valves, triodes are usually used and their relatively large electrode spacing and close pitched grids ensure very little characteristic variation from valve to valve.

For low power needs—high-quality audio amplifiers for example—a reduction in equipment costs may be realized by the use of the specially low impedance pentodes and beam tetrodes which are now available. The characteristics of a typical valve of this type are shown in Fig. 5. It will operate directly from the mains via a metal or valve rectifier to give an output of 25 watts from a pair of valves operating in push-pull, with a line voltage of 220 volts. The heaters are connected for series operation. It can also be used as an inverter to provide a source of a.c. to operate, for example, gramophone motors from d.c. mains, and is quite a useful series stabilizer. Constructionally it consists of two separate cathode, control-grid and screen-grid systems mounted inside a common suppressor and anode system. Separate electrode systems are used to avoid the loss in mechanical strength and lack of characteristic uniformity which usually occurs with close electrode spacings in a large valve.

Trends of this sort must continue, and there will undoubtedly be a more extensive use of the pressglass base, which, since it is farther away from the electrode system, runs cooler and is less liable to failure than is the older glass-pinched type of foot tube.

**Commercial Literature**

Dual-channel Oscilloscopes; three models covering respectively d.c. to 10 Mc/s (with 6-in tube having separate gun systems), d.c. to 100 kc/s, and d.c. to 250 kc/s. Time bases are calibrated for time measurement. Specifications on leaflets from Nagard, 18, Avenue Road, Belmont, Surrey.

Hearing Aids using glass-sealed transistors and powered by single "Penlight" battery giving approx. 150 hours' service. Dimensions are 2\(\text{in}\times 2\(\text{in}\times 1\(\text{in}\) and weight is 2\(\text{oz}\). One type has volume control and top-cut switch, and another the addition of optional automatic volume compression. A choice of three frequency responses is offered. Leaflet from Amplivox, 2, Bentinck Street, London, W.1.

Wire-twisting Tool, in the form of pliers with a simple spinning mechanism, for joining pairs of wires. Any length can be twisted in two or three seconds and the ends cut off by the side-cutters incorporated. Descriptive leaflet from Douglas Kane Associates, 55, Pall Mall, London, S.W.1.

Q Meter for measuring circuit magnification, inductance, capacitance and power factor over the frequency range 100 kc/s-100 Mc/s. Q values from 10 to 400 can be handled. Specification and description from Advance Components, Marlowe Road, Walthamstow, London, E.17.

Measuring Instruments and accessories for r.f. and s.f. by Rohde and Schwarz of Munich. A comprehensive catalogue in English from the agents, Aveley Electric, Ayron Road, Aveley Industrial Estate, South Ockendon, Essex.

**Wireless World, October 1955**
Instrument Kits
A Critical Assessment of Test Gear for Home Assembly

By CHARLES B. BOVILL,
A.M.I.E.E., M.Brit.I.R.E.

**THE rapid development of radio techniques during the past few years has made it almost impossible for the amateur to carry out any experimental or constructional work without a certain amount of measuring equipment. Recognizing this, the American Heath Company has introduced a range of some forty different kits of parts from which test gear can be constructed.* These include complete sets of components for signal generators, impedance bridges, valve voltmeters, Q meters, and so on, together with the appropriate instruction booklets.**

Apart from the interest of the kits to amateur experimenters, they seem to fulfil a need that has long been felt in technical schools, where many instructors find themselves at a loss to impart the practical knowledge of layout of components to students. If one of these kits is made up by a class and the various components are examined, and if necessary criticized, and the reasons for details of layouts are discussed, the students can be given a valuable insight into the practical design of modern electronic apparatus.

In order to assess the value of these kits for instructional purposes, two were obtained and tested under the conditions which would be expected to be found in a normally equipped technical school. The ones selected were a signal generator (Type SG8) and a Q meter (Type QM1). It would appear after perusal of the instruction booklets that they are each intended for a different kind of constructor. The signal generator instructions are of the wire-by-wire type and enter into the greatest detail and evidently assume very little previous experience on the part of the constructor, whereas the instructions for building the Q meter are general, although they include comprehensive wiring diagrams, and it is supposed that the constructor of this equipment must have some previous technical knowledge.

In view of the different nature of the two kits, their construction was carried out in an appropriate manner in each case. The signal generator was made step-by-step, following the instruction booklet in the closest detail and without any reference to the theoretical circuit diagram. This enabled the instruction booklet and the general idea of the kits to be checked. In the case of the Q meter, the circuit diagram and the wiring diagrams were used in order to build up the three main units, but no rigid plan for their construction was followed.

Upon completion, each instrument worked at once when switched on and without any fault—evidence of the soundness of the design and of the efficacy of the instructional booklets.

The signal generator's mechanical design consists of an oscillator sub-chassis which is first assembled and wired as a complete unit. This is then fitted to the main chassis and connected to the modulator, power supply and to the various switches, output and input sockets, and so on. The final operations are attaching the panel knobs and making up the output lead.

The critical wiring, from the point of view of the r.f. circuits, is so arranged that the constructor is obliged to follow the instructions carefully, and in this way the manufacturer of the kit evidently sustains the claims for accurate calibration. All of the components are of good quality and the only criticisms which can be made are in connection with the knobs supplied and the cursor of the tuning capacitor. The knobs are supplied with tapped holes for the grub screws which hold them to the spindles, but the grub screws are a separate item. In practice it was found that the threaded holes were badly tapped and it was necessary to retap them before the grub screws could be fitted satisfactorily. The Perspex cursor was badly warped on delivery and when fitted to the capacitor drive spindle scraped the front panel until it was rewarped back to a position at right angles to the spindle.

Following the instruction booklet, the SG8 was completed in 5 hours 35 minutes, and it was estimated that a total of two hours was taken in checking the calibration.

The Q meter was found to be no more complicated than the signal generator to construct and took about

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the same time to complete. The instrument consists of three separate units, the main chassis and power supply, the oscillator generator unit and the valve voltmeter unit, with its associated calibrated variable capacitors. The units are assembled as complete equipments, then the oscillator and valve voltmeter chassis are attached to the main chassis and interconnected, after which the front panel is fixed to the main chassis. This attachment depeneds entirely upon the spindles of the various controls, and some care is needed in aligning the chassis and the front panel. In practice it appears to give adequate rigidity to the instrument.

Great care has been taken to ensure that the constructor makes up the instrument correctly; for example, a jig is supplied for the alignment of the four test terminals on the top of the case and a generous surplus of nuts, bolts, screws, washers and so on is included in the kit. Even the vernier capacitor string drive assembly is designed to be practically foolproof. The 50-microamp meter, which serves as the indicator of the instrument, is supplied very carefully packed and with a shorting wire across its terminals. The only faults noted with the QM1 equipment were the same as experienced with the SG8 and in the quality of the wire supplied with the kit, which was discarded in favour of plastic sleeved type.

The Signal Generator.—This is what would be considered in this country as a calibrated servicing oscillator. It is of good electrical and mechanical design and of attractive appearance, both internally and externally, when completed. The whole chassis is copper plated and the front panel is finished in a medium grey colour with calibrations, dial titles and so on in white. The characteristics of the instrument are as follows:

Frequency ranges:
- 160–500 kc/s
- 500–1,650 kc/s
- 1.65–6.5 Mc/s
- 6.5–25 Mc/s
- 25–110 Mc/s
- 110–220 Mc/s (harmonic range)

R.F. output: in excess of 100,000 microvolts
A.F. output: 2–3 volts
A.F. input: 5 volts across 1M Ω
Power supply: 110/125/210/240 volts a.c.
(export models)
Dimensions: 9 3/4in x 6 3/4in x 5in

The circuit comprises a Colpitts type oscillator, a cathode-follower output stage and a triode modulator. The power supply from the mains is through a transformer and the a.c. is converted to a 200-volt h.t. supply by a selenium rectifier.

The coupling between the oscillator and the output stage is by a small capacitor connected between the anode of the oscillator and the grid of the output valve. The modulation is applied to the grid of the output valve and is derived from an a.f. Colpitts oscillator working at about 400 c/s. The r.f. output is developed across a 2,000-Ω resistor in the cathode of one half of a 12AU7 double triode, the other half being used as the r.f. oscillator. A part of the cathode load consists of a potentiometer which feeds into a three-step attenuator and thence to the output socket. There is a d.c. connection between the cathode and the output socket, a point that is considered to be a weakness, and it would appear to have been better to have included a capacitive coupling between the attenuator and the output socket. The modulator stage can be modulated externally if necessary and switching is included to permit of the stage being used as a fixed-frequency a.f. source with a variable output if required. The variable a.f. control serves the dual purposes of an input control to the modulator and an output control when the valve is used as an a.f. source.

The modulation being applied to the output-valve grid has undoubted advantages and it was found that the modulation percentage varied very little over the whole frequency range of the instrument. The advantages of the output stage are apparent also when the attenuator controls are varied, it being found that their variation has very little effect on the oscillator frequency, even on the highest frequency range.

One of the weaknesses of oscillators of the servicing type lies in their rather large leakage of r.f., and a test was made with the SG8 to determine its performance in this respect. The test was made with a communications receiver having a sensitivity of better than 5 microvolts on all ranges which was connected to a vertical aerial 41/2 ft. high. The SG8 was used with its output lead disconnected and with the attenuator at maximum output. The following results were obtained:

Long waves, 300 kc/s: signals became undetectable at 3ft.
Medium waves, 1,000 kc/s: signals became undetectable at 5ft.
H.F., 10 Mc/s: signals became undetectable at 15ft.

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| Table 1 |
|-----------------|-----------------|----------------|
| Band A, long waves | 200 kc/s | 5 kc/s low | 2\% error |
|                  | 235 kc/s | 5 kc/s low | 2\% error |
| Band B, medium waves | 647 kc/s | no error | no error |
|                  | 908 kc/s | 8 kc/s low | 2\% error |
|                  | 1430 kc/s | 20 kc/s low | 1\% error |
| Band C, short waves | 3000 kc/s | 10 kc/s high | 0.3% error |
|                  | 4000 kc/s | 50 kc/s high | 1.25% error |
|                  | 6510 kc/s | 150 kc/s low | 2.3% error |
| Band D, short waves | 7100 kc/s | 150 kc/s low | 2% error |
|                  | 11910 kc/s | 410 kc/s low | 31% error |
|                  | 20000 kc/s | 500 kc/s low | 21% error |
| Band E v.h.f. | 4150 kc/s | 400 kc/s low | 1% error |
| Band F u.h.f. | 194 Mc/s | 8 Mc/s low | 4% error |
V.H.F., 41.5 Mc/s: signals became undetectable at 15ft.*
U.H.F., 190.0 Mc/s: signals became undetectable at 15ft.*

One of the claims made by the suppliers of the kit is that the adjustment of the coils in the factory before delivery makes it possible to expect the calibration of the finished article to fall within 2-3%. It is suggested in the instruction booklet that the U.S. Bureau of Standards station WWV should be used as a check (2.5-5.0-10.0 Mc/s) and that main broadcasting stations can also be used for this purpose. It must be understood, however, that there is no provision for individual adjustment of calibration on different ranges and that the only variable provided is the position of the cursor on the tuning capacitor spindle. It is recommended that this should be set initially to cover the whole tuning scale. This was carried out, with the results in Table I.

The stability of the oscillator was found to be good over a series of checks lasting 90 minutes each. These checks were made by heterodyning the SG8 against stable transmissions on m.f. and h.f. At 200 kc/s the drift was sufficiently small to be considered as being negligible and on 17,100 kc/s the maximum drift over the 90-minute period was less than 2 kc/s.

In view of the type of attenuator and the absence of an oscillator output indicator in the design of the instrument, the output of the generator varies with the frequency and with the setting of the tuning control on each range. No attempt was made, therefore, to measure the output of the SG8, beyond verifying that the claimed output of 100,000 millivolts was obtainable with the controls at maximum on each range.

The Q Meter—The principle of this type of instrument is doubtless well known to readers of Wireless World and the subject was very fully dealt with by "Cathode Ray" in the July 1949 issue. It should therefore suffice to recall that in the usual design of Q meter a small voltage $e$ is introduced in series with the coil under test and when this is tuned to resonance, a voltage $E$ appears across it, which is usually observed on a valve voltmeter. The $Q$ is then equal to $E/e$. If the inserted voltage $e$ is adjusted to a predetermined level, the valve voltmeter can be calibrated to read $Q$ directly. This is the method used in the Heath instrument.

The Q Meter when assembled and set up has the following characteristics:

- **Frequency range:** 150 kc/s to 18 Mc/s.
- **Inductance range:** measured at 250 kc/s, 790 kc/s, 2.5 Mc/s and 7.9 Mc/s: 1 microhenry to 10 millihenries.
- **Capacitance measurement range:** 40 pF to 400 pF
- **Vernier capacitance range:** 3 pF
- **Q measurement ranges:** 0-250 and 250-500
- **Power supplies:** 110-250 volts a.c. (export models).

In the circuit the r.f. generator is a cathode-coupled type, with four switched ranges. Its output is fed to the grid of a valve arranged as a cathode follower which serves to isolate the tuned circuits from the test circuit. The generator and output valves are the two halves of a twin triode, type 12AT7. A variable resistor in the anode circuit of the oscillator valve enables its output level to be adjusted. The voltage developed across the cathode of the isolator stage is fed through a small capacitor of preset type to the test-circuit insertion element. This is formed by a 5000-pF fixed capacitor of low loss and minimum inductance which is connected in series with the coil test terminals. These terminals and the insertion capacitor are shunted by a resonance capacitor of 450 pF which is, in turn, shunted by the valve voltmeter diode. A 3-0-3 pF capacitor is connected across the resonance capacitor to enable fine adjustments to be made. The valve voltmeter is of conventional type with its indicator between the cathodes of a twin triode valve. A second diode is placed across the grid circuit of one of the triode valves to neutralize variations in the standing output of the detector diode. Further to stabilize the diodes, they have their heaters slightly under run.

A 0-50 microammeter is used as an indicator both for direct Q measurement and for the setting up of the output level of the r.f. generator, these functions being selected by a switch. In the position for Q indication, the meter is connected between the cathodes of the triode valves, whilst in the other position the meter is connected to a germanium diode and thence to the output of the isolator stage. A variable resistor between the cathodes of the valve voltmeter triodes, with its moving arm connected to h.t. negative, balances the valves and sets the zero of the indicator for initial calibration. An OD3 valve stabilizes the h.t. supply to the generator and valve voltmeter stages.

*Tested with a television receiver connected to appropriate aerials.

Wireless World, October 1955
To set up the instrument, the r.f. generator frequency scale must be calibrated. This is an engraved scale and the correct procedure is to set the cursor to the position where the scale and capacitor minima coincide and then to set the capacitor to the calibration corresponding to some known and accurate frequency, such as a broadcasting station. A trimmer across the capacitor in the oscillator stage is then adjusted until the frequencies are identical, this usually being done by zero beating and with the aid of a receiver. This adjustment will determine the accuracy of the scale on all ranges as there is no individual trimming on each range.

As shown in Table 2, the results using this method are reasonably good, evidently due to careful trimming of the coils, and by the inclusion of a close-tolerance capacitor for tuning.

When the oscillator is calibrated, the resonance capacitor has to be set up. To facilitate this adjustment a standard coil is provided with the kit; in the one supplied the coil had an inductance of 250 μH and the required tuning capacitance marked upon it was 96 pF, at a frequency of 1 Mc/s. This capacitance is slightly less than the normal value required to tune a typical coil of this inductance to 1 Mc/s and the value is given so as to take into account the stray capacitance in the valve voltmeter and measuring stages, which is evidently about 10 pF.

The setting up of the resonance capacitor is purely a mechanical procedure. The capacitor is adjusted to tune the coil and the cursor is set to 96 pF.

### TABLE 2

<table>
<thead>
<tr>
<th>Range</th>
<th>Frequency (kc/s)</th>
<th>Kit reading (kc/s)</th>
<th>Error (kc/s)</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>164</td>
<td>164</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>A</td>
<td>190</td>
<td>-1</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>233</td>
<td>-1</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>692</td>
<td>+1</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>881</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>1403</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1448</td>
<td>+1</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>2500</td>
<td>0</td>
<td>0.04</td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>5000</td>
<td>+10</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>6025</td>
<td>-75</td>
<td>1.2</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>7105</td>
<td>-95</td>
<td>1.4</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>11730</td>
<td>30</td>
<td>0.2</td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>15120</td>
<td>-20</td>
<td>0.1</td>
<td></td>
</tr>
</tbody>
</table>

The scale associated with the resonance capacitor is also graduated in microhenries and millihenries for spot checking on frequencies of 250, 790, 2500 and 7900 kc/s, and its accuracy depends upon the setting up to exactly 96 pF at 1 Mc/s.

The final adjustment is for the Q meter proper. The inductance test terminals are short circuited and the valve voltmeter indicator is adjusted to zero with the balancing control. The generator level is then set to a mark on the microammeter, which for this test is switched to read the output from the isolator stage. Next, the standard coil is placed in the inductance test terminals and the microammeter is switched to read Q in the valve voltmeter circuit. The Q reading with the coil tuned to resonance is noted and, with the aid of the preset capacitor between the isolator cathode and the test circuit, it is adjusted so that the Q meter reads the figure indicated on the standard coil, which was, in the example tested, 110. This setting theoretically holds good over the whole range of the instrument.

The performance of the Q meter was measured against Marconi Instruments laboratory standards types TF329G and TF886A, and the results obtained are shown in Table 3. It will be noted from this table that errors are negligible up to a frequency of about 6 Mc/s, after which they become appreciable, evidently on account of the losses in the resonance capacitor, which is only of normal commercial quality, and because of losses in the valve voltmeter circuit.

In the view of the simplicity of the oscillator, its stability is reasonably good and after an initial warming-up period of 15 minutes it was run for one hour at 2.5 Mc/s, during which time its drift was less than 500 c/s. The harmonic output is low and has to be carefully searched for to be detected. The buffer cathode follower stage is effective and variation of the carrier level control even on 15 Mc/s does not perceptibly alter the carrier frequency.

### TABLE 3

<table>
<thead>
<tr>
<th>Kit</th>
<th>Laboratory Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency (kc/s)</td>
<td>Q reading</td>
</tr>
<tr>
<td>250</td>
<td>70</td>
</tr>
<tr>
<td>1000</td>
<td>110</td>
</tr>
<tr>
<td>2500</td>
<td>67</td>
</tr>
<tr>
<td>6700</td>
<td>133</td>
</tr>
<tr>
<td>7900</td>
<td>132</td>
</tr>
<tr>
<td>9000</td>
<td>46</td>
</tr>
<tr>
<td>10000</td>
<td>170</td>
</tr>
<tr>
<td>12000</td>
<td>114</td>
</tr>
<tr>
<td>15000</td>
<td>186</td>
</tr>
</tbody>
</table>

Transistor research work for British firms is being done in Switzerland by an independent non-profit-making organization, the Battelle Memorial Institute, which undertakes research contracts in a wide variety of scientific subjects. Founded by an American industrialist, it has its main laboratories at Columbus, Ohio, and European establishments at Frankfurt and Geneva. This picture shows work in progress in the well-equipped electronics laboratory at Geneva.

Wireless World, October 1955
OCTOBER

Institution of Electrical Engineers

Radio and Telecommunication Section.

October 19th. Address by H. Stanesby (chairman).

October 31st. "The technique of ionospheric investigation using ground back scatter" by E. D. R. Shearrman; and "A study of ionospheric propagation by means of ground back scatter" by E. D. R. Shearrman; and "An experimental test of reciprocal transmission over two long-distance high-frequency radio circuits" by F. J. M. Laver and H. Stanesby at 2.30; "V.H.F. propagation by ionospheric scattering and its application to long-distance communication" by W. J. Bray, Dr. A. Saxton, R. W. White and G. W. Luscombe at 5.30.

Both meetings will be held at Savoy Place, London, W.C.2.

Cambridge Radio Group.—October 11th. Address by Brig. E. J. H. Moppett (group chairman) at 6.0. at the Cambridge Technical College, Collier Road, Cambridge.

North-Eastern Radio and Measurements Group.—October 17th. Address by H. W. Lackey (group chairman) at 6.15 at King's College, Newcastle-upon-Tyne.

Physical Society

London.—October 18th. "Travelling wave tubes" by Dr. R. Kompfner at 5.0 in the Lecture Theatre, Science Museum, Exhibition Road, S.W.7.

British Sound Recording Association

London.—October 21st. "Audio amplifiers" by R. Chapman at 7.0 at Royal Society of Arts, John Adam Street, Adelphi, W.C.2.

Radar Association

London.—October 12th. "Deep sea diving by radar and underwater camera" by J. Gilbert at 7.30 in the Anatomy Theatre, University College, Gower Street, W.C.1.

Radio Society of Great Britain


CLUB NEWS

Cleckheaton.—The civil defence officer to the West Riding County Council will speak on emergency communications at the meeting of the Shipley Valley and District Radio and Television Society at 7.30 on October 5th at the Temperance Hall, Cleckheaton. Sec.: H. W. Whiteley (G3HDB), 24, Thornby Avenue, Kenilworth, Warwick.

Coventry.—At the meeting of the Coventry Amateur Radio Society on October 25th members will describe their stations. Meetings are held on alternate Mondays at 7.30 at 9, Queens Road, Coventry.

Edinburgh.—"The subject of the suppression of amateur transmitter interference with television will be discussed at the meeting on October 29th of the Lothians Radio Society. The club meets at 7.30 on alternate Thursdays at 25, Charlotte Square, Edinburgh, 2. Sec. J. H. Watt Memorial Institute, Great Charles Street, Birmingham.

Teesside Section.—October 11th. "The practical uses of electronics in industry" by K. A. Zandstra at 7.0 at the Technical College, Darlington.

Luton Section.—October 25th. "Principles of colour television" by P. F. Carnt at 7.30 at Skelto Ball Bearing Co., Ltd., Luton.

MEETINGS

British Institution of Radio Engineers

London Section.—October 26th. Annual meeting at 6.0 followed by "Recent advances in microwave tubes" by Dr. R. Kompfner at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1.

Merseyside Section.—October 5th. "Stereophonic sound" by R. A. Bull at 7.0 at the Chamber of Commerce, Old Hall Street, Liverpool, 3.

North-Western Section.—October 6th. "Colour television" by Dr. G. N. Patchett at 6.30 at the College of Technology, Sackville Street, Manchester. This will be followed by the annual general meeting.

West Midlands Section.—October 12th. "Frequency modulation broadcasting and reception" by H. E. Farrrow at 7.15 at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton.

Television Society

London.—October 7th. "Progress in American colour television" by D. C. Birkintash at 7.0 at the Cinematograph Exhibitors Association, 164, Shaftesbury Avenue, W.C.2.

October 27th. "V.H.F. aerial problems" by G. J. Lomer at 7.15 at 164, Shaftesbury Avenue, W.C.2.

British Kinematograph Society


Both meetings will be held at 7.15 at the Gaumont-British Theatre, Film House, Wardour Street, W.1.

Institution of Production Engineers

Midlands Section.—October 19th. "The application of electronics to industry" by J. B. C. Robinson at 7.0 at The James Watt Memorial Institute, Great Charles Street, Birmingham.

Tees-side Section.—October 11th. "The practical uses of electronics in industry" by K. A. Zandstra at 7.0 at the Technical College, Darlington.

Luton Section.—October 25th. "Principles of colour television" by P. F. Carnt at 7.30 at Skelto Ball Bearing Co., Ltd., Luton.

British Institution of Electrical Engineers

Radio and Telecommunication Section. October 19th. Address by H. Stanesby (chairman) at 6.30 at the Council at 6.30 at the Communications Council at 6.30 at the Royal Society Museum, Exhibition Road, London. -read the Anatomy Theatre, Science Museum, Exhibition Road, S.W.7. Leadership in telephone and telegraph transmission conditions over an ionospheric path of 740 km by R. W. Meadows; and an experimental test of reciprocal transmission over two long-distance high-frequency radio circuits by F. J. M. Laver and H. Stanesby at 2.30; "V.H.F. propagation by ionospheric scattering and its application to long-distance communication" by W. J. Bray, Dr. A. Saxton, R. W. White and G. W. Luscombe at 5.30.

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Radio Society of Great Britain


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RANDOM RADIATIONS

By “DIALLIST”

Yet Again!

THE poor old Radio Show! In three out of the last five years its fate has suddenly gone into the balance only a few days before the announced opening date. With the rights or wrongs of the matters in dispute I’m not concerned. What’s worrying me is that this almost annual uncertainty about the opening date (or, indeed, whether it would be open at all!) is doing no good to our internal and external trade in broadcast receivers and sound-recording gear. One of the most important days from the business point of view is the pre-view, for normally it is marked by the visits of buyers from abroad. As there’s then nothing like the crowd that comes on the other days, visitors to the pre-view have every chance of taking unreservedly to the representatives on the stands. Cancellation of the pre-view must be a big blow to the industry, for it’s their biggest and best shop-window display to those ready to place large orders.

Interval for Indignation

I write with some feeling. Though I’m not a buyer in the big business sense of the word, I’d been invited to the pre-view and had made my arrangements accordingly. I’m living at present too far from London to make it possible to get home the same day after a visit to the Show. It isn’t funny to have to cancel hotel accommodation when the opening is postponed and then to find that it isn’t to be had at a later date. It must have been still less funny for those coming from farther afield who had reserved seats or berths in trains, ships or planes. Our prestige is lowered by this sort of thing and we shall certainly have to do something about it. What we’re to do, I don’t know. But I’m not sure that it wouldn’t be better to have no Radio Show at all than one with an uncertain opening date and the possibility that it may never open at all.

“Hi-Fi”

ONE wonders how far the B.B.C. (or should it be the G.P.O.?) intends to go in giving us real “high fidelity” from the v.h.f. service. The bandwidth is, I believe, somewhat greater than that used in medium-wave and long-wave transmitting gear; but so far it’s a lot short of what one would have liked—and hopes eventually to have. It seems rather a missed opportunity. “Hi-Fi” is already having something like a boom among recording enthusiasts, who are not far to spend freely on first-rate equipment. Don’t you think that “high-fidelity” v.h.f. programmes would lead to similar enthusiasm among listeners. I’m quite sure that it would and that it would mean excellent business for both receiver and component manufacturers.

F.M. Only

As soon as the three programmes become available on v.h.f. in my locality I shall be looking for a new set. I shan’t want to make any further use of the medium-wave or the long-wave bands for broadcast reception, for nearly all the home and Continental stations are affected most of the time by interference of one sort or another. Therefore, I don’t want a medium-wave set. Still less do I want one with two or three short-wave bands as well, for I prefer to use a special short-wave receiver for the reception of distant stations. I’d like my money to go into really good v.h.f., if. and a.f. circuitry and components and not into a whole lot of things that I’d never use. I believe there is a future for Band II only receivers and I am glad to see that two or three manufacturers were featuring them at Earls Court.

In Western Germany

Writing of f.m. reminds me to thank a kind reader, who was recently serving in Western Germany with the R.A.F., for sending me a list of the Band II f.m. broadcasting stations operating in that country. It contains no fewer than 109; but as it is dated September, 1953, there are probably a tidy few more in action by now.* Of 40 channels between No. 2 (37.6 Mc/s) and No. 41 (99.3 Mc/s) 35 were then in use by West German stations. From the look of the map which accompanies the list I’d say that there must be few places in that country—except, possibly in the more mountainous districts—that aren’t within the service area of a v.h.f. station. What’s more, I’m told that the modulation bandwidth is 10-12 kc/s. The figure isn’t official.


- Ed.

“WIRELESS WORLD” PUBLICATIONS

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Wireless World, October 1955

www.americanradiohistory.com
but my correspondent says that the quality is so good that he can’t think that it’s any less than that.

When Pictures Won’t Stay Put

MOST of us with television receivers must have had bother at one time or another with the line-hold or the frame-hold of our television receivers. The component actually used for each of these controls in most, if not all, sets is a potentiometer, in series with which is one, or maybe two, fixed resistors. If the picture won’t stay put in one sense or the other, the oscillator concerned is clearly not being properly held by the sync. It’s not uncommon to find that just when you think you’re going to get the picture steady by turning the knob in one direction, you have come to the end of its travel and just can’t make the tiny further movement that seems to be needed. The very first thing to suspect in such cases is the resistor(s) in series with the pot, for it’s more than likely that one has gone high. If not, the valve is probably to blame. A very annoying form of slipping or rolling is that which develops when the set has been in use for a time, for you have to keep jumping up to try and steady things down by knob-tweiddling. If you have that experience it’s long odds on its being due to a resistor going high or the valves becoming defective as the set warms up.

LAB. LIFE

Holidays over!—A sad refrain!
The boys are back in the lab, again: Back to the grind, the snags, the moans— More horrible sounds come out of the ‘phones.
Noise and distortion, percentage mod.— Who designed this? The silly old Bod! Are you ambitious? A glutton for work? Study each evening and plough through the muck?
You’re climbing the ladder, press on non-stop.
Earn nearly as much as the Model Shop. How they all laughed when it went off BANG!
You’re holding the baby for somebody’s dang.
Let’s check all the drawings, they’re bound to be wrong, The draughtsman’s resigned, and you won’t be long.
During these days of trouble and strife Peculiar to laboratory life, There’s only one thing that’s worth a small fee, Somebody tell me how soon we’ll have tea.

E. E. Rowe.

Wireless World, October 1955
“Transistor TV”

THE architects of our post-war houses seem singularly lacking in imagination. I have yet to come across a new house equipped with a coaxial TV socket in each room on the ground floor so that the trolley-borne television receiver can be taken from room to room. Surely it is high time that architects and builders installed coaxial cables at the same time as ordinary electric wiring. The TV aerial mast, too, should be architect-designed as an integral part of the house.

Even this doesn’t really go far enough for the day is coming when each room will be fitted with a built-in TV screen fed from a master receiver in the roof. I am not forgetting the necessity of high voltage supply to each tube and other complications. There would, I admit, be very great complications and the ultimate solution to these will, I think, be the development of what I will call “transistor TV.”

To explain my meaning I would remind you that only yesteryear we appeared unable to get away from thermionic valve technique with its demand for lots of volts and amps. Almost overnight transistor technique has shown us the way out; in the same manner something will be developed which will relegate present-day television techniques to the Science Museum. The thermionic valve is on its way out and a decade hence the c.r. tube will be following it.

Radio Golf Balls

FROM an item of news in Tele-Tech (August 1955) I learn that the Great White Chief of a big American radio concern has had a radio transmitter built inside a plastic golf ball. I need hardly say that use of a transistor has made this possible. The main idea behind the construction of this radio golf ball is the boosting of transistor technique for not only does it show the compactness of transistors but also their ruggedness. Knocking the ball about does not put the transmitter out of action.

One useful feature is that the radiated signals are sufficiently strong to be picked up on a personal portable so that it is very easy to locate a lost ball by ordinary d.i. methods. If such unlossable golf balls could be produced cheaply they would find a ready market among Scotsmen.

The idea is not so simple as one I dealt with in these columns some years ago. I suggested that golf-ball manufacturers should incorporate a small piece of radio-active material in the core so that if a lost ball could easily be found by rooting around the long grass with a Geiger counter.

Transmondial Television

ONE idea which I have always wanted to see tried out is the interchange of television programmes between this country and the U.S.A. and now at last there seems to be nothing to hinder the installation of a link similar to that being set up between England and France.

As the result of the experience we have gained with the experimental European link I think we can dispense with any temporary American link and get to work immediately on a permanent one. The sea—three thousand miles of it—has always been the impassable barrier to the men of little imagination in the ranks of radio engineers. I asked one of these professional obstructionists why it was impossible to send TV signals to America across the shortest sea route.

As I expected, he fell into my trap and pointed out with a great wealth of sarcasm that the gap of 1,800 odd miles between Newfoundland and Ireland would prove a far more formidable task for television engineers than Brown and Alcock found it for the first transatlantic plane crossing in 1919. He was quite incredulous when I retorted that there was only sixty miles of sea separating London from New York and that even this was broken up by the presence of an island into two stretches of 22 and 38 miles.

It will be quite obvious to readers of Wireless World, of course, that the two stretches of sea are the Straits of Dover and the Bering Strait, the island being the continents of Europe and Asia which together form the world’s largest island as they fulfill the definition of a piece of land surrounded by water. There is, however, any political reason why a chain of relay stations should not be built between Calais and the Asian shore of the Bering Strait from which it is a mere 38 miles across to the U.S. territory of Alaska.

Back to Methuselah

IN the announcement in the September issue of the publication of “Second Thoughts on Radio Theory” mention is made that “Cathode Ray” has been writing for Wireless World for over twenty years. This set me wondering who is the “oldest inhabitant” among Wireless World’s regular contributors. After much turning up of old issues I found that the palm must be awarded to the Editor himself, whose name first appeared as a contributor over thirty years ago. I myself take second place with just over a quarter of a century while “Diallist” and “Cathode Ray” both have over twenty years to their credit.

I was interested in “Diallist’s” reference to myself in one of his recent radiations in which he told us that he began writing his feature for W.W. on January 18th, 1935, and has never missed an issue. “Unbiased” commenced on September 17th, 1930, and so I have 4½ years seniority. I must confess, however, that “Unbiased” has not appeared in every issue since it started.

There are also one or two “irregular” contributors like M. G. Scroggie (28 years) and W. T. Cocking (26 years) who are entitled to claim admission to the Methuselah Club. I am, however, more interested in readers than in writers and I have often wondered how many genuine readers—since-the-first-number (April 1911) are still on this side of Jordan.
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.

It has a sensitivity of 20,000 ohms per volt on all D.C. voltage ranges and 1,000 ohms per volt on A.C. ranges from 110 V. upwards. A decibel scale is provided for audio frequency tests. In addition, a press button has been incorporated which reverses the direction of current through the moving coil, and thus obviates the inconvenience of changing over test leads when the current direction reverses. It also simplifies the testing of potentials, both positive and negative, about a common reference point. A wide range of resistance measurements can be made using internal batteries, separate zero adjustment being provided for each range.

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. VOLTAGE</th>
<th>D.C. CURRENT</th>
<th>A.C. VOLTAGE</th>
<th>A.C. CURRENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.5V</td>
<td>50mA</td>
<td>2.5V</td>
<td>10mA</td>
</tr>
<tr>
<td>10V</td>
<td>250mA</td>
<td>10V</td>
<td>1A</td>
</tr>
<tr>
<td>25V</td>
<td>1mA</td>
<td>25V</td>
<td>2.5A</td>
</tr>
<tr>
<td>50V</td>
<td>10mA</td>
<td>50V</td>
<td>10A</td>
</tr>
<tr>
<td>100V</td>
<td>1A</td>
<td>100V</td>
<td>--</td>
</tr>
<tr>
<td>250V</td>
<td>100mA</td>
<td>250V</td>
<td>--</td>
</tr>
<tr>
<td>1,000V</td>
<td>1A</td>
<td>1,000V</td>
<td>--</td>
</tr>
<tr>
<td>2,500V</td>
<td>10A</td>
<td>2,500V</td>
<td>--</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>RESISTANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>First indication 0.5Ω</td>
</tr>
<tr>
<td>Maximum indication 20MΩ</td>
</tr>
<tr>
<td>0—2,000Ω using internal batteries</td>
</tr>
<tr>
<td>0—200,000Ω using external batteries</td>
</tr>
</tbody>
</table>

£23:10s.

Size 8½" x 7½" x 4½"  
Weight 6½ lbs. (including leads)
Improved beam focus and picture positioning with minimum effect on scan coils and ion trap assemblies.

- Fitted with latest type dual "Magnadur" sintered Oxide Magnets.
- Magnets DO NOT ROTATE during adjustment.
- Friction damping ensures smooth positive movement without backlash.
- Rapid and easy adjustment of focus and picture position.

For wide angle tubes with 38 mm. diameter necks.

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Type FD13/90 (Medium flux) .......... 23/-
Type FD14/90 (High flux) ............ 25/-

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Mullard

MULLARD LTD., COMMUNICATIONS & INDUSTRIAL VALVE DEPT., CENTURY HOUSE, SHAFTESBURY AVE., LONDON, W.C.2

<table>
<thead>
<tr>
<th>ABRIDGED DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>These figures are for each section:</td>
</tr>
<tr>
<td>$V_a$ ............... 100V</td>
</tr>
<tr>
<td>$I_a$ ............... $8.5 \pm 4mA$</td>
</tr>
<tr>
<td>$V_g$ ............... $-2.1V$</td>
</tr>
<tr>
<td>$g_m$ ............... $6.0 \pm 1.2mA/V$</td>
</tr>
<tr>
<td>$\mu$ ............... 27</td>
</tr>
<tr>
<td>$V_g$ (Ig = +0.3μA) .... $-0.2V$</td>
</tr>
<tr>
<td>$p_a$ max ........... 2.0W</td>
</tr>
<tr>
<td>$I_k$ max ........... 15mA</td>
</tr>
<tr>
<td>Heater ............... 6.3V, 0.4A</td>
</tr>
<tr>
<td>Base ................. B7G</td>
</tr>
</tbody>
</table>
The ADVANCE “Q” Meter is different! It is small, portable and has an excellent specification—a useful addition to any electronic laboratory and well suited for production testing. Furthermore, it is offered at a price to suit all applications. With the T1, RF measurements can be made of “Q” inductance, impedance, capacitance and power factor at frequencies between 100 kc/s. and 100 Mc/s.

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- Rapid calculation of “L” and “Z”
- No “Set-Zero” problems
- Small and portable

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The valves tabulated below are examples from our standard range. The frequency coverage can be varied, within certain limits, to suit the requirements of equipment designers. Further particulars are available on request.

![KLYSTRONS 'ENGLISH ELECTRIC'](image)

<table>
<thead>
<tr>
<th>Tube Type</th>
<th>C.V. No.</th>
<th>Minimum Mechanical Frequency Range (Mc/s)</th>
<th>Typical Operation</th>
<th>Electronic Tuning Range (Mc/s)</th>
<th>Type of Tuner</th>
</tr>
</thead>
<tbody>
<tr>
<td>K.300†</td>
<td></td>
<td>9320-9500</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.328†</td>
<td></td>
<td>9555-9685</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.302*</td>
<td>2164</td>
<td>9320-9500</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.305*</td>
<td>2263</td>
<td>9250-9500</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.312*</td>
<td>2273</td>
<td>9430-9650</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.313*</td>
<td>2343</td>
<td>9645-9775</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.335*</td>
<td></td>
<td>9555-9685</td>
<td>25-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.308*</td>
<td>2282</td>
<td>8800-8900</td>
<td>30-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.315*</td>
<td>2263</td>
<td>9105-9205</td>
<td>30-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.317*</td>
<td>8200-8300</td>
<td>30-0</td>
<td>30-0</td>
<td>30</td>
<td>Micrometer</td>
</tr>
<tr>
<td>K.311*</td>
<td>2304</td>
<td>8500-9500</td>
<td>40-0</td>
<td>25</td>
<td>Shaft</td>
</tr>
<tr>
<td>K.324*</td>
<td></td>
<td>9000-10000</td>
<td>40-0</td>
<td>25</td>
<td>Shaft</td>
</tr>
</tbody>
</table>

† Operate into Standard British Waveguide (1-0" x 0-5" inside dimensions).
* Operate into Standard American Waveguide (0-9" x 0-4" inside dimensions).

All valves are supplied with an integral resonant cavity.

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more contrast
extra tube life

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extra-play

magnetic recording tape

190m

THE FINEST BASE-FILM EVER MADE

The astonishing new polyester base-film for 'Scotch Boy 190M,' is so much stronger than other tape bases that it can be made 33 1/3% thinner — and still be stronger. This means you get 50% more length — and 50% EXTRA PLAYING TIME — on the same-sized reel.

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★ Can be used from a car battery.

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Full technical data from "Vibration Dept. W"
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Due almost entirely to their own continuity of effort to improve the performance of iron dust cores, The Plessey Company now hold an unchallenged position in the breadth and quality of their standard range of cores, both for use at normal I.F. and broadcast frequencies and again for the more recent exploitation of the V.H.F. region and television. In the latter context, the Company is able to announce the introduction of several materials possessing greatly improved qualities for use in these fields. These are the Grade 22 and Grade 23 powders, mechanically suitable for use in conventional constructions and available at economic prices.

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FTV rectifiers

from 125V 30mA
to 250V 300mA

Specially designed for use in domestic Radio & Television receivers, these miniature rectifier stacks have an established position with manufacturers to whom reliability, small dimensions and low costs are important.

FEATURES

- Instant starting — no warming-up period
- Unlimited instantaneous overload
- No limit to size of reservoir capacitor
- Simple mounting—no valve holder
- Withstand overloads such as charging current of de-formed electrolytic capacitors
- Low heat dissipation
- Practically indestructible in service
- Simple wiring—two connectors only
- Small size . . . low weight
- LOW COST

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Telephone: Harlow 26811
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The selection of Hi-Fi equipment is the widest you can find under one roof, and comparative demonstrations and good advice will help you to select the precise equipment for the results you want to get.

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for fair play all the time

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THE
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IN THE
WORLD
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Push button control brings any one of four preselected channels into immediate operation; this facility is also available when the equipment is installed for remote unattended operation. The 60 watt Fixed Station Transmitter offers R/T, C/W, or M.C.W. operation with ‘break-in’ facilities on telegraphy.

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- Condensers
- All controls likely to be met in electronic, radio and television equipment.

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FREE with any purchase of the LABpak range, these units are the complete answer to the storage problems of small production units, laboratories, etc.

MAKE UP YOUR ORDER TODAY — DELIVERY EX-STOCK

All LABpak resistors are carded in ohmic value, rating and tolerance, colour indexed and tabbed for easy selection.

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B.C.C. V.H.F. Mobile Radio

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Telephone: WEMbley 1217
Telegram: BEECEEC EE
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For Low Voltage or Mains
Illustrated are a few signal lamps taken from our wide range. The insulation of every Arcolectric signal lamp will resist a flash test of 1,500 volts A.C. The S.L.90 illustrated here is a typical Arcolectric 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 3/4in. hole. The mains voltage signal lamp S.L.88/N is supplied complete with an M.E.S. neon tube and a suitable series resistance.

Write for Catalogue No. 130

Arcolectric

SWITCHES LTD

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F M TUNER

An extremely sensitive 5-valve tuner with internal power supply for AC Mains 200/250 volts. 2 position switch for Gram and F.M. (tuner switched off in Gram position). Permeability tuned and temperature compensated against drift. Geared drive with illuminated calibrated dial. Valve line-up: ECC85 twin triode as grounded grid RF stage and mixer. 6B36 I.F. amplifier 6B36 limiter 6AL5 ratio detector 6V4 rectifier. Your existing radio or amplifier converted to FM in a few minutes.

Price £13 15 0 Complete
Carriage and Packing 7/6 extra.

7 VALVE RADIOGRAM CHASSIS

Three Wavebands:—
SW 13.6 m. to 50 m.; M.W. 195 m. to 550 m.; L.W. 800 m. to 2,000 m.
7 latest type valves: 12AH8, 6BW6, 6AT6, 12Ax7, 2-6AQ5, 5Y3. Push Pull Output. AC Mains 200/250. Output transformer fitted. Large illuminated dial. Sockets for speaker and pick-up, 4 position wavechange switch. High Q RF and IF coils. Special detector circuit for high gain and superior A.V.C. Complete with knobs.

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AC/DC Models £10/- extra.

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Price £7 10 0 Complete.
The Success of the new AXIOM ENCLOSURES and of the AXIOM range of Loudspeakers when demonstrated at the National Radio Show was such that many enthusiasts were unable to gain admission to the demonstrations.

The AXIOM range now includes the AXIOM 80 for distribution to the home market for the first time. For those who wish to hear the speaker that has captivated AMERICAN HIGH FIDELITY ENTHUSIASTS, and for those disappointed at Earls Court, we are holding a short series of demonstrations at our Wembley factory as follows:—

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At 10.0 a.m., 11.0 a.m. and 12.0 noon.

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Axiom Works, Wembley, Middlesex. Tel.:—WEMbley 1200
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SPECIALIZE
in equipment for the DEAF
and for PHYSIOTHERAPY

Actual Size of the A.V.C. Instrument (Covers removed).

AUTOMATIC
VOLUME COMPRESSION

now available in the sub-miniature 4-stage

Transistor "MINUET" Hearing Aid
Multitone were the first to introduce A.V.C. in Hearing Aids in 1936. It has proved essential for:

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Weighs only 1½ ounces complete with battery

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CONDENSER SPECIALISTS FOR OVER 20 YEARS
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Regardless of whether your relay problem is simple or complex, the fact remains that the only reliable solution is that which entirely eliminates risk.

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MAGNETIC RECORDING TAPE

GIVES ALL for that little extra...

... because it possesses ALL the qualities essential to a product that is outstanding in its field. This PVC based recording tape is naturally a little more expensive than some other makes ... but the initial cost is more than offset by its performance and extra-long life.

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Price 1 gang, 9/3.
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WITH VARIABLE SPEED ADJUSTMENT

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MAIN FEATURES

- Speed continuously variable from above 78 r.p.m. to below 16 r.p.m. Pre-set adjustable "click-in" positions for 78, 45, 33⅓ and 16 r.p.m.
  These features are invaluable for:
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  Correcting for mains frequency variations.
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EXCLUSIVE LOWTHER DESIGN AND BUILD

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Plus £7.6s.4d. P.T.

Existing AM/FM tuner units can be modified for A.F.C. Apply for details.

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Advanced circuit technique includes • tuned R.F. Pentode stage • separate oscillator valve • Pentode mixer • high gain I.F. stage • limiter stage • FOSTER-SELEY discriminator • Automatic frequency control valve • cathode follower output • 50 c.p.s. injection “check tune.”

N.B.—Only Lowther offer all these features.

No finer sound than that which is broadcast can be attained. Lowther gives you just this.

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- High insulation resistance
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4. Vertical input 1 M.ohm and 40 pF (Max.)
5. Built in pulse generator 220-2,500c/s.
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FOR RADIO and T.V. APPLICATION

GRADE M.E.
Low cost cores for frequencies up to 50 Mc/s.
GRADE M.F.
High quality cores for frequencies up to 300 Mc/s.

Write for List No. GRC 5303/6

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A SUBSIDIARY OF THE GENERAL ELECTRIC CO. LTD. OF ENGLAND

WE PROUDLY PRESENT OUR LATEST HIGH STANDARD LOW PRICED INSTRUMENT WHICH WE KNOW WILL BECOME A PRIZED AND INDISPENSABLE POSSESSION IN EVERY CONSTRUCTOR'S SHACK

MODULATED TEST
OSCILLATOR MTO.1

* Provides a modulated signal suitable for I.F. alignment also trimming and tracking R.F. circuits.
* Frequency is continuously variable from 170-475 Kc/s and 550-1,600 Kc/s.
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* Supplied with full operating instructions.

PRICE £3 - 15 - 0

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"OSRAM F.M. TUNER COMPONENTS" Aerial Coil O/T1, 2/9. R.F. Coil O/L1, 2/6. Osc. Coil O/L2, 2/-
**QUAD II MAIN AMPLIFIER**

The amplifier is unique in that the performance is obtained with stability which is complete. It is thus entirely independent of load or signal conditions.

The specification is fully met with random valve replacement from standard commercially tested valves.

The frequency response is completely free from "ears." The input is not prone to embarrassment by the presence of frequencies outside the audio range.

**SPECIFICATION**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>POWER OUTPUT:</strong></td>
<td>15 watts throughout the range 20-20,000 c/s.</td>
</tr>
<tr>
<td><strong>FREQUENCY RESPONSE:</strong></td>
<td></td>
</tr>
<tr>
<td>Within 0.2 db</td>
<td>20-20,000 c/s.</td>
</tr>
<tr>
<td>Within 0.5 db</td>
<td>10-50,000 c/s.</td>
</tr>
<tr>
<td><strong>DISTORTION:</strong></td>
<td></td>
</tr>
<tr>
<td>(Measured at 12 watts output)</td>
<td></td>
</tr>
<tr>
<td>Total 3rd and higher order</td>
<td>less than 0.1% at 700 c/s.</td>
</tr>
<tr>
<td>Higher order alone: less than 0.03% at 700 c/s.</td>
<td></td>
</tr>
<tr>
<td>Valve mismatching up to 25% (introducing 2nd harmonic) not to cause distortion to exceed 0.18%.</td>
<td></td>
</tr>
<tr>
<td>Total distortion at 25 c/s not to exceed 0.25%.</td>
<td></td>
</tr>
<tr>
<td><strong>INPUT:</strong></td>
<td></td>
</tr>
<tr>
<td>Sensitivity: 1.4 V. rms for 15 watts output.</td>
<td>Load imposed on input: 1.5 MΩ in parallel with 10 µF.</td>
</tr>
<tr>
<td><strong>BACKGROUND:</strong></td>
<td></td>
</tr>
<tr>
<td>+80 db referred to 15 watts.</td>
<td></td>
</tr>
<tr>
<td><strong>OUTPUT IMPEDANCES:</strong></td>
<td></td>
</tr>
<tr>
<td>150Ω and 70Ω.</td>
<td>Effective output resistance: 10Ω for 150 output.</td>
</tr>
</tbody>
</table>

**POWER SUPPLIES:**

- **INPUT:** 200-250 A.C. single phase (or 100-130 A.C.).
- **40-80 c/s:** 80 watts consumption (excl. control unit, tuners, etc.).
- **H.T. and L.T. supplies available for external equipment:** 330 V, 40 mA.
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- 18 lb. (8.3 Kg.)

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All windings impregnated and housed in compound filled casings. All metal work fully rust-proof processed and stoved steel grey. Metal work, rust-proofing, finishing, transformer winding, tropicalisation, assembly and tests, all carried out under constant supervision by our AID approved inspection section. The equipment is suitable for use under all climatic conditions.

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To meet the exacting demands being made on the efficiency of aerial systems, the Glover range of Cellular Polythene insulated downleads have been designed to utilise the superior electrical properties of this new form of polythene.

Details of three designs are given as being most representative of modern practice.

The two Cables G.R.1., G.R.2. are intended for use in the service area and one G.R.3. for use in fringe areas and in situations where interference is high.

<table>
<thead>
<tr>
<th>CO-AXIAL TELEVISION DOWNLEADS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic Impedance ohms.</td>
</tr>
<tr>
<td>Service Area</td>
</tr>
<tr>
<td>Attenuation dB/100 ft. at 50 Mc/s.</td>
</tr>
<tr>
<td>75 Mc/s.</td>
</tr>
<tr>
<td>Copper Conductor</td>
</tr>
<tr>
<td>Diam in inches.</td>
</tr>
<tr>
<td>Over Polythene.</td>
</tr>
<tr>
<td>Wire Braid.</td>
</tr>
<tr>
<td>P.V.C. Sheath</td>
</tr>
</tbody>
</table>

W.T. GLOVER & CO. LTD.
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We will gladly send you our catalogue and full information on request.

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**The Super**

We guarantee that this will be the FINEST Radiogram you have ever heard

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HF 912 £3 9 6

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Axiom 102 £9 10 9

Axiom 101 £6 12 1

Axiom 22 £15 9 0

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Golden 10 CS £8 6 7

Super RC5 £8 6 7

Super RC5/AL £8 19 11

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Cossor

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Oscilloscope 1052 £104 0 0

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Mic 32-L £1 0 0

Mic 35-S (Crystal) £1 5 0

Lustraphone

Mic High Imp £5 15 6

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Floor or extensions £12 12 0

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Point 2, TL 25 £28 7 0

Quad, Mk II £42 0 0

Mullard £18 18 0

E.A.R, 4 watt £9 9 0

TEP 1 watt £16 10 0

All Garrard, Connoisseur, Decca and Collaro heads, Sapphire and diamond stylus for the above heads now available.
HIGH-STABILITY Magnetic Amplifiers

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New ranges of Hunts tubular ceramic capacitors are now available in High-K, High-Q, and special purpose types. These miniatures are both precise in their characteristics, and robust in design. Full technical specifications available on request.

**HIGH-Q TYPE**

<table>
<thead>
<tr>
<th>Capacitance Range (pF)</th>
<th>Insulated</th>
<th>Uninsulated</th>
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<tr>
<td>1.5 to 7</td>
<td>12</td>
<td>10</td>
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<tr>
<td>7.1 to 11</td>
<td>14</td>
<td>12</td>
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<tr>
<td>11.1 to 16</td>
<td>17</td>
<td>15</td>
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<tr>
<td>16.1 to 26</td>
<td>22</td>
<td>20</td>
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Temp. Coeff. N33 ±60x10^-6 pF/pF°C

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<tr>
<td>5 to 27</td>
<td>12</td>
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<td>27.1 to 45</td>
<td>14</td>
<td>12</td>
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<td>45.1 to 69</td>
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<td>15</td>
</tr>
<tr>
<td>69.1 to 100</td>
<td>22</td>
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Temp. Coeff. N750 ±250x10^-6 pF/pF°C

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<th>Range (pF)</th>
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<th>Uninsulated</th>
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<td>10 to 80</td>
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<td>80.1 to 110</td>
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**HIGH-K TYPE**

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**TYPE CT 10-18K**

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<td>18</td>
</tr>
<tr>
<td>4700</td>
<td>20</td>
<td>18</td>
</tr>
</tbody>
</table>

Diameter of all tubes:
- Insulated = 6 mm
- Uninsulated = 5 mm

A. H. HUNT (Capacitors) LTD.
WANDSWORTH, LONDON, S.W.18. BAT 1083-7

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B.2027

INPUT ... 200/250V. 40/60 c/s.
OUTPUT ... 0-12V. 5A. Max.

VARIAC CONTROLLED

<table>
<thead>
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<th>LOAD</th>
<th>RIPPLE</th>
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<tr>
<td>1 amp.</td>
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<tr>
<td>2 &quot;</td>
<td>0.05%</td>
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<tr>
<td>3 &quot;</td>
<td>0.09%</td>
</tr>
<tr>
<td>4 &quot;</td>
<td>0.14%</td>
</tr>
<tr>
<td>5 &quot;</td>
<td>0.20%</td>
</tr>
</tbody>
</table>

Additional A.C. output 0-20 volts at 10 Amps Variac controlled. Built-in M/C meter. Size: 14½in. x 12in. x 11in. Weight: 50 lb.

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OSMOR RADIO PRODUCTS LTD.

OSMOR COIL TYPES (all coils Dust iron cored) Circuits on Request

<table>
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<th>Coil No.</th>
<th>W'band</th>
<th>Winding</th>
<th>Price each</th>
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<td>6 1.1 4-</td>
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<td>H'5</td>
<td></td>
<td></td>
<td>130 250 4-</td>
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<tr>
<td>QA6</td>
<td>800-2000</td>
<td>Single</td>
<td>750 140 4-</td>
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<td>H'6</td>
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<td>750 140 4-</td>
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<tr>
<td>QA7</td>
<td>18-50</td>
<td>Aperiodic</td>
<td>1.4 1.9 5-</td>
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<td>H'7</td>
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<td>1.4 1.9 5-</td>
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<tr>
<td>QA8-H'10</td>
<td>Cup coil</td>
<td>Some Connections as A-HF5</td>
<td>6/9</td>
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<tr>
<td>QA9</td>
<td>Cup coil</td>
<td>Some Connections as A-HF5</td>
<td>6/9</td>
</tr>
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</table>

SMALL 1/4 W RESISTORS 63 each

| 4.7Ω | ± 10% | 260 | ± 10% | 490K | ± 10% |
| 10   | 230   | 10K  | 230   | 490K  | 10K   |
| 15   | 300   | 13K  | 300   | 680K  | 13K   |
| 22   | 360   | 52K  | 360   | 730K  | 52K   |
| 27   | 420   | 78K  | 420   | 830K  | 78K   |
| 33   | 500   | 156K | 500   | 980K  | 156K  |
| 50   | 680K  | 3.3M | 680K  | 3.3M   | 3.3M  |
| 56   | 820K  | 5.2M | 820K  | 5.2M   | 5.2M  |
| 68   | 1K    | 7M   | 1K    | 7M     | 7M    |
| 90   | 1.2K   | 70M  | 1.2K  | 70M    | 70M   |
| 120  | 1.5K   | 120M | 1.5K  | 120M   | 120M  |
| 150  | 2K    | 250M | 2K    | 250M   | 250M  |
| 180  | 2.2K   | 3.3M | 2.2K  | 3.3M   | 3.3M  |
| 200  | 2.5K   | 4.7M | 2.5K  | 4.7M   | 4.7M  |
| 270  | 4.7K   | 10M  | 4.7K  | 10M    | 10M   |

ULTRA-SMALL CERAMIC NEG. TEM. CO.-EFF. CAPACITORS for V.H.F. etc.

| 10 each | ± 10% | 300pF ± 20% | ± 10% | 750pF ± 20% |
| 1pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 2pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 3pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 4pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 5pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 6pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 7pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 8pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 9pF    | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 10pF   | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 15pF   | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 20pF   | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |
| 22pF   | ± 2.5% | 33pF ± 20% | ± 2.5% | 75pF ± 20% |

OSMOR Coils are the obvious choice of manufacturers. Technical Colleges, Universities, etc. also use Osmor Coils for research.

FREE:
Send 6d. (stamps) for fully descriptive literature including circuit and practical drawings. 'The really efficient 5-valve superhet,' 6-valve 6-Set, 3-valve (plus rectifier) T.R.F. circuit, Battery portable superfet circuit, Coil and Colpck loop, and full radio and component lists, etc.

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12 Way Actual Size

Line-to-line, line-to-chassis or inter-chassis connectors. Adequate contact 'float' allows for slight mis-alignment of male or female units. Sockets fitted with McMurdo No. 9 Octal valvholder contacts which have proved their reliability on many jobs. Low contact resistance with reasonable insertion and withdrawal forces. Life tests prove that low contact resistance persists through more than 5,000 insertions. AVAILABLE in 8, 12, 18 and 25 way also covers with top side or end cable entry.

For full details apply to:

THE McMURDO INSTRUMENT COMPANY LTD - VICTORIA WORKS - ASHTEAD - SURREY. Tel.: ASHTEAD 3401
Improved filter units with Ferroxcube pot cores

1. High performance combined with small size and light weight.
2. Designed and built to customers' individual requirements.
3. Long term stability, even under conditions of temperature variation.

High quality electrical filter units built around Ferroxcube cores can now be supplied to communications equipment designers' individual specifications. These filter units have significant advantages over comparable types designed without the use of Ferroxcube, particularly in the frequency range 300 c/s to 500 kc/s. For audio frequencies the use of Ferroxcube cores permits the winding of compact coils with very high inductances. This results in a considerable reduction in the size and cost of the associated condensers and hence of the filter unit as a whole. The high Q values obtained for a given volume, especially above 10 kc/s, enable sharp cut off characteristics and low pass-band losses to be achieved, while negligible stray flux facilitates the production of compact and mechanically robust filters.

Electrical filter units are among a number of high quality components now being made available by Mullard. Full details of the complete series of components will be gladly supplied upon request.

Mullard

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'Ticonal' permanent magnets
Magnadur ceramic magnets
Ferroxcube magnetic cores.
THE NEW ARMSTRONG F.M.56
F.M. TUNER

85-95 Mc/s; High Impedance Output. Magic Eye Tuning Indicator, £21.

8 Valves, incl. 2 double triodes. 8 watts output. Provision for using F.M. adaptor. Separate Bass and Treble controls. 2 shorts, medium and long wavbands £23 18 0 Or 1/3 dep. and 29/2 monthly.

ALL SPECIFIED COMPONENTS FOR:
Osram 912, Mullard 10 watts and Williamson Amplifiers and Amos & Johnson F.M. Unit.

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Collaro RC.14-3 sp. Auto, with Studio Pick-up £13 4 2
Garrard 301—Transcription Unit—J speed £25 3 6
Garrard TA—3 speed Grzm. Unit T/O Head £10 16 0
Garrard R.C.R.OM 3 sp. Auto, with Xtal T/O Pick-up £17 9 6
Collaro 2010 Transcription Motor and Turntable complete with 3 speed Gear and Switch mounted on Rectangular Plate with Studio 'P' High Fidelity Pick-up £18 4 9

THE NEW ARMSTRONG F.M.56
F.M. TUNER

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Collaro 2010 Transcription Motor and Turntable complete with 3 speed Gear and Switch mounted on Rectangular Plate with Studio 'P' High Fidelity Pick-up £18 4 9

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H.F. REPORER

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LIST PRICE 12 GNS

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H.F. REPORER

Manufactured by Kelly Acoustics Ltd.
EXCLUSIVE WORLD-WIDE DISTRIBUTION BY THERMIONIC PRODUCTS LIMITED - HYTHE - SOUTHAMPTON - HANTS. Phone: Hythe 3265
The PYE Provost Amplifier and Proctor Remote Control Unit have been critically designed and produced with one end in view . . . to provide true high fidelity sound reproduction in a versatile, practical and attractive combination. An undistorted output of 25 watts provides ample power for high fidelity systems in the home, the school, the broadcasting studio or the social club.

**PROVOST AMPLIFIER HF25**

26db negative feedback and an output from 2 c.p.s. to 160,000 c.p.s. (over 16 octaves) ● Practically distortion-free response combined with the infinite damping factor gives a standard of reproduction formerly unobtainable ● The output transformer is specially designed to meet the exacting specification of the amplifier ● The amplifier can be controlled from a distance of up to 20 ft. (6m.) Cathode follower output from the remote control unit minimises cable losses.

**PROCTOR REMOTE CONTROL UNIT HF25A**

Smooth, highly flexible controls and facilities for record player, tape recorder, microphone and radio tuner inputs ● Five types of plug-in compensators are available, which match all known types of pick-up ● Four switched inputs and a choice of four record replay characteristics for U.S. COL. L.P., R.I.A.A. or EUR. L.P., U.S. 78, or EUR. 78 ● Continuously variable lift and cut controls for bass and treble with clearly marked level positions ● Treble filter control gives three sharp cut-off frequencies and an unrestricted response position.

Price complete: 40 GNS

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You can still buy Tape Recorders on Low Deposit and easy repayment terms from us. We can deliver from stock all this popular series of Recorders

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The most compact COMPLETE Tape Recorder with single joystick control.

35 gns. only

Or 15% deposit with balance and service charge spread over any period up to 18 months

PLAYTIME

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. Single knob control for all functions. Size only 12½" x 10" x 5½"; weight 18 lbs. For A.C. mains, 220/250v.

Or supplied complete and ready for use with High Fidelity crystal microphone and One Hour Spool of tape for £31. 4s. 6d.

Simple to operate—even a child can use it.

Magic eye recording level.

Completely self-contained for Recording and Playback.

For A.C. mains 200/250v.

May be used as an amplifier or with external Playback medium.

The finest and smallest lightweight complete Tape Recorder with such a versatile performance.

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TWO-SPEED Multi-Purpose TAPE-RECORDER

45 gns.

Mail Order Supply Company

Come to the Radio Centre for Personal Service—variety of equipment easy purchase—Service after Sales.

MAIL ORDER SUPPLY COMPANY
A de-luxe version of the popular Editor with many refinements

A truly superb British-made recorder, rich in range and tonal qualities, for home and business recording and for using pre-recorded tapes. The "Editor Super" is sufficiently powerful to meet any volume requirement, with a range of tone from maximum brilliance to a deep rich bass. Simple in operation, it has unequalled smooth and reliable single-knob control. Fitted in padded simulated crocodile case.

**Brief Specification**

- **Mixing and Monitoring Facilities** for separate Radio-Gram and microphone inputs.
- **Tonal balancing control.**
- **Twin track heads giving TWO HOURS PLAYING TIME**
- **Uniform frequency response between 40-10,000 c/s.**
- **Overall size 16¼"x12"x5" (with lid 7").**
- **For A.C. mains 200/250v. 50 c/s.**

**For the Ultimate in Recording Perfection**

Incorporating a 10 in. Loudspeaker PLUS a 5 in. Monitor. An additional 10 in. high quality speaker is fitted into the detachable lid in this series so that apart from the built-in speaker the lid can be placed in any desired position. Ideal for P.A. dance halls, concerts, etc. Professional tonal quality, ease of operation and unique features are combined to provide a new world of recording and listening pleasure.

**Editor Hi-Fi** 49gns.
- Two speeds 3½" and 7¼" per sec.
- Fitted in elegant suitcase with gilt fittings.
- Built-in speaker is additional to 10" high flux speaker in detachable lid, giving greater versatility.
- Magic eye level indicator.
- For AC mains 200-250V.
- Easily removable chassis built on unique steel frame.
- Independent BASS and TREBLE controls for Recording and Playback.

**Editor Super Hi-Fi** (Above) 60 gns.
- Two speeds 3½" and 7¼" per sec.
- Fitted in padded simulated crocodile case with continental gilt fittings and locks.
- Completely automatic simple interlocked control.
- Instantaneous braking.
- Elegantly styled super tape deck.
- MIXING and MONITORING facilities.
- Built-in speaker is additional to 10" high flux speaker in detachable lid.
- Size overall 14½"x16½"x12".
- For AC mains 200-250V.
- Easily removable chassis built on unique steel frame, ensuring ease of inspection.
- Magic eye level indicator.

Easy deposit and repayment as for other recorders in this range.

A custom built Radiogram chassis for 22gns. or 33% deposit.

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TYPE L.O. 352

"L.O. 352" IS THE TYPE NUMBER OF AN ENTIRELY NEW ALLEN LINE OUTPUT AUTO-TRANSFORMER NOW AVAILABLE.

Note the following "Star" features:

* E.H.T.: 14 to 18 KV.
* E.H.T. Regulation: Better than 5 M.Ω
* Audible Whistle: Negligible.
* Application: Self-running, Square-wave or Sawtooth driven
* Associated Valves: PL81, PY81.
* Associated Yoke: Allen Type DC605/C.
* H.T. Rail: 190 volts for 14KV
* Core Material: Mullard Ferroxcube (earthed)
* Scanning Angle: 72 degrees.
* Suitable C.R.T.s: Any "wide-angle" tube, from 14 to 21in.

Manufacturers are invited to write for further details and prices. Home-Constructors:
Please send S.A.E. for recommended circuit diagram and details.

COILS FOR WIRELESS WORLD F.M. TUNER

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td>FMC 102</td>
<td>Aerial Coil</td>
<td>7/- each</td>
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<tr>
<td>FMC 103</td>
<td>R.F. Inter-valve Coil</td>
<td>5/- each</td>
</tr>
<tr>
<td>FMC 104</td>
<td>Oscillator Coil</td>
<td>7/- each</td>
</tr>
<tr>
<td>FMC 101</td>
<td>I.F. Transformer</td>
<td>7/6 each</td>
</tr>
<tr>
<td>FMC 151</td>
<td>Ratio Detector Transformers</td>
<td>25/- each</td>
</tr>
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</table>

*(Specialists in high-grade television components)*

ALLEN COMPONENTS LTD. 197, LOWER RICHMOND ROAD, RICHMOND, SURREY
High Grade Instruments


Right. Pulse Height Valve Voltmeter. 0-100 volts in 3 ranges. Model PV 812.

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Universal multi-range test set for electrical and radio engineers.

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British Physical Laboratories
Radlett, HERTS
Tel: RADLETT 5674-5-6
### AMPLIFIERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
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<tr>
<td>Leak T.L.10 with point 1 pre-amplifier</td>
<td>£27</td>
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<tr>
<td>Or with Varislope 2 pre-amplifier</td>
<td>£33</td>
</tr>
<tr>
<td>R.D. Junior amplifier, with control unit</td>
<td>£26 0 0</td>
</tr>
<tr>
<td>R.D. Minor mark 3</td>
<td>£14 0 0</td>
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<tr>
<td>Acoustical Quad 2 with separate control unit</td>
<td>£42 0 0</td>
</tr>
<tr>
<td>Pye P.F.91 with separate control unit</td>
<td>£16 10 0</td>
</tr>
<tr>
<td>Trix with control unit</td>
<td>£42 0 0</td>
</tr>
<tr>
<td>Reconditioned Decca Decola model P.A.9 with two speed units</td>
<td>£17 10 0</td>
</tr>
<tr>
<td>P.A.3 portable amplifier, as new</td>
<td>£10 0 0</td>
</tr>
<tr>
<td>Chapman push - pull amplifier complete with separate power pack, control unit and tuner unit with R.F. stage</td>
<td>£27</td>
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### SPEAKERS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
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<tbody>
<tr>
<td>Goodmans Axiom 22 mark 2 in Salex sand filled, walnut veneered corner baffle</td>
<td>£37 0 0</td>
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<tr>
<td>Chaffey corner horn</td>
<td>£37 0 0</td>
</tr>
<tr>
<td>G.E.C. metal cone octagonal cabinet (lin. speaker extra.)</td>
<td>£14 0 0</td>
</tr>
<tr>
<td>Pye Cantata corner speaker, complete (Speaker extra.)</td>
<td>£35 0 0</td>
</tr>
<tr>
<td>Acoustical Quad 2 with separate control unit</td>
<td>£42 0 0</td>
</tr>
<tr>
<td>Pye P.F.91 with separate control unit</td>
<td>£16 10 0</td>
</tr>
<tr>
<td>Trix with control unit</td>
<td>£42 0 0</td>
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<td>Reconditioned Decca Decola model P.A.9 with two speed units</td>
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</tr>
<tr>
<td>P.A.3 portable amplifier, as new</td>
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</tr>
<tr>
<td>Chapman push - pull amplifier complete with separate power pack, control unit and tuner unit with R.F. stage</td>
<td>£27</td>
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### SPEAKER UNITS

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<tr>
<td>Wharfedale Super 12 CS AL</td>
<td>£17 10 0</td>
</tr>
<tr>
<td>Goodmans Axiom 22 mark 2</td>
<td>£14 14 0</td>
</tr>
<tr>
<td>Tamnoy 15in. Dual Concentric</td>
<td>£35 12 0</td>
</tr>
<tr>
<td>Barker Duode 12 C</td>
<td>£20 0 0</td>
</tr>
<tr>
<td>Goodmans 150 mark 2</td>
<td>£10 5 6</td>
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<tr>
<td>Wharfedale Super 8 CS AL</td>
<td>£7 0 0</td>
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<tr>
<td>Goodmans Axiom 102 (S/H)</td>
<td>£8 0 0</td>
</tr>
<tr>
<td>G.E.C. metal cone (S/H)</td>
<td>£5 0 0</td>
</tr>
<tr>
<td>12in. Goodmans Axiom (S/H)</td>
<td>£4 10 0</td>
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### GRAM UNITS

<table>
<thead>
<tr>
<th>Model</th>
<th>Price</th>
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<tbody>
<tr>
<td>Garrard 301B transcription units</td>
<td>£25 2 6</td>
</tr>
<tr>
<td>Connoisseur 3-speed motors</td>
<td>£27 2 6</td>
</tr>
<tr>
<td>Collaro 2010 with PX pickup</td>
<td>£18 11 11</td>
</tr>
<tr>
<td>Lenco continuously variable transcription unit with Goldring 500 turnover vari-reluctance pickup, complete</td>
<td>£18 18 0</td>
</tr>
<tr>
<td>Decca R.C. 80M 3-speed auto changers with 2 Decca XMS heads</td>
<td>£16 7 6</td>
</tr>
</tbody>
</table>

---

### SIMPLE EASY PAYMENTS

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Phone: FLEet St. 9391/2
A NEW-PRINCIPLE
A-C AUTOMATIC
VOLTAGE STABILISER

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The NEW “ASR-1150”
costs only £24 net

Complete information is obtainable from

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Electronics Division, Gas Purification & Chemical Co. Ltd.)

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**SUPERIOR BUREAU**

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**DULCI BAND 3**

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TYPE I. K.O. PATENTS

A complete self-contained unit, suitable for converting all makes of T.V. Housed in a polished wood cabinet size 7in. x 10in. x 8in. All channels are iron core tuned with pre-set adjustments. Input signal equalising is provided. Valves Z77, Z77, 12AX7, 6X4. Power supply, A.C. mains 200/250 volts. Service data available on request. Price £9/9/- Plus 3/- post and packing.

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**F.M. AND A.M./F.M. CHASSIS**

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**DISC PLAYERS**

Specially designed for the Hi-Fi enthusiasts and home constructor. These Disc Players consist of the latest Three-speed Automatic Record Changer, complete with crystal turn-over pick-up head for long playing and standard records. This unit is mounted on a Sycamore veneered base which is complete with fitted mains lead, and screened pick-up lead ready for connecting to Brand new and boxed. Price £10/16/- Plus 5/- post and packing.

---

**The "SUPEREX 55" ATTACHE PORTABLE**

BUILDING COST £7/15/- Plus 3/- P.P.

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TERMS: Cash with order or C.O.D. Extra charge for C.O.D. U.K. and N. Ireland only.

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A.T.E. Telegraph Equipment

TELEGRAPH DISTORTION MEASURING SETS
This equipment is available either in portable form or arranged for standard width rack mounting. There are two units each 18\(\frac{1}{8}\) x 13\(\frac{1}{2}\), both mains driven, either may be used independently for certain tests or both may be used in combination to cover a comprehensive series of tests. These tests, which need not interfere with normal transmission, cover transmission and reception. The transmitting unit can send perfect or distorted signals at any speed from 20 to 80 bauds or up to 200 bauds with modification. It can generate reversals and character repetitions and incorporates a 100 character test message sender. An additional feature of this unit is its use as a relay tester.

The receiver unit indicates the distortion on a working circuit without interrupting the service. Each element of a start-stop signal appears separately on the CRT which produces a spiral time base display. Adjustable speeds from 20-80 bauds or up to 200 bauds with modification.

REGENERATIVE REPEATER
A mains operated, start-stop, five unit code equipment. Designed for use in both radio and line teleprinter circuits to regenerate and correct distorted signals, it also arranges for the automatic insertion of correct length stop-elements and the rejection of spurious signals.

FREQUENCY SHIFT TELEGRAPH TERMINAL EQUIPMENT
Designed to work in conjunction with conventional receivers for the reception in dual diversity, of wide or narrow band frequency-shift and on/off, or reversed on/off, hand or automatic radio telegraph and teleprinter signals. Up to 85 db of rapid variation in input signal level can be accepted with frequency-shift working, and up to 35 db with on/off or reversed on/off, working. Keying speeds up to 200 bauds can normally be handled—this range can be extended if required. This versatile receiver is also suitable for use with the new 50 c/s Pilot Carrier frequency shift system.

AUTOMATIC TELEPHONE & ELECTRIC COMPANY LTD.
LEC TURE D E M ON STRATION by G. A. BRIGGS
In CARNEGIE HALL, NEW YORK
3.00 p.m. on Sunday, 9th October, 1955
(with the collaboration of P. J. WALKER, of Acoustical Manufacturing Co. Ltd.)

The loudspeakers illustrated above will be used for this demonstration. The 3-
speaker system includes W15/CS, Super 8/CS, Super 3 and HS/CR3/2 crossover
unit. The R-J cabinets will be fitted with Super 8/CS and Super 8/CS/AL units.
Live and recorded items of organ, piano, oboe and wind quartet will be compared.

Wharfedale

In the DOG HOUSE ?
(G.E.C. nickname)

"912" Plus

This sensational modification makes the 912 Plus suitable for all
magnetic and Xtal Pick-ups. Provision for record and replay from tape
recorders.

Ki t 1. With pre-Amplifier Compensating unit .......... £23 19 0
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    Super 8 CS ........................................ £6 19 11
    Golden 10 ......................................... £7 13 3
    Golden CSB ........................................ £8 6 7
    W.12 ................................................ £9 15 0
    W.12 CS ........................................... £10 5 0
    Super 12 CS/AL ..................................... £17 10 0
    W.15 ................................................ £17 10 0
    W.15 CS ........................................... £17 10 0
GOODMANS: Ason 101 ..................................... £6 12 1
    " 102 .............................................. £9 15 2
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    Audiom 50 .......................................... £9 7
    " 70 ................................................ £14 10 0
    " 80 ................................................ £22 10 0
    " 90 ................................................ £28 0 0
    W.B. HP 812 ......................................... £3 5 6
    HP.1012 ............................................ £4 17 6

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ACOS HGP.90 Head Std. & L.P. ........................ £2 3 3
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COLLARO Studio O or P. Pick up ................................ £3 14 8
COLLARO Transcription Arm Studio "P" Pick up ................................ £4 15 9
COLLARO Transcription Arm Studio (Super) PX ........................ £5 2 5
R.J. Arm ................................................ £2 19 11
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OUTPUT. 1.2 volts from cathode follower stage.
TAPE RECORDING OUTPUT. 1.2 volts cathode follower independent of monitoring.
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DISTORTION. Total harmonic less than .1% at 10 watts—700 cycles.
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FREQUENCY RESPONSE. Within 0.2 DB 20—25,000 c/s ± 0.5 DB 10—60,000 c/s.
FEEDBACK. 40 DB total.
OUTPUT IMPEDANCES. 4 ohms, 7 ohms, 15 ohms.
INPUT VOLTAGE. 1.2 v for rated output.
ANCILLARY POWER SUPPLIES. 375 volts 45 millamps, 6.3 volts 2.5 amps available for VHF Tuner, Pre-amplifier and Tape Reproducer amplifier.
POWER CONSUMPTION. 130 VA at full load. AC Input 100/150 and 200/250 volts.

PRICE £48.0.0 COMPLETE.
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Each outfit is despatched in transit case at the amazingly low price of £31/- plus carriage 10/-. If despatched without Transit Case, £210/- plus carriage 8/6.

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- Increased gain at the aerial of over 20 db.
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FREQUENCY RANGE 1.6 Kc/s TO 55 mc/s

The experience gained in manufacturing quartz crystals to the stringent requirements of our own apparatus and those of the Services, enables us to offer a comprehensive range of crystals covering the frequency band 1.6 Kc/s to 55 mc/s. Years of intensive research and development work in this field guarantee the reliability and quality of this Marconi Product.

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**FULLY INTERLEAVED**

SCREENED AND IMPREGNATED. ALL GUARANTEED.

ALL PRIMARIES ARE 200/250 v. Half Shrouded

<table>
<thead>
<tr>
<th>TRANSFORMER</th>
<th>PRIMARY</th>
<th>SECONDARY</th>
<th>CURRENT</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>F63</td>
<td>200-0-250 v</td>
<td>6.3 v</td>
<td>3 amps</td>
<td>Fully Shrouded</td>
</tr>
<tr>
<td>F64</td>
<td>200-0-250 v</td>
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<td>6.3 v</td>
<td>3 amps</td>
<td>Fully Shrouded</td>
</tr>
</tbody>
</table>

**FOR HIGH QUALITY ELECTRONIC MINIATURES**

Make contact with Ardente Acoustic Laboratories Limited, for details of high-quality Miniature Earphones, Transformers, Switches, Volume Controls, Plugs and Sockets; also of the widely-known ARDENTE Hearing Aids.

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The latest Miniature Earphone is characterised by its high efficiency and slim, elegant appearance. The curve shown above was taken on a Post Office type 11 c.c. artificial ear and the dotted lines represent the 95% confidence limits calculated from a batch of Earphones of this type.

Controlled methods of manufacture, in which the magnet in each unit is individually adjusted and aged; plus a detailed inspection procedure which includes an automatic curve trace on each Earphone, ensures a uniform product of high quality and reliability.

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**MINIATURE COMPONENTS**

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Telephone: AC001 4161-1282
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**BRIEF SPECIFICATION TYPE R1184**

<table>
<thead>
<tr>
<th>INPUT</th>
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<tr>
<td>200-250 v., 40-100 c.p.s.</td>
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<tr>
<th>OUTPUT</th>
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<tbody>
<tr>
<td>High stability low ripple D.C. supply variable between 300 and 1,100 volts. Max. current 2 mA. Pos. or neg. may be earthed.</td>
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<tr>
<th>STABILITY</th>
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<tr>
<td>A 10% change in mains input voltage results in a change of less than 0.1% between 1,100 volts and 600 volts output.</td>
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<tr>
<th>OUTPUT RESISTANCE</th>
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<td>Approximately 1,500 ohms.</td>
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<tr>
<th>RIPPLE</th>
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<tr>
<td>Less than 0.01% R.M.S.</td>
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</table>

**MOUNTING** The Unit is suitable for standard rack mounting or for bench use. Bench Stands are available.

**PRICE — £48**

Further information is available on request.

**EDISWAN**

**RADIO DIVISION • THE EDISON SWAN ELECTRIC COMPANY LIMITED**


Member of the A.E.I. Group of Companies
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TAPE RECORDER COMPONENTS
AND ACCESSORIES

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MARK IIIU SERIES

Technically identical with the world-famous Deck supplied, in bulk, to Recorder Manufacturers. With B.S.S. sense of tracking, it is fully approved for playback of pre-recorded tapes. List Price remains at 22 gns.

Details of complete recorders incorporating the TRUVOX Tape Deck are available on request.

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Frequency-modulated oscillator designed for the rapid and accurate alignment of T.V. and F.M. receivers. Also suitable for checking band pass amplifiers.
Frequency range: 5-250 Mc/s.
Frequency deviation: Continuously variable to approx. 15 Mc/s.
Output: 40 microvolts to 2 millivolts continuously variable.
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Sweep: Sweep voltage continuously variable to a max. of 300 V.R.M.S.
CASH PRICE £30.0.0 Prompt Delivery
Available on advantageous Hire Purchase Terms

TAYLOR OSCILLOSCOPE MODEL 31A
An Oscilloscope of advanced design and reliable performance intended primarily to meet the requirements of T.V. and Radio Servicing and Alignment, but its versatile features make it ideally suitable for general laboratory work.
Tube: Flat faced C.R. tube 4in diameter.
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Hard Time Base: Covers frequencies from 10 c/s to 500 Kc/s, free running or triggered.
Amplifiers: Both horizontal and vertical with push pull output are provided. High gain amplifier band width 10 c/s to 6 Mc/s.
Flyback Suppression Circuit fitted with tube modulator.
CASH PRICE £60 Prompt Delivery
Available on advantageous Hire Purchase Terms

TAYLOR SIGNAL GENERATOR MODEL 67A
For Television up to 240 Mc/s
The Colpitt's oscillator circuit used gives good frequency stability and waveform over the wide frequency range.
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Total Scale Length: 48in.
Accuracy: ±1%.
Modulation: 400 cycles, 30% depth.
Output impedance: 75 ohms.
Direct A.F. output provided.
Attenuation: 100 dB continuously variable.
Automatic cut-out against mains overload.
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WIRELESS WORLD

October, 1955

4 reasons why...
IT PAYS TO SOLDER
with
Wolf Electric
SOLDERGUNS
and
SOLDERING IRONS

Type 22

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- CONSTANT
- HEAT

- ABSOLUTE
- DEPENDABILITY

- SOLID
- CONSTRUCTION

- PERFECT
- BALANCE

Alternative Types

Type 31
Type 41
Type 71
Type 81

Type 21

Type 32
Type 42

Unbeatable from every point of view, well able to withstand hard workshop treatment and ideal for continuous use. Features include rapid constant localised heat—solid sturdy construction—low current consumption—perfect balance—absolute dependability. A type and bit for every purpose from fine instrument to heavy industrial work.

Each tool includes 5 feet tough rubber 3-core cable.

Obtainable from all leading tool merchants and factors.

Fully descriptive Brochure free on request.

WOLF ELECTRIC TOOLS LTD
PIONEER WORKS
HANGER LANE
LONDON W.3

TRIGGER FEED
SOLDERGUN

Type No. 51 is designed specially for all assembly operations. Solder is fed automatically with trigger-action and two reels are supplied—one 15 ft. acid-cored and one 15 ft. resin-cored.

Announcing—

TELECLIP
UNDER-CHIN HEADPHONES

OUncES LIGHTER—GIVING MORE COMFORT
AND CONVENIENCE AND BETTER SOUND

A new development in headphones which will save many a headache and hair-do. Weighing less than 2 ounces, TELECLIP suspends from the ears under the chin, leaving ample clearance for speaking. The earphones, cushioned with foam nylon plugs, have a high sensitivity and wide frequency range. TELECLIP is hygienically finished in aluminium grey plastic, is inconspicuous in use and can be worn for hours without fatigue.

SOME OF ITS USES

By telephone operators, receptionists and dictaphone typists. . . In hospitals, churches, lecture rooms, beauty parlours and hairdressing salons . . . for military communications . . . by radio operators and constructors.

Send for leaflet fully describing TELECLIP and its many applications, also for quotations and terms.

ARDENTE

ELECTRO-ACOUSTIC ENGINEERS

ARDENTE ACOUSTIC LABORATORIES LIMITED
SPRINGFIELD WORKS, HORN LANE, ACTON, LONDON W.3
TELEPHONES: ACORN 4161-1282
In the field of component assembly, 'Scotch Boy' electrical tapes have long been unrivalled for strength, ease of application, and excellent dielectric properties. Now a new range of 'Scotch Boy' electrical tapes, with thermosetting adhesive, has been introduced. These remarkable new paper, glass cloth, and acetate cloth tapes have the same ability to stick at a touch, but the adhesive cures firm when components are subjected to the normal drying cycles. The cured adhesive has greatly increased solvent resistance, and soft spots are eliminated. The new tapes are, therefore, ideal for use with solventless varnishes and casting resins.

**HERE ARE TYPICAL APPLICATIONS:**

**TOP LEFT**  
No. 38 Paper Tape binds and insulates motor field coils

**TOP RIGHT**  
No. 38 Paper Tape is used to anchor, start, and finish wires

**CENTRE RIGHT**  
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**BOTTOM RIGHT**  
No. 28 Acetate Cloth Tape anchors leads in secondary windings, and No. 38 Paper Tape holds fibre lead pads of a transformer

**FOR SPEED AND ECONOMY IN COIL ASSEMBLY**

'SCOTCH BOY'  
(Regd. Trade Mark)  
Electrical Tapes  
ANOTHER 3M COMPANY PRODUCT

MINNESOTA MINING AND MANUFACTURING COMPANY LIMITED  •  LONDON  •  BIRMINGHAM  •  MANCHESTER  •  GLASGOW
WHY ENGINEERS SPECIFY

EGEN

topotiometers—

Egen Potentiometers are based on long experience of requirements of television and electronic equipment manufacturers. In design, dependability, accuracy and freedom from wear they are outstanding, but, above all, they are completely NOISELESS.

DUAL POTENTIOMETERS with concentric operating spindles. The new Egen Dual Potentiometers incorporate all these outstanding design features—multiple contact rotors, smooth easy movement, thorough screening between sections, plus a convenient soldering tag for earth screening screened connections on each metal case. Switch and Potentiometer soldering tags are of high-grade brass heavily silver plated for easy soldering; they are positively located and withstand soldering heat and bending without loss of rigidity. Control spindles can be supplied to suit customers' requirements.

PRE-SET POTENTIOMETERS. Completely enclosed in high-grade phenolic mouldings. Solder tags heavily silver plated for quick soldering. Fully insulated spindles with integral control knobs. Tapped for 2-hole 6 B.A. fixing on 1” centres. Type 126, wire-wound. Type 127, carbon.

STANDARD CARBON POTENTIOMETERS. Made by an entirely new method ensuring a highly stable resistance element, which is also very durable. Silent and smooth in operation, these controls offer both mechanical and electrical reliability. Soldering tags are heavily silver plated to resist oxidation, and the mains switch has an efficient quick make-and-break action.

PRE-SET RESISTOR. This has a wire-wound resistance element, traversed by a nickel-silver slider. Adjustment is effected by a worm drive spindle fitted with a knurled and slotted knob. This component is smooth and noiseless in action and is designed to meet the many and varied requirements of the Electronic Industry. Egen pre-set resistors can be supplied in multi-bank assemblies to suit individual requirements. There are also twin-track models, and types with an electrically divided slider, giving adjustment on two resistors with one operation.

EGEN ELECTRIC LTD. Charfleet Industrial Estate, Canvey Island, Essex • Phone: Canvey Island 691/2
Are you bewildered... by the variety of Hi-Fi apparatus now offered?

If so our unbiased guidance is at your command. APPARATUS RECOMMENDED BY WEBB'S BEARS THE HALL-MARK OF RELIABILITY AND QUALITY, we list a few examples, each offering the very best value in its price range.

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<th>LIST PRICE</th>
<th>Or if you so desire, here are Webb's &quot; Terms &quot; to assist</th>
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<tr>
<td><strong>WEBB'S &quot;6 MONTHS PLAN&quot; NO INTEREST CHARGES</strong></td>
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<td><strong>WEBB'S &quot;SAND-FILLED&quot; CORNER BAFFLE</strong>, exquisitely finished in walnut</td>
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**ANY APPARATUS or ANY COMBINATION over £15 in value can be accommodated under WEBB'S "EASY" TERMS. BUT, before ordering, do first avail yourself of our expert guidance on the best possible combination for your proposed outlay.**

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The model "315" Loudspeaker is the latest product of the H. A. Hartley Co. Ltd. It is a 12in. diameter unit with a very wide frequency range.

This wide frequency range is obtained by means of a special voice coil construction and a two-part cone joined by a compliance, which together form a mechanical crossover system.

This method of construction possesses four major advantages:

- Expensive electrical crossover systems as used with dual speaker arrangements are eliminated.
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- Every speaker is individually assembled and tested to ensure the finest quality workmanship.

We are pleased to offer this new speaker at the price of:

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152, HAMMERSMITH ROAD, HAMMERSMITH, LONDON, W.6.

Telephone: RIVerside 7387
**WIRELESS WORLD**

OCTOBER, 1955

**ALL AT MANUFACTURERS COST!**

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**RADIO RECEIVER CHASSIS**

Built to the highest specifications, these chassis offer the finest value to the enthusiast. Supplied with set of selected knobs. Socket panels for aerial, earth, speaker, pick-up and gram motor. 200/250/50 cycles only.

- **TYPE A 5 VALVES**
  - 5-valve Superhet with full negative feedback and A.V.C. Built-in Ferrite antenna. Full range tone control, £9/19/6

- **TYPE B 7 VALVES**
  - 7-valve Superhet with specially designed push-pull output stage. Separate Bass and Treble control, £15/4/6

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**SPECIAL F.M. CHASSIS**

A six-valve pure F.M. chassis with single waveband only, covering all existing and projected B.B.C. FM transmissions. Highest degree of I.F. amplification making it ideally suitable for fringe areas. Output stage specially designed around an EL 41 output valve ensuring a really wide audible frequency range. Permeability-tuned circuits with high stability factor. Special wide-range tone control. Output 4 watts. A.C. 50 cycles only. Provision for external speaker. Co-axial socket for dipole aerial. £9/19/6

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**A.M./F.M. CHASSIS**

A nine-valve A.M./F.M. chassis with 4 wavebands (Long, medium, short and F.M.) push-pull output stage and magic eye for precision tuning. Specially designed, with permeability-tuned F.M. circuit and a very high degree of I.F. amplification for fringe-area reception, it offers the finest quality regardless of price. Automatic volume control and a special wide-range tone control. Push-pull output stage and compensated network for electrostatic treble speaker, with an output of 5 watts and the widest possible audible frequency range. Special large 10in. high flux-density F.M. Speaker with hyperbolic cone plus matched high-tone electrostatic Speaker. Co-axial socket for dipole aerial. A.C. 50 cycles only. Provision for external speaker. £23 Gns.

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**DOMESTIC DIRECT SALES LTD.**

ALL FULLY GUARANTEED GENEROUS HIRE PURCHASE TERMS

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THE NEW PREMIER TELEVISOR
13 CHANNEL DESIGN
SUITABLE FOR USE WITH ANY POPULAR WIDE ANGLE TUBE

DESIGN 1. Includes a Multi-Channel Tuner (Channels 1-13) continuously variable 40 — 100 Mc/s and 170-225 Mc/s. The Tuner is supplied wired and tested and is complete with valves, all connecting leads and fixing brackets.

THIS DESIGN MAY BE BUILT FOR £34/7/7 (plus cost of C.R.T.). Packing and carriage extra.


* Constructors who have built Design 2 (5 Channels) may convert their receivers to Design 1 for £6, this price includes Multi-Channel Tuner, New Vision Input Coil and full instructions.

* All coils supplied for these two Superhet Receivers are PRE-TUNED ASSURING ACCURATE ALIGNMENT and EXCELLENT BANDWIDTH.

* Duomag permanent magnet focusing with simple picture centring adjustment.

* Exceptionally good picture “hold” and interlace. Noise suppression on both Sound and Vision.

THE COMPLETE TELEVISOR IS SAFE TO HANDLE, BEING COMPLETELY ISOLATED FROM THE MAINS BY A DOUBLE WOUND MAINS TRANSFORMER. ALL PRESET CONTROLS CAN BE ADJUSTED FROM THE FRONT, MAKING SETTING UP VERY SIMPLE.

The Televisor may be constructed in 5 easy stages: (1) Vision, (2) Time Base, (3) Sound, (4) Power Pack, (5) Final Assembly. Each stage is fully covered in the Instruction Book, which includes layout, circuit diagrams and point-to-point wiring instructions.

The Instruction Book also includes full details for converting existing Premier Magnetic Televisors for use with modern wide angle tubes. All components are individually priced.

Instruction book 3/6, Post Free. Includes details of both designs

CONSOLE CABINETS
For 14", 16" and 17" Televisors

A handsome Walnut Cabinet that will be a fitting housing for a first-class Televisor.

Folding doors are fitted to cover the Cathode Ray Tube when not in use. A flap is provided which gives access to the preset controls on the front edge of the Chassis. A baffle board suitable for a 10in. Loudspeaker and all the necessary Tube and Chassis bearers are included. The overall dimensions of the Cabinets are the same: Height 38in. Width 19in. Depth Top 19in. Depth Bottom 21in.

TUBE ESCUTCHEONS

17in. White Moulded .................................................. 2/- (pkg. of 10)
17in. Bronze Moulded, complete with Protective Glass .......... 4/- (pkg. of 20)
14in. Black Moulded .................................................. 2/- (pkg. of 10)
Dark Screen Filter suitable for 14in. Tubes ...................... 3/- (pkg. of 5)
Dark Screen Filter suitable for 17in. and 19in. Tubes .......... 3/- (pkg. of 5)
Plywood Shroud for E.E.T.901 ...................................... 6/-
Rubber Ring (anti-Corona) for E.E.T.901 ...................... 6/-

PRICE £13-10-0 PLUS 2/- PKG. & CAR.

TERMS OF BUSINESS: Cash with order or C.O.D. over £1. Please add 1/- for Post Orders under 10/-, 1/- under 40/-, unless otherwise stated.

H.P. TERMS: DEPOSIT £4.10.0 & 10 MONTHLY PAYMENTS OF £1.0.0
**PREMIER RADIO COMPANY**

**4-WATT AMPLIFIER**

**V.F.F. FREQUENCY MODULATION**

**RECTIFIERS**

**PREMIER BAND III CONVERTER**

**E.H.T. Pencil Type S.T.C.**

**MINIATURE TUNING CONDENSERS**

**RADIOGRAM CHASSIS**

**AN F.M. TUNING UNIT COMPLETE IN EVERY DETAIL INCLUDING ITS OWN POWER SUPPLY**

**FOR £12. 12. 0 CASH OR**

**H.P. TERMS DEPOSIT £4. 5. 4 AND 10 MONTHLY PAYMENTS OF £18**

**PLUS POSTAGE AND PACKING 5/-**

The above tuner incorporates the latest type permeability tuning unit with coverage of 66-103 mcs. Radiation less than 26 microvolts Receivers (this type of fault is present in many of the Tuners at present offered for sale to the public).

Only two controls, a gear driven slow motion tuning control and an output volume control. Dial size 11 in. x 3 in.

**V.H.F. Tuning Unit type UT340 permeability tuned, coverage 26-103 mcs.**

**PUSH-PULL OUTPUT TRANSFORMERS.**

The above tuner incorporates the latest type permeability tuning unit with coverage of 66-103 mcs. Radiation less than 26 microvolts Receivers (this type of fault is present in many of the Tuners at present offered for sale to the public).

Only two controls, a gear driven slow motion tuning control and an output volume control. Dial size 11 in. x 3 in.

**ILLUSTRATED LIST AVAILABLE GIVING FULL DETAILS OF BUREAU TYPE CABINETS**

**A RANGE OF BAND 3 AND F.M. AERIALS IS NOW AVAILABLE**

**TISSON RECEIVER UNIT**

**GRADE B**

**POWER SUPPLY UNIT WITH OUTPUT STAGE FOR**

Jones plugs for connecting the Power Pack to the Re-ceiver are fitted. The 6.3 V output stage complete with output transformer and 0.6 ohms speaker is built into the unit. Price £2/6/- plus 5/- packing and carriage.

**POWER-FULL OUTPUT TRANSFORMERS. 2X6V6 into 8 ohms, £1. 6/- post free.**

**A RANGE OF BAND 3 AND F.M. AERIALS IS NOW AVAILABLE**

**PORTABLE TAPE RECORDER CABINETS**

**ALL REXINE COVERED**

**Type**

<table>
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<td>LM 6</td>
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<td>LM 13</td>
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**We carry a comprehensive stock of components by all leading Manufacturers.**
**PREMIER RADIO COMPANY**

**WILLIAMSON AMPLIFIER KIT 15 gns.**

H.P. Terms:
Deposit £3.15s. 6d. & 6 monthly payments of £1.1.8

This Kit is absolutely complete and all components are guaranteed exactly to the Author's specification.

**WILLIAMSON OUTPUT TRANSFORMER**

Author's Specification 2.4 ohms secondaries £10.10.0

Mains Transformer SP425A

(Completely Shrouded)

This Transformer has an additional 0.3 v. 3 A and is capable of supplying an extra 50 mA. for Pre-amp or Preamplifier unit. £12.12.6

**WILLIAMSON CHOKES**

12H 110 mA. Fully shunted 18/6

30H 20 mA. Fully shunted 11/9

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**PRE-AMPLIFIER AND TONE CONTROL UNIT**

Suitable for use with the "Williamson" or any other Quality Amplifier. Two switch inputs with pre-set volume control. Tone control, bass boost and treble boost & cut controls fitted. Bass boost & cut controls are engined in silver. Power requirements LT 1 volt, 8 mA, HT 250 volts 8 mA. Kindly state HT voltages required, if over 250 volts, to enable the correct dimpling resistor to be fitted in the Pre-amplifier. Completely wired, tested and supplied with Valves for £17.11.6, post age and packing 2/6.

**DECCA MODEL 33A RECORD PLAYER ADAPTABLE FOR STND. OR LP.**

Includes crystal pick-up with magneto stylus and a light-weight plastic turning balanced arm. Heavy gauge brass steel case with brown enameled black in excellent quality for operation on A.C. mains 200-250 volts. 50 c.p.s. Supplied complete with single lead (either standard or low play) cartridge £3/10s. Elastic head can be supplied. Price £17.11.6. Postage and G.D. 2/6.

**DECCA MODEL 37A.**

Appearance as above (Model 33A) except that the pickup is 78 r.p.m. and standard, crystal turnover head. £21.10.6. Price packing and carriage 2/6.

**3-SPEED AUTOMATIC RECORD CHANGER**

Made by World-famous manufacturer, The Unit designed to play 10-15, 78 and 45 r.p.m. records. In any order at 78s, 45 or 78 r.p.m. Capacity 10 records. New revolving dual stylus crystal Pick-up has extended frequency range. For use on 100/150-250/300 volts 50 cycles. A.C. makes.

LIMITED QUANTITY ONLY.

Brand New, guaranteed and in manufacturers' original packing. BARGAIN OFFER £9.19.6

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**CRYSTAL MICROPHONE INSERTS**

Ideal for tape recording and amplifier. No. 5315. Matching transformer required. 11/6 post free.

**SPECIAL OFFER**

Acos Microphone type 122 complete with Stand 39s.

**PREMIER MAINS TRANSFORMERS**

All primaries are tapped for 200-230-250 v. mains 40-100 cycles. All primaries are screened.

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SP3819 100-350, 15 m.A., 1 v. 8 1.5 v. 3 v.

SP3820 100-350, 15 m.A., 1 v. 8 1.5 v. 3 v.

SP3821 200-400, 30 m.A., 1 v. 8 1.5 v. 3 v.

SP3822 200-400, 30 m.A., 1 v. 8 1.5 v. 3 v.


PREMIER RADIO COMPANY

NEW

A TAPE RECORDER COMPLETE

IN EVERY DETAIL AND READY FOR USE FOR

£40 CASH OR

H.P. Terms. Deposit £10.0.0 and 12 Monthly payments of £2.15.0. Plus Packing and Carriage 21/-.

- Case finished in Brown & Antique Fawn.
- Size 15" x 12½" x 7½" with the very latest type continental gilt fittings.
- Two speeds 7½ and 3½ per sec. playing time of 1 hour and 2 hours.
- Standard 7" reels 1,200ft.
- Drop-in tape loading.
- Positive brakes, no tape "slipping" after braking.
- Fast rewind forward or reverse without removing tape.
- One knob deck operation.
- Amplifier may be used for gramophone or microphone purposes giving high-quality reproduction.
- Microphone compartment.
- Complete with reel of Scotch Boy tape (1,200ft.), spare reel and Acos type 33-1 microphone.
- Latest type Lane Mark 6 Tape Deck.
- Detachable lid and control cover.
- Control panel finished in matching colours with the tape deck.
- Elliptical speaker of the latest type 7" x 4½".

Completes a standard work for Television Engineers

Television Receiver Servicing: Volume 2

Receiver and Power Supply Circuits

By E. W. A. Spreadbury M.BRIT.I.R.E. Volume 2 of this unique work follows logically where Volume 1 left off. It covers the video circuits, vision tuning and detector circuits and includes methods of multi-channel tuning, the sound channel and power-supply circuits. There is also a chapter on television aerials and another on the technique of circuit alignment.

With Volume 1 this book provides the experienced service engineer a complete picture of the problems likely to be encountered in television service work. 8½" x 5¼", 308pp., 21s. net. By post 21s. 8d.

NOW ON SALE — GET YOUR COPY TO-DAY

Universal praise for Volume 1.

"... worth double its cost. This book is highly recommended."— The Practical Radio Engineer.

"... a very valuable book, excellently written, illustrated and produced."— Journal of the British Institution of Radio Engineers.

"The Book succeeds where others have failed."— Marconi Review.
Who ever heard of a set designer with no headaches? We haven't. But we do know of many with considerably fewer headaches since they discovered the Monarch Automatic Record Changer.

Many manufacturers have, in fact, found the Monarch to be so completely reliable they have eliminated their own tests!

Any designer with more than his fair share of headaches would do well to examine the Monarch carefully. His critical appraisal will reveal a changer with many virtues, no vices—and no headaches.

The Monarch is now fitted as standard equipment by the majority of the world's leading set makers.

---

special features

* Exclusive 'Magidisk' automatically selects 7 in., 10 in. and 12 in. records, intermixed.
* Plays up to 10 records at 33 1/3, 45 or 78 r.p.m.
* High compliance crystal cartridge fitted with dual sapphire styli.
* 'Rotocam' centralized control is simple, foolproof and trouble-free.
* Independently tested Monarchs have completed equivalent of over 90 years' faultless performance.

MONARCH
world's finest autochanger
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VOLUME 61 NO. 10
PRICE: TWO SHILLINGS
FORTY-FIFTH YEAR OF PUBLICATION
The need for efficient timebases for 90° picture tubes was mentioned in “Valves, Tubes, and Circuits” No. 33 (a reprint is available). The line timebase shown above is for use with the Mullard MW53-80 21-inch, 90° tube, operating at 16kV e.h.t. The h.t. drain of 19W is little more than that of a typical 70° scanning system.

The change from 70° to 90° necessitates, for scanning coils of a given length, an energy increase of \((\sin 45°/\sin 35°)^2 = 1.5\) times. The sensitivity of the coils is reduced because their magnetic length must be shortened to avoid corner cutting (partial compensation is obtained by extending the coils up the flare of the tube). And, for the larger picture area, the e.h.t. voltage must be increased if the beam current is not to be excessive.

For given values of scanning coil energy, booster diode conduction period, e.h.t. voltage, flyback time, and peak pentode anode current, there is an optimum h.t. line voltage for highest circuit efficiency. Thus for a given h.t. line voltage there is an optimum value of peak pentode anode current. In a conventional 70° circuit a resistor in the cathode lead of the output pentode, commonly dissipating 1.5W, is used to reduce the h.t. potential. Its removal increases the scanning coil current and peak anode current and voltage. If the peak anode current is corrected by alteration of the turns ratio of the diode and pentode windings, the h.t. drain is unchanged and the output to the scanning coils is increased. The resulting excessive peak voltages on the booster diode and output pentode are counteracted by tuning the leakage inductance of the e.h.t. overwind (points 6 to 7) to approximately the third harmonic of the flyback oscillation. This does not lengthen the flyback; and it helps to eliminate ringing at the start of the scan. Energy flows, during flyback, from the primary to the leakage inductance of the overwind and then back to the primary. The tuning is not critical.

The scanning coil connections (points 3 and 4) are equidistant respectively from points 1 and 5, which are at a.c. earth during scan. Ringing voltages at points 3 and 4 are equal and of the same polarity, therefore the ringing current through the coils is zero. The series width coil and the linearity coil are in opposite ends of the scanning coil feeds in order to disturb this balance as little as possible. Operating conditions for the circuit will be included in the reprint of this advertisement. They should be closely reproduced in the interests of maximum valve life. The reprint will also include a frame timebase circuit.

Reprints of all advertisements in this series are available without charge from the address given below.

MULLARD LTD., Technical Service Department, Century House, Shaftesbury Avenue, London, W.C.2
**Transistors are good!**

These long life transistors in your circuits will save space and power and incidentally save weight.

Brimar transistors are the result of extensive development. Exhaustive tests have proved their reliability over a long period.

Brimar are now able to offer several types in small quantities for development work.

The BRIMAR TP1 and TP2 are point contact, in type, germanium transistors.

Type TP1 may be used in control and switching circuits at frequencies up to 100 Kc/s. and will work consistently and reliably within this range.

Type TP2 may be used as an amplifier or oscillator at frequencies up to 2 Mc/s.

Collector dissipation 150 mW max. at 20°C.

The BRIMAR TJ1, TJ2 and TJ3 are p.n.p. alloyed junction transistors intended for use in low frequency applications up to 500 Kc/s. The small size and low power consumption of these transistors permits the design of light, compact equipment. Since the cases are of metal there is little danger of accidental fracture, and the transistors are also thereby rendered lightproof.

Collector dissipation 200 mW at 20°C.

Send for data sheet of these transistors to

**Standard Telephones and Cables Limited**

Publicity Department: FOOTSCRAY, SIDCUP, KENT. FOOTscray 3333
"g" is the symbol for acceleration which, to the technical, is defined as the differential of velocity with respect to time. More simply this means the rate of change of speed.

When "g" is too great, damage will be done. A locomotive leaves the rails when it takes a curve too fast. At only 6 "g", a pilot blacked out when he pulls out of a dive; at 20 "g", which is very much more than any plane can possibly encounter, the plane would disintegrate.

The stylus tip of a pick-up is subjected to the same acceleration but to an infinitely greater extent. The undulations of a record groove cause the stylus to vibrate as much as 10,000 times per second or more. It moves to one side of the groove, stops, moves to the other, stops again and so on throughout the record. The accelerations acting upon the stylus tip are measured in "g" and with modern recordings may be well over 1000 "g".

Obviously a light freely suspended stylus will follow rapid changes of direction in record grooves more easily than a heavy, stiffly mounted one. On a heavily recorded record a "stiff" pick-up will tear through record grooves or even jump right out of them. Result: rapid record and stylus wear and poor reproduction.

Correct tracking of modern electrical recordings with their great musical and dynamic range calls for pick-ups specially designed to cope with very high "g". They are available, after much patient research and development, under the name "Hi-g". ACOS "Hi-g" pick-ups perform perfectly at any multiple of "g" they are called upon to meet, representing a truly revolutionary advance in pick-up design. If you want your valuable records to reproduce as well as the makers intended—and to go on doing so for a long time—use an "ACOS Hi-g" pick-up.

(Write for a free copy of the new Cosmocord booklet "The ABC of Hi-g".)

... always well ahead

ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

COSMOCORD LIMITED • ENFIELD • MIDDX • TEL: ENField 4022
"BELLING LEE" NOTES

G9AED LICHFIELD

Soon after the publication of this issue, G9AED will be radiating a test transmission from the I.T.A. site at Lichfield. According to schedule we commence on October 10th. Arrangements are being made now to enable us to dismantle the transmitter at Croydon and to install it in a trailer that may be taken north when required.

We will invite readers to send in reception reports which will be acknowledged by a Q.S.L. card. From these reports we will build up a map similar to the one resulting from the Croydon transmission.

MIDLAND AERIALS FOR I.T.A. RECEPTION

It is a fact that, owing to the frequency relationship that will exist between the B.B.C. Sutton Coldfield and the I.T.A. Lichfield transmitter, it will be possible for a considerable number of viewers to receive I.T.A. signals on their B.B.C. band I aerials. But it should be remembered that, when so used, the band III polar diagram is very poor and interference from passing motor vehicles may be troublesome.

EXPANSION OF PRODUCTION FACILITIES

This autumn we are bringing into production an additional 41,000 sq. ft. of factory floor space distributed between Enfield, Welwyn Garden City, and Liverpool, and we have purchased 8 acres of industrial land in Enfield, and 4½ acres in Liverpool, adjacent to our existing lines. We are starting the season with the largest stocks of aerials and parts in the history of the Company. In aerials alone the stock is more than double that previously held.

£25,000 THIRD PARTY INSURANCE

"Belling-Lee" were the first aerial manufacturers to offer a £1,000 third party cover for a period of three years; this cover has now been increased to £25,000. A card giving details of this and the guarantee is enclosed with each aerial. The cards should not be returned to "Belling-Lee" unless in support of a claim.

BAND III LOFT AERIALS

A WARNING

Whereas a loft aerial may be expected to give good results up to 15-20 miles, when only tiles or slates are between the aerial and the transmitter, there is likely to be disappointment if there is a brick or stone gable end in the way: the signal will be considerably attenuated by the more solid building materials.

We scored a "first" when we extended the period of our aerial guarantee and insurance from one to three years—now we again take the lead by announcing that the insurance is increased to £25,000 in respect of third party claims for the same period.

Only a firm with unbounded faith in the quality of its products can make such an offer—it is a further measure of our supremacy.

MARCONI–SIEMENS

Five Band Split Privacy Radio Telephone Equipment

(TYPE HW 12)

This equipment, which may be switched in or out of use at the radio terminal, provides a very high degree of privacy for speech on a radio-telephone circuit by:

1. splitting the speech band of 250-3000 c/s into five sub-bands of 550 c/s and recombining them in different relative positions,
2. inverting the frequency range of any one or more of the sub-bands, and
3. rearranging the combination of the sub-bands simultaneously at both ends of the radio-circuit in accordance with a pre-arranged sequence at controlled intervals between 4 and 20 seconds.

The resulting speech band, which modulates the transmitter, is unintelligible and the frequent regrouping of the sub-bands, with or without inversion precludes any simple method of interception. A reversal of the process at the distant terminal restores the original speech. The processes involved are reversible, thus common channel equipment can be used for both transmission and reception. Amplifiers in the privacy path compensate for the losses in band splitting and recombining. The simultaneous switching system, operates by means of relays under the control of a synchronous motor driven by a high precision crystal oscillator, this does away with the need for a transmitter pilot tone.

THE LINK BETWEEN RADIO AND LINE COMMUNICATIONS

Full technical details of this and other Marconi-Siemens equipment, which provides completely integrated radio and line telegraph and telephone systems may be obtained from either

MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, CHELMSFORD, ESSEX
OR SIEMENS BROTHERS & CO., LIMITED, WOOLWICH, LONDON, S.E.18
NEW! THE PRACTICAL WAY
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Why Ediswan Clix P.T.F.E. Valveholders are widely used in B.B.C. Television equipment

Large quantities of Ediswan Clix P.T.F.E. Valveholders are used in B.B.C. Television equipment. Only the combination of the finest insulation—P.T.F.E., the most efficient contact material—Beryllium copper—and Ediswan Clix design and manufacture can match the requirements of efficiency and reliability in this and all other stringent valveholder applications. Ediswan Clix P.T.F.E. Valveholders are fully type approved for Services Grade 1, Class 1 conditions. Full details of these valveholders and other components in the Ediswan range are given in catalogue CR. 1681. Manufacturers and Development Groups may have a copy on request.

EDISWAN

CLIX

RADIO, TELEVISION & ELECTRONIC COMPONENTS

THE EDISON SWAN ELECTRIC COMPANY LIMITED, Member of the A.E.I. Group of Companies
Marconi 6kW HF ISB Transmitters

Types
HS 71 and HS 72

These transmitters, designed in accordance with the most advanced practice, provide:

(a) Telegraphy on CW and FSK (A1 and F1)
(b) Independent Sideband Operation (A3b)

The drive equipment is external and provides either ISB modulation or telegraph keying at 3.1 Mc/s and suitable RF oscillator signals for frequency changing in the transmitter. HS 71 is manually operated; HS 72 provides full automatic tuning and selection of any one of six pre-set frequencies.

Features include

- Tuning over the whole range without change of components
- Air cooling throughout, with dust filtering.
- Double screening of power stages reduces indirect radiation and cooling air noise.
- Envelope feed back to reduce distortion.
- Compact assembly with good access for servicing and safety interlocking.

More than 80 countries now have Marconi equipped telegraph and communication services, many of which, completed 20 years ago, still give trouble-free operation.

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MARCONI

Complete Communication Systems
Surveyed, planned, installed, maintained

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SUBJECT(S) OF INTEREST
(We shall not worry you with personal visits)

POSTED OCTOBER 1955
VORTEXION TAPE RECORDER

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

★ The total hum and noise at 74 inches per second 50-12,000 c.p.s. unweighted is better than 50 dbs.
★ The meter fitted for reading signal level will also read bias voltage to enable a level response to be obtained under all circumstances. A control is provided for bias adjustment to compensate low mains or ageing valves.
★ A lower bias lifts the treble response and increases distortion. A high bias attenuates the treble and reduces distortion. The normal setting is inscribed for each instrument.
★ The distortion of the recording amplifier under recording conditions is too low to be accurately measured and is negligible.
★ A heavy mu-metal shielded microphone transformer is built in for 15-30 ohms balanced and screened line, and requires only 7 micro-volts approximately to fully load. This is equivalent to 20 ft. from a ribbon microphone and the cable may be extended 440 yds. without appreciable loss.
★ The 0.5 megohm input is fully loaded by 18 millivolts and is suitable for crystal F.U.S., microphone or radio inputs.
★ A power plug is provided for a radio feeder unit, etc. Variable bass and treble controls are fitted for control of the play back signal.
★ The power output is 3.5 watts heavily damped by negative feedback and an oval internal speaker is built in for monitoring purposes.
★ The play back amplifier may be used as a microphone or gramophone amplifier separately or whilst recording is being made.
★ The unit may be left running on record or play back, even with 1,750 ft. reels, with the lid closed.

POWER SUPPLY UNIT to work from 12 volt Battery with an output of 230 v., 120 watts, 50 cycles within 1%. Suppressed for use with Tape Recorder. PRICE £18 0 0.

We supply and recommend the Jason F.M. Feeder Unit. PRICE £15 17 0, including Purchase Tax.

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
Telegrams: "Vortexion, Wimble, London."
MARCONI'S need can carry you to the top of your profession

The career of installation engineer of broadcasting communications and radar equipment with Marconi's, has extremely high international traditions of resourcefulness, ability and breadth of experience both technically and generally. It leads to the top ranks in the company and to world-wide travel. Well paid, permanent and pensionable it is attractive to men who rise to a challenge and who have also a sense of responsibility to their dependents. When serving abroad engineers receive an overseas allowance. Living expenses on all work which takes them away from their homes whether overseas or not, are on a generous scale suitable to their high standing as the Company's representatives. Generous leave, at overseas rates, is granted on return from work abroad.

Marconi's are seeking both those who already have the technical and general qualifications and experience for this work, and younger men with the right technical education, whose abilities can be developed by the experience and training which the Company gives.

SPECIAL PURPOSE VALVES

Z319 SECONDARY EMITTER PENTODE

It is well known that the limiting factor of conventional valves in wide-band applications is the ratio of the mutual conductance to valve capacitances. Little improvement in this factor can be expected from the conventional type of R.F. pentode made to normal commercial tolerances.

The Emitron Z319 applies to thermionic valves the techniques successfully employed by E.M.I. in the design and manufacture of photomultipliers. A single stage of electron multiplication is used and an anode current of secondary electrons three times higher than the primary cathode current is obtained, with a three-fold improvement in the slope of the valve and little increase in the capacitances. Below is given a table comparing these parameters for the Z319 with those of Z77, a standard R.F. pentode.

In addition to its uses in R.F. amplifiers, the fact that the secondary cathode current of the Z319 is equal to, and 180° out of phase with the anode current, makes it suitable for use in a number of unusual trigger circuits. Moreover a push-pull output can easily be obtained from an unbalanced input.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Z319</th>
<th>Z77</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mutual conductance</td>
<td>19 mA/V</td>
<td>7.5 mA/V</td>
</tr>
<tr>
<td>Input capacitance</td>
<td>8.0 µµF</td>
<td>7.5 µµF</td>
</tr>
<tr>
<td>Output capacitance</td>
<td>3.0 µµF</td>
<td>3.2 µµF</td>
</tr>
<tr>
<td>Anode to contact grid capacitance</td>
<td>.003 µµF</td>
<td>.01 µµF</td>
</tr>
</tbody>
</table>

The Z319 has a standard B9A base and is the commercial equivalent of the CV2276.

For further data and prices apply to:

E.M.I. ELECTRONICS LTD
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TELEPHONE: SOUTHALL 2468, EXT. 655, 658 & 657. CABLES: EMIVISION, TELEX, LONDON
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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 on weight work. 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 obtained 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 for all our public demonstrations, including those at the New York Audio Fair. These are some of the reasons why the average monthly sales of the TL/10 and "Point One", since their introduction in April last year, are more than three times as great as for the famous TL/12—and why the size of our factory has been more than doubled to cope with this increased demand.

"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%.

★ Hum
Negligible, due to the use of recently developed valves and special techniques.

★ Input selector
Radio, tape, records; any and all records can be accurately equalised.

★ Volume Control and Switch
The switch controls the power supply to the TL/10 power amplifier.

★ Tape Recording Jacks
An exclusive feature. Readily accessible jacks are provided on the front panel for instantaneous use with Tape Recorders which have built-in (low level) amplifiers.

ELECTROSTATIC LOUDSPEAKERS

Reprints of "The Gramophone" article (May, 1955), by H. J. Leak, summarising his work and findings on Electrostatic and Dynamic Loudspeakers, are available on request, free of charge.

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In the fields of electronics and radar, EKCO equipment is known all over the world for its standards of design, performance and reliability: and EKCO radio and television receivers have earned the same reputation. The cabinets are handsome and well-made while the receivers themselves embody the same high standards of design and engineering. On both sides of the picture, in the air and in the home, Ekco stands for all that is meant by 'quality engineering.'

**Model A239**
A high-grade 6-valve (plus tuning indicator) AM/VHF receiver designed to do justice to the B.B.C. V.H.F. broadcasts and at the same time provide excellent performance on long, medium and short waves.

35 GNS tax paid

**Model TC220**
A luxurious 21" screen receiver with every technical feature known to modern television plus facilities for V.H.F. radio reception. The cabinet, too, is an outstanding example of craftsmanship.

140 GNS tax paid

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POTTED MAINS TRANSFORMERS

These are of really superior construction and are made in cast metal cases and completely finished. Terminals come to shoots which form part of the transformer. They are designed to have conductors and have 200/230 normal 80 cycle mains input and output type screened primary and secondary. Type EPF, 250-0-250 at 300 mA; $3.75 + 2/6 carriage.

Type EPF 300-0-300 at 150 mA at 2 3/4 A; 5.75 + 4 1/2 carriage.

Type EPF 1500-0-1500 at 14 1/2 A; 6.5 + 4.2 carriage. Price $32/6, carriage 3/6.

Type EPF, 750-0-750 at 14 1/2 A; 6 + 4.2 carriage. Price $32/6, carriage 3/6.

POTTED CHOICES

These are similar type cases and are intended for the switch transformers. Type EPS, 3 3/4 at 150 mA. Price 100/-

Type EPS 1 1/8 at 50 mA. Price 100/-

Type EPS 10 at 150 mA. Price 12/6.

Post and packing 3/6.

RELAYS P.O. 3000 TYPE

Rel. P1, 250 ohm, slow decay coil. Plate, two make. Price 5/6 each.


Rel. P4, 10 ohm standard coil, one pair plate, contact also mounted but not operated by the relay, and thermal change over contacts, make before break. Price 5/6 each.

WELD TYPE WIRE JOINER

This pliers melts the end of the metal of each to run past the metal and makes the strongest and permanent joint. It is not intended to replace the soldering iron, but it can be done to a reasonable saving of current. Price 5/6.

Complete with europen metal transformer, 20/6.

AUTOMATIC TRANSFORMERS

For working anywhere. To suit all mains from 50 to 60 cycle. For use with all standard fixtures, lights, etc., Input tapped 0-200-400. Price 115. In addition to those listed above we have special this month 120/200 watt totally enclosed in metal box with input and output leads. Price 47/6, plus 9/6 post and packing.

Totaly enclosed and screened.

50 watt...$6.00

100 watt...$11.00

250 watt...$27/6

500 watt...$45/6

1000 watt...$69/6

Unscreened

1.5 kVA (1,500 w.)...$24/6

2 kVA (2,000 w.)...$30/6

3 kVA (3,000 w.)...$30/6

5 kVA (5,000 w.)...$45/6

VARIABLE RESISTORS

Heavy Type

Ohms Ams. Price

4...5--40...3/6

1...10--10...5/6

1/2...3...6/6

1...3--11...5/6

1/2...5--11...5/6

1...6--11...5/6

These are spiral type, output type.

For remote control of D.C. motors between 1 and 3 kw., adjustment in 1500 w. or 2400 v. Insulated and in all weather condition, complete with switch and wire covered cable. Price 21/6, carriage 5/6.

MAINLY FOR THE INDUSTRIAL USER

UNITS FOR CONTROLLED AUTOMATIC FITATION

We have brand new, still in original wrapped packing cases as supplied from America two lines of equipment which form part of the electron system RCO4. These two units work together to form a Tower rotating device, with remote control.

Item 1, known as Tower 94A, is in fact the ground driving motor which rotates the mast. This is a heavy construction which would reduce a heavy carrying, reflector, drain scap, etc.

Item 2, known as Indicator 102-A is a device which allows the azimuth position of Tower 94A to be controlled from a remote point. Conversely, it enables the azimuth position of the tower to be known, giving 102-A the mast's azimuth position. The equipment is standard for 117 volt A.C. mains and will operate from our mains if connected through step down transformers of 1 K.V.A. rating.

Price 1-911-1 $35 plus carriage.

Price 2-912A-1 $25 plus carriage.

Special discount of 50 for cash or order by 12/6. Both units purchased together.

R.F. HEATERS CONSTRUCTORS KIT

THE ELPRO R.F. HEATER

The ELPRO R.F. Heater has been planned to fill the need in industry for a reasonably priced unit to be used in the works or for development.

The heater is supplied in form, mainly to keep the cost low but also so that users will wish to make the unit suitable for the production line. It is not possible to have a unit which is equally efficient for both dielectric and inductive heating a frequency efficient for dielectric work has been chosen. It being that this fills the need the greatest.

THE POWER PACK

The Power Pack used is the "Elprop Variable 300" which is fully described in another section, the price (exclusive of tax) of a variable of 300 watts, 1,000 volts is approximately £10 15/6 continuous rating.

THE R.F. UNIT

Two carbon anode, high power tube works into a push-pull circuit at 12,000 volts. The R.F. output is the "work" which is taken from the tank coil. Two meters are provided. The one in the main H.T. line shows the total milliamperes being drawn by the R.F. unit. The other in the R.F. output stage indicates the R.F. current into that circuit.

The output frequency is approximately 15 megacycles but this will vary with the work and can be deliberately changed by tuning or by altering the size of the tank coil.

The equipment intended for 117 volt A.C. is 7 amp. at 4.4 v. and 4.2 amp. at 6.9 v. for dielectric work. It contains salvo transmitter/receivers and it is these that provide the impulses which causes the metal to rotate backwards or forwards. The equipment is standard for 117 volt A.C. mains and will operate from our mains if connected through step down transformers of 1 K.V.A. rating.

Price 1-911-1 $35 plus carriage.

Price 2-912A-1 $25 plus carriage.

These chokes are in similar type cases and contain selenium transmitting/receiving and it is these that provide the impulses which causes the metal to rotate backwards or forwards. The equipment is standard for 117 volt A.C. mains and will operate from our mains if connected through step down transformers of 1 K.V.A. rating.

Price 1-911-1 $35 plus carriage.

Price 2-912A-1 $25 plus carriage.

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Price 1-911-1 $35 plus carriage.

Price 2-912A-1 $25 plus carriage.

These chokes are in similar type cases and contain selenium transmitting/receiving and it is these that provide the impulses which causes the metal to rotate backwards or forwards. The equipment is standard for 117 volt A.C. mains and will operate from our mains if connected through step down transformers of 1 K.V.A. rating.

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Price 1-911-1 $35 plus carriage.

Price 2-912A-1 $25 plus carriage.
HEAVY DUTY POWER PACKS

500 WATT 1,000 V. (VARIABLE)
The conventional circuitry is employed throughout and all components are accurately proportioned to permit substantial overloading. A master switch controls the whole unit and whenever this is on current is supplied to the rectifier circuitaries, thus keeping them always in the emissive state. The R.T. transformer is derived from the primary of the filament transformer, connecting wires being arranged to permit connection of a switch and a tapped choke. The only thing that contains the R.T. and the tapped choke in conjunction with its selector switch gives ten powers from "low power" to "high power."

Two directly heated rectifiers give a full wave output which is produced by a 10 Henry choke and a 4 mfd. condenser. A bleeder resistor connected across the output serves as a dummy load and also discharges the smoothing condenser which otherwise would be a source of danger to users.

The continuous rating of the power tube is 1,000 volts at 2,000 watts. But the variations of the components are such that 100 per cent. overloading can be allowed for pulse work or other intermittent operations. The size of the power tube is approximately 14in. x 11in. x 5in. and its weight is approximately 80 lb. Price: Kit of parts £27/10/-, or made up ready £37/10/-. 500 WATT 2,000 V. (VARIABLE)

The maximum continuous rating of this is 2,000 milliamperes at 2,000 volts. Rectification is half wave. Specification otherwise is as for the variable 500/1,000, v.

1,000 WATT 1,000 V. (VARIABLE)

The maximum continuous rating of this is 1 amp. at 1,000 volts. Rectification is full wave, output is variable. Weight approximately 30 lb, size 14in. x 11in. x 12in. Price £37/10/- in kit form, or £47/10/- made up ready to work.

FIXED MODELS

Any of the models mentioned above can be supplied without the tapped choke and selector switch. The prices are as follows:

Fixed 500/1000, 500 v. £22/10/- in kit form, or £40 made up.
Fixed 600/2000, 300 v. £20/10/- in kit form, or £40 made up.
Fixed 1000/2000, 200 v. £22/10/- in kit form, or £40 made up.
Fixed 1000/3000, 150 v. £20/10/- in kit form, or £40 made up.

All prices quoted are ex Works.

SPECIAL PURPOSE VALVES

Triode Type CV 1098—this is a high-powered aluminized triode. Specification of which is as follows:—Filament voltage 8.2 v., filament current 35 amps., anode dissipation 275 watts. Maximum anode voltage 50 kV. This valve is very suitable for R.F. heating at high frequencies and two of these in push-pull under Class C conditions will produce an output of approximately 1 kilowatt. Brand new, still in original shockproof packing, price £15 each.

Tetrode Type VT31

This is a high-powered air-cooled tetrode. Specification of which is as follows:—Heater voltage 250 v., heater current 3.75 amp., screen voltage 500 v., screen current 0.4 amp., plate voltage 2 kV., plate current 2 amp., anode dissipation 500 watts. This is half wave. Specification otherwise as for the variable 500/1,000, v. Rectification is full wave. These tubes are usually supplied in kit form, so as to permit the user to select the values of the tapped choke and selector switch according to his own requirements. Price £15.

METERS

SPECIAL AERIAL FANS

Ideal for serial con

PLUG AND SOCKET

PYREX GLASS BASES

FLEXIBLE COUPLINGS

JUMBO VALVE BASES

30 AMP ROTARY SWITCH

SPECIAL EQUIPMENT SALES

IMPORTANT NOTE

Owing to the bulkiness of many of the items listed on these two pages it may not be possible to ship the goods by stage-coach at a later date, therefore please telephone confirmation that the item is actually on the coach before ordering specially to see it.

SPECIAL SALES DEPT., E.P.E. LTD., 123, TERMINUS ROAD, EASTBOURNE.

The gross weight of the items listed on these pages will be approximately 110 lb. Each is packed separately and is shipped in a shockproof case. Please order the quantity required and specify the quantity.
"WIRELESS WORLD" BAND III CONVERTOR

One of the most successful circuits for Band III conversion was published in the Wireless World, May 1954. The results we have received from Eastbourne laboratory have been more than satisfactory and we consequently offer a complete kit of parts, including the specified EF86 valves, wounded coils, drilled chassis, in fact, everything including a circuit diagram as already published in the Wireless World, only 4½/6, post 2/6.

Mains components, if required, 25/- extra.

**BAND III AERIAL KIT**

An interesting aerial, "The Folded V," was described in the July number of a T.V. magazine. We tried this and found it to be most efficient both for interference reducing and lowfrequency reception. It is simple to make. We, therefore, offer this aerial as a constructor's kit. The kit contains alloy elements and component plastic centres, ready with all necessary insulators and saddles for mounting on existing mast or in locket, window frames, dinol pipe, etc., etc. Construct in data with parts or available separately, price 1/-.

**ADDITA—BAND III CONVERTOR**

Our convertor has given very satisfactory results from the experience reported in our station, and we have had many very complimentary reports from others. It is a neat looking unit and fits to the side or the back of the set and is designed to convert any T.V. superhet or T.R.F. and no internal modifications of any kind are required. Simply plug in the aerial, mount it on the mast, and you have Band I or Band III at the flick of a switch. Standard mounting is provided, and complete kit including parts and instructions, 42/6.

**Build it Yourself**

You can save at least 2½ on the above if you build the convertor yourself. Price of all components with any enclosed case and even transfer heads for the front, is 3½/10/-, post and insurance 2/6. It is designed to convert any T.V. set, no modifications of any kind are required. It is a very neat looking unit and fits to the side or the back of the set. Build it yourself. Price only 10/-.

**READY BUILT BAND III CONVERTOR**

This is a 2-valve unit for conversion at aerial frequencies. It is largely based upon the "Wireless World" circuit described above. Its frequency can be set anywhere within the 186/196 mobs band, and will convert to any frequency between 40 and 48 me/s (higher or lower). It is simple to make. It is designed to convert any T.V. superhet or T.R.F. and no internal modifications of any kind are required. Simply plug in the aerial, mount it on the mast, and you have Band I or Band III at the flick of a switch. Standard mounting is provided, and the unit is completely trouble free for any combination of stations.

Build it Yourself

This as is illustrated and contains 5½ fine Bourne mounted on a flexible steel foot-look. The box opens under slight pressure of the hand and snaps automatically when lifted. The tools are all that a practical electrical needs, including trim saw, rashet brace, back-saw, chisels for wood, and steel, pieces, side counters, hammers, spanners, socket wrenches, Andrews, etc. Price 5½/10/-, or 37½/- deposit and 22 payments of 20/6.

**TRANSFORMER 100 WATTS**

These are transformers with a wound primary tapped 250, 500, 240, but no secondary. There is ample window space, however, for the hard winding of secondary to suit your own requirements. Approximately 255 turns at 20 volts, 38 turns at 50 volts, 20 turns at 110 volts, etc., etc. Price 10/-, post and insurance 2/6.

**PUSH BUTTON UNIT**

9 way. Price 2/- Post ed.

Ref. 2½/6.
OCTAGONAL SPEAKER CABINET

CONTENTS: 1 x 12" speaker, 2 x 8" speakers, furniture, case. Excellent finish save for top veneer.听众, price £15.

EMPRESS CONSOLE

This cabinet is incredibly beautiful and generously proportioned. It is also elegantly veneered in figured walnut, externally finished in satin. The radio section is identical to the console's counterpart, with a £100.00 price tag.

CORDS FOR ALL

Note: This section contains information about various electronic components and accessories available for purchase.

TABLE RADIO CABINET

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 16 x 14 x 6", at £10.50. Walnut veneered and legs finished, 37/6, carriage, and insurance 7/6 extra. The cabinet is suitable for the Windsor chassis above with 6" speaker.

CABINETS FOR ALL

Note: This section contains information about various electronic components and accessories available for purchase.

THE TWIN 20

This is a complete fluorescent lighting fixture. It has been designed to be used as a starter switch or as a control device. The set comprises 20-watt lamps, Price, complete less tubes, 2/6, or with two tubes, 3/6. Post, carriage, and insurance 2/6.

MONTH’S SNIP

POWER TRANSFORMER

Table-top model suitable for 195-255 V, tapped at 5 V, steps. Originally designed for forces transmitters, this is extremely well made and will give years of service. Upright mounting, size 6 x 6 x 6. Price, 5/6. Carriage and insurance 7/6.

VALVE HOLDER PLUGS

Each is fitted with a rubber grommet. For 870 button base and type 2 for 82A. Price 2/- each, discounts for quantities.

FAMOUS WARTIME "CALS,EY" used for seeing in the dark. This is an infra-red image converter cell with a silver cadmium screen which lights up like a candlelight tube. However, the latest type is made from the infra-red cell, which is used in the kitchen, because it is not affected by electricity. The latest type is now available in the UK and is recommended for all use.

TABLE RADIO CABINET

Due to a special purchase, we are able to offer this very fine cabinet, size approx. 16 x 14 x 6", at £10.50. Walnut veneered and legs finished, 37/6, carriage, and insurance 7/6 extra. The cabinet is suitable for the Windsor chassis above with 6" speaker.
One of the finest all-purpose microphones ever made by Ronette is this type G-210. Chrome plated die-cast housing with patented "Filtercel" cartridge. Available with several types of voltage/frequency response curves. Type GS-210 has noiseless on-off switch. For use with long lines these models are available with built-in 200 ohm line transformer.

G-210 type microphones are supplied with screened standard microphone connector. 5/8 -27 thread for all normal stands.

Further information will be gladly supplied upon request.

FAMOUS MICROPHONES

TRIANON ELECTRIC LTD. LONDON NW10
95, Cobbold Rd., Willesden Telephone: Willesden 2116

E. & G. DISTRIBUTING CORPORATION LTD.
33 Tottenham Court Road, London, W1 Telephone: Museum 6667

KAYE'S for RELAYS

B.P.O. 3,000 and 600 type to your specification. Coils up to 100,000 ohms. Tropical Baked or Vacuum Impregnated. Component parts and/or coils supplied separately. Prototype relays made, if required.

CONTACT BLANKS supplied to order

KEY SWITCHES and TELEPHONE EQUIPMENT

Please may we have your enquiries NOW!

KAYE ELECTRICAL MANUFACTURING Co.
Havelock Works, Havelock Place, Harrow, Middlesex

TAPE PRE-AMPLIFIER

. . for those who want the best . .

Used with the WEARITE 2B DECK, our Tape Pre-amplifier 4/WRB/2b is capable of giving recorded quality to the highest professional standards; yet at moderate cost.

★ Completely separate recording and replay chains with direct/replay monitor comparison switching.
★ Correct pre- and post-equalization to C.G.L.R. standards.
★ Peak-programme signal metering.
★ Positive metering of bias and erase voltages.
★ Designed mainly for WEARITE 2B Tape Deck—uses all the facilities provided on this deck.

Price 55 gns.

For full details, write or telephone:
ARIEL SOUND LTD.,
57, LANCASTER MEWS, LONDON, W.2.
Telephone: PADDINGTON 5092
where
small size
and
performance
count

The Venner Lightweight Silver-Zinc Accumulator is ideal in every application where minimum size and weight are essential. It is particularly suitable for radio and "walkie-talkie" equipment. Write for full particulars and catalogue W9P.

VENNER ACCUMULATORS LTD.,
KINGSTON-BY-PASS, NEW MALDEN, SURREY.
Phone: MALden 2442.

Associated Companies: Venner Limited — Venner Electronics Ltd.

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Associated Companies: Venner Limited — Venner Electronics Ltd.
New Standard Instrument Cases

News item: the Imhof Standard Range of metal instrument cases has been considerably expanded through the addition of yet more "Standard" cases, racks, consoles and handles. Obviously, that means a wider, more comprehensive range to select from. Each item is different: each has been designed (in the full sense of the word): each is soundly constructed: and every housing is available in a number of finishes, either Standard or special.

New "Off-the-shelf" Deliveries

News item: complementing the increased range of "Standards" are the new deliveries now in force:

- 3 DAYS for Cases, Chassis and Handles.
- 7 DAYS for Racks and Consoles.

These new deliveries apply to existing "Standard" cases: the same deliveries will soon be announced for the new and more recent additions to the Range.

So there it is. If you are a user of instrument cases write (or phone) to the address below for further details: or, of course, come along to our new showrooms on the Third Floor of Imhof House—and see for yourself!

For worthwhile cases, racks, consoles and handles

Imhof's


Telephone: Museum 7878.
THE LEAK DYNAMIC PICKUP

This new pickup results from five years continuous development of our first moving coil design. Reports from users during the first few months of its sales have justified our earlier belief that the pickup might earn recognition as the best in the world.

PRICES
The arm: £2/15/-, plus 19/3 Purchase Tax.
L.P. head with diamond stylus: £5/15/-, plus £2/0/3 Purchase Tax.
78 head with diamond stylus: £5/15/-, plus £2/0/3 Purchase Tax.
Mumetal-cased transformer: £1/15/6.

SPECIFICATION

★ THE ARM
This is of advanced design having very low inertia. Friction is kept to a minimum by using a single pivot bearing. The arm is counter-weighted and has provision for plus-in interchangeable heads. An arm-rest is provided.

★ GENERATING SYSTEM
Dynamic (moving-coil). Coil impedance approximately 6 ohms, 1,000 c/s. No magnetic material is embodied in the moving parts, and the pickup is free from the inherent distortion of moving iron (magnetic variable reluctance) types. These distortions are also inherent in those dynamic pickups in which the moving coil is wound on a magnetic core.

★ STYLUS
Material: Diamond, guaranteed unconditionally not to chip or break. Stylus sizes: L.P. 0.001 in. radius ± 0.0001 in.
78, 0.0025 in. radius ± 0.0001 in.

★ PLAYING WEIGHTS
Between 2 and 3 grammes for L.P.
Between 5 and 6 grammes for 78. Automatically adjusted by the weight of the head.

★ RECORD AND STYLUS WEAR
These are lower than on any pickup of which we have cognisance. Diamond has a playing life of approx. 100 times longer than sapphire, and because it will take a higher polish than any other material it therefore causes less record wear.

★ OUTPUT
The shielded step-up transformer delivers an output of 8 mV for each cm/sec. r.m.s. recorded velocity. This means that an amplifier with a sensitivity of 40 mV at 1,000 c/s will be easily loaded by the pickup from commercial records.

★ FREQUENCY RESPONSE
Total variation ± 1 db 20,000 c/s to 40 c/s with the LP head, including transformer (recorded velocity 1.2 cm/sec, r.m.s. above turnover).
Low frequency resonance: 20 c/s ± 5 c/s with our very lightweight arm.
High frequency resonance: 0.001 in. radius on Vynil, 21,000 c/s ± 2,000 c/s.
0.0025 in. radius on shellac, above 27,000 c/s.
The frequency response does not change with temperature.

★ SIGNAL-TO-HUM-RATIO
It is not possible to specify this important ratio without stipulating the strength of the interfering fields. These fields will, of course, vary according to the installation. However, for the purpose of comparison measurements have been taken under working conditions, i.e. with various pickups mounted normally within inches of the electric turntable motor and within two feet of a power transformer in an amplifier. The results show that the Leak Dynamic Pickup has a lower hum content than any variable reluctance (moving-iron, magnetic) pickup and a very much lower hum content than a single turn moving coil (i.e. “ribbon”) pickup. This confirms what would be expected from theoretical considerations.

★ DIMENSIONS
From the centre of the fixing stem to the front of the pickup head, 9¾ in.
From the centre of the fixing stem to the rear of the arm, 2 in. The height of the pickup is adjustable and it can be used with any turntable.

★ MOUNTING
A template of original Leak design is supplied, enabling the pickup to be accurately located on the turntable mounting board. There is a single fixing hole and the stem contains a miniature socket which accepts the plug leading to the transformer (see illustration).

★ TRANSFORMER
The transformer has a step-up ratio of 1.80 and is heavily shielded in mu-metal. The primary lead is terminated in a plug and a shielded secondary lead is supplied.

★ Write for illustrated leaflet ‘W’.

Sole distributors for H. J. LEAK & CO. LTD.

AUDIO TRANSUDCERS LTD., PICCADILLY HOUSE, 33-37 REGENT STREET, LONDON, S.W.1

Telephone: REgent 5659
Telegrams: HIFI, PHONE, LONDON
Cables: HIFI, LONDON

ELECTROSTATIC LOUDSPEAKERS
Reprints of “The Gramophone” article (May, 1955), by H. J. Leak, summarising his work and findings on Electrostatic and Dynamic Loudspeakers, are available on request, free of charge
Special Offer
Brand New

T-350XM
TRANSmitters

These magnificent 350-watt Transmitters manufactured by the Technical Radio Co. of California, U.S.A., are offered at a fraction of their original cost.

Frequency Range: 2,000-20,000 Kc/s.
Power Output: Radiotelegraph 350 watts.
Radiotelephone 250 watts.

Frequency Control by Built-in Master Oscillator or Crystal Multiplier.
A.C. Mains 210/250 volts, 50-60 cycles.

Size: 58½in. high.
16in. wide.
24½in. deep.
Gross Weight: 967 lbs.
Shipping Capacity: 44.6 cu. feet

Comprising: - As Shipped in Manufacturers’ Original Sealed Transit Cases.
Case 1. Transmitter 725 lbs.
Cable 82 lbs.
36 cu. feet
Case 2. Speech Amplifier 3.9 cu. feet.
Case 3. Low Voltage Power Deck 160 lbs.
and Modulation Transformer.

The whole Transmitter complete with all Valves, full instruction books containing complete circuits, wiring and technical data, ready for immediate shipment.
October, 1955

WIRELESS WORLD

CHEMTHED LTD

TRADE ENQUIRIES INVITED
FOR ALL RADIO BARGAINS

DEAF AIDS 19/6.
An exceptional offer of new Deaf Aids made to dealers.
Complete with three sub-miniature valves crystal
mike, crystal ear-piece and coil, etc., not
only outside bakelite case. Deaf Aids Units
complete less crystal mike only 12/6 each.
Minature ear-pieces to match 3/6, or with
lead and plug 4/6. DEAF AID VALVES.
Brand new, 6,000/8, 2/4, holders 6d., each. Deaf Aid Pots, 1
megohm with switch, 1/- each.

100 MICROAMP METERS.
2 in. flush mounting meter, scaled 0-1500, yards, first
grade instrument, brand new and boxed, 39/6 each.

HEAVY DUTY L.T. TRANSFORMER.
Input 240 volts 50 cycle. Output 17.75 volts 0-150 m/a.
Housed in wooden instrument case, size 14 in. x 8 in. x 9 in. Complete with all valves and supplies, 5/6 each.

HEAVY DUTY VOLTAGE REGULATORS.
These transformers will regulate the voltage between 220 and
350 volts at 24 amps. Price £12/11/- each.

PYE 45 MC/IS. I.F. STRIPS.
Complete London Channel Television I.F. Strip, with
six EF50 valves and one EA50 valve. Supplied brand new, 59/6 each, or slightly used but in
perfect condition, 50/6 each.

AVO ELIMINATOR POWER PACKS.
Input 240 volts A.C. Output 90 volts, stabilised
V507, and 1.4 volts. Supplied brand new in
bakelite case, 39/6 each.

MARCONI BAND THREE CRYSTAL
CALLING DEVICES.
Frequency range 700-1200 Kc/s. Complete with 5 MC/s,
crystal, accuracy ±0.1%, and all other parts.
Brand new, 42/6 each, or slightly used in
original transit cases with spare set of five
valves, 35/6 each.

TRANSFORMER BARGAINS.
No. 1. Secondary 230 volts 50 cycle. Secondary
620/0/620 volts, 250 m/a, tapped 550/50/550 and 370/0/370 volts. Two 5 volt 3 m/a output.
Ample space for 6.3 volt windings. Supplied boxed.
Price 2/9 each.

No. 2. Primary 230 volts 50 cycle. Secondary
510/0/510 volts, 510/0/510 volts. This will give any voltage between 5 and 30 volts in
5 volt steps at 5 amps. Supplied brand new, 39/6 each.

No. 3. Primary 200/250 volts 50 cycle. Secondary
350/0/350 volts 180 m/a, 6.3 volt 4 amp, and
5 volt 3 amp. Only 2/9 each.

No. 4. Primary 200/250 volts 50 cycle. Secondary
200/0/200 volts 150 m/a, 6.3 volt 4 amp, and
5 volt 2 amp. Only 2/9 each.

No. 5. Primary 230 volts 50 cycle. Secondary
230/0/230 volts 150 m/a, 6.3 volt 4 amp, and
5 volt 3 amp. Only 2/9 each.

TRANSMITTERS.
BENDIX TA-12C.
Frequency range 300-
600 Mc/s. 500 ohms.
2/07 P.A. loaded.

COLLINS TC5.
Frequency range on three bands 250, 500 and
1500 Mc/s. A “Collins” type, 51/2 henry 4000 m/a.
Price 4/9 each.

MICROAMP METER, 0.250 microamp, 3 in.
long, round, 5 volt 200 m/a. Price £11/12/6.

CROSSOR DOUBLE-BEAM OSCILLO-
SCOPES.
A few only of these famous type 3330 scopes, operated on 200/250 volts A.C.
 mains. Supplied in absolutely perfect condition, and tested prior to despatch,$7/10/0 each.

R.I.132 RECEIVERS.
11 valve receiver covering
100-240 M.C/s. Super slow motion drive.
5 m/s tuning meter, R.F. and L.F. controls.
Electrolytically converted to receive F.M. stations.
Supplied with all valves and in good condition.

VOLTMETERS. No. 2. Few only of these grand instruments. Specification as follows:- A, a full scale 300 volt 50 cycle input.
S.A. ranges 1, 5, 15 and 50, and 150 volts. D.C. readings can be made up to 300 volts. Input impedance 5 meg., accuracy 1% at
50 meg. and 5% at 200 meg. Meter is a 3 in.
100 microamp. movement. All instruments are complete with detachable probe and are supplied as new in transit cases, £7/10/- each.

MIDGET REVERSIBLE MOTORS.
For operation on 4, 6 or 12 volt D.C. Size
2 in. x 2 in. Ideal for model makers, locos, boats, etc., £1/6 each.

METEER SWITCHES.
Standard Yaxley type, 8 bank, single pole, 9, 11 or 12 way, 7/6 each.

COMMUNICATION RECEIVERS.
MARCONI CR100 RECEIVERS.
Frequency coverage 40-300 Mc/s on six bands.
0-5 volt steps at 50 cycles.
Brand new, 72/6 each.

R.I.155 RECEIVERS.
Frequency coverage 130-260 Mc/s.
A really
universal AVO minor, 7/6 each.

RADIO TOOLS.
INSTRUMENT POTENTIOMETERS.
Brand new American type, 10,000 ohms.
5 in. dia. Ideal for bridge, 22/6 each.

DEAF AID VALVES.
6H6, 6/6; 6F6, 5/9; 6V6, 6/6; 654, £6/6.
Brand new and boxed, 39/6 each.

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6H6, 6/6; 6F6, 5/9; 6V6, 6/6; 654, £6/6.
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Brand new and boxed, 39/6 each.

FIELD TELEPHONE DON Mk. V.
A pair of these telephones will give communica-
tion between any two points. Supplied in
perfect condition, complete with buzzer, bell,
key, handset and instructions, 39/6 each.

INTENSITY BARS.
Supplied brand new and complete with spare valves
and calibration charts, £35 each. Also TF
5177/1. Frequency coverage 130-260 Mc/s.
and 160-500 Mc/s. Brand new £35 each.

H.R. 6 VOLT VIBRATOR SUPPLY.
Output 165 m/a, 6 volt 3 amp. £2/9 rectifier, choke and condensers, 2/9 each.

BATTERY CHARGING EQUIPMENT.
For operation on 200/250 volts A.C.
BINTERS.
200-350 volts input. Output 9 or 15 volts 1 amp, 9/6; 11 or 17 volts 1.5 amp, 12/6; 3.5, 9 or 17 volts 4 amp, 16/6. Rectifiers, full
wattage bridged for 9/6. 12 volt 1.5 amp, 11/3; 12 volt 3 amp, 12/6; 12 volt 10 amp, 2/6; 24 volt
1 am, £1; 24 volt 2 amp, 17/6; 24 volt 4 amp, 29/-.

INDICATOR UNITS.
Type 96. These indicators contain a VC979 CRT, 6, 5SP6, 1 5AR4, and thousands of com-
ponents, supplied brand new, 39/6.

AMERICAN CONDENSERS.
Oil filled. 4 mfd. 600 v., £/6; 5 x 5 mfd. 8000 v., 7/6.
35 mfd. 10,000 v., 5/6. Brand new and complete
unit, 8 x 8 x 4 mfd. 650 v., 12/6.

“RECORD AMPLIF-
IFIERS.” A push-pull pentode amplifier giving
20 watt output. For operation on 200/250 volts A.C.
Standard gram input, output matched to 3 or
4 ohms. £9.25. Complete with.macrophones.

HOURS OF BUSINESS:- 9 a.m.-6 p.m.
Thursday 1 p.m. Open all day Saturday.

CABLES: SMITHEX LESQUARE
PHONE: GERRARD 8204/9155
RECEIVER CHASSIS

Modernise your old Radiogram

COMPLETE RADIOGRAM EQUIPMENT—QUALITY AT LOW COST

STERN'S AMAZING BARGAIN OFFER!

WE HAVE BOUGHT THE ENTIRE STOCK OF THE FAMOUS

MODEL B3PP RADIO or RADIOGRAM CHASSIS

A 6-VALVE 3-WAVEBAND SUPER-HET with PUSH-PULL OUTPUT

Thousands of these successful and very popular Receiver Chassis have been sold for 

£15/15/- each

WE CAN NOW OFFER THEM for 

£11/19/6 (cash & insurance)

H.P. Terms: Deposit £4 and 10 monthly payments of 11/10.

DETAILS

(a) For use on A.C. Mains 100-110 Volts and 200-250 volts.
(b) Waveband coverage is Shortwave 16-50 meters, Medium 190-500 and Long Wave 190-2,000 meters.
(c) Has four controls: (1) Volume Control (C0mplete with R.F. Control); (2) Tone Control; (3) Volume Control (Complete with R.F. and Audio Control); and (4) Tuning Control (Fly wheel type driver).
(d) Positive Feedback is employed over the entire audio stages.
(e) Excellent reproduction up to approximately 6 watts output.

They make an excellent replacement Radiogram Chassis having a P.U. connection on the Waveband switch.

They are the ideal replacement chassis for that "old Radiogram".

ALL CHASSIS ARE BRAND NEW and GUARANTEED for 12 MONTHS.

The minimum base price is

£37 19/6 (Plus 7/- carriage and insurance). 

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

£2318/0 (Plus 7/- carriage and Insurance).

H.P. Terms: £3 Deposit and 12 months at £19/8.

We cannot at the time of going to Press provide an illustration of Chassis, nor publish the specification, but briefly it incorporates:—

(a) "Magic Eye" TUNING EYE INDICATOR.
(b) Complete switch for high and low frequency reception, including R.F. and Audio Control.
(c) A well-known set of manufacturers and incorporate the latest Osram Valve Line-up of X79, 6BA6, 6AT6, ECC83, GZ30 and a g.ohm Speakers.
(d) For an F.M. Feeder Unit.
(e) Magnificent build and finish.

WE CAN ALSO SUPPLY

(1) THE GARRARD 3-SPEED CHANGER MODEL R.C.30. 
(2) THE GARRARD 3-SPEED NON-AUTO MODEL "T". 
(3) THE COLARRO 3-SPEED CHANGER MODEL R.C.45. 
(4) THE COLARRO 3-SPEED NON-AUTO MODEL 3/54. 
(5) THE B.S.R. 3-SPEED NON-AUTO MODEL HF100.

All of these are the very latest models. Send S.A.E. for details.

RECORD PLAYERS

AUTOCHANGER is offered for

£7/19/6 (Plus 7/- carriage and Insurance)

To be attached to these 3-Speed Chassies.

A TEMPORARY EXCEPTIONAL OFFER for CASH ONLY. This Latest B.S.R. MONARCH 3-SPEED AUTOCHANGER is offered for

£7/19/6 (Plus 7/- carriage and Insurance). 

(a) These units will autochange on all three-speeds, 7in., 10in. and 12in.
(b) They play MIXED 7in., 10in. and 12in. records.
(c) They have separate supplies for

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(b) They have separate supplies for

WE RECOMMEND THE W.B. STENTORIAN P.M. SPEAKERS

They have the NEW CAMBRIC CONE and a matching device for 2 ohms, 7.5 and 15 ohms outputs.

(a) 4 in. Model HF510 £4 6 6 (5) 6 in. Model HF912 £4 7 3
(b) 6 in. " HF610 £4 12 6 (10) in. " HF1012 £4 17 6
(c) 8 in. " HF810 £4 2 9 (12) in. " HF1214 £4 19 3

When submitting orders, please include postage and packing.

STERN RADIO LTD.
OCTOBER, 1955

The ARMSTRONG MODEL F.M. 56 is in stock. A fully descriptive leaflet is available but please send S.A.E.

(c) Latest VALVE LINE-UP: EABC80, ECC85, two EF898, 6 x 4 (Rectifier) and an amplifier and most radio receivers and incorporates:

(c) A "Magic Eye" TUNING INDICATOR.

The performance of this Tuner is

H.P. TERMS: Deposit £5/12/8 and 12 months at £1/9/8.

The undistorted output level of up to 10 watts is produced from an input of 200-250 volts at 45 mA and 6.3 Volts at 150 mAs. It is designed for really good reproduction employing two 6L6s in push-pull for approxi-

THE COMPLETE UNIT ASSEMBLED and READY FOR USE.

The NEW "LEAK" TL10 AMPLIFIER and "Point One" PRE-AMPLIFIER

This Amplifier has a maximum output of 10 watts and maintains in every respect the unsurpassed LEAK reputation for precision engineering, the appearance and finish. The Pre-amplifier will operate from any make or type of pick-up. A continuously variable input attenuator at the rear of the Pre-amp. permits the instantaneous use of crystal, moving iron and moving coil pick-ups. H.T. and L.T. supplies are available for a Radio Tuning Unit. An input attenuator is fitted. B.A.E. for descriptive leaflet.

PRICES:

(a) The COMPLETE AMPLIFIER WITH PRE-AMPLIFIER: £28/7/- or £7/2/6

(b) The TL10 MAIN AMPLIFIER ONLY: £17/3/- or £4/7/6 Deposit and 12 months at £1/10/8.

(c) The COMPLETE UNIT PRE-AMPLIFIER ONLY: £10/10/- or £2/12/6 Deposit and 9 months at £1/10/8.

THE GODSELL F.M.I. TUNER

A valve preamplifier Unit incorporating the NEW MULLARD INDUCTION-TYPE TUNING HEART, a new principle leading Tuner giving full F.M. coverage and incorporating a "Magic Eye" TUNING INDICATOR.

The complete set of AMPLIFIERS ASSEMBLED or KITS OF PARTS

A very high quality Unit attractively priced in deep gold, and 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 Drilled Chassis, etc. (Plus 2/- car & ins.). We will supply it Completely Built for £9/10/- (Plus 5/- Carr. & Ins.). H.P. Terms £6/6/6 Deposit, 12 Months at £1/10/6.

The measured frequency range of the amplifier with this unit shows an excellent response from 14,000 cycles down to 20 cycles, the bass and treble controls allowing independent control of gain at both ends of the frequency range from zero to a gain of 50. It is seen, therefore, that ample correction is provided to suit any type of pick-up with its

The DULCI F.M. TUNER

A completely self-contained Tuner accommodating the WALNUT CABINET (size 10) x 6 x 51 ins. in size. The remote control Unit, which is identical to that supplied with the 12 Watt "Hi Fi" Amplifier described above, has two PX25s in push-pull incorporated over the whole of the main Amplifier and the PARMEKO OUTPUT TRANSFORMER ensures really good reproduction.

Price £16/- (plus 7/- Carr. & Ins.)

THE COMPLETE KIT IN AVAILABLE FOIL

The complete assembly of the Tuner giving full F.M. coverage and incorporating a "Magic Eye" TUNING INDICATOR.

The complete set of AMPLIFIERS ASSEMBLED or KITS OF PARTS

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**Tape Recorder**

**Build it for £40!**

**It only needs connecting up!**

H.P. Terms are shown below.

We are completely satisfied that this Tape Recorder, although supplied at a genuinely low price, provides absolute Fidelity Recordings and, in addition to being completely dependable, has a performance at least equal to recorders marketed at a far higher price. The actual assembly of the Tape Recorder is extremely simple and only involves a few connections. The Truvox Tape Deck and the Quality Amplifier are supplied tested and ready for use, and all that is required to complete the Recorder is to connect the two together (a connection chart is supplied for this purpose) and secure them by the screws provided into the Attache Case. The items illustrated and described below form the complete equipment.

**PRICE SUMMARY**

<table>
<thead>
<tr>
<th>Description</th>
<th>CASH</th>
<th>DEPOSIT</th>
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</thead>
</table>
| **Complete Recorder** | £11 | £1 
| **TRUVOX Mk. TR7U TAPE DECK** | £33 10 0 | £8 10 0 |
| **ATTACHE CASE** | £6 10 0 | — |
| **ACOS CRYSTAL MICROPHONE** | £2 10 0 | — |
| **1,200 ft. REEL OF TAPE** | £1 15 0 | — |

Please include £1 when ordering (a) or (c) for packing charge, this whole amount will be refunded if case is returned to us intact.

---

**THE NEW TRUVOX MODEL TR7U TAPE DECK**


---

**MODEL T.R.I./F. QUALITY AMPLIFIER**

This amplifier has been expressly designed to meet the requirements of enthusiasts for fidelity reproduction, and in particular to CORRECTLY operate the above TRUVOX DECK. It is supplied complete with a matched Elliptical 3 ohm P.M. Speaker, it incorporates an efficient Tone Control arrangement and has a Magic Eye Level Indicator (Operative on Record). In addition it can be used as a general purpose Amplifier for high quality reproduction of gramophone records direct from a Gram Unit.

---

**PORTABLE ATTACHE CASE**

This, as may be judged from the illustration above, is a neat, compact and attractively finished case, being covered with maroon rexine and having an ivory coloured speaker escutcheon. It contains concealed pockets to accommodate the Microphone, Mains Lead and a spare 1,200ft. reel of tape.
THE Denco F.M.
FEEDER UNIT
INTEGRATING AN R.F.
STAGE
A 5 VALVE SUPERHET DESIGN having a frequency coverage of 88 to 100 m.c.s. This F.M. Receiver is designed to operate with any type of Amplifier and most Radio Receivers. It incorporates R.F.—F.C. Changer and two I.F. Stages followed by a Radio Discriminator, the valve line-up being F.A.M.
—2AR5—two 6L6G's and 6AQ5. Overall size of assembled chassis 7in. x 5in. x 4in. High excluding power supply, or 7in. x 5in. x 4in. high with power supply,

THE COMPLETE E.I.G.H.T is now supplied complete with variable Tuning Unit (6SN7. and G Z4) and two I.F. Stage, providing for excellent reception of stations on the short wavebands (16-50 metres) medium waveband (200-250 metres) and the long waveband (800-2,000 metres).

Price for complete assembly excluding Power Supply £6.9/10/. Price completely assembled excluding Power Supply £9.11/-.

THE W.B. PRE-FABRICATED CABINET
Primarily designed for "HI Fi" equipment where a separate Speaker is not used, but equally suitable for (a) Building a RADIOGRAM
(b) TAPE RECORDER CABINET
This attractive WALNUT POLISHED CABINET (Overall size 10in. wide x 12in. deep x 35in. high) is very subconsciously designed and is ideal for mounting a Radio-gram, Speaker, etc. It has:-
4. ELECTRIC No. 3 SPEED AUTOCHANGER.

The Controls on the Unit are:-
(a) A Station Selector Switch which immediately selects either Transmitting Station.
(b) An On-Off Switch which also switches the T/V Receiver on or off.
(c) Band II Station Tuning Control.
THESE CONVERTERS ARE AVAILABLE:-
1. THE AERIALITE MODEL TA3 (Illustrated here). Contained in a brown crackle finished case size 9in. long x 8in. high x £in. deep. Price £9.10/-.
2. THE DULCI T/V CONVERTER. In polished walnut case size 9in. long x 8in. high x £in. deep. Price £11.15/6.
3. V.H.F. RADIO TUNER. A curtate Type Converter (without Case) for direct incorporation into an existing T/V receiver. Price £3.10/-

USING AS A RADIOGRAM CABINET
As will be gathered from the description of the CONSOLE CABINET there is no provision for mounting a Speaker but it is simple matter to fix one to either of the two sides after first cutting a circular hole to the size of the Speaker in use, and then covering with Speaker Carriage and a suitable grille. These Speaker grilles are available but please ask B.A.E.

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This attractive WALNUT POLISHED CABINET (Overall size 10in. wide x 12in. deep x 35in. high) is very subconsciously designed and is ideal for mounting a Radio-gram, Speaker, etc. It has:-
4. ELECTRIC No. 3 SPEED AUTOCHANGER.

The Controls on the Unit are:-
(a) A Station Selector Switch which immediately selects either Transmitting Station.
(b) An On-Off Switch which also switches the T/V Receiver on or off.
(c) Band II Station Tuning Control.
THESE CONVERTERS ARE AVAILABLE:-
1. THE AERIALITE MODEL TA3 (Illustrated here). Contained in a brown crackle finished case size 9in. long x 8in. high x £in. deep. Price £9.10/-.
2. THE DULCI T/V CONVERTER. In polished walnut case size 9in. long x 8in. high x £in. deep. Price £11.15/6.
3. V.H.F. RADIO TUNER. A curtate Type Converter (without Case) for direct incorporation into an existing T/V receiver. Price £3.10/-
SELENIUM RECTIFIERS

L.T. Types

2/6 v. 1 a.h.w. 
1/9 120 v. 40 mA. 3/11
6/12 v. 1 a.h.w. 2/9 250 v. 50 mA. 7/9
F.W. Bridge Types

6/12 v. 2 a. 9/9 250 v. 150 mA. 9/9
DIAL BELLS

6/12 v. 2 a. 8/9 11/9
6/12 v. 10 a. 12/11
6/12 v. 10 a. 35-5

CO-AXIAL CABLE

75 ohms bim. 8d. yard. Twin screened feeder. 104. yard.

SILVER MICA CONDENSERS

5, 10, 15, 20, 25, 30, 35, 40, 100, 150, 180, 200, 240, 300, 400, 470, 500, 1,000 pfd. (101,01, 002, 0002, 0003, 0004, 0005, 0006, 0007, 0008, 0009, 1000, 2000, each 1000 each type of material.

DIAL BELLS, M.E.S. 8 v. 0.2 a. 6/9 oz.
6.5 v. 0.3 a., 6/9 oz. 4 oz.

Electrolytics (current production).

NOT ex-Govt.

128

 Tubular Type

Can Types

8.5 v. 450 v. 1/9
8 v. 500 v. 2/3
16 v. 350 v. 2/3
16 v. 450 v. 2/3
32 v. 350 v. 2/3
32 v. 500 v. 2/3
5 v. 400 v. 4/11
5 v. 500 v. 4/11
5 v. 600 v. 4/11
10 v. 250 v. 1/11
8 v. 350 v. 3/13
8 v. 600 v. 2/11
16 v. 350 v. 2/11
32 v. 500 v. 2/11

Many other types in stock.

VOLUME CONTROLS with lamps. All types, less switch. 2/9; with S.P. switch. 3/9.

WIRE WOUND POTS: 200 ohms, 5000, 2 ohms, 20,000, 100,000 ohm (bimetal strip, 20, 220 ohm, 20k, 20k. Preset type. 1/19 each.

VIBRATORS


EX GOV. E.H.T. CONDENSERS

25 mfd., 4000 v. Blocks
3 mfd., 2500 v. Blocks
5 mfd., 1500 v. Cans
1 mfd. plus 1 mfd. 8000 v. large blocks (common negative isolated)
1.5 mfd. 4000 v. Blocks

EX GOV. METAL BLOK PAPER CONDENSERS

2 mfd. 1000 v. 1/9
2 mfd. 2000 v. 3/9
4 mfd. 1500 v. 5/9
4 mfd. 2000 v. 5/9
1 mfd. 3000 v. 4/9
3 mfd. 5000 v. 5/9
4 mfd. 7500 v. 5/9

EX GOV. VALVES, VR137 Ild., EA50, EB34, SP61 I/11, VS10 I/11

EX GOV. UNITS, type RF26 in original sealed cases 39.6/. Transmitter Receivers type TR9D complete with all valves 45.00. Carr. 6/6.

CONTROL PANEL with 1 stposition 3-warer

Pasley, 1 point knob, 2 S.P.S.S. switches, various plugs and sockets. Only 1/6.


MANUFACTURERS SURPLUS TRANSISTORS

FULLY shrouded upright. Mainly 200-250 v. C.A. Mains Receister with selenium rectifier. For inclusion in either of cabinets illustrated above. It employs valves 6K7, 6P6, 6F6, and is specially designed for simplicity of control and cabinet size. The sensitivity and quality is well up to standard. Point-to-point wired. Dimension and parts list, 10/11. Receiver can be built for a maximum of 64/196 including rectifier for use in any type of cabinet, be it brown or cream bakelite, or veneered walnut.

P.M. SPEAKERS. All 2-3 ohms. 6 m. A. R. 15/9. 6j. M. Pleasy with 5000 ohm output transformer, 10/11. Bm. R.A. field. 5000 ohm.

R.S.C. BATTERY CHARGER KITS. For mains input 200-250 v. 50 cts. To charge 6 v. accumulators. 1.5 amps. 22/9.

L.T. TRANSFORMER, 500 v. 5 mA. 2.0-2.1 ln. 2.2-2.1 ln. for VRB97. VCR317

THE SKY FOUR T.R.F. RECEIVER

A design of a 3-valve 200-250 v. A.C. Mains receiver with selenium rectifier. For inclusion in either of cabinets illustrated above. It employs valves 6K7, 6P6, 6F6, and is specially designed for simplicity of control and cabinet size. The sensitivity and quality is well up to standard. Point-to-point wired. Dimension and parts list, 10/11. Receiver can be built for a maximum of 64/196 including rectifier for use in any type of cabinet, be it brown or cream bakelite, or veneered walnut.
R.S.C. HIGH FIDELITY 25 WATT AMPLIFIER

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, DANCE HALLS, etc., etc. For ELECTRONIC ORGAN OR GUITAR. For STANDARD OR LONG RECORDS. Size 12 x 10 x 9 in. For mains A.C. 200-250 v. 50 c/s. Power consumption 175 watts. Outputs for 3 and 15 ohm speakers. The kit is complete in every detail. Chassis is fully punched. Easy to follow point-to-point wiring diagrams are supplied. EXTRA loops giving total H.R.P. Terms on assembled units. Deposit 26/- and 12 monthly payments of £1. Plus carr. 10/-.

Terms to cover microphones, speakers, etc., on request. Cover as illustrated if required, price 17/6 extra.

H.P. Terms on assembled units. Deposit 26/- and 12 monthly payments of £1. Plus carr. 10/-.

Radio Supply Co. (Leeds) Ltd.

32 THE CALLS.

LEEDS, 2.

Terms C.W.O. or C.O.D. No C.O.D. under £1. Postage 1/- extra under 10/-, 1/6 extra under £5. Full Price List 4d.

Open to Callers: 9 a.m. to 5.30 p.m. Saturday until 1 p.m.
TABLEGARN CABINETS. Manufacturer's Surplus! Handmade dark varnish finish, 24 in. x 12 in. x 7 in. 15/4 each. Motorized already cut for latest type B.S.R. Monarch. Adjustable in all sections. Provision at side for amplifier, etc., etc., in good condition. Complete in original manufacturer's carton, fully guaranteed. Price only 17/6 each. Buy now at 15/- only. All cut-off very suitable for oscilloscope. 35/-. We also have VCR97 with slight damage. Ideal for oscilloscope 211 in. screen at guaranteed full picture. VCR97 at 15/-, plus 1/6 packing and postage.

Mains Transformers. Manufacturers' surplus. 350-350, 80 ma., 6.3 v. 5 a. 12/6 each, or 350-350-130 ma. 6.3 v. 6 a. 5/6 each. Also P. & P. 15/6 each. We also have BC929A. 28D7GT, relay -plugs, sockets, and packing.

Baffle Changer. Provision at side for amplifier, etc., etc., in good condition. Complete in original manufacturer's carton, fully guaranteed. Price only 17/61 each. Buy now at 15/- only, plus 1/6 P. & P. Also their very latest model. TR1196 TRANSMISSION PORTION.

We can also supply the transmitter portion of these complete sets. We have a few brand new R1155A at 79/6, also R1155 for A.C. 200/250 volts at 79/6. We have a few brand new R1155A at 11/1, plus 1/6 P. & P. All our complete Kitts are extremely small incorporating valve rectifier type 6X4 and built on chassis No. 4. Semi-conductor. etc., etc., in good condition. Com- complete with valves at 30/6, in very good condition. We regret we cannot extend this facility to anyone interested. We regret we cannot extend this facility to anyone interested.

DEALING with stubby midget mixers, change over. Complete with turn-over changer. Complete in original manufacturer's carton, fully guaranteed. Price only 17/6 each. Buy now at 15/- only, plus 1/6 P. & P. In brand new, enthroned in black crackle varnish finish and can be supplied at 65/-. plus 5/- P. & P.
The R.C.P. ON-EIGHTY BATTERY RECEIVER KIT. Simple. Five.$19.95. Fullfledged portable. Complete, ready to play any four-waveband, etc., etc,
LASKY'S RADIO

DENCO F.M. FEEDER UNIT
All components and valves in stock. Use 6A46, 12A38, EB91, and two 6BA6. COMPLETE PARCEL £6/7/6 Post extra. DATA BOOK, 1/6 post free. All components available separately.

DENCO F.M. COMPONENTS
Coils, each 3/11 I.F.s, each 7/- Ratio Discriminator, 12/6 Chassis and Screens, 7/6 Dial and Drive, 9/- Valves, complete set of five, 42/- Post 1/-

THE JASON F.M. TUNER
Special Parcel containing Database Book, chassis, front end, dial, drive, tuning condenser, full set of coils, I.F.s, ratio detector, etc. 6/-/9
Post 2/6. Book only, including our fully itemised price list, 2/- post free. The above Tuner uses 4 6A46 and 2 crystals. The complete Tuner unit can be built for £6. 15. 0 plus 2/6 post. We can also supply the above Unit built by the Jason Co., aligned and tested for £15. 17. 0, including P. Tax.

VAL RADIO BAND III TUNERS. Full range in stock. Price 46.

CERAMIC CONDENSERS for F.M. All valves, 1/- each, 10/- per doz. Post extra.

SAVE POUNDS! ORDER BY POST IF YOU CANNOT CALL EVERYTHING FOR THE HI-FI ENTHUSIAST!

HI-FI SPEAKERS
The fullest range of W/B, Stentorian, Wharfdale, G.E.C., Goodmans, Baker, etc., all sizes, 3-15 ohms. We have the one to suit your purpose and pocket. The W/B type HF102 has increased in price to £14. 17. 6. We can still supply this well-known popular Speaker at the former price of 77/6. Post 3/6. Buy now and save 20/- while stocks last.

HI-FI at a price you can afford

“TWEETERS” Electrostatic H.F. Speakers for use with amplifiers or sets. Supplied with full data and circuit diagrams. Examples:
- LEAK, Point One £28/7/0
- R.D. Junior £12/17/6
- R.D. Minor £12/17/6
UNITELEK. 8J and 9J gns.

HI-FI AMPLIFIERS
A very large and comprehensive range.

GROLER LATEST DESIGN CONTINENTAL F.M. COMPONENTS
UT.340 (as illustrated). A self-contained V.H.F. front end Unit incorporating a grounded grid amplifier, mixer oscillator (ECC85) and first I.F. amplifier. Completely wired and tested, 59/9. (Valve extra).

UT.341. As above but with baseplate and 2-gang condenser incorporating 1:3 reduction drive. Supplied pre-aligned 95/5.

TA.350. 6-button Coil Pack for long, medium and short waves, gram and off, together with a F.M. position which incorporates switching for change over from A.M. to F.M. Designed for use with UT.340 or UT.341. 85/-

Ratio Discriminator Coils, URF, 10/- each.

10.7 Mc/s. I.F. Trans., UF376, 7/- each.


As above but for 2 stages of I.F. amplification. No variable selectivity on A.M. Types KF363 and KF364, the pair, 26/3.

“WIRELESS WORLD,” F. M. Feeder (Amos & Johnson) Reprint. 2/- post free.

THE “UNIVERTER” A new book just published, giving full details of how to build your own Band III Converter for any TV receiver, home constructed or factory made. All components and valves in stock, prices on request. Also available as a complete unit. Uses two 6A46, one 12AT7, one 6X4. Contains its own power supplies. THE BOOK, containing full circuit diagram, wiring instructions and component lists. £3/6 post free. Can be supplied complete in Cabinet for £9/9/- post free.

6-VALVE RADIOGRAM CHASSIS COMPLETE WITH VALVES
Famous Manufacturer’s Surplus. 6 valve 3-wave Superhet, 13-50 m. short, 200-550 m. medium, 1,000-2,000 m. long. Brand new Mullard valves: ECH42, EP41, L63, EB41, 6V6 g.t., E240, and finest quality components. Gramp. switch, 45/2 Kc/s.f., tone control, 3-colour dial. Overall size: 133 x 5, height 121. Aperture required for dial and controls 11 x 3½ in. Complete with valves, complete set of valves, knobs, etc.

LASKY’S PRICE £10/19/6 Carr. & Pkg. 7/6 extra

B.S.R. MONARCH 3-SPD. AUTO CHANGERS
LATEST DESIGNED MODEL, NEW & UNUSED
Takes 10 records of all sizes (mixed) in one loading. HGP.37 crystal turnover-pick-up. Handsome cream finish. Supplied complete in maker’s carton.
LASKY’S PRICE Post 3/6

SPECIAL COMBINED OFFER.
The above 3-speed Auto-Changer and the 6-valve Radio- gram Chassis supplied together for Carr. free

B.S.R. £18/19/6

CABINET NOW AVAILABLE.
An attractive contemporary design Cabinet, oak veneer, to take the above Auto-changer and Radioogram Chassis can now be supplied.

CABINET £8/15/- Carr. 17/6

MORE MONEY-SAVING LASKY BARGAINS ON NEXT PAGE
**RADIO • TELEVISION • HI-FI • ELECTRONICS • RECORDERS**

**THE CYLDON TURRET "TELLETUNER"***

**OFFERED FOR THE FIRST TIME**

Previously supplied to Set manufacturers only. This 12 channel Tuner consists of a turret having 12 clip-in aerial and mixer coil strips. When the turret is rotated the appropriate strip locates on a contact panel providing the necessary connections to the valves and circuit.

This type of tuner construction enables you to clip in pre-arranged coils for the reception of any station not already provided for in Bands I, II & III, at the same time affording for maximum gain, high stability and minimum noise, which are essential in a modern tuner.

Valves used: PC084 R.F. double triode, cascode R.F. amplifier. PCF080 Triode periodie i.e. and mixer. Will work with most sets. Full instructions and circuit diagram supplied free.

**TELETRON BAND III CONVERTER**

**COIL SET.** For use with TRF and superhet. TELETRON BAND III. Full instructions and circuit diagram supplied. Includes drilled chassis, condensers, resistors, etc., and you have your choice of transformers and chokes by Partridge, Haddon, WIB or Filison. Demonstrations given any time.

**CONVERTER.**

The complete Kit to build this Converter, including drilled chassis, condensers, resistors, coils, two ES80's etc. 48/- Post 1/-

**THE NEW "REMPLOY" INSTRUMENT SOLDERING IRON**

Copper bit, warming neon light in handle. 12 months guarantee. Sold separately or with chassis.

**ALUMINIUM CHASSIS**

18 S.W.G., undrilled, 4 sides, reinforced corners. Depth 2½in.

Size 13½ x 7 x 2½in., drilled for five latest type miniature valves mains trans., I.F. etc. Dial 13 x 14½in., for horizontal or vertical mounting. Spin wheel tuning. All pulleys and spindle supplied separately. Price 3½/-

**DULCI RADIO CHASSIS**, full range 3 & 6 wave, £6 19/6 to 21 gns.

Also DULCI AM/FM CHASSIS, P.M. FEEDER UNIT, BAND III CONVERTER.

**COMPLETE 5-VALVE RADIO CHASSIS**

Brand new and unused. A.C./D.C. 200/250 volts. I.F. 465 k.c/s. —A.V.C. —4 watts output—3 station pre set—frame aerial —fully aligned chassis 10 x 5½in. —max. height 5½in. Completely wired and ready for use, with the addition of a speaker and output transformer. Two controls—volume and station switch. Valves used: 10C1, 1089 or UF41, 10LD11, 10P14, U404 or UY41.

**LASKY'S PRICE 69/-**

Post 3½/- extra.

With valves £5/19/6.

**MICROPHONE BARGAINS**

ACOS MICRO.22/2. Complete with stand as illus. List 4 gns.

**LASKY'S PRICE 42/-**

Moving Coil Hand Type with switch. List 5 gns.

**LASKY'S PRICE 45/-**

**TABLE MIKE STANDS.** Chrome, heavy base, 2 sections. 12½/-. Post 2½/-

**SPECIAL PURCHASE**

**ACOS TURNOVER CRYSTAL CARTRIDGES**, complete with styl. G.P.29, listed £4/11

**LASKY'S PRICE 21/-**

**SPECIAL PURCHASE OF PICK-UPS**

Standard play. Offered at ALMOST HALF PRICE

Goldring Bantam magnetic 25/-

Acorn Crystal, type GPI 25/-

Post free

**PARCEL No. 1**

Contains everything to build a 1½-watt Class B, 3-valve superhet for 200/250 A.C. mains. Uses 6K8, 6K7, 6Q7, 6V6 valves. Attractive wood cabinet, nut mahogany, or plastic cabinet as illus. Size 12 x 6½ x 5½in. deep. CAN BE BUILT FOR £7/19/6. Carr. and p/kg. 2½/-

**INEXPENSIVE EASILY BUILT RADIO SETS**

Lasky's Radio Constructors' Par- cels contain everything to build up-to-date and very efficient sets at low cost. Note also that all components and cabinets are available separately.

**PARCEL No. 2**

Contains everything to build a T.R.F. 3-valve set for 200/250 A.C. mains, med. and long wave. Uses 6K7G, 677, 6V6, and metal rectifiers. Neat plastic cabinet, walnut or ivory finish, or wood cabinet. Size 12 x 6½ x 5½in. deep. CAN BE BUILT FOR £5/10/6. Carr. and p/kg. 2½/-.
THE LATEST BRENNEL TAPE EQUIPMENT

The DECK. 3-speed, 37, 74 and 15in. per sec., 3 motors, record and play-back. All latest refinements. 186 ns.

The AMPLIFIER. 4 watts, for use with 3 ohms speakers. Magic eye, high fidelity. 162 ns.

The CARRYING CASE. ²$/18. Write for details.

SPECIAL! PLASTIC COVERED WIRE, stranded copper. 807. All colours in 100 ft. lengths. Per coil 2/6. Post 9d.

EX-GOVT. ACCUMULATORS. 2 volt, 10 a.h. Size 11in. square, 5 ¾ in. high. Made by Canadian Exide. LASKY'S PRICE 4/6. Per cell 2 ½. Post 9d.

AERIAL ROD SECTIONS. Steel heavily copper plated. 12in. long, 1 in. diam. Any number may be supplied, frs. each. 7/6 post type. 6/11.

SET OF 3 MOTORS (Collaro) for Tape Decks. Clock, anti-clock and captain. LASKY'S PRICE 3/11. 6/1. Post extra.

HEA:'Y FLYWHEELS for Tape Decks. 3in. high. 2/6 post 1/1.

COUNTERS up to 9999, cable drive, each 5c. Post 1/-.

3-WATT MIDGET A.C./D.C. AMPLIFIER

PUSHPULL, VERY HIGH GAINS

4 valves, 2 U41, in push pull. 1 U1CH42 and 1 U1A42. Input voltage 100/100 A.C./D.C. Very easily con-structed, and supplied complete with circuit diagram and all details. Size: 9 x 4 x 4in. Uses 2 metal rectifiers, 1 each RM2 and RM3. Ideal for ships, record players, tape recorders, home record players, baby alarms, etc. etc. Supplied complete, fully assembled and wired, with 4 valves. LASKY'S PRICE 6/5. Post free.

LASKY'S 4-WATT A.C. AMPLIFIER KIT

Uses 1 each 6SL7, 6V6, 12AU7. All components, chassis, valves, output trans., mains trans., 14/6. Carriage and packing 2/6. INSTRUCTION BOOK and shopping list. 1c. post free.


MINIATURE CRYSTAL DIODES

Glass type, wire ends, each 1/6. GEX. 45 and equivalent types, various makes. 3/6.

TRANSISTORS AND GERMANIUM DIODES.

All types available from stock.

SPEAKER FRET

Large selection of materials for frets—plastic, tygan, cloth, expanded metal.

GANG CONDENSERS

.0005, less trimmers. 2-gang, standard, 5/6, min., 6/6. 3-gang, standard, 7/6, min., 10/6. 4-gang, standard, 10/6. With Trimmers:— 2-gang, standard 7/11, min., 7/6. Post extra.

TELETRON COILS

All types in stock.

TELETRON FERRITE ROD AERIALS

Med. wave, 5in. long, 8/9. Long wave, 8in. long, 12/9.

IGRANIC JACK PLUGS

St nard type, each 2/6.

CYLIND TAPE SPOOLS

5in. each, 1/6.

OVER 50,000 VALVES

Our valve stock is one of the largest in England. All makes and types, B.V.A. and ex-Govt.

SPECIAL PURCHASE BUREAU RADIOGRAM CABINETS

Handsome design, solidly constructed, beautiful Walnut veneer finish, with generous record storage space. Further details and illustration on request. LASKY'S PRICE 14 gs. Carr. 17/6. Available on H.P. Terms.

SPECIAL COMBINED OFFER

The above Tape Deck Case together with the above Truvox Tape Deck. Carr. Free.

LANE TAPE DECKS

Mk. VI, 2-speed, 74, 36 in. per sec. 3 high grade motors. Takes standard reel of tape up to 1200 ft. capacity. £18/10/-.

LATEST GRUNDIG TAPE RECORDER in Stock. 45 Gns.

RECORDING TAPE


All makes of Tape stocked—Scottish Boy, EMI, Grundig, Puretone, Ferrograph, Basif, Ayla, Gevaert, etc., and the new Scotch Boy Thin Tape 190M, and Grundig Long-playing Tape. All types of Spools stocked.

SPECIAL! PLASTIC COVERED RECORDING TAPE

You can build this professional Tape Recorder for less than £30, using Truvox Tape Deck. Write for full details and list.

DIRECT FROM TRUVOX

Nothing cheaper. 1½ speeds, 3f, 7½ and 15in. per sec., 3 motors, record and playback. £10/15. Post extra.

LATEST COLLARO RC 54

3-speed High Fidelity Mixer Changer, Studio crystal turnover p.u., in leatherette covered carrying case. £35/6.

THE CARRYING CASE.

Expense saving Lasky Bargains on next page.
EVERYTHING FOR HOME CONSTRUCTOR & SERVICEMAN

E N I G M A 369

LASKY'S PRICE 79/- Carr. 5/10.

MAINS TRANSFORMERS.
All 200-250 v. 50 c.p.s. primary finest quality, fully guaranteed.

MBA/3. 250-0-250 v. 80 ma. 6.3 v. 4 a., 5 v. 2 a. Both filament tapped at 4 volts. 38/-.
MBA/6. 200-0-200 v. 100 ma. 6.3 v. 3 a., 5 v. 2 a. With mains tapping board. 22/6.
MBA/7. 250-0-250 v. 80 ma. 6.3 v. 3 a., 5 v. 2 a. Both filament tapped at 4 volts. 18/.
MBA/10. 500-0-500 v. 150 ma. 6.3 v. 4 a., 5 v. 3 a. 32/6.

OUTPUT TRANSFORMERS.
Min. type (354, etc.). 3/6.
Midgo 3/3.
Standard ratio 3/11.

FILAMENT TRANSFORMERS.
6.3 v. 1, 5 amp. 5/11.
6.3 v. 3 amp. 9/6.
200-250 v., special 0-30 v. tapped. 17/6.

CONDENSERS & RESISTORS.
CZ1, C22, C23, WX6.
2/6. 1/6. 64. 1/6.

FOR CALLERS ONLY. Sale of VCR97 C.R. Tubes, 64 in., electrostatic. To clear, each 5/11.

RI155 RECEIVERS now available on Easy Terms. Ask for details.

LASKY'S PRICE
BRIMISTORS.
CZ1
CZ2
CZ3
WX6
2/6
1/6
64
1/6

LIMITED NUMBER 17-14 in. aperture, pre-fabricated ready for home assembly. Solidly constructed of fine laminated wood. Walnut veneer finish. JIN. top. Suitable for the Tele-King, Wide-angle Viewmaster and other home constructor TV sets. List £14/10/-.
LASKY'S PRICE £8/10/0.
Carra. 10/6.

MIBERS' SURPLUS TV COMPONENT BARGAINS.
WIDE ANGLE 38 mm.
Line E.H.T. Trans., Ferrocube, core 9-16 V.
Scanning Coils, low imp. line and frame.
Ditto by Igranic.
Frame or line blocking osc. Trans.
Focus Magnets Ferro-dure.
Focus Magnets, Iron Core.
Duomag Focusallers.
300 m/. Smoothing chokes.
Electromagnetic focus coil with combined scan coils.

C.R.T. MASTERS.
12 in. rubber, complete with armour plate glass. Dustproof. Black, White, 10/-.
De Lint, 7 in., 15/-.
EE 16 in. polystyrene. List 42/.
Rm. 1 in. Moulded Implosion Guards, 7/6.
Post extra.

OUTPUT TRANSFORMERS.

LASKY'S PRICE 95/- Post & ins. 3/6.
TEST LEADS, 3/6 extra.

MULTI-TEST MASTERS.
1,000 ohms per volt. Basic movement 400 microamp. 3 in. A.C./D.C. 0-5,000 v. 0-1 amp. 11 switched ranges: 100,000 ohms and 1 meg., also decibel range, in polished wood carrying case (6 x 6 x 4 in. closed) with leather handle and space for test leads.

HIRE PURCHASE TERMS ON CERTAIN ITEMS.
Please give details of your requirements.

LASKY'S RADIO

LIIMITED NUMBER 17-17 in. aperture, pre-fabricated ready for home assembly. Solidly constructed of fine laminated wood. Walnut veneer finish. JIN. top. Suitable for the Tele-King, Wide-angle Viewmaster and other home constructor TV sets. List £14/10/-.
LASKY'S PRICE £8/10/0.
Carra. 10/6.

AERIAL MASTS
Complete with metal mast, 15 ft. square, 15 ft. square, 45 ft. square. Any length supplied.

AERIALS of all types stocked, TV, Band III, F.M., 300 ohms FEEDER, per yard, 8d. 80 ohms Co-axial, doz yards, 7/6.
Complete with cut-out for 14 in., 16 in. and 17 in. C.R. tubes at no extra cost. An allowance of 4/6 will be made if the mask is not required. Inside Dim.: Depth 16 in., width 17 in., Height 28 in. Overall height 32 in.: Width 18 in.

WHY NOT CONVERT YOUR TABLE RECEIVER TO A CONSOLE MODEL?
Adaptor frames for fitting 9 in. or 10 in. C.R. tubes available if required.
LASKY'S PRICE
Carriage 12/6 extra.
H.P. Terms. Deposit £2/17/6 plus carriage. Balance plus charges spread over 12 months.

THE ROTHERSAY
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.

NOTE THESE GENEROUS SIZES.
Outside dim.: 34 in. high, 21 in. wide, 21 in. deep. Inside dim.: 18 in. wide, 19 in. deep. Size of top: 221 x 211 in. Thickness 4 in.
LASKY'S PRICE £19/19/6.

THE BURKE CABINET WITH FULL-LENGTH DOORS veneered all sides, polished to match the cabinet and mounted with full-length piano hinges. Price £14/9/6.

ARMOUR PLATE GLASS.
12 in., actual size 13 x 10 x 3 in. 3/6.
14 in., actual size 13 x 10 x 5 in. 5/6.
17 in., actual size 17 x 15 x 7 in. 7/6.
Post extra.

SENTENCER METAL RECTIFIERS.
Rm 1 Rm 2 Rm 3 Rm 4 1/3/0 5/6 16/.
Post extra.

SENTENCER E.H.T. RECTIFIERS.
Post extra.

L.V. RECTIFIERS.
12 v., all types in stock.
1 amp., 4 wave, 3/6, 2 amp., 4 wave 4/11, .4 amp., full wave, 15/6.
16 amp., full wave, 21/6. Post extra.

TWO ADDRESSES FOR PERSONAL CALLERS.
Open all day Saturday. Early closing: Thursday.
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Between T.C.R. and Goodge St. Stns.
Museum 3605.
(Reverse Paddington Hospital)
CUNingham 7972/7124.

ALL MAIL ORDERS TO HARROW ROAD PLEASE.

OCTOBER,1955.
BRAND NEW CERAMIC V/HOLDERS: 813, 9/6 each; 8321 LITTLE NEWPORT ST., LONDON, W.C.2.

INVITED.

MANY OTHER LINES IN STOCK. YOUR ENQUIRIES COMPETITIVE PRICES.

SELENIUM METAL RECTIFIERS BUILT TO SPECIFICATION. With base and Mu metal screen, 20-, p.p. 2/6.


PHOTO -ELECTRIC MULTIPLIER CELLS. Type 931A. £2/10/-, each. Limited quantity only, £4/7/6, and 3.9-8.5 Mc/s continuous.

R. J. 32A RECEIVERS. In perfect condition, £3/17/4, carr. 7/6.

CRYSTAL CALIBRATOR BY MARCONI INSTRUMENTS. NO. 5, MK. II. Brand new and unused, complete with set of 5 spare valves, operation manual and aerial. Frequency range: 52-90 Mc/s with 9 fixed frequencies: 53, 56, 66, 65, 70, 75, 78, 84 and 90 Mc/s. Accuracy: One part in 10,000. The price £7/6, carr. 10/6.

CRYSTAL CALIBRATOR BY MARCONI INSTRUMENTS. NO. 6, MK. III. Brand new and unused, complete with spare set of 5 valves and operating manual. Frequency range: 170-240 Mc/s. Accuracy: ± 1 part in 10,000. Our price £7/6, carr. paid.


HEAVY DUTY L.T. TRANSFORMERS: 230 v. Pri. 50 cycles. Sec. 12 v. @ 70 amps. £4/5/-, carriage paid. DITTO Sec. 15 v. @ 60 amps., same price.

PHOTO-ELECTRIC MULTIPLIER CELLS. Type 931A. £2/10, p.p. 1/-. Also 931A complete on chassis with multiplier network and 2,492 valve holders, etc. £3/10/-, p.p. 2/-.


CONDENSERS: 2 mfd. 7.5 kv. working at 15 kw. (Test (Dubilier). Brand new £2/10/- each. carr. 5/-.


CATODOE RAY TUBES. Types BP1, 3in. new and unused with base and screen, 4/6, p.p. 2/-; Type VCR138 (ECR35), 3in. with screen and base in new and unused condition, 4/6, p.p. 2/-; Type VCR97, 6in. ex-equip. in good order, 30/6, p.p. 3/6; VCR131, 1in. C.R.T., new and in perfect condition. Miniscope replacement tube, etc. 35/-, p.p. 1/-; Type CV153, 21in. 4 v. filament, 3,000 v. anode, complete with base and Mu metal screen, 20/6, p.p. 2/6.

AMERICAN ESPEY "MODEL 100" All-PURPOSE TEST METER. 7 D.C. volt ranges, 3 x 4,000 ohms; 20,000 and 1,000 ohms per volt. 7 D.C. current ranges, 12 amps.-300 microamps. 7 A.C. volt ranges, 3 x 6,000 v. x 1,000 ohms per volt. 3 resistance ranges, 300,000 ohms. 600,000 ohms and 1,000 meg. 50 microamps, 4in. scale meter. In perfect working condition, tested before dispatch. Complete with chart, test probes and batteries. £3/6, p.p. 3/6.

BRAND NEW CERAMIC V/HOLDERS: 813, 9/6 each; 8321 LITTLE NEWPORT ST., LONDON, W.C.2.

ADJOINING LEICESTER SQUARE TUBE STATION

GE. Rard 6794(1453)
C.R.T. ISOLATION TRANSFORMERS
For Cathode Ray Tubes having Heater/Cathode short-circuits or for C.R.T. Tubes with failing emissions. Type A. Low leakage windings. Ratio 1:2 giving a 50% boost on secondary. 2 volt each 10/6 each With Tag 4 volt each 10/6 each Panel and 5/6 each 10/6 each 10.8 volt each 10/6 each 13 volt each 10/6 each Ditto with mains primaries 12 volt each. Type B. Low capacity sound transformer for use with C.R.T. Tubes with falling emissions. Multi-Output 2, 6, 3, 7.5, 10 and 12 volts. Input has two taps which increase output by 50% and 50% respectively. This transformer is suitable for most Cathode Ray Tubes. With Tag 10/6. Type C. Low capacity sound transformer for use with C.R.T. Tubes with falling emissions. Multi-Output 2, 6, 3, 7.5, 10 and 12 volts. Input has two taps which increase output by 50% and 50% respectively. This transformer is suitable for most Cathode Ray Tubes. With Tag 10/6.

WIRE-WOUND RESISTORS 10/6 each 6 in., 0.5 watt. 12 in., 2/6 per foot.

CRAMIC CONDENSERS, 500 v. .001 to .01 mid., 1/-; .05 .1, 1/9; .25 1/6; .5 1/9; 1 2/6.

NEW CRYSTAL DIODES, 500 v. .001 to .01 mid., 1/-; .05 .1, 1/9; .25 1/6; .5 1/9; 1 2/6.

MISTS, GRINTEN.

Kit of parts complete to build this most successful unit competing drilled chassis. $12.50, values, wound coils, and all necessary components, slightly modified version using E28 instead of E260 value, £3/10, post free. Send for blue print and wiring diagram, 1/6 post free.

 Provision has been allowed on chassis for small power pack and AE switching.

Power Pack Components, including Main Switch, 30G extra.

RADIO-GRAM CHASSIS

3 WAVEBANDS. - L. W. 800m - 2000m, M. W. 200m - 550m, S. W. 15m - 50m. Chassis size 13in. x 14in. x 71/2in. Attractive Glass Dial 18in. x 4in. edge lit by 2 pilot lamps. Horizontal or Vertical Static Name and 4 control knobs, balanced or lumpy to choose. 4 position W/C switch, L.H. S. and F. N. sockets. Modern electronics, all coils adjustable d.c. and only quality components used throughout. Delivered A.V.C. and our feed-back. A.C. mains 240/250 v. Double wound transformer. Isolates chassis from mains. Aligned and balanced ready for use.

BRAND NEW & GUARANTEED £9.15.0 Car. and ins, 4/6.

5-ohm speakers suitable for this chassis available 8" 19/6, 10" 31/2.

This chassis is a genuine bargain and delivery is reasonably good.

BEST EVER VALUE IN RECORD PLAYERS

Leading Makes New Stock

TUBULAR & CAN TYPES

52/33 v. .5/33 v. 5/1/9
50/30 v. 5/1/6 1/9
100/35 v. 1/9
8/14/50 v. 5/6
8/21/50 v. 5/1/6
4/14/50 v. 6/6
18/35/50 v. 1/6
21/35/50 v. 5/8
32/35/50 v. 5/8
32/50/50 v. 1/8
32/50/50 v. 8/9
32/60/50 v. 1/8
6/32/50/50 v. 8/6

CONDENSERS - Mica, 6, Mica, mica, mica. All values 10000 ohms to 2 Meg., 5/-, 10/-, 25/-, 50/-

JASON F.M. TUNER UNIT 87-105 mc/s

SPEAKER FRIT - Expanded Bronze anodised metal 8in. x 8in. x 2in. 85 ohms, 8in. x 12in. x 3in. 125 ohms, 10 ohms, x 2in. 10 in., 20 in.

RESISTORS

Carbon type. Pref. values 10 ohms-10 megohms. 20in. Tol. x 24. 1/6. x 8d.
16 in. 3d.
10 in. 6d.
5 in. 3d.
21/2 in. 3d.
1 in. 9d.
1/2 in. 3d.
1/6 in. 2id.
1/12 in. 11/2.

WIRE WOUND TYPES

Wires used. Silicium doped. 25 ohms-10000 ohms, 8 in. 3/4. x 10. x 10.
16 in. 3/4. x 12. x 12.
30 in. 32. x 16. x 16.
25 in. 32. x 16. x 16.
50 in. 32. x 32. x 32.

Diodium Chassis

18 g. Plain undrilled. Folded 6 sides. riveted framework. Lattice facing box. Depth 8in. 12in. x 12in. x 12in. x 12in. 24in. x 24in. x 24in.

ALUMINIUM CHASSIS

14 g. Plain undrilled. Folded 6 sides. riveted framework. Lattice facing box. Depth 8in. 12in. x 12in. x 12in. x 12in. 24in. x 24in. x 24in.

RADIO COMPONENT SPECIALISTS

70BRIGSTOCK RD., THORNTON HEATH, SURREY

Phone: THO 2168 Hours 9 am - 6 pm, 1 pm. Wed. Open all day Saturday.

BY THORNTON HEATH STATION. BUSES 305A, 303, 159, 160, 190. W/C or C.O.D. Post & Packings 3/- to 1/- 6d. 4/- 6d., 1/- 6d., 1/- 3d., 1/- 6d., 1/6 3d., 1/- 6d., 2/- 6d. Send for our Bargain List, 3d.

WIRELESS WORLD 138

A New AMBASSADOR VISOUNT Radiogaphophone

Ambassador Viscount Radiogaphophones are in world-wide demand. Powerful long-range nine-valve receiver with push-pull output. Eight wavebands, six with electrical bandspreading. 3-speed auto changer. Twin speakers. A.C. mains only.

Write for full details:

AMBASSADOR RADIO & TELEVISION LTD.
PRINCESS WORKS, BRIGHOUSE, YORKSHIRE, ENGLAND

Superior SPRINGS, METAL PRESS WORK

The HEATH SPRING & NOTION C1 LTD.
HEADLESS CROSS, REDDITCH, ENGLAND

Telephone REDDITCH 861 - 862
NEW SUPER LIGHTWEIGHT PICKUP MARK II giving an extended frequency range on L.P. disc.

- Head only (Standard or Microgroove) £7 + P.T. £2 9s. 10d. Total £9 9s. 10d.
- Pickup with one head £9 3s. 0d. + P.T. £3 5s. 2d. Total £12 8s. 2d.

A. R. SUGDEN & CO. (Engineers) LTD.
WELL GREEN LANE : BRIGHOUSE : YORKSHIRE
Phone : Halifax 69169. Grams : Connoisseur, Brighouse

WEYRAD
A COMBINED AM/FM RECEIVER ENABLES YOU TO ENJOY THE HIGH QUALITY OF B.B.C. TRANSMISSIONS ON V.H.F. WHILE RETAINING FACILITIES FOR THE RECEPTION OF MEDIUM AND LONG-WAVE BROADCASTS.

COMBINED AM/FM COIL PACK—TYPE B.60.
Completely assembled with four-position switch, valve holders, screens and all associated components. Designed for use with valves types 6AM6 (R.F. amplifier on FM only) and 6BE6 (frequency changer AM and FM).
Dimensions—width 3½in., length (plus switch spindle) 4½in. (plus switch spindle).
Overall Depth 4½in.
PRICE 71/9 plus 23½ P.T.

TUNING CONDENSER
The B.60 is designed for use with a special 2-gang condenser having separate sections mounted on a common rotor shaft. The low capacity sections are selected by the switch for FM tuning.
PRICE 21/-. 

TUNING SCALE TYPE TS60.
Printed on glass in 3 colours. Calibrated with station names on L.W. and M.W. Frequency calibration only on FM band. Size 9½in. x 4½in. Pointer travel 7½in. horizontally.

COMBINED AM/FM I.F. TRANSFORMERS AND RATIO DETECTORS.
I.F. type P21/1, price 12/6. R.D. type P21/2, price 14/2.

WEYMOUTH RADIO MFG. CO., LTD., CRESCENT STREET, WEYMOUTH, DORSET
INDICATOR UNIT: TYPE BC-912A. Complete with 19P1 C.R. tube (with screen and base), 2-5ST, 662, 2-811, 0 x 5 and 2 x 2 valves, resistors, condensers, potentiometers, etc. Ideal for constructing oscilloscopes, etc. Brand new in original cartons, with black crackle case 14 1/2 in. x 9 in. x 9 in. Price: £7/6, plus 5/- carriage and packing.

TRANS/REG. UNIT, TYPE 7/A.P.1-1, with 3-125I7, 4-12H7, 2-12166, 2-455 and 2-565 valves (best OD 12) Volt. stab, 27V, D.C. Dynamo, Resistors incl. 3-1 megohm 1%, Condensers, Pots, etc. Covers approx. 4.5 to 8 Mc/s. Includes: 5/- carriage and packing.

PACKARD-BELL PRE-AMPLIFIERS. Complete with 6L5 and 2B7 valves, medium grid radio, condensers, pot, loway midget plug and socket. Brand new in original cartons, with circuit. Price 12/- only.

MARKER CONTACT, TYPE 2, with a superb clockwork movement. Gives two impulses per second; 7 hours running. Brand new in sound-proof case. Ideal for constructing clockwork, etc. Price 9/-, plus 1/- post and packing.

SANGAMO MOTOR UNITS. These are brand new pre-paid motor movement with dozens of gears, and a Sangamo-Weston 200-250 v. A.C. 50 cycles motor (holder run). Has numerous applications (clockmaking, etc.). Price 10/6 each, plus 1/- postage.

ALL CONDENSERS (AMERICAN). Oil filled. 1 mfdo. 600 V., D.C. wk., 5/- each, plus 1/6 post; 2 mfdo. 1000 V. D.C. wk., 3/6 each, plus 1/6 post; 7 mfdo. 800 V., D.C. wk., 5/6 each, plus 1/6 post, also 4 mfdo. 1000 V. D.C. wk., (English), 3/9 each, plus 1/3 post.

SPECIAL ORDER POTENTIOMETERS. 2000 m.0 linear with D.P. switch, at 12/- per doz. 100 k ohm with S.P. or D.P. switch. Full length, 6 1/2 in. long; 20 1/2 in. wide. Price 7/6 each, plus 1/- post.

FITS INTO INT. OCTAL HOLDER TO MAKE A 15/6.

SIDE PIN TRANSFORMERS FOR BATTERY RECEIVERS, at 1/- each.

FOOT MOUNT/IONS (U.S.A). 1 meg 0 double bank with 71/6 in. spindle, 2/6 each; 24/6 doz. 2 meg.0 double bank pre-set type, 2/- each; 30/-; 3/- post.

PRE-SET POTENTIOMETERS. TV types, viz. 50 k ohm and 100 k ohm, at 1/- each; 15/- doz.

VAXLEY SWITCHES. 8way, single pole. Midget type with 1/16 in. spindle. Three-pole 8-way single bank midget type with 5 in. spindle, 1/- each; 15/- doz.

FLAT-IRON SWITCHES. D.P.S.T., 3.5 mm, 250 -volt on safety switch for rack-mounted equipment, etc. Price 3/- 6d.

VEEDER-ROOT REV. COUNTERS, 0-9999, with digital drive. Brand new and boxed. Price 7/6 each.

TELCOTHENE TWIN-FEEDER. 2-1/363. Type K20C, 2/-6 doz. per yards.

C. MARKS & Co. (Newport, Mon.) Ltd.

October, 1955

WIRELESS WORLD

PROOPS BROS LTD

The Walk-around Shop

TYPE 62a INDICATORS

Ideal for conversion to oscilloscopes, T.V., units, etc. Containing C.V.97, 12 VR.91 (EF.50), 2 VR.54 (EB.34), 3 VR.92 (EA.50), CV.118. Slow-motion dial, 13 Pots and scores of useful components. Size: 83/4" x 11 1/2 x 18". New in wooden packing case.

A bsorption Weaver

Easily converted to 2 metres or 70 cm. In Copper-plated metal case 31/2" x 4 1/4" x 5 1/4" with dial calibrated 0-100 and 80V neon Tube. Coverage approx. 190-210 Mc/s. New, 6/- each post paid.

REFLECTOR

In lakelide case fitted with small bayonet cap holder. Size 5 inches in diameter by 3 inches deep. 2/- post paid.

R.F. UNITS

R.F. 24 20/30 Mc/s Switched Tuning Valved 9/6 ea.

R.F. 45 40-50 Mc/s Switched Tuning Valved 9/6 ea.

R.F. 26 50-65 Mc/s Variable Tuning Valved (Dials Damaged) 1/-

Packing and postage 2/- ea.

DINGHY TRANSmitters B.C. 988

American manufacturer in new condition. Comprising 12A6, 12SC7 valves, Excellent Hand Generator (can be used as Mains A.C. Motor) with extensive chain of gears, plus a quantity of useful Radio components. Bargain price £1. Packing and postage 10/-

F.L. 8a RADI0 FILTERS. 10/6 ea. 1/6 post & packing.

ELECTROSTATIC LOUDSPEAKERS

High fidelity Electrostatic Speakers 3,000 to 20,000 cycles. This loudspeaker is essential when receiving FM transmissions or reproducing high quality recordings and TV sound. 20,000 cycles response+10db.

Type LSH 75 size 3" x 3" x 3" Price 12/6 post paid.

Type LSH 100 size 5" x 4 1/4" x 3 1/2" Price 21/- post paid.

POTENTIOMETERS

American manufacturer 100k & 25k ohms. Size 1" dia 1" Spindle (Carbon) 1/- ea. post paid.
RECEIVER TYPE R1392

FREQUENCY 95-150 Mc/s (2-3 METRES)
AIR TESTED 15 VALVE SUPERHET

Valve line up: 1st and 2nd R.F. Amp VR.136 (EF.54); 1st local oscillator VR.65 (SP.61); 2 Oscillator Multipliers VR.136 (EF.54); 3 I.F. Amp V.R.53 (EF.39); A.G.C. 6Q7; Output 6J5; Muting VR.92; (EA50); Noise Limiter VR.92 (EA.50); B.F.O. 6J7; Mixer VR.136 (EF.54); De Mod. 6Q7.

Slow motion Tuning over 95-150 Mc/s or can be Crystal controlled.


MAINS POWER UNIT TYPE 234 USED WITH R1392

Double smoothed. Input 200-250 volts 50 cycles. Output 240 volts at 200 mA, 6.3 volts at 6 amps. with volt-meter 0-300v Reading Input and Output voltages. Size 19" x 10" x 6 1/2" Standard Rack Mounting.

PRICE £3. 10. 0. Packing Postage 7/6 (limited quantities).

RECEIVER TYPE R1132

FREQUENCY 100-126 Mc/s, 11 VALVE SUPERHET

Valve Line Up: R.F. Amplifier VR.65 (SP.61); Frequency changer VR.65 (SP.61); Local Oscillator VR.66 (P.61); Stabilizer VS.70 (7455); 3 x I.F. Amplifiers VR.53 (EF.39); B.F.O. VR.53 (EF.39); Detector VR.54 (EB.34); A.F. Amplifier VR.57 (EK.32); Output VR.67 (6J5).

Switchable A.G.C. and A.V.C. Variable B.F.O.

Circuit diagrams with units. Easily converted to cover Wrotham Band. No alterations to wiring required. Conversion Slugs and instructions. 5/- Extra. Size 19" x 10" x 10" Standard Rack Mounting.

PRICE £3. 7. 6. Packing and carriage 15/-, 10/- returnable on Packing Case.

MAINS POWER UNIT TYPE "3" USED WITH R1132

Double smoothed. Input 200-250 volts 50 cycles output. 240 volts at 80 mA, 6.3 volts at 4 amps.

PRICE £2. 5. 0. Packing and postage 7/6 (Limited quantities)

Miniature POCKET RADIO

Incorporating high “Q” technique using the New Ferrite rod. Made possible by simple conversion of an ex-Govt. Hearing Aid.

Technical Details. A Germanium Diode Detector circuit followed by the existing 3 valve Amplifier, giving adequate amplification throughout the medium wave band.

This conversion can be carried out in approximately 30 minutes.

SEE and HEAR this Miniature POCKET RADIO demonstrated.

THE COMPLETE KIT OF PARTS includes a Type OLIO Hearing Aid (with Crystal microphone) in perfect working order with miniature ear phone and moulded ear insert attached; ferrite rod, germanium diode, components, circuit diagram and full instructions. Price £2 6s. Od. post paid

ALL COMPONENTS SOLD SEPARATELY

Deaf Aid Unit with earpiece £1. 15. 0.
Plastic Ear Mould 2. 6.
Ferrite Rod 5. 0.
Conversion Components 4. 0.
Batteries 1.5v. L.T. (Type D.18) 8.
30v. H.T. (Type B.119) 4. 3.

NOTE: As the crystal microphone is not used in the Pocket Radio, it can, if desired, be used as a general microphone and it does not require a matching transformer.

NOTE : Orders and Enquiries to Dept. ‘W.’ Shop hours : 9 a.m. to 6 p.m. Thursday : 9 a.m. to 1 p.m. OPEN ALL DAY SATURDAY

PROOPS BROS. LTD.
52 TOTTENHAM COURT ROAD LONDON W.I.

The Walk-around Shop
NEW LIFE FOR YOUR OLD RECEIVER!

TRANSFORM YOUR PRESENT SET AND HEAR RADIO UNDER PERFECT CONDITIONS OF RECEPTION

THE NEW TSL FM/VHF ADAPTOR UNIT. A laboratory designed TSL FM/VHF Adaptor attached to your present radio set, AM table receiver or audio amplifier will enable you to hear the new VHF high fidelity transmissions from the B.B.C. without interference from cars and domestic electrical appliances, heterodyne whistles or static. This Adaptor is self-powered and completely self-contained and only one connection is required to turn your old AM set into a modern FM receiver. Automatic tuning by means of a Magic Eye indicator ensures that maximum selectivity is obtained at all points on the band from a cold start to operating at all critical points and drift is less than 20 Kilocycles

BANDWIDTH. Due to the unique design of this unit the audio range is from 15 to 30,000 cycles, free from distortion. This, of course, depends upon the strength of the signal received and the characteristics of the associated amplifier.

OUTPUT. Controlled by a red knob, output alone depends on signal received.

FREQUENCY COVERAGE. Coverage is 85 to 101 megacycles. This allows adequate overlap at each end of the band so that all present and proposed FM/VHF transmissions in the U.K. can be received.

AERIAL DETAILS. For high signal strength areas an indoor aerial is quite adequate but for fringe area reception a folded dipole is advised.

SCALE. An illuminated scale 6fin long for easy reading is incorporated in the TSL FM/VHF Tuner. Only machine cut gears are used in the dial mechanism which ensures that all backlash is eliminated.

TUNING. Permanent distortion free reception is obtained by means of a Magic Eye indicator.

DO IT YOURSELF. If you do not wish to buy this unique FM/VHF adaptor as a complete unit all the several components are marketed by TSL through all good Radio Supply Houses and a 32-page booklet called "FM TUNER CONSTRUCTION" giving practical wiring diagrams, layout and point-to-point wiring details is available. (Published by Barnards Publishers Ltd. Book No. 134 price 2/6.)

THE CIRCUIT. The circuit contains 6 valves and 18 tuned circuits for maximum sensitivity and best signal to noise ratio. A grounded grid RF stage followed by a double triode stage which ensures that all parts are in a completely balanced condition. All parts are of a very high order of performance. The grid stage is capable of handling 18-7 megacycles with six valve circuits employing two EF89 valves give maximum gain followed by R94A, double diode valve as ratio detector. GZ30 and EM80 or EM86 valves are employed respectively as rectifier and Magic Eye tuning indicator.

SENSITIVITY. 0.1 microvolts. The extreme sensitivity of the TSL FM/VHF Adaptor enables it to be used up to 100 miles radius of any FM transmitter. Tests show that good reception of the London FM transmitter is possible in such places as far distant as Bournemouth, Birmingham, Swindon and Norwich provided suitable aerials are used.

SIGNAL TO NOISE RATIO. The layout of the 3,000 microvolts gives a signal to noise ratio of better than 50:1.

RADIATION. Due to the sealed construction of the tuning heart oscillator radiation is at the extreme minimum and has not been bettered by any other commercially designed model.

ESSENTIAL COMPONENTS FOR THE TSL FM/VHF ADAPTOR.

VHF UNIT
GÖRLER TYPE UT340
GÖRLER TYPE UF376
GÖRLER TYPE UF377
GÖRLER TYPE UF378
TSL HIGH STABILITY RESISTOR KIT
IS RESISTORS
DRILLED CHASSIS
TSL FM DIAL

IN CASE OF DIFFICULTY WRITE TO:
TECHNICAL SUPPLIERS LTD.
HUDSON HOUSE, 65, GOLDHAWK ROAD
LONDON, W.2.

TUNING BRIEF. High stability capacitors are used at all critical points and drift is less than 20 Kilocycles on any part of the band from a cold start to operating temperatures.

NEW LIFE FOR YOUR OLD RECEIVER!

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RADIO ENGINEERING
ELECTRONICS
RADIO SERVICING

There's a big future in T/V and Radio. Act now to increase your knowledge. Back up your theoretical background with a sound practical background. I.C.S. offer courses of instruction in—

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I.C.S. will also coach you for the following examinations—

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We can now offer this self-contained
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Stages and separate local oscillator and
Matched graduated vernier drive
COMPONENTS OFFERED TO COM-
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• Complete set of all components
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• Special offer of all above items
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Send S.A.E. for illustrated leaflet, or 1/3 for 14 page booklet, which gives technical information, circuits, etc., and is supplied free with each receiver.

V.H.F. RECEIVER R.I.132.A

An 11-valve receiver, covering 100-124 M.cs. Has large tuning dial with slow motion drive, R.F. and L.F. gain controls, phone and output sockets, and 0.5-ma. tuning meter. In grey enamelled metal case with plasticed handles, size 18in. x 10in. x 11in. Complete with valves, circuit diagram and calibration charts. ONLY 61/- (carriage 10/6).

POWER UNIT TYPE 3

Made for use with the R.132.A, this is a standard rack mount 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, 10/6.

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Manufactured by Pye. 3 switched wave bands: 12-49 meters. 200-600 meters, 800-2100 meters. Valve line up of EF93, I, each 6K8, ECC83,6V6. Has large calibrated dial with slow motion tuning, aerial trimmer control and tone control. Output sockets provided for 3 ohms speaker. Requires normal 6.3v. and 5 mA. speaker. Used, tested working before despatch. ONLY 44/19/6 (carriage, etc. 10/6). OR A.C. Mains version £7.5 (plus carriage).

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* Valve line up, 2 of 6L6, 4 of 6J7, 1 of 5U4.
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RECEIVER 25/73 (TR1194) superhet receiver with 465 kc/s AFC and 250 kc/s AFC, with all valves 2-4EF3, 1-EK32, 2-EF36, 1-EBC33. Receiver is completely wired for full conversion to F.M., with list price. Only £36-7/6 plus 2/6 post.

R.F. UNITS, ALL BRAND NEW and BOXED. RF24, 20-30 Mc/s, 12/6, RF25, 40-50 Mc/s, £19; RF26, 50-65 Mc/s, 7/6, RF27, 65-85 Mc/s, £2/6.

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RISS BRAND NEW "MINT" condition, in portable transit case. Transmitter/Receive R1155A. £1/11/6. R1155B with super slow-motion drive, 4£2/10/-.

R1155A, sharp sound quality, motor-driven tuning, with 465 kc/s AFC. Used models £2/19/6 "E", and "N" MODELS. COVER trawler and shipping bands. Equally excellent condition. £1/17/6/5 Carriage. On all models 10/6 extra. All receivers supplied complete with FREE BOOKLET giving circuit data and details of the power pack required for A.C. mains. Full re-aligned and tested before despatch and gladly demonstrated to callers. Send S.A.E. for full details of power packs and receivers or 1/3 each for booklet. DIF, Loop and Visual Indicator Meters available.

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NOTE: 10/- REDUCTION ON PURCHASE OF TWO ABOVE POWER PACKS WITH RECEIVER.


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RECEIVER 25/73 (TR1194) superhet receiver with 465 kc/s AFC and 250 kc/s AFC, with all valves 2-4EF3, 1-EK32, 2-EF36, 1-EBC33. Receiver is completely wired for full conversion to F.M., with list price. Only £36-7/6 plus 2/6 post.

R.F. UNITS, ALL BRAND NEW and BOXED. RF24, 20-30 Mc/s, 12/6, RF25, 40-50 Mc/s, £19; RF26, 50-65 Mc/s, 7/6, RF27, 65-85 Mc/s, £2/6.

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R1155A, sharp sound quality, motor-driven tuning, with 465 kc/s AFC. Used models £2/19/6 "E", and "N" MODELS. COVER trawler and shipping bands. Equally excellent condition. £1/17/6/5 Carriage. On all models 10/6 extra. All receivers supplied complete with FREE BOOKLET giving circuit data and details of the power pack required for A.C. mains. Full re-aligned and tested before despatch and gladly demonstrated to callers. Send S.A.E. for full details of power packs and receivers or 1/3 each for booklet. DIF, Loop and Visual Indicator Meters available.

AC Mains POWER PACKS AND OUTPUT STAGE. Enable the R1155B to be used to operate receiver from 200-250 volts A.C. without A.U.R. and with a good tuning transformer and Jones plugs and are guaranteed for 6 months. Type B with 8in. x 4in. x 4in. less speaker, price £4/11/6 plus 5/- for 5/- carriage. Type C with 8in. speaker in specially designed oak cabinet and speaker in bakelite case size 13in. x 5in. x 5in. 12/6. Price £5/10/- plus 5/- carriage.

NOTE: 10/- REDUCTION ON PURCHASE OF TWO ABOVE POWER PACKS WITH RECEIVER.


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ADMIRALTY TYPE B28 (MARCONI) V.H.F. Receiver. Valve line-up? 12 RF, 2 P.C's, & local osc., 3 F.E., 2nd Det., Output, B.F.O. and rectifier. "SERVICE"! Completely wired and tested 200-250 volts A.C. 50 c/s. Variable selectivity (crystal filter). 6,000, 3,000, 1,200, 300 and 100 Hz. Coverage 60 Mc/s in four ranges, continuous except for flat response. Size 16in. x 13in. x 12in. Weight 82 lb. The set for the serious operator. Thoroughly overhauled. In complete with all valves and set tested prior to despatch. A real bargain at only £30.

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PC24, ex-government surplus manufactured by Pye Ltd. Three wavebands-12-30, 190-570 and 900-2,000 metres. Lineins: RF-EF39, PC-X61, 2 IF EF39, Det., AVC, 1st AF-EBC33. Output 6V6. In black case size 171in. x 91in. x 8in. with ear-cup microphone calibrated dial, flywheel tuning, aerial trimmer. Requires power supply and straight-line face speakers. In first-class condition, complete, with all valves. £4/1/16. SPECIAL OFFER — can be supplied with built-in A.C. mains power pack, fully realigned and tested for £3 extra.

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RISS BRAND NEW "MINT" condition, in portable transit case. Transmitter/Receive R1155A. £1/11/6. R1155B with super slow-motion drive, 4£2/10/-.

R1155A, sharp sound quality, motor-driven tuning, with 465 kc/s AFC. Used models £2/19/6 "E", and "N" MODELS. COVER trawler and shipping bands. Equally excellent condition. £1/17/6/5 Carriage. On all models 10/6 extra. All receivers supplied complete with FREE BOOKLET giving circuit data and details of the power pack required for A.C. mains. Full re-aligned and tested before despatch and gladly demonstrated to callers. Send S.A.E. for full details of power packs and receivers or 1/3 each for booklet. DIF, Loop and Visual Indicator Meters available.

AC Mains POWER PACKS AND OUTPUT STAGE. Enable the R1155B to be used to operate receiver from 200-250 volts A.C. without A.U.R. and with a good tuning transformer and Jones plugs and are guaranteed for 6 months. Type B with 8in. x 4in. x 4in. less speaker, price £4/11/6 plus 5/- for 5/- carriage. Type C with 8in. speaker in specially designed oak cabinet and speaker in bakelite case size 13in. x 5in. x 5in. 12/6. Price £5/10/- plus 5/- carriage.

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Books on radio theory, practice and maintenance for the beginner and books on new developments in circuit design, new components, methods of application, and the established text books can be obtained through your local Smith’s shop or bookstall. Books not in stock at the branch can be quickly obtained from Head Office.

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Our technical department is at your service. Send for details of this brilliant instrument to-day.

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4/A6-406 v. A.C. and D.C. types

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Friday 30th September, 9.0 a.m. - 8.0 p.m.

**UNIVERSITY ARMS, CAMBRIDGE**
Thursday 6th October, Friday 7th October
9.0 a.m. - 8.0 p.m.

**74-76 BROADMEAD, BRISTOL I**
Thursday 13th October, 9.0 a.m. - 8.0 p.m
Friday 14th October, 9.0 a.m. - 5.30 p.m

**MARCONI HOUSE, STRAND, LONDON**
Monday 17th October, Tuesday 18th October, 9.0 a.m. - 8.0 p.m.

**NORTH BRITISH HOSTEL, EDINBURGH**
Thursday 20th October, Friday 21st October, 9.0 a.m. - 8.0 p.m.

DEPT. C.P.S., 336/7 STRAND, LONDON, W.C.2, REF. NO. 1353K
OCTOBER, 1955

WIRELESS WORLD

1/6.

35L6GT
25Z60T
158C7
10P13
EL41
2525
20D1
12J7

METAL RECTIFIERS

ea.: 250 v. 75 mA.

ea.: 12 v. 1 amp.

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<td>840A</td>
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<td>750</td>
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COMMUNICATION ENGINEERS AND DRAUGHTSMEN

The Transmission Department invites applications in senior, and junior, categories for LINE TRANSMISSION LABORATORY ENGINEERS, and APPARATUS DESIGN ENGINEERS, and also DRAUGHTSMEN with experience in telecommunication and light current engineering. Expanding programmes offer progressive opportunities in interesting work.

Specialist experience in any branch of line transmission engineering is desirable for some of the posts.

The positions offered are on the Company staff, with contributory Pension Fund, and usual staff conditions. Assistance in establishment in the Liverpool area will be given in some cases.

Applicants should write to the Personnel Manager, Automatic Telephone & Electric Co., Ltd., Strowger Works, Edge Lane, Liverpool 7, giving full details of age, experience and qualifications.

SITUATIONS VACANT

DESIGNER-DRAUGHTSMEN. Vacancies in the Research Department. Apply to SHORT BROTHERS & HARLAND, LTD., for work on INTERESTING military and commercial projects, including automatic control, navigational systems and guided missiles.

APPLICANTS must have EXPERIENCE of precision, electronic, electromechanical, instrument and hydraulic devices, and be able to work on their own initiative. These are permanent positions in an expanding organisation with new and well equipped laboratories, good prospect and project, selection scheme, assistance with housing and removal.

PARTICULARS of age, qualifications and experience, with references, to Staff Appointments Officer, P.O. Box 241, Birkenhead.

ULTRA ELECTRO, Ltd., Western Avenue, Croydon. ANNOUNCE the following vacancies for ENGINEERING STAFF:

(1) TELEVISION Development.

(a) SENIOR ENGINEERS required for TV receiver development: applicants should have good experience in one of the fields mentioned above, design of radio frequency amplifiers, preferably up to frequencies of the order of 200 Mc/s.

(2) SENIOR ENGINEERS for time base development: should have had good academic qualifications and previous experience in the design of TV time base circuits.

(3) JUNIOR ENGINEERS with academic qualifications or experience in receiver development required.

(4) RADIO DEVELOPMENT.

(a) JUNIOR ENGINEERS required for development of radio receivers embodying the most recent AM/FM frequency modulation, knowledge of FM receiver design desirable.

(b) JUNIOR ENGINEER required for receiver design: experience desirable but not essential if possessing H.R. N.C. or C. & G. (Telecoms.) Final Cert. Prac.

(5) ELECTRICAL ENGINEERS.

(a) SENIOR ELECTRONICS ENGINEER with some experience in circuit design for work on the following: (1) Pulse techniques and general waveform circuitry.

(2) Radar systems.

(3) Feedback techniques at video frequencies.

(b) Junior Electrical Engineer with some experience in circuit design, preferably in television work on one or more of the above subjects.

(6) TEST EQUIPMENT DEVELOPMENT.

(a) Test equipment engineers: knowledge of production test equipment for TV, radio or contract work; applicants should have B.Sc. N.C. or equivalent and good experience.

(7) JUNIOR ENGINEERS with some qualifications or preferably some experience.

(8) MECHANICAL ENGINEERING LABORATORY ASSISTANT (m. or f.) with some technical knowledge of electronic instruments, their calibration and certification of electronic equipment.

APPLICANTS should write to the Personnel Manager, stating which of the post(s) they desire, and giving full details (in strict confidence), including age, experience and salary expected. Saturday morning interviews can be arranged if desired.

APPLICANTS should have a clear logical sequence suitable for publication, ability to assimilate information supplied by laboratory technicians and to prepare this in technical standard. A GOOD general educational and engineering background is necessary, with H.N.C. (including electronics) or equivalent and good experience.

AN ASSISTANT (m. or f.) with mechanical, electrical or physical (including electronics) knowledge and applicants should have good experience in testing engineering instruments, with at least one of the fields mentioned above.

SALARIES are in accordance with experience and qualifications, age, illness, etc.; vacancies expected; Saturday morning interviews can be arranged if desired.

APPLICATIONS, which can be made in the London area to compile factory records and assist with the appointment of new employees, should be addressed to The Personnel Manager, stating which of the post(s) they desire, and giving full details (in strict confidence) including age, experience and salary expected. Saturday morning interviews can be arranged if desired.

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VOLTAGE REGULATORS. Input 220 v. A.C., 21 amp. Output 72/- v. to 228 in 16 steps with current limiting reactor. Three variable transformers are brand new and must not be removed from equipment. $12 carriage 15/.

VARIC TRANSFORMER type 20 CO oil filled. Input 200/240 v. Output 220 v. 7.5 amps. 50/- each; carriage 7/.

VIEWER DRIVES. Multibead, scaled 0-100 deg. 56 in. diam. 3 inch. 10/-; Post 5/.

AERIAL ROD SECTIONS, heavy copper plated, 110/6. each; carriage 21/6.

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BUILT TO YOUR SPECIFICATION—EASILY DELIVERY—QUOTATION BY RETURN—ROBUSTNESS OF CORE REQUIRED AND CONTACT BUILD UP.

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gives V.H.F. F.M. reception plus the normal wave

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Panel Tape. £1 6/9/0. 100ft. Cartons.

0578

installations engineer required, preferably

with experience of carrying out microwave

field surveys.

All these posts will involve a considerable amount

knowing it is essential that applicants be able to drive.

APPLICATIONS, giving full details of experience etc., and quoting Ref. 187/1, to the Personnel Manager, Communications, Ltd., Division Office, Works, Cambridge.

R. E. Pullin & Co. Ltd., invite applications for the following vacancies in its recently formed and developing Electronic Development Division:

(a) SENIOR Development Engineers: Applicants should possess an Honours Degree or equivalent qualifications, and should have had several years experience of the development of electronic circuits, preferably including work on electronic servos and magnetic amplifiers.

(b) DEVELOPMENT Engineers: Qualifications to O.N.C. or Higher standard together with some previous experience of valve circuit design.

The positions are of a permanent nature; they offer excellent prospects and the opportunity to work in a newly equipped Laboratory on a variety of projects requiring considerable individual technical responsibility and initiative.

A COMMENDATORY salary will be paid. Considerable personal schemes are in operation. We have a township with swimming baths, library, etc., and hold monthly parties.

The company offers a wide variety of interesting work in an interesting environment with excellent opportunities for promotion. Goodwood Works, Cambridgeshire. [5014]

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RADIO and Television engineers required;UNITED STATES.

AIRCRAFT Radio mechanic required for maintenance and overhaul work at Croydon Radio and Electrical Services, Crayford. Tel.: 7171.

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RADIO and television engineers required;
top wages, excellent conditions, pension;

--- Apply Boyd, Ltd., 18, Crown Place, Kentish Town, N.11.

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APPLY, Works Director, Pye, Ltd., Cambridge.

TELEVISION engineer, fully qualified, able to drive; good wages for the right man.

RADIO & Electrical Services, 45, Westminster Ave., Wood Green, 532. [5008]

RADIO and/or television engineer required for bench and outside repairs; driver; ref -

prices, age, experience, salary expected.

Field's Radio, Ltd., 52, Hall Gate, Doncaster.

ELECTRICAL SERVICE (EDGWARE), Ltd., required good service engineers, bench and outside; clean licence; top salary; permanent; con-

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ENGINEER, aged about 30 years, experienced in National Service, to service amplifier and telephone systems, London area; all applicants interviewed. Immediately. Address: E. R. Pullin & Co. Ltd.,邀请 applications for the following vacancies in its recently formed and developing Electronic Development Division:

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(b) DEVELOPMENT Engineers: Qualifications to O.N.C. or Higher standard together with some previous experience of valve circuit design.

THESE positions are in an expanding project

and offer good prospects for the right person.

Minimum qualifications to Personnel Manager, Goodwood Works, Cambridgeshire. [5178]

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EXPANDING company manufacturing direct sound recording equipment requires sales engineer, age 35-40, experienced in the Industry essential.—Write, stating qualifications and salary required to J. M. G. [0179]

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SENIOR engineer required, over 45, first-class experience in audio-telephony. Salary and pension position in London an advantage. Write, quoting Reference.—E. F. P. Ltd., 20, Milsey, Surrey. [0117]

TELEVISION service technicians for field and bench work in N.W. London; excellent conditions including holiday & surrounder.—Tel. Speedwell 9811 for interview at Northern Television, Ltd. [0118]

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between 21 & 40 years for

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SENIOR DESIGN AND DEVELOPMENT ENGINEERS

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Low winding capacitance. Radio 10 Kfl A-A, 8 x 0.97 sec sections, Max D.C. 120 mA each snobe, Adequate insulation, voltage proof, 3 V K peak overall.

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Wireless World

October, 1955

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3. CANDIDATES with lesser qualifications but who have considerable experience in industrial design.

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TECHNICAL radio engineer required to control technical aspect of radio and TV production and liaison between design department and works in a well-known London factory. Good position for a keen person with sense of responsibility Apply for leaflets: AMPLIFIER INSTRUCTION BOOK

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CAR radio or associated leading motor vehicle distributors; substantial installation experience an advantage. Excellent rates of pay. Pension scheme, etc.-Apply Service Home, Lambeth, 178 Southend Rd., Woodford. Essex. (2151)

FACSO require Assistant development engineer. Expanding company. Excellent prospects for young engineer. Apply in confidence to Personnel Director, FACSO Electrical (Holdings), 18-20, Harrow Road, London, W.2, Tel. Brixton 4651. (2152)

ASSISTANT engineers required for radio and television installation work; good prospects for men with H.N.C. or equivalent. Dacca 78 r.p.m. variable speed record players, ideal for radio and television installation. Write or phone. Atkins Laboratories, Gowan Ave, Fulham. Renown 5601. (2151)

DECA and Brothers, Electrical and Mechanical Engineers, require Draughtsmen for the electronics design office of the British Thomson-Houston Company, Blackbird Road, Leicester.-Please send a letter in Writing to Manager, Drawing Office, British Thomson-Houston Company, Ltd., boxes, giving details of age, experience, etc. (2160)

DEVELOPMENT engineers, a leading manufacturer of domestic radio and television receiver sets, are in constant need of qualified men with experience in this field for responsible positions in their laboratories.-The interested should write, giving brief details of qualifications and experience, to the Personnel Manager, Ref. D.E. Box 4584. (2082)

C. H. W. Duff and Co., Ltd., Chester-Manufacturer and Illustrator with experience of preparation of drawings for technical publications required in recently formed publications group, dealing with guided weapons and other military equipment projects. Apply, stating age and experience, to the Personnel Manager, The General Electric Co., Ltd., Brown's Lane, Cowenby, Ref. RG. (2150)

VACANCIES exist for engineers in radio and television production and development, for N.O. and B.O. Wireless Certification or Ministry of Supply Radar Certificate.-Applications from former service Naval personnel welcomed.-Reply to W. E. Smith & Co., Electrical Engineers, 46, Grosvenor St., Manchester, Ref. M. 66, Grosvenor St., Manchester, 1. (2152)

ELECTRONIC engineers and physicists read for quickly expanding research department; candidates should have experience of electronic development equipment; experience in various circuits or ultrasonics desirable but not essential.-B.E. or H.N.C. standard.-Write full particulars to Glass Developments, Ltd., Brixton, S. (2167)

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