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Telephone Listening

A Return to Favour

A YEAR ago we drew attention to a change of circumstances since loud speakers were first welcomed as providing a wonderful improvement in reception conditions as compared with listening by means of telephones. At the time that the loud speaker appeared broadcasting was still very much of a novelty, and every member of the family was prepared to spend many hours listening in. In those days there was little choice in the way of alternative programmes and very little criticism of them, because to receive anything at all was looked upon as very wonderful and entertaining.

As time went on, listening to wireless became less and less of a family affair and personal preferences reasserted themselves, so that a programme selected by one member of the family was not necessarily acceptable to others.

The time has now come, we believe, when receivers providing for telephone listening as an alternative to the loud speaker would be very generally welcomed, and it is a matter which we believe is well worth the consideration of the set manufacturers. At little additional cost or trouble, plug sockets could be provided to enable phones to be used with any set if desired and provision made for disconnecting the loud speaker meanwhile.

A year ago, in discussing this subject, we said that telephone quality was very good, and although not, perhaps, up to the standard of the best modern loud speakers, there was no reason why telephones should not be improved.

Even without any special stimulation, the past year has seen remarkable improvements in the design of the telephone, as an article published in last week's issue will have indicated to our readers, and we can foresee that if the use of telephones returned to favour generally, and it became worth while for manufacturers to devote special attention to their design, further important progress might be made. From many points of view it is easier for a set designer to design to a given quality with earphones than it is with the loud speaker, because the conditions for reception are less variable than they are where the designer has no knowledge of the acoustic properties of the room where the set provided with a loud speaker is to be accommodated.

Among the several advantages it is well known that it is possible to concentrate much more easily on a programme when listening with headphones than it is with a loud speaker. Volume can be conveniently controlled to suit the individual, whilst means for limiting the strength of signals are now available. In any sets where the loud speaker was dispensed with the audio-frequency amplifier could also disappear, and so cost and, in some cases causes of distortion, too, would be reduced.

Television

The Programme Side

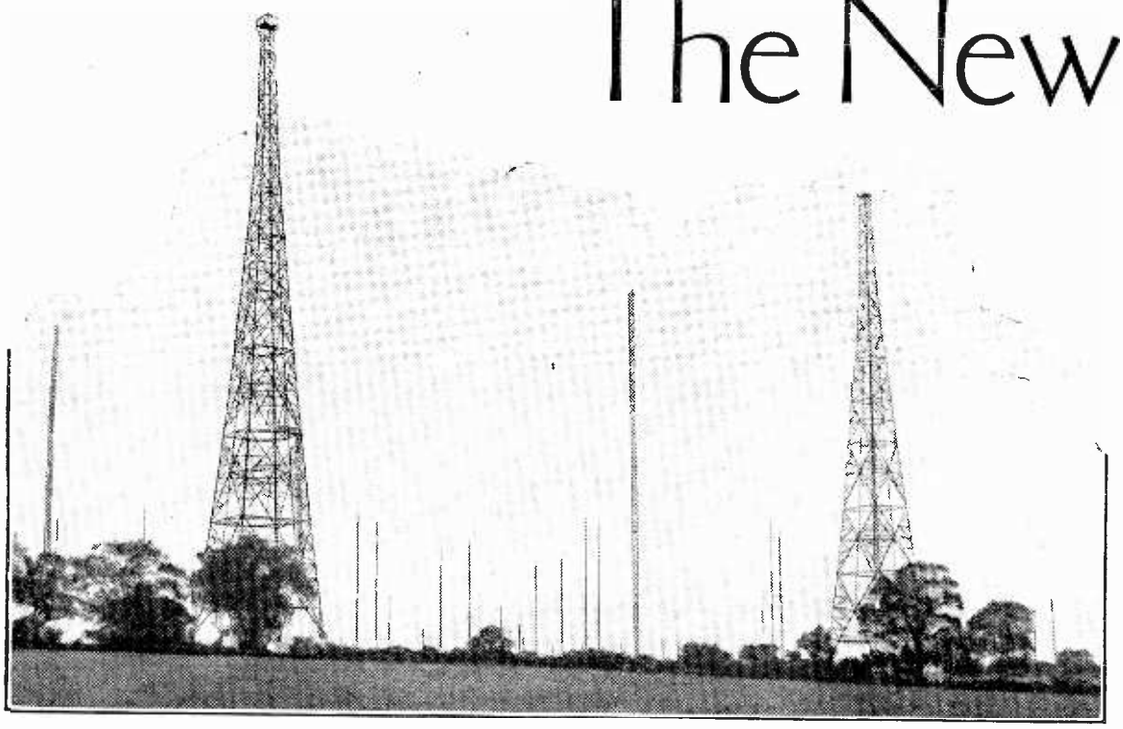
WHEN the television transmissions to Olympia started we criticised the choice of programme material and expressed regret that more attractive matter had not been chosen for the initial broadcasts. We are glad to be able to record that, in our view, a very pronounced improvement in the transmissions occurred as these continued through the period of the Show, and, in particular, the skill which the B.B.C. acquired in using the Marconi-E.M.I. camera indicated how much more may be expected as the production staff becomes accustomed to the new tools available.

Some means has yet to be devised for making the intensity of the sound proportional to the size of the picture. It is obviously absurd to have speech from a small figure in the distance producing at the same volume as when the subject appears as only a few paces from the listener.

The New Empire

By LESLIE BAILY

THE immense scale of th expansion work now bein carried out at the Empi Broadcasting Station is reveale in this exclusive interview give by the B.B.C.'s Chief Engine to our contributor



A photograph, taken last week, of the existing Empire aerial system at Daventry. All the aerials are at present carried on four masts, the old 500 ft. 5XX masts being used for some of them, while others are supported on two trellis towers. The new station will have 12 masts.

BY the early summer of next year a new and stronger Voice of Britain will have made itself heard in every distant corner of the world, and, if all goes well, there will no longer be cause for Britishers in certain of the more remote backwoods of Empire to complain that the German and American short-wave transmissions are stronger and clearer than the British ("not that they are normally," says the B.B.C.).

How determined the B.B.C. is to bring the Empire broadcasting service up to the highest pitch of efficiency was revealed when Sir Noel Ashbridge, the Chief Engineer, discussed with me the work which is now going forward at Daventry.

My first impression was one of surprise at the magnitude of this work; the brief official statements issued by the B.B.C. about the extensions to the Empire station have given small idea of this bold scheme, the cost of which has not been disclosed but must run up to a pretty penny. Now that the Ullswater Committee has emphasised the importance of what it called "the projection of Britain" through Daventry, and now that the new B.B.C. Charter is expressly to authorise the Empire service, and to provide the B.B.C. with extra revenue so that this expansion (among others) may be carried out, the B.B.C. means to get down to the job with characteristic thoroughness.

Broadcasting Our Point of View

Governments, for obvious reasons in these times, attach great importance to long-distance broadcasting services by short waves. The Germans, it is understood, are carrying out extensive improvements. It is important, in understanding the new status of the British service, to realise that the old idea that this was a benevolent private gesture by the B.B.C. —with a pious hope that the Dominions and Colonies would contribute to the cost —has been left aside; now the Empire service is recognised officially (to quote the Ullswater Report) "as an important normal function of the broadcasting organisation of this country."

The existing transmitters at Daventry have done extremely valuable pioneer work during the past three-and-a-half years, and even now are supplying a reasonably good service to a large area of the globe. The new aim is to extend that area, to increase strength of reception, probably to augment the programme hours (already over 16 hours daily), and possibly, on special occasions, to provide more than one programme at a time. To achieve any or all of these objects, new transmitters and aerials are the first necessity of the Empire Service.

Plans for More Effective "Projection of Britain"

"The present state of progress on the new station is up to our every expectation," the Chief Engineer told me, "and I hope we shall be able to go on the air with tests in the late spring of next year. The building which we are putting up at Daventry to house the new equipment is two-thirds finished. The roof is partially on. It is quite a large building—the ground area, in fact, is greater than that of the Droitwich station. Indeed, in every respect this will be a bigger station than Droitwich."

This is an impressive statement, especially if you have visited the spacious Droitwich station. It will not be necessary for a short-wave station to have masts so high as the 700ft. towers at Droitwich, but the New Daventry will have no fewer than twelve masts of varying heights up to 325ft., supporting a spectacular array of aerials. It has been necessary to buy an additional eighty acres of land, making 150 acres in all.

The single-storey building has been designed to accommodate four transmitters, though only three have been ordered.

Eventually, in the total power of its new transmitters, Daventry will certainly beat Droitwich, but the individual power of each is not yet being revealed. Two transmitters are now being constructed in the works of the Standard Telephones and Cables Company, and one by the Marconi Company.

"They will be going into the building towards the end of the year," said Sir Noel Ashbridge. "The transmitting circuits are of new design, quite different from those of the present two short-wave transmitters at Daventry, which work on the low-power choke-control system. Two of the new transmitters will be 'high power Class B' instruments. The third will use high-power series modulation, which is similar to the system used at Droitwich.

"Power will be taken from the mains, but we are building a separate emergency power house containing two 750 horse-power six-cylinder Diesel engines driving alternators, in case of breakdown of the power supply.

"The new aerials and masts are all on order, and erection will start in about a month's time. All the eight new masts we are going to put up are of the stayed

Station

type, varying in height from 150 to 325ft. In addition, we shall make use, in the new scheme, of the existing two self-supporting 350ft. masts which were built for the Empire station about two years ago, and also the two old '5XX' masts, each 500ft. high. These last four masts which I have mentioned are all used just now for various Empire aerials, which are draped around them and between them until they look almost like Christmas trees! But an entirely new aerial scheme has been worked out, embracing all twelve masts."

Twenty-five Aerials

The Chief Engineer emphasised that this aerial scheme has been planned comprehensively. The existing aerials will be modified to take their place in the new network, which, when finally slung up between those dozen masts on Borough Hill, will consist of about twenty-five different aerials. The transmissions will be directional, and will bear on eleven different directions instead of the present six. Sir Noel humorously remarked that the whole thing looked on the plans rather like a "wild spider's web." All the directions have been worked out to the best possible bearings, and the designs of the aerials are based on extensive trials carried out during the last two years.

This big increase in the number of aerials does not necessarily imply that the B.B.C. will wish to use a larger number of wavelengths than at present. In fact, I rather gathered that the B.B.C. is already using all the waves it is likely to need for quite a long time. The new arrangement will permit much greater flexibility in the combination of wavelengths with directions to suit the time of day.

"All this means better coverage," said Sir Noel. "There will be stronger signals everywhere, but, of course, it will be more noticeable in some places than in others. This re-planning will bring a lot more territory into really good service. But, in considering where especially to apply our better signals, we have to compromise, of course. We considered the big cities of the Dominions—the local broadcasting authorities want to relay us a lot, therefore they have a good claim for the best possible signal we can give them. Then we considered people who live in remote parts of the Dominions and Colonies where there is no local service—there are not so many of these listeners, but their individual need is greater; they also deserve a good service from the Home Country. We hope our new plan provides as far as possible for everyone the Empire over.

"Incidentally, we shall be in no doubt as to how the new station does work, for there are keen listeners throughout the Empire who are in regular touch with us. A good number of them send in carefully prepared charts of reception strength. From the broadcasting authorities in Canada, America, Australia, and elsewhere we also get field-strength measurements. If any unexpected snag developed we might send one of our own men to investigate reception conditions, but I don't anticipate that for a moment.

"The increased strength we hope to give raises another interesting point. It is not generally known that the present Empire station does not use the same dynamic range as our home transmitters. There is not the same range from loud to soft as you get from your local station. We sacrifice fidelity for intelligibility, because when you are transmitting over long distances and you have fading and mush to contend with, it is better to concentrate on being heard clearly. So we don't let the soft passages in music go so low as in home programmes. This is done automatically, by what we term a compressor. It is an adjustable device. With the increased power from the new transmitters we hope that it may no longer be necessary to use the volume compressor."

So the New Daventry means better quality as well as increased volume. I asked Sir Noel what he intends to do with the Old Daventry.

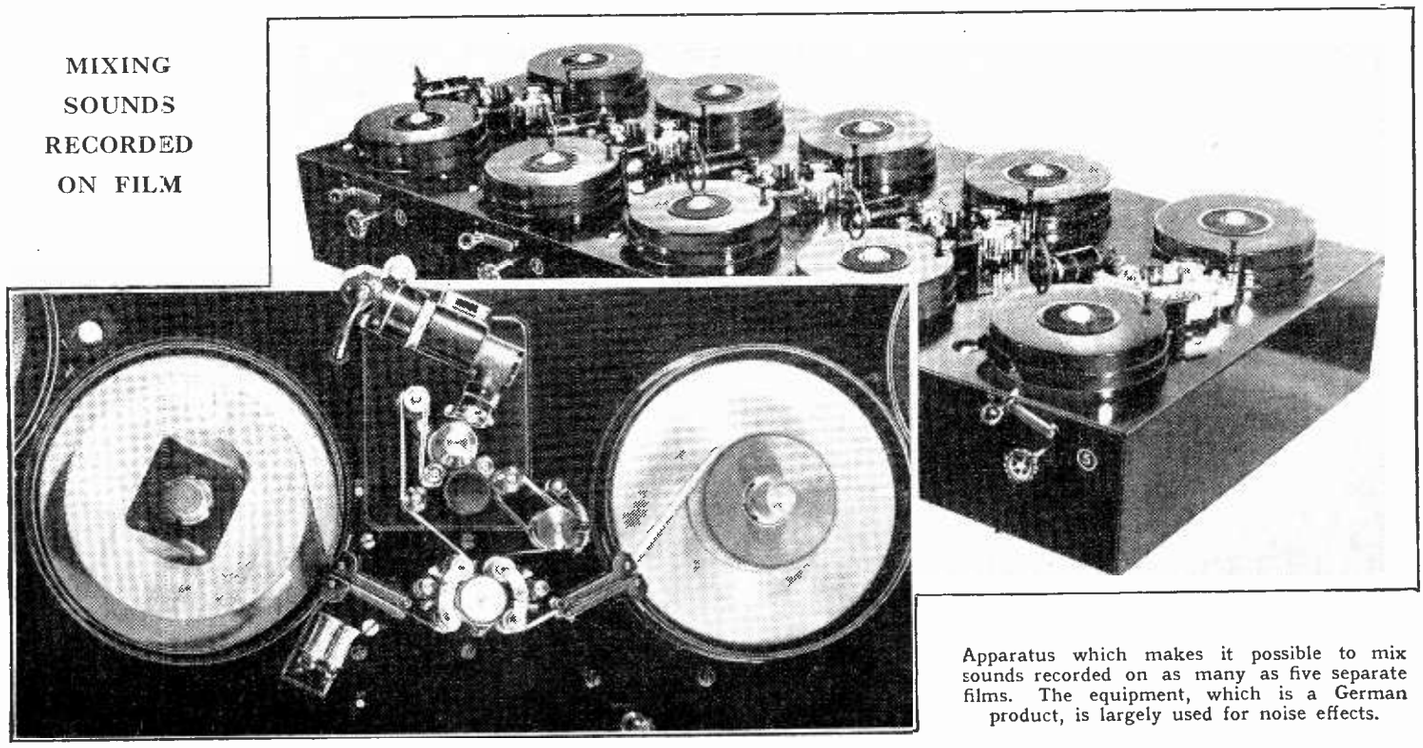
The Fate of "Old Daventry"

"The two short-wave transmitters which were opened in 1932 will probably stay as they are," he said, "but they may be combined into one. It depends whether, in consultation with our Empire programme people, we ultimately decide to go for increased power all round, or for a larger number of transmissions. The latter is the more likely. It will give us five transmitters—the three new ones and the present two. Whether they will all go on the air together depends on programme developments.

"Actually, we are using three transmitters at present, the old 5SW set still being in service. This will be kept permanently, but only for test purposes. It is useful to have such a transmitter handy for lining-up aerials."

Finally, I asked the Chief Engineer what all this will mean in terms of staff. He said that it will add fifteen to the present Daventry staff of twenty-five engineers.

MIXING SOUNDS RECORDED ON FILM



Apparatus which makes it possible to mix sounds recorded on as many as five separate films. The equipment, which is a German product, is largely used for noise effects.

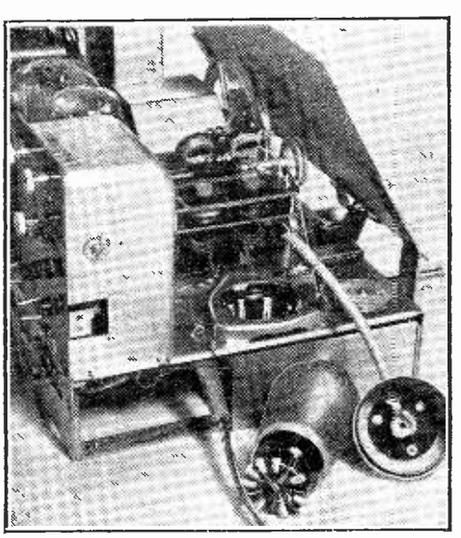
Berlin Radio Show

GERMAN NATIONAL EXHIBITION REVIEWED

BY OUR SPECIAL REPRESENTATIVE AT THE SHOW

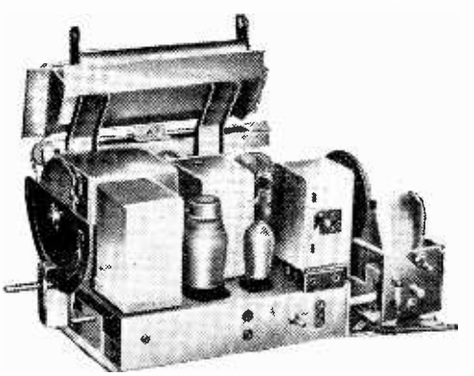
FOLLOWING the usual practice, the Exhibition was divided into two main sections—the General Exhibition and the Industrial Show. The former included the Post Office exhibit and the television demonstration, and the latter the products of the German radio industry. The number of exhibitors (184 firms) was slightly below last year's figure, for certain small manufacturers of components confined themselves this year to the Leipzig Autumn Fair.

The total output of the industry during the past "radio year" was less by about one-third than that of the year 1934-1935. 470,743 People's Receivers were sold, a drop of about 40 per cent. Other receivers had a sale of 827,839, against about one million for last year—a 20 per cent. drop. Listeners increased by about one million, so that the total number of new receivers sold (about 1.3 millions) exceeded by about 25 per cent. the number of new listeners.



The Telefunken T612 single-circuit two-valve receiver which includes a mains transformer although designed for AC/DC operation.

For some years the majority of receivers have been of the two- and three-valve, one- and two-circuit type. Although such sets were still prominent this year at prices ranging from 140 marks upwards, there was evidence of the increasing pupularity of larger receivers of the superheterodyne type.



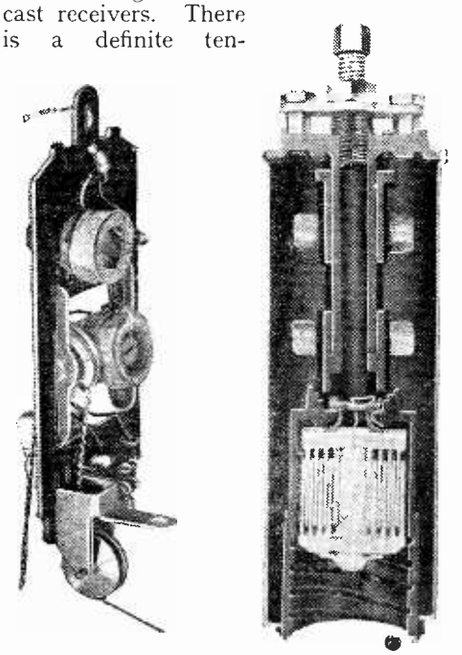
The Nordmark 237 three-valve receiver includes AVC and has constant reaction over the tuning range. It is of the two-circuit type.

Considerable improvement has been made in the quality of reproduction, largely through the use of new types of output pentodes, while in the big superheterodynes we find the AD1 triode much in evidence, either alone or in push-pull. The loud speaker flux density has been greatly increased, up to 10,000 gauss, and in one model a diaphragm stiffened by ribs is used, and it is claimed that this considerably decreases non-linear distortion. In several big receivers, and also in one of the two-circuit type, two loud speakers are provided for the high and low notes.

Tuning is facilitated by the widespread use of the "quick-tuning" scale in conjunction with the "fine-tuning" scale. This arrangement is found not only in most superheterodynes but even in two-circuit receivers.

Quality is improved in most of the superheterodynes, but also in some two-circuit receivers, by variable selectivity—either continuously variable or, in a few models, by steps. This band-width adjustment was seen last year in a few receivers, but is now much more common. Short-wave reception is almost entirely confined to superheterodynes. Only one maker provides it in a smaller set.

As regards external design, the loud speaker is nearly always mounted at the side of the receiver; a loud speaker above or below the receiver is seldom seen. A surprising number of radiogram combinations were in evidence this year; and several furniture and cabinet-making firms showed special designs for holding broadcast receivers. There is a definite ten-



Two types of variable-selectivity IF transformer. The one on the left is used in the Telefunken receivers and the moving-coil is controlled by a cord-drive, while the right-hand transformer is used by Philips and a Bowden-wire type control is employed.

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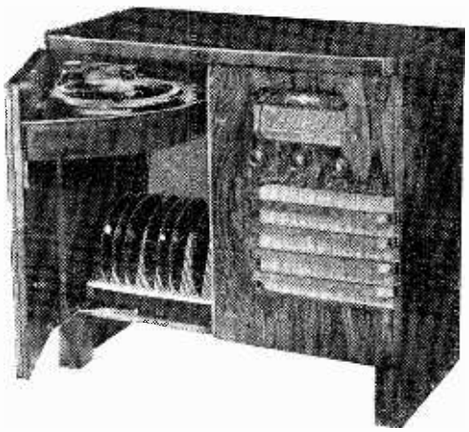
dency towards the modern in cabinet design.

Among the very popular "universal" receivers special interest attaches to the



The Stassfurt Broadcasting Company's "Music Cabinet" which includes a four-valve superheterodyne. Two loud speakers are fitted and a triode output valve is used.

designs of Telefunken and of Körting, in which a mains transformer is used, so that good results are ensured on mains of only 110 volts. When the set is used on DC supplies, however, the transformer functions as a choke. Among other firms making universal models, Philips provide a "converter" unit for use on DC mains. This is of the vibrator type, as used in car sets. Even the small portable receivers of Braun and of Wego can be adapted to "universal" supply.

Among miscellaneous points it is to be noticed that the practice of combining the "on-off" switch and volume control has been discontinued. Many firms have some form of visual tuning indicator, and some —Körting and Ideal-Blaupunkt—have provided their big superheterodynes with a switch for transforming them into straight sets for local reception. An exceptionally high standard of reproduction is claimed. Even two-circuit receivers have, for the most part, excellent AVC, or fading compensation as it is called in Germany.

Reflex Circuits

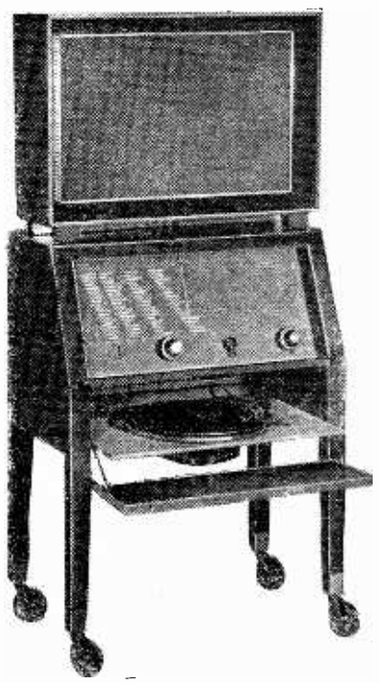
Nearly all the two-valve one-circuit receivers use the new pentode AL4 because of its high amplification and low distortion. These receivers give remarkably good reproduction in almost every case, and they can no longer be looked upon as local-station receivers only. Various devices for giving accurate scale calibration and easy tuning, for a large number of stations, are embodied.

Among single-circuit types, the "Union" receiver, made by a combination of six firms (including Brandt, Braun-Radio, Schaleco, and Wego), is remarkably cheap at 137.50 marks. The "Rügen," of Detewe, has a permanent-magnet MC loud speaker, and consumes only 15-17 watts from the mains.

The Lorenz "Tefadyn 162" and "Tonmeister II" are two-valve reflex receivers distinguished by their ability to give good distant reception. Saba has a very useful single-circuit model, with its medium waveband in two sections to facilitate tuning.

The two-circuit receivers fall into two classes—with and without fading compensation. They are good distant-reception receivers, and many have variably coupled input band-filters. Five types have fading compensation.

The trend towards superheterodynes is unmistakable this year, and the four-valve type in particular is attracting great interest. This is partly because of its reduced price and partly because of the greater advantages it has over the three-valve superheterodynes. On the other hand, the latter have been improved by the new pentodes AL4 and CL4, with their high amplification and low distortion; they now possess IF amplification (which the last year's type did not), and have the same advantages as the four-valve type as regards selectivity and fading compensation; they have, however, one LF stage

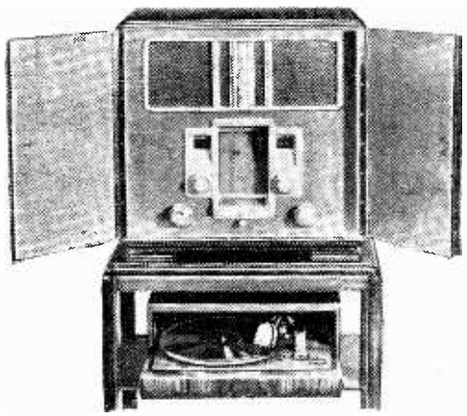


The Telefunken "T686 Trolley De Luxe" is a nine-valve superheterodyne with a push-pull output stage and variable selectivity. It is of the all-wave type and is provided with a 9 kc/s whistle filter.

less. But the high amplification of the AL4 and CL4 nearly compensates for this.

The cheapest three-valve superheterodyne is the Blaupunkt "3W56" with five circuits and band-width variation in two steps. The Saba "341 WL" has six circuits, band-width variation, and "darkening" tuning scale; it also has an input band-filter. Several four-valve superheterodynes have been designed, so that a remarkably good performance is secured with only five circuits in place of the usual six, thus reducing the price. In some cases optical tuning has been omitted, but in most designs band-width variation (in the IF circuit) is included.

In the four-valve superheterodyne with six circuits the sixth circuit is in the IF portion, so that the receiver has two IF band filters. The seven-circuit type has three band-filters. Most of the four-valve superheterodynes have an LF amplifier valve between the duo-diode and the output valve, but the Saba "441 WL" has an input amplifier and only one LF amplifier, namely, the output valve.



The Körting "Ultramar 37" is an all-wave set with two short-wave ranges. It is a superheterodyne, but can be switched to a straight set for local reception.

Almost all the firms making four-valve superheterodynes are showing two models, one with more circuits than the other. The model with the greater number of circuits is generally provided with a short-wave band. Braun turns out three models, with five, six, and seven circuits respectively, all with band-width adjustment and optical tuning, and some with a short-wave band and a gramophone unit. "Ideal" shows six- and seven-circuit types for AC and five- and seven-circuit for "universal" operation. To give a wide range of fading compensation, the LF stage is brought in to amplify the regulating voltage. All "Ideal" receivers have the "flywheel" drive for quick tuning, and also an automatic waveband switching device.

The Körting five-valve six-circuit portable receiver has a built-in frame aerial. It is a battery set.

Körting shows the five-circuit "Etos" and the seven-circuit "Supra-Selector 37." The former has an IF band filter, and the latter an input band filter in addition. Both have band-width adjustment, the seven-circuit model also having optical

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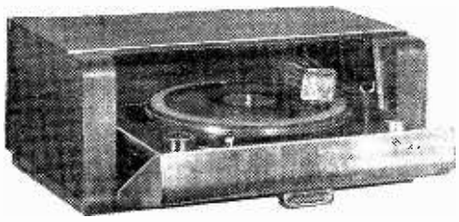
tuning. The short-wave range of the larger set is subdivided, and extends from 13 to 65 metres. The Loewe "universal" model



The Telefunken "Bayreuth 360" playing desk is designed to form a base for the receiver.

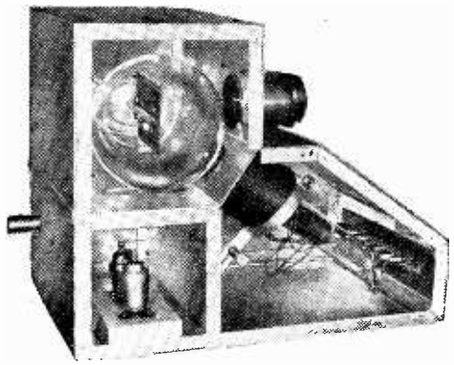
is built also for a main frequency of $16\frac{2}{3}$ cycles per second! Specially noticeable is the seven-circuit four-valve superheterodyne of Neufeldt and Kuhnke, in which the "automatic telephone" method of station selection (first seen last year) is used.

It may be remarked that automatic tuning correction, contrast expansion, automatic noise suppression by rapid AVC, frequently met with in other countries, are not yet to be found in Germany. Large superhetereodynes, however, are shown in greater numbers than before. They have from five to nine valves, and give pre-eminently good performance with—in many cases—very reasonable prices.

The T.O. 1000 pick-up of Telefunken has a sapphire needle and will reproduce up to 10,000 c/s.

Battery receivers are made by some six firms. Car receivers are made by three firms; they are five- and six-valve superheterodynes, and cost from 332 to 450 marks. The Körting model is specially insensitive to interference; it has seven circuits and a push-pull output stage.

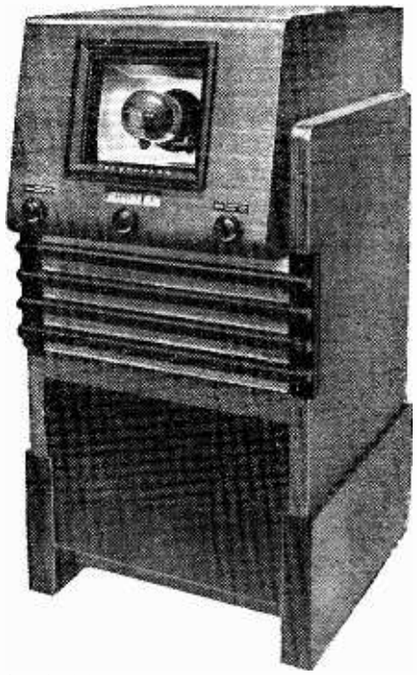
Portable receivers were more numerous than in previous years. The "Olympia" was the winning design in a competition got up by the Radio Wholesalers' Association, for a very light, small portable for owners who have no motor car to carry it about in. It is $34 \times 36 \times 11$ cm. in dimensions.



An interior view of the Telefunken television camera which employs the Zworykin tube.

The permanent-magnet type loud speaker with 10,000 gauss flux density (Oerstit) wins more and more ground in Germany in view of the desire for small mains current consumption and for extension loud speakers. Whenever such economy in mains current is referred to (for instance, in the "current economising" arrangements in certain receivers) it must be remembered that in Germany the price of mains current is often very high.

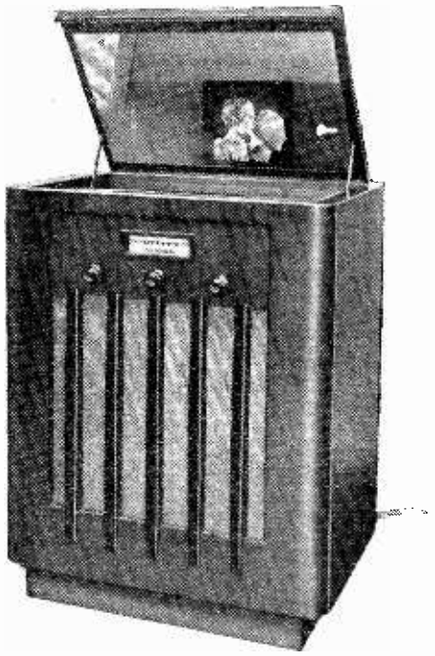
Since public address systems are becoming more and more important nowadays in Germany, most of the loud-speaker manufacturers, together with Telefunken and Körting, have brought out "mushroom" types. Some of these show new developments; thus, in some types (Telefunken and others) the quality of speech reproduction is particularly good—a combination of mushroom MC speaker, which is good for low notes and fair for high, with one or more high-note loud speakers above the "mushroom" top, radiating directly into space, is used. For the Olympic Games,



A television receiver designed for the projection of pictures. It is made by Telefunken.

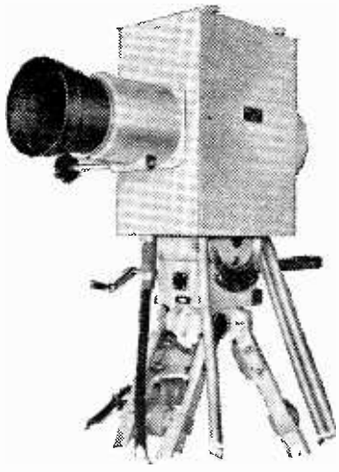
Telefunken also developed the "quenching" loud speaker, consisting of two "mushrooms," one above the other, with their circuits so connected in parallel that one diaphragm is being bent *in* while the other is being bent *out*. Through the interference produced by this phase displacement, "dead" zones are formed in a plane between the two "mushrooms." The great advantage of this arrangement is found in a tiered sports-ground "grandstand" with another series of seats on the other side of the terrace for an audience watching a different contest; if, as often happens, the loud speaker has to be erected in a rather high row of seats it is impossible to prevent the sound from reaching the other side of the grandstand unless such a "dead" zone is formed.

The Telefunken 1,000-watt amplifier was designed for the Olympic Games, but naturally has many other applications; in common with the new Te-Ka-De 150- and 300-watt amplifiers, it uses Class B amplification. In the Te-Ka-De amplifiers a glow-discharge lamp keeps a guard on over-modulation.



The Telefunken home-television receiver in which the picture is viewed through a mirror. It also provides sound reception.

In the remarkable sound-recording and reproducing equipment known as the "Tefi-phon," an ordinary celluloid cinema film is used. The record is not made photographically, however, but by cutting into the celluloid to form very narrow sound tracks, a number of which can run side by side across the film. It can be used for recording telephone conversations, for dictating, and for recording broadcast programmes, etc. The reproduction is said to be very free from needle scratch and the playing time is enormous.



The television camera of Fernseh employs the Farnsworth tube.

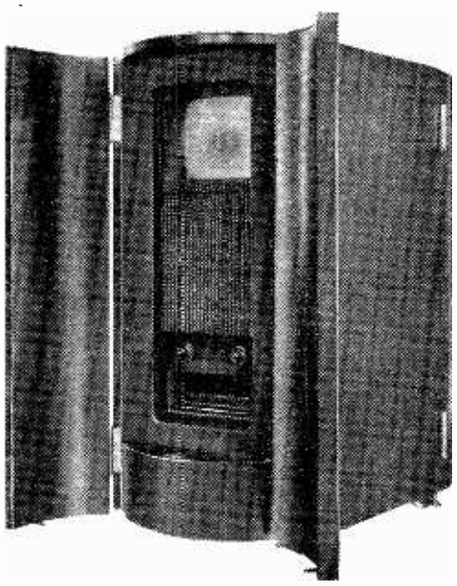
Among the gramophone equipment the Telefunken T.O.1000 pick-up is worth a mention. The weight on the record is less than an ounce, and the frequency response extends up to 10,000 c/s. The needle is

Berlin Radio Show—

a sapphire crystal ground, not to a point, but to a flat edge, and has a life of about 20,000 playings. Even then it can still be used if a response higher than 5,000 c/s is not needed.

The home constructor, as well as the industry, is well provided with low-loss coils, "Calit" being much used for the formers. Havenith make a neat aerial coil coupler in which a special drive device allows the coils to be raised or lowered. Görler makes short-wave plug-in coils on "Calit," while Mozar, in Düsseldorf, has a very good barrel switch.

Various aerials were shown, including the "Kapa" communal aerial with aperiodic pre-amplifier. Siemens make a



The television receiver produced by Fernseh gives a picture of 31 cm. by 36 cm. The tube is mounted vertically.

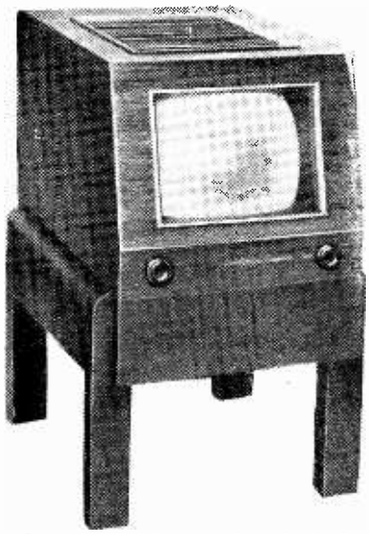
simplified communal aerial without pre-amplifier for a small number (say, five) of participants, each having an aperiodic transformer (with "Sirufer" core) which has an attenuation variation of only ±0.1 neper over a frequency range of 150 kc/s to 1,500 kc/s.

All the firms interested in German television took part in the Exhibition: Telefunken, Fernseh Company, Philips, Loewe, Lorenz, and Te-Ka-De.

The present position in Germany is that television is on the brink of changing from 180 to 375 or 405 lines. Philips and Loewe have already, therefore, built their receivers so that they can be adapted to these numbers—in the Philips receiver simply by a switch movement.

All except Te-Ka-De again confined themselves to cathode-ray tube receivers, and in some cases the size of the fluorescent screen has been greatly increased, so that direct images 19 cm. by 23 cm. are obtainable. Others use projector tubes with small images on a 5 cm. × 6 cm. screen, so extremely bright (by use of very high vacuum and very high voltages—20,000 volts) that they can be projected to a size 1 m. × 1.20 m. One development has been the decrease in size of the home-television receiver.

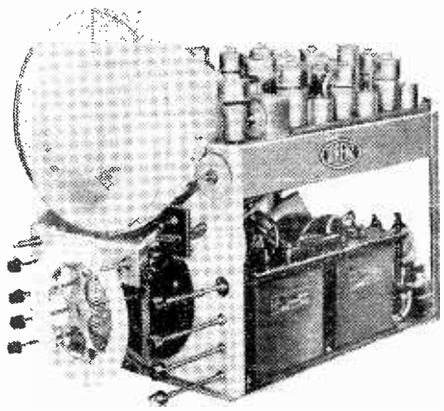
Open-air television (as at the Olympic Games) is being demonstrated by Telefunken, using an electron camera on the Zworykin principle, and by Fernseh,



The Loewe television receiver is designed for 375 and 405 lines and gives a picture of 22 cm. by 26 cm.

who employ an electron camera operating on the Farnsworth principle. Several firms this year use interlaced scanning as well as ordinary scanning, and the Fernseh 375-line interlaced scanning is entirely free from flicker. This company was not demonstrating its intermediate-film system this year.

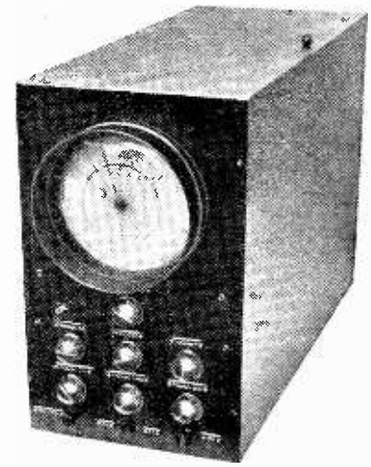
Te-Ka-De showed a new projecting receiver using two mirror wheels at right-angles and their crystal light-control cell;



The chassis of the Lorenz television receiver. The mains equipment is mounted in the base.

very good pictures 50 cm. × 60 cm. were shown on wireless reception from Witzleben (180 lines). They also showed a projecting receiver using their well-known mirror-screw in a new way, projecting its image by a line system on to a screen so that the picture can be seen well even from the side. They make use of interlaced scanning.

Loewe have also developed a projecting tube in which, however, the images are not formed on a flat screen in the tube but on a glass lens-mounted in the tube with its rear surface carrying the fluorescent material, so that the light begins its travel through glass, and only emerges at the curved surface of the lens. Refraction here ensures that the whole of the light emerging from the tube falls on the projecting lens mounted behind the tube; a picture three or four times as bright is obtained with this arrangement. In a home receiver, Loewe have mounted a deflecting mirror inside the cabinet to reflect the upward-directed image on to a ground-glass screen in the front of the cabinet. Loewe have also altered the time-base system; whereas other firms use electromagnetic deflection, they use electrostatic, obtaining their saw-tooth potentials from simple transformers instead of from valves consuming a great deal of power. The

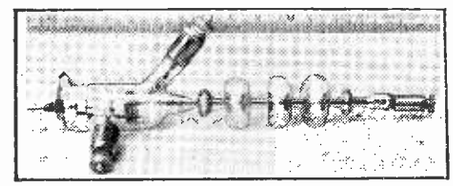


The Leybold-von Ardenne Polar-Co-ordinate oscillograph with rotating field ray path.

total consumption of the receiver is thus reduced from 250 to 150 watts.

The Philips KO70 oscillograph is particularly handy and cheap. A mains unit is included, and two stages of amplification can be used for frequencies of 10-500,000 c/s.

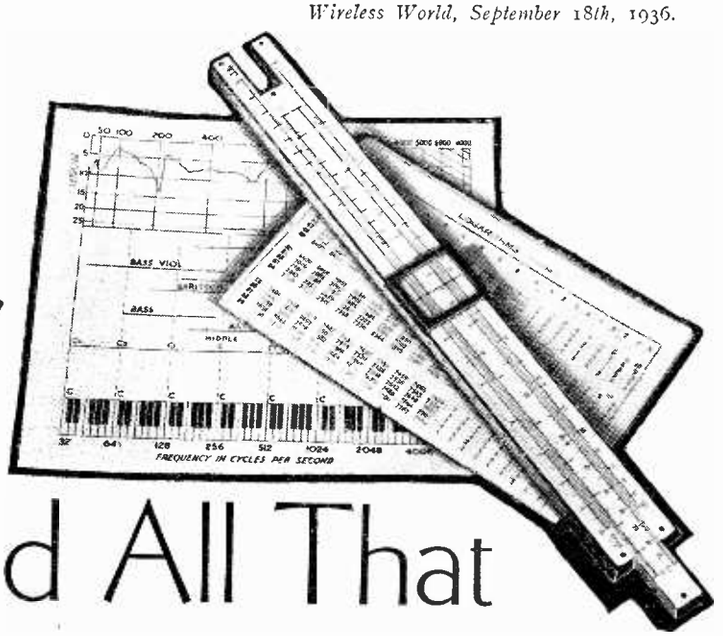
The Leybold-von Ardenne "polar-co-ordinate" oscillograph has a circular scale length of 300 mm., and the quickest rotation takes 1/200,000 sec., so that 1 mm. on the oscillograph corresponds to 1/60,000,000 sec. The longest time value measurable is 1/600 or 1/50 sec. Leybold-von Ardenne also show a tube giving two cathode rays simultaneously, each acting independently of the other.



The Leybold-von Ardenne diode with adjustable anode-cathode spacing for measurements at decimetre wavelengths.

A special diode for a mains-driven diode-voltmeter, for frequencies up to 1.5 × 10^8 c/s was shown by this same firm. The glass "spring" can be compressed by a kind of microscope drive so that an electrode-gap of as little as 5/1,000 mm. can be accurately obtained. The transit time of the electron can thus be made extremely small, and voltage measurements at decimetre wavelengths can be made.

Decibels, Slide-Rules, Logarithms, Octaves, and All That



By "CATHODE RAY"

IN settling down into a new town or district one usually experiences a phase at which there is a jumbled mental impression of a number of known places or streets. It may come as quite a surprise to find that what were noted as two separate streets are really one and the same approached from different directions. At this stage it is a good idea to get out a map and weld these disconnected viewpoints into a properly related system.

The ideas conveyed by the title of this article, and others with them, may similarly be floating about in the minds of some readers, to whom it may not have occurred that they are all different aspects of the same thing. That thing is one that it is advisable to have tidily disposed in the mind, in order to make the best of much that appears in *The Wireless World* and elsewhere.

"To measure is to know," said some great scientist (or was it a disillusioned housewife?), and the first scale of measurement, which must have been devised somewhere around the Stone Age, was based on equal intervals. This is still adopted for most commonplace measuring instruments, such as the foot-rule or the clock. Curiously enough, the scale constituted by the keys of a piano, which I believe is termed a scale of equal intervals, is really nothing of the kind, but is actually the single popularly used example of the second sort of scale.

Its merits were first clearly recognised about 300 years ago by Napier of Merchiston (not to be confused with Napier of Magdala), the inventor of logarithms.

Multiplication by Addition

Unless schooldays have entirely faded from the mind, the subject of logarithms may perhaps be assumed to be one of the familiar landmarks in the city of knowledge. I merely remind those who were educated on the Classical side that to every number there corresponds another number, called its logarithm (or, more popularly, log); and that when you wish to *multiply* any two or more numbers you have the option of *adding* their logs. Addition being, in general, a less tedious process than multiplication as ordinarily practised, the utility of logarithms is obvious.

There is one catch in it; the memorising of the logarithm table being quite impracticable to anyone other than Mr. Datas, it is necessary to have a log table handy, and to look up in it the logs of all the numbers concerned, and again the number corresponding to the log of the answer. By this time you might almost have done the multiplication some other way if, as is usual, only a few "significant figures" were needed.

When it is essential to have the answer correct to a great many figures, logs are still the easiest way of getting there. But the engineering student who uses his experimental data, which he is unlikely to be sure of within 1 per cent., to calculate the result to about six places of decimals, deserves to be harshly blue-pencilled. When Sir Malcolm Campbell performed his record speed the result was published to as many as four decimal places, which implied that the distance was measured to $\frac{1}{100\text{th}}$ of an inch and the time to $\frac{1}{500{,}000\text{th}}$ of a second! Pukka engineers are usually content with a three-figure approximation, and log tables are abandoned in favour of the slide-rule. This is where the log system appears literally as a *scale*. The distances along each scale are made proportional to the logs of the numbers appearing on it, and addition is carried out simply by sliding one scale along beyond another, so that the result is obtained without having to know the actual distances and (hence) the logs themselves. This really is a boon and a blessing to technical men, for they can read off the answer before other people have had time even to write down the data.

"To Measure Is To Know"

So, although looking at it, a slide-rule (or log) scale appears to be much less simple and natural than the ordinary foot rule (or linear) scale, there evidently must be some fundamental merit about it. The two scales are, in fact, related in the same way as the fundamental operations of addition and multiplication. Each step on a foot rule represents an addition of so much; each step (in distance) on a slide-rule represents a multiplication. Steps backward, of course, represent subtraction and division respectively.

When drawing graphs to show how things happen people who are not mathematically minded always use linear scales. In this they are (accidentally) quite right when relating such things as distance and speed, or time and rainfall. But there are some things in life that work naturally according to a log scale; and although it is possible to plot them on a linear scale, this is a distortion which prevents one from getting a clear picture of the thing. It is like a map of the World on Mercator's Projection, which is all very well for making out Canada to be about twice as large as the United States, but not for giving a true and well-proportioned picture of what it is supposed to show.

At the beginning I mentioned the piano scale. This is so naturally a log scale rather than a linear one that musicians can't help working to it, perhaps unconscious of the fact. The human ear existed before Napier, and while it is pleased by combinations of sounds whose frequencies are connected by certain ratios, it can find no significance in any particular additive intervals. The musical intervals—semi-tones, tones, and octaves—are logarithmic or multiplying intervals. An octave does not correspond to an addition of so much frequency; it

Decibels, Slide-Rules, Logarithms and All That—

multiplies the frequency by 2. It is equivalent to about 3 inches on the A and B scales of a 10-inch slide-rule; so these scales include just over 3 octaves. The C and D scales are over 6 octaves.

When electrical sound-reproduction first began to be quantitatively studied, graphs showing the performance of intervalve transformers, loud speakers, etc., were drawn on a linear scale. From 1,000 to 2,000 cycles per second was given the same room as from 0 to 1,000, regardless of the fact that it is only one octave while the latter is an infinitely large number of octaves. Now we know better, and always use a log scale for frequency.

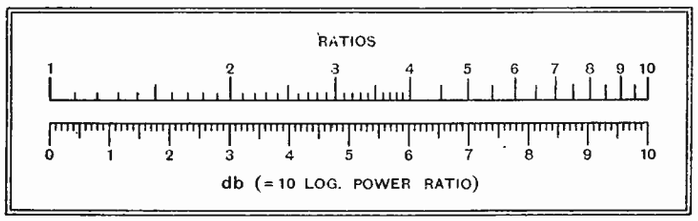


Fig. 1.—Comparison of log and linear scales.

The vertical scale, devoted to sound or its equivalent in electrical units, refers to something of which the ear again is the judge. And again the ear rejects the linear scale, and is fitted more naturally by a log scale. The octave unit has been bagged for frequency; the sound or electrical unit is the decibel, which is about a third of an octave, or 26 per cent. instead of 100 per cent. If you protest that 3 times 26 is not 100, you are hopelessly foot-rule minded. It may be quite difficult, having been brought up to think exclusively in terms of additive scales, to get used to multiplying scales.

With regard to decibels, it is always rather helpful at first to hold on to the idea that one db. is about the least rise or fall in sound intensity that the ear can distinguish. I must add here that the ear (as interpreted by the brain) is not perfectly logarithmic in its action, but nearly so except for very loud or very weak sounds.

Voltage, Current and Power Ratios

A little trick about decibels that is apt to cause confusion is that a voltage or current decibel is a smaller ratio than a power decibel. This does not really mean that there are two sizes of decibels, like avoirdupois and troy ounces; the distinction is more like that between a linear foot and a square foot, which are respectively three and nine to the yard. Decibels are fundamentally *power* ratios, and power is proportional to the square of voltage or current. Doubling the power is approximately 3 db, as already stated; but doubling the voltage (which implies double current also) means four times the power, and therefore 6 db. So the ordinary slide-rule scale, if it is used for voltage or current ratios, is 20 db long, and not 10.

My slide-rule bears a uniformly divided scale (0 to 10) below the A scale, and I have marked it "db (P)" together with extra figures from 0 to 20 labelled "db (V or C)," so that when, for example, the result of a certain experiment shows an increase in signal voltage from 15 to 24, I can read off not only the ratio, 1.60 (giving the percentage increase, 60), but also the decibels, just over 4.

When mentally converting the log scale of a graph into a linear one, or vice versa, it is useful to know one or two equivalent points. Fig. 1 shows the two together, and 2 on the upper comes near enough to 3 on the lower to be taken as practically equivalent. The correspondence of 3 and 5 is not so exact, but useful to know. Almost dead opposite one another are 5 and 7, and with these three points, and the ends, it is possible to construct a rough log scale on ordinary squared paper. Special log paper is obtainable, but not always handy.

As we have seen, there are certain quantities, including some of special importance in radio, that are intended by Nature to be measured logarithmically. But even when one cannot invoke such high authority in defence of the procedure, it is sometimes a useful dodge for getting a curve nicely in. Suppose it is desired to illustrate the action of an AVC system in the usual manner by drawing a curve of milliwatts output from the receiver against microvolts input. The signal may be taken up to 100,000 or even 1,000,000 microvolts, and if this were plotted on a linear scale anything less than some thousands of microvolts would occupy such a small part of the whole as to be indistinguishable. This would probably include the most important part of the diagram.

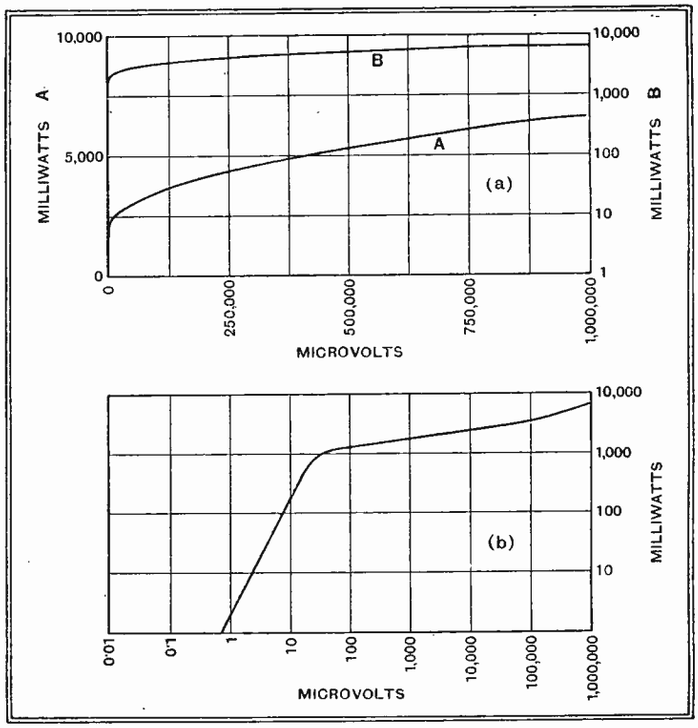


Fig. 2 (a).—The A.V.C. curve of a receiver plotted on linear scales would tell one nothing about the behaviour with weak signals. Curve A is drawn with both scales linear; B is plotted to a log milliwatt scale. By making both logarithmic (b) a complete picture is given of the action.

The difficulty might be avoided by plotting the curve in sections on different linear scales; but besides being clumsy this would prevent one from judging the curve as a whole. The best solution is to plot on a log scale, which gives equal prominence to both weak and strong signals (see Fig. 2). The milliwatt scale would be log in any case, we hope, but curve A shows what it looks like with a linear scale, too.

There is one circumstance that rules out this sort of treatment, and that is when the quantity concerned goes to zero. There is no zero on a log scale. You can get nearly, but never quite, there.

This is not intended to be a complete exposition of logs or db. as such—only a map of the connections—but while referring to their advantages for graphical scales I may as well include one feature that is pretty well known and understood by now; namely, that the shape of a curve plotted on a log scale is unaffected if the scale is multiplied. It merely slides bodily up or down.

The linear scale, on the contrary, is as if an object changed shape when a telescope was used to magnify it. The effect on a given frequency characteristic curve of adding a uniform stage of amplification appears on a decibel graph as a change in level but not in shape of the curve. Which is as it should be. It is a change in loudness but not in balance of tone.

Actually the matter of sound is a little bit more complicated and controversial than this. But the db. scale is much nearer the truth than the linear sort.

INSTITUTE OF PUBLIC ADDRESS

We are asked to say that many letters have been received by the Acting Secretary of the proposed Institute of Public Address as a result of the note which appeared in *The Wireless World* of August 28th. All letters will be replied to when particulars of the proposed Institute are available to send out; in the meantime, enquirers are asked to accept this intimation of the receipt of their letters.

The Acting Secretary is Mr. L. B. Candfield (Ross and Robinson, Ltd.), 8, Western Circus, London, W.3.

UNBIASED

By FREE GRID

Garden City Life

IT has been said by somebody or other that even the finest invention of man can be put to base uses by people whose minds are inclined that way, and I must admit that there is considerably more truth in this statement than there is usually in the wisecracks uttered by our great thinkers. A very illuminating instance of its truth has recently occurred in one of our Garden Cities, those earthly paradises where, as Heber truly said, "Every prospect pleases, and only man is vile."

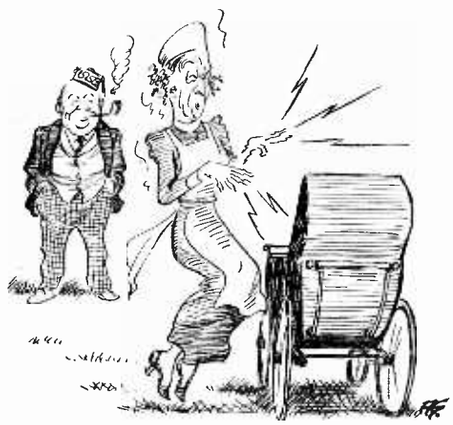
The trouble, I am sorry to say, arose through the activities of one of those ether-hogs who persist in dragging the loud speaker out into the garden and sullying the fair evening air of summer with horrid swamp songs and other negroid noises dished up by many so-called dance bands. Unfortunately for the particular ether-hog in question, a by-law has recently been passed against this sort of thing by the authorities of the county in which this Garden City is situated. The result was that after a mild protest had been tried without effect, the strong arm of the law was invoked and the offender received the just reward of his misdeeds, an injunction being obtained restraining him under heavy penalties from causing further annoyance in this manner.

Now, as many of you may know, among the other pests which infest garden cities, as well as less exotic centres of population, are babies, and this particular place was no exception, the night being rendered hideous by their yells and screams. The vanquished loud-speaker owner thought, therefore, that he would have his own back by suing the owners of the more irascible infants for neglecting to fit them with suitable silencers, but, unfortunately for himself, he learnt that babies are privileged persons who are allowed to yell their heads off and keep the whole neighbourhood awake without incurring the wrath of the law.

Enfants Terribles

The next move in this little ultra-suburban drama occurred a few evenings later, when the twice-vanquished loud-speaker owner—a hardened old bachelor—appeared in his back garden trundling a smart new pram from which truly prodigious infantile caterwaulings were emanating. The yells were, in fact, such as would be quite beyond the lung power of any single baby, and so twins, or even triplets, were indicated, this being borne out by the size of the pram, which was of unusual dimensions. The many and varied speculations as to the origin of the children which were indulged in by the neighbours were speedily merged into the certainty that they had been obtained at a reduced price from some orphanage, and were being deliberately ill-treated in order to annoy other residents, as the strength and consistency of the cries were such that no other explanation was possible.

Needless to say, allegations of cruelty were quickly made to the authorities, with the result that the full majesty of the law arrived, together with an ambulance in charge of an officious-looking nurse, to remove the ill-used children to a home.



The ill-used children proved to be bright young sparks.

Before the representatives of the law could make their investigation and question the offender the nurse officiously thrust her arms into the pram to remove the contents and speedily withdrew them to the accompaniment of a yell of her own production which completely drowned those emanating from the pram.

It appeared that the good lady had received a somewhat hefty electric shock, and small wonder, since it turned out that the pram contained an outsize in amplifiers operated from a car battery and a vibratory transformer, the former also supplying juice to a gramophone turntable and an automatic arrangement which kept it continually repeating a record which had apparently been specially made for the occasion.

There was, of course, nothing for it but for the law to retire as gracefully as it could. The offender has not, however, got off scot-free, and at present stands charged with disobeying the original injunction of the Court restraining him from causing annoyance with a loud speaker. As the matter is still *sub judice* I must not say any more at present.

A Dastardly Plot

FOR no apparent reason I seem to be pestered by babies this week, but I've simply got to put up with it, and so will you, as the following information has only just reached me, and the ordinary feelings of humanity compel me to give it immediate publicity.

As you know, it is not often that I permit myself to indulge in comments upon radio matters other than those of a technical nature, but certain happenings have been brought to my notice which are so serious, involving as they do the well-being of certain members of the rising generation, that I have no option.

As many of you may know, the danger of Transatlantic telephone conversations being overheard by unscrupulous eavesdroppers is prevented by a very simple method, the speech being "scrambled" at the transmitting end and duly "unscrambled" at the receiver. I do not propose to go into the technical details concerning the method by which the scrambling and unscrambling are done as, for one thing, the P.M.G. wouldn't like it, and my respect for authority prevents me from flouting his wishes in any way. It must therefore suffice for you to know that this scrambling process exists. If you listen to it you will find it strangely reminiscent of certain Oriental languages.

Now, quite naturally, the Transatlantic telephone service is used considerably by stockbrokers, book-makers, and other collectors of our superfluous cash, and there are many evilly disposed persons who would be in a position to make a considerable amount of ill-gotten money were they only able to overhear these conversations and the important financial secrets which they contain.

"The plot was whispered to me over the 'phone."

It would be well-nigh impossible for anybody to construct a successful "unscrambler" without obtaining the necessary blueprint from the G.P.O., but, alas!

such is the waywardness of human nature that realisation of this fact has not prevented a great deal of misplaced ingenuity from being applied to the solution of the problem and, if the details of the plot that were whispered to me over the telephone hold any truth, a truly diabolical solution has been found.

In brief, a gang of unscrupulous hangers-on of our stock exchanges have got together and put up the necessary capital for the adoption and upbringing of a large number of babies, and these hapless infants have been incarcerated with their nurses in a large country mansion surrounded by a high wall which is situated somewhere in the Home Counties. A wireless receiver has been installed which is permanently tuned to one of the main Transatlantic wavelengths, and this feeds its output into loud speakers which have been lavishly distributed all over the house and grounds.

The idea, of course, is that by constantly hearing this "scrambled" speech and nothing else—for all the nurses are deaf and dumb—the wretched infants will adopt it as their normal language just as ordinary children grow up to speak the language of their parents through hearing it constantly used in their presence. After the children have reached a sufficient age for this language to be indelibly impressed upon their young minds, they are to be taught English by normal methods and will naturally be in a position to interpret the "scrambled" speech for their heartless captors.

Of course, all this will take considerable time—several years, in fact—but the people responsible for these dastardly doings are quite prepared to wait for the final harvest which, when it is reaped, will be truly abundant.

I can, of course, only present to you these facts as they have been given to me in the hope that if any of you living near a large, secluded mansion should see or hear of anything suspicious, you will let me know at once. Needless to say, if any of you receive a tempting offer for your offspring you should communicate with the nearest police station, since, I am informed, these rogues are on the alert to approach parents in the early morning after a particularly bad "teething" night.

t Topics

Men's Association

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Goes One Better

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e crows has been told
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nark, but in this case
stead of crows.

iss Broadcasting Chief

ber 1st there will be a

cycles per second, the pictures will be so coarse in definition that they will not be worth looking at.

Women Listeners Predominate

SURPRISING figures have just been published by the Columbia Broadcasting Co. of America as a result of a recent survey of its radio audience. It appears that, contrary to the state of affairs existing in ordinary life, women do far more listening than men. Actual figures show that in the afternoon 64 per cent. of the radio audience are women, this declining to 53 per cent. in the evening.

Educational Opportunities

DURING the last few weeks

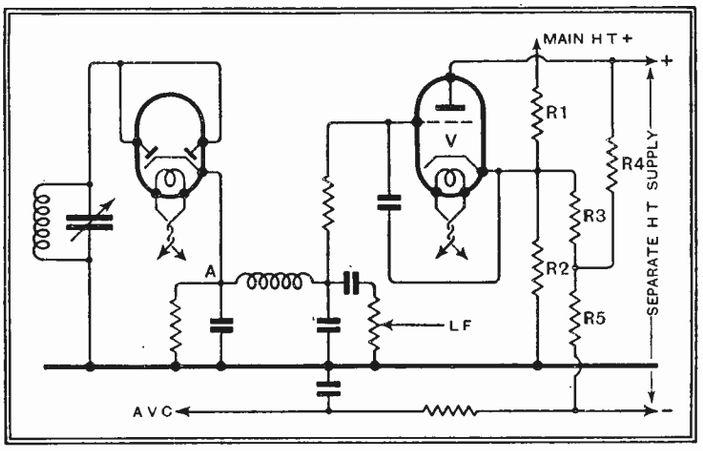
MOUTHPIECE OF THE G.P.O. Mr. J. H. Brebner, M.B.E., formerly Press Officer, has been appointed to the newly-created post of Controller of Press, Information and Publications to the General Post Office.

Letters to the Editor

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

New AVC Circuit

YOUR readers may not realise that it is possible to devise an amplified AVC circuit to work with a straight set with the tuned circuits earthed. The circuit to which I refer is a modification of that used in the "Q.A. Super." I have never seen it described before, though it will be remarkable indeed if I am the first to have thought of it. It appears perfectly satisfactory in operation.



AVC circuit described by Mr. W. J. Cluff.

With the detector circuit shown in the diagram, the point A is at a positive potential with respect to earth when HF voltages are applied. This positive potential is applied through a filter to the grid of the valve V, fed from a separate HT supply. By means of resistances R1 R2 its cathode is given such a potential that no anode current flows until A is at the potential corresponding to the input at which the AVC is required to start acting. When anode current flows the voltage developed across R3 in the cathode lead is used for bias purposes. In order that the AVC line shall not be initially positive, two resistances R4 R5 are introduced, when the voltage drop across R5 becomes equal to that across R2. These are most simply adjusted to the values exactly required by noting the anode current of a controlled valve in the absence of a signal and altering R4 or R5 until it reaches the value known to be correct.

Maidenhead. W. J. CLUFF.

U.S.W. Reception Experiences

DURING the tests and experiments carried out on the receiver units of the new Scott Sessions Ultra Short-wave Transreceiver apparatus, the following effect was apparent.

The Alexandra Palace sound transmissions were being received on the 2nd harmonic (presumably) at unbearable strength on the 'phones. The writer and other engineers of the development department noticed that the signal strength varied according to the position of the listener if the set was not being carried by him.

The strength went to a maximum at a certain distance and direction from the receiver, and was very weak or blocked out when the listener and the receiver were in a line parallel to the Palace.

The effect was more prominent if the listener was of average height. Knowing that the average person is a ½-wave resonator at about 3.66 metres (sound broadcast is on 7.24 m., the 2nd harmonic of which is 3.62 m.), it would be interesting to know if any of your readers have had the same experience and to what conclusion this brought them.

It may not be out of place to mention that, though it is a dangerous experiment to play with, the average person standing near an aerial working on 3.66 m. may (with medium power on the aerial) light wave-meter lamps in his abdominal region, where there would be a current maximum. If he feels like taking more risks (and there are risks) when using higher power, he can even expect a neon tube to light on applying it to his ear or nose, due to the potential maxima being developed at the extremities of the human aerial.

P. K. CHATTERJIA.

Russell Effect

WE are more than interested in the radio phenomena quoted by your correspondent, Mr. G. J. Russell.

We have been aware of this and similar effects for the past two years, and have been endeavouring to take advantage of them with a view to getting noise suppression and high speed AVC on those wavebands where noises are such an impediment to communication.

We have reached a point where we would have taken out patents, but now the matter has come to light our experiences will be recorded for what they are worth.

In general, our first effects were much the same as your correspondent quotes. In addition, 5-metre transmissions by North London amateurs which were previously inaudible on a super-regenerative receiver came in very strongly when a simple detector and LF set, tuned to 40-metre band and in an oscillating condition, was switched on. Loud speech was available on both receivers simultaneously. The quench noise was heard in the loud speaker employed with the det-LF set, whilst strong speech was coming in, and on neither set did there appear to be any silent point, i.e., "hole in the mush." The signals were of such strength as normally produced speech on the super-regenerative receiver with a quiet background.

Shortly after these effects had been noted a second effect was observed under different conditions, which we believe fits in with the effects quoted above. Experiments were being carried out with a simple super-regenerative receiver (which we see has been dubbed the "Minute Man" in America). This receiver had a LF amplifier attached giving some 40 db. gain and capable of 2½ watts of undistorted output. Whilst adjusting this for super-regeneration we were agreeably surprised to hear Radio Normandie 269.5 kc/s at almost the full output of the set.

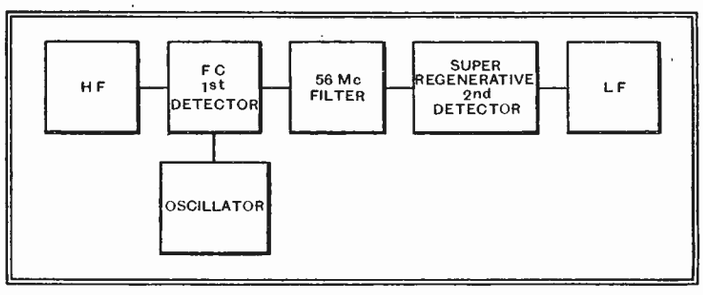
The point to note here is that *no* aerial was attached to the set, and no aerial of any kind was within thirty yards.

The amplifier and power supply were very well screened, HF chokes and condensers were also incorporated as this equipment performs various other duties when required.

When it is pointed out that the transmission was noise-free and moderately free from distortion at a site where Radio Normandie on all normal types of reception is almost obliterated with noise, this represented an advance if the mode of operation could be ascertained and "pinned down."

During the days that followed many stations were received at intervals from all parts of the world, and widely differing fundamentals. For instance, GJG turned up within a division or so of Radio Normandie setting.

A sudden inspiration on our part traced the effect to be simultaneous with the use (in another building close by) of an automatic tuning circuit using a biased oscillator similar to the one used by Murphy in their self-tuning set. No doubt the fundamental of this oscillator and its harmonics (we know what bias does to oscillators) were beating with the various transmissions to give a "Russell Intermediate Frequency" which travelled through space to be demodulated in our antenna-less super-regenerative set. Since the radiating receiver was also in the same high noise field, the noise suppression must be attributed, we thought, to the super-regenerative. Acting on these lines we made up a receiver on conventional lines, employing tuned HF frequency changer and super-regenerative second demodulator. This implies IF of 20 megacycles or more, in order to get the benefit of the second super-regenerative demodulator. No IF amplifier is used, thereby a filter twixt a frequency changer (1st det.) and



Arrangement of the receiver used by Messrs. Search and Edwards.

Letters to the Editor—

super-regenerative stage. It works, and we believe, time and patience permitting, we shall get the "bugs" out of it.

C. J. SEARCH.
P. A. EDWARDS.

"The Beedle Effect on Ultra Short Waves"

THIS is, of course, the same as the Russell effect, *vide* July 31 issue, only about eight years older, for I first gave demonstrations of these and other interesting effects during the autumn of 1928. By using a pentode detector and screen grid quench it is possible to dispense with the external oscillator, and thus extend the capabilities of reception. On several occasions during the past three years, whilst lecturing at the University of London Goldsmiths' College, I have shown the possibility of the reinversion of transatlantic telephony (not new by about five years) and the reception of Continental broadcast programmes. It is amusing to note that on March 29, at 2335, G5HF and I (G6OW) attempted duplex working. He reported me as being in the middle of the Radio Normandie programme, whilst he was in the middle of high-speed Morse stations. However, on the serious side, I have a number of things to say and questions to ask.

Recently I have been working on a series of detailed 5-metre experiments with G5HF, being on the air from 1000 to 0100 nearly every day for a fortnight, and have noted some very curious effects.

1. Periods when both our receivers would "go quiet" for no apparent reason. Adjustment failed to rectify.

2. Mysterious signals that *increased* the quench with, in some cases, pure CW in the middle of EW and sometimes BR. Sharply tuned (unusual when using super-regen). Sometimes rhythmic (*a*) 1 burst per 4 sec., (*b*) 8 per second, (*c*) 24 per second, and on Sunday, July 4, built another super-regen. receiver without quench coils—same result. Built another, using mains valves —same result. Twice I have noted high-speed fading!

By careful adjustment it is possible to cover the 20- and 40-metre amateur band with good CW and fone signals, but how is one to determine when reception is due to supposed harmonics or Mr. Russell's superhet principle?

Extracts from my log:—

March 8: 2140 G5JW clg Test, R5-6. 2235 G6Gi, saying he was only using 1.5 watts, R8.

May 24: 0945 G5JA, of Cambridge clg on fone and stg bi for a call on 40 metres, R9, QSA5. 1005 G5QO ses QRM to G5PT, R7-8. 1007 G2QY giving congrats on new hamship to another station, ?G2XN.

And so on. I have heard clear, loud signals of amateurs from Scotland to Southampton and from Bristol to Essex on 5 metres, and having in some cases removed the quench valve and turned off the oscillator. I cannot think it would be harmonics, and I know it cannot be superhet. But the signals come in.

In conclusion, may I ask where all the 5-metre people have gone, and for the benefit of those interested in reception on this band that xmitters when on the air would state their location and the fact that it is a 58 mc. transmission.

There is much interesting work here.

ALBERT L. BEEDLE,
Morden, Surrey. G6OW.

On the Short Waves

NOTES FROM A LISTENER'S LOG

WITH the advent in six weeks' time of a regular public television service, the first in the world, there will be plenty of opportunities for the amateur to indulge in ultra-short-wave propagation studies, especially for those of us who live within one hundred miles or so of London.

An interesting article[1] on this subject has already appeared in this journal, but I do not think that it would be out of place also to recount my experiences whilst receiving the Alexandra Palace vision and sound signals at Epsom.

A single-valve triode-hexode (X31) converter was used in front of a commercial six-valve all-wave receiver working from the DC mains, which, incidentally, are of the mercury-arc type. These are adequately smoothed before reaching the receiver by means of the primary of a "mains-transformer" plus a 4-mfd. condenser. It is amusing to note that quite high AC voltages —mainly at 150 c/s—can be obtained on the idle secondary windings of this transformer. If desired, a metal rectifier may be used in conjunction with these secondaries to obtain *really free* grid bias.

To return to the U/SW converter. Experiments were first made to discover the most suitable IF frequency by switching the all-wave superhet. receiver from one band to another.

It soon became apparent that a good compromise performance was obtained when the receiver was tuned to, roughly, 3.75 Mc/s (80 m.), but complete freedom from pulling between the oscillator and hexode sections of the X31 was not obtained until frequencies of 7 Mc/s (40 m.) or higher were used.

An initial oscillator drift of 150 kc/s was also noticed during the first minute or so after switching on, but after this the oscillator frequency became quite stable, and good signals were received from Alexandra Palace on 7.2 metres throughout the complete transmissions without retuning after the initial period of warming up.

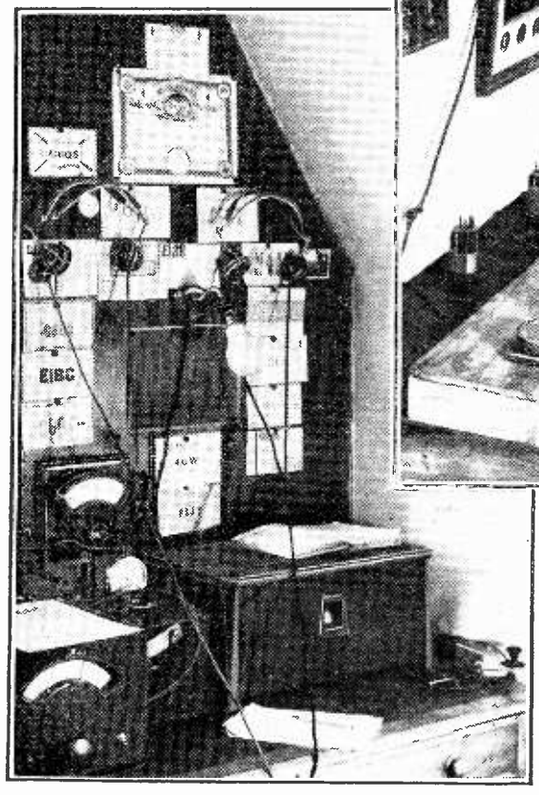
Aerial Experiments

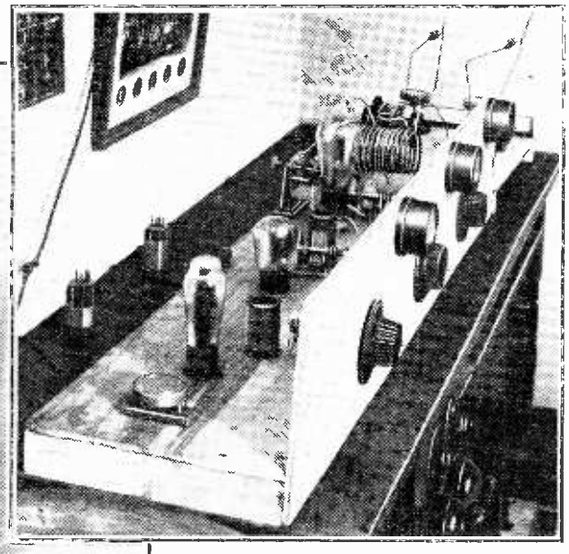
At first the ordinary outside inverted L aerial was used, with fair results, but distinct fading was noticed every time a "Southern" electric train passed on a nearby line, the down trains from London appearing to give the greater effect!

It was obvious, of course, that these vertically polarised transmissions would be better received on a vertical aerial, so, after considering the merits and demerits of various arrays, it was decided to put up a vertical "Kirke" aerial, comprising a $\frac{3}{8}\lambda$ uppermost section 8ft. 6in. long coupled to a lower $\frac{1}{4}\lambda$ section 11ft. 6in. long by means of a "postage stamp" 0.00005 mfd. condenser. A lead-in an odd quarter-wave long was taken away at right angles from the bottom of the $\frac{1}{4}\lambda$ portion to the receiver. All the other arrays considered required either too much space or too many insulators.

[1] "Television and the Aerial." *Wireless World*, Aug. 28, 1936.

G 6 P W





AN ACTIVE SCHOOL STATION.—For many years Warwick School has shown a keen interest in wireless; its radio society has now been granted full facilities for transmission on the amateur bands. On the left are seen the short-wave and broadcast receivers and key, while the other photograph shows the transmitter, which is at present working on 7,150 kc/s; reports of reception are welcomed.

The results on the new aerial were considerably better, and, furthermore, the advent of Southern trains no longer produced fading. Car-ignition interference was not serious, but was audible at intervals; the situation is, however, remote from a main road.

Apart from this slight blemish, reception on the "Kirke" aerial was on a par with daylight reception of Brookmans Park.

Reverting now to our fortnightly study of short-wave conditions, one notes in general a slight but definite trend to autumn conditions on the lower frequencies, though the higher frequencies are still, so far, putting up a summer-time performance.

For example, at 10.30 p.m. on Saturday, August 29th, W1XK on 9.57 Mc/s was a fair, deeply modulated signal, giving a pianoforte recital. Unfortunately, no comparison with W2XAF was possible, as this station was blotted out by a very strong signal from LKJ1.

A little earlier in the evening W3XAL on 17.78 Mc/s had been quite good, so also was W8XK on 15.21 Mc/s at 10.30 p.m.

An audible signal from W2XE was intercepted on 21.52 Mc/s at 3 p.m. on Sunday, August 30th, but only poor signals were obtained on this occasion from VK2ME later in the afternoon.

Later on the Sunday, W8XK was fairly good on 15.21 Mc/s, and after midnight COCH, Havana, was fair, and better than W2XAF on a near-by channel. Very good results, indeed, were obtained from W2XAD late on the following Tuesday and Wednesday evenings during the special transmissions for the Walker Cup broadcasts, and fairly good results were also obtained from W3XAL and W8XK, but neither of these stations was as strong or stable as W2XAD on his European beam.

Some very good programme value receptions, better than that obtainable from Berlin on either the medium or long waves at the time, was obtained from all the four Zeesen transmitters—DJE and DJB for the East, DJL for Africa, and DJQ for South America, during the midday and afternoon period on Sunday, September 6th.

Fair results were also obtained from PHI on 17.75 Mc/s during the afternoon, and VUB, Bombay, on 9.565 Mc/s, also gave moderately good signals at 5.55 p.m.

Strong Japanese Signals

A feature of Sunday, however, was the outstanding performance of several stations using very high frequencies. JNN Tokio on 19.5 Mc/s (approx.) was a terrific signal nearly all day, and signals were heard on frequencies up to 23 Mc/s.

Conditions were similar on Monday, September 7th, and coincided with the meridian passage of two large groups of sunspots; at 8 p.m. on this day LSE Buenos Aires on 20.5 Mc/s was as strong as I have heard him since 1927/29.

Good results from W3XAL and both W2XE and W8XK on the 15 megacycle band were obtained on Tuesday evening, September 8th, and at 11 p.m. strong signals were the order of the day from W1XAL Boston on 11.79 Mc/s.

New stations heard well during the week were HIN, Trujillo City, giving announcements in English on 11.28 Mc/s at about 10.40 p.m., and further tests by OLR Podebrady on 15.23 Mc/s last week, and 11.76 Mc/s this week at 9 a.m., 5 and 8 p.m. daily.

ETHACOMBER.

Notes on Contrast Expansion

METAL AND CARBON LAMPS IN COMBINATION

By GERALD SAYERS

THE problems associated with contrast expansion are in practice those of other attenuators, while if the usual conditions of constant input resistance are aimed at there is a ready means of estimating the probable degree of expansion. We have to remember first that in using the decibel unit we refer here to a ratio of loudness between the highest and lowest degree of expansion and that this has to be added to the normal maximum programme variation. If we take any ordinary set and operate the volume control manually the range of "Expansion," so to speak, of a low-level signal such as "Bow Bells" is some 60 decibels from the threshold of hearing to full undistorted output.

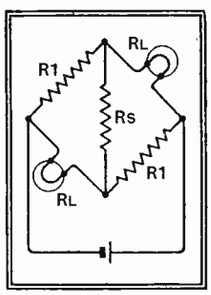


Fig. 1. The bridge type of volume-expansion circuit.

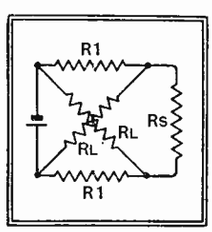


Fig. 2. The equivalent circuit of Fig. 1.

What we are trying to do is to make a similar movement over a narrower range, the movement being controlled by the programme level itself, and such action is to be very roughly the reverse of that done at present manually by the control engineer at the transmitting end of the chain. Bearing in mind the upper limit of undistorted output set by the last valve, and the lower one of inaudibility, then some 10 db. is the greatest extra range that can normally be applied.

Another reference to our manual control demonstrates that the "wick" of any ordinary set will not bear much turning up on loud passages, also that a proportion of the available power must be sacrificed to operate the contrast device (the latter may be visualised as a permanent volume control across the loud speaker which one is unable to open fully out).

		Resistance in ohms.		
		Cold.	Hot.	
L1	carbon filament	8.2	5.2	
L2	,, ,,	8.2	5.2	
L3	metal ,,	12.2	19.2	
L4	,, ,,	12.2	19.2	
Rs	speaker ..	—	—	10 ohms

We can now call maximum desired attenuation A1 and minimum A2, and A2-A1 is to be 10 db. The bridge arrangement (Fig. 1) which has been recently described can be re-drawn as a lattice-type attenuator (Fig. 2) terminated in a characteristic resistance Rs. To meet possible criticism it must be admitted that the speaker impedance (Rs) is not a constant quantity for all frequencies, but that point is beyond the scope of the present investigation. Call Rs 10 ohms.

Taking A1 (minimum volume) the problem now is: "What are the values of the resistance elements of a lattice-type attenuator to give 10 db attenuation and to have a characteristic of 10 ohms?"[1] C1 and C2 are constants for this type of network for a given attenuation in db.

C1 is 0.5194
C2 is 1.925

each of which have only to be multiplied by the characteristic resistance (Rs)

then R1 is $10 \times 0.5194 = 5.2$ ohms
R2 is $10 \times 1.925 = 19.2$ ohms

Taking A2 (maximum volume, minimum attenuation) in a similar way but for 20 db (20 − 10 = 10) and our constants for 20 db

C1 is 0.8183
C2 is 1.222

then R1 is $10 \times 0.8183 = 8.2$ ohms
R2 is $10 \times 1.222 = 12.2$ ohms

It will be observed that the resistance of one pair of arms should be rising while the other pair is falling, from which it might seem that a rather more elegant attenuation network might be constructed having lamps (or lamps shunted by resistances or filters) possessing either rising or falling temp. characteristics—a combination of metal and carbon filament lamps—in all arms of the bridge as re-written in Fig. 3 and shown in the table. Such an arrangement will present an approximately constant impedance to the applied set output and give an expansion of 10 db beyond the usual maximum modulation (say, 35 + 10 = 45 db).

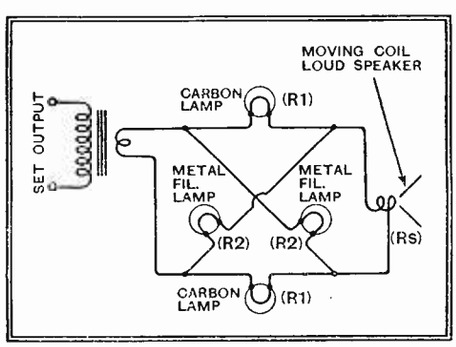


Fig. 3. Use of lamps with both positive and negative temperature coefficients in a volume expansion bridge.

[1] "Design of Constant Resistance Networks." T. S. Rangachari. *Wireless Engineer*, Nov., 1934.

H.M. Irish Guards will broadcast to-morrow.

Listener

Outstandin

THE first of a series of representative programmes to be broadcast from different continents will be heard by Regional listeners at 9 o'clock on Sunday and has a duration of half an hour. "Intercontinental Programme No. 1" comes from the U.S.A., and will be presented by the National Broadcasting Company of America and the Columbia Broadcasting system. At the opening of the programme will be heard the majestic roaring of the famous Falls of Niagara, and this will form a prelude to the first section, which is devoted to Indian music. Two Iroquois War Songs are to be chanted by Chief Jesse Cornplanter, of the Seneca Indians, direct descendant of the great Chief Cornplanter, who was a great power among the Iroquois; accompaniment is provided by a flute, shell rattles, tom-toms and Seneca singers. Part II deals with old traditional Cowboy songs of the range—"The Streets of Laredo" and "Roll Out, Cowboys" being contrasted with a modern descendant.

The third section deals with Negro music, past and present, and finally comes a selection of Anglo-American music which includes an old song, "Sourwood Mountain," sung to the accompaniment of a dulcimer. The programme ends to Lamar Stringfield's "Cripple Creek" from his orchestral suite, "From the Southern Mountains."

DIRLETON

ERECTED in the thirteenth century by the Norman family of De Vaux, and partly destroyed in the War of Independence, owned successively by Haliburtons and Ruthvens, alternately besieged and banqueted in, the Castle of Dirleton provides the subject for a Regional broadcast at 9 o'clock on Wednesday. Relayed from the Castle itself, this broadcast is the third of a series of "Castles in Scotland," and takes the form of a story in narration and reconstructed scenes from the past. It is compiled by Dr. W. Mackay MacKenzie and the music has been written by John Gough, who will also produce the programme.

SCRAPBOOK

"SCRAPBOOK for 1901," which will be presented and produced by Leslie Baily and Charles Brewer, the joint authors, was originally down for broadcasting in January last, but was postponed on account of King George's death. This is the last of the present series of "Scrapbooks," but the B.B.C. has arranged with Leslie Baily for a new series to be produced between October, 1936, and September, 1937.

In this edition one of the outstanding glimpses into the past will be that of the Marchese Marconi and the late Mr. G. S. Kemp, who, thirty-five years ago, carried out the first transmission of wireless signals across the Atlantic.

The programme is timed for 8.10 on Thursday, when it will be radiated Regionally.

ROMANCE OF THE SUEZ CANAL

FELIX FELTON, the brilliant young B.B.C. producer who was entrusted for the first time with the Round-the-World programme of Christmas Day, 1935, is to do another high-spot broadcasting this (Friday) evening, when a programme designed by himself and dealing with the story of the Suez Canal will be broadcast in the Regional programme at 8.10 under the simple title of "Ferdinand de Lesseps."

The story, revolving about the central figure, de Lesseps, tells how for four years the plans of the great project were constantly modified until in 1858 a company with a capital of two hundred million francs was formed. Eleven strenuous years passed, the apparently impossible was achieved; the Suez Canal became one of the main arteries of world trade.

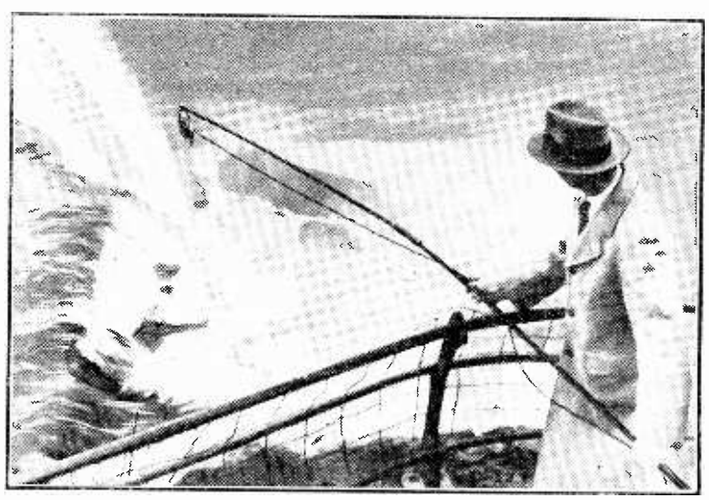
PROMS

RELAYS from the Promenade Concerts continue each night this week, and the item selected for this evening at 8.55 is Beethoven's "Eroica." On Saturday at 8.30 (Reg.) Lisa Minghetti will be heard in the Max Bruch Violin Concerto and the Symphony will be Beethoven's No. 5 in C Minor. On Monday the Wagner concert is devoted to "Parsifal," and will include the Prelude, Grail Scene and Finale.

Tchaikovsky's Sixth Symphony (the "Pathétique") will be broadcast at 8.45 (Reg.) on the following day and then on Wednesday (Nat.) there will be a Brahms concert, when Szigeti will be the soloist in the Violin Concerto in D. A feature of the concert of Russian music on Thursday will be the second appearance at the Proms of Nicholas Medtner, the Russian composer-pianist, who will play his Second Piano Concerto in C Minor. The programme is to be radiated on National at 8 o'clock.

IRISH GUARDS BAND

ALTHOUGH it is more than a year since Colonel A. G. C. Dawnay relinquished the post of Controller of Programmes at the B.B.C., he still takes an active interest in wireless entertainment, and as officer commanding H.M. Irish Guards the permission granted by him for a broadcast by the Band of the Battalion to-morrow (Saturday) is something more than a mere courtesy act. Colonel Dawnay is still to be seen now and then in the corridors of Broadcasting House. The Band's performance on Saturday between 6 and 7 o'clock (Reg.) will be conducted by Lieutenant J. L. T. Hurd, who is Director of Music to the Irish Guards. As an offset to the instrumental part of the programme solos will be sung by that old favourite of broadcasting, Norman Williams (bass).



FISHING FOR SOUND with a microphone. This picture was taken on the occasion of a previous relay of the voice of Niagara, which will again be heard in the Intercontinental Programme on Sunday.

A NOVELTY IN SPORT

THE Six-Day Cycle Race, which has for some years past enjoyed great popularity on the Continent, is to be introduced to England at the Wembley Pool Stadium this month. The teams, entered by various countries, are not representative of those countries, as, for instance, an Englishman is riding for Hol-

Guide for the Week

oadcasts at Home and Abroad

land and a Dutchman for England. Mr. J. E. Holdsworth, who described the Herne Hill Cycle Race, will give a commentary on the opening of the race at 10.30 on Monday evening (Nat.). This should be a new sensation for English listeners and should be welcome as a novelty.

Orde and the Eight Step Sisters. This show attracted the attention of a B.B.C. talent scout. The result was that Sidney Chasid was offered an engagement at Broadcasting House, where he made his début before the microphone on June 23rd. He has now been given a second engagement and will be heard in the National programme on Thursday at 5.15.

A SCENE from the stage version of Edgar Wallace's play "The Calendar." Adapted for broadcasting by Barbara Burnham and produced by Val Gielgud, it will be heard on Monday and Tuesday.

OUTSTANDING PIANOFORTE RECITALS

THE first of two outstanding pianoforte recitals, both on National, is to be given this evening at 7.30 by Irene Scharrer, who will include in her programme the Beethoven "Waldstein" Sonata.

The second recital (timed for 9 o'clock on Sunday) will be given by Moiseiwitsch, who was given such a thunderous reception at the Promenade Concert last Tuesday. He will play two Preludes and the Sonata in B flat Minor by Chopin.

A STAR "FIND"

IN the early months of this year Sidney Chasid and his Band were appearing in the cast of a variety show at a cinema in Kingston-on-Thames which included Florence Oldham, Harold Ramsay, Beryl

OPERA ABROAD

To the student of contemporary opera "La Leggenda di Sakuntala," by Alfano, should provide more than a little interest. Alfano is one of the finest of present-day composers from the technical point of view and he is a teacher of his craft. This opera, which is presented in three acts, is founded on an Indian legend, and will be radiated at 8.45 on Sunday from Rome, and then again from Milan on Tuesday at the same time.

TELL THE WORLD

SOMETHING new in the line of talks has been evolved in Swedish broadcasting. A series under the somewhat pugilistic title of "Straight from the Shoulder" is to be launched on Sunday at 9.30. Great hopes are entertained by the broadcasting authorities for the success of these talks, as they will offer prominent personalities an excellent opportunity to speak their opinions very frankly on the topics of the day.

THE AUDITOR.

HIGHLIGHTS OF THE WEEK

FRIDAY SEPTEMBER 18th

Nat., 8.10, B.B.C. Dance Orchestra. 8.55, Prom. 10.10, "Down to the Sea in Ships": Talk by Arthur Cargill.
Reg., 7.30, Northern Music Hall from Sheffield. 8.55, Celebrity Trio. 9.20, Comic Opera.
Abroad.
Vienna, 8.20–10, "Algira"—Two-Act Opera by Verdi.

SATURDAY, SEPTEMBER 19th.

Nat., 6.50, Theatre Orchestra. 8, John Watt tells "The Full Story." ¶Music Hall. 10.30, B.B.C. Orchestra (C).
Reg., 7.30, Albert Whelan in "That Reminds Me." 8, Reah Sadowska (pianoforte). ¶Prom. 9.35, The Continentals.
Abroad.
Sottens, 8.35, Debussy Festival Concert.

SUNDAY, SEPTEMBER 20th.

Nat., 7.45, Federation of Festivals: talk by C. Armstrong Gibbs. 9.30, Theatre Orchestra.
Reg., 5.0, "Voices of the People." 7.55, Presbyterian Service. ¶Owen Nares Appeals. 9.30, London Mozart Orchestra.
Abroad.
Munich and most German Stations. 8, Classical Concert (Mozart, Liszt, Debussy, etc.).

MONDAY, SEPTEMBER 21st

Nat., 7, B.B.C. Dance Orchestra. ¶Federation of Festivals. 8, Prom. ¶Variety compered by Brian Michie.
Reg., 7.30, Alfredo Campoli Trio. ¶The Calendar. 9.15, Anona Winn and her Winners. ¶Recital.

Monday, Sept. 21st (*continued*).

Abroad.
Berlin, 8.10, "Money Songs" and Melodies about Money.

TUESDAY, SEPTEMBER 22nd.

Nat., 6.25, Leslie Bridgewater Quintet. 8, Fictional Fame on Parade: A Satirical Revue of Best-Sellers. ¶The Callendar. 10.10, B.B.C. Orchestra (C).
Reg., 7.30, George Scott-Wood and his Six Swingers. 8, Talk: Tameness in Birds by Tom Harrison. ¶Karl Caylus Players.
Abroad.
Radio-Paris, 8.30, From the Opera.

WEDNESDAY, SEPTEMBER 23rd.

Nat., 6.30, "Talks in French" by M. E. M. Stephan. ¶B.B.C. Military Band. Gerald Kasses (bass baritone). 8.55, Al Collins and his Dance Orchestra. ¶Theatre Orchestra.
Reg., 7.30, The Tudor Singers, conducted by Cuthbert Bates. 8, "Patricia Brent, Spinster": A Comedy.
Abroad.
Frankfurt, 8.45, A Beethoven Concert with piano, choir and orchestra.

THURSDAY SEPTEMBER 24th.

Nat., 6.20, Talk by John Hilton. ¶Prom. ¶9.5, The Roosters. 9.20, Forthcoming Changes in Programme Timing. By the Controller of Programmes.
Reg., 7.30, Problems of Non-Aryan Refugees: Talk by the Bishop of Chichester. ¶B.B.C Orchestra
Abroad.
Warsaw, 7.40, Unfamiliar Ballet Music.

SCRAPBOOK.—A picture taken on Signal Hill, Newfoundland, 35 years ago, which shows Mr. Marconi, on the extreme left, approaching his assistants as they wrestle with the aerial-carrying kite which made their epoch-making experiment possible.

RANDOM RADIATIONS

By "DIALLIST"

A Televisiomaniac

AN old friend of mine who is a still older hand at wireless has recently become what I can only describe as a television addict. No viewing booth can be opened, no demonstration staged without his arriving at the earliest possible moment and leaving at the latest. He babbles o' time-bases and o' cathode-ray tubes as Sir John Falstaff once babbled o' green fields. But he also grouses, as it is the prerogative of every native of these Isles to do. He doesn't grouse about television itself; far from it; television is to him a kind of delectable ointment in which there can be no fly.

What then, the reader may ask, is biting this old friend of yours, O Diallist? Just this. He objects and objects strongly to the fact that the Press, despite the warm welcome (and the wonderful publicity) that it gave to television, has ventured to remark mildly, here that perfection in technique has still not been attained; there that to own a television receiver one must have a respectable bank balance—or be of the kind to whom overdrafts are lightly granted.

Are We Playing Fair?

"Why," says he, "should they harp on—or even mention—the shortcomings of television in these, its infant days? They didn't point out in 1922 that wireless receivers (and transmitters, too, for that matter) distorted pretty badly. When three-valve sets cost about £40, they didn't try to make out that wireless was a rich man's hobby. Why, then, say that for some time television must be a hobby for the few and that it is still not so good as it might be, and eventually will be?"

There are lots of good reasons. First of all the mechanical and electrical reproduction of sound was in a pretty elementary state when broadcasting began. The obvious standards of comparison were the gramophone and the telephone. In the days before electrical recording, the gramophone could reproduce only a very limited range of radio-frequencies. The same was true of the kind of telephone that was in use 14 or 15 years ago. Since we had never heard anything better than squeaky, scratchy reproduction of music with no real bass whatever by the gramophone, and speech so muffled on the telephone that nearly every proper name had to be spelt out, we did not realise that there was very much lacking in the early wireless sets.

Sweet Reason

With television matters are rather different, for before it came we had already reached a rather high standard in the perfection of moving pictures by the cinematograph, not only of the professional, but also of the amateur variety. Not just those who push pens to earn their living, but every man, woman or child that sees a television demonstration will naturally compare its images with those of the ciné screen. Everyone, then, must realise that, wonderful as is the television of to-day, there is room for improvement. This is no "crabbing" of an infant science.

Then the matter of expense. When the three-valve receiver cost a great deal in "ready-made" form, it was possible for the man in the street to obtain reception of the broadcast programmes—if he was not too far from the transmitter—with a crystal set. Or he could build his own valve set quite cheaply, even in those days if he made, as many of us did, his own variable and fixed condensers or wound both high- and low-frequency transformers. It has always been possible to receive broadcast wireless on the cheap. Any such thing is quite out of the question with television.

In Thundery Weather

WHEN the "Lady Peace," the 'plane flown across the Atlantic by Mr. Merrill and Mr. Richman, landed in Carmarthenshire, some of the papers reported that the absence of wireless signals during the latter part of the flight was due to the aerial's having been struck by lightning. The damage was certainly due to the thunderstorms through which the flyers passed; but there can't have been a direct hit by lightning, otherwise there wouldn't have been much left of the 'plane. The trouble was probably caused, as it nearly always is when "broadcast" receiving sets are put out of action by thunderstorms, by very high voltages induced in the aerial. Some time ago experiments were carried out to see what kind of voltages could appear in an ordinary receiving aerial system in thundery weather. It was found that when a storm was passing directly overhead they could reach 5,000 volts or more. Hence the wisdom of fitting a good earthing switch—and using it!

A.P. and Interference

MANY complaints have been received from listeners living near the Alexandra Palace that they suffer from severe interference with their reception of the broadcast programmes on the medium wavelengths whenever television transmissions are toward. This had not been expected, but there is no doubt that the trouble is real. The B.B.C. is busily seeing what can be done about it, and talks of evolving some simple and inexpensive device on wavetrap lines. Listeners in the neighbourhood protest that they should not be put to the cost of fitting gadgets to stop the interference, but really they haven't much to complain about for the necessary outlay will be small.

The Demand for Big Sets

I WAS very interested to see that R. G. D. and other firms who showed large and pretty highly priced sets at Olympia had been agreeably surprised by the volume of orders received for them. I'm pleased too, but not a bit surprised. You may remember that I have long held it to be folly on the part of so many of our manufacturers to neglect the market for really high-class sets and to concentrate on moderately priced gear. There is very definitely a useful demand for the "quality" receiver. And there's a market, far wider than many people think, for the set of many valves which is sensitive, though working well within itself, and containing a dozen or so refinements that cannot possibly be put into apparatus in the £10-£15 class. It is good to see that makers are at last waking up to these facts and beginning to realise that a large section of the listening public wants the very best that can be obtained in the way of wireless sets—and doesn't mind how much they cost, within reason.

THE RADIO INDUSTRY

DURING the Manchester Show period, Voigt speakers will be demonstrated at the premises of Forsyth Bros., Ltd., 126, Deansgate, Manchester. Times: September 23rd, from 3 p.m. to 6 p.m.; September 24th, 25th and 26th, from 3 p.m. to 10.30 p.m.

A very readable booklet issued by Bakelite, Ltd., of 68, Victoria Street, London, S.W.1, describes the properties and uses of Bakelite insulating varnishes, which have many applications in the construction of wireless apparatus, particularly for coil impregnation.

The price of the W.B. 1937 Stentorian Junior chassis model appeared in a recent advertisement as 37s. 6d., instead of the correct price, which is 32s. 6d.

B.B.C. EMPIRE TRANSMISSIONS

The revised times and wavelengths of the short-wave transmissions from Daventry are given below. Readers should listen carefully to announcements since wavelengths and times are liable to be changed.

Call Sign.	Frequency Mc/s.	Optimum Direction.	Times (G.M.T.).
GSD	11.75	East and West	26th July–29th Aug. 05.15–07.15
GSB	9.51	East and West	30th Aug.–3rd Oct. 06.15–08.15
			4th Oct.–7th Nov. 07.15–09.15
GSH	21.47	North and South; East and West	11.00–13.45
GSG	17.79	East	(Sundays 12.00–13.45)
GSH	21.47	East and West	14.00–16.30
GSG	17.79	East	14.00–17.00
GSF	15.14	East	14.00–17.00
GSO	15.18	North and South	17.15–20.40
GSD	11.75	North and South	17.15–20.25
GSB	9.51	North-West and South-East	17.15–20.40
GSG	17.79	West	20.40–22.45
GSF	15.14	West	20.40–22.45
GSB	9.51	North and South	20.40–22.45
GSP	15.31	East and West	23.00–01.00
GSD	11.75	North-West and South-East	
GSC	9.58	East and West	
GSF	15.14	North-West and South-East	02.00–04.00
GSC	9.58	North-West and South-East	

Visual Direction Finders

FOR U.S. COASTGUARD PLANES

New Cathode-Ray Application

WE are daily hearing of new applications of the cathode-ray tube, which seem to be getting as numerous as those of the ordinary thermionic valve. Some time ago details appeared in *The Wireless World* of the use of a cathode-ray device on board ship in order to prevent collisions during foggy weather in congested waters such as the English Channel.* This virtually consisted of an ultra-short wave DF arrangement of very limited range whereby the bearing of any neighbouring ship was indicated visually on the screen of a cathode-ray tube suitably mounted on the bridge. This principle of visual indication of bearing has now been applied in the U.S.A. to direction-finding apparatus on aircraft of various types.

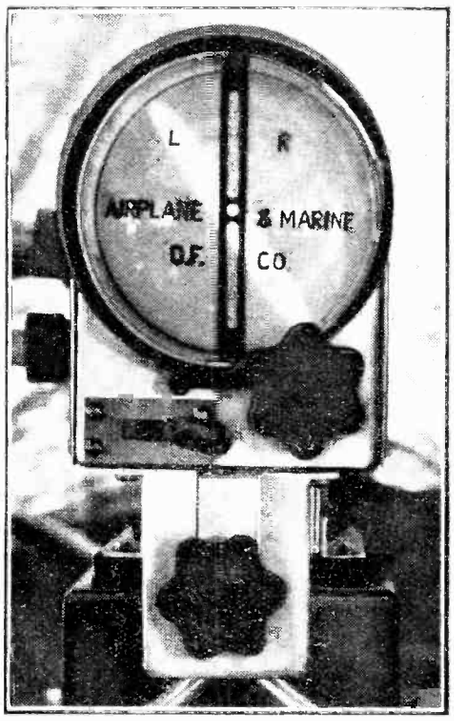
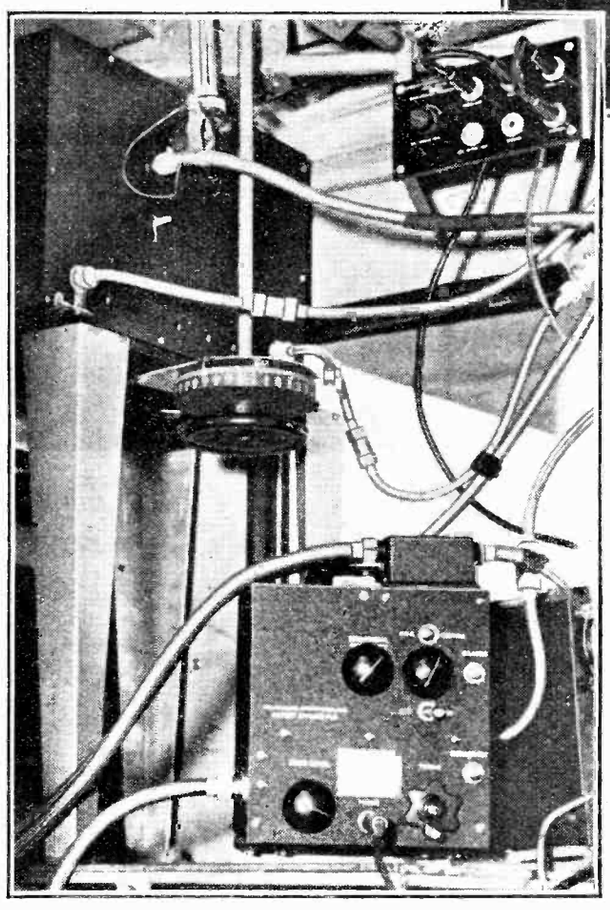


Fig. 1.—The direction of the wireless transmitting station relative to the aeroplane is indicated by the luminous beam.

In place of ordinary aural indication the bearing of the aeroplane in relation to any given transmitting station is shown by a luminous beam on a cathode-ray screen (Fig. 1). The apparatus is worked in conjunction with an ordinary fixed aerial and earth system, and a rotating frame, the former being connected to the top and bottom deflecting plates and the latter to the side plates of the cathode-ray tube. The fluctuating voltages on these plates deflect the electron stream in the customary manner, so producing the necessary variations in the position of the luminous beam.

When the operator desires to know the actual bearing of the station indicated on the cathode-ray screen he rotates the frame aerial by means of a wheel (Fig. 2) until the beam of light on the screen coincides with the "fore and aft" line of the plane. The bearing is then read directly from the scale attached to the wheel actuating the frame aerial. In cases where the aeroplane is directly over the transmitting station a circular pattern appears on the screen, while an elliptical pattern (Fig. 3) indicates that a station is being approached. Apart from its use as a direction finder and homing device, the apparatus can also be employed for indicating the aeroplane's wind drift by co-ordinating the visual indication with the directional gyro.

Fig. 2 (below).—By rotating the horizontal wheel until the beam of light in Fig. 1 coincides with the aeroplane's longitudinal axis, the bearing of the station can be read directly on the scale shown.



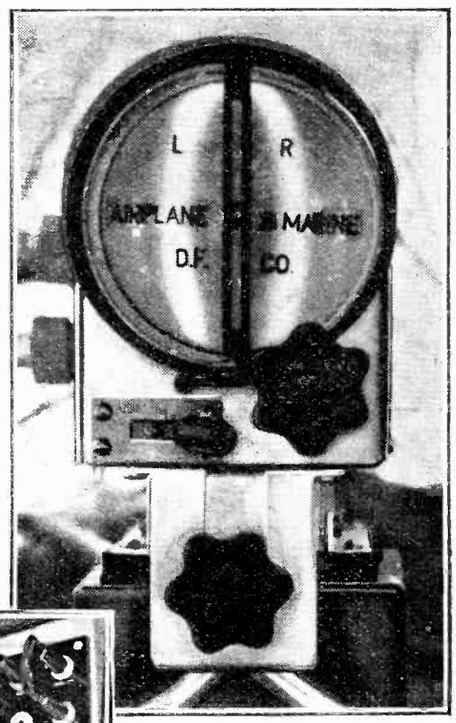


Fig. 3.—When two beams forming an elliptical pattern appear on the cathode-ray screen, it indicates that the transmitting station is directly ahead.

It is claimed that this invention will give accurate bearings through very heavy interference from other stations working on the same wavelength and through severe atmospherics.

Another very great advantage claimed for the apparatus which will be appreciated by all who have had much to do with DF work is that night-effect errors are never sufficiently great to be of any consequence.

This valuable development is due to Edward Hefele, Chief Engineer of the Airplane and Marine Direction Finder Corporation of Lindenhurst, U.S.A., and has been extensively tested by the United States coastguard authorities.

* New Radio Aid to Navigation, *The Wireless World*, August 3rd, 1934, page 76.

Broadcast Brevities

"In Its Infancy"

THE papers are now using the time-worn phrase "in its infancy" in connection with television, with the result that sound broadcasting seems to recede suddenly into middle-age. A talk by Captain H. B. T. Wakelam, truly a veteran among sporting commentators, to be given next week on "Reminiscences of Ten Years' Broadcasting" will also remind us of the antiquity of broadcasting.

In point of fact, broadcasting was a lusty adolescent when Captain Wakelam's microphone adventures began way back in 1926.

Veterans

It is quite a solemn thought that the men who started the great game of broadcasting are now, with barely an exception, verging on middle-age; some of them, indeed, are well stricken in years.

One of the exceptions, surely, must be Cecil Lewis—the "Uncle Caractacus" of Savoy Hill days—who made history once again during Radiolympia by giving the first "running commentaries" by television. Visitors to the television booths caught a brief glimpse of his tall, and still youthful, figure as he began his description of the view from Alexandra Palace as seen by the "electric eye."

First Television Commentary

It was not generally realised, perhaps, that Mr. Lewis's comments were based on what he saw *via* the television screen. After being "seen" on the terrace, he ran indoors, hopped over the trailing cables on the studio floor and took his seat at a check receiver in a darkened corner.

If, as the days went by, he began to lose his first fine frenzy at the beauties of Hornsey and Harringay, he never betrayed the fact.

Popularity of Daventry

THE Empire station at Daventry appears to be gaining in popularity, largely on account of its increasing dependability as a universal provider of good signal strength. (Stations not consistently heard are never favourites, no matter how good their fare.)

New Zealand listeners are asking their local broadcasting authorities to record Daventry during the day for rediffusion in the evening.

NEWS FROM PORTLAND PLACE

In the Antipodes

Australia, too, is becoming more Daventry-conscious.

"Daventry can be heard almost throughout the day at varying strengths," writes a Brisbane enthusiast, who tempers his praise, however, with the remark that Moscow has the strongest signal and is consistently good. All the European short-wave stations, apparently, are heard at their best in the Antipodes at about 7.0 a.m.

Television in Sound

IS sound broadcasting jealous of television? At present there is no evidence of such a thing; in fact, Broadcasting House intends to pay a very pretty compliment to Alexandra Palace towards the end of October, when a Television Feature Programme is to be given on the National wavelengths.

The details have yet to be worked out, but the indications are that this forty-minute transmission will give the "junior service" an excellent send-off.

One day Alexandra Palace should reciprocate with a Sound Feature Programme, setting forth—in pictures—the nightly drama of life in the studios of Broadcasting House.

Recording Entertainment

THE B.B.C. mobile recording unit is now equipped with two new vans, each containing a miniature studio. The unit has not hitherto played a large part on the entertainment side, its scope having been confined mainly to the "potted O.B." type of programme.

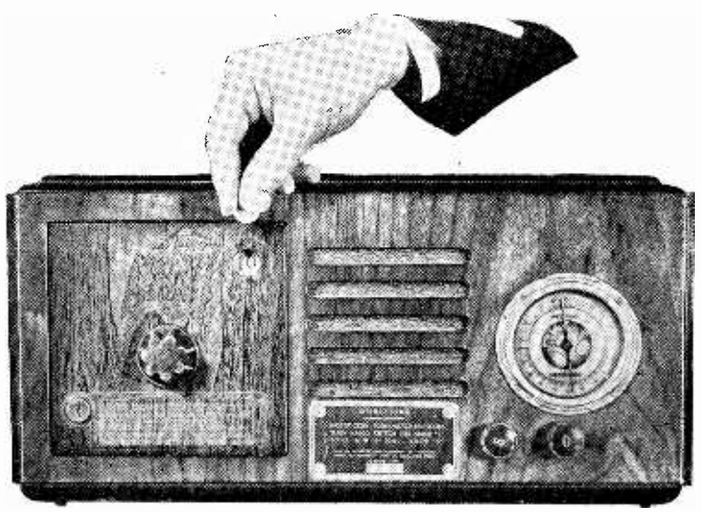
Things are changing, however, for it is expected to contribute a good deal to the success of "Entertainment Parade," Eric Maschwitz' new feature, which comes on the air for the first time early in October.

Visits to Theatres

"Entertainment Parade" will exploit the "trailer" idea to give listeners a panorama of London amusements, and for this purpose the recording unit may visit the foyers of theatres and cinemas on "first nights" and "premières"—the distinction is a subtle one—picking up the buzz of conversation and perhaps luring "personalities" to express themselves to the world at large.

"What's On" the World Over

The new feature will also contain excerpts from shows both at home and abroad, and will offer a news commentary apropos "what's on" in the world of entertainment generally. Music will also be dealt with, probably through the medium of records, and perhaps composers may occasionally be induced to comment on their new works.



PAY WHILE YOU LISTEN. An automatic 5-valve superhet receiver of the type being installed in hotels in America. The insertion of a coin enables the set to be operated for either half an hour or an hour. A wide range of home and foreign stations can be tuned in.

The Coronation Broadcasts

ALREADY the "O.B." Department, under the direction of Mr. S. J. de Lotbinière, is preparing for that world event, the Coronation. So far as the Abbey ceremonial is concerned, little difficulty should be encountered, for the B.B.C. has nothing to learn regarding the dignified presentation of great national events in the Empire's Shrine; the real problems present themselves outside Westminster Abbey.

Appropriate sites must be chosen for microphone points—sites which will afford commentators ample opportunity to entertain listeners while awaiting the procession. Technically, the event should provide the B.B.C. with one of its biggest opportunities, for all the world will be listening.

100 O.B. Points?

The Royal Progress throughout London on the day following the Coronation will again test the O.B. Department to the uttermost. The route, several miles in length, will entail the services of large numbers of commentators, and if the atmosphere of this great day is to be worthily communicated, attention will have to be given to the building up of a faithful sound picture of all that goes on. Possibly a hundred or more microphone points will be necessary, linked up by a cobweb-like span of cables with the control room at Broadcasting House and the International Telephone Exchange in Carter Lane, E.C.

Delay at Burghead?

THE path of true broadcasting—like love—never did run smooth, and this is proven once more in the case of Burghead, where North Scottish is, to all appearances, a complete broadcasting station.

Sundry little technical hitches may or may not be overcome before the end of this month; at any rate, there is a possibility that the North of Scotland may have to wait a week or two longer than was expected before the long-awaited signals go out regularly from the B.B.C.'s most northerly station.

"Here's Looking at You"

THE latest "revelation" in television is that Elizabeth Cowell, the girl announcer, and D. H. Munro, Productions Manager, were lucky to be "in the running" during the Radiolympia transmissions.

On the Monday morning of the second week Mr. Munro took Miss Cowell to Alexandra Palace in his car, rehearsing her *en route* for her duties in the spotlight studio.

For one brief moment the Productions Manager took his eye off the road to note whether his fair pupil was registering the correct facial expression, and it might have been their last brief moment, for the car nearly collided with a lamp-standard. "Here's Looking at You" has its dangers.

New Apparatus Reviewed

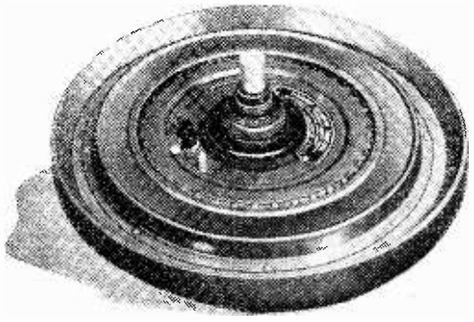
Recent Products of the Manufacturers

SIMPSON RECORDING TURNTABLE

A HEAVY-DUTY electric turntable, which has been designed especially for home recording, is now included in the range of gramophone units obtainable from Kingsway Electricals, Ltd., 3-9, Dane Street, High Holborn, London, W.C.2.

Like the standard-size models, the recording unit employs the turntable plate as the rotor of a synchronous motor, the stator being built in the centre.

The new model weighs slightly less than 18 lb. and is fitted with a massive rotor-cum-turntable plate measuring 12in. in diameter and 1in. thick at the periphery. The underside is recessed to accommodate the stator, and this part measures 7in. across.



New heavy-duty Simpson electric recording turntable.

Fitting the unit is particularly easy, as it is secured to the motor board by one large nut only, which is on the outside of the housing for the bearing of the rotor plate. This requires a hole $1\frac{1}{8}$in. in diameter.

Though it is a slow-running machine, there is ample power in the motor for all normal home-recording requirements. The centre spindle is screw-threaded on the outside, so that a small pulley may be fitted to drive the traversing mechanism.

The motor is not self-starting and has to be rotated by hand at the outset, but thereafter it runs at a constant speed of 78.9 rpm when connected to the 50 c/s AC supply mains. Its consumption is about 30 watts at 200 to 250 volts AC.

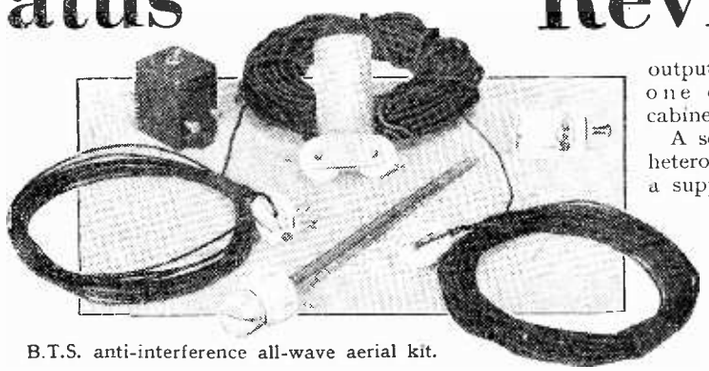
Recording blanks up to 12in. in diameter can be used on this machine, and the price complete is £5 5s.

B.T.S. ANTI-NOISE AERIAL

THIS aerial system has been designed for use with all-wave receivers, its special function being to give a better signal-to-noise ratio in localities where electrical interference is especially bad.

It is claimed to have an effective range of 13 to 2,000 metres, and is arranged in the form of two separate aerials of dissimilar length joined to a special aerial transformer, from where a pair of twisted feeder wires is taken down to the receiver.

The horizontal, or effective, part of the aerial must be erected well away from buildings and as high as facilities will allow, so as to bring it outside the field of the interference. The feeders merely convey the



B.T.S. anti-interference all-wave aerial kit.

signal voltages from the aerial to the receiver, and when correctly balanced and terminated do not pick up any energy either in the form of signal voltages or interference noises.

The lower ends of the feeders are joined to a special matching transformer located close to the input terminal of the set, and this transformer unit in the B.T.S. system is not aperiodic over the whole waverange but has to be switched from one combination for the normal broadcast wavelengths to another for the short waves.

The aerial is supplied ready assembled and insulators for securing the feeder down-lead are included. On one side of the aerial transformer is a 17ft. length of aerial wire, while on the other is one 43ft. long.

It is essential for the satisfactory operation of the system that the 17ft. portion be kept intact, but the longer length can be shortened if facilities are not available for erecting an aerial 60ft. in length. It should not be reduced, however, to less than 25ft.

The arrangement is such that it shows promise of being quite effective as a noise-reducing system both on normal broadcast as well as on the short waves, and it is obtainable from British Television Supplies, Ltd., Faraday House, 8-10, Charing Cross Road, London, W.C.2.

The price is 25s. complete.

ELECTRO DYNAMIC DC TO AC CONVERTER

SINCE quite a large number of modern receivers now embody a short-wave range, where the need arises to use a rotary converter in order to obtain AC from the DC supply mains it is, of course, essential that the filtering circuits embodied in the outfit be as efficacious on the short waves as they are on the normal broadcast bands. This has led the Electro Dynamic Construction Co., Ltd., St. Mary Cray, Kent, to evolve a new type of filter unit, and a small rotary converter fitted with one of these has been sent in for test.

This machine is rated at about 90 watts output and was enclosed in one of their sound-proof cabinets.

A sensitive all-wave superheterodyne receiver requiring a supply of this order happened to be available and tests were accordingly made with it.

The machine was rated for 220 volts DC input, but it was necessary to make our tests on a 210-volt supply; however, this small difference is of no great consequence, though it may affect very slightly the efficiency of the machine.

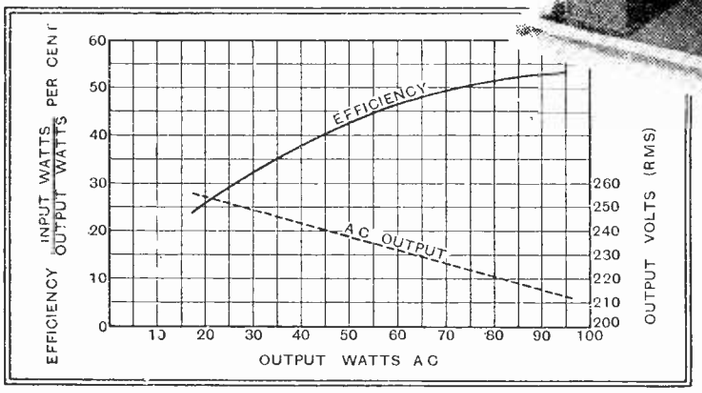
The tests were entirely satisfactory and no difference could be determined in the performance with normal mains AC supply or with the AC taken from the converter. There was not the slightest trace of commutator ripple and it was impossible to tell from which source the supply was taken. Only a very faint hum arises from the silence cabinet, and even this is inaudible a few yards away.

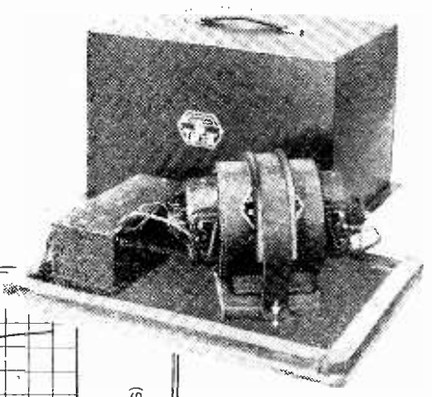
No interference was experienced down to the shortest wavelengths of the set, namely 16 metres.

A subsequent test made on the ultra-short waves produced some interference if a very sensitive set is employed, but this was found to become progressively better as the wavelength increased, and at about nine metres, the upper limit of this set, it was not very noticeable.

The curves reproduced show the AC output on loads up to 95 watts, and from these it will be seen that at about 90 watts, the normal full load, the AC voltage is approximately equal to the DC input voltage, so that on 220 volts DC about 225 volts AC will be available. Also the efficiency is about maximum at this loading.

These new filters are being fitted on all Electro Dynamic rotary converters in future without extra charge. The model illustrated, for example, costs £14 complete.





Electro Dynamic rotary converter fitted with new-style filter unit for use with all-wave sets.

Output and efficiency curves of a 90-watt model.

Recent Inventions

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

RELAYING WIRELESS SIGNALS

SIGNALS from a main transmitter are picked up at an intermediate point, where they are amplified or boosted-up and then re-radiated to a further station. Either the carrier-wave alone, or one or both sidebands, may be intercepted and strengthened. Or in the case where the main transmitter sends out only a single side-band, the relay station may be arranged to radiate the carrier-wave necessary to receive this type of signal on a "straight" circuit receiver.

The relay station is provided with means for maintaining the re-radiated energy at a constant strength. This ensures stabilised working, irrespective of variations in the strength of the received signals, and prevents undesirable reaction between the receiver and transmitter circuits at the relay station.

J. Robinson. Application date December 19th, 1934. No. 449322.

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WAVE-BAND SWITCHING

THE setting of the circuits of a wireless receiver to one or other of several wave-band settings is altered simultaneously with the value of a steady magnetising current applied to a coil having an iron core. The degree of saturation of the core determines the effective inductance of the coil, and of other coils associated with it. The value of the control current is varied by means of a rotary potentiometer, which simultaneously operates a pointer to indicate the corresponding wavelength setting on an illuminated dial. The rotary movement of the rheostat also operates an escapement device, which controls the wave-band switch.

L. L. de Kramolin. Convention dates (Germany) October 23rd and November 10th, 1933, and March 5th and 14th, 1934. No. 449240.

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ELIMINATING DISTURBANCES

FIG. 1 represents the signal voltage V to be received, and the corresponding rectified or "envelope" curve U, together with interfering static impulses S of greater amplitude than the envelope. In order to suppress the disturbances the circuit shown in Fig. 2 is used. A diode valve D is shunted across the input of the low-frequency amplifier A, and a portion of the output of that valve is diverted through a transformer T and rectifier D1 to a resistance R. The bias so applied from the resistance R to the diode D causes the latter to act as a limiter. It will pass all signal voltages within the limit of the signal "envelope" U in Fig. 1, but cuts out any disturbances, such as S, of greater amplitude.

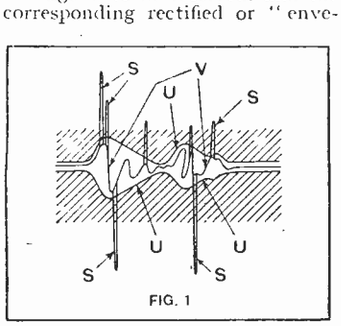

FIG. 1

Schematic representation of received signal voltage, rectified envelope and static interference.

K. Pulvari-Pulvermacher. Application date October 4th, 1935. No. 447593.

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MOTOR CAR SETS

TO prevent ignition "noise" in a motor car set it is desirable to enclose the receiver completely in an earthed metallic casing, which usually consists of a container proper and a cover or lid to fit over it. In order to ensure a good electrical contact between the two, and to prevent the lid from rattling, the casing is formed with a groove around its upper edge, and the cover is clamped firmly on to it by a number of metal clips provided with detents which spring into the groove once the lid is in position.

J. Y. Johnson (communicated by Philadelphia Storage Battery Co.). Application date December 3rd, 1934. No. 448045.

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"THERMOMETER" TUNING

THE tuning-indicator of a wireless set consists of one or more vertical glass tubes in which a flexible opaque metal rod is moved up and down, in the same way as the mercury thread in a thermometer. Preferably there are two such indicators, one mounted on each side of the panel, for the medium- and long-wave stations respectively. Station-names, or wavelengths, are set off along the length of each tube. The inside "thread" or marker is moved up and down by cord-and-pulley gearing driven from the shaft of the main tuning-condenser.

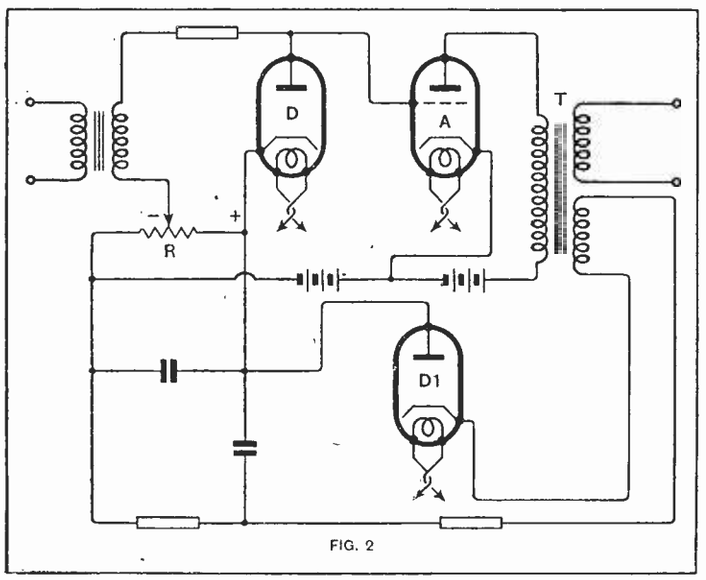

FIG. 2

Circuit arrangement employed to suppress static interference.

A. C. Cossor, Ltd., and D. G. Rennett. Application date November 10th, 1934. No. 447125.

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SHORT-WAVE DETECTORS

FOR rectifying short-wave signals, of the order of 10 metres, a valve is so arranged that the mean potential of the anode is equal to that of the negative cathode-lead, whilst the mean potential of the control grid is approximately equal to that of the positive cathode-lead. This is secured by connecting the grid-lead to a potentiometer in the grid circuit. Curves showing variations of anode current and grid current with grid voltage are available to support the theory underlying the invention, which is distinguished from the well-known Barkhausen-Kurz or Gill-Morrell effect.

J. R. H. Forman and Baird Television, Ltd. Application date January 30th, 1935. No. 446778.

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RESONATORS

A "RESONATOR" or oscillatory circuit, for use with very high frequencies, consists of a hollow metal sphere enclosing two rods which carry plates forming a condenser at the centre of the sphere. The whole of the inductance is distributed over the surface of the sphere, whilst the capacity is more or less "lumped" inside. The value of the condenser is varied by adjusting the distance between the two end plates. The device can be used for storing or building-up oscillations of the order of 300 megacycles, with very low loss.

Marconi's Wireless Telegraph Co., Ltd. (assignees of B. J. Thompson). Convention date (U.S.A.) September 29th, 1934. No. 446804.

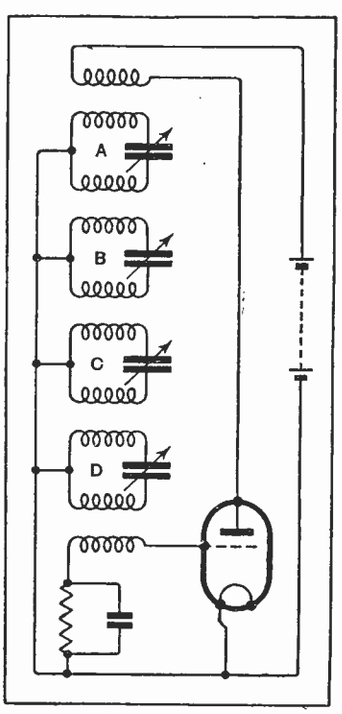
o o o o

MASTER-CONTROL OSCILLATORS

IT is well known that an ordinary back-coupled valve will not produce oscillations of constant frequency unless it is controlled by a piezo-electric crystal or other "stabiliser." The inventors have discovered that the generated frequency is, in fact, largely dependent upon the effective phase of the impulses fed back from the plate to the grid circuit. For a given cycle, the earlier such impulses occur, the higher the frequency tends to drift; conversely, the later the impulses, the lower the frequency. In practice the phase relation is determined not only by the electrical constants of the coupling, but also by the characteristic curve of the valve.

According to the invention, the plate is back-coupled to the grid through a cascade arrangement of tuned circuits A . . . D weakly coupled together. This is stated to have the effect of neutralising any phase-variations, and of thus preserving a constant frequency-output in spite of accidental fluctuations in the supply-voltage or elsewhere.

Marconi's Wireless Telegraph Co., Ltd., and G. M. Wright. Application date November 14th, 1934. No. 447280.



Self-excited valve oscillator with frequency stabilising circuits.

1ST AND FOREMOST THREE NEW RADIO BOOKS

PUBLICATIONS OF VITAL INTEREST TO ALL RADIO CONSTRUCTORS:

1. BULGIN CATALOGUE. Bigger and even better, surpasses all previous issues. Describes and illustrates the largest range of components in the world—all up-to-the-minute British made quality products—backed by a name as old as Radio itself. Includes 100 entirely new components, augmented technical data on all lines, and for the first time 12 pages of dimensional prints.

Price 3d. *Post free.*

2. "PROGRESS MAGAZINE" A wonderful new edition artistically printed. 40 pages, 55 photographs and diagrams. Ten of the world's most modern circuits for home construction, details of—

9 Valve A.C./D.C. Receiver. Car Radio Receiver. Symphonic Band Amplifier. A.C./D.C. Family Three. Modulated Oscillator. Three Valve A.C. Set. Quadraband Super-het. All Wave Battery Super. Three Valve Battery Straight. 6 Valve A.C./D.C. Straight.

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3. RADIO SERVICE MANUAL. Compiled by Service Experts, essentially for every set owner. 64 pages, 240 pictures, and simple explanation of all working parts of a radio receiver. Enables one to rectify faults and improve performance of any make of set.

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BULGIN

A THOUSAND AND ONE QUALITY RADIO PRODUCTS

COUPON

To A. F. Bulgin & Co., Ltd., Abbey Road, Barking, Essex.

Please Send Post Free.
Radio Progress (1/-)
Bulgin Catalogue (3d.)
Bulgin Service Manual (1/-)
(Strike out if not wanted)
P.O. Value .....

Name .....
Address .....
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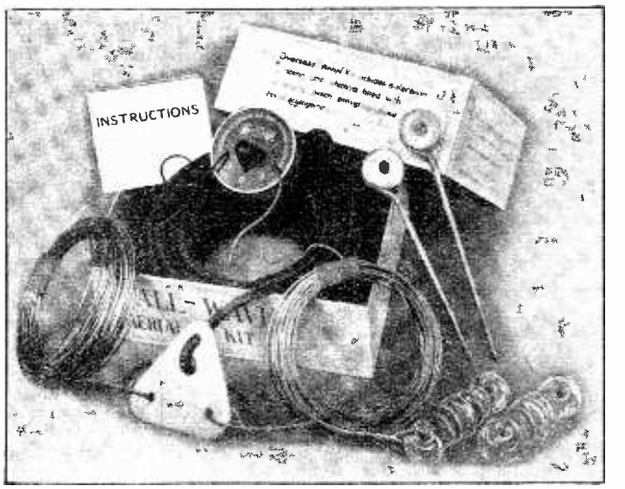
(PLEASE USE BLOCK LETTERS)

ADVT. OF A. F. BULGIN & CO., LTD., ABBEY ROAD, BARKING, ESSEX.
TELEPHONE: RIPPLEWAY 3474 (3 lines)
SHOWROOMS: 64, HOLBORN VIADUCT, LONDON, E.C.1

'GOLTONE' OVERSEAS ALL-WAVE AERIAL KIT



No All-Wave Radio Set can be expected to give enjoyable, noise-free reception unless a modern scientifically designed All-Wave Aerial be employed. The Goltone 'Overseas' All-Wave Aerial Kit is scientifically designed to give exceptionally good results on all wavebands

FROM 15 TO 2,100 METRES.

Provided with refinements usually unobtainable in other kits. **Price complete 17/6**

Obtainable from First-class Radio Stores.
Pamphlets with full particulars on request.

Our Technical Department can solve your interference problems. Send P.C. for Interference Elimination form and descriptive folders.

Ward & Goldstone PENDLETON MANCHESTER LTD

FREE ON REQUEST
New Edition Radio Catalogue
NOW READY.

Collie Knox writing in the "Daily Mail"—

...pplied with
...ol the Admiralty.
... beat the British Navy.

The Aristocrats

SOME years ago, in a moment of enthusiasm, I described the R.G.D. sets as "The Aristocrats of Radio." The name stuck. There is a lot in a name if you live up to it. These sets are all wrought by hand and look very beautiful. Their all-wave radiogram is a gem.

Yes, the R.G.D. machines are still exceedingly aristocratic, and if I could think of a better description for them I would. But it is too hot.

A special word for the ... tributions ...

R·G·D

are the undisputed leaders in the design and production of high-grade radio receivers and radio gramophones.

If you desire world-wide reception, with the finest attainable truth in reproduction you must choose an R.G.D.

Available on Hire Purchase terms, from the leading radio dealers.

Reception from 16 to 2000 metres

Variable Selectivity

High Fidelity Reproduction

'Mystic Ray' Tuning

Table Receiver 25 Gns.

Console 30 Gns.

Radio Gramophones from 45 to 120 Gns.

Send postcard for Literature.

RADIO GRAMOPHONE DEVELOPMENT CO. LTD.
Globe Works, Newtown Row, BIRMINGHAM, 6
and at
London and Manchester.

Mention of "The Wireless World," when writing to advertisers, will ensure prompt attention.

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NEW RECEIVERS AND AMPLIFIERS

A

A

DEGALLIER'S, Ltd., the firm for reliable short wave radio (1937), have on show in London the largest selection of fully guaranteed brand new all-wave receivers; callers invited to handle all at their leisure without obligation to purchase; all S.W. receivers guaranteed to get stations on the low bands, including the Americas, etc. Hours of business 10 a.m.-7 p.m., Saturdays 9 p.m. All goods cash with order or c.o.d.; send 2d. stamp for beautifully illustrated catalogues and full reports by technical department of this journal on Challenger receivers. With every application for catalogues, gratis, Instructions to Novices in Short Wave Tuning with time data.

6/6 Each, Valves, "never before such a bargain," every one a first, no throw-outs or seconds, metal, metal-glass, glass counterparts, and glass: 1a6, 1b5/25s, 1c6, 1y, 2a3, 2a5, 2a6, 2a7, 2b7, 5y3, 5z4, 6a6, 6a8, 6b5, 6b7, 6c5, 6c6, 6d6, 6e5, 6e6, 6f5, 6f6, 6f7, 6h6, 6j7, 6k7, 6l6, 6l7, 6Q7, 6z5/12Z5, 10, 12a, 12a5, 12a7, 12z3, 15, 18, 19, 22, 24a, 25y3, 25z5, 26, 27, 30, 31, 32, 33, 34, 35/51, 36, 37, 38, 39/44, 41, 42, 43, 45, 46, 47, 48, 49, 50, 53, 55, 56, 57, 58, 59, 71A, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 89, 6r7, 25a6, 25z6, 6n7, 6X5, 5W4. Line cords for American Midgets, 4/9.

£3/10.—5-valve Midget T.R.F., medium and long wave, 7X, 10X6, A.C./D.C., 200-250 volts, carriage 1/4; also several others at £2/15, £4, £4/10, and £4/2/6.

£7.—"Challenger" Table Model 6-valve superhet, 3 bands, 16-52, 190-550, 900-2,000 metres, A.V.C. tone control, P.U. terminals (17×13×9), A.C./D.C., 100-250 volts; carriage 4/-.

£8.—"Challenger" Table Grand Model 6-valve superhet, "Mono-vision" tuning control, A.C. 200-250 volts, 3 bands, 18-55, 190-550, 800-2,000 metres, 3½ watts output, tone control, delayed A.V.C.; carriage 4/6; (16½×16×8).

£9.—Challenger Car Radio 6-valve superhet, no interference, A.V.C., remote control, definitely no suppressors needed on plugs, carriage 4/3; also the R.C.A. Car Aerial, "the last thing," 15/-, post paid.

£10.—Band Repeater Sound Equipment, complete transportable unit incorporating 3-valve amplifier with 3½ watts undistorted, A.C. 200-250 volts, 2-button hand mike, Garrard electric motor and P.U., M.C. speaker with baffle, complete in every detail, the whole assembled into leatherette case with handle, 14×10½×18½, this outfit incorporates all leads, tone control, switches, etc., suitable for the home or for use with dance bands, etc.; carriage 7/-.

£13.—The New Challenger 8 (Type 800) table model De Luxe, 17½×22×12½, high fidelity 8-valve superhet, A.C. 200-250 volts, 4 distinct bands covering 11-30, 38-108, 180-550, 900-2,000 metres; this receiver has the following improvements and additions over the famous Challenger 8 of the past year: Centro-master automatic control unit, automatic volume control, stabilised frequency control, manual tone control, automatic bass compensation, polychromatic dial scale with station names, Prizmatone high fidelity, Uni-control two-speed free wheeling tuning, separate bass boosting amplifier, individual coil system, separate coils for each band, electrostatically shielded transformers, special line filters, gramo-P.U. with switching, double spaced non-microphonic variable condensers, multi-purpose valves, Audio frequency range 30-8,000 cycles, hair line selectivity, diode detection, sensitivity control for noise suppression, rubber cushioned condenser mountings; all parts are impregnated against moisture for tropical use; 10½in. M.C. speaker, R.F. preselector stages on all bands; carriage 6/-; for experimenters, less cabinet, deduct 10/-; if public address Rola G.12 supplied in place of standard speaker add £2 (this cannot be supplied in the table model cabinet).

£16/16.—Challenger 8 Console 800C, height 46½in., width 30in., depth 20in., chassis as incorporated in 800 model but incorporating the G.12 high fidelity 12in. speaker; carriage and crate 10/-.

£28.—"Challenger 800 R.G." radiogram with automatic record changer, measurements 47×30½×20½; this also incorporates the G.12; carriage and crate 15/-.

NOTE.—The Challenger 800 is available for A.C./D.C. 200-250 volts, employing 11 valves, at an additional cost of 30/- on each model.

£17/17.—Challenger 12 A.C./D.C. 200-250 volts, the first time that D.C. users have been able to get 10 watts undistorted from their speaker, which is a large 12in. K. type Rola, triple parallel rectification, push-pull parallel-four pentode output; carriage and crate 7/6; chassis, valves and speaker alone, £16/16.

£26/5.—Midwest R.T. 18 chasiss valves and P.A. speaker, 6 bands A.C. 100-250 volts, calibrated in metres and K.C. illuminated pointer indicator, silent tuning control, automatic visual band selector, metal valves, 36 tuned circuits, 10 tuned circuits in cascade, range 4½-2,400 metres, outpnt 20 watts undistorted; carriage 10/-; also available in the Midwest D.C. cabinet at £36/15; carriage and crate 20/-.

(This advertisement continued in third column.)

DEMONSTRATIONS

The result of our demonstrations at Isleworth during the period of the Radio Show was a healthy crop of orders. There is no doubt that the Hartley-Turner Duode Speaker has speedily established itself in the ears of discriminating listeners.

The S.A. Kit which was used to drive the speaker has been proved to be a receiver of honest straightforward design which will give the magnificent Duode every opportunity to show what a wide flat frequency response can do to a good transmission.

There are many people who want to hear these new productions and we are trying to make it as easy as possible for you.

South country listeners will be welcome at any reasonable time after business hours at headquarters, if they will make an appointment beforehand. Of course, we are open all day until 6 p.m., if you prefer to call then.

Scottish listeners will be welcomed by our Glasgow agents Messrs. W. S. Steele, Ltd., 111, West Regent Street, Glasgow, C.2, at their stand No. 17 at the Radio Exhibition at St. Andrew's Hall, from September 16th to 26th. A demonstration room inside the exhibition will give them an opportunity of hearing the S.A. Kit and the Duode Speaker on both radio and gramophone records. A technical staff will be in attendance.

Our Manchester agents, Messrs. Forsyth Bros. Ltd., 126, Deansgate, Manchester, are giving demonstrations every evening from September 28th to October 2nd, starting at 7.30 p.m. After you have had your fill of the Manchester Radio Exhibition, you could not do better than call in at their shop and hear something really good.

Deliveries of the Duode Speaker have begun and the S.A. Kit will be ready very shortly. We shall be able to undertake conversions of old type energised speakers from October 1st. P.M. speakers cannot be converted.

PRICES OF THE NEW HARTLEY-TURNER REPRODUCTION.

D.C. DUODE SPEAKER, £6.0.0

A.C. DUODE SPEAKER, £7.5.0

Output transformer £1 extra.

Conversion of old type energised speakers to Duodes **£2.10** (net cash with order).

S.A. KIT. Complete with steel chassis, valves, all components, calibrated and named scale; 12 watts output; flat response to 10,000 cycles, **£19.15.**

New G.A.12.S. amplifier. More power, more cycles, **£15.**

HARTLEY TURNER RADIO LTD.,

THORNBURY ROAD, ISLEWORTH, MIDDLESEX.

Telephone: HOUnslow 4488.

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The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

For particulars of Box Number Advertisements and Deposit System see previous issues.

NEW RECEIVERS AND AMPLIFIERS

(This advertisement continued from first column.)

£40.—Challenger 24-valve superhet twin chassis, valves and 2 speakers, handling 50 watts output, sensitivity 14 microvolt absolute, tuned H.F. stages on all bands, 3 I.F. stages, the last one being used for selectivity only, frequency response at the speakers, within 2db. over whole range, wave band coverage 8-2,050 metres in 5 bands, magic eye tuning, variable selectivity; carriage 18/-; various cabinets available; this is the actual receiver that we supply to the Navy, Army and Air Force canteens.

£50.—Midwest 24-valve twin chassis and 3 speaker, 6 bands, 4½-2,400 metres, A.C. 100-250 volts, 30 watts undistorted; this receiver covers the television wave bands; carriage 18/9.

ALSO in Stock, complete Ferguson, Belmont and Emerson range.

FARES Paid to Enable Patrons to Come to London and See the Sets that we Advertise; we will refund train fares up to 20/- on the production of the return half ticket to all purchasers of our merchandise selling at £13 and over.

NEAREST Point, Marble Arch, down Bayswater Rd., 2nd turning right is Albion St., top Albion St. and Southwick St. in Southwick St.

DEGALLIER'S, Ltd., 20, Polygon Mews South, Marble Arch, London, W.2. Paddington 2745. [2753

A

AIR KING Introduces Sensational Models for 1937, featuring

BEAM Tuning Exclusive to Air King Receivers.

MAGIC Edge Illuminated Dials Enabling Station Names to be Clearly Read.

CATHODE Ray Magic Eye Tuning Indicator on all Models.

LATEST G Type Octal Base Valves, which are interchangeable with the metal prototype.

SPECIAL Output Valves for A.C./D.C. Models, giving undistorted output equivalent to that of an A.C. set; 1937 range includes:—

MODEL 507 "Empire" 11-valve 4-band A.C. High Fidelity Superhet, with variable selectivity, H.F stage on all bands, push-pull audio system using two new power output valves giving 15 watts undistorted, 1 large concert type auditorium dynamic speaker and 1 small special high frequency reproducing unit, 8 inch multi-coloured dial with lit up indications to show high fidelity and gramophone pick-up.

MODEL 504 "Duchess" 6-valve 3-band A.C. Superhet., with large 8 inch dynamic moving coil speaker, also special features mentioned above.

MODEL 604 "Envoy," same as model 504 but for A.C or D.C. supply.

MODEL 502 "Marquis" 6-valve 3-band A.C. Superhet., in magnificent moulded bakelite cabinet available in various attractive colours including ivory, walnut, ebony, green and red; this set has a moving coil dynamic speaker with special acoustic chamber giving excellent tone and quality.

MODEL 602 "Knave," same as model 502 but for A.C. or D.C. supply.

MODEL 73 "Royal" 7-valve 3-band A.C./D.C. Superhet., recently advertised 9½ guineas.

BARGAIN Offer.

MODEL 6E 6-valve 3-band A.C. Superhet, in large handsome walnut cabinet with 8 inch moving coil speaker; 12½ guineas.

CUT Out that Interference with an Air King All-wave Doublet Aerial, doubles signal strength and increases reception range, especially on short waves; price 15/-.

ALL the Latest Type American Glass and Metal Valves Stocked.

CALL, write or 'phone for further particulars to:—

AIR KING RADIO, 115, Shaftesbury Avenue, Cambridge Circus, W.C.2 (1st floor above Barclays Bank). 'Phone: Temple Bar 4875 (two lines). All receivers assembled in England. [2702

ALERT RADIO Co.

"THE People's Set," Philco's new masterpiece, £6/6, or 8/6 down and 1/11 per week; also a large range of all-wave models at prices to suit all pockets.—21, East Rd., N.1. Clerkenwell 4871. [2747

HARMAUR RADIO

FOR High-class Economical American Midget Receivers, all-wave sets, car radio, etc.; trade enquiries.

THE HARMAUR RADIO Co., Ltd., 8, Clifford St., New Bond St., London, W.1. Regent 4336. [0499

"SERVICE With a Smile."

HENRY FORD RADIO, Ltd.,

ELECTRONIC House, 22, Howland St., Tottenham Court Rd., W.1. Museum 5675. [0511

"Radio Data Charts," A Series of Abacs Post free 4/10

NEW RECEIVERS AND AMPLIFIERS

ARMSTRONG COMPANY wish to thank all old friends who visited them at Radiolympia and also those who have written to wish them success.

ARMSTRONG 1937 Range of Radio Chassis are Briefly Described Hereunder.

ARMSTRONG 9-valve 4 Wave-band Superheterodyne Chassis, covering 12.9-34 metres, 34-100, and broadcast bands, radio frequency amplifier, variable I.F. transformers, two Marconi PX25 valves in loaded secondary push-pull output, amplifier and power pack separate unit; price 18 guineas complete.

ARMSTRONG 8-valve All-wave Radiogram Chassis; this model has a stage of R.F. amplification and covers four wave-bands, 12.9-34 metres, 34-100 metres and the usual broadcast bands, output stage 2 Marconi PX4 valves in push-pull, loaded secondary transformer coupled; price 11 guineas complete.

ARMSTRONG 7-valve All-wave Radiogram Chassis, 4 wave-bands, 12.9-34 metres, 34-100 metres and broadcast bands, has R.F. amplification and interstation noise suppressor, Triode valve output; price with valves, 10 guineas.

ARMSTRONG 8-valve, 4 wave-band Radiogram chassis; £9/17/6 (see displayed advertisement).

ARMSTRONG 6-valve 4 Wave-band Radiogram Chassis; £8/17/6 (see displayed advertisement).

ARMSTRONG 6-valve 3-Wave-band Radiogram Chassis, complete with valves and Rola 8in. speaker; £7/10.

ARMSTRONG 8-valve Push-pull Radiogram Chassis; this model designed to give good quality reproduction on the 2 broadcast bands, the output stage consisting of two transmitting triodes arranged in resistance capacity coupled push-pull with phase reversed preceding stage; price £8/10.

ARMSTRONG 6-valve Radiogram Chassis; this chassis has a resistance capacity coupled transmitting triode valve output stage, covers usual broadcast bands; price £7/10.

ARMSTRONG 10-watt Push-pull Amplifier, fitted with self contained pre-stage amplifier for microphone, volume and tone controls, also plugs and jacks for gramo- and microphone stages supplied complete with Rola G.12 speaker for 10½ guineas.

ARMSTRONG Chassis Carry Generous Guarantee, no charges for labour, material, carriage or packing for 12 months (valves carry the makers' guarantee).

ARMSTRONG Chassis are Sent on 7 Days' Trial, packing and carriage free.

ARMSTRONG COMPANY have Catalogues with Illustrated Technical Information now Available.

ARMSTRONG COMPANY, 100, King's Rd., Camden Town, N.W.1. [2684

ROYAL RADIO COMPANY.

ESTABLISHED 1908.

THE Cheapest House for all the Latest 1937 Models with metal valves; from £3/10.

AS it is Impossible to Give Full Specifications of all Models in This Advertisement, send stamp for illustrated catalogue.

£3/10.—5-valve T.R.F., long and medium, 200-250 volts.

£4/15.—5-valve Superhet., long and medium 200-250 volts.

£5/15.—5-valve Superhet., 19-2,000 metres, 200-250 volts.

£7/15.—6-valve Table Model, 16-2,000 metres, A.C. or D.C., any voltage.

£7/15 and £9/9.—All-wave receivers, suitable for ships, as supplied to the P. & O., B.I., and other shipping lines, guaranteed free from interference.

£13/10.—8-valve Table Model, 11-2,000 metres A.C., the set that gets America at full volume on an indoor aerial.

£9.—Latest 6-valve car radio, A.V.C., remote control, no suppressors required.

A FULL Range of the World-famous Ferguson and Pilot Models Stocked.

ALL Sets Fully Guaranteed by Ourselves.

ALL Types of American Valves in Stock.

PAY Us a Visit Any Time, week-end included. Fares paid up to £1 to customers spending £13 or over. Nearest station George Lane, L.N.E. Rly.

ROYAL RADIO COMPANY 5, Buckingham Rd., South Woodford, London, E.18. 'Phone: Buckhurst 2736. [2687

SIX-VALVE Superhet. Chassis, with A.V.C. 3.5-watts pentode output, at £6/5.

SIX-VALVE All-Wave A.C. Superhet. Receivers, with cabinet and speaker, 3.5-watts pentode output, station marked dial, A.V.C. wave ranges 16.5, 50, 200 to 600., and 1,000 to 2,000 metres; price £9.

WE Can Supply Kits of Specified Parts with Valves for any "Wireless World" Receiver or Amplifier, including the "1936 Monodial A.C. Super Receiver," "Quality Amplifier," Imperial Short Wave Six and All-Wave Super-Seven. Hire purchase terms can be arranged on the above goods and any other radio equipment; details upon application.

UNIVERSAL Amplifiers, with undistorted output of 8 watts, 2 pentodes in parallel in output stage, £6/10; A.C. amplifiers, double R.C.C. push-pull with 2 triodes in output stage, undistorted output of 5 watts, £7.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0458

£3/10 to Save, per set.—Write for free list to Kay, 1, Old Church Lane, N.W.9. Colindale 8266. [0537

FERGUSON, Belmont and Air King All-wavers lead the field; wholesale distributors.—Leonard Heys, 36, Henry St., Blackpool. [0530

TRANS-ATLANTIC RADIO Stock the Latest American Radio Sets; compacts from £2/16; 6-valve all-wave table grands from £7/17/6; write for lists.

TRANS-ATLANTIC RADIO Co., 15, Percy St., W.1. Museum 3096. Guaranteed Radio Repairs. [2749

SPECIALIST. Car radio only. Expert fitting and repairs. Sets from £7/10 to 40 guineas.—St. John Chesney, 38, Hugh St., London, S.W.1. Victoria 0780. [0534

FOR the Finest Value in All-wave Receivers, see McCarthy advertisement on page 6.—McCarthy Radio, Ltd., 44a, Westbourne Grove, London, W.2. Telephone: Bayswater 3201. [0510

BARGAIN.—1937 model A.C. 5-valve superhet sets, full A.V.C., handsome walnut cabinet, B.V.A. valves, 8in Rola speaker, complete deliveries; £6/6; sent on seven days' approval.—Stott, Clare Hill, Huddersfield. [2656

No. 4

Notes on the Suppression of Electrical Interference with Broadcast Reception

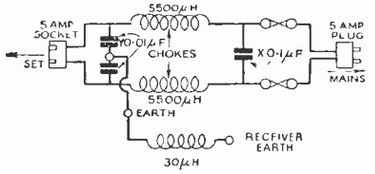
At the time of writing we have just completed a term of duty at the Radio Exhibition, Olympia, and it occurs to us that a review of some of our conversations with members of the public will be helpful to many readers.

1. A man with more than usual technical knowledge alleged that our †meter board suppressors were useless in his case. When asked if he lived in a detached, semi-detached, terrace house, or in a flat, he wanted to know what that had to do with it. It was explained to him that unless he was in a detached house his wiring might be re-infected by re-radiation from unfiltered neighbouring wires. He was badly situated regarding interference, and the only mains filter likely to help would be one of the *Set Lead range. But if direct radiation was present he might have to erect an "Eliminoise" anti-interference aerial (35s.; cable extra, 8d. per yard).

2. An electrical and radio engineer had fitted an "Eliminoise" anti-interference aerial to an indoor aerial and complained of poor results. He had not bothered to read the instructions, he knew he should use an outside aerial, but his wife did not like the idea. So he blamed us!

3. An "Eliminoise" aerial was blamed for making things worse when attached to the old and very short low aerial which had been in use for years. As the transmission line did not pick up signals the pick-up was down, and as the open aerial was within a few feet of a zinc roof, guttering, mains, etc., it picked up all the interference that was going. Noise to signal ratio was impaired.

4. Many people do not realise what we mean when we say the open part of an aerial must, in bad cases, be 15ft. from any conductor. They immediately think of mains leads, etc., whereas water mains, guttering, metal poles, wire stays, zinc roofs, are all conductors, and carry and radiate interference.



5. We were frequently asked whether or not our Set Lead Suppressors at 17s. 6d. and 19s. 6d. would give suppression on all waves including down to 10 metres. The answer is a definite "No." This is the first year that there has been a real call for all-wave reception, and we have designed a suppressor for the job, type 300, price 21s., and with circuit arrangements as shown above.

★ Set Lead Suppressors, type:—

	s.	d.
1211, ½-amp. medium and long wave	17	6
1256, 1-amp. medium and long wave	19	6
300, 1-amp. all-wave from 10 metres	21	0
305, 1-amp. 10-600 metres	19	6
1118, Condenser Suppressor, general purpose	10	6
†1257, Meter Board Suppressor ...	13	6

NEW RECEIVERS AND AMPLIFIERS

6-VALVE 9-stage All-wave Superhet Manx Chassis, comprising large micro-dial, volume control and variable tone control, pick-up connections; circuit: tuned H.F. stage on all wave-bands, Octode mixer, band-pass I.F.'s, double diode triode detector, giving full A.V.C. 3-watt pentode output, complete and ready to use with 6 Dario valves; chassis and valves carry 12 months' guarantee; cash with order; £8/10, on 7 days' approval, or c.o.d.

FREE with Above Chassis.—Mains energised 8in. moving coil loud speaker.—Hulmes, Station St., Birmingham. [2704

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VAUXHALL.—Above, fully guaranteed, complete with humbucking coils; state power or pentode transformer; unused manufacturers' stock.

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MAGNAVOX D.C. 152 (9in. cone), 22/6; Magnavox 154 (6½in. cone), 16/3; all with humbucking coils, power or pentode transformers, and 2,500 or 6,500-ohm fields; Magnavox P.M.254, 18/-; Magnavox P.M.252, 22/6.

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ALL Types of American Valves in Stock, of Raytheon, Sylvania, and Arcturus makes, at competitive prices, guaranteed for six months; send for full list; 350 ohms line cords, 2/8.

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VALVES by Well Known Non-ring Manufacturers, complete range of battery, a.c. mains, rectifiers, brand new stock with six months' guarantee; 2 volt, detector 2/3, power 2/9, screen grid pentode, H.F. pentode, 5/-; the following American type valves, fully guaranteed, at 5/6 each, No. 80, 42, 43, 57, 58, 77, 78, 6C6, 6D6, 25Y5, 25Z5.—Write for other prices to Dulci Electrical Co., Ltd., 7, Lizard St., London, E.C.1. [0530

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UNIVERSAL Avometer, 36-range, very good condition; £8 2/6; D.C. Avominor, unused, 27/6.

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VAUXHALL.—Volume controls, Erie, Colvern, Centralab, 2/-; with switch, 3/-; all values, from 2,000 to 2 meg.

VAUXHALL.—Pushback wire, four colours, 6 yds. 6d.; 6B.A. screws or nuts, 2d. dozen.

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COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

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RADIOMART.—Smoothing chokes, 20 hy. 120 ma., 3/11; 100 ma., 2/11; 40 ma., 1/11.

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RADIOMART.—Order 5/- post free; get our bargain catalogues; General 1½d., Short wave 1½d.—44, Holloway Head, Birmingham. Tel.: Mid. 3254. [0507

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ELECTROLYTICS, cardboard case type, 500v. working, 8 mfd., 1/9, 8 plus 4 mfd., 2/5; 8 plus 8 mfd., 2/9; B.I. and T.C.C., 8 mfd., 2/4; 4 mfd., 2/1; 25 mfd. 25v., 1/-; 50 mfd. 50v., 1/9; 50 mfd. 12v., 1/3.

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THE Proprietor of British Patent No. 290,642 relating to "Improvements in radio telephone signalling," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the invention either by sale of the Patent rights or by the grant of Licences on reasonable terms. Interested parties who desire further particulars should apply to Albert L. Mond and Thiemann, 19, Southampton Buildings, Chancery Lane, London, W.C.2. [2724

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ANY Moving Iron Loud Speaker, L.F. transformer, or pick-up, 2/6; output transformer, 4/-; postage extra; mains transformers, moving coils, electric clocks quoted, trade discounts.—See below.

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CLARION and Majestic Service Depot.—L.F. and mains transformers rewound, American valves and parts; trade supplied.—Metropolitan Radio Service Co., 1021, Finchley Rd., London, N.W.11. Speedwell 3000. [0435

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"ZETAVOX" Conversion and Repair Specialists. Guaranteed repairs, any receiver, British or American Car radio experts. Estimates free.—Radio Service and Television Co., 68a, Colebrooke Row, Islington, N.1. Clerkenwell 1157. [2305

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REPAIRS to Moving Coil Speakers a Speciality; cones and coils fitted, fields altered; prices, including eliminators, quoted, loud speakers, 4/-; L.F. and output transformers, 4/-, post free; guaranteed satisfaction; trade invited; estimates free; prompt service.—Loud-Speaker Repair Works, 5 Balham Grove, London, Battersea 1321. [0394

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30 Vacancies.

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TUITION

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DIRECTORATE of Technical Development.

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APPLY (quoting appropriate reference number), and stating salary, age, qualifications and experience, to the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants.

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IN the Rapidly Growing Field of Radio Transmission and Reception a Large Engineering and Manufacturing Company is Augmenting its Staff. The following positions require to be filled:—

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FIRST Class Service Man.—Age, experience, copies of references, salary expected, to 8 West, St. Matthew's St., Ipswich [2725

RADIO Engineer Urgently Required, with design and works experience.—Universal High Voltage Radio, Ltd., 28-29, Southampton St., Strand. [2721

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YOUNG Man Required for Constructing and Wiring Receivers, amplifiers, etc.; state experience and wages required.—Box 9272, c/o *The Wireless World*. [2748

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DRAUGHTSMAN for Radio Factory, first class man with good general experience in similar capacity.—Write, stating age, particulars of experience and salary required, to Box 9254, c/o *The Wireless World*. [2720

EXPERIENCED Glass-blower Required by London Research Laboratory for Glass and Quartz Work, neon benders need not apply.—Write, giving experience, age, and wage required, to Box 9244, c/o *The Wireless World*. [2714

ENGINEER (Young), London, W.1., design, research, midget low frequency amplifiers, sound knowledge microphone technique and tool experience essential.—Write, stating age, experience, salary required, Box 9269, c/o *The Wireless World*. [2751

RADIO Engineer Wanted by Manchester Firm, must be capable of designing all classes of transformers and chokes, also be conversant with the latest radio developments.—State in confidence, age, salary and experience, Box 9264, c/o *The Wireless World*. [2723

TESTERS Required for Checking and Aligning All-wave Superhets; applicants must have good theoretical and practical knowledge of radio; previous experience essential.—Write, stating age, particulars of experience and salary required, to Box 9253, c/o *The Wireless World*. [2719

"Wireless Servicing Manual." Post free 5/4

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