A TELEVISION PRE-AMPLIFIER

Practical Wireless

9D EVERY MONTH

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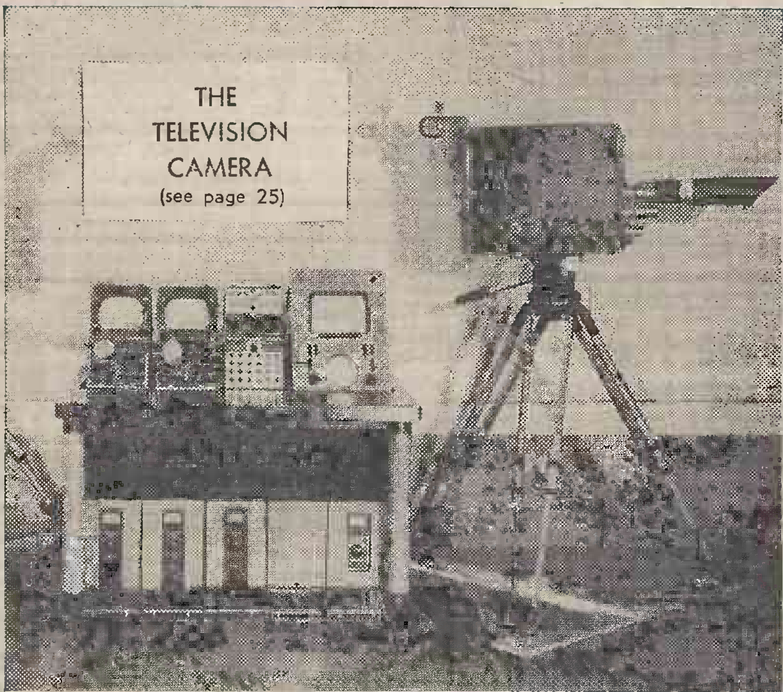

THE TELEVISION CAMERA
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PRINCIPAL CONTENTS

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SP.350B.	350-0-350 v. 100 m/a. 4 v. 2-3 a. 4 v. 2-3 a. 4 v. 3-5 a.	29/-
SP.351.	350-0-350 v. 150 m/a. 4 v. 1-2 a. 4 v. 2-3 a. 4 v. 3-6 a.	36/-
SP.351A.	350-0-350 v. 150 m/a. 4 v. 2-3 a. 4 v. 3-6 a. 4 v. 1-2 a. 4 v. 1-2 a.	39/-
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Practical Wireless

and PRACTICAL TELEVISION

14th YEAR OF ISSUE

EVERY MONTH
VOL. XXIII No. 486, DECEMBER, 1946.

Editor F. J. CAMM

COMMENTS OF THE MONTH. BY THE EDITOR

The Third Programme

THE third programme, which commenced on Sunday, September 29th, seems to have been generally approved; as everyone now knows it is transmitted daily from 6 p.m. till midnight on 203.5 metres (1,474 kc/s) and 514.6 metres (583 kc/s).

The transmission on the lower wavelength is intended primarily for listeners in London, Manchester, Edinburgh, Brighton, Portsmouth, Southampton, Bournemouth, Glasgow, Sheffield, Belfast, Plymouth, Middlesbrough, Preston, Dundee, Liverpool, Leeds, Newcastle, Aberdeen, Bristol, Cardiff and Huddersfield, whilst the transmission on the higher wavelength is intended primarily for listeners living in the central midlands.

In accordance with the Government's decision, the West of England Home Service, formerly radiated on 514.6 metres, has been transferred to 307.1 metres (977 kc/s). The Bristol and Somerset areas, where formerly the West of England Home Service was given on 203.5 metres, is now served by 216.8 metres (1,384 kc/s). Listeners to the West of England Home Service in Hampshire and South Wiltshire should now also tune to 216.8 metres when reception on 307.1 metres is not satisfactory.

Listeners in Kent and Sussex, particularly in the coastal areas, who have been accustomed to receive the West of England Home Service on 514.6 metres, should tune to the London Home Service on 342.1 metres (877 kc/s).

There has been no other change in the distribution arrangements for other Home Service programmes or for the Light programmes.

At a meeting at Broadcasting House when Mr. George Barnes, who is in charge of the third programme, gave the first details of it, Mr. Kenneth Adam, who presided at the meeting, informed the Press that owing to Russia suddenly deciding to broadcast from Latvia on what was to have been our main wavelength (514.6 metres) we should only be able to put out the third programme to 50 per cent. of the population instead of about 80 per cent. Although this has seriously embarrassed the B.B.C., they admit that the Russians had a right to the wavelength. The decision has, however, caused considerable difficulties, but it was decided to go ahead although on a smaller scale.

The new programme is, of course, on a higher plane than the other programmes and it is freer from routine broadcasts. There is no news, time signals, etc., to break the continuity. In the event of a play with a number of acts being broadcast there will be interludes of either poetry or music.

The whole idea of the programme is for the selective listener, who makes a date with his radio. The programme is intended to bring only the best in artists and material to the microphone, each work is repeated the following night and at least once more some weeks later.

We welcome the appearance of the Radio Critic. If the theatre and screen critics are given the freedom of the air, it is only right that this newest form of entertainment should also be independently criticised without fear or favour. The music and dramatic criticism is not undertaken by the same person. The programme means 42 extra hours per week broadcasting time, and in our view it does much to remove criticism of the other two programmes by those more intellectually inclined.

Queries

WILL readers please note that our query service is still discontinued owing to staff shortage. We are hoping to be able to reintroduce it in the New Year.

The Radar Association

THE Radar Association has recently been formed. Its membership is drawn from all personnel, irrespective of rank or trade, of the radar establishments of the Royal Air Force. Radar has had a considerable amount of publicity from the technical point of view. The new association intends to take care of and to continue the cordial and co-operative relationship which existed among all of those associated with the manufacture and use of radar equipment. The Radar Association will maintain an independent identity and will not affiliate to the Royal Air Force Association or any other recognised Royal Air Force organisation. It will exist solely for the purpose of providing social facilities for its members.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in "Practical Wireless." Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor, "Practical Wireless," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

ROUND THE WORLD OF WIRELESS

Short-range Radiotelephone Service to Ships at Sea

A SHORT-RANGE radiotelephone service between ships and inland telephone subscribers in this country was introduced on October 1st, 1946. The service is available for passengers and members of the crews on coasting and other short-voyage ships which are suitably equipped to communicate. It was provided in the first instance through the Post Office Coast Stations at Humber (Mablethorpe), Cullercoats, Seaforth (Liverpool) and Portpatrick, and is being extended to other coast stations. It covers sea ranges up to about 150 miles from these stations.

The inclusive charge for a call is 10s. 6d. for three minutes and 3s. 6d. for each additional minute.

B.I.R.E. Meeting

THE annual general meeting of the London section of the British Institution of Radio Engineers was recently held, and was followed by a Paper by L. H. Bedford, O.B.E., M.A. (the vice-president) on "The Strobe Principle in Radio and Radar."

Radio Surplus in U.S.A.

SENATOR WILEY, of Wisconsin, has complained to the House Committee, now investigating war surplus disposal, that radio surplus sales are being handled in a "scandalous" manner. He pointed particularly to $200,000,000 worth of electrical equipment from $400,000,000 worth declared surplus. He said that private, commercial sources got $198,000,000 worth, whilst priority claimants such as veterans and schools only got equipment worth $2,120,000.

London-Colombo Radiotelephone Circuit

ON Monday, September 30th, a direct radiotelephone circuit was opened between Colombo and London. The service is operated in London by the Post Office.

This enables a reduction of rates for telephone-calls between London and Colombo to £1 a minute (minimum £3 for three minutes). The report charge is reduced from 6s. to 4s.

The new service is available from 9 a.m. to 10 a.m. G.M.T.

Sir Edward Appleton in Norway

SIR EDWARD APPLETON, K.C.B., Secretary of the Department of Scientific and Industrial Research, went recently on a ten-day lecture tour in Norway arranged by the British Council in co-operation with the Royal Norwegian Society.

Sir Edward visited Oslo and Bergen and lectured on "British Science in War and Peace," "British and Norwegian Co-operation in Radio Research," and "The Ionosphere and Terrestrial Magnetism."

Sir Edward Appleton is one of the world's leading research workers on electricity and the scientific problems of wireless-telegraphy. His research into the upper atmosphere led to the discovery, and naming after him, of the Appleton layer. During the recent war his activities were very largely directed to the development of radar.

Growth of Radio in U.S.A.

THE following table gives the expected increases in radio services in America, largely due to wartime technical developments, which, it is claimed, have pushed forward radio technique a whole generation:

Standard broadcast stations, from 1,000 to 1,400.
Frequency modulation (F.M.) stations from 50 to 3,000.
Television stations from six to 200 or 300.
Radio-equipped 'planes from 3,000 to 50,000.
Aviation ground stations from 700 to 2,500.
Two-way service for autos, taxicabs, etc., from one city to 200 cities.
Radio-equipped railroads from one road to 150.
Fire department radio from no cities to 5,000.
Citizens' walkie-talkie from none to 200,000.
Amateur operators from 60,000 to 100,000.

In addition there will be thousands of channels for radar, for point-to-point communication, for diathermy and many other safety and special services.

American News Bulletin

AMATEURS anxious for interesting DX Morse practice may like to try to pick up official news bulletins. These are given from three stations as shown in the following schedule:

	Mc/s	G.M.T.
WGEX ..	17.880	13.45-23.00
	9.855	23.15-06.45
WLWR2 ..	12.967	13.45-03.00
	9.897	03.15-06.45
WCDA ..	13.442	13.45-22.15

Short-wave Absorption

AT a recent meeting of the American Physical Society it was announced that selective absorption of very short radio waves may have an effect on propagation at U.H.F.

Water vapour molecules absorb a wavelength of 1¼ centimetres, while the oxygen molecules absorb a wavelength of ½ centimetre. These waves are mere fractions of an inch and much shorter than the waves used at present.

The cast of Itma at rehearsal. Tommy Handley explains some of the points of presentation.

New Radio Valve

IT is claimed that wide-band amplification will take on a new meaning as a result of a new valve. Conservative figures for the valve show a power gain of 10,000 times over a band width of 800 mc/s. By comparison, the present pentode can give a power-gain of only ten times over a band-width of 20 mc/s., and a velocity-modulation valve, operating in the micro-wave range, gives the same amplification over a band-width of 10 mc/s.

Mains Supply Standard

IT is now confirmed that the future standard low-voltage A.C. supply for the country is to be as follows:

50 c/s at 240 volts on two-wire single-phase circuits.

480/240 volts on three-wire single-phase circuits.

415/240 volts on four-wire three-phase circuits.

415 volts on three-wire three-phase circuits.

Existing systems at 50 cycles have already been adapted and new systems are required to comply exclusively with the standard unless the Electricity Commissioners specifically approve some other system.

British I.R.E. President

AT the annual general meeting of the British Institution of Radio Engineers election of the president was confirmed. For the current year, the president is to be Admiral Lord Mountbatten of Burma, C.B., G.C.V.O., D.S.O., who succeeds Leslie McMichael, who has held the chair for the past two years.

This pocket transmitter-receiver (compared with a normal cigarette case) has been developed from wartime secret service sets. Teleradios are producing it.

P.A.Y.P.! Pump as you pedal! Mr. F. J. Camm's new invention, an automatic tyre pump, being televised for "Picture Page". It incorporates a check valve which blows off when correct pressure has been reached, and will keep the tyre inflated even with a slow puncture.

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ending August 31st, 1946:

Region	Number
London Postal	2,038,000
Home Counties	1,353,000
Midland	1,542,000
North Eastern	1,643,000
North Western	1,415,000
South Western	884,000
Welsh and Border	617,000
Total England and Wales	9,492,000
Scotland	1,033,000
Northern Ireland	155,000
Grand Total	10,680,000

Television Interference

AMATEURS using the 14.1 to 14.3 mc/s band are warned that interference may be caused to television-receivers, unless special care is taken to suppress the third harmonic. As a matter of interest, those using this band who have television receivers in the vicinity would be well advised to co-operate in order to see the effects of different aerials and keying systems on the television frequencies.

Film Sound-tracks

UNITED MOTION PICTURES have opened a well-equipped studio at 24, Denmark Street, London, W.C., which may be hired either by amateurs or professionals for the making of film sound-tracks. Full facilities are provided for mixing sound-effects or music from disc recordings or the radio. The recorder utilises the variable density method with a gas-discharge glowlamp source and a quartz lens with a focal length of .004in. The recorder may be used for playback through a photo-electric attachment.

A Television Pre-amplifier

Details of a Simple Television Amplifier Which Makes Possible Reception of Vision Signals Outside the B.B.C. Service Area. By S. A. KNIGHT

THERE are some readers who no doubt have a television receiver, either home-constructed or of commercial design, and yet are unable to obtain satisfactory results from it due to their being situated at distances greater than some 45 miles from Alexandra Palace. Where the receiver is commercially built, this failure is simply due to the fact that the instrument was in all probability pre-war designed and was never intended to operate at extreme distances, the circuit incorporated being either one of the straight variety with about three R.F. stages before the detector, or a super-heterodyne with a single R.F. valve (if one at all) before the frequency changer. In the latter type of commercial receiver, the R.F. stage contributes little or nothing to the useful gain of the whole, being generally inserted solely for the purpose of improving the signal-to-noise ratio. Only very erratic results, therefore, will be obtained on such receivers if they are used at distances outside the reliable range of some 35 miles from the B.B.C. studios.

A case of this difficulty rose when a commercial receiver with a single R.F. valve before the mixer was put into operation at a distance of about 65 miles from Alexandra Palace. No results whatsoever could be obtained on either vision or sound, even with a fairly efficient aerial system, and some form of pre-amplification, therefore, became a vital necessity. At first a single-stage amplifier was contemplated, but finally two valves were employed to make certain of worthwhile results. A certain amount of experiment was necessary with coil types and other component values, of course, and the circuit finally evolved into that shown in Fig. 1.

Choice of Components

The first design consideration was obviously that of valves, and the Osram Z62 "television" pentode was chosen for both stages. The reason for this choice was partly due to the fact that the writer had several of these valves in hand, and partly due to the convenience of a 6.3 volt heater system so that a rectifier such as the 6X5 could be contained in a compact amplifier without the necessity of a separate rectifier heater winding on the mains transformer. A few Mazda SP 41's were also to hand, but on account of their 4-volt heaters they were not used in the final circuit. There is no reason, however, for equivalent results not being obtained by the use of the latter type of valve provided anode, screen and cathode voltages are set up in accordance with the maker's recommendations.

The Osram Z62 has a slope of about 8 mA. per volt and is of the short-seal base, giving excellent results at frequencies far in excess of those used for vision and vision-sound transmissions at the present time.

The matter of tuning came next on the list and a form of plunger tuning was immediately decided on in view of the extremely wide band requirements of the amplifier. Since the instrument had obviously to tune both the sound channel on 41.5 mc/s and the vision channel on 45 mc/s, a substantially flat band width of some 6 to 7 mc/s. was called for, centred about 43 mc/s. This was not an easy proposition if capacity tuning was to be involved, and iron-dust plungers moving along the axes of the tuning coils were, therefore, decided upon as the most efficient method of securing the desired end.

The coils were wound on ceramic formers of ⅜in. outside diameter, and of length 1⅝in., the wire used being bare 22 s.w.g. tinned copper, spaced by one diameter between turns. Details of the coils are shown in Fig. 2, where the plunger mechanism is illustrated at (a). Three identical formers are required in all, the number of turns being (see Fig. 1): L1 = 9 turns, L2, L3 = 8 turns, L1 and L3 being tapped up one and one-half turns from the earthy end of the winding. These tappings are for the aerial feeder connections, and the matching cable leading to the receiver proper, respectively. A brief diversion is necessary at this stage to discuss these matching arrangements.

As shown on the circuit diagram, the tappings are arranged for an aerial system using 80 ohm coaxial feeder, and for a receiver demanding an 80 ohm coaxial

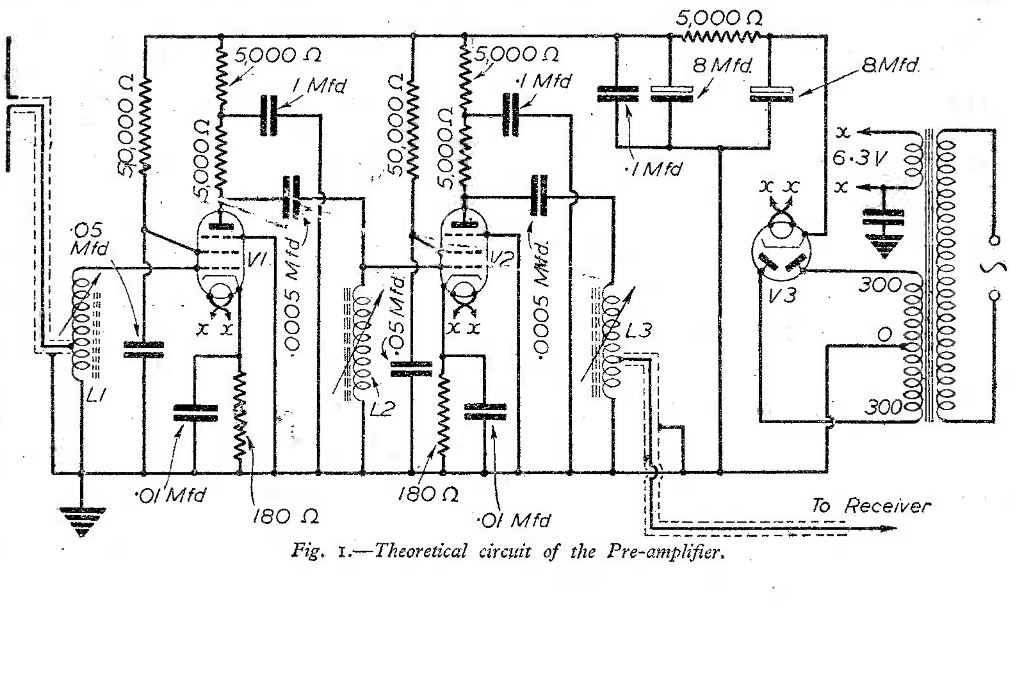


Fig. 1.—Theoretical circuit of the Pre-amplifier.

input. The writer has experimented with various input and output-matching systems, but the tappings as described give the most superior results. Where the receiver demands a twin 80 ohm feeder line, or the aerial system in use employs such a feeder, tappings may still be used on the input and output coils, but better results will be obtained if a single turn coupling coil is wound at the earthy end of the coils concerned, the system then being as shown in Fig. 3. A centre tap from the coupling coil to earth may be found of

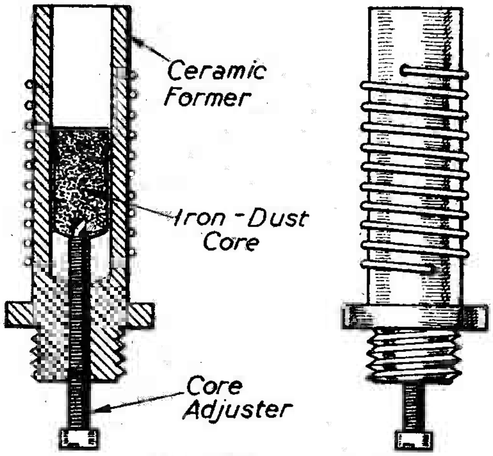


Fig. 2.—Details of the tuning coils.

advantage in these cases. Regarding the output end of the amplifier, the best plan in any case is to find out from inspection or from the circuit diagram the type of matching the makers of the main receiver employ, and adjust the system accordingly on the amplifier output coil.

There is no reason why paxolin or polystyrene or similar formers cannot be used for the tuning coils provided the plunger mechanism is substantially the same as that described above.

Having selected the valves and laid out the tuning system, the choice of bias voltages, anode and screen supplies, and intervalve coupling arrangements had to be decided. The power supply was made self contained for convenience, being simply designed to give a smoothed output of about 240 volts at 25—30 mA. Resistance smoothing was employed in view of the substantially low H.T. current demands of the amplifier. With 50 kΩ screen resistances, 5 kΩ anode loads and 5 kΩ decoupling values, with 180 Ω bias resistances,

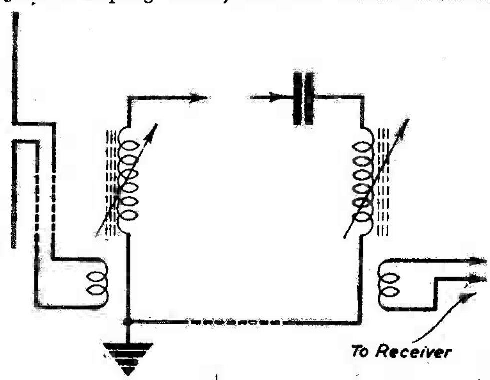


Fig. 3.—Modifications to enable a feeder to be utilised.

the anode voltage of each valve was about 220 volts, with the screens at 130 volts and a cathode bias of approximately 1.75 volts, suitable working conditions in accordance with the manufacturers figures.

The low anode loads of only 5,000 ohms prevent anything like a high gain being obtained from each valve, but at the same time such low values are necessary in order to heavily damp the tuning coils L_2 and L_3

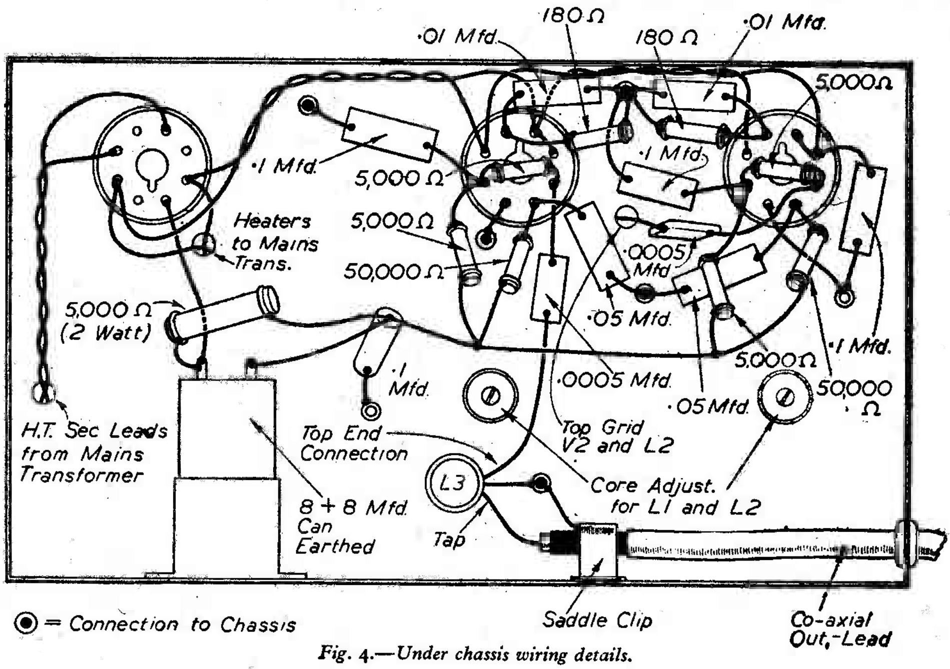


Fig. 4.—Under chassis wiring details.

so that the requisite band width is fairly easily obtained. A gain of about five to six times is obtained from each valve under these conditions, which gives the complete amplifier a gain of something in the order of 30 times, which, while not great, is certainly sufficient for normal purposes on which the instrument would be employed, keeping in mind the enormous band width requirement involved.

Condensers of 0.0005 μF. capacity, mica insulation, are used for intervalve coupling purposes, though no doubt values down to 0.0001 μF. could be tried without affecting the performance to any noticeable extent. The decoupling values of 0.1 for the anodes and 0.05 μF. for the screens may seem small when judged by ordinary broadcast standards, but larger values may do more harm than good in these positions due to resonant effects on account of self inductance at frequencies around 45 mc/s. Although the amplifier under discussion is quite stable with the indicated values of components, instability in similar types of amplifiers can often be traced to such condenser resonant effects and lower capacities than those indicated may therefore be employed to give an added margin of safety in the present case. Similarly the 0.1 μF. condenser in parallel with the 8 μF. smoothing condenser may seem superfluous, but it has been added for the reason just discussed.

Layout of Components

Contrary to popular opinion, the layout of components in a 45 mc/s amplifier circuit is not (within reason) so critical as might be supposed. The diagram of Fig. 4 gives a general view of the complete amplifier from below the chassis, the only components above being the valves, two of the coils and the mains transformer. The rectifier is housed immediately behind the mains transformer. Below the chassis things are laid out as conveniently as possible and are clearly shown in the diagram. L3 is included beneath the chassis, being adjustable from above the chassis, the output length of coaxial feeder passing through one end. All small components are rigidly wired directly across the valve pins or suspended firmly in the wiring. There is nothing special about the valveholders used and ordinary Octal types are quite suitable.

The Z62 is an unscreened valve and no screening is employed on the amplifier except in the form of flat plates inserted between each valve stage and its associated coil. This works quite satisfactorily. The size of the main chassis—which is constructed entirely of 18 gauge aluminium—is 9in. by $4\frac{5}{8}$in. by 2in., and the screens consist of 20 gauge aluminium measuring $4\frac{3}{4}$in. wide by 4in. high rigidly bolted to the chassis. A perforated zinc cover may with advantage be fitted above the whole upper assembly.

Operating Details

The amplifier should at first be checked regarding voltage readings at the various points previously mentioned to ensure that nothing is drastically amiss; it may then be connected to the aerial feeder and to the main receiver with which it is to be used. The length of the output connecting lead is unimportant, although a foot or so will generally be found ample, since the amplifier can then be placed immediately behind the main receiver, the A.C. mains connections being conveniently paralleled. All the dust plungers should be set half-way along their lengths of travel and the main receiver and the amplifier should then be switched on.

The tuning of the main receiver will depend upon its make, but results of some kind should be obtained at once, if not vision *and* sound, at least one *or* the other. The plungers of the amplifier should then be adjusted to give the most satisfactory compromise between vision and sound. Plunger tuning is invariably flat and no difficulty should be experienced. It will be generally found that as each plunger is adjusted either sound or vision will "come in," the latter being recognised by an intensification of picture contrasts, to the detriment of the other. A suitable sound-vision ratio must be found by careful adjustment of the plungers, together with the main receiver's "volume" and "contrast" control, and line- and frame-hold controls if these are made accessible.

In the writer's amplifier the results secured were well past expectations, excellent, well-synchronised pictures being regularly received on the commercial instrument which failed to produce any results whatsoever without the additional amplification. The building of a two-valve amplifier of this kind is certainly an essential and worth-while job for those televiewers (if I may use the word!) living beyond the reliable B.B.C. service area.

A Multi-range Meter

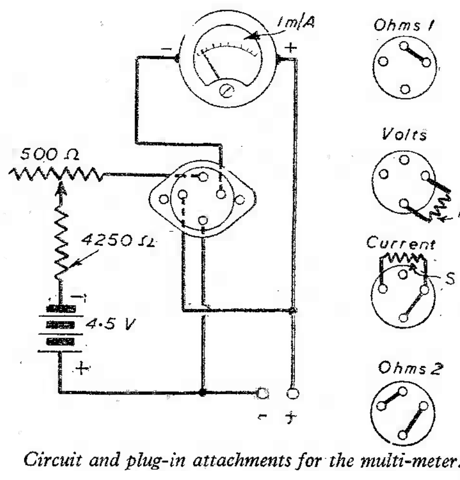
As a meter was wanted with a large number of ranges, so that various voltages and currents could be measured at almost full-deflection to obtain accuracy, it was decided to use individual plug-in resistors for both voltage and current ranges. This proved very convenient, as by using old valve bases it was possible to arrange for any voltage or current reading merely by plugging in the appropriate base.

The diagram shows the connections. The meter and a 4-pin valve holder are mounted in a case and wired up as shown. From the points "plus" and "minus" test-leads are taken.

The valve bases are wired up as depicted. It will be seen that when measuring volts the resistors R are in series with the meter. For current readings the test-leads are connected to the meter *via* the plate and filament legs, while the shunts S are in parallel with the meter. For the lowest current range no shunt is added.

The shunts are wound with resistance wire; these, and the voltage dropping resistors, are placed in their appropriate valve bases, a disc bearing the range being included on top.

"Ohms 1" valve base enables resistance values from about 1,000 to 100,000 ohms to be measured. "Ohms 2" base alters the connections so that the resistance under test is shunted across the meter, the latter being at full-scale deflection. This enables values from zero to 100 ohms or so to be checked. For this latter test the polarity of the internal battery must be reversed. Ohms readings, and R and S values, may be calculated from Ohms' Law.—(F. G. Rayer, Longdon.)



Circuit and plug-in attachments for the multi-meter.

Tone Controls

The Intricacies of Bass and Treble Boosting and Cutting, and Other Similar Circuit Details Explained by E. N. BRADLEY

WHILST both the commercial receiver and the commercial audio amplifier are now provided with tone controls as a matter of course, the home-constructed article is still, more often than not, "corrected" for tone by a fixed condenser coupled across the output transformer, or from one of the valve anodes to earth. Even the tone control as fitted to commercial apparatus often leaves much to be desired, for it is probably no more than a treble-cutting device, variable either in steps or smoothly over a restricted range.

A far more flexible tone control is easily fitted, especially to a circuit still under design or construction, and it is the purpose of this article to demonstrate and explain the more useful of these devices.

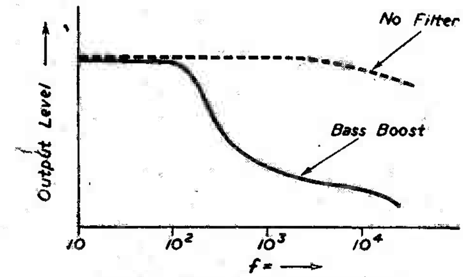


Fig. 1.—Bass boost characteristic.

It is held in some quarters that control of tone is, in any case, undesirable; but the idea is scarcely tenable, particularly when it is remembered that all gramophone records are made with a falling response in the bass, a "constant amplitude characteristic" being impressed automatically upon all frequencies below approximately 200-250 c.p.s. If this were not done, the increasing swing of the cutting stylus as the frequency is decreased would break down the inter-groove walls.

For anything like fidelity reproduction, therefore, a bass-boosting circuit should be included in the first stages of a gramophone amplifier.

The use of terms such as "bass boost," "treble lift," etc., is rather unfortunate, although they are now commonly accepted and must be allowed to stand. The impression given, however, is that in a bass-boost circuit, for example, an increase of bass amplification is obtained whereas the actual state of affairs, as shown in Fig. 1, is generally that the reproduction level of the bass frequencies is left in its original state whilst all the middle and higher frequencies are suppressed. Immediately it can be seen that the *overall* reproduction, whilst balanced for tone, is at a lower level—another stage of amplification is needed to bring the new tone up to the required output level unless the amplifier has good reserves and was originally working below full volume.

Resonant Tone Control Circuits

A tone-controlling stage almost always introduces a loss in the overall amplification of the apparatus with which it is incorporated, the only exception to the rule being provided by the true boosting circuit (as used in the anode of a television video amplifier), which utilises an inductance parallel tuned by a capacitance to "peak" on a selected frequency. For general audio work, however, this is not of great value, for not only are inductances

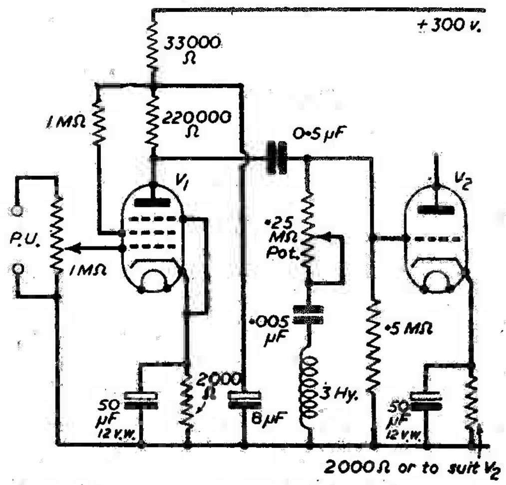


Fig. 2.—Resonant tone control for bass and treble boost.

more expensive than resistance-capacitance combinations, but they are also extremely prone to hum pick-up, whilst the boosting is carried out over a restricted frequency range. Moreover, the resonant unit is easily shock-excited into a temporary condition of oscillation.

A better way of using a resonant tone control is to allow a series tuned circuit, as shown in Fig. 2, to absorb power over a chosen frequency range, the degree of absorption being controlled by a variable resistance. In the circuit of Fig. 2, the absorption takes effect round the middle range frequencies centred at about

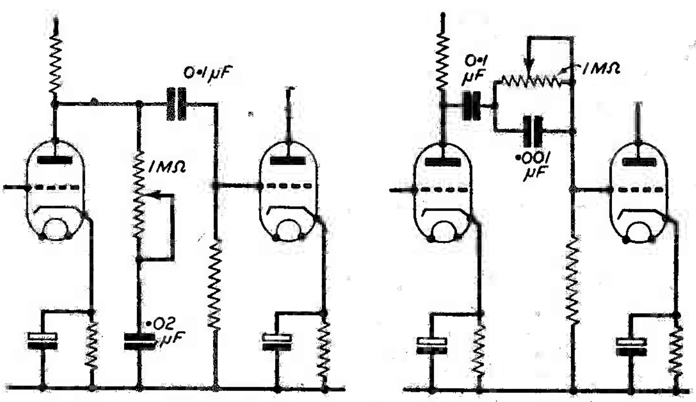


Fig. 3.—(a) Treble attenuator. (b)—right—Bass attenuator.

1,500 c.p.s., giving both bass and treble boost, the boost "rising" as the resistance value is decreased. The resonant frequency for any inductance-capacitance combination is given by the formula:

$$f = \frac{10^3}{2\pi\sqrt{LC}}$$

where f is the resonant frequency in c.p.s., $2\pi = 6.28$, L is the inductance in Henries, and C is the capacitance

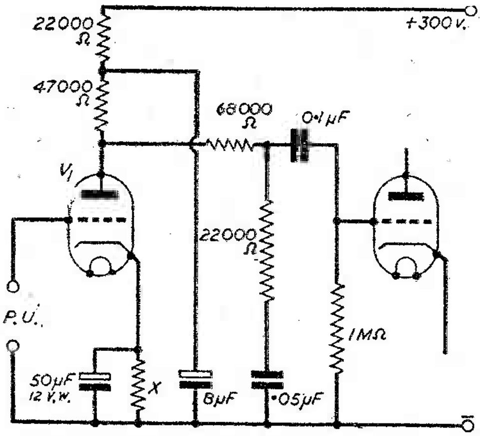


Fig. 6.—Bass boosting first stage (triode).

in microfarads. The tuned effect takes place over a broad frequency range, however, the resonant frequency indicating the central band of the range, and where a simple circuit for giving a boost at both ends of the audio range is required, this arrangement is very useful. In any such circuit the inductance must be well shielded with, preferably, a mu-metal or iron can, otherwise the benefits of the tone control will almost certainly be nullified by hum and interference. This type of control should follow a pentode valve for best results.

Non-resonant Tone Control Circuits

The simplest non-resonant tone control—"non resonant" indicating that no inductance is used and that the control is not tuned to any particular frequency —is the capacitance-resistance combination by-passing an anode circuit for audio frequencies. The working of the circuit is simplicity itself, since it depends upon the characteristic reactance change with frequency of a capacitance—in other words, a condenser changes its reactance inversely as the A.C. frequency across it changes. The resistance presented by a condenser to D.C. is, of course, infinity (unless the condenser leaks!), but to A.C. the condenser appears no longer as an open circuit but as a reactance. For example, a capacitance of 0.02 mfd. presents a reactance of about 1,700 ohms to an A.C. current at 5,000 c.p.s. If the frequency drops to 50 c.p.s., however, the reactance of the same capacitance rises to something in the nature of 160,000 ohms. Exact values for any reactance and frequency are obtained from the formula:

$$R = \frac{10^6}{2\pi fC}$$

where R is the reactance in ohms, $2\pi = 6.28$, f is in cycles per second and C is in microfarads.

A capacitance, then, is an automatic control which discriminates between high and low frequencies, and passes high notes far more readily than low notes. A variable resistance in series with the capacitance

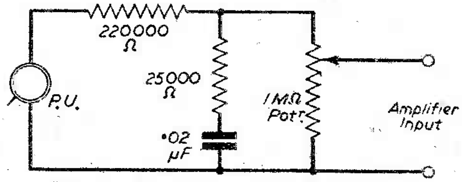


Fig. 4.—Bass boosting pick-up circuit.

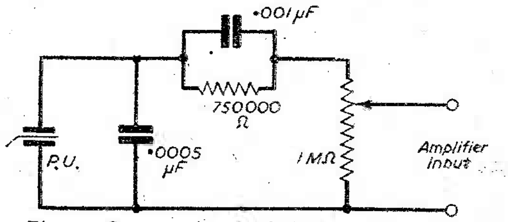


Fig. 5.—Compensating circuit for crystal pick-up.

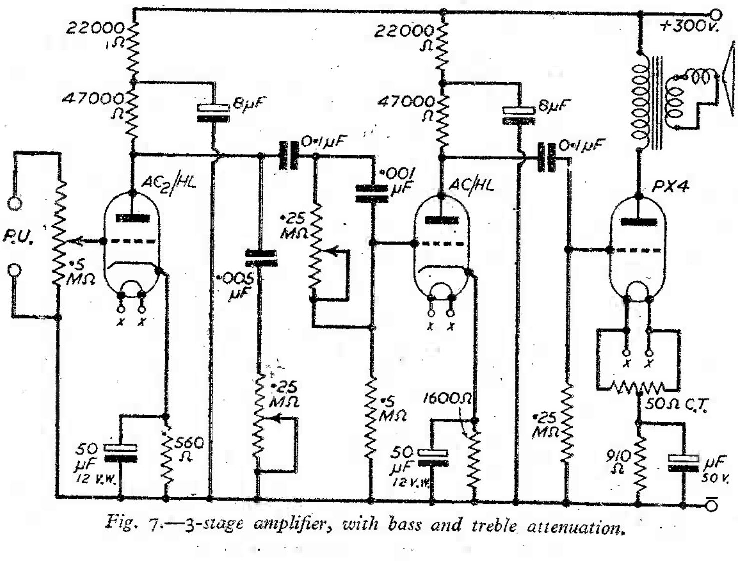


Fig. 7.—3-stage amplifier, with bass and treble attenuation.

obviously enables the effect to be controlled more readily, since the circuit now has an overall impedance and the reactance changes of the capacitance are swamped to a degree by the resistance.

In Fig. 3 (a) a capacitance-resistance control of this type is shown in the coupling circuit between two valves where it acts, naturally, as a treble-cutting unit. By changing the connections and providing another D.C. blocking condenser, however, it is possible, as in Fig. 3(b), to obtain a bass-cutting control, since now the condenser is passing high notes to the next stage more readily than the low frequencies, the latter having to make their way via the variable resistance. With the resistance short-circuited the whole tone control is out of action, the degree of bass cut rising as the resistance is increased.

Bearing in mind these simple

examples of tone control, it is now possible to examine each stage of a normal record player or amplifier, and to suggest devices which may be used to afford either a fixed or variable tone control or corrector of tone. It is not intended that all the circuits should be used together in one amplifier, of course, but a note with each circuit will show whether or not that circuit provides complete or only partial control of tone, and whether it is to be the only control in the amplifier or not.

The Pick-up and Input Stage

Modern recording and pick-up techniques have fortunately caused the scratch filter, as such, practically to disappear. Since filtering out needle scratch also meant filtering out the frequencies from 5,000 or even 4,000 c.p.s. upwards, the higher notes of the recorded music suffered sadly, and with the latest recordings which have a frequency range extending to far above this

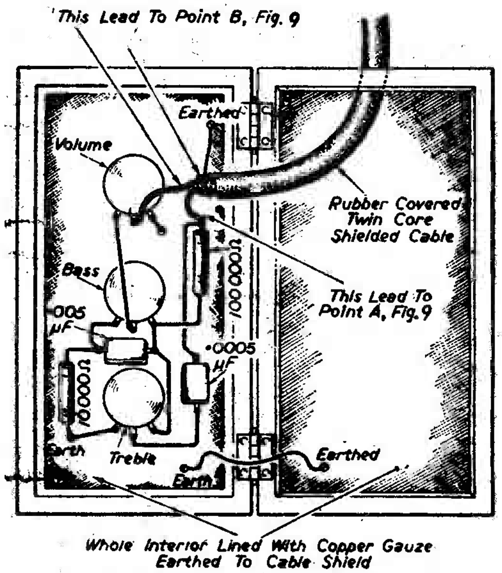


Fig. 10.—Interior of remote control box, open.

level the use of such a filter would render the new techniques practically valueless.

In general the magnetic pick-up, whether of the internal or needle armature type, may be used without any filter between it and the input terminals of the amplifier, although a bass-boosting circuit of variable characteristics can be inserted into the pick-up leads if desired. The circuit is shown in Fig. 4, and its use generally entails the provision of an extra stage of amplification, unless the amplifier has a reserve of power.

The high-fidelity light-weight type of magnetic pick-up is used in conjunction with a transformer into which a bass-boosting circuit is often introduced. The manufacturer's equipment should, however, be used in this case.

The crystal pick-up should have a filter included in its input circuit, although, since many of these pick-ups are now built to have bass-boosting characteristics, it is wise to use a filter as designed by the makers. Where such a circuit is not available, however, that of Fig. 5

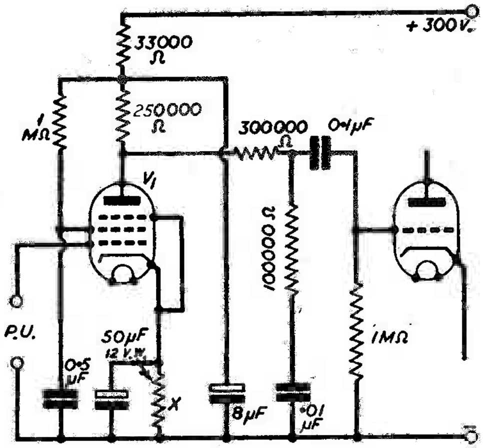


Fig. 8.—Bass boosting first stage (pentode).

may be used, which also incorporates a volume control. If any such compensation circuit is used with a crystal pick-up a bass-boosting input stage should not be included in the amplifier. Such a stage, shown in Figs. 6 and 8, is of greatest value where a magnetic pick-up is fed directly into the input terminals. As can be seen, the bass boost is in the form of a set control by-passing the anode of the valve to earth, the second stage being fed from a potentiometer type tapping on the by-pass combination. The use of such a stage gives not only an accentuated bass response but also, since it may be added to an existing amplifier, an extra degree of amplification which will be sufficient to overcome the losses caused by a flexible tone control in another stage. The bass-boosting stage is generally used with a second, variable, tone control, but may also be used as a small tone-correcting pre-amplifier (with a gain of about 5, in the triode version) with no further provision for tone adjustments. Many combinations of capacitance and resistance may be chosen, but those shown for a triode and pentode input

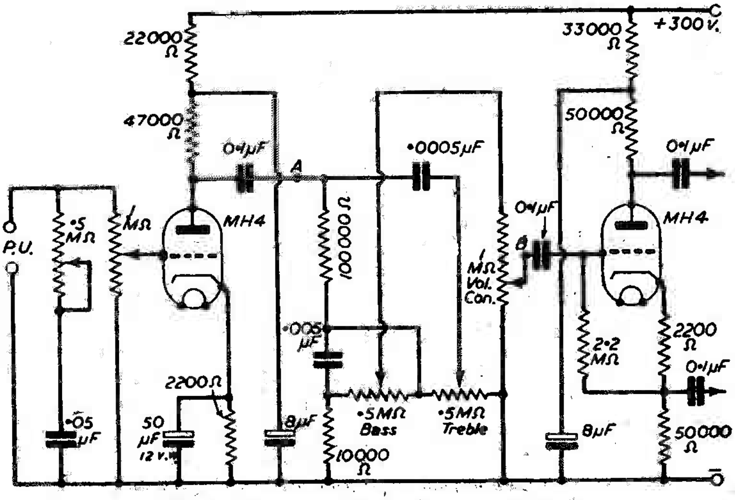


Fig. 9.—Remote tone and volume control circuit.

stage respectively give approximately correct bass boosting for the average record. At X in each diagram is inserted the correct bias resistance for the valve to be used. Volume control should come after this stage, and if the grid of the valve is overloaded for any reason, perhaps because of a high pick-up output, a fixed potentiometer should be used to reduce the input voltage to the correct level.

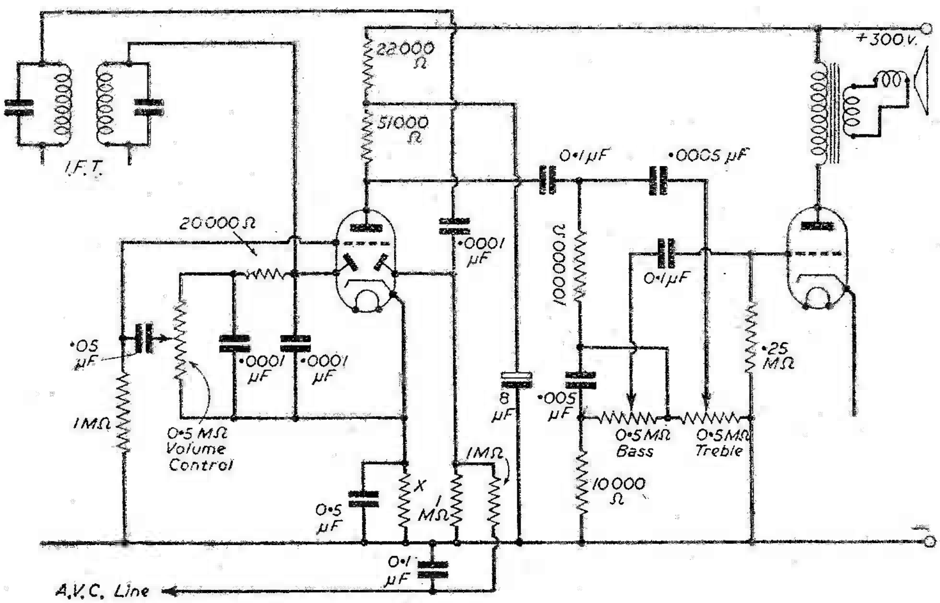


Fig. 11.—*Detector, A.V.C. and tone control stage.*

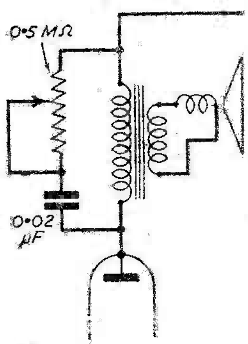


Fig. 12.—*Simple treble attenuator.*

The Tone Control Stage

The flexible tone control enters the amplifier circuit at the most convenient point, before the phase splitter in a push-pull or paraphase amplifier, or between the first and second, or second and third stages of a single-ended amplifier, and may include the volume control as well. Probably the simplest circuit providing bass and treble attenuation is that shown in Fig. 7, the diagram being of a simple 3-stage amplifier suitable for many applications. The fixed bass-boosting circuit of Fig. 6 may be incorporated in the first stage, but where the amplifier is to be used for both pick-up and microphone working it is best omitted.

Whilst the circuit of Fig. 9 is similar in many respects it does take the form of a complete and compact control of both tone and volume, and, moreover, is very suitable for a remote-control box. The author has used it in this way with complete success, a powerful paraphase amplifier being installed in a wall cabinet with 4yd. of twin-core screened cable allowing the control box to be moved to almost any position in the room, the amplifier thus being under control from the fireside. Despite the long cable there is absolute freedom from hum. The first two stages, fed from a crystal pick-up, are shown in the diagram, the phase-splitter feeding a normal two-stage output circuit, and the interior of the remote-control box is shown in Fig. 10.

In this case the crystal pick-up output overloaded the first valve, which is accordingly fed from a compensating circuit which has a treble-cutting characteristic and acts as a preset volume control, with variation possible in the degree of treble cut.

Radio Receivers

So far as a tone control for radio receivers is concerned, the last circuit of Fig. 9 is undoubtedly the best and may be introduced into the receiver between a double-diode-triode and output stage, a double-diode-triode being substituted for a simple double-diode valve where necessary, the losses caused by the tone control thus being made up. Such a stage, including provision for delayed A.V.C. is shown in Fig. 11, the volume being controlled into the triode grid in the usual way, and the tone controls appearing in the triode output circuit.

In older receivers, of course, a measure of treble attenuation is really all that is required, generally because a tetrode or pentode output tends to accentuate the treble, and here there is something to be said for the shunted transformer control, shown in Fig. 12.

It must always be remembered that tone control is a personal problem in aesthetics, and that what appears correct and desirable to a trained musical ear is often unbalanced to a casual listener. In general, the careful listener will require a better rendering of the higher frequencies than will the average listener, especially those to whom music is no more than a background for conversation.

ON YOUR WAVELENGTH

By THERMION

Music Hath Churns!

EVERY time I criticise jazz music and dance bands I am certain to get a rude letter either from a member of a dance band or from one of his relatives. I thought the days of the claque were over! However, I intend to go on criticising this form of music, whilst I have ink in my pen until this foul thing which has been spawned upon the air is either expunged from our radio entertainment or kept down to reasonable limits. I want greater encouragement given to English musicians and not to tin-pan alley.

It is perhaps in keeping with the times that musicians have their own trade union, which operates more or less on the lines of the closed shop. I suppose in future we shall refer to dance band orchestras as consisting of a number of piece workers with a foreman in charge! The tragi-comic aspect of the musicians' trade union is that it will admit non-musicians into its membership, and even conductors who do not know a note of music, cannot read a note of music, cannot play any musical instrument, not excluding a mouth organ or a comb and paper, may refuse to work with trained musicians who have spent years passing examinations. In other words, the musicians' union can keep musicians out.

Whenever I visit a home when dance music is being played everyone wants me to be dumb when all I want is to be deaf. You have probably heard the definition of an oboe—an ill wood wind which nobody blows good. Also the definition of a fugue—one of those compositions where, as the voices one by one come in, the audience, one by one go out. (World copyright deserved.)

Notwithstanding the third programme and the changes which have been made in the other two, there is still far too much dance music played to a vast audience, only a small percentage of which dances to it.

Radio Eirann

AN Irish reader disagrees with the views expressed in a recent issue that a large amount of anti-British propaganda emanates from Radio Eirann. He says that the output of commercial programmes from Radio Eirann does not exceed eight hours per week, which forms about one-seventh of the total time the station is in operation. That is about seven hours too long, anyway. He says that much of the eight hours is devoted to music, mostly of the lighter variety, though a recent programme in the sponsored hour, by the London Philharmonic Orchestra, was much appreciated. I gladly give space to this reader's views and leave my readers to judge.

I.P.R.E. Lectures

THE Institute of Practical Radio Engineers is recommencing its lectures in January, 1947, and it has been suggested that district radio societies and clubs be invited, in turn, as guests. The dates will be the first Friday evening of each month, that of January 3rd, 1947, being the first. Secretaries of clubs wishing to attend should address a letter to the Secretary, Institute of Practical Radio Engineers, Fairfield House, 20, Fairfield Road, Crouch End, London, N.8. The first lecture will be one on high-frequency heating.

Radar Aids the Prophets

SCIENTISTS attached to the meteorological office during the war developed a method of aiding weather forecasting. The device consists of a tiny radio set attached to a balloon 6ft. in diameter, which soars to an altitude of about 12 miles and then releases a parachute to which the radio set is attached. It has now been adopted for civil aviation and the G.E.C., Ltd., have redesigned the instrument for quality and quantity production.

The new instrument provides the most accurate meteorological readings yet obtained from the stratosphere, and Britain is now ahead of any other country in the development of this technique.

Of course, such instruments were used long before the war and they were known as "Radio Sonde." It is a polished black cylinder from which projects delicate aluminium housings in which are sensitive barometers, thermometers, and hygrometers. As it rises into the air it broadcasts a radio signal which is received as a musical note, varying according to the different conditions encountered during its ascent.

The transmission is picked up by a radio receiver on the ground, and the exact value of the note is determined by using a miniature television tube with an indicator. These results are plotted, and within a few minutes of the ascent into the stratosphere results are sent by teleprinter to the central forecasting office at Dunstable. Measurements of the speed and direction of the upper winds are obtained by tracking the balloon by radar.

When the balloon bursts a small parachute opens and brings the set safely to earth. Each instrument carries a stamped, addressed postcard and an offer of 5s. reward for its recovery. Many are lost at sea, but those recovered can generally be used again after slight overhaul.

So if any of my readers finds one of these instruments I hope they will return it in the interests of radar development, irrespective of the 5s. they will receive for their trouble.

Epitaph

CAPT. J. LINDSAY sends me the following: "In the little old town of Electron, way out beyond Anode Bend, there's the grave of a radio mechanic, who lies earthed at his positive end. Let us give him his due in all fairness—he was good at his job; he had brains. But he *once* was a little too careless while fixing a plug to the mains. There's a moral to this little story, a moral an infant could see. If you don't want short circuits to Glory, don't frolic around with H.T."

"The People Who in Darkness Sat"

[Press Note.—Speaking in London, Sir William Haley, Director-General of the B.B.C., said he believed that the success of the Brains Trust was due to the fascination of millions of people "hearing sustained and intelligent conversation for the first time in their lives."]

Oh! how profound our darkness was
Before the Brains Trust came;
No intellectual talk we heard—
This filled our hearts with pain.
We knew our limitations,
Uncultured, boorish, dense;
The very name of Education
Filled us with offence!
For not one of our company
Was filled with Culture's light,
Till Brains Trust got upon the air
And quickly put things right!
They claim they have enlightened us.
These pundits should we thank?
Or should we tell them that we think
Such claim is arrant swank?
Which verges on impertinence,
And merits hearty slap,
Because their claims for super-brains
But few of us will clap!

"TORCH."

Analysis of the Television Receiver—5

Synchronising Pulse Separators and Scanning

WE have now arrived at the stage where we can analyse the line and frame synchronising pulses as obtained from the synch. separator into those parts which operate the various time-base generators of the television receiver.

Most people experience difficulty in understanding how the line and frame pulses are sorted out so that they only operate their respective line and frame time-base circuits, and also how interlacing of the lines on the alternate frames is accurately carried out. The explanations are quite straightforward, and we will attempt to put them in the clearest possible language.

The separated synch. pulses at the end of even and odd frames are shown respectively at (a) and (d) in

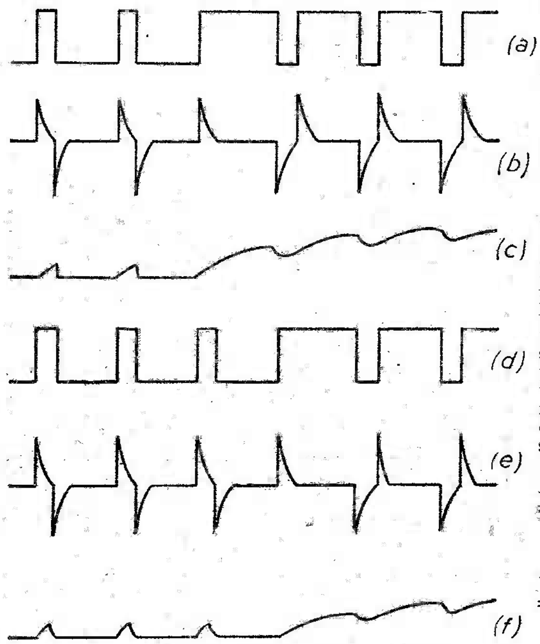


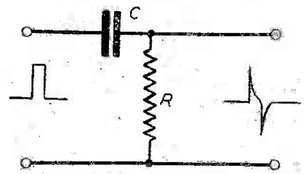
Fig. 27.—The effect on the synch. pulses at the end of both even and odd frames by differentiation and integration.

Fig. 27. As was mentioned in connection with the television signal earlier on in this series, the vision signals are suppressed for at least 10 lines at the end of each frame, the even frames ending up on the 405th line while the odd frames end up after one-half of the 203rd line. (Refer back to Fig. 3 in the August issue in connection with this.) The consequently different forms of the synch. pulses at the end of alternate frames are shown in Fig. 27 (a) and (d). It is this difference which leads to an interlacing of the lines as will be described later on.

In the meantime, it is necessary first to devise some means of separating the line pulses from the frame pulses. Amplitude filters are obviously not the solution, so systems are used which discriminate against the *duration* of the pulses and not against their amplitude. The usual practice is to feed the line time-base from the synch separator through a low time-constant coupling known as a "differentiating" circuit, and the frame time-base through a kind of high-frequency filter known as an "integrating" circuit. These terms have little in common with the usage of them as found in mathematics.

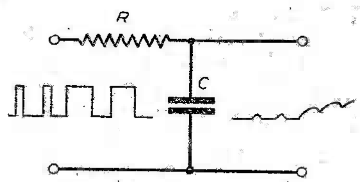
A differentiating circuit is shown in Fig. 28, where the values of C and R are assumed to be very small. If the direct voltage impressed upon the input terminals of this circuit changes abruptly, condenser C charges or discharges exponentially until its voltage equals the new value of impressed voltage. Suppose a rectangular pulse such as is shown on the left of the figure is applied to the input of the circuit, then the output voltage across the resistance R will be a replica, as far as waveform is concerned, of the current flowing in this resistance. Now when the abrupt leading edge of the rectangular pulse is applied to the system a charging current will

Fig. 28.—A differentiating circuit.



flow into C through R and a sharp rise of voltage will appear across the latter component. C will charge exponentially at great speed and the charging current will consequently fall to zero, remaining there for the remainder of the pulse period. When the pulse falls to zero, the condenser discharges, and the current through R rises immediately to a maximum in opposite sense to that occurring during the discharge. Again the current falls to zero, and the circuit is quiescent until the arrival of another pulse, when the cycle of events repeat themselves. The rectangular pulses are thus converted into a series of alternate positive and negative spikes of quite short duration.

Fig. 29. An integrator circuit.



The effect of passing the line and frame synch. pulses through a differentiating circuit of the above nature is shown for even and odd frame endings in Fig. 27 (b) and (e) respectively.

An integrating circuit performs the opposite function of a differentiating circuit, producing a steady voltage of some predetermined level from a series of short duration pulses. A simple circuit of this type is shown in Fig. 29 where condenser C and resistance R of Fig. 28 have changed places; they have also a greater time constant in this case. When ordinary line synch. pulses are applied to such a circuit as this, the charge developed upon C by each individual pulse is very small and is discharged during the comparatively large line interval between the pulses; thus the voltage rise across C is negligible. When, however, the frame pulses arrive, being of much longer duration, the condenser will be almost completely charged during the first pulse and only a very small percentage of this charge will leak away during the interval between it and the following pulse. The voltage across C consequently shows a rise as the figure indicates.

The effect of passing the frame pulses through an integrating circuit of the above nature is shown for even and odd frame endings in Fig. 27 (c) and (f) respectively. Note that the "integrated" frame pulse starts one-half line later at the end of an odd frame than it does on an even frame; this ensures that the odd-frame lines fall in between the even-frame lines and correct interlacing is secured.

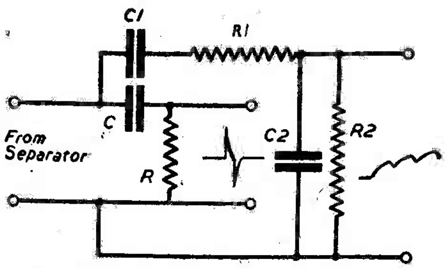


Fig. 30.—A practical form of combined integrator and differentiator for line and frame synch. pulse separation.

A practical line and frame pulse separator consisting of a combined differentiating and integrating circuit is shown in Fig. 30, where the typical line and frame pulse outputs are shown in their respective positions. The leading edges of the pulses actually go to fire off the time-base generators, and for this reason interaction between the two outputs must be avoided. If the pulses set up by the line time-base separator reach the frame time-base due to a bad design of integrator, synchronisation will go awry and nothing intelligible will appear on the screen of the cathode-ray tube. Properly set up, the line pulses are almost distorted out of existence in the frame integrator and therefore cannot affect the frame time-base discharger valve. A slight disadvantage of the integration circuit is its failure to produce a sharp leading edge to the frame pulses, so that there is a

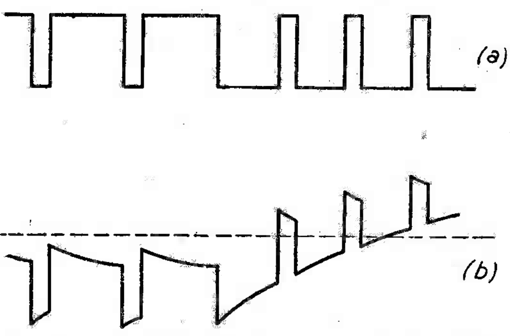


Fig. 31.—The effect of the frame separator circuit of Fig. 1 on the frame synch. pulses.

chance of erratic frame time-base firing. This fault manifests itself as an inability on the part of the picture to interlace correctly, and the lines are superimposed upon one another from alternate frames.

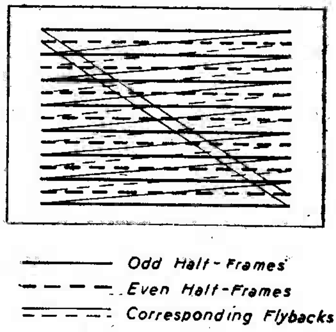
In Fig. 30, C and R form the differentiating circuit, the values of these components being so chosen that the pulse voltage falls to zero in the time (10 μsecs.) of one line pulse. Suitable values are: $R=50{,}000\Omega$, $C=45\ \mu\mu F$. The integrator circuit proper consists of R_1 and C_2 and suitable values are: $R_1=20{,}000\Omega$, $C_2=0.001\ \mu F$. C_1 and R_2 are simply included to isolate any steady voltages from the synch separator circuit.

A Valve Circuit

The simple differentiating-integrating circuit of Fig. 30 has the merits of simplicity coupled with reasonable performance. A different type of pulse discriminator, however, utilising two valves is shown in Fig. 1 (August issue), and this circuit has the great advantage that it produces frame pulses with a sharp leading edge.

Turn to Fig. 1 and consider the stages V_{10}, V_{11} and V_{12}. V_{10} is a double diode and constitutes the synch. separator of the receiver. Vision signals appear at the anode of V_9 in negative phase, but the synch pulses move in a positive direction. V_{10} is biased by the voltage developed across R_{17} and conducts only when the synch. pulses swing the anode sufficiently positive to overcome this bias. Positive going synch. pulses thus appear across R_{15} and R_{16} in a manner described for the

Fig. 32.—How the interlaced system of scanning covers the screen area in a series of half-frames.



previous diode separator circuits. Now the line synch. pulses are taken from R_{15}, through C_{18} and C_{19} and to the line time-base gas discharger valve V_{16}, while the frame synch. pulses are taken from R_{16} through a special circuit containing the triode V_{11} and the diode V_{12} to the frame time-base gas discharger V_{13}. Both outputs are equivalent to begin with, of course, containing line *and* frame synch. pulses, and separate cathodes are only chosen in V_{10} to avoid any effects of interaction.

The line discharger valve V_{16} is fed through a differentiating circuit and correcting network, consisting of C_{18}, C_{19}, R_{33} and R_{34}. The series resistance R_{35} is included in order to obtain stable operation of the discharger and has a value of some $5{,}000\Omega$. For a thyratron valve such as the GDT.4, suitable values for the components are: $C_{18}=C_{19}=50\mu\mu F$. $R_{33}=10{,}000\Omega$, $R_{34}=50{,}000\Omega$. The sharp leading edge of each differentiated line pulse then fires the thyratron in a manner to be discussed later on.

The frame discharger valve is fed through a special circuit. The output synch. pulses from R_{16} are taken through a resistance-capacity coupling to the triode valve V_{11}, which is operated with zero grid bias so as to retain

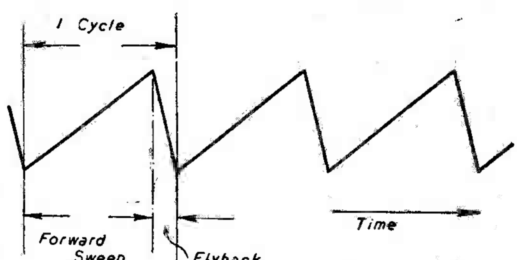


Fig. 33.—Sawtooth waveforms such as are applied to the tube deflector plates for production of a raster.

the D.C. component, and the output developed across the anode resistance R_{20} is therefore a copy of the synch. pulses developed across R_{16} but amplified and reversed in phase, i.e., negative going. The coupling C_9 and R_{21} is actually a differentiating circuit, but with a time-constant chosen to be equal to the time of one complete frame pulse, approximately 40 μsecs. C_9 may therefore be 0.0008 μF, and R_{21} 50,000Ω. With this value of time constant the frame pulses are not distorted into alternate positive and negative going spikes of the type discussed before, but appear, instead, as shown in Fig. 31, where the end of an even frame is shown at (a) with the differentiated version at (b). The line synch. pulses cause a sudden negative pulse to appear across R_{21} with an almost equal positive rise at the end of the pulse as shown; this is because the voltage loss across C_9 during the time of the pulse is very small. The frame pulses, however, being larger than the line pulses, allow C_9 to lose much more of its charge, and the voltage rise at the end of each pulse therefore swings the potential much more positive than was possible with the line pulses. The important thing to notice about the whole operation is that the synch. pulses are such that the voltage rises regularly at the end of every line even during the period of the frame pulse, and that it is the *interval* pulses which occur during the frame period and not the frame pulses proper which are used to instigate the actual triggering of the frame discharger valve V_{13}.

V_{12} is simply an amplitude filter biased by R_{23}, so that only the frame interval pulses cause anode current to flow and an output corresponding to the pulses above the dotted bias line of Fig. 31 (b) appear across the frame thyratron grid resistance R_{24}. The first of these pulses, which has a sharp leading edge, fires V_{13} and sets off the frame time-base.

For the odd frame endings, the first firing pulse is delayed by one-half line, as discussed previously, so that interlacing of alternate frames is automatically secured.

Scanning Sequence

Having obtained line and frame synch. pulses to operate the respective time-base generators, the next problem to be met is the method of feeding the cathode-ray tube with sawtooth voltage waveforms so that the picture "raster" is built up on the screen. We shall deal only with electrostatic deflection in this series, which is somewhat simpler to set up by the home experimenter than the various electromagnetic systems.

The deflecting plates of a cathode-ray tube must be fed with sawtooth voltage waveforms so that the spot is drawn out into a series of lines across the screen, at the same time moving down the screen, thus marking out the pattern, or raster, shown in Fig. 32. The lines traced horizontally for one complete vertical movement are not immediately adjacent to one another but are separated by a gap approximately equal to their own width. When the spot reaches the bottom it returns quickly to the top and traces out another series of lines which lie between the first. This closes the gaps and "fills in" the whole picture area. When it again reaches the bottom it returns to trace out a third series of lines on top of the first, and then a fourth series on top of the second, and so on. This process constitutes the interlaced sequence of scanning which is adopted to reduce flicker without increasing the width of the transmitted frequency band. The first article of this series discussed this point.

To each series of lines there are two vertical sweeps; each half-series is known as the frame, and there are, therefore, two frames to every complete picture. As there are 50 frames a second and each complete picture consists of 405 lines, the frame-scanning oscillator in the receiver must operate at 50 cycles per second (vertical traversals) and the line-scanning oscillator at $25 \times 405 = 10{,}125$ cycles per second (horizontal traversals). Both vertical and horizontal deflecting plates are therefore fed with sawtooth waveforms of the pattern shown in Fig. 33, the only difference being in the frequency of recurrence.

It is essential for the sawtooth waveforms to be strictly linear over their rising portions, for if there is curvature at this point the received image will be obviously distorted at the trailing edges of the lines and at the bottom of the frames. The fly-back or return period is not critical as regards shape so long as it is sufficiently rapid to ensure that the spot is returned in time to begin the next complete line or frame without loss. In the case of the line sweep, the picture signals occupy 84.5 per cent. of the whole line, so that the time of the scanning stroke is 83.7 μsecs. and the fly-back time 15.3 μsecs. For the frame scan, the forward stroke must occupy 38.12 millisecs., with a fly-back period of 1.98 millisecs. Since the methods of producing sawtooth waveforms depends almost exclusively on the gradual charge and sudden discharge of a condenser, the latter being determined by the synchronising pulses at the end of the individual lines and frames, the spot is blacked-out during the return periods and therefore makes no trace on the screen. Thus the shape of the fly-back waveform is, within reason, immaterial.

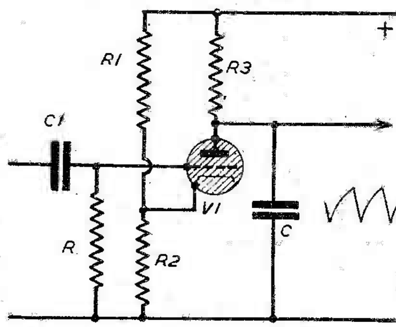


Fig. 34.—The basic gas-discharger circuit.

Basic Saw-tooth Generator

Fig. 34 depicts the basic saw-tooth generator consisting of a gas triode V_1 in series with the charging resistance R_3 across the charging condenser C. This condenser charges up from the H.T. supply through R_3 and carries the anode of the valve more and more positive with respect to its cathode. Now, a gas-filled valve is very similar in construction to an ordinary high-vacuum triode with the exception that, owing to the presence of an inert gas such as argon, the former does not pass anode current until the anode voltage has exceeded a certain critical voltage. The magnitude of this anode voltage depends upon the grid bias applied to the valve, and increases as the grid bias is increased. As soon as the anode voltage reaches the critical stage in a given case, the gas within the valve ionises and the valve "fires" or breaks down. The anode current which then flows is determined *only* by the anode potential and the resistance of the anode circuit, being quite independent of the grid voltage. This condition of saturation can only be interrupted by a reduction in the anode potential to a value lower than the ionisation potential of the gas, keeping it there for a sufficiently long period to allow de-ionisation to take place. Once the valve has fired, the anode voltage (drop across the valve) remains constant at about 10 volts. The valve behaves like a switch in series with a small resistance and a constant voltage equal to the anode potential.

In Fig. 34, V_1 is normally cut off by the bias developed across R_2, and condenser C charges up through resistance R_3. As soon as the condenser voltage becomes equal to the firing voltage of the valve, the latter becomes conductive and C is rapidly discharged. The valve goes out as soon as the condenser voltage has fallen to a value equal to the valve drop, after which the cycle repeats. This generator is free-running, for it develops saw-tooth voltage waveforms across C indefinitely, the frequency of operation being given approximately by the formula:

$$f = \frac{1}{CR_3 . \log e \dfrac{(E - Ea)}{(E - Ef)}}$$

where E is the H.T. available, Ea is the valve drop, and Ef is the firing voltage.

(To be continued.)

Battery-operated Transmitters

Details of Two Simple Circuits Which May be Operated from Batteries

By R. BALDWIN (G3WZ)

THOSE radio amateurs who live in districts where mains electricity has not penetrated—and there are still plenty of such places—have to get on the air, if at all, without the aid of mains supplies.

It is surprising what can be done with small rotary generators running off a six- or twelve-volt car battery kept charged by a wind generator. It is possible, however, to get quite a lot of experience of amateur radio transmitting by using no more than an ordinary two-volt accumulator to run all filaments, and a 120-volt high-tension battery to supply the high tension for both receiver and transmitter!

Battery transmitters use, most conveniently, single valves of the LP2 type running at between one and two watts input as oscillators on the 7 mc/s band, where, with no more aerial than 66ft. of wire to resonate as a half-wave radiator, they will give sufficient propagation to get around Europe. Before the war, with such gear, the author had about 300 contacts with home stations and Norway, Sweden, Denmark, Belgium, Germany, Switzerland, France, Eire and Portugal. With similar gear on the 1.7 mc/s band there is plenty of local working to be done, and occasional contacts of up to 300 miles range can be had in hours of darkness. It is doubtful if one-watt gear could hope to get through the present interference on 14 mc/s, though in years past plenty of amateurs have worked the U.S.A. with one watt from a battery transmitter running into a good transmitting aerial—the aerial system is the key to successful low-power transmitting. With beam aerials it may yet be proved that six watts is by no means the minimum with which it can be hoped to work all continents on 14 mc/s.

The Essential Wavemeter

Before describing two convenient low-power transmitting circuits, it must be pointed out that a wavemeter of the dynatron oscillator type is necessary to prevent the danger of off-frequency operation, while the ease with which these transmitters can be put on the air makes it necessary to add that any transmitting "pirate" may expect short shrift from the authorities!

Most transmitting amateurs have at one time or other worked with the Hartley circuit shown in Fig. 1. Most British ships still use modifications of this circuit with powers up to 2 kw. in this present year of 1946.

The core of the outfit is the coil system. For 7 mc/s this can be made of copper tubing such as is used in automobile feeds, and ¼in. tubing if bent round a 2¾in. cylinder (such as a jam jar!) will spring open to a coil of about 3ins. diameter. Eight turns spread out to 4ins. will be enough to tune into the 7 mc/s band, using a variable condenser of up to .0002 mfd. capacity. With the grid-leak value shown in Fig. 1 the no-load anode current will be about five milliamps at 120 volts, rising to something just over 10 milliamps when the aerial is clipped on somewhere between the earth tap and the anode end of the coil. The nearer the latter, the greater will be the aerial draw, but the greater the note drift due to aerial movement. The earth tap should be made about three turns from the grid end of the tank coil. Vibration is very important indeed with self-excited transmitters, especially when the coils are copper tube such as described. In a shack subject to vibration it may even be advisable to wind the thickest copper wire you can get on a coil former instead of using the tube—the rigidity of the coil-former will prevent that abominable splurging known as "spitch" when somebody slams the shack door while the transmitter is being used!

A 3½in. loop of wire connected to a fuseholder and flashbulb will indicate when the transmitter is oscillating—since the bulb will glow when the loop is brought near the transmitter tank coil.

The T.N.T. Circuit

The writer has always favoured the variation of the tuned-plate-tuned-grid transmitter known as the "TNT" circuit for 7 mc/s (Fig. 2), though since it depends for its excitation on the valve anode-grid capacity, which is a small value, the circuit is of little use on the 1.7 mc/s band where the capacity is not sufficient to provide adequate feedback for strong oscillation.

The grid coil is designed to resonate in the centre of the 7 mc/s band. In one practical case it consisted of 20 turns of 19 s.w.g. enamelled wire on a 1¼in. former which resonated at the required frequency without any but stray and inherent capacity. The making of such coils is a matter largely of trial and error—the aerial is, of course, not on the transmitter during the tests. When the dial of the transmitter condenser is swung a broad anode-current dip will occur when the anode tuning matches the resonance of the grid circuit. The frequency band of oscillation of the transmitter must then be observed on a wavemeter and turns added or subtracted from the grid coil as necessary.

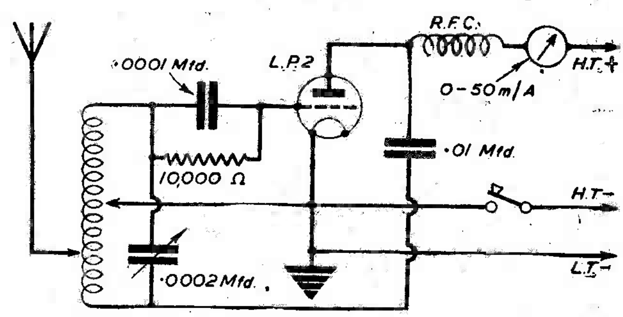


Fig. 1.—This simple transmitter uses the Hartley arrangement.

An absorption wavemeter—shown inset in Fig. 2—is enough to determine *roughly* the position of such a broad band of frequencies. It consists of a flashlamp bulb which glows when the circuit is on transmitter frequency, a .0003 variable condenser with dial, and a plug-in type coil with about eight turns on a 2¼in. former. Such an instrument can be calibrated quite easily, as follows: first, allow a straight receiver to oscillate gently on a known shortwave station. Then bring the wavemeter coil near the receiver detector coil and rotate the wavemeter condenser till it resonates with its coil to the same frequency when, by absorbing energy from the detector circuit, it will stop it oscillating. Increasing the distance of the wavemeter will make for finer adjustment. By picking several different stations on the receiver a calibration graph can be drawn up for the wavemeter.

Rigid Aerial

The T.N.T. circuit is a very strong oscillator with battery output-triode valves, and the no-load anode current may be as low as three milliamps, increasing to 15 or more by tapping the aerial successively nearer the anode or "hot" end of the coil. But the largest satisfactory aerial loading will, as before, be determined by the carrier stability. Unless your aerial wire is stiffly hung, gales and high winds will play havoc with your note, which in good conditions will, because of the absence of ripple, get you invariable reports of a very satisfactory "T9." The variable grid leak, which should be a reliable make wirewound type, provides an easy way of power adjustment.

Remember that half the secret of low power, or QPR, is good operating. Do not expect to go on 7 mc/s in the thick of the noise on Sunday mornings and expect to get contacts against folk using perhaps a hundred times your power—go on the air in the early mornings on weekdays. Don't waste your time when conditions are bad, operate intelligently, and you'll get a big kick out of low-power transmitting.

Remember, finally, that equipment such as is described here must not be built unless you have a G.P.O. transmitting licence.

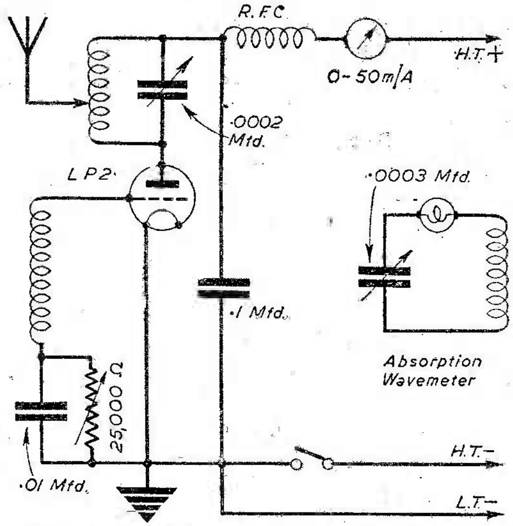


Fig. 2.—The T.N.T. circuit, and (inset) an absorption wavemeter.

Books Received

RADIO VALVE VADE-MECUM. By P. H. Brans. Obtainable from Messrs. Ritchie Vincent & Telford, Ltd., Harrow, Middlesex. 232 pp. Price 12s. 6d. post free.

THIS is the 1946 edition of a most valuable and comprehensive book, which should be in the hands of every experimenter and serviceman. It is divided into eight sections, each of which is "thumb indexed," and these give the following details: Table 1 is a list of characteristics and working data of practically every valve in common use on the Continent. Table II (occupying 40 pages) deals similarly with valves found in the British market and includes many of which details cannot now be obtained, such as those manufactured before the war by the 362 and Clarion Companies. Table III gives the equivalents of European, American and British types. Table IV gives a most exhaustive table of equivalents, indicating types which might be used as replacements although not exactly equivalent, together with details of modifications to circuits or components which might be required in the event of substitution. Table V illustrates 689 valve bases with the theoretical symbol of the valve. Table VI is a list of Russian valves similar to the first two tables. Table VII is a list of various Service valves with the nearest commercial equivalent, and Table VIII gives complete data and characteristics of German and Italian army valves. This includes transmitting valves, magnetrons, accelerator tubes, etc.

ADDRESSING THE PUBLIC. By P. J. Walker. Obtainable from the Acoustical Manufacturing Co., Ltd., Huntingdon, England. 61 pp. Price 3s. 6d. post free.

THIS book deals with the Fundamentals of good Public Address technique, and covers the equipment and its locations, both indoor and outdoor; loudspeaker matching; microphone lines; gramophone pick-up matching; testing and operating, and a useful Appendix dealing with loudspeaker matching circuits, decibels to voltage and power ratios and capacitive reactances. The chapters are well illustrated and contain a number of amusing sketches to illustrate certain points. For the engineer who is new to P.A. work it will be found invaluable, and in many workshops will be kept as a standard guide to cover all types of work.

WAVE PROPAGATION IN PERIODIC STRUCTURES. By Leon Brillouin. Obtainable from McGraw-Hill Publishing Co., Ltd., Aldwych House, W.C.2. 247 pp. Price 20s.

OF American origin, this volume deals with Electric Filters and Crystal Lattices and has a powerful mathematical background. It extends from electrical engineering to electromagnetism and wave mechanics of the spinning electron. Explanations applying to electric filters, rest-rays, anomalous optical reflection, and selective reflection of X-rays or electrons from a crystal are covered, as well as those in regard to omission of energy dissipation, a wave striking from the outside and frequency falling inside a stopping band. It is one of the International Series in Pure and Applied Physics. It is of interest mainly to students and those to whom the mathematical side of radio has the greatest attraction.

QUALITY THROUGH STATISTICS. By A. S. Wharton, F.S.S., A.I.I.A. Obtainable from Philips Lamps, Ltd., or through any bookseller. 62 pp. Price 6s. post free.

THE purpose of this little book is to put forward an elementary explanation of Quality Control methods as applied in Philips factories in a form that can be understood by those with little or no statistical knowledge. Mathematical formulæ are avoided wherever possible.

The book is in three parts. Part 1 deals with Raw Material Inspection—Philips Tables—Calculating Number of Defective Parts—Stores Control and Breakage.

Part 2 deals with Probability—Fraction Defective Control—Fixing Control Lines—Measurement Charts—Normal Curve—Inset Limits—Range Control—Design Tolerance and Statistical Limits and Cumulative Defects.

Part 3 deals with Analysis of Charts—Methods Reports—Hand Operations—Quality Bonus—Master Graphs—Small Production Runs—Operational Efficiency—Process Control—Grading—Correlation.

The book ends with an Appendix in which the need for, and importance of, higher quality in the manufacture of all classes of goods is discussed.

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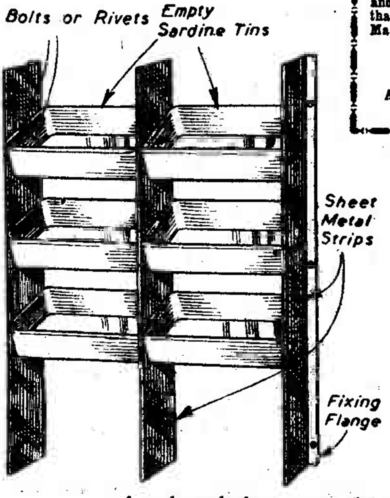
Practical Hints

A Handy Rack

THE appended illustration shows a very useful rack for small components such as resistors, etc. It can be made up in any number of sections and fixed to the workshop wall or mounted on a wooden stand at the back of the table or bench. —F. R. ESTALL (Sth. Benfleet).



A rack made from empty tins.

Valve Adaptor

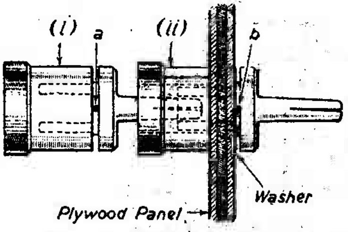
AN easily made adaptor for using 1.4 v. battery valves with normal 2-volt valves can be made with a small piece of ebonite, 5 valve pins, two short lengths of 6BA screwed rod and a couple of old spade terminal holders for spacer washers and an octal valve holder. The idea is fully illustrated below.—R. HANSEN (Balham, London, S.W.12).

Plug and Jack

RECENTLY you published my idea for a plug and jack. If a push/pull switch cannot be obtained, here is an idea for a plug and jack using two wander plugs.

For the construction of the "plug and socket," fasten a wander plug to the panel after taking out the middle metal portion and drilling the holes "a" and "b" for the wire to go through for connections.

Fasten the wander plug marked (i) to the wire and push it into the plug (ii); if the circuit has to be broken, pull out the plug (i).—D. DOWLING (Haslingden).

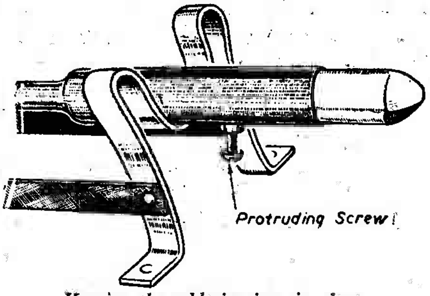


A novel plug and socket idea.

Soldering-iron Rest

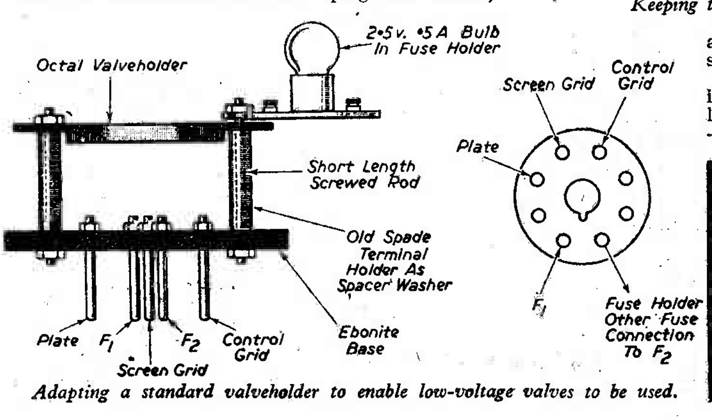
WHEN using the "Solon" soldering iron with the usual form of rest, I found that the weight of the on-off switch in the mains lead tended to pull the iron off the stand, because it was so light.

This was overcome very simply by removing the small screw at the "bit" end, and replacing it by a longer screw and lock-nut as shown in the diagram. The screw now prevents the iron being pulled off the stand by resting against the frame of the stand as shown.



Keeping the soldering-iron in place.

It may also be used to hang the iron in an upright position on a ledge—or any other handy protrusion. —J. NOBLE (St. Mawgan).



Adapting a standard valveholder to enable low-voltage valves to be used.

Frequency Modulation—4

This Month C. A. QUARRINGTON Deals With the Limiter, the Frequency-amplitude Converter, and the A.F. Side of the Receiver

THE previous article on the subject of frequency modulation dealt in detail with the R.F. amplifier, the frequency changer, and the I.F. amplifier. It remains therefore to give similar attention to the limiter, the frequency-amplitude converter, and the audio-frequency amplifier and output arrangements.

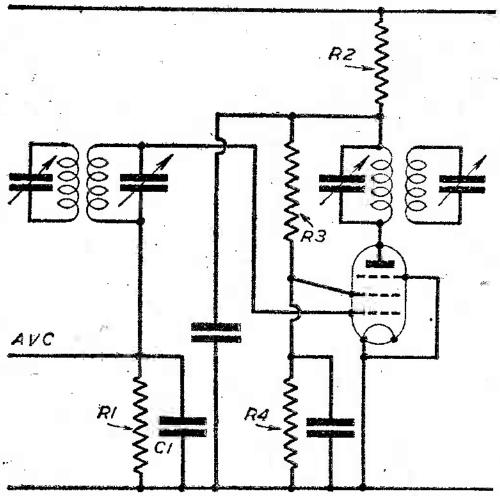


Fig. 1.—A single stage saturated-amplifier amplitude limiter. Values of R1, C1 must be a compromise, and 150,000Ω and 100 pfd. are suggested for all-round purposes.

It will be recalled that the limiter and frequency-amplitude converter replace the second detector circuit in the conventional amplitude-modulated receiver; very roughly speaking the limiter replaces the normal A.V.C. arrangement and the frequency-amplitude discriminator replaces the actual detector.

The primary purpose of the limiter stage is to suppress amplitude changes which may be present in the incoming wave-form. Where it is possible for the limiter valve to provide a source of A.V.C. voltage, the stage is normally called upon to perform the additional office. There are several basic ways of achieving amplitude limitation, some of which have not proved themselves likely to meet with universal favour. One particular system has, in fact, been almost universally adopted, and is known as the saturated-amplifier amplitude limiter. This basic type of limiter is described below in alternative forms and will be sufficient for the present purpose.

The basic circuit of the saturated-amplifier amplitude limiter appeared in a previous article but is here repeated at Fig. 1 in more complete form. Reference to the circuit will show that the arrangement somewhat resembles a grid detector, but has very low anode and screen voltage, and an anode load taking the form of a tuned circuit which is in fact an I.F. transformer, the design of which will be influenced by the type of frequency-amplitude converter which immediately follows it.

The values of the biasing components R1, C1 and the anode and screen voltage network R2, R3, R4 are somewhat critical. The purpose of R1, C1 is to provide grid bias which should faithfully follow the shape of the modulation envelope, which forms the input. Admittedly there is no envelope to a frequency-modulated wave-form, but some modulation changes are bound to be present due to interference and it is the purpose of the limiter to "iron these out." If the selected values for R1, C1 give a small time constant, the stage will give best results against high rates of modulation change, such as those due to impulse noise, particularly that emanating from automobile ignition; unfortunately, however, a small time constant greatly reduces the range of signal input amplitudes that the limiter can handle while retaining the necessary constant output. Expressed another way the short time constant is good for cutting out noise, but restricts the range of size of signal that the limiter can handle efficiently. If the time constant is relatively large the opposite set of conditions will obtain, and obviously a compromise must be effected or a more elaborate type of circuit employed, such as that described in due course. A compromise suitable for general purposes is 150,000 ohms and 100 pfd. respectively.

Anode and Screen Voltages

Consideration can now be given to the choice of anode and screen voltages. A decrease of these voltages results in the limiter functioning correctly with a smaller signal input, but brings about the corresponding disadvantage that the limiter output level will be lower. Fig. 2 shows the performance of the circuit shown at Fig. 1. Curve I was taken with 30 volts on anode and screen. Curve II was taken with the same anode voltage but an increased screen voltage which it would be observed has the effect of reducing the steepness of the

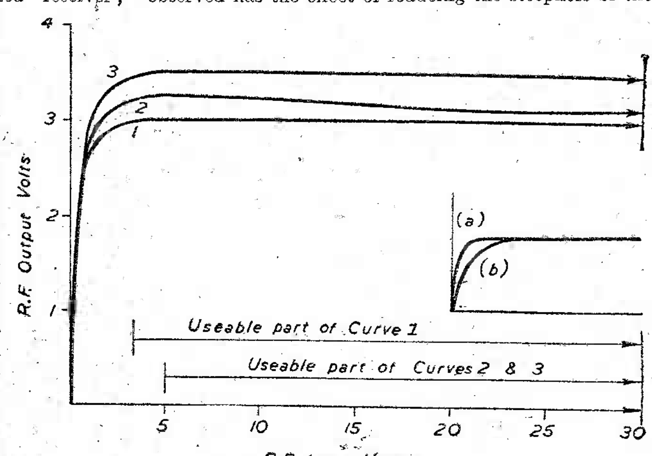


Fig. 2.—Curves showing performance of amplitude limiter with various anode and screen potentials as detailed in the text. (Inset.) The effect of double limiter curve action (a) compared with single limiter (b). Slope of curves not to same scale as 1, 2 and 3.

curve, at the zero end, and introduces less efficient control of amplitude. Note that the flat part of the curve is not so horizontal as Curve I. Curve III is taken with the original screen voltage, i.e. 30 volts and increased anode voltage, which results in a curve having similar regulation qualities to that of Curve I, but giving a higher output at the expense of the flat portion commencing at a higher signal level. This series of curves illustrates the point made above that a decrease

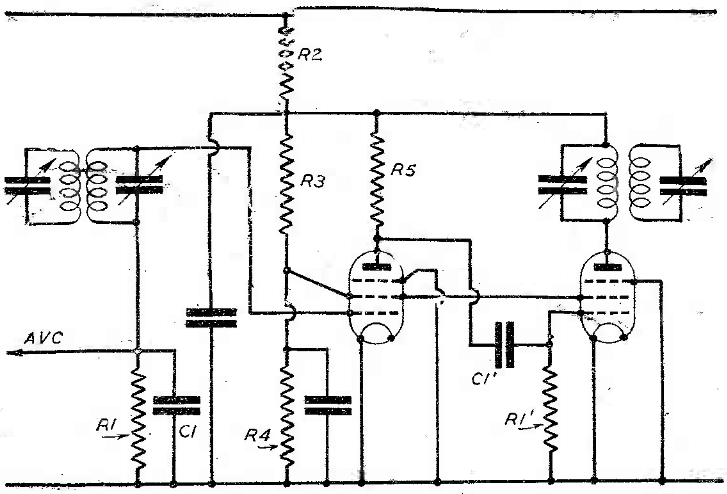


Fig. 3.—A two-stage amplitude limiter ; compromise is not necessary as each stage performs its task under optimum conditions. Suggested values are : R1—50,000Ω ; C1-90pfd. ; R1¹—200,000Ω ; C1¹—250 pfd. ; R5—5,000Ω (approx.).

of anode voltage enables the limiter to work satisfactorily on a small input but gives a correspondingly smaller output, while increase of screen voltage brings about less efficient regulation and should not therefore be used as a means of adjusting the input and output performance of the limiter, which should be accomplished by adjustment of the anode voltage, the screen voltage being adjusted for best possible regulation.

Avoiding the Compromise

It will be recalled that in the simple limiter circuit shown at Fig. 1 the value of R1 C1 had to be so selected that a compromise had to be effected between two desirable qualities which required opposed conditions for their maximum fulfilment. If it is desired to avoid this compromise, and thereby obtain limiter action which more closely approaches perfection, the arrangement shown at Fig. 3 may be adopted. It is, in fact, two limiters, which handle the signal in turn. The first has a very short time constant selected for the best possible limiter action of the type of wave-form associated with noise, while the second valve has a long time constant selected for handling a wide range of signal input. It will be noticed that the valves are resistance-capacity-coupled, which is convenient since it is not desired to obtain amplification in this stage. It may also have the advantage of assisting general stability. The same circuit, using I.F. transformer couplings in place of resistance coupling, is shown at Fig. 4 and is useful, since it emphasises more readily that the arrangement of a double saturated-amplifier amplitude limiter is the single valve variety in duplicate, R1 C1 performing the service for the first valve that R1¹ C1¹ performs for the second. In Fig. 3 R1¹ C1¹ are necessarily arranged in a slightly different manner, so that C1₁ performs the additional function of isolating the grid from the D.C. anode voltage of the preceding valve.

The double limiter arrangement shown at Fig. 3 is extremely efficient as in addition to the obvious advantage accruing from two sets of time constants, additional overall efficiency is automatically obtained due to the fact that the second limiter is called upon to accept restricted variation to input, since the first limiter will make a valuable contribution towards levelling out various input strengths, even though it has a very short time constant. This double action enables the limiter as a whole to accept an exceptionally wide range of input, while maintaining an output level constant to within narrow limits, with excellent limiter action on noise type of input due to the first valve working at optimum conditions for this particular purpose.

Optimum values for the double limiter shown at Fig. 3 are R1, 50,000 ohms, C1, 90 pfd., R1¹, 200,000 ohms, and C1¹, 250 pfd. Owing to the great efficiency of this two-valve arrangement it is not necessary to compromise with the anode voltage which can be increased slightly to bring about a corresponding increase of output. It is, however, necessary that the screen be adjusted for the most constant possible output. In determining these values due regard must be given to the fact that the voltage drop across R3 will be influenced by the screen current drawn by the valves in addition to the current flowing through R3 and R4. The overall value of R3 and R4 must be kept low in order to keep the screen voltage reasonably constant, which will mean that the value of R4 will be below 10,000 ohms, and screen voltage can therefore be measured with a high resistance voltmeter as the current drawn by such an instrument will be negligible to that flowing through R4, and the voltage will not, therefore, be significantly influenced by the connection of the voltmeter. The only other component in the circuit Fig. 3 that requires comment is the anode resistance of the first limiter valve, which should be quite low since amplification is not required; a value of 5,000 ohms being typical of the value used.

Using a Buffer Stage

Generally speaking, the frequency-amplitude converter will follow immediately after the limiter, consequently

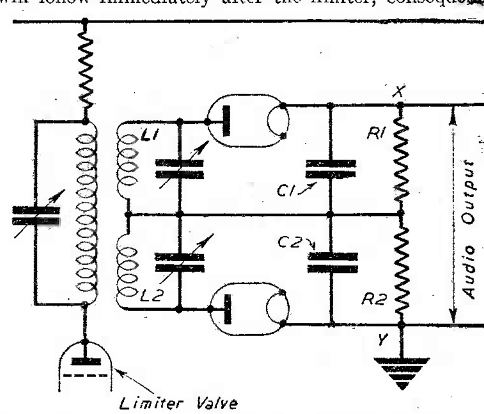


Fig. 5.—The amplitude-discriminator frequency-amplitude converter ; the diodes may be in a single bulb. Average values for R and C are 100,000Ω and 50 pfd.

the I.F. transformer shown as the output circuit in Figs. 1 and 3 will not normally take the form of a single untapped secondary as shown, but will be designed to suit the physical requirements of the discriminator. That is to say, the secondary may be centre tapped or be in two separate halves or, alternatively, the entire transformer may be replaced by two single tuned circuits in series.

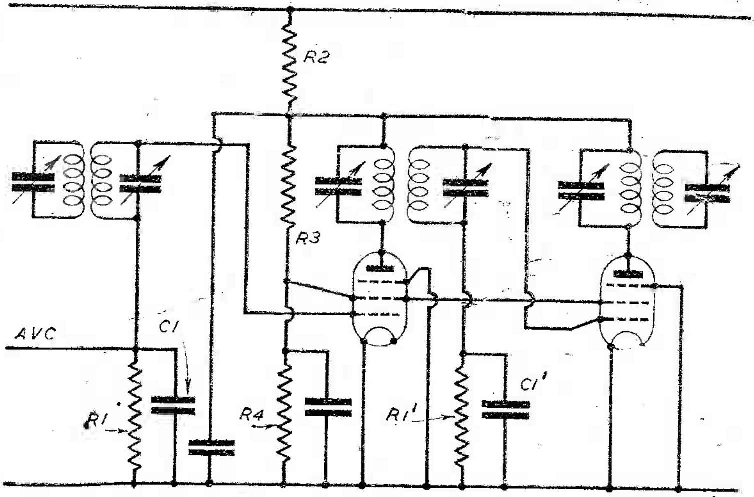


Fig. 4.—A similar circuit to Fig. 3, but R.C. coupling replaced by a tuned transformer; not often used, but illustrates more clearly the twin-stage action.

There is no theoretical objection to a buffer stage being introduced between the limiter and the frequency-amplitude converter; such an arrangement is, in fact, occasionally used. It is desired to emphasise the point already made that the frequency-amplitude converter normally follows the limiter, as circuit diagrams are to be seen in various text books and elsewhere where limiter diagrams and frequency-amplitude converter diagrams are drawn in such a way as to give the impression that the latter is not built around the anode load of the former.

The choice of frequency amplitude converter circuits is somewhat large and selection is often greatly influenced by convenience. For example, it may so happen that difficulty is experienced in obtaining a particular type of special I.F. transformer and the use of an alternative may be unavoidable. Although undesirable it is conceivable that some special form of tuned circuit may be employed as a convenient way of introducing some correction in the overall frequency response characteristic. Quite apart from variations of the tuned circuit, there are innumerable other possible variants, but for the present purpose the two most popular forms are examined in detail. The functioning of the amplitude-frequency converter requires special care in its presentation if it is to be readily understood. To clarify the circuit diagrams two separate diode valves are shown, but in practice these two valves may be enclosed in a single glass envelope without influencing the performance in any way, provided, of course, that the type selected has separate cathodes. It is actually possible to modify one of the circuits shown to use a single cathode double diode, but the arrangement results in an unfortunate distribution of capacity and is not illustrated for that reason. Further licence is taken in the interests of clarity, by omitting the customary damping resistances from across the tuned circuits, although they will normally be used.

Fig. 5 shows the circuit diagram of a simple discriminator which, although perhaps less efficient than the arrangement shown at Fig. 6, is simpler in its action and makes a more convenient starting point for explanation. As will be seen it lends itself readily to modification of the tuned circuit. Reference to Fig. 5 will show that the circuit, broadly speaking, consists of two diodes rectifying the current induced in the two secondary windings, and combining their output. One secondary is tuned above the carrier or unmodulated frequency, and the other is tuned, by a precisely equal amount below the carrier frequency; the actual values of deviation being such that the two secondaries together cover the necessary band-width. The actual deviation in kc/s necessary to produce this condition will be influenced by a number of causes, the principal factor being the overall frequency response characteristic of a single secondary winding. Study of Fig. 5 will show that when the carrier is unmodulated the audio output will be zero, since the voltages developed across L1 and L2 will be equal; consequently, the current flowing through R1 and R2 will be equal, and as they are connected back to back, the potential difference across the pair will be zero, although the potential difference will be appreciable. The balance is upset when, in course of modulation, the instantaneous frequency moves in the direction of the resonant frequency of either of the secondary windings; the current flowing through one diode will then be greater than the other. The potential difference will be dissimilar across R1 and R2, and the difference between these potentials will appear across the points X Y. Obviously, the input frequency can only move in one direction at a time, so that the increase in one diode load resistance will be imitated by a more or less similar decrease in the other. This produces a change across points XY approximately double that which would appear if this see-saw action did not take place.

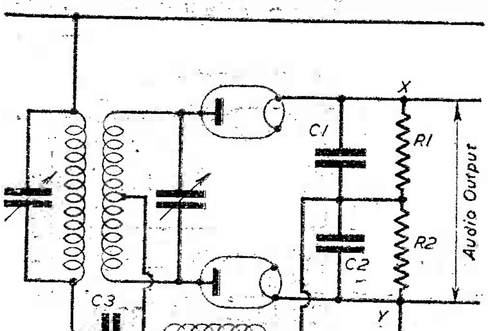


Fig. 6.—The phase-discriminator frequency-amplitude converter; values are the same as for Fig. 5. The inductance of the radio frequency choke should be appropriate for intermediate frequency or be replaced by a resistance.

Suitable Values

The value of R1 C1 and R2 C2 is conventional for a normal diode circuit, 100,000 ohms and 50 pfd. being general values. It is not desirable to increase the value above 100,000 ohms, owing to the risk of attenuating the higher audio frequency.

The type of circuit shown at Fig. 5 is known by the rather cumbersome title of the amplitude-discriminator frequency-amplitude converter.

An alternative principle is incorporated in the circuit at Fig. 6, which is known by another cumbersome title, the phase-discriminator frequency-amplitude converter, and is probably the most internationally popular circuit. This circuit employs a centre-tapped I.F. transformer, usually constructed so that the coupling can be adjusted, both primary and secondary being tuned to the unmodulated intermediate frequency; the action of the diode relies on voltage changes arising from two sources, (a) the potential set up by current induced in the secondary winding, and (b) by capacity coupling which takes the form of a condenser from the anode end of the primary winding to the centre tap of the secondary, C3 in Fig. 6. The primary and secondary of a tuned transformer are either 90 deg. or 270 deg. out of phase with each other at resonant frequency; this phase relationship produces equal distribution of energy in the secondary circuit causing currents to flow through R1 and R2, of equal value but in opposite directions, resulting in zero potential difference across the points XY. As stated, the phase relationship between primary and secondary is 90 deg. or 270 deg. at resonance, but this relationship is upset when frequency modulation is present, since the tuned circuit will no longer be at resonance; the induced current in the secondary will either lag or lead as the signal frequency increases and decreases in course of modulation.

This lagging and leading causes the two sources of energy (a) and (b) to combine in such a manner that the anode potential of one diode differs from the other when the signal frequency increases, and the reverse condition applies when the signal frequency decreases. As the diodes are connected back to back the difference of potential across R1 and R2 will appear as their difference across the points XY.

The values of R1, R2, C1 and C2 can be 100,000 ohms and 50 pfd. as tentatively suggested for the circuit shown at Fig. 5. The optimum value for C3 will be influenced by the design of the associated I.F. transformer and the intermediate frequency in use. The choke should be of efficient design and have inductance appropriate to the intermediate frequency or may be replaced by a resistance.

Notes from the Trade

Aerialite and Ekco in London

THE above two well-known firms have now opened London offices. E. K. Cole, Ltd., are installed in Rembrandt House, 5, Vigo Street, London, W.1.—a stone's throw from Piccadilly Circus. This will be their London office, covering all the products of the company, including their export interests. The premises are centrally situated for the convenience of visitors. The E. K. Cole head office and factory remain at Southend-on-Sea.

Special showrooms for radio and television, thermo-vent, lighting and plastics are in course of preparation and will be available as soon as present circumstances permit. Television demonstrations are already taking place regularly.

Aerialite have opened their London sales office and show room at 91/93, Baker Street, London, W.1, where their range of cables and wires, etc., may be seen.

Aerialite also announce that all their Ashton Cables are now made to Specification B.E.S.A.7, and contain only pure rubber, which means they are now of pre-war quality.

Philips Battery Chargers

PHILIPS LAMPS, LTD., announce det[illegible] full range of battery chargers which [illegible] or almost any battery-charging need.

Four types are available, E 1378, E 162, E [illegible] and E 1377.

E 1378 is of the "home-charging" type for use in domestic garages where it is a convenience to charge the battery while it remains in position on the car.

It is suitable for mounting on the garage wall and is provided with a 6ft. heavy flexible lead, with 2-pin plug, for connection to mains supply. For connection to the battery, 9ft. of flex is provided fitted with a 3-pin non-reversible plug. This plug connects to a special socket for attaching to the dashboard or other suitable place on the car.

In consumption, the charger is most economical, taking only 40 watts approx., or 25 hours charging for 1 unit of current. Batteries of 12 volt or 6 volt rating can be charged without alteration to the instrument.

Consumption: Full load in watts (approx.) 40.
Dimensions: Approximately $5\frac{1}{4}$in. × $3\frac{1}{2}$in. × 5in.
Weight: Approximately $5\frac{1}{4}$lb. Valve type—328.
Charging rate: Approximately 1.3 amps.

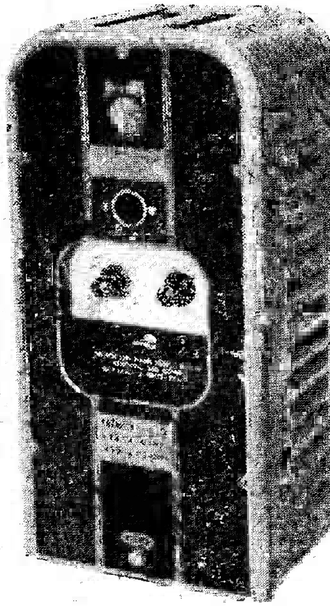
Type E.162 is a larger model (illustrated below) and is also for charging 6 volt or 12 volt starter batteries in position on the vehicle. It delivers 6 volts at 6 amps, or 12 volts at $4\frac{1}{2}$ amps, and is a most convenient unit for over-night charging.

These battery chargers are suitable for use on mains supply of 200/250 volts, 40/60 cycles, but can be supplied without extra charge for use on 100/120 volts, 40/60 cycle supply.

A readily accessible mains adjustment panel is incorporated. The charging rate is automatic, irrespective of whether a 6 volt or 12 volt battery is connected, and a charging indicator is incorporated which illuminates the front panel when charging is taking place.

Battery terminals are clearly marked, are of heavy construction and are recessed so that they do not project beyond the front panel.

Type E 1373 and *E 1377* are heavy-duty chargers suitable for use in garages and large charging stations.



This is the Model E. 162 charger. Designed for 6 or 12 volt starter batteries it can be mounted on the wall of the garage, and the batteries may be charged overnight whilst still left in position on the vehicle.

PSE QSL!

Some Notes on Useful Radio Reporting and Its Value to the Amateur

JUST how QSL cards started nobody knows for certain. Sometime about twenty-five years ago an amateur transmitter in Britain or America conceived the idea of confirming a contact with a post-card giving solid evidence of the contact, station details, and the call-sign of the station concerned in large printed letters. That was how QSL (international abbreviation for "I give you acknowledgement of receipt") cards began. They ended temporarily on the outbreak of war in the sort of cards illustrating this article. Maps, jokes and photographs had become commonplace on them, and their collection a major international hobby. Broadcast-stations rewarded reports of reception with QSL's, high-powered phone-transmitting amateurs got fan-mails that would have needed a private income and a secretary to satisfy, while the QSL Bureaux of the R.S.G.B. and A.R.R.L. became clogged with cards for listeners they could not deliver, because the listeners were unknown to them.

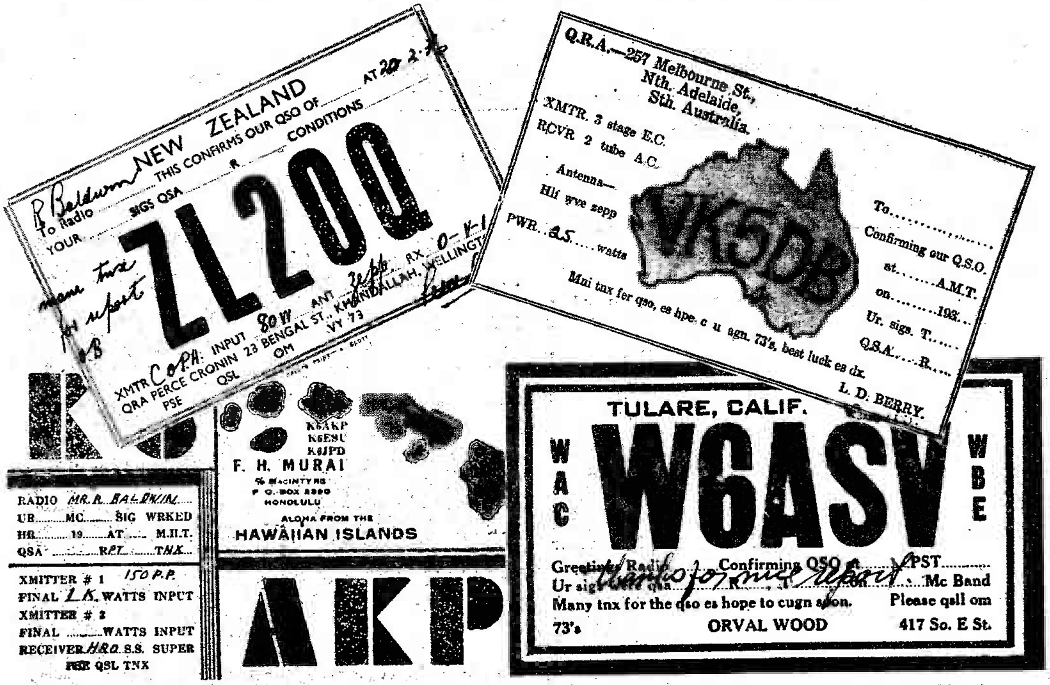
Reporting is often the first step to amateur activities in the transmitting line—and reporting can be very valuable. But, to be of value, reports of reception should contain all essential details of the transmission—the date, the time and frequency, the fading, the readability and strength of the signals. That the latter pair of details can be vastly different because of interference should be obvious. If you report frequency drift or overmodulation or spacer-wave between morse dots or note impurities, you may help an amateur to improve the quality of his transmission. Record your details on a postcard and ask for a QSL, and if you have reported wisely you may have a card sent back. Sometimes you will even get photos and letters of thanks from grateful amateurs who can't hear much because of fierce interference, as in such cities as New York, but who are glad to hear that their signals are getting out.

When to Report

The question for the beginner is: what amateurs want telephony reports? The high-powered ones scattered over the world and often to be heard on the bands—they do not want listener-reports. As explained above, they get too many of them. It is the amateur who is weak and only heard once who is more than likely to welcome a report.

If you hear a North American amateur on the 160-metre band—probably in the middle of a winter night—the same amateur will be glad to hear about it, since crossing the ocean on that band is a feat whether it be on 'phone or morse. The 10-metre band is ideal for reporting—all Europe and, in fact, the very best DX can be heard during good conditions—and since these good spells are sometimes rare, if you hear someone calling fruitlessly in an inactive but good time, the amateur may be very glad to hear that his signals were being heard somewhere and respond with his card. But if you want British cards and you know no morse, then get a set working in the amateur five-metre band. On that band, most definitely, any amateur report is welcomed—your percentage of QSL's returned should be high.

Because of the high number of reporters of 'phone transmission, it is worth while learning morse. Many amateurs transmit nothing else, and it is a very rare thing for them ever to receive a report from any listener. It is quite true to say that half-a-dozen hours spent



A representative collection of QSL cards. These are, of course, produced in interesting colour combinations, and present a very effective display.

learning how to pick up CQ calls and morse call-signs will rapidly save the equivalent time spent in writing fruitless reports of telephony transmissions heard. If you have a good interest in morse, it is quite easy to learn.

Where to Send ?

Addresses are a thorny problem. But if the given town of an amateur is in, say, a little township in New Zealand, or any small place, it is quite probable that the local postal authorities are quite well aware of the continual trickle of cards going to the amateur in question, and your report will be delivered without a hitch. Equally, it is foolish to address a big-city amateur by his call-sign only—probably the post office there will not bother to ferret out the full address and your card will find its way into the dead-letter office.

Anybody interested in radio enough to send serious reports should ask himself whether it would not be worth while joining the Radio Society of Great Britain. Members have the privilege of making use of the Society's QSL Bureau for sending and receiving cards. This bureau makes bulk exchanges of cards with other amateur organisations all over the world. It should be pointed out, though, that at present the R.S.G.B. is asking all members to send cards for "rare" stations (e.g., out-of-the-way countries) direct.

It is not generally known that any person can use the R.S.G.B. Bureau for *receiving* cards. It is merely necessary to send several stamped, self-addressed envelopes about 6½in. by 4½in. in size to the QSL Bureau at 29, Kechill Gardens, Hayes, Bromley, Kent. You can then safely put "QSL direct or via R.S.G.B." on your reports, and when three or four cards accumulate for you they will be sent on in one of your envelopes.

Remember that your reports can be of the utmost value or, conversely, can be just a drug in the mail to some often-heard high-powered transmitting amateur. If you exercise discretion in reporting stations you will be doing them a service and will get a high percentage of replies.

The Television Camera

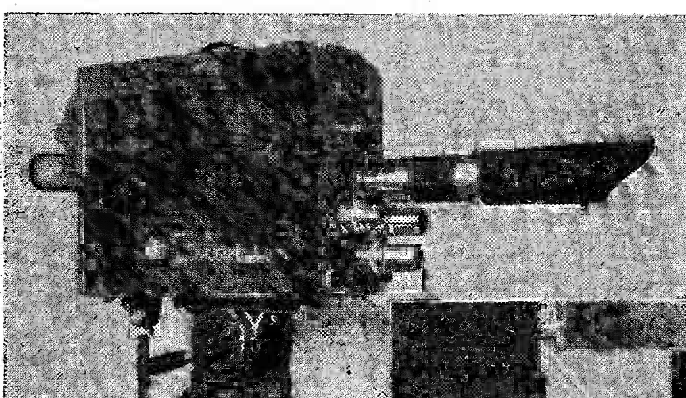
Interesting Details of One of the Latest R.C.A. Image Orthicon Cameras

MANY readers have often seen illustrations of the Television Camera, and have wondered just what is concealed inside the case. How does the lens convert the scene into electrical impulses? Are there any moving parts? The following details will no doubt prove of interest, and give details previously not released. The illustrations show the latest R.C.A. camera, known in its full title as the Image Orthicon Camera, Type TK-30A. This piece of apparatus weighs about 100 pounds complete, including the electronic view-finder, and breaks down into several units for easy carrying. Its extreme sensitivity makes it possible to telecast a scene at incident light levels as low as one or two foot-candles with an F1.9 lens, which is now available.

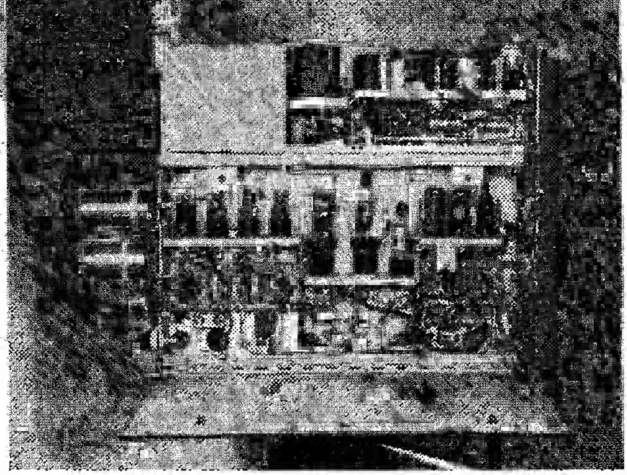
The camera is built in two cases which fit snugly together when set up for operation. The lower unit houses the Image Orthicon pick-up tube and the video pre-amplifier circuit and controls. On the front is a four-position lens turret which is operated by a handle on the back of the case. A smaller unit, containing the electronic view-finder, mounts on top of the camera proper.

The lens turret control on the back of the camera, engaging the turret by means of a stainless steel shaft supported on needle bearings, which runs through the inside of the unit, permits the operator to change from one lens to another of a different focal length and refocus in less than two seconds. A trigger switch incorporated in the turret control cuts off the picture while the turret is being revolved.

One of the lens positions may be used for mounting a small film projector with a continuous strip of 16 mm.



On the left is one of the new R.C.A. Image Orthicon cameras with telephoto lens mounted on the multiple lens mount. Below is an inside view of the camera.



film, containing 36 different pictures, to provide illustrative material or titles. This permits insertion of "commercials," test charts, station call letters, and still pictures in remote pick-up programmes, without switching back to the studio.

It is also possible to insert a special lightweight telephoto lens into any of the turret openings, for use when it is necessary to locate the camera at a considerable distance from the action.

Standard Photographic Lenses

Because the photocathode of the Image Orthicon is much smaller than those of previously used pick-up tubes, it is possible to use relatively inexpensive standard camera lenses for all types of pick-up.

Focusing of this camera is accomplished by rotation of a large knob on the side of the camera which moves the pick-up tube backward or forward, bringing the scene in focus on the photocathode without moving the lenses themselves.

Controls for centring, linearity, brightness, contrast and picture height and width are adjusted when the camera is first set up. Controls for adjustments necessary during actual operation are located on a remote camera control unit. The operator needs only to keep the camera directed on the scene of action and the picture correctly focused.

The electronic view-finder employs a 5in. Kinescope with sufficient second-anode voltage to produce a very satisfactory picture under normal light conditions. Since this picture is identical to that which is being transmitted to the camera control equipment, the operator is able not only accurately to frame and focus the picture, but also to monitor its quality. The electronic view-finder also eliminates the need for a complete set of duplicate lenses which would be required for an optical system.

For shutting out extraneous light from the viewing tube, two viewing hoods are furnished with the camera, one opening directly into the view-finder, while the other is a periscope-type hood with two 45-degree mirrors mounted in it, for viewing positions either below or above the level of the view-finder.

An "on the air" tally light inside the view-finder hood informs the operator when the camera is supplying video signals to the transmitter, and red signal lamps on both ends of the camera indicate to the announcer and all others concerned which camera is "on the air."

The camera case is constructed to give ready access to all the interior components. By a half-turn of two catches, either of the side doors can be opened to expose all the circuit components, valves, resistors, and condensers, for easy maintenance and replacements. On the bottom of the camera case is the connecting plug for the power line, and a 110-volt utility outlet for a soldering iron and lights to assist in minor adjustments when needed. There is a screened air-intake in the bottom of the camera for an air blower which furnishes forced draught ventilation for cooling the Image Orthicon unit. A set of jacks is provided for plugging in interphones which allow the camera operator to communicate with the operator at the central control position. There are also plugs for the announcer's microphone and for his headphone for cueing and monitoring.

The Image Orthicon Pick-up Tube

The electronic view-finder unit is also constructed in such a way as to allow for easy checking and replacement of parts. It is electrically coupled to the camera circuit by means of a contact plug which engages automatically when the view-finder is placed in position on the camera.

When used in the field, the Image Orthicon Camera is usually mounted on a tripod or a turret. For studio use, it can be mounted on a tripod which in turn is placed on a dolly for easy manœuvrability. It is also possible to use the camera with a crane-type studio dolly for special angle effects and overhead shots.

The R.C.A. Image Orthicon pick-up tube, which is about 15ins. long and 3ins. in diameter, has three main parts: an electron image section, which amplifies the photo-electric current; an improved Orthicon-type scanning section, smaller and simpler than those built before the war; and an electron multiplier section, the function of which is to amplify about 1,000 times the relatively weak video signals before transmission.

The principle which makes the new tube supersensitive to low-light levels is known as secondary electronic emission, which makes use of electrons emitted from a primary source as missiles to bombard a target or series of targets known as stages or dynodes. At these dynodes, two or more electrons are emitted for each striking electron.

Light from the scene being televised is picked up by an optical lens system and focused on the photocathode of the tube, which emits electrons from each illuminated area in proportion to the intensity of the light striking that area.

Streams of these electrons, accelerated by a more positive voltage and held on parallel courses by an electromagnetic field, speed from the back of the photocathode to a target. Secondary emission of electrons, caused by this bombardment of the target, leaves on the target a pattern of varying positive charges which corresponds to the pattern of light from the scene being televised.

The back of the target is scanned by a beam of electrons generated by an electron gun in the base of the tube. The electrons making up this beam are slowed down so that they will stop just short of the target and return to the base of the tube, except when they approach a section of the target which carries a positive charge. When this occurs, the beam will deposit enough electrons on the back of the target to neutralise the charge, after which it will again fall short of the target and turn back until it again approaches a positively charged section.

The returning beam, with picture information imposed upon it by varying losses of electrons left behind on the target, is directed at the first of a series of multiplier stages near the base of the tube. Secondary electrons, knocked out of this electrode by the bombardment, strike a second dynode, and this process continues, with the strength of the video signal multiplying at each dynode until it reaches the signal plate and is carried out of the tube through an external connection.

"Baku Speaking . . . !"

THE Azerbaijan Soviet Republic is shortly celebrating the twentieth anniversary of the inauguration of broadcasting in the Azerbaijan language. This was indeed a great event in the life of the people, for, in the pre-Soviet period, they were not allowed the use of their own tongue for any public purposes, such as the publication of newspapers.

At 7.45 a.m. in Greenwich time, from the wireless sets in Azerbaijan come the sounds of the national anthem of the Azerbaijan Soviet Republic, written by its oldest composer, Uzeir Gajibekov. This is followed by the words: "Danshir Baki," meaning "Baku speaking."

Thus begins the day of the Baku Wireless Studio on wavelengths of 1,379 and 49 metres.

Besides the chief Baku station, 130 radio relay stations are functioning in the Azerbaijan republic. These have been set up in district towns, large industrial enterprises and rural areas. Sixty thousand loudspeakers are connected with the relay stations. In addition, thousands of Azerbaijan citizens have their own radio sets. Local broadcasts, for which one and a half to two hours are set apart daily, function in the various districts of the republic. You will not now find a single village, however remote, that does not listen-in to the Baku broadcasts.

Every day the Baku station relays the Moscow broadcasts for six and a half hours. The rest of the time the Baku station broadcasts its own programme.

Britain Can Make It

A Glance at the Wireless Exhibits

By THE MARQUIS OF DONEGALL

FOR reasons best known to the authorities, several of the radio exhibits are isolated from all their fellows. We come upon two almost immediately in the section known as "War to Peace." This section is designed to show examples in which wartime industrial discoveries are being applied in peacetime.

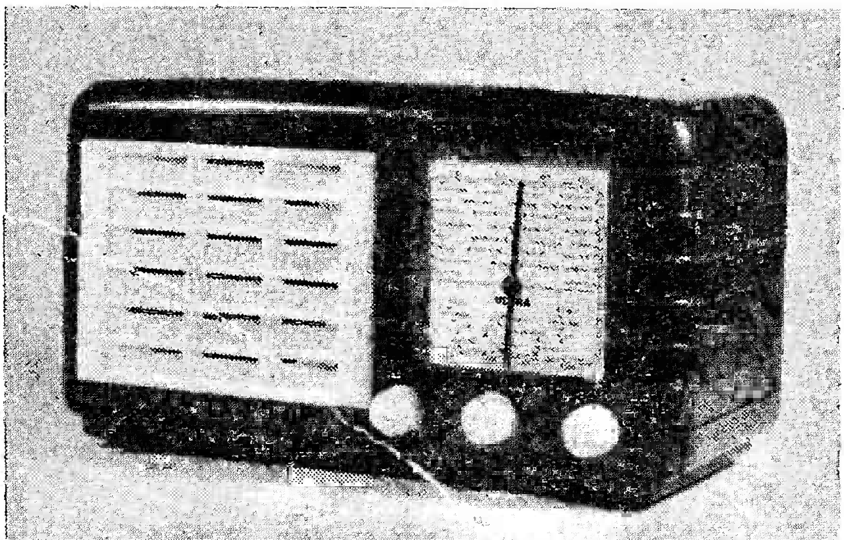
Most of the exhibits are self-explanatory, such as the plastic tea-trays derived from the formation of the pilot's seat in the crashed Hurricane with a back-drop of bombed London.

The two radio exhibits in this section are a portable combined receiver and transmitter for use by the police and derived from sets developed for parachutists. In the same case we have the Romac midget dry-battery portable radio, which derives its power from one battery of the type of the Ever-Ready No. 26 all-dry, and one Ever-Ready No. U.2 or other similar unit cell. I imagine that it has been put in this section because certain parts, especially the valves, were used in the development of the "walkie-talkie." In appearance it is like an over-grown Leica camera; the aerial is in the strap that is slung over the shoulder. As far as I am aware, this is the first British dry-battery midget, and I have been using one for some time. In both tone and range it is superior to the American midget that I carried throughout the war as a war reporter.

Having left these two lonely specimens we would, if we followed the crowd, go through all the other sections of the exhibition before reaching the main Radio and Gramophone Section in the basement, or lower gallery, as it is more politely called. It adjoins, appropriately, the example living- and dining-rooms which in turn lead into the kitchens, bedrooms and bathrooms, and in several of these sections we find a built-in radio as part of the furnishing of the room.

For instance, there is a very nice radio-gramophone in cherry by Messrs. Story, of Kensington; a radio-gramophone control unit by Murphy Radio, and a radio cabinet and gramophone in Honduras mahogany and Bombay rosewood by Messrs. Cohen, of E.C.2. Also extraneous to the main section is a McMichael miniature radio receiver (mains only) and Ferranti table-model and Console-model television sets.

Of the built-in sets or radiograms, I would only say that I dislike them so much, no matter how beautiful they may look, that I would rather sacrifice precious space in order to have something that can, if necessary, be moved about. Besides, a really attractive radiogram with television can be a considerable asset to the furnishing of a room.



This Ultra Table Model has a plastic cabinet and speaker fret. It is a two-waveband model.

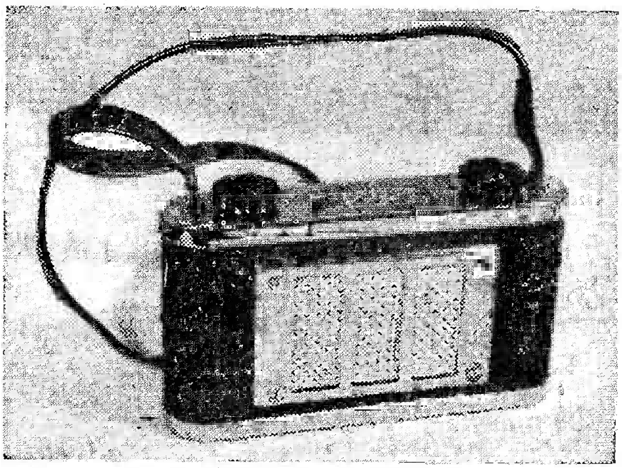
Main Exhibits

We now come to the main Radio and Gramophone Section, where most of the exhibits are displayed singly on pedestals. First we come to the circular Ekco. It is a three-wave band table model, and I put it down in my notes as black plastic cabinet with white illuminated dial. I don't propose to quarrel with the catalogue, which chooses to call it a green-table radio receiver. However that may be, what I am talking about is the Ekco A.22 model. I like its moving lit-up station-finder, but I should think that its loudspeaker is rather on the small side.

Next we come to the Ferranti—a nice-looking rectangular workmanlike job of conventional design. On the next pedestal we have a table-model Murphy which is a relief from everlasting plastics in that the cabinet is constructed of wood combined with an attractive fabric or textile.

Then we come to Ultra models, and of these I will deal with the midget. It is one of the neatest of the several mains-midgets displayed in a separate show case; its case in black-and-white plastic. There is one criticism that applies to this set, as it does to a good many others. That is, that there is nothing to tell a person using the set for the first time which of the three little white knobs does what. I have an American midget about the same size which has no less than four unidentified knobs. I have always found it maddening because, to this day, I am never quite sure which knob is which on that particular set. The infuriated owner is usually reduced to spoiling the appearance of the set by labelling the knobs.

There are three Pye radios. Take the medium-sized model No. 15a, a four-valve, three waveband, table set. This model does not have push buttons for selecting the wavebands and certain stations, automatically, as is the case with my pre-war Console model which is still doing very good service. But it has the knobs engraved to tell the newcomer immediately which is which, and I do suggest that this should be a universal practice. The makers claim radiogram tone for their sets, but I have not had an opportunity of trying one of their new models. However, as most people know, Pye were pioneers in the field of radar, and therefore should have some good things in store. To my mind, their fly-wheel tuning system has long been one of the best.



A miniature receiver having the aerial enclosed in the shoulder sling.

Kolster-Brandes, of Foot's Cray—I used to Home Guard their premises at one time—shows three models. Their A.R.30 is a very nice-looking set—it looks more expensive than any mentioned so far and, indeed, is slightly more so. It is a five-valve, three waveband superhet table model. In this case the makers go so far as to attach paper discs to the controls to show which knob is which, but again no permanent engraving.

An Original Design

There is always a crowd round that curious-looking Murphy which appears to have its "works" tucked away into nothing and stands up like a photograph frame. I was told that it also hangs on the wall, though for the life of me I cannot conceive why anybody should want to hang a radio on a wall. The whole thing, in fact, reminded me of the man who invented a machine to enable a pianist to read a piece of music nailed to the bottom of the piano.

Cossors seem to have got a bad start in the race. They have produced a very nice grey table model, and when you come to look at it you find that it is nothing but a dummy. Still, they have produced some very good sets in the past, so we will presume that something really good is on the way.

As a dry-battery portable (as opposed to midget), I have always sworn by the Double-Decca. I have two pre-war ones still going perfectly and on one of them I used regularly to get American stations from my bedroom, while living at the not-exactly-ideal-for-radio Dorchester Hotel.

This is to warn you that I may be biased in expressing the opinion that the new Double-Decca, with its cream plastic panel and improved circular dial is the most advanced looking set in the exhibition.

Of the various mains midgets, the Ekco, the Pye and the Murphy, together with the Ultra, already mentioned, are the most attractive.

Altogether, I am sorry to tell you—but there is no use beating about the bush—I was extremely disappointed in the whole Radio Section. I am speaking now of the outward appearance of the sets as opposed to the sundry degrees of performance claimed for them.

Conventional Designs

With the sole exception of the Double-Decca, I did not see a single exhibit that would make a man—or, for that matter, his wife, who is possibly more important—exclaim: "Now that really is something! We must get one of those. Its 'chic'—would absolutely make the sitting-room." And from the comments I heard as I was going round, a good many people seemed to agree with me. Perhaps it is too much to ask that designers should have made more use of the beautiful shades of plastic which are such a feature of the rest of the exhibition to give a more post-war trend in design to the conventional lines of these exhibits.

For conventional they are, in the sense that they are precious little different in appearance from the sets that we were used to before the war.

Nor do I think that I am trying to leap ahead of other countries. Towards the end of the war I saw some very arresting models in Spain, most of which had come from South America. That is perhaps being a little unfair, but what is more surprising is that at the beginning of this year I saw some superbly finished and artistically designed sets in Switzerland. On inquiry they mostly turned out to be German sets made and exported during the war. The answer to that might be that, of course, if the Germans did that sort of thing, it is no wonder they lost the war.

I do not know quite how the selection of radios for "Britain Can Make It" was done. But some of the omissions are as startling as some of the inclusions are uninteresting. For instance, there is nothing from G.E.C. or Dynatron, who produce an expensive Console set that is alleged to do everything.

Where are our old friends Messrs. Phillips, with whose model No. 170A a technical friend of mine is in raptures, especially as to short-wave?

No Pilot, Ferguson, Sobell, Cameo or Alba? And H.M.V. have only one exhibit in the shape of a 15-tube Console television receiver. The only other television receiver is a Marconiphone. Both are quite nice but nothing out of the ordinary. As far as I can see the only two firms that I have omitted in this short survey are Messrs. Fitton, with their "Ambassador" radiogram, and Bush Radio, who show a battery portable.

SPREAD THE GOOD NEWS

An increased paper ration has been announced and, commencing with this issue, more copies are available.

For many years thousands of our readers have had to borrow from a friend, and although the number of copies that may be printed is naturally still limited, these readers now have a good chance of obtaining regularly from a newsagent, provided an order is placed immediately.

May we invite you to spread the good news? Please do not delay, as the extra quantity we shall be printing will soon be exhausted.

Underneath the Dipole

Television Pick-ups and Reflections. By "THE SCANNER"

IN pre-war days autumn was considered to be the opening of the radio, the car and the ideal home year. The next year's models and gadgets were revealed to the public with trumpet flourishings at great exhibitions, and salesmen had a busy time demonstrating their wares and booking orders. It was an appropriate moment to attract the attention of would-be buyers of radio sets, who were preparing to put aside their tennis racquets and other perquisites of the hot summers we used to have. The fireside, the pipe—and the latest super-het—held promise of comfortable relaxation for the long winter evenings. Happy hours were spent scanning the advertisement pages of the radio journals and the details of the latest super-reflex circuit for the home constructor. In response to popular demand, set designers produced many variations of circuits in which a couple of valves and a crystal did almost everything except turn somersaults, and thousands of semi-skilled radio constructors experienced the thrill of making them work, though sometimes with accompaniments of howls and buzzes.

The "Glamour" of Home-constructed Radio

There was a glamour about radio as a hobby which was enjoyed by a large army of unskilled experimenters. This class of radio man now usually buys a factory-made set, unless he has graduated into the smaller and more select band of radio "hams" who explore the very short waves. Television, however, has caught the fancy of many new "graduates," and the high cost (and purchase tax) of the ready-made television receivers has turned the thoughts of many of them to the fascinating enterprise of building their own sets.

This autumn there has been no special flourishing of trumpets, and the deliveries of new television receivers, components and replacement parts for old sets has been painfully slow. Matters have not been helped by the attitude of one or two manufacturers, who now refuse to supply replacement cathode-ray tubes for early electrostatic type sets of 1937 "vintage." Several hundred of one of the most popular 10in. x 8in. picture sets of that year will, therefore, become useless when their tubes fail, and there will, in due course, be several hundred dissatisfied customers regretting the purchase of this particular make. The manufacturers are advising radio service stations to fit smaller tubes to these old electrostatic type sets, involving the rewinding of a transformer, the fitting of additional components—and a resultant picture which is much smaller. Of course, the cost of setting up plant for making new tubes of an old type may be prohibitive, but I would have thought that it would have been possible to recondition the old tubes. Good will and prestige are valuable assets, and it seems incredible that the purchasers of these early models should be brushed on one side in this arbitrary manner.

Improved Pictures

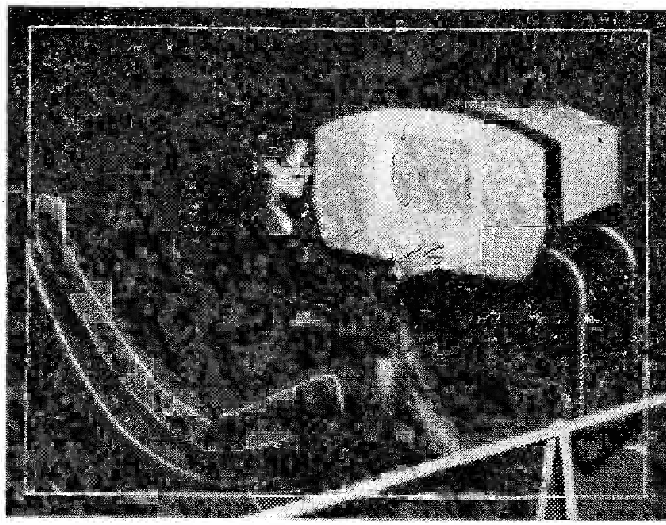
Great progress was made, of course, in the transmission of ultra-short waves during the war. Six metres is now, comparatively speaking, a long wave! The increased bandwidth which is now transmitted from the Alexandra Palace is one of the results of this development, and the three-megacycles bandwidth radiated can be accepted by the majority of post-war receivers. The bandwidth transmitted before the war was a little over two megacycles, and 1938 receivers were capable of accepting about $1\frac{1}{2}$ megacycles. However, the improvement in picture detail is noticeable on pre-war sets, particularly when the aerial is a good one and the new "fat" signal forces its way through the old set by brute force!

The Moving Camera

The advertisements of one of the radio manufacturers tells us that television is a "pretty exciting thing." It is a nice phrase, and accurately describes the experiences of viewers who are able to appreciate the many little technical improvements in the transmissions. One has the impression of watching steps in technical history. Lately, the improvements have been chiefly in the handling of the equipment at the studio, particularly the Emitron cameras. The smoothness of the "tracking shots," when the camera slowly moves from the long-shot position to the close-up, is a case in point. A little while ago, the B.B.C. acquired a cinema studio camera "velocillator," an elaborate camera stand which takes the form of a kind of miniature crane on wheels. This wonderful gadget, which costs about £800, has every kind of control for raising and lowering the camera head, and the operators have built-in seats which are rotated bodily with the arm of the crane. If the floor on which it is used is reasonably smooth, it can be operated without the usual rails or wood track which restricts the movement to a straight line. The B.B.C. men seem to have acquired great skill in using this and other similar equipment, and no longer make the mistake of attempting to move the camera about too quickly.

Lighting

The television camera men are at a disadvantage as compared with film studio cameramen, who have ample time to adjust the studio lights for each individual shot.



Seen at the "Britain can make it" exhibition—a modern design of television receiver, with easy chair to match

Quick decisions and silent instructions for lighting alterations have to be made during the progress of a scene, bearing in mind the view points of several cameras at the same time. Here, for the time being, at any rate, "straight" lighting seems to be the best policy, and efforts to get special effects, particularly when they are in a dark or low key, lead to disappointment. Apart from the natural tendency of the viewer to turn up the brilliancy knob and thus destroy the arty-crafty lighting effect, dark scenes are far more susceptible to the flashings caused by motor-car ignition and other man-made static. All long-distance viewers favour a good high-key picture.

Looking at the Audience

There is a growing tendency to encourage artistes to look straight into the camera lens, to give the effect of looking directly at the viewers at the receiving end. The announcers, of course, have always done this, though not all of them have acquired the particular technique which makes it wholly successful. The trick is to look directly at the lens of the Emitron camera, with the eyes focused on it and not *through* it. You will notice at the receiving end how some announcers appear to be vaguely looking in your direction, either at nothing, or at something which is located behind you. The effect is disconcerting, and the producers should give the artistes and announcers more precise directions on this point. Close-up faces are frequently distorted owing to the effects of the wide-angle lenses which are invariably used in the television studios. These give a picture equivalent to a 35 m.m. (1½in.) cine camera lens; whereas the lens most favoured by film cameramen for close-up work and portraits is the 75 m.m. (3in.). The latter lens has a much more narrow angle of view, and has the effect of flattening the features. The wide-angle lens makes large noses larger and seems to magnify any defects of the features, and is also subject to distortions when shooting upwards or downwards instead of on a level with the person's face. On the other hand, narrow-angle or long-focus lenses are large in price and dimensions, when they are designed to have a large aperture, thus passing the maximum light and permitting use under weak lighting conditions. The very long focus lenses, usually called "telescopic," are really only suitable for use in strong sunlight, which is thirty or forty times as bright as studio lighting.

The Truth About Television

An Interesting Article About the Television Position from an American Point of View

ALTHOUGH conditions in this country cannot be compared with those obtaining in America (where the listener does not pay a licence for his radio, and where the expenses of the broadcasting companies are met by advertising revenue), the following article by Hugo Gernsback, editor of the "Radio-Craft Magazine," will, we think, be of interest to our readers. Many modern fundamental radio developments came from America, where their particular conditions expedited those developments. This article may, therefore, be the forerunner of some interesting fundamental change in television technique.

Recent speeches, press articles and advertisements in the U.S.A. have heralded "the television era" as something immediate. Public expectancy has been built up to the point where the average person thinks that within the next few months he can purchase a high-grade television set at about the price of a radio receiver and, at the turn of a dial, enjoy a steady stream of programmes on a par with the Louis-Conn telecast. Mr. Gernsback says:

We hear continuously from the general public, who are bewildered as to the true status of television to-day. There is a great deal of confusion regarding television as a whole. Nor is it abated by the industry, which itself is at odds on more than one of the art's major questions. The entire video picture is highly complex, to say the least, while little is being done to clarify the situation.

Within the industry certain factions are at odds with each other. Much could be written about such points as the disagreement between the industry and the Federal Communications Commission as to time schedules of operation, freezing of standards, etc. Within the industry one faction is for colour television, which is denounced by the other. Then there is the size of screen for best viewing, whether the image should be on the cathode-tube screen or whether it should be projected on the wall (or a wall screen). These are but a few points.

Commander E. F. MacDonald, Jr., President of Zenith Radio Corporation, has long taken the stand that commercial television procedure is all wrong in following the paid-advertising broadcast technique. He maintains—not without good reason—that it will never be possible to have nation-wide "free" television reception as we have "free" broadcasting. The cost of good television broadcasts is in the order of making good motion-picture films. And as everybody knows, production of a good motion picture costs anywhere from a quarter of a million dollars to two million dollars.

What makes matters worse in television is that there cannot be any "re-takes." Inasmuch as a television production must be carefully rehearsed and must be letter-perfect at the moment of broadcast, the television director has no way of correcting any mistakes, as is the case in motion pictures.

Therefore, a good television broadcast programme would of necessity cost more than a like motion picture production. Commander MacDonald thinks that the excessively high cost of television broadcasts cannot be met by sponsored advertising, as it is in broadcasting to-day, but that television programmes should be paid for in some other way; either over line wires or by radio using special equipment, where only those who pay for the service would have sets that could receive such paid programmes. That is one angle.

Filming First

Dr. Lee de Forest, of radio fame, pointed out in an article in "Radio-Craft" (April and May, 1945, issues), that the simplest way would be to take a motion picture film of the production. This could then be edited *before* the broadcast; the final film would *then* be run at the television transmission studios and broadcast. This would make it as cheap, or cheaper than motion picture practice. Sponsored advertising programmes could be presented in this way whereby the admittedly still high production costs would leave a profit to the television broadcasters. That is another angle. This suggestion, however, is not at all welcomed by the television industry, who wants none of it, but believes that television's credo is that events should be broadcast *when the event actually occurs*, instantaneously, as for instance, the recent Louis-Conn fight.

This is only one part of the story. So as not to lose our perspective, let us turn the clock back to 1921 when broadcasting started. At that time anyone with a

$10 bill—or less—could receive radio broadcast programmes simply by either buying a crystal detector and a pair of headphones, or by making the detector himself and buying the phones. From such small beginnings broadcasting began.

A little later the radio valve came into its own, and then with one- or two-valve sets, which gave better selectivity, stronger and clearer reception, broadcasting marched on its triumphant way. Still later, loudspeakers were added. Millions of enthusiasts in the United States now were building their own sets, and the radio age was here to stay. Soon—with tens of millions of listeners getting programmes—the advertised products via the radio waves paid handsomely for the broadcast effort.

Thousands of Transmitters

Now let us turn to television. The situation here is far from parallel. To begin with, television must in its very nature be broadcast on higher frequencies (low wave lengths). That means that the reception range cannot be greater than an average of 25 to 30 miles from the transmitter. Now then, if the entire country is to be blanketed with television, this requires thousands of television transmitters. The capital outlay, therefore, for the television broadcast industry will be immeasurably greater than was the case with the broadcast industry. At the present time we only have a handful of television transmitters in this country, in actual numbers only six stations, now operating on a schedule, plus three *experimental* stations.

Against this, the radio broadcast industry has 1,003 transmitters as at December, 1945. Even if we soon had a like number of television transmitters in the United States, they would by no means blanket the entire country to support an advertising-sponsored television programme that could conceivably pay out. To cover the entire nation with television transmission—as is the case with radio broadcast to-day—we need a minimum of 1,500 television transmitters. It does not appear that such a programme could be possibly realised within even ten years from to-day. Until such time, mass production of television receivers, to run into the millions, does not seem feasible.

It is true that Westinghouse has proposed their so-called Stratovision, whereby a small number of television transmitters, cruising continuously in the stratosphere, could blanket the entire country. This, however, is as yet a mere proposal. It is not known if such a scheme is feasible technically and whether or not it could be soon realised. If and when it is and has proven its worth, then, the total number of transmitters and the ten-year estimate mentioned could be cut to a great extent.

For the present, only a few large centres in this country will conceivably be served by television. The programmes will have to be more or less mediocre because highly expensive productions must remain completely out of the picture. The reason: no advertiser is going to spend millions, or even hundreds of dollars, to broadcast to a few thousand television receivers. To-day there is no real television audience in existence, and there is not much likelihood that there will be one for a number of years to come. So much for a few of the complex problems that confront television to-day.

Cost of Receivers

Again this is not the whole story. There is, for instance, the high present cost of television receivers. To sell these by the tens of millions the price must be low enough to appeal to the great general public in this country. To-day the lowest price of video receivers is around $200.00, and for this amount of money you do not get much.

For a really acceptable televisor that throws a fair-size, clear image, the price is in the neighbourhood of $500. Remember, television receivers are complex. To have both sight and sound you really must have two sets in one: one for video, the other for sound. This alone increases the price a great deal. It seems improbable at the present state of the television art that the American public would soon be able to absorb 54 million television receivers—even at $200 a set—a quantity necessary to support continuous daily expensive and elaborate television programmes to parallel the high-quality broadcast programmes current to-day.

In our estimation, the present fundamental television technique is not the final word in the art. The popular price televisor will not arrive until our entire conception of television has been radically changed. The means current to-day are not what television will be in years to come. We have made this clear editorially for many years past. It is certain that the ultimate solution will not be the present-day scanning cathode-ray tube.

We quote from our editorial in the February, 1934, issue of "Radio-Craft":

"This scanning idea, to my mind, is all wrong and totally unnecessary. When the final television invention comes along, one which may be likened to the radio tube of to-day as compared with the radio crystal of yore, it will be found that the scanning idea is conspicuous by its absence.

"Some 30 million years ago, nature invented the first real television machine, which, so far, has not been duplicated by man. I refer, of course, to the animal eye, which has been in existence on this planet for millions of years, and is open for study by all television aspirants.

"The animal eye (which, of course, includes the human eye) is almost a perfect television receiver and transmitter. Not only does it receive an image from the outside world by means of light rays and then transmit it through the optic nerve to the brain, but it takes the television engineer several steps better; because, in the first place, the eye gets along marvellously well *without any scanning mechanism*, but the image is received and transmitted in colours as well."

What was said above in 1934 still holds true now, if the television industry is to succeed as has the broadcast industry.

Basically, television as we know it to-day is technically unsound. Shortly after the year 1800 there was an "automobile" running in the streets in London. It made about two or three miles an hour and was built by James Watt, of steam-engine fame. It was as big as a good-sized room, but nevertheless it was an "automobile." It was totally impractical and nothing came of it until Gottlieb Daimler perfected the gasoline internal-combustion engine. Then, in 1887, his automobile became the first practical self-propelled road vehicle.

We have always been strong in our belief in television, and are certain that it is here to stay. However, it will slowly evolve, as did radio. Nor do we believe that there is a short cut to country-wide, popular television on the horizon.

We wish to emphasise the point that what has been said here pertains only to broadcast television and programmes received in the home. It does not refer to television in the theatre, television in department stores, and television for other commercial purposes, where the high cost of a receiver does not matter. Such specialised receivers are not bought by the millions and therefore are in a class by themselves.

Programme Pointers

MAURICE REEVE Here Deals Further With Transcriptions and Special Arrangements

LAST month I raised the subject of the vice that has permeated our musical programmes, in recent years, of the indiscriminate transcribing of compositions, written for a specific instrument or combination, to other and totally unsuitable media.

The original sin is almost as old as music itself. We find it in early French and Italian music, where church modes and chorales and hymn tunes are used by sixteenth and seventeenth century writers as the themes for sonatas and various chamber music works. Mozart and Gluck were also "guilty," whilst no less a deity than Beethoven himself wrote pieces, chiefly variations, based on other masters' themes and melodies.

But neither discretion in the choice of work or tune marked down for sacrifice, nor the treatment to which the poor victim was to be subjected, was the subject of criticism until the exotic Liszt came on the scene. He was the greatest virtuoso the piano had ever known; consequently, he was the first to embark on the virtuoso concert tour as we know it to-day. Furthermore, he was the contemporary of a whole bevy of other composers, including such masters of melody as Gounod, Verdi, Wagner, and diverse other operatic and song composers. Nor should it be overlooked that he unearthed many of Schubert's most famous works, which he actually "popularised" through his own arrangements of them!

Transcriptions and Paraphrases

Small wonder is it that the programmes of this lion of the concert hall and salon, whose own inventive genius knew no bounds, whose technique only had the sky for its limit, and whose magical playing was listened to by enraptured thousands, studded his programmes with transcriptions, paraphrases and variations of almost everything by everybody. Frequently, an arrangement of the latest operatic success was part and parcel of the concert contract. The example has been followed by almost all the famous concert artists ever since.

In the course of transcribing between three and four hundred works, or parts of works, from the voice and other instruments to the piano, Liszt gave to the literature of his instrument some noble works and a few gems. He also committed some horrible outrages. The Bach organ transcriptions, half a dozen of Schubert's songs, as well as his arrangement as a concerto with orchestra of the "Wanderer Fantasie"—to limit ourselves to but a few—have made beautiful piano works. As have one or two of the operatic fantasias like the "Rigoletto" quartet and the "Valses from Faust." Beautiful pianistic workmanship woven into perfection of form have failed to impair in any way the original spirit of the music. They are master works for the instrument in every way. The "Soirées de Vienne," too, are delightful symposiums of old Vienna: pieces built round three or four of the delectable Landler dances.

Schubert—Good and Bad

But, strange to relate, just as the best of the transcriptions are of Schubert's music, so are the worst. Oh, Franz, what crimes were committed in thy name! If an inquest were to be held on "The Serenade" or "Ave Maria," it would be as hard to identify the body as it would be to identify one of flesh and blood that had been run over six times by a three-ton lorry. No thought could have been paid to the suitability or otherwise of the piano as the medium through which to present these particular examples. Consequently, the tastefulness of the decorative work and the inventiveness displayed in the former in the conversion of the originals to piano technique are completely lacking. The same applies to the arrangements of the "Tannhäuser" Overture, the "Don Giovanni" paraphrase, and many others. They are just vehicles for the most fashionable virtuoso of the day to display his pianistic and improvisatory gifts. We have the same thing to-day.

Strauss

Strange to say, Liszt never handled the immortal Strauss waltzes, the favourite vehicle for the virtuoso pianist from Tausig onwards to 1914, when those sort of things went out of fashion. Most of them were written during the latter half of his life, too, and were contemporary with much that he gave his attentions to. Neither did he court the favours, or perhaps the frowns, of Carmen.

Strauss is peculiarly suitable to transference to other mediums than the small theatre orchestra for which he wrote most of his music. Short of being given the artificial respiration of the accordion or being impaled on that instrument of torture known to some as a cinema organ, and such-like perversions of musical expression (they would destroy equally the souls of Strauss, Schubert or "Let's All Go Down the Strand—Have a Banana)"; they lose very little of their original Viennese charm and infectious gaiety. Neither does Sullivan, Offenbach or Waldteufel. The romance and perfume of a ballroom, and the emotions and humours of Gilbert's characters in the immortal Savoy operas, are easily preserved on many instruments or combinations, though, naturally, the vocal numbers are at their matchless best in their original state. But it is the poetic fancies and the tender passions enshrined, both in the words and the music of the classical "lieder"—as apart from opera comique and like genres, whether classical or not—which suffer so cruelly when roughly taken from their original hothouse environment. Exceptions only prove the rule.

Next month I shall try to conclude this short survey of musical transplanting by discussing what is done with the classical repertory right under our very ears, wherever we go, and all day and every day. When looked at in perspective, the results are staggering. The reader will be able to accompany me, from dawn till nightfall, through a collection of murdered masterpieces of which he is probably unconscious owing to the distraction of his normal everyday life.

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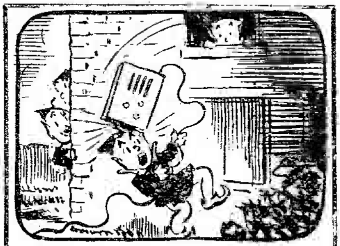

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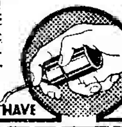

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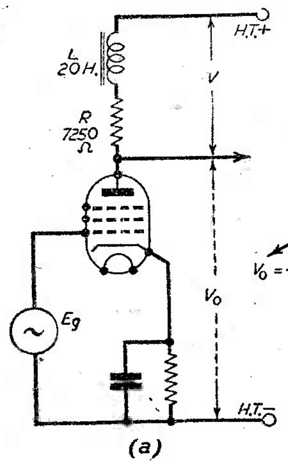
Technical Notes—2

In This Article "DYNATRON" Deals Further With the Subject of Vectorising Valve Circuits

In the first article of this series, basic rules for vectorising were discussed with the fundamental electrical engineering principles from which they were derived.

For the benefit of new readers it will be useful to give a brief summary of these principles. We emphasised, first, that some things are indisputable *facts*, not conventions.

Thus, in any and every A.C. circuit there must be an *applied* (or "supply") voltage; in a pure resistance the current and voltage are in-phase; a *back E.M.F.* is, by definition, opposed to and therefore at 180 deg. to the applied voltage, and a vector diagram must take account of both.



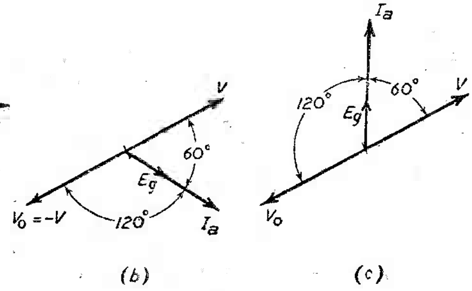


Fig. 1.—Phase-shift (b) in the given circuit at a frequency of 100 cycles per sec. Diagram (c) shows the conditions if the load had capacity reactance.

In a valve circuit having a pure resistance load, and with one end of that resistance tied to the fixed potential of H.T.+, the "sign" of the *output voltage* Vo will be opposite to that of the *supply* voltage component developed across the load.

This last fact may not be so obvious. There are several ways of looking at the matter. A voltage-*rise* across the load resistance is accompanied by a voltage-*fall* across the valve, and Vo is represented by the latter —or Vo is phase-reversed relative to V.

Or: since one end of the resistance is at a constant potential, the sign of the alternating potential variation at the opposite (anode) end will be that of the *load reaction*, or the internal potential-difference opposing the applied E.M.F. Hence, again, Vo must be of opposite phase to V.

If the load resistance were inserted on the *cathode* side, the H.T.— end will be at constant potential, and we get an output voltage Vo of the *same sign* as V—no phase-reversal occurs, since the alternating potential at the cathode has the sign of the *applied* voltage.

With a purely inductive anode load there is a pretty tangible back E.M.F. to consider (the equivalent of the "load reaction" in the resistance case). Evidently, this must be counterbalanced by the component V at 180 deg. to it. But the valve (anode-to-cathode) potential Vo has the sign and phase of the *back E.M.F.* in the load. Both have a negative sign relative to the supply, or applied E.M.F.

If there should be a little difficulty in grasping the idea of "load reaction" in the resistance case, the inductive load makes it abundantly clear that *two* E.M.F.s, mutually at 180 deg., must be considered in drawing a vector diagram. The output voltage (Vo) cannot have the phase of both!

Next, let us formulate our vector rules derived from the above considerations.

Summary of Vector Rules

These are as follows:

First, and in all cases, show Eg and Ia in phase—Eg being the effective input E.M.F. impressed on grid-cathode, and Ia the alternating component of anode current.

If the load is a pure resistance, draw V in phase with Ia and Eg. If a pure inductance, show V *leading* on Ia by 90 deg.—*lagging* 90 deg. if the load were equivalent to a pure capacitance. If there is resistance and reactance, show, instead of 90 deg., an angle ϕ (phi), where, mathematically, *tangent* $\phi = X/R$, i.e., if X and R are the *series* reactance and resistance of the load. The angle ϕ may then be found from Tangent Tables.

The output voltage Vo will always be a vector at 180 deg. to V, as above. The *phase-shift* in an amplifying stage is the angle between Eg and Vo—the angle by which the output and input voltages are phase-displaced. Usually, this is all that is required, but we might go a step further.

In the equivalent generator we have an *internal resistance*, ra, and by Ohm's law there will be a loss of Iara volts in this. The "drop" will be in-phase with the current Ia—whatever the anode load. Then, adding

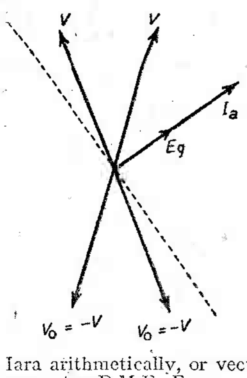


Fig. 2.—The load approaches a pure reactance, 90 degrees phase-shift, as the frequency increases, i.e., reactance becomes large compared with resistance.

Iara arithmetically, or vectorially, to V gives the total generator E.M.F. μEg.

Numerical Illustration

Let us consider the stage shown in Fig. 1 (a), where: L=20H., R=7,250 ohms. What will be the phase-shift between input and output voltages if the E.M.F. applied to the grid is at 100 cycles per sec.?

The inductive reactance at 100 c/s is, $X=2\pi fL=6.28\times100\times20=12,560$ ohms. $R=7,250$ ohms, therefore, *tan* $\phi=X/R=12,560/7,250=1.732$.

Reference to a Tangent Table shows that $\phi=60$ deg. In Fig. 1 (b), we start by showing Eg and Ia in phase —not to any particular scale, unless values are given. Then, show V leading by 60 deg. Draw the output voltage vector Vo at 180 deg. to V (and of the same length as V.)

The phase-shift is obviously (180 deg.—60 deg.)= 120 deg., i.e., Vo is *lagging* 120 deg. on Eg., instead of the usual 180 deg. as for a pure resistance load. Or, what is the same, Eg is *leading* Vo by 120 deg.

If the load had a capacitive reactance of —12,560

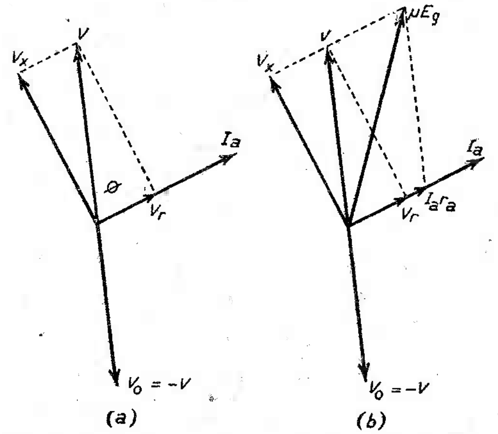


Fig. 3.—(a) The applied voltage V, across the load, is the vector sum of two 90 *degrees components, Vx and Vr. In (b), the internal voltage-drop Iara is again added vectorially to V, giving the total equivalent generator e.m.f.,* μ*Eg.*

ohms, the vector diagram becomes that shown in Fig. 1 (c). The arithmetic is exactly the same as above, but V *lags* 60 deg. on Ia and Eg, and the phase-difference between Eg and Vo is again 120 deg., with Vo leading.

The *power-factor* of the load is *cosine* 60 deg.=0.5, and the true power supplied is, VIa × p.f.=VIa × 0.5.

We need not carry the working of this example further. It shows clearly how to arrive at the phase-shift, remembering, of course, that we took a very low frequency, 100 c/s.

The phase-shift in an amplifying stage embodying reactances is a function of frequency. For example: at 1,000 c/s in the stage just calculated, $X=125,600$ ohms, $R=7,250$ approx., as before. Then, *tan* $\phi=17.32$, when $\phi=86$ deg. 42 min.—not much short of 90 deg. At higher frequencies still, the phase-shift will approach closely to 90 deg., as shown in Fig. 2.

Observe, too, that the phase-angle ϕ (and therefore the phase-shift in a stage) depends only upon the resistance and reactance of the *load*, R and X. It is independent of ra, which determines the phase of μEg in the equivalent generator circuit.

This is because the output voltage Vo is always equal to, and at 180 deg. to V, whilst Eg is in phase with the current Ia. Hence the angle ϕ depends only upon the amount Ia lags or leads upon the *load voltage* V, hence upon the resistance and reactance of the load.

If we let ϕ denote the phase-angle between Ia and the *total* E.M.F., μEg, then, *tan* $\phi=X/(R+ra)$, i.e., it is determined by the total circuit resistance, and will be less than ϕ.

At radio-frequencies, loads are apt to become complex owing to shunting capacitances, etc., both extraneously and inside the valve. Until we come to fairly high radio-frequencies, however, ordinary vector theory will suffice to show the general phase conditions which must be satisfied in oscillator circuits, and so forth.

Note, in Fig. 1, that the voltage V may be resolved into two separate *components*, existing across R and X, respectively. The drop across R will be in phase with Ia, whilst that across X will be leading by exactly 90 deg.— the "wattless," or quadrature component, which contributes nothing to the true power output. The total load voltage V is the *vector sum* of these two components, Vr and Vx, Fig. 3 (a). In 3b the internal drop Iara is shown added vectorially to V to give the E.M.F. μEg.

As always, Vo is the vector V reversed; the voltage across the valve always varies in opposite phase to the *resultant* load voltage V.

Parallel-connected Loads

When dealing with a load consisting of reactance and resistance in parallel, Fig. 4a, the best plan is to start with the *current* components, Ir and Ix in the two branches.

The total current Ia is then found, and it will be lagging or leading on V by an angle ϕ—depending whether X is inductive or capacitive. The resistance branch-current Ir will be in phase with V; the reactive current Ix lagging or leading 90 deg.; in 4b, we have shown a lagging phase.

Completing the parallelogram, as shown, gives Ia, and the phase-angle ϕ may be measured. We keep to the rule that Eg has the same phase as Ia, and Vo will be V reversed.

There are a few interesting facts about the relative shifts caused by series and parallel connected loads, but we will not consider them now. The important point is that we use the same procedure with *currents*, as we did with voltages in Fig. 3, i.e., make use of in-phase and 90 deg. components.

It is also possible to replace a parallel-connected load by an equivalent series one, and proceed as in Fig. 1.

Tuned-anode Load

A *resonant* tuned circuit, Fig. 5a, is fairly easy to vectorise, and is important in the treatment of oscillators.

When tuned exactly to the incoming frequency, the impedance of L and C in parallel will be a pure A.C.

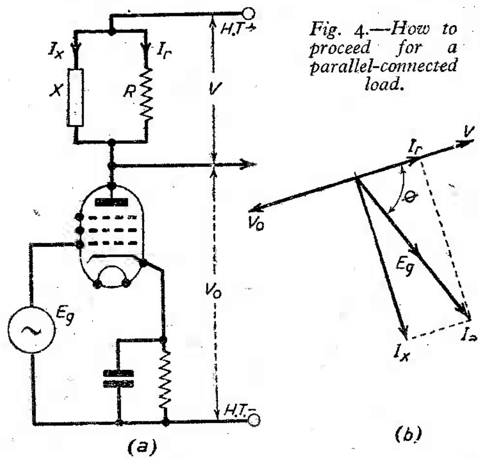


Fig. 4.—How to proceed for a parallel-connected load.

resistance of L/Cr ohms, or, for high-Q circuits, Q^2r ohms —where r is the H.F. resistance of the coil.

Hence the vector diagram takes the straight-line form, 5b, as for a simple resistance. The D.C. resistance, of course, will generally be negligible. Vectors Eg, Ia, and V are all in phase, whilst the output voltage Vo (if tapped directly off the anode, as shown) will be V, phase-reversed, giving a phase-shift of 180 deg. exactly as if the load were an ordinary resistance.

Conditions off-resonance are a little more complicated. At frequencies *below* that to which LC is tuned, the net parallel reactance will be *inductive*, e.g., the circuit may be replaced by a resistance and inductive reactance, and solved by the previous methods.

At frequencies *higher* than the resonant one, the reactance changes sign, becoming capacitive. It is hardly worth discussing these cases in detail, since it is resonance that is mainly of interest in connection with tuned circuits. The nature of the anode load impedance is, however, of importance in H.F. amplifiers

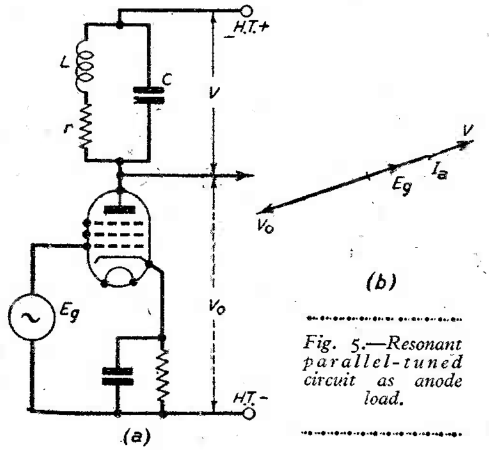


Fig. 5.—Resonant parallel-tuned circuit as anode load.

from the point of view of stability or freedom from self-oscillation.

Certain types of oscillator depend upon the "sign" of reactances in the anode and grid circuits—whether these are such as to give the necessary phase-shifts in the feedback from anode to grid to sustain an oscillation.

Thus, some of these will oscillate when the anode circuit (or grid circuit) is detuned on one side of the resonant point, but not on the opposite side. A full vector analysis of the conditions is beyond the scope of the present article.

We will examine with the aid of vectors the phasing of simple types of oscillator in the concluding article of this series. In this instalment, we will go on to consider applications of our rules to one or two more amplifying circuits.

Transformer Coupling

The important thing to remember about transformers or magnetically-coupled circuits is that the phase of the E.M.F. impressed on grid-cathode of the next valve depends how we make the secondary connections.

As already explained, 180 deg. reversal of the output E.M.F. may be got simply by changing-over the two leads to the secondary terminals. The fact accounts for a good many things. For example; if an amplifier shows signs of instability (to generate a whistle, or a howl), a complete remedy sometimes results by reversing the terminal connections to a transformer, as described.

This writer recalls in the early days quite a startling improvement in quality in some amplifiers by this trick. No actual oscillation was apparent with normal connections, but, though at somewhat reduced volume, quality was vastly improved by reversing a transformer.

The explanation was probably negative feedback. With normal connections, the amplifier gave a certain amount of positive feedback—not enough to cause an audible oscillation, but nevertheless giving appreciable distortion. Reversing a transformer changed this to negative feedback.

The best illustration of the phase-reversal is a simple magnetically-coupled oscillator. The grid is energised from a secondary coil, coupled to the anode or grid tuned circuit, and an oscillation will build-up only if the reaction coil is connected the right way round.

But remember once more that this ambiguity of ± 180 deg. about the terminal voltage of a transformer makes no difference whatever to the phase of the *induced E.M.F.* in the secondary—that is always at 180 deg. to the primary supply voltage.

Vectorising a Typical Amplifier

Leaving you to do the diagrams yourself, let us consider next the overall phase-shift in a two-valve amplifier, constructed as follows:

The first valve has simple resistance-capacity coupling to the grid of the next, and we will suppose the frequency is sufficiently high to neglect any phase-shift due to the coupling condenser.

The second valve has the primary of an L.F. transformer series-connected between the anode and H.T.+. At the frequency assumed, the inductive reactance of the primary is extremely large compared with the resistance of the winding.

First, what will be the total phase-shift from the grid of the first valve to the anode of the second valve?

The first valve is very easy. It has a pure resistance load, and therefore, a phase-shift of 180 deg. Start with a vector for Eg, and draw the output voltage Vo at 180 deg. to it.

Vo is the "Eg" applied to grid-cathode of valve 2. The load in the anode circuit is to be considered purely inductive (resistance neglected), hence Vo will be shifted another 90 deg. Clockwise or anti-clockwise?

Well, remember what we have stressed all the time—the 180 deg. difference between V and Vo. The current Ia will be in phase with the grid-cathode potential, and V will be 90 deg. *leading*. But if we took an output voltage off the anode of valve 2, this itself is at 180 deg. to the applied volts across the transformer primary.

Hence the shift up to the *anode* of valve 2 is 90 deg. lagging, i.e., the output voltage of valve 1 will be shifted backwards (clockwise) 90 deg. Therefore, the overall phase-shift up to this point will also be 90-180 deg. in valve 1, and 90 deg. in valve 2.

Show these facts step-by-step, using vectors and sine curves.

But, next, we come to the *secondary* of the transformer. The induced E.M.F. will be at 180 deg. to the primary applied volts, or in phase with the output voltage we have just considered as taken off the anode.

It means that if the winding directions and internal terminal connections are the same, a given terminal of the primary and secondary will have the same phase as the voltage at the *anode*—if we connect the opposite terminal to cathode.

However, we can reverse the secondary phase by changing-over the two terminal connections. A little consideration will show the overall phase-shift still ± 90 deg., depending how we make the secondary connections.

Negative Feedback

Could we obtain any negative feedback by taking a connection from one side of the secondary in the above amplifier, back to the grid of valve 1?

Not unless further phase-shifting reactances were introduced. As seen, the output voltage of this amplifier is at 90 deg. to the signal applied to the first valve, whether a connection is taken off the anode (through a blocking condenser, of course) or off the secondary.

Negative feedback means a voltage at 180 deg (opposing) the Eg of valve 1. But we must be careful about this statement. What we should have said is, a "voltage *component*" at 180 deg. to Eg.

As long as the overall phase-shift is ± 90 deg., as supposed, there is no possibility of getting such a component in the circuit as it stands. But, if the overall angle were less than 90 deg.—say 60 deg.—it would be possible to find a component antiphased to Eg, i.e., by adopting suitable connections from the anode or the secondary.

Remember, however, what was shown in our numerical example: that, where reactances are concerned, phase-shift is a function of the frequency of the signal being amplified. What is negative feedback at low (or high) frequencies may become positive at the other end of the scale.

This accounts for the fact that feedback is not always so easy to apply as is suggested by a circuit drawn on paper. It is possible to insert phase-correcting reactances in the feedback circuit having a phase characteristic the inverse of that of the amplifier, but these call for comprehensive measurements and design data.

Introduction to Oscillator Diagrams

The vector relations for basic oscillators will be dealt with in my next article in this series—omitting the more complicated types.

But we may conclude the present article by considering a few principles.

Suppose we take the H.F. amplifying stage illustrated in Fig. 5. Would this "oscillate" if we fed-back voltage from anode to grid circuits via a small capacity condenser?

There is such a condenser in any *triode* valve, whether wanted or not—the anode-to-grid internal capacity, of the order of 5 $\mu\mu$F. In Fig. 5 we have represented an H.F. pentode having adequate internal screening, which brings the interelectrode capacitance down to a minute fraction of its value in a triode.

If, however, we deliberately joined such a condenser—say a piece of twisted flex—between anode and grid, we would be re-introducing feedback externally. If you remember this, you will better appreciate the importance of adequately separating and screening anode and grid leads, and how easy it is to develop "instability" in an H.F. stage if precautions are not taken.

However, to answer our question: we know from experience that, with tuned circuits on the anode and grid sides, self-oscillation *will* result from capacitive feedback. The feedback will be *positive*, or will have a voltage component in phase with the signal E.M.F. Eg.

But, if pure resistances were substituted, the voltage at the anode would be at 180 deg. exactly to Eg, which means we could only get *negative* feedback by coupling anode and grid through a condenser. The internal anode-grid capacitance could not cause any instability, though the gain would be diminished.

Now, theoretically, the two tuned circuits we are discussing (anode and grid) will *look like* pure resistances when tuned exactly to resonance. Theoretically, therefore, there should be no oscillation by coupling anode and grid through a condenser—or the internal Cag capacitance!

Unfortunately, a Tuned Anode-Tuned Grid stage is an amazingly complicated device when we start trying to do a detailed vector analysis. Matters are further complicated by *magnetic* as well as capacitive coupling, and what is true of one type is not necessarily true of the other.

Otherwise, there is one principle which decides whether oscillation will take place in any amplifying stage: the E.M.F. feedback from the anode must *fall into phase with Eg* (or a component thereof), and the feedback network must contain reactances of such magnitudes and "signs" as to bring about the necessary phase-shifts from anode back to grid.

We shall enlarge upon these ideas with the aid of vectors in our next article on the subject.

News from the Clubs

OSWESTRY AND DISTRICT RADIO SOCIETY

Hon. Sec.: Mr. A. D. Narraway, "Lamorna," Pant, Oswestry, Salop.

MOST encouraging support was given to the first meeting of the Oswestry and District Radio Society.

Since the purpose of the meeting was the formation of the society, the evening was confined to business but an active programme is being prepared for the future.

Membership is in two classes: Full Members and Junior Members (under 18 years). Visitors to the district will be cordially welcomed at any of the meetings.

THE RADIO SOCIETY OF NORTHERN IRELAND

Hon. Sec.: A. J. Kennedy, 49, Kansas Avenue, Belfast.

ATTENDANCE for some time past has not been very satisfactory.

As the annual meeting will be held soon, defaulting members should take this opportunity to redeem themselves.

BRIGHTON AND DISTRICT SHORT-WAVE CLUB

REGULAR meetings of this club are being held at 63, London Road, Brighton, and full details may be obtained from the Acting Secretary, Mr. G. E. Robson. The present headquarters are temporary, until more suitable premises are found. Meetings are being held every fortnight.

STOKE-ON-TRENT AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: D. Poole, 13, Oldfield Avenue, Norton-Le-Moors, Stoke-on-Trent, Staffs.

MEETINGS are held every Thursday evening at the Tabernacle Church, High Street, Hanley, S.O.T., at 7.0 p.m., all are welcomed.

Morse classes have commenced and technical classes will soon be starting, the latter will be in the form of lectures with a practical lesson at the end.

G3UD (Mr. V. Bloor) has recently succeeded to the chairmanship, vice Mr. T. Rudge.

Membership is now 40 and more arriving at each meeting; we hope to have at least a 100 and each one a "G." We have 12 BRS and 7 "Gs," they are: G3UD, 2CHI, 3AJQ, 2CHG, 2FFQ, 8IX and 5VA: 3AJQ and 8IX have just come through. Another member is expecting his "G" any day now.

At a recent meeting, with 25 members present, 3UD brought along a Tx and Rx for a demonstration on operation and procedure. Contacts were made with G3TO and GM3WO.

The former was contacted by Mr. Roberts, second operator to 3UD, by W/T—R.S.T.589. GM3WO came through on phone, but QRM spoilt the contact. G2FX and G2CHI were heard and called but no contact made.

At our next meeting 2FFQ is to give a talk on his equipment, followed by morse practice.

BRADFORD SHORT-WAVE CLUB

Hon. Sec.: V. W. Sowen (G2BYC), 6, West View, Eldwick, Bingley, Yorks.

THE Bradford Short-wave Club expects to be on the air within the next two or three weeks. The transmitting room has been completely redecorated and the gear is now being installed. Our aerial experts are busy planning the aerial system and we are looking forward to having QSO's with clubs and amateurs.

The membership now stands at 52 and the morse class is still going strong.

Visitors and members always welcome!

RADIO CLUB VISITS MULLARD MITCHAM FACTORY

ON October 8th, 50 members of the Surrey Radio Contact Club visited the Mullard Radio Valve works at Mitcham, in Surrey.

The object of the visit was to show club members the present range of Mullard Radio Valves, both transmitting and receiving, available to the amateur, and various technical processes employed in their manufacture.

The Surrey Radio Contact Club were the guests, for the evening, of Mr. E. C. Greaves, Quality Manager and Head of Technical Department, who is of the opinion that, now that restrictions have to a large extent been removed, the amateur transmitter should be given an opportunity to see the effect of the intense research of the war years on valve manufacturing technique.

From 7.30 p.m. to 8.30 p.m. the club members were taken on a conducted tour of the valve departments. They visited the first floor of the factory to see receiving valves in the making and then went to the fourth floor to see transmitting valves, both silica and glass types, being made. The production of cathode-ray tubes was inspected.

Later they inspected an exhibition of valve types staged for their benefit in the main conference room at the works.

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RELAYS. G.P.O. 1,000 ohms 2-S.P.C.O., **5/-** ; 500-1,000 ohms, 2-make, **5/-** ; 30 ohms 2-make 2-break, **5/-.** Telephone type 2-coil polarised S.P.C.O. 325 ohms, **5/-.** Siemens high speed keying relays two 500 ohm coils, **7/6** ea. Siemens slugged 200 ohms 1-break S.P.C.O., **5/-.** We have a large stock of Relays for immediate delivery ; send us your enquiries.

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VIBRATORS and Transformer. Mallory 12 volt 60 ma. New, in metal can, **15/-.** Special transformer, **37/6. Transformers** for small welding jobs or soil heating, 230 volts 50 cy. to 12 volts 250/300 watts, totally enclosed, **37/6.** Transformers double wound for Model work, 230/12 v. 3 amps., **32/6** ; 20 volts 2 amps., **30/-.**

AUTO-TRANSFORMERS. New. 230/110 v. 85 watts, **25/-** ; 150 watts, **35/-** ; 300 watts, **60/-** ; 1 kw., **£7/10/0** ; 3 kw. (second hand), **£9/10/0.**

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EX.-G.P.O. MAGNETO GENERATORS, hand-driven approx. output 75 volts 20 m/amps. A.C., useful to the experimenter, small pattern, **7/6** each.

ROTARY CONVERTERS, condition as new. 24 volts D.C. input at 2½ amps 75 volts A.C. 1 phase output, **35/-** each, post 2/6.

USEFUL PANELS made by Standard Telephone for the R.A.F., size approx. 19in. x 8in. x 5in., consisting of condensers calibrated to decibels, chokes, mod. xformers, resistances and many other useful components, condition new, **12/6** each, post 2/6.

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EX.-R.A.F. 10-VALVE CHASSIS (sold for components only). Consisting of : 2, 150 ohm Mult. Contact Relays, 9 British type Octal Base Valve Holders, 30 Tubular Condensers, ranging from 10 P.F. to 1 M.F. 25/30 Resistances ¼, ½, 1 and 2 watts all mounted on chassis, size 12in. x 8in. x 2in. Components all in good condition. " A real bargain " at **12/6** each, postage 1/6.

EX.GOVT. ROTARY CONVERTERS, input 12 to 18 volts D.C. at 3½ amps. output 450 volts 60 m/amps. fitted with automatic switching and smoothing, **32/6** each. 2/6 carriage.

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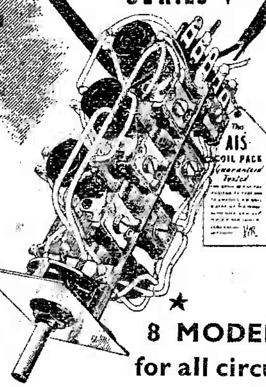

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Impressions on the Wax

Review of the Latest Gramophone Records

RACHMANINOV was himself a pianist of exceptional virtuosity and taste, and in his series of preludes for solo piano he exploits the potentialities of the instrument to the full. They are not written to preconceived programmes, despite the fanciful tales that have woven themselves round the one in C sharp minor. This month Cyril Smith has given us the dramatic G minor prelude and its companion in the major of the same key. Both these pieces receive a brilliant performance on *Columbia DX*1279.

If Eric Coates had written nothing but the marches which bear his name he would still rank as one of the most successful composers of light music to-day. This success is founded upon fastidious craftsmanship in orchestration and a sure instinct for the kind of melody enjoyed by a wide public. On *Columbia DB*2233 we have the composer himself conducting the London Symphony Orchestra in two of his newest pieces, the "Television March," prophetic of the new world in which television will become an everyday service, and another descriptive piece, "London Calling March."

"The Magic Bow"

THE new film which has recently been released includes sound tracks of Menuhin playing several pieces by Paganini and the "Minuet in D" by Mozart. The story of the film is that of Paganini's early life and struggles to become famous, and the part is taken by Stewart Granger. Two of the great violinist's love affairs are also included: the aristocratic Jeanne de Vermond and the humbler Italian girl Bianchi both strive for his affection. One of the highlights of the production is, of course, Menuhin's masterly performances of the various works featured in the film. This month he has recorded two of them, "Romance" (based on a theme by Paganini) and "Minuet in D" (Mozart), on *H.M.V. DA*1861.

Moritz Moszkowski, whose Spanish dances are his best-remembered pieces to-day, was celebrated in his time for his popular music for the piano. This included concert studies, miscellaneous pieces and waltzes, all frankly designed to attract by their melodiousness. This month Rawicz and Landauer have chosen the waltz Op. 34, No. 1, and their scintillating version of it on *Columbia DB*2262 is a triumph of careful timing and perfect rapport between the two artists. The coupling is Chopin's "Polonaise in A Flat, Op. 53."

Haydn's "Symphony No. 104 in D ('London')" is really no more a "London" symphony than any of the others commissioned by the impresario Salomon during Haydn's two English tours. Nevertheless the name has stuck, and this masterly work continues its immortal life of a hundred and fifty odd years under the name of our capital. The Philharmonia Orchestra under Issay Dobrowen gives a beautiful performance of this last and crowning glory of Haydn's symphonic output on three 12in. records—*H.M.V. C*3515–17.

Walton's Viola Concerto

IT is generally agreed that the Viola Concerto is one of the most characteristic works of William Walton. It was composed during 1928-9, receiving its first performance at a Promenade Concert in October, 1929, with the composer conducting and Paul Hindemith playing the solo part. A new recording of the Viola Concerto has been made this month on *H.M.V. DB*6309–11. It is not only one of the finest concertos in modern British music, but, in the opinion of many, one of the finest for any instrument. William Primrose plays the solo part and reveals a masterly technique and insight into the composer's intentions truly remarkable. The Philharmonia Orchestra is conducted by Walton himself, and the interpretation is absolutely authoritative.

Two French Songs

ONE of the outstanding French song writers of the later 19th century was Henri Duparc. The "Elegie," a translation of a poem from our own Thomas Moore, and "L'Invitation au Voyage" are two of Duparc's most attractive pieces. Pierre Bernac (baritone) and pianist-composer Francis Poulec continue their superb recitals of French songs with this fascinating new issue on *H.M.V. DB*6312.

Composers of purely English race have from time to time felt drawn to Welsh folk-music, and among them Edward German stands high with the brilliant "Welsh Rhapsody" recorded this month on *Columbia DX*1274–5. Based on traditional Welsh themes, the Rhapsody unfolds in a truly inspiring poem, and is as brilliant a tribute in music to its subject as could be found. Under the able baton of George Weldon, the City of Birmingham Orchestra give a very polished performance.

Wagner's "Die Walkure"

OF outstanding interest this month is a recording of Wagner's "Die Walkure" on eight 12in. records—*Columbia LX*955–62. This impressive production of Wagner's great opera includes a superb cast. The part of Brunnhilde is taken by Helen Traubel, one of the finest Wagner singers of the Metropolitan Opera of New York. Herbert Janssen, a remarkable baritone of great power, sings Wotan. The protagonists are supported by the vocal ensemble of the Metropolitan and the Philharmonic Symphony Orchestra of New York under Artur Rodzinski. Wagner at all times makes great demands on his principal actors, and there are many passages in "The Valkyrie," notably the gathering of the warrior-maidens on their rock, where the orchestral volume is considerable. Both Helen Traubel and Herbert Janssen rise magnificently to the occasion in this notable recording.

Variety

ONE of the outstanding films of the moment is the Irving Berlin film "Blue Skies," which introduces many of Berlin's earlier songs that help to make him famous. The only new song is "You Keep Coming Back Like a Song," and Leslie A. Hutchinson ("Hutch") has made a recording of this on *H.M.V. DB*1143. It is sung in his own inimitable style and he couples it with "You Always Hurt the One You Love."

There are also new records from Frank Sinatra singing "I Fall in Love with You Every Day" and "Paradise" on *Columbia DB*2238, Dinah Shore singing "Laughing on the Outside" and "Shoo-fly Pie and Apple Pan Dowdy" on *Columbia DB*2228, Tessie O'Shea singing "The 'Ampstead Way" and "Let it be Soon" on *Columbia DB*2232 and Turner Layton, who has recorded "Down in the Valley" and "Surrender" on *Columbia FB*3245.

For dance fans there is a big selection of up-to-the-minute tunes played by popular dance bands.

Times Have Changed

NAT. D. AYER, the Well-known Composer, Here Looks Back on the Music He Wrote 35 Years Ago

DURING the years 1910-11, sophisticated songs, as we now call them, were not approved of, and not tolerated even in the United States. That is, tolerated in public. I do remember adding quite a lot to my private collection at that time, however. Whatever so-called "sophisticated songs" were in evidence were parodies on the popular songs of the day. The manager seemed to allow these all right, but a song "on its own" wasn't permitted.

Although times have changed since then, still the fact remains that one can still hear a certain kind of a song in a night club that wouldn't be permitted on the stage. That is all right, I suppose, as not everyone can afford to go to night clubs. The more money one has, the more "sophistication" one can acquire. How many times have I been to parties where someone has said, "But, Nat, won't you sing us one of those songs you don't sing on the stage?" There are parties and parties and songs and songs, but I have written extremely few that I haven't sung on the stage some time in my life. Still, I have my own "sophisticated" catalogue.

One night, it was during the autumn of 1911, I was at a gathering and overheard the conversation on the very enlightening subject about talking in one's sleep. I had been talking to a very attractive young thing and she bantered me with, "Now, Nat, surely you wouldn't mind if I talked in *my* sleep, would you?" Well, I ask you—answer that one? I knew she was married—I suppose she was happy—but she did give one ideas in her conversation, so I plucked enough courage to reply, "Well, do you—er—sleep alone?" "Silly," she answered, "Certainly not! I sleep with my husband." "Well, what does he say?" I asked. "Why, he doesn't say anything; he probably sleeps too soundly," she laughingly replied. "Oh, yeah?" I said. "Well, darling, if you *do* talk in *your* sleep never mention *my* name!"

Birth of a Song

Although I hardly realised what I had said, there was a sudden outburst of laughter all around, and "was my face red"? My partner, A. Seymour Brown, who did my lyrics, was with me and on the way home we discussed the evening, etc. Brown said, "What an idea for a song? That wise-crack of yours was great!" Instead of retiring, we sat down in my apartment, poured ourselves out a couple of "stiff ones" and wrote the song then and there. I rushed down to my publishers the next morning and got the orchestration immediately in hand. Brown and I were playing at the Colonial Theatre on Broadway, and I sang the song the next night. It went over with a bang, and is what is usually called a "natural." It was a sure-fire success—all I had to do was to sing it—pay particular attention to my diction so that the audience caught all the words. I had a rather good tune to it and it certainly "caught on." The song was another big seller and reached nearly a million copies in sales.

I sang this song for a year in America and it was a sort of trade mark to our act. To-day, the word "trade mark" is used as a signature tune. I had a little difficulty with the managers about it, but they agreed to let me continue singing it until complaints came in. None came. I let another artist, Clarice Vance, sing it and it went just as well for her as it did for me. In spite of the puritan wave through which America was passing at that time, we were the only two artists who were allowed to sing it in public.

After three months, this song was put on the gramophone records and so, naturally, as records were allowed in "homes" it was obvious that the song was allowed on the stage. I remember that even the publication was withheld for a time. What the objection was, I never could find out. Did "public" mean on the stage, or in the home, or what? Better leave that to the hypocritical censors and ask them. Finally, it was sung everywhere and paved the way for those so-called "naughty but nice" songs that came into vogue about that time.

A Comparison

It might be interesting to note how "awful" the song was and then compare it to some of the songs one hears to-day. Here is the chorus:

I can see that you are married,
Well, you know I'm married too;
And nobody knows that you know me—
And nobody knows that I know you.
So if you care to, we'll have luncheon,
Ev'ry day here just the same;
But; sweetheart—if you talk in your sleep—
Don't mention my name.

Isn't it terrible to think that a song like this can corrupt one's morals? Evidently the moralistic people in the States disapproved of it thoroughly as, I repeat, it only sold nearly a million copies.

I became known in America, through the medium of this song, as a singer of sophisticated numbers. When the time came for me to replace "If you talk in your sleep" in my repertoire, I wrote another song; this was titled "You were all right in your younger days, but you're all in now." This was a story of the proverbial old man marrying a young girl—'nuff said! I introduced this song in Brooklyn at the Orpheum Theatre at the Monday matinee. The Orpheum Theatre had a marvellous reputation for its matinees, as the audience consisted of practically all the debutantes, etc., from Brooklyn, New York and its environs. Needless to say, this song "clicked." There is such a thing as a song going too well. The laughter that followed it was exactly the kind of laughter that one hears at a masonic smoker.

The manager of the theatre was waiting in the wings when our act finished. He beckoned me to one side, didn't even wait until I was in the privacy of my dressing-room, but jumped all over me with "That's all right, Nat. You might sing that song in the dumps and get away with it, but you can't do it here at the Orpheum. Haven't you got another number that you can substitute for to-night's performance?"

I told him I had and sent for the conductor of the orchestra to come to my dressing-room directly he was free. The conductor arrived; I handed him an orchestration of the song I was to sing that evening. The title of this one was "You were all right when I met you first, but you ought to see the one I've got now." I duly sang the song that evening, and, if anything, it went better than the other song did in the afternoon. After our act was finished, and I came off the stage, the manager was waiting in the wings again to see me. But his attitude was not as antagonistic as in the afternoon. This time he came to my dressing-room with me. Once inside, he turned to me and smiled. It so happened that Brown and I were topping the bill—of course this made a difference in his managerial attitude towards us. He had evidently been in communication with the head office in New York and they probably told him to go easy with us because we were a decided draw. He said: "That song you sang to-night was pretty hot. Now I'm not going to ask you if you have another. So to-morrow, at the matinee, would you kindly put back the song which you sang this afternoon?" He couldn't say much more and gracefully retired. Brown and I looked at each other and Brown remarked: "Well, Nat, you're one up."

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

Indian Census

SIR,—I take much pleasure in informing your Indian readers through the courtesy of your columns that the working committee of The Electrical Association has decided to publish a census of wireless and electrical amateurs in India, towards the end of the year.

Will amateur readers please send their addresses and details of experiments being conducted, to reach The Public Relations Member, The Electrical Association, Visram Bhavan, Rajahmundry, S. India, as soon as possible. Copies of the census will be sent direct to them on publication.—PUBLIC RELATIONS MEMBER (Electrical Association, S. India).

Two-valve Portable

SIR,—I have recently constructed the two-valve portable from the October issue and have got very successful results. I have slightly altered the tuning circuit so that the set can work on either an open aerial or the frame aerial. On an open aerial reception improved up to loud-speaker strength. The battery consumption of the set is so very low, which makes it, I think, one of the best possible two-valve receivers.

PRACTICAL WIRELESS still continues to be the most instructive and up-to-date wireless magazine on the market.—J. A. H. MCDOUGLE (Morpeth).

A.C. versus A.C.-D.C. Receivers

SIR,—Further to my letter which appeared in the September issue, may I reply to Mr. Copley-May on the subject of A.C. versus A.C.-D.C. receivers?

If the gentleman re-reads my statements he will find I said: "No doubt Mr. Harrison and myself would welcome details of a voltage doubler circuit to work on D.C."

This is where he appears to have fallen into the trap, for he states himself that: "In order to accomplish voltage doubling with a D.C. supply, presumably it is necessary first to convert the D.C. into A.C." Therefore, I maintain that the voltage-doubler circuit proper is essentially one for A.C. input. Also, I would point out that I certainly did not mention the word "impossible."

Regarding his recommendation that I should apply myself to a standard work on radio, I would refer him to *Radio Engineering*, by F. Emmons Terman, published by McGraw-Hill, page 401, and figure 211d, and also to *The Wireless and Electrical Trader*, issue of December 18th, 1943, on "Voltage-doubler H.T. Rectifiers," with circuits, all of which are for A.C. input, and any apparatus to provide this from D.C. is subsidiary to the voltage-doubling portion of the circuit. I would also mention that a "D.C. transformer" does not, as Mr. Copley-May states, convert D.C. into A.C.

Commercially, a "D.C. transformer" is a rotary apparatus, comprising two separate fields, armatures and commutators, providing a D.C. output for D.C. input. A similar apparatus for providing an A.C. output from D.C. input (or vice-versa) is termed a rotary converter.—"EXPERIMENTER" (Chailey)

SIR,—I feel I must write once again on the vexed question of A.C. v. A.C.-D.C.

In the September issue of this journal, Mr. R. G. Harrison, of Newcastle, replied to my earlier letter in the July issue. In this reply I notice that he is not quite so sure of himself as he was in his previous letter in the May issue. There he implied that *all* A.C.-D.C. sets were inferior as he only meant *commercial* sets. Why, then, all this previous waste of space if he now admits that, given suitable design, A.C.-D.C. sets can be made as good as A.C. ones?

And now to deal with the October letter from Mr. F. C. Palmer, of Truro. In this he states that A.C. sets can be made to operate on 250 v. A.C., and, by means of a tapping on the mains transformer, on 175 v. A.C. or similar voltages, but on the Universal sets "this simple remedy does not exist." I will correct this. My A.C.-D.C. amplifier, which I have previously mentioned, will operate on any voltage, A.C. *or* D.C., between about 180 v. and 250 v. without *any* tappings whatever, simply by using a self-regulating Phillips Barretter to keep the heater current constant. The valves' anodes work satisfactorily on any H.T. voltage between 150 v. and 250 v., so it is obvious that all that is necessary is to plug in with no worrying about tappings and measuring mains voltages. This can apply to any Universal set.

With regard to the letter by "Experimenter," of Chailey, also in the September issue, re voltage doublers, this point has already been dealt with by Mr. J. Copley-May, of Richmond (October). However, voltage doublers should not be necessary in commercial receivers designed for home use, as A.C.-D.C. pentodes, for instance, have been designed with as much power output and comparable distortion as similar A.C. pentodes *and actually working on less anode and screen voltages*, e.g., Mullard PenA4 (A.C.) and Mullard CL33 (A.C.-D.C.). Incidentally, the CL33 has a lower impedance than the PenA4, thus it will damp the response curve of any given speaker more, therefore giving a more level frequency response.

I look forward to an even greater storm of protest against these remarks than was produced by my last letter.—GEOFFREY W. HOUSE (Bradford).

D.X. Listening

SIR,—Since writing under "D.X. Listening," in the July issue, I have acquired a fuller and more varied log on 14.mc/s, which I hope will be of real interest to the growing number of short-wave enthusiasts. Listening has only been done sparodically since June, but I have managed to land a few "hot" items.

The Rx is 1-v-2 battery, home constructed.

14 mc/s 'phone/c.w. :—

CE1AA, AO, 3FG, CN8MA, MZ, S, CO2LY, CX1CX, 3CN, CO, EA1D, EL5B, EP1C, FA8J, HK3CX, K6PLZ, KH6CT, KP4JA, LU1CA, 6AJ, DG, KE, 7CD, 8F, LZ1XX, OE5PG, RG, OA4M, OQ5BR, JF, LL, OX1AD, MJ, PY1AEB, FG, GJ, UJ, 2AC, AY, 4BU, IE, IK, IO, 6AG, 7AG, 9AC, ST2OK, SU1CX, KE, 3RC, SVIEC, GY, TI2OA, 4AC, VE1EK, HI, KE, LZ, PQ, 2QS, 3KE, 7VO. VK2AM, PX, RA, TGV, TW, VK2ZS, 3JE, WL, 4EL, JU, KS, 5BC, VP6YB, 9F. W's (dozens of 1's, 2's, 3's, 8's), 5FNA, HCH, 6FYE, LHN, LXA, TSW, ERL, 8VRD/KP. 1DEB/CT2, 9CAC, GVK, JPF, W/NVF/KG6 (Guam I.), YR(6), YV5AB, ABY, AE, AN, ZB2B, ZC1AR, ZL2CO, 4GM, ZP1L, ZS6GW.

I have had QSL's from LU6AJ, OQ5BR, PY2AY, VE1PQ, and OQ5BR has mentioned that he would appreciate more reports from us.

New enthusiasts are puzzled, why they are unable to receive the more uncommon calls, even though possessing a very good receiver. Time of the day is the possible reason; in the present season the following times are more or less reliable: Asia, India, Pacific, S. Africa, 7 p.m. to 9 p.m.; Australia, Hawaii, New Zealand, 7 a.m. to 9 a.m.; W5, 6, 7, KL7 (Alaska), 5 a.m. to 7.30 a.m.; South and North America, Cuba and W. Indies, 9 p.m. to 1 a.m.; Br. Columbia (VE7) and Yukon (VE8), 5 a.m. to 7 a.m.

Hoping all this will be of use, I wish you all the best for the continued success of your excellent journal.—MR. R. W. FINCH (Ilford).

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