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Mysterious Interference

—and the Luxembourg Effect

PARTICULAR interest attaches to an article published elsewhere in this issue, describing the nature of yet another of the many kinds of interference to which broadcast reception is subject. Although this effect, to which the name of "external cross-modulation" has been given, has been investigated for some time in America, it is believed that the case in North London which we describe is the first of its kind to be dealt with by the Post Office anti-interference specialists, at any rate so far as broadcasting is concerned.

Cross-modulation interference is happily a rare phenomenon as compared with other sources of interruption with broadcast reception, and there is no reason to believe that its effects will ever be widespread or serious. We suggest, however, that many cases of interference that have hitherto been ascribed to poor selectivity in the receiver may ultimately be traced to the "new" effect, now that its nature is properly understood.

It would be in the interests of the cause of broadcasting if everyone who encounters what appears to be external cross-modulation would report the matter to the Post Office engineers, using the official questionnaire form obtainable from the local Post Office. But before assuming too hastily that the trouble is due to causes outside the receiver it would be well to make sure that the cross-modulation is not due to incorrect operating conditions or a defective valve in an early stage of the receiver.

Fortunately, re-radiation of spurious frequencies from metal structures or networks which happen to include a fortuitous partial rectifier appears to be restricted to a very short distance, and, where it is inconvenient or impossible to prevent rectification, the alternative of moving the aerial to an interference-free position will often be a practicable one. If external cross-modulation is proved to be more common than is anticipated, we foresee an extension of the use of screened aerial systems; these are obviously better adapted to use in such cases than those of the normal type, as it is likely to be the downlead that is mainly affected.

In Mr. Foster's article in the American *R.C.A. Review*, to which we have referred elsewhere, it is stated: "It is entirely possible that the [Luxembourg] effect was due to some non-linear element in the neighbourhood of the receiving location and was therefore what we have called external cross-modulation, especially since the Luxembourg effect is the first phenomenon which would indicate the possibility of a non-linear medium of propagation. Examples have been found in this country of external cross-modulation at distances from the interfering station of over 100 miles, which are similar to the observations of Luxembourg effect. In general, when the interfering station is at such a distance, it has been found that the interfering station has high power and that there are high-tension lines extending in the direction where the interference was found, so that field intensity of the interfering signal was high at those points."

We can hardly think that scientific observers who have investigated the Luxembourg Effect in Europe have overlooked the possibility of local cross-modulation, but henceforth those who encounter what appears to be the famous Effect would be well advised to make sure that it is not in fact a case of the simpler phenomenon.

The Paris Shows

"Salon de la TSF" and the "Foire de Paris"

By E. AISBERG

Editor of "Toute la Radio"

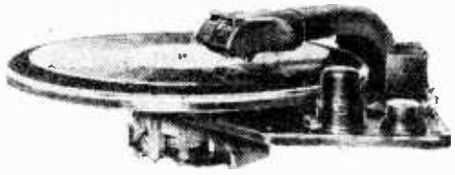
LAST year Paris had two Radio exhibitions, one in the spring and the other in the autumn; both bore the name of "XIIIth Salon of Radio." This paradoxical situation arose from the dissensions existing among radio manufacturers, who are grouped in two associations, the "Chambre Syndicale des Industries Radioélectrique" and the "Syndicat Professionnel des Industries Radioélectriques." The first of these associations includes only some fifteen firms, but these are, however, the most important as regards the number of receivers which they turn out. The "Syndicat Professionnel" includes several hundred firms of small or medium importance. The rivalry between the two associations led last year to the organisation of the two exhibitions.

This year only one exhibition carries the title of "XIVth Salon": this is the one conducted by the S.P.I.R. in a large hall in the Montparnasse quarter from May 14th to June 3rd. But, almost simultaneously, from May 22nd to June 7th, the rival association, the "Chambre Syndicale," has organised at the Paris Fair an imposing display which includes not only all the member firms of the association but also a number of their agents and retailers. The share of radio at the Fair is represented by about 250 stands, whereas the XIVth Salon includes only about 150 exhibitors.

It may be mentioned that it will be impossible to hold the usual Salon in September, because the Grande Palais, which housed it in previous years, forms part of the buildings of the 1937 Exhibition.

The Fair attracts numbers of the general public as well as the business men for whom it is primarily planned; the Salon of Radio has, on the contrary, a character which is technical and almost professional. It certainly has not drawn great crowds, possibly owing to its unfortunate choice of date (the provincials are awaiting the opening of the Exposition before coming to Paris) and partly, perhaps, because the publicity for this exhibition might have been better.

In the components field, the most interesting developments relate to coils. The XIVth Salon marks the definite victory of the iron-cored coil. Practically all the intermediate-frequency transformers employ cores of powdered iron with open or closed magnetic circuits. The idea of variable selectivity has undergone a certain evolution: to-day the methods of mechanical variation of the distance between two windings seem to have lost favour. Thus Ferrolyte, one of the first firms to introduce this system, have abandoned it in favour of a method of selectivity variable by switching, the windings being immovable. Each transformer has only two "positions" of selectivity—wide band and narrow band In a receiver embodying two IF transformers, however, it is easy to foresee that a three-position switch could be provided.



Silence, smooth running and compactness are features of the Max Braun electric turntable.

In place of adjustable condensers for the tuning of IF transformers (and also in place of the trimmers and padding condensers for RF) one finds, more and more often, combinations of a fixed condenser of fairly high capacity and an adjustable condenser of very small capacity, the latter serving to compensate for the stray parasitic capacities of the wiring. This adjustable condenser often has an air dielectric, which ensures not only better stability but also a reduced loss at high frequencies.

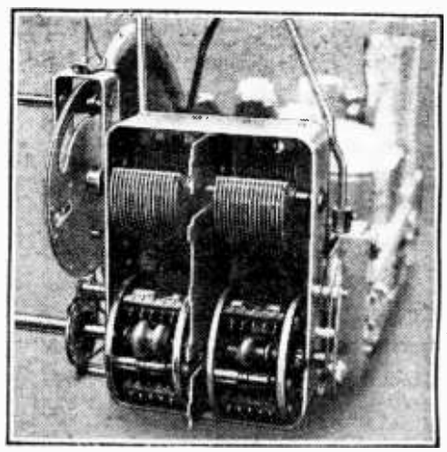
A new tendency is seen in RF windings (tuning, band-filter, and heterodyne oscillator circuits). In order to reduce to a minimum the length of the connections linking each section of the winding to the corresponding element of the switch, two firms, Le Materiel Ondia and the Compagnie Française de Bobinage, have had the idea of mounting the windings on the actual rotating discs of the switch, so that the end of the winding comes directly opposite the corresponding part of the switch. The fact that the coils turn at the same time as the switch presents no inconvenience; on the contrary, thanks to this principle, the design of the coil-switch assembly is very compact.

In the "Rotomutateur" of the Cie. Française de Bobinage, the trimming condensers are also mounted on the rotating discs, and a series of holes in the screening, provided for the passage of the screw-driver for adjusting them, is arranged in such a way that in each position of the commutator the trimming condensers corresponding to the wave-band in circuit at the moment present themselves to the screw-driver.

An ingenious artifice which may be noted is the plan of screening (e.g., of IF transformers) adopted by the Cie Française de Bobinage, which interposes a piece of insulating paper in the lateral joint of the screening can, which thus remains perfect as regards electrostatic screening, but opposes a high resistance to eddy currents. This considerably diminishes the high-frequency losses.

Hitherto, in France, permanent-magnet moving-coil loud speakers were few and far between, and very expensive; in this year's Salon, Princeps present the greater part of their loud speakers in permanent-magnet form and at very reasonable prices. One may hope that this will facilitate the return of the battery-driven receiver, which even this year is only offered at a single stand (Dervaux). In spite of the successful efforts of the Ministry of Leisure to convert the Frenchman from a stay-at-home into a lover of the open air, it seems that little effort has been made to satisfy the demand that presumably exists for portables.

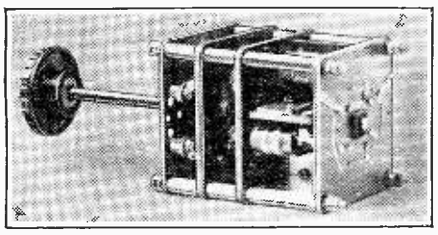
To return to the things which *can* be seen at the Salon, it may be noted that here for the first time the public has been able to see the new valves of the "trans-continental" series (as we call the



The Ondia tuning unit comprises a switch-coil "ensemble."

The Paris Shows—

European valves with side contacts on the base), made by most of the important European firms such as Philips, Mullard, Radiotechnique, Telefunken, Valvo and Tungsram. Among these new valves

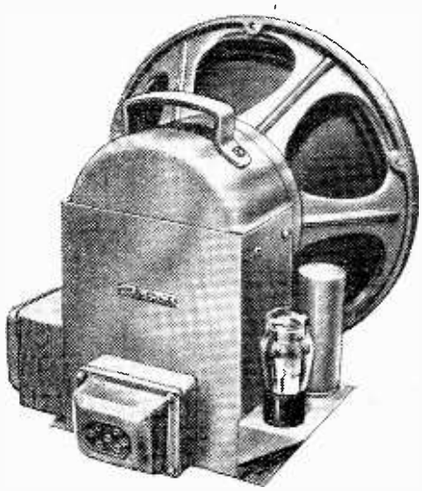


In the " Rotomutateur " the coils are also mounted inside the rotary switch assembly, and turn with it.

may be noted the heptode EH2, specially designed as a modulator-frequency-changer for working with a separate oscillator valve.

Components are to be found on few of the stands at the XIVth Salon, most of the novelties in this field having already been shown at the Components Exhibition which was held in February, and which was not open to the general public.

It is true to say that the Salon is primarily an exhibition of complete receivers. Before examining their design from the technical standpoint, one may well note the visible progress in outward form. Most of the cabinet receivers are now of "horizontal" design, the loud speaker being no longer above the chassis, but at its side. The cabinet work is executed with much taste and often forms a veritable work of art. Chromium-



A high-power speaker rated at 30 watts.

plated metal is combined harmoniously with woods of the rarest kinds. Further, wood itself begins to be replaced by other materials, such, for instance, as the enamelled metal of which the containers of the small Stécora receivers are made.

Although every stand still exhibits those classic combinations of four valves and one rectifier which represent the favourite formula of French receivers, it is no longer uncommon to see receivers with eight or nine valves. This, no doubt, is due to the influence of American technique, which continues to exert a great influence on the French manufacturer. The increased number of valves is most frequently made to benefit the audio-frequency stages.

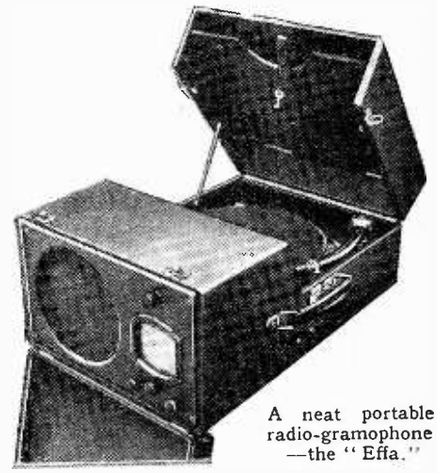
New "automatic" receiver designs deserve attention. One of these comes from the firm of Gody, which has devised an ingenious mechanical system. A cord, wound round a drum on the axis of the variable condenser, passes through a hole in the front of the receiver and terminates in a plug. The actual tuning scale comprises a series of holes arranged in a vertical line with the station name opposite to each. Inserting the plug into the appropriate hole rotates the condenser to the angle corresponding to the desired station. To perfect the tuning and to allow for small changes of length in the cord the plug need only be twisted slightly in its hole, the cord being attached to it by an eccentric pin. When the plug is not inserted in any hole, a high negative bias is applied to one of the valves so that the receiver is quite silent; insertion of the plug removes this bias.

One of the few French portables—the " Week-end."

In the Elcosa automatic tuning receiver the solution is less mechanical than in the Gody model. Each station corresponds to a combination of one letter and two numbers. Two series of keys arranged like those of a calculating machine in vertical rows allow this combination to be "set." The four lowest keys, corresponding to the letters A, B, C, and D, connect the windings of the four first wavebands, 16-31, 31-60, 150-325, and 300-580 metres. When none of the four keys is pressed, the fifth waveband (1,000-1,950 m.) is obtained.

As regards the keys corresponding to the numerals, these connect in circuit fixed condensers with ceramic dielectric. With the 22 keys provided, 500 different settings can be obtained. The repertoire of stations shown on the front of the receiver amounts to 120. In the second row of keys the variation of capacity between two neighbouring keys is 3 $\mu\mu$F; in the first row it is 30 $\mu\mu$F.

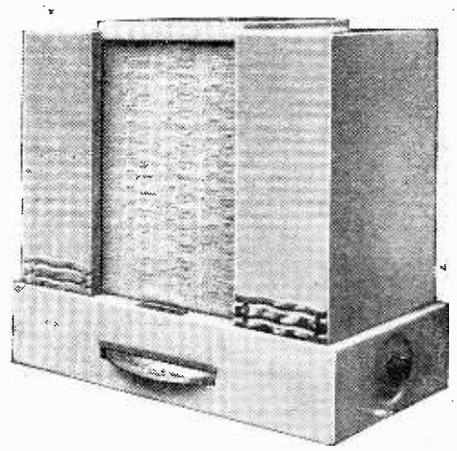
This automatic tuning system forms part of the luxurious Parsifal receiver which is undoubtedly the most ambitious exhibit of the Show; on this account it is worthy of a detailed examination. First, the automatic tuner in this receiver works with a complementary automatic tuning stabiliser which, with its four valves, func-



A neat portable radio-gramophone —the " Effa."

tions on the short waves as well as on the broadcasting bands. The control of variable selectivity allows progressive variation of band-width from 7-12 kc/s. The receiver chassis proper comprises the following American metal valves: one signal-frequency pentode, one heptode frequency-changer, one pentode IF amplifier, one duo-diode-triode, one intermediate IF triode, then one phase-changing triode, and, lastly, a double push-pull stage providing a power output of 20 watts and working in a negative feed-back circuit. The output valves feed three loud speakers, which handle respectively the low, middle and upper registers. The receiver comprises a total of eighteen valves and is equipped with an automatic record changer. As a matter of interest, it is priced at 17,250 Fcs. (about £157).

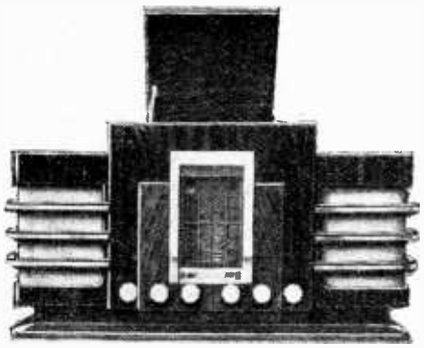
There is only one specialised short-wave receiver of which mention need be made. Built by Secterodyne, this set employs the principle applied in the well-known American HRO receivers; the tuning coils for each band are mounted in a multiple screening can which, with the help of two handles, is inserted in a space provided in the chassis, when the contacts



The lower part of the enamelled metal cabinet of the Stécora receiver serves as the chassis.

The Paris Shows—

are made automatically. The components of the receiver are designed to withstand tropical conditions. France, though possessing a large Colonial Empire, is generally inclined to leave the receiver market

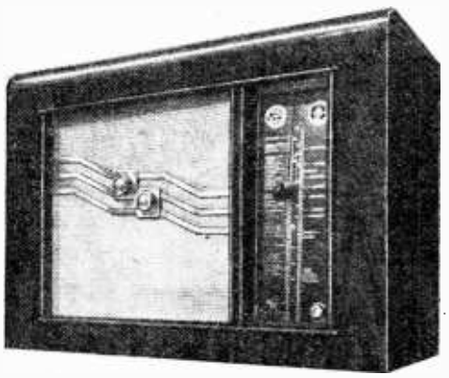


Modern French cabinet design : the speaker of the Lemouzy receiver is mounted horizontally, with an adjustable reflector above it.

in her colonies to the importers of American, Japanese or German sets.

In the field of measuring equipment, alongside excellent instruments of American origin, are to be found two new instruments of French construction. Bouchet & Cie. have introduced two new output meters of an extremely practical type. The output meter, which is connected in place of the loud speaker, comprises on the input side an impedance adjustable between sufficiently large limits (2 to 16,000 ohms, with the possibility of connection to a push-pull output). The sensitivity of these instruments is such that accurate power measurements can be made between 1 mW and 5 W for the small model, and up to 50 W for the large.

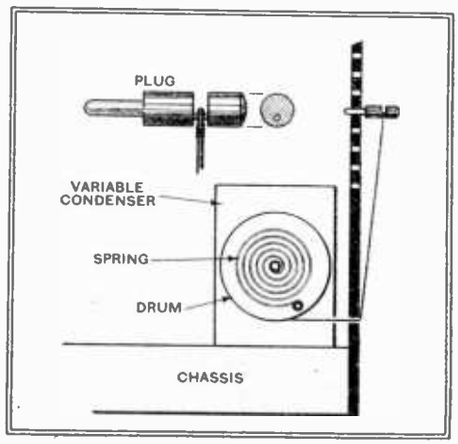
Another instrument of interesting



A plug-in tuning system is the feature of the Gody receiver. Waveband changing is effected automatically through a relay.

design from several points of view is the new universal valve tester shown by Da and Dutilh. It allows detailed tests to be made, not only of all existing valves but also of those that the future may bring to us. It is provided with twelve valve sockets, corresponding to the types of bases now in use, including "Acorns." Moreover, a space is provided for the subsequent fitting of any new type of base. Similarly, of the six selector switches provided only five are actually used. Each switch bears an indicator, which causes a sign indicating its position to appear in a window. With each instrument is an index of all valves, in which each type is given a number which corresponds to the respective positions of the switches. Thus, for example, we find for a directly heated AF pentode the sign 423, and we set the first three switches in the positions 4, 2, and 3. On placing the lamp in its socket the normal working voltages will be applied to its electrodes. When a new valve makes its appearance the makers of the tester will inform all their customers of the corresponding code. The instrument gives reading of emission, slope, hardness, and insulation (hot) of each electrode.

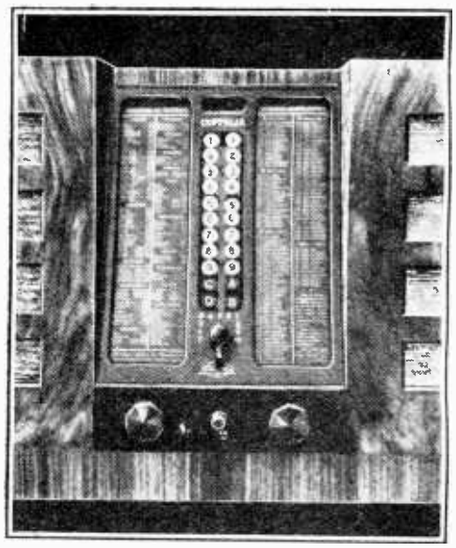
Whilst speaking of valve testers, Philips are showing at the Foire de Paris a new type of instrument of this kind which appears to be unique. In this case there is a perforated card applying to each valve. This card is inserted in a slot, and



Operation of the Gody tuning system. Note the cord round the condenser drum, which is rotated against the tension of a return spring.

through its perforations are established automatically the contacts necessary for supplying each electrode with its appropriate voltage. A card will be made available for each new type of valve. Moreover, the use of certain special cards allows measurements of currents and voltages, both AC and DC, to be carried out, as well as measurements of resistances and capacities.

As we have already said above, the Foire de Paris is confined mainly to certain large manufacturers and a number of their agents and retailers. From the technical point of view the crop of novelties there has been poor, as the larger firms had already presented their new models at the Salon last September. Certain small firms have, nevertheless, tried to give to their productions an outward air of originality, and this has led to some cabinets in extremely doubtful taste. The writer can hardly see himself using a receiver in a cabinet of clouded rose-coloured glass, and still less does his fancy turn towards another in which the case is covered with mirrors!

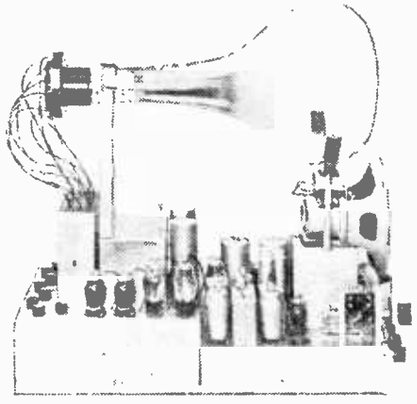


Keyboard and station index of the Elcosa automatic tuning system.

And what has become of television? Apart from the receivers already described in last year's report, only one newcomer has made its appearance. This is a production of Marc Chauvierre, which, for vision and sound, employs a total of seventeen valves and a cathode-ray tube giving an image of 17 × 20 centimetres. Two chassis are mounted side by side, and the use of a power transformer with a toroidal core, by restricting the magnetic field, permits screening of the cathode-ray tube to be omitted. Amongst other original points in the design of the instrument it is noted that the designer has been able to isolate the synchronising signal without the use of a separate valve.

The present time is certainly not auspicious for launching new television sets, as no decision has yet been made as to the transmission system which will be inaugurated in July.

The conclusion reached after visiting the two great French radio shows is, generally speaking, quite satisfactory.



Television receiver designed by Marc Chauvierre.

French manufacturers have not made feverish searches after novelties, but have seriously pursued technical development, and, so far as the external form of their productions go, have generally achieved an excellent appearance.

A New Kind of Interference

CROSS-MODULATION EXTERNAL TO THE RECEIVER

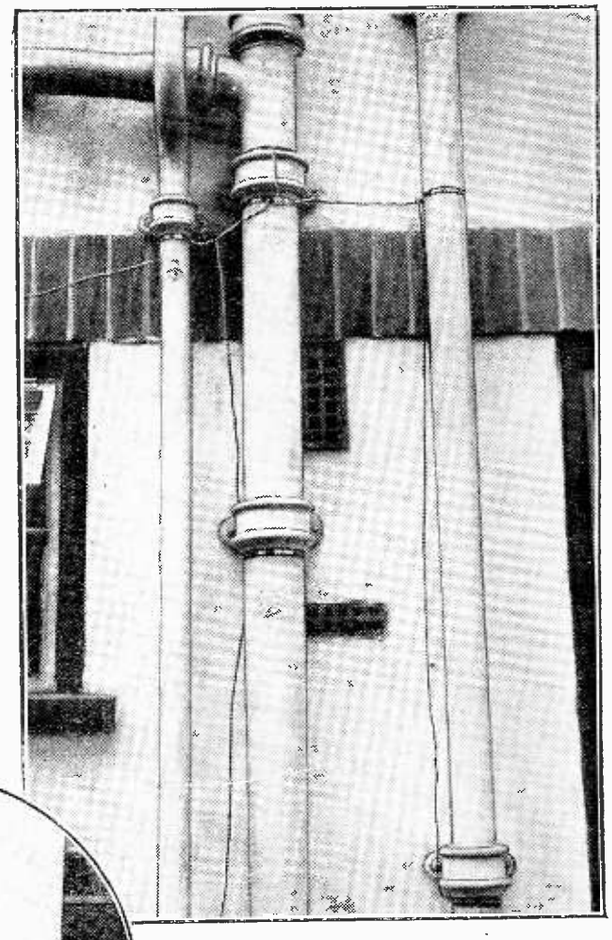
SOME licence must be claimed for the use of the word "new" in the title of this article. The effect to be described has probably occurred to some extent ever since wireless transmission began, but it is only since stations began to use high power and receivers became sensitive that it has had serious potentialities in the way of interrupting reception.

What is described as external cross-modulation is not readily distinguishable from the well-known cross-modulation which occurs in an early stage of a receiver, and which gave so much trouble in the days of the early screen-grid valves. It manifests itself only in areas where signals from one or more stations are really strong; the local signals may be heard as a background when the receiver is tuned to a given distant station, but not to others. Again, two local stations may be heard together at a wavelength widely different from that on which either is working. The trouble must not be confused with lack of selectivity, as in many cases where it occurs the local station can normally be tuned out sharply.

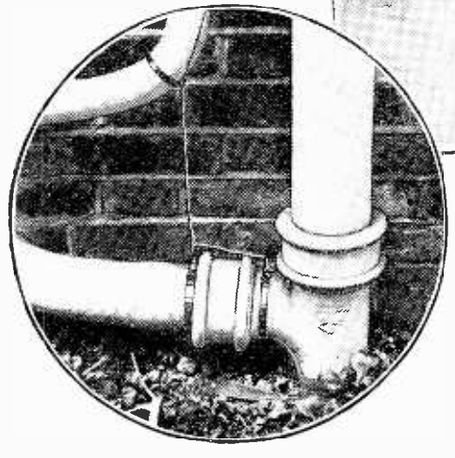
If a receiver suffering from cross-modulation interference is moved to another site where sensibly the same field strength from the local station exists and the trouble still persists, it would be fairly safe to assume that the trouble is internal. If, on the other hand, the trouble disappears, there is a strong *prima facie* case for assuming that the much more mysterious phenomenon of external cross-modulation was occurring at the first receiving site.

The question of external cross-modulation has been under investigation in America for more than a year, and in the April issue of the *RCA Review* Mr. Dudley E. Foster discusses its cause and cure. It is concluded that the necessary conditions may arise when rectification takes place in a domestic waterpipe system, in electric wiring or metallic conduit, or metallic roofing or guttering adjacent to the receiver. Wherever there is a poor contact between two metallic bodies, rectification can take place, especially if oxidation is present at the point of contact.

When such a rectifying contact is situated in a strong field of radiation from one or more nearby stations, new frequencies are created; in the case of a single local transmitter these will be multiples of the fundamental



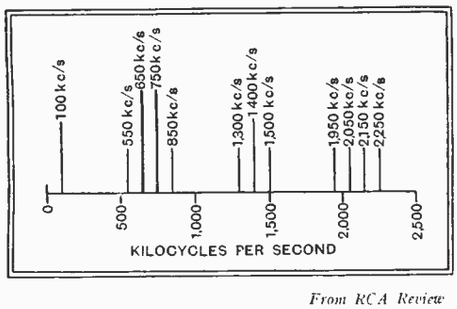
Mysterious interference in a block of London flats was traced to rectification and re-radiation by metal roofing and waterpipes of the local-station signals. Bonding of the pipes effected a partial cure.



(second harmonic, third harmonic, etc.), but in the neighbourhood of a twin station a number of cross-modulation combinations occur. Calling the frequency of one station a, and that of the other b, then the rectifier produces frequencies equal to:—

$a+b$	$2a-b$
$a-b$	$2b+a$
$2a$	$2b-a$
$2b$	$3a$
$2a+b$	$3b$

Further, the modulation of station a is heard superimposed on station b, and vice versa. An example of what can happen in the vicinity of powerful stations working on 650 and 750 kc/s is shown graphically in the accompanying diagram from which it will be seen that the two stations would produce (by the effect of rectification) five new frequencies within the broadcast band at which one or both the stations would be heard as interference on a receiver situated within the field of re-radiation.



From RCA Review

Frequencies at which interference may be produced by external cross-modulation from nearby stations working on 650 and 750 kc/s.

Curing the trouble is largely a matter of locating the spurious rectifier. Having established that the interference is true external cross-modulation by the test already described and also by determining whether the frequency at which it is occurring corresponds with the foregoing table of possible combinations, a search is made for possible rectifying contacts in large—and particularly lengthy—metallic bodies capable of re-radiating on to the receiving aerial. According to the American article referred to, rectification may take place at a defective joint in the aerial itself. Contacts between crossing pipes (water, steam, gas, etc.) should all be suspected, and they should be either separated by a block of wood or bonded together. Generally speaking, the free use of bonding and earthing on all masses of metal and also the application of low-resistance short-circuits to joints in pipes would appear to afford the most certain cure. If the rectification is taking place in the electric supply wires the use of a conventional anti-interference filter will effect a cure.

An interesting case of external cross-modulation in a block of flats in North London is at present being investigated by

A New Kind of Interference—

the Post Office Radio Branch. The trouble was confined to two adjacent flats on the ground floor; in both of these the London National transmissions were heard with a background of the Regional programme and vice versa. The two local stations were also to be heard together on a wavelength of about 500 metres. This latter spurious signal was always present, although the other form of interference varied considerably in intensity from hour to hour, and sometimes disappeared altogether.

The investigating engineers discovered that, although the building is a new one, a certain amount of rectification was taking place in the lead-caulked joints of several iron drainpipes at the front and rear of the building. Thorough bonding of these joints appeared to reduce the interference, but did not effect a complete cure. A further search revealed that rectification was also taking place between the various sections of a long strip of lead on the roof which was in electrical contact with the drainpipes.

It is assumed that these horizontal lead strips, in conjunction with the vertical drainpipes already referred to, form an effective aerial system, and the re-radiation from it of spurious frequencies produced by rectification at the joints affects the indoor aerials used in the flats where the interference takes place. Thorough bonding of the lead strip has effected a temporary cure, but it will probably be necessary to fit insulating joints at the top of the drainpipes in order to clear the trouble permanently.

Cathode-Ray Control

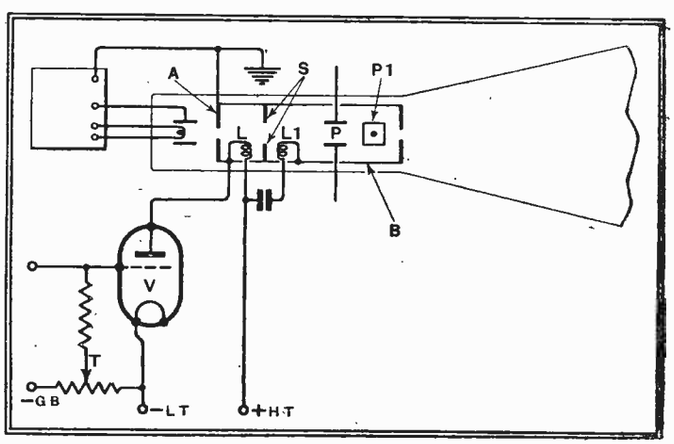
ELECTROSTATIC AND MAGNETIC METHODS COMBINED

THE path of the discharge stream through a cathode-ray tube can be controlled, for scanning purposes, either by the electrostatic field between a pair of plates or by the electromagnetic field from oppositely disposed coils. Actually for high-definition work magnetic control gives less picture distortion than condenser control, though it demands a greater expenditure of energy than is convenient in the case of a television receiver. Von Ardenne has, however, suggested the use of a "mixed" control in which electrostatic deflection is used for the high-speed line-scanning frequency of, say, 5,000 cycles a second, and magnetic deflection for the slower frame frequency of 25 cycles a second.

He is also in favour of applying magnetic control to the picture signals. As shown in the figure the output from the last amplifier V is passed through two coils L, L1, located on each side of the shutter S. The coil L, which carries the direct anode current from the amplifier V, can be used to control the "resting" position of the spot by adjusting the tapping T in the grid circuit of that valve. Alternatively both coils L and L1 may be arranged to carry only the alternating current component, the resting position of the spot then being independently controlled by means of a small external magnet.

It will be seen that the whole of the electrode system is enclosed in a long tube B, which is connected to the first anode A, to the shutter S, and to the control coils L, L1, so that the latter carry the same potential as the anode.

One advantage of the arrangement is that the picture control voltage is applied to the stream at a point where the electrons are travelling at constant speed. They acquire this speed at the moment they pass through the aperture of the first anode A, and retain it until they leave the aperture at the other end of the tube B. If, by contrast, the picture control is applied at a point where the stream is being accelerated, a spurious voltage is created by the passage of the stream which, to some extent, "masks" the signal voltage and so gives rise to picture distortion.



Combining electrostatic and magnetic control of the beam in a cathode-ray tube.

A second advantage is that the tube B serves to screen the scanning electrodes P, P1 from the return flow of electrons from the fluorescent screen towards the anode. If these "slow" electrons are allowed to collect on the plates P, P1 they set up variations in the normal scanning voltages, which, in turn, give rise to irregularities in the line and picture formation on the screen.

Television Programmes

Transmissions are from 3-4 and 9-10 daily.

Vision 45 Mc/s. Sound 41.5 Mc/s.

FRIDAY, JUNE 4th.

3, Fashions for Ascot, Harrow and Eton and Lord's—Part 1. **3.15,** Friends from the Zoo. **3.30,** Gaumont-British News. **3.40,** Marie Lohr in "Now You're Here," with Leonard Hayes, Pat Denny and James Hayter.

9, Fashions—Part 11. **9.15,** Friends from the Zoo. **9.30,** British Movietonews. **9.40,** Repetition of 3.40 programme.

SATURDAY, JUNE 5th.

3, Woods and Jack. A rink played by members of the Alexandra Palace Bowling Club. **3.15,** Paddy Drew (cartoonist). **3.25,** British Movietonews. **3.35,** Variety.

9, The garden scene from Gounod's opera, "Faust." **9.20,** Gaumont-British News. **9.30,** Milk Dishes, by Marcel Boulestin. **9.45,** "Dark Laughter," with Nina Mae McKinney and Leslie Thompson.

MONDAY, JUNE 7th.

3, Tee Time: Golf demonstration by Poppy Wingate. **3.20,** British Movietonews. **3.30,** Theatre Parade.

9, Songs at the piano: Edward Cooper. **9.10,** C. H. Middleton introduces Mr. R. Findlay of the Royal Horticultural Society who will show some of his prize Irises. **9.20,** Gaumont-British News. **9.30,** The B.B.C. Dance Orchestra.

TUESDAY, JUNE 8th.

3, Comedy Act. **3.10,** Gaumont-British News. **3.20,** Excerpts from "Hassan," with Campbell Gullan in the name part and Greer Garcon as Yasmin. The second part of this drama will be presented on June 14th.

9, Comedy Act. **9.10,** British Movietonews. **9.20,** Repetition of 3.20 programme.

WEDNESDAY, JUNE 9th.

3, En route for Richmond: Major Faudel-Phillips exhibits some of his entries for the Richmond Horse Show. **3.20,** British Movietonews. **3.30,** Sixty-first Picture Page.

9, "A la Carte," with Fredrika. **9.20,** Gaumont-British News. **9.30,** Sixty-second Picture Page.

THURSDAY, JUNE 10th.

3, Musical interlude. **3.10,** Artists and their work. **3.25,** Gaumont-British News. **3.35,** Cabaret revue.

9, Comedy Act. **9.10,** Repetition of 3.10 programme. **9.25,** British Movietonews. **9.35,** Recital. Sidonie Goossens (harp) and Margot Fonteyn (ballerina).

HISTORIC RECORDING

H.M.V.'s Coronation Issue

WHAT is undoubtedly a masterpiece of recording has this week been issued by His Master's Voice. This comprises the whole of the Coronation service, including the Rev. F. A. Iremonger's commentary as broadcast by the B.B.C. and His Majesty's address on Coronation evening.

H.M.V. chartered a special line from Broadcasting House to their studios in St. John's Wood and had four machines in use to record the whole ceremony.

In the broadcast, because of the distance of some speakers from the microphones, the volume level in places was very low, but it is the pride of the engineers that in the recordings they have equalised the general level.

The set of fifteen double-sided twelve-inch records (14 of the service and one of the address), complete in a souvenir album, costs £3 15s. H.M.V. have so arranged matters that each record is, as far as is possible, complete in itself, and can be purchased at 5s. The profits from the sale of these records are to be devoted to the Industrial Welfare Society, which charity has been nominated by the King.

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

Wireless at the North Pole

ACCORDING to reports received, the wavelengths being used by the Russian Expedition at the North Pole for communicating with headquarters are 20, 40 and 60 metres.

Telephones at Sea

THE Norwegian P.O. have decided to establish a regular ship-to-shore telephony service, and with this end in view six new stations are to be erected around the Norwegian coast. There are at present five coast stations fitted with wireless telephony apparatus, and for some time past an irregular experimental service has been conducted.

Police Radio Failure

IT is reported that in many districts of Lanarkshire the results obtained from the police radio installations have not come up to expectations. A list of roads is being prepared where reception by the police radio cars is poor or virtually impossible, and a series of tests is to be made in the presence of the Inspector of Constabulary for Scotland.

An Enterprising Radio Society

THE expedition to the Paris Radio Show recently promoted by the Southall Radio Society was extremely successful. The party was composed of some thirty members and friends who spent a very instructive time at the Show and afterwards took the opportunity to explore the city. It is not impossible that trips may be arranged to other Continental wireless exhibitions during the course of the year.

Television in France

THERE are signs that strong efforts are being made to establish television on a definite and permanent basis in France. The French P.M.G. had several interesting things to say in this connection at the banquet held on the occasion of the Paris Radio Exhibition. A new transmitter is being installed in the Eiffel Tower by Le Materiel Telephonique, the French Concessionaires of the Western Electric Co. The power will be 20 kW, and the number of lines will not be less than 400, the band width being 2.5 megacycles. There are, however, several details yet remaining to be settled for, although Le Materiel Telephonique have secured the contract to build the station they have yet to be told which particular system they are to install. An ultra-high frequency cable, made in Germany, has been erected between the summit of the Eiffel Tower and the studios below.

Indian Broadcasting

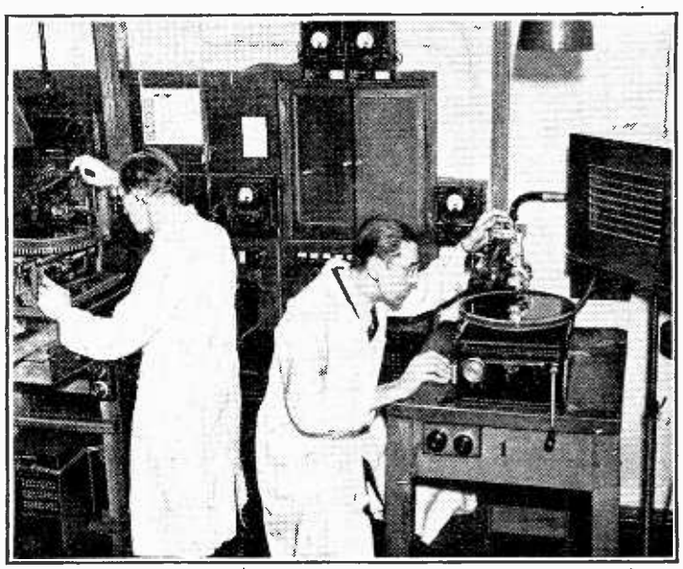
THE Government have sanctioned the final estimates for the building of broadcasting stations at Lahore and Lucknow. The cost of each station will be approximately 340,000 rupees. A new short-wave transmitter and a relay station at Delhi have been sanctioned at a cost of 290,000 rupees. All the above should be ready for service in September. The building of the Madras and Bombay stations, which will cost 271,000 and 250,000 rupees respectively, will not be put in hand until the commencement of the cold weather.

Ruritanian Radio

IT seems hard to realise that there are still some half a dozen countries without a regular broadcasting service. Their number will be reduced by the entry of Liechtenstein into the ranks of broadcasters. The Government of this small country has just notified its intention of building a 2 kW broadcasting station. A claim is being made to the wavelength of 1,429 metres, and if this is persisted in a very serious problem of interference will arise.

An Unfair Omission

IN order to encourage tourists, the French Customs authorities have agreed to permit the temporary importation, without payment of duty, of a large number of articles, including gramophones. Great indignation has been aroused in certain quarters by the omission of portable wireless sets, and it is hoped that this will soon be rectified.



Two of the four machines used by H.M.V. for recording the Coronation ceremony and the King's speech. These were employed in pairs to minimise the chances of a failure, and to insure continuity the second pair came into operation before the first had completed a record.

Strange Rumours

THE story that the Marchese Marconi recently demonstrated at Rapallo the transmission of power by wireless does not seem to lose by circulation. On the contrary, it is now reported that in addition to this, Marconi demonstrated the use of micro-waves for long-distance work by communicating on these wavelengths with a station over three thousand miles away, very low power being used.

Outwitting the Obstructionists

BITTER warfare is being raged between the broadcasting authorities and various sporting interests in Sweden. At the recent Anglo-Swedish football match held in Stockholm Stadium the broadcasting authorities adopted the same tactics which the B.B.C. used at the Wembley Cup Final some years ago. Twenty commentators bought tickets, and one left the stadium every few minutes to broadcast, from a temporary studio rigged up outside, an account of what he had just seen.

Kabul Calling

THE 20-kW. station which is being built by the Government of Afghanistan at Kabul will work on long, medium and short waves. It will be completed by the latter part of this year.

Trouble Averted

THE projected strike of Danish wireless operators was settled by the Public Conciliator. Salaries are to be increased by from 7 to 8 per cent. Additional seniority pay will be received after twelve years' service. Those with more than eight years' service will be granted three weeks' annual leave in place of the customary fortnight.

Empire Exhibition, 1938

BROADCASTING promises to play a prominent part in the 1938 Empire Exhibition which is to be held in Glasgow from May to October next year. This Exhibition will be held in the 170-acre Bellahouston Park, and will be the biggest held anywhere in the world since the Wembley Exhibition of 1924-25.

High Court Judgment

AN important ruling has just been delivered by the French State Council, which corresponds more or less to the High Court in this country. The Council has decided that it is illegal for wireless communication to be established between the various flats in a block of such dwellings even though no messages are radiated outside such a building.

On the Road to Mandalay

THE development of broadcasting in Burma is being tackled by the Post Office. Short-wave tests are being made at the Government station at Minguladon to ascertain reception data in different parts of Burma. The short-wave transmitter at this station is normally to be used to augment the existing medium-wave service which provides communication with the aerodromes at Calcutta, Karachi and Bangkok.

McCarthy

An Efficient Three-Waveband Superheterodyne Chassis

MODEL RF7AW

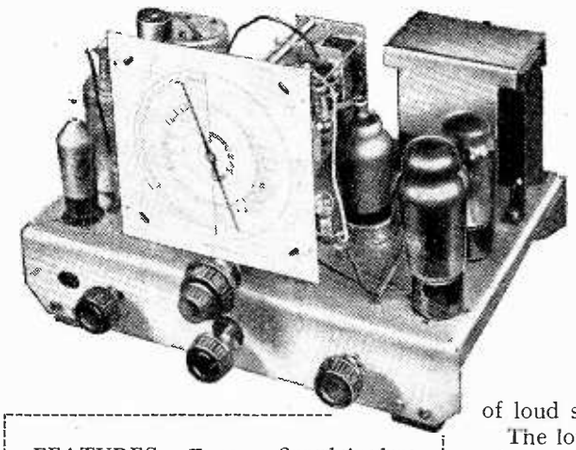
THE popularity of the range of receiver chassis made by this firm is based on the fact that an efficient performance is provided without unnecessary frills. Although the workmanship in all essentials is sound, money has not been expended in making, say, special mountings for components or in making the wiring look pretty; yet the external appearance is neat enough, and the set will look well in any cabinet which the purchaser may choose for it.

The circuit starts with a stage of RF amplification using a variable-mu pentode. This valve is transformer-coupled to a triode hexode frequency-changer which is given a fixed standing bias and is not controlled from the AVC line. A pentode of the same type as that used in the RF stage is employed for IF amplification, and the second detector stage is a double-diode which is arranged also to supply AVC bias to the IF and signal frequency RF stages. A separate triode valve provides a stage of AF amplification between the second detector and the pentode output valve. The output transformer is built into the chassis, but a field replacement choke must be added if a permanent magnet loud speaker is to be employed.

The number of Continental stations received during a rapid exploration of the medium-wave band during the hours of daylight confirms the circuit's promise of high sensitivity. Due no doubt to the high intermediate frequency, there is a commendable absence of second channel interference, and the selectivity is such that when using the set in Central London two channels are lost on either side of the London Regional transmitter and one channel on either side of the weaker National transmitter. On long waves the selectivity is, if anything, better, and good results are obtained from the Deutschlandsender if one is prepared to use the tone control to remove a slight trace of sideband splash. The overall sensitivity of the set is such that the output stage is easily overloaded. Provided the volume control is used when this occurs, however, there is little fault to find with the quality of reproduction. Even on long waves where the selectivity is at its highest there is an excellent high-note response, and the component values chosen ensure that the low frequency cut-off will be well below that of the majority of loud speakers.

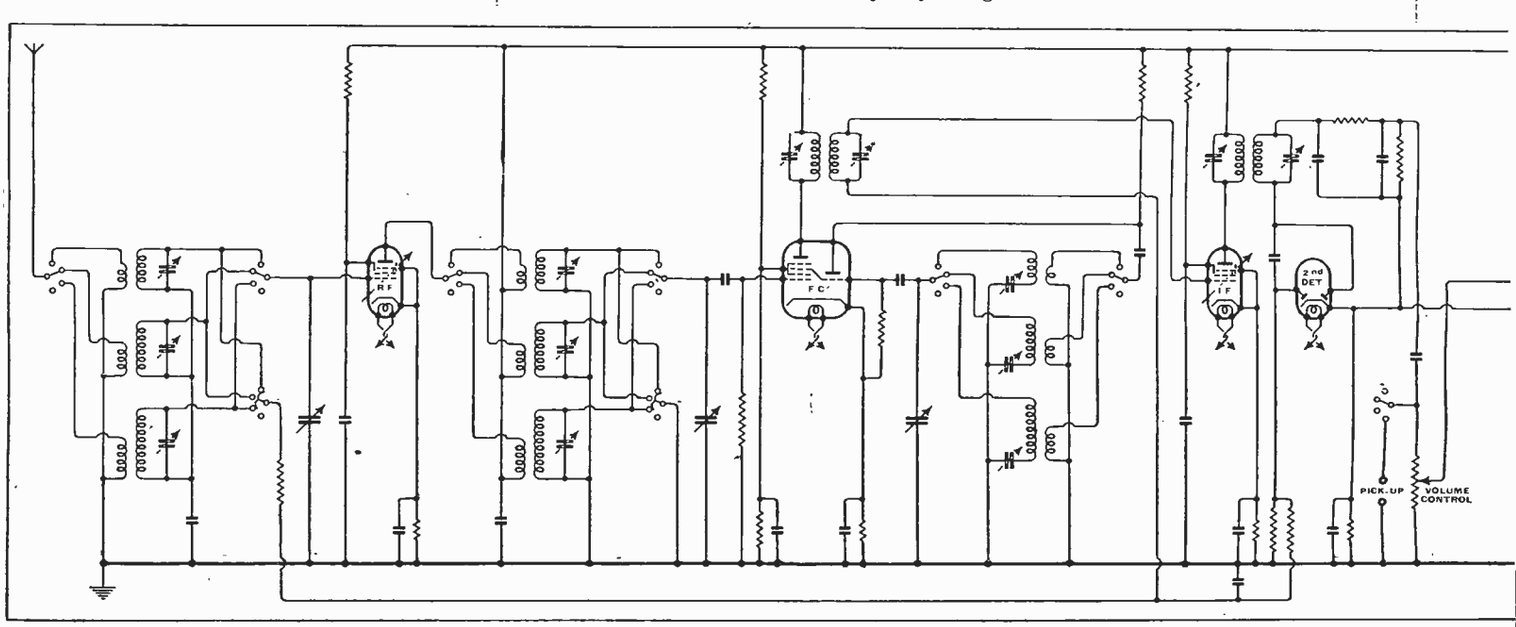
The low background noise on the short-wave range at first gave the impression of poor sensitivity. Between stations the volume control can be turned up to the maximum without discomfort, a state of affairs which is all too rare in commercial all-wave receivers. As soon as a station is picked up, however, it is revealed that the low background is the result of a good signal-to-noise ratio and not of insensitivity as might at first be supposed.

Conditions for transatlantic reception at the time of the test were poor, and at the first attempt no American stations could be found. On the afternoon of the following day, however, Bound Brook (W3XAL) on 16.87 metres obliged by an hour's entertainment at full volume; so that there can be little doubt that under favourable conditions regular transatlantic reception will be possible. In the presence of a strong carrier some instability was noticed with the volume control at maximum on the short-wave range, suggesting



FEATURES. ***Type.*** *— Superheterodyne receiver chassis for AC mains.* ***Wave-ranges.***—*(1) 16 to 50 metres. (2) 180 to 550 metres. (3) 800 to 2,100 metres.* ***Circuit.***—*Var.-mu pentode RF amplifier—triode hexode frequency-changer — var.-mu pentode IF amplifier—double-diode second detector — triode AF amplifier — pentode output valve. Full-wave valve rectifier.* ***Controls.*** *— (1) Tuning (2) Volume. (3) Waverange.—(4) Combined tone control and on-off switch.* ***Price.***—*(including royalties) £10 17s. 6d.* ***Makers.***—*McCarthy Radio Ltd., 44a, Westbourne Grove, London, W.2.*

Complete circuit diagram. AVC is supplied to the RF and IF stages but not to the frequency-changer valve.



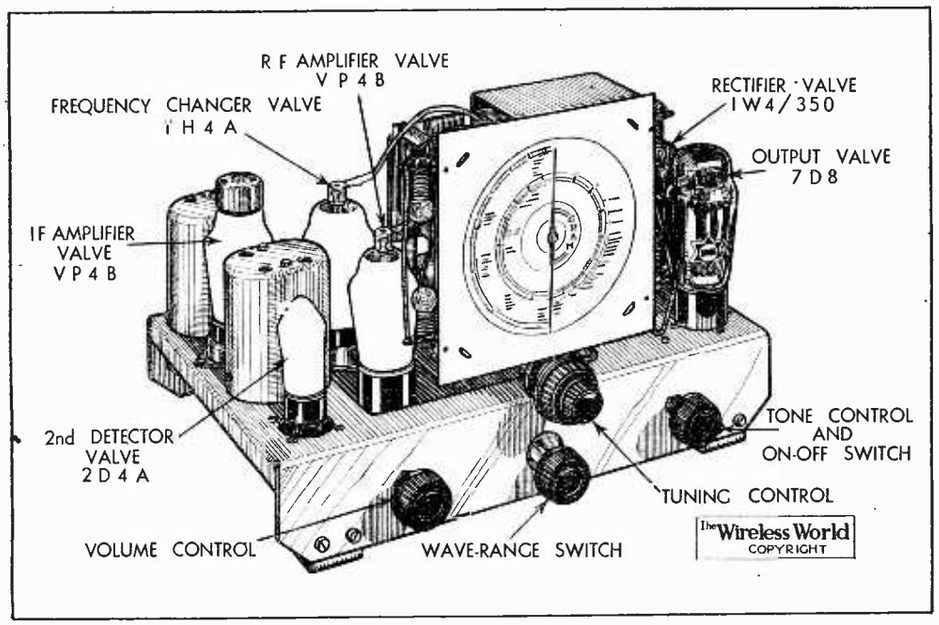
a trace of IF in the audio-frequency stages. Fortunately this effect only occurred on stations where an ample reserve of volume was already available, and where the volume control would normally be used at a setting below the critical point.

Another minor criticism was that the short-wave scale readings were on the high side near the bottom end of the scale, but no doubt this will be remedied in production models.

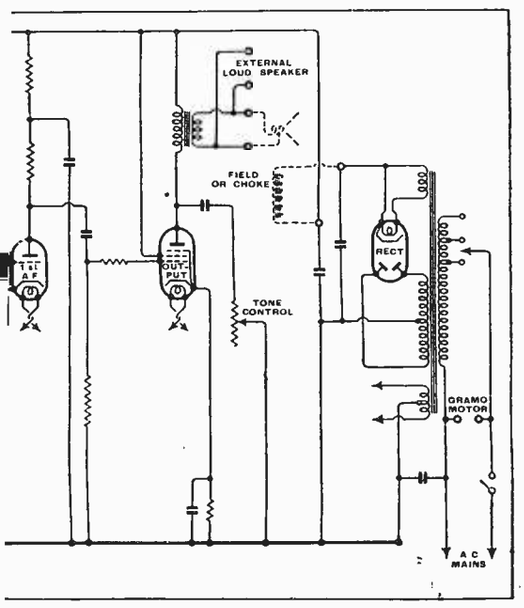
The foundation of the chassis is a well-known and well-tried tuning unit in which the condenser has been raised to permit the use of a 6-inch square tuning dial. This is driven by a two-speed reduction gear in which both ratios are on the high side. The dial is surrounded by four pilot lights which are selectively operated from the waverange switch.

We were impressed by the generous proportions of the mains transformer in which the windings are paper interleaved. Sockets for the loud speaker field or smoothing choke are situated on the terminal panel of this component, and there are also sockets for connecting a gramophone motor.

The low impedance output terminals for the loud speaker are situated at the back of the chassis, and a pair of parallel-connected sockets are provided for an external speaker. Accessories for fitting the chassis into the cabinet include a dial glass, escutcheon plate and lock ring, dial lamps, mains lead and plug, loud speaker and aerial and earth plugs.



The chassis is supplied complete with loud speaker and all accessories ready for incorporation in a cabinet of the purchaser's choice.



The Low-Voltage Cathode-Ray Tube. By G. Parr. Pp. 177. Published by Chapman and Hall. Price 10s. 6d.

THE cathode-ray tube is already an extremely important piece of apparatus, and it is rapidly becoming indispensable not only in the laboratory but in certain branches of industry. It has received much publicity of recent months because of its application in television; such publicity is justifiable, for it is not too much to say that high-definition television would be almost impossible without it. The tube, however, is in reality much more widely used for non-television purposes.

These applications are probably familiar to those who are already using the tube, but those who are not are unlikely to realise its usefulness and versatility, while many who have a nodding acquaintance with it do not appreciate its full capabilities. To all these *The Low-Voltage Cathode-Ray Tube* should prove valuable, since it not only deals with the application of the tube but it also explains its operation.

The treatment is comprehensive, and the scope is wider than one would expect from the title, for both low- and medium-voltage tubes are dealt with; it is only tubes of the really high-voltage (60 kV or so) type that are omitted. The book opens with a description of the construction of the tube, and goes on to explain the operation, the principles of both electro-magnetic and electro-static deflection being treated, while in the succeeding chapter the three methods of focusing are discussed. This is followed by an extremely clear chapter on Lissajou's figures, in which both the way in which such patterns are built up and their interpretation are dealt with in a manner which is refreshingly easy to follow.

The operation of both hard- and soft-valve linear time-bases is treated, in addition to special arrangements giving elliptical, circular, spiral and zig-zag traces. The rest of the book deals chiefly with the applications of the tube, and three chapters are devoted to its uses in radio engineering, industry and television. There is an appendix in which the photography of CR tube images is treated, and the book concludes with an extraordinarily complete bibliography; it occupies no less than 15 pages.

The book is comprehensive, for there are few applications of the tube which are not touched upon, and it is clearly written. It is well printed and bound and remarkably free from errors. W. T. C.

The Intermittent Fault

A BLACKHEATH reader sends us a particularly interesting example of how baffling the intermittent fault in a wireless receiver can be. In the course of his professional activities he was called in to deal with an AC superhet, whose owner complained that during reception of broadcast programmes the set was prone on occasion to become completely silent. Our correspondent spent some time with the set, which functioned perfectly while he was there, and could find no defect when testing apparatus was used. Two days later he received an urgent call by telephone, but on arrival found the set again working beautifully. The same thing happened when he paid other visits, though on one occasion he was asked to stay to both lunch and tea, the set being kept at work all the time. In despair he had the set collected and placed it under his own observation all day and every day for a fortnight. Still no breakdown. He returned it—and the very next day received an irate postcard saying that it was up to its old tricks!

The set was collected again on the understanding that he should keep it until the fault manifested itself in his presence. It was nearly three weeks before it did so. Broadcast signals suddenly disappeared, though morse and atmospherics could still be heard. As soon as he began to make tests with his instruments the London Regional bobbed up again at full strength and remained steady. Convinced that the fault must be somewhere in the band-pass circuit preceding the frequency changer, he connected an oscillator, set at the London Regional's frequency, to the A. and E. terminals, and placed a milliammeter in the plate circuit. For an hour nothing happened. Then the milliammeter needle moved down the scale and remained stationary. One more test, and the fault was found. What was it? Just this (and it's worth bearing in mind in case you come across similar trouble): In the grid circuit of the MX40 there is a 0.0003-mfd. blocking condenser to prevent a short circuit of the AVC voltage. This condenser was found by test to be open-circuited. A new one was fitted and there has been no recurrence of the trouble. The morse and atmospherics heard when the Regional programme faded out may have been due to IF pick-up.

Listeners' Guide fo

THE broadcast of the ceremony of Trooping the Colour on the Horse Guards Parade provides a colourful military sound-picture each year. By no means the least important reason for this being the admirable description of the scenes given by Major J. B. S. Bourne-May, of His Majesty's Foot Guards.

This impressive occasion when the King, supported by his brothers and other members of the Royal Family, rides with his staff and a Sovereign's Escort of Life Guards, from Buckingham Palace down the Mall to the Horse Guards Parade, will be described for Regional listeners on Wednesday morning from 10.45. From a roof overlooking the Horse Guards, Major Bourne-May will have an unimpeded view of the picturesque scene.

The King's Colour of the Battalion of the Brigade of Guards furnishing the King's Guard on the day of the ceremony is the one which is trooped. The colour, carried by an Ensign and accompanied by an escort, marches down the line of guards. The troops then march past the King, first in slow and then in quick time, after which His Majesty takes his place at the head of his troops and returns to the Palace.

TROOPING THE COLOUR. This age-old ceremony will be described for listeners on Wednesday morning. The regimental marches form a fitting background for this impressive broadcast. This photograph was taken at the 1936 ceremony.

FROM CAMBRIDGE

ANNUALLY, in June, the famous choir of King's College Chapel, Cambridge, sing early English madrigals from punts moored under the arches of King's Bridge. The scene possesses unparalleled charm, there being no lovelier place in any university than the "backs" of Cambridge. For those unacquainted with the scene the "backs" can be described as a beautiful, old ornamental river running behind the Cambridge colleges. On the one side is parkland, whilst on the other stretch the lawns and gardens of the colleges.

F. H. Grisewood will journey up to the Cam to describe the scene for Regional listeners on Tuesday at 9.25. Often as many as five thousand people assemble around King's Bridge to hear this superb choir. Towards the end of the performance the punts are cut adrift, and the choir, drifting down the stream, continues to chant the beautiful madrigals.

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"YOUTH AT THE HELM"

THAT delightful satire on modern business methods, "Youth at the Helm," which had such a successful run at the Globe Theatre two years ago, and was heard by listeners in April of last year, will be revived on Wednesday and Thursday of this week. In the stage production Owen Nares was in the leading part of a young man who, although a stranger, walks into "The London and Metropolitan Bank," and by sheer bluff dominates the board of directors and negotiates loans which set the wheels of industry turning.

The cast is largely the same as for the first broadcast, the part of the young man, Randolph Warrender, being again taken by Jack Melford, and that of the charming distraction Dorothy Wilson, the typist, by Ann Trevor. It will be produced on Wednesday at 6.50 (Nat.) and Thursday at 8.50 (Reg.).

◈ ◈ ◈

REVUE

A TYPICAL light affair, described in theatrical circles as an "out of hand revue," will be produced by Ronald Frankau, best known as a comedian, but again breaking forth as a radio author for this, his second, radio revue. It will

HIGHLIGHTS OF THE WEEK

FRIDAY, JUNE 4th.

Nat., 6.25, A. P. Herbert's comic opera "Derby Day." 8, Ronald Frankau's revue, "Beyond Compère." 9.20, Mr. Lloyd George on the Responsibilities of Empire.
Reg., 3.15, Commentary on the Oaks. 8.15 and 9.20, Toscanini concert from the Queen's Hall.
Abroad.
Budapest 1, 8.10, Budapest Philharmonic from the Royal Hungarian Opera.

SATURDAY, JUNE 5th.

Nat., 2.30, Commentary on the Shelsley Walsh Hill-climb. 9.20, Recital, Arthur Fear (baritone) and Cyril Smith (piano).
Reg., 6, "Beyond Compère." 8.20, Replanning Burbleton: imaginary town-planning scheme. 9, The Theatre Orchestra and Tessa Deane.
Abroad.
Paris PTT, 8.10, "Carmen" (Bizet) from the Opéra Comique.

SUNDAY, JUNE 6th.

Nat., 5.35, George Robey as Falstaff in "The Fat Knight." 9.5, Leslie Jefferies and the Grand Hotel, Eastbourne, Orchestra.
Reg. 9.5, The London Symphony Orchestra and Réne le Roy (flute).
Abroad.
Deutschlandsender, 8, Songs of the Danube.

MONDAY, JUNE 7th.

Nat., 5.15, Yascha Krein and his Gypsy Orchestra 7, The Music Shop—17.
Reg., 7.30, Pianoforte recital: Kendall Taylor. 9, Western Salon: Dartington Hall, Totnes.
Abroad.
Strasbourg, 8.30, Gala Variety Concert from Metz.

TUESDAY, JUNE 8th.

Nat., 7.50, Organ recital by Berkeley Mason. 8.15, Franz Lehár's operetta, "Frasquita." 10.10, Act III of "Falstaff."
Reg., 9, Paradise Isle—musical picture of the South Seas. 9.25, Madrigals from King's College, Cambridge.
Abroad.
Warsaw, 8, Moniuszko opera excerpts, from the Old Royal Palace, Cracow.

WEDNESDAY, JUNE 9th.

Nat., 6.50, "Youth at the Helm." 9.25, The Theatre Orchestra and George Clarkson (saxophone).
Reg., 10.45 a.m., Trooping the Colour. 6, "Frasquita." 8, Excerpts from Shows at Blackpool.
Abroad.
Paris PTT, 8.30, "The Rivers of France—the Garonne," a musical fantasy.

THURSDAY, JUNE 10th.

Nat., 7.15, Reginald Foort at the Theatre Organ, with George Melachrino (versatile musician). 9.20, Painting the Town: programme from N. Ireland.
Reg., 7.50, Variety. 8.50, "Youth at the Helm."
Abroad.
Leipzig, 7.10, European Folk Songs and Dances: relay from Dresden.

The Week — Outstanding Broadcasts at Home and Abroad

be presented to National listeners on Friday at 8, and Regionally on Saturday at 6. Like all his productions, there is a humorous twist to the material for this revue, which is entitled "Beyond Compère."

As Elsinore is in the news with Laurence Olivier departing thither to play Hamlet, Ronald Frankau has decided to produce in his revue a *slightly* condensed version of Hamlet, giving the story in drama and effects in seven minutes.

At his last revue Ronald Frankau dispensed with an audience, but has requested one for this occasion, for he is now of the opinion that for an ensemble such as a revue he should have the atmosphere of an audience although as a single artist he prefers to broadcast without one. This is an admission which will be interesting to both bodies of listeners who debate the audience question.

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TOWN PLANNING

THE story of an imaginary town planning scheme has been written in dramatic form by F. Leslie Halliday, F.R.I.B.A., architectural lecturer for town planning at Manchester University. This will be heard by Regional listeners at 8.20 on Saturday. Entitled "Replanning Burbleton," it will describe how the mythical Burbleton, a small northern borough, is being slowly transformed from a country town into an industrial centre.

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FALSTAFFIAN

To use Peter Cresswell's own words, he has been "tampering with Shakespeare." The result of the B.B.C. drama producer's tampering will be heard by National listeners on Sunday at 5.35, when George Robey plays Sir John Falstaff in "The Fat Knight." This comprises all the Falstaffian scenes extracted from Shakespeare's histories, "Henry IV," parts I and II, and linked into a coherent whole.

George Robey, it will be remembered, was hailed as the perfect, roisterous Sir John Falstaff when he made his first appearance in Shakespeare at His Majesty's Theatre in 1935.

Another Falstaffian broadcast will be heard on Tuesday at 10.10 (Nat.), when the third act of Verdi's opera, "Falstaff," is relayed from the Royal Opera House. The name part will be played by Cesare Formichi.

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OPERETTA

FRANZ LEHÁR'S operetta, "Frasquita," is to be broadcast for the first time in this country on Tuesday in the National programme and again the following night Regionally. There will be no dialogue, but, in addition to the music, a narrator will tell the story. "Frasquita," first produced at a West End theatre in 1925 with José Collins in the lead, includes the song "The Serenade," which was sung and whistled by everybody twelve years ago, and has since been revived by Richard Tauber.

◈ ◈ ◈

OPERA

As a substitute for the usual Friday relay from the Royal Opera, the season having ended, Bucharest announces a recorded performance of Wagner's "Tannhäuser" for 7.30.

Although not giving a complete opera, Milan I is putting on an interesting programme of opera music, mainly Italian, for its 9 o'clock transmission to-night (Friday).

Breslau has chosen Nicolai's "Merry Wives of Windsor" for its 8.10 transmission on Saturday. This is always pleasing to English listeners, since its theme is derived from Shakespeare. Falstaff will always delight English-speaking people the world over, and the tale of his amorous adventures in Windsor Forest is ever fresh. Bizet's "Carmen," always attractive and always popular, will be relayed from the Paris Opéra-Comique by Paris PTT at the same time.

GEORGE ROBEY as Sir John Falstaff, who will be heard in that rôle in "The Fat Knight" on Sunday.

Dresden makes a notable contribution to this week's opera programmes when Leipzig relays at 6.40 on Sunday its interpretation of "The Jolly Cobbler." This opéra-comique is the work of two composers, the overture being by Hiller, while the opera proper was composed by Standfuss. We are promised music of an unusually gay type.

From the old Royal Palace at Cracow, which was for a very long period the residence of the Kings of Poland, comes a relay by Warsaw at 8 on Tuesday of a Moniuszko opera programme. The greater portion of the palace is now used as barracks, but the old state-rooms and an excellent theatre have been preserved.

◈ ◈ ◈

MORE SHAKESPEARE

THE Old Vic Company has gone to Denmark to perform, among other works of Shakespeare, "Hamlet," "on the spot" in the courtyard of the ancient castle of Kronborg. The performances, which will be before some two thousand five hundred people, will provide several broadcast excerpts. The players' first introduction to Danish listeners will be to-night (Friday) at 8.10, when they will broadcast scenes from "Hamlet" in the studio.

◈ ◈ ◈

MUSICAL GATHERING

A MONSTER concert is being relayed by the Norwegian stations on Sunday at 5. It will be given by the united orchestras of two provinces at a large musical gathering being held at Haugesund. They will render, among other items, Wagner's "Nieberlunden March."

THE AUDITOR.

THE FRANKAUS. Ronald Frankau and his wife René Roberts at the christening of their baby daughter last year. They will be heard in "Beyond Compère" this week. On the right is Gilbert Frankau, the author, brother of the comedian.

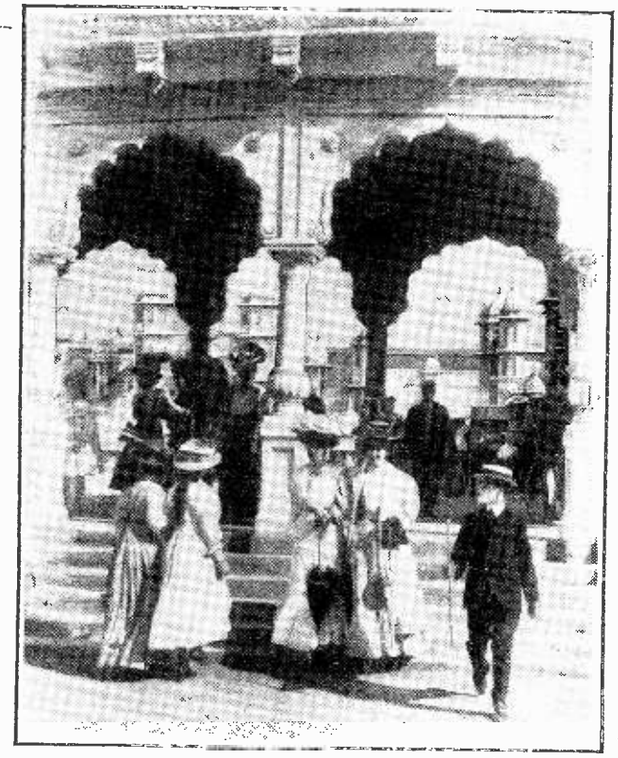
UNBIASED

A Radio Romance

IT is astonishing what a lot of fuss is being made about the so-called radio romance in New York which has resulted from a hick dweller in the Back Blocks of Tennessee falling in love with some wretched girl whom he chanced to see on his television screen. What annoys me is all the sentimental talk about this being the first instance in which radio in any form has played a direct part in a romance. Why, even I can lay claim to have experienced one of these alleged radio romances, and, what is more, long before broadcasting was thought of.

No doubt a good many of you will recollect the great spy mania which afflicted us in the dear happy old days immediately preceding the War. I always remember the case of the unfortunate flapper who was paying a visit to her brother in a certain naval dockyard in which was a powerful spark transmitter. She was standing within a few feet of the aerial mast when the operator commenced transmitting. The field strength was so great that the metal ribs supporting her stays—a type of female garment much favoured in those days—were forced into oscillation, they apparently resonating to a harmonic of the wave being radiated. The induced oscillations were so strong that sparks were observed to be leaping from her person to some earthed iron railings near which she was standing. Such a phenomenon was then a complete novelty, and the upshot of the matter was that she and her brother were immediately placed under arrest and escorted to the guardroom.

Although the girl was subsequently acquitted, many were the wild rumours which were floating about to the effect that she was in the pay of a foreign power and was using her pigtail to conceal a trailing aerial, colour being lent to the rumour owing to the fact that her hair was actually done up in two pigtails which were supposed to conceal a primitive dipole aerial. This rumour got such a hold on popular fancy that for a long time flappers and their pigtails were subject to the direst suspicions, and I well recollect joining the amateur army of Wireless Sleuths which was bent on exposing this horrible canker in our midst.



Pre-war hotbed of Romance.

My zeal in this matter was so great that sometimes I would follow a suspect for hours in an endeavour to find out whether she had anything hidden in her pigtail. On more than one occasion I incurred the unjust suspicions of the mother by whom these girls were invariably accompanied—for, of course, in pre-War days no really nice girl ventured out without her mother—and narrowly escaped being handed over to the police on a charge of "loitering with intent." It was this over-zeal on my part which led to the romance of which I have already spoken, and by a stroke of good luck I am able to reproduce herewith an old photograph which a friend happened to take at the psychological moment when my suspicions were first aroused by the hanging tresses of the female who afterwards became Mrs. Free Grid.

As many of you will recognise at a glance, the photograph was taken at the old White City, that pre-War hotbed of romance. I think that a glance at the lady's hair should be quite sufficient to prove that I had ample justification for my suspicions, and should enable you to acquit me of the evil intent with which Mrs. Free Grid's mother—who can be seen in the photograph holding tightly to her daughter's arm—accused me when subsequently she gave me in charge. Needless to say, the constable whom she accosted refused to take up the charge, but even to this day relations between us are somewhat strained over the matter as she is by no means convinced of the honesty of my intentions on that occasion.

An S O S from Germany

I HAVE had such a cry of distress from a German correspondent concerning the perversity of women—or, at any rate, one woman—in connection with an application of ultra-short waves in an endeavour to help her deafness that I cannot refrain from publishing it herewith in the hope that one of you may be able to help him. The only thing I can think of is to bore a hole in her spine and thus, in some manner, make direct connection with the hearing centres of the brain, but unfortunately the addiction of women to low-backed dresses completely puts the tin hat on this idea. Perhaps you can think of something. At any rate, here is the letter.

Dear Mr. Free Grid,—In token of the profound impression your weekly communications make even on the benighted foreigner, in view also of the spiritual uplift and useful information I have derived therefrom, in short, as an act of common gratitude for very many minutes spent with a grin on my features and a friendly glow in my heart, let me tell you of a brain-wave of my own for such use as you may see fit.

My wife (poor thing), being afflicted with increasing deafness and hardly able to follow the warblings of her favourite tenor in one of our numerous Opera houses, one day went so far as to pass (in the presence of strangers) some scathing remarks on electrical science in general and on my abilities as a member of the engineering profession in particular, for not providing her with the means of overcoming her deficiency.

By FREE GRID

As one of your most devoted readers I forthwith set to work on a suitable gadget. You may be aware—as I was not, before actually experiencing it—how the square law for the decrease of acoustic energy with distance works out for a person hard of hearing. She can hear almost normally at a distance of a few inches, but is practically deaf at a distance of, say, ten yards. In the same way, if you attach a microphone to the flimsy stuff ladies wear instead of clothes, it not only has a destructive effect on the finery, but practically no effect as a deaf-aid, because the distance between the seats and the stage is much too great. This, by the way, seems to be the chief drawback in most deaf-aids. They are either not sensitive enough for distant sounds or else they produce nerve-racking noises when shaken or spoken into at short range.

I bethought myself of no better plan—as I could obviously not place the "mike" on the stage and connect it all the way to our modest back-row seats by wires—than to borrow one of the small portable transmitters which some of my colleagues have brought out for O.B. purposes. This, in connection with a microphone, I managed to smuggle into the souffleur's box by remembering the unsatisfactory financial position of one of the stage hands. Needless to say, I carried the receiver with me concealed in my old opera hat, which reposed on my lap, where I could twiddle the knobs in the dark. All went well, up to the moment when I presented the pair of earphones to my queen. A grunt of indignation was all I had in the way of gratitude for my untiring efforts. I had not thought of fitting invisible earpieces.

I feel convinced of your sympathy. But could you or any of your readers suggest a better method? I can't help feeling that my method will be rather expensive and troublesome in the long run.

Yours gratefully,
W. F. EWALD.

Berlin-Halensee.

A very similar idea is, of course, used in some cinemas in this country which provide headphones in certain seats for the benefit of their deaf patrons. These headphones are wired to a suitable point in the talkie circuits and are each provided with a separate volume control. They are, however, far from being invisible.

New Apparatus Reviewed

Recent Products of the Manufacturers

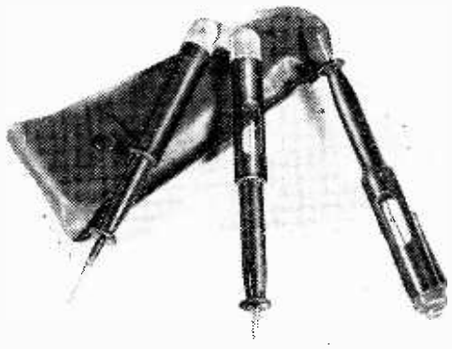
PRESSLER NEON PRODS

EUGEN J. FORBAT, 12-13, Henrietta Street, Covent Garden, London, W.C.2, has introduced some novel test prods fitted with small neon tubes that can be used for making tests on receivers.

One of these is made in the form of a compass and it consists of two testing prods hinged at the top. In one is contained the neon tube, which, in the sample sent to us, is calibrated to give an approximate indication of voltage.

These prods can be used on either AC or DC supplies of from about 100 to 500 volts. In the case of DC the test prods provide a ready means for ascertaining the polarity, and where the nature of the supply is doubtful they will also indicate whether it is DC or AC.

When connected across an AC voltage the glow in the neon tube is distributed about both the electrodes, but if the supply is DC the glow is restricted to one only of the electrodes.



Forbat Pressler neon test prods.

The neon tube in the compass model has a long centre stem and a small circular electrode at one end. The glass bulb is engraved with two indicator lines. With 150 volts DC the glow extends up to the first indicator line, while with between 250 and 300 volts it just reaches the second line. It requires about 500 volts for the glow to completely fill the tube.

The single-prod type, which is known as the Pressler Junior, costs 6s., and the twin-leg or compass model, which, incidentally, can be used very conveniently with one hand, costs 15s. This is the senior model with calibrated gauge giving approximate indication of voltage.

SIMPSON ROTO-RANGER

THE Model 202 Roto-Ranger is a multi-range measuring set for use on either AC or DC supplies. It has twelve ranges selected by a rotary switch, and an interesting feature of the instrument is that only one scale is visible at a time, although separate scales are provided for each of the twelve ranges. The scales are engraved on a large drum operated by the range selector switch. Six of the ranges are for DC measurement, three each for current and and voltage. The current ranges provide for full scale readings of 1 mA, 8 mA, and 130 mA DC respectively, while on the voltage ranges the full scale readings are 8, 130 and 1,000 volts DC or AC according to the position of the switch.

The remaining three ranges are for resistance measurement, these giving full scale readings of 100 ohms, 50,000 ohms and 2 megohms. No external batteries are needed for any of the resistance ranges as two batteries, one of 1½ volts and the other of 24 volts, are contained in the instrument.

It is also possible to use the Roto-Ranger as an output meter and sockets are provided for this purpose. For these measurements any of the AC voltage ranges can be used.

The nucleus of the instrument is a sensitive moving-coil meter that requires one milliamp only for a full scale deflection. Shunts are not used on any of the voltage ranges so that the resistance is 1,000 ohms per volt throughout. The meter is dead-beat and it is fitted with a thin knife-edge pointer.

Measurements made on all the ranges show that a high degree of accuracy is attained and measurements made with the Roto-Ranger compare favourably with laboratory-type testing equipment.

One advantage of employing separate scales and having only the one in use visible is that many ranges can be provided without confusing the user, while each can have its graduations marked in the most convenient manner for that particular range. There are, of course, other ways of marking the scales for easy interpretation, especially when a large dial is used. In the Roto-Ranger the scales are approximately 2¾in. long so that the system adopted is undoubtedly the best for this particular instrument.

The instrument is attractively finished and the internal workmanship is very good indeed. High grade components are employed and the meter unit, which includes the rotating scales, is particularly well made, being totally enclosed in a cast aluminium case. It is an instrument that fully meets the requirements of the service engineer as well as that of the amateur experimenter. The price is £10 10s.

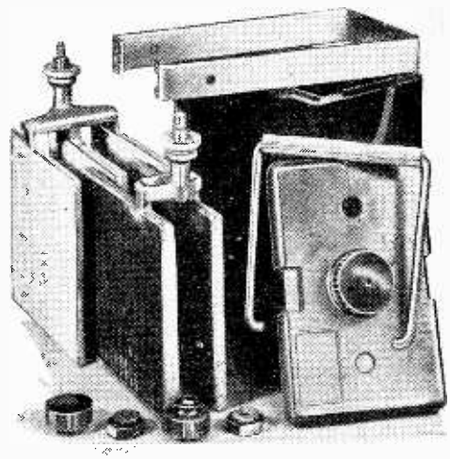
Simpson multi-range Roto-Ranger measuring instrument.

The Roto-Ranger is a product of the Simpson Electric Co. of America, and it can be obtained from Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1.

SIMPLAK ACCUMULATOR

THOUGH a brief description of this accumulator appeared in our issue of May 7th last, we omitted to mention its most interesting feature as full details of the battery were not available at the time.

It appears that this accumulator can be easily dismantled and the plates removed for cleaning or, if needs be, for replating by the user without the aid of special tools. The metal band that appears to be a part of



Simplak type M5 accumulator dismantled using only the special tool provided.

the carrying handle is, in fact, a combination spanner which, when removed—and this is done by springing off the handle and using the turned-in end-part as a lever to remove the U-shaped band—is used to unscrew the nuts underneath the terminal heads. There is a thin metal nut and a larger one below it. It is not essential, however, to completely dismantle the plates for examination, as with the strap removed the lid, complete with plates, can be taken off. On examining the sides of the case, two slots, one on each side, will be found for the insertion of the end of the tool.

Between the lid and the case is a layer of sealing compound, and this must not be wiped off, for when the accumulator is reassembled and the metal band replaced it will re-seal the battery and prevent acid leakage.

The ease with which the cell can be taken to pieces is a most valuable feature and it is probably unique in batteries of this size and type.

The makers are Simplak Batteries, Ltd., British Industries House, Marble Arch, London, W.1, and the price of this particular model is 12s. 6d.

Wireless Engineer, June, 1937

THE Design of Coupling Filters in Broadcast Receivers is discussed in the Editorial this month. E. T. Wrathall reviews the principles of AF transformers and shows how to apply them to design work.

Dr. H. A. Thomas describes some new equipment for measuring RF of from 1 to 70 Mc/s and W. Ross, M.A., gives some interesting facts regarding the effect of inonospheric reflected rays on DF bearings.

A calibrated time base for use with CR tubes is described by F. C. Williams, M.Sc., D.Phil., and J. P. Wolfenden, B.Sc.

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength

(This list is included in the first issue of each month. Stations with an Aerial Power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Ankara (Turkey)	152	.....	1973.5	5
Kaunas (Lithuania)	153	.....	1961	7
Radio Romania (Brasov) Romania	160	.....	1875	150
Hilversum, No. 1 (Holland) (10 *kW.* till 1840)	160	.....	1875	150
Lahti (Finland)	166	.....	1807	150
Moscow, No. 1, RW1 (Komintern) (U.S.S.R.)	172	.....	1744	500
Paris (Radio Paris) (France)	182	.....	1648	80
Istanbul (Turkey)	185	.....	1622	5
Irkutsk (U.S.S.R.)	187.5	.....	1600	20
Deutschlandsender (Germany)	191	.....	1571	60
Droitwich	200	.....	1500	150
Minsk, RW10 (U.S.S.R.)	208	.....	1442	35
Reykjavik (Iceland)	208	.....	1442	16
Motala (Sweden)	216	.....	1389	150
Novosibirsk, RW76 (U.S.S.R.)	217.5	.....	1379	100
Warsaw, No. 1 (Poland)	224	.....	1339	120
Luxembourg	232	.....	1293	150
Leningrad, No. 1 RW53 (Kolpino) (U.S.S.R.)	232	.....	1293	100
Kalundborg (Denmark)	240	.....	1250	60
Vienna, No. 2 (Austria)	240	.....	1250	0.5
Kiev, No. 1 (U.S.S.R.)	248	.....	1209.6	100
Vigra (Aalesund) (Norway)	253	.....	1186	10
Tashkent, RW11 (U.S.S.R.)	256.4	.....	1170	25
Oslo (Norway)	260	.....	1153.8	60
Moscow, No. 2, RW49 (Stchelkovo) (U.S.S.R.)	271	.....	1107	100
Tromsö (Norway)	282	.....	1065	10
Tiflis, RW7 (U.S.S.R.)	283	.....	1060	35
Saratov (U.S.S.R.)	340	.....	882.3	20
Finmark (Norway)	347	.....	864	10
Archangel (U.S.S.R.)	350	.....	857.1	10
Rostov-on-Don, RW12 (U.S.S.R.)	355	.....	845.1	20
Budapest, No. 2 (Hungary)	359.5	.....	834.5	18
Sverdlovsk, RW5 (U.S.S.R.)	375	.....	800	40
Voroneje, RW25 (U.S.S.R.)	390	.....	769	10
Boden (Sweden)	392	.....	765	0.6
Banska-Bystrica (Czechoslovakia) (15 *kW.* after 1700)	392	.....	765	30
Geneva (Switzerland)	401	.....	748	1.3
Moscow, No. 3 (RCZ) (U.S.S.R.)	413.5	.....	723	100
Ostersund (Sweden)	413.5	.....	726	0.6
Oulu (Finland)	431	.....	696	10
Tartu (Estonia)	511	.....	587.1	0.5
Hamar (Norway)	519	.....	578	0.7
Innsbruck (Austria)	519	.....	578	1
Ljubljana (Yugoslavia)	527	.....	569.3	6.3
Viipuri (Finland)	527	.....	569.3	10
Bolzano (Italy)	536	.....	559.7	10
Wilno (Poland)	536	.....	559.7	50
Budapest, No. 1 (Hungary)	546	.....	549.5	120
Beromünster (Switzerland)	556	.....	539.6	100
Athlone (Irish Free State)	565	.....	531	100
Klaipeda (Lithuania)	565	.....	531	10
Palermo (Italy)	565	.....	531	3
Stuttgart (Germany)	574	.....	522.6	100
Alpes-Grenoble, P.T.T. (France)	583	.....	514.6	20
Madona (Latvia)	583	.....	514.6	50
Vienna, No. 1 (Austria)	592	.....	506.8	100
Rabat (Morocco)	601	.....	499.2	25
Sundsvall (Sweden)	601	.....	499.2	10
Florence (Italy)	610	.....	491.8	20
Cairo, No. 1 (Egypt)	620	.....	483.9	20
Brussels, No. 1 (Belgium)	620	.....	483.9	15
Lisbon (Portugal)	629	.....	476.9	15
Tröndelag (Norway)	629	.....	476.9	20
Christiansand (Norway)	629	.....	476.9	20
Prague, No. 1 (Czechoslovakia)	638	.....	470.2	120
Lyons, P.T.T. (France)	648	.....	463	100
Petrozavodsk (U.S.S.R.)	648	.....	463	10
Cologne (Germany)	658	.....	455.9	100
North Regional (Slaithwaite)	668	.....	449.1	70
Jerusalem (Palestine)	668	.....	449.1	20
Sottens (Switzerland)	677	.....	443.1	100
Belgrade (Yugoslavia)	686	.....	437.3	2.5
Paris, P.T.T. (France)	695	.....	431.7	120
Stockholm (Sweden)	704	.....	426.1	55
Rome, No. 1 (Italy)	713	.....	420.8	50
Kharkov, No. 1, RW20 (U.S.S.R.)	722	.....	415.4	10
Fredrikstad (Norway)	722	.....	415.4	1
Tallinn (Estonia)	731	.....	410.4	20
Madrid, EAJ2 (Spain)	731	.....	410.4	3
Seville (Spain)	731	.....	410.4	5.5
Munich (Germany)	740	.....	405.4	100
Marseilles, P.T.T. (France)	749	.....	400.5	100
Pori (Finland)	749	.....	400.5	1
Katowice (Poland)	758	.....	395.8	12
Scottish Regional (Falkirk)	767	.....	391.1	70
North Scottish Regional (Burghead)	767	.....	391.1	60
Stalino (U.S.S.R.)	776	.....	386.6	10
Toulouse, P.T.T. (France)	776	.....	386.6	120
Leipzig (Germany)	785	.....	382.2	120
Barcelona, EAJ1 (Spain)	795	.....	377.4	7.5
Lwow (Poland)	795	.....	377.4	50
North Welsh Regional (Penmon)	804	.....	373.1	5
West Regional (Washford Cross)	804	.....	373.1	70
Milan, No. 1 (Italy)	814	.....	368.6	50
Bucharest (Romania)	823	.....	364.5	12
Kiev, No. 2, RW9 (U.S.S.R.)	832	.....	360.6	35
Agen (France)	832	.....	360.6	1.5
Berlin (Germany)	841	.....	356.7	100
Sofia (Bulgaria)	847.5	.....	354	1
Norwegian Relay Stations	850	.....	352.9	—
Valencia (Spain)	850	.....	352.9	3
Simferopol, RW52 (U.S.S.R.)	859	.....	349.2	10
Strasbourg (France)	859	.....	349.2	100
Poznan (Poland)	868	.....	345.6	16
London Regional (Brookmans Park)	877	.....	342.1	70
Linz (Austria)	886	.....	338.6	15
Graz (Austria)	886	.....	338.6	15
Helsinki (Finland)	895	.....	335.2	10
Limoges, P.T.T. (France)	895	.....	335.2	1.5
Hamburg (Germany)	904	.....	331.9	100
Dniepropetrovsk (U.S.S.R.)	913	.....	328.6	10
Toulouse (Radio Toulouse) (France)	913	.....	328.6	60
Brno (Czechoslovakia)	922	.....	325.4	32
Brussels, No. 2 (Belgium)	932	.....	321.9	15
Algiers (Algeria)	941	.....	318.8	12
Göteborg (Sweden)	941	.....	318.8	10
Breslau (Germany)	950	.....	315.8	100
Paris (Poste Parisien) (France)	959	.....	312.8	60
Bordeaux-Sud-Ouest (France)	968	.....	309.9	30
Odessa (U.S.S.R.)	968	.....	309.9	10
Northern Ireland Regional (Lisburn)	977	.....	307.1	100
Genoa (Italy)	986	.....	304.3	10
Torun (Poland)	986	.....	304.3	24
Hilversum No. 2 (Holland) (15 *kW.* till 1840)	995	.....	301.5	60
Bratislava (Czechoslovakia)	1004	.....	298.8	13.5
Midland Regional (Droitwich)	1013	.....	296.2	70
Chernigov (U.S.S.R.)	1013	.....	296.2	4
Barcelona, EAJ15 (Spain)	1022	.....	293.5	3
Cracow (Poland)	1022	.....	293.5	2
Oviedo (Spain)	1022	.....	293.5	0.7
Königsberg, No. 1 (Heilsberg) (Germany)	1031	.....	291	100
Paredo (Portugal)	1031	.....	291	5
Leningrad, No. 2, RW70 (U.S.S.R.)	1040	.....	288.5	10
Rennes-Bretagne (France)	1040	.....	288.5	120
Scottish National (Falkirk)	1050	.....	285.7	50
Bari No. 1 (Italy)	1059	.....	283.3	20
Paris (Radio Cité) (France)	1068	.....	280.9	0.8
Tiraspol, RW57 (U.S.S.R.)	1068	.....	280.9	10
Bordeaux-Lafayette (France)	1077	.....	278.6	35
Zagreb (Yugoslavia)	1086	.....	276.2	0.7
Falun (Sweden)	1086	.....	276.2	2
Madrid, EAJ7 (Spain)	1095	.....	274	5
Vinnitsa (U.S.S.R.)	1095	.....	274	10
Kuldiga (Latvia)	1104	.....	271.7	10
Naples (Italy)	1104	.....	271.7	1.5
Moravska-Ostrava (Czechoslovakia)	1113	.....	269.5	11.2
Radio Normandie (Fécamp) (France)	1113	.....	269.5	10
Alexandria, No. 1 (Egypt)	1122	.....	267.4	0.5
Newcastle	1122	.....	267.4	1
Nyiregyhaza (Hungary)	1122	.....	267.4	6.25
Hörby (Sweden)	1131	.....	265.3	10
Turin, No. 1 (Italy)	1140	.....	263.2	7
Trieste (Italy)	1140	.....	263.2	10
London National (Brookmans Park)	1149	.....	261.1	20
North National (Slaithwaite)	1149	.....	261.1	20
West National (Washford Cross)	1149	.....	261.1	20
Kosice (Czechoslovakia)	1158	.....	259.1	10
Monte Ceneri (Switzerland)	1167	.....	257.1	15
Copenhagen (Denmark)	1176	.....	255.1	10
Nice-Corse (France)	1185	.....	253.2	60
Frankfurt (*and Relays*) (Germany)	1195	.....	251	25
Prague, No. 2 (Czechoslovakia)	1204	.....	249.2	5
Lille, P.T.T. (France)	1213	.....	247.3	60
Bologna (Radio Marconi) (Italy)	1222	.....	245.5	50
Gleiwitz (Germany)	1231	.....	243.7	5
Cork (Irish Free State)	1235	.....	242.9	1
Saarbrücken (Germany)	1249	.....	240.2	17
Riga (Latvia)	1258	.....	238.5	15
Rome, No. 3 (Italy)	1258	.....	238.5	1
Bilbao, EAJ8 (Spain)	1258	.....	238.5	1
Nürnberg (Germany)	1267	.....	236.8	2
Radio Mediterranée (Juan-les-Pins) (France)	1276	.....	235.1	27
Dresden (Germany)	1285	.....	233.5	0.25
Aberdeen	1285	.....	233.5	1
Klagenfurt (Austria)	1294	.....	231.8	5
Vorarlberg (Austria)	1294	.....	231.8	5
Danzig	1303	.....	230.2	0.5

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Swedish Relay Stations	1312	.....	228.7	—
Magyarovar (Hungary)	1321	.....	227.1	1.25
German Relay Stations	1330	.....	225.6	—
Montpellier, P.T.T. (France)	1339	.....	224	1.5
Lodz (Poland)	1339	.....	224	2
Dublin (Irish Free State)	1348	.....	222.6	0.5
Rjukan (Norway)	1348	.....	222.6	0.15
Salzburg (Austria)	1348	.....	222.6	2
Tampere (Finland)	1348	.....	222.6	0.7
Cairo No. 2 (Egypt)	1348	.....	222.6	0.5
Königsberg (Germany)	1348	.....	222.6	2
Nottoden (Norway)	1357	.....	221.1	0.15
Italian Relay Stations	1357	.....	221.1	—
L'Ile de France (France)	1366	.....	219.6	2
Basle (Switzerland)	1375	.....	218.2	0.5
Berne (Switzerland)	1375	.....	218.2	0.5
Warsaw, No. 2 (Poland)	1384	.....	216.8	7
Lyons (Radio Lyons) (France)	1393	.....	215.4	25
Stara-Zagora (Bulgaria)	1402	.....	214	2
Vaasa-Vasa (Finland)	1420	.....	211.3	10
Alexandria, No. 2 (Egypt)	1429	.....	209.9	0.5
Turku (Finland)	1429	.....	209.9	0.5
Miskolc (Hungary)	1438	.....	208.6	1.25
Paris (Eiffel Tower) (France)	1456	.....	206	7
Pecs (Hungary)	1465	.....	204.8	1.25
Belgian Relay Stations	1465	.....	204.8	0.1
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Binche (Belgium)	1487	.....	201.7	0.1
Belgian Relay Stations	1492	.....	201.1	0.1
Nimes (France)	1492	.....	201.1	0.7
Albacete (Spain)	1492	.....	201.1	0.2
Santiago (Spain)	1492	.....	201.1	0.5
Belgian Relay Stations	1500	.....	200	0.1
Pietarsaari (Finland)	1500	.....	200	0.25
Radio Alcalá (Spain)	1500	.....	200	0.2
Karlskrona (Sweden)	1530	.....	196	0.2
Liepàja (Latvia)	1734	.....	173	0.1

SHORT-WAVE STATIONS OF THE WORLD

Station.	Call Sign.	kc/s.	Tuning Positions.	Metres.	kW.
Batavia (Java)	YDA	3,040	.....	98.68	10
Kharbarovsk (Russia)	RV15	4,273	.....	70.20	20
Caracas (Venezuela)	YV5RH	5,800	.....	51.72	1
San Jose (Costa Rica)	TIGPH	5,820	.....	51.52	0.5
Vatican City (Vatican State)	HVJ	5,970	.....	50.26	10
Mexico City (Mexico)	XEBT	6,000	.....	50.00	1
Moscow (Russia)	RW59	6,000	.....	50.00	20
Montreal (Canada)	CFCX	6,005	.....	49.96	—
Havana (Cuba)	COCO	6,010	.....	49.92	0.5
Prague (Podebrady) (Czechoslovakia)	OLR	6,010	.....	49.92	30
Bogota (Colombia)	HJ3ABH	6,018	.....	49.90	1
Zeesen (Germany)	**DJC**	6,020	.....	49.83	50
Boston (U.S.A.)	W1XAL	6,040	.....	49.67	10
Miami (U.S.A.)	W4XB	6,040	.....	49.67	2.5
Daventry (Gt. Britain)	**GSA**	6,050	.....	49.59	10-50
Cincinnati (U.S.A.)	W8XAL	6,060	.....	49.50	10
Philadelphia (U.S.A.)	W3XAU	6,060	.....	49.50	10
Skamlebaek (Denmark)	OXY	6,060	.....	49.50	0.5
Motala (Sweden)	SBG	6,060	.....	49.50	1
Chicago (U.S.A.)	W9XAA	6,080	.....	49.34	0.5
Nairobi (Kenya)	VQ7LO	6,083	.....	49.31	0.5
Toronto (Bowmanville) (Canada)	CRCX	6,090	.....	49.26	0.5
Hong Kong (China)	ZBW2	6,090	.....	49.26	2
Johannesburg (South Africa)	ZTJ	6,100	.....	49.20	5
Bound Brook (U.S.A.)	W3XAL	6,100	.....	49.18	35
Chicago (U.S.A.)	W9XF	6,100	.....	49.18	10
Belgrade (Yugoslavia)	.....	6,100	.....	49.18	1
Manizales (Colombia)	HJ4ABB	6,105	.....	49.12	1
Daventry (Gt. Britain)	**GSL**	6,110	.....	49.10	10-50
Calcutta (India)	VUC	6,110	.....	49.10	0.5
Wayne (U.S.A.)	W2XE	6,120	.....	49.02	10
Pittsburgh (U.S.A.)	W8XK	6,140	.....	48.86	40
Winnipeg (Canada)	CJRO	6,150	.....	48.78	2
Lisbon (Portugal)	CSL	6,150	.....	48.78	0.5
Caracas (Venezuela)	YV5RD	6,150	.....	48.78	1
Parede (Portugal)	CT1GO	6,200	.....	48.40	5
San Jose (Costa Rica)	TIPG	6,410	.....	43.80	0.5
Valencia (Colombia)	YV4RV	6,520	.....	46.00	0.5
Riobamba (Ecuador)	PRADO	6,620	.....	45.31	2
Amateurs	.....	7,000 to 7,300	.....	42.86 to 41.10	0.01
Moscow (U.S.S.R.)	RW96	7,520	.....	38.89	25
Prangins (Radio-Nations) (Switz'l'd)	HBP	7,780	.....	38.48	20
Budapest (Hungary)	HAT4	9,125	.....	32.88	5
Bangkok (Siam)	HS8PJ	9,350	.....	32.09	20
Madrid (Spain)	EAQ2	9,480	.....	31.65	20
Rio de Janeiro (Brazil)	PRF5	9,500	.....	31.58	5
Daventry (Gt. Britain)	**GSB**	9,510	.....	31.55	10-50
Melbourne (Australia)	VK3ME	9,510	.....	31.55	1.5
Hongkong (China)	ZBW3	9,520	.....	31.49	2
Jelöy (Norway)	LKJ1	9,520	.....	31.49	1.5
Schenectady (U.S.A.)	W2XAF	9,530	.....	31.48	30
Zeesen (Germany)	**DJN**	9,540	.....	31.45	50
Suva (Fiji)	VPD2	9,540	.....	31.45	3
Prague (Podebrady) (Czechoslovakia)	OLR	9,550	.....	31.41	30
Zeesen (Germany)	**DJA**	9,560	.....	31.38	50
Bombay (India)	VUB	9,565	.....	31.36	4.5
Millis (U.S.A.)	W1XK	9,570	.....	31.35	10
Daventry (Gt. Britain)	**GSC**	9,580	.....	31.32	10-50
Lyndhurst (Australia)	VK3LR	9,580	.....	31.32	1
Philadelphia (U.S.A.)	W3XAU	9,590	.....	31.28	10
Sydney (Australia)	VK2ME	9,590	.....	31.28	20
Huizen (Holland)	PCJ	9,590	.....	31.28	20
Prangins (Radio-Nations) (Switz'l'd)	HBL	9,595	.....	31.27	20
Moscow (Russia)	RW96	9,600	.....	31.25	20
Rome (Italy)	12RO3	9,635	.....	31.13	25
Sourabaya (Java)	YDB	9,640	.....	31.11	1
Lisbon (Portugal)	CT1AA	9,655	.....	31.09	2
Buenos Aires (Argentina)	LRX	9,660	.....	31.06	5
Lisbon (Portugal)	CT1CT	9,680	.....	31.00	0.5
Madrid (Spain)	EAQ	9,860	.....	30.43	20
Lisbon (Portugal)	CSW	9,940	.....	30.18	5
Bandoeng (Java)	PMN	10,260	.....	29.24	3
Ruysselede (Belgium)	ORK	10,330	.....	29.04	9
Buenos Aires (Argentina)	LSX	10,350	.....	28.99	12
Teneriffe (Canary Isles)	EAJ43	10,360	.....	28.94	4
Tokio (Japan)	JVM	10,740	.....	27.93	20
Bandoeng (Java)	PLP	11,010	.....	27.25	3
Lisbon (Portugal)	CSW	11,040	.....	27.17	5
Motala (Sweden)	SBG	11,700	.....	25.63	1
Winnipeg (Canada)	CJRX	11,720	.....	25.60	2
Paris (Radio-Colonial) (France)	TPA4	11,720	.....	25.60	12
Daventry (Gt. Britain)	**GSD**	11,750	.....	25.53	10-50
Zeesen (Germany)	**DJD**	11,770	.....	25.49	50
Boston (U.S.A.)	W1XAL	11,790	.....	25.45	20
Tokio (Japan)	JZJ	11,800	.....	25.42	20
Vienna (Austria)	OER2	11,800	.....	25.42	1.5
Rome (Italy)	12RO4	11,810	.....	25.40	25
Daventry (Gt. Britain)	**GSN**	11,820	.....	25.38	10-50
Wayne (U.S.A.)	W2XE	11,830	.....	25.36	10
Lisbon (Portugal)	CT1AA	11,830	.....	25.36	2
Prague (Podebrady) (Czechoslovakia)	OLR	11,840	.....	25.34	30
Zeesen (Germany)	**DJP**	11,850	.....	25.31	50
Daventry (Gt. Britain)	**GSE**	11,860	.....	25.29	10-50
Pittsburgh (U.S.A.)	W8XK	11,870	.....	25.27	40
Paris (Radio-Colonial) (France)	TPA3	11,880	.....	25.23	12
Moscow (Russia)	RNE	12,000	.....	25.00	20
Lisbon (Portugal)	CT1CT	12,082	.....	24.83	0.5
Reykjavik (Iceland)	TFJ	12,235	.....	24.52	7.5
Parede (Portugal)	CT1GO	12,400	.....	24.20	0.35
Warsaw (Poland)	SPW	13,635	.....	22.00	10
Amateurs	.....	14,000 to 14,400	.....	21.42 to 20.84	0.01
Sofia (Bulgaria)	LZA	14,970	.....	20.04	1.5
Zeesen (Germany)	**DJL**	15,111	.....	19.85	50
Vatican City (Vatican State)	HVJ	15.123	.....	19.84	10
Daventry (Gt. Britain)	**GSF**	15,140	.....	19.82	10-50
Bandoeng (Java)	YDC	15,160	.....	19.80	3
Daventry (Gt. Britain)	GSO	15,180	.....	19.76	10
Hongkong (China)	ZBW4	15,190	.....	19.75	2
Zeesen (Germany)	**DJB**	15,200	.....	19.74	50
Pittsburgh (U.S.A.)	W8XK	15,210	.....	19.72	40
Huizen (Holland)	PCJ	15,220	.....	19.71	20
Prague (Podebrady) (Czechoslovakia)	OLR	15,230	.....	19.70	30
Paris (Radio-Colonial) (France)	TPA2	15,243	.....	19.68	12
Boston (U.S.A.)	W1XAL	15,250	.....	19.67	20
Daventry (Gt. Britain)	**GSI**	15,260	.....	19.66	10-50
Wayne (U.S.A.)	W2XE	15,270	.....	19.65	10
Zeesen (Germany)	**DJQ**	15,280	.....	19.63	50
Buenos Aires (Argentina)	LRU	15,290	.....	19.62	5
Daventry (Gt. Britain)	**GSP**	15,310	.....	19.60	10-50
Schenectady (U.S.A.)	W2XAD	15,330	.....	19.57	18
Zeesen (Germany)	**DJR**	15,340	.....	19.56	50
Budapest (Szekesfehervar) (Hungary)	HAS3	15,370	.....	19.52	20
Hongkong (China)	ZBW5	17,750	.....	16.90	2
Zeesen (Germany)	**DJE**	17,760	.....	16.89	50
Wayne (U.S.A.)	W2XE	17,760	.....	16.89	10
Huizen (Holland)	PHI	17,770	.....	16.88	23
Bound Brook (U.S.A.)	W3XAL	17,780	.....	16.87	35
Daventry (Gt. Britain)	**GSG**	17,790	.....	16.86	10-50
Bandoeng (Java)	**PLE**	18,830	.....	15.93	60
Bangkok (Siam)	HS8PJ	19,020	.....	15.77	20
Bandoeng (Java)	**PMA**	19,350	.....	15.50	60
Daventry (Gt. Britain)	**GSH**	21,470	.....	13.97	10-50
Wayne (U.S.A.)	W2XE	21,520	.....	13.94	10
Daventry (Gt. Britain)	**GSJ**	21,530	.....	13.93	10-50
Pittsburgh (U.S.A.)	W8XK	21,540	.....	13.93	40
Daventry (Gt. Britain)	**GST**	21,550	.....	13.92	10-50

Experimenting

HOW TO KEEP IN TOUCH WITH WHAT OTHERS HAVE ALREADY DONE IN YOUR FIELD OF RESEARCH

IN well-equipped laboratories experimenting is dignified with the title of RESEARCH (with a capital "R"); in the home it is generally called "*tinkering about in the workshop.*" Sooner or later we all come to it. The home-constructor of *The Wireless World* sets tries a valve or component different from that given in the published design, or alters the lay-out, in the optimistic hope of improving the performance; and at the moment that a written note or record of a result is made, such "tinkering" is entitled to the status of *Experimenting,* no less than the work in the research laboratories of a manufacturing firm where a group of experts is spending years in evolving, say, a new method of television reception.

Nothing is more heartrending than to spend a lot of trouble over some piece of experimenting, only to find out afterwards that it has already been worked out by someone else, who has not only made notes for his own use, but has also published his results. Even if the solution of the exact problem on which one may be engaged has not been published, there are nearly always articles or papers on some parallel line of work which it would be helpful to read, as indicating a promising line of attack, or which would save much preliminary "trial and error" by enabling one to start where the other man left off. In almost any work of this sort, time spent in looking up the references before starting one's own experiments is time saved in the end. This is where the "Old Hand" scores over the beginner; not that the most expert of whole-time research workers, who makes his living at it, can possibly attempt to *know* everything that has been written on any particular point, but he *does* know *where to look* for it.

The number of journals in different languages which contain information that may be of use to the wireless experimenter is so vast that, first, no one could afford to buy them all, and, secondly, if he could afford to buy them, he would never have time to read them, and, thirdly, if he could read them all he would never be able to remember where he had seen an article or paper on a particular point, unless he made himself some sort of index. Furthermore, if such an index were a mere list of titles of papers, it would not be much use without some further indication of the contents, such as is generally called an *abstract.* It would be beyond the capacity of any one man to make even a simple index, let alone abstracts, of more than a very small part of the available literature. To do the job properly and thoroughly requires a proper organisation. THE RADIO RESEARCH BOARD has organised such a scheme, and some 4,000 articles and papers are abstracted every year, primarily for the use of the Board and its workers in their own researches.

Concentrated Abstracts

But, fortunately, for the individual worker the results are made available to all by an arrangement for their publication in the monthly issues of *The Wireless Engineer.* Each abstract is numbered. Starting afresh from No. 1 each year, they appear grouped and classified under fourteen headings, ranging from *Propagation of Waves* to *Miscellaneous,* and including sections on *Reception,* on *Acoustics and Audio-Frequencies,* and on *Phototelegraphy and Television.* Where there is any doubt as to the heading under which a particular abstract should be placed, a full abstract is given under one section, and cross-references in the others. The length of an abstract varies. It may be affected to a slight extent by the importance of the original article, but it is much more dependent on the general accessibility of the publication in which this is to be found. In the case of a reference to an English journal, usually little more than the title is given with perhaps half a dozen words indicating the scope of the work described. References to American, French, and German journals are more extensive. Usually, a sufficient summary is given to enable the reader to decide if it is worth his while to go to some trouble to look up the original in a large library (if he have access to one), or even to order the particular issue from his bookseller. Papers in languages such as Russian or Japanese, which few of us could read even if they were accessible, are usually abstracted in much more detail. Often a column or more of small print (say 500 words or more) is devoted to a single abstract if the original paper seems likely to be of importance.

In December an Index to all the abstracts of the year is published, under the same fourteen headings, indexed under each heading in alphabetical order of the most important word in the title, which is printed in heavy type to catch the eye.

As an illustration, let us suppose that we are thinking of trying some system of remote-control tuning for a receiver, and that we start by looking up references. Taking the December issue of *The Wireless Engineer,* we turn to the INDEX TO ABSTRACTS AND REFERENCES, 1936, and in

Experimenting—

the section headed **RECEPTION** we find **Tuning** in alphabetical order, and we read :—

A New Method of **Tuning** using Magnetic Bias.—Leithäuser & Boucke, **2974.**

We then turn up abstract No. 2974 of 1936, which is found in the August issue, and read :—

RECEPTION

2974. A NEW METHOD OF TUNING USING MAGNETIC BIAS [applicable to All Wave Bands including Ultra-Short].—G. Leithäuser and H. Boucke. (*Funktech. Monatshefte*, May, 1936, No. 5, pp. 167–171.)

The heading is followed by a detailed abstract of about 600 words, indicating the application of the principle to remote control, etc.

A certain amount of intelligence is required to make full use of the information provided, for example, if information is sought on oscillators of the Dynatron variety, one should look up *Oscillator* and *Dynatron* in the section VALVES AND THERMIONICS, and also *Negative Resistance* in the section PROPERTIES OF CIRCUITS. It does not take long to get used to the arrangement of the abstracts, and one can then turn up information on any subject to which reference may be required with very little delay.

These abstracts are exceedingly comprehensive, and they go back, with their annual indices, for more than ten years. At the cost of an hour or two of work it is possible to look through these indices for several years back, making a note of the number and year of any abstract which seems, from its title as if it might have a bearing on the problem in hand; and then looking up each of these abstracts themselves, found by number and year, which will usually serve to eliminate many of those items which, from the index entry alone, seemed worth considering. One thus arrives at a bibliography on one's special problem, from which it is very improbable that any published work of importance has been omitted. Without the aid of the abstracts such a search of the literature would have taken months rather than hours, and even then one would be far from sure that one had not missed something, probably the very paper that it was most important to see.

New Osram Photo-Cell

HIGHLY SENSITIVE SECONDARY EMISSION TYPE

PHOTO-CELLS are now widely used in many different kinds of apparatus, and a new specimen introduced by Osram is especially interesting in view of its high sensitivity, low noise-level and wide frequency response. It is the type CWS 24 and is claimed to have the sensitivity of the gas-filled type with the low noise-level usually associated only with vacuum types.

The evacuated glass envelope, which houses the electrodes, itself carries the primary cathode, which is of the caesium on silver-oxide type; this cathode is deposited on one-half of the internal surface of the bulb. The other electrodes, the secondary cathode and the collector or anode, are carried by separate glass pinches.

In operation the primary cathode emits electrons under the influence of light. These strike the secondary cathode or target and their impact causes a greater number of electrons to be ejected from this electrode, and this secondary emission is collected by the anode.

The maximum potential between the primary cathode and collector should be 800 volts, but 500 volts is usually sufficient. The voltage between the primary and secondary cathodes should be about 75 per cent. of that between the primary cathode and collector, and a safety resistance of 10,000 ohms should be inserted in the secondary cathode lead as a safety device. The primary emission is of the order of 40 μA/lumen after a preliminary ageing period, and the secondary emission cofficient is about 7.

The frequency response up to 1 Mc/s is of the same order as that obtained with a vacuum type of cell. The cell is priced at £8.

New Halcyon Battery Set

A Six-valve Superheterodyne With Fly-wheel Tuning

IN external appearance this set, which is to be known as the Model B691, is similar to the A581 AC mains receiver. The fly-wheel tuning principle which was one of the leading features of the mains receiver is again used, but the 14 × 4½-inch scale is printed in black and white and is not illuminated.

There are six valves in the circuit—a hexode frequency-changer, separate triode oscillator, variable-mu pentode IF amplifier, double-diode-triode second detector, and two pentodes in quiescent push-pull. The output of 1.5 watts is taken by an 8-inch PM speaker with a flux density of 10,000 lines.

The three waveranges covered are 16.5-51, 190-560 and 850-2,000 metres, and there is band-pass tuning on the medium- and long-wave ranges. Without batteries the price is 14 guineas and the makers are Ismay Distributors, Ltd., Dagenham, Essex.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

A Word About Birmingham

BIRMINGHAM was once proud to own the biggest B.B.C. studio in the country. But that was in the days before Broadcasting House was constructed, and when the skating rink at Maida Vale was still a derelict shell.

Has Birmingham's glory departed for ever?

Worth Watching

Sleuths in the Midlands would tell you that there is still hope. They would tell you that the B.B.C.—and the letters do not stand for Birmingham Borough Council—has acquired a magnificent new site in one of the southern suburbs covering an area larger than the Maida Vale skating rink.

Watch Birmingham.

B.B.C. Staff as Critics

"LISTENER Research" begins at home, in the opinion of the B.B.C. chiefs, and to put the idea into practice they have issued an invitation to the Corporation staff to criticise the programmes. Comments, favourable or the reverse, will be welcomed.

When the "Heads" Conferred

This is a highly interesting development of less democratic schemes which have held sway for several years past. Originally programme criticism within the Corporation was practically confined to the heads of Divisions, who met in conclave once a month. It was later extended to include heads of Departments, who in turn nominated certain members of their staff to listen critically to the evening programmes for a week at a time.

This failed to yield the success hoped for, as it was found that people who had been at work all day were not altogether reliable critics.

On the Dotted Line

The new scheme makes critical listening optional. Forms have been distributed enabling would-be critics to fill in on the dotted lines full particulars of the programme, with the date, time and the locality of the transmitter, and there is ample space for full-blooded criticism.

Equal Chances for All

The programme chiefs feel, probably quite rightly, that the B.B.C. staff represents a cross-section of the community. Everybody from a studio attendant in Belfast to a senior engineer at Droitwich is free to express an opinion; and as all names are to be treated confidentially, many people will have a chance to get rid of annoying inhibitions.

Broadcasting in 1837

SUPPOSE broadcasting had been invented a hundred years ago. That is what Jonquil Antony did when she devised the programme which is to be broadcast on the National wavelengths on June 20. Entitled "London Calling, 1837," it will give an imaginary rendering of the sort of broadcast which listeners would have heard when Queen Victoria came to the throne.

There will be a commentary on the obsequies of William IV and also a health talk by a leading doctor on "The Danger of Taking Baths: A Practice Unfortunately on the Increase."

The programme, which will be repeated on the Regionals on June 22, is being produced by Moray McLaren and M. H. Allen.

Harking Back

Why go back only a hundred years? The Great Fire of London would provide an illuminating commentary, and the microphone could be swung back through the ages to Agincourt, to the landing of the Romans or to a domestic talk broadcast by Eve to Adam.

Broadcasters in Uniform

SOUNDS of a modern battle will provide the most thrilling episode in the broadcast from the Aldershot Tattoo on June 12. The "battle" is being specially staged by units of the mechanised army.

To enable them to describe another episode—"The Passage of the Douro"—B.B.C. commentators will wear uniforms of the Peninsular War period, so that they can move among the troops without spoiling the spectacle.

Pageant of Empire

Another feature of this Coronation Tattoo will be a Pageant of Empire, in which troops from the Dominions will take part.

LARGE-SCREEN TELEVISION IN AMERICA. Dr. R. R. Law, of the RCA Laboratories, examines an image projected by means of his "Kinescope."

This, and the marching of massed bands, will be included in the broadcast, as well as the Grand Finale in the form of a "royal spectacle" entitled "The Challenge."

Three Dollars a Watt

THE B.B.C. is keenly interested in the suggestion of Mr. George Harry Payne, of the U.S. Federal Radio Commission, that broadcasting stations should be taxed according to their wattage. Mr. Payne would exact one dollar a watt from stations of less than 1,000 watts, two dollars a watt from stations between 1,000 and 10,000 watts, and three dollars a watt from those above 10,000 watts.

Bravo, Mr. Payne!

If the B.B.C. were taxed by the Treasury on the three-dollar scale the amount payable annually would be approximately £430,000, the total wattage of the Corporation's transmitters, omitting the Empire station, being 718,000.

In 1936 the Treasury took £1,050,000.

The B.B.C. considers that Mr. Payne's scale should be adopted forthwith.

Variety Department Changes

THE B.B.C. Director of Variety, Eric Maschwitz, has asked to be released, as from July 1st, from the position which he has held since 1933. He joined the B.B.C. in 1926 as an assistant in the Outside Broadcast Department, and from 1927 until the establishment of the Variety Department in 1933 was Editor of *The Radio Times*. As Director of Variety he has been largely responsible for the expansion of the light entertainment programmes, to which, we understand, he will still be a contributor from outside.

Watt Next

His successor will be John Watt, who is well known to listeners as the producer and compère of many programmes. He joined the B.B.C. at Belfast in 1927 and came to London in 1930. Charles Brewer, well known as collaborator with Leslie Baily in the Scrapbook programmes, will remain as assistant to the Director.

B.B.C. Film Ready

THE new B.B.C. film which is to fill most of the extra television hour is now ready. Actually, it runs for about forty minutes, so it is probable that the remainder of the demonstration period each day will be filled with that former *tour de force*, "Television Comes to London" and one or two "shorts."

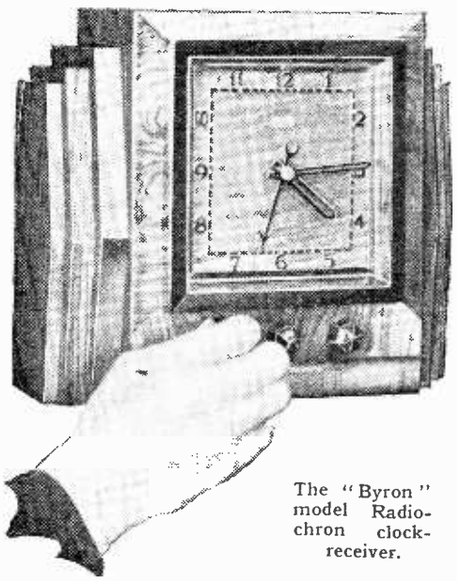
Those Teleciné Channels

If the introduction of this trade demonstration hour—for it is no more than this—depended solely upon when the film could be run through teleciné apparatus, it could take place to-morrow. Unfortunately, teleciné facilities at Alexandra Palace are limited, and the transmission of the film at the present moment during the morning hours would probably interfere with rehearsals for the afternoon and evening programmes.

It may still be a matter of weeks before television is on the air for three hours a day.

The "Radiochron"

WIRELESS AND TIME FROM ONE INSTRUMENT



The "Byron" model Radiochron clock-receiver.

IN these days a wireless receiver is for most people as much a necessity as a reliable clock. Why not, then, combine the two in a single instrument particularly where space is valuable as it is in the modern flat? The idea is, of course, not new, and we have seen many wireless receivers incorporating the modern synchronous type of clock as an auxiliary feature. In the Radiochron, however, the clock has absorbed the wireless receiver, and this has been done without any apparent loss of efficiency.

Surprisingly good volume and quality are obtained and the receiver has a range, using mains as an aerial, which suggests that more than the usual attention has been given to the design of the coupling and filtering circuits. A trimmer is provided at the back of the "clock," and when this was correctly adjusted no difficulty was experienced in tuning in the Midland, West and North Regional stations during the hours of daylight. Radio Normandie gave a volume level second only to that of the two Brookmans Park stations, and there can be little doubt that on most mains supplies the set will give all the Continental stations which one would expect with the average small superheterodyne on an outdoor aerial after dark. Naturally there will be a higher susceptibility to local interference which may find its way into the mains leads, but the level of background is much below that of the usual mains aerial tapping provided as an alternative in some domestic receivers.

Considerable ingenuity has been displayed in compressing the four-valve AVC superhet circuit together with its moving-coil loud speaker into so small a space (10in. high × 2in. wide and 4in. deep). The choice of all-metal valves has helped, and the idea of driving the clock hands through the hollow pole piece of a specially designed moving-coil loud speaker was a stroke of genius. It is only on close inspection that one discovers that the clock dial is also the loud speaker grille. It is made of sheet metal perforated with fine holes, and functions on the same principle as the sound-permeable screen used in cinema theatres.

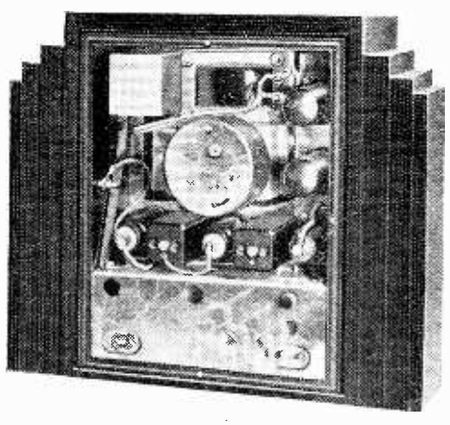
There are three controls arranged unobtrusively below the dial. Tuning is on the right, tone in the centre, and the combined volume and on-off switch on the left. By pulling out the latter control the dial may be floodlit from a pilot lamp concealed in the lower edge of the chromium-plated frame.

The "second" hand of the clock is really the tuning pointer, and a calibrated chart is provided converting "time" into station settings. The set is for medium waves only (230-560 metres), and is suited for controlled A.C. supplies between 200-250 volts. The makers are Radiochron, Ltd., Oaklands Road, Cricklewood, N.W.2, and the price is 15 guineas.

Numbers and Names

COINCIDENCES in broadcast programmes are now much rarer than in the early days when so many artistes and speakers were coming to the microphone for the first time and were heard by friends who had been out of touch with them, perhaps for years. Two incidents of the last few days, however, can be added to the record of singular events. In a radio play from Broadcasting House a telephone number had to be mentioned, and a number actually in the London area was given in the script. It was not until the subscriber on that number was rung up by several listeners that he discovered why his number had gained such notoriety. On looking through the cast published in the radio programme he saw that it included the name of a personal friend. No; this actor was not the writer of the script and was not responsible for the inclusion of this particular number.

The other coincidence concerned a programme written around the production of "Music Hall." For the purpose of the broadcast, producer John Sharman invented a number of purely mythical names for the imaginary artistes whom he was engaging to take part in a typical Music Hall programme. It turned out that one of his fictitious names happened to belong to a man who had in fact worked on the variety stage, and a letter reached Mr. Sharman from a friend of this artiste saying that he had not been in touch with the artiste since the War and asking for his address.



Back view of Radiochron showing all-metal valves grouped round central synchronous clock movement. The hands are driven through the hollow pole-piece of the moving-coil loud speaker.

RANDOM RADIATIONS

By "DIALLIST"

From the Empire

IT was a brain-wave on the B.B.C.'s part to take advantage of the presence in London of so many prominent men and women from different parts of the Empire to discuss with them the question of increasing the number of broadcasts to this country from the Empire. We maintain an outward service from the Mother Country for 18 hours out of the 24 on the short waves, and it is very right and proper that we should. But hitherto what we may call the inward services have been very few and far between, except on occasions such as Christmas Day and Empire Day. The B.B.C.'s suggestion that we should take more from the Empire has received a warm welcome. The great difficulty is that there are comparatively few short-wave broadcasting stations in existence in far-away countries that are sufficiently powerful to be reliable. However, South Africa, Australia, Canada and New Zealand are all going ahead with up-to-date short-wave transmitters, and before long we should hear a great deal more from the Empire about itself.

I have always believed that wireless could be and would be the most wonderful instrument for helping our peoples to learn more about one another and for uniting them yet more closely.

Automatic Tuning Control

WE are promised this season a number of those larger sets whose production I have for so long been urging in these notes. I am only hoping that they are going to be large enough; that is to say, that they will contain sufficient valves to ensure not only high sensitivity and high quality, but also many of the refinements that are possible in the up-to-date broadcast receiver. One of the most important of these, in my humble opinion, is automatic tuning control, especially in the set intended for use by the man in the street, who neither knows nor wants to know much about the finer points of handling his apparatus.

The other day I was talking to a couple of friends who fall into this category. They complained that one of the nuisances about many wireless sets was that after you'd switched on and tuned in a distant station you had presently to get up from your chair and make small readjustments, and that you might have to repeat the process later on. That is perfectly true of a good many sets as they warm up. And there are others which wobble rather badly, especially on their short-wave ranges. Then there are people who seem rarely to manage to tune a superhet correctly at all on the nearer and stronger stations. I believe that automatic tuning control would make a big difference to the popularity of the really large set. In its absence there should most certainly be some sensitive form of visual tuning indicator.

PA Quality

LATELY I have been rather struck by the poorness of speech reproduction by many of the public-address equipments that I have heard. Even the loud speakers of some of the police cars are not above criticism in this respect. The difficulty about reproducing speech at considerable volume is that the low frequencies are so apt to take charge. When they do so they mask the high frequencies, which are what the human ear chiefly needs if speech is to be intelligible. You may find, for instance, if you are using an ordinary superhet and want to make speech clear to a biggish audience, that turning up the volume control makes the words more difficult and not more easy to hear for those at the back of the room. By deliberate slight mis-tuning so as to make speech more "edgy" you can often effect considerable improvement. Some public-address amplifiers are excellent, but there are others whose designers would do well to pay greater attention to cutting out the "woomphs" when speech is being reproduced.

A Long Interval

IT seems a pity that our only television stations should have to close down for three whole weeks this summer, but I suppose it is inevitable if the necessary overhaul is to be made and improvements introduced into the apparatus. One can't help wondering, though, whether by means of a little speeding up something rather less than three weeks might not have been sufficient. What we badly need is a stand-by television transmitter, but I am afraid there is little chance of our getting it until the number of televiewers is much greater than it is now.

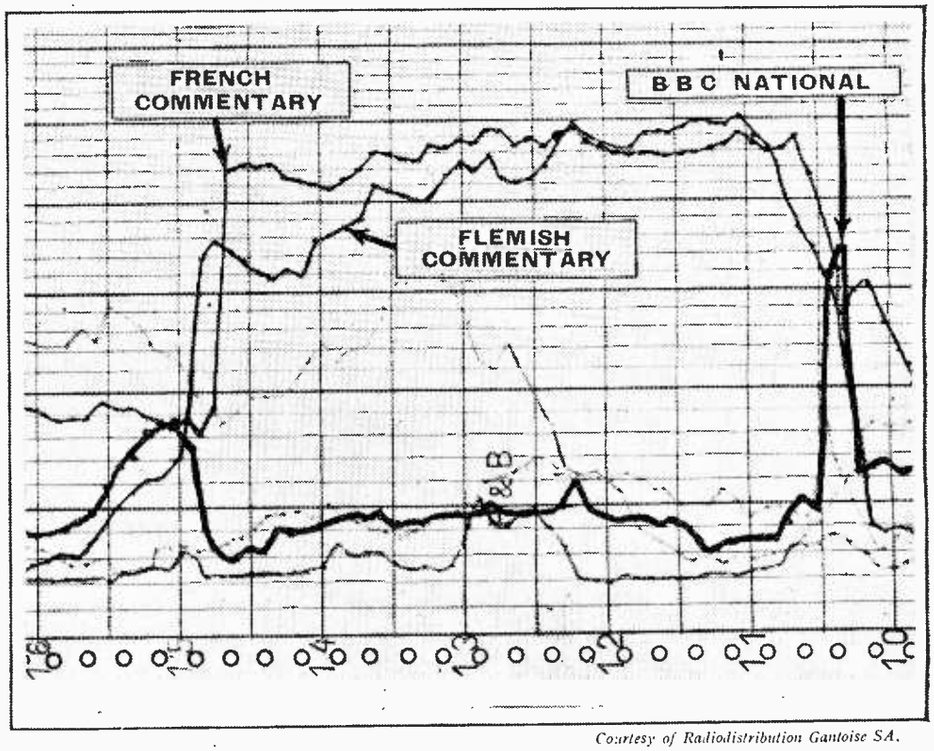
In any event, the interval, whether or not it runs to three weeks, provides an admirable opportunity for the ultra-short-wave sound transmitter at Broadcasting House to step into the breach by sending out portions, if not the whole, of the London programmes and thus making it possible for owners of television receivers to assess the superior acoustic qualities of U.S.W. transmission on a wider variety of programme material.

Brave New Words

IN the programmes of American stations I have just come across two words which are new to me. One of them is readily comprehensible and I am not sure that it isn't one of those neat and graphic American portmanteau words which are so useful that their invention is amply justified. This is "Newscaster." It means an outside broadcast commentator and it seems to me at any rate a great improvement on the B.B.C.'s "Observer"; it has a dynamic suggestion, while the latter's is mainly static. The other word, which puzzles me, is "Smoothies," which is used to describe a trio of jazz singers. I gather that a "Smoothy" is a kind of super crooner. If I am right, let's hope that, however suave their powers of persuation, they will be allowed to remain in the land that named them so.

Some Station!

WHILST hunting for news about the B.B.C.'s proposals for the extension of Empire broadcasting I came across this in *The Morning Post*, which doesn't often make a slip in matters wireless: "Major W. E. Gladstone Murray, General Manager of the Canadian Broadcasting Corporation, declared recently that it will be the aim of that body to establish a 50,000-kilowatt short-wave transmitter for relays of programmes to the British Empire." Some short-wave station!



Courtesy of Radiodistribution Gantoise SA.

HOW THE CORONATION NEWS CAME TO GHENT. This graph, taken from the automatic load recording apparatus of "Radiodistribution Gantoise," which conducts a six-line relay service at Ghent, shows that at noon on Coronation Day 2,540 subscribers (out of a total of 3,400) were listening to one or other of the commentaries on the ceremony.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

What is "An Oscillation"?

FROM time to time I have read articles in *The Wireless World* on nomenclature and clarity of wireless and electrical terms. Recently I was corrected by my son (attending a senior technical school) on the definition of the word "oscillation." He informs me that a vibration is equal to a swing of a pendulum to and fro, and is also equal to two oscillations. The same evening I read in my *Wireless World* an article by M. G. Scroggie on the "Hartley Circuit." On page 486, column 2, of the May 21st issue I was pleased to find I am in very good company. If an oscillation is a single swing, the word must be loosely used by many.

London, N. A. M. RIX.

Sunspots and Short Waves

MR. D. W. HEIGHTMAN, in his interesting letter which appeared in your issue of May 7th, suggests that the sudden fade-outs of short-wave signals are caused by decreased ionisation brought about by a solar corpuscular radiation which neutralises the ionising effect of the ultra-violet radiation. It is presumed that Mr. Heightman is referring to F layer ionisation, and that the mechanism of the effect is that positively charged corpuscles ejected from the sun combine with free electrons in the layer and so reduce the overall level of ionisation.

Surely, if this were the case, when a bright hydrogen eruption occurred, the highest frequencies would be the first to penetrate the layer, and then, as the ionisation became more and more reduced, lower and lower frequencies would penetrate. Conversely, the highest frequencies would be the last to reappear on the cessation of the disturbance. I think it is now well established by a number of independent observers that the opposite is the case, i.e., the highest frequencies are the last to fade out and the first to reappear, and this would certainly be the nature of the effect if it were that the radiation brought about a sudden increase in E layer ionisation, and thus caused a rise in attenuation. In this connection it will be noted that F layer ionisation is not increased (at any rate, in anything like the same proportion), because, owing to the comparative rarity of the gas molecules in this layer, the extra radiation is ineffective in increasing the ionisation.

Again, as fade-outs due to bright hydrogen eruptions have on several occasions been observed to commence at the same time as the eruption started, it seems that the radiation travels at the speed of light, and is therefore of the wave type, and not corpuscular, as your correspondent suggests. From this it appears that the "neutralisation" theory will not hold when applied to Dellinger fade-outs.

It seems quite possible, however, that the comparatively long period fade-outs or, rather, periods of erratic conditions, which occur on paths passing near the poles, may be caused by a reduced F layer ionisation brought about by some such neutralisation process, i.e., by positively charged particles ejected from the sun and swept towards the poles by the earth's magnetic field. The associated phenomena mentioned by Mr. Heightman would also appear to be due to this form of radiation, and all these phenomena were observed during the period April 24-28th, when short-wave conditions on "east/west" paths from England were exceptionally poor.

The reason given by your correspondent for the failure of the very high frequencies in summer contained in the last two paragraphs of his letter is certainly very interesting. However, it is fairly certain that, due to the expansion of the air at the F layer during the summer, less of the solar radiation is absorbed, the ionisation level falls, and thus the penetration frequency is lowered. As to the reason why communication on the very high frequencies is still possible in summer on a "south" path (though it is not so good as in winter), is it possible that the F layer air density in equatorial regions becomes so low that so little of the ionising radiation is absorbed as to permit it to reach the E layer in sufficient quantity to raise its ion content, so that refraction of the frequencies in question can occur there? L. HIPSMAN.

Kenton, Middlesex.

Phase Reversal

THE ingenious use of a frequency changing valve for phase reversal described by C. C. Inglis in the April 30th issue of *The Wireless World* is exceptionally interesting. Your contributor mentions one or two points which seem to indicate that the device may function in a somewhat similar manner to the negatron. I am here referring to the zone of instability shown in Fig. 5 and the statement that the success of the system depends upon the critical adjustment of the cathode temperature.

The negatron, a valve developed about sixteen years ago, was intended as an oscillation generator. The theory of operation which was advanced was that a very limited cathode emission was distributed between two anodes, whereby increase of anode current in one branch of the circuit was accompanied by a corresponding decrease in the other, simply owing to the fact that the valve was functioning under a saturated condition. A decrease of current due to an increase in grid voltage naturally produces a negative resistance characteristic which is necessary for the generation of oscillations.

In your contributor's arrangement G2 in the heptode is connected to the cathode. Normally, of course, this acts in the manner of an accelerating electrode as it has a positive potential. Under the special conditions of operation, therefore, there is an exceptionally heavy space charge, and the total emission available for the remaining electrode system is then comparable with that existing in the negatron. It certainly appears that the valve may function on the principle of "robbing Peter to pay Paul," and, assuming that this is the case, the adjustment of the cathode temperature must be an important controlling factor. Further, the negative resistance characteristic shown in Fig. 5 is typical of that of the negatron, and it occurs under very similar current and grid voltage conditions. I feel that the apparent similarity of the operating conditions of the two devices is of interest.

Watford. PAUL D. TYERS.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

SHORT-WAVE SIGNALLING

A NEGATIVE-CONDUCTANCE effect produced between any two of the electrodes of a Barkhausen-Kurz oscillator is used to maintain secondary oscillations, the "static" frequency of which is independent of the signal oscillations, though the "dynamic" amplitude, and/or frequency, varies with the received signal. The secondary oscillations so produced may be used either to heterodyne the received signals, or to modulate them in frequency or amplitude.

Standard Telephones and Cables, Ltd. (assignees of Le Materiel Telephonique Soc. Anon.). Convention date (France) November 24th, 1934. No. 461763.

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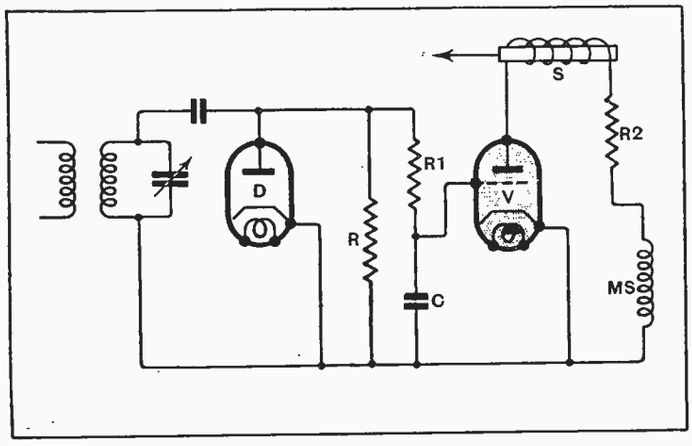
AUTOMATIC SELECTIVITY CONTROL

AN auxiliary gas-filled valve V, capable of passing considerable current, is used to vary an intervalve coupling—and, therefore, the effective selectivity—of a wireless receiver. A part of the incoming signal is applied to a diode rectifier, and the rectified voltage across R, after being smoothed by R1 and C, is applied to the grid of the valve V. The latter is connected to the AC mains through a transformer MS, a current-limiting resistance R2, and a solenoid S being included in the anode circuit.



Circuit for automatic control of selectivity.

For a strong signal, the negative voltage across R is sufficient to keep the valve V out of action. But for a weak signal, the bias drops, until the valve V is able to pass sufficient current from the mains supply MS to operate the solenoid S. The resulting movement of the solenoid plunger is used to loosen the coupling between two or more of the high-frequency valves (not shown), thus increasing the selective action of the set.

Ferranti, Ltd., and E. G. O. Anderson. Application date August 13th, 1935. No. 461256.

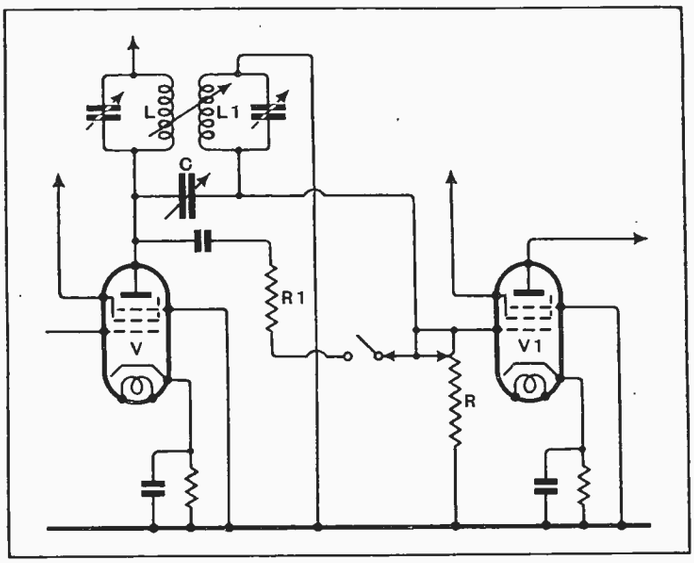
o o o o

VARIABLE SELECTIVITY

WHEN searching, the circuits are set to maximum selectivity, but as soon as a station has been picked up, the listener can expand the bandwidth of the accepted signals either (a) symmetrically about the centre of the carrier wave, when conditions admit, or (b) unsymmetrically so as to favour either the upper or lower side-band when the congestion is severe.

In the Figure the intermediate-frequency amplifiers V and V1 are coupled inductively at L, L1, and capacitatively through the condenser C, the two couplings being in opposition. When the inductive coupling is tightened, the bandwidth is broadened symmetrically, the "double-hump" effect being minimised by a resistance R. If the value of the condenser C is reduced, the centre of the accepted band moves towards the higher-frequency side-band, whilst an increase shifts it in the other direction. A resistance R1 may be switched across the condenser C to improve the response during searching.

Hazeltine Corporation (Assignees of J. F. Farrington). Convention date (U.S.A.) May 7th, 1935. No. 460821.



Circuit arrangement for control of selectivity in IF amplifier.

TELEVISION AERIALS

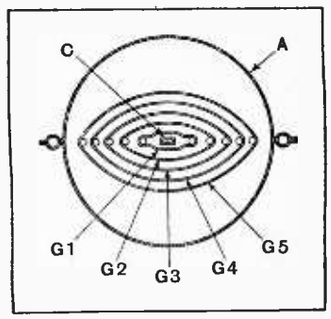
A TELEVISION aerial is made up for sale as a compact unit, ready for installation. The two limbs of a V-shaped dipole are separated from the supporting ropes, and from the downlead, by rubber insulators which are moulded *in situ* around the knotted or looped ends of the respective wires, so as to hold them firmly in position, and insulated from each other. Rings of non-conducting material are threaded through the ends of the aerial and supporting wires, inside the rubber insulator, in order to take tensional strains. The use of rubber insulators, moulded in position in this way, reduces the risk of breakage in transit between the factory and the customer.

British Thomson-Houston Co., Ltd. Convention date (U.S.A.) September 7th, 1935. No. 460830.

o o o o

"MIXER" VALVES

The grids in a frequency-changing valve, used, for instance, in a superhet set, are arranged as shown at G1—G5 around an indirectly-heated cathode C, the cylindrical anode A being of blackened nickel to prevent secondary emission. One grid is connected to the radio-frequency input, a second applies reaction, and a third is connected to the local-oscillator circuit, the relative spacing and dimensions of these three grids being so arranged that the input grid is at a potential node to the others.



Electrode assembly for a frequency-changing valve.

The local-oscillator circuit is thus isolated from the radio-frequency circuit, so that re-radiation from the aerial is prevented and ganged tuning is facilitated. A fourth grid is used to give a variable-mu characteristic to the valve, for automatic volume control, whilst the fifth serves as a screening grid.

J. H. O. Harries. Application date August 15th, 1935. No. 461282.

o o o o

HT SMOOTHING FOR CR TUBES

CONDUCTIVE coatings are applied to the inside and outside walls of part of a cathode-ray tube, and the condenser so formed is used as a smoothing - condenser for the high-tension supply. Preferably the negative pole of the mains is earthed, so that the interior coating can be connected to the anode of the CR tube. The external coating is then also at earth potential.

C. Szegho; W. P. Anderson; and Baird Television, Ltd. Application date August 29th, 1935. No. 461999.

o o o o

MIRROR SCANNING

A SINGLE mirror is controlled by two torsion rods so that it vibrates simultaneously in two directions. Each rod is cut to have a predetermined "natural" frequency—depending upon its dimensions and modulus of elasticity. The natural frequency is, however, adjustable within limits, and once so adjusted the vibration is maintained by an electromagnet. Owing to the small inertia of the system, it is stated that a line-scanning frequency up to 5,000 per second can be produced in this way.

W. H. Priess. Convention date (U.S.A.) May 11th, 1934. No. 461128.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Miniature Transmitters

Neglected Possibilities

THE story circulated recently that an American journalist present in the Abbey during the Coronation service communicated an account of the ceremony by means of a miniature transmitter concealed in his clothing to a receiving van stationed outside, has not yet been explained. Whether or not this stunt was actually achieved, the report, nevertheless, serves to focus attention once more on the possibilities which miniature transmitters offer as an aid to the newspaper reporter.

Just a year ago *The Wireless World* drew attention to the fact that in America the Press, in particular, was making the fullest use of wireless for news-gathering purposes, and that extremely portable ultra-short wave transmitters were used by reporters to pass information to head offices or to other reporters stationed at the end of the telephone line. For broadcasting purposes there never appears to be any difficulty in this country in arranging for the commentator to be stationed with a microphone in front of him and so be in direct communication with the B.B.C. headquarters. Yet facilities of this kind are at present denied to newspaper men because the Post Office has, so far, not seen fit to issue transmitting licences for portable outfits of this nature.

There is nothing to prevent newspapers using a microphone and recording apparatus for such functions, but then, apart from the delay, the bulky nature of the equipment required would, in most cases, make it impossible for the reporter to get near to any scene of action. A miniature transmitter could, however, be conveniently carried and used for communication on ultra-short waves to a receiver at the nearest telephone connection.

It is difficult to understand just why the Post Office is not more sympathetic to this idea. The Post Office already has authority to license commercial stations, and also private stations under certain circumstances. Portable transmitters of this kind would presumably come within the category of private stations; and we have always understood that provision for the licensing of private stations was intended to meet cases where telephone lines were not available. Surely the newspapers should have at least equal facilities with the B.B.C. in the matter of gathering news for their public!

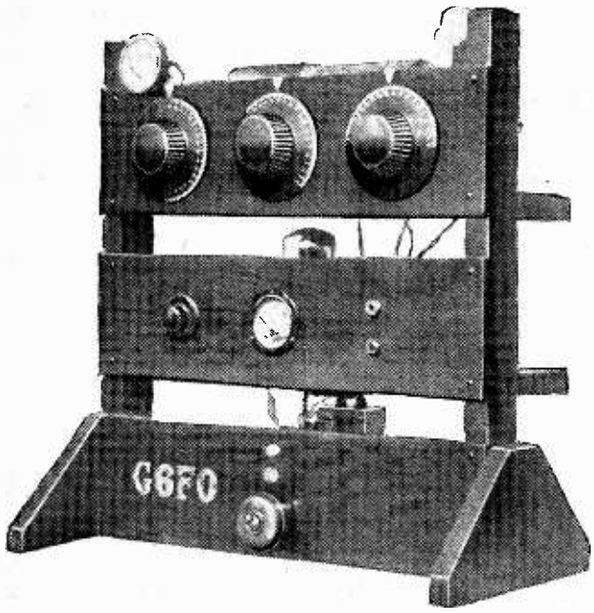
Television Exhibition

Display at the Science Museum

THE section devoted to the subject of wireless has, for some years now, been one of the most popular of the Science Museum, South Kensington. Readers will remember especially that the Museum set up a high-quality receiver and loud speakers some years ago for the purpose of giving demonstrations to educate the listening public to an appreciation of what could be done in the way of obtaining high quality from broadcasting.

To-day the Museum opens to the public a special television exhibit, which incorporates a section tracing the history of television, whilst there will be working models of early and present-day receivers. A local transmitter has been installed which will provide programmes for these demonstrations from cinema films.

Every reader who is, or may be, in London should endeavour to attend the Exhibition, which will remain open until September.



Simple Two-Valv

By AUSTIN FORSYTH (G6FO)

A DESCRIPTION of a simple and straightforward transmitter designe for working both telephony and telegraphy on the 160-metre amateu band. Full instructions are given for making initial adjustments.

AMONG beginners and experienced operators alike there is a demand for a simple type of transmitter for working on the 1.7 Mc/s (160m.) amateur band; the former need one because 160 metres is without doubt the best band on which to gain experience in amateur operation and procedure, while the latter often wish to be able to transmit on 160m. because local contacts are easier and more comfortable on this wavelength than on any other. Without either a separate transmitter or one which is easily and quickly adaptable for all-band operation, changing over becomes a nuisance, as most people necessarily use multi-stage transmitters for working on 40 and 20 metres.

160 metres will give local coverage up to a radius of 50 miles or so with low power and, in fact, in no case is more than ten watts input allowed on this band. Further, a simple type of radiating system will get one out quite effectively, and so we have all the essentials for enjoying contacts with and making the better acquaintance of local stations which otherwise we should probably not "meet" so often owing to the crowded state of the other bands and the difficulties of skip.

Fig. 1 shows a straightforward circuit arrangement which the writer has found most effective for just the purposes outlined. It has one or two features worthy of comment. Either 'phone or CW can be worked, the change-over being made by the switch S. V1 is the crystal-controlled oscillator; V2, the modulator, is a pentode, which gives the greatest modulating power with the smallest number of valves. Modulation is by the well-known choke control system, still unbeaten for simplicity and certainty in operation. From the point of view of the beginner, this circuit can form the basis of a more ambitious rig, since the oscillator stage is easily converted into a driven PA.

Notice the method of crystal-controlling the oscillator. C1-L1 and C2-L2 comprise a tuned-plate-tuned-grid circuit with the 160m. crystal across the grid coil. This arrangement—very effective for either 160 or 80 metres, on which bands crystals are robust enough to stand it with low power—is neither as well known nor as widely used as it should be, though it provides a simple means of obtaining direct crystal-control of a triode power oscillator. Tuning is described fully later, as the method may not be apparent to amateurs unused to this type of circuit.

For 160m., where space considerations usually make it impossible to get out the necessary 265ft. of wire for Hertz operation, it becomes simpler to use any existing aerial as a Marconi, working either to ground or against a counterpoise. Though parallel tuning is shown, a big aerial (something over 100ft.) and long earth lead may necessitate series tuning with a fairly large coupling coil at L3. The usual 66ft. aerial with an earth connection about 20ft. long will, however, normally require to be parallel tuned, as indicated by C3-L3 in Fig. 1. The same applies if a counterpoise is used. This can be either a single or multi-wire span about 8ft. high, not necessarily below the aerial, but in whatever position may be convenient for getting out the maximum length of wire.

Where the existing radiating system involves "Zepp." feeders, the dead side should be disconnected, the live feeder and aerial together being regarded as an inverted L. If a Windom aerial (or any derivative of it) is used for short-wave working, simply clip the feeder to one end of the aerial coupling coil, either earth

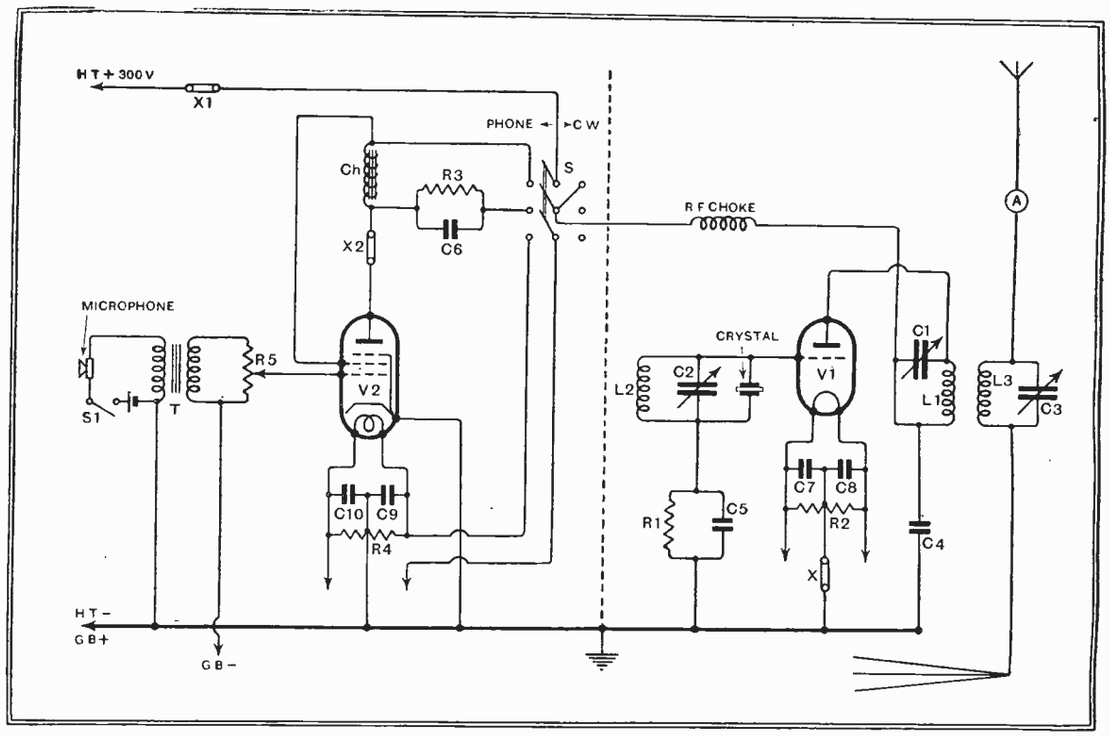


Fig. 1.—Circuit diagram for the transmitter, showing change-over switching for morse or 'phone. With centre-tap keying as shown (key at X), separate LT windings are necessary for V1 and V2. With certain valves, conditions may arise where it is better to connect the screen of V2 to the anode side of the choke.

Transmitter

A BEGINNER'S DESIGN WHICH ALSO FILLS EXPERIENCED AMATEURS' REQUIREMENTS

or counterpoise going to the other, tuning then being as for a Marconi system, i.e., maximum indicated radiation in the aerial ammeter A, consistent with proper load and output conditions, as described later.

Reverting to the circuit again, L1 should by 30 turns 3½in. in diameter with about ⅛in. between turns, using for convenience 7/22's aerial wire for winding the coil. The former can be a Paxolin tube, carrying notched ebonite strips to hold the wire, or a former can be built up with six strips, either wood (oak) or ebonite, held by circular or star-shaped end-pieces. Wood is a very good insulator at radio frequencies, but it must be hard and dry. C1 is 0.0005 mfd. maximum capacity. This should be a good quality receiving condenser with its vanes spaced not less than 1/20th inch and having good insulation between rotor and stator. The type with a ¼in. "muckite" bush supporting the rotor in the stator frame will *not* do.

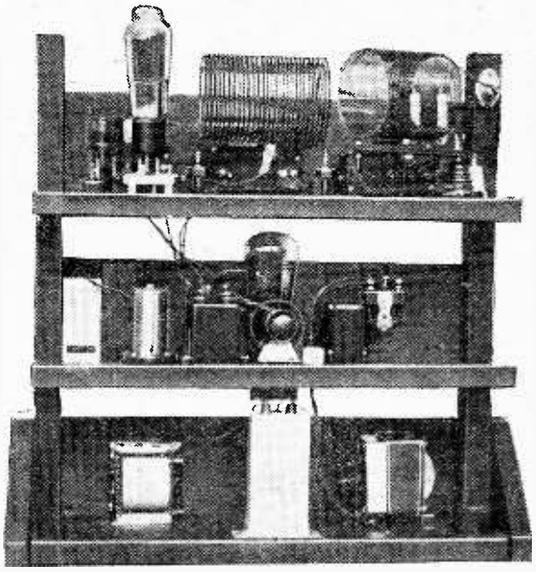
Crystal Frequency

L2 is a 45-turn coil 2in. in diameter. This can be of No. 18 enamelled, close-wound, mounted in any convenient way. C2 is 0.0003 mfd. and can be of the midget receiving type, vane spacing not being so important here as for C1. The crystal in its holder goes right across L2. A word here for those who, not having a 160-metre crystal on hand, may be contemplating buying one. Choose a frequency between 1,752 and 1,798 kc/s, since any frequency in this range will double down through all amateur bands, without falling outside the harmonic range on any of them.

L3 is rather difficult to specify as regards size, as it will evidently depend on the electrical length of the existing radiating system, which will vary widely in different cases. However, 15 turns similar to L1, with 0.0005 mfd. for C3, should cover most requirements. If this does not seem to tune, first try reducing the number of turns by tapping back from one end, then series tuning with the full 15 turns. L3 should be mounted such that it can be variably coupled to L1 through a range of 9in. This gives scope for one's mechanical ingenuity. The simplest method is to have C3/L3 mounted together on a strip of wood pivoted so that variable coupling is possible with the coils in the same horizontal plane.

R1 is the grid-leak, rated 3 watts, and should be chosen for the valve used, 25,000 ohms being a good value to start with. R2 and R4 are 30-ohm "humdingers," required if mains valves are used. C7, C8, C9, C10 are 0.003 mfd. condensers (ordinary receiving type will do) for balancing the filament feed. Where an *indirectly* heated valve is used in the modulator position V2, C9, C10 and R4 may not be necessary, but they should be incorporated to keep on the safe side, as shown. Note that the cathode is taken to the centre-point on R4.

C4 is the 0.001 mfd. by-pass condenser tying down the low potential side of the tank circuit. It should be rated at not less than twice the working HT voltage to take care of modulation peaks. The value suggested should not be exceeded



Rear view of the transmitter : immediately to the left of the oscillator valve on the top shelf is the combined grid coil and crystal holder; a valve base is used for this purpose.

or the "highs" will be cut off. and, indeed, it is worth trying a lower value here. C5, the 0.002 mfd. grid condenser, can be of the receiving type. The RFC comprises 300 turns of No. 30 enamelled wire on a 2in. former. It is not a vitally important component in this circuit, merely serving to keep stray RF out of the modulator side.

We come now to the condenser-resistance network R3-C6, the function of which may not be apparent. Without using space here to go fully into the whole process of choke control modulation, it may be said that if the plates of V1 and V2 were directly connected, the limiting factor of valve characteristics would preclude more than 75 per cent. modulation being obtainable. In practice, it would be rather less, about 50 per cent. In order to increase the depth of control, therefore, the oscillator plate voltage is reduced in relation to that of the modulator by the insertion of the series resistor R3. This means that the modulator is able —to use a crude but descriptive expression—to get a better grip on the oscillator, and so swing its plate voltage through a relatively larger range, thus giving deeper modulation than would be the case if both valves were running at the same plate voltage in the quiescent (unmodulated) state.

As we seldom get something for nothing in this world, it will be obvious that carrier-power must be reduced when telephony is being used, since R3 will then be in circuit (it is cut out by switch S for CW, when full power is available). But we shall be getting deeper modulation, the point here being that a 5-watt carrier fully modulated is much more effective than a 10-watt carrier only 50 per cent. modulated. It follows from this that R3 is rather an important component, also that its value is somewhat critical. It should be rated at least 10 watts for this transmitter, of 6,000 ohms maximum value, preferably being of the semi-variable type. The actual resistance value required is a matter of adjustment, as will be shown. The 2 mfd. by-pass condenser C6 is essential; it serves as an audio by-pass in this instance to carry the voltage variations due to modulation.

From the modulation point of view, the speech choke Ch. is also important. It has to carry the plate current for both oscillator and modulator valves, totalling 60-70 mA in this transmitter, and that with the minimum of voltage drop. For good speech quality the inductance should be not less than 20 henrys, so be on the safe side, and use a component rated 20 H at 100 mA. Since the plate voltage required is only 300, the question of insulation so far as the choke is concerned is not of great importance, as one of the specified rating will be quite safe at this voltage.

Choosing a Microphone

R5 is the gain control—a 1-megohm volume control will do—and T is the microphone transformer. Now, it is clear that if the output of the modulator V2 is to be sufficient to give fairly deep control of the oscillator, V2 must itself be fully driven. This in turn means using, in simple equipment of this kind, a sensitive microphone with a suitable step-up transformer. The most sensitive type of microphone—and the cheapest—is the G.P.O. "solid-back" which, incidentally, can be made to give much better speech

Simple Two-valve Transmitter—

quality than some people suppose if it is properly handled. The solid-back mike requires a 30 : 1 step-up transformer to give a good match under average conditions, and the writer has found the old B.T-H. 30 : 1 cannot be bettered in this respect. These and solid-back microphones are still available on the second-hand market, but other makes of the required type and ratio will do quite well. The best excitation voltage for the solid-back mike has likewise been found to be 7½V., which can be supplied by two batteries, 4½V. and 3V., in series; these can be of the ordinary flash-lamp or bell-ringing size. The current drain is only about 10-15 mA, so that they will last months.

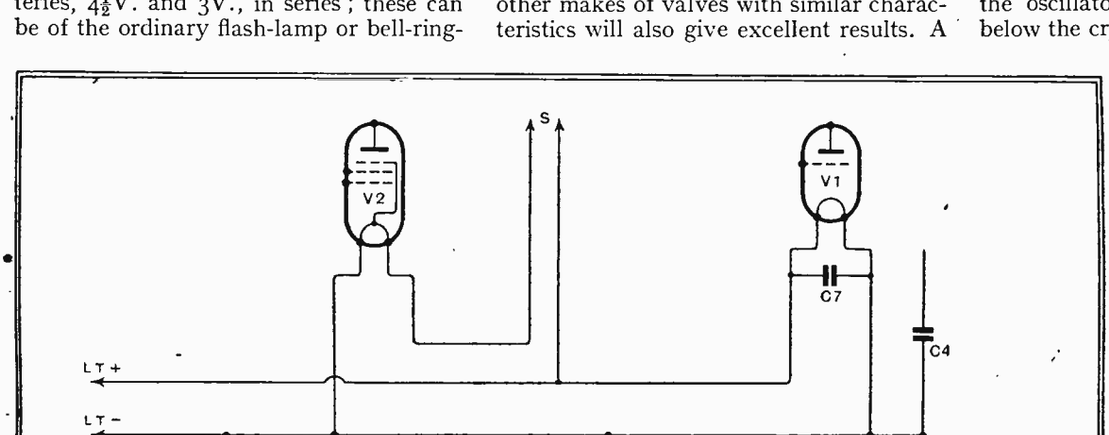


Fig. 2.—Filament wiring for battery valves; other circuit details as in Fig. 1.

As regards construction of the transmitter, for the more experienced amateur it is a matter of choice and any convenient arrangement which pays due regard to the accepted standards will give satisfactory results. The beginner, for this or any other type of circuit, is, however, definitely advised to use "breadboard lay-out." That is, the components are spread out on a wooden baseboard 24in. long by 12in. wide, carried on three wooden runners 1in. deep by 12in. long. By adopting this method of construction, everything is immediately accessible, so that study and experiment can be carried out on the "works" without it being necessary to dismantle everything.

Actual lay-out is neither very difficult nor, truth to tell, terribly important. The only precaution which should be taken is to see that there can be no interaction between C1-L1 and C2-L2, since for proper operation they should only be coupled through the capacity of the valve. Setting the coils about 6in. apart, and at right angles will take care of this. What *is* important is insulation; this must be good.

The best advice which can be given as regards lay-out is, follow the circuit. That is, place the components as they come in the circuit diagram, keeping all leads as short and as direct as possible. The tank condenser C1 can be mounted on midget stand-offs, with good heavy connections, at least equal to the wire used for the coil, to L1. The rest of the wiring can be carried out in No. 18 enamelled, or whatever similar may be available. The change-over switch S, the volume-control R5, microphone switch S1, milliammeter jacks (indicated by X1 and X2 in Fig. 1) and keying jack X can all be arranged on a small panel. It is also advisable to keep oscillator and modulator in two separate units, with a screen between them, as shown dotted in Fig. 1.

As regards valves, the Mullard AC044 for V1 and the Mazda AC2/Pen for V2 team up very well in this circuit, though other makes of valves with similar characteristics will also give excellent results. A plate supply giving about 300 volts at 80 mA will be ample for mains valves of the type suggested. If the station is battery operated, or a very simple battery transmitter is required, a Mazda P220A for V1 with a Pen220A of the same make can be recommended, though here again other valves which may be available will work well. For battery working, 200 volts HT will be sufficient, the current drain being about 40 mA maximum. Fig. 2 shows the necessary circuit modifications to permit battery valves being used, the only actual changes being in the filament supply.

Preliminary Adjustments

In starting up and adjusting the transmitter for the first time, set switch S at the CW (left-hand) position, adjust R2 and R4 to the mid-points as near as they can be judged, and insert a key at the filament centre-tap at J. If possible, HT should be reduced to about 100 volts or so for these initial tuning operations, and the grid side of the crystal holder must be disconnected. With an 0-100 mA meter in the HT lead at X, and the two condensers C1 and C2 at about half-mesh, touch the key. The milliammeter needle will probably try to wrap itself round the stop, unless low voltage is being used, indicating, of course, that the circuits are not in resonance. Press the key again and swing C1 steadily till the meter needle drops back to a low value, showing that resonance has been obtained. This low reading should be about 10-15 mA with the *full 300 volts HT applied*. If it is more, the grid-leak value is too low, and *vice versa*. Having thus got the circuits C1-L1 and C2-L2 resonating, a test loop ("tuning lamp") will give a bright glow when presented to the plate end of L1, and a dimmer one on the grid side of L2.

The next move is to get the oscillator running on the crystal frequency, so that the latter can take control. If a monitor-frequency meter is available (as it should be) this becomes a simple matter. First find out from the frequency meter where the oscillator setting is, either above or below the crystal frequency; the beat note will probably sound rather "fuzzy." The setting on the frequency meter indicates which way the tuning dials have to be moved to bring the oscillator on to the crystal frequency. Now put the crystal in circuit and restore resonance by adjustment of C2, since the capacity across the crystal and its holder will upset C2 slightly. Then set the monitor on the crystal frequency, put a book on the key, and move both C1 and C2 *together*, in such a way that the milliammeter reading remains more or less constant, till the beat note from the oscillator is heard in the frequency meter, which is now on the crystal frequency. When this happens, the crystal will take up control, the note becoming clean and "sweet" and tuning on C2 rather flat, while it will be possible to vary C1 over quite a number of degrees *without changing the frequency*.

The oscillator is now tuned on the crystal, which is holding the frequency constant, the next step being to adjust C1 and C2 for maximum RF output as indicated by the loop. This means a touch on each condenser, the milliammeter reading remaining at about the original low value of 10-15 mA. Now "bounce" the key a few times to make sure the crystal will pick up when CW is being used. If it hesitates or there is any perceptible lag, adjust C1 till the crystal follows the keying smoothly and steadily. Any trace of AC in the note can be cleared by slight movements of R2 and R4, assuming a common LT feed is used, till this disappears.

The aerial can now be coupled up and tuned. The method is as follows: Close the keying circuit and note the plate current. Set the aerial coupling, L3 against L1, at about 4in. and such that L3 is at the plate end of L1. Swing C3 steadily, watching the aerial ammeter A, which should have a range of 0-1 amp. The needle will begin to creep up the scale as the aerial circuit approaches resonance, while the plate current to the oscillator will also rise. Assuming a plate voltage on V1 of 300 volts actual, it must not exceed 33 mA to give ten watts input. It may

Simple Two-Valve Transmitter—

be found that the aerial current is still increasing when this figure has been passed, in which case coupling between L3 and L1 must be backed off till resonance tuning of the aerial is obtained with the plate current round about 33 mA. This means that it must be possible to tune C3 through a resonance point, as indicated by a peak reading at A, which does not increase plate current beyond the figure given. When this degree of coupling has been found—it may be quite close or several inches, depending upon aerial characteristics, and must be varied accordingly—readjust C1 slightly to make sure it is at resonance, since coupling up the aerial and loading the oscillator will affect tank tuning a little. The resonance tune will now be indicated on A, which may rise a little and then fall as the correct setting on C1 is passed.

From the above, it follows that if aerial coupling happens to be made too loose in the first case, L3 will have to be pushed nearer L1 if it is found that the oscillator cannot be pulled up to 33 mA when C3 is tuned through resonance.

With the transmitter thus tuned for full CW output, the keying can once again be tried to make sure the crystal "follows." If there is any lag this time, it can be taken up by a slight movement of C2.

All the above adjustments *must* be made with the modulator out of circuit, i.e., with switch S in the CW setting, as previously mentioned.

Coming now to 'phone operation, the first thing to do is to pull V1 out of its socket and change S over to the position for 'phone. Then get V2 correctly biased. If a Mazda AC2/Pen is used, the plate current should be adjusted to something near 30 mA, for which the required voltage will be about minus 7-9V. with 300V. HT. Close the microphone switch S1 and speak into the mike. A meter in the plate lead at X2 should show kicks.

Now set R3 at about half-value (3,000 ohms or thereabouts), insert V1 and with S in the right-hand position again, note the aerial current at A, making sure the oscillator is working by listening in the monitor. The milliammeter should be transferred to position X1. The first point to notice is that aerial current will show a reduction compared with the previously obtained CW setting, this being due to the voltage drop across R3 and to a certain extent also across Ch., while the voltage output from the power pack may drop somewhat under the combined load of the two valves.

Speech Tests

Next, turn up the gain control R5 to maximum and speak into the microphone. If all is well, speech will be heard in the carrier as picked up by the monitor, the aerial ammeter needle will kick *upwards* slightly, while the milliammeter at X1, now showing the total plate current to both V1 and V2, will remain more or less steady. The point to notice is the percentage rise in aerial current. Speaking loudly into the microphone with full gain should produce upward kicks of about 25 per cent. on the steady carrier value. A few assumed figures, of the kind to be expected, may help in clarifying this. On full CW output, the aerial ammeter at A might read 0.5 amp. This drops perhaps to 0.35 amp. on the 'phone setting. A sustained whistle into the mike with the modulator "full out" might produce a reading of 0.44 amp., upward kicks to about this figure occurring with normal speech.

All this would indicate correct adjustment. If, however, the upward kicks are considerably more than 25 per cent., showing that the modulator is over-driving the oscillator, R3 can be decreased in value to increase the carrier-power. Similarly, if it is found that with the gain right up a whistle only kicks the aerial current up about 10 per. cent. or so, R3 must be increased, thus reducing carrier-power to meet the modulating output from V2.

The whole idea behind these adjustments is to get R3 set so that fairly deep modulation—indicated by the 25 per cent. upward kick on A—is obtained. Note that 25 per cent. increase in aerial current does *not* mean 25 per cent. depth of modulation; full 100 per cent. modulation is, theoretically, indicated by a 27 per cent. increase in aerial current on peaks, so that if 25 per cent. upward movement is registered, it means that modulation is very full.

Crystal Control

Actually, the depth of modulation which can be obtained is governed largely by the inherent stability and loading of the oscillator. Hence the idea of using a crystal lock, even in a simple transmitter of this type working on 160 metres. Though the transmitter can be operated self-excited as an ordinary TPTG without the crystal, the note will not be so good nor will it be possible to get modulation as deep as when crystal-control is used. Briefly, the reason for this is that deep modulation of a self-excited oscillator inevitably produces frequency modulation of the carrier, i.e., unsteadiness corresponding to the speech input, which results in distortion and blurred speech. The CW output without the crystal will be fairly good, though the note will not be so pure, as among other things the crystal has the effect of "ironing out" ripple besides holding the frequency constant. Another point is that a self-excited oscillator is always affected by aerial movement, vibration in the operating room and so on, which are just more reasons why the crystal should be used.

If it is found that adjusting the transmitter as described—with the crystal in—for 25 per cent. increase in aerial current breaks the carrier wave and causes unpleasant noises, the modulation must be reduced, either by decreasing R3 or turning down the gain control R5, whichever gives the better result as advised by an outside station co-operating in the tests. In fact, when one reaches the point where speech is going out, the help of another station becomes extremely useful in finding the best adjustments.

Remember also that the movement of most aerial ammeters is sluggish. If you get the required rise in aerial current by a sustained whistle into the mike, do not expect that the meter needle will follow normal speech. All you will see will be a series of flicks which will not have time to reach peak value.

Best Adjustment

One or two further points worth mentioning: The best adjustment for normal working is that by which comfortable speech input to the mike produces deep modulation. In other words, don't be afraid to reduce carrier power to get deep modulation. With a less sensitive microphone than the solid-back, a stage of speech amplification before V2 will be necessary.

A transmitter using battery valves and supply is set up, adjusted and operated in exactly the same way as that described for the circuit of Fig. 1.

Finally, when tuning up the set, the greatest care should be taken to avoid, so far as is possible, running the oscillator valve out of resonance; that is, with abnormally high plate current and in a non-oscillating condition. A few minutes of this sort of treatment—as when first getting the oscillator circuits into resonance—takes more life out of any valve than many months of use as a radio-frequency power oscillator running at higher plate voltages than the makers recommend!

[*New readers are reminded that a P.O. transmitting licence must be obtained before a transmitter may be set up and operated.—Ed.*]

City and Guilds Certificates for Service Engineers

ACTING on recommendations made by its Advisory Committee on Radio Service Work, the City and Guilds of London Institute have prepared a pamphlet containing regulations and syllabuses for examinations which the Institute will be conducting from 1938 onwards. Certificates of the First or Second Class will be awarded to successful candidates.

The syllabuses, which are set out in some detail, have been framed mainly for students who attend evening classes for a period of two or three years, and every candidate is required to have satisfactorily attended an approved course of lectures and laboratory instruction.

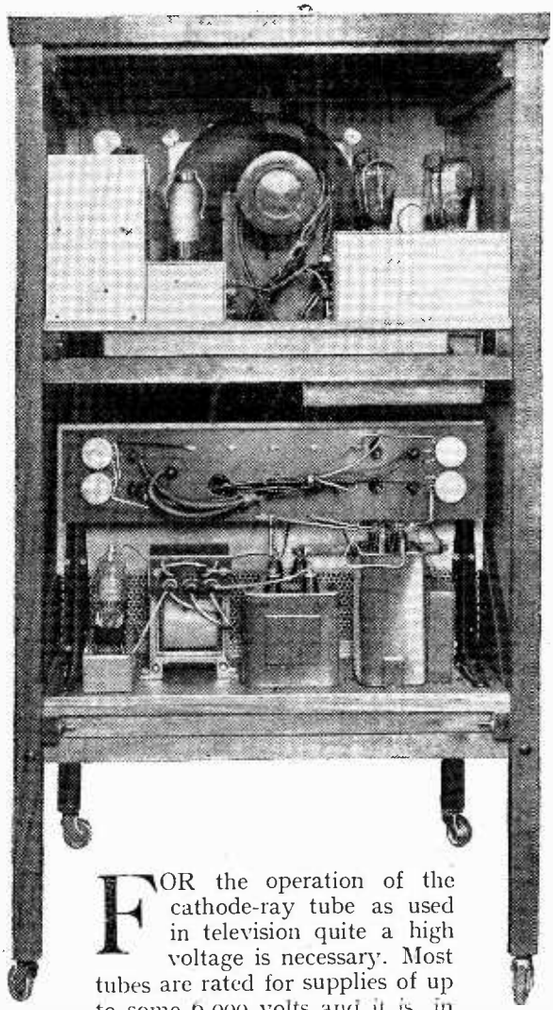
A fairly high standard is imposed, the syllabus of theoretical subjects embracing radio-frequency theory (mainly as it affects broadcast reception) and general electrical theory. Practical work and calculations come under separate headings.

Copies of the pamphlet are obtainable from the Superintendent of the Department of Technology, 31, Brechin Place, South Kensington, London, S.W.7.

The Televisior

XI.—THE CR TUBE HT SUPPLY

A CATHODE-RAY tube requires a high voltage for its operation, and an electrostatically focused type needs several different potentials for the various anodes. There are many ways in which these can be obtained, and the advantages and disadvantages of several rectifier systems are discussed in this article.



A rear view of a complete television receiver, showing the high-voltage unit in the lower compartment. The safety screen has been removed.

FOR the operation of the cathode-ray tube as used in television quite a high voltage is necessary. Most tubes are rated for supplies of up to some 6,000 volts and it is, in general, inadvisable to use less than 3,000 volts with present-day types. The cost of the equipment increases rapidly with the voltage, for a very high standard of insulation is necessary not only in the mains transformer and smoothing condensers themselves but throughout the apparatus and including the connections to the tube. Experience shows that very satisfactory results indeed are obtainable with 4,000 volts, and in what follows it will be assumed that this voltage will be adopted; the various circuits discussed will, of course, be suited to any voltage, but the circuit values and insulation will be based on 4,000 volts.

The design of the equipment is to some extent affected by whether the positive or negative pole of the supply is earthed. The construction of the mains transformer is often greatly dependent upon this factor, and it is consequently unwise to use a transformer built for a positive earth in a circuit which has the negative pole earthed. If the transformer is so used the insulation will probably break down very quickly.

Consider, for example, the typical rectifier circuit of Fig. 33. When the positive is earthed the transformer is normally wound with the primary next to the core, the high-voltage winding comes next and the rectifier filament winding on the outside. The inside end of the HV winding is earthed, and so quite a small amount of insulation is needed.

The maximum voltage across the terminals of the HV winding is 1.414 times the RMS rating and this is also the maximum across the reservoir condenser. The maximum voltage across the rectifier during the non-conductive half-cycles is double this. Thus with a 4,000-volt RMS winding the reservoir condenser must be rated for 5,656 volts, and there will be 11,312 volts peak across the valve.

Now suppose we earth the negative of the supply. The insulation between the inside of the primary and the core must withstand 5,656 volts instead of 0 volts, and that at the outside 11,312 volts instead of 5,656 volts. If the transformer is built for use with a positive earth, it is easy to see that the use of a negative earth makes a breakdown highly probable.

Experience shows that when the negative is earthed it is better to wind the transformer for the circuit of Fig. 34. As regards the HV winding itself, conditions are no worse than with a positive earth and the circuit of Fig. 1; it is, however, necessary to insulate the rectifier filament winding for 11,000 volts from the HV winding and 5,600 volts from earth.

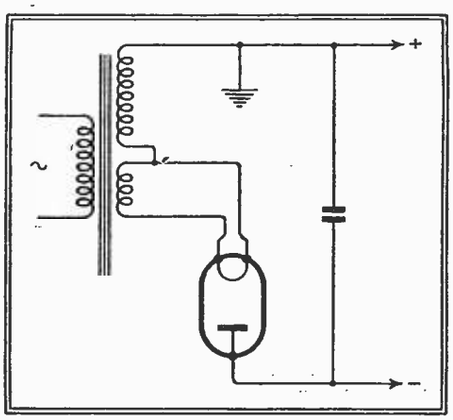


Fig. 33.—A simple half-wave rectifier circuit with the positive HT lead earthed.

An alternative type of rectifier is the voltage-doubler shown in Fig. 35. Here the HV winding need have a voltage-output of only about one-half of that of the half-wave rectifier, so that we need legislate for a winding of 2,000 volts RMS only. Now this circuit really consists of two half-wave rectifiers operative on opposite half-cycles. When B is positive with respect to A, V1 is conductive and C1 becomes charged. The maximum voltage which can appear across C1 is 1,414 times the RMS voltage of W3, or 2,828 volts in this case. During the following half-cycle B is negative with respect to A and the maximum voltage across V1 is 5,656 volts. With respect to earth, therefore, B and W1 can reach maximum values of 2,828 volts and 5,656 volts.

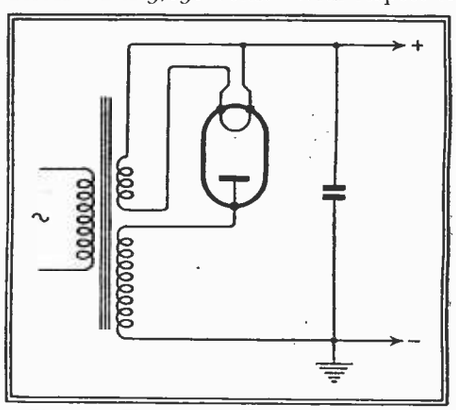


Fig. 34.—The same half-wave rectifier with negative HT earthed. This increases the voltage between the transformer windings.

Now during the non-conductive cycle for V1, V2 is conductive and C2 is charged to a maximum of 2,828 volts. The voltages across C1 and C2 are additive, and so the maximum output is 5,656 volts. When V2 is non-conductive the maximum voltage across it is 5,656 volts, just as in the case of V1. Consequently, this voltage can occur between W1 and W2.

We now have to find the maximum voltage which can occur between W2 and earth. At first we are tempted to think that it is 11,312 volts, since W2 can be 5,656 volts above earth and W2 can be 5,656 volts above W1. This is not so, however, for we must remember that the 5,656 volts between W1 and earth exists only when V1 is non-conductive and that V2 is then conductive. Similarly, the high voltage between W1 and W2 occurs

Receiver

By W. T. COCKING

only when V2 is non-conductive and then V1 is conductive. The voltage between W2 and earth is thus 5,656 volts plus the drop across one valve when it is conducting. This drop depends on the load current and the valve characteristics, and is no more than a few hundred volts at most. We can safely say that the voltage between W2 and earth is not likely to exceed 6,000 volts. This is a very considerable improvement over the 11,300 volts of the half-wave rectifier.

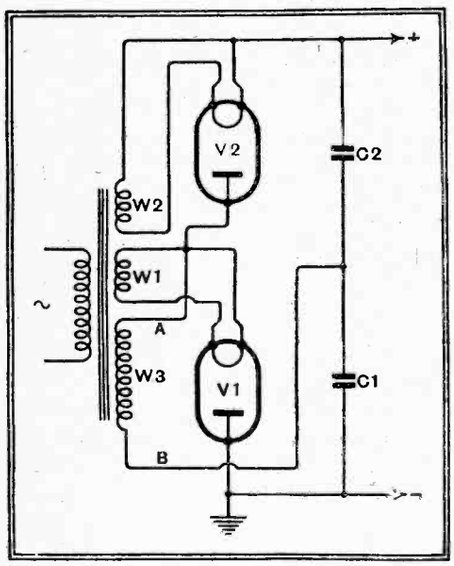


Fig. 35.—For a given output voltage, the lowest voltages between windings are obtained with the voltage-doubler circuit shown here.

Now before we go any further with the rectifier circuits, let us consider the voltages required by the CR tube, the voltage-divider, and the smoothing circuit, for the exact voltage and insulation requirements of the transformer will depend on these. The usual three-anode tube requires about 4,000 volts for anode 3, about 900/1,200 volts for A2, and some 400 volts for A1, while some −250 volts is needed for grid bias. In addition we have to provide shift voltages. These shift voltages are really bias voltages applied to the deflecting plates in order to permit the picture to be centred on the screen. Provision must be made for applying a voltage varying positively or negatively with respect to the third anode voltage to one of each pair of deflecting plates. A change of voltage of about ±100 volts is usually enough.

Although there are many ways of obtaining it, it is simplest to use the high-voltage source, and in the writer's experience the circuit of Fig. 36 is entirely satisfactory. Since the tube current is negligible the calculation of resistance values is quite easy. The grid voltage is the drop across R10 and R11 and the first anode voltage that across R9; the second anode voltage is that across R7 and R8 and R9, and the third anode voltage that across R6, R7, R8 and R9 plus half the drop across the combination R2, R3, R4 and R5, assuming R2 and R3 have the same value.

Now, look at the connections to the plates. The output of the frame time-base is taken through C8 and C9 to one pair of plates, and one of these plates is joined through the resistance R13 to the third anode. The other plate is taken through R15 to the potentiometer R5, and it is easy to see that when the slider of this component is placed centrally its potential is the same as that of A3. When the slider is moved to the left on the diagram a potential positive with respect to A3, and when it is moved to the right a negative potential, is applied.

The Voltage Divider

Exactly the same thing happens with the other pair of plates and R4. In this way, R5 enables the position of the picture to be moved vertically on the screen, and R4 horizontally. Suitable values for the components associated with the plates are C6=C7=0.01 μF., C8=C9=0.1 μF., R13=R14=R15=R16=5.0 MΩ.

In order to find the voltage-divider resistances, it is only necessary to assume a convenient current, say 2.0 mA., and knowing the voltage required across each to calculate the resistances from Ohm's Law. Unfortunately, this straightforward procedure usually leads to non-standard values of resistances. It is desirable, wherever possible, to use standard values, and this is especially so in the case of variable resistances. A certain amount of trial and error procedure will usually be necessary, therefore, before the most convenient values are obtained. The best course is probably to choose a standard value for the variable resistance R7 and from the known voltage drop across it calculate the current, R6, R8, R9, R10, and R11 can then be found directly, as also can the combined value of R2, R3, R4 and R5. The last two can be arbitrarily selected as standard values and R2 and R3 calculated. Since the voltages available for shift are by no means critical, it is usually sufficient to choose the nearest standard values for R2 and R3. Some effect will be experienced in the other voltages if the exact values are not used, but the changes are unlikely to have any appreciable effect. Only the second anode and bias voltages are critical, and these are made adjustable.

The best course is to tabulate the various voltages and work out the resistance values; the figures in the accompanying table show this and will repay study. In this case a convenient current to take is 1.0 mA., for this leads to standard value resistances throughout save in the case of R6 and R7. The latter can

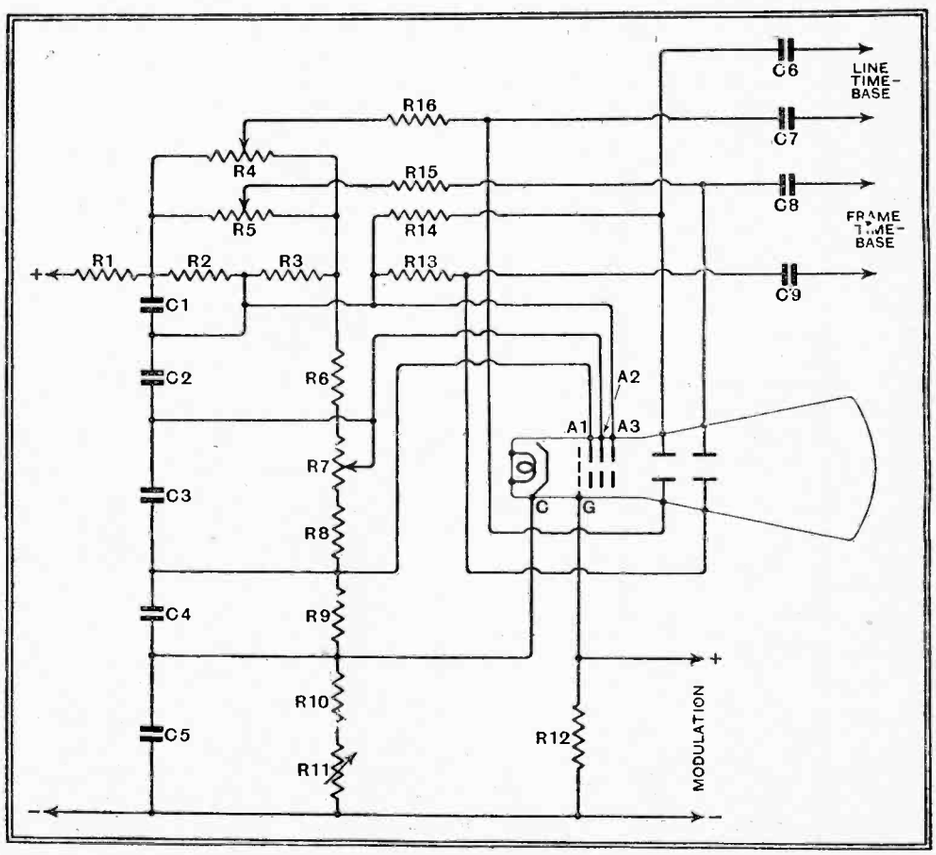


Fig. 36.—The smoothing equipment for the high-voltage supply and the potential divider for obtaining the various anode voltages are shown here.

The Television Receiver—

be made standard by changing the values of voltage slightly, and we get the figures of the next columns, where only R6 is non-standard. This does not matter, for in any case we shall have to use several resistances in series for this component on account of the high voltage across it. In general, it is unwise to apply more than 1,000 volts to the ordinary carbon-type resistance, even if it is worked within its wattage rating.

Now consider the condensers. Experience shows the following values to be satisfactory: C1=2.0 μF., C2=1.0 μF., C3=1.0 μF., C4=2.0 μF., C5=4.0 μF. The voltages across the terminals are given in the table and it can be seen that only one (C2) need be of really high voltage rating. In this, however, there is a trap for the unwary. Consider C1; as there are only 200 volts between its terminals one is tempted to use an ordinary condenser of 250 volts rating. When the negative of the supply is earthed, however, there is no less than 4,350 volts between one terminal and the earthed case! A low voltage condenser will almost certainly break down. The same thing happens in respect of C5 if the positive HT lead is earthed.

We must not use ordinary low-voltage condensers with earthed metal cases in such positions, therefore; on the other hand, it is definitely unsafe not to earth the cases, for one can get a bad shock from such an unearthed case. Indeed, if metal-cased condensers are placed close together, but not touching, and the cases are not earthed, sparks will jump across between the cases!

There are two remedies. Use ordinary condensers, insulate the cases as carefully as if they were in direct connection to positive HT, and cover them with an earthed metal screen so that it is impossible to come into contact with them. The alternative is to use special condensers which are provided with adequate insulation between the inside and the case, so that the latter can be earthed.

The remaining point to be considered is R1. This provides smoothing in conjunction with the condensers following it, and a satisfactory value is 0.2 MΩ; the drop across it is 200 volts, and this brings up the unsmoothed rectified voltage required to 4,550 volts at 1.0 mA.

The circuit of Fig. 36 must be preceded by a rectifier such as that of Fig. 34. The reservoir condenser can well have a capacity of 0.25 μF., and the rectifier must provide 4,550 volts across it with a load current of 1.0 mA. With a valve such as the U16 or HVR1, this output will be obtained with a transformer winding of about 3,300 volts RMS. The peak inverse voltage, as the voltage across the rectifier on the non-conductive half-cycle is called, will be $3,300 \times 2\sqrt{2} = 9,350$ volts, and the insulation between the HV and rectifier-filament windings of the transformer must be sufficient to withstand this figure. The reservoir condenser must be rated for $3,300 \times \sqrt{2} = 4,675$ volts.

RESISTANCE AND CONDENSER VALUES FOR THE CIRCUIT OF FIG. 36.

Volts from Cathode.	Volts from Negative HT.	Volts Across —.	Values of R (MΩ for Current of 1.0 mA.)	Volts Across Resistances.	R MΩ.	Watts.	Min. Wattage Rating to be Used.	Volts Across —.	Max. Volts from C to —HT.
Grid —100/250	C +100/250	R1 200	0.2	200	0.2	0.2	1.0		
A1 +400	A1 +500/650	R2 100	0.5	100	0.5	0.5	1.0	C1 200	4,350
A2 +900/1,250	A2 +1,000/1,500	R3 100	0.5	100	0.5	0.5	1.0	C2 3,000	4,150
A3 +4,000	A3 +4,100/4,250	R4 200	0.5	200	0.5	0.5	1.0	C3 900	1,550
Plates +3,900/4,100	Plates +4,200/4,350	R5 200	0.5	200	0.5	0.5	1.0	C4 400	650
		R6 2,650	2.65	2,600	2.6	2.6	6.0	C5 250	250
		R7 350	0.35	400	0.4	0.4	1.0		
		R8 500	0.5	500	0.5	0.5	1.0		
		R9 400	0.4	400	0.4	0.4	1.0		
		R10 100	0.1	100	0.1	0.1	0.5		
		R11 0–150	0.15	150	0.15	0.15	0.5		

On the other hand we can use the voltage-doubler of Fig. 35, making the condensers C1 and C2 each of 0.25 μF. capacity. The voltage required across each condenser is one-half the total, or 2,775 volts at 1 mA. This will be provided by a transformer winding of some 2,200 volts RMS. The transformer insulation must, therefore, start up to $2,200 \times 2\sqrt{2} = 6,220$ volts only, and the condensers need be rated for $2,200 \times \sqrt{2} = 3,110$ volts only. It must not be forgotten, however, that although the maximum voltage applied between the terminals of each condenser is only 3,100 volts, that between one terminal of C2 and earth may be twice as great. A special condenser must be used for C2, one of twice normal rating, or a normally rated condenser with an unearthed and protected case.

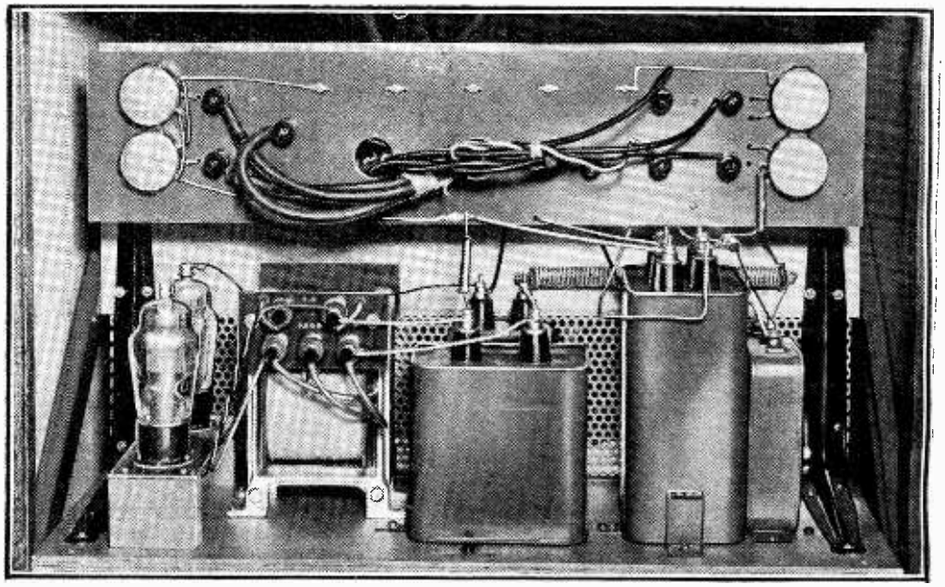
The Time-Base HT Supply

In the matter of cost there is probably very little between the two circuits, for although the voltage-doubler requires more components than the half-wave rectifier, those components are less expensive on account of the lower standard of insulation required.

Now, before we go any further, let us consider the question of the HT supply for the time-base. When electrostatic deflection is used the time-base requires a current of about 20 mA. at 1,000 volts. It is easy to build a mains unit with such an output using a half-wave rectifier such as the U17, but this course is naturally rather expensive and it would be much nicer if we could derive the necessary power from the high-voltage unit.

It is, however, hardly feasible to provide a current of 20 mA. or so at the 4,000 volts required by the tube and then use a dropping resistance to obtain the 1,000 volts needed by the time-base. It is a possible course but not an economic one, for not only should we be wasting 60 watts in the dropping resistance, but the cost of both rectifier and mains transformer would be greatly increased by the heavier current.

There is a way out, however, which entails much less waste and which results in probably the most economical of all mains equipment. We can use the voltage-doubler of Fig. 3 and tap off the current for the time-base from the junction of C1 and C2. At this point we shall have



A rear view of the high-voltage unit.

The Television Receiver—

roughly 2,000 volts, so that we have to drop in a resistance only 1,000 volts at 20 mA., or 20 watts—a much more reasonable figure. The resistances needed for this can actually provide the smoothing for the time-base supply.

This arrangement is shown in detail in Fig. 37 and the tube supply is taken off through the network of Fig. 36. The rectifier V1 supplies the time-base entirely and the full current at roughly half the voltage for the CR tube; its output current is consequently 21.0 mA. The other rectifier V2 need supply only 1.0 mA. V1 must thus be a valve such as the U17, but V1 can be a U16. There is, however, really no point in using different types, for they are the same price, and as the U17 is a lower resistance valve we shall obtain the same output for a slightly less AC input. The lower AC input will permit some reduction in transformer insulation and in the voltage ratings of condensers.

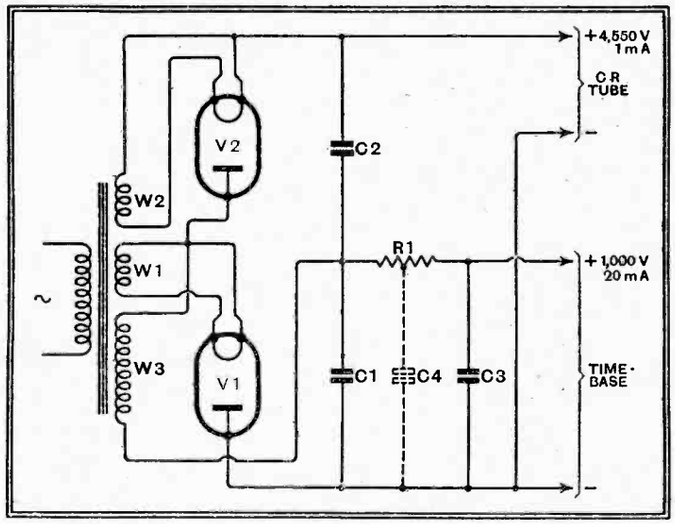


Fig. 37.—With the voltage-doubler rectifier it is possible to run the time-base, as well as the tube, from the HV unit in the manner shown here.

We can decide, therefore, to use U17 valves for both V1 and V2. Owing to the dissimilar currents the two condensers will no longer be of the same value, and suitable capacities are 1 μF. and 0.1 μF. for C1 and C2 respectively. We find from the valve curves that a transformer winding W3 of 1,750 volts RMS should provide 2,100 volts at 21 mA. across C1 and the same voltage should provide some 2,500 volts at 1 mA. across C2. This latter assumes a 1 μF. condenser for C2 and it will be rather smaller if we use only 0.1 μF. We should, however, obtain a total output of some 4,500 volts with a winding of only 1,750 volts RMS. The maximum peak voltage which may occur in the transformer and for which insulation must be provided is thus rather less than 5,000 volts. The maximum potential across the condensers C2 and C1 is only 2,500 volts, and that between one terminal of C2 and its case 5,000 volts.

It can thus be seen that the use of low-resistance type rectifiers pays because we can obtain the required output with a lower voltage winding on the transformer and in consequence the reservoir condensers can be of lower voltage rating.

Now, in the resistance R1 we have to drop 1,100 volts at 20 mA., so it must have a value of 55,000 ohms, and it will dissipate 22 watts. In order to save the cost of chokes, we should like to use this resistance also for smoothing. Now a single resistance and condenser following it will not prove adequate with any reasonable capacity for the condenser. If we split R1 into two halves, however, and connect an extra condenser C4 to earth, then we can obtain adequate smoothing with capacities no greater than 1 μF.

During normal operation C3 has 1,000 volts applied to it and C4 some 1,550 volts, so that ratings for these condensers slightly in excess of these figures will be adequate. We must not forget, however, that until the valves in the time-base have warmed up sufficiently to take current there will be no voltage drop across R1. Consequently, as much as 2,500 volts may be applied to C3 and C4 and most condensers in the time-base for a short time after switching on. Rather than use condensers of such a high voltage rating throughout it would be cheaper to adopt a separate 1,000 volt power-pack for the time-base.

The difficulty can be got over, however, by arranging delayed switching for the HV unit, and this is advisable in any case because the CR tube cathode should be heated before the high voltage is applied. We shall be safe, therefore, if we arrange to provide the heater current for the time-base valves and CR tube from a separate transformer, which can well be the one supplying the vision receiver, and to switch this on perhaps half a minute before the HV unit.

It will, of course, be obvious that this method of combining the HV and time-base HT supplies is only practicable when the negative is earthed. Similarly, the particular circuits described in Part IX must also be used only with a high-voltage supply having its negative terminal earthed. For reasons given in Part I the use of a negative earth has been adopted throughout this series of articles, and in cases where the positive of the supply is earthed it is necessary to introduce the appropriate alterations into the circuits.

New Cossor Valves

TWO new valves are announced by Cossor; they are the MS/Pen B and the MVS/Pen B. They have characteristics similar to the well-known MS/Pen and MVS/Pen types, but differ in having the control grid connections brought out to the top of the bulb instead of the anode. In other words, the valves have type 7E base connections, referring to the designations adopted in *The Wireless World Valve Data Supplement*.

The MS/Pen B is an RF pentode with a mutual conductance of 2.8 mA/V under normal operating conditions, which are 200 volts, 100 volts, and −1.5 volts anode, screen, and grid potentials. The MVS/Pen B is a variable-mu RF pentode with a mutual conductance of 2.2 mA/V and the same operating voltages. About 20 volts grid bias is needed for anode-current cut-off. Both valves are indirectly heated and take 1.0 ampere at 4 volts.

Television Programmes

Transmissions are from 3-4 and 9-10 daily

Vision 45 Mc/s. Sound 41.5 Mc/s.

FRIDAY, JUNE 11th.

3, Music Makers: Carroll Gibbons. **3.10,** Weaponless Self-defence, demonstration No. 4. **3.20,** British Movietonews. **3.30,** 100 per cent. Broadway—Variety.

9, Lina Menova (songs). **9.10,** Repetition of 3.10 programme. **9.20,** Gaumont-British News **9.30,** Broadcasting in India—talk by Lionel Fielden, Controller of Broadcasting in India. **9.45,** Starlight: Steve Geray and Magda Kun.

SATURDAY, JUNE 12th.

3, Gardening Demonstration by C. H. Middleton from the grounds of Alexandra Palace. **3.15,** Folk Dancing in the open air by the winning teams of the Folk Dancing Competition. **3.25,** Variety. **3.50,** Gaumont-British News.

9, John Carr and his family give another entertainment with their Jacquard Puppets. **9.10,** Gardening talk. **9.20,** British Movietonews. **9.35,** "Regatta": a revue for television.

MONDAY, JUNE 14th.

3, Starlight: Aileen Stanley (American singer). **3.15,** Gaumont-British News. **3.25,** "Hassan": Part II of the story of Hassan of Baghdad and how he came to make the golden journey to Samarkand. Part I was televised on June 8th.

9, Repetition of 3 programme. **9.15,** British Movietonews. **9.25,** Repetition of 3.25 programme.

TUESDAY, JUNE 15th.

3, Starlight: Bill Barr (American impressionist). **3.10,** Cartoons: Bruce Bairnsfather. **3.20,** British Movietonews. **3.30,** "Damon and Phyllida," Opera by John Gay.

9, Personalities. **9.10,** Starlight: Evelyn Dall (songs). **9.20,** Gaumont-British News. **9.30,** Repetition of 3.30 programme.

WEDNESDAY, JUNE 16th.

3, "Linoleum"—a floor show. **3.20,** Gaumont-British News. **3.30,** Sixty-third Picture Page.

9, Repetition of 3 programme. **9.20,** British Movietonews. **9.30,** Sixty-fourth Picture Page.

THURSDAY, JUNE 17th.

3, Model Yachting. A regatta for model yachts on the lake in the grounds of Alexandra Palace. **3.15,** Music Makers: Lisa Minghetti. **3.25,** British Movietonews. **3.35,** Revue.

9, Music Makers: Esther Coleman. **9.20,** Gaumont-British News. **9.30,** Architecture: designing rooms for comfort. **9.40,** Cabaret with Walsh and Barker (American Duettists) and Rosorito (Spanish dancer).

UNBIASED

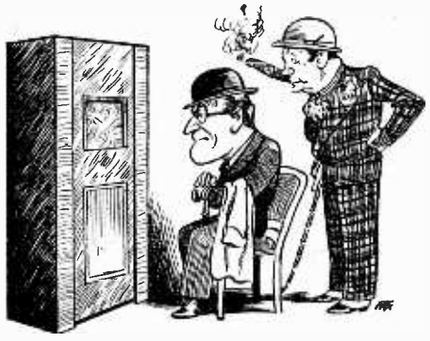
By FREE GRID

My car folded up

Seen on the Air

I WONDER if any of you television enthusiasts have been suffering recently from a very peculiar form of interference in which the received picture seems partially obliterated by a confused kaleidoscopic jumble. The aforementioned jumble is not, of course, stationary, but constantly moving like a mass of worms on a plate. For a long time it puzzled me sorely, for it was observable not only when the Alexandra Palace transmissions were coming through, but also at various other periods of the day, particularly in the small hours of the morning. I suspected some unusual type of electrical interference.

Now television has been with us for such a relatively brief period that we cannot recognise various forms of interference on the screen as we can noises in the loud speaker in the case of ordinary broadcasting, where the sound of a vacuum cleaner, for instance, is readily distinguishable from that of a violet-ray



Shocked and astonished.

machine. This profound thought was the cause of my getting on to the track of the mystery, as it suddenly occurred to me to couple up the loud speaker in place of the cathode-ray tube and so turn the interference into sound.

Having done this I immediately recognised the noise as being nothing more than "scrambled" telephony butting in on the television wavelength. As many of you may know, speech on the ordinary transatlantic and other wireless telephony services is first jumbled up, or "scrambled," by a special apparatus at the G.P.O., in order to make it unintelligible to any chance eavesdropper who may pick up the transatlantic wave. At the receiving end it is unscrambled by another set of apparatus before being passed on as normal speech to the subscriber.

It was quite obvious to me, of course, that somebody had applied the scrambling principle to television with a view to preserving the secrecy of the pictures, and, as I think you will agree, it was no more than natural that my curiosity was aroused, and I made attempts to construct a network of unscrambling circuits.

In spite of my efforts I should have given it up as a bad job had I not chanced to meet in a neighbouring hostelry an expert in these matters who was on his beam ends owing to having been sent down from Oxford and later thrown out of the B.B.C. for smoking a cigar with the band on it. He had, it appeared, learnt all about scrambling and unscrambling while serving as an office boy in the establishment of a shady New York stockjobber who made a living out of information of market movements obtained by eavesdropping on the transatlantic conversations of financial magnates.

It did not take this expert long to figure out the necessary unscrambling circuit, and we were rewarded—or perhaps I should say shocked and astonished—to see portrayed on the screen certain goings-on of a type which would certainly not be permitted in any but the most advanced Sunday schools. After seeing the "vision" side of the programme I am not at all surprised at the omission of any sound accompaniment. As Shakespeare, or somebody like that, once remarked, more can be conveyed by the delicate, almost imperceptible, lifting of an eyelid than could be compressed into ten thousand words. Needless to say, I have forwarded the documents in the case to the proper authorities.

They're Off!

I SUPPOSE that, like myself, you fellows often go along to your garage with the intention of getting out the best car to take a friend for a moonlight drive out into the country, only to find that the lady of the house has been there before you and driven herself off to some wretched women's sewing meeting.

This sort of thing befell me last week, with very disastrous consequences. As a matter of fact it was not evening but quite early in the day when I had an important board meeting to attend and I desired to listen in, on my way there, to the B.B.C.'s running commentary on a certain well-known sporting event.

To put it mildly, I was extremely annoyed, this being due partly to the fact that I should have to turn up to the board meeting in the next best car, which was of rather ancient vintage and likely to be looked at askance by my fellow directors. The chief cause of my annoyance, however, was that my best car, which, I learned from one of my garage hands, Mrs. Free Grid had taken on a shopping expedition, was fitted with the last word in car radio, and I was compelled to rake out an old-fashioned portable to take with me in the second best car.

Even then all would have turned out alright had I taken the main arterial road to my destination, but owing to the fact that a natural love of the countryside and that delightful feeling of early summer in the air had filled my mind with thoughts of romance, I and the car wandered off down leafy lanes and by-roads. The many twists and turns had a disastrous effect on my reception, owing to the strong directional effect of the frame.

Eventually I turned into a straight section of road which was unfortunately at right angles to the direction of the frame aerial of the set, which was in the back seat. I sought to remedy this by turning the set sideways, but this meant that the loud speaker was no longer turned towards me, and owing to the rush of the wind caused by the speed at which I was travelling I could hear nothing. Eventually I recollected the old zig-zag method of progress used by our ships during the war in order to dodge torpedoes, and I found that this answered the purpose very well. During the "zig" the frame aerial was more or less aligned with the direction of the signals, and although they were completely cut off during the "zag," this did not matter provided I kept up a sufficient speed to prevent my ear "noticing" the gap. A similar idea is, of course, used in the latest scheme for eliminating atmospherics, and was originally cribbed from the "persistence of vision" phenomenon with which we are all so familiar in the cinema.

All would have gone well had not some crazy fool of a lorry driver coming in the opposite direction tried to hold on to his course instead of fitting himself neatly to my track by zig-zagging 180 degrees out of phase with me. The net result was, of course, that there was a collision and my car folded up like a concertina. My wireless set was irretrievably ruined and, worst of all, I missed the most exciting part of the running commentary, to say nothing of the fact that I was late for the director's meeting. All this, owing to a woman's folly in taking the best car without pausing to think what she was doing.

Water-pipe Earths

SHOULD THEY BE BANNED?

By "MAINSMAN"

WATER Supply Authorities who seek to obtain powers to prohibit the earthing of broadcast receivers to their pipes have no justification for their action. At any rate that is the conclusion likely to reached after reading this article by an electrical supply engineer with a wide experience of the effects of leakage currents.

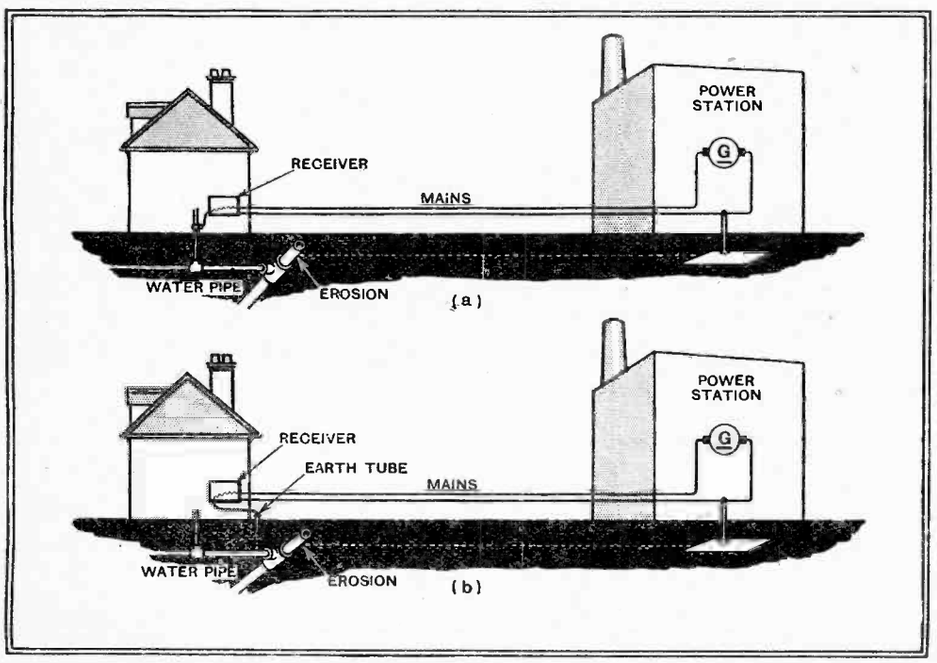
MOST readers are probably aware of the growing feeling among water authorities regarding the question of earthing receiving sets to water-pipes; indeed, it has been suggested that legislation should be introduced to prohibit what is, to the majority of listeners, the only available earth unless the gas-pipe is used, but here the risk of explosion and fire is too great for any normal person to give the idea a second thought.

The supposition that water-pipes, either iron or lead, are damaged by the electrolytic action of the earth current from the average receiver is rather far-fetched, for several reasons.

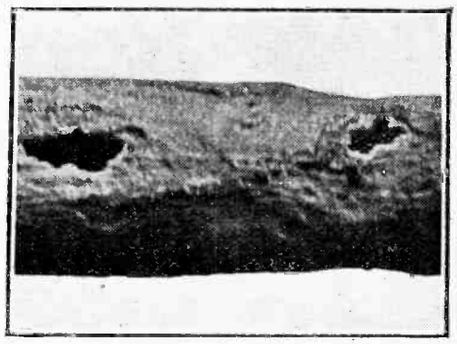
First of all it should be noted that average receiver was mentioned, and by this it is meant to imply any DC or AC receiver which is earthed in accordance with, and has either a condenser or transformer which complies with, the Institution of Electrical Engineers' Regulations for the Electrical Equipment of Buildings (tenth edition), September, 1934, section 9, Regulations numbered 907 and 908. Assuming that these regulations are satisfied, then the quantity of electricity which would pass to earth is such that no apparent damage would be done to pipes or cable sheaths during the course of many years. It has been stated that one ampere flowing continuously for twelve months will remove 75 lb. of lead from the sheath of a cable or a lead water-pipe if it is handy, but it will be realised that the extremely small DC component passing to earth from a receiver will not move much lead; indeed, it would hardly pit the surface of the pipe, even if it were flowing continuously for the twelve months.

But suppose, for a moment, that there is an appreciable current flowing from the set, and consider what will happen. If it is the result of defective insulation in the components, then the water authorities case against radio earthing is altered, because this current flowing to earth from the set is decidedly not a radio current, but is very definitely what electrical power distribution engineers call a leakage current, the result of defective insulation, and cannot, therefore, be laid at the door of the radio set, *per se*. This may seem to be mere splitting of a hair, but it is not so.

Furthermore, it makes no difference if this defective set had a water-pipe earth or direct earth connection, such as a buried plate, a driven copper bar or tube, or a copper bowl, for the leakage current, in its passage from this electrode back to its source at the generating station, may possibly travel along any metallic pipe or cable that happens to be in its path.



Diagrammatic sketch showing (a) how erosion of a water-pipe may be produced by a receiver in which there is a serious leakage to earth. But the substitution of a direct earth (b) would not necessarily prevent, or even greatly reduce, the erosion of the pipe.



Section of a pipe damaged by a leak in domestic wiring (not in a broadcast receiver!).

AC is Harmless

Now one important point to be noted here is the type of electricity supply, for if the receiver is fed from an alternating-current system the effect of a leakage current is practically negligible. AC electrolysis is extremely slow in its action; broadly speaking, one-half of the cycle almost cancels the action of the preceding half-cycle, so therefore only direct current need be considered harmful. The relatively insignificant radio-frequency currents flowing in the aerial-earth circuit of a broadcast receiver can be ignored when other sources of damage are considered.

As mentioned above, any mains leakage will naturally flow back to its source, travelling via the earth or, if more convenient, metallic pipes of any description, including gas- and water-pipes, compressed-air pipes used for sewage systems, electric power and lighting cables, Post Office telephone cables, tramway and sometimes railway lines, but, whatever the metal path is, it is only damaged at the point where the current leaves, so that as long as the current can be kept on the pipe no action takes place, also no harm is done at the spot or spots where current flows on to the pipe.

The current will be recorded on the leakage-recording ammeter inserted in the earth circuit at the generating station or sub-station, and is dealt with by the electricity supply authority, where it is usual for a member of the mains staff to be detailed for the location and removal of leakage. The writer has had over twenty years' experience on a public-supply system which includes approximately thirty miles of direct-current cables, and he can speak from experience in locating leaks, the various sources that cause them, the usual paths taken, and the effects of electrolysis on various classes of pipes, etc., buried in the soil. The piece of iron gas-pipe shown in the photograph was covered when laid with a waterproofed

Water-pipe Earths—

hessian tape, but the leakage current found a path through it, and, as can be seen, has punctured the pipe and destroyed the metal over a length of eight inches, but only on one side of the pipe and that part of the pipe is the point of leaving; the metal on the opposite side to the damaged portion is as new and quite untouched by the action. The appearance of the affected portion is similar to a badly rusted pipe, if it were not for the fact the surface is clean and even bright in places.

It is not fair to blame the radio set for this kind of damage, any more than other current-consuming devices, such as suction cleaners, electric fires, or the house-wiring system, for any part of an electrical installation can be the possible source of leakage, and, as mentioned before, the current will get on a pipe somewhere in the earth despite any rules, regulations or Acts.

Another cause of damaged pipes is present in sour soil or some particular areas of made-up ground. Cases have been noted where the chemical action has been almost identical with electrolytic action (both, of course, are chemical, but here it is meant to imply a chemical action without electricity, electrolytic action being caused solely by an electric current). It is usually difficult to determine from appearance the difference between the two causes, but if the local soil and electrical conditions are known a more definite opinion can be given as to the probable cause.

A further source of damage is the pure earth currents which seem to flow in various directions and in varying degrees of strength. Currents have been measured in milliamperes, it is true, but no apparent source can be found for them, but surely the broadcast receiver will not be blamed for these?

The wireless set owner would not be the only one to be affected by legislation prohibiting the use of a water-pipe as a means of earthing, for practically all the electricity supply authorities will have to make some provision for earthing their domestic apparatus if they do not already use their cables where suitable. The regulations mentioned earlier in this article, while not definitely specifying a water-pipe as an earth, do mention that only a cold-water pipe having a metal-to-metal joint throughout should be used (Regulation No. 1006 (*a*)).

As stated before, damage to pipes only occurs at that point where the current leaves the pipe, and it is a fairly easy and usually inexpensive matter to ensure the current leaving by a properly connected path and thus avoiding the electrolytic action. It has been done by the writer in a case where the lead sheaths of cables would only last approximately three months before the leads were properly drained (in the electrical sense). After that was done there was no more trouble from electrolysis.

It is felt that the water authorities are too concerned with the supposedly evil effects of radio earthing and not fully aware of other sources, where currents can be literally thousands of times greater than the extremely minute radio earth current. Even if independent earths were made compulsory—well, the danger would still exist.

SWIMMING BATH INTO RADIO STUDIO

ONCE upon a time, deep down in the bowels of Bush House, there used to be a swimming bath, constructed, presumably, for the amusement and delectation of tenants with offices in the building. But these plans did not materialise. The bath was then boarded over and used as a Badminton court during the winter and as a store-room in the summer.

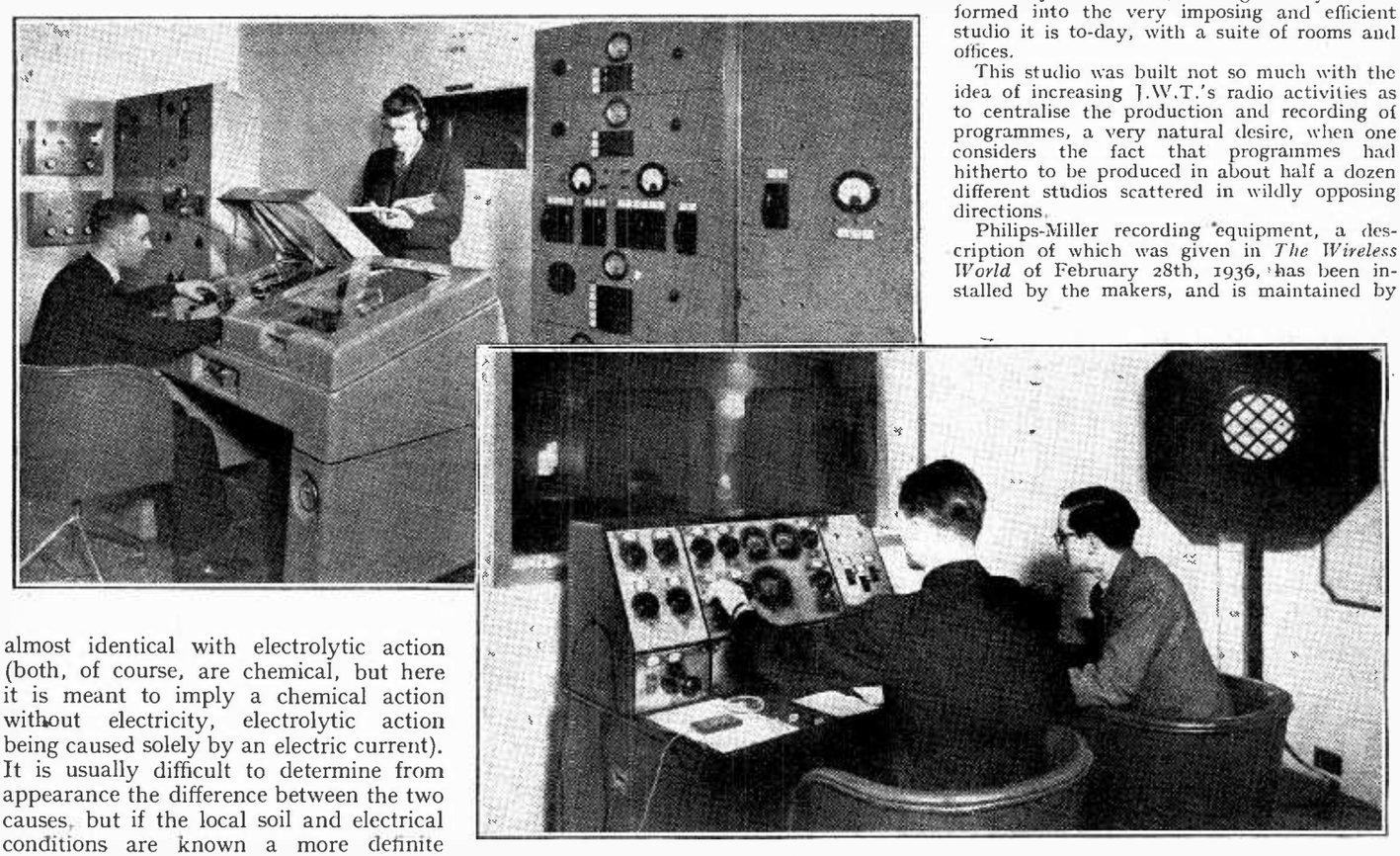
But two years ago one of the programme directors of J. Walter Thompson's growing radio department happened to hear of the existence of this old swimming bath. That very day, actually, he had worked for more than twelve hours non-stop, nearly six of which had been spent in tube trains, taxis and buses, travelling between Bush House and the five radio studios, scattered to the four corners of London, in which J.W.T. programmes were then being produced.

Here, almost ready-made, in his own office building was a suite of rooms with the height of ceiling essential for a good studio. The bath, which, as anticipated, the Bush House management was delighted to let at a phenomenally low rental, was gradually transformed into the very imposing and efficient studio it is to-day, with a suite of rooms and offices.

This studio was built not so much with the idea of increasing J.W.T.'s radio activities as to centralise the production and recording of programmes, a very natural desire, when one considers the fact that programmes had hitherto to be produced in about half a dozen different studios scattered in wildly opposing directions.

Philips-Miller recording equipment, a description of which was given in *The Wireless World* of February 28th, 1936, has been installed by the makers, and is maintained by them in conjunction with J.W.T. technicians. A visitor to the studio to-day might find it difficult to believe that only a few short months ago it was a gloomy, dusty and empty shell.

Through observation windows at the end of the recording studio what is going on can be watched from the control rooms. The Philips-Miller equipment which is seen in the photograph, is the very latest available; and with it it is possible to record continuously without any breaks, while another important advantage is that recording in the studio can be played back perfectly within a few seconds, so that the producer can edit the recorded programme while it is being made.



The control room and, above, the recording studio in the basement of Bush House.

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

Lightning Disables Transmitter

IT is unusual for a broadcasting station to be damaged by lightning, even though nowadays they carry on in all but the worst thunderstorms. There was an exception, however, in the case of Radio Toulouse, which was put out of action for twelve hours recently when its aerial was completely destroyed by lightning.

National Transmitter to Go ?

A CERTAIN amount of speculation has been aroused as to what lies behind the recent changing of the big identification boards in the grounds of Brookmans Park station. For the past seven years these boards have announced the station to the world as the London Twin-Wave High-power transmission station. Now they simply say, "Brookmans Park Transmitting station." The omission of all reference to twin-wave is thought by many to presage the long-rumoured closing down of the National transmitter.

Finnish Expansion

THREE new broadcasting stations are to be built in the Eastern Provinces of Finland, where interference from Russian stations is extremely bad. The first of these, a 1 kW station, is to be built near Kuopio, and is expected to be ready in August. The second station, also of 1 kW, which will be located at Joensuu, will be ready by Christmas. The third will be a 10 kW station, but will not be commenced until December. It will probably be built near Sordavala.

Danish News

THE number of wireless licences issued in Denmark is now 667,403, which is equivalent to 18 per cent. of the population. A great drive to round up pirates will commence at the end of the present month, and it is estimated that the bag is likely to be in the neighbourhood of 35,000.

During the past year the Danish State Broadcasting authority has averaged about 13½ hours' daily transmission, the actual number of programme hours for the year being 4,921, which is 210 in excess of last year. 53 per cent. of this time was devoted to music, this being by far the biggest item, the smallest being outside broadcasts, which only occupied 2½ per cent. of the total time.

Trouble in Norway

THE new Bergen transmitter is causing grave dissatisfaction among Norwegian listeners, it being alleged, among other things, that the wavelength which it uses is a very unsuitable one for a Regional station. It is stated that in future the station will radiate the National programme, and a separate 1 kW transmitter will deal with the Regional programmes on 845 metres.

Transmitting Contest

THE first five places in the recent R.S.G.B. International Transmitting Test went to South Africa, England, Holland, Australia and Sweden. The winner of the contest was Mr. G. Shoyer, of the Cape Town station, ZS1H.

Wireless "Fox-hunting"

WE are quite accustomed in this country to the field days organised by the R.S.G.B. and other amateur radio societies, in which members armed with portable DF stations endeavour to locate a hidden transmitter. The Danish amateurs go one better. In their wireless foxhunting, as they call it, things are made much more difficult for the hounds as the transmitting station is kept on the move.

Danish amateur transmitters now total 286 and are licensed to use up to a 100-watts power. For their benefit valve manufacturers in Denmark have just produced a new type of a 100-watt valve to be sold at less than half the price of its foreign counterparts, this being part of the vigorous campaign being waged at present for the capturing of the Danish valve market. European valve makers will reduce all prices in Denmark by 12 per cent. on July 1st.

Safety at Sea

DURING the present year the Royal National Lifeboat Institution will equip an additional fourteen of its boats with wireless telephone transmitters and receivers. Another measure towards ensuring safety at sea is the recent decision to erect three radio beacon stations on the shores of the Cook Strait, which divides the two main islands of New Zealand.

I.E.E. Nominations

THE Council of the Institution of Electrical Engineers has nominated Sir George Lee, the Engineer-in-Chief of the G.P.O., to the Presidential Chair. Sir Noel Ashbridge is to be one of the Vice-Presidents, filling a vacancy which will occur on September 30th. Sir Noel is at present a member of the Council.

Television.

FOR the benefit of visitors to the Television Exhibition at the Science Museum a booklet has been prepared which deals briefly with the history of television and explains the functions of a large amount of the apparatus employed.

In the first chapter is treated the early history of television, commencing with the original discovery of the electro-chemical effect of light as early as 1839 and ending with the B.B.C. low-definition transmissions by the Baird system in 1935.

Photo-electricity is discussed in the second chapter, both photo-emissive and photo-voltaic cells being treated, in addition to the electron multiplier. This is followed by descriptions of scanning and of light control.

The cathode-ray tube and the electron camera have a chapter to themselves, as also has the vision transmitter at the Alexandra Palace. Receivers and aerials are then discussed, and the book concludes with a general chapter on the London Television Station.

The booklet is by no means highly technical, but it would not be true to say that it is non-technical. Actually, it strikes a good compromise between the two extremes and should form an extremely useful guide to the exhibition in the sense that its perusal will put the visitor in a much better position to appreciate and to understand the exhibits.

It contains 63 pages and is edited by G. R. M. Garratt, M.A., with the assistance of G. Parr, and published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, at 6d., postage extra. Copies are also obtainable at the Science Museum.

Turkey Goes Ahead

THE contract for the equipment of the new Turkish Broadcasting House at Ankara and the erection of a 120-kW transmitter, as well as a short-wave one of 20 kW, has been secured by Marconi's Wireless Telegraph Co. The transmitters will actually be at Etimessut, some fifteen miles from headquarters at Ankara, and a special wide-frequency cable is to be laid to link the two.

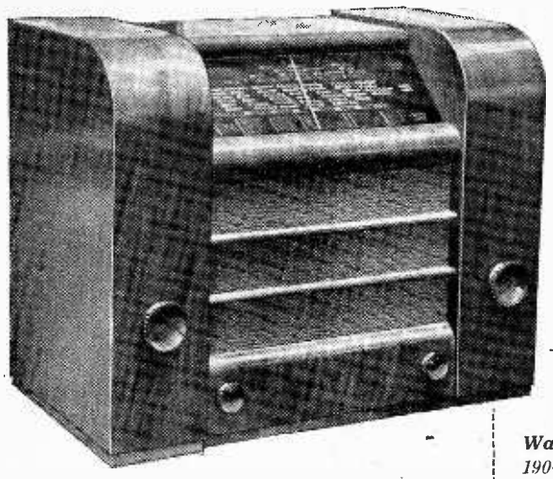
Lt.-Col. Sir George Lee, O.B.E., M.C., Engineer-in-Chief of the Post Office, who has been nominated to the Presidential Chair of the Council of the I.E.E.

The long-wave station will be constructed so that its wavelength can be varied between 1,000 and 2,000 metres and the power reduced to 60 kW when required. Modulation will be by the Marconi high-level "class B" system. The permissible distortionless modulation will be 90 per cent. A similar modulation system is to be used in the SW transmitter, which will cover a waveband of 14-100 metres. Actually, 80 per cent. modulation will be available with less than 4 per cent. distortion, and the frequency response will be linear between 30 and 10,000 cycles per second. A crystal drive with two pairs of crystals for two spot wavelengths will be employed.

There will be two 750ft. aerial masts, and radiation will be directional. At the Ankara HQ there will be five main studios, including one large concert hall. Turkish engineers are to be sent to the Marconi College at Chelmsford for special training in handling the station.

N.R.E.A. News

THE Fellowship examination of the National Radio Engineers' Association will take place on June 16th and 17th. The practical section will be held between 3 and 6 p.m. at the radio service workshops at Keith, Prowse and Co., Ltd., 49, Poland Street, W.1. The theoretical and oral section will be held between 7 and 10 p.m. at the Northern Polytechnic Institute, Holloway Road, N.1.



Halcyon MODEL A581

A FULL-SIZED TABLE MODEL SUPER-HETERODYNE WITH MANY ORIGINAL FEATURES

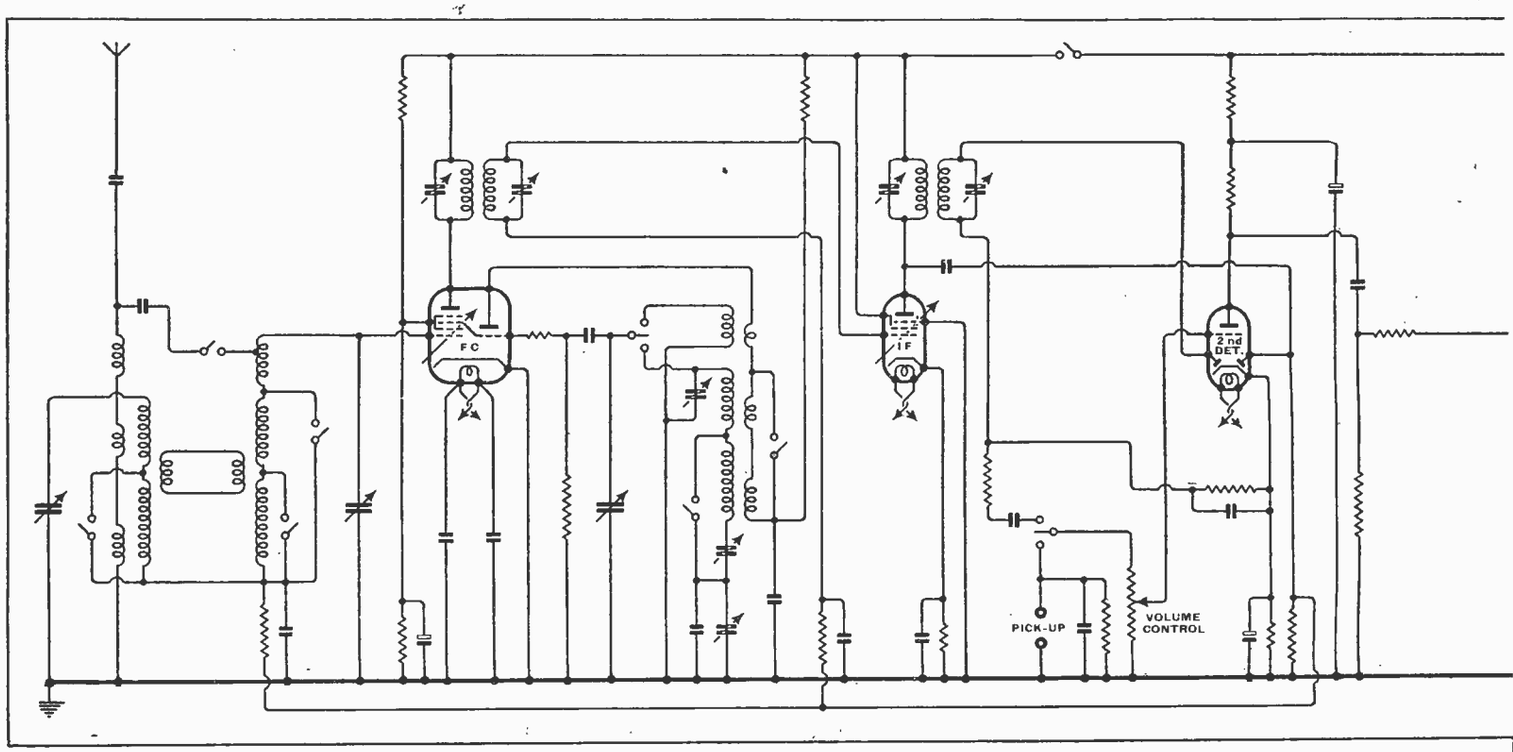
FEATURES. ***Type.***—*Table model superheterodyne for AC mains.* ***Waveranges.***—*(1) 16.5-51 metres. (2) 190-560 metres. (3) 850-2,000 metres.* ***Circuit.***—*Triode hexode frequency-changer—var.-mu pentode IF amplifier—double-diode-triode second detector—pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Tuning. (2) Volume and on-off switch. (3) Tone. (4) Waverange. (5) Radiogramo. switch.* ***Price.***—*15 gns.* ***Makers.***—*Ismay Distributors Ltd., Sterling Works, Dagenham, Essex.*

ON making a first acquaintance with this receiver one cannot fail to be impressed by the exceptionally lucid tuning scale. This is inclined at an angle, and the lettering is of such a size that the most short-sighted of users can read the station names with ease from any position in which they are able to reach the tuning controls. The scale is 14in. long and 4½in. wide, yet it does not seem to be out of proportion with the rest of the cabinet, which is appreciably larger than the average table model. It is so designed, however, that it does not appear in any way clumsy, and the space inside has been usefully employed in arranging for a liberal chassis layout with the components associated with the power supply on a separate unit. A single high-voltage pilot lamp provides general illumination for the interior of the cabinet and uniform distribution of light for the large tuning scale.

The station names associated with the three wavebands are printed in distinctive colours on a black background, and the waverange switch carries coloured markings corresponding with the tuning scale. The setting of the tuning control is indicated by a vertical white pointer travelling horizontally across the scale. This is actuated by an ingenious flywheel drive combining the advantage of a high reduction ratio (100 : 1) with the ability to move rapidly from one part of the scale to another. Even when a two-speed drive is provided there is still a certain amount of effort required to traverse wide sections of the scale, but in this case a single flick of the wrist is sufficient to cause the pointer to traverse a third of the scale length. In addition, the inertia of the flywheel invests the control with a smooth action which is in itself a refreshing change from the rather dead feel of the majority of tuning mechanisms.

On first switching on the set one is made to realise that apart from its other advantages, a big cabinet is conducive to improved quality of reproduction. Indeed, the breadth of bass response is in this case little inferior to that of a console type cabinet of good design. We were also particularly impressed by what might be termed the depth of tone. This is a quality which appears to be independent of frequency response and produces the same effect as one occasionally sees in a photograph which, although printed on a flat surface, nevertheless gives the impression of three-dimensional space. This, of course, is not entirely a quality of the cabinet design, and one of the essential ingredients is a clean output from the

Complete circuit diagram. The change-over switch from radio to gramophone and the switch breaking the HT supply to the first two valves are combined in a separate control at the back of the chassis.



receiver free from harmonic distortion. It goes without saying that the loud speaker itself must also be a little out of the ordinary, and in this case it is significant that the diaphragm is of a type which is moulded with radial as well as concentric indentations.

We were unable to improve upon the balance of tone provided when the tone control is in the "high" position except, perhaps, on the medium-wave band, where a slight excess of top is noticeable unless the station is very accurately tuned. Here some reduction of top may be tolerated as compensation for the very slight inaccuracies of tuning which are likely to creep in under normal conditions of use.

Sensitivity and Noise Level

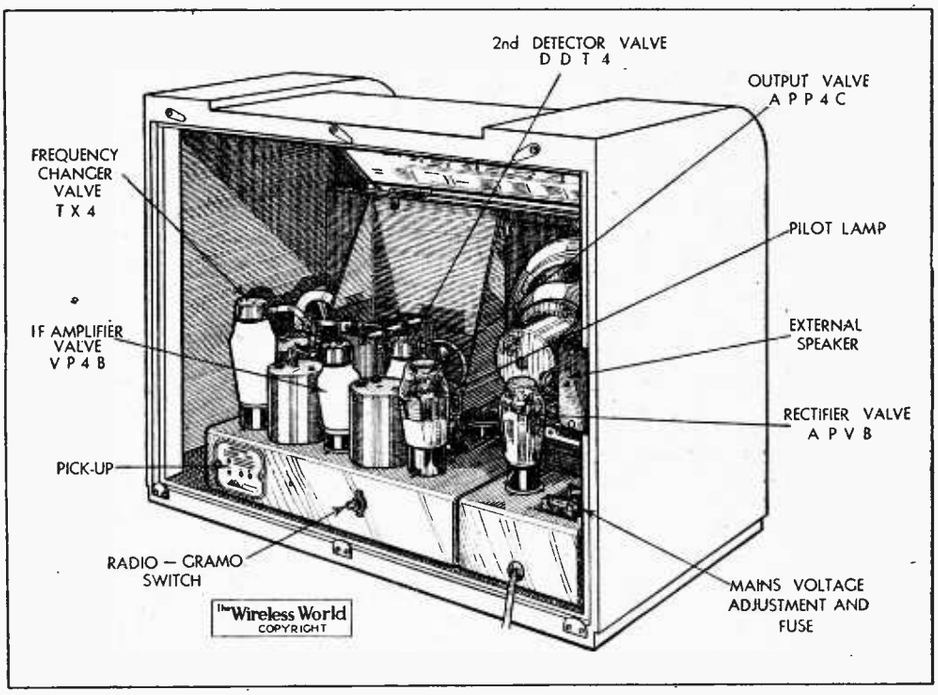
When assessing the merits of a receiver from the point of view of range and selectivity the medium-wave band generally provides the key, and in this case we have to record a sensitivity and signal-to-noise ratio which are as high as it is practicable to make them in the present state of the ether. When properly tuned and with the volume reduced to the normal working level we would defy anyone to distinguish between West, North and London Regional when these stations are relaying the same programme. Continental stations, such as Paris PTT, Langenberg, Radio Normandie, etc., give a signal-to-noise ratio in daylight which is not inferior to that of the British stations.

With the set working in Central London it was found possible to approach within one channel of the Brookmans Park stations before their modulation became audible. Apart from one fairly strong second-channel whistle from the local Regional station, both the medium- and long-wave ranges were clear of self-generated interference. Selectivity on the long-wave band was sufficient to give good reception of the Deutschlandsender with the usual irreducible medium-band sideband splash. The sensitivity on this range gave an ample reserve of volume on Droitwich and the principal stations lower in wavelength, but there was an apparent falling-off in sensitivity at the top end of the range, though Radio-Paris and Huizen were quite satisfactory with the volume control at maximum.

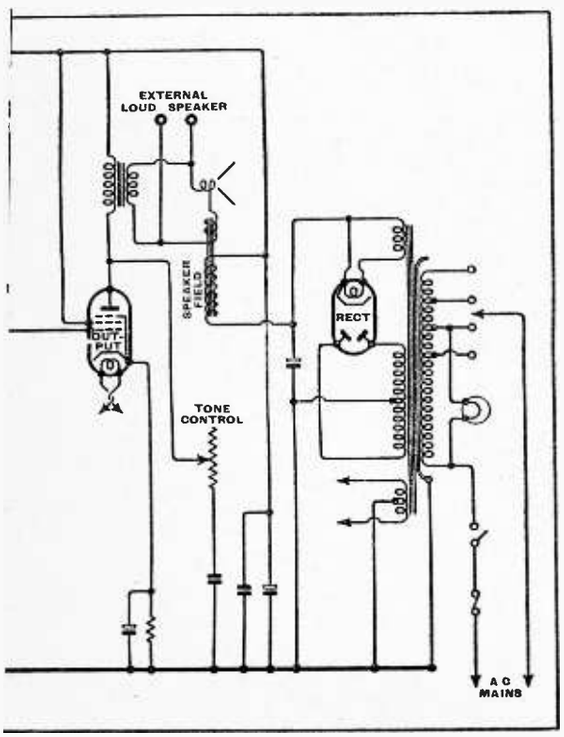
The short-wave range gives a lively performance which is in every way in keeping with the character of the medium-wave range and W3XAL, which at the time of writing appears to be the principal American short-wave broadcast station, was so well received as to make it certain that this set will hold its own with the leading short-wave receivers.

In view of the high sensitivity it is somewhat surprising to find that there is no stage of RF amplification. The first valve in the circuit is a triode-hexode frequency-changer. It is preceded by a band-pass filter with magnetic coupling on medium and long waves and a single tuned circuit on the short-wave range. On all three wavebands the input impedance is low to enable aerials of widely different characteristics to be used satisfactorily. The IF amplifier operates at 130 kc/s and is a variable-mu pentode. Both the frequency-changer and the IF amplifier are controlled by delayed AVC derived from the double-diode-triode second detector stage. There is provision for a gramophone pick-up, and the change-over from radio to gramophone is effected by a separate switch at the back of the chassis. Resistance coupling is employed between the amplifying portion of the second detector stage and the power pentode output valve. Special care has been given to the design of the output transformer, and the maximum power is rated at 3.5 watts. This is all usable, since there is no sign of harmonic distortion in the early stages before this level is reached.

The makers have shouldered a certain responsibility in giving the A581 so imposing an exterior, but those who handle the set will find that its standard of performance is fully in keeping with its appearance.



A single high-voltage pilot lamp mounted in the centre of the receiver chassis provides uniform illumination for the large rectangular tuning scale.



SUPPRESSOR CONDENSERS

Capacities Giving Virtual Immunity from Shock

COMPROMISE must necessarily enter into the choice of condenser values for use as interference suppressors on vacuum cleaners and similar unearthed devices, and in the interests of safety a somewhat smaller capacity than usual is chosen for such purposes. The author of "Anti-Interference Filters" (*The Wireless World*, May 7th and 14th) wishes to add the following comments to his remarks on this subject; see p. 469, col. 2, para. 3:

Although the use of two 0.005-mfd. condensers makes it possible to receive an electrical shock, no matter in what direction the appliance plug is inserted, it must be made clear that the shock is now imperceptible in all but the most extreme case, e.g., when standing on a conductive sheet and lightly touching the sensitive part of the back of the hand on the case of the appliance.

With a single 0.01-mfd. condenser a large percentage of sensitive subjects only experience unpleasant shocks under the worst conditions, but two 0.005 mfd. connected in the manner described may be regarded as sensibly shock-proof for all practical purposes.

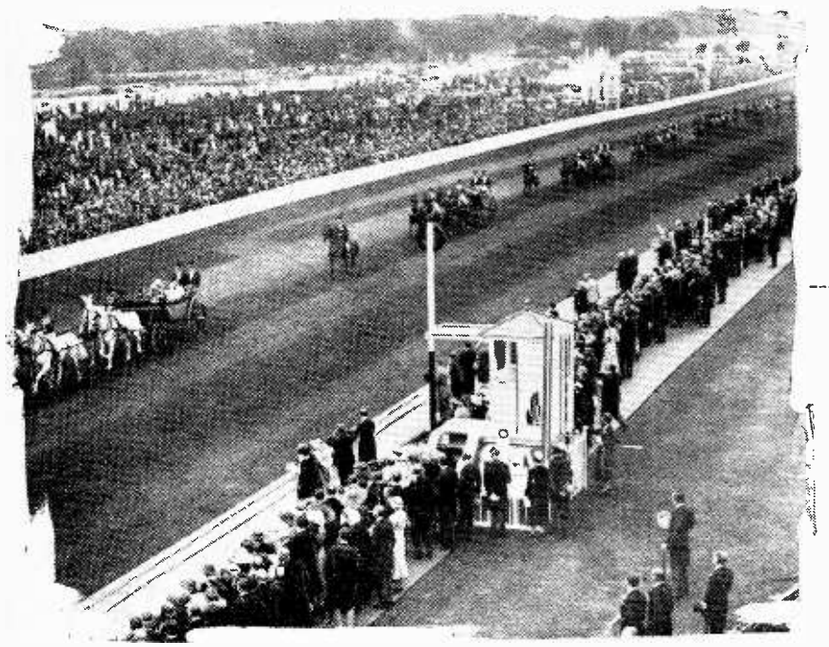
Listeners' Guide for

ANOTHER military spectacle provides the highlight of the Outside Broadcasts this week. From the Aldershot Searchlight Tattoo at the Rushmoor arena, a natural amphitheatre which accommodates many thousands, an impressive broadcast will be given for those who will continue to listen-in until midnight.

The broadcast, which is on Saturday, opens at 10.5 with the music of the massed mounted and dismounted bands of the Aldershot and Eastern commands. This will continue for twenty minutes.

The second phase of the broadcast, from 10.50 to 11.20, will be "Lodging the Colours," a Caroline spectacle, all those taking part being dressed in contemporary uniforms. At the time of King Charles II's campaigns, on arrival at billet the Ensign, bearing Standard, was ceremoniously conducted to his quarters, from which the Standard was then hung out of a window. The rallying point in case of alarm was at the place where the Standard hung. The spectacle of the Lodging of the Colours and an alarm rally round the Standard will be portrayed in this second part of the broadcast, which will fade out to the music of the massed pipe bands and march of the Highlanders.

The final episode, which will be heard from 11.40 until midnight, will be devoted to the "Challenge," which is the Grand Finale of the Tattoo. It is essentially a Coronation piece, and forms an act of allegiance to our newly crowned Sovereign.



FOR THE FIRST TIME the unforgettable sight provided by the State Landaus trotting down the course at Ascot, bearing the King and Queen with members of the Royal family to the races, will be described for Regional listeners on Thursday. This photograph shows Their Majesties King George V and Queen Mary arriving in Jubilee year.

ROYAL ASCOT

A DESCRIPTION of the scenes on the flower-decked and tree-lined Ascot Race Course will be given to listeners this year for the first time. The drive of the Royal party in the open State Landaus drawn by the Windsor Greys is an unforgettable sight. This will be described for Regional listeners at 12.15. Following the arrival of the Royal party, a lady commentator will come to the microphone to describe, from the feminine angle, the fashionable spectacle presented at Ascot.

The second part of the broadcast at 2.30 (Reg.) will be devoted to a commentary on the preliminaries leading up to, and the race for, the Ascot Gold Cup.

FAREWELL TO TOSCANINI

THE last two concerts of the London Music Festival conducted by Arturo Toscanini will be heard by listeners on Monday at 8.15 (Reg.) and Wednesday at 8.15 (Nat.), respectively. Wednesday's appearance of the B.B.C. Symphony Orchestra will be the last before the public until the Summer Proms, which begin on August 7th. As usual, these will last for eight weeks, being conducted by Sir Henry J. Wood.

The concert on Monday begins with the Mozart Symphony No. 40 and includes Sibelius' symphonic poem En Saga, concluding with Berlioz's Marche Hongroise from The Damnation of Faust. The final concert is devoted entirely to Wagner. The programme begins with a Faust Overture and includes the Overture and Venusberg Music from Tannhäuser, Forest Murmurs from Siegfried, and concludes with Day-Dawn and Siegfried's Journey to the Rhine (Götterdämmerung).

ARTIST AND PREACHER

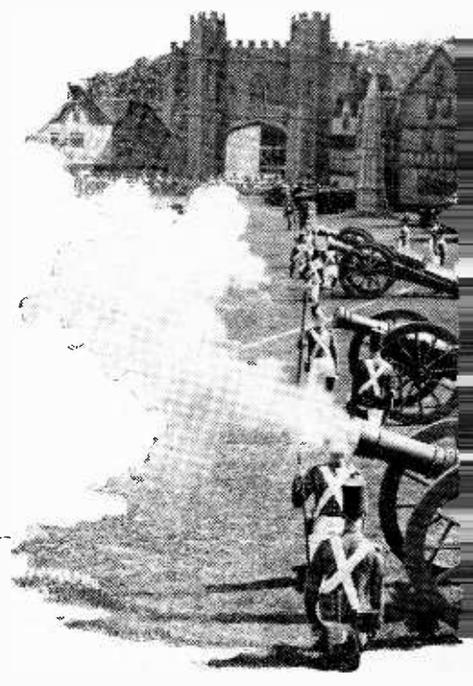
LONG before Vincent van Gogh's art made him one of the greatest painters of the nineteenth century he lived, a humble apprentice, in London. His ambition then was to be a missionary among the poor folk of Streatham where he was lodging. Sixty years have passed since the time when the young man with the flaming red hair gave earnest sermons in broken English to the people of South London. H. L. Morrow and Marianne Helweg will present a dramatic reconstruction of the tragic life of this great artist on Saturday at 8 (Reg.).

TRIPPERS

THE care-free escapades of a typical crowd of trippers will be portrayed in the programme "Follow the Crowd," devised by Leonard Henry and Ernest Longstaffe, which will be broadcast to-night (Friday) at 8 (Nat.), and on Saturday at 6 (Reg.). Among those travelling in the imaginary bus to the coast will be Alma Vane, Clarence Wright, Sidney Burchall (one of Ernest Longstaffe's recent discoveries), John Rorke, Bertha Ricardo (her first broadcast), and, of course, Leonard Henry. The escapades will not be confined to the journey, but will include donkey rides on the beach and the inevitable posing for beach photographers.

HIGH LIFE

AFTER spending a holiday at Mentone, George Gordon, who is at the B.B.C. Staff Training College, decided to write a romantic play around the winning and losing of the gamblers on the French Riviera. This he has done in collaboration with Orford St. John, and called it "To-morrow's Luck." It will be produced by Archie Campbell in the Regional programme on Wednesday at 8.15, and again, Nationally, on the following Friday.



LONDON'S SKY-LINE of the days prior to the Great Fire forms the background to the scenes at the Aldershot Searchlight Tattoo, which provides three National broadcasts on Saturday night.

ne Week — Outstanding Broadcasts at Home and Abroad

SPORT

THREE venues of varied sport will be visited for National listeners on Saturday between 3.30 and 4.30. The first commentary, at 3.30, will be given by H. M. Abrahams from the Balmoral Show Grounds, Belfast, where the Royal Ulster Constabulary Athletic Meeting will be in progress. Following this, at 4.5, the microphone will be switched over to the Northampton County Cricket Ground, where Marjorie Pollard will give a commentary on part of the first day's play in the first England *v.* Australia Women's Test Match to be played in this country. Miss Pollard will also give commentaries at 1.15 on Monday and Tuesday, the second and third days of play.

At 4.15 F. J. Findon will describe the early stages in the motor race at Donington Park for the Nuffield Trophy. This road race is for cars of 1,500 c.c. and is run over a distance of 155 miles, which is made up of 60 laps of the circuit.

MODERN SWEDISH MUSIC

LISTENERS who want to hear modern Swedish music at its best should not miss the opportunity presented by the Swedish stations on Monday at 7.30, when two distinguished instrumentalists, Carl Garaguly (violin) and Stig Ribbing (piano) will be giving a concert. The programme will comprise selected compositions by one of the greatest living Swedish composers, Hugo Alfvén.

HIGHLIGHTS OF THE WEEK

FRIDAY, JUNE 11th.

Nat., 4.20, Richmond Royal Horse Show. 8, Revue, "Follow the Crowd."
Reg., 7.30, "While the Billy Boils," an out-back interlude with Australian artistes. 8, Act I of "The Flying Dutchman."
Abroad.
Frankfurt, 8.10, German composers' Festival Concert from the Saalbau.

SATURDAY, JUNE 12th.

Nat., 3.30–4.30, Sports Commentaries. 8, Variety—"Laughter and Harmony." 10.5–12, The Aldershot Searchlight Tattoo.
Reg., 6, "Follow the Crowd." 8, The life of Vincent van Gogh.
Abroad.
Hilversum, 8.10, Gala ballet programme from the Municipal Theatre, Amsterdam.

SUNDAY, JUNE 13th.

Nat., 5, The Order of the Garter: Talk by the Rev. A. C. Deane, Canon of Windsor. 9.5, Ghosts of London—musical memories.
Reg., 6.15, Eugene Pini and his Tango Orchestra, with Diana Clare. 7.20, Recital, Yves Tinayre (Tenor).
Abroad.
Vienna, 6.55, "Der Rosenkavalier," comic opera (Richard Strauss).

MONDAY, JUNE 14th.

Nat., 7, "Monday at Seven." 9.35, "Record of a Birthday," tragedy.
Reg., 6, B.B.C. Military Band and Robert Easton. 8.15 and 9.20, Toscanini Concert.
Abroad.
Cologne, 7.25, "The Taming of the Shrew" (Goetz), comic opera from the Opera House, Düsseldorf.

TUESDAY, JUNE 15th.

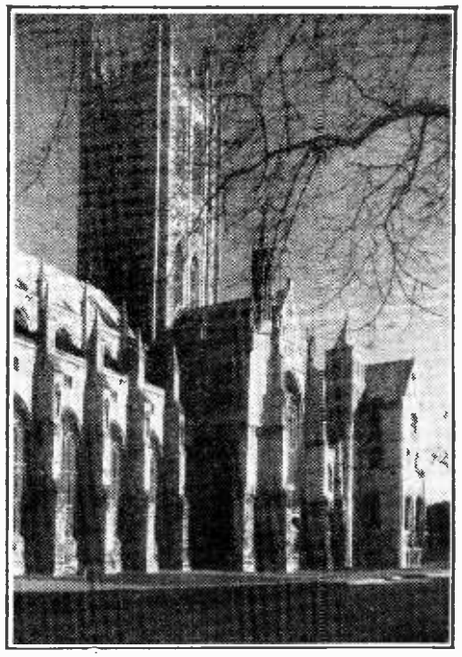
Nat., 7, Music from the Movies. 8.15, Two plays: "Atmospherics" (Lord Dunsany), "Little Ena" (N. Edwards).
Reg., 7.30, Variety from the Hippodrome, Southampton. 9.30, Commentary on the Farr-Neusel Boxing Contest.
Abroad.
Strasbourg, 8.30, "Richard Cœur de Lion," opera (Grétry).

WEDNESDAY, JUNE 16th.

Nat., 6.40, From the London Theatre. 8.15 and 9.35, Last Toscanini Concert.
Reg., 8.15, Musical comedy, "Tomorrow's Luck." 9.30, From Poona to Putney: programme on polo.
Abroad.
Munich, 9.10, Contemporary Italian Music.

THURSDAY, JUNE 17th.

Nat., 8, Al Collins and his Dance Orchestra. 8.40, Words Fail Me. Alistair Cooke on "The Impact of America."
Reg., 12.15 and 2.30, Commentaries from Ascot. 6.15, Two plays: "Atmospherics" and "Little Ena." 8, Canterbury Festival of Music and Drama.
Abroad.
Kalundborg, 8, Leo Fall and Franz Lehàr operetta music.



CANTERBURY CATHEDRAL, from the cloisters of which the London Symphony Orchestra will be heard by Regional listeners at 8 on Thursday. This will be a relay from one of the concerts in the Canterbury Festival of Music and Drama.

SERIOUS JAZZ

FROM the Swedish stations on Saturday at 7 comes a programme of serious jazz compositions, played on two pianos by Anita Harrison and W. Witkowsky. One of the items, "Anitavals," is by Witkowsky himself and is dedicated to his partner.

OPERA

TO-NIGHT (Friday) brings to Regional listeners, at 8, the only relay from the Royal Opera House this week. This will consist of the first act of Wagner's "The Flying Dutchman." The scene for this act is set in a bay on the coast of Norway, where a ship is seeking shelter from the raging storm, which is wonderfully portrayed in the music.

Richard Strauss' opera, "Feuersnot," which Berlin broadcasts to-night (Friday), at 8.20, is a work not often heard. First produced at Dresden in 1900, it created a remarkable sensation by reason of its voluptuous love music and its brilliant treatment of folk-song elements. The finale is one of the most gorgeously coloured of Strauss' many brilliant tone pictures.

"Khovanstchina," a brilliant picture of Russian life, full of political intrigue, terror and horror, at the time of Peter the Great, comes in the Milan programme this evening at 9, and from Rome on Saturday at the same hour. Like most of Moussorgsky's work, it has been orchestrated by his intimate friend Rimsky-Korsakov.

Two programmes celebrate the gay life of Rossini this week, "The Swan of Pesaro," from Stuttgart on Sunday at 8, and Paumgartner's "Rossini in Naples," from Leipzig, at 7 on Monday. The latter, an opera on Rossini themes, was not an unqualified success when broadcast from Brussels 1 last year, but doubtless the German producers have learned something from their Belgian *confrères'* mistakes.

OPEN-AIR THEATRE

FOREMOST among the concerts from abroad this week is the gala Sunday concert which marks the re-opening of the oldest open-air theatre in Germany. This will be relayed by Hamburg from 4.30 to 6.0. The theatre is situated at Castle Herrenhausen, the Versailles of Hanover. An avenue of two thousand lime trees leads from the heart of Hanover to the wooden hunting box which the one-time Elector of Hanover, George I of England, converted into a magnificent building surrounded with gardens.

MADRIGALS

IN the last issue I stated that the Choir of King's College Chapel, Cambridge, would sing the Madrigals from under King's Bridge on Tuesday, June 8th. On this broadcast we were misinformed by the B.B.C., the Cambridge University Madrigal Society being the singers.

THE AUDITOR.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Repairing Broken-down Transformers

REFERRING to the "kill or cure" method of repairing AF transformers, which was described in your issue of May 21st, I have used a somewhat similar method, but the discharge of a bank of condensers is sent through the windings. By this means a voltage of up to 500 can be used, and the initial current, although of only very short duration, can reach a very high instantaneous value—much higher than would be obtained by the use of a mains supply.

The effect is similar to that of a method of welding in which a bank of condensers is discharged through the contact made between two pieces of metals to be joined.

One word of warning: always short-circuit the other windings of the transformer under repair. This has the two-fold effect of safeguarding against a dangerously high surge voltage which would be developed and also of lowering the impedance of the faulty winding, thus enabling a higher instantaneous current value to be reached.

Manchester. JOHN A. BROOKS.

Horn-loaded MC Speakers

IN *The Wireless World* of May 21st, Mr. Leaver criticised Mr. Maggs' trumpet and expressed the opinion that its folds should not have been pure bends, but definite reflections. We are inclined to the belief that Mr. Maggs was correct in using pure bends, as he was not concerned with high notes, these being supplied by a separate tweeter. The mechanical filter effect of the pure bend on high frequencies would therefore be desirable rather than otherwise.

Mr. Leaver's contention that any speaker constructed with timber cannot be satisfactory is most interesting, particularly as at one time we had similar suspicions and went to the trouble of surfacing a corner with concrete, and making the bottom reflector and the horn up to a section near the mouth all of this material.

The result of these tests has given us "concrete evidence" that there is nothing to be gained from a performance point of view by increasing the amount of concrete used in the construction of our domestic corner horns. We think if Mr. Leaver will study the construction of the current type of domestic corner horn in detail, and bear in mind our comments below, most of his criticisms will disappear.

In the first place, one of the disadvantages of a plane piece of wood in the neighbourhood of a source of sound is that it is capable of vibrating in several different modes upon the application of relatively small exciting forces.

As soon, however, as the wood is bent out of the plane into a curved surface, the possible vibration under a given force is enormously reduced. Since the side surfaces of the horn in our loud speaker are curved, the change from a wooden material to something much more solid has but little effect. This has been checked experimentally by actually building a corner horn in which the back walls were the brick walls of the workshop surfaced with concrete, and in which the bottom reflector and the horn up to an air column section over 12in. square were of concrete.

The only plane surfaces in the main portion of our corner horns are the two back boards. If this horn is situated, as it should be, in a corner, the air cushion between these boards and the wall proper will be so stiff as to prevent serious displacements owing to vibration of these back boards. It is only when the horn is removed some distance from the corner, so as to free this air cushion, that appreciable general vibration of the back boards can occur.

With regard to the high pressure end of the horn, i.e., in the immediate neighbourhood of the unit, this part (called the input passage) is of concrete on three sides, the fourth side being a block of wood rather more than 2in. square and less than 6in. long, cast into position. A wooden block of these dimensions, and supported so rigidly, cannot vibrate appreciably, more especially as in our case it is used for anchoring other parts to the input passage.

The lower reflector, also, is of concrete, but the material on each side of the lower reflector is carved from wood originally about 1½in. thick. This wood is also closely bonded to the concrete input passage, so that to all intents and purposes it becomes an extension of the concrete. It will be seen, therefore, that the sound from the unit travels a matter of about 8 to 10 inches before it comes out of the region in which it is enclosed, either by concrete or wood of very considerable thickness, closely bonded to concrete for rigidity.

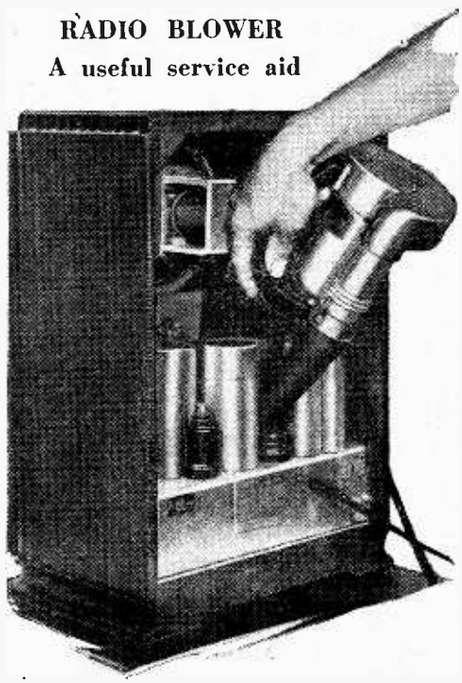
Above this point, where the sound is expanding in the horn proper, the wave is bounded by four surfaces. Two of these are the back boards, which, in addition to the rigidity due to the air cushion acting on the walls behind, are rigid owing to the support all round their edges. The two other surfaces are the curved horn surfaces, which acquire rigidity by bending.

It would be quite easy to cut away the back boards so that the wall of the room itself takes the place of the two outer surfaces of the horn. Doing this would enable us to add a thick layer of concrete to the inner face of the curved surfaces of the horn, and by replacing the few wooden parts near the high pressure end of the horn with concrete, we could make a distributor type horn which would comply with Mr. Leaver's requirements. The only alteration which would be necessary in his home would be to cement the walls for a distance of 24in. from the corner flush with the skirting board. The horn could then be fitted into position and small gaps filled with concrete. This would not be such a domestic upheaval as casting the horn in position, and Mr. Leaver would be spared the expense of sending his wife away for a holiday.

P. G. A. H. VOIGT,
Voigt Patents, Ltd.

London, S.E.26.

RADIO BLOWER
A useful service aid



Specially designed for blowing dust out of the nooks and crannies of a receiver chassis, this American machine is fitted with an insulating nozzle of soft rubber that cannot damage delicate parts.

Obsolete Marine Wireless Gear

AS a ship's operator whose task it is to work with some of the obsolete apparatus to which you refer, may I be permitted to express appreciation and to make some belated comment on your editorial of January 8th demanding improved efficiency for marine transmitters.

The two main requirements for ensuring that transmission is kept within allotted frequencies are, first, an accurate wavemeter by which the transmitter may be adjusted, and, secondly, that the transmitter is capable of "holding" this frequency.

With regard to the first, Article 9 (3) of the General Radiocommunication Regulations, Madrid, 1932, provides that "All ship stations emitting in the bands from 100 to 160 kc/s (3,000 to 1,875 m.) and on frequencies above 4,000 kc/s (below 75 m.) must be provided with a wavemeter having an accuracy at least equal to 5/1,000 or with an equivalent device." Where ships are provided with wavemeters it is doubtful if many of them approach the accuracy prescribed, but more often than not this regulation is completely flouted, and many ships falling into the above categories carry no wavemeters whatever.

As regards the second requirement, the most usual type of transmitter for the medium waves is of the direct aerial excitation system. Besides being notoriously rich in harmonics, this system has the disadvantage that, as the aerial forms part of the tuned circuit, any changes in the aerial due to slack halyards, etc., or in the position of adjacent stays or derricks (outside the control of the operator) alter the transmitted wavelength. The only indication the operator gets of this is that other stations fail to answer his repeated calls. In the event of his transmitter becoming seriously detuned, the only means of readjusting at his disposal is to tune roughly, very roughly, by listening on his own broadly tuned receiver till by trial and error he attracts someone's attention who can tell him approximately where he is. If he had a wavemeter, tuning would be a matter of seconds, but note that the regulation quoted

Letters to the Editor—

above does not call for a wavemeter for the 600 m. band, where it seems particularly essential. However, wavemeter or not, the harmonic content and frequency instability inherent in this type of transmitter remain.

And now for that "Menace to Communication"—spark transmission. *The Wireless World* readers will be surprised to hear that there are so-called first-class passenger ships still going to sea wholly dependent on spark for clearing all their traffic, which is at its peak as the ship approaches port (1½ kW of spark in the Channel! And this may go on till 1940). And, in case too much reliance is put in the assumption that "ultimately spark sets will disappear," may I point out that a loophole has been found. The regulations state that no spark transmitter shall be installed exceeding 300 watts input at the transformer. I understand that new ocean-going cargo ships have recently been fitted with QG spark as their sole transmitter. So, provided the power limitation is not exceeded, spark transmission is to continue indefinitely—and 300 watts can produce quite a hefty signal (or noise, according to the point of view).

But, since modern apparatus may cost just a little more and perhaps require a little higher technical qualification in the operator, any change will be opposed by the shipowners, whose policy it seems to be to satisfy the bare Government requirements as regards wireless gear and operators at the minimum possible cost, with complete disregard for efficiency.

Communication with ships was one of the earliest applications of wireless, but it has been left behind in the progress of recent years till this service is the most backward of all branches of wireless. Most readers would be astounded if they knew how crude and old-fashioned the installations aboard even some of the larger passenger ships are.

It is high time this deplorable state of affairs was remedied, and I hope *The Wireless World* will continue to agitate for reform. OPERATOR.

London.

Long-distance 5-metre Reception

FOR several week-ends past I have had the opportunity of taking a 5-metre kit into the country and have spent many hours on each occasion listening for possible DX. My QRA has been Medstead, Hants, and from there I have picked up English stations at quite considerable distances. Once or twice a definite rise in static noise has been observed, leading one to suppose that a certain amount of indirect reception was, perhaps, taking place. During one of these periods on May 18th a crystal-controlled telephony carrier was received 11.07 BST. to 11.27 BST. The general strength was R3, but at 11.22 it rose for a few seconds to R6 and I was able to make out quite distinctly a man singing a ballad type of song. The transmission faded out at 11.27. The approximate wavelength was 5.3 metres.

From the type of fading, unlike that experienced on distant (70 miles or so) reception of English stations, coupled with the unusual liveliness of the band, I feel that the station may quite possibly have been a DX one.

As the transmission was received continuously for 20 minutes without break, and because of the quality and type of music transmitted, I do not think it was an amateur station. I have checked the wavelength up with short-wave broadcast stations, which may have been on at that time, with the view in mind that it might have been a harmonic; none of them, however, appear to tally.

I have written this letter, therefore, in the hope that some of your readers may be able to help in tracing the station.

I. CAMPBELL-BRUCE (G5IB).

London, S.W.

Contrast

ALTHOUGH the practical system might be rather more involved than that outlined by Mr. A. S. Ball (March 19th issue), there does not appear to be many technical reasons from a reception aspect to prevent its adoption. However, the monitoring system would probably have to be more than 20 kc/s away in the spectrum. My own suggestion was published in *The Wireless Engineer* of November, 1935—that two ultra-short-wave transmitters (such as those at Alexandra Palace), could be utilised during idle hours, one for the slow expansion monitor; such a system leaving it to the transmitting engineers to contrive their own compression system, manual, automatic or mixed. The G.P.O. work compression and expansion, and the B.B.C. for some time have been experimenting on the Empire wavelengths (while retaining some manual control). Many of us must by now be quite ready for proper contrast expansion, waiting only to know the law we have to work to. Working on the present programmes the results are decidedly weird, as is only to be expected, but after making allowances there is enough to show what the future has in store for us. Unless 'phones are used something decidedly over 5 watt set output *must* be in reserve. GERALD SAYERS.

Ware.

What is Your Wavelength ?

MANY transmitting amateurs are possibly unaware that their signals can often be heard on frequencies other than the fundamental. Though generally only the second harmonic is receivable at any appreciable distance, occasionally one does hear quite strong signals on some of the high-frequency amateur bands, especially the 28 Mc/s one, from stations working in either the 14 or 7 Mc/s bands.

To the ultra-short-wave experimenter these harmonics are very confusing, since he does not know whether it is the fundamental, second or fourth harmonic that is being received. For very few amateurs make a practice, even when sending out a "test" call, of stating the frequency they are using or the band in which they are working.

Were this practice to become general it would be exceedingly helpful to the ultra-short-wave experimenter and to those interested in the study of conditions on the higher radio frequencies.

When a station has been heard "signing off" but standing by for a call it is often doubtful if it is worth while calling this station, since it might quite likely be operating in one of the lower frequency bands.

This information need only be given at the beginning and the end of a transmission, and it might take the following form: "This is G . . . calling XYZ on 14 Mc/s," or whatever the frequency may be, while at the termination, "G . . . signing off with XYZ and standing by on 14 Mc/s." G2MC.

Pinner.

RANDOM RADIATIONS

By "DIALLIST"

Good Luck!

THE news that Eric Maschwitz is to leave the B.B.C. to take up work which will give his talents a wider scope will be received by listeners with mingled feelings. On the one hand, we are more than sorry to lose one who has done so much to provide us with light entertainment from our loud speakers; on the other, we look forward to seeing him go on to fresh triumphs in his new sphere. When his "Balalaika" proved such a success, most of us realised that the B.B.C. would hardly hope to keep him for long. He is another of the successful young men who learnt the ropes at Broadcasting House, went far within its walls, and will go farther still in the world outside.

Thank you, Eric Maschwitz, for all that you have given us, and the best of good fortune in your new career.

The Television Show

TO-DAY (June 11th) the Television Exhibition opens at the Science Museum in South Kensington. As it is going to continue for three months, large numbers of people will have opportunities of paying it a visit, and I'm sure that it will be well worth while to do so. Nine different firms are showing television receivers of various kinds, and amongst them are three newcomers to the television field—Murphy, Ferranti and Scophony. Scophony actually had a set on the Ecko stand at last year's Wireless Exhibition, but it was not, I believe, a working model, and their receivers have not yet appeared on the market. They won't do so, in fact, until late in the autumn. So far as the technical aspects are concerned, Ferranti has been ready to enter the market for some time.

I told you some time ago of a demonstration that I had seen at the Scophony Laboratories, during which sound films were transmitted and received over a cable between two studios. I have not yet seen reception of Alexandra Palace programmes by this method, so I don't know what progress has been made. If, though, the Scophony people have succeeded in solving the problems before them, the method has great possibilities. What impressed me about it was its large *flat* viewing screen (24 × 22 inches in the "Home" model) and the fact that no higher voltage than 250 was required in the receiver.

North Pole Radio

HAS anybody yet managed to pick up the short-wave transmissions of the Russian exploring party who are spending a year at the North Pole? Moscow gave some details of its radio equipment and intentions the other night which may be of interest to short-wave enthusiasts. There are three transmitters, the biggest rated at 70 watts and the smallest at 10. These are to be used for sending weather reports and so on to the Soviet authorities. It was stated that the operators hoped before long to be able to establish contact with amateurs in various countries. The call-sign to be used was given as R A E M, and the wavelengths will be 20 metres and 40 metres. I imagine that Morse only will be used, and I didn't hear whether transmissions were likely to be made in languages other than Russian. However, anyone who picks up that call-sign will know where it is coming from. When the history of the Expedition comes to be written it will be interesting to learn how they found short-wave reception when living at the top of the world.

Valve *versus* Page-boy

ONE London hotel has installed what may be called an electric page-boy for the purpose of finding any of its guests who may be wanted. The system is so arranged that any room can be "paged" singly by microphone, amplifier and loud speaker, or, if need be, a simultaneous call can be made in all of them. Not a bad idea, I think, on the whole; but it will probably be some time before it catches on in the older and more conservative hotels and clubs. Paging by means of the human boy has always been a bit of a nuisance at certain crowded hours in such places. Some launch strident bellowings within inches of your unexpectant ear; some mumble inaudibly; some make the queerest hashes of rather out-of-the-way surnames. The loud-speaker page will, I understand, have none of these drawbacks. Its voice is to be gentle though perfectly audible, and, of course, the operator at the microphone can be chosen for his or her clear enunciation.

GERMANY'S MOBILE POLICE are now making extensive use of wireless. "Acting on information received" by means of a set installed in the car, this policeman is signalling a motorist to stop. Note the neat and effective telescopic aerial mounted on the windscreen pillar.

PA Again

LATELY I ventured to suggest that a good many of the public address outfits that one heard here and there were not too good in reproducing speech. On Empire Air Day I came across a PA equipment which was extraordinarily good in this way, every syllable being clearly audible, and there being no trace of boominess, "woomphiness" or the half-swallowed potato. It had obviously been specially adjusted for the job by giving its response a high-frequency tilt and by cutting down the low frequencies rigorously. On speech, as I have said, the results were excellent. Unfortunately, during an interval somebody had the idea of whiling away the time by putting on a few gramophone records. Never have I heard anything more appalling in the way of reproduction since the days when five-valve receiving sets—five "R's" with no negative bias on the LF grids and positive bias to hold down the HF stages—operated the original horn-type loud speakers! When you amplify the human speaking voice enormously you don't want much of the lower audio frequencies; but you can't do without them when music is being sent out. It seems to me that PA apparatus may need a two-position switch marked "Speech" and "Music."

Puzzling

ONE item that appears in the monthly reports of radio imports and exports rather perplexes me. This is valve parts. We do a very small export trade in these (it was only £354 last month and £31 the month before), but our imports are simply colossal, running, as they do, to some £20,000 a month. The actual figure last month was £21,808. Just what a valve part is I am not quite sure, though one would imagine that it is something that we ought to be able to make for ourselves. I have heard it suggested that it means, as a rule, the complete "foot" with all electrodes ready fixed in position and requiring no more than the addition of bulb, cap and pins, together with the processes of pumping and gettering to turn it into the finished product. Whether this is so or not I can't say; but it is very certain that we are obtaining far too many valves and valve parts from other countries. The figures are really astonishing.

During the month in question we took 9,328 finished valves and £14,802 worth of valve parts from Holland, 8,183 valves from Austria, 20,517 valves and £3,346 worth of parts from Hungary, and 91,614 valves and £1,957 worth of parts from the U.S.A.

Insuring CR Tubes

IT is announced that a scheme has been drawn up for the insurance of cathode-ray tubes installed in television receivers. There are two policies. The first gives limited cover against loss or damage due to external agency but excludes, *inter alia*, damage by over-running, excessive pressure, short circuiting and damage caused directly or indirectly by the application of electrical energy. The rate here is 5 per cent. For 15 per cent. a much wider policy is offered. This, I read, covers loss or damage by any accident or misfortune other than war, riot, etc., and loss or damage arising through wear and tear or gradual deterioration or the use of any tubes contrary to the maker's instructions. If this is a fact it seems almost too good to be true, for with a premium of 15 per cent. on the catalogue price the owner of a cathode-ray tube would be the gainer if it wore out in less than about seven years. Though the announcement does not say so, I should imagine that there must be a sliding scale for the compensation payable, the amount being automatically reduced as the age of the tube increases. Or is the policy limited to the first year of the tube's life?

Broadcast Brevities

NEWS FROM PORTLAND PLACE

Will the "D.G." Retire ?

RUMOUR has again been rife that Sir John Reith is meditating retirement in the near future. But the "D.G." has cried wolf so often that knowledgeable people have ceased to pay any attention.

Almost since the beginning of broadcasting he has referred to the time when he will leave the B.B.C., but these remarks need not be taken any more seriously than those wistful day-dreams of ordinary members of the staff when they think of the fat pension coming to them at the age of sixty, and of the imaginary hostelry which they will open after shaking the dust of Portland Place from off their feet.

Encyclopædia of Broadcasting

The longer the "D.G." stays the greater the boon to posterity, for he has never failed to make his daily entry in that private diary which now assumes such considerable proportions as to be almost an encyclopædia of broadcasting. (*The Wireless World* was privileged to print extracts some ten years ago, and many things have happened since then.)

That there will be many more entries about broadcasting need not be doubted, for there is no real indication that Sir John is thinking of "handing over." Some of the prophets will, however, be saying next autumn that, "as announced months ago," the D.D.G. is retiring from the Corporation. But they will carefully avoid mentioning that the forecasts omitted the first D.

It is the Deputy Director-General, Vice-Admiral Sir Charles Carpendale, who has announced to his friends and colleagues at Broadcasting House his definite intention of retiring before the next winter season.

Coronation Echo

TRANSATLANTIC Press cuttings show that American listeners to the Coronation broadcasts were impressed by the dignity of the commentaries as much as by the "100 per cent. solid" reception.

Said the Cincinnati "Times Star": "The British announcers seemed to have no purpose to exploit their own personalities, to let the world know what dazzling clever fellows they are. They made no effort to steal the show from the King and the Archbishop of Canterbury."

The writer goes on to compare American and British methods. "Thus, simply, briefly, beautifully, quietly and fully, he (the commentator) described the steps towards the climatic moment of coronation: 'The Archbishop reverently sets the crown on the head of the King.'

"A breathless American announcer might have said: 'What a day, folks. What a day! The Archbishop is on the way to the altar to get that crown. In a minute, folks, he'll have it on the King's head. There he goes! He's raising it over the King's head. Bingo! He's got it on.'"

Basso Profondo

A TOUCH of comedy added flavour to the recent broadcast from Covent Garden. While the opera was on the air Mr. H. Saunders-Jacobs, of the Music Department, who is in charge of the Home and Empire opera broadcasts, was startled by the overpowering volume of the double basses. He was unable to do anything about it at the time, but took a taxi to Covent Garden immediately after the broadcast. There he found that a double bass player did not like the microphone in the position in which it had been so carefully placed by the O.B. engineers and properly balanced by Mr. Saunders-Jacobs, so he had blandly moved it about 6ft. out of position and tied it to the rail of the orchestra pit.

Television's Radio Link

IT has been hinted that the radio link will be very sparingly used when the mobile television units come into regular commission. It is quite true that whenever a cable is available it will be chosen in preference to radio; but this is a perfectly sound principle, especially since the Coronation broadcast proved that the new twin-wire cable produces a flawless picture.

Yet excellent results have been obtained with the radio link. The mobile transmitter has provided some interesting surprises in the course of testing.

Interference Bugbear

The bugbear in the London area is interference. The 5-metre wavelength seems to act as a strip of flypaper, with the high-frequency splutters of car ignition and therapeutic apparatus in the role of flies. Conditions are not nearly so bad when transmitting over open country, so the recent suggestion to televise the Regatta Finals at Henley is not so ambitious, perhaps, as, say, a relay from Epsom.

Good work is being done at the receiving end with specially designed aerials. During the Hyde Park transmissions two aerials were in use at Alexandra Palace; one above the transmitting aerials and another on the terrace.

Baffle Boards or Cabinets ?

THE average loud-speaker baffle is beautiful in inverse proportion to its acoustic merits, hence the popular prejudice in favour of cabinets. The question does not bother schoolchildren, however, and the Central Council for School Broadcasting is not hesitating, therefore, to recommend "a flat baffle-board of stout construction" in preference to a cabinet.

Quality in the Classroom

The school talks syllabus for the coming winter embodies hints for class reception which might well be written in letters of gold in every headmaster's study.

It is urged that the loud speaker should be placed three to six feet above the floor in a central position, and that the quality should be tested particularly from the farthest desk and from the desks at the end of the front row.

The school hall should *not* be used for broadcast reception unless it is well filled. Acoustics suffer in a large room if it is half empty, and, moreover, bitter experience has shown that reception in the school hall is particularly liable to interruption.

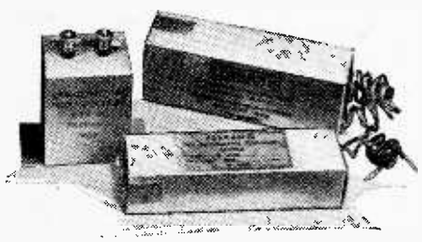
It is strongly recommended that sets fitted with tone control should be adjusted to the "brilliant" position when talks are in progress. Nothing is more tiring to the listener than "booming" speech.

New Apparatus Reviewed

Recent Products of the Manufacturers

NEW FERRANTI ELECTROLYTIC CONDENSERS

THE conditions under which a condenser has to operate must have some influence on the construction of the component, and since it is not always economical to design one that will be entirely satisfactory under all conditions of use Ferranti, Ltd., Moston, Manchester, 10, have evolved several new models for use under widely different climatic conditions.



The New Ferranti dry electrolytic condensers in waxed cardboard containers and the metal-cased Model C16 of 2 mfds.

Of these the Type CE 100AT is a specially designed dry electrolytic condenser for use in tropical countries. It embodies many interesting constructional features adopted to comply with the severe conditions prevailing, and it is filled with a special wax having a melting point of 76 degrees Centigrade.

The model in question is a double 8 mfds type in a cardboard container rated for working at 500 volts (peak value), and it can be obtained with either the negative or positive elements joined to a common lead. Its price is 7s., and a single 8-mfd model of the same construction is available at 4s. 6d.

The Type CE 100CW is also a new dry electrolytic, but possesses some of the characteristics of the wet variety. At 500 volts DC, the maximum normal operating potential, the leakage current is of the order of 0.6 mA, but this model is designed to stand short duration surges up to 600 volts when the leakage current rises to between 12 and 15 mA. It will definitely withstand momentary surges up to 600 volts peak, but not continued operation at this voltage, for, tested under these conditions, the condenser broke down, though "flashing" tests at 600 volts did not have any injurious effects. Single and double 8 mfds sizes are available, an 8 + 8 mfds costing 5s. 6d. with either negative or positive elements common, while a single 8-mfd model costs 3s. 6d.

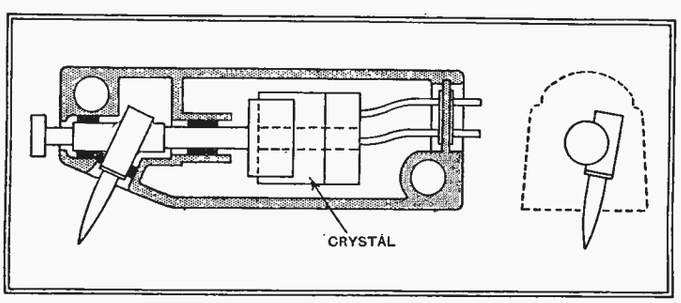
For use in very low temperatures Ferranti have introduced a dry electrolytic described as the Type CE 100C. It will also take care of comparatively high surge potentials and, like the other models in the range, is rated for continuous operation at 500 volts peak. Its particular usefulness is in aircraft radio equipment and in apparatus operating in cold climates. Single and double 8-mfd types are made, and the prices are 4s. and 6s. respectively.

All the condensers mentioned so far are assembled in waxed cardboard containers and are, of course, polarised.

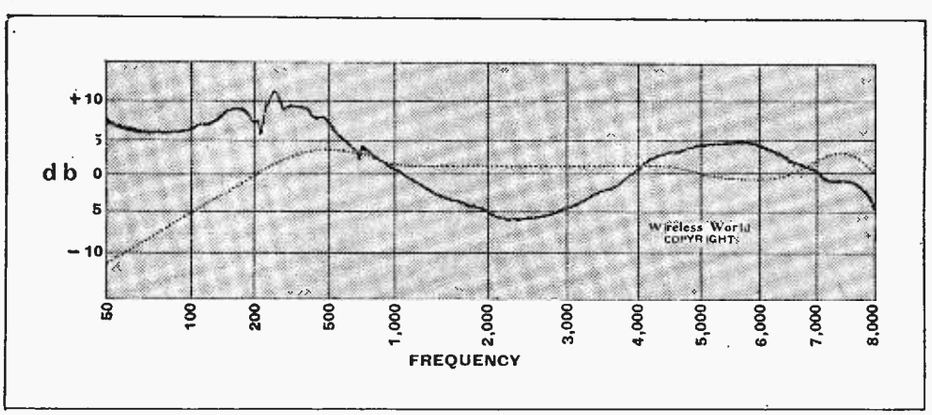
The new Model C16, on the other hand, is a metal-cased condenser with, presumably, paper insulation, and it is intended for use out-of-doors and in moist atmospheres but protected from rain. For out-door PA equipment, ship's apparatus, etc., are two examples of its usefulness.

In view of the conditions under which it will be used, special care is taken in the construction to leave no possible entry for moisture. The specimen tested is a 2 mfds size rated at 500 volts DC test, but this model successfully withstood peaks of 800 volts DC without breakdown. Its price is 4s.

All of the new electrolytic models were tested at the full rated DC voltage, and no signs of breakdown became apparent until the potential was raised to about 600 volts.



Diagrammatic section and end view of Shure pick-up showing tilt of needle in two planes.



Response curve of Shure Model 99A crystal pick-up with 0.5 MΩ, shunt. Zero db is equivalent to 1 volt RMS and the dotted curve shows the characteristic of test record.

Shure "Zephyr" Model 99A crystal pick-up.

SHURE "ZEPHYR" PICK-UP

COMPENSATION for tracking errors is effected in this American pick-up by a principle which differs fundamentally from the method in favour in this country. In addition to the normal trailing angle the needle is given a tilt inwards towards the centre of the record and the resultant is arranged, by the choice of suitable arc for the needle point, to cancel the tracking error. The residual error is small and varies from −5.2° to +6.8° on a 12-inch record. There is a slight deviation from the vertical as the needle traverses the record, amounting to −2.4° inside and +3.0° at the outside of the spiral.

The advantage of the scheme is that a straight tone arm can be used and the pick-up mechanism (in this case a crystal unit) can be mounted parallel with the axis of the tone arm. A cone-pointed set screw is used to clamp the needle, and the motion of the point is converted to a torque which is transmitted through a short bar to the free end of the crystal doublet. Damping is effected by clamping the crystal between strips of a plastic material known as "viscalloid."

With the exception of a peak at about 250 cycles the curve taken on our automatic recording gear shows an average deviation of about ±5 db on a mean output of 1 volt RMS. Transient response is good, and record wear should be extremely low. The bass response can, of course, be modified by using other values of load resistance.

Supplies are obtainable in this country through Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1, and the price is £3 3s.

1921 Addresses Required

WE should be glad if any reader could give us the present addresses of the following, who took part in the Transatlantic Amateur Tests organised by *The Wireless World* in1921, as we have a communication from abroad to forward to them:

Mr. W. R. Burne, then of Sale, Cheshire.
Mr. Whitfield, then of Birmingham.
Mr. Corsham, then of Willesden.
Mr. Spence, then of Huntley, Aberdeenshire.

On The Short Waves

NOTES FROM A LISTENER'S LOG

THERE have been a number of Dillinger fade-outs during the past week or so—there was a very severe one lasting 40 minutes on June 3rd from 0610-0700 GMT. It has also recently been noted that even 21 Mc/s signals are now being noticeably attenuated during the peak of the fade-out—due presumably to the ever increasing solar activity as we approach the maximum.

It will be remembered that at first it was believed that these fade-outs and their associated bright hydrogen eruptions occurred once every 54 days—that is one for every two solar revolutions, and although this does not now seem to be the case, it is interesting to speculate whether the "charged-particle" fade-out of April 22nd-29th will reoccur 54 days afterwards—on June 14th-21st. There was no sign of this type of disturbance 27 days after the original, as might have been expected.

The attention of short-wave listeners is also drawn to the solar eclipse of June 8th, which was observed by an American expedition on Canton Island in the Pacific. A small 25-watt U.H.F. transmitter working between 30 and 40 Mc/s, W10XEP transmitted the N.B.C. commentaries to the U.S. Naval minesweeper "Avocet," which in turn relayed them to the R.C.A. receiving stations on the Californian coast. The "Avocet" WMEF worked on 12.862 and 17.31 Mc/s.

Whilst we are on this subject readers may care to note for reference purposes that the call-sign of Dick Merrill's plane was KHMER—using a 100-watt phone transmitter.

Short-wave conditions generally have been what can be termed "good commercial," although the effect of the increased solar activity and summer daylight has been rather unduly to narrow the useful band of frequencies during day time.

Generally speaking, 19 Mc/s has been the optimum frequency for transmission to any part of the world between dawn and midnight, irrespective of the distance, although useful signals have been heard as high as 23 Mc/s and as low as 11 Mc/s on occasion. The 15 Mc/s broadcasting band and 14 Mc/s amateur band do not really come into their own until quite late in the evening.

It is a great pity that the F2 region gets so hot in summer, because 28 Mc/s would be a very valuable frequency for summer use. In spite of considerable sunspot activity recently, the highest frequency intercepted has been the second harmonic of Rabat CNR on 25.66 Mc/s.

Will somebody please start broadcasting in Africa in the 26 Mc/s band? One would be sure to obtain a deal of valuable information from the performance of such a station.

On the reverse side of the medal there is little doubt that 28 Mc/s conditions are now becoming quite good in the Southern Hemisphere, now that winter is with them.

Starting with Thursday, May 20th, we find that sunspot activity was very high, and at 10.30 p.m. W3XAL was very good on 17.78 Mc/s. At this time, too, JZK Tokyo was heard testing on 15.16 Mc/s, but apparently the transmitter was unstable, and when modulated splashed over badly into GSF and GSO, both situated 20 kc/s away on either side. There was very little else to report, other than fairly good or good reception of the regulars until 11.20 p.m. on Wednesday, May 26th, when LSZ was heard, a good R9 signal on 23 Mc/s approx. This is a telegraphic transmitter on Buenos Aires.

Ionisation levels fell somewhat towards the end of the week, and Thursday evening W1XAL was almost good on 11.79 Mc/s—but jerky. There were no signs of WKN or WKF, the very regular Lawrenceville phone transmitters on 19 Mc/s this evening, but LQC was R9 nevertheless.

Finally, very strong signals (in S.W. London) have been intercepted recently from the Scophony television transmitter G8YB on 49 Mc/s (vision) and 47 Mc/s (sound). The sound signal in particular was very strong and of excellent quality; on the video channel synchronising signals only [240 lines 25 frames] were being transmitted. The transmitters are situated in Kensington.

In closing here are the latest details of some of the more obscure Europeans:—

LKJ, Jelöy, 6.12 Mc/s.
YTC, Beograd, 6.10 Mc/s.
SASH, Motala, 6.064 Mc/s.
SBG, Motala, 11.704 Mc/s.
OXY, Skamlebäk, 6.062 Mc/s.
OXY, Skamlebäk, 11.803 Mc/s.
OXY, Skamlebäk, 9.52 Mc/s.

There is a bad heterodyne between SASH and OXY in the 6 Mc/s band.

The Radio Industry

A NEW model of the Philco People's Set has been introduced. It is an AC all-wave receiver covering wavelengths between 16 and 2,000 metres in three steps. An AC/DC model will follow shortly.

Eves Radio, Ltd., the short-wave specialists, have moved to larger premises at Willenhall Road, Wolverhampton. A new department for the construction of special equipment (receiving and transmitting) has been organised.

The work of 250 men engaged in laying 68,000-volt power cables across Wandsworth Bridge is being controlled through G.E.C. PA equipment. The handling of the seventeen-ton drums on which the cable is wound is greatly expedited by this method of passing orders, which compares more than favourably with the old system of whistle signals.

The Mullard cathode-ray tube Type E.10G3 (3-inch screen, 500 volts) has been reduced from £4 15s. to £3 10s.

"Superspeed" flux-cored solders have been reduced in price, the reduction averaging a little over 6½ per cent. It is claimed that this solder, while retaining the non-corrosive qualities of the old-fashioned and slow-working resin-cored material, permits the speed in operation that is demanded by modern production practice. The makers, Superfluxes, Ltd., of Aintree Road, Perivale, Greenford, Middlesex, also produce a special "electrical" flux which carries official Air Ministry approval.

Galpin's Electrical Stores, 75, Lee High Road, Lewisham, London, S.E.13, have just issued a Summer Clearance List.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

TUNING ARRANGEMENTS

A WIRELESS receiver is tuned manually up a predetermined small distance from the "dead-right" setting, and then the control knob is automatically thrown out of action. Tuning is completed and the circuits "held" at the correct setting by means of a control current, which is derived from the incoming signal and amplified up to the required level by one of the AF stages. Once the receiver has been brought into correct tune, the hand control knob is released from its temporary "paralysis," and is restored to normal, either automatically or by means of a switch, or else by moving the knob inwards.

E. K. Cole, Ltd., and G. Bradfield. Application date October 7th, 1935. No. 462475.

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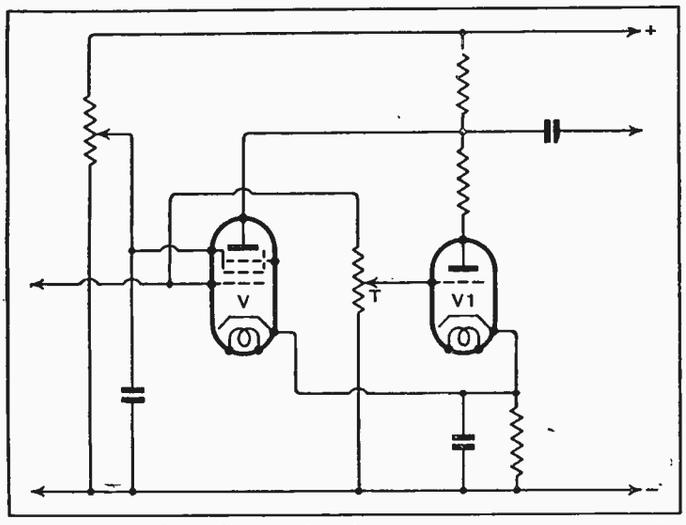
TELEVISION AMPLIFIERS

THE light intensity produced by the spot on the fluorescent screen of a cathode-ray tube is not strictly proportional to the modulation voltage applied by the incoming signal, but follows a curved law. According to the invention the resulting distortion is corrected by the parallel arrangement of valve amplifiers shown in the figure. The valve V is a variable-mu valve, whilst the valve V1 is a triode capable of handling large signals.



Arrangement of amplifying valves in television apparatus to correct for distortion.

In operation the gain applied to small signal voltages will depend almost entirely upon the "slope" of the SG valve V, whilst the heavier signals will be handled almost entirely by the valve V1. By varying the tapping T, and hence the ratio of the signal voltages applied to the grids of the two valves, the overall gain of the amplifier can be made such that it corrects for the curvature mentioned above.

A. J. Brown and Baird Television, Ltd. Application date September 4th, 1935. No. 462247.

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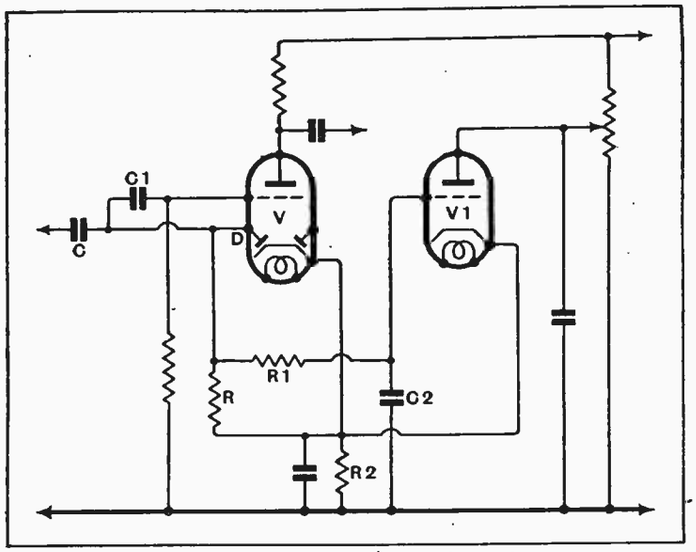
MUTING CIRCUITS

SIGNALS below a predetermined strength are automatically prevented from getting through to the loud speaker. Incoming signals are fed through a condenser C to the diode D of the input valve V. Rectified signal voltage is fed back from the load resistance R to the control grid of the same valve through a condenser C1. Simultaneously, a DC biasing voltage is fed through a smoothing circuit R1, C2 to the grid of a muting valve V1.

The resistance R2, which is in the anode-cathode circuit of both the valves V and V1, serves to mute the set until the incoming signals reach a predetermined strength. For weak signals, very little biasing voltage reaches the grid of the valve V1, so that the latter passes a comparatively heavy current through the resistance R2, which, therefore, applies a cut-off bias to the grid of the valve V. This is gradually reduced as the signal strength grows until, at a certain level, the valve V becomes conductive. The range of muting can be controlled by varying either the resistance R2, or the HT volts applied to the valve V1.



Method of suppressing inter-station noise.

British Tungsram Radio Works, Ltd., and J. H. Reyner. Application date August 22nd, 1935. No. 461966.

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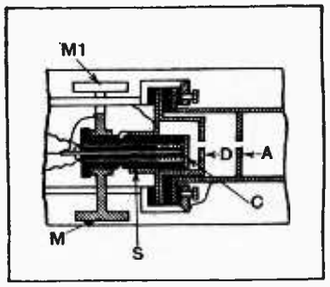
PORTABLE WIRELESS EQUIPMENT

IN a portable or field service set, designed to be used both for transmission and reception, the heaviest item is usually the battery, and to reduce this it is necessary to have high efficiency in the other components, particularly in the pick-up qualities of the aerial.

With this object in view, a frame aerial is made of four hollowed and tapered conductors, preferably of aluminium-silicon alloy, and is strapped to a soldier's back so that it does not impede him, either on the march, or when crawling forward on his hands and knees under fire. The transmitter valve is mounted at the top corner of the frame, the sides of which serve as anode and grid inductances. Microphone currents are fed to the valve for transmission, whilst in reception the same valve is used as a super-regenerative amplifier.

L. L. K. Honeyball. Application date July 4th, 1935. No. 462459.



Constructional details of C.R. tube with adjustable cathode.

CATHODE-RAY TUBES

IN order to prolong the life of a cathode-ray tube the cathode is made movable about an axis which is parallel to, but not coincident with, the main axis of the control electrodes. In this way the emitting surface of the cathode can be shifted from time to time so as to make a fresh part available.

As shown in the figure the cathode C, which has a flat top, is arranged eccentrically to the aperture disc D through which the main electron stream passes. The disc D, together with the first anode A and the other electrodes, is, of course, firmly fixed in position relative to the glass walls of the tube. The cathode C, however, is carried in a rotatable sleeve S having two magnetic arms M, M1. By applying a horseshoe magnet to these arms, from outside the tube, the cathode is rotated as a whole, so as to bring a fresh part of its emissive surface below the aperture of the fixed disc D.

H. P. Barasch. Application date September 2nd, 1935. No. 462243.

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PRODUCING LARGE PICTURES

THE light produced on the fluorescent screen of a cathode-ray tube is not sufficiently intense to allow of direct magnification by lenses. Accordingly, to produce a large-sized picture a "relay" of photo-electric cells is interposed between the fluorescent screen and the final viewing-screen.

The picture is first reproduced by a cathode-ray tube in the ordinary way. The fluorescent image is then focused by a lens on to an auxiliary screen, which is built up of as many small photo-electric cells as there are picture points. These cells are, in turn, linked up to a corresponding bank of "lamps" on the final viewing-screen, which is of considerable size. Actually each of the photo-electric cells is coupled to the control grid of a miniature cathode-ray tube, a number of which serve as so many "lamps" to illuminate the surface of the viewing-screen point by point.

Marconi's Wireless Telegraph Co., Ltd., and R. J. Kemp. Application date September 7th, 1935. No. 462330.

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CONTENTS

EDITORIAL COMMENT

Components and Spare Parts

WE noticed in a recent issue of our contemporary, *The Wireless Trader*, a contribution dealing with the subject of wireless components. As the circulation of the journal in question is confined to the trade, it will be well to summarise very briefly the arguments put forward. The writer takes the manufacturer severely to task for neglect of what he considers to be a valuable market and for treating the would-be purchaser of components so casually as to discourage him to a point where it would almost seem that an intentional effort is being made by manufacturers to prevent the purchase of components by the public.

We recognise that there was a time when the home construction of receivers interfered to a considerable extent with the business of those manufacturers who were selling sets, but at that date the prices of complete sets were so high that if it had not been for the home constructor who could build sets from component parts at a much lower cost, broadcasting would not have made the rapid progress which it has. The very fact that sets could be made cheaply by reasonably skilled persons provided an essential element of competition.

Now that for some years set manufacturers have got into their stride, it would be childish and absurd to even suggest that the comparatively small *percentage* of listeners interested in building sets for themselves, or modifying existing ones, can be regarded as a menace to the prosperity of the set business. On the contrary, interest in the technicalities of wireless receivers, prompting and encouraging experiment, should be regarded as a very healthy factor in this industry.

There was a time when components were manufactured in huge quantities and were purchasable over the counter because almost any retail wireless shop kept stocks. Unfortunately these components were very often the choice of the manufacturer and were not necessarily the components which the constructor required; fashions, too, would change from one season to another, rendering such components obsolete. Even in the days when interest in home construction was at its highest, there was still difficulty in obtaining component parts which were a little out of the ordinary run.

A Suggestion

We would not suggest that manufacturers should attempt to-day to manufacture and distribute components to be available in pretty cartons in retail shops on demand.

We believe that a solution could be found to the present difficulties in obtaining components and that a variety sufficient for most requirements would become available if manufacturers of sets accepted the principle that suitable component parts from which their own sets are built were available for purchase separately.

In almost every branch of an industry where articles are built up from component parts, the individual components which are listed in detail in catalogues and easily identified can be purchased either direct from the manufacturer or to order through an agent. A similar policy adopted in the radio industry would, we believe, go a long way towards retaining the good will and interest of the constructor and experimenter, who, although a minority, is, nevertheless, an extremely important section of the wireless community.

An Inexpensive Amplifier

WITH NEGATIVE FEED-BACK A CHEAP DESIGN IS NOT NECESSARILY NASTY

By

M. G. SCROGGIE, B.Sc., A.M.I.E.

NO doubt many people who would like to have a high-quality amplifier, giving rather more than the two or three watts of the usual output stage, are deterred by the cost. The extra power is particularly useful for extension loud speakers, or when a little "public address" work is occasionally done. Now the pentode never gives *quite* such a pure output as the triode, even when the loud speaker load is well matched to it; and if extra speakers are connected in parallel both volume and quality fall right off. But the triode is decidedly less efficient; and if, say, five good watts are wanted, the power unit is rather expensive. Moreover, the sensitivity is low, so an adequate driving stage is necessary.

IT is shown how, by applying the negative feed-back principle, an amplifier rated at over 5 watts may be built at the exceptionally low cost of about £3 for components.

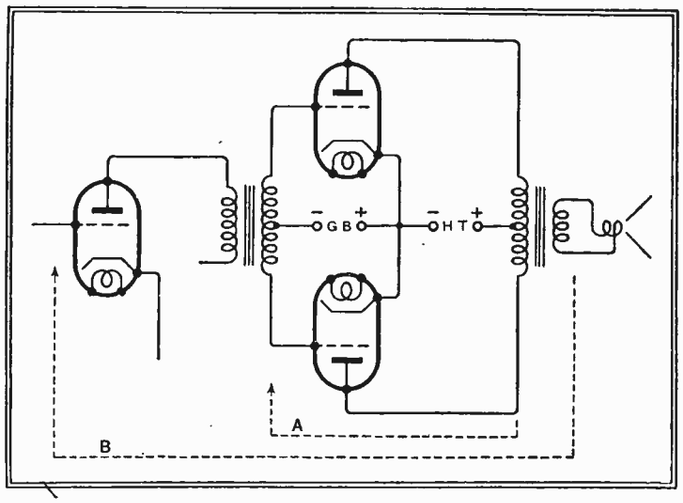

Fig. 1.—Negative feed-back may be applied across the output valves only, as indicated diagrammatically by A. But by extending its scope in both directions, as shown by B, its benefits are applied to the whole amplifier, provided that proper precautions are taken.

The principles of negative feed-back have been explained in these pages, and constructional details of its application to an amplifier giving a large output at the necessarily limited voltage available from DC mains have been published.[1] Very briefly, the idea is to tap off a part of the output signal voltage and use it to oppose the input voltage. One result, as might be expected, is to reduce the amplification; but, if enough has been provided to start with, a turn of the volume control will set this right again. A less obvious consequence is a reduction in all forms of distortion, which is a very valuable result.

In the DC amplifier just referred to, the feed-back was carried out over the output stage only. This makes it necessary for the previous stage to supply a signal several times greater than would otherwise be needed. Unless this stage is generously designed, therefore, there is a risk of somewhat increased distortion therein, which would lessen the value of the feed-back device. By taking the feed-back over the previous stage too, it may be run at a low signal level, which, as will be shown later, has more advantages than one; and reduction of distortion applies to both stages (Fig. 1). Furthermore, if feed-back is extended in the opposite direction, by taking it from across the secondary instead of the primary of the output transformer, the deficiencies of the transformer are made good, or alternatively a cheaper transformer is allowable.

Pitfalls to be Avoided

This extension of the feed-back system is not without its difficulties. If at some frequency (which may be outside the audible range altogether) the phase of the signal is shifted in its progression down the amplifier so far that the feed-back at that frequency is positive, oscillation may take place, or severe distortion owing to the amplification being increased instead of decreased (Fig. 2). If such a frequency does happen to be outside the wanted range of frequencies it might appear that the trouble could easily be avoided by providing some sort of filter circuit to cut it out. Unfortunately, any such filter is very liable to increase the phase shift and bring the danger spot nearer the working band of frequencies, if not right into it.

Transformers cause a phase shift in one direction at very low frequencies and in the opposite direction at the very high, and although the shift due to one transformer may not be too much, the cumulative effect of two is almost certain to give trouble unless special precautions are taken. If the phase-shift can be kept within certain fairly wide limits, it is automatically corrected by feed-back.

A resistance-coupled stage can be made practically free from phase shift, but the amplification is low (whereas we want plenty of it to compensate for the feed-back), it necessitates an extra phase-reversing valve for push-pull (the desirability of which will be explained in a moment), and, other things being equal, an amplifier with resistance coupling to the output stage has less apparent reserve of power, because of the serious nature of the distortion produced when small amounts of grid current are allowed to flow.

The merits of push-pull have recently been extolled by "Cathode Ray."[2] Not only is there reduced distortion, but a cheaper output transformer and much less HT smoothing may be used. So for what is now required—a cheap but good amplifier—push-pull is obvious. The design is beginning to sort itself out. Pentodes because they give plenty of watts with a small, and, therefore, cheap power supply, and plenty of amplification which is wanted to make up for that lost by negative feed-back, which in turn is

[1] "Negative Feed-Back Amplifiers," November 6th, 1936; "Negative Feed-Back Amplifier," November 13th, 1936; "Degeneration," March 5th, 1937.

[2] "About Push-Pull," April 9th, 1937; "Practical Push-Pull Points," April 30th, 1937.

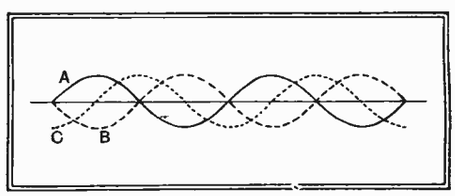

Fig. 2.—If A is a sample of the original signal applied to the amplifier, the amplified voltage fed back is connected in opposition, as shown by B. But at certain frequencies some parts of the amplifier cause a lag, and the fed-back voltage may then be represented by C, which does not have quite the same opposing effect. And if this lag is added to by further stages in the amplifier, the fed-back voltage may actually coincide with A, causing positive feed-back.

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needed to improve the quality possible with pentodes. Push-pull because the cost of the most expensive components is reduced, and the quality improved. Transformer coupling for sufficient amplification, for adaptability to push-pull requirements, and for minimising distortion due to occasional overloading.

Reducing Phase Shift

The problem is to avoid excessive phase shift. In the article by Cocking, referred to earlier, it was explained how feed-back voltage taken in parallel with the output and injected in series with the input has the effect of reducing the apparent resistance of the output valves—a very desirable thing with pentodes. This makes it practicable to reduce the inductance of the output transformer well below what is considered necessary for pentodes, whose output falls off rapidly if the impedance of the load is reduced (Fig. 6). The leakage inductance, which is responsible for the most serious phase shift at the upper frequencies, is proportionately reduced. This is helpful. A special output type specified is incapable of supplying a large grid swing at the lowest frequencies, but the total voltage for the pentodes, grid-to-grid, is only about 9. If the feed-back were taken only so far as the grids of the power valves a much larger signal would have to be provided by the transformer, and a type costing something like five times as much as the one specified would be needed.

In spite of the small phase shift due to this transformer, for satisfactory feed-back without risk of oscillation the further precaution of a resistance shunt across the secondary is needed. The value specified, 100,000 ohms, seems rather drastic, but is satisfactory in practice, in conjunction with a typical loud speaker. A pure resistance load could be worked with a higher transformer shunt, while one with an exceptionally large inductive component may even need it to be reduced to 60,000 ohms to take full feed-back.

Pentodes in push-pull are liable to oscillate on their own, quite apart from feed-back, and the 100,000-ohm resistor from the centre of the transformer secondary is to counteract this tendency.

80 milliamps, the power supply is only 250 volts 58 milliamps, and therefore is obtainable more cheaply. It is easy to modify the design for use with a loud-speaker field coil of about 1,500 ohms run in series as a smoothing choke, by substi-

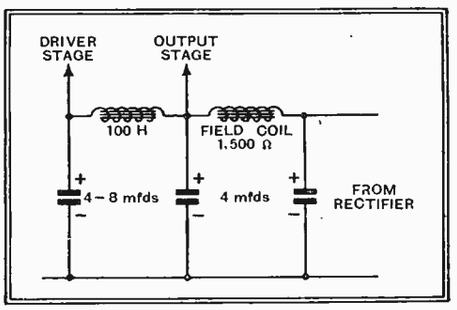

Fig. 4.—Suggested modification for energising a loud-speaker field.

tuting mains transformer No. T350/60 for that specified, and using an extra smoothing condenser, as suggested in Fig. 4. Otherwise, there is no choke smoothing for the output stage. Any hum left over after push-pulling has done with it is reduced

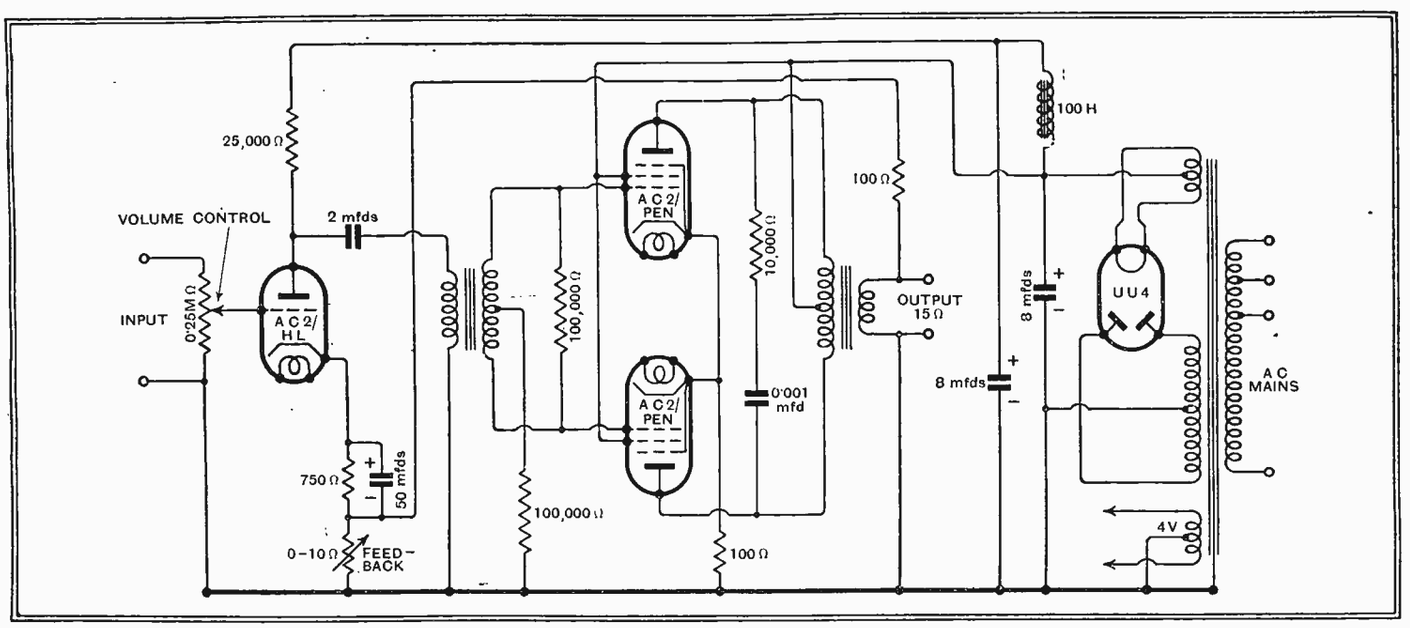

Fig. 3.—Circuit diagram of complete amplifier. With slight modifications a tone control stage giving exceptionally comprehensive adjustment of tone and, if needed, extra gain, can be added. Details will be given later.

transformer has been designed for this amplifier with an optimum load resistance under these conditions, and taking account of distortion, and of the possible use of extension speakers, of 15 ohms. A suitable resistance-capacity shunt across the primary is another help. The capacity shown in the circuit diagram has purposely been kept low to minimise loss of power in this circuit at the highest frequencies. A somewhat larger value may be tried if there seems to be rather much "top."

For the inter-valve transformer, the parallel-fed nickel-iron core type has far less phase shift and gives more level amplification than others, and has the further merits of cheapness and compactness. The

Note that no by-pass condenser is used across the bias resistor. To be effective at all frequencies across such a low resistance as 100 ohms, the capacity would have to be hundreds of microfarads. But if the valves are well matched (and as they are not provided with the luxury of separate bias, they ought to be) the signal currents passing through the bias resistor cancel out. If the balance is not perfect, owing to one valve having a higher mutual conductance than the other, the residual signal current has a feed-back effect on its own which tends to hold back the stronger valve and encourage the weaker, and so to equalise them.

Although the output obtainable is equal to that from triodes at a total of 350 volts

to inoffensive proportions by the negative feed-back.

Actually the freedom from hum compares favourably with accepted commercial standards even when the valves are ill-matched; and modulation hum is unnoticeable except on a continuous signal note approaching maximum output: but anybody who has conscientious qualms about omitting a smoothing choke entirely should keep its resistance low—not more than about 200 ohms—if the 250-volt transformer is used. The circuit with choke would be similar to Fig. 4.

A useful setting for the feed-back control is about 5 ohms. If at a certain point of this control a pronounced hum starts, it is probably due to oscillation. The tendency

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to oscillate depends appreciably on the nature of the loud speaker, as already hinted.

The total cost of the specified components for the amplifier is less than three guineas, plus £2 7s. for valves, and of course it may not be necessary to buy all of them. The amplifier is suitable either for incorporating in a receiver or for making up into a separate unit. The extreme simplicity is obvious from Fig. 3.

As regards performance, the amplifier has been tested both in laboratory fashion with beat-frequency oscillator and cathode-ray tube and by listening to various programmes received with a high-quality

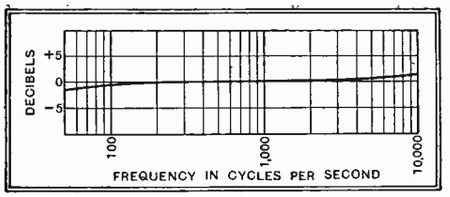


Fig. 5.—Overall frequency characteristic of amplifier.

local-station receiver and reproduced alternately by the amplifier described and by a very high quality set using triodes. To make this test more exacting, resistance networks were connected to both amplifiers so that the loud speaker obtained only one-tenth of the output from each, and one could study the overloading point without being deafened so much as to be unable to make a proper judgment. The benefit due to the feed-back was clearly demonstrated by both tests. Apart from volume and quality it was interesting to note that the connection of an extra load of, say, only 3 or 4 ohms in parallel reduces the volume very seriously and increases distortion in the absence of negative feed-back, but with feed-back in use these tendencies are small. This is obviously important when the number of speakers connected is variable. So far as volume is

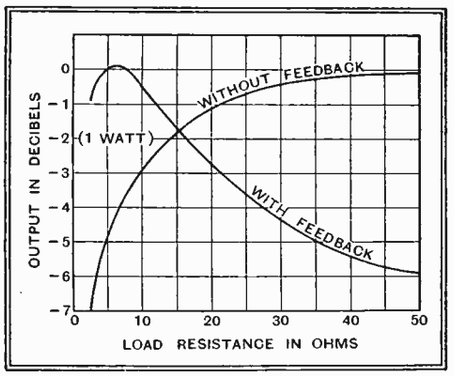


Fig. 6.—The effect of negative feed-back on the output/load resistance characteristic of the amplifier described. These curves do not take account of distortion, which is excluded by running well within the rated output.

concerned, Fig. 6 illustrates the point clearly.

The input signal to give 5 watts into a 15-ohm load is, with no feed-back, 0.23 volt; with half feed-back resistance in use, 0.7 volt; and with full feed-back, just over 1 volt. All these are peak values; RMS values are 30 per cent. less. Actually the maximum output on the secondary side of the transformer with moderate distortion is somewhat more than 5 watts.

To those persons who have a way of pulling valves out of their sockets quite gaily while the power is on, it is necessary to point out that such an act is most unwise in this case, as the current through the remaining valve is thereby greatly increased. If the total current materially exceeds 60 mA the grid bias resistor should be increased above 100 ohms so as to prevent the power transformer from being over-run.

A quarter-megohm volume control is shown, but it is advisable to use the lowest resistance that will not unduly load the circuit to which it is connected. Any tendency to introduce hum at about two-thirds maximum volume setting is thereby minimised.

[Readers who propose to build this amplifier may consider it worth while to wait, before ordering the components, for a sequel, to appear shortly, containing particulars of a very flexible and comprehensive tone control system which, while adaptable to most amplifiers, involves a slight change in the power transformer if it is to be fed from the same unit as that just described.—ED.]

THE LIST OF PARTS REQUIRED

1 Mains transformer if for 1,500-ohm energised field coil,	**Partridge T250/60**
or if for use with tone control stage	**Partridge T350/60**
1 Output transformer 25:1	**Partridge S250**
1 Smoothing choke 100 h., 6mA	**Partridge S25**
1 Intervalve push-pull transformer 1:4	**Partridge S100**
	Sound Sales "CT"
Condensers	
1 0.001 mfd., mica	**Dubilier 690W**
1 2 mfds., 250 volts	**Dubilier "BB"**
1 50 mfds., 12 volts, electrolytic	**Dubilier 3016**
1 8 + 8 mfds., 500 volts, electrolytic	**Dubilier 317**
or if for use with tone control stage 8 + 8 + 8 mfds.	**Dubilier 312**
(condensers of 350-volt working rating may be substituted)	
Resistances	
2 100 ohms, ½ watt	**Dubilier F½**
1 750 ohms, ½ watt	**Dubilier F½**
1 10,000 ohms, ½ watt	**Dubilier F½**
1 25,000 ohms, ½ watt	**Dubilier F½**
2 100,000 ohms, ½ watt	**Dubilier F½**
1 Volume control, resistance as required	**Dubilier "B"**
1 Variable resistance, 0-10 ohms	
3 Valve holders, 7-pin	
1 Valve holder, 4-pin	
Connectors as required	
Valves	
2 AC2PEN, 1 AC2HL, 1 UU4	**Mazda**

DISTANT RECEPTION NOTES

IT is just four years since the details of the Lucerne Plan for broadcasting in Europe were published. And what has been accomplished in that short time! You don't realise the amazing changes and developments that there have been unless you examine a table of European broadcasting stations for June, 1933, as I have just been doing.

When the old Prague Plan was on its last legs there were 218 stations in the European lists, which included then, as they do now, several in Northern Africa and the Near East. Of the stations listed 181 belonged to the medium band, 26 to the long waves and 11 to the intermediate waves about 600 metres but below 1,000. The total output rating of these 218 stations was 3641.6 kilowatts. There were 12 stations rated at 100 kilowatts or more, 23 at between 50 and 100 kilowatts, and 15 at between 20 and 50 kilowatts. This makes a grand total for 1933 of 50 stations that could claim to be regarded as high powered.

Lists to-day show 241 stations: 201 on the medium waveband, 13 on the intermediate, and 27 on the long. But though the 1933 lists were complete, those of 1937 are not. In the old ones *all* relays appeared; but this is not so now. Against some of the "National Common Wave" channels, which may actually contain dozens of tiny stations rated at from 0.1 to 0.25 kilowatts, only one or two names are shown—there is no point in detailing stations that cannot possibly be heard save as a confused chorus.

The number of stations is now probably not less than 300. I make the total kilowatts of those appearing in the lists 6,531.4, so that Europe's broadcasting power has been very nearly doubled in four years. Actually it has been more than doubled in all probability for, in the absence of a standard method of output rating, the power of many stations was overstated in the old lists. There are now 85 high-powered stations, 34 of 100 kilowatts or more, 23 of between 50 and 100 kilowatts and 28 of between 20 and 50 kilowatts.

Long-wave Power Increases

Had you replied offhand to a query about the relative numbers of long-wave stations in 1933 and 1937 you would probably have said that there are many more now than there were then. But you will notice that the numerical increase is only one, from 26 to 27. Measured in kilowatts, the growth has been considerable: the 1933 long-wave stations totalled 1355.1 kilowatts; those of to-day reach 2348.5. But nearly the whole of the long-wave increase in power is accounted for by six stations. Moscow No. 1 has added 400 kilowatts to its original 100; Hilversum shows an increase of 141.5, Motala 120, Kalundborg 52.5 and Lahti 110. The sixth station is the 150-kilowatt newcomer, Radio Romania.

It is on the medium waves that the biggest progress has been made. Here stations of 100 kilowatts and over have increased from 4 to 21, those between 50 and 100 kilowatts from 18 to 19, and those between 20 and 50 kilowatts from 6 to 20. There are thus 60 high-powered stations today in the medium wave band lists against 28 four years ago.

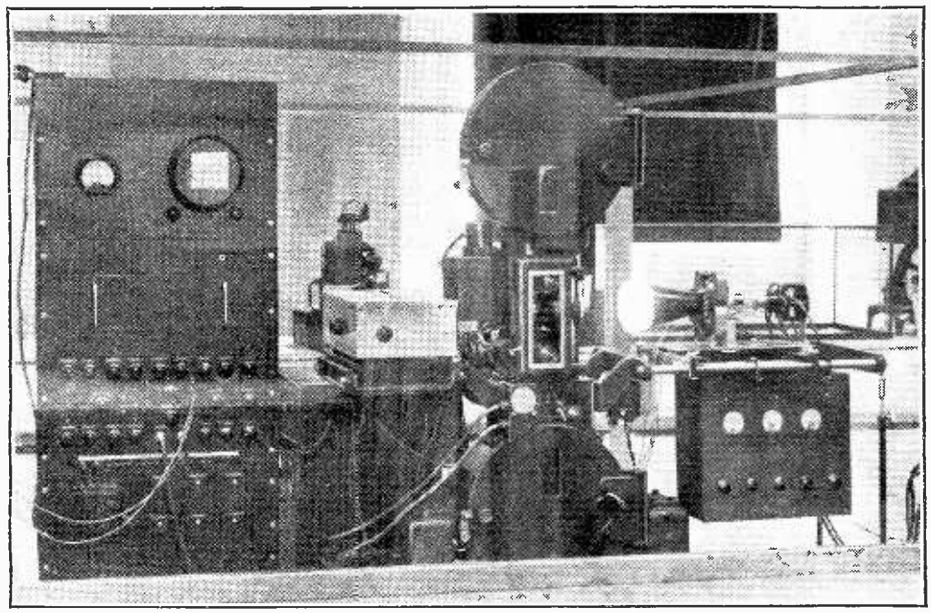
Taking into consideration the vast changes that have occurred in Europe's broadcasting systems since the Lucerne Plan was drawn up, it must be admitted that it has worked wonderfully well and that those who compiled it showed remarkable foresight. But there have been other changes, too. The effects of sideband splutter were not fully appreciated in 1933; no allowance was made for the possible radiation of strong harmonics by long-wave stations and those near the top of the medium wave-band; the "Luxembourg Effect," though it had been observed, had not been widely investigated or fitted with a tenable theory. Many feel that a new plan should be devised before long and that steps should be taken to straighten out the long-wave band in particular before its present confusion becomes worse confounded.

D. EXER.

Television Exhibition

PUBLIC DEMONSTRATIONS OF ALL TYPES OF RECEIVERS AT THE LONDON SCIENCE MUSEUM

THE exhibition that opened last week at South Kensington, and which will continue for some three months, is intended to demonstrate the history of television. It is divided into two sections, one largely illustrative of early endeavour in this field, but also containing representative apparatus of the latest type, and the other demonstrating the achievement of the latest equipment.

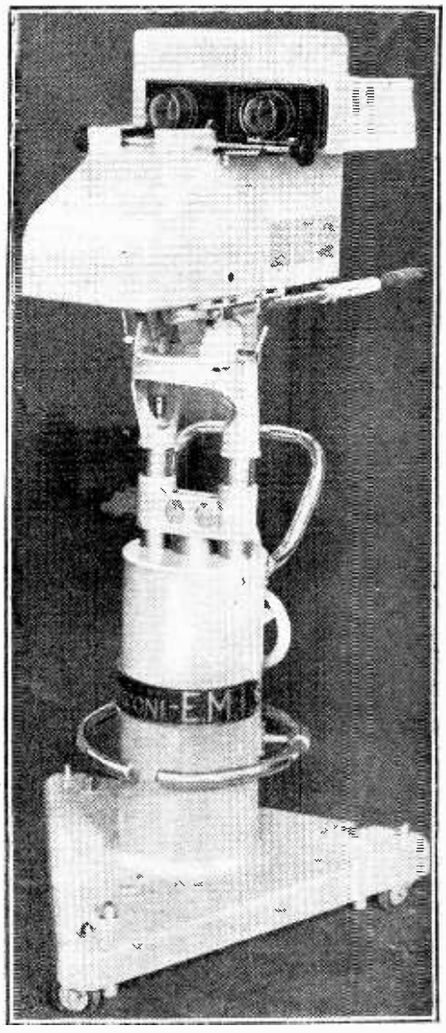


The Cossor film transmitter which is used to provide a signal for demonstrations when the Alexandra Palace is not operating.

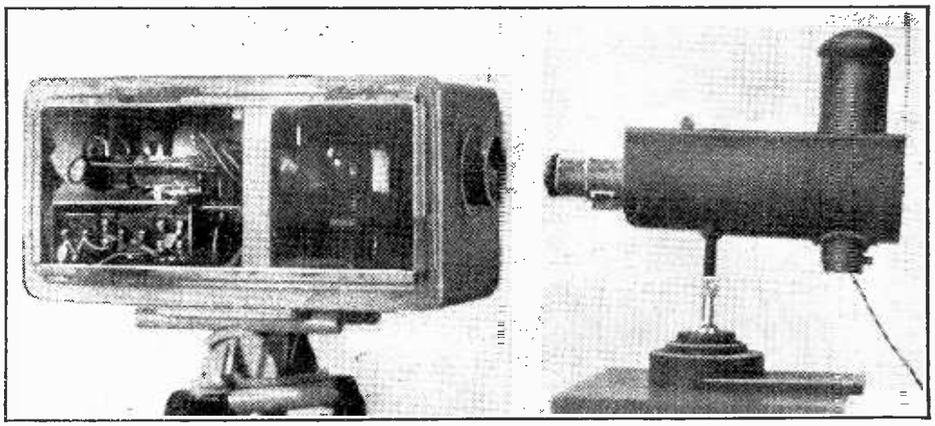
It is this second section which will prove the more attractive to many for all the leading makes of television receiver can be seen in operation. The Baird, Cossor, G.E.C., H.M.V., Marconiphone, Murphy, Pye, and Ferranti receivers are there, each in its own cubicle, and during broadcasting hours operating on the B.B.C. transmissions from Alexandra Palace. In order that demonstrations can continue out of hours, however, a local signal has been provided and is generated in the main section of the exhibit and fed at vision frequency to the various receivers. The Scophony demonstration is also in this section and is operated on a signal radiated by their own transmitter located in the neighbourhood.

The central exhibit in the main section is the Cossor film scanner, which provides the local signal for demonstration. It consists essentially of a cathode-ray tube upon which a plain raster is developed and the light from which is focused upon a photo-cell. The film to be scanned is interposed between the two. The photo-cell output is amplified and mixed with the sync pulses and fed to the various demonstration receivers. The gear is equipped with monitor tubes upon which the picture can be seen, and the whole equipment is mounted in a prominent position and can readily be inspected.

E.M.I. are showing a model of the latest type of television outside broadcast van and one of the Emitron cameras. The camera is, of course, entirely electronic and is equipped with two lenses, one for the camera proper and the other purely for focusing. This secondary lens is mounted alongside the main one and moves with it when the focusing control is operated; it throws an image on a ground glass screen and enables the operator to focus readily and quickly. In order that the scene on the focusing screen may be the same as that on the camera screen, the focusing lens is given a lateral movement, and as the lenses are racked



The latest model Emitron camera. The lens on the right of the picture is for focusing purposes.



A model of the television camera proposed by Campbell-Swinton in 1911.

Television Exhibition—

out for nearby objects they move closer together.

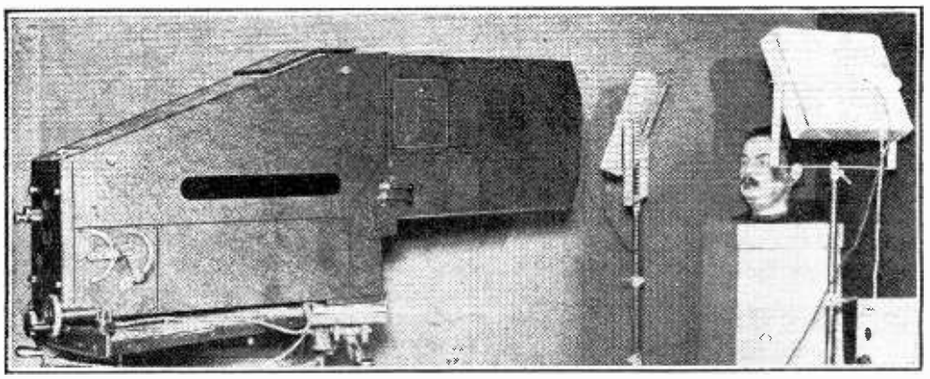
It is not generally realised that the principles upon which the Emitron camera depends were described as long ago as 1911 by Campbell-Swinton, and a working model of his original idea is being shown. This model has been constructed by E.M.I., and in its essentials is remarkably like the present-day cameras. Actually, Campbell-Swinton's idea was not tried out when he originally put it forward, and at that time it would probably have been impossible to make it work, for neither CR tubes nor photo-cells had been adequately developed.

In this main section of the exhibit there is a small booth in which Baird are demonstrating the old 30-line television. On one side of the booth is a wax model of a man's head with banks of photo-cells on either side, and in front of it a spot-light mirror-drum scanner. On the other side of the booth is the mirror-drum receiver. Baird have also on view a large cathode-ray tube designed for electromagnetic deflection and focusing; it is of the type used in their television receivers. They have also photo-cells equipped with electron multipliers and the Farnsworth electron-image camera.

As one might expect in an exhibition which shows the history of television, a large part of the apparatus consists of mechanical scanners. Probably the most familiar of these is the Nipkow disc, closely followed by the mirror-drum. Many will less readily recognise the Mihaly drum, which consists of a circle of stationary mirrors with a small central rotating mirror. The latest form of this, the Mihaly-Traub scanner, is also shown, and in this the fixed mirrors are reduced to five mounted in the form of an arc, and the rotating element is a nine-sided polygon.

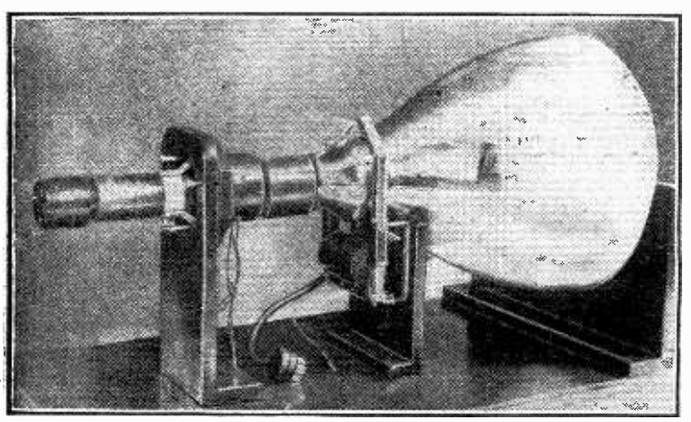
A variety of extremely interesting apparatus is being shown by Scophony, and it includes mechanical scanners of high efficiency as well as a method of modulating light by setting up waves in a liquid through which the light is passed. The particular feature of this system is the possibility of projecting a line of light on to the viewing screen instead of merely a spot, and this is obviously of the first importance, since it greatly improves the efficiency of the apparatus.

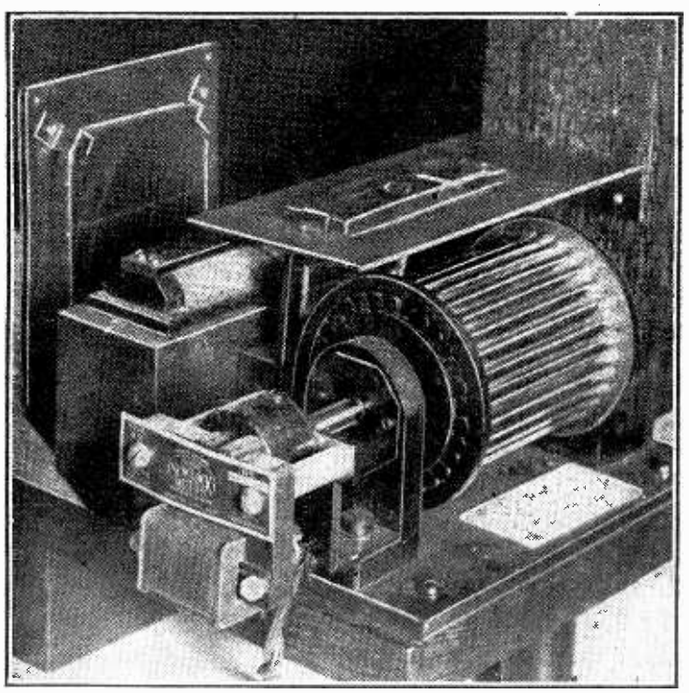
A large cathode-ray tube operating with a very slow-speed scan to demonstrate how the raster is built up is being shown by Ediswan, and there are also models showing how focusing is accomplished.



The Baird 30-line Spot-light scanner which was used in the B.B.C. transmissions up to 1932. The banks of photo-cells can be seen on either side of the head.

The coils for deflection and focusing can be seen around the neck of this large Baird cathode-ray tube.





One model of the Scophony beam-converter is shown here. The drum is driven by a small motor and has an echelon behind it.

The Radio Industry

TWO new Cossor valves have been introduced. Type 240QP is a double pentode for use in the output stage of a battery receiver, while Type 210DT is a double-diode-triode, also for battery feed. Data sheets are available from the makers.

◇ ◇ ◇

Trix Sound Equipment, including ribbon microphones of the latest pattern, has been installed at the Victoria Palace Theatre, while a permanent Trix PA installation has been supplied to the Metropolitan Police College at Hendon.

◇ ◇ ◇

International Technical Developments, Ltd., of Thames House, Millbank, London, S.W.1, have sent us information regarding a series of miniature ball bearings for which the firm holds the exclusive British agency. The overall diameter of the smallest bearing so far produced is 1½ mm. It is suggested that these bearings might have many applications to electrical and radio instruments.

◇ ◇ ◇

The title of Nuvolion, Ltd., has been changed to Metropolitan Relays, Ltd. Address: 46, Bedford Hill, Balham, London, S.W.12.

Brighter Photography. By David Charles, F.R.P.S. Pp. 143, 161 diagrams and illustrations. Published by Iliffe and Sons Ltd., Stamford Street, London, S.E.1. Price 2s. 6d.; postage 4d.

THIS book takes the embryo amateur photographer through the whole subject from A to Z in an unusually entertaining and interesting manner, and there is no part which the reader will be tempted to skip. It can be thoroughly recommended to all who desire to know something about processing their photographs as well as taking them.

The author has long been recognised as an expert in photographing wireless apparatus and equipment. N. P. V.-M.

Broadcast Brevities

NEWS FROM PORTLAND PLACE

Tennis Television Tests

AT the moment of writing B.B.C. engineers are busy testing the 5-metre radio link between Wimbledon and Alexandra Palace, with a view to televising the Lawn Tennis Championship from June 21st onwards. Their first discovery has been that the handsome receiving aerial atop the transmitting mast at Ally Pally is about as useful as a piece of string.

A di-pole only 30ft. above the terrace is proving far more satisfactory.

The Di-pole on the Terrace

It was always rather debatable whether good reception could be achieved on an aerial placed just above the two transmitting antennæ. In theory the position was the only possible one, as no other point in the neighbourhood was expected to be outside the wipe-out area. In practice it turns out that portions of the terrace are far less susceptible.

Whether or not the Wimbledon pictures are clear, they will at least be rock steady, for, as there is no space for a tripod, the swivel mounting for the camera is being screwed down to the wooden rails adjoining the broadcasting huts.

The camera lens will be less than 30ft. from the south-west corner of the Centre Court.

"Black-outs"

The telephoto lens will be used only if the light is really good. There being only one camera, brief "black-outs" will occur while the lenses are being changed.

When the telephoto lens is in use viewers should get as good an image as front-seat patrons with binoculars.

Avoiding Eyestrain

Mr. Gerald Cock, Director of Television, has given special instructions to cameramen not to "pan" more than is absolutely necessary. A shifting picture is disturbing enough on a full-size cinema screen; on the small television screen it can produce serious eyestrain.

The camera will be trained first on one end of the court, and then on the other. Viewers will thus be able to study playing styles with more concentration than the rubber-necked occupants of the seats.

At the end of each game it is hoped that victor and vanquished will be persuaded to face the television camera in close-up to explain why they won or lost.

Is It Cricket?

Tennis is not the only game on the television horizon. Last week several white-smocked figures took up queer stances on the greensward in Alexandra Park while a camera viewfinder was levelled at them from a window in the Palace.

Knowledgeable onlookers swore that the people in the smocks were in cricket formation.

Independence for Wales

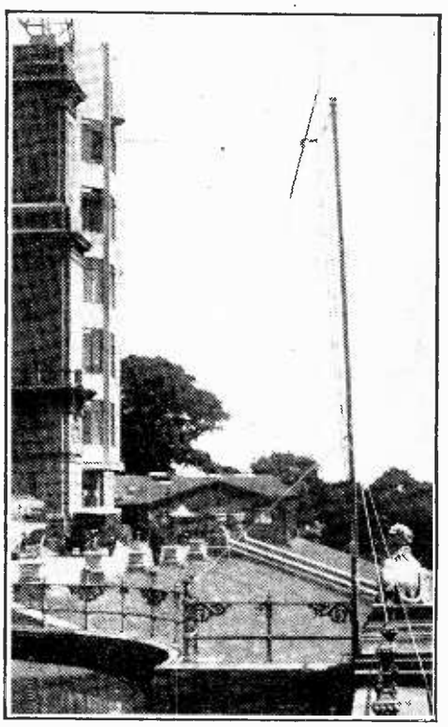
AS already forecast in this column, "Welsh Independence Day" occurs on July 4th, when the 373.1-metre transmitter at Washford Cross will be reserved for an all-Welsh programme service. Programmes from the other Washford Cross transmitter will go out on 285.7 metres and will be intended for listeners in the West of England Region.

After July 4th listeners in the West who still yearn for the National programme will have to tune in Droitwich.

Bournemouth and Plymouth

It is interesting to note that the Bournemouth and Plymouth low-power stations will transmit the same programmes as the new West of England Regional. When it is silent or is radiating the National programme they will relay London Regional.

Work on the new high-power station at Start Point, and a further station in Bristol will be begun shortly.



AERIAL FOR TELEVISION RELAYS.

The ultra-short-wave antennae on the terrace at Alexandra Palace with which the B.B.C. engineers are carrying out 5 metre reception tests.

It looks as if the West Country will at last get a square deal in the matter of broadcasting.

Meanwhile, another Cinderella district—East Anglia—is sitting up and taking notice of rumours of a 100-kW station in Norfolk.

Unfortunately for East Anglia these rumours are slightly exaggerated, but it is understood that a 5-kW transmitter may later be erected near Norwich.

It is unlikely, however, that the search for a site will begin this year. The B.B.C. has too many other irons in the fire.

The New Vice-chairman

MR. MILLIS, the new Vice-chairman of the B.B.C., mentioned at a recent cocktail party that his principal concern would be with the financial side of the Corporation's activities, which is not surprising, as he comes from the world of banking. He intends to learn all about broadcasting from the beginning and to get a set which will enable him to study the system as it exists to-day.

Mr. Millis is 43 but looks much younger.

The salary of the vice-chairman is £1,000 per annum.

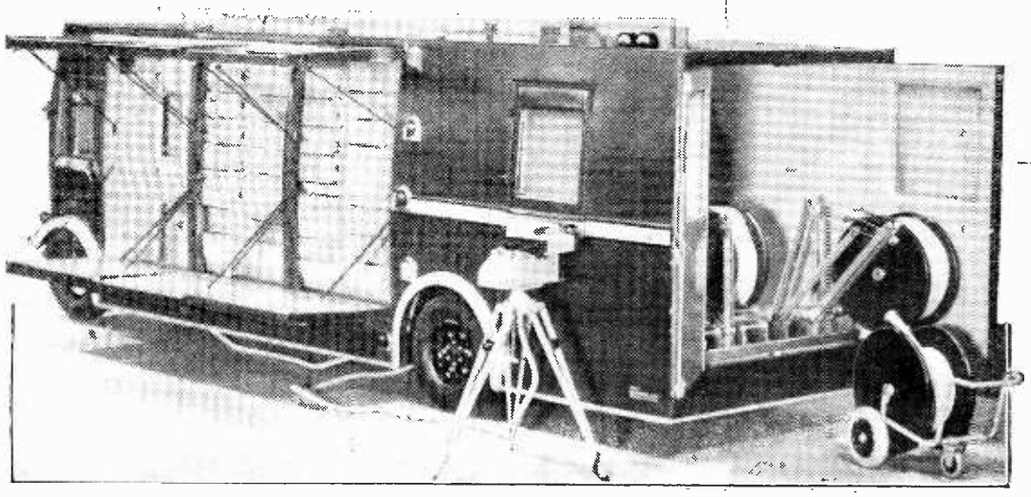
Queer Spectacles

HOW to avoid recognition is one of the problems facing Harry S. Pepper, of White Coons fame, who is touring East Coast resorts this summer spotting likely concert parties for a ten-week broadcast series which he is producing from July to September. To escape being spotted himself, Mr. Pepper will wear dark glasses.

Henry Hall, when travelling incognito, adopts the opposite course. If he removes his glasses he says he is "safe" even in the orchestra stalls in the Palladium.

MOBILE TELEVISION IN MINIATURE.

Many details of the Marconi-E.M.I. outside broadcast van can clearly be seen in this model, which is on view to the public at the Television Exhibition at the Science Museum, South Kensington. The sides of the van can be opened to obtain access to the rear of the apparatus. Four drums are fitted at the back of the van and carry the cables for the connections to the camera, the power supply, and the transmitter van.



Measuring RF Resistance

RAPID COIL TESTING BY THE DYNATRON METHOD

RAPIDITY of testing is of importance when coils are manufactured by mass production, and the ordinary methods of measuring RF resistance are far too slow. In this article is described a method of determining resistance which is not only speedy and simple but is claimed to be also sufficiently accurate for all normal commercial requirements.

By P. H. PETTIFOR, B.Sc.

ALTHOUGH recent articles in *The Wireless World* have fully described the use of the dynatron[1] for the measurement of RF resistance, a brief account of the principle upon which it operates will be given here in order to facilitate the description of the apparatus given later.

When a valve is operated with the anode at a lower positive potential than the grid with respect to the cathode, the anode volts/anode current characteristic exhibits a negative slope; in other words, if the anode voltage is raised by a small amount dEa, then the anode current will *fall* by a small amount dIa. Thus the anode resistance of the valve appears negative and by an amount equal to $\frac{dEa}{dIa}$. A screen grid valve is generally used as a dynatron, as the control grid offers a ready means of adjusting the magnitude of the negative resistance to practically any value.

It was shown in the articles mentioned above that if a tuned circuit is connected in the anode circuit of the dynatron, then, so long as the dynamic resistance of the tuned circuit is greater than the negative resistance of the valve, oscillations will be maintained in the tuned circuit, very approximately at a frequency equal to $159.2/\sqrt{CL}$ kc/s.[2]

It has been shown that, for a given valve operating with given anode and screen voltages, the value of the voltage on the control grid bears a definite relationship to the negative resistance of the dynatron.[3] The dynatron may be simply calibrated by taking two readings of the anode current, $i1$ and $i2$, first with a certain anode voltage $v1$, and secondly with a slightly, say 2 volts, different anode voltage $v2$, then the negative resistance for the particular grid bias at which the readings were taken is $\frac{v1-v2}{i1-i2}$.

It is only necessary to repeat the process for a series of control grid bias voltages—the screen grid voltage remaining constant—when a calibration curve such as Fig. 1 may be drawn. Thus, if the control grid voltage is gradually increased, negatively until the oscillations cease (as detected in a nearby oscillating receiver), then from the value of this critical bias voltage the value of the RF resistance may be found directly from the curve, oscillations ceasing when the negative resistance becomes equal to the dynamic resistance of the tuned circuit.

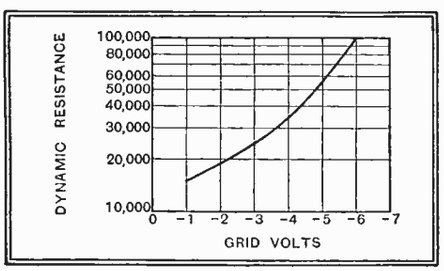


Fig. 1.—Specimen calibration curve: AC/SG valve with 90V on anode and 30V on screen.

In practice, the operation of the usual dynatron testing equipment may be reduced to the following four operations:—

(a) The coil under test is plugged in, and the tuning condenser is set to give the required frequency of oscillations.

(b) The control grid bias is slowly increased, until, by some suitable means, oscillations are observed to cease. It may be noted here that as the bias is increased the frequency of oscillation changes slightly, so that if an oscillating receiver is used to detect the oscillations, the frequency of the beating oscillator may have to be changed in order that the beat may remain audible.

(c) The control grid voltage at which oscillations cease is measured, and from the calibration curve the RF resistance is determined.

(d) The coil is unplugged, and the bias is returned to minimum ready for the next coil.

It will be readily seen that such a sequence of operations is both lengthy and cumbersome when there are hundreds, let alone thousands, of coils to be tested.

To simplify the operation of the test apparatus, it was arranged, first of all, to use an aperiodic device, such as a valve voltmeter, for the detection of the oscillations, there being no AC voltage across the dynatron when oscillations cease. This was found to reduce the time taken to test a coil considerably, but it was still necessary to adjust the bias voltage manually. However, in the valve voltmeter we have a ready means of controlling the voltage on the control grid.

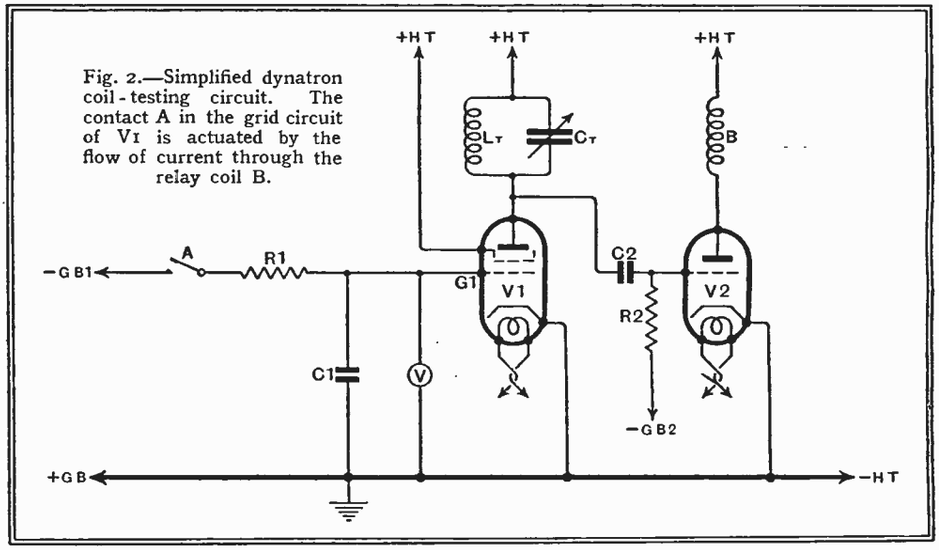


Fig. 2.—Simplified dynatron coil-testing circuit. The contact A in the grid circuit of V1 is actuated by the flow of current through the relay coil B.

Now consider Fig. 2, which shows a dynatron oscillator V1 with the coil under test LT—tuned by CT to the desired frequency. The valve V2 is given such a bias that when there are no oscillations in the tuned circuit LT CT (such a condition is easily obtained by short-circuiting the closed circuit) its anode current is reduced to the order of $\frac{1}{4}$ mA or less. In the anode circuit of this valve is a relay B, having one contact A which closes when sufficient current is flowing through the coil B. The control circuit of the dynat-

[1] *The Wireless World*, pp. 122 to 125, and 132-133. Vol. 39.

[2] "High Frequency Measurements." A. Hund, page 175, McGraw-Hill Book Co., New York.

[3] H. Iiruma, *Proc. I.R.E.*, p. 537, 1930.

Measuring RF Resistance—

ron is composed of the voltmeter V, large-capacity condenser C1, and charging resistance R1. Now when contact A closes it allows the condenser C1 to charge up through the resistance R1, applying a gradually increasing voltage to the control grid G1 of the dynatron, the value at any instant being recorded by the voltmeter V.

First examine what happens when the coil to be tested is plugged in. The contact A is initially open, due to the anode current of V2 being less than the operating current of the relay. However, as soon as oscillations commence, the anode current of V2 rises—it is working as an anode bend rectifier—and the relay operates, thus permitting a gradually increasing voltage to be applied to G1. As already explained, oscillations will be maintained as long as the negative resistance of the dynatron is less than the RF resistance of the tuned circuit; thus the negative voltage on G1 goes on increasing until oscillations cease, when the anode current of V2 will fall, there being no longer any AC voltage on its grid, and the contact A will open. Now, if the voltmeter V is of the thermionic or voltage operated type, then it will give a steady reading of the voltage at which oscillations ceased, and hence the dynamic resistance of the tuned circuit may be obtained from the calibration curve. If, however, the voltmeter is of the moving-coil or current-operated type, then as soon as A opens, C1 will begin to discharge through the meter, so that the voltage on G1 will fall and oscillations will recommence, thus causing A to close again. The net result is that the contact "chatters," while the voltmeter pointer will also be found to "shudder" slightly, although if it is well damped it will give a substantially steady reading. The calibration of the dynatron is sensitive to small changes in the anode and screen voltages, and while this necessitates special precautions being taken in the power supply equipment, it enables the range of negative resistance covered to be readily changed, simply by altering the screen voltage by a known amount. Facilities should also be provided for rapid checking of the calibration.

It was with this end in view that the circuit finally adopted (Fig. 3) was provided with change-over switches, enabling the calibration to be checked in a short space of time. With the switches in the positions shown, it will be seen that the circuit is essentially the same as that of Fig. 2, with the addition of decoupling RF chokes and condensers. With all the switches except S changed over to their alternative positions, the meter is ready to be calibrated. The bias on G1 is under the control of the potentiometer, whilst the micro-ammeter and backing-off battery have been inserted in the anode circuit of the dynatron. The method of calibration is as previously described, switch S being put into position 2 to change the anode voltage by the voltage of the battery *b*.

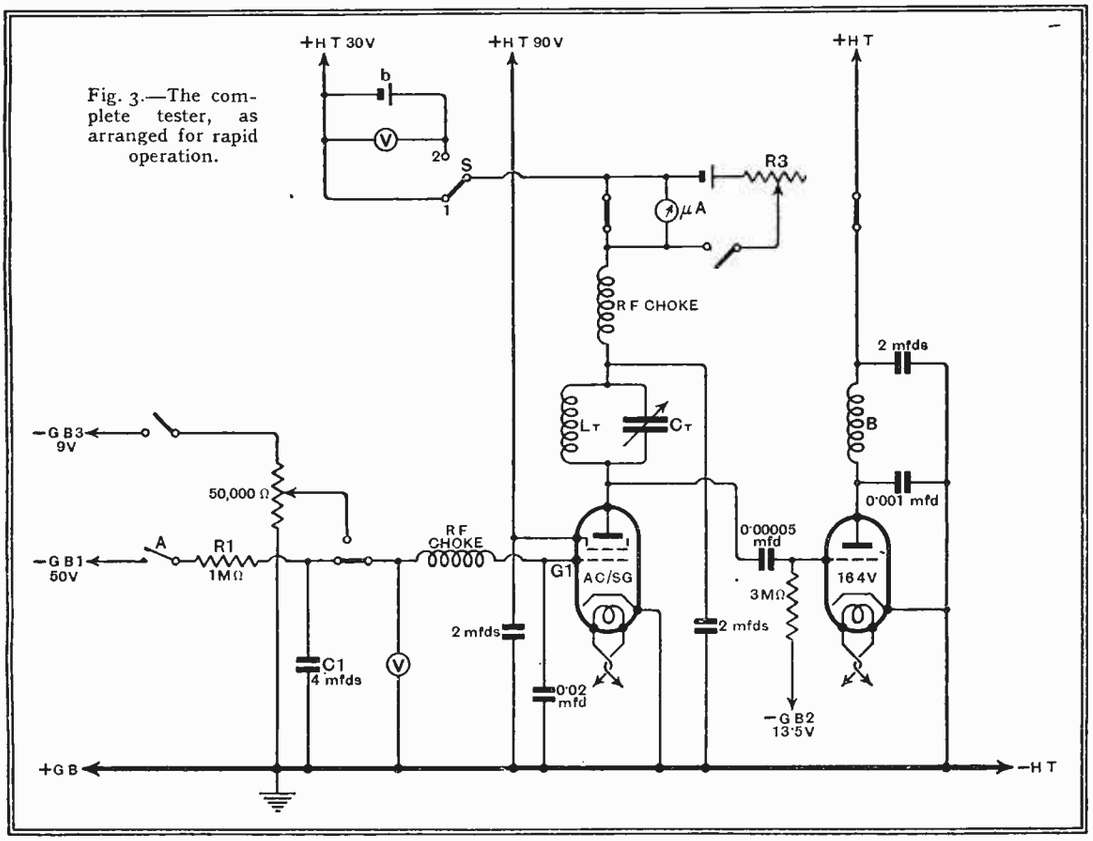


Fig. 3.—The complete tester, as arranged for rapid operation.

It is seen that the voltmeter V may be calibrated directly in terms of the dynamic resistance of the tuned circuit, while if LT and the frequency of oscillations are fixed, then the calibration might even be in terms of the RF resistance of the coil itself. An accuracy of the order of $\pm 2\frac{1}{2}$ per cent. may be expected when the valve V1 has been aged and the various HT voltages properly controlled. The mains equipment is not shown in Fig. 3, as the neon stabilisers and ballast resistances, which are necessary, are generally too expensive for the average experimenter, it being very much safer, as regards consistent results, to use batteries than unstable mains supplies.

In conclusion, the author wishes to acknowledge the permission given by Messrs. Siemens Bros. & Co., Ltd., Woolwich, to publish this article.

APPENDIX

If a micro-ammeter is not available the negative resistance for any particular grid bias may be found by inserting the dynatron across one arm of a bridge, such as shown in Fig. 4. R2 is varied until a minimum is heard in the phones, and the C is adjusted to give a better minimum. R2 is then set for final balance.

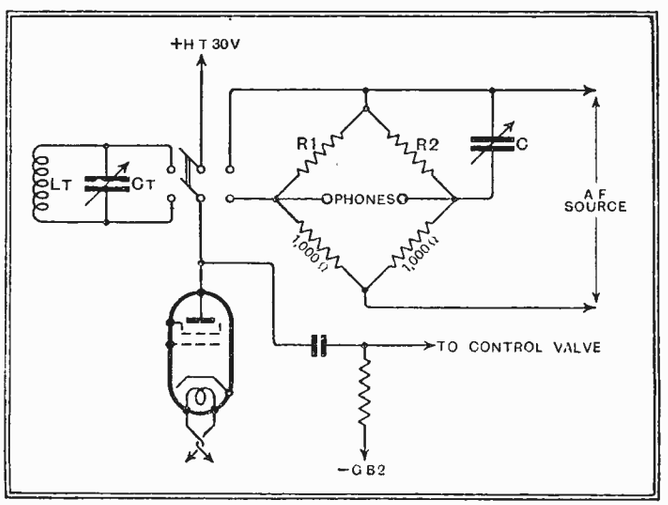


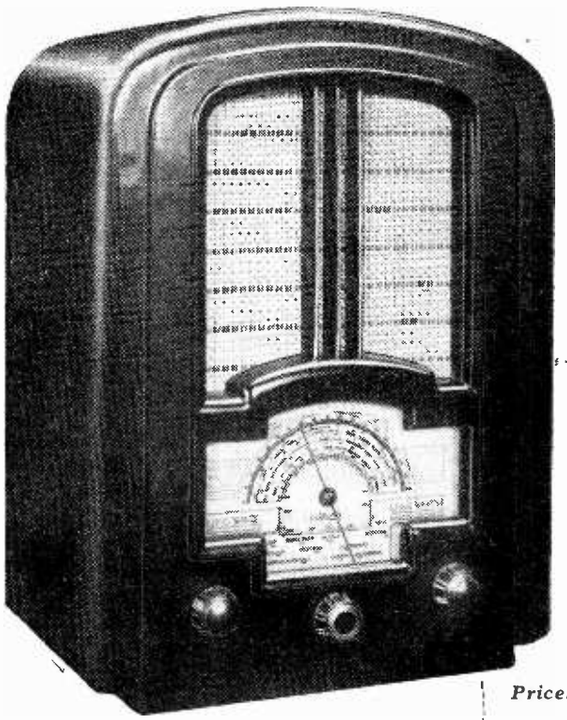
Fig. 4.—Ascertaining the negative resistance for a given grid bias voltage by the bridge method.

The negative resistance $R' = \frac{R_1 R_2}{R_1 + R_2}$.

For a tuned circuit $R_D = \frac{L}{Cr}$, where R_D is the dynamic resistance, L the inductance in μH, C the capacity in mfds. and r the series resistance of the coil in ohms.

Ferranti MODEL 837

EFFICIENT ALL-WAVE PERFORMANCE AT LOW COST



FEATURES. ***Type.*** *— Table model superheterodyne for AC mains.* ***Waveranges.*** *—(1) 16.7-52 metres. (2) 200-550 metres. (3) 1,000-2,000 metres.* ***Circuit.*** *—Heptode frequency-changer.—Var.-mu pentode IF amplifier—double-diode pentode second detector and output valve. Full-wave valve rectifier.* ***Controls.*** *—(1) Tuning. (2) Waverange. (3) Volume and on-off switch.* ***Price.*** *—8 guineas.* ***Makers.*** *—Ferranti Ltd., Moston, Manchester, 10*

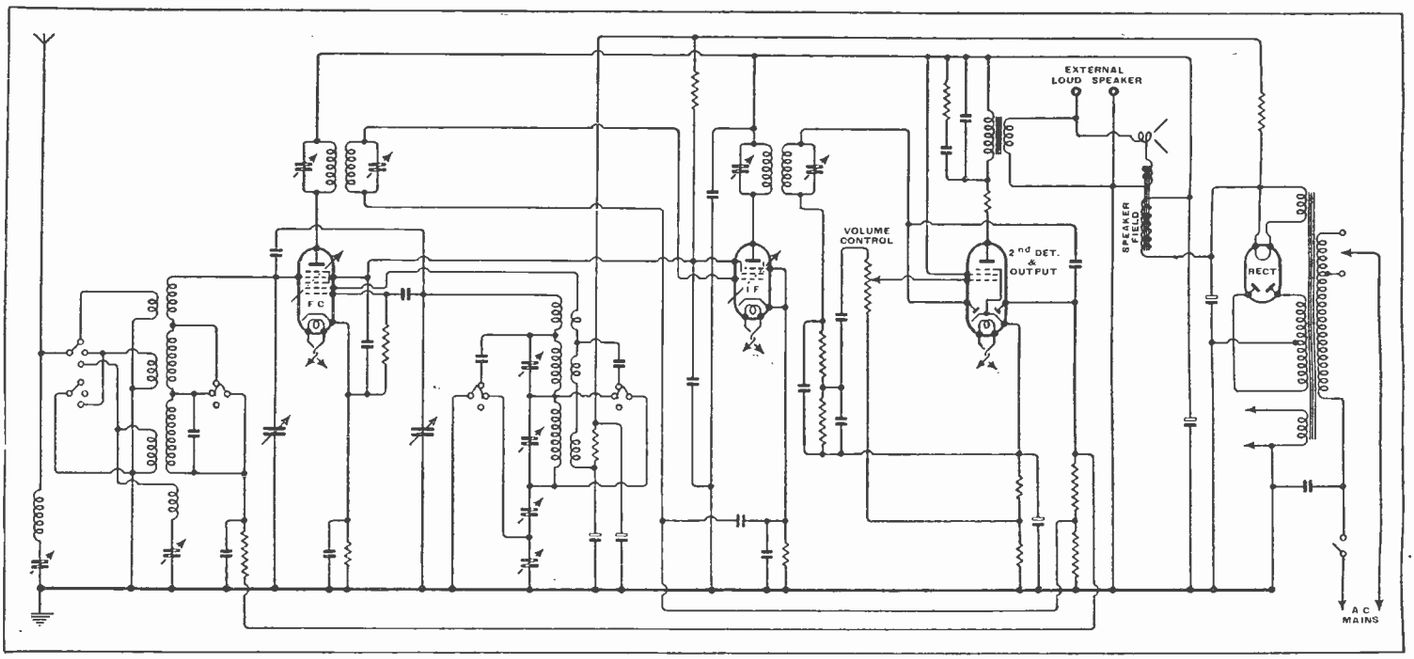
SIMPLICITY of design and construction is the keynote of this AC mains receiver recently introduced by Ferranti, Ltd. It is frankly built to a price, but the makers have wisely taken the course of evolving an entirely new design rather than paring down the specification of an existing chassis.

The basic circuit is the simplest form of superheterodyne making use of only three valves. The first is a heptode frequency changer preceded by a single tuned circuit in which the medium- and long-wave coils have iron cores. The switching of the secondary follows the usual custom of short-circuiting sections not in use, but the primary coupling coils are parallel-connected with a three-wave selector switch. On long waves the medium-wave coupling coil is short-circuited. An IF filter is connected between aerial and earth, and an additional filter is provided to suppress second channel break-through of medium wave stations at the lower end of the long-wave range which might result from the high intermediate frequency which has been chosen.

The circuit connections of the frequency-changer with its associated oscillator coils is fairly straightforward, and AVC is applied to this valve on all three wave-bands. An interesting refinement is to be found in the use of neutralising between oscillator and input grids. Also a separate by-pass condenser with low impedance at high frequencies is connected close to the screening of this valve.

The IF amplifier stage, which functions at a frequency of 450 kc/s, makes use of the usual variable-mu pentode, and the functions of second detector and output stage are combined in a single double-diode-pentode valve capable of an undistorted AF output of 2½ watts. An anti-parasitic resistance is connected next to the anode of the output valve and a fixed degree of tone correction is applied to the primary of the output transformer. Terminals for an external loud speaker are provided, and are situated on the back of the loud speaker itself.

A strong steel chassis with a special grey rust-proof finish is employed, and it is in the distribution of components above and below the baseplate that the ingenuity of the designers is most apparent. By careful design it has been found possible to dispense completely with screening cans. Even the output IF transformer on top of the base plate is open, though the high potential lead to the valve cap is screened. A further saving has been effected by dispensing with the usual form of mains voltage adjustment, and a soldering iron is necessary to alter the setting of the receiver in this respect. There are only two tappings (for mains voltages approximating to 225 and 255 volts), and the correct



Although the superheterodyne circuit makes use of only three valves it has a remarkably efficient performance, particularly on long waves.

A 10

Ferranti Model 837—

connection will presumably be made either at the works or by the local dealer.

Turning to the front of the set we find the same simplicity in the controls themselves. These are three in number, namely, the combined volume control and on-off switch, wave-range switch with colour code markings corresponding to the colour of the three wave-range scales on the semi-circular dial, and the tuning control. The latter has been given a single reduction ratio which is necessarily a compromise between the requirements of the normal broadcast and short-wave bands. If a little more care than usual is called for in tuning in stations on the short waves, it can at least be said that the reduction gear is free from backlash, which can be a source of irritation in gears of abnormally high ratio. Further, there is an additional 180 deg. scale which not only gives the eye something to concentrate upon when sorting out the closely packed stations in each of the short-wave broadcast groups, but also provides a means of recording the exact settings of stations when identified.

Performance

Although at the time of the test no American stations were available, we are of opinion that the sensitivity provided on this range will be sufficient for the enthusiast to sample the abundant fare which is now offered on the short-wave band. The signal-to-noise ratio on the short-wave range is about average, and although in the absence of a tuned RF stage there is a certain amount of second-channel duplication of stations, the spacing, due to the high intermediate frequency, is sufficiently wide to avoid any possibility of wrong identification.

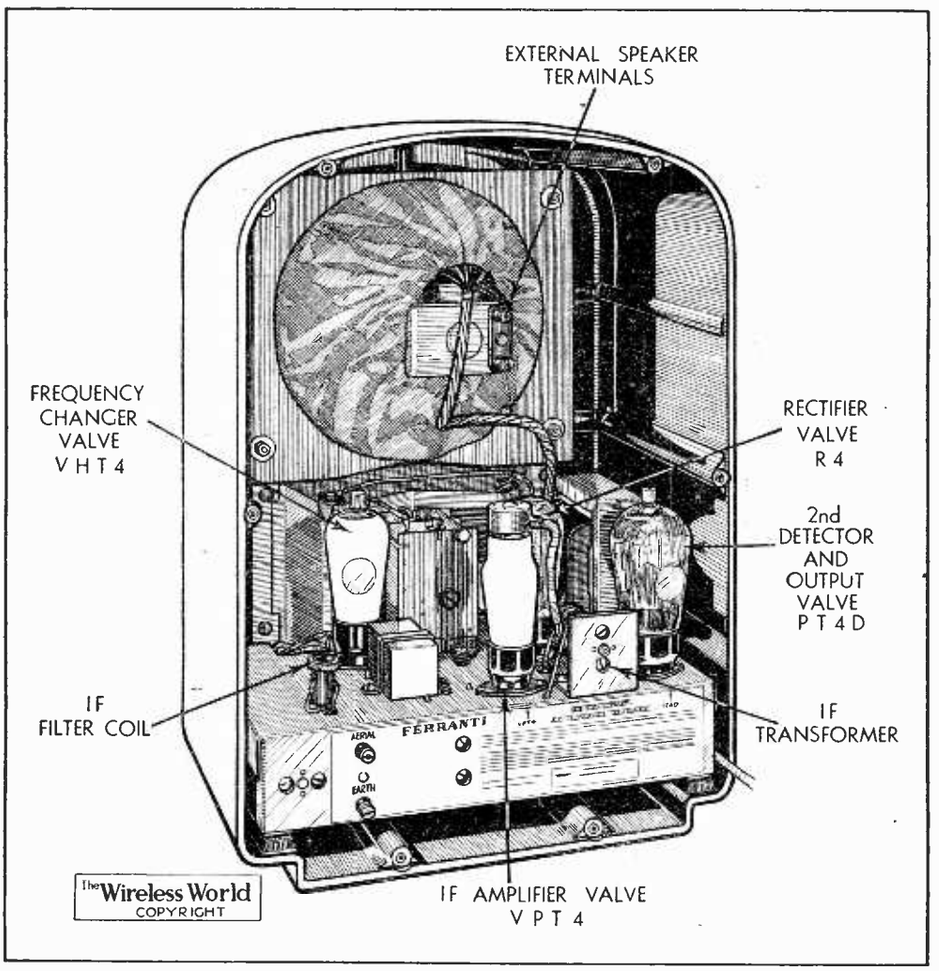
On the medium waveband no trace of any second-channel whistles could be found, and the range was sufficient to bring in about ten Continental stations in daylight. Selectivity permitted an approach to within 1½ channels of the Brookmans Park transmitters when using the set in Central London. A feature which impressed us favourably on this waveband was the manner in which the sensitivity was maintained right up to 550 metres.

Lastly, we come to the long-wave range on which the performance in every respect was exceptionally good. In fact, we have tested few superheterodynes, irrespective of the number and arrangement of valves, which have given better results. The Deutschlandsender proved to be quite equal in volume to Radio Paris, and was received clear of interference from that station and from Droitwich when accurately tuned. The signal-to-noise ratio of Huizen was much above the average, and other stations showed a like improvement in programme value over that to which we have lately became accustomed on the long waves.

Quality of reproduction is of the crisp and bright type, with good attack and freedom from harmonic distortion up to higher levels than will be required for the average living room. The bass response is not particularly full, but most people will prefer it to the type which draws attention to itself by its "boomy" quality.

The set is housed in the attractive type of moulded cabinet which has long been a characteristic of Ferranti products, and the new style of semi-circular dial is remarkably easy to read. Special care has been given to its uniform illumination, and a double concave reflector is used to distribute the light from two pilot lamps at the sides.

In providing a set of such attractive appearance and performance at the low price of 8 guineas the makers are to be congratulated on a most efficient piece of work. The only drawback is that with no intermediate amplification between the second detector and the output stage it has been thought advisable to omit provision for a gramophone pick-up.



By careful disposition of the components above and below the chassis it has been found possible to dispense with screening cans for all coils, with a consequent increase in efficiency.

News from the Clubs

Wirral Transmitting and Short-Wave Club

Headquarters: King's Square Café, Birkenhead.
Meetings: Last Wednesday in the month at 7.30 p.m.
Hon. Sec.: Mr. J. R. Williamson, 49, Neville Road, Bromborough, Birkenhead.

At the last meeting Mr. J. Davies, G2OA, gave a talk on transmitter efficiency and design. Two more members have succeeded in obtaining their full transmitting licences and another is awaiting his call-sign. Mr. Angus D. Taylor, 2BDT, has been appointed host to the club and will be pleased to welcome new members.

Thames Valley Amateur Radio and Television Society

Headquarters: The Albany Hotel, Station Yard, Twickenham, Middlesex.
Meetings: Wednesdays at 8.15 p.m.
Hon. Sec.: Mr. J. N. Roe, 19a, The Barons, St. Margarets-on-Thames, Middlesex.

In spite of the bad weather, four stations took part in the recent 40-metre field day. Power was limited to 5 watts input supplied from batteries. The four stations were respectively situated at Chobham Common, near Sunningdale, on the Hog's Back, near Guildford, at New Malden and at Box Hill, Dorking. Apart from many English stations, contacts were made with transmitters in France, Belgium, Holland, Germany and Denmark. Every station participating employed crystal control.

Golder's Green and Hendon Radio Scientific Society

Headquarters: 60, Pattison Road, Hampstead, N.W.2.
Hon. Sec.: Mr. A. G. Griffiths, "Hornbeams," Priory Drive, Stanmore, Middlesex.

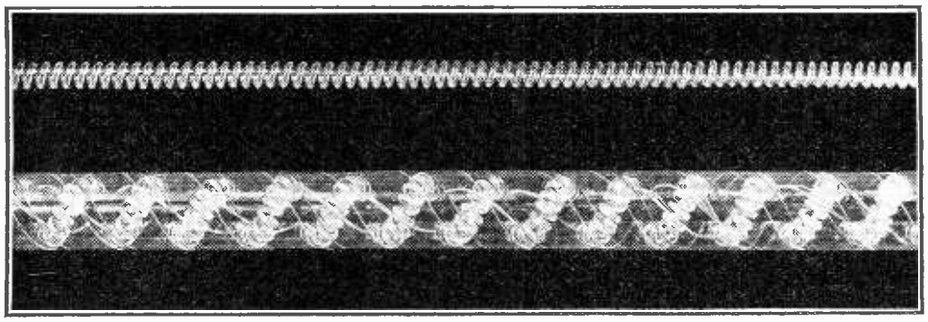
The recently held annual D.F. competition went off very well indeed. Dr. Smith-Rose was unfortunately unable to be present and his place was taken by Mr. P. H. Barfield, of the N.P.L.

Watford and North Middlesex Radio Society

Between now and the autumn it is proposed to form a wireless society under the above name. Those interested are invited to communicate with Mr. H. L. Gibson, 50, Oundle Avenue, Bushey, Watford, Herts

A New High-frequency Cable

EXPERIENCE has shown that it is possible to make use of cables for carrying currents at high frequencies over considerable distances, and in America and Britain a co-axial cable is used for the purpose. In Germany a slightly different type of cable has been developed, but recent development shows a trend to the co-axial type in preference to the symmetrical type which is used at present. It has been found that a cable with only one main conductor is advantageous for frequencies above 300,000 c/s.



A length of the flexible Styroflex insulating material, and (below) method of winding it round a conductor in such a way as to provide insulation consisting mainly of air.

The German high-frequency cable makes use of an entirely new insulating material which is manufactured from Trolityl. The new material is called Styroflex. It permits of the manufacture of "broad-band" cable (this is a literal translation of the German term) on ordinary cable machines, and is therefore much less expensive than co-axial cables made with non-flexible insulators. Styroflex has the same excellent dielectric properties as the materials hitherto used, and, as compared with paper, is equally flexible, is non-hygroscopic, and much superior in other respects.

The symmetrical type cable consists of two main conductors separated by Styroflex windings and kept perfectly parallel by a further band of Styroflex. It has an exterior diameter of 25.5 mm. and at one million cycles has a "damping" factor of 0.19 neper per kilometre. The single conductor or concentric cable has a damping factor of only 0.16 neper per kilometre at the same frequency, and has an external diameter of 19 mm.

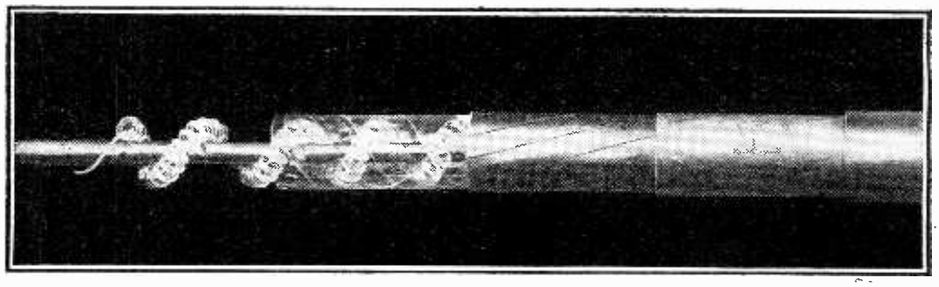
The makers claim that frequencies up to four million cycles can easily be handled with this type of cable. It has not been publicly stated, but it is understood on good authority that the German Post Office television cable between Berlin and Leipzig was supplied by the makers of the new cable.

Receivers for India

NOW that nine new broadcasting stations will be opened in India at an early date the demand for receivers is bound to grow rapidly, and All-India Radio Service is anxious to see that such receivers are available in India as would be satisfactory both from the technical point of view and price.

For this reason "All-India Radio" has issued the general requirements of three representative types of receivers which would be suitable for Indian conditions. The first of these has been termed the "local receiver," which is intended for picking up the local medium-wave stations, and, under favourable conditions, other medium-wave stations operating on wavelengths between 200 and 550 metres. The set should have four valves and be suitable for operation by alternating or direct current on electric supply mains. This set must be of a moderate cost to be within the reach of the greatest number of people.

The second type of receiver, called the "All-India Receiver," is required to cover the medium wave and short wave bands which will be used in India. Three ranges should be provided—25 to 42 metres; 40 to 100 metres; 200 to 550 metres. Such a receiver ought to be a four-valve superheterodyne also of the AC or DC mains type.



Construction of a Styroflex-insulated high-frequency cable made by the German firm of Felten and Guilleaume.

The third type of receiver of the "All-Wave Receiver" is the standard type at present available on the market. For Indian conditions, however, it is essential that the "All-Wave Receiver" should be capable of picking up a minimum wavelength of 13 metres, and the wave range from 13 to 550 metres should be covered continuously without gaps.

Most of the requirements specified above are not met in the receivers at present available in India, and, besides, their prices have been very high, though there has recently been a tendency for prices to drop. A good "All-Wave Receiver" with continuous coverage from 13 to 550 metres may now be obtained at a cost of Rs.250 or so.

Here an excellent opportunity is provided for manufacturers of radio sets to take pains to supply receivers suited to India's growing requirements and her climatic conditions.

The new short-wave stations, it has been decided, will operate within the wave bands 25, 31, 49, 60, and 90 metres. None of the stations will operate on the long-wave lengths.

After extensive listening tests by the Research Department of All-India Radio, suitable wavelengths for the new stations have been chosen which would be free from interference at night from distant European medium-wave stations.

Television Programmes

Transmissions are from 3-4 and 9-10 daily.

Vision 45 Mc/s. Sound 41.5 Mc/s.

FRIDAY, JUNE 18th.

3, Fashion forecast. **3.10,** Friends from the Zoo. **3.25,** Gaumont-British News. **3.35,** Theatre Parade, "The Wasp's Nest," by Agatha Christie.

9, Repetition of 3 programme. **9.15,** British Movietonews. **9.25** and **9.40,** Repetition of 3.10 and 3.35 programmes.

SATURDAY, JUNE 19th.

3, Fire engines of the last two hundred years exhibited in the grounds of Alexandra Palace. **3.15,** Boxing demonstration by instructors of the Army School of Physical Training. **3.30,** British Movietonews. **3.40,** Cabaret with Walsh and Barker, Drury and Raymond and Charles Heslop.

9, Starlight: Argentinita, the celebrated Spanish dancer. **9.15,** Repetition of 3.15 programme. **9.30,** Gaumont-British News. **9.40,** "Paddle Steamer": A trip down-river from London Bridge to Southend in 1850.

MONDAY, JUNE 21st.

3, Buddy Langley, songs at the piano. **3.5,** Panache, a miscellany of songs and mimes. **3.20,** British Movietonews. **3.30,** Theatre Parade.

9, Jane Carr. **9.10,** Specimens of cacti from the Royal Horticultural Society's Cactus Show, presented by C. H. Middleton. **9.20,** Gaumont-British News. **9.30,** Theatre Parade.

TUESDAY, JUNE 22nd.

3, Stock Judging: a demonstration with farm animals by members of a young farmers' club. **3.20,** Gaumont-British News. **3.30,** Victorian afternoon: a revue for television.

9, Aulikki Rautawaara, the Finnish opera star. **9.10,** Fire precautions. **9.25,** British Movietonews. **9.35,** Cabaret.

WEDNESDAY, JUNE 23rd.

3, Television Follies: a television concert party, including Vera Lennox, Michael North and Pat Denny. **3.20,** British Movietonews. **3.30,** Sixty-fifth Picture Page.

9, Repetition of 3 programme. **9.20,** Gaumont-British News. **9.30,** Sixty-sixth Picture Page.

THURSDAY, JUNE 24th.

3, Popular musical artiste. **3.10,** The Danger of Tobacco: a monologue by Anton Chekhov, played by John Abbott. **3.20,** Gaumont-British News. **3.30,** Wizardry with Words: Hubert Phillips presents word puzzles—anagrams, palindromes, etc. **3.40,** "Quintet" with Ivy St. Helier.

9, Comedy Act. **9.10,** Repetition of 3.30 programme. **9.20,** British Movietonews. **9.30,** Victorian Afternoon: a revue for television.

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

Canadian High-power Station

IT is reported that work is to be commenced almost immediately on the projected 50 kW. broadcasting station at Hornby, Ontario. The station, which will use the call-sign CRCT, will radiate on 840 kc/s and will be the most powerful installation in Canada.

Irak Calling

THE Baghdad broadcasting station has now resumed transmission on a wavelength of 391 metres. Programmes are broadcast on Mondays, Thursdays and Saturdays from 16.30 to 19.00 (G.M.T.).

Hospital Radio

THE wireless installation presented to the University College Hospital by Sir Walter Layton, of the *News-Chronicle*, and Colonel Ozanne, of the R.M.A., was formally accepted on behalf of the hospital by Princess Marie Louise. The installation includes 400 pairs of headphones in the ordinary wards and ten loud speakers in the children's wards and nurses' home.

Radio Normandie

LISTENERS who are taking their holidays in Normandy will probably be able to spend an interesting time in the studios of Radio Normandie at Caudebec. Those desiring to visit the studios should make formal written application. At present, permission to visit the transmitter at Louvetot is not being granted.

Radio Service in India

WHAT is considered to be the largest radio engineering institution in the East has been recently equipped in Bombay and named the Abdulla Fazulbhoy Technical Institute after the late Mr. Fazulbhoy, one of the pioneers of the Radio Industry in India. The object of the institution is to satisfy the demand for efficient radio service engineers by providing a complete theoretical and practical training in radio engineering.

Man-Made Static

AN entirely new form of wireless interference which can truthfully claim to be called man-made static is said to have been brought to light by the Radio Club of Ostrau, Czechoslovakia, which is investigating the case of two men who are said to cause interference when they are in the neighbourhood of a wireless set. They are to be sent to Prague for a special examination.

Marconi's Son

IT is reported that Giulio Marconi, only son of the Marchese, is to work for the R.C.A. for a time in order to acquire practical knowledge of American broadcasting technique.

Indian Broadcasting

FOR the post of News Editor of All-India Radio, sixty-three applications have been made in India and thirty in this country. Some of the former have been interviewed by Mr. Lionel Fielden, Controller of Broadcasting in India. The final selection for the post, which carries a salary of 1,000 rupees a month, is expected to be made shortly.

Prison for Listeners

SEVERAL inhabitants of Hamburg are said to have received prison sentences varying from two to six years for listening to transmissions from Moscow.

Down on the Farm

WHAT is stated to be the first radio-equipped farm tractor has just made its appearance in the U.S.A. It is for the use of an American farmer who is a rabid baseball "fan" and desires to listen to running commentaries while he is at work.

Wireless and Biology

FROM July 12th to 17th a Congress will be held in Vienna at which discussions will take place concerning the relationship of short-wave and ultra-short-wave radio to biology and medicine.

Record Royalties

THE French Tribunal of Commerce has now announced its findings on the question of authors' royalties on certain broadcast gramophone records. Hitherto the royalties have not been paid on certain records issued to broadcasting stations as distinct from those on sale to the public. The Tribunal has now decided that any issuing of records to broadcasting stations constitutes publication, and royalties are payable.

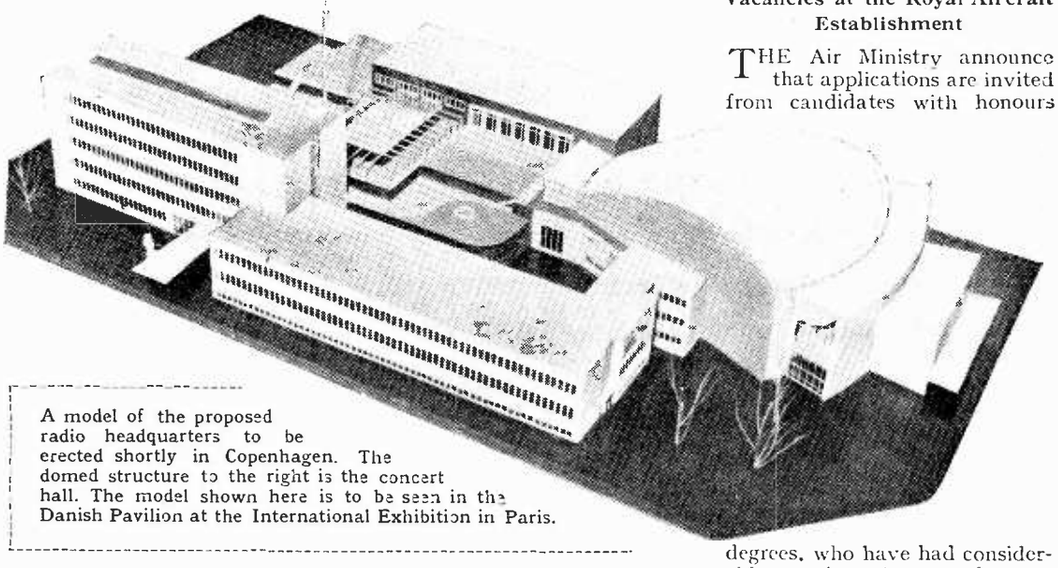
Abyssinian Wireless

A SIX-YEAR plan of colonial development recently launched by Italy includes the establishment of a chain of commercial wireless stations in Abyssinia. The Italians are using the International prefix "I" for their stations in Abyssinia, instead of "ET."

No Radio Research Board for India

A RESOLUTION recently moved in the Upper House of the Central Legislature for the establishment of a Radio Research Board for India was rejected without a division. The Government's spokesman, who opposed it, while stating that he felt every sympathy for those desiring to establish such a Board on the lines of the one in Great Britain, said that no funds were available for such a purpose. A suggestion that money be raised by a 2½ per cent. tax on radio imports was not accepted.

DENMARK'S NEW BROADCASTING HOUSE.



A model of the proposed radio headquarters to be erected shortly in Copenhagen. The domed structure to the right is the concert hall. The model shown here is to be seen in the Danish Pavilion at the International Exhibition in Paris.

Emergency Amateur Radio Network ?

PROMPTED by the reports of the valuable assistance to communications rendered by American amateur organisations during the floods and other emergencies, Mr. J. Cuthbertson, of Dunromyn, Cross Lane, Scarborough, hopes that some similar organisation may be built up in this country. His proposal is for an emergency radio network of amateur stations capable of linking up the whole of the British Isles in the event of air attack or some other situation where a breakdown of the normal means of communication might occur.

P.R.S. Income from B.B.C.

THE income derived by the Performing Right Society from the B.B.C. during the year ended January 5th was £128,226 out of a total revenue of £182,500.

RADIO RESEARCH

Vacancies at the Royal Aircraft Establishment

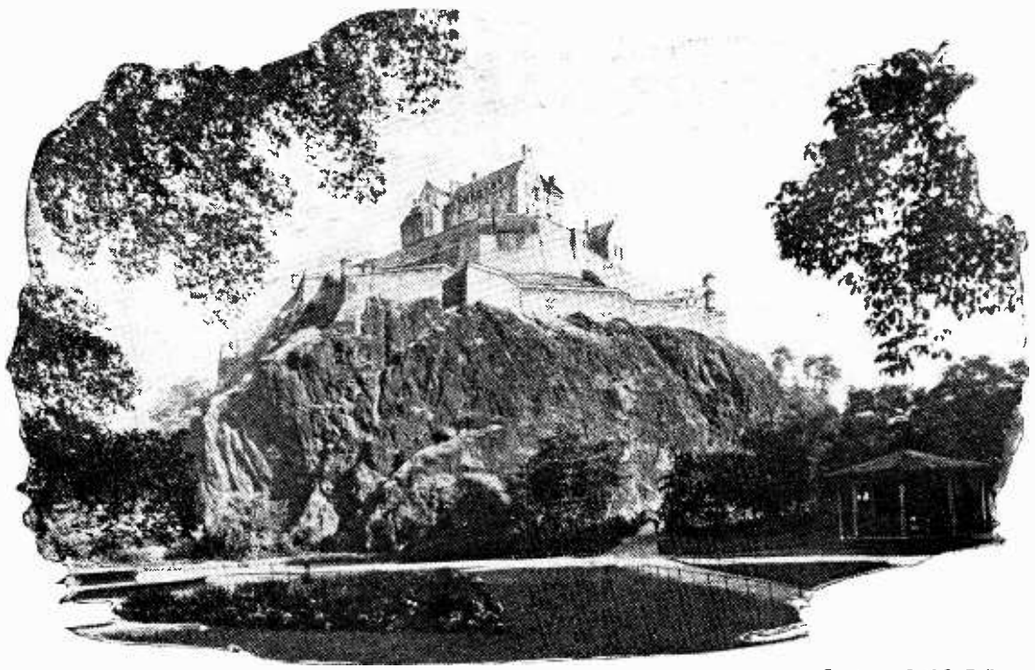
THE Air Ministry announce that applications are invited from candidates with honours degrees, who have had considerable experience in research or experimental work on the problems of radio communication, to fill permanent pensionable positions on the staff of the Air Ministry Scientific Research Pool. Fuller details will be found in the small advertisement pages at the back of the journal.

Listeners' Gu

Outstanding Broadcasts at H

WHAT would listeners have heard if there had been broadcast programmes in 1837, the year when Queen Victoria came to the throne? What is described as an impression, or conjecture, of the type of programme that might have been on the air will be given in the broadcast, "London Calling, 1837," which will be heard by National listeners on Sunday at 9.5 and Regionally on Tuesday at 6.

Considerable research by Jonquil Antony has been necessary for the preparation of this programme, the adaptation and production of which will be carried out by Moray McLaren and M. H. Allen. One of the high spots of the broadcast will be a health talk by a leading doctor on "the danger of taking baths; a practice unfortunately on the increase." News bulletins will be included, one of which will tell of the passing of the monarch William IV.



Courtesy: L.M.S. Railway.

EDINBURGH CASTLE, which will be the scene of a special broadcast to be heard on Saturday at 7.30 (Reg.). The broadcast will be of historic incidents re-enacted at the place of origin. This fortress, arsenal, prison and palace on the Castle Rock has always been one of the sights of Edinburgh. From it can be seen an extensive panoramic view of the Firth of Forth.

YACHTING

IT has often been contemplated by the Outside Broadcast Department to include commentaries on one of England's famous yachting regattas. This year an attempt will be made to describe the races and the attractiveness of the Torbay International Regatta, which takes place in the beautiful bay of that name from June 19th to July 3rd with some 300 entries, a record.

The B.B.C. will have two observers at Torbay, probably stationed on the roof of the Torquay baths. They will be Major Arthur Waycott and John N. Lampson, who will broadcast descriptions of races on Saturday and Monday. On the first occasion, which will be at intervals between 3 and 4 (Nat.), they will give descriptions of races for small craft, it being thought that listeners will be more interested in competitions of such craft, which are within the reach of the more modest pocket, than of the larger classes. On Monday a commentary will be given at 11.15.

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TENNIS

ANOTHER outside broadcast alternates with the above on Saturday. This will be from Queen's Club, where the Grass Courts Championships will be reaching their final stages. Colonel R. H. Brand and F. H. Grisewood will be the commentators, and they are expected to take this opportunity of meeting as many of the foreign visitors as possible, telling listeners of the results of their conversations with them.

OLYMPIA HORSE SHOW

THE broadcasts from the International Horse Show at Olympia this year will have even a wider public appeal than in the past, for riding is becoming a still more popular pastime.

The two big jumping events of the show, for the Edward Prince of Wales Cup and the King George V Cup, will be described for National listeners on Monday at 4 and Thursday at 4.15, respectively. The Edward Prince of Wales Cup competition is for a team of three officers in uniform, each being members of a regiment or cavalry school; that for the King George V Cup is an individual competition also for officers in uniform.

Major H. F. Faudel-Phillips will describe the actual competition, while John Snagge, of the O.B. Department, will picture the scene of the hydrangea-decked Olympia, ablaze with the colours of the uniforms of the representatives of many nations.

HIGHLIGHTS OF THE WEEK

FRIDAY, JUNE 18th.

Nat., 6.25, "To-morrow's Luck." Musical comedy of the Casino. 9.45, Act II of "Cosi Fan Tutte."
Reg., 11 a.m., 12.30 and 2, commentaries on the Senior T.T. Race. 8.15, Paste and Paper (V)—a schoolgirl's diary of 1914-18.
Abroad.
Munich, 8, Wagner and Richard Strauss Concert from Garmisch.

SATURDAY, JUNE 19th.

Nat., 3, Commentaries on tennis and sailing. 8, Music Hall. 9.20, B.B.C. Theatre Orchestra and Denis O'Neil.
Reg., 6, Ambrose and his Orchestra, from the Paris Exhibition. 9.20, Conversation on The Younger Generation.
Abroad.
Rome, 9, Giordano's opera, "Fedora."

SUNDAY, JUNE 20th.

Nat., 5.20, Recital, Gaby Vallé (soprano) and Felix Salmond ('cello). 6, I Knew a Man—Lord Fisher. 9.5, "London Calling, 1837."
Reg., 7, A. B. Campbell on queer happenings at sea. 9.5, Gladys Lorimer (coloratura).
Abroad.
Strasbourg, 8.35, "The Dollar Princess": operetta (Fall).

MONDAY, JUNE 21st.

Nat., 4, Commentary on the International Horse Show. 7, The Music Shop—18.
Reg., 8, "Full Swing"; Footlights Dramatic Club. 9, The Royal Artillery (mounted) Band.
Abroad.
Königsberg, 8.10, Zeller's operetta, "The Bird-Fancier."

TUESDAY, JUNE 22nd.

Nat., 6.25, Intermission: B.B.C. Variety Orchestra. 8, "Mr. Barley's Abroad."
Reg., 6, "London Calling, 1837." 7.40, Harry Hemsley and Hermione Gingold in "Trifles."
Abroad.
Strasbourg 8.30, Lehár's "The Land of Smiles."

WEDNESDAY, JUNE 23rd.

Nat., 6.40, The Friary Brewery Band. 9.30, Act 2 of "Le Prince Igor."
Reg., 8, Harry Gordon of Inversnecky and his company. 9, The Band of the Garde Republicaine.
Abroad.
Kalundborg, 8.45, Scandinavian Midsummer Festival.

THURSDAY, JUNE 24th.

Nat., 4.15, Commentary on the International Horse Show. 8, The Air-do-Wells.
Reg., 6, "Mr. Barley's Abroad." 8 and 8.50, Goossens' "Don Juan de Manara."
Abroad.
Lille, PTT, 8.30, "La petite mariée," operetta (Lecocq).

e for the Week

and Abroad

Courtesy: H.M.V.
BENIAMINO GIGLI, the world-famous Italian operatic singer will be heard from Berlin on Tuesday at 8.

FOOTLIGHTS CLUB

BRYAN MICHIE, producer in the Variety Department, travelled to Cambridge last Monday to see the revue, "Full Swing," which is being produced by the Cambridge University Footlights Dramatic Club. He went to spot the best scenes and situations in the show, and will include them in a 40-minute entertainment in the Regional programme on Monday next at 8.

The Footlights Club has seen the beginning of many great stage careers, among them being those of Davy Burnaby, Jack and Claude Hulbert, and Eric Maschwitz, to mention but a few.

REVIVAL

ONE of the successes of last summer's broadcast variety shows was "Mr. Barley's Abroad." This will be revived on Tuesday at 8 and Thursday at 6 in the National and Regional programmes respectively. It was specially written for broadcasting by Henrik Ege, based on a story by Tom Arnold. This musical comedy is built around Mr. Barley's habit, whenever the telephone bell rings, of instructing his secretary to say "Mr. Barley's abroad." The intriguing situations which come about because of this make interesting listening. Production will be in the hands of Bryan Michie, who, it is hoped, will include, as far as possible, the original cast, which was strong in humour.

OPERA RELAYS

THREE operatic broadcasts come into the National programme this week, and one into the Regional programme. The first is to-night (Friday) at 9.45, when the second Act of Mozart's "Cosi fan Tutte" will be heard from the Glyndebourne Festival Opera House. On Monday at 9.50 Act II of Gluck's "Orphée" will be heard, with Maggie Teyte in the rôle of Euridice. Wednesday brings the Second Act of "Le Prince Igór" (Borodin), with Dennis Noble in the title rôle.

The first two Acts of Eugene Goossens' new opera, "Don Juan de Manara," will be heard from the Royal Opera House on Thursday at 8 and 8.50 (Reg.). This will be the first performance at Covent Garden. Acts III and IV will be heard by National listeners on Monday, June 28th.

OPERA FROM ABROAD

SATURDAY has little to offer the opera lover. The late concert (11 to midnight) from Brussels 2 consists of recordings of Wagner's "Mastersingers" and "Dusk of the Gods." Königsberg brings the beautiful allegorical opera, "Tiefland," from the German Opera, Berlin, at 8. This is the masterpiece of Eugen d'Albert, the Glasgow-born son of a former master of Covent Garden, who, in the midst of a concert career which was one continual tour of triumph, found time to compose some half-dozen operas of varying merit. Much of his artistic career was passed in Germany, and that country would seem to have adopted him as her own. A German acquaintance described his personality and performance as *damonisch*, a word which signifies uncanny force and power.

Moussorgsky's five-act opera, "Khovanstchina," figures in the Rome programme again this week-end, on Saturday, at 9. This work made a great impression when produced at Covent Garden in 1913. Wagner's "Valkyrie," from the Vienna State Opera, at 6.25, completes Saturday's opera events.

On Sunday, at 8, Hamburg gives a big evening of Verdi and Puccini opera music. The singers are Margarita Perras and Walter Ludwig. The Saarbrucken station offers a novelty at 8 in the form of an "Opera Alphabet." This will go through the whole alphabet of operas from "Aïda" (Verdi) to Die Zauberflöte (The Magic Flute) of Mozart, giving the most popular melodies from each.

"Der Vogelhändler," a classical operetta by Zeller, comes from Königsberg at 8.10 on Monday.

The event of Tuesday is the visit of the Company of the Scala, Milan, to the German Opera House, Berlin-Charlottenburg. Part of their performance of Verdi's Aïda is being broadcast by Berlin (Deutschlandsender) from 8.10. The cast includes Gigli, Gina Cigna, and Mafalda Favero. Since Italy's campaign of imperial expansion began, this opera has been repeatedly on the boards. The reason is not far to seek if one examines the plot. The closing triumph scene shows the King of Abyssinia being dragged across stage a prisoner in the hands of the conquering Egyptians.

MIDSUMMER FESTIVALS

ORCHESTRAS, bands, choirs, and soloists representative of all the Scandinavian peoples will be heard during the Scandinavian Midsummer Festival arranged by the Municipality of Copenhagen which will be relayed from the Town Hall Square by Kalundborg at 8.45 on Wednesday. Listeners will hear the traditional blowing of the Lur—a large, curved, ancient Scandinavian bronze horn, several of which have been found through archæological excavations in various parts of Scandinavia.

Another interesting national festival comes from the famous old Swedish castle of Gripsholm. This festival will mark the four-hundredth anniversary of the building of this palace of Sweden's Kings. Part of the ceremony will be broadcast by all Swedish stations on Saturday at 2.15, and a second relay will be given on Sunday at 1.15.

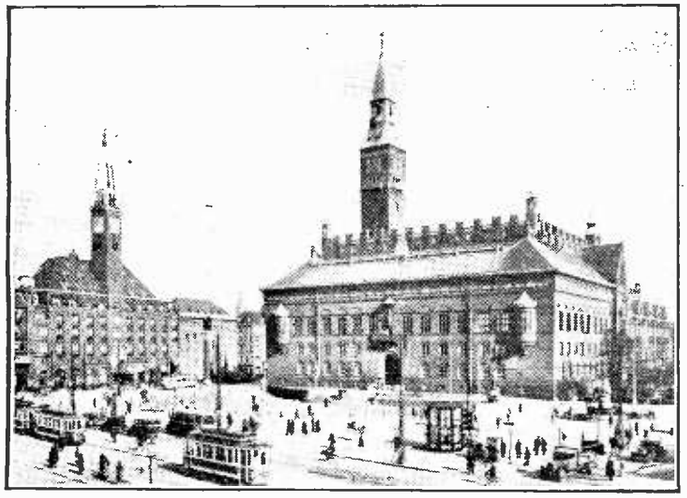
DEAF MUSICIANS

PART of the Jubilee concert by the Dansk Tunghøreforening, the orchestra of a Danish national association for the deaf, will be broadcast by the Danish stations from 8.15 until 9 on Saturday.

DARDANELLES

AN historical sequence of the events of the Dardanelles and Gallipoli encounter will be broadcast from Cologne to-night at 8.10. For those with a knowledge of German, this should be an interesting broadcast.

THE AUDITOR.



THE TOWN HALL SQUARE, COPENHAGEN, will be thronged with people on Wednesday evening for the Scandinavian midsummer festival. Listeners to Kalundborg at 8.45 will be eavesdroppers on the scene of national merriment. The programme, which includes music by the band of the Danish Royal Life Guards, will be given from the area in front of the Town Hall.

UNBIASED

By FREE GRID

Look Under Your Seat

LIKE a great many of you, I have been enjoying a few days' well-earned rest by the sad sea waves in order to get over my strenuous exertions during Coronation month, which for me was one long round of rushing hither and thither to various local functions where my presence was demanded. Through no fault of my own, I found myself one evening ensconced with my family in the stalls of the local theatre of varieties, as it called itself, although I quite failed to grasp the reason why, as anything more monotonous and lacking variety as the various "turns" I have yet to meet.

At the end of the first turn I was amazed at the spontaneous roar of applause which burst forth from the audience. I not unnaturally suspected that the actors in the first "turn" had resorted to the age-old dodge of planting friends, or possibly paid applause-claques, at intervals among the audience.

As turn succeeded turn and the cheering and hand-clapping showed no signs of abating, however, I was compelled to abandon the theory, and I finally concluded that the audience must be largely made up of the local inhabitants, who, poor folk, were unaccustomed to good music-hall "turns," and had deluded themselves into thinking that they were being entertained. Had it not been for the sharpness of one of the little Grid

... monotonous and lacking in variety ...

Leaks, who eventually remarked in a somewhat *blasé* tone that it would have sounded better had they used a scratch filter, I might never have stumbled across what I can only regard as one of the most ingenious stunts of our great advertising agencies.

A few moments' consideration of the little Grid Leak's implied suggestion that the whole of the applause, or, at any rate, 90 per cent. of it, was coming off a gramophone record via a powerful amplifier was all that was necessary to convince me of the truth of it. The great puzzle, however, was to find the loud speakers which were giving tongue to all this noise, for, although I peered carefully around the auditorium with my opera glasses, and in so doing stimulated a good deal of coarse and unmannerly jesting from the uncouth provincial audience concerning my personal appearance, I completely failed to locate them.

It was, in fact, not until we rose from our seats that the mystery was solved. As we all got up on our hind legs, the seats tipped up automatically in the normal manner, and it was only then that I noticed that their depth was fully twice as great as usual, and that the place of the usual canvas bottom was taken by the fret of a loud speaker concealed in the seat.

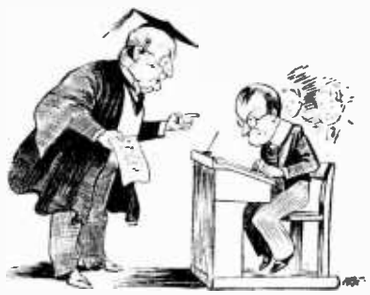
It appeared from the subsequent explanation which I received from the manager that he had been approached a few weeks previously by a large advertising agency with a request that they be allowed to try out this new publicity scheme free of all charge. The idea is that the members of the audience, stimulated into enthusiasm by the uproarious cheering and clapping which they fondly imagine to be coming from their fellow-sufferers all around them, go home and tell their friends what a fine show it is. Just as theatrical producers, acting on the principle of "trying it on the dog first," usually test their new plays in Manchester before they venture to bring them to London, so this scheme was first being tried out in one or two obscure provincial music halls.

An Impending Tragedy

IT is with a heavy heart that I take up my pen to write these few notes this week, as I am in very deep domestic distress, and I am wondering if any of you *patresfamiliarum* who may have gone through a similar experience can help me with your advice. A crisis has developed in the scholastic career of one of the little Grid Leaks, and, needless to say, it is entirely the fault of the B.B.C. The fact of the matter is that the little Grid Leak in question has been threatened with superannuation from his school unless his age/knowledge ratio improves very drastically in the near future.

The basic cause of the trouble is that, like myself, he is very conscientious, and in order to utilise every precious moment of his years of education, he has been supplementing the efforts of his legitimate taskmasters by using a small headphone portable in order to listen to the B.B.C. schools broadcast, and also the pearls of wisdom which they drop at other times for the edification of the general public.

Needless to say, listening to the mass of misinformation broadcast from Portland Place has been the cause of his downfall. The final catastrophe that brought forth the ultimatum from the school authorities occurred only a week or two ago as the result of an examination paper which his form were set on general knowledge. Since Coronations and other matters of historical interest are very much to the fore this year, it was not altogether unnatural that many questions in the paper dealt with matters of past history. One of them demanded to know the precise date of the Treaty of Pretoria which concluded the Boer War.



... result of an examination paper ...

As it was only a few days previously that this piece of historical information had been dealt with at some length by the B.B.C. in the 1902 Scrapbook, the little Grid Leak naturally thought that he was in clover, since he had diligently imbibed all the so-called information which the B.B.C. had to give on this matter. He was quite naturally very astonished when he was sarcastically informed by the much-tried pedagogue dealing with the examination paper that not only had he got the date wrong, but that even in 1902 it did not take forty hours or so for a cable to come from Pretoria to London, especially one of such importance as that announcing the signing of the Peace Treaty. For such is what we must conclude if we are to reconcile the B.B.C.'s alleged time and date of signing with what they stated to be the time when the news reached London.

There was another little matter also concerning the B.B.C.'s accuracy with regard to the illness of King Edward VII, but since this has been dealt with by the medical press I will say no more about it.

The thing which is causing me such worry and distress of mind is not the B.B.C.'s lack of accuracy, for naturally past experience teaches us to take that for granted, nor is it the threat of superannuation, for I shall merely send Mrs. Free Grid down to interview the headmaster—after all, he fully deserves it. No, the cause of my worry is that I shall be compelled to shatter a very beautiful illusion which the little Grid Leak has built up in his mind around the B.B.C. which he, with his negligible experience of the world, has always idealised as a model of truth and moral beauty. It will, I fear, be such a shock to his subconscious mind if I reveal to him the feet of clay which his idol possesses that it may set up a dangerous complex leading him to believe with Solomon that all is vanity, and in consequence take to a life of crime.

New Apparatus Reviewed

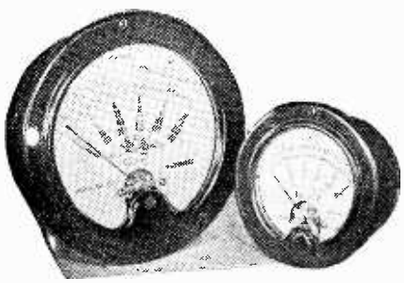
Recent Products of the Manufacturers

TRIPLETT FOUNDATION METERS

THESE meters have been introduced for use in home-constructed multi-range test sets. The description of Foundation meters is a very appropriate one, since it serves to distinguish them from the orthodox pattern, which generally has a single scale with an arbitrary calibration or one marked in milliamps.

The meters, of which two models are available, one 2½in. and the other 4in. in diameter, are high-grade moving-coil instruments requiring one milliamp. only for a full-scale deflection.

With each meter is supplied a leaflet giving a circuit diagram and values of the resistances for use as shunts, etc., for the construction of a multi-range Volt-Ohm-Milliamp. test set for use on DC. By the addition of a small rectifier provision could be made for AC measurements.



Triplett Foundation Meters for use in home-constructed multi-range test sets.

As it is assumed that the recommended circuit and resistance values will be used, the makers have engraved appropriate scales on the dial. The upper one is for resistance measurement, and is calibrated 0-100,000, but provision is made in the circuit to extend the ohmeter range to 1.5 Megohms. For DC voltage and milliamp. measurements the scale is divided into five major divisions, each sub-divided in tenths. The ranges provided are 0-10, 0-50, 0-250, and 0-500 respectively, but by the addition of an extra series resistance the ranges could easily be extended to over 1,000 volts if required.

As the meter requires one mA only for a full-scale deflection the resistance on the voltage ranges will be 1,000 ohms per volt.

The smaller meter is described as the Model 321, and it costs £3 3s., while the larger is Model 521 and its price is £3 15s.

These instruments are of American origin, and can be obtained from the Universal Electrical Instruments Corporation, 7, Chapel Street, London, W.C.1.

LEXINGTON VALVE TESTER

THIS valve-testing unit has been introduced primarily for the use of service engineers and radio dealers requiring a reasonably simple yet reliable means for ascertaining the state of any valve. It adequately fulfils this purpose.

In the Lexington test set this is accomplished by measuring the rectified AC output from the valve, but as this figure would convey little to the non-technical user the indicating meter is calibrated in terms of Good, Questionable and Bad.

As the rectified output from different types of valve varies over quite wide limits it must be arranged for a good valve of any type to give the same deflection on the meter. This is effected by fitting a variable shunt to the meter, which is described as the Selector, and has an arbitrary calibration of 1 to 65.

Thus, by choosing the Selector position for each type of valve it is possible to comply with this condition.

With the Lexington Valve Tester there is supplied a valve data book giving the Selector setting for all valves at present on the market as well as the correct filament voltage of the valves; for this instrument is designed to handle every type from the 2-volt to 40-volt filament kind. By the side of the Selector switch is another for adjustment of filament volts and covering this range.

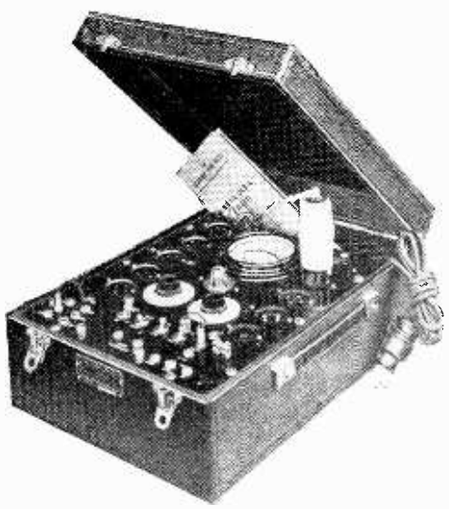
When new valves are introduced the correct Selector setting can be found by inserting one of the new type and adjusting the Selector to bring the meter needle about midway on the Good position of the scale.

By careful arrangement of the circuit it has been possible to guard against damage to the meter since under no condition can it be overloaded to a greater extent than 10 per cent. and the meter is designed to stand this amount of overload.

Provision is made for a leakage test between the valve's electrodes and for this a neon lamp indicator is employed. This indicator can also be used for external test of continuity and two sockets are fitted for this purpose.

In addition to its use as a valve tester the instrument can also be employed as a DC voltmeter with a resistance of 1,000 ohms per volt. Three ranges are available, viz. 0-10, 0-250, and 0-500 volts respectively, and the meter has scales suitably engraved.

Any type of British, American (including Octal) valves, and those with side contacts can be tested on this unit. The test set is AC mains operated and costs £10 10s. The makers are The Lexington Instrument Laboratories, Ltd., 155-157, Great Portland Street, London, W.1.



Lexington Valve Tester operated entirely from the AC supply mains.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

The Hartley Circuit

I WAS very interested in Mr. Scroggie's article on the evolution of the Hartley Circuit in the May 21st issue of your periodical.

There is one statement, however, which I disagree with, and that is the reference to the bifilar winding, which the author states "complicates the coil but gets over the resistance difficulty."

I remember doing some experimental work in connection with a battery all wave superheterodyne in which the bifilar winding was employed in the oscillator coil. Considerable difficulty was experienced on the lower signal frequency coils, due to the relatively large dimensions of the oscillator grid coil. Since both the lower part of the coil as well as the neutralising winding are in series with the filament one is forced to make the resistance of the total external circuit no greater than 1 ohm if a 2v. 0.1 amp. valve is used, and a filament voltage of 1.9 volts is permissible.

To design an oscillator coil to this resistance specification in, say, the 150-300 kc/s band is no easy matter. The difficulty may be minimised by using an iron-cored choke in place of the air-cored one shown in Fig. 7 (a) as this enables a large ratio of reactive/resistance to be obtained. As explained in the article, this filament choke must be wound carefully, as slight variations in its electrical characteristics cause quite large differences in the oscillator frequency.

Mansfield. D. R. PARSONS.

"Flutter"

I HAVE been interested in the letters appearing in *The Wireless World* on the subject of "flutter," for it is evidently the same effect which I described as "hunting" in my letter which you published in your issue of March 19th last.

All the explanations of the effect which your readers have put forward seem to me to be unnecessarily far-fetched. I suggest that it is a form of self-oscillation, the AVC system forming a sort of back coupling between the end and the beginning of the amplifying chain. The sequence of events seems to me to be somewhat as follows: An increasing signal causes an increase in the bias of the amplifying valves; owing to the inevitable lag of the change of bias behind the change of signal which causes it (due to the charging of decoupling condensers, etc.), the change of bias will overshoot the mark; the unduly increased bias causes a decrease in the signal; the decreased signal causes a decrease in the bias, which again, lagging behind the change of signal which causes it, overshoots the mark; the unduly decreased bias causes an increasing signal, and the process starts all over again, and it only needs the AVC to be sufficiently amplified for the "oscillation" to be continued indefinitely.

Referring to previous letters on the subject, it would seem that the type of flutter investigated by Mr. G. H. Bradbury must be different from the type your other correspondents are talking about, for his type appears to be independent of the AVC system, and connected with the frequency changer, while Mr. R. G. Young has had the effect with a straight set, and only when using amplified AVC (this latter fact fits in with my theory).

With regard to Mr. Young's suggested cures, the receiver in which I had the trouble uses transformer-coupled QPP in the output stage, and it is designed for a bass cut-off at 100 cycles, which seems to dispose of cures (a) and (f) as being infallible. It is a battery receiver, and as far as I remember the trouble occurred with quite new batteries, so that increasing the capacity in the main HT circuit cannot be considered a certain cure. I did not try increasing the decoupling of the screen-grid circuits. I did not find that altering the time constant of the AVC circuit *in the ordinary way* made any difference, but, as mentioned in my previous letter, I did effect a cure by shunting the AVC line decoupling condenser by a condenser in series with a resistance. I have imagined this as damping out the "oscillation" just as a shunting resistance will damp out RF oscillations, but in this case it does so without reducing the desired DC amplification at all. It would be exceedingly interesting to know if this cure were found effective in other cases.

Commenting on Mr. Harold Stripe's letter, I agree with his remark No. 1, but by no means with No. 2. With regard to (3) I did not notice any change in the frequency of the flutter with change in the setting of the volume control, but it did depend on the time constant of the AVC circuit. It did stop at certain settings of the delay voltage, but as in my circuit it is probable that the DC amplification varied with the setting of the delay control, the stopping of the flutter was as likely to be due to a reduction of the amplification as to any other cause. Flutter will occur on any medium or long wavelength, and is thus certainly not confined to short wavelengths.

I hope that this may help to throw some light on what seems to be a rather puzzling phenomenon. A. K. GORDON.

Crowborough.

The Straight Set v. Superhets.

YOUR leading article regarding the question of superheterodyne receivers *versus* straight receivers prompts me to ask if you could now publish the design of a straight receiver embodying the following requirements:—

Two RF stages, diode detection, delayed amplified AVC, and straight-line frequency response on all wavelengths as under:—

Long waveband: 30 to 10,000 cycles.

Medium waveband: 30 to 10,000 cycles.

Ultra-short waveband for television sound only: 30 to 15,000 cycles.

Variable selectivity: To be obtained by a simple "tone control" device which would reduce the high-note response to a predetermined degree (according to the interference experienced).

Such a receiver coupled to the "W.W." Quality Amplifier or PA Quality Amplifier would form a superlative equipment, and in my opinion would be welcomed by a great number of quality enthusiasts.

I have at the present time a straight receiver comprising a single RF stage, power grid detector and phasing valve coupled to an amplifier based on the "W.W." PA amplifier. The speaker is a "Baker" Super Triple.

Variable selectivity is obtained by means of a simple "tone control" on the grid of the phasing valve, which restricts the high-note response when interference warrants this.

I myself favour the straight receiver in preference to the superheterodyne receiver, as I have found from experience that simplicity goes a long way in the quest of high-quality radio equipment.

Cleethorpes, Lincs. A. A. HEWSON.

"NAUTICUS" asks, "who says the TRF set is a nonentity on grounds of selectivity . . ." No one, certainly; but there is no evidence that really satisfactory selectivity on all the frequencies the modern set should cover can be obtained in the TRF set at the moment.

He also condemns the superhet. on the rather illogical ground that many are equipped with a faulty audio-frequency system.

I agree on many points with him, however. I think that the objections he makes to superhets. can be cleared up in other ways than by completely discarding the type. Almost all the difficulties he complains of can be removed by providing sufficient RF amplification and by efficient shielding.

He speaks of the desirability of a five- to eight-valve TRF set. The five-valve set would, presumably, consist of either one or two RF stages, a detector, and either an audio amplifier and push-pull class A triodes or an audio amplifier and one triode power valve. Without reaction on the detector I cannot imagine that such a set could provide adequate selectivity on short waves, while with reaction there would appear the noise which "Nauticus" objects to. Shielding must be quite difficult if such a set is to have reaction and remain satisfactorily stable.

I do not know to what use "Nauticus" could put his further three valves except to provide more audio output. More RF stages would almost certainly lead to instability.

The real need of superhets. is for signal-frequency amplification. A superhet. containing two RF stages before the mixer, and with only one IF stage using variable-coupling iron-core transformers, will remove completely image frequency interference, direct IF interference, and should cut out almost completely cross modulation if the aerial is loosely coupled to the RF stage, as it can be in such a set.

To return to the original point, that of a separate IF channel in the frequency spectrum, I think there is little need for it if sufficient signal-frequency amplification is provided.

I might add to "Nauticus'" objections to superhets. one which can, however, be avoided in design: that of the IF signal beating with the oscillator voltage to produce general instability in the signal-frequency end of the set. G. M. FOLEY.

St. Andrews, Fife.

Horn-loaded M.C. Loud Speakers

IN your issue of May 28th Mr. Brierley queries whether a moving-coil unit designed for baffle loading should not give unsatisfactory results with horn loading.

This question leads to the second question —was the moving-coil unit "designed" for

baffle loading, or did it happen? Perhaps this accounts for why horn loading suits some but not all speakers sold for use with baffles "HORN-LOADING."

WITH reference to the discussion in your correspondence columns regarding the Voigt system of reproduction, and the challenge by Mr. Barden that a baffle speaker would give more realistic reproduction than the Voigt combination, it may interest you to have the results of a comparison of the two systems by a jury of five members.

The jury was well balanced, consisting of two people without knowledge or special interest in wireless or music; the third an accomplished amateur musician; the fourth the son of a musical instrument maker, with some experience of gramophone recording; and the fifth, without any knowledge of music, but very interested in wireless quality reproduction.

A Goodman 10in. High Fidelity Auditorium Speaker was mounted on a 2ft. 6in. baffle generally arranged as suggested by Mr. Barden in his recent letter to you. The Voigt Corner Horn was alongside the Goodman. A change-over switch to the speakers gave correct matching as recommended by the respective makers, to a *Wireless World* quality amplifier worked by a piezo crystal pick-up. In order to help the Goodman the Voigt field was run at half the proper strength, so that the two speakers were of equal sensitivity. (Actually, of course, there is no comparison between the Voigt in this condition, and when it is correctly fed). The speakers were switched over several times on each of the following records:—

"Isn't it a Lovely Evening," sung by Hildegarde F.B.1990

"Shylock," by the Black Dyke Mills Band (a wonderful record of a brass band) E.B.5526

"In the Chapel by the Moonlight," organ played by Reginald Foort B.D.401

"Mi par D'udier Ancora," sung by Gigli D.A.126

"Orient Express," organ by Sidney Torch F.B.1133

Paul Robeson singing "Mah Lindy Loo," B.4309

In every case five votes were given for the Voigt system. Upon asking what distinguishing quality caused the decision, the replies were:—

"Realistic bass."

"Seems to stand out."

"There is an extra dimension in the sound."

"The top is less 'edgy' but brighter."

The trial is interesting in view of the challenge by the makers of the Goodman unit, but it is only fair to point out that the latter is a very fine job, giving a quality of reproduction hard to beat by any other baffle speaker. It, like the Voigt, is far too good a reproducer to sound well on any ordinary commercial set. Further experiments have been made to trace the difference between the two systems. The difference is clearly due to something apart from the baffle and horn; for a corner horn with bass chamber has been built specially for the Goodman unit, as well as for two other quality speakers, but the results were very inferior to the combination of Voigt speakers and horn.

Is the difference due to the twin cone diaphragm? As both the Goodman and Voigt possess this feature the difference cannot be explained in this way.

Does the stronger field explain it? The Voigt was run at 20 watts, and gave about the same sensitivity as the Goodman, so any advantage was balanced out.

Incidentally, I have warped the speech coils of two quality speakers by putting up the field watts and vainly trying to get Voigt reproduction.

It would seem that the Voigt speaker and horn embody a number of refinements which together produce the outstanding results. With a *Wireless World* amplifier or set, from the best B.B.C. transmissions, startling realism results.

I have no connection with Voigt or Goodman, except as an admirer of their products.

Barrow-on-Soar. A. L. WYKES.

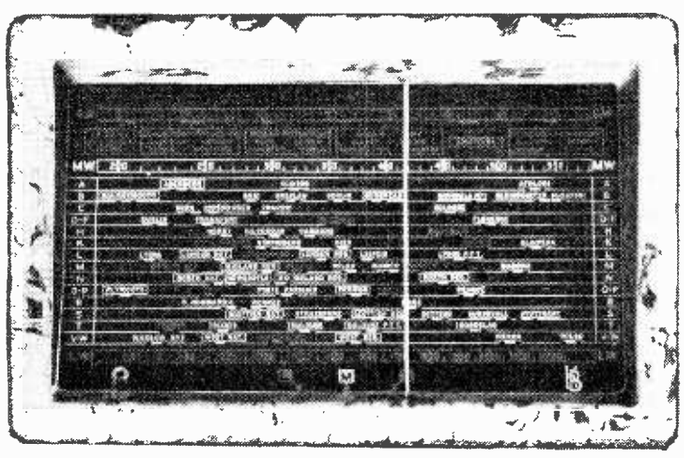
NEW KB RECEIVERS

All-Wave Mains Superheterodynes

Two new all-wave receivers have now been added to the KB range: Model 632 a DC/AC superheterodyne at 13 guineas, and Model 640 at 9 guineas for AC mains only.

The circuit of the Model 630 is unusual in that it employs two IF stages following the triode hexode frequency-changer. The second detector and AVC valve is a double-diode and the output valve a pentode. A two-speed tuning control is provided, and the "Alphadex" three-colour dial in which stations are grouped alphabetically in horizontal lines simplifies the search for any required station.

A horizontal cabinet of attractive design has been evolved for the Model 640 receiver in which a heptode frequency-changer is followed by a single IF stage, double-diode-triode second detector and pentode output. The tuning scale is of the semi-circular type with a single ratio reduction drive for the pointer, and the three wavebands cover 16.5-50, 195-550 and 970-2,300 metres. An 8-inch MC speaker takes the 3 watts output from the last stage, and the specification includes a whistle suppressor in the aerial circuit.



The "Alphadex" tuning dial used in the Model 632 and other KB receivers.

RANDOM RADIATIONS

By "DIALLIST"

My New Set

FOR the first time I am thinking of buying a set this year instead of making it myself. That's my intention, but so ingrained in me is the love of construction that one of two things will probably happen. Either I shall eventually pass on the bought set to Mrs. Diallist and construct another in my own workshop, or I shall keep it but so much alter it in course of time that its own designer wouldn't know it. The big difficulty is to find the kind of set that has the greatest possible number of the things that I do want and the smallest possible number of those that I don't in its make-up. Some of my wants probably can't be met at all. For instance, I should like a set without a built-in loud speaker; but that doesn't seem possible nowadays. If I can get hold of one I rather think I shall go in for an overseas model without a long-wave range. I don't need to use Droitwich and there's hardly anything else now really worth listening to on the long waves. I am rather fond of the short waves and I want a set that is pretty good on these and that covers them in at least two bands.

The Loud Speaker Question

Just now I mentioned that I'd prefer a set which hadn't a built-in loud speaker. The chief reason is that I have a first-rate loud speaker which stands behind a large, thick baffle board and gives me boom-free reproduction. The trouble with so many sets to-day is that the cabinets are made of thin wood or other material so that resonances are almost bound to occur. Possibly my ears are over-sensitive to low frequencies; I don't know, but if there's one thing I can't stand it's boomy reproduction. In fact I've never yet used a "ready-made" set whose tone control knob I did not keep permanently as far as it would go from the low-pitched position—and I have wished that a good many of them would go further than they did. All the same, I do like my whack of genuine bass and I find that I get it best by means of the separate loud speaker with its big baffle. If I do buy a set, one of my first jobs will probably be to remove its loud speaker and to arrange it so that mine can be used.

Felt Wants

Whilst I am on the subject of the receiving set of commerce, may I make one or two suggestions to designers who are now busy with their new autumn models? First of all, the more expensive receivers, at any rate, should certainly be able to go down at least to 13 metres on the short waves. A good many sets that I have come across have a lower tuning limit of 16 metres, and one or two don't go much below 19. This coming winter we are likely to find the bottom end of the short-wave band pretty good, and it's a pity to miss what's going. Next I'd suggest the possibility of providing all receiving sets with sockets or terminals for use with a dipole aerial. Any number of people now have these, and their owners are not likely to buy sets which are not so arranged that they can be readily used with them. Next, I want to make two points about battery sets, for which there is still a surprisingly large market. If there is a dial lamp there should most certainly be some provision for switching it off once a satisfactory station has been tuned in and the operator sits down to listen to it. Some of these lamps consume as much current as the filament of a power valve and it is quite ridiculous to keep them always alight. Secondly, the battery set with three or more HT leads and two or three for the grid battery is just an anachronism nowadays. There should be no separate grid battery and just two HT leads, positive and negative.

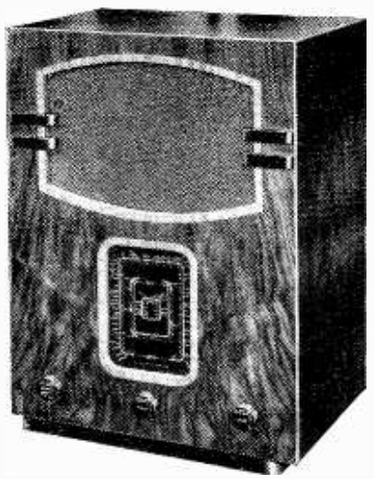
Do You Like Them?

A GOOD many sets nowadays are fitted with what is, I believe, known technically as reverse slow-motion drive for the ganged tuning condenser. As you turn the knob forward the gearing of the drive is of the normal moderate ratio, but when you stop and turn backwards it automatically changes down to slow-motion over about ten degrees of the scale. It is a very neat idea, one of its advantages being that it reduces the number of knobs by making it unnecessary to have a small one for slow motion in the middle of the main tuning control. But I am not sure that for short-wave reception I don't prefer the more cumbersome arrangement. I like to be able to search very slowly over the whole of any particular short-wave band without having to gallop forward for a space and then crawl back.

Shall We Answer Back?

AT present both our home stations and those of the Empire short-wave service give their news bulletins and talks on home and foreign affairs entirely in English and without the inclusion in them of any propaganda matter. Our attitude has hitherto been that we could afford to take no notice of the propaganda radiated by other countries and that it would be undignified to answer back, as well as being unpopular with home and Empire listeners. One hopes that we may be able to maintain this policy, though it is becoming more and more difficult to do so entirely.

There is an old saying that in throwing mud some of it sticks, but even if none does—there's plenty of mud-slinging from some of the Continental stations. We may not so much mind their pouring propaganda in English into this country: it's generally so deadly dull that those who listen to it must be few and far between. But it's rather a different business when "impropaganda" talks and highly coloured news in a large variety of languages flood parts of the Empire in which comparatively few of the native inhabitants speak English. In sheer self-defence it may be necessary to erect special short-wave stations for the dissemination in other languages of our own points of view.



McMICHAEL MODEL 371. Coloured light bands are used as tuning pointers for the three wavebands in this new 10½ guinea McMichael AC superhet. The slow motion drive incorporates a flywheel for quick tuning, and the station names are printed in colour on a black background. Three valves and a rectifier are employed in the circuit of the set, which is available also as an AC/DC model at 11 gns.

The Newly Discovered Interference

THE recent article in *The Wireless World* on a new kind of interference caused by rectification between joints in the metal parts of a building that are imperfect from the electrical point of view explains many queer happenings that were complete mysteries in the past. I can remember more than one instance of local stations being heard on wavelengths entirely different from their own in certain houses. Possibly it explains, too, a case which produced a good deal of argument but no satisfactory result some fourteen years ago, shortly after the original 2LO had begun to transmit. The occupier of an apartment situated not far from the transmitter found that he could hear the programmes perfectly by putting on a pair of telephones and letting the tags at the ends of their leads lie on an iron mantelshelf. I remember discovering one day that I, too, could hear 2LO faintly without any wireless set at all. For some reason or other I connected a pair of telephones directly between aerial and earth and was surprised to find the broadcast programme coming in. The joint between the horizontal span of the aerial and the lead-in was rather a dicky one; I suppose that rectification was taking place there.

High-fidelity Transmissions

IT was mentioned editorially in a recent issue of *The Wireless World* that there was a rumour that strong opposition from the trade was holding up the high-fidelity transmission of the London Regional programmes by the ultra-short-wave plant at Broadcasting House. So far as I can discover this appears to be the case, and it does seem to be about the last word in futility. Here, surely, is an opportunity of making the public, or such part of it as live in and around London, realise the beautiful quality of reproduction obtainable from such transmissions and of selling them sets that will bring it out to the full. Many people would be only too willing to buy simple ultra-short-wave sets in addition to their present receivers and a whole new market would be opened for "all-wave" sets that would tune down to, say, six metres. If, instead of opposing high-fidelity transmissions, the trade had whole-heartedly backed them up, more than half the population of the country could very soon have been served by them, for some of the most densely populated parts of the country have already been reached by the coaxial cable and the rest will have it before long. It would not be difficult or expensive to erect ultra-short-wave relay stations at Birmingham, Manchester and Leeds.

Mains Transformer Design

METHOD OF ASCERTAINING THE OPTIMUM SIZE OF CORE

By

H. B. DENT

WHEN working out the design for a small mains transformer it is permissible to assume that a core of certain known dimensions will be used, and then, with the aid of the Radio Data Charts, ascertain the turns per volt needed for a transformer having a core of the chosen size.

This method of design is perfectly satisfactory for transformers up to 50 watts output when the size of the core is approximately the same as that given in the aforementioned charts.

After a little experience it is possible to judge reasonably well the increase in core size needed for a transformer of slightly larger output, but guesswork is never very satisfactory, since it always leaves a feeling of uncertainty.

On the other hand, it is not easy to arrive at the size of the core solely by calculation, and the only alternative is to find a formula based on experiment and measurements with various transformers that can be applied with confidence to the design of the smaller sizes of mains transformers.

A formula that has been found to give the required information and that will hold good for transformers up to 500 watts or so is:—

$$S = \frac{\text{watts}}{f} \times K$$

where S = weight of iron in the core in lbs.
f = supply frequency in cycles per sec.
K = a constant depending on the operating conditions.

If the transformer is in a well-ventilated position where air can circulate freely K can be 2.5. Should the ventilation be poor with restricted air circulation K must be increased to 3, and if the transformer is in a confined space it would be advisable to make K = 3.5. It is thus a constant that depends mainly upon the ventilation of the transformer.

This formula will give the weight of iron in lbs. required for the core and to convert it into volume the weight is multiplied by 3.57, which gives the volume of the core in cubic inches.

Stalloy stampings have paper insulation on one side so that, in order to find the actual size, on gross volume, of the core, the iron volume must be multiplied by 1.11.

As some latitude is permissible either way in the weight and consequently the size of the core, the usual procedure is to find a stock size of stamping that will give a core as close as possible to the required weight, and of the shape that enables the winding to be carried out in the easiest manner. A core in which the centre limb on which the windings are supported is square, or nearly square, is generally the best shape to adopt.

Core Thickness

The following table has been prepared for a few of the sizes of Stalloy stampings that have been found very useful in the construction of mains transformers for radio purposes. The correct thickness of the core is now quite easily found, since it is only necessary to divide the "Watts for core 1in. thick" amount for the stampings it is proposed to use into the total watts for which the transformer is designed. This gives the total thickness of the core in inches, for in the table due allowance has been made for the insulation on the stampings.

The majority of small transformers designed from the Radio Data Charts will show an efficiency approaching 90 per cent., and a good average value would be 87 per cent. In working out the core thickness it is usually safer to take the figure for primary watts, thus a transformer for use on a 50 c/s supply and giving 60 watts output will take approximately 69 watts from the supply mains, and it could be constructed by employing No. 33 Stalloy stampings built up to give a core 1.2in. thick, this figure being obtained by dividing 69 by 57 (see table).

The nearest stock size of bobbin for these stampings has a centre hole 1¼in. x 1¼in., so No. 33 would appear to be a very convenient size to use in this particular case.

DESIGN OF MAINS TRANSFORMERS.

Stalloy Stampings.	Size of Stampings.	Width of Centre Limb.	Actual Volume of Iron in Core 1in. thick.	Weight of Iron in Core 1in. thick.	Watts for Core 1in. thick.	Winding Space.
No. 4	3 9/16 in. × 3 3/16 in.	15/16 in.	6.56 cu. in.	1.84 lb.	33	2 sq. in.
No. 33	4 1/16 in. × 4in.	1¼in.	11.25 cu. in.	3.15 lb.	57	2.75 sq. in.
No. 28	5in. × 4¼in.	1.22in.	12.4 cu. in.	3.47 lb.	63	3.75 sq. in.
No. 35	6¼in. × 5¼in.	1½in.	18.5 cu. in.	5.18 lb.	94	6.1 sq. in.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

TELEVISION SYSTEMS

A PHOTO-SENSITIVE screen for use in a television transmitter consists of a conducting plate, say, of copper, which is coated with a thin layer of copper oxide, the latter then being subjected to electron bombardment—or else covered with resin—to form a "blocking" layer. Finally, a mosaic of photo-electric silver globules is deposited by evaporation on to the blocking layer, through a suitable grid or mesh.

When the picture to be televised is focused through a lens L on to the prepared screen S, electrons flow through the oxide to the silver elements, which are then scanned by the electron stream from the "gun" G of the cathode-ray tube. The stream restores their potential to normal, and discharges picture currents through the resistance R.

Instead of focusing the picture on the side of the screen that is traversed by the scanning stream, the screen may be made sufficiently transparent to allow the picture to be projected on to the opposite face.

H. Miller. Application date September 10th, 1935. No. 462550.

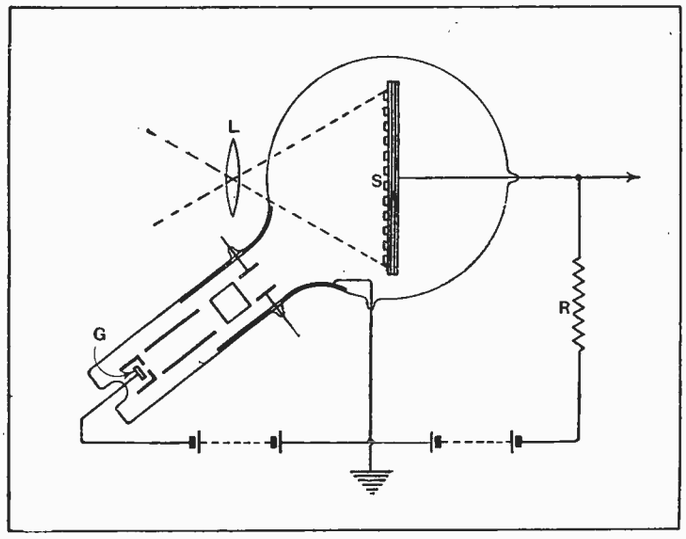


Photo-sensitive screen mounted in a CR tube for use in television transmitters.

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WIRELESS NAVIGATION

IN order to provide a wireless "landing" path for aeroplanes one set of aerials, consisting of a pair of dipoles "backed" by another dipole energised in phase-opposition, is used to radiate two overlapping beams which mark out the horizontal line of approach. A second pair of dipoles arranged some distance in front of the first radiate another pair of overlapping beams, which are directed upwards from the ground so as to indicate the correct angle of glide to bring the machine safely to earth. Both pairs of beams are modulated with characteristic signals, which warn the pilot when he is flying either to right or left, or above or below, the correct course.

Soc. Industrielle des Procédés, W. A. Loth. Convention date (France) October 31st, 1934. No. 462843.

CONTACT RECTIFIERS

THE object is to turn out, by mass-production methods, a contact rectifier or detector which shall have a specified or standard self-capacity. For this purpose, one electrode consists of a copper base coated with a layer of cuprous sulphide on which an insulating layer of silicon dioxide is formed. The second layer is made of definite thickness, say, 5 microns, by evaporating a measured quantity of the dioxide.

The other electrode consists of an iron rod ending in a "point" 0.25 millimetres square. The capacity of the rectifier is determined by the area of the iron point and this thickness of the silicon layer.

N. V. Philips' Gloeilampenfabrieken. Convention date (Germany) July 29th, 1935. No. 462579.

o o o o

HT SUPPLY FOR TELEVISION RECEIVERS

WHEN a cathode-ray television receiver is to be operated from ordinary DC mains it is difficult to derive the necessary operating potentials, which are usually of the order 1,000-3,000 volts. Motor alternators are expensive, whilst mechanical vibrators and gas-discharge converters are liable to generate noise and require elaborate smoothing circuits.

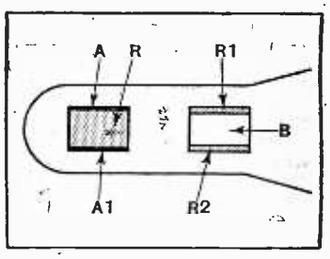
According to the invention the domestic mains supply of, say, 220 volts feeds a back-coupled valve, which generates sustained HF oscillations. These are supplied through a step-up transformer to a rectifier, which supplies a DC output up to, say, 3,000 volts, through a smoothing circuit. In order to simplify the smoothing, and to prevent interference "ripples" appearing on the picture, the valve-oscillator is "locked" by, and to the frequency of, the incoming synchronizing signals.

The General Electric Co., Ltd., and D. C. Espley. Application date November 27th, 1935. No. 462488.

o o o o

CATHODE-RAY TUBES

IN order to prevent stray fields of force from invading the space between the horizontal and vertical deflecting electrodes in a cathode-ray tube each pair of plates is boxed-in at its sides by a thin sheet of high-resistance material. The edges of the plates A, A1, for instance, which are set perpendicular to the plane of the paper, are closed in by a resistance sheet R; whilst the plates B, which are set parallel to the plane of the paper, are closed in at the top and bottom by resistance sheets R1, R2. Both pairs of electrodes are in this way converted into open-ended boxes, which give free passage to the electron stream, but shut out any stray fields extending laterally across the tube.



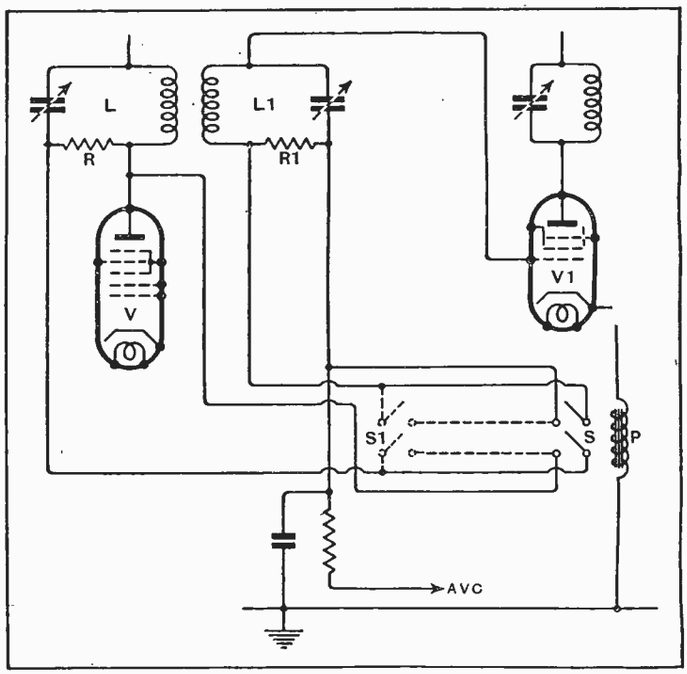
Method of preventing stray external fields from affecting the electron stream in a CR tube.

M. Von Ardenne. Convention date (Germany) August 28th, 1935. No. 462275.

o o o o

AUTOMATIC SELECTIVITY CONTROL

THE selectivity of a superhet set is automatically varied in accordance with the strength of the incoming signals. As shown, resistances R, R1 are inserted in series with the circuits L, L1, coupling the "mixer" valve V with the first intermediate-frequency amplifier V1. Both resistances are connected across the terminals of a switch S, which is operated by a relay P in the cathode-return of the amplifier V1.



IF amplifier circuit for automatic and manual control of selectivity.

The latter is controlled by the normal AVC bias, so that when signals are strong the anode current through the valve is cut down and the switch S is open, leaving the resistances R, R1 in circuit to broaden the resonance. When signals are weak, the switch S is closed by the relay P, so that both resistances are cut out to sharpen selectivity. As shown in dotted lines, a second switch S1 is provided to allow the selectivity to be altered by manual control.

E. K. Cole, Ltd., and H. Hunt. Application date September 24th, 1935. No. 461910.

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CONTENTS

EDITORIAL COMMENT

Components

An Unsatisfactory Position

OUR comments last week on the subject of components for set building and for the requirements of the experimenter have already caused something of a stir in interested circles. The feeling of readers seems to support the view that the lack of interest shown in supplying individual components lends colour to the suggestion that an intentional effort is being made to discourage the purchase of components by the public.

Some manufacturers have expressed to us the view that it is not worth their while to cater for the component market. Our reply to such a suggestion would be that the sale of any article should be worth while to the manufacturer, provided the sale shows a profit.

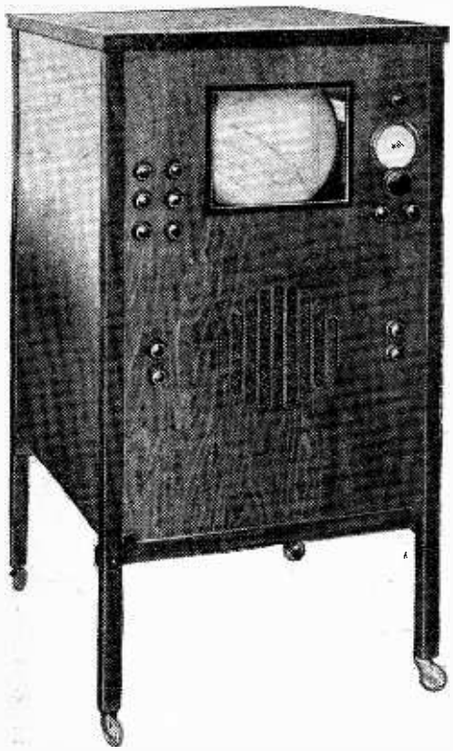
There are still to-day several manufacturers who do cater for the constructor but whose ability to serve him satisfactorily is hampered by distributing and selling arrangements. It must also be remembered that however satisfactorily some manufacturers deal with the constructors' requirements it will not help much if this only means that certain components such as, for instance, fixed condensers and resistances are readily procurable whilst other essential items for the construction of apparatus are not forthcoming.

An objection which has been raised to the proposal which we put forward last week that set manufacturers should make the individual components from which their receivers are built up available for separate sale to the public, is that many of these components are supplied to set makers by manufacturers who are component specialists and that, therefore, set manufacturers, in supplying these components to the public, would be reselling components which they had already purchased from another manufacturer. The obvious solution to this, if it presents a difficulty, would be for the original manufacturer of these components to make them available to the public himself. No doubt he could do so in all cases except where he was making products of a design not his own.

What is Needed

There are two main objects which we aim at in putting forward these proposals; first, that there should be a wider selection of components available to the experimenter, and, secondly, that by supplying components already being made in large quantities for manufacturers' set construction, prices could be kept low and the components would not be weighted with the additional cost of fitting them with terminals and other refinements which are no longer essential to the competent constructor. In days gone by, when sets were built at home by persons with no ability to solder a connection and who slavishly copied a wiring diagram, there was a reason for terminals and for components specially designed for the amateur set builder.

There may be difficulties to be overcome in adjusting what we may describe as the domestic trading arrangements of manufacturers before it can be possible for these proposals to be carried out, but we are not prepared to accept, without good evidence, any contention that such a scheme is unworkable. There is a demand for components and at the right prices this demand could be greatly stimulated. It is worth while to make the effort to overcome prejudices and petty obstructions which at present stand in the way of meeting this demand.



Practical Television

A RÉSUMÉ OF VARIOUS CIRCUIT ARRANGEMENTS AND A GUIDE TO THE CHOICE OF A SATISFACTORY DESIGN

By W. T. COCKING

RECENT articles in *The Wireless World* have dealt in detail with the design of television apparatus, and the various alternative methods of obtaining the required performance have been treated at some length. Just because so many alternative arrangements have been discussed, an impression may have been gained that television apparatus is extremely complex and difficult to handle. In reality nothing could be farther from the truth. The apparent complexity is due to the amount of apparatus needed for good results, for in no individual part is there anything of an intricate nature.

This will be readily appreciated if the apparatus is considered in its separate parts of vision receiver, time-base and power supply units. Let us take the vision receiver first; the requirements are an overall gain of about 50,000 times, a response characteristic free from frequency and phase distortion up to about 1.5 to 2.0 Mc/s, and an undistorted output of some 30 volts p-p. To obtain these characteristics we can use either a straight set or a superheterodyne, and we can obtain all the amplification before the detector or we can split the gain between the post- and pre-detector circuits.

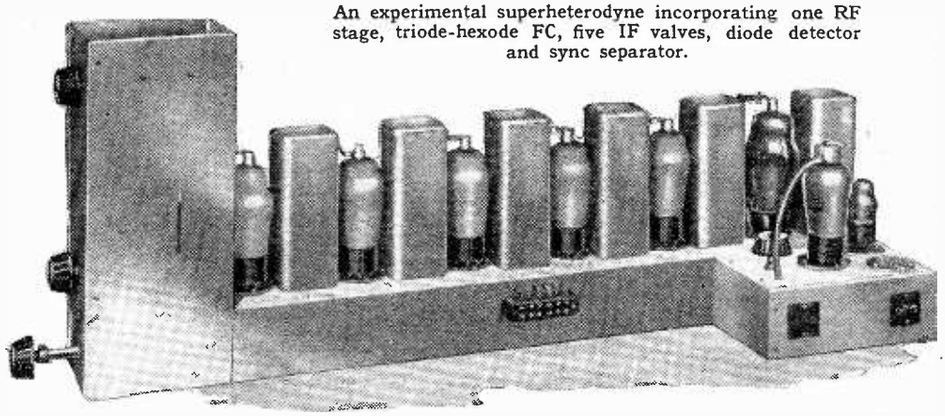
Either of the two latter alternatives is possible with the superheterodyne, but it is not very practicable to dispense with vision-frequency amplification with the straight set. It is difficult to secure the necessary gain with stability at such a high frequency at 45 Mc/s and it is not possible to obtain sufficient undistorted output for an average cathode-ray tube with a reasonably simple circuit. In practice, therefore, we are almost forced to the use of vision-frequency amplification with the straight set.

In the superheterodyne the same difficulties exist but to a much lesser degree on account of the lower operating frequency. Consequently, it is quite feasible to dispense with VF amplification and there is no doubt that sync separation is somewhat easier under this condition. There is, however, one big drawback to the superheterodyne, and this is its liability to certain types of interference which are not present with the straight set. So troublesome are these forms of interference that it is not easy to obtain good results with the superheterodyne.

A distinction should be made at this point between a factory-built set and one which is constructed and adjusted with but little assistance from measuring equipment. When elaborate testing facilities are available it becomes possible to adopt circuits which are too critical in adjustment for use in cases where adjustments have to be carried out with little or no test gear. The statement that the straight set is better than the superheterodyne, therefore, must not be taken to mean that it is invariably so. In the writer's view it is the better of the two for amateur use because it is at the present time so much easier to obtain good results with it. In factory production the superheterodyne can give an equally good performance, and it has certain advantages in that the test frequencies are lower and more readily handleable. Largely because of this, the majority of commercially produced receivers are superheterodynes.

Having decided on a straight set, and seen that with such a receiver we must use vision-frequency amplification, our receiver begins to take shape. Experience shows that it is possible to use three RF stages without difficulty from instability, and a single VF amplifier will then give adequate gain. The vision receiver proper thus consists of three RF stages, a detector, and one VF stage; the detector is a diode and the other four valves are RF pentodes.

The output of this receiver feeds the cathode-ray tube with the picture signals just as the output of a broadcast set is taken to a loud speaker. In addition, however, it must provide the synchronising pulses for keeping the time-base operating correctly. These sync pulses are in the received signal, and must be separated from the picture signals. This is done by means of an amplitude filter or sync separator, which consists of an RF pentode having a high resistance in its grid circuit and driven into grid current. Such a stage necessitates the retention of the direct-current component of the signal for its proper operation. Unfortunately, it is hardly feasible to retain this with vision-frequency amplification, and it is necessary to replace it artificially in the output. This is done by means of a diode, the two electrodes of which are connected across the output terminals.



An experimental superheterodyne incorporating one RF stage, triode-hexode FC, five IF valves, diode detector and sync separator.

It is convenient to mount these two valves on the vision-receiver chassis, which thus contains a total of seven valves and has output terminals feeding the picture signal to the CR tube and the sync pulses to the time-base, which we must now consider.

There are many possible kinds of time-base, and the one selected is of simple type and is especially suitable for tubes having electrostatic deflection. The time-base must provide an output of about 1,000 volts p-p of saw-tooth wave form at a frequency of 10,125 c/s for the line

Receiving Equipment

THE details of television receiver design have been treated at some length in past articles, and the pros and cons of the various possible alternatives are here discussed briefly

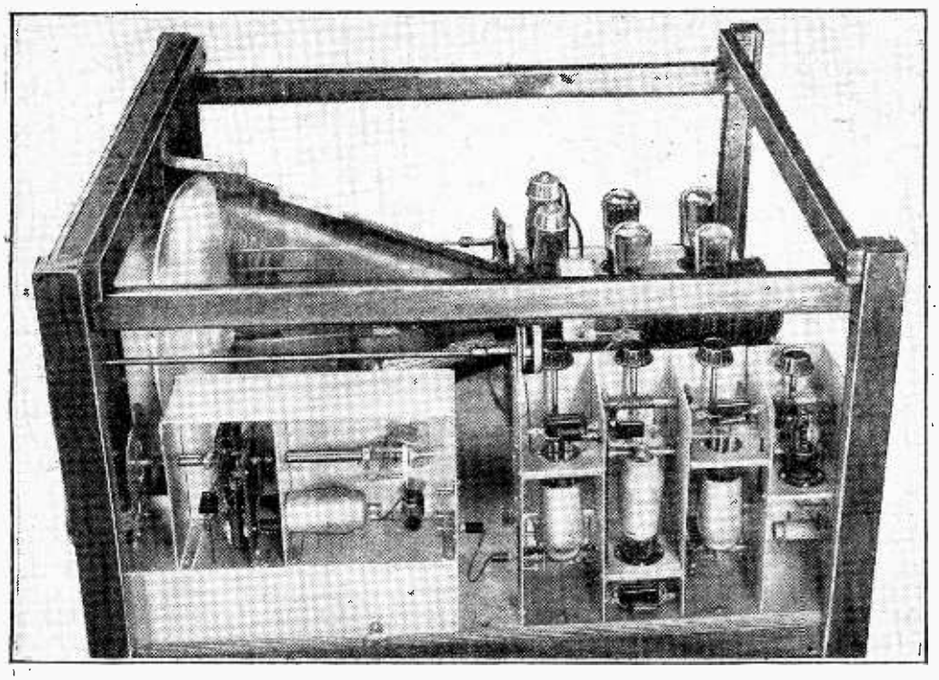
scanning, and a slightly smaller voltage at 50 c/s for the frame scanning. Moreover, if the picture is to be rectangular, push-pull output must be adopted.

The most convenient form of scanning oscillator is the gas-filled triode, and this will provide the requisite output when followed by an amplifier containing two triodes in push-pull. Resistance-capacity coupling is naturally adopted, and there are six valves in the double time-base. Two of these are gas-filled triodes for the line and frame-scanning oscillators, and the remaining four are triode amplifiers. In order to obtain an adequate output it is necessary to use an HT supply of 1,000 volts to this unit. The output of the time-base is taken through coupling condensers to the deflector plates of the CR tube.

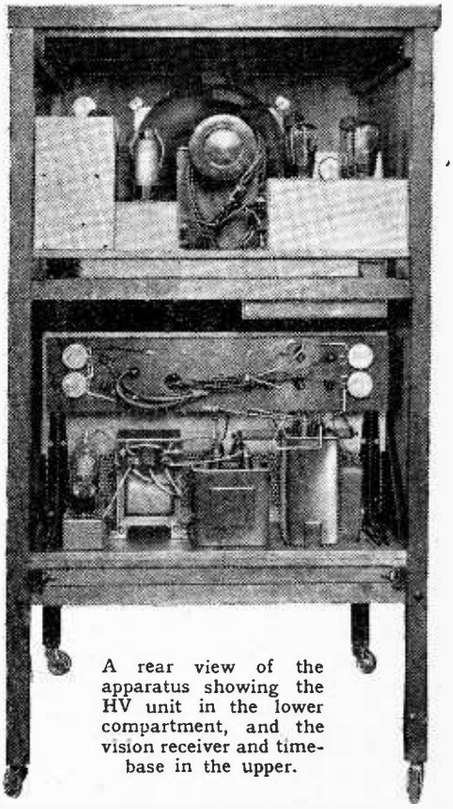
Six controls are provided, three for the frame and three for the line scanning. Two of these control the amplitude of the sync pulses fed to the oscillators and two control the frequency of the oscillators. The remaining two fix the amplitude of oscillation, and hence the picture height and width.

Apart from the tube itself and the power supply this is the whole of the television equipment. For the sound accompaniment it is, of course, necessary to provide a separate receiver which can be of simple nature. One RF stage with a reacting detector and two resistance-coupled AF stages is adequate, but it can be elaborated if desired. Because many may wish to do this, and because many will have an existing AF amplifier which they wish to use, it is best to adopt an entirely separate power supply for the sound receiver. It is possible to combine the supplies for the vision and sound receivers, but extensive decoupling is needed for the avoidance of interaction, and the total current consumption becomes rather heavy for a single rectifier. The use of separate supplies consequently leads to little increase in cost and to a considerable saving in cases where existing equipment can be pressed into service.

We have, therefore, only to consider the supplies to the vision receiver, the time-base and the CR tube. Now, the vision receiver requires some 75 mA. at 250 volts for HT and 8 amperes at 4 volts for LT; the time-base needs 20 mA. at 1,000 volts for HT and 8 amperes at 4 volts for LT; and the tube needs 4,000



In this view of the upper deck of the complete television equipment the vision receiver can be seen on the right, with the sound receiver on the left. The time-base is on the far side at the back of the CR tube.



A rear view of the apparatus showing the HV unit in the lower compartment, and the vision receiver and time-base in the upper.

volts at a negligible current for its third anode, and lower voltages for the other electrodes, and 1.5 amperes at 2 volts for LT.

There are many ways of obtaining such supplies, but the most economical would seem to be to combine the time-base and tube HT supplies. By using the voltage-doubler circuit with two rectifiers this can readily be done, and it is then possible to employ resistances for smoothing even in the time-base circuit; this represents a considerable saving over chokes. It is, however, necessary to include a thermal delay switch so that the high-tension supply is not switched on until the valves are all warmed up.

The second power unit then supplies HT to the vision receiver, a rectifier of conventional type being used, and LT for vision receiver, time-base and CR tube. It also contains the delay switch. A high degree of smoothing for the vision receiver HT supply is not needed, and experience shows that a single choke is entirely satisfactory. The power supply unit is thus by no means expensive.

The layout of television equipment is a matter of considerable importance. Short leads between the various units are desirable, and adequate insulation must be provided for high voltages. In addition, mains transformers must be kept well away from the CR tube, unless this is provided with a Mumetal screen, which is very expensive. Stray magnetic fields can seriously distort the picture, and even the leakage from a loud speaker magnet can have bad effects.

There are two general methods of mounting the cathode-ray tube—vertical and horizontal. A vertical mounting leads to a somewhat more compact design, but has the disadvantage that it is necessary to

Practical Television Receiving Equipment—

provide a surface-silvered mirror for viewing. Such a mirror is not cheap and is quite easily damaged; more serious, however, is the restriction of the field of view in the vertical plane with mirror viewing. This restriction is, in the writer's opinion, decidedly inconvenient, and he consequently feels that the horizontal mounting for the tube is better.

The equipment is then most readily built in a wooden framework with two shelves. The upper carries the CR tube, with the sound and vision receivers and time-base grouped round it. The lower shelf carries the loud speaker and the power packs.

For reasons of safety, the high-voltage unit is completely enclosed, and all points where connections are made externally to this unit at high voltage are protected. Consequently, it is not possible to come into accidental contact with any high-voltage point if the obvious precaution is taken of keeping all protective covers in place while the gear is in operation.

Considerable practical experience with the apparatus shows it to function reliably and well and to be easy to handle. A large number of controls appear on the panel, it is true, but many of these are little more than pre-set controls, and require only occasional adjustment. They are brought out to the panel, however, largely for convenience, because they must be adjusted while looking at the picture, and experience shows that the adjustments are by no means as easy if the knobs are in such a position that one has to be something of a contortionist to see the end of the tube!

Owing to the good sync separation obtained the synchronising is very strong and stable, with the result that a picture can be obtained without critical adjustment to any control. Even in the case of the time-base frequency controls considerable latitude is permissible. For the most stable operation and the best picture, however, the controls must be set precisely, but each is then independent of the others and the adjustments are easy.

In use it is by no means essential for the room to be dark, but light should not be allowed to fall on the end of the tube if it can be avoided. Experience shows that the receiver is best placed with its back to any light. Except on light, sunny days, it is only necessary to draw the curtains in the room to darken it sufficiently for good pictures. Better results are naturally obtained in darkness, of course, for then the tube can be operated at less brilliancy and better detail obtained in the white portions of the picture.

It is actually the loss of detail in the white parts which sets a limit to the brilliancy obtainable, and hence to the amount of room lighting tolerable, for if the brilliancy exceeds a certain value defocusing of the spot occurs. The range obtainable is such that this limitation is not reached in dark and semi-dark rooms, and the light emitted by the tube at full normal brilliancy is sufficient to read by if it falls directly on the paper.

It is naturally difficult to give a good idea of the results obtainable in words, and it is unfortunate that it is by no means easy to secure good photographs of television pictures. Photography would, in fact, be almost impossible if it were not that the CR tube screen has some afterglow, for it must be remembered that what the eye sees as a picture is never actually on the tube. In reality, there is only a single spot of light, but the retentivity of the eye permits the visible effect of a picture to be secured. The camera, however, is not as easily deceived as the eye, and with ordinary apparatus a long exposure is needed for a good picture. A long exposure is out of the question in most cases, however, because the subjects rarely remain sufficiently still. A large aperture lens and very fast plates become essential.

At the optimum viewing distance of some six feet the lines disappear, and a smooth picture is obtained which is quite sharp and free from blurring. A surprising amount of detail is evident, and in a close-up of a head it is often possible to detect individual hairs.

RECENT TELEVISION ARTICLES IN "THE WIRELESS WORLD."

Scanning in Television	Jan. 8th, 1937
The Time-base in Television	Jan. 15th, 1937
Synchronising in Television	Jan. 22nd, 1937
Synchronising Problems in Television	Jan. 29th, 1937
THE TELEVISION RECEIVER.	
I.—The Cathode-ray tube and Receiver Characteristics	Feb. 12th, 1937
II.—IF or VF Amplification	Feb. 19th, 1937
III.—Superheterodyne IF Amplifiers	Feb. 26th, 1937
IV.—Intermediate Frequency Couplings	March 5th, 1937
V.—The Detector and its Associated Circuits	March 12th, 1937
VI.—The Output Stage	April 9th, 1937
VII.—The Signal-Noise Ratio and Superheterodyne Interference Problems	April 16th, 1937
VIII.—The Straight Set	April 30th, 1937
IX.—Sync Separation with VF Amplification	May 14th, 1937
X.—Vision - Frequency Amplification	May 28th, 1937
XI.—The CR Tube HT Supply	June 11th, 1937

In Next Week's Issue

The "Wireless World"

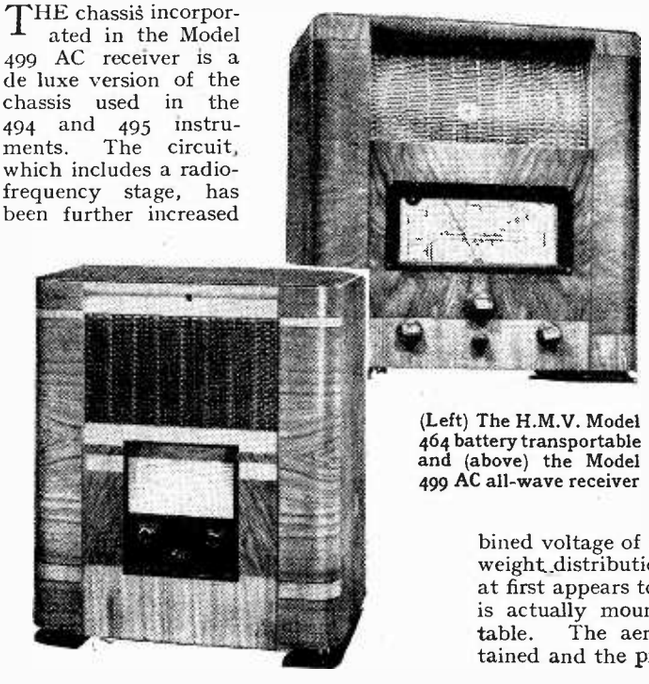
TELEVISION RECEIVER

The first of a series of PRACTICAL ARTICLES describing in detail the design for a complete and efficient receiver. The series will be fully illustrated with circuit diagrams, practical wiring plans and many photographs.

TWO NEW H.M.V. RECEIVERS

An All-wave AC Superheterodyne and Battery Transportable

THE chassis incorporated in the Model 499 AC receiver is a de luxe version of the chassis used in the 494 and 495 instruments. The circuit, which includes a radio-frequency stage, has been further increased in sensitivity on the short waves and a new type of rectangular dial giving greater ease in station identification has been evolved which has an effective length of 13in. and is calibrated in half-metres. Control knobs of a new type have also been introduced and the price of the new model is 14 guineas.



(Left) The H.M.V. Model 464 battery transportable and (above) the Model 499 AC all-wave receiver

In designing the Model 464 battery transportable the makers have had in mind the provision of the highest possible performance obtainable from batteries without exceeding the economical rate of current consumption. It is a two-waveband model with a superheterodyne circuit incorporating an RF stage. Two HT batteries with a combined voltage of 168 are used to obtain even weight distribution, and the cabinet, which at first appears to stand on legs at the sides, is actually mounted on a concealed turntable. The aerial is, of course, self-contained and the price is 15½ guineas.

The Beginnings of AVC

EARLY ATTEMPTS TO MAINTAIN CONSTANT SIGNAL STRENGTH

ALTHOUGH automatic volume control is now the accepted hall-mark of up-to-date broadcast reception, its origin can be traced back for at least a quarter of a century in connection with ordinary line telegraphy and telephony. There is nothing unusual in this—since few inventions are born full-grown—though the fact remains that AVC has been rather slow to "arrive" at its present position in radio practice.

The problem of regulating the conductivity of a wire line so as to offset automatically the effect of varying weather conditions is very much on all fours with that of compensating for the "fading" of a wireless signal as it travels through the ether. The precise factors involved—and, therefore, the methods which can reasonably be applied—naturally differ in the two cases, but the broad idea of keeping the signal at a uniform level in spite of varying attenuation losses remains the same.

The arrangement shown in Fig 1, for instance, which dates back to 1911, was designed to maintain the conductance of a telegraph line constant in spite of slow variations in resistance caused by rain and by seasonal and day-by-day changes of temperature. Here the automatic regulation is effected by means of a slider S, which is moved to and fro along a series resistance R through a motor M. The latter is operated by relays K, K1 controlled by the current in the line. If the level of signal strength falls too low, the motor starts to cut out some of the resistance R, until the increasing deflection of the needle of an ammeter A dips the longer of two contacts C, C1 into a mercury cup. This energises the circuit of the relay K, and opens its contact to stop the motor.

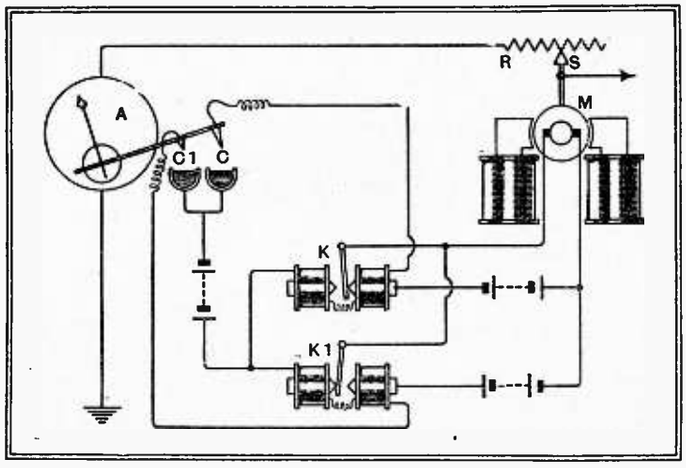


Fig. 1.—Automatic control of signal current as applied to land-line communication.

Signals are now at normal strength, but should the line-current continue to increase, a further deflection of the ammeter needle will depress the shorter contact C1 into its mercury cup. The second relay K1 is thus brought into action, to reverse the motor M, and insert more of the series resistance R into the line. In this way the signals are automatically prevented either from falling below or rising above a predetermined level, irrespective of casual changes in the electrical characteristics of the line.

A few years later, the thermionic valve became available as a substitute for the older contact-making type of relay in line "control" systems, and various schemes were devised in which either a separate pilot circuit was used, or a special supervisory current applied to the line under test. Any abnormal change in line resistance then automatically made itself felt by upsetting the balance of a Wheatstone bridge. The resulting current was used to move an arm around a series of contacts, which in turn applied a suitable grid bias to the repeater valves, so as to increase or decrease their overall amplification in a compensating sense.

ALTHOUGH the pioneers of AVC worked under serious handicaps — notably the lack of variable-mu valves — they devised ingenious methods of maintaining constant signal strength which were basically very similar to those in use to-day

These early methods are, however, scarcely suitable for dealing with the problem of "fading" in broadcast reception.

In the first place the Heaviside layer is obviously out of reach, and, therefore, not subject to direct control like a line wire, so that any gain regulation must be limited to the terminal circuits at the receiving end. Also, in the case of a carrier wave it is not feasible to use the modulation or signal components for the purpose in view, because this would result in "regulating" the soft and loud passages in a musical programme down to the same dead level of sound in the loud speaker.

However, the carrier-wave itself can be used as the necessary control without in any way affecting the musical content of the signal as finally heard in the loud speaker.

The first automatic volume control system suitable for use in broadcasting seems to have been developed in America early in 1922. The inventor points out that since any fluctuations in the "conductivity" of the ether must inevitably affect the amplitude of the received carrier-wave the rectified component of the latter will increase in strength as transmission conditions improve, and decrease as they fall off. It, therefore, provides a very convenient means of controlling the gain of the amplifiers used in the receiver, so as to offset the effect of any "fading" *en route*.

He accordingly biases the grid of the first detector valve so that under normal conditions it works at such a point of its characteristic curve that signal rectification is neither at its best nor at its worst. This normal bias is then automatically varied by the DC output from a second valve, so that as signal strength increases the operating point of the first detector is moved farther up the curve, where the rectifying action becomes even less effective.

Regulating Detector Efficiency

On the other hand, if the signal strength falls off, the biasing voltage derived from the rectified carrier-wave shifts the operating point of the detector down to the knee or lower bend of its curve, where it rectifies the signal at maximum efficiency. In addition to regulating the AF output from the detector valve, the "gain" of the unrectified carrier is similarly controlled, and this serves to increase the efficiency of the system as a whole.

Although the inventor's explanation may seem a little out of touch with modern ideas, there is sufficient evidence in his disclosure to establish a very close relation between this 14-year-old method of AVC and those now in everyday use.

The circuit shown in Fig 2 came three years later, in 1925, and forms a still closer link with present practice. The two first RF valves V, V1 are neutralised —as was customary in those days. They feed the first detector D of a superhet set,

The Beginnings of AVC—

the local oscillations being supplied from a source O.

A branch circuit L, C, tuned to the intermediate frequency, is tapped off from the second detector valve D1, to feed IF energy to an auxiliary amplifier A. This is coupled, in turn, to a rectifier valve D3, which passes rectified current through a resistance R in its plate circuit. The resulting potential drop is applied to the grids of both the HF valves V and V1, so as to regulate their overall amplification in the sense required to offset the effects of fading.

On the face of it, this circuit closely resembles the modern method of amplified AVC—except in one very essential point. There is no advantage to be gained in keeping the signal at constant strength if it involves a serious falling-off in quality, and in practice one cannot "swing" the grid-bias of an ordinary valve to and fro over a wide range of voltage without throwing it off the straight-line part of the working curve. This inevitably leads to distortion and a certain amount of "cross modulation."

The discovery of the variable-mu valve, with its long and tailing characteristic curve, brought a solution of this final difficulty, though we have to move forward to the year 1930 to see it first applied to AVC, and to mark the real beginning of modern practice.

Since then the double and triple diode-triode and the double-diode-pentode have enlarged and, in a sense, simplified the application of gain control. Delayed, amplified, and quiet AVC have followed on each other's heels to improve the operation of the modern receiver. Stations below a predetermined level of signal strength are now automatically suppressed, so that they cannot make a nuisance of themselves, whilst the usual pandemonium of interference between stations has been similarly abolished.

Television Programmes

Transmission times are from 3-4 and 9-10 daily.

Vision 45 Mc/s. Sound 41.5 Mc/s.

FRIDAY, JUNE 25th.

3, Ivor Vintor in "For Harold's Sake." **3.30,** British Movietonews. **3.40,** "The Happy Journey to Trenton and Camden," a comedy on American family life by Thornton Wilder.

9, The Music Hall Boys. **9.10,** Artists and their work—Miss Rhoda Dawson. **9.25,** Gaumont-British News. **9.35,** "The Lover": a comedy in one act by Martinez Sierra.

SATURDAY, JUNE 26th.

3, In our garden: C. H. Middleton in the grounds of Alexandra Palace. **3.15,** Dress designs—Peter Mercer. **3.25,** Gaumont-British News. **3.35,** Roy Fox and his band.

9, Act III of Verdi's opera "La Traviata": cast includes Noël Eadie and Parry Jones. **9.20,** British Movietonews. **9.30,** Summer Gardening V—by C. H. Middleton. **9.40,** Ivy St. Helier in "Quinet."

MONDAY, JUNE 28th.

3, Fashion forecast. **3.15,** Comedy Act. **3.25,** Gaumont-British News. **3.35,** Colonel W. de Basil's "Ballets Russes" from the Royal Opera House.

9, Repetition of 3 programme. **9.15,** Bridge experiment No. 2—Hubert Phillips. **9.25,** British Movietonews. **9.35,** Repetition of 3.35 programme.

TUESDAY, JUNE 29th.

3, Comedy Act. **3.5,** Sports Review No. 3. Sportsmen who have been in the news during June interviewed. **3.25,** British Movietonews. **3.30,** A dance band programme.

9, "Panache"—songs and mimes, presented by Eric Crozier, with Madge Bradbury at the piano. **9.15,** Gaumont-British News. **9.25,** Repetition of 3.5 programme. **9.40,** Revue.

WEDNESDAY, JUNE 30th.

3, The Hawaiian Islanders. **3.5,** Starlight: Bebe Daniels and Ben Lyon. **3.20,** Gaumont-British News. **3.30,** Sixty-seventh Picture Page.

9, The Hawaiian Islanders. **9.5,** Repetition of 3.5 programme. **9.20,** British Movietonews. **9.30,** The Sixty-eighth Picture Page.

THURSDAY, JULY 1st.

3, Music Makers: Daisy Kennedy (violin). **3.10,** "Coffee Stall." **3.25,** British Movietonews. **3.35,** A little show.

9, Operetta: "Black-Eyed Susan." **9.15,** Repetition of 3 programme. **9.35,** Gaumont-British News. **9.40,** "The Happy Journey to Trenton and Camden." Repetition of comedy televised on June 25th.

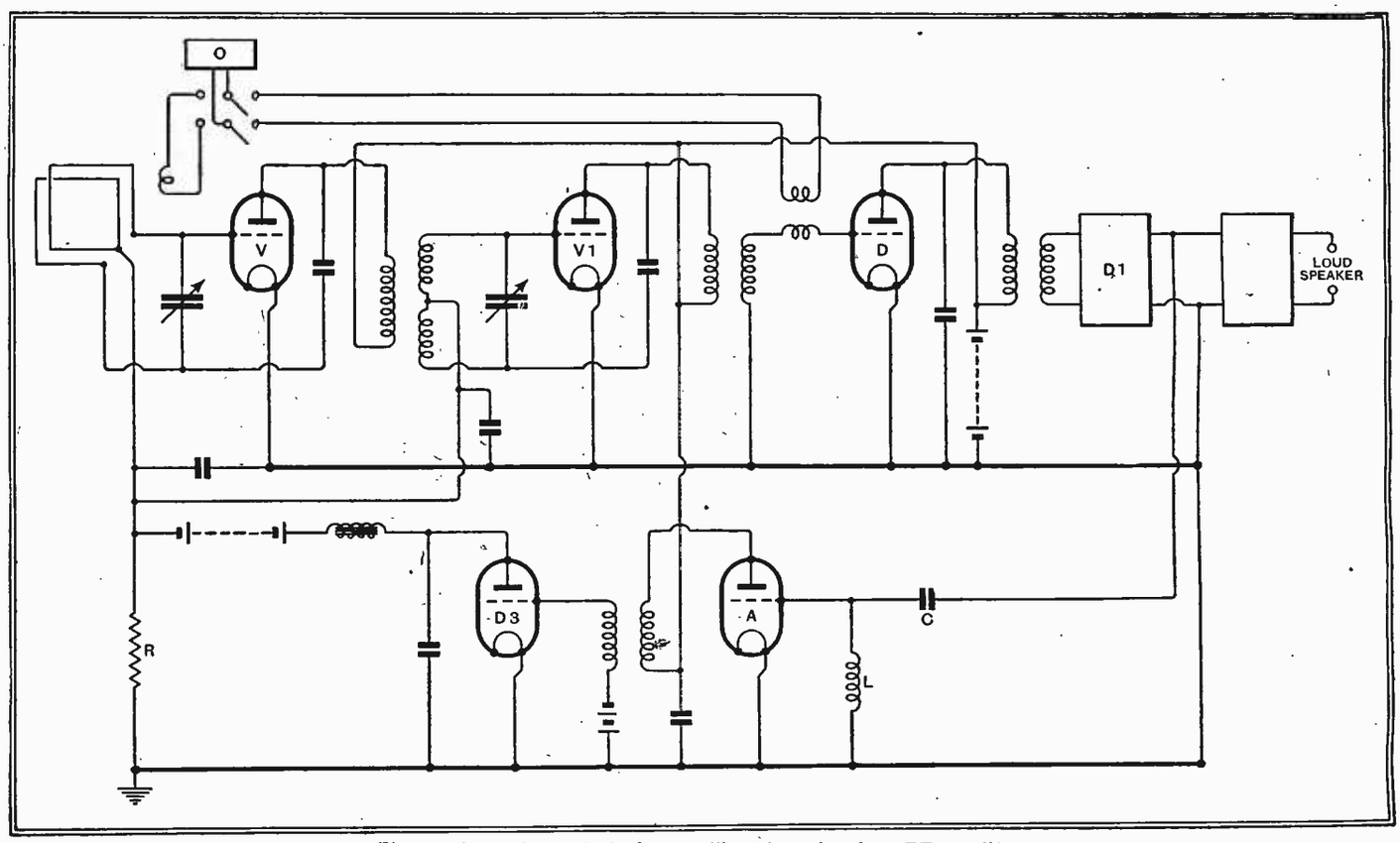


Fig. 2.—An early method of controlling the gain of an RF amplifier

Broadcast Brevities

NEWS FROM PORTLAND PLACE

The Moving Finger Writes . . .

THE impending retirement of Vice-Admiral Sir Charles Carpendale from the Deputy Director-Generalship of the B.B.C. (first announced in *The Wireless World*) is a reminder that several other high officials are nearing the age limit. Mr. Joseph Lewis, the popular conductor, whose departure will be keenly felt in the Midlands, has another year to run; but Mr. J. Dormer, the Chief Cashier, and Mr. P. Kitson, one of his assistants, leave at the end of this month.

Those Young Engineers

The engineers are a younger race. Sir Noel Ashbridge, the "Chief," is only forty-seven, though probably senior in years to most of his staff.

Research into the ages of the higher officials has revealed that the star of broadcasting was in the ascendant in the year 1889. Sir John Reith was born then; so were Sir Adrian Boult, Music Director, and Sir Richard Maconachie, Director of Talks.

Then eleven winters passed, and Mr. Val Gielgud saw the light.

Producer with Broken Neck

EMPIRE listeners have often been entertained of late by a man who is in a class by himself, if for no other reason than that he has a broken neck.

He is Mr. F. H. C. Piffard, light entertainment producer in the Empire Department. Less than a year ago Mr. Piffard lay unconscious in hospital with a broken neck and displaced vertebra, the result of a motor accident. His life was despaired of, but he refused to die. Medical science was nonplussed. He was defying the rules.

"Red, White and New"

Eventually he left the hospital, unable to move his head, but had further treatment. Now the joints of his spine are once more correctly set, and only X-ray photographs reveal the fracture.

Mr. Piffard's revue, "Red, White and New," to be heard in both Empire and home programmes to-night (Friday), is full of extraordinary situations, but none so extraordinary as that of its producer a few months ago.

Storm in Television

THE studio engineer at Alexandra Palace who recently "rocked the ship" in "Cabaret Cruise" by means of an ingenious tilting mirror device, will co-operate with Harry Pringle in one of the most ambitious trick scenes yet attempted in television.

The occasion will be another "Cabaret Cruise," but this time the good ship "Sunshine" will all but founder in a storm.

Among Harry Pringle's requirements are a violent rainstorm, mountainous seas, lightning, thunder, the roar of a tempest, and a ship on its beam-ends. Yet not an artist must get wet or seasick.

A nice little problem for a wet week-end.

Fishy Interference

AT the moment of writing the interference on the television signals from Wimbledon takes the form of a shimmer, giving the effect of seeing through an aquarium. Fortunately, the trouble is only intermittent.

Experts with frame aerials who have been combing the twelve and a half miles between Wimbledon and Alexandra Palace have their eye on a certain power station.

The B.B.C. Film

ALTHOUGH the new B.B.C. film is intended solely for demonstration purposes in viewing rooms, television set owners will find it quite entertaining—for a time. It is devoutly hoped, however, that when they have tuned it in *ad nauseam* they will not write to the B.B.C. complaining of lack of variety in the morning programmes.

The film was privately viewed by the television staff at Alexandra Palace last week. Immediately the new teleciné channels are ready it will go on the air.

Mr. Robey's Colleagues

THE appointment to the B.B.C.'s General Advisory Council of Mr. George Robey calls for loud cheers and restrained hilarity. He joins illustrious colleagues, representing practically all the arts and professions.

Henry Hall for Denmark

HENRY HALL'S future is already mapped out in the early stages. He and his Boys have just signed a contract to broadcast from the Danish stations immediately they leave the B.B.C.

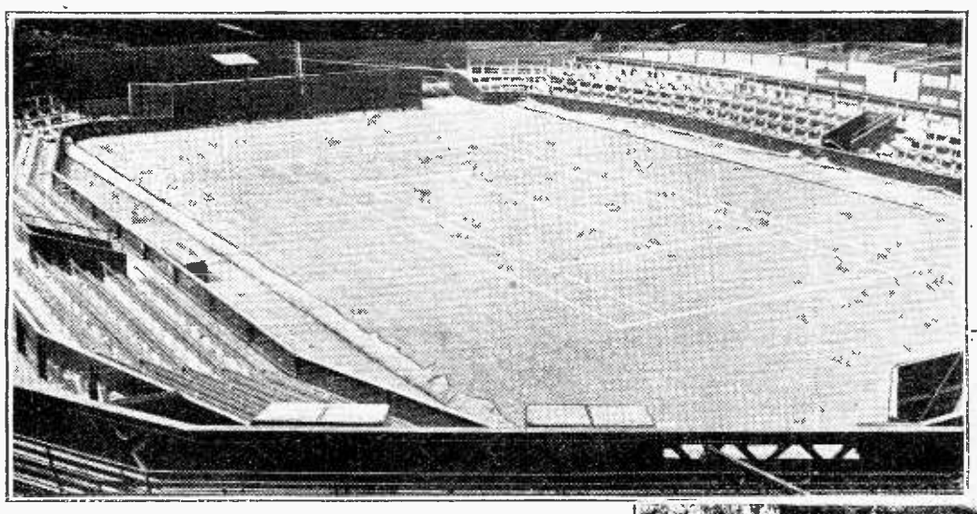
"Here's to the Next Time"—with the tuning knob at 1,250 metres instead of 1,500 metres.

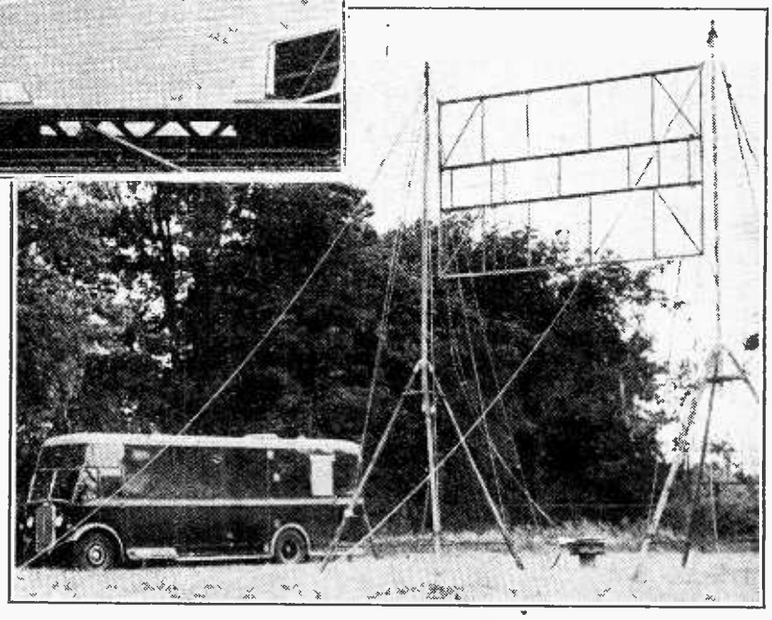
Wails from Wales

WALES wins its broadcasting independence on July 4th, but is the Principality satisfied? Perish the thought!

Mr. Rhys Hopkin Morris, the Welsh Regional Director, has just been engaged in a tussle with representative listeners, and, without reading between the lines, it is obvious that Wales still feels "slighted."

During the summer the Welsh Region will provide sixteen programme hours a week of its own material, to be increased to twenty-two in October and twenty-four later on. Is this enough?





TELEVISING THE TENNIS CHAMPIONSHIPS. A very clear view of the position of the two television cameras, the covered tops of which are visible, in relation to the centre court will be seen from the picture above. The cameras are linked by a long cable to the transmitting van, nearly a quarter of a mile away, from where the picture signals are transmitted by the five-metre radio link direct to Alexandra Palace.

Amplifier Correction and Waveform

By J. H. REYNER, B.Sc., A.M.I.E.E.

HOW HIGH-NOTE "BOOSTING" ACCENTUATES HARMONIC DISTORTION

IT is shown in this article that the application of drastic high-note accentuation may produce waveform distortion; the nature of this distortion is clearly shown by the accompanying oscillograms.

THE use of compensating circuits in audio-frequency amplifiers to provide accentuation or reduction of either top or bass is often resorted to in modern practice to allow for deficiencies in the original material. Bass boost, for example, may be incorporated to compensate for the falling level on gramophone recording below 250 cycles per second, while accentuation of the top may be used to allow for treble loss either through the exigencies of recording in gramophone reproduction or by side-band cutting in a radio receiver.

At first sight it would seem that a satisfactory arrangement of this type might easily be devised, but in practice an examination of the results shows that there are certain factors to be contended with. Consider, for example, an amplifier having a gradually rising characteristic. It is possible by setting the amplifier to the correct adjustment to bring the strength of some high audio-frequency such as 4,000 cycles up to its correct level. A pure audio-frequency note, however, is not often encountered, and in the general run of things the 4,000-cycle note in question will contain a percentage of harmonics, the most important for our purpose being the second and third at 8,000 and 12,000 cycles per second. These harmonics should be increased in exactly the same proportion, but, in point of fact, since the amplifier possesses a steadily rising characteristic, the second harmonic will be perhaps twice as great as it should be and the third harmonic may be four times as great.

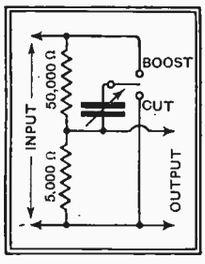


Fig. 1.—Principle of the simple tone-correction circuit discussed.

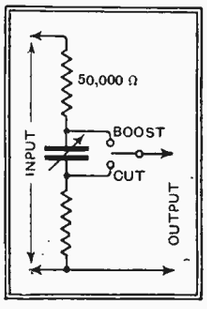


Fig. 2.—Circuit for bass control.

The converse is equally true. By introducing a small amount of top cut we can reduce harmonics in a very much higher proportion than the fundamental, and it will be shown later that a thoroughly distorted waveform may be made to look like a sine wave by the application of sufficient top cut. This explains why the "mellow" tone on the average small receiver of to-day sounds so comparatively pleasing despite the technical fact that it ought not to do so.

These ideas will become clearer from a more detailed consideration of specific cases. We will begin with a brief description of the amplifier itself, showing the type of correction circuit adopted and the extent of the correction obtainable.

Fig. 1 shows the basic principle used for top correction. The input from the preceding valve is applied to a potentiometer chain giving a ten to one step-down. In order to provide top cut, capacity is connected across the bottom half of the chain which reduces the effective impedance of this portion of the circuit and thereby cuts down the voltage. This capacity will only begin to be effective when its reactance is comparable with 5,000 ohms, while as the frequency rises its reactance will get less and less until ultimately it provides practically a complete short-circuit and no voltage is handed on at all. By varying the capacity, the point at which this progressive reduction commences may be varied.

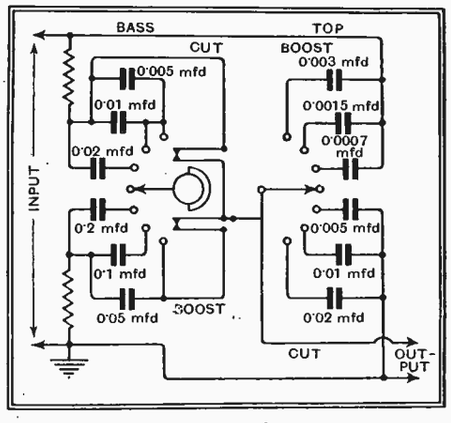


Fig. 3.—A composite circuit providing control of both bass and treble.

To provide top boost, capacity is connected across the top half of the potentiometer. When the reactance of this capacity becomes comparable with 50,000 ohms it starts to shunt the upper portion of the potentiometer and hence more than the normal voltage is transferred to the output until, when the frequency has risen sufficiently to make the capacity practically a short circuit, the full voltage is handed on. Once again, the point at which the actual separation commences is varied by altering the value of the capacity, and it will be clear that the maximum rise that can be obtained is ten to one.

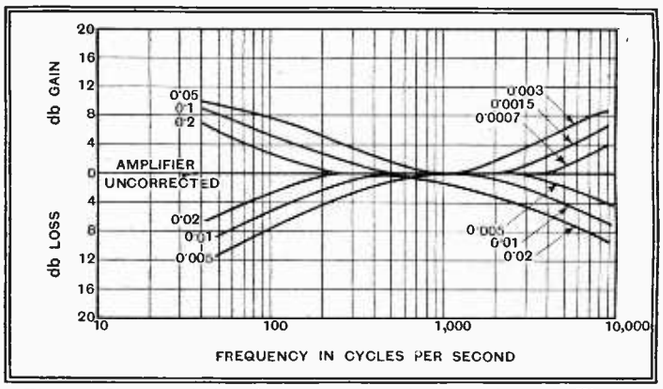


Fig. 4.—Characteristics of the tone-control system shown in Fig. 3.

It should be noted, in passing, that in the condition of maximum top boost the effective impedance at the input of the network is only 5,000 ohms, and the preceding valve must be designed so that it will not distort under these conditions.

Bass Control

Fig. 2 represents the arrangement for bass control. Here series condensers are introduced in either the top or bottom half of the network as required. For bass cut, the condenser is introduced in the top half of the network; then when the reactance of the condenser begins to become appreciable (in comparison with 50,000 ohms) the impedance of the top half of the network rises and in effect the tapping point is progressively reduced. For bass boost the condenser is introduced in the bottom half of the network, where it raises the effective tapping point in similar fashion.

It should be noted that in certain types of amplifier bass control is obtained by shunting low-frequency chokes across the suitable portions of the potentiometer in the same way as condensers are used for the top control. While this operates satisfactorily it is found that at the upper frequencies the self-capacity of the chokes begins to introduce a certain amount of top control, either loss or accentuation according to the position.

Amplifier Correction and Waveform—

Although for many practical purposes this would not be objectionable, it might well be considered undesirable, and so the slightly more elaborate arrangement incorporating series condensers was adopted.

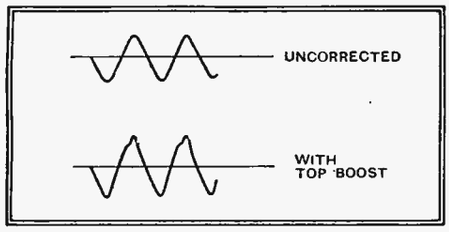


Fig. 5. — How top boost accentuates the harmonic distortion of the uncorrected waveform

Fig. 3 shows the composite circuit, the extra contacts on the bass control switch serving to short-circuit the series condensers in whichever part of the potentiometer is not being used. This is obviously essential, for otherwise the two effects would be working in opposition and either the boost or the loss would not be as great as it should be.

Fig. 4 shows the effect of the various compensations. The bass compensation commences at frequencies of 1,000, 500 and 250 cycles per second, according to the switch position, while the corresponding top corrections start at 1,000, 2,000 and 4,000 cycles per second.

It will be seen with this arrangement it is possible to obtain an amplifier with a very flexible characteristic and some oscillograms of waveforms passed through the amplifier may be of interest. Fig. 5 is an alleged sine wave generated by an oscil-

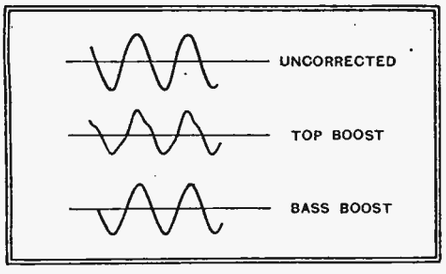


Fig. 6.—Top boost makes evident the harmonic content of the uncorrected waveform ; bass boost has the opposite effect.

lator. The experienced eye will detect at once that there is a slight angularity about the peaks indicating the presence of a certain amount of harmonic content. The lower half of the figure shows the same waveform with full top boost in play. That is, everything above 1,000 cycles is boosted on a rapidly increasing scale and the presence of the harmonic is immediately shown up on the waveform. It should be noted that the relative phase of the harmonic is not necessarily the same as in the fundamental, because the form of correcting circuit adopted may introduce some phase shift. The fundamental frequency was 1,000 c/s.

Fig. 6 shows a similar waveform at 128 c/s, which again looks tolerably like a sine wave but which is easily shown by the introduction of top boost to contain quite an appreciable harmonic content. It is, however, interesting to note that by the application of bass boost the effect of the harmonic is suppressed and the waveform becomes very nearly a true sine wave. Actually, of course, this is the same thing as the application of top cut, for in both cases we accentuate the fundamental and suppress the harmonic; this, indeed, is one of the ways of obtaining a relatively pure waveform in a laboratory by the inclusion of a top-cut circuit or preferably a low-pass filter tuned to a frequency a little above the fundamental.

The next two oscillograms (Figs. 7 and 8) are perhaps even more interesting. The first of these represents the waveform with one of the valves in the amplifier (prior to the correction, of course) heavily overbiased so that it is producing serious bottom bend rectification. It is well known that this form of distortion gives

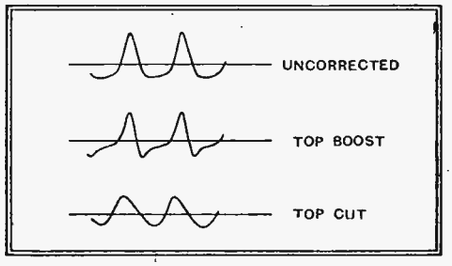


Fig. 7.—Effect of over-biasing one of the amplifier valves.

rise to heavy second harmonic and by the application of top boost we can accentuate this as shown in the second oscillogram where the definite distortion of the waveform by another wave of double the frequency can clearly be distinguished. In fact, in this case the amplitude of the second harmonic is nearly 50 per cent. of that of the fundamental. Top cut, on the other hand, suppresses the second harmonic and subsequent harmonics to a still greater degree, with the result that the wave becomes much more symmetrical. It is still far from pure, but it is no longer so violently uneven on either side of the zero line and such a wave actually heard on a loud speaker would sound tolerably pure.

Fig. 8 shows a somewhat similar state of affairs, this time produced by a valve which was saturated. Actually, to reproduce this a directly-heated valve was used with the filament deliberately under-run, and the cutting off of the top half of the

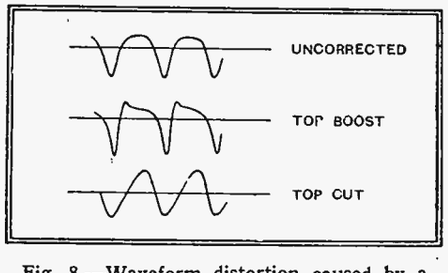


Fig. 8.—Waveform distortion caused by a saturated valve.

wave is quite clearly marked. Top boost again accentuates the distortion to a very marked extent, while top cut reduces the wave to something which approaches a sinusoidal character.

It should be noted that in the last two oscillograms the leved of the output was adjusted in each case to be approximately equal. The application of top boost to both the waves, of course, actually makes the peaks greater than before, while the application of top cut reduces the effective output very considerably and more amplification has to be provided in order to bring them up to the same level, but we are concerned with the relative purity of the wave rather than its specific intensity.

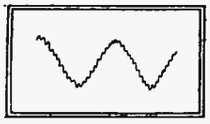


Fig. 9.—Waveform of 50-cycle mains with full bass cut and maximum top boost.

As a final point of interest, Fig. 9 shows the waveform of the electric light mains. In this case the frequency, of course, was 50 cycles, but it was used with the full bass cut and the maximum top boost. Reference to the curves shows that at 3,000 cycles this gives a rise of something like 25 times, which has been sufficient to bring up a very pronounced 3,000-cycle ripple. This is due to some unidentified machine operating on the mains. It was not a synchronous machine because the ripple was actually passing slowly along the wave, giving the appearance of a very agile snake. Under normal conditions, of course, this would be quite unnoticed.

Perhaps the most interesting point, however, is that the application of these two relatively large corrections have not distorted the fundamental to any noticeable extent. The general form of the wave still remains practically a perfect sine wave, which is an interesting comment on the purity of the electrical supply on the National Grid.

The International Broadcast and Sound Engineer 1937 Year Book, by A. L. J. Bernaert, Assoc.I.R.E. 225 pp. Published by J. Davey, 30, Davis Street, London, E.13. Price 6s.

A FEATURE of considerable value in this year book is the section entitled "Scanning the World's Technical Literature," as in this brief synopsis of the latest developments in radio and sound engineering the information is extracted from papers that have been published in the numerous technical journals.

The special articles contributed by well-known authors of various nationalities are, in this book, published in English.

At the end of the technical section is a very brief résumé in seven languages of the contents of the book. Though very much abridged this résumé adequately conveys the essential information contained in the various articles treated more fully in the English version.

Finally, there is a review of recently developed equipment for sound reproduction and broadcast use. H. B. D.

UNBIASED

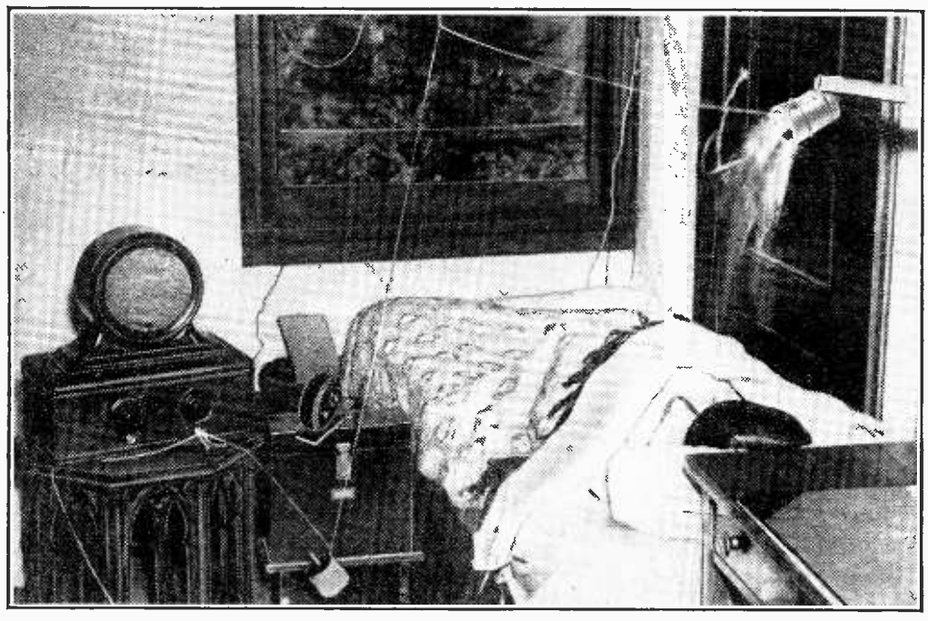
By FREE GRID

Radio Therapeutics

ALTHOUGH very wonderful strides have been made by the medical profession during the past few years in finding cures for all the ills to which flesh is heir, there are still many diseases which seem to defy all efforts to combat them. One of these latter scourges has as its principal symptom a strong disinclination to get up in the morning, and I am sorry to say that just lately I have myself fallen a victim to it. My malady, I feel sure, is a sort of first cousin to *encephalitis lethargica*, which, as many of you may know, is liable to afflict sailors, and others whose calling leads them into a life of indolence.

In an effort to find a cure for my particular case, my medical adviser and I have recently been staying in the country where I have been existing on a very strict diet and following a very ascetic mode of life, going to bed with the cows (I speak figuratively, of course) and endeavouring to get up with the lark. Unfortunately all my efforts to emulate the lark have proved abortive. Since, however, radio has played a very prominent part in my attempts at finding a cure, I thought perhaps that you might find some interest in the matter as it is quite on the ing of success by the method illustrated in the photograph, although there is a long and weary path to travel before a complete cure is discovered, and it is in this connection that some of you may be able to make suggestions.

The photograph is, I think, more or less self-explanatory. A cord is wound round the alarum-winding key of the clock shown by the bedside, and when the alarum goes off the key rotates and releases the cord to the bottom end of which is attached a heavy weight—in this case a paste-pot. The weight pulls on the cord, thus switching on the wireless set and upsetting a glass of water on to my face. The cord is also attached to the shutter release of a small previously-adjusted cine-camera, this being necessary, of course, so that the



The automatic arousing equipment "caught in the act." To prevent damage to the face, the tumbler is tied to the shelf.

cards that a great many of you may suffer from a similar complaint.

Needless to say, all the usual methods, such as an alarum clock, and a crowing cock just outside the window, have been tried without success, but I am very glad to say that my medical man has at last managed to achieve just a faint glimmer- doctor can, later on, study at leisure my reactions to the rousing effect of alarum bell, wireless set, and water. Actually the photograph reproduced herewith is a "still" enlarged from the cine film, and shows the glass of water just in the act of falling from the shelf.

I must apologise for the fact that the

Well known in the world of letters.

set is an American one, but American programmes are the only ones creating sufficient din to have any hope of rousing anybody suffering from my disease, and, of course, a British set cannot possibly stand them for long. With the treatment outlined, my medical adviser has, as I have already mentioned, succeeded in getting a faint glimmering of results—sufficient, at any rate, to give him encouragement as the cine film shows distinct signs of movement in my figure.

If any of my medical readers can suggest any better treatment, please don't let professional etiquette stand in the way.

Is the B.B.C. Human?

A LARGE number of readers have written in to accuse me of a lack of knowledge of the niceties of English grammar, insomuch that when talking of the B.B.C. I invariably use the pronoun "they" instead of "it." Some readers have even gone to the length of sending me elementary textbooks on the English language. I fear, however, that these accusations will not have any effect in inducing me to mend my ways. Even the fact that, as one reader says, "in more respectable sections of the journal correct grammar is invariably used," has no effect on me, and I must decline to shoulder any blame for what appears in other parts of *The Wireless World*.

I know full well, of course, that the B.B.C. by their disgraceful and pig-headed conduct fully deserve to be referred to as "it," but nevertheless, however bitterly disposed I feel towards them, I always allow my more humane feelings to prevail and consequently prefer the use of "they." I do not allow myself to refer even to one of Nature's lowliest creatures as "it."

Even if the Editor, in other sections of the journal, were sufficiently callous to permit the use of the pedantically correct "it" instead of the humanitarian "they," it would have no effect on me whatever. Apart from this, I have made a special journey down to Oxford to consult a figure who is extremely well known in the world of letters, and he warmly endorses my views.

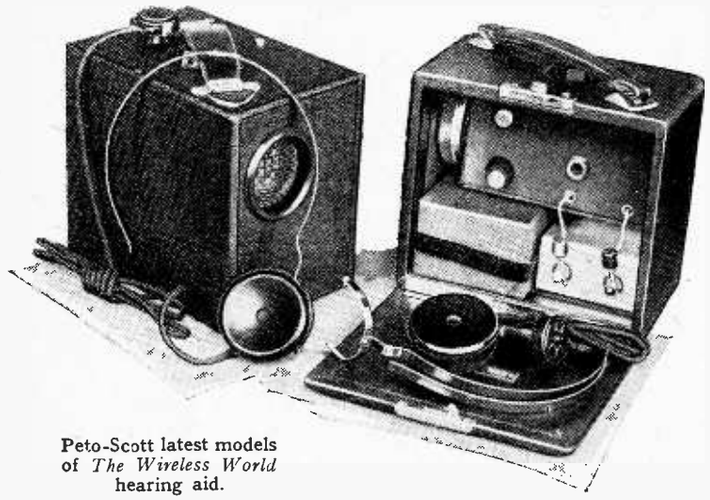
New Apparatus Reviewed

Recent Products of the Manufacturers

PETO SCOTT W.W. HEARING AID

THE Peto Scott Co., Ltd., 77, City Road, London, E.C.1, have sent in for examination two of their latest hearing aids, based on the design of *The Wireless World* model that was described in the spring of last year.

Though fundamentally the circuit is the same as in the home constructor's model, sundry minor modifications have been introduced, and the layout has been altered to enable the set to be accommodated in a case measuring 6in. × 5in. × 4in.



Peto-Scott latest models of *The Wireless World* hearing aid.

In the Peto Scott version two Hivac midget valves are used, an XD for the first stage and an XP for the second stage. These two valves, which are transformer-coupled, give considerable amplification, and although the sensitivity is high there is no trace of microphony. Its response to severe shocks is minimised by mounting the microphone on sponge rubber.

The two dry batteries, one of 45 volts and the other of 3 volts, for HT and LT respectively, are very accessible and quite easy to replace when the need arises. The HT consumption is about 1.5 mA at normal volume and rises to just under 2 mA at full volume. The valves take 0.2 amp of filament current. These currents are well within the capacities of the batteries fitted.

Both models of this hearing aid are similar in size and in external appearance and differ only in one detail. One of the models has a tone control embodied, but as it is intended to be used only as a frequency corrector to compensate for individual deficiencies in hearing, the control knob is located inside the case.

Complete with a single ear-piece and head-band the model, without tone controls, costs 6 guineas and the one with, 8 guineas.

PREMIER S.W CONDENSERS

THE Premier Supply Stores, Jubilee Works, 167, Lower Clapton Road, London, E.5, have introduced a new range of short-wave condensers which, although quite low in price, are very well made and possess many attractive features.

These new condensers are particularly well suited for use on the ultra-high frequencies as the minimum capacities of the smaller sizes are very low indeed. For example, the 15-m-mfds. condenser has a minimum of 3.5 m-mfds. and a measured maximum of 17.5 m-mfds.

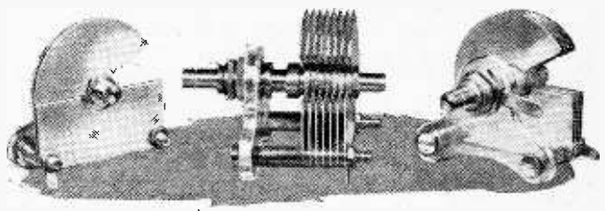
Curiously enough, the next size, viz., 25 m-mfds., has a still lower minimum value, being between 2.5 and 3 m-mfds. only. Though the construction is the same in both, the former has four plates with wide spacing while the 25 m-mfds. one has three only with close spacing.

The minimum and maximum capacities of some of the other sizes tested are: 100. m-mfds. nominal, minimum = 5 m-mfds., maximum = 96 m-mfds.; 160 m-mfds. size, minimum = 6.5 m-mfds., maximum = 166 m-mfds.

Apart from the low minimum capacities of these condensers which makes them attractive for use on the ultra-high frequencies is the fact that the single end-plate of insulating material employed possesses particularly good high-frequency properties. It is made of a tough transparent material described as Trolitul.

Rigidity is obtained by using a large bearing giving good support for the rotor, the spindle being carried in a ball bearing. All the condensers have end extension pieces of ¼in. diameter so that several can be ganged.

The condensers are made of brass throughout and the prices are: 15 m-mfds. 1s. 4d., 40 m-mfds. 1s. 7d., 100 m-mfds. 1s. 10d., 160 m-mfds. and 250 m-mfds. 2s. 6d. each.

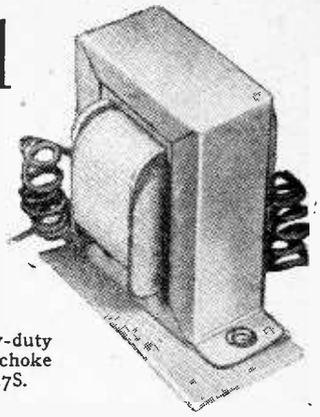


Selection of the New Premier Supply short- and ultra-short wave condensers.

BULGIN CHOKE TYPE LF.47S

THIS recent addition to the range of components made by A. F. Bulgin and Co., Ltd., Abbey Road, Barking, Essex, is a low-inductance smoothing choke intended for use in circuits carrying comparatively heavy currents. It has a nominal inductance of 0.25 henry and is rated to carry up to between 3 and 4 amps.

Occasions arise when a choke of this kind is needed, for example, in interference suppression circuits, and it could be used also to give additional smoothing for a DC set. In this case, if the choke and the appropriate smoothing condensers are inserted between the set and the mains it will have to carry the total current taken by the receiver. With modern valves, series connected, the current is not likely to be much in excess of 0.3 to 0.4 amp., so that the choke will be working well within its capacity. Being required to carry heavy currents, it naturally has a very low DC resistance, and that of the specimen sent in for test has a resistance of 5.7 ohms only.



Bulgin heavy-duty smoothing choke Type LF.47S.

It was not possible at the time of test to measure its inductance with the full rated amount of DC flowing, but some values have been obtained with up to half an amp. of DC through the winding.

With no DC its inductance was found to be 0.75 henry; with 0.3 amp. it was 0.63 henry, and with 0.5 amp. the inductance was 0.44 henry.

The choke thus has an adequate inductance for the majority of purposes for which it will be used.

It should be mentioned that our measurements were made at 50 c/s and with 20 volts AC across the choke.

The choke is a well-made article and comes within the category of skeleton models made by this firm. Its price is 12s. 3d.

Club News

Halifax Experimental Radio Society

Headquarters: Friendly and Trades Club, Room 13, St. James's Road, Halifax.
Meetings: Last Thursday in the month at 7.30 p.m.
Hon. Sec.: Mr. J. B. Bedford, Oak House, Triangle, Halifax.

At recent meetings lectures have been given by Mr. L. Cobb (2ABC) on self-excited oscillators, by Mr. J. A. Dixon on problems in the design of LF. amplifiers and by Mr. T. Murgatroyd on his experiences below 10 metres. Mr. J. A. Dixon has been elected chairman in place of Mr. Crewe.

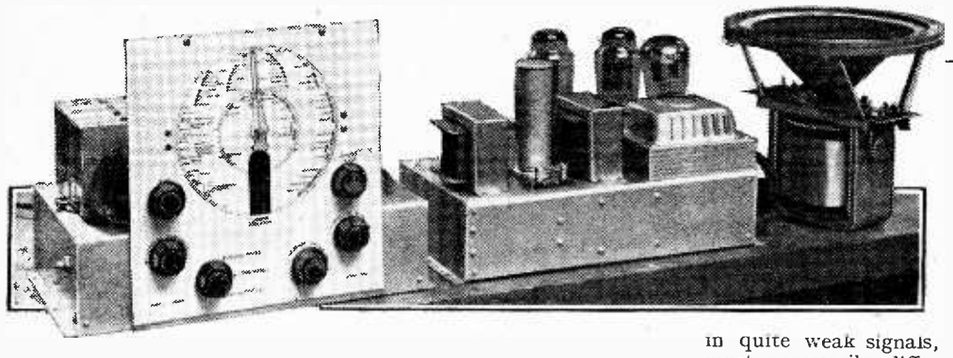
Milnes Radio and Television Society

Hon. Sec.: Mr. F. Ridler, Technical Department, Milnes Radio Co., Ltd., Bingley, Yorks.

A society has been formed under the above name principally for the staff of Milnes Radio Co., Ltd. However, all interested in wireless are invited to join and several outside members, including a number of local amateur transmitters, have already been enrolled. The annual subscription is 7s. 6d., and for those under 18 5s. Visits to places of interest are being arranged, and a leading feature of the club is to be experimental transmitting work, chiefly on the ultra-short waveband.

Hartley Turner MA RECEIVER

A FLEXIBLE CIRCUIT DESIGNED FOR HIGH-QUALITY RECEPTION



Complete MA12 equipment together with Duo-de-Luxe loud speaker.

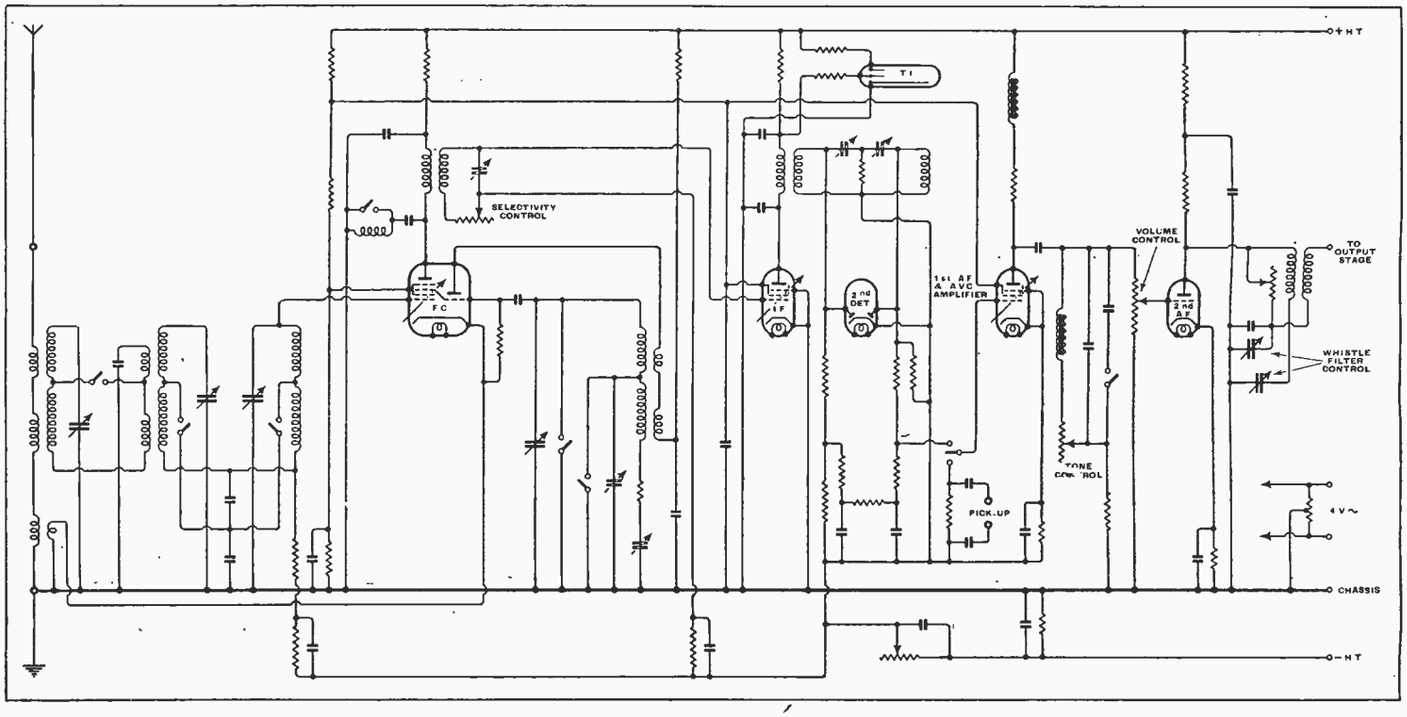
STARTING with receivers designed primarily to give the highest possible quality of reproduction from the nearest British broadcasting stations, the succeeding models produced by this firm have been gradually extended in range and narrowed down as regards selectivity until with the present model it is possible to derive from many of the principal Continental stations results which are acceptable to the fastidious tastes of the uncompromising quality enthusiast.

A superheterodyne of special design has provided the most satisfactory solution, and from a study of its circuit a long list could be made of refinements and deviations from standard practice which the manufacturers of mass-produced sets cannot afford to include. In general principle, too, it differs radically from the standard superheterodyne circuit, for, instead of effecting a compromise between quality and selectivity by means of flat-top resonance curve in the IF circuit, the overall response of this stage has been given a single-peaked response, the effects of which are corrected subsequently in the AF stages of the receiver.

FEATURES. ***Type.***— *Tone-compensated superheterodyne receiver for AC mains.* ***Circuit.*** ***—(Receiver chassis)*** *Triode-hexode frequency-changer — var.-mu pentode IF amplifier — double-diode second detector — var.-mu pentode first AF amplifier, AVC amplifier and tone correction valve—triode second AF amplifier.—* ***(Power Pack)*** *Push-pull triode output valves. Full-wave valve rectifier.* ***Controls.*** *— (1) Tuning. (2) Variable selectivity. (3) Wave-range and gramo. switch. (4) Volume and on-off switch. (5) Tone Control. (6) Whistle filter control.* ***Price.***—*Complete with 12-watt power pack and all valves, £38 10s. Duode-de-Luxe loud speaker, £7 3s.* ***Makers.***—*Hartley Turner Radio Ltd., Thornbury Road, Isleworth, Middlesex.*

As the set is primarily a quality receiver for powerful stations well above the threshold of background noise, the approach to the design of the AVC circuits is somewhat different from that to which we are accustomed. In fact AVC is included primarily to protect the detector from overloading and only incidentally to give some measure of control over the fading of weak stations. Since the range of the set is sufficient to bring in quite weak signals, and since opinions must necessarily differ as to the signal-to-noise ratio which provides an acceptable programme from the quality point of view, a wide range of control over the degree of selectivity and the complementary tone correction in the AF stages has been provided. As far as the aerial input is concerned, it has been found difficult to provide, with the usual two-element band-pass filter, a satisfactory response over the exceptionally wide range of sidebands called for in this receiver. Accordingly a three-element filter has been worked out in which magnetic coupling is employed between the first and second circuits, and capacity coupling between the second and third. This gives a response curve with three subsidiary humps instead of the usual two, and, by suitable design, it has been found possible to produce a flat-top curve at least 20 kc/s wide with undulations of only a few decibels throughout its entire width.

The frequency-changer is a triode hexode in which special precautions have been taken to ensure a constant output from the oscillator section. An "anti-coupler" is also included between the cathode circuit of this valve and the aerial for the suppres-



Circuit diagram of receiver chassis. The output stage and power pack have been omitted as their connections are straightforward apart from the fact that the —HT lead is below earth potential.

Hartley Turner MA Receiver—

sion of second channel interference. The coupling between the two elements is adjustable by means of a set screw projecting from the top of the chassis.

To ensure adequate selectivity a low IF frequency has been chosen, the actual value being in the region of 110 kc/s. This is necessary as there are only three tuned circuits in association with this stage. The primaries of both input and output IF transformers are untuned, and the input transformer primary circuit includes a filter to prevent break-through of stations near the top of the long waveband which might depress AVC and reduce sensitivity.

The output IF transformer is interesting for the special type of resistance-coupled double circuit used in the secondary. This circuit not only gives an easily calculable response curve in combination with the single-tuned circuit preceding the IF valve, but it has been found useful to have circuits of slightly different selectivity from which to draw the voltage input to the signal rectifying and AVC diodes. Before leaving the tuned circuits it may be mentioned that for the most part they are litz-wound and provided with iron cores; the latter are useful in effecting the final adjustment of inductance for purposes of alignment, and, of course, a high circuit efficiency is obtained with screening cans of small dimensions.

The first stage of AF amplification makes use of a variable-mu pentode valve, and is used also to amplify the AVC voltage which is supplied to its grid after very thorough filtering in the somewhat complex RC circuits associated with the second detector. The −HT line is about 50 volts below earth potential, and the circuit is so balanced that with no signal a small negative bias remains at the grids of the frequency-changer and IF valves. A balancing resistance, adjustable by means of a set screw in the side of the chassis, has been provided to compensate for slight changes of current distribution should at any time a valve have to be replaced. Before leaving the first AF stage it should be noted that in the latest models the gramophone input is now applied at this point instead of at the grid of the triode second AF amplifier. This enables the output stage to be fully loaded with the least sensitive types of pick-up and also enables the advantages of tone control to be applied if necessary.

Recent improvements in the power factor of the tone correction choke have resulted in rather too drastic a reduction of bass response when the highest degree of tone compensation is being applied. Consequently a fixed series resistance has been added to ensure a suitable minimum reserve of bass response. At the other end of the control a switch reduces the fundamental resonance of the circuit from 9,000 to 5,000 cycles, thus giving a drastic cut-off of top (drastic, that is, by Hartley Turner standards) for cases of severe sideband splash.

A sharply tuned whistle filter of the balanced type, described in an article in the December 4th, 1936, issue, is included in the circuit coupling the triode second AF amplifier to the push-pull triode output valves. These, together with the power rectifier, are included in a separate chassis. Alternative power packs for 7 or 14 watts output are available, the particular unit with which the receiver was tested being of the 14-watt type.

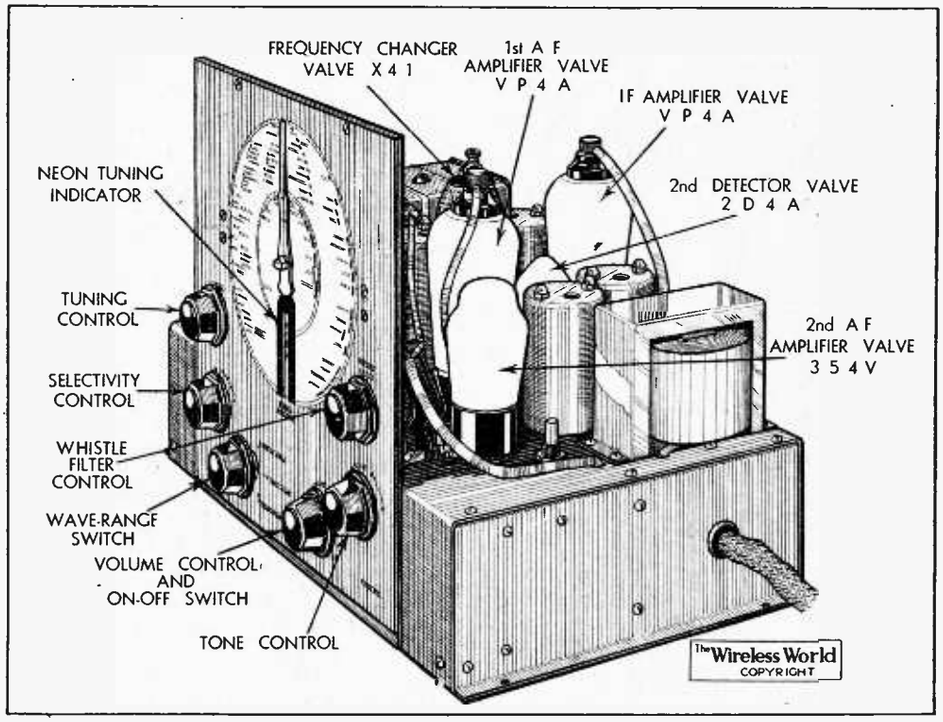
Partisanship is strong among enthusiasts for high quality reception, and it must be admitted that adherents of the Hartley Turner camp start with a very strong case. The new Duode-de-Luxe speaker has all the good qualities of earlier models—a remarkable clean bass response, freedom from modulation of high notes by low, and negligible harmonic generation—and, while its top response has been still further extended the quality in this region is less "edgy" than heretofore. There is still on occasion some emphasis on the letter S in speech, but generally this is symptomatic of errors in the adjustment of the tone compensation. Here the user has no meter to guide him, and the results must depend entirely upon aural judgment of what he considers to be the correct balance. Our own findings were that a setting of about one-third of the range of the controls from the positions of maximum selectivity and minimum bass response gave the best results for a wide variety of stations including the locals. With either the selectivity or the tone control near the extremes of this range it became increasingly difficult to restore the quality to its highest standard by adjustment of the complementary control. With the selectivity control adjusted to give the sharpest tuning we could approach to within two channels of the Brookmans Park transmitters before their modulation could be detected in the loud speaker. On long waves the Deutschlandsender was easily cleared of the modulation from Droitwich and Radio-Paris, but the 5,000-cycle cut-off was barely sufficient to eliminate sideband splash.

Sensitivity is very uniform over both wavebands, and although the general radio performance may not at first appear to be markedly superior to that of cheaper sets, there can be no possible doubt that for a given set of conditions the MA receiver provides a much superior performance from the point of view of quality. The tunable whistle filter is an invaluable adjunct, and proved to be capable of dealing with all the well-known heterodynes between stations without any apparent detriment to the quality of reproduction. The filter was also on occasion useful for removing one or two isolated and feeble self-generated whistles which would be overlooked in any ordinary set, but which acquire prominence when so many other common faults are absent.

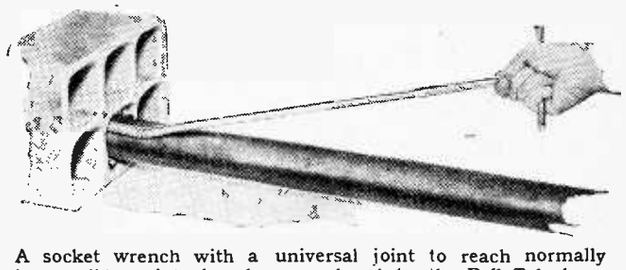
The circular 300° dial with well-arranged station calibrations is accurate to the extremes of its range, and can be read with comfort. Subsidiary kilocycle graduations are also included. The neon tuning indicator is mounted inside the circle of the dial itself and is screened from the four pilot lights at the back. A feature deserving of special commendation is the clear identification of the six controls on the ivorine panel.

Wiring and mechanical construction are neat and thorough, and a good deal of attention has been given to the grouping of decoupling and filter resistances. Another good point is that the aerial and oscillator tuning coils can be removed complete with waverange switch as a single unit.

This is undoubtedly an ingenious if unconventional design, and one which provides the quality enthusiast ample scope for experiment in tonal balance.



Controls are clearly marked and mounted on the large ivorine tuning panel.



A socket wrench with a universal joint to reach normally inaccessible points has been produced by the Bell Telephone Laboratories of New York City.

Mutton Dressed as Lamb

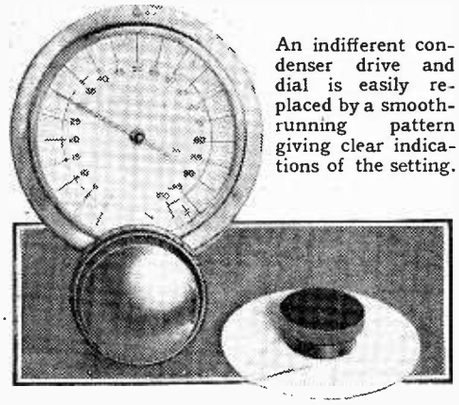
AIDS TO THE PROCESS OF REJUVENATION

By "CATHODE RAY"

A CONSIDERABLE time ago I read a somewhat entertaining article in a motor paper showing the various ways in which the ordinary family saloons, or the standard 8 or 9 h.p. "babies," are touched up to look like super-sports models, kept below 90 m.p.h. only by the superb restraint of their drivers. There is the long, sleek, sloping-fronted bonnet, eloquent of power till one opens it and reveals the puny engine and the false radiator; and the quickly detachable hubs, proclaiming half a mile away that here comes somebody who knows how to make a lightning pit stop in the 1,000-mile race. It is quite harmless, and keeps the plutocrat from having *all* the fun. And, incidentally, the pleasing lines of the modern moderately priced car owe not a little to such innocent make-up.

One might follow the same tendencies into more personal applications; but turning hurriedly to safer ground, I recall a visit to one of the B.B.C. subsidiary stations, resplendent as usual with highly efficient-looking control panels, all in the customary battleship grey (tropical shade). Only by very close inspection was it possible to identify one or two perfectly ordinary broadcast receiving sets, as sold over the counter at the local dealer's. Hiding behind their grey uniform they looked as correct in that exalted engineering atmosphere as Mr. Herbert Muggs in his scarlet outside Buckingham Palace.

Broadcast receivers, at full current list price, are marvels of cheapness. But if they are not on the current list, such



An indifferent condenser drive and dial is easily replaced by a smooth-running pattern giving clear indications of the setting.

cheapness seems by contrast almost an extravagance. The official allowance values for sets only one year old are around 10-15 per cent. of the original price. If cash is offered, there ought to be no difficulty in securing "slightly used" sets at nominal prices.

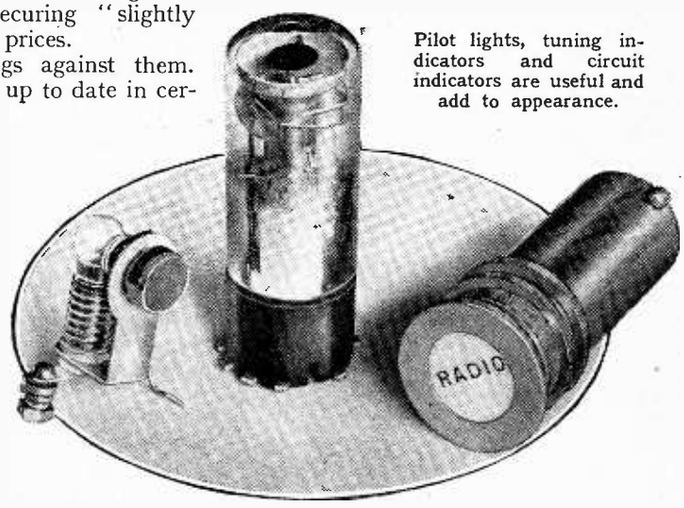
There are two things against them. They may not be quite up to date in certain aspects. Sometimes it is possible to do a little internal modernising. Or perhaps a more extensive rehash. The alternative of making up an experimental set right from ground level is a formidable business. The chassis and mountings common to all sets are more than half the job. By keeping one's eyes open it may be possible to acquire at almost negligible cost a junk receiver containing all the essential foundations, cans, and fittings; rewinding coils is comparatively easy work, and many of the original components may be worked into the new

Lever-type knobs are sometimes a great improvement over the awkward patterns fitted on certain commercial receivers.

design. Or perhaps there is a set which has an excellent RF and IF specification wasted on the ordinary pentode output. By cutting out the latter and substituting a proper push-pull stage and a good external loud speaker, a satisfactory equipment can be produced more cheaply than by buying a "custom-built" instrument, and more easily than by making it from the foundation up.

The other thing that pulls down the value of a set as each successive summer passes over its head is the appearance. It dates most terribly. The more technically minded enthusiast will not grant that even the latest model out of the factory has any charm, for domesticity is abhored by him. His ideal is a grim grey switchboard gleaming with meters, pilot lamps, and black bakelite knobs.

The year, make and unintellectual status of the bargain line can be successfully camouflaged without serious expense. The original cabinet is scrapped; the chassis is mounted, perhaps, in a steel box, such as those sold by Stratton



Pilot lights, tuning indicators and circuit indicators are useful and add to appearance.

& Co.; in any case hidden behind a new panel, or the old panel refaced with frosted aluminium or thin bakelite sheet of an appropriate colour.* A heterogeneous collection of apparatus can be given a uniform frontage in this manner without arduous toil expended on working thick panel material. For the brown knobs, moulded into the shape of rosettes or lotus buds, can be substituted something more after the style of those illustrated here. Some sorts of tuning control and scale, more especially those of the quaintly named "airplane" type, are not altogether incongruous; but if it gives the show away too badly it may possibly be replaceable by one of those that can be bought separately, such as the Eddystone Type 1070, which has ratios of 20 and 100 to 1, and an extended 100-line scale allowing settings of some precision to be made. Personally, I would put in a blank scale and calibrate it myself. White ivorine scales of exactly the right size (3½in. dia.) are sold by Bulgin, and to go with them they have "laboratory" knobs and transparent cursors with pinholes for marking an exact set-

* Ordinary aluminium sheet, as sold by metal merchants, of about 22 gauge, can be given a frosted surface by treatment with hot caustic soda solution, which must be handled very carefully as it is highly unpleasant in its effects on most substances, including the human person; and it may be difficult to find a suitable bath of unsurfaced iron for the process. Insulating panel material, in "natural" or black, can be obtained in all sizes and thicknesses from Ellison Insulations, Ltd. Sheet 1/32in. to 1/16in. thick is suitable for facing, and 1/4in. sheet stands on its own up to quite large areas.

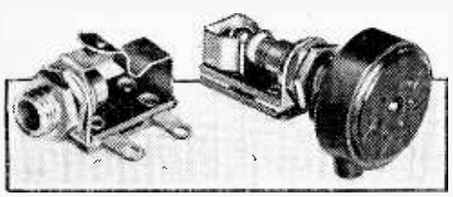
Mutton Dressed as Lamb—

ting with the point of a pencil. It is remarkable how impressive and attractive an effect can be gained by dotting a few coloured pilot lights about to show what is "on." They need not be ugly great excrescences like rear reflectors on bicycles; those shown in the photograph are only half an inch overall, and are obtainable in four colours, besides any others that you care to manufacture by painting the inner surface of the "white" window. These take low-voltage bulbs, which can usually be run off an LT supply; for mains voltage indicators a rather larger type of fitting must be used.

Measuring Instruments

For a real engineering appearance, of course, meters are immensely valuable, to say nothing about their incidental utility; but price is rather a bar, and the very cheap sort are worse than nothing, either for use or eyewash. The Ferranti 2-inch moving-coil meters are at least within the realm of practical consideration at the price of a guinea, and are genuine engineering instruments. I have had a milliammeter showing HT feed to the household receiver for the last six years; it is most valuable for showing up any abnormal condition even before one suspects it on other evidence. But if an instrument cannot be spared for a full-time job on the panel, why not put in a jack socket so that the portable meter can be plugged in as easily as the doctor applies a clinical thermometer when things seem unhealthy? There are several sorts of socket; for milliammeters there are those that maintain a closer circuit when the jack is pulled out; but for voltmeters the plain open-circuit type is obviously appropriate. Jacks are useful, too, for plugging in phones or extension lines, and for switching quickly over from one receiver to another.

A possible alternative to a meter, in certain circumstances when an exact *reading* is non-essential, is the so-called "magic eye" tuning indicator. The change of potential necessary to produce the full range of indication is from about 4 to 20 volts, according to the type of tube.



Meter sockets and jacks facilitate the checking of circuit conditions.

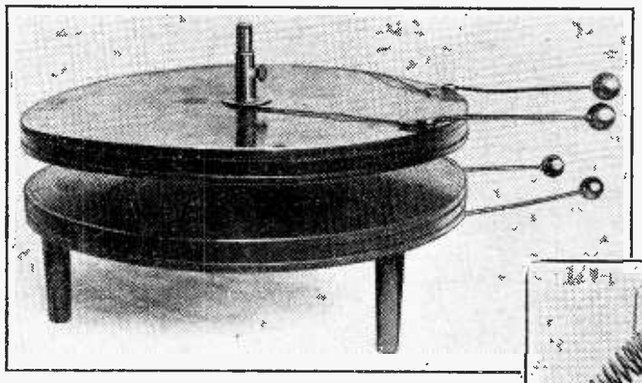
With a little window dressing it is possible to retain a satisfactory degree of self-respect even when funds are quite incapable of looking at a new receiver of a type that would do justice to one's local reputation. And, as I have tried to show, such beauty is more than skin-deep.

Fifty Years of Radio

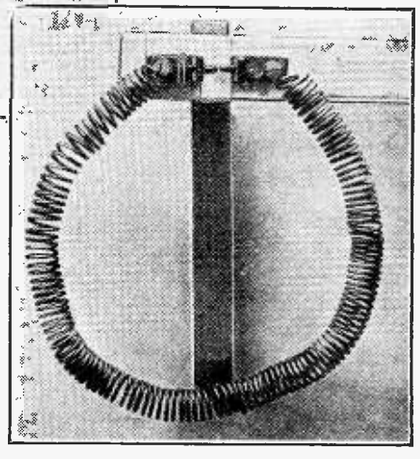
"HERTZ effected an achievement that will hand his name down to posterity as the founder of an epoch in experimental physics." These words, coming from such an eminent scientist as Sir Oliver Lodge, sum up the magnitude of Hertz's discovery which led to the development of wireless communication.

IN 1887, just fifty years ago, Heinrich Rudolf Hertz made the epoch-making discovery that the generation of rapid oscillating electric currents set up etheric disturbances which were detectable some distance away. Although it was some few years before practical use was made of this discovery, nevertheless it was the foundation of wireless communication.

Hertz, who was born at Hamburg on February 22nd, 1857, was a professor of Theoretical Physics at Kiel when he devoted much time to the study of Clerk Maxwell's electro-magnetic theory. This theory was that a conductor charged with electricity being suddenly discharged emitted electric waves. From Kiel he went as Professor of Physics to the Karlsruhe Polytechnic, and it was here, in 1887, that during an experiment he more or less accidentally made the discovery which proved Maxwell's theory. From this time, by laborious and often difficult experiments, he fathomed deeper and still deeper the phenomena which he had so happily discovered, publishing his findings in a number of papers addressed to the Berlin Academy of Sciences between November 10th, 1887, and December 13th, 1889.



Electric waves were produced by Hertz by means of what is now usually termed a Hertzian oscillator (left). The waves were detected at a distance by the simple "resonator" shown below.



Hertz showed that the electro-magnetic waves varied in length from an inch to one thousand miles, and proved that their rate of travel corresponded with that of light, and that they possessed all the fundamental properties of light, differing from light waves only in frequency and penetrating power.

Strange it is, indeed, when it is realised that Hertz did not seem to appreciate the full significance of his discovery, for when Huber, a civil engineer in Munich, suggested to Hertz that the oscillations might be used as a means of communication without wires, he discouraged the idea. He believed that the alternations of current in the telephone were too slow in comparison with the period of the electro-magnetic oscillations for it to be utilised in conjunction with them. The idea was left for others to develop, and Hertz missed adding further to his fame.

He was a very modest man and made no attempt whatever to turn his discovery into a commercial proposition. In letters to his people in July, 1887, he wrote: "My work has at last been crowned with success. It is not for me to say whether the discovery I have made is truly wonderful, but it makes me very happy to hear other people say so; moreover, I think that only the future will be able to judge of its importance, if it has any." He was, however, not to reap the full reward of his arduous labours, nor was he to see the adaptation of his simple "exciter" or oscillator and "resonator" to the wireless transmitting and receiving stations of Marconi's early experiments, for at the very early age of thirty-seven Heinrich Hertz died at Bonn on January 1st, 1894.

The loss to science by his death is aptly expressed in the words of Helmholtz, his late professor, when referring to the appointment of a successor to the Chair of Physics at Bonn, which Hertz had held since 1889: "No choice could be made as regards finding a successor who could continue Hertz's work, for he was really unique."

The outcome of the efforts of this great scientist is everywhere apparent to-day, and the strides made in fifty years in development from so simple a piece of apparatus as that used by Hertz is truly remarkable.

Listeners' Guide for

FOR those who by desire or necessity are unable to take part in or witness an outdoor event on Saturday afternoon, there is a diversity of interest in the matter to be broadcast which will keep them well informed of the progress at the big events of the day. It will be a very busy afternoon for the O.B. Department, for there are to be between 1.15 and 5 no fewer than eleven broadcasts from five different gatherings—at Westminster, Hendon, Wimbledon, Lord's, and Hurlingham.

The observers at the last four events will all be connected to a control panel at Broadcasting House where the O.B. official will be keeping in close touch with each of them. Should the schedule need to be varied he will, with ease, be able to inter-weave the various commentaries, and thus give a continuous review of events.

◈ ◈ ◈

H.M. QUEEN MARY

NOT the least important of the O.B.s for Saturday afternoon will be that when Her Majesty Queen Mary lays the foundation stone of the new Church House at Westminster. The broadcast of the ceremony will commence at 2.55 (Nat.) and continue until 3.30. During this time Her Majesty will be heard speaking as she declares the stone well and truly laid, after which the Archbishop of Canterbury will give an address.

◈ ◈ ◈

HENDON

THE annual R.A.F. display at Hendon, which this year will include some four hundred and fifty machines, nearly double the number of last year's pageant, will on Saturday provide three thrilling commentaries for National listeners. The broadcasts will be at approximately 1.45, 2.55 and 4.45. The commentators, Squadron Leader R. L. Ragg and John Snagge, will open the broadcast with an impression of the final of the Dive Bombing competition. The commentary will be punctuated with the roar of the 'planes. For this competition a target is erected in the middle of the aerodrome, and the competing pilots, using small bombs, come hurtling down at over 300 miles per hour to drop them on the target.

A description of a burlesque flying instruction will comprise the second episode. The instructor goes up in a machine and his pupil goes up in another, then begins a game of follow-my-leader, and some of the most crazy flying will be demonstrated by the pupil.

The broadcasts will end with a description of the fly-past of the new machines.

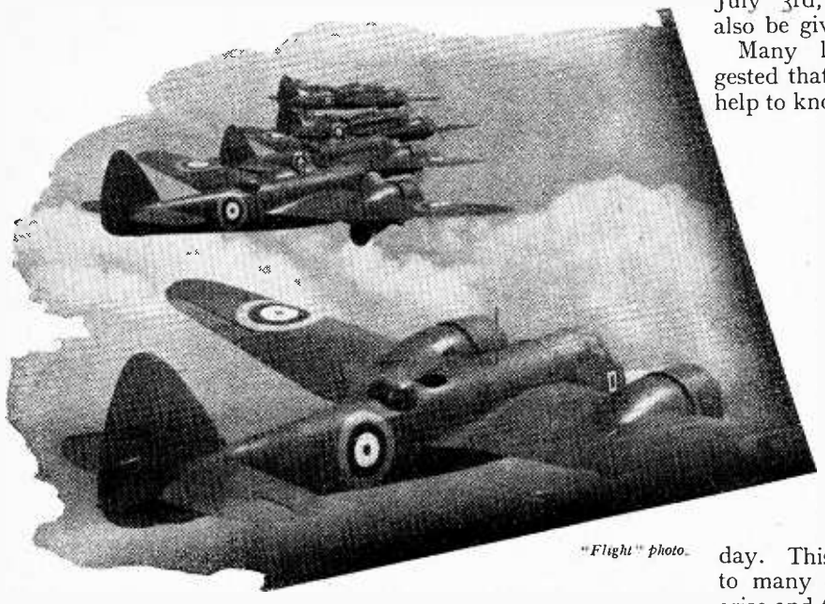
◈ ◈ ◈

WIMBLEDON

ARRANGEMENTS have been made by the Outside Broadcast Department to cover the All-England Lawn Tennis Club Championships during the whole of the meeting at Wimbledon. The commentators will be John Snagge, F. H. Grisewood, Colonel R. H. Brand, and Captain H. B. T. Wakelam.

On Saturday at 2, 3.15 and 4.15 (Nat.) descriptions of the progress in the matches on the centre court will be given. Each day, until the close on July 3rd, commentaries will also be given.

Many listeners have suggested that it would be a great help to know beforehand which matches are to be covered each day. This is impossible owing to many circumstances which arise and thus alter the existing schedule. Arrangements have, however, been made that daily at 2 (Nat.) an announcement will be made giving as accurately as possible the matches to be broadcast that afternoon with their approximate times.



"Flight" photo.

WORLD'S FASTEST BOMBERS. This photograph was taken from the sixth machine of a Bristol Blenheim Unit — No. 114 (Bomber) Squadron from Wyton, near Huntingdon. These planes will be seen at the R.A.F. pageant on Saturday, from which three "flashes" will be broadcast.

◈ ◈ ◈

LORD'S AND HURLINGHAM

THE first Test match between England and New Zealand at Lord's will provide four flashes in Saturday's National programme. Howard Marshall will be the observer, and will be heard at approximately 11.20 a.m., 1.15, 2.45, and 5. Descriptions of the second and third days' play will be given at intervals during Monday and Tuesday afternoons' programmes, the times of which will be announced each day.

Major G. Phipps-Hornby, the famous polo international, will give a running commentary on Saturday at 3.30 (Nat.) on the last three chukkas of the final polo match for the Champion Cup at Hurlingham.

◈ ◈ ◈

REVIEW BY HIS MAJESTY

THE address of His Majesty the King at the review of ex-Servicemen and women in Hyde Park on Sunday afternoon will not be broadcast as it is felt that this is intended for those whom His Majesty will be addressing. A description of the review, however, will be given to National listeners between 2.25 and 3.

◈ ◈ ◈

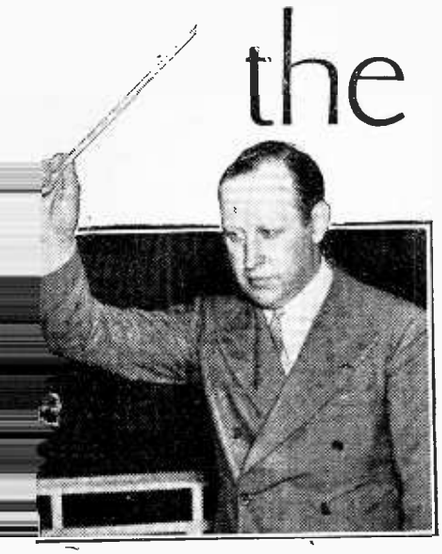
GALSWORTHY PLAY

"THE SILVER BOX," the first of Galsworthy's plays to see the light of day, which was produced at the Royal Court Theatre in 1906, will be heard by Regional listeners this evening (Friday) at 8.30. In it is to be found the burning compassion for the under-dog, the hatred of injustice and of the exploitation of the poor by the rich that is the theme of so many of his plays. Since the theme, that of "one law for the rich and another for the poor" is timeless, the play does not date.

AT THE PIANO, Victor Hely Hutchinson with Leslie Heward, standing by his side. Mr. Hutchinson will be playing the accompaniment for two vocalists when they give a recital of his songs on Monday at 7.30 (Reg.) He has written the music for the melodrama, "The Man in the Iron Mask," which will be broadcast twice this week.

the Week

Outstanding Broadcasts at Home and Abroad

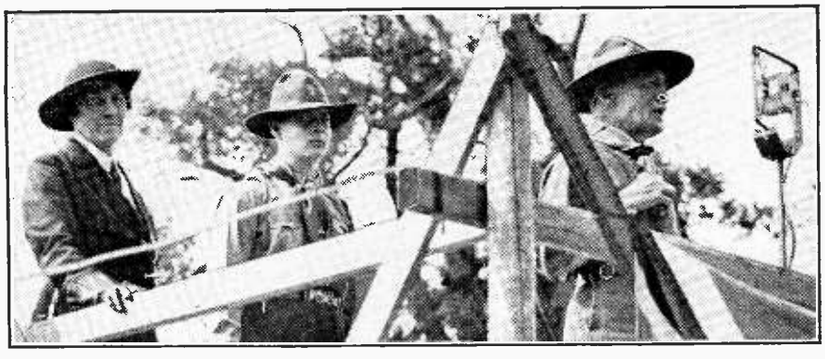


EUGENE GOOSSENS, conducting in the H.M.V. studios. Part of his new opera will be heard on Monday, with him conducting.

MEMORIES

THE nights when everyone in the house walked about gently for fear of shifting the cat's whisker from a sensitive spot of the crystal will be recalled by the presentation of Ernest Longstaffe's "Savoy Hill Memories" on Thursday at 8 (Nat.) and again on the Regional wavelength the following evening. Many of the pioneers of the days when the B.B.C. was first putting radio revues on the air will be taking part. They will be heard in some of the well-known sketches and double turns and singing the hits of the 1920's.

Among the artistes taking part will be Tommy Handley, who has been called the friendliest friend of the microphone; his wife, Jean Allistone, the well-known comedienne; Miriam Ferris, of the cleverly amusing character studies; Alma Vane, the original whispering soprano; and John Rorke. When Ernest Longstaffe had gathered the cast, he discovered that all but John Rorke appeared in his first broadcast revue.



THE CHIEF SCOUT, Lord Baden-Powell, with Prince Michael of Rumania and the Chief Guide at a recent Scout and Guide rally. He will be heard broadcasting a message to Empire Scouts on Saturday at 9.20 (Nat.).

"FAN-FARE"

THIS is the apt title of the Saturday night variety entertainment to be presented by Ernest Longstaffe in the National programme at 8, for it certainly is fare for radio variety fans. It will bring to the microphone Bertha Willmott, who, by the way, is in her twelfth year of broadcasting, and has during that time appeared in every type of programme put over by the Variety Department. Other stars in the programme include the Vagabond Lover, Murgatroyd and Winterbottom, the Southern Sisters, and Mabel Constanduros in a Buggins episode.

OPERA SEASON ENDS

ACTS III and IV of Eugene Goossens' new opera, "Don Juan de Manara," the first two acts of which were heard last week, will be broadcast from the Royal Opera House on Monday at 9.40 and 10.45 (Nat.) respectively. The composer will be conducting.

The last night of the season will bring to listeners Act III of Wagner's "Tristan und Isolde" at 10 (Reg.). The occasion is noteworthy in that the part of Tristan will be sung by Walter Widdop, the well-known English tenor, with Kirsten Flagstad as Isolde.

OPERA FROM ABROAD

THIS week brings two performances of "Carmen," both in French, as is fitting. The first is to-night (Friday) at 7.40 when Bucharest and Brasov give recordings by the Opéra Comique Company of Paris. The second is a full-dress performance from the Théâtre Antique at Orange, broadcast by the 60-killowatt station Nice Côte d'Azur on Sunday at 8.30.

Following their recently introduced custom the French stations are dividing the performance of Moussorgsky's sombre masterpiece, "Boris Godunov," at the Salle Gaveau between Friday and Wednesday. Four hours of this class of work would be far too much for most listeners, they are therefore giving the Prologue and Acts I and II to-night (Friday) at 8.30 from Eiffel Tower and Lyons. The third and fourth acts are being broadcast from Radio Paris at the same hour on Wednesday.

Lortzing's romantic opera, "Czar and Carpenter," is the work by which this composer is best remembered. It will be heard from Königsberg to-night (Friday) at 8.10. As is well known, its hero is Peter the Great, most gifted and most eccentric of the Czars, whose passion for amassing useful knowledge led him to work as a shipwright at Amsterdam and Deptford.

Rossini's "The Barber of Seville" will be heard from Milan on Sunday and from Rome on Tuesday at 9 on both occasions.

Germaine Taillefère, the foremost French woman composer, is the author of the comic opera, "Le Marin de Bolivar," which Radio Paris is broadcasting from the Théâtre des Champs Elysées on Tuesday at 8.30. Immediately after will be heard Manuel Rosenthal's "La Poule Noire."

THE AUDITOR.

HIGHLIGHTS OF THE WEEK

FRIDAY, JUNE 25th.

Nat., 7.50, Recital: Carl Flesch (violin) and Carl Friedberg (piano). 9.20, Viscount Halifax on The Responsibilities of Empire. 9.35, The Vienna Philharmonic Orchestra playing Bruckner's Symphony, No. 8.

Reg., 6, B.B.C. Military Band and Trefor Jones (tenor). 8, Midsummer Music—Janet Lind and Paul England. 8.30, John Galsworthy's "The Silver Box."

Abroad.

Eiffel Tower and Lyons, 8.30, "Boris Godunov," opera (Moussorgsky).

SATURDAY, JUNE 26th.

Nat., 1.45–5.15, Out of doors. 8, "Fan-fare." 9.20, The Chief Scout.

Reg., 6, The Air-do-Wells. 8, Concert by the B.B.C. Scottish Orchestra

Abroad.

Vienna, 8.5, 150 Years of the Viennese Waltz.

SUNDAY, JUNE 27th.

Nat., 2.25, His Majesty reviews ex-servicemen and women in Hyde Park. 6.50, "The Carlyles at Cheyne Row." 7.55, The Cromer Convention service from Cromer Parish Church. 9.5, "The Enchanted Island," operetta.

Reg., 5, Light music from Germany. 9.5, B.B.C. Orchestra (B) conducted by Eugene Goossens.

Abroad.

Vienna, 7.35, "The Count" of Luxembourg," operetta (Lehár).

MONDAY, JUNE 28th.

Nat., 7, Monday at Seven. 8.20, B.B.C. Dance Orchestra. 9.40 and 10.45, Acts III and IV of Goossens' new opera.

Reg., 7.30, English song-writers—Victor Hely Hutchinson. 8, "Weather or No": a revue in miniature. 9, Imperial Ballet.

Abroad.

Stuttgart and Frankfurt, 7.30, "Il Trovatore," opera (Verdi).

TUESDAY, JUNE 29th.

Nat., 7.50, B.B.C. Orchestra (B) and Alec Whittaker (oboe). 9.20, America to-day.

Reg., 8, Esta Stein and her Yiddish Chauve Souris Company. 8.30, "The Man in the Passage" (G. K. Chesterton).

Abroad.

Luxembourg, 9, Recorded concert version of Charpentier's opera, "Louise."

WEDNESDAY, JUNE 30th.

Nat., 6.40, Imperial Ballet. 8, "The Man in the Iron Mask": adaptation from Dumas' novel.

Reg., 7.30, Fingle Bridge—programme from the West. 9.50, Discussion—International travel restrictions.

Abroad.

Strasbourg, 8.30, Vienna Philharmonic Orchestra.

THURSDAY, JULY 1st.

Nat., 8, Memories of Savoy Hill. 9.20, Pianoforte recital—Edward Isaacs. 10.20, B.B.C. Orchestra (G) and Jelly D'Aranyi and Adila Fachiri (violins).

Reg., 6, "The Man in the Iron Mask." 7.30, Variety from the Argyle Theatre, Birkenhead.

Abroad.

Konigsberg, 8.10, "Madam Butterfly," opera (Puccini).

Current Topics

EVENTS OF THE WEEK IN BRIEF REVIEW

Iceland Calling

THE Reykjavik short-wave station broadcasts a programme in English regularly every Sunday at 7.40 p.m. (BST). The programme consists of news, a topical talk and musical selections. The station uses a frequency of 12,230 kc/s (24.52 metres) and a power of 7 kW.

A Remarkable S O S

WHILE flying between Prague and Warsaw recently an S O S was picked up by the wireless operator of one of the Air-France liners for Professor Bauer, the celebrated German surgeon, who was wanted at Breslau to attend an urgent case. Professor Bauer was on board, and the air liner immediately flew with him to Breslau, where he carried out a successful operation.

Wireless Operators to Strike ?

THERE is a possibility of a strike taking place among the wireless operators of the Kastrup air port near Copenhagen. They are seeking an increase in their present pay, which amounts to approximately £13 8s. a month, and so far they have not succeeded in obtaining it by peaceful methods.

Women Want More Talks

THE Czechoslovakian broadcasting authorities have decided to devote a far greater part of the programme time to features which are of special interest to women. They have been led to this decision by the fact that the majority of their correspondence is received from women. It is stated that women show a desire for a greater proportion of talks dealing with the concrete realities of life, and are far more serious-minded than men.

Wireless and Cable Laying

AN ultra-short-wave radio-telephone link was used by G.P.O. engineers across Loch Awe in order to co-ordinate the work of the parties on either bank who were engaged in the delicate task of laying cables across the notoriously irregular bottom of this particular stretch of water. These new cables will enable the main trunk telephone system to be extended to the Highlands and to the islands on the West Coast of Scotland. In the case of the Outer Hebrides the final link will be by wireless telephone from Oban.

Aeroradio Jubilee

IT is twenty-five years this summer since the first of a series of wireless tests were carried out between an aeroplane in flight and a ground station. In the initial tests the transmitting key was strapped to the knee of a pilot flying a biplane round an aerodrome upon which a ground station had been established. As a contrast it may be mentioned that on her recent non-stop flight between Southampton and Alexandria one of the new Imperial Airways long-range flying boats was in direct wireless touch with London during the entire flight, short waves being employed. On the projected North Atlantic flying route the air liners will be at all times in wireless touch with land.

Broadcasts to Schools

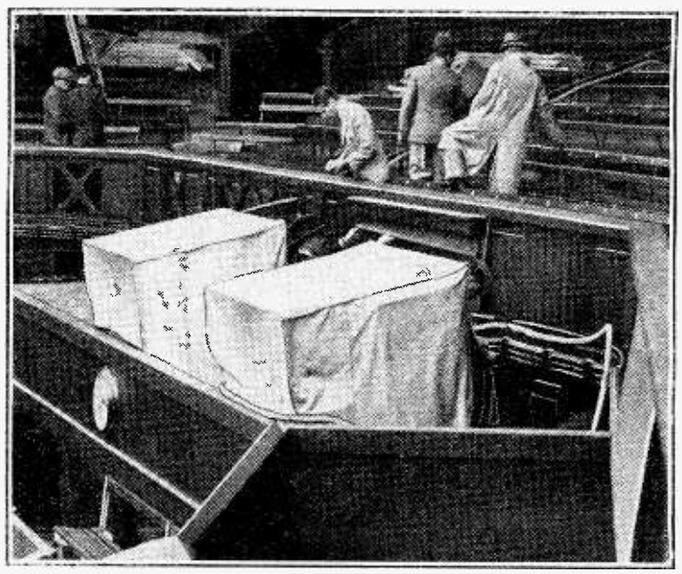
REPLYING to a question in the House of Commons, the Parliamentary Secretary to the Board of Education said that the number of schools in England, Wales and Northern Ireland which listen to the broadcasts to schools is 6,466 compared with 4,415 a year ago.

Burmese Broadcasting

THE Post and Telegraphs Department of Burma is at present engaged in carrying out experiments on short wavelengths at the Mingaldon station in order to decide upon suitable wavelengths for a Burmese broadcasting service.

Ship-to-Shore Telephony

PASSENGERS crossing the North Sea on ships fitted with wireless telephony can now talk direct to any telephone subscriber in Denmark via the station at Blaavandshuk. This station is situated near Esbjerg, which is the main gateway to Denmark for passengers from England, there being a daily steamer service between it and Harwich. The Blaavandshuk station has hitherto only handled morse, but has recently been entirely modernised and reconditioned.



TELEVISION FROM WIMBLEDON. The two cameras that have been keeping their eyes on those preliminary rounds of the Lawn Tennis Championships which have been played on the centre court are here seen protected from the elements during an inactive period. The cable connecting the cameras to the distant transmitter can be seen disappearing through the stand.

Radio Rowdies

THERE is a great deal of agitation in Paris against the loud-speaker nuisance, which is stated to be particularly bad among the municipal dwellings, to enter any of which gives the casual visitor the impression of visiting a madhouse. Car-drivers in particular are demanding to know why they should be compelled to put up with regulations which forbid the use of horns during the night while radio rowdies are allowed to make both day and night hideous.

Radio El Maghreb

AN Arabic wireless journal is to be published weekly in Morocco under the title of *Radio El Maghreb* (Radio Morocco).

Nearly 8¼ Million

THE total number of licences in force in this country at the end of May was 8,202,000, which represents an increase of 530,230 during the year. There were 360 successful wireless prosecutions during the month.

Wireless Trade Union

A NEW union affiliated to the French General Federation of Labour has been formed under the title of "Syndicat des Spécialistes Exécutants de la Radio." This Union will include wireless journalists, commentators, lecturers and those who adapt plays and other works for broadcasting.

An Interesting Appointment

MR. H. FRANCIS WHITE has become Marine General Manager of Messrs. Gambrell Radio Communications, Ltd. Mr. White was one of the early pioneers of wireless, and in his thirty-four years' experience has occupied many posts, including that of wireless operator on the maiden voyage of the Cunard liner "Caronia."

I.E.E. Appointments

THE Chairman of the Wireless Section. Committee of the Institution of Electrical Engineers for the year 1937-38 will be Mr. T. Wadsworth, M.Sc., who succeeds Dr. E. Mallett. Mr. W. J. Picken will be vice-chairman. Among the well-known names on the committee are those of Dr. R. L. Smith-Rose, Mr. E. B. Moullin, Mr. H. L. Kirke, and Mr. R. P. G. Denman.

More Wireless Schools

AS a result of the new regulations made by the Norwegian Government concerning the carrying of wireless by merchant ships there has arisen a great shortage of wireless operators. There are at present four training schools for operators, situated at Oslo, Bergen, Tonsberg and Kristianssand, which, between them, are turning out about 120 new operators every year. In view of the new regulations, however, it has been decided to provide courses for wireless operators at the various navigational schools in the country.

On the Short-waves

NOW that we have passed Midsummer Day it is probably time to consider rebuilding the 28 and 56 Mc/s transmitter, since conditions on 28 Mc/s are sure to be very good again from October to April. It is very difficult to say whether many 56 Mc/s transatlantic contacts will be made during this period, but conditions will certainly be more favourable to such contacts during the coming winter (in daylight) than perhaps at any other time during the sunspot cycle.

One feels, however, that there is in general an even better chance of 56 Mc/s working with South Africa than there is with New York, in view of the reports of consistent reception of the Alexandra Palace sound and vision signals on 41.5 and 45 Mc/s during last winter. The number of days on which signals were received in South Africa apparently considerably exceed those on which signals were received in the U.S.A. The peak month in both cases was February.

I am accordingly rebuilding my transmitter, retaining the usual crystal oscillator and doubler stages, using a Ferranti LP4 triode for the final doubler from 14 to 28 Mc/s, 8-watt (grid top-cap) pentodes being used for the earlier stages.

The final doubler drives a Marconi DET5 neutralised triode buffer, which in turn drives a new Marconi ultra-high-frequency triode—a DET12.

The DET12 is a new carbon anode triode of 50-watt dissipation, i.e., 150-watt carrier, at 75 per cent. efficiency; with the grid and anode leads brought out through seals on the top of the bulb. No difficulty is anticipated in obtaining quite a good output on 56 Mc/s.

From the standpoint of aerials, it has been decided to improve the existing 28 Mc/s horizontal array and to add a similar 56 Mc/s array, but having more stacks and erected to give maximum radiation to Africa.

There are probably some readers who will criticise my use of triodes, but it may be pointed out that, since one's licence is in terms of input power to the final stage, plate and not efficiency modulation is desirable, which rules out suppressor or grid modulation. You can, of course, apply "high-level" modulation to pentodes, but it is a more difficult business, especially if series modulation is employed.

Incidentally, it is pleasing to note that the G.P.O. are now offering some encouragement to the transmitting amateur, and 25-watt licences can now be obtained readily after six months' transmitting experience.

I must also compliment the "Interference Section" of the G.P.O. upon the manner in which complaints of B.C.L. interference are handled, and trust the G.P.O. will still further encourage the amateur and the vast potential market and internal development field which he could offer were he sufficiently numerous.

Conditions have been good during the past fortnight, although they started off rather below normal on Saturday, June 5th, but on Sunday W2XE, on 15.27 Mc/s, was really very good during the late evening, with W3XAL also very good and W2XAD down to second or third place.

On Tuesday, June 8th, conditions had still further improved and W2XAD was really excellent even as early as 9.40 p.m.; W3XAL, using his European beam, was definitely very good, too, at this time, the active band of signals extending from 19 to 14 Mc/s.

Since June 7th the "Press wireless" transmitter, W2XGB on 17.31 Mc/s, has been testing daily between 4 and 7 p.m. (excepting Saturdays and Sundays), and has been a good but over-modulated signal, also spoilt by a bad hum. This station sometimes relays WOR of the Mutual System.

During the rest of the week very good conditions prevailed and many signals were heard, but those of real programme value were confined to the American transmitters, with the possible exception of VK3LR, some mornings before breakfast on 9.58 Mc/s, and one or two of the Cuban transmitters.

To conclude these notes one would refer to the very excellent reception of W2XE on 21.52 Mc/s (13.94 metres) some afternoons, especially on Sunday afternoon, June 13th, when this station was practically equal to the London Regional, and no other U.S. transmitter could be heard above a very weak signal. A final point of interest is the broad band of frequencies over which reception has been good during the past week, on Wednesday evening, June 16th, for example, W3XAL on 17 Mc/s and W2XAF on 9 Mc/s were excellent.

ETHACOMBER.

Television Up to Date. By Robert W. Hutchinson, M.Sc. (Second edition.) Pp. 211+viii. Published by University Tutorial Press, Ltd., 25, St. Giles High Street, London, W.C.2. Price 2s. 6d.

IN the words of the author, this book is intended for beginners and experimenters in television, and he consequently assumes little knowledge of electrical matters on the part of the reader, and commences in Chapter I with an outline of the electrical theory of matter. He goes on to deal very briefly with fundamental electric and magnetic conceptions as well as simple optics. The second chapter contains a discussion of high-frequency currents and their radiation and also a description of the action of the valve.

This preliminary outline occupies about one-fifth of the book, and in the third chapter we find the first reference to television proper. Here low-definition television with mechanical methods of scanning is treated. Later we come to high-definition television and the reasons for the use of ultra-short waves are explained in detail. The various systems adopted at the transmitter, such as the electron-image camera, the Iconoscope, and the intermediate film camera are briefly described. A chapter is devoted to the receiving cathode-ray tube and time-bases are touched upon.

A misleading statement occurs in connection with receiving aerials, for the author describes a horizontal dipole and goes on to say that if it is inconvenient to erect such an aerial it may be fixed vertically. Actually, the receiving and transmitting aerials should be in the same plane, and consequently a vertical aerial is normally essential for reception.

This is a minor point, however, in a book which is otherwise unusually free from errors. It is extremely wide in its scope and can be recommended to those wishing to obtain a bird's-eye view of the subject.

W. T. C.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

"Broadcasting to Schools"

I AM in the sixth form at school, and there we regularly listen to the talks for sixth forms on Friday afternoons. For this purpose a schools' model radiogramophone has been installed in the music room and several extension speakers placed in various classrooms, one of these being usually used for the talks.

Now although high fidelity is not necessary, at least a tolerable likeness of the original should be aimed at. One would have to be kind to call the reproduction given by the built-in speaker tolerable, and at times that from the extension speakers—these in small boxes placed flat against a hard wall—is hardly intelligible.

If this sort of thing is general it is surely time some interested body took upon itself to give demonstrations with really suitable apparatus. I know a committee has been set up, but seeing that the set mentioned is a model recommended by it, there seems to be need of something else.

An interesting sidelight is a master's comment after a quarter of an hour of particularly bad booming—"Mr. Shaw's voice is evidently not suitable for broadcasting."

Sheffield, 2. E. F. GOOD.

Superhet v. *Straight Receiver*

I HAVE received numerous communications anent my published letter of May 28th, 1937, and many points of interest have been raised. Indeed, one kind manufacturer sent me a great deal of information relative to the basic design of his apparatus, and, I am glad to say, the primary objective in his case is to provide really faithful reproduction. The various points raised prompt me to make further comparisons of the two types of receivers on parallel grounds, and after my criticism I propose to make some suggestions which I believe to be original, and which should provide food for thought. It is obvious the fundamental difference in the two types lies in the high-frequency section, therefore audio-frequency technique need not be considered.

The signal-frequency tuned stage of a normal superhet is usually a band-pass filter, the first section of which is in the aerial circuit and so subject to damping; the second section is in the grid-cathode circuit of the pentode or tetrode section of the mixer valve. In a TRF receiver an almost identical state of affairs exists, excepting the first valve is usually a pentode or tetrode instead of a mixer. All the same, it is fundamentally identical. Therefore, the disadvantage of varying band width over the complete rotation of the tuning condenser is present in both types of receivers. The claim that a superhet. gives constant band width because of a fixed intermediate frequency is thus disproved, since the signal-frequency circuit is the governing factor. It is not disputed that the signal-frequency band width may be adjusted to give a minimum of, say, 10 kc/s, in which case the maximum may be even 20 kc/s, thus providing comparatively poor signal-frequency selectivity. Also, it is not disputed that operating the band-pass filter between two valves instead of in the aerial circuit, for one part, does give improved results. This must apply equally to both types. Therefore, the TRF receiver is the absolute equal of the superhet. at signal frequency. We are then left with the IF circuit to consider. As is known, a fixed relationship must exist between the local oscillator and intermediate frequency; thus a drift in the constants of each or either materially affects this relationship, and thereby destroys the selectivity and effective band-width constants of the IF amplifier, not to mention ulterior effects. It must be clear to most readers that the stability of these circuits is by no means good enough to attain the constancy demanded. This is a very weak spot in superhet design. In contrast, the trimmer drifts in TRF receivers do not make nearly so great a difference, since each circuit is operating at a common frequency. So far it would appear that I unreservedly champion the TRF receiver. Yet this is by no means the case. I believe a complete modification in superhet. design would give much better results overall. We have seen how selective signal-frequency circuits are disadvantageous, and also how the superhet. depends largely upon the IF circuits for selectivity. We have also seen how stability plays a very important part in the latter. The writer, therefore, makes the following proposals:—

(1) The signal-frequency circuit should be either aperiodic or very flatly tuned throughout,* and should be buffered before the mixer valve. An admirable arrangement would appear to be Colebrook's resistance-coupled triode arrangement. The main purpose of the buffer is to prevent radiation of the local oscillator into the aerial circuit. A single tuned circuit, not band-pass, is indicated in the first stage.

(2) The oscillator portion of the mixer should preferably be driven by an oscillator of the Dow electron-coupled type, the anode of which should be tuned to the frequency of oscillation to afford a good degree of harmonic filtration.

(3) The most important item. The first IF circuit should be of the wide-band (say, 9 kc/s) quartz crystal filter type. That this is feasible is aptly shown by the recent work and papers of W. W. Waltz. Herein we have *real* stability, definite selectivity, and an almost dead square response characteristic attainable.

(4) A second IF amplifier can be fitted having quite wide-band width characteristics (since the first IF provides all necessary selectivity) and used for a measure of amplification as well as subsidiary functions such as AVC.

To recapitulate. The signal-frequency circuit simply has no selectivity, and so does not cut side bands of the denomination we have interest in. The IF channel is a highly stable circuit of very definite characteristics, with close approach to square-top bandwidth. Herein I consider to be a more feasible solution for to-day's problems.

Portsmouth. "NAUTICUS."

I HAVE read with much interest the remarks and letters in *The Wireless World* concerning the respective merits of the superhet and straight set. I would add my comments on the matter, as requested of readers.

Technically I am not well versed in the merits or details of one or the other set, but practically I know which I like—the straight set. I have built many *Wireless World* receivers, but never of the superhet variety; perhaps a certain complexity suggests itself and deters me, but a friend of mine—an ardent home constructor—has tried his hand at one or two superhet sets. "Snags" seem to arise everywhere, so I have kept to the straight set. I built and still run *The Wireless World* AVC Straight Four some three and a half years ago. I have made certain alterations such as using a double diode triode instead of pentode, and I have added a 2½-watt Duophase Amplifier (the set and amplifier being in two units) on the style of the Haynes Radio units, and, with all due respect, I back my set for quality and volume (the latter perhaps to a lesser degree) against my friend's Quality Amplifier and superhet.

"Nauticus," in a recent issue of *The Wireless World*, puts forward sound arguments for both types of receivers, but he seems to favour the "straight." So do I. A good modern straight can easily hold its own against a superhet on all points. It is time *The Wireless World* considered a modern product (in two units, please, set and amplifier), so what about it, Mr. Editor?

Bournemouth. E. J. B. CURTIS.

AS a service engineer dealing with many receivers daily, I wish to reply to your correspondent "Nauticus."

I fail to see why a superhet is more prone to morse interference than a TRF set, when the interference is at signal frequency.

In my opinion, the reservation of a special IF channel would be useful but impracticable. It is unusual nowadays to find a superhet that causes any *serious* aerial reradiation. Self-generated whistles are rarely troublesome, except on cheap or poorly designed superhets.

I am afraid "Nauticus" does not display a great knowledge of the radio trade; the reason superhets are so popular is the fact that they can be manufactured to give a satisfactory performance in the way of selectivity and ease of working for a price the public are prepared to pay.

It would be impossible to produce a TRF receiver of comparable performance at a comparable price. Selectivity of a receiver depends to a large extent on the number of tuned circuits incorporated, and the cheapest superhet generally has seven, and to make a TRF set with the same number is an expensive job, especially as the public rightly demands one-knob tuning control.

Also, high fidelity can be secured more easily with a superhet than with a TRF—this can quite easily be proved by anyone with a QA super.

In my experience the public do not desire a flat high-frequency response up to 10,000 or so c/ps, as this accentuates any interference they may pick up and causes many dealers' service men wasted hours explaining that the set is in perfect order.

Although I myself fail to understand why a manufacturer uses a double diode pentode instead of two separate valves, the reason

* Much like Single-Span principles.

pentodes are used as output valves is to save costly LF amplification.

I consider the superhet has come to stay, and think Philips would be the first to confirm that the cost of making a super-inductance receiver cannot compare with that of a superhet of equivalent performance. What about a "super inductance superhet"? H. J. DIX.

Erith, Kent.

I WHOLEHEARTEDLY agree with the last part of "Nauticus'" letter on "Straight Circuits v. Superhets."

I have had wireless from the early days of Writtle and have made numerous sets, crystal, reflex, Hartley, "W.W." Everyman Four, etc., but have never made a superhet.

Three years ago I purchased one for £14 and sold it in less than a year for £3 10s. I then went back to *The Wireless World* Ferrocart Three, which I am still running.

Although my own experience of superhets. is therefore very limited I have heard a number and have friends who have them. With the exception of the ones that only millionaires can afford I have not yet heard one that comes up to a good straight for quality. I do not profess to have heard the whole bunch, but I have heard enough.

Personally, I regret the tendency of both manufacturers and the technical Press to concentrate on superhets. In the case of the latter, I think it is a rather short-sighted policy. The people who can readily build a straight set are not always prepared to tackle a superhet.; there is a feeling that this requires special instruments to calibrate it.

Years ago thousands of people made up their own circuits, and I really believe that it was the lack of attention that was given to straight circuits that caused them to cease doing so.

There are without doubt thousands of people who are quite content with really good quality on locals and just a few foreign stations that the straight set can easily get.

Why all straight sets end at three valves and consider band pass the start and end of things I cannot imagine.

Unfortunately, I rather doubt whether much can be done now. The set-constructing class is to-day far less numerous, and probably now works sets manufactured without much regard to fidelity, either high or low. J. W. B.

Marconi Equipment at S.B.A.C. Exhibition

NEW DESIGNS OF RADIO EQUIPMENT FOR USE IN AIRCRAFT AND AT GROUND STATIONS

A WIDE range of wireless transmitting and receiving equipment for aircraft will be shown by Marconi's Wireless Telegraph Company at the annual exhibition to be held at Hatfield on June 28th and 29th by the Society of British Aircraft Constructors. New equipment for military, passenger and transport aircraft has been developed by this firm, which has had experience in the design and manufacture of this type of apparatus since wireless was first used for the purpose of communication between the air and the ground.

Compact medium-wave radio equipment, Type A.D.41C/50C, designed by Marconi's Wireless Telegraph Co. for use in privately owned aircraft and fitted to a D.H. Rapide aeroplane.

Of special interest will be the many different types of direction - finding apparatus both for use in the air and at ground stations. The Marconi-Adcock spaced aerial system, designed to eliminate night effect, has been improved and the latest type of equipment embodying this system is to be shown.

The type D.F.G.12 is for use on the short waves, and has an aerial of this pattern.

There will be shown also some ultra - short - wave telegraph and telephone transmitting and receiving sets for use on wavelengths of from 1.8 to 2 metres.

Random Radiations

By "DIALLIST"

Short-Wave Receivers

A GOOD many people have expressed surprise to me that so many of the outstanding feats of short-wave reception are accomplished with quite small "straight" receiving sets and not with superhets. On the face of it it's a bit of a mystery, for actual measurements show that far more amplification is obtainable from the superhet with an efficient IF stage than from a three-valve "straight" with reaction. It is quite true that telephones are generally used with the small "straight" when searching for the less-strongly received stations, and it is amazing how feeble a signal a sharp pair of ears can pick up via headphones. But telephones can, of course, be used with the superhet.... Or can they? I think that if you try them with a small superhet in a search for weak and distant short-wave stations you won't find them too satisfactory. The trouble with the superhet is that when you give it its head with the volume control its own noisiness may be distinctly distressing when sensitive phones are in use, and quite sufficient to drown feeble incoming signals. Thus you can work the superhet only in such a state of sensitiveness that the internal noise level is not too obtrusive. In other words, you can make use of only a proportion of the amplification that is theoretically available. But if the "straight" set is well designed and well made you can make the very fullest possible use of all the amplification of which it is capable.

The Reaction Problem

Or, rather, you can do so if the reaction control is so perfectly smooth that it is possible to work the set on the very verge of oscillation without its plopping over. And that's a point worthy of the consideration of those who make small straight "all-wave" sets for those who want to hear short-wave stations but can't afford to pay much for their equipment. To produce velvet reaction, even in a set designed for the short waves only, may be no easy matter, as old hands who build their own apparatus know by experience. It wouldn't be possible to provide perfect reaction control on all the wavebands covered by a low-priced straight "all-wave" set, for manufacturing costs would be prohibitive. Still, I do think that manufacturers of such receivers might well strive for improvement on the short-wave ranges of their products. Fierce, plopping and overlapping reaction doesn't make for easy tuning, and short-wave results may be disappointing even if the operator has some skill.

A Television Disappointment

ONE of the disappointments of the Television Exhibition at the Science Museum—or perhaps I should say its only disappointment—is that the Scophony people are not demonstrating apparatus for the reception of television signals from the Alexandra Palace. Instead, they are making their own 240-line transmissions from their laboratory, which is no great distance away. Quite apart from the fact that one would have liked to be able to compare Scophony reception of the A.P. programmes with that of receivers using cathode-ray tubes, a 240-line instrument with 25 frames a second cannot possibly have the same definition, smoothness and freedom from flicker as the others receiving the 50-frame interlaced scanning transmissions. Big-screen television would be much more satisfactory and convincing if the normal programme service could be received.

Vacuum Cleaning

POSSIBLY you've discovered the usefulness of the domestic vacuum cleaner for keeping the inside of your receiving set reasonably free from dust, or the idea may have been suggested to you by the recently published picture of an American radio blower. I need hardly say that you should switch off the set before using the cleaner, and, better still, disconnect it from mains or high-tension battery, as the case may be. But apart from its possibilities as a causer of short circuits, the metal nozzle of a vacuum cleaner is perhaps rather a dangerous thing to introduce amongst such fragile and expensive affairs as wireless valves. You can make everything perfectly safe if you obtain about a foot of rubber hose-pipe just big enough to fit the vacuum-cleaner tube. It's well worth while to give the set a regular clean in this way, for it's surprising what a lot of dust accumulates within it even in the cleanest of living rooms. The backs with which many receiving sets are fitted are supposed to act to some extent as dust excluders, though, myself, I very much doubt whether they do anything of the kind. There are a good many holes in most of them, and as the set warms up currents of dust-laden air are drawn in though these.

Why Have Backs?

There is only one good reason that I can see for having any kind of back to the cabinet of a receiving set, and that is that it acts not only as a dust-excluder but as a fool-excluder, preventing the cheerful idiot who does not know the first thing about electricity from tinkering inside his set whilst it is working. My experience is that in many cases the back with which the cabinet is fitted adds considerably to the natural boominess of the small receiver; in fact, I always remove the back entirely from any battery set that comes my way. I haven't tried the experiment, but I should think that a foolproof back for mains sets could be made from fine-meshed wire netting. And whilst I am on the subject of cabinet backs, may I beg makers of battery sets to discard for good and all the method of attaching them by means of half a dozen screws? There may be a little door which opens to enable you to change the LT accumulator, but it's really a bore to have to remove and replace a lot of silly little screws when it comes to renewing the HTB.

Wireless and Fish

IF you are a fisherman, as so many people are to-day, you may find your wireless set a useful ally owing to the predictions that it issues of unsuitable conditions. I am not referring to the weather forecasts or anything of that kind, but just to the behaviour of the set itself. I have often noticed that it is no good going out for salmon or trout on days when atmospherics are frequent and violent. I expect it's the same, too, with other fresh-water fish, and possibly with sea fish as well. Fish always seem to be off their feed at times when there are electrical disturbances about, so if you contemplate an expedition with rod and line it's just as well to switch on the wireless set beforehand. It may not tell you when conditions are going to be favourable for good bags, but it will tell you when they are likely to be just the reverse.

What's Your Resistance?

Some time ago "Free Grid" cast doubt on my statement that the human body's resistance was lowered after a hot bath. He proposed, if you remember, to demonstrate by experiment that it was not, but was advised by his doctor not to do so. Well, here's a perfectly safe way of discovering how much your own DC resistance varies. All you need in order to find out is a microammeter or a sensitive milliammeter and a 9-volt grid battery. A measuring instrument which answers very well is the "One-meter," which, with no shunt in circuit, reads from 0 to 2 milliamperes, each division of its fifty-division scale representing 40 microamperes. Connect the negative socket of the grid battery to the negative terminal of the instrument, hold the bared end of a lead from the positive terminal of the instrument in your left hand, and press your right forefinger on to the positive socket of the battery. I find after making tests on myself that with dry hands a current of about 40 microamperes passes, indicating a resistance of the order of 225,000 ohms. If I wet my fingers with cold water the current rises to 100 microamperes (resistance 90,000 ohms). But after washing my hands in hot water and leaving them still damp the current registered is a full 160 microamperes, which means that the resistance is down to one-quarter of what it was originally. The experiment is quite an interesting one to make. Try it and see what your own resistance figures are.

He Jumped!

Talking of "body resistance" reminds me of an incident which happened during the war in a battery whose commander (high-tension, I hope) I was. A signaller had been sent out to locate a fault in a telephone line and found a break not very far away. He wanted to make sure that the rest of the line was in working order, and, remembering that you can "taste" a feeble current, he put the broken ends into his mouth. The leap that he gave must have come near to breaking all high-jump records had there been anyone there to measure it. Unfortunately for him, the 'phones in use were, for some reason or other, not of the standard Army type, but were Siemens' instruments, which used a 3-volt battery with a high-ratio transformer and gave a pretty useful line voltage when the buzzer key was pressed.

Human Receivers

STORIES of people who claim to be able to hear broadcasting without the aid of any kind of receiving set are always cropping up, and though we may probably dismiss at least ninety-nine per cent. of them as mere instances of hallucination there may

be something in the remainder which is worthy of investigation. After all, the human body does possess several pretty efficient detectors of waves of various kinds in its apparatus for seeing and hearing, and possibly also, in those concerned, with feeling and smelling. There are many who believe that the process of thinking involves some kind of radiation, which might partly explain why it is that we so often know what is going on in a friend's mind before he puts his thoughts into spoken words. Probably, too, you've many times tried with success the experiment of making a person some distance away turn and look at you simply by willing him to do so. If such things are concerned with radiation it seems just within the bounds of possibility that some people are able to detect radio waves of certain frequencies.

BOOK REVIEW

Thermionic Valves in Modern Radio Receivers. By Alfred T. Witts, A.M.I.E.E. Pp. 192+x. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 8s. 6d.

IN his preface the author states that "this book is for the purpose of presenting an outline of the theory and practice of the application of thermionic valves to modern radio receivers." He opens with a discussion of electron emission and continues in the second chapter to treat fundamental valve characteristics. These two chapters are good and a clear, if elementary, picture of the valve is given in a manner which can be understood even by those whose technical knowledge is limited.

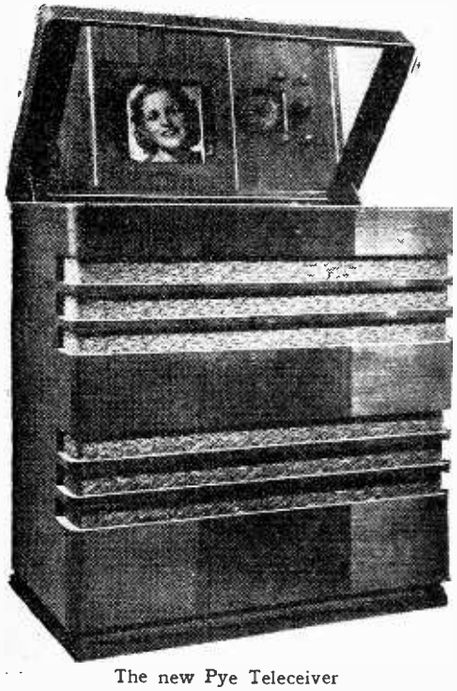
The succeeding chapters deal with the application of valves to various circuits, and here the author has created unnecessary difficulties for himself by electing to commence with the difficult subject of detection. The amplifier is much easier to understand than the detector, and it is consequently logical that its discussion should be taken first. The reader may thus find it helpful to read chapters III to V in inverse order.

The treatment is fairly extensive and should enable a good insight into the operation of many circuits to be obtained. There are, unfortunately, some errors. The description of the operation of the diode detector, for instance, is incorrect and would only be true if there were no load circuit. This error is surprising because the same action is correctly described later on in connection with the grid detector, and it is unfortunate because unless one understands how it works it is difficult to follow the action of the AVC circuits which are treated later.

Several errors occur in the treatment of AF amplifiers; one is of fundamental importance and is repeated several times. It is the assumption that reactance and resistance can be added directly. In speaking about the coupling condenser C and grid leak R2 of an RC amplifier on page 95 this surprising statement occurs: "If, for example, the reactance of C at any particular frequency is equal to the resistance of R2, the voltage provided by R1 (the coupling resistance) will be equally divided over C and R2 and only half will thus be applied to V2." The addition of resistance and reactance must, of course, be made vectorially, and as a result the efficiency of the coupling when resistance and reactance are equal is not 50 per cent., but 70.7 per cent. This error is not only repeated in practical examples on the following page, but crops up again on page 99 in the discussion of transformer coupled amplifiers.

Apart from these blemishes the book enables a good insight into the working of valves in modern receivers to be obtained. In few cases does the author go sufficiently deeply enough into the operation to enable the reader to carry out any design, nor does he mention the operating limits often imposed on modern valves by their makers, limits such as the maximum permissible resistance in the grid circuit and the maximum allowable voltage between heater and cathode. Several important applications of valves are also omitted, notably AC/DC apparatus and the rectifier for HT supply.

W. T. C.



The new Pye Teleceiver

Pye "Teleceiver"

Incorporating "All-wave" Receiver

THIS new television receiver is now being demonstrated at the new showrooms of Pye Radio, Ltd. It has an unusually comprehensive specification which includes a 4,000-volt cathode-ray tube with electrostatic line deflection and magnetic frame deflection. There are five chassis units comprising the vision unit, time base and sync separator, Type T10 broadcast receiver chassis, sound channel feeding to the gramophone input of the T10 receiver and the power pack with three rectifiers. The price of the Model 4044 is 75 guineas, and this includes supplying and fixing a special television aerial as well as servicing for a period of one year from the date of purchase.

McCarthy Model S7AW

THE makers of this receiver chassis ask us to point out that the price given in our review does not include a loud speaker, as was stated. A suitable loud speaker can, however, be supplied as an extra if desired.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

CONTROLLING SELECTIVITY.

IN most systems of automatic selectivity control the determining factor is the strength of the incoming signal, the circuits being broadened to take all the sidebands when the signal is strong and tightened up, to cut out interference when the signal is a weak one from a distant station.

It is the object of the invention to secure a more elastic control by making the presence of interfering signals the primary factor in regulating the selectivity of the circuits. Under these circumstances, the tuning can be broadened, so as to accept all the sidebands required to give high quality, even in the case of a distant station, so long as there is no danger of interference from another station. If, however, interference is threatened, the tuning of the circuits is automatically tightened up to give a higher degree of selectivity.

Murphy Radio, Ltd., and L. A. Moxon. Application date September 18th, 1935. No. 462832.

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AERIALS.

THE down-lead from a dipole aerial consists of a twisted pair of wires, one of which is screened and the other not. Both are taken to the set through a switch. On one setting of the switch the down-lead acts as the usual transmission-line for short-wave reception, the screening element being left "floating" and, therefore, inoperative.

On the alternative switch setting the screen is connected to earth, one of the two lead-in wires is left "floating," whilst the other is screened from local inductive interference, and is connected direct to earth for receiving medium-wave broadcast signals.

K. C. Bridges. Application date January 14th, 1936. No. 462571.

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TUNING INDICATORS.

THE full sideband "spread" of a broadcast transmission may extend over roughly 20 kc/s, whilst the band-pass characteristic of the modern receiver is usually restricted to about 8 kc/s. The difficulty then arises that ordinary automatic tuning control systems are not designed to distinguish between the case when the receiver is tuned (a) so that the incoming carrier-wave is symmetrically arranged with respect to the response curve of the circuits, and (b) when the carrier-wave is not so favourably disposed. In the latter case distortion may be produced.

To prevent this, the anode circuit of the IF amplifier V of a superhet set is arranged as a Wheatstone bridge, containing two circuits A, B, one of which is tuned, say, 3 kc/s above, and the other 3 kc/s below, the intermediate frequency. If the set is not correctly tuned, the unbalanced voltage across the diagonal X, Y of the bridge is rectified at R, and applied to trigger a gas-filled valve V1, which thus produces a warning light on the tuning scale. The glow valve V1, which may be mounted behind an indicator scale of the moving-slot type, is energised from the mains supply at M.

Marconi's Wireless Telegraph Co., Ltd., and R. F. O'Neill. Application date September 7th, 1935. No. 462328.

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AIRCRAFT WIRELESS

TO facilitate landing in fog, or under similar conditions of bad visibility, an aeroplane is fitted with a dipole aerial which is constantly rotated about its centre by means of a small airscrew. In this way the aerial is made to trace out two cones about an axis which is located in a plane containing the direction of flight, but which is inclined at a small angle to the horizontal when the aeroplane is flying on a level keel.

The pick-up voltages are fed to a commutator switch, rotating at the same speed as the aerial, and, in combination with a transmitting beacon, give "up and down" or "right and left" indications according as the plane deviates from the correct landing "glide."

A. H. Cooper. Application date September 7th, 1935. No. 462464.

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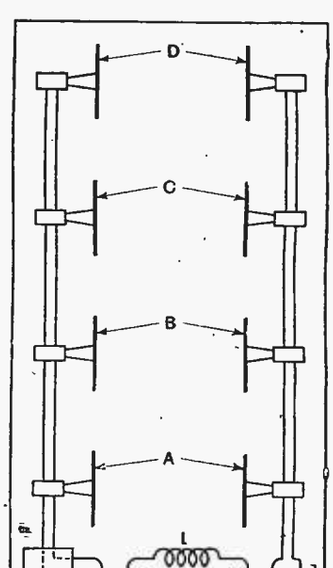
DIRECTION FINDING

A DIRECTIONAL aerial of the Adcock type is arranged to discriminate between signals which arrive at different vertical angles of incidence. The figure shows the two opposite pairs of a spaced-aerial arrangement, which, in practice, is supplemented by a second similar arrangement set at right-angles to the first. The dipoles A - - - D are all coupled at T and T1 to one of the field-coils L of a radiogoniometer. The other field-coil is not shown, but would be similarly coupled to the second or supplementary pair of aerials.



Method of assembling spaced dipole aerials for direction finding.

The directional field of the dipoles A - - - D is substantially circular in the horizontal plane, but is limited in the vertical plane to a comparatively small angle of incidence. This cuts out any unwanted signals that may reach the aerial from different angles of inclination.

R. W. W. Watt. Application date September 19th, 1935. No. 463052.

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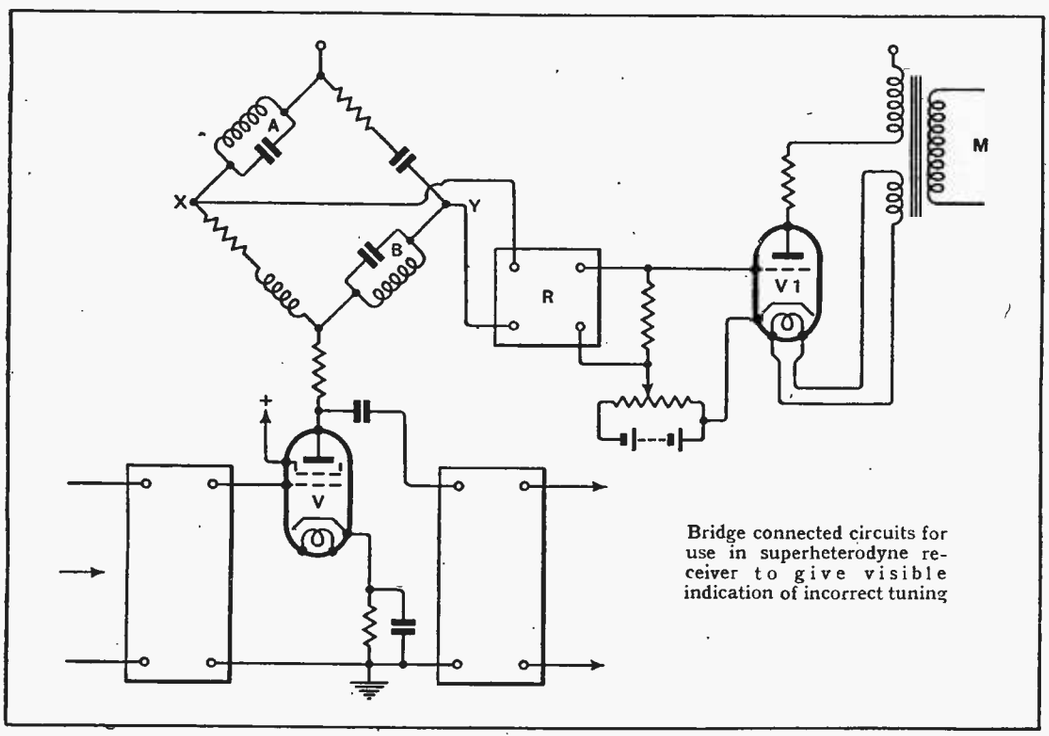
ALL-WAVE SETS

IN a receiver covering, say, five different wave-bands, it is found that the normal provision for automatic volume control is not equally effective on all settings of the wave-change switch. According to the invention, the sensitivity or gain control and the "fidelity" response or tone control are ganged to the wave-change switch in such a way that the signal strength supplied to the rectifier stage is automatically controlled in a uniform manner. In other words the voltage-input to the rectifier is kept at approximately the same value throughout the entire operating range of the set.

Marconi's Wireless Telegraph Co., Ltd. (Assignees of L. R. Kirkwood). Convention date (U.S.A.) September 29th, 1934. No. 462323.



Bridge connected circuits for use in superheterodyne receiver to give visible indication of incorrect tuning