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Wireless World
September 7th, 1939.
EDITORIAL

Wireless and War

Services to the Nation

THOSE of us who have spent our working lives in the service of wireless must often have taken encouragement from the thought that the part we have played, humble though it may be, has contributed something towards the good of humanity. The record of wireless is indeed nothing to be ashamed of: we think of the thousands of lives saved from the perils of the sea by wireless telegraphy and of the interest and widening of outlook brought to millions by broadcasting. But it has long been a cause for regret to many of us that the self-evident potentialities of broadcasting in the cause of peace have been exploited with such poor success.

"Nation shall speak peace unto nation" was an inspiring motto for those responsible for British broadcasting, and it was one which they conscientiously strove to justify. That it has so far failed to achieve results does not imply that any blame is to be apportioned, and, even if it were, this is no time for recriminations.

International Broadcasting

Although wireless may not have succeeded in this respect, it has performed a wonderful service to everyone during the dark days of suspense. Anxiety and uncertainty has been relieved, and the extraordinary calmness of the British nation must surely be due in no small measure to the thoroughness of the B.B.C.'s news service. Other organisations that deserve the thanks of the world are the great American broadcasting networks. Considering their position as neutrals and making allowance for the Transatlantic tendency towards dramatisation of news, the crisis has been handled with admirable restraint. So far as broadcasts that we ourselves have heard or seen reported are concerned, nothing has been done to exacerbate the European situation; on the contrary, obviously genuine efforts have been made to play the part of peacemaker. The broadcasting of news bulletins from America in the languages of all potential belligerents has probably done good. Coming from a neutral country, such messages probably carry more weight than if they emanated from a more directly interested and inspired source.

We must not delude ourselves into thinking that the kind of international short-wave broadcast to which we have just referred reaches a very wide audience. The number of efficient short-wave sets in use is still small, though the better types are now more readily available than hitherto. We can foresee a wide market for them when more normal conditions return. As a contributor says elsewhere in this issue, there is nothing like a good wireless set for collecting news; it gives its owner the feeling of being in intimate touch with things as they happen, and he becomes something more than a mere spectator, remote and aloof from actualities.

Whatever the days ahead may have in store for us, there is one thing that we can face with the most serene confidence. The wireless service, though young in years, has already established a tradition of steadfast devotion to duty on the part of its personnel of which we are all justifiably proud. Maintenance at extreme efficiency of all forms of wireless communication is now vital to the successful prosecution of the war; the various branches of the service may meet with difficulties that none of us can yet foresee, but, whatever these difficulties may be, communication will be maintained.
RELATIVE SUSCEPTIBILITY TO BREAKDOWN

THERE is no substitute for the close inductive reasoning of which every serious radio man must be capable—especially if he has much to do with the tracing of faults in modern receivers. But out of experience comes an intuitive knowledge of where common troubles are likely to lie, and this enables the skilled man to short-circuit some of the laborious fundamental testing and go straight to the component that is the probable cause of the trouble.

A knowledge of the primary causes of breakdown in generally used components is a useful aid to such speedy diagnosis.

Speaking very generally, it may be said that those components combining mechanical movement with electrical function are, on the whole, liable to develop unsatisfactory behaviour, if not complete failure, before the rest. It is probable, as a matter of fact, that such components only seem to develop faults before the rest because their physical movement reveals impending defects. In other components the process of deterioration is difficult to detect before the stage of complete failure is reached. Placing them roughly in order of liability to give trouble, then, volume controls of the high-resistance potentiometer type are notoriously liable to give rise to noises; switches seem to come next, then loud-speaker speech coils. In the class of fixed components, condensers seem to fail before resistors, and coils, including the windings of chokes and transformers, last of all. Valves are in a class by themselves. The nature of the defects to which these various components are liable will now be discussed.

In these days of AFC for preventing excessive amplification of signals in the RF stages, output level is usually controlled by high-resistance potentiometers connected across two points of AF difference of potential, such as the secondaries of transformers or the load circuits of detector rectifiers. In these positions they seldom handle much power and the causes of their failure lie more in the inherent shortcomings of their materials and construction than in the functions they have to perform.

Potentiometers usually consist of a thin layer of composition resistive element fixed to an insulating base, and the moving contact is made by a squash-plate. The expansion with heat of the element itself may not be the same as that of the base to which it is fixed, and the frequent and considerable temperature changes that occur in a mains-driven receiver cause the element to crack. This may happen at some part of the element that is not normally used, either the extreme loud or low volume ends, and until the crack is complete it may pass unnoticed. Although the squash-plate is a far better method of making contact than a rubbing slider (which is liable to break up the smooth, hard surface of the element) it does not entirely overcome a very common difficulty which is known as "hop-off resistance." As the contact passes from the end contact to the body of the element, a sudden change of resistance in that arm of the potentiometer from almost zero to, perhaps, many thousands of ohms, takes place, and the volume, instead of decreasing gradually, does so abruptly. Again, since contact at the ends of the element is often made by painting with colloidal copper—finely divided copper or bronze particles suspended in liquid—this thin layer of copper paint may crack away from the element, and when the squash plate impinges on this cracked contact the resultant noises are only too familiar.

Switches suffer from the effects of either dirt or oxidation. Rubbing contacts usually avoid these effects, but if the insulating material over which the rubbing contacts pass between the fixed contacts is soft, or picked up with age, through surface oxidation—ebonite is a frequent offender in this respect—it forms a layer on the rubbing contact. This can be removed with very fine abrasive paper. Pressure contacts in the better class switches are coated with some non-oxidising metal, and, as this is usually very thin, it should not be cleaned with abrasive; petrol, or even "penetrating oil," if afterwards removed, is best. The on-off switch in mains-driven receivers should, if of good quality, stand up to some 20,000 operations on full load of about 2 amperes at 250 volts. Their failure is usually mechanical—the speed of opening the contacts falls and gives rise to arcing.

Speech Coil Defects

Considering the hard work they do, speech coils show a reliability that does credit to the immense amount of trial and research preceding their manufacture. Apart from obvious troubles due to incorrect centring and the like, they are liable to a loosening of the wire on the former, owing to the unequal expansion with heat of wire and former. This causes a shrill buzz, often only on certain frequencies, and the defect is usually discernible when the coil is inspected cold. Coating the ends of the speech coil with cellulose or bake-lite cement is always a wise precaution if nothing else is obviously wrong.

Electrolytic condensers are essentially electro-chemical devices, and their behaviour can therefore be upset both during the forming processes in manufacture and in subsequent use by minute chemical impurities in either the electrolyte or the metal of the electrodes, especially the positive element, which is usually aluminium. The action of chemical impurity is cumulative, so that even if a film of oxide forms during manufacture on the positive aluminium it is sufficiently continuous and thick to enable the condenser to pass ordinary tests, in subsequent use further electrolytic action will take place due to the impurity and result in corrosion of the electrode and the destruction of the oxide layer. Hence a leakage path is set up by this process, heat generated at that
Why Components Fail—spot by the passage of current makes matters worse.

An electrolytic condenser has a limited "shelf-life"—if not used, the oxide film slowly dissolves and if, on again putting the condenser into use, the full rated voltage is applied, so much current passes that heat is generated and the oxide layer cannot re-form. Hence, a long disused electrolytic condenser should be gradually re-formed by the application of low initial voltage which can be steadily increased until the rated value is reached. Loss of capacity is due to drying up of the electrolyte or to the oxidation of the aluminium where it is attached to the external lead—at which point soldering is almost impossible. Loss of capacity also occurs as a natural result of the passage of the small leakage current that is inevitable with electrolytic condensers; this current tends to exhaust the active chemicals of the electrolyte by continued electrolysis, or even to build up the oxide layer faster than it is dissolved by the electrolyte, making it a thicker dielectric.

Superimposed on the steady DC voltage, at which the condenser is designed to operate, there is very often an AC component—such as the ripple that electrolytic condensers are required to eliminate in smoothing circuits. This ripple voltage drives a current through the condenser which may be concentrated at spots where the oxide film is thinner and so give rise to localised heat. For this reason the breakdown of some component in another part of the circuit which tends to increase the ripple voltage, for example, a partial short-circuit of the HT supply so that excessive current passes through the smoothing choke, reducing its inductance—may cause an electrolytic condenser to break down. Although normally the temperatures reached in a mains driven receiver keeps the atmosphere round the electrolytic condensers dry, cases may arise in which the condenser can absorb moisture, which may cause internal sparking, with consequent charring of the impregnated cotton spacing between the electrodes.

Paper—dielectric Condensers

The larger solid dielectric condensers usually have aluminium foil plates, and the impossibility of attaching these to external leads by soldering gives rise to poor contact at these points and apparent loss of capacity. Short-circuits in such condensers, without the application of excessive voltage or the passage of AC, seem usually to be due to impurities in the paper or the wax used as the dielectric; leakage currents initiated by such defects give rise to localised heat and charring of the wax and paper.

Fixed resistors deserve a book to themselves. They are, as a matter of fact, a makeshift forced on us by the failure of Nature to provide us with a good choice of substances having specific resistance between that of the fairly good conductors and that of the insulators. Those that have such intermediate resistivity, such as germanium, are either rare and expensive or chemically and physically unsuitable. Moreover, it seems to be impossible to predict from its chemical or physical structure what the electrical behaviour of any compound is going to be, and knowledge in this direction is largely empirical. Hence, in order to obtain high resistivity with reasonable bulk and cost, resort is had to mixtures of a good conductor, such as powdered graphite, with insulating binders such as resins and clays, the mixture being subjected to various processes to render it durable. This is the modern method, and, fortunately, the day of the simple graphite rubbing or painting on a stick of pipe-clay has gone: good modern resistors do not now give much trouble if they are not overloaded.

But certain shortcomings in composition resistors remain. For one thing, such mixtures are not very successful as elements in variable resistances, as has been indicated when discussing potentiometer volume controls, for which the element must be thin in order that the moving member can make some approach to contact with the main body of the element instead of merely with its surface. Moreover, certain heat and pressure treatments become difficult when the element must be annular in shape and fixed on an insulating base; thus something in the nature of a mixture of graphite with a gummy self-drying binder must be used. Since the high resistivity of the element is in this case obtained merely by the attenuation of the conducting paths through the body of the resistor, it is difficult for internally generated heat to reach the surface and be dissipated by radiation. Hence composition resistors cannot handle much power without the heat causing changes in the nature of the binder.

Then there is the difficulty of making effective contact with the element at the ends: usually this is done by a metal cap or wrapping of wire, and the application of a hot soldering iron may cause the contact to separate from the element or become loose. Finally, there is a curious electrostatic effect in composition resistors used in high voltage circuits. "Like charges repel..." and particles of graphite in the element similarly charged at high voltage may repel each other unless they are very firmly embedded in the binder. This causes the resistance to "go high," and was one of the difficulties that high-voltage television experimenters encountered. With a steep potential gradient through the resistor, too, internal sparking may occur, giving rise to crackles and intense local heat.

LF Transformers and Chokes

Now let us consider coils. Multi-turn windings are not used in modern receivers nearly as much as in early types, and to-day are found only in the form of mains and output transformers. Hence they are not prominent trouble-makers: for that matter, well-constructed transformers and chokes never did give much trouble unless grossly overwound. Litz wire RF coils can still give rise to loss of amplification if soldered connections are made to their ends, but by fusing the strands together in a small hot gas flame and so welding them to a thicker lead, even this difficulty has been largely overcome.

Failures in iron-cored RF coils can be traced to either the penetration of moisture or to bad winding processes, and the latter is a negligible factor in the products of reputable firms charging economic prices for their goods. Mass-production winding machines are extremely expensive, and this must be taken into consideration when considering the prices of multi-turn coils: they cannot be efficiently produced at very low cost. Moisture in the windings causes corrosion by electrolysis and the generation of localised heat by leakage currents. Bad construction has the following effects:

Overrun turns: superimposed layers press hard on the overrun turns to cause the wire to bite through enamel insulation and give rise to a short-circuited turn which, by induction, has excessive current generated in it, causing heat and further deterioration of insulation.

Loose winding: in circuits carrying power, insecure windings may vibrate just as the speech coil of a speaker, and this vibration, though of small amplitude, may rub off the insulating varnish, causing short-circuited turns. This is a very common cause of failure in mains input transformers.

Cheap and nasty varnish: this may contain acid impurities that corrode the copper, absorb moisture, and becomes...
Wireless World

PROBLEM CORNER

No. 36.—Mysterious Disappearing Trick

An extract from Henry Farrad’s correspondence, published to give readers an opportunity of testing their own powers of deduction:—

Rose Cottage, Nitting Sockbury, Worcs.

My Dear Henry,

You will be interested to know I have gone in for a new wireless! Well, it was getting a bit passé, if I may say so; and then when that interesting man spoke some time ago—Mr. Volt, wasn’t it—and made such queer noises, he quite convinced me that it was time to get a new one. One thing I particularly remembered that he said was if you wanted to get the best results from yourvalve you had to get a set with Variable Selectivity, so I made a special point of this when I went to buy mine.

It was a bit rash, I suppose, getting one without asking your advice first, Henry; but it does bring in a wonderful lot of stations when you turn the knob only quite a little way round. I cannot understand what they all say, except that some of them seem very angry. Most of them come in only one at a time, which I am afraid they never did on the old wireless! But there is one thing that seems rather queer, and I wonder if you can explain it. The book says that if you want to get the best tone you should have the variable selectivity knob fully to the right; then if you get other stations interfering you turn it to the left until they disappear. Well, I have tried this; and instead of the interfering station disappearing it was the one I wanted that disappeared! Wasn’t that a strange thing?

Yours very sincerely,

Jane Stoughton.

Why does the variable selectivity behave in this way, and how can it be put right?

Solution on p. 232.

The complete disappearance of amateur 5-metre signals across the Atlantic since all the recorded cases of transatlantic transmission appear to have been via the normal E-layer mechanism, as distinct from the U.S. lower atmosphere transcontinental phenomena of last year. Amateur communication on 10 metres (28 Mc/s) will also suffer to some extent, but 28 Mc/s’ conditions during the last sunspot minimum showed a peculiar habit of becoming quite good when the sun’s face was completely devoid of spots.

The reason for this anomaly is not clearly understood and will probably be the subject of further investigation in 1944 or thereabouts. It is just possible that the somewhat higher frequency television transmissions may behave in a similar way, but more erratically.

In conclusion, one notes that W2XE on 17 Mc/s is at the moment giving the latest news summaries in German, Polish, French and Italian, at 3 a.m. GMT. The inclusion of Polish is noteworthy and constitutes a precedent.

"Ethacomber."
Impressions of Olympia

“DIALLIST” LOOKS BACK AT THE SHOW

HAVING read that there was to be an Export Section at Radiolympia, I saw in my mind’s eye a cluster of smallish stands—small because they would display only selected products—provided over by bronze men well versed in what is needed in the way of radio receivers in the far countries of the Empire, and surrounded by other bronzed men, eager to see the receivers designed for their special requirements by the Export Section. Hence, when I decided, would requirements. The rounded smallish stands consisted of Export where that Department. didn’t observed. to rapid receiving Africa. Instance, in which I was acom missionaire if he could direct me to the Export Section, which I hadn’t so far observed.

"Couldn’t say, sir," he replied; "perhaps this commissioner knows. George, where’s the Export Section?" But George didn’t know. Nor did Charlie when hailed by George, or Bill when Charlie applied to him.

However, I espied the stand of the Department of Overseas Trade and felt sure that they would put me right. They did. If I would but turn about in their doorway where I was standing, there would be the Export Section before my eyes.

It was rather a blow to find that it consisted of a single large stand, at the back of which were a number of show cases. In these were receivers and components; and notices referred one to the main stands of the firms that produced them. I suppose that really it wasn’t a bad idea, for you’d only to jot down the numbers of these stands to know where the overseas goods were. But I would have liked to see my cluster of stands, my bronze men demonstrating and buying...

And there was plenty at Radiolympia to have made a full-dress Export Section, or a Long-distance Section—or both. You found that when you came to go round the stands and to examine their wares in detail, I don’t know how many sets there were, for instance, in which there were two or more short-wave ranges instead of one, but there were certainly a good few.

Short-wave Sets

Some time ago I wrote that the tuning of the “all-wave” receiver with a single short-wave range and no kind of band-spreading arrangements was apt to demand more patience than its owner might care to devote to searches for stations on wavebands such as the 16-metre, the 19-metre and the 25-metre. There are welcome signs that designers have realised that if they want short-wave reception to be popular they must make it as easy as the price of the set will allow.

One receiver has gone the whole hog. It covers only the 13-, 16-, 19-, 25-, 31- and 49-metre bands and none of the intervening wavelengths. But it devotes a full-scale sweep to each of these six bands; and what is more it bears the actual names of over 100 short-wave stations, whose exact setting are marked on the scales.

In a word, it aims at making the reception, not only of WGEA, WCAI, XGQY and other strongly received short-wave stations, but also of dozens of the smaller fry as easy as that of European medium wave stations. That is indeed a laudable effort, and I look forward very much to trying one of these sets a little later on.

I was much attracted by the ingenious methods used by other designers. Some employed band-spreading of one kind or another; others pined their faith to bigger and more clearly marked dials with finer pointers than in the models of yester-year; others, again, were waging war against second-channel “images” and whistles by the use of signal-frequency stages.

All of the “all-wave” models shown by one firm had a range of from 50-150 metres. These, I take it, are made with an eye to duty until the rectifier had warmed up to a certain temperature. When that was reached, there was a slight click: by means of a relay the batteries had been cut out and current from the mains cut in. If the mains current was switched off, the relay immediately brought the batteries into action again.

I’m not sure that that principle isn’t worth adapting to sets other than portables. Is there anything more annoying than when you suddenly realise that some item you specially want has just begun, switch on and have to wait what seems hours for the heaters to warm up?
Impressions of Olympia—

I don’t know if I was specially lucky, but I seldom had any difficulty in finding at the stands I visited someone who would deal with technical questions. In past years one has too often found, on returning hopefully at intervals to a stand where there was something of particular interest, that the only technical man provided appeared to have taken tea as soon as he had finished his lunch and on dinner the instant his teacup was empty.

Makers have realised that what the public is yearning for above all things in their receivers is reliability. At stand after stand I was told of the steps that had been taken to ensure it, and of the amazingly complex tests to which sets are subjected before they leave the factories. The lessons of the past have been taken to heart, and I do think from what I saw of the insides of sets and of the components therein that real progress has been made in this respect.

One stand that impressed me was the stress laid by many firms on the quality of the reproduction given by their better models. And, listening to the questions asked by Mr. and Mrs. Everylistener, I found something of a change there also. The first enquiry always used to be: “Will it bring in every station in Europe?” or “Will it get America?” This year I heard many less off the wall questions about the reproduction of the local stations’ programmes, absence of hiss, hum, other hateful background noises, and so on.

“The Services’ stands were of considerable interest.” This portable ground station, which was among the interesting apparatus to be seen, stands, consists of the transmitter and receiver as used in a ‘plane. Complete with message pad, key and ‘phone, they are fitted into a metal cabinet the front of which is covered by a drop sheet.

Radiolympia 1939 was certainly the most stunt-free exhibition that I can remember. And that, I feel, is a very good sign. Manufacturers had come down to brass tacks and were showing the public what the public had come to see.

No Longer a Marvel

They had come to see television receivers as well as wireless sets. There wasn’t much doubt about that. And my impression, from what I saw and heard here and there, was that the public interest in television was over: the enquirers were fully alive to the entertainment value of television, and most of them were seriously considering the installation of receivers in their homes, if they hadn’t already made up their minds to do so.

The Services’ stands were of considerable interest, though the organisers of each were naturally much harassed by not being able to display devices that would indeed have produced thrills! But what they gave us was enough to show they aren’t exactly behind the times. Something more than a word of thanks is due to the able and most willing demonstrators on all these stands.

There are those, and I am one of them, who lament that the fun-fair side of the Exhibition was so strongly stressed in the advertisements of Radiolympia. These urged you to come and be televised, to visit Miss Radiolympia’s boudoir, to see the stars in the theatre; they also mentioned that there were wireless sets and television receivers on view. It was the worst of bad luck that the Exhibition should coincide with the crisis. But for that, I feel that it could well have stood on its own feet as a radio show, without the help of the boudoir or the great bowl theatre. The purely technical “sideshow” always seemed to be well patronised, and it was noticeable that many of the visitors were professional wireless people.

HENRY FARRAD’S SOLUTION

(See page 230)

If the instruction book is correctly quoted by the correspondent, it is not a very good one. Stations should be tuned in first with the greatest selectivity, and the response then broadened out if conditions permit. If a station is tuned with least selectivity, it is difficult or even impossible to do so accurately. Especially is this so if the variable selectivity is not much more perfect than is often the case. A common fault is that the response curves at the extremes of the selectivity control are something like those shown here. When tuned to the least selective setting it is natural to bring the wanted station, W, in line with the peak. If the frequency separation of an unwanted station is represented by that between W and U, it is likely that some interference from U will be heard. If the selectivity is increased to get rid of U, it can be seen that W will be cut out and U remain almost unaffected.

Although this asymmetrical broad response curve is not ideal, the system could at least be made to serve its purpose by tuning with maximum selectivity. W would then come where U is shown, and U would be excluded. Conditions permitting, the best would also be obtained from the wide response adjustment.


This book is Volume VII of a series of monographs on electrical engineering and deals very thoroughly with the problems associated with valve oscillators. Fundamental principles are treated in the first chapter and types of oscillators and the conditions for oscillation in the second. Here the close relationship which exists between many apparently dissimilar circuits is well brought out by their derivation from a single prototype. The dynatron and multi-vibrator are not omitted, and in Chapter III the efficiency of oscillators is dealt with in some detail.

This occupies 76 of the 270 pages, and apart from the bibliography and index the rest of the book is devoted to the problems of frequency stability in one form or another. There are chapters on frequency drift due to the valve, to the effect of temperature on the coils, the effect of temperature on condensers, as well as the stabilisation of the maintaining system, the inductance, and the capacity. The book concludes with a chapter on methods of obtaining automatic frequency stabilisation.

Crystal-controlled oscillators are not treated, the discussion being confined to uncontrolled oscillators. Among the methods of stabilising the valve circuit, it is shown that much can be done by the choice of suitable circuit values. The author gives a list of seven principles, which are not mutually exclusive, by the observance of which a considerable improvement can be obtained. Special circuits, such as the Franklin oscillator, the phase-compensated oscillator, the line-stabilised oscillator, the Kolster high-Q circuit, and the Dow circuit, are dealt with.

It is often believed that frequency variations are due chiefly to the valve and the voltage supplies. The author shows that while they undoubtedly affect the frequency appreciably, the effect of temperature on the coils and condensers is often much greater. The chapters dealing with the stabilisation of inductance and capacity are thus especially important.

The book is admirable for its lucidity and accuracy. The treatment is often mathematical, but it is rarely necessary to follow the equations in order to obtain a qualitative understanding of the subject. The book is consequently of considerable value to the non-mathematical, and can confidently be recommended to all interested in this important subject.

W. T. C.
Cathode-ray Photography

MAKING PERMANENT RECORDS FROM OSCILLOSCOPES AND TELEVISION SCREENS

By JOHN H. JUPE

This article gives information on the choice of films and plates for use in photographing cathode-ray tube screens of various types. It also deals with such questions as exposure, aperture and reduction of image; formulae for developers are also given.

With the ever-increasing use of cathode-ray tubes the recording of the images by photographic means is likewise increasing, and although in some respects the methods follow those of normal photography, there is at the same time much difference.

Television is in the "normal" class, whilst oscillograph traces are more allied to the older scheme of recording with a moving spot of light. For television photography the problem is simply to record a projected picture, and it can be dealt with in much the same way, with regards to apparatus, materials, exposure and development, as a normal scene.

Any ordinary camera is suitable, providing it is fitted with a fast lens, f/4.5 or faster, and a focusing device, reflex or otherwise. To increase the size of the image on the negative, a portrait attachment or other "close-up" lens is desirable, but most important of all is that suitable negative material should be used. This applies to every class of cathode-ray photography, and to assist in classifying materials the fluorescent screens can be considered under the following headings.

1. Screens with green images.
2. Screens with blue-green images.
3. Screens with blue images.
4. Screens with red images.
5. Screens with black-white or sepia images.

In most cases the groups 4 and 5 require the same materials, but as group 5 is used almost exclusively for television it is quoted separately.

Almost any good make of plate or film may be used, but to give examples of suitable types, tables of various kinds made by two manufacturers have been prepared. Obviously other equivalent makes could be substituted in any group, and the materials in each section are arranged in order of sensitivity.

Exposure for Television

Exposures in cathode-ray photography are determined by a number of factors, though in television scenes the matter can be simplified owing to the limits set by the brightness of the screen and the number of frames per second. Only experiment can show what is most suitable, but 1/25th second is the fastest exposure suitable for present-day television, and this exposure at f/4.5 and a fast panchromatic film should provide a basis upon which to operate. Normal developers are most suitable for this work, and "soft" or "contrast" ones should be avoided.

In the case of other cathode-ray

An example of an untouched photograph of a television picture produced on a 9 in tube. The photo was taken with an exposure of 1/14th second and an f/4.5 lens.

Photographic work further matters must be considered, and the problem must be solved by a compromise between the following:

1. Brightness of the screen.
2. Writing speed of the tube.
3. Aperture of the taking lens.
4. Spectral radiation from the screen.
5. Spectral response of the photographic emulsion.
6. Magnification at which the photograph is made.
7. Developing conditions.

If the brightness of the screen can often be improved by designing the electrical circuits so that the control grid voltage is reduced during the time a transient occurs, of course, the screen would necessarily be damaged by such high intensities of radiation as it would then be subjected to, but as the damage is a function of the screen input power per unit area, per unit time, the momentary increase has practically no effect on the life of the tube. This method usually gives greater photographic speed than the use of larger aperture lenses. It is useful to know, too, that the intensity of the screen image is roughly proportional to:

1. The square of the control grid voltage.
2. The second anode voltage.
3. All other voltages being kept constant.

Consequently, if exposures are known for one set of voltages, others can readily be calculated.

An alternative method for the photography of non-repeating transients is to use a tube with a red screen which usually has a very long afterglow. In this case panchromatic materials are the only ones possible.

Lens Aperture

Taking the other points in the list of variables, aperture of lens is fixed by the equipment available, whilst spectral conditions of screens and emulsions are covered to a great extent by Tables 1 and 2 (overleaf). Apart from developing conditions, which will be dealt with later, there is the tremendously important question of the writing speed of the tube. This is linked with the magnification at which the record is made, and the optical
Cathode-ray Photography

Choice of Developer

For the development of negatives used in cathode-ray photography regular methods may be followed in general. The quality of the image is very important, and good contrast is desirable, but where the "spot" travels at rapidly varying speeds an attempt to obtain maximum contrast will often result in parts of the record being obliterated.

Broadly speaking, it is best to develop for contrast any records which do not show great variations of "spot" speed, and to use a normal developer where rapid movements occur irregularly. High degrees of enlargement from small negatives may force the use of fine grain developers, but their use is not recommended for oscillograph photography.

The following list gives developers, etc., suitable for cathode-ray recording, and, like the film and plate tables, is only intended to be representative.

Kodak Special Developer (D.163)

- Stock Solution
  - Avoirdupois
  - Hydroquinone, 5 ozs.
  - Sodium Sulphite, 12 ozs.
- Developer
  - Water, up to 40 ozs.
  - to use, dilute 1 part with 2 parts of water.
  - for tank use, dilute 1 part with 5 parts of water.
  - for tube use, develop for 35-5 minutes at 18°C.
  - for tube use, develop for 10 minutes at 18°C.

Kodak High Contrast Developer (D.19)

- Water (warm)
  - 32 ozs.
  - 2 ozs.
- Developer
  - Water, up to 40 ozs.
  - to use, mix equal parts of A and B.

Ilford Moso Developer (D.2)

- Solution A
  - Avoirdupois
  - Hydroquinone, 5 ozs.
  - Potassium Bromide, 2 ozs.
- Solution B
  - 7 ozs.
  - 100 grains
  - 100 grains
  - 20 ozs.
  - 40 ozs.

Ilford Pyro-Metol Developer (D.4)

- Solution A
  - Avoirdupois
  - Hydroquinone, 5 ozs.
  - Potassium Bromide, 2 ozs.
  - Pyrogallic Acid, 4 ozs.
- Solution B
  - 7 ozs.
  - 100 grains
  - 100 grains
  - 20 ozs.

Ilford Osmiochrome Developer (D.32)

- Stock Solution
  - Avoirdupois
  - Sodium Sulphite, 2 ozs.
  - Potassium Metabisulphite, 1 oz.
- Developer
  - Water, up to 40 ozs.
  - for use in equal parts of A and B.

Acid Fixing Bath for Plates and Films

- Sodium Hyposulphite, 1 oz.
- Potassium Metabisulphite, 2 oz.
  - Chrome Alum, 2 oz.
  - Water, 40 ozs.

Combined Fixing and Hardening Bath

- Sodium Hyposulphite, 1 oz.
- Potassium Metabisulphite, 2 oz.
  - Chrome Alum, 2 oz.
  - Water, 40 ozs.

The hypo and the metabisulphite are dissolved in 20 ozs. of hot water and allowed to cool. The chrome alum is then dissolved in 10 ozs. of warm water and added to the remainder of the bath when cool. Finally, the amount of solution is made up to 40 ozs. with cold water.

The information given here is sufficient to cover most cathode-ray photography in ordinary engineering research, but for special purposes contact should be made with the makers of the films and plates. The writer's thanks are due to Kodak, Ltd., A. C. Cossor, Ltd., Ilford, Ltd., and the Eastman Kodak Company of America for their help in supplying him with data.
The Mechanics of Receiver Design

TEMPERATURE — HUMIDITY — VIBRATION

It is not always sufficiently well realised that wireless apparatus has its mechanical side as well as its electrical. Considerable attention is paid to the electrical design, but sometimes the mechanical is slipshod. This is especially so in the case of home-made apparatus and is due partly to an incorrect choice of components and partly to poor workmanship on the part of the constructor himself. The former is due chiefly to a desire to save money, for the best components are rarely cheap, and the latter to an excess of enthusiasm which leads him to rush the construction in order to get the apparatus working.

In the electrical design certain definite values of resistances, capacities, inductances, and valves are called for, as well as certain degrees of screening and insulation. These values are optimum ones and are rarely precisely realised in practice. It is, for instance, very unlikely that if one buys a 10,000-ohm resistance its value will be precisely 10,000 ohms—it may be anything between 9,900 ohms and 10,100 ohms. Moreover, its value will vary somewhat with temperature.

All components and valves are subject to similar variations in different degrees, and as far as possible the designer has to see that the performance of the apparatus is not greatly affected by these probable departures from the optimum values. In very many cases quite large alterations in component values have only a moderate influence on performance. The majority of the resistances and fixed condensers in a receiver, for instance, are by no means critical and normal tolerances on their values are ± 10 per cent, or even ± 15 per cent.

Components associated with the tuning arrangements, however, are very critical and it is usually unsatisfactory to specify fixed values. Coils and variable condensers may be specified with tolerances of ± 1 per cent, or ± 0.5 per cent, but adjustable capacities are always provided so that the precise values needed can be obtained by adjusting them while the receiver is in operation.

Temperature

All this is well known and is allowed for by the designer. What is not always remembered is that the value of a component may not be constant but may change with time, temperature, humidity, and vibration. If the changes are moderate and slow and they occur in non-critical parts of the set, they may not be of much importance. Thus a resistance in an AF amplifier might conceivably change from 10,000 ohms to 11,000 ohms over a period of an hour or so. While readily measurable, the result might well be inaudible.

On the other hand, much smaller rapid and erratic variations are likely to cause rustling noises and are consequently very definitely undesirable.

Troubles of this nature arise less in components themselves than in badly made connections to them. A dirty or badly soldered joint has an erratically variable resistance and is a common cause of noise.

The mechanical side of a receiver is often given much less attention than the electrical; in fact, it is only comparatively recently that its importance has become realised to any great extent. The effect of temperature upon the performance is another point which deserves the serious consideration of the designer. These matters are discussed in some detail in this article and the effects of poor design are described.

It is only natural to find that variations in components affect the performance most when those components are in the more critical circuits. Condensers and coils can be badly affected by temperature, humidity, and vibration and so the tuning of the various circuits is affected, leading to reduced sensitivity and selectivity.

Temperature changes may be cyclic. This means that if we take a condenser of known capacity and change its temperature there will be a certain change in capacity; if we bring it back to its original temperature, however, it will also go back to its original capacity. With a non-cyclic change, however, the capacity would not come back to its original value, but would take up a new value between the two. In addition to short-term variations which follow the temperature changes, there is a long-term alteration in capacity which is more or less permanent.

Most people have noticed that the tuning of a receiver drifts during the first ten minutes or so after switching on. This drift is caused by changes in coils, condensers, and valves while they are warming up, and it does not cease until they have acquired their final temperature. This is the short-term variation; the long-term change is much less noticeable, partly because they are slower and partly because they are of less magnitude. They affect the performance in the same way, however, and at length make it necessary to re-gang the receiver.

The complete avoidance of these effects is probably impossible, but they can be very greatly reduced by good design. One method is to use compensated parts. Many, but by no means positive and negative temperature coefficients. A coil with a positive temperature coefficient, for instance, may be tuned by a condenser having a negative coefficient, so that the product of inductance and capacity, and hence the resonance frequency, is a constant and independent of temperature.

Apart from these expedients, however, it often happens that much of the drift experienced is due to mechanical defects in the apparatus rather than to normal temperature variations. Let us, therefore, consider the important components in turn.

Electrically, the average IF transformer is quite a good component, but mechanically it is not always up to the same standard. If a transformer is set up, adjusted, and its resonance curve is measured, and is then subjected to vibration and temperature and humidity changes such as are normally encountered in practice, it will be found that the resonance curve has altered. Sometimes the changes are of a minor character, sometimes of a large size.

Usually, the peak of the resonance curve is displaced somewhat, and its height is reduced. In extreme cases, a single-peaked curve may become double-humped and displaced by as much as 5 kc/s from the true intermediate frequency. Sometimes, too, there is a big drop in efficiency.

Normally, the trimmers are responsible for the major changes. Many, but by no means all, trimming condensers of the mica-dielectric compression type are badly affected by vibration and temperature. It is changes in the trimmers which cause a large part of the shift in position of the resonance curve, and which in bad cases

This photograph shows two similar coils, one unfinished and the other dipped in wax.
The Mechanics of Receiver Design—

cause the appearance of a double-humped curve. Humidity affects the losses in the trimmer, but usually not to a very serious degree with the changes normally experienced in this country.

The temperature effect on the coils is chiefly to expand or contract the copper and the coil former. It is likely to be more nearly cyclic than in the case of trimming condensers. The effects of humidity on the coils may be very serious if the coils and their formers are not impregnated. An increase in humidity will then seriously lower the efficiency.

If the coils are home-made they are often left unimpregnated. Although the initial efficiency may then be higher it is unlikely to be retained unless the coils are kept in a dry atmosphere, which is not always possible. It is, therefore, advisable to impregnate them and paraffin wax is quite good for this. Unless the former is of ebonite or similar fairly hard material it is likely to shrink during the process of impregnation and so lead to trouble.

With wooden or card formers the best course is to prepare the former, dry it well in a hot oven, and then dip it in molten paraffin wax. After shaking off the surplus wax, it should be left to dry. After winding, the coil (and former, of course) should be dried in the oven and then dipped in wax, again shaking off the surplus. Such a coil, although it loses a little in Q, will remain very largely unaffected even by extremes in humidity. If desired shellac can be used instead of wax, and is sometimes more convenient.

Vibration has little effect on the coils provided that they are rigidly mounted. This is important, for in some forms of construction very small relative movements of the coils have a big effect on the coupling between them, and hence on the selectivity and efficiency. Movement of the coils in relation to the screening can, wiring and trimmers also affects the tuning of the circuits in some degree.

Trimmers

The trimmers are most important and their importance increases rapidly with the selectivity. If compression-type trimmers must be used on account of their small size and cost it is a good plan to use only very low capacity trimmers and to obtain the bulk of the capacity in fixed ceramic-type condensers. Air-dielectric trimmers are best if they are soundly made with good bearings. Good air trimmers are substantially free from vibration troubles, are capable of more accurate initial adjustment, are less affected by humidity, and are more cyclic in their temperature variations than compression types. Some of the latest patterns of the latter, however, are very good and are greatly superior to older ones.

In order to avoid the condenser troubles permeability trimming has been evolved. Here a fixed ceramic-type condenser is used, because of its stability and low losses, and the coil is provided with a movable powdered iron core. This scheme is perfectly satisfactory if properly carried out and is then as good as an air trimming condenser. If it is badly done, however, it is as bad as a poor compression trimmer. Everything depends on the movable core system. The core must fit the coil former without side play, and once its longitudinal position has been determined it must stay there unaffected by vibration.

This is easier said than done, but it can be done, and the result is that permeability trimming is becoming more common. It is probably no better than an air-dielectric trimming condenser, but can be as good if properly made and is cheaper and more compact.

Very similar considerations apply in the case of the signal-frequency tuned circuits, but to a lesser extent owing to their lower selectivity. The use of capacity trimmers is usually essential, because it is necessary to equalise the stray capacities of the various circuits in order to maintain accurate ganging.

For reasons of cost mica-type compression trimmers are nearly always used; it is, therefore, important to choose good ones. If they can be afforded, there is no doubt that air trimmers are better, but they take up more room.

The most important circuit of all is the oscillator. This is because it has the whole selectivity of the IF amplifier behind it, and a given change in capacity or inductance has more effect on the performance here than anywhere else. Although the other circuits can be quite important, the cause of the major part of the drift commonly encountered lies in the oscillator. The troubles here, however, are not only of a mechanical nature but also of an electrical.

Among the electrical troubles, drift is caused by supply voltage variations. This can be reduced in some degree by special circuits and substantially eliminated by the use of voltage stabilisers. The application of AVC voltage to the mixer is also liable to cause trouble. Changing the bias of the mixer is liable to react on the oscillator and alter its frequency. In the reception of a fading signal, therefore, the continual changes of bias make the oscillator frequency vary, and the net result may be worse than if there were no AVC. This effect has been greatly reduced in modern frequency-changer valves, and can in any case be avoided by omitting to control this stage for AVC purposes.

On the mechanical side the troubles differ only in degree from those encountered in the IF amplifier and the remedies are consequently the same. It may be remarked, however, that even when all precautions have been taken to use only mechanically sound components, temperature variations are inevitable and have a very appreciable effect on the oscillator frequency.

The variations are of two kinds—those due to the weather and those due to the set itself. Under average domestic conditions the room temperature lies within the limits of 40-80 deg. F.; in the extremes of winter and summer the variations may occasionally be greater. In summer the variation is normally to exceed 24 hours, and in winter the variation is not likely to exceed 60 deg. F. and may be 30 deg. F or so within an hour or two’s listening period. More often, however, the room temperature is fairly even during the listening period and only varies a few degrees.

The changes in room temperature tend to be slow and of moderate order during a considerable period. They consequently cause little noticeable thermal drift. They may just noticeably affect dial settings between winter and summer.

Internal Heat Generation

The self-generated heat of the receiver is another matter, however. Quite a large amount of heat is produced in the receiver. If we take an average case of a receiver with its mains equipment and loud speaker all in one cabinet, then the whole of the power input to the set from the mains, plus the RF power input and less the acoustic power output is dissipated as heat within the cabinet.

The input RF power is negligibly small and the acoustic power radiated as sound by the speaker is also small. It rarely
heat not amounts

The exact heat production, in this instance, is the same as that of the output, and the effect on the ventilating system is nullified.

Ventilation

When the set is on, it is at room temperature. Afterward its temperature rises until the loss of heat by conduction, radiation, and convection is equal to that supplied to it internally. The final temperature and the time it takes to reach it depend on many factors, among which the most important are the amount of heat generated and the ventilation of the set. Conduction and radiation convey little heat from the set, since the cabinet is usually of wood or some other poor conductor of heat, and is usually polished so that it is a poor radiator. The heat loss is mostly by convection.

Ventilation

If the final temperature is to be kept at a minimum, it is essential that the air be allowed to circulate freely around all parts of the set. The most important factors in obtaining this are the provision of adequate outlets and inlets for air at the top and bottom of the set respectively. The common pierced back to the cabinet, while better than nothing, is by no means ideal.

The best arrangement is probably to have a series of large holes spread over the base of the cabinet, which is provided with small feet to allow the free passage of air to these holes. Similar holes in the top of the cabinet are needed to allow for the escape of the heated air. If the chassis fills the cabinet, as it usually does, then it must be pierced with an adequate number of air holes, or the ventilating scheme will be largely nullified.

All this is easy except for the top holes, which are likely to spoil the appearance of the cabinet. With careful design, however, the holes can be disguised. For instance, the method shown in the above sketch can be adopted. Alternatively, metal deflecting cows can be provided above the set to carry the air to the upper half of the back and prevent its being trapped in the top of the cabinet.

Layout of Components

In spite of good ventilation, all parts of the receiver will not reach the same temperature. Consequently, it is important in design to keep those parts which should operate at a constant temperature away from the hot spots. The output valves and rectifier are generally at the highest temperature and should be kept well away from all tuning circuits, especially the oscillator. The mains transformer, too, may get quite warm if it is not very efficient, and there are nearly always several hot resistances. The speaker field should not be overlooked, since 6-12 watts are commonly dissipated within it. Economy in total power consumption is important, so that it minimises the total heat produced in the set.

By careful attention to detail in design, the frequency drift can be reduced well below the figures often obtained. The important factors are the avoidance of an unnecessarily large production of heat in the receiver. The most important factors in this are the use of a cabinet adequate in size and with properly arranged ventilating holes, the layout of the components so that the important parts are well spaced from hot components, the proper choice of condensers and coils for the power output of the output stage. Even this is only developed on peaks of music, and the result is that the average acoustic power is very small indeed compared with the power input from the mains. We shall not be far wrong in saying that the whole of the mains power input is dissipated as heat in the cabinet; this is with a Class A output stage, and is strictly true during intervals in the programme.

The power consumed by an average set varies from about 60 watts for the smaller types to 120 watts for the larger. This produces a large amount of heat and in the confined space of the cabinet results in an appreciable temperature rise.

There is no indication of the output power of the set. Since this is usually the same as that of the output, and the effect on the ventilating system is nullified.

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Good ventilation can often be secured by making the outlet holes a part of the cabinet decoration.
American Progress—and Ours
WHERE BRITAIN LEADS IN WIRELESS TECHNIQUE

FOR a good many years it has been possible to parody a well-known claim of a certain moist city in the North (which shall be nameless) by saying that what America does in radio now we shall be doing next year or the year after. Personally, I have found this extremely satisfactory, because for the price of subscriptions to the leading American technical journals I could put myself in an impregnable position in relation to those people—you know the sort!—who are always asking, "Well, what's the next thing going to be in wireless?" For example, about a year and a half ago, when push-button receivers were prac-

tically unknown here, I had no hesitation in predicting that they would sweep the board at Radiolympia. They did. Incidentally, we seem now to have gone in for them even more wholeheartedly than the Americans, and our designs are no less advanced than theirs. A year or two earlier it was possible to prophesy the addition of the short-wave band. And so on.

But now my reputation is about to totter, for its foundations have shifted. The horse's mouth is running dry. Last year it spoke with an uncertain sound, and this year the horrid suspicion is confirmed. I turn to a review of progress published in a recent issue of one of my most reliable sources of advance information from across the Atlantic, and what do I find?

Under the title "The Art Advances," one of the first things that hits the eye is this: "The outstanding contribution in radio sets within recent months is the battery-operated portable receiver." I wonder how many people here can cast their minds back ten years and remember what they saw around them in this exhibition. There may have been other types of model exhibited, but so far as real sales were concerned the only type that really mattered was the battery-operated portable receiver. The firm I was with then was working day and night turning them out by the thousand. But when I took one over to the U.S.A. it was a complete novelty, even among the technicians.

Portables are still popular. You will find them on many of the stands outside; perhaps I would be correct in saying most of the set makers' stands. Ten years ago portables weighed about 30lb. and cost about the same figure. Now, a typical price is in the region of £6 and weight 12lb. There are, of course, others even cheaper and lighter. The modern portable is devoid of any wet battery with its acid that always seems to find its way out, causing many of the faults to which the old portables were prone.

This may be one reason for the belated appearance of the portable in America. They may have been waiting till it could be worked without an accumulator. The reason actually given in the journal I have been quoting is a curious one. Designers have been finding that frame aerials, properly screened, are helpful against types of interference in which the electrostatic field predominates. Then they were surprised to find how many stations could be picked up on them. The model I took over ten years ago could receive about two-thirds of the stations then working in Europe—but not when it was in America, of course—even with the valves available at the time; but then our publicity is so bad!

Another contributory feature is the high-efficiency permanent-magnet loud speaker, which is still quite new in America, though well established here, thanks to the efforts of the Sheffield metallurgists, who put us in the lead in this department with a succession of magnetic alloys. It is common in this country to find PM speakers giving a higher efficiency than the corresponding energised types and being employed where energised types would be technically feasible.

Turning again to "The Art Advances," we find among the new "tubes" one that readers are expected to find almost incredible. It is described as "a pentode, a triode and a diode all bound in one envelope." This is no more sensational than the old Loewe valve which contained not only three valves in one "bottle," but also all the couplings, etc., for a complete receiver! It scored a big commercial success as long ago as 1926; so much so that the Loewe Company suspended the manufacture of single types. More recently, too, we had a burst of enthusiasm on the part of the valve makers for multiple valves; but when it was seen that the permutations and combinations of existing types would swell the already excessively bulky valve lists out of all reason, and that many of the combined types offered no technical advantage—in
American Progress—and Ours—

fact, quite the contrary—is there now a disposition to combine valves only when there is some solid justification for it.

Secondary Emission Valves

Talking about valves; one of the most significant recent developments has been the use of secondary emission. For some time we have had several types on the market, giving phenomenally high mutual conductance; and in this exhibition are to be seen secondary emission valves with a conductance of nearly 40 m/\text{A V}^{-1}. Another valuable advance is the abolition of the top cap connection. I hope I will be justified in predicting that before many more Radiolympias have gone by the component makers will have been able to scrap their tools for the variously shaped hats that so many of our valves still wear. There are signs that the time-honoured pinch form of construction has at last been recognised to have outlived its usefulness so far as valves are concerned; and by its abolition valves will gain in stability and freedom from loss. Progress in these directions has been going ahead on both sides of the Pond, but I think it is safe to say that at the moment Europe leads on points.

Quoting once more from the description of the new American valves: "The heater voltage of these combination tubes runs as high as 70 volts, to avoid the necessity of dropping the line voltage within a resistor, ballast tube the line could. In 1933 The Wireless World was giving particulars of the well-known Ostar-Ganz valves, having the same object, with heaters up to 250 volts. But as the title of this discussion names British technique we had better refrain from roping in various other parts of Europe.

Another novelty (in The Art Advances) is the "wireless phonograph player." It consists of a small oscillator modulated by a pick-up, and tunable to any convenient point in the broadcast band, with the object of avoiding the need for any connecting line to the receiver. This interested me, because when I wrote about how to make such a device, 35 years ago, the idea was already so old that I can no longer trace the original reference. Incidentally, it is amusing to note how even in details the traditional roles have been exchanged—the American writer calls it "wireless"; the British, "radio."

But now we come to the pièce de résistance: "Of all the events of the year, the most eagerly awaited by the engineering public in the New York area was the beginning of public television service." This is where our chests really do begin to swell uncontrollably. In days gone by if we could anticipate our American friends by a few days in the matter of some trifle it was cause for self-congratulation. But to ante-date them in something of major importance—to put it mildly—by a margin of nearly three years that is terrible! We have had our public television service just three years, which is with a 9in. tube at £30 must make the New Yorker wonder how it is done, just as we have wondered in the past when looking through American catalogues. Most of the vision tubes, too, are long, electrostatic types, which are practically obsolete here.

Directions in which British television has a clear lead are large-screen projection apparatus, optico-mechanical methods and colour television. Even though America is the home of the iconoscope, we have it on no less authority than that of Mr. Gerald Cock that they have nothing yet to equal the super-emitron which has been used by the B.B.C. for nearly two years, and that the only department that seems in advance of ours is the telecine equipment.

Will America Catch Up?

All this is most distressing. The American radio papers are so preoccupied with the first fine careless rapture of embracing television that there is little room left for discussing things that might be new to us. Perhaps—dare I say it again?—it is only a temporary phase, and when they have caught up with us in television—as they certainly will very soon if we rest on our oars—a source of information on what we are going to do next will again be available.

Another thing: just think of the expense the B.B.C. would have been saved if they had had a model to copy! And think of all the troubles our manufacturers will have next season because nobody has shown them in advance what to avoid! Unless, of course, they mark time until new designs are once more tried out in the States. Well, one cannot have it both ways—safely and gloriously. It may be interesting to discuss later which you prefer.

It would be unjust to suggest that no pioneering at all is being done now in America. You will realise that I have been presenting a rather one-sided picture. For instance, there is a development that is really worth while, yet, unfortunately, there doesn't seem to be the ghost of a chance that we shall have it in the near
American Progress—and Ours
future. I am referring to frequency modulation.
You are no doubt all painfully aware how limited is the range at which high-quality reception can be guaranteed at all times and in all places. That is true even if “high quality” is interpreted in an everyday commercial sense. But if it is understood to mean, for example, reproduction up to 15,000 c/s and complete inaudibility of such nuisances as electrical noise, atmospherics, other transmissions, etc., the range of even a modern 100 kW. transmitter is only a mile or two. Of course, that means that the vast majority of people are outside such range and have to put up with something less than the best.
Recent tests carried out in America seem to show conclusively that really high-quality noise-free reception can be obtained in unfavourable circumstances at much greater ranges and with lower transmitter powers than by conventional methods.

And that prompts me to suggest that it ought to be possible to receive the Armstrong frequency modulation station here. If I had time I would certainly have a shot at it myself. There is ground for optimism in the fact that both sound and vision from the Alexandria Palace were logged almost every day during the winter of 1937-8 at Long Island, New York, output of one loupe as high as 600 microvolts per metre. Now the Armstrong station is just between the sound and vision in frequency—42.8 Mc/s to be exact—and is transmitting considerably higher power. So there ought to be no difficulty in receiving a strong signal at one end of a glint-reflector aerial. Moreover, as the type of transmission gives an enormously improved signal/noise ratio, there is reason to hope for very good results. So who is going to be the first to receive the frequency modulation programmes in this country? I leave that as a parting suggestion to those who have a fancy for establishing records.

**Random Radiations**

### “Diallist” Bug Out

**By “DIALLIST”**

**Indispensable**

Still, in critical times you just can’t be without a ‘phone and so with a short-wave range or ranges for choice. In the country, where such evening papers as we see are printed pretty early in London, we should have been sadly short of late news if we hadn’t had the B.R.C.’s bulletin. And you can supplement them to a remarkable degree by spending a brief spell at the controls of the radio set.

Looking over my log for the week before this note was written, I see that I collected news fairly regularly from France, Belgium, Sweden, Italy, Russia, Germany, the United States, Japan, China and various South American countries. I’m sure that there’s nothing like having a loud speaker to make you do that. It gives you a feeling that you’re in touch with things as they happen and not just a kind of audio spectator.

### Messiness

LOTS of people have written—I’ve done it myself—of one of the important points that this complete absence of messiness. But I found to my cost the other day that in certain circumstances these cells can be as messy as the wet ones. I wanted a bit of stout copper wire and a length of rubber cord and under the influence of warmth set for enabling you to do that. It gives you a feeling that you’re in touch with things as they happen and not just a kind of audio spectator.

### Local Effects

Of late there have been big thunderstorms all round the district in which I live, but so far (touch wood!) they have merely passed, rumbling and flashing, some distance to one side or the other of us. It’s curious to wonder what the wireless sets will be doing at such times. The other afternoon I was using my wireless set a good deal on both the medium and the short waves, but noticed nothing very remarkable in the way of atmospherics. Certainly they weren’t bad enough to get me listening really unpleasant, let alone impossible. But that same evening, a friend who lives some seven miles away in a valley running parallel to the coast line, told me on the telephone that they had had a big storm. If you’d asked me to guess from the atmospherics heard how near the storm had been, I’d have put it at many times that distance away. And yet sometimes you’ll get great crashing X’s from a very distant storm centre.

**E&F Use Headphones?**

Do you ever use headphones nowadays? If you’re not a professional operator I don’t suppose you often do. I find a job of work for mine occasionally when I’m hunting up some dots for communication or when I want, possible, to catch the call sign of some station from which no efforts of mine will produce more than a ghost of loud speaker volume. Except for communications receivers comparatively few sets nowadays have ‘phone jacks; rather a pity, perhaps, because there’s nothing to equal the plug and jack for making or unmaking connections. For mine, that’s all right. You can make use of the extension loud speaker terminals, if they are fitted. Not a bad tip is to mount a jack on a small box containing a suitable output transformer, connecting the primary to the X’s and the secondary leads to the extra LS terminals. You can then plug in the phones when you want to. A switch for cutting out the loudspeaker is advisable.

**Noisy Noises**

At one time everyone had a pair of head-phones and all wireless shops had big stocks of them at prices ranging from five shillings to three guineas. I believe that the development of the portable receiver—ther the popular now—put paid to the wide use of headphones even amongst DX enthusiasts. With its great sensitivity and big overall gain, the superhet makes loud speaker reception of a huge number of stations possible. It’s certainly more comfortable to be able to work directly on to the loud speaker; ‘phones do produce aches and pains in the top of one’s head and the gristy bits of one’s ears. It’s immensely more comfortable to have this nuisance when you get up quickly from your chair and start to cross the room, forgetting that you are still yoked to the set by the ‘phone leads! But there’s another reason why the superhet helped to relegate ‘phones to the bits and pieces cupboard, and that’s noise. With phones you get the full benefit of hiss.
DEFEENCE REGULATIONS

Wireless Telegraphic Communications

Regulations issued under the Emergency Powers (Defence) Act have been published as a White Paper under the title Defence Regulations, 1939, by the Stationery Office, price one shilling.

Two regulations under Part I—"Provisions for the Security of the State"—relate to interference with and the control of wireless communications.

Regulation 2 reads: "No person shall knowingly (a) cause interference with the sending or receiving of communications by means of wireless telegraphy, wireless telephony or wireless television, or (b) cause interference with, or intercept, telegraphic or telephonic communications made otherwise than by the said means: Provided that the preceding provisions of this regulation shall not apply to anything done by or with the permission or under the direction of, any servant of His Majesty or constable acting in the course of his duty as such."

Controlling Communications

Under the section devoted to the control of means of communication, Regulation 8 states that the Postmaster-General may by order direct that, subject to any exemptions for which provision may be made by the order, no person shall, except under the authority of a written permit granted by such authority or person as may be specified in the order, keep in his possession or under his control (a) any such article as may be specified in the order, being a type of apparatus which is designed to be used also as wireless transmitting apparatus or which appears to the Postmaster-General to be readily adaptable for the purpose of being so used.

Subsection 2 states that the competent authority may by order provide for prohibiting in certain circumstances, and otherwise for regulating, the use of wireless transmitting apparatus; and if any apparatus is used in contravention of an order under this paragraph, then (without prejudice to any proceedings which may be taken against any other person) the occupier of the premises on which the apparatus is situated, or, where the apparatus is on board any vessel or aircraft, the master of the vessel or the pilot of the aircraft, as the case may be, shall each be guilty of an offence against this regulation. In accordance with Subsection 4, which reads: "Notwithstanding anything in Section 2 of the Wireless Telegraphy Act, 1904, the Postmaster-General in discretion may refuse to grant a licence under the said section, and may revoke at any time a licence granted under that section, to the Postmaster-General's announced last Thursday the withdrawal of licences for the establishment of:

(a) Wireless telegraph sending and receiving stations for experimental purposes.
(b) Wireless telegraph receiving stations for experimental purposes and the use of wireless sending apparatus in conjunction with artificial aerials.
(c) Wireless telegraph sending and receiving stations for Royal Naval Wireless Auxiliary Reserve purposes.

THE B.B.C.

"Broadcasting Carries On!"

The slogan adopted by the B.B.C. at this critical time is "Broadcasting Carries On!" and, with this in mind, plans, laid many months ago, were brought into being by the B.B.C. at the outbreak of war to ensure a broadcasting service for the Country. London is no longer the centre of British broadcasting. Promises in the country have been taken over by the B.B.C., and from these will come most of the "live" programmes which will replace the recorded items heard during the past few days.

The Home Service, as the transmissions have been named, is, as is now so well known, broadcast on 391.1 metres (767 kc/s) and 499.1 metres (668 kc/s), the wavelengths assigned to the Scottish and North Regional transmitters.

With the publication of the supplementary issue of The Radio Times on Monday, it was learned that World Radio will be incorporated with The Radio Times.

Television

In an announcement broadcast by the B.B.C. last Friday it was stated that the television service would be discontinued until further notice.

Indian Listeners

The total number of licences in force in British India at the end of June this year was 76,841. The increase for the first half of the year was 12,361, as compared with 4,739 for the same period last year. There were 18,117 sets imported into India during the half-year ending June, 1939.

BROADCASTING HOUSE, LONDON. The continuance of broadcasting throughout the war is a vital factor and endless precautions have been taken at the headquarters of the B.B.C. to ensure this.

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H.R.H. THE DUKE OF KENT talking to Mr. A. F. Bulgin during his visit to Radiolympha, which closed abruptly last Friday morning. Between them is Mr. J. H. Williams, of Marconiophone.

B.B.C. Foreign Bulletins

A short daily news bulletin in German, broadcast from the Brookwich National transmitter (1,500 metres) between 12.30 and 12.45 p.m. GMT, was introduced on Wednesday, August 20th. This, however, like the foreign-language news bulletins broadcast on the medium wavelengths, ceased with the inauguration of the "Home Service." The foreign news bulletins from the Empire short-wave station are continuing, with additional Afrikaans and German broadcasts.

Amateurs in South Africa

SOUTH AFRICAN radio amateurs are joining the South African Air Force Civilian Wireless Reserve.

New York's Third Television Station

The Mutual Broadcasting System has applied to the Federal Communications Commission for a licence to operate a 10-kv television station in New York.

Television in Hollywood

PARAMOUNT PICTURES is erecting, in collaboration with the Don Lee television laboratories, a television station in Hollywood. It is understood that this station will transmit principally films.

New Spanish Station

The Spanish Government proposes to erect a broadcasting station at Larache in Spanish Morocco. The transmitter will operate on 293.5 metres, with a probable power of 20 kw.

Broadcasting in Travancore

One hundred community receivers will be installed at all important villages and towns in the Travancore State in readiness for the new broadcasting station which is to be erected at a cost of Rs. 280,000.

NEWS OF THE WEEK
Rhodesian Rhapsody

I HAVE been having some technical correspondence during the past few weeks with a reader who has the good fortune to 'dwell in the wilds of far-away Rhodesia, free from all the cares and worries of this so-called civilisation. It is true that he is, as he has told me, sometimes troubled by marauding elephants roaming over his farm at night, but when he sees them he has at least the satisfaction of knowing that they are real flesh-and-blood elephants.

However, he does suffer from one great disadvantage, and that is the inability to get his LT battery charged, as the local radio shop is apparently a few hundred miles away. HT is a problem, too, although if the LT problem could be settled really satisfactorily, that would disappear, as he would naturally use a vibrator for his source of HT supply.

I was deeply engaged in considering his problem the other evening, and must, in my profound meditation, have unknowingly started muttering aloud, as Mrs. Free Grid looked up from her knitting and demanded to know who Maggie was, and it took me two solid hours to convince her that it was merely the pet name with which we old-timers used to designate the magnetic detector which I had momentarily considered as a possible solution to my correspondent's problem.

In the hope that the much-vaunted 'woman's intuition' would solve the problem, I told her of my correspondent's troubles, explaining carefully that he was not connected to the electric lighting mains, and that it was, therefore, useless for her to suggest an all-mains set as a means whereby he could get rid of his battery troubles. She was nothing daunted, however, and, emulating the historic example of Marie Antoinette, said rather tartly that if he were so behind the times as not to have the electric light laid on, he must use the gas mains.

I somewhat wearily explained to her that even here in England the gas mains were not of much avail for running a wireless set, and almost immediately, as if to belie my words, there was a knock at the door, and a railway vanman staggered in with one of the new gas-operated wireless receivers which the Editor had sent to me for my opinion. I am afraid that as a result of this unfortunate contretemps I have definitely lost technical caste in Mrs. Free Grid's eyes, and am quite unable to convince her that it would not be a good thing for my Rhodesian correspondent to install one of these sets and have gas sent out to him in cylinders in order to operate it.

Esau Up-to-date

I TRUST that you will excuse my somewhat un Kemp appearance this week, but, as I mentioned briefly last week, I am in the throes of struggling with an electric razor, and, although I have high hopes for next week, I have not yet got to that schoolgirl complexion stage which the makers of the razor have promised me will be the reward of perseverance.

Obviously, as a keen wireless and electrical man I could not ignore this latest example of the electrical engineer's art, and have flung away my old-fashioned soap and razors, and am now sharing the lot of all pioneers. I may not look too good just now, but wait until next week or the week after, and I shall have the laugh on all you musty old Victorians with your old-fashioned gashers and scrapers.

To be quite honest, the real reason why I got hold of one of these devices was because I had read such a lot in The Wireless World correspondence columns about the ease with which they could be 'suppressed' by a simple condenser, and I wished to experiment for myself. When I sent Mrs. Free Grid off to London to get me one I had not the slightest intention of using it on my own face, but was intending to experiment on a pestilent Pekingese which has been introduced into my household. When Mrs. Free Grid arrived back from town she was in high glee, and put the package containing the razor on my desk triumphantly, and stood obviously waiting for my approval, as though she were a child who had just performed some clever trick.

Feeling somewhat suspicious and uneasy, I slowly opened the package and found that she had brought what I believe is the one and only razor on the market which is 'suppressed' by its makers. She would! Before I had time to protest, she commenced to explain how she had ransacked half the shops in London before she had found a razor fitted with a suppressor, as she knew that I would be very particular on this point.

You will readily understand that since the thing was already suppressed my casus experimenti was gone, and there was simply no use to which I could put it other than to employ it for the purpose for which it was designed, namely, shaving my face. The first morning I shaved very badly indeed, as I forgot that I was not using an ordinary razor, and absent-mindedly dipped it into the hot water.

As I happened to have my other hand on the earthed tap at the time I was brought out of my reverie somewhat abruptly, and in addition, had to spend the whole of the day taking the thing in pieces and carefully drying-out the motor.

At present my face is rather like the curate's egg, as it is a bit patchy, but I must admit that this is only what the makers' instructional booklet told me to expect for the first week, and so, having found the book of words to be accurate so far, I am looking forward confidently to the schoolgirl complexion which the book promises me next week.

Surprise Item

DURING the course of the exhibition I left my card at several stands with a request that certain sets which took my fancy should be sent down to me for test. I had quite overlooked the fact that several wireless manufacturers nowadays make other electrical goods as well as wireless sets, with the result that my garden is at present cluttered up with a miscellaneous collection of refrigerators, vacuum cleaners and similar electrical impedimenta. I must, however, pay a tribute to the members of the despatch department of one big firm. They really have sent a wireless set, but it is the wrong model, of course.

Actually this particular set is one which I do not recollect seeing at the show. It is a motor-tuned push-button set and has one of the buttons labelled 'surprise item.' By means of an ingenious device, matters are so arranged that each time you press the button you get a different station. Moreover, you don't get the various stations one after another in a regular rota. This button is therefore well and truly named, as when you push it you never know what station you are going to get.
British Technical Progress

Some Comparisons with America

At the first day's meeting of the Convention, Mr. M. G. Scroggie, B.Sc., A.M.I.E.E., a consulting radio engineer, introduced by Major L. H. Peter (a Vice-President of the R.M.A.), the Chairman, opened the discussion. His remarks are reported at length elsewhere in this issue.

The next speaker, Mr. T. E. Goldup, A.M.I.E.E., of Mullard's, said that valve development had run along two different tracks here and in the U.S.A. Here, the trend had been to cram as many valves into one "envelope" as possible, and to make the valves highly efficient. This resulted in valves being individually dear, and thus there was a tendency to design a set to use as few valves—or "envelopes"—as possible in order to cheapen the set. In America, however, the tendency had been to design sets to use as many valves as possible, because the valves were cheap, of low efficiency and were "simple," i.e., one valve in each envelope. He did not express an opinion as to whether the American or the British method was the better of the two; both had dictated by particular circumstances existing in the two countries, but he claimed that the British method had resulted in the production of much more efficient valves.

Mr. G. Parr, of Ediswan's, who followed, compared British and American television, first dealing with the development of the open sound broadcasting, which in America had had about two years start, and had kept it ever since. But in the matter of television, it was this country that had had the start; and, it was up to us to keep it. He drew particular attention to the way in which television had served to develop the cathode-ray tube. He said that, so far as he could recall, development had been more rapid than had that of any other electrical device. For a long time the cathode-ray tube existed in a crude state. It was a "soft" tube with a useful life of not much more than 24 hours. Under pressure of the demands of television it had been developed from this stage to a more or less perfected state in not much more than a year.

Television: The Position in America

He said also that in spite of it being the home of the Iconoscope, America was still very much behind this country in the matter of direct television transmission and reception. They were still in the "electro-static" receiving tube stage, whereas we had advanced fully to the "magnetic" stage. Only two-way television appeared in which the U.S.A. had had the lead was the apparatus for showing television in the cinema. Apart from being inferior in performance, television sets in the U.S.A. were much dearer than over here, and were likely to remain so for some time to come. In America the tendency was to use films instead of direct transmission. He attributed this to the fact that here the money for programmes obtained was obtained from licences, whereas in the U.S.A. it was derived—or at any rate going to be derived—from advertisers. They preferred that their sponsored programmes—and more especially plays—should be on film, because it was possible to prepare film programmes with infinite care, shooting a scene over and over again until it was entirely satisfactory, as is done in the case of ordinary cinema films. The result was a finished and polished performance, greatly superior to what the Americans claimed must be obtainable from "direct" transmission, because in the case of "direct" transmissions the plays, etc., were likely to be insufficiently rehearsed. Furthermore, the advertiser sponsoring the programme was able to see the trial film and approve of it before it went on the air.

The meeting was then thrown open to general discussion, and one of the speakers protested against the growing idea that American apparatus was always best, and always in advance of the British product. He also asked why manufacturers did not produce for battery users 2-volt indirectly heated valves with the cathode brought out to a separate lead. The amateur transmitter's demand for more and cheaper transmitting valves was also voiced.

Quality Reproduction

What It Means To-day

The Chairman, Mr. Leslie McMichael, in welcoming the audience at the second meeting on behalf of the R.M.A., spoke of the advances in receiver design since the beginning of broadcasting. In no direction had greater strides been made than in quality of reproduction.

Mr. P. G. A. Voigt, B.Sc., A.M.I.E.E., of Voigt Patents, Ltd., set himself the task of defining good-quality reproduction and opened his argument by pointing out that quality had different meanings for different people. He recalled many years ago listening to the distorted speech from an aerodrome transmitter and the almost unintelligible reply from an aeroplane, which was nevertheless acknowledged as "O.K." by the recipient. Subjective opinion was clearly unreliable since it had been continually revised and remoulded by technical progress. It had been suggested that the perfect reproducer might be one which would create the impression that the Queen's Hall orchestra was actually in the room. This was an ideal which could not be realised, for the echo pattern of the listening room would be added to that of the Queen's Hall.

AN OLYMPIA "SIDESHOW"

Dual-controlled transmitters and receivers such as that shown on the R.A.F. stand at Olympia are used in Army cooperation planes.

The two valve master—oscillator—controlled transmitter, which works on telephony, CW and ICW, employs grid-modulation for telephony. The HT supply is interrupted for ICW. The transmitter can be used either on the 250-ft. trailing aerial or the 12-ft. fore-and-aft fixed aerial. The complementary receiver employs a 5-valve straight circuit with a separate one-valve oscillator for CW. All the controls are in duplicate.
Olympia Convention — and congratulate the performers in the large hall outside, then there must be some defect in the electro-mechanical link between stage and listener.

To show what a near approach to this ideal is possible, Mr. Voigt arranged a demonstration of sounds rich in transients, such as the hammering of nails and the sawing of wood. The reproducers were two corner-horn loud speakers placed back to back, and the sounds were picked up by a microphone in an adjoining room. In an earlier demonstration the presence of an electric motor horn in front of the loud speakers deceived many of the audience. Not until it was disconnected and removed did they realise that the sound was coming via the microphone and loud speakers.

By means of a selection of gramophone records, Mr. Voigt also demonstrated the effects of different degrees of reverberation. One record of a trumpet made at a distance of four inches from the microphone, thus consisting almost entirely of direct sound, was particularly realistic. The demonstration as a whole was warmly applauded by the audience.

The second speaker was Mr. A. B. Calkin, M.A., A.M.I.E.E., (Philips Lamps, Ltd.), who pointed out that the standpoint of the set manufacturer was fundamentally different from that of the quality enthusiast. Whereas the latter was quite prepared to sacrifice range, selectivity, and even appearance to quality, the manufacturer of sets for general sale had to keep in mind five principal requirements: (1) appearance; (2) range; (3) selectivity; (4) quality; (5) volume. It was his experience that if any one of these attributes were developed at the expense of the others, the set was hard to sell; the most popular models were those with a balanced performance.

That was not to say that progress in quality had not been made. Recent advances in modern sets included reduction of amplitude distortion, straightening of overall response curves, removal of cabinet resonances and the prevention of focusing of high frequencies. In fact, receivers of the £15-20 class provided sufficiently natural reproduction for all reasonable requirements. He had doubts as to whether the ordinary listener appreciated the standard of quality given by modern sets, for the service department reported that the majority of receivers returned for investigation were found to have the tone control in the extreme "mellow" position.

Wanted: New Power Output Rating

Speaking of the difficulties of expressing quality and volume in terms which had any real meaning, he explained the inadequacy of the customary wattage rating. This did not state where the power was measured (cross and secondary or secondary of the output transformer), neither did it take into account the electro-acoustic efficiency of the loud speaker. So many conflicting factors were involved that a new unit seemed to be called for.

Another problem for the set manufacturer was to decide at what volume level the set should give the best quality. Mr. Hughes had already pointed out in Telephony and Telegraphy World that even in the concert hall the distance of the listener from the orchestra affects the tonal balance of what he actually hears. Should one compensate on the assumption that the purchaser always tries for a seat in the front stalls, or are there many who prefer the balance at the back of the hall? Since it was a matter of personal preference, tone control must be provided. The brightening effect of an excess of treble compensation was found to be acceptable. Similar compensation in the bass could be arranged but was expensive. In general it was unnecessary if the response could be maintained equal to 70 cycles without serious falling off.

Summarising the position from the point of view of the set maker, Mr. Calkin concluded: (1) that although quality of reproduction is important, it cannot be allowed to account for too high a proportion of the cost. (2) Variable selectivity was indispensable to a satisfactory compromise between quality and other functions of the receiver. (3) "Fake" tone compensation was justified if it satisfied the "discriminating listener." (4) That while there was still room for further improvement in cabinet design, the reduction of harmonic distortion and better control of frequency response, any radical advance, apart from binaural reproduction, was not to be anticipated.

Mr. G. A. V. Sower, B.Sc. (Eng.), A.M.I.E.E., (Telegraph Construction and Maintenance Co., Ltd.), was of opinion that there was considerable room for improvement in commercially produced loud speakers. Manufacturers seemed both to avail themselves of the accumulated design data already available, and it was not to be wondered at that little fundamental research was being done since they were not prepared to pay for a product of higher quality. He thought they were content to cater for the "standard" ear rather than the "discriminating" ear.

He was sorry to note the disappearance of the bath tub, though he appreciated the strength of domestic influences. In cabinet design appearance seemed to be given precedence over acoustic requirements.

The set should not be blamed for faulty reproduction. Response curves of a loud speaker taken in an ordinary room might show deviations of as much as 20 db. compared with the same loud speaker when measured in an anechoic chamber. The selection and arrangement of the listening room should receive as much care as the choice of a loud speaker.

Output Transformer Distortion

Dealing with the subject of harmonic distortion, Mr. Sower drew attention to need for careful design of the output transformer and referred to the recent work on iron core distortion by Mr. N. Partridge. The use of nickel-iron alloys in place of the usual silicon-iron pointed to a satisfactory solution of this problem.

The Chairman then declared the convention open for general discussion. Dr. G. F. Dutton (Electric and Musical Industries, Ltd.) was the first speaker and he drew attention to the disturbing influence of background hiss and "man-made static." There was biological reasoning to support this fact, for in the animal world high-pitched sounds were usually signals of danger and produced an immediate escape reaction. When used as a background for other activities broadcast music called for a cut in top, but high fidelity reproduction was acceptable when one concentrated on the matter being broadcast.

It was permissible to change the balance of tone for different types of transmission. Dance music, for instance, called for a good bass response to convey the foundation of rhythm. In some cases tone correction would be better if introduced at the transmitting end.

With regard to the adjustment of room characteristics, if damping materials were gradually reduced until the quality of speech sounded natural, the reverberation period thus achieved would be a good average for other forms of speech.

He hoped that advantage would be taken of ultra-short waves to transmit binaural or multi-channel sound, but special receivers would be necessary.

Mr. Barden (Goodmans Industries, Ltd.) could not agree that loud speaker manufacturers were neglecting to use new developments in design. Better loud speakers were always available to the set manufacturer, but so far the demand for cheap units was the greater.

Mr. A. K. Webb (Murphy Radio) thought there was no need to go above 8,000 c/s in a broadcast receiver and that a sharper cut-off at this frequency could be obtained by a single curved-sided cone. The quality of such a loud speaker was sufficiently good to show up differences in the B.B.C. transmissions.

Mr. Sower thought the public could be educated in the proper use of tone controls. The controls and dials of the modern aero-plane were in no way hopelessly complex, but were taken as a matter of course by the young man of to-day. He thought that if the public were more persistent and were prepared to pay, they could have much better quality of reproduction than they were getting.

Telephony and telegraphy communication between battalion and company headquarters is provided by this pack transmitter-receiver which was an interesting exhibit on the Royal Corps of Signals stand at Olympia. Working on an 8-ft. sectional aerial, which, when not in use, stoys away in the lid of the case, it has an effective range of three miles. This latest acquisition of Royal Signals, which weighs 28 lb. and is made by Marconi, is still in its experimental stage.
Wireless World

Olympia Conferences

Mr. Voigt thought there was no need for additional lifting of top. In most of their transmissions the B.B.C. were already doing this and he found it necessary to use a filter at the top. The B.B.C. control engineer should be provided with a tone control independent of the line correction circuits and a monitoring speaker which really heard the ears could be used. The excess of top was allowed to pass to the transformer.

With regard to the effect of room characteristics, the strength of walls had a profound influence. In modern houses, houses, found influence the ponderance of homes, frequencies, in short-wave broadcasting, the third meeting was held under the chairmanship of Mr. E. M. Tee, Chairman of the R.M.A. Technical Advisory Committee. Dr. R. C. G. Williams, C.B., D.I.C., Ph.D., D.R.E., of Murphy Radio, opened by giving a brief résumé of the methods by which short waves are propagated, emphasising that the indirect ray, via the reflecting layers of the upper aurora, was all-important in this branch of our work. He then went on to deal with the intermediate frequency of superheterodynes, explaining why the value of 110 to 120 kc/s, used in the days of 2-band reception, was unsuitable for the modern "all-wave" set.

Considerations leading up to the choice of the present-day frequency of about 465 kc/s were discussed at length.

Dr. Williams then proceeded to describe the design of the short-wave side of specific receivers, explaining the importance of band-spreading in overcoming tuning difficulties. He discussed the design of the Murphy A46 receiver, with its double frequency changer, showing how the rather costly second frequency changer has been eliminated in later models. Present methods of using the ordinary tuner as the band-spreader were described. He showed how the principal obstacle in short-wave broadcasting, is being partly overcome by improvements at the receiving end, but chiefly by the intensive development of short-wave anti-fading aerials. The difficulty has been to keep the mechanical valve and set makers to turn their attention to the 2-3 metre band with the same energy they had applied to 5 and 7 metres.

A report of the last meeting of the convention, which coincides with Television, will appear in our next issue.

VOLTAGE-DROPPING RESISTANCES

Possible Dangers—and a Remedy

In the letter reprinted below, which appeared recently in the Electrical Review, attention is drawn to the risk of fire introduced by resistor cords used for absorbing surplus mains voltage in midget AC/DC receivers.

"For the third time in five weeks I have been called in to attend to fire damage caused by American 'midget' AC/DC radio receivers. These sets are made for use only up to 250 V unipolar; to be on a 200 to 250 V supply necessitates a resistance to reduce the mains voltage.

"Until recently many of them were equipped with a two-core resistor cord, wired in series, with the leads of the valves, the idea being that as the resulting heat was dissipated along a relatively long cord, it was safer than utilising a small wire-wound resistance inside the cabinet. This arrangement has now been abandoned by American manufacturers in favour of compact 'resistor tubes,' resembling receiving valves, mounted on the chassis. The danger arises when a short-circuit takes place at the low-potential end of the resistor cord. The resistance wire is wound on a few strands of asbestos, and is enclosed by a thin layer of the same material wound spirally over it. This resistance element is enveloped in the same outer covering as the other stranded flexible conductor, and where it passes through the (usually) unbushed hole in the metal chassis, the rubber insulation often becomes defective, and the two conductors come into contact. As the resistance is fairly high, even a light fuse will not blow as a result of the fault, but instead the resistance wire becomes red-hot, and remains in this state for a considerable time—until the two red-hot ends meet near the wall socket outlet. I have seen many scorched and burnt carpets from this cause, and two more or less serious fires.

"The prevalent custom of fixing switch sockets in the head, which leaves access to the mains voltage of the exception of the fire, has been well demonstrated. When the switch terminals on the set are short-circuited, and a switch socket is provided for connection, then when the switch is found to be on the floor, the switch is turned off, and in most cases the cord is left alive. The remedy is quite simple. If the switch terminals on the set are short-circuited, and a switch socket is provided for connection, then when the switch is found to be on the floor, the switch is turned off, and it is lightly held by the users. If the switch is turned on, it is easily turned back to the main trouble can be eliminated.

The Wireless Industry

A LEAFLET describing the Premax "Rota-" a universal tunable for supporting beam aerial arrays, will be sent to interested readers by Holiday and Hemmerder, Ltd., 74-78, Hardman Street, Manchester 3.
TUNING INDICATORS

A single dial shows a tracing dial L for illuminating the indicator scale M and the ring electrode, which is kept at a fixed potential. During the interval between successive scannings, each mosaic cell builds up an individual charge equivalent to the light intensity of the corresponding part of the original picture. The sudden change of potential, brought about by the two scanning operations, liberates electrons from each mosaic cell a signal voltage representative of that particular part of the picture.

Where several control knobs are used for different purposes, each may be similarly fitted with an illuminating lamp for the associated dial. The advantage of the arrangement is that the lamp is centrally situated and takes up no valuable space. It is particularly suitable in cases where diffusion illumination is required, as, for instance, in flying by night.

Telefunken Gesellschaft für drahtlose Telegraphie m.b.H. Application date (Germany), October 20th, 1937. No. 504150.

TELEVISION TRANSMITTERS

The image of a picture to be televised is focused on one face of a double-sided mosaic screen mounted inside a cathode-ray tube. The screen is preferably made of a mesh of insulated wires, the interstices being filled with silver “rivets,” which are visible on both sides and coated with caesium. The face of the screen on which the image is projected is scanned by a stream of electrons from the gun of the cathode-ray tube. Each mosaic cell of the screen then emits electrons towards an adjacent ring electrode, which is kept at a fixed potential.

The other face of the screen is independently scanned by an intense beam of light, which again causes electrons from each mosaic cell to fall on to a second ring electrode, also kept at a fixed potential. Where several control knobs are used for different purposes, each may be similarly fitted with an illuminating lamp for the associated dial. The advantage of the arrangement is that the lamp is centrally situated and takes up no valuable space. It is particularly suitable in cases where diffusion illumination is required, as, for instance, in flying by night.

The drawing shows a magnetron valve M arranged for the reception of very short waves.

LOUD SPEAKER IMPROVEMENT

The modern type of flexible diaphragm is designed to do justice to the lower frequencies, but has so little natural stiffness or rigidity that it tends, when the loud speaker is mounted vertically, to “flop over” to one side or other. This displaces the speech-coil in the air-gap, so that it is no longer perfectly symmetrical.

The force of springs to correct this fault has not been favoured because it was thought that they must inevitably prevent the proper free movement of the speech coil. It has now been found, however, that this need not be so, if the springing is made sufficiently long. If this be done, it does not contribute to the con-

Spring-balanced LS diaphragm.

ETHERIC “WATCH DOG” DEVICE

It is sometimes convenient to know what transmissions are taking place, at any given time, over a certain range of wavelengths. The invention provides what may be termed a “watch dog” device, which constantly supervises the whole of a given band of frequencies and shows what stations are operating, and on what wavelength.

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<tr>
<td>0.05 microamps to 5 amperes.</td>
<td>0.0005 microamps to 1 ampere.</td>
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EDITORIAL

Broadcasting in Wartime
A General Survey

ANY further proof that may be needed of the fact that broadcasting has now become essential to our national life has been provided during the last week or two. Many who have hitherto regarded it as one of the first things that could be dispensed with would now consider it a real hardship to be deprived of access to a receiver.

Perhaps this accounts for the totally unexpected demand, approaching a minor boom, that has arisen since the outbreak of war for certain classes of sets—and by no means the least expensive ones. Although the receivers are probably being bought mainly for news-gathering, the closing down of other forms of entertainment has probably caused their purchasers to turn to broadcasting for relaxation.

Nothing can interrupt the national sport of B.B.C.-baiting, and so it is not surprising that the usual Press correspondence on the badness of news bulletins was in full swing within a few days of the outbreak of war. As the Corporation was at the time fully engaged in putting into effect plans made to ensure the continuance of its service in any eventuality, this criticism may be considered as premature; the wonder is that the main service was so effectively maintained through a period of intense strain.

New Technique Wanted

Although it is considered that this criticism was premature, we believe that the whole technique of news presentation must be revised to suit war-time conditions. It is hardly the function of this journal to discuss details, but, without suggesting that the methods of American broadcasting are suitable to the British mentality, we maintain that many useful lessons could be learned from the way that news has been handled by the great American network during the past few weeks. Many of our correspondents have expressed admiration of the service, and it is perhaps significant that contributors who usually confine themselves to the technicalities of wireless have been diverted into the technique of news presentation.

Time-saving Artifices

Transatlantic tempo may be too breathless for us, but there are several time-saving tricks that might be adopted here. Instead of the cumbersonsome “As was announced in earlier news bulletins” of the B.B.C., the brief “You know that...” of the American networks serves equally well as a warning that the item of news that is coming is not fresh. We might also adopt the idea of the “news analyst” who interprets the significance of the latest official communiques for the benefit of those who listen to American broadcasts.

Complaints have been voiced in Parliament that there is too much delay in giving us news of important happenings. That again is a matter with which this journal is not directly concerned, but we submit that the authorities should keep a close watch on foreign broadcasting with a view to considering whether there is any point in withholding from our own people an item of news that has already been transmitted from abroad, and so presumably has become known to our enemies. A still more important reason for keeping foreign stations under constant observation is that it may often become necessary to correct inaccurate reports without delay.
Scanning Coil Construction

By PAUL D. TYERS

MAKING THE DEFLECTING SYSTEM

These notes on scanning coil construction are based upon the results of much experimental work initiated with the object of determining suitable mass production methods. The suggestions put forward are modifications of the system adopted, so as to be suitable for individual construction without the use of expensive equipment.

This photograph shows a finished scanning coil assembly.

recommendation if such exists.

More than anything else, in the early days of television the bogy of scanning-coil construction was probably responsible for the long adherence to electrostatic tubes. Many designers considered that it was not an economic proposition to make a small quantity of all-magnetic receivers. Should any experimenter who is contemplating fixing up an all-magnetic receiver be tempted to listen to such heretic doctrine he may rest assured that for a negligible outlay he can make an entirely satisfactory set of coils.

Scanning coils can be divided into two groups, those for long tubes and those for the so-called short tubes. The shorter the tube the more difficult is it to make the coils, and the greater must be the care exercised in paying attention to small details. The short tube appears to have come to stay, and, therefore, most interest is likely to be in coils for it, but the experimenter who prefers the easier job should use a long tube. Other things being equal, the only disadvantage of the long tube is its length. Off-set against the extra few inches of tube neck is the advantage of an easily made set of coils, the use of less scanning power, smaller valves and the abolition of the iron yoke.

The first point to realise before making a coil is that when a current flows through a coil the field or deflecting force is at right angles to the windings. If, therefore, we want to deflect the cathode-ray beam uniformly any old roughly made coil badly aligned on the tube neck will obviously produce a distorted scan. We must aim at symmetry and some degree of precision. Winding up a pancake coil around a match box, and then trying to persuade it to assume the desired shape by bending with the fingers won’t get us very far, even if all the turns don’t fall into a jumbled mess.

Fig. 1 shows three coil forms. The first is what one might term the theoretical shape. It is simply a flat coil lying, of course, parallel with the plane in which the beam is to be deflected. Such a coil used with a short tube would require very high ampere-turns. The effective field is increased in practice by slightly bending the coil round the neck of the tube as shown in the second position, this being suitable for a long tube. The third position shows what is required for a short tube.

Coil Shape

This bending of the coil brings with it a number of conditions which have to be satisfied. A good indication of the general shape of the coil is given in Fig. 2. First of all it is necessary that what we may call the effective scanning portion is substantially rectangular. This applies to both halves. The two rectangles are parallel, thereby making the coil symmetrical. The rectangular form must be continued to the ends, the bend-over being at right angles. This applies particularly to the corners. A coil having the form shown in Fig. 3, while not only tending to give a technical scan, will give a distorted one which is far worse, since loss of scanning field can be compensated for by increasing the power, whereas a distorted field cannot be easily rectified.

Inspection of Fig. 4, which is a cross-section through a coil, shows that there is a marked difference between the scan mark. In any case, however, the writer has had experience of satisfactory coils for tubes made by three well-known manufacturers, and details of the exact sizes and number of turns employed are included. It should be pointed out that the sizes and turns have been determined by the writer, and they must not be considered as the manufacturers’ official
Scanning Coil Construction—
section and the bend-over. It is easy to see that if we wound a coil of uniform thickness and tried to bend it to the desired shape with a semi-circular bend-over, all the turns in the bend-over would require different lengths since they form a number of semi-circles of increasing radii. There are several methods of simplifying the problem by some form of pre-shaping carried out in the winding process, which really amounts to using a tapered or stepped former. Even when the coil is wound to the desired shape, when it comes off the winding mandrel much has yet to be done.

It is wound as a flat coil of varying thickness and has to finish as a most complicated form having precise dimensions. It is very obvious that some moulding or similar operation will have to be carried out. No doubt the necessity for winding to a special shape followed by a forming or moulding operation will give the impression that the construction of a scanning coil is about the last thing which the experimenter should attempt. However formidable the process may sound, it is actually exceptionally simple. No complicated or expensive machinery is necessary, and provided the experimenter has available a few simple tools and is prepared to spend more time making the necessary formers than in winding the actual coils all will be well.

In considering just what has to be done we cannot do better than refer to the shape of the finished coil shown in Fig. 2 and try to imagine what it would be like if squashed flat. The resultant shape would obviously be that which it should assume when it comes off the winding mandrel. Fig. 5(a) shows a pair of coils arranged round the tube neck. It will be noticed that the edges do not touch; the gap distance may well be of the order of one-quarter of an inch. Fig. 5(b) shows the appropriate shape of the coil as a flat development on half the tube neck. Assuming that we have been given the optimum coil length and width of the rectangle we can now determine the dimensions of the mandrel. Here we can fall into a trap which results in the production of a most irritating coil, one which is more or less the correct shape but has badly rounded corners or alternatively one which for an apparently inexplicable reason is much too small.

Dimensions

The really critical dimension is the inside window of the developed scan coil. Referring to Fig. 5 (c), if the peripheral distance L, between the inner edges of the rectangles is taken as the inside dimension for the developed coil former all would seem to be well. Actually, however, the coil has thickness, and when bent to the required shape a distance of L' is necessary. In addition, in order to bring about the necessary right-angle bend, and allow the rectangular scan portion to lie correctly on the tube neck, the length of the bend-over has to be greater than the distance L. It is better to err on the long side rather than the short, as any tightness will prevent the scan portion from lying correctly on the tube neck, and the coil will assume the shape of Fig. 6, which is disastrous.

Fig. 7 shows the arrangement of the winding mandrel, which should be built up in the following manner, using either metal or a hard close-grained wood. There are five main parts. First of all there is the core piece. The length is that of the peripheral distance plus the extra which is necessary as just explained. Actual dimensions are dealt with later in a table of suggested dimensions. The width is obviously equal to the length of the rectangular portion of the coil. The thickness is determined by a number of factors which really do not lie within the scope of the present article, as the thickness controls the number of turns. In practice it works out to something of the order of 2 millimetres. There is one very important point to remember when making the core piece. It is essential to give it a really good “draw” or taper. What is necessary is shown in an exaggerated form in Fig. 7(a). This is necessary to assist in removing the coil from the former when wound. If there is any tightness the inner turns will drag and the coil will be spoilt.

The next part is the bed, which consists of a flat piece of either metal or very close-grained hard wood. The width of this is equal to the width of the core, and the length is not critical so long as there is ample winding space. To the sides of the bed piece are fixed two taper pieces. These are approximately 45 degree fillets, and are best set back from the edge of the bed by about one thirty-second of an inch. Lastly, there is the cheek which is a flat plate, again made of metal or hard wood.

Unless several vital points are attended to in the construction of the winding jig, trouble will ensue. In the first place we have to spin the mandrel round exactly on the centre. If it is not centrally mounted, the winding tension tends to be unequal, and the resultant coil is asymmetrical. In the photograph showing one of the experimental mandrels used for making laboratory coils the mandrel has been provided with a central tube which fits conveniently into the coil winder, but any form of tube or spigot may be used to suit the winding means available. A small hand-drill clamped in a vice can be used perfectly successfully as a winding machine, in which case the mandrel should have a central spigot which should be as large as possible consistent with the size of the chuck.

The next point to observe is that the corners of the cheek, bed and core should have no sharp edges. Those on the inside
Scanning Coil Construction—
of the bed and cheek can be considerably rounded. In the case of the core, there must not be too much rounding. Sufficient smoothing to prevent cutting the inner turns is all that should be used.

In the mandrel illustrated in the photograph the core and cheek are held on studs, but it does not matter much how the assembly is held together so long as it is possible to remove the coil without difficulty. If desired the core can be permanently fitted to the bed.

It has been stated that it is essential to maintain the rectangular form of the active scanning portion, and it is obvious that a loose coil removed from the winding mandrel must be the most awkward thing imaginable to bend by hand into a complicated form and still maintain an accurate rectangular form. Once more a little constructional work in the manufacture of a bending or moulding jig will be amply repaid.

The following steps in the production of the final coil have been modified from the mass production system so as to be within the constructional scope of the experimenter. Briefly, the system is to bend the bunched up sides at right angles to the rectangular portions, and apply a fixative to the rectangular portions only, and when partially dry transfer the coil to a mould where the coil is finally formed to the desired shape.

As a fixative use can be made of either a cellulose varnish or a wax, in which case heat is necessary. For the construction of a single set of coils cellulose varnish is probably the most convenient. The solvent must not be acetone, which, although quick drying, attacks many insulating enamels used on the wire. Xylol is similarly best avoided, the best solvent being amyl acetate, which, although slower drying, is perfectly safe. A commercial cement such as Durofix thinned down with amyl acetate is very satisfactory and will hold the turns together with reasonable security.

(To be concluded.)

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**Advice to Inventors,** by K. Trevellay Hardman. Pp. 64. Published by Frederick Warne and Co., 1, Bedford Street, Strand, London, W.C.2. Price 2s.

**This book does not set out to tell the inventor how to fulfill the various formalities necessary to take out a patent. It is written from an entirely different angle, and explains the many pitfalls which beset the path of the inventor in the actual marketing of his invention, and gives a great deal of useful information concerning whom to approach and the better manner of doing it.**

**Lanchester's "Potted Logs,"** by F. W. Lanchester, LL.D., F.R.S. Parts I and II. This booklet comprises log tables in antilog form, the numbers being given to eight figures. Tables of both common and natural logarithms are included. Pp. 27. Published by Taylor and Francis, Ltd., Red Lion Court, Fleet Street, London, E.C.4. Price 2s.
Low-power Transmission
LONG RANGES ON ONE WATT
By W. OLIVER (G3XT)

EVIDENCE of a growing interest in low-power transmission is afforded by the fact that, of 169 British amateur stations with which the writer has been in contact during the past five months, over 50 were using well under ten watts, the lowest being half a watt. All these contacts were established on the 7 Mc/s band, using ultra-low power at G3XT, as the supply, up to the present, is derived solely from batteries, and rarely exceeds two watts. Most of the work at this station has been done with an input of one watt (10 mA at 100 volts), and a good many successful contacts have been maintained with the HT voltage still further reduced, bringing the input down to barely half a watt.

Mains supply will shortly be available at G3XT, but even then it is proposed to continue low-power experiments, as the results which these have yielded are of considerable interest and, in many cases, little short of amazing. It is felt that many more amateurs would experiment with low power if they fully realised its possibilities, and the purpose of the present article is to draw attention to these possibilities by giving a detailed analysis of the results obtained at this station. From the data available it should be easy for any amateur contemplating low-power work to form a fairly accurate idea of the results he can expect to get with an input of the order of 1 to 2 watts.

The consistency of the results obtained at G3XT over the five-month period under review, in widely varying conditions and always with a comparatively poor transmitting aerial at a location only 50 feet above sea level, seems completely to disprove generally accepted ideas and should remove any doubts in the minds of amateurs who are wondering whether low-power working is any good.

The 7-Mc/s band has lately been alternating a great deal between periods of what might be termed “deep depression,” in which conditions are so poor that scarcely any stations are audible, and periods of liveliness in which so many stations take advantage of the temporary good conditions that the band becomes congested with signals packed “three deep” on every available channel.

These difficult circumstances put low-power transmission to a severe test, and it is remarkable that, in the five months under review, communication was established with 217 different stations (42 Continental in addition to 169 British) using only a watt or two of power. A large proportion were worked more than once, and, in some cases, regular schedules were kept successfully; consequently the total number of contacts effected during this period amounts to three hundred and fifteen.

The reports on G3XT's signals received in the course of these 315 conversations are summarised concisely in the following table, which shows the comparative results at a glance.

In this table use is made of the Readability-Strength-Tone code employed by all amateurs, and usually known as the RST code. Only the R and S portion are actually shown in the table, tone being omitted. In this code signal strength is graduated from S1 ("just audible") to S9 ("extremely strong").

Using various factors such as interference and poor tone, readability does not bear any constant ratio to signal strength. In the RST code it is graduated from R1 (audible but unreadable) to R9 (readable without any difficulty). For the purpose of the above analysis in cases where more than one report was received when working a station, the lowest of the reports has been adopted for the analysis table. For example, in the case of signals reported RST 5 6/4 9 ("Perfectly readable, good signals, lacking to fair signals, purest D.C. note") the report is classified in the table under "Readability 5, Strength 4," the 4 representing the minimum signal during fades. Peak signals have also been ignored, e.g., if the report just quoted had been RST 5 4/6 9, indicating that the steady level of signal strength was S4, and that it occasionally "peaked" to S6, it would have been entered in the table as RST 5 4 9. The third figure in these examples refers to tone, which, as already mentioned, we are not taking into account in the table. It will be seen from this explanation that the table can be taken as giving a reliable indication of the consistent results obtained, all freak results and flukes due to temporary periods of exceptionally favourable conditions having been ignored.

It will be seen, from a study of the table, that the average strength report is a little over S5 ("fairly good signals"). Only one steady S9 ("extremely strong") report was received during the five months, although a transitory peak of strength of S9 was actually reached on several occasions, the reports in the analysis. The vast majority of the reports (105) were S5; then come S6 ("good signals") with 87 reports; S7 ("moderately strong signals") with 62 reports, and S4 ("fair signals") with 29 reports.

As regards readability, which is really more important for practical purposes than signal strength, it will be seen that the reports show a remarkably high standard. No doubt the tone of the CW note played an important part in securing this, since the beautifully clear T9 note of a crystal-controlled and battery-powered transmitter in 100 per cent. readable under conditions in which a rough note from a "chirpy" mains-operated transmitter of the electron-coupled oscillator type would be almost unintelligible.

"Perfectly Readable" Signals

A glance at the table shows that no fewer than 249 out of the 315 reports gave the readability as R5 ("Perfectly readable"). Now, there is obviously the possibility that a proportion of these reports might be more flattering than accurate. We are all familiar with the type of amateur who reports signals as being RST 59 without stopping to think, and adds to this assurance of "perfect readability" the naive request: "Pse rpt all, OM, I missed the lot."

To verify as far as possible the accuracy of the reports, therefore, the writer has gone carefully through the records of messages received, and as practically every CW message from each station worked has been written down and kept at G3XT, it has been possible to abstract much more information than is evident from the nominal reports alone. These records show quite definitely that a very high pro-
Low-power Transmission—
portion of the transmissions from G3XT have been received “100 per cent. solid copy” by the stations concerned.

It should, however, be frankly admitted that most of these “100 per cent. solid copy” reports have been given at times of the day when interference on the 7-Mc/s band is not at its height. Those amateurs whose working hours make it impossible for them to transmit except in the evenings or on Saturday afternoons and Sundays must not expect to get anything approaching the results indicated in this analysis. When conditions are good, and there are scores of stations active on the band, it is difficult to establish communication at all on ultra-low power during the peak hours of interference. But if conditions are poor and a great many stations have closed down to await an improvement in conditions, leaving the band comparatively clear, the ultra-low power transmitter—quite contrary to what one might expect—stands a much better chance of success. This brings us to a feature of outstanding interest in connection with the results obtained at G3XT.

500-mile Range

On many occasions communication has been maintained, with “solid copy” both ways, between G3XT and stations at distances ranging from 3 miles to 500 miles or more, under conditions so poor that the band seemed virtually “flat” and very few stations were audible at all. Two further facts regarding the 7-Mc/s band under these conditions are remarkable. In the first place the stations worked during periods of very poor conditions have been mostly low-power stations, and, secondly, when higher-powered stations have been audible their signal strength has often been no better—and occasionally worse!—than that of low-power transmitters at a similar distance.

Experience at G3XT has repeatedly shown that patient calling and careful searching at times when the band appears to be hopelessly “dead” will frequently be successful in “raising” a station, and that, once contact has been established, it can generally be maintained with “solid copy” in both directions for a long time, owing to the absence of interference. Admittedly, signals are weak under these “flat” conditions, but an S3 signal “in the clear,” with little or no fading and quiet background, is far more easily readable than an S7 or S8 signal under heavy interference from an over-modulated telephony station.

From the results obtained at G3XT it would certainly seem that the only real drawbacks to low-power transmission are that it is seldom able to hold its own against very heavy interference, and that signals from a low-power station suffer more from fading than those radiated by a higher-powered transmitter.

CW telegraphy was used in about 95 per cent. of the instances referred to in the analysis table. The remainder were telephony. In order to modulate adequately with an audio power which had been minimised to avoid overrunning the batteries, it was necessary to reduce the power-amplifier input to a lower value even than that used for CW work. With such low power the telephony was no match for heavy interference, but on a clear channel some surprisingly good results were obtained.

The transmitter used at G3XT for these experiments is as simple and straightforward as it well could be; it uses receiving-type valves in an ordinary, conventional crystal-oscillator power-amplifier circuit. A pentode (as in Fig. 1 (a)) and a super-power triode (Fig. 1 (b)) have been tried with success in the crystal oscillator stage, but for the power amplifier a super-power triode (arranged as in Fig. 2) has been used throughout the experiments.

For the occasional excursions into telephony a small battery-powered modulator was added; but the continuous current-drain from the batteries when working telephony means that this is not a paying proposition and, therefore, it is hardly worth while going into further details about the modulator here. When the triodes were used in both CO and PA stages, keying was done in the PA, leaving the CO running continuously so that it could be adjusted for maximum efficiency without risk of instability or a chirpy note.

Fig. 1.—Alternative use of pentode or triode in the crystal-oscillator stage.

Fig. 2.—Connections of the power amplifier stage.

If one is constructing a low-power transmitter to one’s own design, one’s aims should be: (a) to keep the wiring short and direct in parts of the circuit where this is important; (b) to arrange the layout of the circuit in such a way that there is no unwanted interaction (e.g., between the CO and PA stages, or between the CO and the aerial circuit—this latter form of interaction being liable to produce a spacer-wave if the keying is being done in the PA stage); (c) to achieve low-loss construction so as to conserve the limited energy consequent upon so small a margin of power.

As regards the inductance, capacity and resistance values for the various components, these do not seem to be very critical in practice, but there is, of course, an optimum value for a given set of conditions, and the nearer one can approach to this the better the results are likely to be. One can arrive at the optimum value by calculation or by practical experiment.

Broadly speaking, however, inductances which resonate at 7 Mc/s with 50 m-μfd. of capacity in circuit (i.e., a 0.0001 μfd. variable condenser half enmeshed in parallel) are found suitable for a power approximating to that used at G3XT. With regard to the fixed by-pass condensers, 0.002 μfd. is suitable for 7 Mc/s. The best value for the CO grid resistor with any particular oscillator valve can be found easily by practical experiment.

Particular care should be given to wiring and layout in the PA grid circuit, as it is easy to spoil results by, say, undue capacitance to earth at this point. A fixed or variable condenser (mica or air dielectric) with a maximum capacity of 0.0001 μfd.
Low-power Transmission—
can be used for the capacity-coupling be-
tween CO and PA, but the leads to it
should be short and well away from
earthed metal such as the chassis.

As to aerials, various well-known types
of transmitting antenna have been tried
at G3XT, but none of these so far has been
erected at a height exceeding 25 feet. A
simple 66-ft. aerial of the end-on type
adjusted to resonance, of course, proved
satisfactory, and was used for a while. As,
however, plenty of space is available here,
a full-wave antenna for 7 Mc/s was sub-
sequently erected and this (shown in Fig.
3) was employed during the greater part
of the period under review.

For reception a fairly low inverted-L
aerial (also shown in Fig. 3) has been used
throughout. Quite recently it was found
by chance that this is surprisingly effective
as a radiating antenna! With the full-
wave antenna lowered to the ground, and
the receiving aerial connected to the trans-
mitter, communication was effected with
various stations at distances up to five or
six hundred miles, and the signal-strength
reports were fully equal to those obtain-
able with the full-wave antenna.

It will be quite evident from a glance at
Fig. 3 that neither of these aerials as
erected at G3XT has any pretensions to
theoretical efficiency, yet it is equally ob-
vious, from the analysis of reports, that
they work surprisingly well in practice.

The results obtained would seem to dis-
prove the widely accepted idea that a high
and efficient aerial is essential to success in
low-power transmission.

**Wireless World**

**Model 40 “Avometer”**

**FORTY RANGES AND CIRCUIT
PROTECTION BY MEANS
OF A CUT-OUT**

**Fig. 3—Elevations and plan showing
general arrangement of transmitting (T)
and receiving (R) aerials.**

An automatic cut-out protects the move-
ment in the Model 40 “Avometer.”

external circuit as a precaution, by depress-
ing a button on the front panel which occu-
pies the same position as the fuse in the
earlier model.

In addition to the inertia control oper-
ates when the pointer is in an inter-
mediate position on the scale, the cut-out
is also brought into action by excursions
of the moving coil or pointer beyond the limit-
ing stops. Thus the meter is still fully pro-
tected if it is working near full-scale deflec-
tion or if DC of the wrong polarity is applied
when the pointer is at zero.

Of the four ranges which have been
added, two are for alternating current
(0-6 mA and 0-12 mA), and two for DC
voltage (0-240 v. and 0-480 v.). The 0-100,000
ohm range, for which external bat-
teries are required in the DC Avo-
meter, is operated

Self-contained bat-
teries are provided for resis-
tance readings up to 100,000 ohms.

The total resistance of the instrument is
200,000 ohms. A press button on the
centre of the front panel doubles the sensi-
tivity and is of great value in reading accu-
rately deflections on the normal ranges
which fall in the earlier part of the scale.

Each instrument is calibrated to B.S.
First Grade standards of accuracy, and the
meters magnets, which are of cobalt steel,
are aged before assembly.

The price of the Model 40 is 14 guineas,
and the makers are The Automatic Coil
Winder and Electrical Equipment Co., Ltd.,
Winder House, Douglas Street, London,
S.W.1. Leather carrying cases with handle
and shoulder strap are available, price 25s.
Wireless in the Tropics

WHERE LIGHTNING IS TREATED WITH SCANT RESPECT

It is with interest I have been listening on the short-wave programmes under British summer conditions, and comparing my personal tropical reception experiences over the last few years. As a result, the opinion has been formed that, even during thundery weather, conditions in British India are infinitely better than anything we ever come across in Malaya and the East Indies. The Dutch East Indies, our next-door neighbours, are one of the places where a large amount of atmospheric interference heard in other parts of the world originates.

It is a relatively common occurrence to have equipment damaged, not so much by direct lightning discharges hitting aerials, as by surges caused by strong induction in power lines. In fact, it is not unusual to find the aerial system undamaged after a receiver has been `struck' and the power end ruined.

Sparks from the Aerial

With a storm five or six miles away, it is often possible to draw sparks up to 60 ft. long from the aerial. It is interesting to watch them `build up' in strength until the tension is released by a lightning flash either from cloud to cloud, or cloud to earth. This game is not so dangerous as it appears, and yet carries an element of risk which makes it a practice not to be indulged in too frequently, and only if one has experience of the `habits' of one's local thundersstorms.

Some localities in the tropics are struck much more frequently than others, and the old adage that `lightning never strikes twice in the same place' does not hold, and it is common to find houses which are struck regularly two or three times a year during April or May—which is the worst time of year for electrical storms. A cure, which the writer has installed in several instances, and which it is claimed has been a complete cure in two cases, is the use of a high galvanised steel pole made of ordinary galvanised gas grade tubing (4 in. x 8 ft., 3 in. x 10 ft., 2 in. x 18 ft., and 1 1/2 in. x 18 ft.), making a pole, one end of which is in the ground about 4 to 6 feet, and between 60 and 70 feet high. The aerial is attached in the usual way to the top, but the presence of this earthed pole on the high ground near the house appears to take direct hits without damage, or to form a conductor which releases tension around the house to such an extent that charges do not build up sufficiently to form a flash. It should be mentioned that on estates the bungalows are usually on small hills, and may be two or three hundred feet above the surrounding country. The pole being higher still, has the effect of eliminating flashes or reducing their occurrence.

Inside Damage

Surges on power lines usually cause damage inside buildings by bursting bulbs, destroying switches and wiring, and similar action. Switch porcelains may be `powdered,' leaving all the brass connections hanging loose, and the opening of main switches is not enough protection, as the surge reaches, at times, sufficient strength to jump the gaps.

Lightning arresters of the surge absorber and also of the pellet type have proved very effective forms of protection against this type of damage, protecting the radio receiver, house wiring and all appliances such as cookers, geysers and irons, etc.

Damage by a direct hit naturally results in a different type of damage, and in no instance in the writer's experience was the radio receiver damaged when the aerial was struck.

Without detailing the several direct hits the writer investigated, it is sufficient to say that in each of four instances the flash or charge, after coming down the aerial, jumped to the building before reaching the receiver, and usually in the vicinity of the point where the aerial lead-in entered the house.

Electric Shock

The results here consisted of physical shock to the unfortunate inmates of the house—at least in each case the people claimed to have felt no ordinary electric shock—pictures knocked off adjacent walls, timber beams in the walls and floors split, weather boarding and floor boards shattered as by an internal explosion, cracks in brickwork pillars, and in one case a hole 18 in. was punched in an unreinforced concrete floor 4 in. thick.

The only effective protection which can be offered in this instance is the installation of a good type of arrester on the lead-in, and the use of a high steel aerial mast, properly earthed and bonded, and lightning conductors at all ridges and roof corners.

The question of lightning protection has only been treated from the private radio owner's viewpoint, but in a country like Malaya it is a serious problem for all electrical supply undertakings, as most of their supply lines are overhead, except in the centres of one or two of the larger towns. However, this does not come within the scope of this article.
Television Progress

REPORT OF THE OLYMPIA CONVENTION

LAST week reports were given of three of the conventions held during the Olympia Exhibition, and we now give the fourth and last. Dealing with the subject of television, it aroused considerable interest in view of the wide variety of problems which were discussed.

IN opening the 4th convention, dealing with television, the chairman, Mr. Barton-Chapple, said that research in television stands on the shoulders of the scientists of yesterday. Eleven years ago 30-line television was shown by Baird; it had developed greatly since then and the rate of progress had been accelerated in the last three or four years.

He then called on the first speaker, Mr. R. G. Clark, of Mullards, who stressed the fact that research is the backbone of television. He spoke of the value of intelligent observation by the public, and said that it must be realised that those engaged in television were creating a new system.

There was a fundamental difference between seeing and hearing by wireless, and television could not supplant ordinary broadcasting.

He felt that insufficient credit had been given to those engaged on the production side; the presentation of programmes was a new art, and important developments must be expected in the future.

On the technical side, Mr. Clark emphasised that the design of transmitter and receiver were closely interlinked, and that the most important matter was the question of definition. The standard was determined largely by the carrier frequency and the range of frequencies was limited. The use of a lower frequency would lead to trouble from interference and multiple images, and the definition would be lower.

A higher frequency would still present the multiple image problem and would give less range, while the generation of the necessary power would be very difficult, if not impossible. He concluded that the present standard represented the middle course between prudence and rashness, and this was confirmed by the fact that other countries have adopted similar standards.

Dealing with the problem of national coverage, Mr. Clark said that many transmitters would be needed even for a limited coverage, and that the provision of separate studios was not favoured on account of their cost. This left the possibility of linking the transmitters to a single studio either by H.F. cable or by U.H.F. radio links. The former was not simple, and its cost was high, while the latter were liable to interference.

On the receiving side the past year had been characterised by real engineering development. Until recently the number of valves needed had been prohibitive, but this had been solved by the production of special types which simplified receivers and gave them greater reliability. The CR tube, too, had been improved in every way—it was more compact, had a smaller and more uniform spot, had greater sensitivity, and a better screen of improved colour and higher luminosity.

Controls on receivers had been reduced to a minimum, and the operation was now simpler than that of a broadcast set. Mr. T. C. Macnamara, of the B.B.C., dealt with transmitting problems. Considerable improvement had been made in details in the last year, and the most important was the introduction of a second studio. This still gave inadequate space, but it greatly eased production problems, it doubled the time available for full-dress rehearsals, and it greatly eased matters in the case of a defect in studio equipment.

The provision of a central control room was also important, and was analogous to the dramatic control panel of sound broadcasting. It enabled one studio to be faded into the other, it allowed the superimposition of pictures, and by permitting fading between a studio and an outside broadcast it ironed out the flashes experienced in the early days. It had done more to increase the slickness of production than anything else.

Cameras had been improved; the Marconi-E.M.I. tubes gave better definition and contrast than a year ago, and their colour response was more consistent.

Studio lighting was better; much knowledge had been gained from the practice of film studios, but television had its own problems. The reason for bad lighting, which it admitted did occur at times, was inadequate time for full-dress rehearsals.

Outside Broadcasts

It was generally agreed that outside broadcasts were the most important, for there was no other visual medium with a completely topical flavour. The B.B.C. now had two O.B. units. One of the difficulties was that while three suitcases of apparatus might suffice for a sound outside broadcast, television needed four vans the size of large passenger motor coaches, and weighing 30-40 tons; a large amount of power was also needed.

Much work had been done to speed up

The central control room of the London television station which handles the outputs of the two studios as well as those coming from the O.B. vans whether by cable or radio link. The vision mixing desk and monitor are on the right with the sound mixing desk on the left and the production manager's desk in the centre.
Television Progress

Post Office telephone line. It was possible to use 1 to 4 miles of ordinary telephone line with a repeater every mile.

Referring to the range of Alexandra Palace, Mr. Macnamara said that it had been expected to be about 25 miles, but it had turned out to have a safe range of nearly 35 miles. Good reception had been obtained up to 70 miles. The range was limited by car-ignition interference. It could be said that if all cars were fitted with suppressors the range would be very greatly increased.

Ultra-High Frequencies

Mr. Owen Harries dealt with the possibility of using wavelengths below two metres. He stressed the need for new research on such wavelengths, both on their production and on their propagation. He felt that it would be found that there was no abrupt change of field strength at the horizon, and he did not think that with high power the range would prove unduly limited. The difficulty was to generate high power, and to the present only a few watts had been produced.

In America a method had been developed in which a beam of electrons in an applied field had a natural frequency and a negative resistance. The difficulty was that the wavelength depended on the voltage and current, and no one had yet shown a way of amplifying or modulating with such systems.

It was practicable to transmit very short waves down a metal tube with conductive walls, and by placing a horn at the end, reflections could be avoided. The system was reminiscent of a speaking tube and was highly directional.

Mr. Harries also referred to the possibilities of micro-waves in medical practice. They had been tried in Germany for anaesthesia, and were said to have no after-effects. An UHF field applied to the head resulted in unconsciousness which lasted as long as the field was applied.

The Chairman then declared the meeting open for discussion, and Mr. Davis expressed his conviction that the British television system was sound. The adoption of 405 lines was originally a bold decision which had been justified by events, and he did not think a change would be necessary for years to come. In the case of cinema television a greater number of lines would be desirable because of the direct comparison with films.

He was glad to see a movement away from the use of very small CR tubes, and he pleaded for greater standardisation of installation methods.

Mr. Lance expressed the view that more elaborate aerials and new circuits for ignition interference suppression would be the next developments. Dipoles had been used for years, but he hoped that something better might be found.

Mr. Barton-Chapple asked if it were possible to screen micro-waves adequately so that they would not prove dangerous to the engineers, and he also referred to the possibility of using vertically and horizontally polarised waves of the same frequency without mutual interference.

In reply Messrs. Clark, Macnamara, and Harries agreed that the screening of micro-waves was difficult. They did not feel that it would be possible to avoid interference between stations on the same wavelength by using vertical polarisation for one and horizontal for the other on account of the tilting of the wavefront. Tilt of 20 degrees had been measured on the Alexandra Palace signals.

September 14th, 1939.

Above Three Megacycles

Conditions on the Short-Wave Band

Though these notes are more closely concerned with the technicalities of short-wave propagation and reception than with the programme side, I cannot refrain from mentioning several broadcasts I have heard, and particularly one that stands out above all others of the many put over by the American networks during the few days prior to the fateful Sunday of September 3rd. The broadcast was that carried out by C.B.S. via W2XE on 17 Mc/s describing the evacuation of London school children from Waterloo. The outside broadcast director of the B.B.C., Mr. Joly de Lotbiniere, was the commentator, and some interviews were provided by the children, who came from one of the poorest parts of London, and one of their teachers.

There is no doubt that the Columbia Broadcasting System has given its listeners a remarkably complete coverage of European events during the past weeks. Not everybody will agree with the comments made by the C.B.S. news analyst, Elmer Davis, but the C.B.S. commentator in Berlin has done a good job of work. The standpoint of Columbia’s European director, Mr. Morrow, has been scrupulously correct throughout this historic period.

Interference from Tokyo

To return to technicalities, some interference with WNBI on 17.78 Mc/s from Tokyo, working on 17.75 Mc/s, has been noticed on some evenings from 10.30 p.m. onwards. GSG, Daventry, on 17.79 Mc/s, in general does not suffer at the moment since Tokyo JZL does not operate at times when a 17 Mc/s frequency is valuable for transmissions from this country.

On Sunday, September 3rd, both W2XE -WNBI and WGEA came on the air some time before their normal opening time and rebroadcast the Prime Minister’s time. Many other special broadcasts were also carried out by these stations during the day, including the King’s Broadcast and a talk from London by Cardinal Hinsley.

On Monday, September 4th, W2XE, on 17 Mc/s, did not really become a strong signal until noon, about one hour later than on Sunday, but as on the other days covered by this report, the waves have never been very good down to 13 metres, though no 11-metre signals have been heard.

President Roosevelt’s first neutral day proclamation was heard hot from the White House via W2XE again at 10.30 p.m. on Tuesday, September 5th.

On September 6th conditions began to deteriorate a little, but at 10.30 p.m. Buenos Aires did not get a signal — and this was still strong on phone to London on about 14 metres.

At the time of writing there is a distinct tendency toward conditions favouring the higher broadcast frequencies, and by the time these words are in print I expect that "very short wave" conditions will be prevailing. The 13-metre band will again come into its own.

So ends a memorable week’s listening.
MINISTRY OF INFORMATION

Wireless Personalities

It was announced by Sir Samuel Hearne, Lord Privy Seal, last Thursday, that the newly formed Ministry of Information was, with the exception of a few posts, now fully staffed.

It is organized in 14 divisions, gathered into four groups, the first dealing with news and Press relations and the censorship, the second with the application of publicity on a geographical basis, covering home, the Empire, U.S.A. and other foreign countries respectively. The third with the production of publicity in the form of films, wireless, literature and art, posters, advertisements, periodicals and pamphlets, etc., respectively, and the fourth with administration and co-ordination.

The Minister of Information, Lord Macmillan, is assisted by an A.D. and five directors, consisting of representatives of the several political parties, of the newspaper world and broadcasting, of business, of the Trades Union Congress and the Co-operative movement, and other general or particular interests.

Among those who have accepted the invitation to sit on the staff is Mr. F. W. Ogilvie and Lord Iliffe.

Mr. J. H. Brebner, who has for a number of years so successfully filled the post of Controller of Press Information and Publications at the G.P.O., has been appointed assistant director of the News and Press Relations Division, which comes under Group I.

The director of the Radio and Communications Division, which comes under Group III, has not yet been appointed. The post of deputy director has been filled by Mr. H. G. G. Welch, who was assistant secretary in charge of the overseas branch of the G.P.O., Telecommunications Dept.

WAR NEWS

American Commentaries

Mr. F. W. Ogilvie, Director-General of the B.B.C., in his broadcast to the United States last week, referred to the changes in British broadcasting since the outbreak of war.

After reference had been made to the fact that the B.B.C. was now transmitting on the short waves for nearly 22 hours out of the 24, Mr. Ogilvie said: "No doubt you are asking yourselves whether any restrictions have been placed upon the freedom of those who speak to you by radio from England. I can give you the answer. "There has to be, and there is, a bar against the disclosure by anyone—British, American, no matter whom—of military information which might be of value to the enemy. This applies not only to the radio, but to the Press and other forms of communication. Apart from that, those who speak to you from England enjoy the freedom of expression which they enjoy in peace time. And, not less important, no one makes suggestions to your speakers as to what they ought to say."

The U.S. President has announced that he is not at present considering the imposition of a news censorship in the States. The dissemination of news by wireless is considered to present a problem, especially when transmitted by short-wave broadcasting and amateur stations. It is pointed out by the Secretary to the President, Mr. Stephen Early, that these transmissions might prove to be a source of aid and comfort to belligerent powers and the establishment of some form of control might become essential.

This move is very probable, for at the moment listeners to the American international short-wave stations are certainly getting first-hand information of the situation in Europe. In fact, news of some happenings are heard from America before it is published in this Country.

C.B.S. and N.B.C. Schedules

The Columbia Broadcasting System, from its station W2XE, is giving three-point (London—Paris—Berlin) commentaries twice each day. The times of these bulletins (G.M.T.) and the frequencies on which they are broadcast are:

- Weekdays: 12.30-1.15 p.m., 7.30-8.15 p.m., 16.27 M/s.
- Sundays: 1-1.45 p.m., 17.15 M/s.

In addition to these three-point commentaries, two news bulletins from London are broadcast on Sundays. These are given at:

- 2.45-3 a.m. on 11.63 M/s.
- 10.30-11.15 p.m. on 15.27 M/s.

The regular English news bulletins from WNH (ex W3XK), the international short-wave station of the National Broadcasting Company, are radiated daily at 4 and 5 p.m. (G.M.T.) on 17.98 Mc/s beamed to Europe. These bulletins are being supplemented as the need arises and the time of the next bulletin is announced at the close of each.

AMATEUR STATIONS

Transmitters Confiscated

Within a few hours of its appearance on the air by the P.M.G. that all experimental transmitting licences had been withdrawn. Post Office engineers were calling at the addresses of licence holders to remove the apparatus.

In the case of three G3 or G4 stations brought to our notice, which have been licensed for a year or less, the P.O. has taken all transmitting equipment. In one case they carried out a search for spare components.

The engineers made no attempt at complete confiscation in the case of three larger and longer established amateur stations about which we have enquired. In these cases they have removed "token components" such as a crystal and rectifying valve, and relied on the good faith of the operator not to go on the air.

A receipt was given in each case for the apparatus which it is understood was removed to a safe place of storage.

VESSELS IN HARBOUR

Transmitters to be Sealed

The Postmaster-General gave notice last week that it had been considered expedient that the Government should have control over the transmission of messages by wireless telegraphy, and that the use of wireless telegraphy on board foreign ships while in territorial waters of Great Britain and Northern Ireland will be subject to rules made by the Admiralty.

On entering any port or harbour the WT office will be sealed by the customs officer boarding the vessel. Foreign vessels within territorial waters are to restrict the use of their apparatus as much as possible to avoid interference with essential communications.

THE BRITISH ASSOCIATION

Electron Optics and Television

Dr. V. K. Zworykin, the American inventor of the Iconoscope, addressed the Mathematical and Physical Sciences section of the British Association during the recent meeting at Dundee. He spoke on the recent advances in electron optics and television. The president of the Association, Mr. Robert S. Whipple, director of the Cambridge Scientific Instrument Company, in his presidential address, dealt with the sub-

N.B.C. LISTENING POST. News bulletins from London, Paris, Berlin and other centres of war activity are tuned in by these N.B.C. engineers in the news room. Some are re-broadcast and others are used in the news summaries which are now so popular with listeners in Europe.
News of the Week—

ject of instruments in science and industry.

In order to give a television demonstration, Mr. A. B. Howe, of the B.C.C., used a transmitter and receiver. He explained that as Dundee was so far from London, he could not, of course, produce the high-definition pictures which were provided in the Alexandra Palace service, although the results with the demonstration apparatus were at least comparable. Mr. Howe, with the aid of lantern slides, described the three methods employed for linking the O.B. units with Alexandra Palace, i.e., short-wave radio, balanced cable and combined balance cable and telephone line.

B.C.C. FOREIGN NEWS BULLETINS

Daily Broadcasts in Eleven Tongues

WITH the inauguration last Thursday evening of news bulletins in Polish, the B.C.C. is now broadcasting nine foreign languages daily in its short-wave service for overseas reception.

The nine languages, in effect, mean working in eleven different tongues as the idiom and accent used in Spanish for Spain, and Portuguese for Portugal, are very different from those required for the Spanish and Portuguese broadcasts for Latin America.

The languages in which news bulletins are now broadcast daily are:—African, Arabic, French, German, Italian, Magy, Polish, Portuguese and Spanish.

The daily African service commenced last Sunday week and the bulletins in Magyar for Hungary on September 5th.

THE POLYTECHNIC

The radio and television engineering courses at the Polytechnic for the session 1939-40, which commences on September 25th, have been arranged to give students a thorough training in the principles and technique of high-frequency engineering. The courses, which extend over a period of five years, will include — electrical technology, alternating current circuit, radio engineering, alternating current measurements, design of radio apparatus, wave propagation and reception and electro-acoustics.

A two-year course on servicing has been arranged, co-operated with the Gramophone Company and E.M.I. Service. Enrolment begins on September 18th at 307-311, Regent Street, London, W.1, where further details may be obtained.

THE ELECTRONIC ORCHESTRA. All the instruments in the string section of this orchestra, which is regularly heard over the N.B.C. red network, are without soundboards. The vibrations of the strings are conveyed to the loudspeakers in each music stand after passing through the control panel which is operated by the conductor.

DEDICATED TO ENLIGHTENMENT

American Non-commercial S.W. Station

THE short-wave broadcasting station of the World Wide Broadcasting Foundation, at Boston, Massachusetts, U.S.A., has, like all international S.W. stations in the States, had its call sign changed. Instead of WAXL it is now WSLR. This station, which has a power of 20 kW, broadcasts on three frequencies—6.04, 11.79 and 15.13 Mc/s. The European and Latin American coverage of the station is being enlarged by the erection of diamond aerials within a few hundred yards of the shore of the Atlantic Ocean. These will also be used by WSLR’s associate transmitter, which, when it is brought into use later this month, will also have a new call sign. Dedicated to enlightenment, the station is operated for peace rather than for profit. It is understood that the autumn programmes, which are now being arranged, will include a special course on radio and television. Details of the World Wide Broadcasting Foundation can be obtained from Station WSLR, University Club, Boston, Mass., U.S.A.

PHOTOTELEGRAPHY

IT has been decided to stop the transmission of photos by wireless. This decision was announced by the Ministry of Information last week.

Ordinary Press photographs may at present be sent by cable and are to be previously censored by the censorship division of the Ministry of Information, to which they will be referred if necessary by the Post Office and cable companies concerned. Only untouched-up photographs are permitted.

RECEIVERS CONFINED

IT was announced last week that a decreed had been promulgated by the German Government empowering the confiscation of all sets capable of receiving foreign stations. The “People’s Set,” of course, was not included in this order. It will be remembered that when discussing the receiver in The Wireless World some months ago, it was stated that this detector-LF set is inherently unsatisfactory, but with dexterous handling of the controls—especially reaction—it is possible to receive foreign stations provided one is not too close to the local transmitter.

EMERGENCY ADDRESSES

MANY radio manufacturers and associations have moved their offices to places of safety in the country. Below are some of the emergency addresses to which correspondence should be addressed.

British Insulated Cables, Ltd., Palmers House, Colamb, Surrey. (Tel.: Colham 2948.)
Gramophone Co., Ltd., Blyth Road, Clapham, London, S.W.7. (Tel.: Southall 2468.)
Mayoress-Eves Instruments, Ltd., Knoll Cottages, Gills Hill, Radlett, Herts. (Tel.: Radlett 621.)
Philips Lamps, Ltd., Clevedon, Cleve Road, Goring, Reading. (Tel.: Beading 298.)
Radio Manufacturers’ Association, 11, Riverdale Gardens, Twickenham, Middlesex. (Tel.: Popesgrove 1747.)
British Radio Valve Manufacturers’ Association, 1, Frogmore Road, Sutton, Surrey. (Tel.: Vignall 2632.)

FROM ALL QUARTERS

Standard Frequency Transmissions

The National Physical Laboratory has announced that the transmission of all standard frequency signals from the N.P.L. station 6S1HW is suspended.

Bristol Radio Exhibition

Like many other functions, the Bristol Radio Exhibition, which was to have been held at the Coliseum from September 6th to 16th, has been cancelled.

No Change

The appointment of the War Cabinet did not bring about any changes in the control of Postmaster-General, which is retained by Major G. C. Tryon, and Assistant P.M.G., which is held by Mr. W. H. L. Haslam, who was appointed in May to succeed Sir Walter Womersley, who is now Minister of Pensions.

I.M.E.

The Institution of Mechanical Engineers is carrying on the bulk of its work at a temporary address in the country—The Monument, Betchworth, Surrey (telephone: Betchworth 63)—but the Institution building in Storey’s Gate will remain open, possibly during restricted hours, for dealing with personal inquiries and for members or others wishing to make use of the library.

The Television Society

The present state of affairs has necessarily led to the temporary suspension of lecture arrangements and other activities of The Television Society. The Society’s library is remaining open in the daytime and also in the evening after the lectures. A R.P. Alteration has been carried out.

Director of Indian Broadcasting

Mr. Lionel Fielden, the director of All-India Radio, is returning to England on medical advice. Mr. Stuart Ball, the assistant director, is in command whilst Mr. Fielden is away.

News in India

The scheme for the centralisation of the news bulletins broadcast by the stations of All-India Radio is expected to be completed by next April. News broadcast from Delhi will then be relayed by all A.I.R. stations.

Red Cross and St. John Joint Appeal

In the grave issues which now confront the British Empire, the British Red Cross Society, of which H.M. The Queen is President, and the Order of St. John, of which H.R.H. the Duke of Gloucester is Grand Prior, have decided to work together as they did in the Great War with results which are still within the memory of the public. With this object a weekly appeal for funds has now been set up, comprising an equal number of members of each body. Considerable voluntary help has already been secured, but it is feared that the necessary funds have not been raised for the pursuance of the work, and a special appeal has been launched by the Duke of Gloucester.
Interference from Electric Razors

ITS NATURE AND CURE

The cutting heads of electric razors which give rise to radio interference are driven by either a commutator, or interrupter motor. The interrupter motor is probably sufficiently unusual to merit a description of its essential features.

Referring to Fig. 1, AB is a dumb-bell shaped soft iron armature placed between the two poles of a horseshoe electromagnet. The electro-magnet is energised from the mains by two magnet coils in series through a pair of contact points P, which are made to open and close by means of a cam on the armature shaft. When the axis of the armature lies along the dotted line X—X the contact points P close, and the magnet is energised by the current which flows through the magnet coils. Since the armature is composed of soft iron, the ends of the armature are attracted to the poles of the magnet to which they are nearest, irrespective of the polarity of the magnet, and if the force of attraction is sufficient the armature turns in a clockwise direction shown by the two curved arrows.

Continuous Rotation

When the armature reaches the position indicated by the dotted line Y—Y the contacts P open, and the torque tending to rotate the armature disappears, since the magnet is now de-energised. However, in rotating from position X—X to position Y—Y the armature acquires sufficient momentum to continue its rotation until it again coincides with X—X and the contacts P close again, the armature receives a further impulse, and the cycle of operations is repeated indefinitely so long as the mains supply is left switched on.

Each time the contacts open they have to break the full current passing through the coils, and as the inductance of the coils tends to maintain the flow of current after the contacts have opened, intense sparking takes place at the points until the current finally reaches zero. To reduce this sparking, and the burning away of the points which it causes, a small condenser C is usually fitted across the contacts. With the commutator type of motor, on the other hand, only slight sparking occurs if the commutator and brushes are in good condition and properly adjusted.

In general, therefore, it was expected that the interference produced by interrupter motors would be more intense than that produced by commutator motors.

Preliminary tests with electric dry shavers employing both types of motor confirmed this view, and showed that the interference from interrupter-driven shavers—which, unfortunately, are the most common—is particularly virulent and obnoxious, and often completely drowns even very strong stations. The interference from shavers driven with commutator motors is less serious, but still warrants suppression.

The preliminary tests also revealed that the interference radiated directly on the medium and long wavebands is small, and becomes negligible a few yards away from the shaver. The major part of the interference experienced is undoubtedly mains borne, and gains access to the set by re-radiation from the house wiring onto the aerial of the receiving set. With mains-operated sets the interference may also enter by way of the mains transformer.

Before describing the tests in detail it should be mentioned that they were carried out in accordance with the regulations of the British Standards Institution. These are not generally considered to be over-exacting, and specify that the magnitude of the symmetrical and asymmetrical components of the interference-producing voltages under measurement must not exceed 500 microvolts at any wavelength from 200 metres and 1,500 metres. By the symmetrical component is meant the radio-frequency interference voltage which appears directly across the terminals of the appliance, and by the asymmetrical component the voltage which appears between earth and the two mains in parallel.

Fig. 2 shows symmetrical components of interference produced by interrupter and commutator type razors respectively, the interference being measured in both cases at the terminals of the mains plug supplying the razors. It will be seen that, while the maximum interference from the commutator type of razor does not exceed 1,000 microvolts over the waveband 200 to 2,000 metres, that from the interrupter type of razor reaches a value of no less than 30,000 microvolts over the same waveband.

By J. E. M. COOMBES, B.Sc. (Eng.)

LETTERS in our correspondence columns have emphasised the severe interference to radio reception which is being caused by the increasing use and popularity of electric razors. The present article describes experiments made to determine the extent and nature of the interference produced, and the relative effectiveness (on the normal broadcasting wavebands) of the various methods of suppression.

Fig. 2.—Typical symmetrical components of radio interference voltage over the medium and long broadcast wavebands produced by razors fitted with interrupter and commutator motors.
Interference from Electric Razors—

Fig. 3 shows corresponding curves for the asymmetrical components of interference produced. The interference is well below 500 microvolts in both cases, and is probably to be explained by the very low capacity to earth of the frames of the motors.

The interference experienced from interruptr type razors appears to depend upon a number of variable factors. Among these may be mentioned the type of mains used, i.e., AC or DC, the instant and rate at which the contact points open, the length of time during which they remain open, and if the points are at all pitted or burnt away.

Ineffective Shunt Condensers

Experiments with and without various values of condensers connected across the contact points show that while connection of the condenser results in a reduction of the visible sparking it brings about little change in the radio interference produced. Moreover, under certain conditions, it actually causes a considerable increase in the interference, as will be shown later.

Fig. 3.—Typical asymmetrical components of interference voltage from interrupter and commutator motor razors.

Fig. 4 shows the effect upon the symmetrical component of the interference by fitting various values of condensers across the mains at the supply plug to the razor. As will be seen, a useful degree of suppression is obtained, which increases as the value of condenser is increased. It is also interesting to notice that the degree of suppression with any one value of condenser increases as the wavelength decreases. This, of course, is to be expected, since the reactance of a condenser decreases with increasing frequency. However, no measurable increase of suppression is obtained on raising the value of the condenser above 0.5 mfd., and as the general level of interference is then still about 1,000 microvolts, this method of suppression by itself is clearly insufficient.

Tests were next made with choke coils connected in series with each of the mains leads at the power plug supplying the razor. It was considered reasonable to expect that the use of choke coils of suitable inductance and self-capacity would result in a fair degree of suppression over the whole of the medium and long wavebands. Actual experiment, however, showed that this was far from being the case, and that the interference was actually increased at certain wavelengths with the choke coils connected.

Curve A of Fig. 5 shows the symmetrical component of interference obtained from the razor without suppression and with the condenser normally fitted across the contact points disconnected. Curve B shows the interference obtained with the addition of 800-microhenry choke coils connected in series with each of the mains leads. It will be seen that although there is a reduction of interference below 700 metres there is a considerable increase of interference at wavelengths above. A distinct maximum of interference occurs at 900 metres, and the RF voltage generated is then some 25,000 microvolts greater than at the same wavelength with the choke coils disconnected.

The reason for this behaviour was not at first obvious, but on investigation it was found to be caused by resonance between the choke coils and the capacity between the moulded rubber flexible leads which exists between the razor and the power plug. Referring to Fig. 6, Z1 represents the periphery impedance of the razor, and V1 the radio frequency voltage which appears across Z1. The flexible leads between the razor and the power plug are represented by ab and cd, and the capacity between them by the condenser C. L1 and L2 represent the choke coils in series with each mains lead, and Z2 is the radio frequency input impedance presented by the mains. It will be seen that the capacity C is in parallel with the inductances L1 and L2 and the mains impedance Z2, and they therefore form a parallel resonant circuit. At resonance the current circulating in the two branches of the circuit will be limited only by the total resistance, and may be many times the current in the leads ab and cd. The voltage V2 which appears across the mains impedance Z2 as a result of this current will thus be very large, and may exceed the applied voltage V1.

Altering Resonant Wavelength

If the value of C is increased by connecting fixed condensers in parallel with the flexible leads at points b and d in Fig. 6, the wavelength at which resonance occurs increases, and the peaks of interference obtained are reduced. If the condenser values are altered, the peak at the resonance wavelength will shift, but the maximum value of interference will remain almost the same. Condenser capacities: Curve B, nil; C, 0.004 mfd.; D, 0.005 mfd.; E, 0.01; F, 0.1 mfd.
Interference from Electric Razors—

Interference move to the right-hand side of Fig. 5. (Compare curves B and C.) With larger values of capacity the resonant wavelength occurs above 2,000 metres, and the effect of resonance upon the interference obtained reveals itself only by a gradual increase in the interference level as the wavelength is increased up to 2,000 metres (curves D and E). Moreover, as the choke coils become increasingly effective, the general level of interference falls, and the degree of suppression obtained between 200 and 2,000 metres increases.

With a condenser value of 0.1 mfd., the curve becomes sensibly horizontal, and at no point does the interference exceed 50 microvolts. This degree of suppression is very good indeed, and should be adequate in the most exacting circumstances. On a sensitive receiver using an indoor aerial in the same room as the razor no trace of interference could be detected anywhere on the medium and long broadcast wavebands.

A useful feature of the arrangement is that it can be used with any make of interrupter type razor with equally good results, for changes in the capacity of the flexible leads or motor will be negligible compared with a condenser value of 0.1 microfarads. For the benefit of readers who may wish to try out a filter on these lines instructions for winding the choke coils are given at the end of this article.

From the preceding discussion it is now possible to explain why, as mentioned earlier on, the fitting of a condenser across the contact points of an interrupter type of motor often causes an increase in the radio interference experienced, despite the fact that it reduces the visible sparking which occurs.

Referring to Fig. 1, it will be realised that the condenser C is in parallel with the magnet coils and the RF impedance of the mains in precisely the same way as the capacity of the flexible leads and choke coils described above. Thus, if the resonant wavelength occurs in, or near to, the normal broadcast wavebands a considerable increase in the interference experienced may occur.

The usual value of condenser fitted across the contact points is about 0.0003 microfarads, and as it is not desirable to omit the condenser completely, the obvious course is to fit a condenser of 0.01 to 0.1 microfarads and so raise the resonant wavelength well above 2,000 metres. Unfortunately, this usually results in the motor slowing down, and either the motor must be designed to give a resonant wavelength well outside the broadcast wavebands with the usual value of condenser, or it must provide sufficient torque to maintain the speed with a larger value of condenser. In both cases the problem is one for the manufacturers, and in the meantime the filter described above should give an adequate degree of suppression with all existing models of interrupter type razors.

Due to the smaller level of interference produced by the commutator-motor type of razor it was found that adequate suppression can usually be obtained by connecting a condenser of about 0.1 microfarads across the mains at the power plug, or preferably, directly across the brushes themselves if room can be found for the condenser inside the case of the razor. As the interference produced depends very much upon the condition of the brushes and commutator they must be inspected periodically and always kept perfectly clean. Also the interference experienced varies considerably with different samples of the same model of razor, so that it may not always prove possible to suppress the interference sufficiently in this way. In such cases the filter described above for use with interrupter type razors may be used, and should always prove satisfactory.

APPENDIX.

Details of 800-microhenry choke coils:—

<table>
<thead>
<tr>
<th>Diameter of former</th>
<th>Length of former</th>
<th>Wire (enamelled)</th>
<th>Number of turns</th>
<th>Approximate winding length</th>
<th>D.C. resistance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.5 inches</td>
<td>2.5 inches</td>
<td>32 S.W.G.</td>
<td>200</td>
<td>2 inches</td>
<td>6.9 ohms</td>
</tr>
</tbody>
</table>

Dear Henry,

I have not been quite satisfied with the quality of reproduction from my receiver, and cannot, at the moment, afford a new one. But I have read a good deal about the merits of negative feedback in this respect, especially where pentodes are concerned. To my joy I learned that it was possible to introduce negative feedback without spending anything on extra components; in fact, one is removed, namely, the condenser shown dotted in the enclosed circuit diagram of the output end of the set. My joy lasted only until I tried it, for quality is worse instead of better! I was afraid the idea was too good to be true.

If negative feedback really can improve pentode quality, will you tell me what is wrong?

Yours sincerely,

Philip Cowe.

Henry Farrad’s suggestions are on page 263.
**Random Radiations**

*By “DIALLIST”*

Battery Hoarding

ONE would have thought that those who indulged in panic buying of wireless and other dry batteries during the crisis of a year ago would have developed the proverbial double shyness of the once bitten. If you remember, some of them bought HTB’s by the dozen with the idea of being assured of a supply for two or three years to come. Such tendencies might get you into trouble at a heavy loss or to cast them into dustbins, useless but unused. The guaranteed shelf life of most radio HTB’s is, I believe, but three months, though good ones will be in excellent order after a very much longer time than that. Still, no dry HTB lasts for ever, even if it isn’t used. Well, much the same kind of battery hoarding apparently occurred, at the beginning of this month. My HTB was showing signs of old age on the 3rd, so I went into a largish near-by town for a new one of the standard 120-volt type. To my astonishment I heard that not a single dry battery of any kind—flashlamp or wireless—was left in the shops. I only hope that the one that ought to have come my modest way goes stale on the hoarder who probably bought it as one of a dozen.

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**The Pity On’t**

SOME time ago I remember reading in *The Wireless World* an article seeking to show that wireless could be one of the most potent factors in preventing war. It might indeed have been, for before it began to be devoted so largely to the most undesirable kind of propaganda, there were distinct signs that international broadcasting, particularly on the short waves was tending to make the nations understand one another better; and if understanding ever does mean pardoning everything, it does anyhow go a long way. You cease to regard the other fellow as so complete a foreigner when you can bring his voice and the entertainments he makes, right into your room by a twist of the knob. But for a long while now wireless has not been allowed to make for peace. Stations have been jammed regularly and deliberately. Lying and propagandistic propaganda broadcasts have poisoned the ether. People in certain countries have been forbidden to listen to stations in other lands. The pity of it! Wireless could have done so much to promote understanding and stability; it has been put to the debased uses of promoting misunderstanding and instability.

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**A Magician**

At the village inn in which I’m billeted at this moment there is a battery set of good make, and by two years old. Soon thereafter such weird noises as came from it when the landlord switched on to give us the news bulletin on the evening of our arrival. The thing was a superhet and it was tuned by such high off resonance that makes superfets give of their very worst. Agonised, I made a bound for the tuning knob and was about to give it the necessary tweak, when the landlord begged me not to upset the adjustment he had so carefully made; the set, he assured me, was tuned just right.” He yielded at length to my entreaties. I helped the announcer to get rid of a mouthful of potatoes—not just the usual one—and turned down the volume till the output valve wasn’t overloaded, and asked how that would do. Apparently he now regards me as some kind of magician, who can make his wireless set do the impossible. At any rate, he says that he didn’t know that wireless could be like that!

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**Quality!**

A LONDON reader sends me an account of a little incident which goes to confirm what I’ve said more than once in these notes—that many folk are content with vile quality of reproduction from their wireless sets and know not that anything better can be obtained. This reader was recently in a cinema, seated just in front of a mother with a kid who showed that there will be the usual intelligent interest in the feature film, whose sound accomplishment was of a very high order of quality. After this film there was a “fill-in” from the Gramophone record, very poorly reproduced. “Listen, Mummy,” said the infant, “that’s the wireless.” Yes. I know lots of sets that sound like that.

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**Whilst the Going is Good**

It wouldn’t surprise me very much if some of this year’s models, as seen at Olympia, are soon at a premium. Many radio manufacturers have been doing a great deal of work for the various Services for a long time now, and in the present circumstances it’s likely that they’ll be doing much more. If, therefore, in your mind that you need a new set, it would be no bad thing to be after it whilst the going is still good. I don’t mean that there is likely to be any kind of famine in wireless sets; it’s most improbable that there will be anything of the sort, at any rate so far as the smaller sets are concerned. But prices may rise, and it may take some time to get delivery if you postpone your order too long. In these times you can’t afford to be without a wireless set, wherever you live; it keeps you in touch with the news, for which we are all athirst, and supplies entertainment, which is sadly lacking now that theatres, cinemas, and so on, are closed.

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**No Restriction on Receiving**

SOME people thought that one of the first regulations to be made on the outbreak of war would be for the revocation of receiving licences and the confiscation of all wireless sets. I can’t think why. The more receivers there are in use the better able are the authorities to keep in touch with the population and keep them in the loop when they want to make important announcements. The use of these sets is, therefore, sure to be encouraged rather than otherwise. Transmitting sets are, of course, on a different footing; but so many amateur transmitters have joined the Wireless Reserve or are busily employed in other helpful ways that restrictions on the use of these won’t cause great hardship. By the way, those who talked about the canaries in wireless sets can’t have given much thought to the problem of storage. You can amuse yourself by working out just how much accommodation would be needed to house, closely packed, the receivers in use in this country!

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**Ample Juice**

SOME may be tempted by the cutting down of the amount of current to 75 per cent. of last year’s requirements to go in for sets with a small number of valves. Or should I put it that they may hesitate to invest in receivers with a higher loading than those that they have at present? I don’t think there’s any need to worry. Seventy-five per cent. of last year’s kilowatt-hours is quite a generous allowance, for usually it’s easy to save 25 per cent. on one’s lighting, at any rate with a few A.K.P. and the lighting regulations will automatically take care of a good deal of it. And most of us use unnecessarily bright lights in the hall, the passages, the bathroom, etc., etc. On.

When I went over my lights before leaving for “somewhere in England,” I found that I could substitute “seventy-fives” for “hundreds,” “singles” for “seventy-fives,” “forties” for “sixties,” and so on, in many places without making things too gloomy. And don’t forget the ten-watt lamp, which will often give light enough in places where “twenty-fives” are normally used. A little juggling with the lights will most likely leave you an ample reserve for running a receiver with quite a lot of valves.

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**News from the Clubs**

**Uxbridge and District Shortwave Club**

Headquarters: 61, High Street, Uxbridge, Middx.

Hon. Sec.: Mr. C. J. Bayley, 61, High Street, Uxbridge, Middx.

*Shortwave listeners in Uxbridge and district who are interested in the affairs of the society are asked to get in touch with the hon. sec. This club is affiliated to those given in our Directory of Radio Societies, which was published in our issue dated April.*

**Edgware Shortwave Society**

*Constitutional Club, Edgware, Middx.*

Meetings: Wednesdays, at 8 p.m.

Hon. Sec.: Mr. F. E. Bell, 119, Colson Crescent, Hendon, London, N.W.5.

The post month has been devoted to lectures given by members concerning their equipment.

**Slosh and District Shortwave Club**

Headquarters: 35, High Street, Slosh, Bucks.

Meetings: Alternate Thursdays, at 8 p.m.

Hon. Sec.: Mr. K. A. Sly, 16, Rockland Avenue, Slosh, Bucks.

*At the last meeting Mr. Bayley gave a talk on “Test Equipment.” He was followed by Mr. Housden, who lectured on “The Theory and Construction of a Milliwatt Transmitter.” Mr. Sly held that discussion of Models should be held at each meeting.*

**Watford and District Radio and Television Society**

*Parlour at Carlton Tea Rooms, 77, Queen’s Road, Watford, Herts.*

Meetings: Alternate M:T, 9 p.m., Nightsdale Road, Watford, E. Herts.

*Mr. N. Salmon lectured on “Radio Activities in Corn- wall” at the last meeting. Mr. P. G. Spencer followed him with a dissertation on the broadcast services and the next meeting will be held at 9 p.m. on September 16th.*
**Recent Inventions**

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

**DF BEAMS**

When transmitting a pair of radio beams which overlap along a given line, so that a pilot hears a continuous signal so long as he keeps to that line, it is found difficult to avoid the production of secondary lobes or beams, of less strength than the primary beams. These secondary beams extend to the rear of the main beams, but since they also overlap, they, too, produce lines along which signals will be heard. Should a pilot happen to fly into this region, he may be led to think that he is flying along the true course whereas, in fact, he is not.

In order to avoid this danger, the beacon transmitter is made to radiate a circular field, which is of sufficient radius to include any false courses formed by secondary lobes of radiation, though not of sufficient range to cover the main beams. This circular field produces in the receiving set an AVC voltage which is used to prevent any false signals due to the short-range secondary lobes from being heard.

_Reader's Wireless Telegraph Co., Ltd., and G. S. Cockerell._ Application date October 25th, 1937. No. 504,144.

**CATHODE-RAY STORING DEVICE**

The figure shows a cathode-ray tube which is designed to store an incoming signal before reproducing it. The tube is fitted with two guns G and G1, located at each end, the electron beams so produced being arranged to move over the two opposite faces of a central screen S. The latter acts as a storing device for a period which is determined by introducing a phase difference between the timing applied to the different sets of deflecting plates D and D1 from a common source X.

The incoming signals are applied to the control grid of the gun G and charge up a series of small condenser elements formed of metallic plugs P (see inset diagram) set in an insulating disc D on the screen S. The plugs co-act with an outer metal ring Pt, which serves as a common condenser plate. The electron beam is given a circular movement by the voltages supplied to the deflector plates D from the source X.

The beam from the gun G1 collects the signals by discharging each of the small condensers P. Pt, in turn, from the opposite face of the screen, the discharge impulses being passed via a load resistance R to an amplifier V. The delay between the recording of the signals by the beam from the gun G, and their collection or reproduction by the gun G1, is controlled by the phase-shift introduced at M in the scanning voltages applied by the source X to the deflector plates D. 

_Standard Telephones' and Cables, Ltd. (assignees of R. R. Riess and H. S. Wetzl)._ Convention date (U.S.A.), May 29th, 1937. No. 501,179.

**ELECTRON MULTIPLIERS**

An electron multiplier is fitted with a special form of target electrode which is permeable to the electron stream. It is made of a metallic film, of the order of a millionth of a centimetre in thickness, which is supported on a mesh or grid structure, the spacing of the mesh being sufficiently fine to make a firm foundation for the film.

When electrons impinge on one side of the film, secondary electrons are emitted from the other side, and pass on to a second target electrode, where a similar action takes place. As used in television, an image of the picture is projected on to a photo-sensitive cathode, and the electrons emitted from the latter are passed in succession through a series of these target electrodes until they reach a luminescent screen, where they produce a brighter image than the owing to the amplifying effect of the secondary emission at each of the intermediate targets.

_J. D. McGee._ Application dates October 28th and December 7th, 1937. No. 504,927.

**AVOIDING INTERFERENCE BY DETUNING**

When receiving stations which are subject to severe interference, it is possible to misplace the set slightly to one side or other of the carrier wave, and to select either set of side-bands according to which shows the greater freedom from interference. It is possible for this operation to be controlled by a current which is automatically regulated by the amount of interference present.

The figure shows a variable condenser included for this purpose in the local-oscillator circuit of a superhet. The normal setting of the fixed and moving plates of the condenser is as shown, and a spiral spring S, with two extensions S1, S2 "straddling" the amount of tilt, to restore this position after any deliberate muting.

A fixed magnet M is energised through leads L by the control current produced by the presence of interfering signals. If the control knob K is then moved to one side or other, the shaft N is "clutched" through a disc D to the shaft P so that the condenser plates are moved to detune the set in the way required. To select a new station, the circuit containing the leads L is automatically opened by operating the main tuning-control knob, thus de-energising the magnet. At the same time the spring S restores the movable plates of the condenser to their normal position.


**SCANNING IMPROVEMENT**

To produce the illusion of movement, it is necessary to make use of the persistence-of-vision effect. But as applied to a cathode-ray television receiver, this leads to a certain loss in the brilliance of the light which can be produced on the fluorescent screen, owing to the short period of activation of each scanning line. There must also be taken into account an inherent "attenuation" in the power of the eye to respond to the persistence-of-vision effect; as a result the apparent brightness of the picture, as perceived by the tired eye, is less than its actual brightness. Finally a considerable amount of artificial flicker is created by the strain imposed on the eye in following the swift succession of changes.

The argument, in short, is that if the persistence-of-vision effect could be eliminated, the picture would seem considerably brighter.

According to the invention, a close approximation to this ideal is secured by making the light produced by each scanning line last...
Recent Inventions—
for a longer period than usual, preferable for almost the whole period between one frame and the next. As soon as one scanning line has been completed, it is kept "alive" by means of secondary emission until the time approaches by means of automatic scanning line. This tends to produce "bubbles" when voltage is rapped, and so causes the machine to break away.

To avoid these difficulties, it is proposed to produce crystal plates of the required size by "growing" them artificially, and under suitable control, from a concentrated solution, and to apply the electrodes by vaporising silver directly on to the crystal surface. This provides a perfectly homogenous crystal, with a firmly attached electrode, capable of reproducing all sounds within the audible frequency at high intensity and without harmonic distortion.

The British Thomson-Houston Co., Ltd., Application date (Germany), December 17th, 1937. No. 50654.

AUTOMATIC TUNING CONTROL

The figure shows an arrangement for automatically varying the tuning of a local-oscillator circuit so as to compensate for any slight error in the initial tuning of the set.

The valve V is a triode hexode used as a frequency mixer, the triode part of the valve feeding the local oscillator circuit L. The latter circuit is coupled by a condenser C to an auxiliary grid in the control or variable-impedance valve V, so that the capacitance between this grid and the cathode of the valve V is in shunt with the circuit L, to be controlled.

Between the anode and the cathode of the control valve V a potentiometer circuit is included, comprising a pilot-cathode resistor R and condenser C1, an anode lead L1 shunted by a condenser C2, and a read-back potential meter placed on the inner grid of the valve V. A voltage which is out of phase with the anode voltage, and so varies the shunt capacity across the circuit L so the extent required to control its tuning. Advantage of the arrangement is that it has no damping effect on the tuned input and on its way is intensified by passing through a number of secondary - emitting electrodes. This circuit is a "mosaic" screen, which is swept by a scanning stream of electrons to produce signal currents for transmission.


PIEZO-ELECTRIC CRYSTALS

The piezo-electric crystals used for microphones and loudspeakers are usually cut from a large crystal, to which electrodes are attached in the form of silver foil. The mechanical resistance of such crystals is however low, and

Controlling frequency-changer tuning.

and on its way is intensified by passing through a number of secondary - emitting electrodes. This circuit is a "mosaic" screen, which is swept by a scanning stream of electrons to produce signal currents for transmission.

According to the invention, a cathode-ray indicator is used to overcome both difficulties. It is arranged so that a circular-trace is formed on the fluorescent screen so long as the machine is on its correct course. If the machine de-

viates to one side or other, one half of the circular trace remains covered; the other half "shrinks" by an amount which shows how far the plane has yawned.

Telefunken Gesellschaft für drahtlose Telegraphie m.b.h. Convention date (Germany), October 8th, 1937. No. 505476.

AUTOMATIC DIRECTION FINDERS

RELATES to a direction finder of the kind used for "homing" on to a distant transmitting station, the "signal" being shown as a continuous trace formed on the fluorescent screen of a cathode-ray tube. In such an arrangement it is usual to combine the pick-up voltage from a frame aerial with that from a vertical or non-directive aerial, alternately in phase and in phase-opposition, so that the resultant response is "heart shaped," and gives both the direction and "sense" of the distant transmitter. This combined signal is applied to the pair of the deflecting plates of the cathode-ray tube, whilst a "tuning" voltage, derived from a local source, is applied to the second pair of deflecting plates.

According to the invention, the combined signal voltage is applied in parallel, and the local tuning voltage in push-pull, to a single pair of valves. These serve both to reverse the phase of the aerial voltage (since when one valve conducts, the other is biased to the cut-off point by the local voltage) and at the same time to apply an approximately rectangular tuning voltage to the cathode-ray tube.

Telefunken Gesellschaft für drahtlose Telegraphie m.b.h. Convention date (Germany), July 8th, 1937. No. 502066.

AIDS TO NAVIGATION

To assist a pilot to find a cross-country course (as distinct from "homing") by making use of a single beacon station, he is provided with a transparent template on which a series of curves are drawn. Each represents the local points of maximum (or minimum) signal strength, as previously determined during a series of calibration flights.

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Marconi's Wireless Telegraph Co., Ltd.; M. Fransenol and B. J. Will; Application date November 18th, 1937. No. 505943.

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Conditions may have changed during the past twenty-one years, but, as we see it, in no material respect has the position become fundamentally different. The higher speeds of surface craft and aircraft make rapid communication more essential than ever, and the use of aircraft for anti-submarine patrols, disclosed in a recent official communique, opens up obvious new opportunities for wireless, which, we are convinced, will play a prominent part in bringing about the final overthrow of Hitlerism.

In 1914 there was a certain amount of wastage of technical ability. Skilled wireless operators and other technicians were called up for Territorial or other non-specialised Army duties, while others, not realising the national importance of their work, volunteered for general combatant service. True, these men were ultimately transferred back to duties for which their qualifications fitted them, but there was a certain amount of waste and confusion.

Later on, when the various wireless services were hastily expanded, efficiency suffered in some directions through insufficient training of personnel. Fortunately, however, there were enough highly skilled men for the more vital wireless branches, and their abilities were not wasted.

After the crisis of September, 1938, The Wireless World, thinking along the lines just set forth, offered its services to the Government in establishing a National Register of those possessing wireless knowledge and experience of a kind likely to be useful in time of war. Our offer was accepted, and shortly afterwards we published a registration form on behalf of the Wireless Telegraphy Board. Response from our readers was good, and the authorities now have access to a fairly comprehensive list from which it should be possible to find the right man for almost any wireless job. There is no reason why the confusion of 1914 should again arise.

Though the needs of the fighting Services and of the Merchant Navy must come first, maintenance of broadcasting is also vital. Letters we have received from servicemen show that, though anxious to play their part in some more active sphere, many feel that their abilities are being best employed in their present work. The quandary in which some of our correspondents find themselves is to make a decision on this point. As we see it, the matter is one that depends on the qualifications and experience of the individual, and each one must decide for himself. We contend, however, that the maintenance of civilian broadcast receivers is an essential service, and, as those capable of carrying it out are almost all young men, adequate steps should be taken by the authorities to ensure its continuance.
Headphone Listening

For Wartime Conditions

By R. H. Wallace

It must not be thought, however, that the indiscriminate connecting of 'phones to the average set is advocated by the writer. There are certain precautions to be observed, more especially with mains-operated sets, and in few cases can this be done without some slight modifications or additions to the set. Further, in most cases the volume on 'phones is either deafening or scarcely audible at all, according to the type of extension speaker provided. These alterations need not be expensive, and indeed, many listeners will have the necessary components, and possibly the 'phones, too, in the junk box.

The chief precaution in respect of safety is against the risk of shock to the wearer, due to the contact of the headband, or other metal parts of the 'phones, with the head. In order to make certain that shock cannot occur it is desirable directly to earth one side of the 'phones, when the voltage at any part of the earpieces cannot well rise above a safe limit. Two methods of isolation are available: either the use of condensers in each lead, or the use of a transformer of suitable ratio between the output terminals of the set and the 'phones; particularly in AC/DC sets there is a risk that, if this is not done, some leakage of the mains potential may take place across the internal speaker transformer, or other component, while it is not in all cases permissible to earth one speaker terminal - hence the use of two condensers. If the 'phones are thus isolated from the set, then one side of them may be directly earthed; if this is done no risk at all remains, but it must be remembered, however, that the isolating condensers or transformer should be able continually to withstand at least 500 volts.

The problem of matching the particular headphones used to the set is not the usual matter of equalising the impedances, as it is with an extension speaker, since only a fraction of the available acoustic output will be required; in case the 'phones are used without the set speaker being connected it will, however, be necessary to absorb in some manner the surplus energy. It is desirable that the apparent volume from the 'phones should be closely equal to that from the speaker, partly to avoid undue use of the set volume control, but mainly to permit the use of extensions at the same time. The relative volume naturally varies with the sensitivity of the 'phones and speakers, and the following suggestions depend therefore on these being of average performance; they will be in any case a guide to the approximate values required and a little experiment will soon settle the precise details.

Group of components suitable for use in phone adaption units and which are to be found in most experimenters' workshops. Iron-cored RF chokes from 0.25 to 0.5 henry, primary of small transformer about 1 henry. Paper condensers should be tested, as old ones are often leaky.

Fig. 1—Methods by which phones of high resistance may be fed safely from extensions of different characteristics. Condensers and transformers must withstand full mains voltage plus plate voltage in the first two cases and possibly in the third if the components in the set are leaky. The earth connection to the phones is essential.
Headphone Listening—

which connection can be made will be the extension speaker sockets. Makers differ considerably in their ideas and any impedance from 2 to 20,000 ohms may be met; the latter, of course, only in the case of battery sets. Where a high-resistance output is provided it will be necessary either to use a step-down transformer, or to put a resistance of considerable value in series with the 'phones, in order to reduce the volume to bearable limits. With 'phones of 4,000 ohms total resistance and an output impedance of 10,000 ohms, such as is the case with the majority of battery pentodes, a ratio of 7/1 will be found to give a volume comparable with that of the set speaker; alternatively a potentiometer of 0.5 megohm may be used following the condensers and in series with the 'phones. These conditions are shown in Fig. 1.

It is probable that most people have a set where the extension impedance required is around 4 ohms. In these cases, provided that the speaker and 'phones are of normal sensitivity, the use of a transformer of about 3/1 ratio will give a suitable volume in 4,000-ohm 'phones. It should be noted that the latter figure is the DC resistance, which is usually stamped on the earpieces, and throughout the present article this is the sense in which specified 'phone resistances are to be understood; the actual impedances vary widely from make to make, with differences in the magnetic circuit, and on this account precise calculations are almost impossible. Where 7.5- or 15-ohm speakers are in necessary when paralleling in this manner to take special care that the sound fed to each ear is in phase; this will be the case so long as the two terminals marked posi-

![Diagram](image)

The various components of a phone adaption unit may be mounted in a box: the simpler form of unit, without tone control, occupies very little space.

![Diagram](image)

Fig. 2.—Simple circuit giving control of volume with a high-resistance extension output. Z, extension impedance in ohms; R1, 1 mfd., 500 volts working; R2, 0.5 X Z ohms, 1-watt. In this diagram and Figs. 3 and 4 the phone resistance is assumed to be 4,000 ohms.

Fig. 3.—Another method, providing greater flexibility, of controlling volume with an HR extension, Z, output impedance in ohms; R1, a X Z ohms, 5-watt: step-down transformer ratio, $\sqrt{\frac{200}{Z}}$

![Diagram](image)

Fig. 4.—Volume control for use with low-impedance outputs. Z, impedance in ohms; R1, a X Z ohms, 3-watt: step-up transformer ratio, $\sqrt{\frac{200}{Z}}$

use than a ratio of unity will probably suit, but it may in the former case be preferable to reconnect the earpieces in parallel, instead of the more usual series connection, thus reducing the resistance from 4,000 to 1,000 ohms. It is necessary when paralleling in this manner to take special care that the sound fed to each ear is in phase; this will be the case so long as the two terminals marked positively are connected together; an attempt to listen with his connection incorrectly made will soon indicate that something is wrong; the type of distortion resulting is difficult to describe but is definitely unpleasant.

Artificial Loading

Throughout the foregoing it has been assumed that the set speaker is also connected, or else some extension, to maintain the load on the output valve. Where 'phones are used as an alternative to the speaker, as will frequently be the case, then it is necessary to ensure that the primary or secondary of the 'phone transformer is shunted by a resistance of suitable value, and since in the latter case the transformer will itself have to handle the full output of the set, it is naturally preferable to place it across the primary. A resistance used for this purpose must, of course, be capable of dissipating safely the peak audio output of the set, which will normally be from 3 to 5 watts; the value is not critical and it is convenient to use a potentiometer, since in this way the voltage fed to the 'phones may be regulated.

The value of the loading resistance will naturally depend on the output impedance of the set and a suitable value is twice the nominal extension value, since this will involve little alteration in the volume of any other speaker in use. Such a value will do no harm to the set even when used alone, since the impedance of this resistance will not rise, as that of the speaker does, at the higher audio frequencies, and thus there will not be any dangerous voltages developed in the output section, even with pentode valves.

Figures 2, 3 and 4 give suitable values (in terms of the output impedance at the extension sockets of the set) for the components; the values suggested will provide a range both above and below the volume of the set speaker, either when used separately or in conjunction with this. The actual figures are not at all critical, and there is no reason why, for example, a transformer of half, or twice, the ratio indicated should not be used, though the range of the volume control may then be curtailed at one extreme or the other. The power-handling capacity of a transformer for this application need not be great, and a midget type will do nicely.

The normal tone controls of the set will, of course, function equally well for headphone reception; thus there is rarely any need to provide the listener of normal hearing with any additional means of reducing high-note response, since this control is almost always incorporated in the set; further, the frequency response of ordinary 'phones not being very wide, any transformer of suitable ratio may be employed, and the quality of reproduction will satisfy most people. In any case, since there is no initial polarisation of the core by DC component, the quality obtainable will be better than would normally obtain. Where it is felt that some correction is needed, it is comparatively easy to provide this by using a transformer of somewhat higher step-up, in the case of low-resis-
Headphone Listening—

the secondary and the 'phones. One method of doing this is indicated in Fig. 5, the values being given a range covering very considerable modification of response; the higher values of inductance and the lowest of capacity are more appropriate to 4,000-ohm 'phones. There are, of course, other methods of achieving the same results; one may use chokes and condensers in resonant or non-resonant circuits. An arrangement of this nature is shown, with suitable values, in Fig. 6, though these suggested in Fig. 5 are preferred by the writer for the present purpose. With the inductive or reactive potentiometer the total impedance reflected across the primary of the transformer tends to fall at unwanted frequencies; this in turn reduces the proportion of the total output taken and offsets to some extent the compensation secured. In many cases also a good deal of the power is wasted even at frequencies of maximum response. On the other hand, with the series arrangements recommended, the reflected impedances at those parts of the scale where one most wants to reduce the proportion taken by the 'phones, while the full volume is available at other frequencies and therefore the apparent volume does not change greatly at different settings of the control.

When using the suggested tone-control circuits it will usually be found preferable to parallel the earpieces, since the effect of the inductive impedances will be thereby enhanced and a greater compensation result. For instance, if 4,000-ohm 'phones are used in the circuit of Fig. 5, an inductance of from 2 to 15 henrys may be required. This is rather outside the range of most tone-control chokes, though too low to permit the use of an ordinary AF type. If a 'phone resistance of 1,000 0.3 and 0.5 henry are required. Suitable components may be found among the mid-gap output transformers of various makers, where the primary has an inductance between 0.5 and 2 henrys, since in this case there is no objection to the use of an ungauged core, there being no DC component.

It should be remembered that with ordinary headphones R3 is not worth while making any attempt to increase the response much above 7,000 cycles, since the response at these frequencies will be in any case small; also an increase of the extreme bass will in some cases cause rattling of the diaphragm on the pole-pieces if an attempt is made to increase the power too much.

It is convenient, in many cases, to assemble the few components needed in a small box, which may be connected to the set by sufficient wire to enable it to be placed upon the chair arm; a jack may be provided for the insertion of the 'phones when desired. If this is done then it is quite easy to use the unit at will in any room fitted with extension wiring and the necessity of adjusting the volume at the set is avoided. When, however, DX listening is frequently indulged in it will probably be more convenient to incorporate the necessary components within the set, providing a suitable switch to cut out either the 'phones or set speaker as required.

The writer can assure those who care to undertake this adaptation that it will well repay them for the small outlay involved, giving at the same time much greater flexibility in reception and removing a frequent source of discord in the home. A subsequent article will deal with the modifications necessary to increase the volume in the 'phones for use by the deaf and will give particulars of the design and construction of a versatile unit especially suited to these requirements but also convenient for the ordinary listener.

Wireless World

Henry Farrad's

PROBLEM CORNER

No. 38.—Where Did the Volts Come From?

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction:

"High Rise."

Shortham.

Dear Henry,

I don't usually worry very much about shocks, even of the 400-volt order, but I have just had one that has given me something to think about. And it wasn't off a television set, either. Just an ordinary 'beam tube' amplifier running off 375-400 volts HT. I had the thing on and working properly, and took hold of an earth lead to connect to it; my other hand, I suppose, must have been resting on the chassis. The next thing I was in the middle of the room wondering who had kicked my chest.

The power unit is a perfectly standard full-wave valve rectifier circuit (see sketch),

with a 425-0-425-volt transformer running off 230-volt mains, being one that I picked up second-hand. The output voltage is correct, however, for I measured it. And after my hands had stopped shaking I measured the DC volts between chassis and earth—440. But it felt a great deal more than that. What do you think it might be? I am finding this weather too hot to think!

Yours ever,

Hugh Vaulter.

P.S.—There was no earth connection, intentional or otherwise, to the amplifier or power unit.

Precisely how did the apparatus cause such a dangerous voltage, and how high might it be? Think it over, and then turn to p. 274 to see if your solution agrees with Henry Farrad's.

Pilot "Twin-Miracle" Portable

On page 198 of the August 31st issue this receiver, which operates from AC/DC mains or dry batteries and has an automatic relay for changing over to batteries in the event of failure of the mains, was inadvertently ascribed to another firm.

The makers are, of course, Pilot Radio, Ltd., 31-33, Park Royal Road, London, N.W.10., and the price of the "Twin-Miracle" receiver, including batteries, is £1 15s.
Power from the Wind
ITS USES FOR ACCUMULATOR CHARGING

WINDMILL generating plants are an interesting source of power for battery charging, and are becoming increasingly popular with the introduction of cheap and reliable plants. Wind power should be of particular interest to owners of radio sets living in remote places far from charging facilities, and also in less remote districts where there is no mains supply available, when a local generating set will save the trouble of transporting batteries to the charging station. Small wind-driven charging installations are now widely used in America.

Wind is free; it blows in most places on most days of the year. Even when it appears calm at ground level, a useful breeze may often be found at an elevation of 40 to 80 feet above ground, as one will find on ascending a building such as a church spire, which stands clear of other buildings.

With wind-power, as with water-power, although the upkeep costs are low, the original capital cost of plant can be so high as to offset the advantages of absence of fuel costs. With mass production methods, however, wind-power is becoming a practical proposition financially, at any rate for lighting and battery charging purposes.

In the old and more leisurely days when windmills dotted the countryside, work could and did wait on the vagaries of the wind. The advent of steam and oil, which were independent of the weather, deflected business from the windmills, and they became mainly picturesque objects of interest, but of limited practical use. Electrical storage batteries have, however, altered matters. One cannot store wind, but electrical energy generated by the wind may be stored to tide over calm periods, and the oldest source of power becomes one of the latest.

A wind-wheel may be of one of a number of different types. There is a horizontal type of wheel with cup-shaped vanes on a vertical shaft, which is slow and rather inefficient but does not require to be turned into the wind. There is also a vertical type of wheel on a horizontal shaft, which is usually kept turned into the wind by means of a tail, but is sometimes mounted so that it works on the lee side of the supporting tower, and acts as its own tail to keep it turned to the wind. The latter wheels, i.e., vertical on a horizontal shaft, may be of a high-speed or a low-speed type, depending on the ratio of the speed of the tips of the blades to the wind-speed. There is a slow-speed type of “American” wheel with a large number of vanes and a tip-speed to wind-speed ratio between 1 and 2, and a high-speed type of wheel with a small number of blades, usually two to four, with a tip-speed to wind-speed ratio of 3 to 6.

The multi-bladed wheel is capable of starting against heavy loads, and this and its slow speed makes it suitable for work such as pumping. When used to drive a dynamo considerable gearing is necessary. Also, the large sail area offers considerable resistance to sudden gusts of wind, and a comparatively strong tower is required.

The high-speed wheel, usually the type with two blades, is perhaps the most popular for small charging plants. The blades are aerofoil-section, either carved from solid wood, as is usual in the smaller plants, or of fabric stretched over a frame. For manufacturing purposes something of a compromise is necessary in the design of the wind-wheel. The most efficient wheel is not necessarily the cheapest to manufacture, and usually a larger wheel of a less specialised design cheaper to produce is employed, instead of a smaller and theoretically more efficient wheel. The high-speed wheel is not good at starting under load, but for battery charging this makes little difference, since the load is not applied by the automatic battery cut-out until the wheel has run up to charging speed. The high-speed wheel, on account of the small area of the blades, offers little resistance to sudden gusts of wind, and a comparatively light tower is sufficient.

A speed governor is necessary owing to the variability of winds, and this is usually designed to limit the speed of the wheel in wind-speeds over 20-25 m.p.h. In the smaller plants a governing action is obtained simply by offsetting the wheel slightly on the turntable, so that the wheel tends to turn out of the wind when the latter increases in velocity. In the larger plants, made by the Wincharger Corporation of America, a pair of metal vanes mounted on the wind-wheel tend to turn against the direction of rotation and offer increased wind resistance as the speed of the wheel increases. The weight of the latter governor acts as a fly-wheel tending to maintain a steady speed in gusty winds.

A three-brush generator is usually employed to give additional control of the charging current. An automatic cut-out is, of course, necessary between the dynamo and battery. The dynamo is usually mounted on the turntable with the wind-wheel, and may be direct or gear driven, the leads being taken through slip rings below the turntable. Ball bearings packed with grease
Power from the Wind—require only occasional attention, and when overhaul or inspection is necessary the wind-wheel is stopped by means of a brake on the shaft, or by folding back the tail to bring the wheel out of the wind.

The wind-wheel should be mounted as clear a position as possible, away from obstructions such as house and trees, which may deflect the wind from a considerable area around and even above them. The wheel may be mounted on a short tower on the roof of a house or barn, or even on a trimmed tree. Lattice sectional masts are perhaps best of all; they are obtainable in 18 ft. sections which may be bolted together to obtain a stayed mast up to 80 ft. or more in height.

Suitable Conditions

There are a considerable number of wind-driven charging plants in use in Ireland. The majority are, perhaps, in the coastal districts within a few miles of the sea. Several plants known to the writer are, however, giving equally satisfactory results in inland districts both hilly and flat, indicating that conditions would appear to be unsuitable localities screened by hills. Where adverse conditions are met it is often possible to overcome them by adding additional sections of tower in order to increase the height of the wind-wheel. Choice of position in relation to prevailing winds is also sometimes important. Incidentally, 18 ft. sections of lattice tower are obtainable at £4 10s. A 12-volt 300-watt plant with 6 ft. wind-wheel and stub tower complete except for the battery works out at about £16 10s. A 32-volt 650-watt plant with 10 ft. blades costs about £50 15s.

The 12-volt 300-watt plant is capable of supplying a radio receiver as well as providing some lighting. The radio set may be a vibrator type receiver, the supply for which is tapped off the main battery. HT supply might alternatively be from a rotary converter, or from 10-volt HT accumulator blocks charged in parallel and discharged in series.

Wind-power generating plants give the amateur constructor plenty of scope. An old car dynamo with other scrap car parts makes the basis of a number of plants constructed by enterprising mechanics. With high speed wind-wheels up to five or six feet in diameter it is possible to drive a suitable dynamo and generator, while for larger wind-wheels a step-up ratio of 3:1 may be required. Much depends on the design of the wheel.

The kinetic energy in the wind may be worked out from the empirical formula: power-horse=0.00000226AV^3 where A is the area in square feet exposed by the wind-wheel in feet per second. The efficiency of a wind-wheel may be 25 to 40 per cent. The maximum possible efficiency has been calculated as 59.26 per cent. Much of the energy is required to carry the wind away from the lee of the wheel. Annual hours of wind above 8 m.p.h. in England and Scotland might be expected to range from about 3,600 to 6,700.

Further information on the subject of windmills is to be found in "Windmills for the Generation of Electricity," published by the Institute for Research in Agricultural Engineering, University of Oxford, price one shilling.

Above Three Megacycles

CONITIONS FOR SHORT-WAVE NEWS-GATHERING

SHORT-WAVE reception remained excellent during the period under review, except possibly during the early afternoons, when on occasion higher frequencies than 17 Mc/s have been indicated for transmission due to impulse contrasts.

On Thursday evening, September 7th, WGEA on 15.33 Mc/s was noted as not too strong at 6.20 p.m. G.M.T., but it improved rapidly. Both WXE and WNBI were strong again on the 17-Mc/s band. Talking about WGEA, the General Electric engineers at Schenectady have developed a number of very large demountable triode valves of the cathode-ray-traced type for use in a 1,000-kW sister station WGEW.

At some of the B.B.C. stations very large demountable screengrid valves are in use, but these new American triodes are the largest of their kind in the world. At 11.40 a.m. G.M.T. on September 8th neither WNBI nor WXE could be heard on 17 Mc/s, but GSG and GSV (B.B.C. Overseas) on the same band were very strong. A new U.S. station could be heard which turned out to be WPIIT, Pittsburg, radiating a programme from London with B.B.C.'s London representative speaking. The 16-Mc/s band was weak but WNBI and WXE were inaudible. Actually, nothing was heard of the two 17 Mc/s Americans until 10.10 p.m., at which time they had risen out of the noise to good signals, but they weakened later.

The position was similar at 2.40 p.m. G.M.T., but at this time WNBI was superior to WXE during the former's English news. The noise level on WNBI was about -10 db., improving to -20 db. by 3.45 p.m. The English Hour on WNBI at 4 p.m. was, however, only 50 per cent. intelligible, since the signal deteriorated badly to zero noise level. The C.B.S. station was somewhat better than WNBI at 6.10 p.m., due to a higher modulation level on WXE, and WGEA had become a useful signal but with high noise. Some strong jamming by an unidentified broadcaster was noted on WXE at 6.40 p.m. G.M.T. onwards.

Shorter Wavelengths Best

Conditions were definitely in favour of the high frequencies on Saturday morning, September 9th, and it was noted that, contrary to experience, Java PMA on 17 Mc/s (using multiplex Morse and phone) was very strong at 10.30 a.m. It is worth recalling that on Thursday, September 7th, PMB on 20 Mc/s was considerably stronger than PMA until well into the afternoon. By Saturday, therefore, we may assume that the maximum ionisation period had passed, but nevertheless conditions were very good from 13 meters upwards.

Both WNBI and WXE came up strongly at noon G.M.T., and WXE opened with a three-cornered broadcast from Berlin, London and Washington. This station was very strong indeed at 12.45 p.m.

The English Hour from WNBI on 17.76 Mc/s was strong and good on Sunday afternoon at 4 p.m., but it was noteworthy that 80 per cent. of the news came from German sources. It is a pity that the American international broadcasters cannot be supplied with more English news; they seem ready enough to use it.

Conditions from the U.S. stations remained good on Sunday, September 10th, and amongst other signals heard was the half-wave of CSW at Lisbon on 22.06 Mc/s; the fundamental was a strong signal.

The Belgian station ORK on 10.33 Mc/s was a strong signal, too, and at the same time (6.50 p.m. G.M.T.), giving a news bulletin in French.

Readers will recall that in last week's notes I suggested that conditions were moving towards the VHF end of the spectrum; this prophecy seems to have been justified, as at 7 a.m. G.M.T. on September 14th snatches of programme were audible from quite a number of American high-fidelity 11-meter broadcasters. Despite the lateness of the hour, the 13-meter band was still "live," and there was considerable Morse activity from 11 meters upwards.

Since then there has been little change, up to the time of writing, in reception of the stations mentioned, and many others have been available, too, as listeners can no doubt testify. I hope to keep listeners informed, however, of any important developments that may occur in the future.

"ETHACOMBER."
Grid-blocking in RC Amplifiers
ITS CAUSE AND CURE

WHILE momentary overloading may cause little trouble with transformer coupling it is often serious with resistance coupling since the grid current charges up the grid condenser. In this article a way of reducing the effect is described.

MOST people agree that the resistance-coupled amplifier is superior to others from the point of view of quality. It does, however, suffer from one defect—its operation is badly affected by grid current. Resistance coupling is, of course, only used for Class A amplification, with which there should be no grid current, but one cannot always guard against momentary signal peaks which may overload the amplifier and drive one or more valves into the grid current region of their characteristics.

Such a peak inevitably leads to distortion with all amplifiers, but with resistance coupling it may paralyse the amplifier for a short period following it. This phenomenon is known as grid blocking.

What happens is easily seen with reference to Fig. 1. Suppose that there is applied to the grid a positive voltage peak of amplitude exceeding the bias voltage, so that the grid is driven positive. Grid current flows and charges the condenser C negatively. After the peak voltage has passed, this charge on C remains and leaks away slowly through R. Until C has discharged, therefore, the valve is operating with excessive grid bias and distortion is likely to occur. In extreme cases, when the positive peak signal is very large, the valve may for a time be driven beyond anode current cut-off.

In the case of an output stage, this last effect is very rare. Grid current usually occurs through momentary overloadings on a loud passage of music, and the overloadings is quite small. Complete blocking is much more likely to occur in an early stage when the amplifier follows a sensitive receiver used in a district where local interference is bad. The writer has met cases where the first AF stage was almost continuously blocked by the peaks of local interference.

Assuming the stage of Fig. 1 to be fed from a low impedance circuit, the time taken for the condenser to discharge depends on the product CR whereas the time taken for it to charge depends on CRg, where Rg is the effective grid-cathode resistance of the valve. In general, the positive peak is of quite short duration and then the voltage to which the condenser is charged depends on CRg. Obviously it is desirable that CRg should be large and CR small, which means that Rg should be larger than R.

In practice, however, the reverse is the case; R is usually some 0.25—2.0 MΩ and Rg is only a few thousand ohms when the grid is positive. Matters are rather better when the input circuit is not of low impedance, for then the impedance to the left of the input terminals of Fig. 1 comes in series with both charge and discharge paths. If this impedance be regarded as added to both R and Rg, then although both the charge and discharge time-constants become greater, their ratio has been increased, which is all to the good.

The Grid-stopper

In order still further to improve matters it has been suggested¹ that the charging time-constant be further increased by inserting a resistance Rr in series with the grid of the valve as shown in Fig. 2. This is the familiar grid-stopper, and the charging time-constant becomes C(R, + Rg) while the discharging time constant remains at CR. If R is made large, much more favourable operating conditions are secured. For instance, if R=Rr, the time-constants become nearly equal. For peaks of short duration the condenser is charged to a much lower voltage. This is itself less harmful to the performance, but in addition what charge there is falls to a negligible amount in less time just because it is smaller to start with. Blocking is not only less severe but lasts for a shorter time. There is, of course, little improvement in the case of peaks of long duration for then the condenser still has time to charge up fully.

The use of too large a value for Rr must be avoided, however, for the presence of this resistance in conjunction with the working input capacity of the valve will cause a drop in response at high frequencies. This capacity is shown dotted in Fig. 2, and is approximately equal to the static grid-cathode capacity of the valve plus (1 + A) times the grid-anode capacity, where A is the voltage ampli-

Fig. 1.—This diagram shows the conventional RC coupling.

Fig. 2.—The use of a grid stopper is shown here; it must not be too high on account of the input capacity of the valve.

¹. *Electronics*, April, 1937.
Grid-Blocking in RC Amplifiers—

Modification of the stage, not the amplification factor of the valve.

For a drop of not more than 1 db, at 10,000 c/s, the product CR/R should not exceed 8.2 \mu F, which is a triode or pentode amplifier 8 \mu F respectively. It will thus have an effective input capacity C of 9 \mu F; consequently, R should not exceed 92,000, or say, 100,000 ohms. In the case of a screened tetrode or pentode amplifier C is much lower and may be less than 10 \mu F.

Values of R up to 1 \mu F may then be permissible. This is all to the good, because such valves usually have a shorter grid base than triodes and so are more liable to grid blocking.

It should not be forgotten that if the valve makers place a limit to the total grid-circuit resistance, it will be necessary to reduce R when inserting R1. Thus some values often have a limit of 2 \mu M, and this is a common value for R in Fig. 1. If R1 is made 0.1 \mu M, the increase in total resistance is quite small—5 per cent.—and R need not be changed. On the other hand, if R1 is made 1 \mu M, then R must be reduced to 1 \mu M to keep within the limit.

In no case should the capacity of C be larger than is necessary to obtain the required bass response. A value for CR of 0.02-0.025 \mu F/\mu M is large enough for the highest quality in normal circumstances and should not be exceeded. This means a 0.1 \mu F condenser with a 0.25-\mu M grid leak, or a 0.01 \mu F condenser with a 2-\mu M grid leak and so on. Often smaller values can be used without a noticeable loss of bass.

HENRY FARRAD'S SOLUTION

(See page 270)

The highest voltage that the apparatus could set up between chassis and earth under the condition described is nearly 900 volts peak, which would happen if the rectifier heater winding became 'shorted' to the mains incoming voltage. If the live side of the mains were shorted to the end of the HT secondary in phase with it, a slightly higher peak voltage still—925—would result, but, being purely AC, it would not show on a DC voltmeter. The only possible fault, therefore, is the one shown.

The hot weather is likely to have been a contributory cause of the severity of the shock, because of the moistness of the skin. In fact, Mr. Vaulter is lucky to have escaped alive; an American, Phil Murray, was killed by exactly this type of fault, although he was not even holding an earth lead, but only standing on a wet floor, and the mains voltage would have been only 110.

The two morals are: be cautious about using transformers of doubtful origin, and earth the apparatus before switching it on or even plugging it into the mains outlet socket.

The severity of the shock received by Hugh Vaulter was due to a failure of insulation between primary and secondary of the mains transformer.

Books Reviewed


UNHAPPY experiences with electrolytic condensers of early vintage have left behind prejudices that are still linger in many minds. While some of the troubles in the first few years of their application were undoubtedly the result of inexperience in manufacture, any unsatisfactory performance of early condensers is now much more likely to be due to the designer who applies them failing to understand the respective advantages and limitations of the various types.

Mr. Cousey's book, now brought up to date by a revised edition, explains clearly the conditions for successful use; showing, for example, how a type of electrolytic condenser that would fail very quickly under certain conditions is capable of exhibiting no appreciable deterioration after three years of continuous life test if used within its proper rating. If set-makers would take the condenser manufacturers fully into their confidence regarding the working conditions, and advertise in terms of extra money that represents the difference between a risk and a certainty, there would be little complaint about the performance of electrolytic condensers.

The characteristics of different types, including the latest surge-proof, etched-foil and multiple-wet varieties, are displayed by excellently produced curve sheets. In view of such minor characteristics as the influence of ripple amplitude on apparent capacity being included, one would like to have more definite data on the important relationship of the magnitude of ripple current to life. Also, the practical value of some of the data concerning operating voltage is lost because the rated voltages of the condensers in question are not stated (e.g., Fig. 94).

With regard to the testing of electrolytic condensers, the chapter is elevated, it is not clear why the connecting of the polarising battery in series with the AC test source is rejected in some arrangements because it would damage to the battery may result, and advocated in others (including the final and apparently preferred method). Among the methods of testing, a place might have been found for reference to the popular and convenient handbook, in which the provision of polarising voltage does not appear to be essential for capacity measurement well within the range of accuracy required.

A minor irritation is the consistent use of of the redundant form "DC current" (i.e., direct current current); there are a few errors, but none likely to mislead were noticed.

There are minor criticisms and suggestions: the book can be confidently recommended to all designers, service engineers and others concerned with electrolytic condensers. A special word of praise is due to the unusually comprehensive index.

M. G. S.
Random Radiations

War and Wireless Progress

WAT will be the effect of the present spot of bother on the development of wireless? One can only make surmises, of course; but it’s interesting to do so. During the Great War wireless was a lot younger and therefore more pliable—although still a good many years away. Nearly all of the countries famed for electrical progress were directly involved. There were developments, but these occurred in the signal or the communications side of the wave. The style of amateurs was cramped during the war and for two or three years after it was over by the restrictions imposed here. But progress was made, particularly in the matter of valves. I think I’m right in saying that the old “R” was a valve designed in the first instance for war purposes. Certainly the “F” and “T” valves—first of the “test-tube” type—were, for they were developed for the Air Force. Then there were the early Admiralty valves. Do you remember them? The filament leads were brought out through a bulb to such an extent that the screw cap (like that of flash-lamp bulbs) and the plate and grid leads were just loose wires intended for soldering or connection to screw terminals. Progress in other directions was concerned largely with endeavours to obtain greater and greater selectivity by means of tuned circuits and to increase sensitivity by making the best use of regeneration on the one hand and of delicate headphones on the other. And, of course, A phones—I still have a fine pair—were war babies, unless my memory is at fault.

Changed Conditions

In the present war conditions are very different. Broadcasting has been in being for some seventeen years and has developed so far that the wireless set has become a necessity rather than a luxury in the home. Owing to the demand for news, the war is likely to increase the sales of receiving sets; and the short waves have so much to offer that one foresees a call for something that is a better performer below 100 metres than the average small “all-wave” set. The United States is not involved directly and progress can continue unhampered there. Here it is likely to be handicapped, so far as broadcast receivers are concerned, by the demands made on designing and research departments by the various fighting and defence services. But there will be progress for these services are always demanding better and better performance, and when we settle down again to peaceful conditions we shall benefit by the discoveries that have been made. Then there are the short and ultra-short waves, in the transmission and reception of which progress is certain. Unfortunately, the amateurs, from whom so much has come in the past, will again be handicapped severely. Many have joined up in one capacity or another. Those who remain in civil life will have their activities greatly restricted. The war is go calamity, but one small consolation for us wireless folk is that it may lead to progress, since vast amounts of money are now available for research and development in so many countries. The pity of it is that this work must be done mainly with warlike ends in view.

The Exhibition in Retrospect

LOOKING back at the Radiolympia of 1939 now that its has passed into history, one can view it in its proper perspective. The impression left with me is that, though the Exhibition itself was run mainly on the tight lines, the publicity publicity efforts etc. with it was conducted largely on the wrong ones. It was, after all, primarily a radio exhibition, intended to let the public see the newest things in wireless sets, television receivers, components and so on. And had Radiolympia’s run not coincided with the days of crisis through which we passed whilst our hopes of peace were being shattered one by one, I believe that the attend- ance generally would have been far greater than it was, primarily because the public could have been brought up to imposing figures by good publicity, stressing the purely radio side of it. As it was, much—far too much—of what one read in the lay papers or saw on the press was devoted to the fun and games aspect. A great pity, for it was quite unnecessary. One excellent and sure way of attracting the man in the street to a wireless exhibition would be to advertise a bureau where he could obtain free expert advice about his radio troubles and perplexities. I don’t think that manufacturers in general realise how difficult it is for ordinary owners to discover where to turn for such help. His only hope is the expert friend, if he is lucky enough to have one. Many of the lay papers used to assist their readers by answering wireless queries; very few of them did so now. Hence, unless the listener reads The Wireless World or has a friend who knows the ropes, he can find out very little indeed. The average listener has, as I know from experience, many perplexities that he would like cleared up. How often would jump at the chance of being able to get his questions answered, were it offered at Exhibition time.

Wireless Show for Wireless Folk

Have we seen the last Radio Exhibition? Will there be others to follow the long series up to 1939, or won’t there? Each year for some time now questions on these lines have been asked; only a couple of years ago there were many who thought that there would be no more Radiolympia. Almost certainly there will be no kind of show, should the war still be on next August; we can regard the whole of the present “duration.” But I see no reason why the show shouldn’t be revived when piping times of peace return; in fact, I see every reason why it should, though not perhaps on the lines of recent years. There will always be a good number of folk who are interested in wireless for its own sake. Add to these the far greater number of half-and-halfers, who are keen on the entertainment that broadcasting provides, but have a certain amount of technical knowledge and like to keep abreast of discoveries and developments, and you have a useful potential audience for a smallish, serious show. And that’s what I think it may come to in future years, a smallish show with no fun—just pure brass tacks. Something on these lines was in fact to have been staged this year by the R.S.G.B. for certain firms which didn’t exhibit at Olympia. It would have been a success, I feel sure. It wouldn’t have drawn huge crowds; but those who attended would have been attracted by wireless itself and not by the glamour girls and the crooners. A wireless show for wireless folk is my forecast for the future.

No Juice

CAN you imagine a more tantalising position just now than has a perfectly good mains-driven short-wave receiver with you and to be unable to use it because no suitable current is available? That’s how I’ve been fixed lately. In the village where I’m billeted there is no house wherein I sleep has its own plant; but, alas! it’s 50 volts DC. And 50 volts DC is also the supply at the scene of my present activities. There’s a battery available, but it is of little use on the short waves. And so here am I, a short-wave enthusiast, knowing that there is more enlightenment to be found on the short waves than ever before and unable to do anything about it. If ever I’m asked to take part in another war, I think I shall refuse to play unless they provide me with at least 200 volts AC. Talking of short waves, I couldn’t help thinking, as I sat garlanding my “battle bowler” the other evening, what tuning one of the old straight short-wave sets would have been like if one had been wearing a tin hat. Hand capacity and build capacity were bad enough when one was unarmoured in the old days. What would have happened had one moved a head covered with a soup-plate thing made of sheet steel and weighing several pounds? I only wish I could try it, for even a funny old set with extension handles to its variable condensers would bring in some of the short-wave stations that I so badly want to hear.

COMBINED VERTICAL-LATERAL PICK-UP

An important innovation by Western Electric in America is this playback unit (type 1300A) with its new 9a pick-up, fitted with a diamond-pointed stylus, capable of reproducing hill-and-dale cut discs as well as ordinary lateral cut records. The overall frequency response of this reproducing set extends beyond 10,000 c/s. Two vertical and five lateral reproducing characteristics can be selected by a switch.
Silent Music

It is a little difficult just at present to know what is the best use to which we can put our now apparently useless television sets. One hesitates to use them as extra coal bins, as is being done by many people of the type who are devoid of all sense of decency. Even the sound side is of no use as it stands, and, personally speaking, I have lost no time in converting my own receiver to a first-class multivalve short-wave set, in order to be able to receive the American programmes at all hours of the day. This has, of course, necessitated rewinding all the coils, and has meant a great deal of hard labour, but it has been fully worth it, not so much because of the ability to receive the transatlantic programmes with ease, but because of a very remarkable discovery which I have made.

It so happens that Mrs. Free Grid possesses among her hundred-odd relatives an individual who is a very big noise in the musical world; at any rate, even if he isn't a very big noise, he certainly makes one when he is let loose with a conductor's baton and a full-blown symphony orchestra. As he is staying with us I managed to rope him in to help me with some of the conversion work, the half of which I held out to him being that he would be able to listen to some of the wretched highbrow musical stuff which certain American stations of a Bostonian turn of mind are apt to churn out from time to time.

Sublime ecstasy.

I supervised his efforts as far as possible, but it was not to be expected that I could keep my eye on him all the time, and it was not surprising, therefore, that when we had finished and I attempted to tune in a short-wave station by way of a test, the loud speaker was dumb. I left him for a few moments idly twiddling the knobs while I went in search of a hammer to remedy the defect, and was amazed on my return to see him kneeling enraptured before the cathode-ray tube with a far-away look of sublime ecstasy on his face.

Knowing that Mrs. Free Grid's family are tainted with a certain amount of what the doctors somewhat euphemistically call nervous instability, I momentarily feared the worst and took a firmer grasp on my hammer. Glancing at the cathode-ray tube I noticed that it was filled with the dancing curves of what was obviously an incoming signal. A swift examination revealed what was happening. The cathode-ray tube had somehow or another got connected up instead of the loud speaker, and the efforts of the orchestra at some far-distant short-wave station, instead of being translated into sound by the loud speaker, were being transmitted into 'curves' by the cathode-ray tube.

To my astonishment I discovered that Mrs. Free Grid's relative was able to 'read' these curves and extract full aesthetic enjoyment from them in a somewhat analogous manner to the way in which many practised musicians are able to get as much enjoyment out of reading an orchestral score as they do out of hearing an actual performance of the orchestra. It was, of course, very stupid of me not to have realised this previously, for, as I told you some time ago, it was already within my knowledge that many musicians find no difficulty in reading the score from a gramophone record.

To my mind this remarkable 'silent music' discovery has great possibilities, for if we can only educate the general public to connect up a cathode-ray tube in place of a loud speaker we ought to solve once and for all the problem of the noisy loud speaker, for you will, of course, realise that if music can be 'read' in this way there is no reason why news bulletins and talks should not be similarly 'read'. Rudolph Plenumiger has, indeed, already given us an Irishman's lead in this respect.

Modernising Medicine

I AM very astonished to learn from a reader who has written from a certain regimental depot 'somewhere in England' that the Army is still sticking to the old-fashioned form of medical examination which has been prevalent since the Norman conquest. Each recruit has apparently to file personally in front of a doctor for examination, thus not only wasting the time of the medical profession, who are compelled to journey daily to the various examination centres, but wasting also valuable petrol and oil in unnecessary car journeys by the doctors.

Much as I regret to say it, we are, I fear, very much behind certain other countries in this respect. It must, I think, be fully five years ago since I was privileged to inspect the arrangements made in one of the South American republics to examine a large number of men with a minimum wastage of the valuable time of highly paid doctors. This scheme has actually been perfected as the result of the necessity of coping quickly with the numerous revolutionary epidemics which break out in these countries during the hot weather, just as measles and influenza trouble us over here in the winter.

In the particular country to which I am referring, the human body is marked out in squares just like the football ground in a B.B.C. commentary. Each recruit passes in front of a trained orderly who places a microphone on a certain part of the would-be soldier's torso, at the same time shouting 'square one' in a stentorian voice. At the other end of the line is a listening doctor who, on hearing the stentorian 'square one' come over the wire to him, at once knows from the chart before him that he is listening to the man's uvula, and records his impressions of it, favourable or otherwise.

In this way the doctor is able to deal quickly with a large number of candidates without leaving his headquarters and so cluttering up the roads with his car and wasting good petrol. One doctor is thus able to deal with candidates all over the country instead of a large number of doctors being employed to give a personal medical examination to every man, as still seems to be the case over here. No doubt by now this method has been vastly improved upon, and for aught I know recruits are examined even more thoroughly and quickly by placing them in front of a television transmitter. If this method were adopted here the B.B.C.'s after-the-war problem of finding the money to build provincial television stations would be solved, as they would be able to acquire at knock-out prices all the stations erected by the Government at the medical examination centres. I am writing to the War Office about the matter before it slips my memory. No doubt a grateful country will reward me suitably after the war.
THE Wireless World, September 21st, 1939

NEWS OF THE WEEK

RESERVED OCCUPATIONS

The Wireless Industry

The purpose of the revised Schedule of Reserved Occupations issued recently by the Ministry of Labour is to ensure that workpeople required for the maintenance of necessary production or essential services are not accepted for service in which their skill and experience will not be used.

Against each occupation in the list given an age which, in general, means that men who follow those occupations, whether they work on their own account or are employers or employees, cannot be accepted for whole-time service in any of the Services of National Defence if they are of or above the age given. Men below the age mentioned can be accepted for service subject to the restrictions, in the case of certain occupations, that a man may only be accepted if he is required in his trade capacity.

Men in listed scientific or professional occupations may be accepted at any age for service in their scientific or professional capacity in any of the Services of National Defence.

RELAY EXCHANGES

Services During the War

Radio relay exchanges have now been authorised to distribute emergency messages if requested by the local Chief Constable or Air Raid Precautions Controller.

Announcements must be confined to instructions and warnings bearing on local precautions or other local emergency arrangements, and should not deal with the matters of general application such as are covered by announcements made on behalf of the Government.

In no circumstances are relay exchanges to be used for announcing the existence of fires or gas-contaminated areas, particulars of damage caused by enemy action, details of losses inflicted on enemy forces, or despatching any air raid warning messages other than the "action warning" and "raiders passing" messages of these latter messages over the relay system is not to be regarded in any degree as a substitute for the official public warning signal.

Under no circumstances is the use of loud speakers fed from a relay system to be permitted in streets or open spaces.

Single-programme relay exchanges must give the B.B.C. Home Service during the hours when the exchange is providing a service, and dual-programme exchanges must relay this programme on one channel.

Musical items from foreign stations may be relayed, but no talks or other spoken items from such stations are to be included.

BROADCASTING AND THE PRESS

During his first speech in the House of Lords as Minister of Information, Lord Macmillan stated that a feature which was a novelty in the present war was that alongside the great organs of the Press in the organisation of publicity was broadcasting.

The B.B.C., Lord Macmillan said, in competition with the Press, had an enormous advantage because it could go on day and night, and one of the earliest problems that he had fallen to him was to see that broadcasting should not be allowed to prejudice in any way the reasonable rights of the Press.

FOREIGN BULLETINS

News for the Balkans

Further increases in the number of bulletins broadcast by the B.B.C. in foreign languages are announced, last Friday. The additions were Serbo-Croat and Rumanian. These bring the total number of foreign languages used in the Overseas transmissions to twelve, which previously included Africans, Arabic, Czech, French, German, Italian, Magyar, Polish, Portuguese, and Spanish.

An additional Italian bulletin was introduced last Friday at 12.45 p.m. G.M.T. and broadcast on 41.49 and 25.29 metres.

The Rumanian and Serbo-Croat bulletins are broadcast at 8 and 8.45 p.m. G.M.T., respectively, on 30.96, 49.59, and 261.1 metres.

ITALIAN TELEVISION

The sound and vision aerials at the top of the 50-metre tower of the Rome television transmitter which is situated at Monte Mario. At present the programmes are transmitted daily from 7.15 to 8.30 G.M.T. on 6.6 metres (vision) and 7.4 metres (sound). The studio shown here is at the E.I.A.R. headquarters in Rome and is connected to the transmitter, which is some distance away, by co-axial cable.

DEFENCE COMMUNICATION

Proposed Australian National Emergency Plan

Australia, because of its vast area, needs a more efficient and flexible communication system than that of smaller and more compact countries. In an article in the June issue of the Proceedings of the Institution of Radio Engineers, Australia, Mr. N. S. Gilmour, the president, submits a plan for providing Australia with "the most comprehensive and modern interlacing of radio communication ever attempted."

The plan is to honeycomb the populated areas of Australia with self-powered transmitter-receiver units of the type already approved in the outback of Australia. In addition, extra units would be provided so that under predetermined circumstances many hundreds of these units, complete with observers, rations, and tents, could be transported to unpopulated points where any raid is expected. The stationary units would be located at the homes of approved residents and the women-folk trained to operate them in emergency, as is regularly done in the outback. This would give the women of Australia an opportunity of training for a most important service in the protection of their country.

In addition to the above transmitter-receiver units, Mr. Gilmour's plan provides for the issue to approved residents of the receiver portion only of the unit, that under predetermined circumstances they would listen to these emergency bulletins (when the regular services failed) and receive instructions.
News of the Week—
which they would distribute by other means to their immediate neighbours.
It is proposed that 5,000 self-powered ra- transmis- receiver units should be provided at a cost of £423,000, and 15,000 self-powered receivers at a cost of £575,000. Commissioning, and maintenance is estimated to cost £100,000 per annum.

The stations would operate on the same short wavelength as the ordinary 525,000, and so provide for interchangeability.

R.S.G.B. CARRIES ON
THE Council of the Radio Society of Great Britain has resolved that the work of the society shall continue for as long as possible. In making this decision the Council expressed the view that it is essential for the future of amateur radio in Great Britain that a strong and active organisation must remain in being.

In order to maintain a link with its members and also between individual members, it has been decided to continue the publication of the Society's journal, The T& R Bulletin.
Although the activities of the experimental section must necessarily be curtailed, the Council anticipates that arrangements will be made for certain of the groups to function, and it is hoped that local activities will continue as far as circumstances permit.
Having reprinted “The Amateur Radio Handbook” last year, the Council is in danger of losing about £300 on this venture unless the stock can be reduced. The Council would be grateful if every member will consider purchasing an extra copy (price 3s. post free) or will recommend it to friends.

BROADCASTING IN EVERYDAY LIFE
WHAT social changes have been brought about by broadcasting? In a booklet with the above heading, recently published by the B.B.C., two woman investigators have surveyed the social effects of the coming of broadcasting. The investigators, who are from the Bristol University Settlement, surveyed a comparatively small, thickly populated working-class neighbourhood in East Bristol.
They declare that, for the wage earner of all grades, broadcasting has taken its place as a normal feature of home life. “It may be said,” they state, “that no social innovation since the coming of compulsory elementary education has affected so large a portion of he working population as has the coming of broadcasting.”

“Broadcasting in Everyday Life” costs one shilling.

NEWS BULLETINS AND TIME SIGNALS
B.B.C. Schedules

The B.B.C. Home Service is now being radiated for more than seventeen hours a day—beginning at 7 a.m. until 11:15 p.m. During this period there are now considerable briefs for bulletins. These are given at 8 a.m., 12 noon, 4 p.m., 8 p.m., 12 midnight. Official and other public bulletins are broadcast at 7.30 and 10.30 p.m. If and when there is any important news it will be broadcast at 1, 3, and 5 a.m., and at every hour throughout the day.
In order to preserve the regional spirit of broadcasting, announcements, etc., intended primarily for listeners in different parts of the country are being broadcast at special times each evening. At present London and Northern announcements are broadcast for Welsh and Western at 7 Q, Scottish at 7.45, and Midland and Northern Ireland at 10.45.

Time signals are also broadcast throughout the day. They are given at 7 and 8 a.m., 12 noon, 4, 6, 7, 30, 9, and 10.30 p.m., and 12 midnight. Seven of these are from Green-which, and two, those at 7 a.m. and 4 p.m., are of Big Ben.

SUMMER TIME ENDS
WITH the reverision from summer time to standard time on different dates throughout the world there is the perennial confusion to listeners to foreign short-wave stations.
On Sunday, September 24th, the Eastern part of the United States and Eastern Standard Time (E.S.T.) and the times of all programmes emanating from the N.B.C. and C.B.S. short-wave stations will be one hour "back" until we in England revert to G.M.T. This should be on October 8th, but it is not yet known whether the proposal to postpone the rever- sion will be adopted.

In a recent issue of "The B.B.C.'s news sheet, which printed in six languages, the list of the programmes from its international short-wave stations, WNNH (ex WJXL) and WRCA (ex WJXAL), is a list of standard times is given.

BRITISH NEWS BY WIRELESS

High-power S.W. stations
Suggested for the Dominions

That the British Empire has failed to make full use of its overwhelming advantages in respect of obtaining world coverage by wireless is stressed in an article under the above heading which appears in the September issue of The Radio World. It is pointed out that countries like Germany or Japan must radiate to the whole world from their own home territory. They cannot possibly employ short-wave radiators at the other ends of the world under their own flag. Great Britain can.
Although every one of the Dominions has a medium-wave broadcasting service for its own national purposes, none of them has a short-wave service capable of giving reciprocity with the Empire service from the United Kingdom, let alone affording world coverage.
Australia, says the writer, “has inaugurated a short-wave service which can be heard in the South Pacific zone, but it is only of low power, and can hardly be regarded as a rational extension of the local broadcasting service. There is a short-wave station in South Africa of which the same is true, though its power is larger. India Radio, controlled by the Government of India, has several short-wave stations, but they are designed entirely for Indian purposes, being more effective than medium-wave stations for so large a country with such difficult physical conditions. In fact, there is not anywhere in the whole British Commonwealth outside Great Britain a single high-power short-wave broadcasting transmitter.

Liability or Asset?
The writer of the article emphasises the fact that the far-flung Empire became, in the matter of broadcasting, a liability to the B.B.C., rather than an asset to British Commonwealth broadcasting.

“Two things in particular,” says the writer, “would have been, and are still, needed to turn its liabilities into a geographical liability into an asset. The first is the erection of high-power short-wave radio transmitters in the several overseas Dominions, with the possible exception of New Zealand, and also in India. The second is the erection, at two or three focal points in the independent Empire, of high-power short-wave stations to relay B.B.C. programmes, and to re-broadcast translations of those programmes in the languages of countries in their region. These measures should have been taken long ago, but it is not too late. The need to take them has increased, not diminished, by the delay hitherto.”

FROM ALL QUARTERS

Car Radio Ban in Paris
A Paris report states that the fitting of complete sets or motor cycles is forbidden under an order issued by the Prefect of the Prefecture de Police on Sunday. Sets which have already been installed must be removed, with all their accessories, within 48 hours.

Manchester Show
The Northern Radio Exhibition, which was opened by The Manchester Evening Chronicle and Provincial Exhibitions, was to have been held in the City Hall, Manchester, in October, has been cancelled.

Continental Radio Shows
Although the two French radio exhibitions which should have been held at the Grand Palais, Paris, from September 7th and at Lyons from September 16th have been cancelled, the Belgian radio shows are being held as arranged. These are the 14th Salon de la Radio at the Grand Palais du Centenaire, Brussels, on September 9th, and the Antwerp radio fair which opens on September 23rd.

Transatlantic Radio-telephone
contact between direct wireless-telephone service between Italy and New York was inaugurated last week with a forty-five per cent. reduction on the existing charges for week-day calls by the indirect route.

Irish Broadcasting Station
It is reported that thirteen of the sixteen broadcasting stations which the Irish Government has ordered will be for medium-wave working, while the remaining three will operate on the short waves. The short-wave transmitters will be erected in Teheran, the capital.

New Guinea Radiophone Service
A radio-telephone service has been inaugurated between four towns in New Guinea by Amalgamated Wireless (Australia). Although the distances between the towns is no more than sixty miles, the roughness of the intervening country makes the use of cables impracticable.

Pacific Island Station
A wireless and meteorological station is to be built at Rovai, on Thursday Island, in the Kermadec Group, in the Pacific. It is being erected by the New Zealand Public Service. The Department of a plan to provide landing grounds and wireless and meteorological stations on New Zealand's Pacific Land Dependencies.

Emergency Addresses
Here are two additions to the list of emergency addresses published by the Departmental Publications who have moved their offices to the country:

Marconiphone Co., Ltd., Sales Dept., Box 1309, Nuffield House, Salisbury, Wiltshire.
W. T. Henry’s Telegraph Works Co., Ltd., Milton Court, Southend, Essex.

SEPTEMBER 21st, 1939.
CONCLUDING the discussion of making scanning coils, the author shows in this article how the coils can be shaped after winding. He describes the necessary jigs and gives some illustrative winding data.

We will assume that the coil has been wound and is now lying on the mandrel. If desired, during the winding a little cement may be run on to the rectangular portion of the winding, but in any case the cheek should be carefully removed, thus fully exposing one side of the coil. The rectangular portions should be symmetrical and what will ultimately be the bend-over portions should be lying bunched up at the sides. Now apply a little more cement and allow it to become tacky. The coil can now be lifted carefully off the core and bed. If it tends to stick it may be gently levered up with a thin but blunt strip of material to avoid cutting into the insulation.

The bend-over portions have now to be bent at right angles and this must be done without distorting the rest of the coil. The coil is therefore turned over and placed on a flat surface. Either the core piece or another piece of metal of similar dimensions is dropped inside the window and a flat bar of wood is laid across the coil. The width of the bar is, of course, equal to the length of the rectangular portion. Pressure is applied to the bar and the edges of the coil which at present are undoped and are therefore very tractable, are very carefully bent up so that they lie against the sides of the pressure bar. This gives a coil having the shape of Figure 8.

The coil thus bent and still in a tacky condition is transferred to the mould. The drawing of Fig. 9 and photograph should make the arrangement quite clear. The mould consists of a cylindrical core and two side pieces, conveniently made from a single block of hard wood. These have top plates which are brought to the correct distance above the centre line. It will be remembered that the two coils do not touch and accordingly these top plates, which locate the edges of the coil, are naturally above the centre line. The cylindrical core has a flat cut into it parallel with the top plates. This flat locates a top bar which has to be removable. The width is exactly equal to the length of the rectangular portions of the coil. The length is of no importance, and the thickness is sufficient to enable it to withstand pressure. A long woodscrew going right through the core and into the wooden block is the most convenient fixing arrangement.

The coil, with the edges bent at right angles and the active portions doped, is allowed to become nearly dry and is then placed on the mould. The top bar is carefully placed in position and screwed firmly into the mould. To guard against the dope sticking to the wood it is best to boil the wood in wax. In addition, the insertion of scraps of thin tissue paper help to guard against sticking.

There are two further parts of the mould, the wedges and the end cheeks. The wedges make a friction fit between the top pieces and the top bar and are curved to the outer surface of the coil. They are best made from hard wood by turning out a circular hole of the exact size and cutting them out of the block as shown in the sketch.

Careful insertion of the wedges presses the rectangular portion on to the curved surface of the core. This will have the effect of pushing the loose sides outwards. The end cheeks are flat pieces of wood with a hole of the same size as the core. It is at this stage that the edges of the coil are doped, but not until they have been roughly formed up to shape by hand. When they become tacky the end cheeks are pushed on and clamped firmly in a vice or suitable clamp.

Aligning the Coils

When the mould is dismantled the perfectly formed coil is simply removed and is then ready for mounting. It is general to assemble the coils on a very thin-walled tube of paxolin. When the coils are wound with thick wire and are operated from a transformer they are quite self-supporting and there is no need to tape them completely.

Accurate alignment is necessary, and as the edges do not touch a distance piece should be inserted. For this purpose paxolin or cardboard may be used. As the two sets of coils have to be interlaced, one set must obviously be shorter than

Fig. 8.—A coil removed from the winding mandrel with the "bend over" turned at right angles. Particularly note that as the rectangles are not dry, and as the coil is not yet moulded, the shape is imperfect. This is corrected in the moulding operation.

Fig. 9.—This sketch gives details of the mould.

One of the wedges used in shaping the coil.
Scanning Coil Construction—
The other. As line scanning is more difficult the line coils are always made the long set. In making the frame coils the bend-over portion has to be longer as it has to clear the line coils. The line coils are set up on the paxolin tube and the frame coils are then dropped into position.

In the case of a long tube the gap distances are greater and the deflecting field is lower than with a short tube. Accordingly the coils are held on the tube by taping them. With a short tube a greater field is necessary and this is normally increased by means of an iron circuit yoke built up from C shape stampings so as to completely encircle the coil. The stampings are stacked to a distance of about one inch and are conveniently held in a metal clamping frame. This can be made from thin tin plate with the aid of tin snips. Such an assembly will hold the coils in position. An experimental coil assembly for a short tube built in the writer's laboratory is shown in the photograph.

Finishing the Coils

It is not necessary to use a low-resistance coil and transformer for frame scanning in which case there is a number of turns, about 1,000, of fine wire are employed. This is much more delicate to handle than that used for a low resistance coil and accordingly it is not safe to press it in a mould without protection in the form of extremely thin oiled silk tape which is simply lapped round it. Fine wire coils are more easily treated by the hot wax process than dope, and in the case of a short tube assembly very great care is necessary.

Lead-out flexible wires should be soldered to the ends of the coils and anchored on the bend-over with a small piece of adhesive tape. It will be realised that in the case of a short tube assembly there is little room to spare between the coils and the core and the minimum possible quantity of oiled silk tape should be used over the coils.

It may be thought that it is not worth while making special jigs for a single set of coils. It can be very definitely stated that the production of an accurate coil by hand without any mechanical assistance whatever is an exceptionally difficult matter. In any case some winding arrangement must be made, even if the bending is attempted by hand. The advantage of a precise coil is shown by the symmetrical evenly focused scan which is obtained. An inaccurate coil will give a distorted raster and in the case of a short tube the accuracy of the focus which is obtainable may leave much to be desired.

It should be realised that the subject of magnetic scanning is one involving many points and the present notes must not be regarded as either final or exhaustive. Field distribution obviously plays a very important part in determining the form of the resonant scan, which is controlled both by the shape of the active part of the coil and also the relative position of the turns. There are two methods of controlling the turn distribution, first by the inside configuration of the winding cheek, and secondly, by the gauge of wire. If the cheek is not parallel with the bed, but slightly inclined, the turn distribution over the active part of the coil is varied. This, however, gives a coil of unequal thickness and a certain amount of useful winding space is lost if the coil is encircled by an iron circuit. The second method of using two or three different gauges of wire is in the writer's opinion a more practical solution and this is a subject which lends itself to easy and interesting experimental work which should have a great appeal to the experimenter.

The writer has endeavoured to indicate how by a little effort and at small expense the enthusiast can make scanning coils capable of giving really satisfactory results.

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<td>Mullard, MW 22...</td>
<td>230</td>
<td>30</td>
<td>1 1/2</td>
<td>3</td>
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<td>Marconophone, 3/3</td>
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<td>40</td>
<td>2 1/2</td>
<td>4</td>
<td>1/4</td>
<td>45</td>
</tr>
</tbody>
</table>

Note.—The above table must not be regarded as official recommendations. The recorded values are taken from laboratory records of coils which have given satisfactory scans. It should be realised that other dimensions can also be used and the above figures should be taken as a guide as to what is required.
Sight and Sound

SOME CLOSE RELATIONSHIPS BETWEEN SOUND REPRODUCTION AND TELEVISION

THE coming of television has brought a great deal of interest into radio. It has also brought an alarming addition to the amount of stuff to be learned! Photographers, and especially cinematographers, are at an advantage here, because things such as "depth of focus" and "critical flicker frequency" are already familiar to them. It is surprising how many radio men are interested in photography. Quite possibly television is stimulating this interest.

In acquiring a new technique it is helpful if there are close parallels, or analogies, with what one already knows. Although in some respects television is very different from sound reproduction, and includes things that have nothing to correspond with them in sound, there are also some parallels. Anybody who knows anything at all about the two systems can see that as the microphone "picks up" the voice, and the camera the picture, these two appliances correspond to one another. At the receiving end the loud speaker and the cathode-ray tube are similar in function because they are the reproducers of their respective parts of the programme. In between, the two systems are almost identical in general nature, because both are required to handle and transmit electrical signals. In fact, at some stages (for example, the receiving aerial and parts of the receiver) the same appliance is made to serve for both at once. Where television shows its independence is in its extending to an additional dimension, necessitating at both transmitting and receiving ends extra apparatus to distribute the light and shade in a systematic manner over the area of a screen. These agreements and disagreements are shown here diagrammatically.

The whole of this apparatus can be considered as electrical equipment. What comes before the microphone and after the loud speaker is, of course, sound, and before the camera and after the screen light. These two things are different, in that sound is a mechanical movement of the air, while light is electrical in nature, differing from radio signals only in the detail of wavelength, and, like them, needs no air or other substance to act as a conveyer. But sound and light are in other ways very similar, because they both move in waves having measurable frequencies. The human ear and eye are restricted to certain narrow wavebands of each, which, therefore, are the wavebands in which the greatest practical interest is taken. The frequency limits of the ear run from about 20 to 20,000 cycles per second; of the eye, from 400,000,000,000,000 to 750,000,000,000,000 cycles per second. The ear therefore responds to a frequency ratio between 1,000 to 1, but the eye to less than 2 to 1, or barely one octave. Change of frequency is heard as a difference in pitch, and seen as a difference in colour.

One of the things that is most discussed in connection with sound-reproducing apparatus is the frequency characteristic, so it is well known to readers of The Wireless World. You all know, for example, that inferior microphones, amplifiers, or loud speakers fail to operate with equal effectiveness over the whole audible frequency scale. And so there is a certain amount of frequency distortion. But, even though

There is an obvious analogy between the various parts of sound and vision broadcasting and reception systems. In the case of the receiving aerial, and usually a good part of the receiver, this analogy extends to an absolute identity. On the other hand, the scanning arrangements at each end are peculiar to television.
Wireless World

September 21st, 1939.

Sight and Sound—

there may be some imperfections or restrictions, the original sound frequencies are more or less preserved in the electrical signals passed from microphone to loud speakers and, subsequently, in the reproduced sound. That is because those frequencies are low enough to be amplified directly, or carried by the higher radio frequencies. Light frequencies are so enormous, however, that they cannot be handled at all by valves or other electrical equipment. Only the variations of strength of the light are low enough in frequency, and even they need ultra-high-frequency radio to carry them. So colour is destroyed entirely. Fortunately, the picture, having an extra dimension, suffers less than sound if the reproduction were reduced to a note of unvarying pitch, merely changing in volume! Distribution of light and shade serves as a very acceptable substitute for colour. If colour television is wanted, the only ways of obtaining it are outside the electrical chain of apparatus—by means of successively interposed colour filters, etc. The various colour frequencies cannot actually be transmitted.

Light and shade can be acceptable as a substitute for colour only if it corresponds reasonably well to one's impression of the relative lightnesses and darknesses of colour. Photographers know how the earlier types of plates and films failed to do this, registering blue as white and red as black, notwithstanding that they might appear to the eye of about equal depth. Panchromatic materials were introduced to correct this defect, because their frequency characteristic is much nearer that of the eye. The sensitive surface in the emulsion camera is fairly good in this respect.

Although the colour of the reproduction is fixed, a fairly large choice of that colour can be made; but practically everybody agrees that a good picture is not composed of all visible colours which the eye sees as white light.

Amplitude Distortion

Evidently there is not a very close analogy between sound and picture reproduction so far as frequency distortion is concerned. But as regards amplitude distortion, the problems are much the same in the two cases. Amplitude distortion, of course, is a lack of proportion in reproducing the intensity. Taken on the scale of single waves, it causes the shape of the waves to be distorted; and in sound that has the effect of introducing new and undesirable sound frequencies. In television, there are effects on the picture definition but they do not occupy such an important place as amplitude distortion in sound. The most obvious sorts of distortion in the picture are due to the department that has no equivalent at all on the sound side—the scanning arrangements.

Amplitude distortion can also be considered on a longer time scale than single waves. Music, or almost any sound programme, has its quiet and loud parts.

The full range of these in music—the more serious sorts, at least—is very large, ranging from almost inaudible to "deafening." Because of unavoidable limitations this range has to be compressed in transmission. It is possible to do a certain amount of expanding again at the receiving end, if desired. Much the same state of affairs exists in television. The eye can perceive at least 100 variations in shade between white and black, even after colour has been removed. Only very faint sounds are drowned by background hiss, hum, interference, etc. And very low lights in the picture are obscured by stray room light, reflections in the cathode-ray tube, halation, and so forth. Very loud sounds are limited by maximum undistorted output; and very bright lights by maximum undistorted screen fluorescence.

Incidentally, the impression of an increase in loudness depends not on the amount by which the intensity of sound has been raised, but by the ratio in which it is increased. If an increase from 10 to 15 milliwatts produces a certain increase in loudness, the same increase in loudness is given by raising power from 100 to 150, not to 105. The same principle holds good in seeing. Both are examples of the Weber-Fechner law, which states the observed fact that human senses respond to changes in logarithmic scale, or an approximation to it.

Contrast Control

The rate of contrast is under control at both transmitting and receiving ends, and is denoted scientifically by $\gamma$ (gamma). If $\gamma = 1$, it means that the contrast is the same as in the original. Values less than 1 mean that the reproduced picture is flatter, and greater than 1, more contrast, than the original. In cinema practice it is usually made rather more than 1, by way of compensating for loss of colour. The proper practice in television transmission has been the subject of discussion; but as it can be adjusted to suit the effects the receiver, perhaps it doesn't matter within reason, so long as it stays constant.

There is a risk, especially with sensitive amplifiers, of the 50-cycle mains butting in uninvited. The effect of this on sound reproduction is aptly called hum. Then there are sundry irregular voltages caused by a host of electrical appliances, besides certain influences in the amplifier. The result, in terms of sound, is justifiably termed noise. As there is a lamentable shortage of suitable terms to apply to the variations in voltage or current that produce these effects they have to be referred to, for want of anything better, as noise and hum voltages (or currents). To avoid having to discriminate between voltage and/or current, and to save time generally, one gets into the way of calling them "noise" or "hum" as the case may be. Now comes television, whose apparatus is subject to exactly the same undesired electrical influence. And one cannot be expected to follow the foregoing train of thought, is bewildered by hearing the blank bars across the screen referred to as "hum," or a speckled appearance of the picture as "noise."

Wanted: New Names

Talking about absurdities of terminology, is it quite impossible for something to be done to avoid the prevailing habit of distinguishing between television receivers "with radio" and "without radio"? The former clearly means a receiver connected up by line to the Alexandra Palace or other source of programme. But it is invariably used to mean a receiver limited to the vision and sound from that station and unprovided for reception on any longer waves. Seeing that television broadcasting is just as much radio as any other broadcasting, a television receiver without radio, as described in so many catalogues, seems a contradiction in terms. In my respectful opinion, a separate shift to avoid this error, receivers are sometimes advertised as including both television and broadcasting, or available at a lower price without broadcast reception. But if television isn't broadcasting, what is? Still another dodge is to express the distinction as television and all-wave reception. But the mere fact that this distinguishes the "all-wave" is wrongly named; if it were it would include the television waves.

Our particular interest, radio, seems to have been put under a curse so that never, never, will any of its language be appropriate, consistent, or logical, or in fact anything but a reproach and irritation. This is why I started to talk about it with. Yet perhaps not. . . . The object of this article was to assist clear thought by tracing the resemblances and differences between sound and vision technique. If anybody can think about them clearly at all, it is in spite of and not because of the language with which we seem to be obliged to talk about it.

The Wireless Industry

Wolfram Products & Refineries, Ltd., makers of tungsten rod for contacts, etc., request that all future correspondences be addressed to 31, Twain Road, Welwyn Garden City, Herts.

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The 1939-40 catalogue of Denco, Warwick Road, Clacton, Essex, contains full particulars of Denco-Polystrylene (British) insulating material and of numerous short-wave components in which it is incorporated.

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Leaflets describing the Models 45 and 47 valve testers, Models 30 and 35 oscilloscopes, and Models 90 and 95 universal and DC multirange meters have been received from Taylor Electrical Instruments, Ltd., 45, Poulets Place, Regent Street, London, W. 1. The scales of all Taylor meters are hand calibrated to B.S. First Grade specification.
Test Report

MURPHY A76

AC Table Model Superhet with Special Short-wave Circuits (Five Valves + Rectifier and Tuning Indicator) - Price £16 10s.

This is the third short-wave "special" to be produced by Murphy Radio, Ltd. It possesses the good qualities of its predecessors-ease of tuning and sensitivity comparable with medium-wave standards- together with improved second channel suppression and greater stability of tuning. These improvements have not added to the complication of the receiver; in fact, the circuit is much simpler than the double-superheterodyne arrangement previously employed.

Circuit.-The basic circuit for medium and long waves is similar to that of the Murphy A72 in which a triode-hexode frequency-changer is followed by a single IF stage, a combined signal rectifier, AVC rectifier and first AF stage, and a beam tetrode output valve. Two degrees of selectivity are provided in the IF stage by increasing the coupling in the first IF transformer. The normal coupling in association with tone correction in the output stage permits an audio-frequency response up to 4,500 c/s, and this is expanded to 6,500 cycles in the position of minimum selectivity. At the other extreme the top response is reduced below 4,500 c/s by the tone control.

Additional tuned filters are introduced in the AF stages to "clean-up" the response. One is a sharply-tuned series resonant circuit connected across the output transformer primary to suppress heterodyne whirls between adjacent channels, and the other is a heavily damped circuit tuned to approximately 3,000 cycles in the cathode return circuit of the output valve. The object of this circuit is to introduce negative feed back in the region of 2,000-4,000 c/s where the loud speaker response might tend to show harshness on some types of transmission.

Advantage has been taken of the three-gang tuning condenser required by the short-wave design of the A76 to introduce a further stage of preselection on medium and long waves. The image suppression in these wavemakers is therefore better than in the A72 receiver.

Adequate image suppression on short waves involves the use either of a very high intermediate frequency or a number of tuned RF circuits before the frequency changer. In the A76 the latter alternative has been adopted, thus enabling the standard 465 kc/s IF components to be employed and also saving the additional valve necessary for double-frequency changing.

Seven broadcast and amateur bands in the 15-500 metre range have been selected and separate groups of coils provided for each band. Single tuned circuits precede the RF stage, which is only in operation on short waves. Since the aerial tuning is broad and the frequency range of each band is narrow, the tuning of each of these aerial circuits has been pre-set. In the coupling between the RF and frequency-changer valves, on the other hand, there are two tuned circuits, and both these and the oscillator circuit are ganged and "bandspread" by the main tuning condenser, a small series capacity being introduced in each case to reduce the total effective change of capacity.

To minimise "warming-up drift" due to changes of capacity in the valve and associated circuits, the stray capacities are swamped by employing a comparatively high minimum across each tuned circuit. Experience gained in designing stable tuned circuits for push-button tuning has been drawn upon in selecting the types of fixed condenser used for this purpose, and the long-term calibration accuracy has also been greatly improved.

The valve used in the RF stage has the high mutual-conductance of 8 and was designed originally for television work. It has shown itself capable of giving a very high gain with a low signal-to-noise ratio on short waves.

Performance.-Those who receive their introduction to short wave listening through the medium of the A76 may be accounted fortunate. They will no doubt take for granted the ease and stability of tuning and will settle down to enjoying the variety of programme material on the short-wave bands which they have been accustomed to receive on medium and long waves.

On the other hand, those with previous experience of ordinary all-wave sets may find it lacking in "punch." If they will take the trouble to investigate they will find that this rather vague description of apparent liveliness and sensitivity was in reality attributable to severe second channel interference. A proper appreciation of the qualities of the Murphy set comes not from general impressions of a whole waveband, but by comparison of the reception of individual stations with the same stations as received on a set without adequate preselection. The superiority of the A76 in the matter of sensitivity and signal-to-noise ratio is clearly established and the comparative emptiness of the scale is shown to be due to the absence of signals which should not be there. Stations which on an ordinary set were almost engulfed by a background of

Schematic circuit diagram of the Murphy A76 receiver.
Murphy A76—

CW signals or apparent sideband interference stood out quite clearly on the Murphy set, usually with several clear channels between them and the next stations on either side.

The expansion of each waveband to the full width of the scale makes tuning a real pleasure, and with the aid of the tuning indicator one can adjust for best quality to the exact centre of the modulation as deliberately as one might for a medium-wave station.

As far as frequency stability is concerned, the results fully justify the designers' efforts, and we have no hesitation in saying that from this point of view, as in many others, the A76 sets a new standard of performance for commercially produced short-wave receivers. After listening, say, to an American station for an hour one can switch off and leave the tuning untouched in the certain knowledge that the station will still be there as soon as the set comes to life after being switched on again later in the day. There may be a drift of half a degree on the arbitrary scale between "stone cold" and the equilibrium working temperature, but this is never enough to put the tuning outside the modulation fringe of the station. Unlike an earlier Murphy short-wave double superheterodyne in which waveband selection was effected by mechanical location of the tuning condenser, the station settings on the A76 are always accurately repeated, since the circuits are changed throughout by switch contacts.

The medium- and long-wave ranges are by no means subsidiary to the shortwaves in this set. They possess all the sensitivity and selectivity required for reliable reception of worthwhile programmes and are quite free from second channel and other self-generated whistles. Rather have the short waves been promoted to the rank of the medium and long waves in entertainment value. The equality of average deflections of the cathode ray tuning indicator on all wavebands gives the user visual proof that this object has been achieved.

Quality of reproduction, while not reaching the standard of sets in the Murphy range which have been specially designed for this purpose, is nevertheless admirably suited to long-distance reception. The frequency limitations introduced by the three settings of the combined tone and selectivity control have been well chosen and quality is not necessarily thrown away in achieving a quiet background. The conditions under which the set was tested, which would normally call for a severe top cut, were met by the "intermediate" setting of the control and quality that could be enjoyed whether the transmission was speech or music.

The absence of a 13-metre band may be excused if one assumes that most short-wave listening is indulged in during the evening when conditions on this band are not as good as those of higher wavelengths.

Constructional Details... The four groups of short-wave tuning coils are housed in a subdivided screening box in the middle of the chassis. The short-wave switch spindle passes through the centre of the box, and connections to the separate sections of the switch are as short as it is possible to make them.

A multiple switch of this type requires quite a considerable torque to operate it and the designers have accordingly pro-

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**Waveranges**

Short-wave Bands .16, 19, 21, 25, 31, 42 and 49 metres

Medium-wave Band . 190-550 metres

Long-wave Band . 970-2,000 metres

Layout of valves and controls in the Murphy A76. The cabinet has been designed to accommodate an optional press-button or remote control unit in the base.

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Wireless World

SEPTEMBER 21st, 1939.
Wireless World

PLEASE ORDER NOW

Readers are earnestly requested to instruct their local newsagents to reserve a copy of this journal for them regularly.

This is in order to facilitate distribution arrangements and avoid the risk of failure to obtain copies.

In the interests of the paper itself in these difficult times it is particularly hoped that regular purchase be made from the same newsagent or bookstall each week.

Please see the emergency order form printed in our advertising pages.

"Trophy" Receivers

PETO SCOTT announce that all list prices of "Trophy" communication receivers have been advanced by 10 per cent. Current prices are therefore as follows:

<table>
<thead>
<tr>
<th>Model</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trophy 8</td>
<td>13 17 3</td>
<td></td>
</tr>
<tr>
<td>Trophy 6 A.C. Model</td>
<td>10 19 6</td>
<td></td>
</tr>
<tr>
<td>Trophy 3 Battery Model</td>
<td>6 6 6</td>
<td></td>
</tr>
<tr>
<td>Preselector</td>
<td>7 8 6</td>
<td></td>
</tr>
</tbody>
</table>

The cost of additional coils for the Trophy 3 to complete the wavemange from 6.2 to 450 metres is 1s. 6d.

Osram Valves

ARRANGEMENTS have been made to ensure regular supplies of Osram valves in all districts. Branches and depots of the General Electric Co., Ltd., in thirty-four towns will maintain stocks of all types.

Simplified Servicing

In the Philips Type 735 receiver, the chassis and front panel may be withdrawn from the cabinet as a single unit. By this means ready access is obtained to the interchangeable station dial. The pointer is released by removing one screw, and the dial may be withdrawn sideways after loosening the single clamping screw by which it is held.

SEPTEMBER 21st, 1939.

Murphy A76—vid an operating knob of really useful size. It is matched by knobs of similar size for tuning and volume control, both of which are consequently light to the touch. Key-type switch knobs are used for selectivity and main wave-range selection.

The principal short-wave station names are arranged in groups down the left-hand edge of the dial and an indicator coupled to the short-wave range switch brackets the group to which the set is tuned. Individual calibrations are made from a 50-division scale covered by an extension of the medium- and long-wave pointer.

The workmanship is well up to Murphy standards and the blue enamelled finish of the chassis and principal components is durable.

The base of the cabinet is shaped to receive the push-button or remote control units which are optional accessories to the majority of current Murphy receivers.

Summary.—Ease and precision of tuning, stability in the tuned circuits and freedom from second channel interference, have been achieved without sacrificing the essential qualities of range and good signal-to-noise ratio. This is a "special" with which the ordinary listener may challenge the expert operator and his "communication" set. It places the short-wave range on an equal footing with medium and long waves as a source of entertainment and instruction.

Murphy Radio, Ltd., Broadwater Road, Welwyn Garden City, Herts.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Carrying On : A Serviceman’s Dilemma

At such a time as this, there are certain questions which the majority of radio service engineers must be asking themselves. I should like to quote my case as typical.

I am in sole charge of a service department, and, in fact, the only technical man in the firm who is capable of the location of faults in a radio receiver. The value of broadcasting in previous crises was so apparent that it is presumed that the Government will continue the service, both on the score of its utility in rapid dissemination of news and also to help in the maintenance of good spirits. (It is perhaps not fully appreciated outside the retail trade just how "lost" the general public can become without its radio).

The general position, therefore, is this: should the service engineers volunteer (or be conscripted) for duties in the Services it would seem that the radio industry must come to a standstill. To quote my own case, my employer would not sell a receiver he was not prepared to service; indeed the situation would be impossible, for obviously a member of the public could not be expected to request service every time the case in use developed a fault. We would like to know, therefore:

(1) Should the service engineers’ work be considered of National importance, or should they be made of the Services?

(2) Have the Government made any alternative provision for the servicing of civilian radio? SERVICEMAN.

[Wireless servicing is a Reserved Occupation for ages of 30 or above.—Ed.]

Separate Speakers

In your issue of July 27th your contributor "Diallist" says that he does not know of any set apart from communication receivers, fitted with a separate speaker.

We have been supplying sets for high-quality reception with separate speakers for many years, and where space and other circumstances permit we invariably recommend the use of a separate speaker.

S. HALFORD,
Halford Distributors, Ltd.

Free Grid’s Speed Indicator

"PARASITE," whose letter was published in The Wireless World of August 21st, has not grasped the significance of relativity in relation to the Doppler effect. Does he not know that the supposed expansion of the universe is computed from the lowered frequency of the light from the nebulae caused by their velocity away from the observer?

Suppose for simplicity that the transmitter on the ground radiates a beam of plane waves, and that the aeroplane is moving directly towards the transmitter along the beam. The equation of the waves can be written:

\[ E = a \sin \phi \left( t - x/c \right) \]

where \( E \) is the electric field strength, \( \phi = x/t \) and \( c \) is the velocity of light; all this being relative to the ground station.

Relative to the aeroplane we shall have a similar equation, which we may write:

\[ E' = a' \sin \phi' \left( t' - x'/c \right) \]

Now the Lorenz transformation from the theory of relativity is:

\[ x' = h(x-u) \quad t' = h(t-xu/c) \]

where \( u \) is the velocity with which the aeroplane approaches the transmitter, and

\[ h = 1/\sqrt{1-u^2/c^2} \]

which when substituted into (2) gives:

\[ E' = a' \sin \phi \left( t + u/c \right) \left( t - x/c \right) \]

Thus the frequency of the transmitter relative to the aeroplane is not \( f \) but \( f(1-u/c) \).

If the relativity condition were ignored, the frequency modified by the Doppler principle would be \( f(1-u/c) \), and for speeds less than a quarter that of light, there is not much difference between these two results. Bright on. W. BAGGALLY, M.I.W.T.
TELEVISION SYSTEMS

In the ordinary way the amplitude of a television signal represents the brightness of the corresponding picture element, its frequency determines the size of the element, whilst its phase corresponds to the instantaneous position of the element relative to the picture as a whole.

The invention is based upon the discovery that, in certain cases, these factors of amplitude, frequency and phase can be used to convey information other than that for which they are normally used. In practice, for instance, a finer gradation of light and shade is carried by the radiated waves than it is possible for the eye to appreciate. It is therefore proposed to use some of this superfluous "information" for other purposes.

More particularly, the amplitude of a single current impulse is used to convey simultaneously the separate "brightness" values of a number of different picture elements, thus condensing the frequency band necessary to give a certain quality of picture. Alternatively, it allows a given frequency band to convey more information than at present. The transmission of pictures in natural colours is one possible application of the system.


TUNING CONTROL

RELATES to the type of set that is tuned under "quiet" conditions, i.e., with the loud speaker out of action, the latter only being switched on when the circuits have been accurately tuned to a desired station. The object of the invention is to arrange for quiet inter-station tuning.

The current consumption or power taken by a set is, according to this invention, automatically regulated so that it bears a constant ratio to the output from the loud speaker. As shown in the Figure, a diode rectifier D is coupled to the amplifier V. A slider P on the resistance R serves as a volume control.

As the slider P is moved downwards the negative bias applied by the resistance R2 to the grid of the amplifier V is increased. Both adjustments serve to reduce the power consumption of the set so that the loud speaker volume is cut down. In the same way, more power is automatically switched on when the volume of the sound is increased.

C. Lorenz, Akt. Convention date (Germany), August 28th, 1937. No. 505878.

AUTOMATIC TUNING CONTROL

THE invention is concerned with automatic tuning systems, particularly for car radio, of the kind in which an electric motor is used to rotate the main tuning control. It is pointed out that if the motor is fast-moving it is difficult to stop it at the correct tuning point for the station selected. On the other hand, if the motor is slow-moving it takes a disagreeably long time to tune between two stations which happen to be widely separated in frequency.

It is therefore proposed to make a compromise by so arranging matters that the motor moves rapidly "between stations," but automatically slows up as it approaches the selected station. This object is attained by passing the DC anode current from one or more of the amplifiers through a saturable choke inserted in series with the field windings of the motor. As the critical tuning point is approached the effect of the AVC voltage cuts down the DC component of the anode current, and so automatically reduces the speed of the tuning motor.

Hazeltime Corporation (assignee of N. P. Case). Convention date (U.S.A,) October 22nd, 1937. No. 505840.

BLIND LANDING BY RADIO GUIDING

A GUIDING beam for an aeroplane can be formed by erecting a dipole aerial some two or three wavelengths above ground, so that the direct radiation combines with that reflected upwards from the earth's surface to produce a "club-shaped" field down which the pilot glides. In practice, it is found that a single dipole aerial produces a field in which "lobes" of high field strength are interspersed with "anti-lobes" or intervals where the field strength sinks to a minimum.

The presence of these "silent" zones is troublesome and misleading to the pilot, and it is the object of the invention to eliminate them. For this purpose the main aerial is combined with a second dipole, separated from the first by half a wavelength in the vertical plane. This, too, radiates a similar field in which lobes of maximum strength are separated by silent zones, but when the two aerials are spaced apart in this way described the silent zones of one coincide with the maximum lobes of the other, and vice versa, so that the resulting field is of uniform strength.


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* CHALLENGER Range for 1940.
  CHALLENGER Radio Corporation, 2d. stamp for illustrated catalogue at battery, battery-radio, or mains radio, and mains receivers; 6/3 to £20; nice list also available.

RADIO CLEARANCE, Ltd.
  LL Lines Previously Advertised Still Available.

All Lines Dear 5/- Cabling Free; under this amount sufficient postage must be included with order.

All Enquiries Must Enclose 1yd. Stamp.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1

ARMSTRONG Can Give Delivery of Practically all 1940 Radio Receivers.

ARMSTRONG Recommends the Following Economically Priced, powerful chassis, suitable for receiving North and Scottish Emergency Transmitters.

ARMSTRONG Model AW35, 8-valve all-wave radio chassis, wholly built, complete with one pull-out; price 8 gu. 6d.

ARMSTRONG Model AW115P 6-valve all-wave Radio-gram Chassis, with radio-frequency pre-amplifier and a wide pull-out output; price 11 gu. 6½d.

ARMSTRONG Models AW35 and AW115P Are Both Effective on the Important 16, 19, 25, 30 and 34 metre short wave bands.

ARMSTRONG Illustrated Catalogue Describing Above Chassis and Many Others of Equal Interest.

ARMSTRONG Co. Announces that, in accordance with their policy of fair trade, prices and chassis will not be increased until absolutely necessary.

ARMSTRONG MANUFACTURING Co. (Hind Office), 20 Vakr Road, Holloway, London, N.7 (Telephone: Hendon 6136). Phone: H.1179.

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INDEX TO ADVERTISEMENTS

Anglo-American Radio & Motors, Ltd., Page 1

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Bays, E. P., Ltd.

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Elliott Radio & Television Co., Ltd.

Flaxico, Ltd.

General Electric Co., Ltd., page 2

Goodman Industries Ltd.

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EDITORIAL

We Carry On

New Publishing Arrangements

DURING the last war, The Wireless World continued publication without interruption, and to us it is inconceivable that we should do otherwise during the present struggle, in which radio has assumed vastly greater importance.

But experience of wartime conditions has convinced us at an early stage that some change is necessary if we are to continue to render to our readers the service that provides the justification for our continued existence. Our technical staff has already been depleted by calls from the various wireless branches of the Defence Services, and many of our contributors can devote less time than formerly to work for this journal. To continue as a weekly publication would, it is feared, introduce some risk of a falling-off in the standard we have set ourselves.

It has therefore been decided that The Wireless World shall in future appear in monthly and enlarged form at the price of one shilling. As there is bound to be some slowing-up of technical progress, we anticipate that the new arrangement will enable us to present an adequate record of developments without too great a time-lag.

Next Issue October 20th

For the duration of the war, this will accordingly be the last weekly issue of The Wireless World, but, to avoid a too sudden transition to the new periodicity of publication, arrangements have been made for the first enlarged shilling number to appear on Friday, October 20th, and the journal will thereafter appear on the 20th day of each month.

Advantage will be taken of the changeover to make such alterations in the format of the journal as are appropriate to the new method of publication, though the scope and technical standard will be unaffected. There will be many more pages, but the page size will be smaller, and the journal will be more compact and convenient.

The relationship between this journal and its readers has always been so friendly that we do not hesitate to ask of them one small favour. This is that a definite order, a form for which will be found inserted in this issue, should be given to newsagents to reserve a copy of each issue, beginning with that of October 20th. Readers in the Services or overseas may find it more convenient to subscribe direct to our publishing office; the new rates are 14/- per annum for home or abroad.

Press and Broadcasting

Unnecessary Antagonism

A RECENT statement by the Minister of Information suggested that the Press of this country was seriously perturbed by competition from the B.B.C. in the dissemination of news.

In the days when wireless was struggling tooth and nail to establish itself, we might have found in this admission some cause for jubilation, but now that broadcasting has "arrived" we merely view the matter with mild disquiet. We, though wireless people, would hate to see a state of affairs where broadcasting became the sole, or even the main, channel of news distribution. There is really no need for antagonism, as both parties will find out when they have had time to evolve the right techniques for changed conditions. The trouble at present is that broadcasting is too much like the newspapers, and the newspapers are too much like broadcasting.
Deaf-aid Adaptor

FOR USE WITH A STANDARD BROADCAST SET

By R. H. WALLACE

As suggested in an earlier article, the use of headphones in conjunction with the set gives an opportunity of raising the volume level to a very considerable extent without making it objectionable to other listeners in the room. Those merely hard of hearing do not generally find much difficulty in reception, as the majority of sets are worked at a volume appreciably above the level of the original, at least for all the quieter portions of the programme time. However, those very hard of hearing, and the deaf, need a step-up in volume far greater than can be provided by the simple use of the set control; that is, unless they sit very close to the loud speaker, which generally involves a cramped and uncomfortable position. In addition, in many cases, some measure of additional tone control is necessary in order that the deaf may enjoy the programmes to the full, and this can be provided with the unit about to be described. These desirable features can be obtained without much expense, and entirely without the use of extra batteries or valves, since the whole output of the ordinary set is not needed even for the very deaf.

Compact and Easily Built

The unit of which the design and construction are now to be described can be easily made up from standard components. It is compact, and gives a controlled increase of the volume level from the normal extension speaker terminals of the set. It is so arranged that the normal listener has only to turn down the volume control to give an output comparable with that of the set. As it can be used from an extension point in another room, it is very suitable for use by an invalid. The assembly is small enough to be readily used on the arm of a chair, and this gives considerably greater freedom to the wearer than if the phones were plugged direct into the set.

Strictly speaking, every deaf person requires a unit expressly designed and corrected for his peculiar aural characteristics; this also applies to every individual of normal hearing. In practice, however, it is not necessary to worry unduly about precise adjustment, but considerable divergences do require correction. It will very often be found that deafness is associated with a progressive diminution in response to frequencies at one extreme or the other, while less commonly these two may be combined, resulting in a pronounced distortion. Therefore if the unit can be arranged to provide some tilting of the response towards either the treble or the bass, then the required conditions will be obtained; this in addition, of course, to the general rise in volume. The latter may be readily attained, in the case in question, by an increase in the ratio of step-up from a low resistance extension.
Deaf-aid Adaptor—

Resistance shown there is all that is needed
to give the required rise in volume; this amended condition is shown in Fig. 1, while the values for the transformer-fed

arrangements are given in Figs. 2 and 3.

It will be noted that in these cases it is assumed that the earpieces will be paralleled to give a net resistance of 1,000 ohms in order to avoid the use of higher inductance chokes with consequent increase in size.

As explained in the previous article, it is preferable to use simple rejection circuits for the tone control, and, while it is easy to multiply the number of response curves available, the writer suggests that these need not exceed four; in the first place a treble control in the set is an almost universal feature, and this gives a bass lift of considerable amount, while the ordinary set is not likely to suffer from any preponderance of top notes. Further two degrees of treble lift will satisfy most requirements, and if it is possible to provide for one position in which both extremes are lifted, the switching requirements will be quite stringent enough for a compact assembly without further subdivision.

There is an especial need for some control of volume to be incorporated in the design of a unit of this type, since it will often be used by older people, who naturally will not wish to leave a comfortable chair and take off the phones in order to make adjustments. An additional requirement for such listeners is that the device must be simple without too many controls, and it should be light enough to be readily carried about.

Features of the Unit

The main specification to be realised is now fairly clear. It must provide a rise, above the normal volume of the set, of the order of twenty or thirty decibels, with, say, one degree of bass lift and two positions of treble lift, also providing for control of volume and for easy attachment to set and phones. It is desirable also that the tone controls should make as little difference as possible to the loudness level when operated, though since the volume control will be close at hand, this is not absolutely essential. It is naturally preferable to use standard parts, which are readily obtainable, and the size should hardly exceed 7 in. x 4 in. x 2 in.—the smaller the better. Technical considerations indicate that the potentiometer must handle short peaks up to 3 watts, and a value of 10 ohms will be suitable for most low-resistance extensions.

The transformer may have to deal with as much as 3 watts when the volume is set at maximum, and the switch must have at least five positions on each of two poles.

The final circuit diagram adopted is given in Fig. 4.

Now it must not be thought that the absence of terminals permitted a shallow container to be used. The specified switch is the smallest one covering the required circuit changes, which is available to the general public, as far as the writer is aware. One of the most difficult components to choose was the choke; calculations and experiment showed that this should have a value between 0.5 and 1 henry; now this value is available in air-cored form, but then takes considerable space, while the usual tone-control choke of the same value is in most

Small-size Components

There is not a large choice of volume controls of the required low value of 10 ohms now available. The one recommended is as small as any; there are several transformers of suitable value among the output types of various makers; the one used was chosen because the
Deaf-aid Adaptor—cases a still bulkier component, since the demand is small and there are few types to choose from. It would, of course, have been possible to use two superhet RF chokes in series, but the smallest of these would still be rather bulky. Finally, a solution was found in the use of an ultra-small microphone transformer, the primary of which has the convenient value of 0.7 henry; it must be noted that this is possible owing to the fact that there is no DC component passing through, otherwise the use of an ungapped core would not give the required induction.

The selection was completed by the making of a dia-frag insulated jack, and it was found possible to assemble the potentiometer, switch, transformer, choke, jack and two wire-end condensers in the total space of \( \frac{3}{4} \times 4 \frac{1}{2} \times 2 \frac{7}{8} \) in.

It will be noticed that the last position of the switch puts the 0.02 - mfd, condenser in parallel with the choke, the combination being in series with the phones; these constitute a circuit very flatly tuned to about 1,000 cycles per second which tends to reduce the response over the middle frequencies, leaving the extremes unaffected. It will not often happen that this position is required, but there are cases where it is advisable. As there was a spare point on the switch this was made use of to switch off the phones, though this is hardly necessary, as it is almost as easy to withdraw the plug from the jack; in either of these cases the load on the output stage is maintained, and it is not necessary to switch the set off for short intervals.

The construction of the unit is not difficult, but does call for some patience in the wiring, owing to the small amount of space available. Unless a small soldering iron happens to be handy it will probably be worth while to make one with a bit not more than an inch long. The contacts of all the components should be tinned with a larger iron before assembling them in the case.

The box in which the unit is housed is preferably of wood, since this makes the construction simpler owing to the confined space, and the fact that the wires and components are in direct contact with the sides; the use of insulating bushes is also thereby avoided.

When making up this case, to work very closely to the prescribed internal dimensions, and as long as these are adhered to the actual thickness does not much matter; however, an armchair unit is liable to be dropped occasionally, and should be robust, so thin plywood is recommended. It is largely a matter of personal taste whether the outside is faced by polishing or covered with leatherette; the latter is favoured by the writer, since it will then cause no damage to any polished furniture on which it may be placed. If this method of covering is adopted it will be found that a lot of difficulty is avoided by drilling all the holes through the box before applying the leatherette, which may then be secured with wood glue or secco-tine, and when dry the holes can be cut through with a sharp knife. It is very difficult to make neat holes when the covering is already on.

Mounting the Transformer

The larger transformer will not fit in until the lugs have been bent down at right angles to the base; it is then secured, at one end only, by a screw through the lug to the side of the case, sandwiched between the switch and volume control, which hold it endwise and prevent it from vertical movements by the top and bottom bush of suitable size for the flex lead-in this should be fitted now. The spindles of the two controls are longer than necessary for the present purpose and must be shortened so that the knobs just clear the case. When all the components have been provisionally fitted, the four corner pieces to which the lid is secured should be cut to the right length, which is such that a flush fitting is secured, and then glued in place; one of these is not right in the corner as this is occupied by the jack; the cover is held to these by four well-counter-sunk screws.

Should it be found that the bobbin of the transformer now favours the lid from fitting properly, a small amount of wood should be pared away, while any small space remaining between the two should be filled in with a slip of wood or card, the object being to secure this rather heavy component independently of its fixing lugs.

The wiring of the unit may now be commenced. It will be found that the lower ratio of the LF62 transformer is normally sufficient, and the tapping marked with a blue spot should be tucked away underneath after the end has been covered by a piece of sleeving; the two leads which comprise this tapping should be soldered together first. The low resistance primary of the LF64 transformer is the only winding used, and it should be noted that this was connected between the green and red leads in the specimen obtained by the writer; in any case, it is easy to check this point, since the other winding has a resistance of the order of 2,000 ohms, and a flash lamp and battery will soon disclose which is the right one to use.

The trip flex lead from the set is knotted about two inches from the end and then bored and tinned; one wire goes to each end of the volume control, and the other (earth) wire to the tag on the case of the latter, this being the most convenient point of anchorage. The two remaining heavy wires from the main transformer, marked with green and red spots, are taken underneath this and soldered, one to the slider of the potentiometer and the other to the low-potential end of the element. Next it is wise to bore the ends of the leads from the choke (primary of LF64) and solder one to contacts 5 and 6 of the switch—remember this is upside down. Then the grey wire from the large transformer is joined to the earthed tag on the case of the

![Fig. 5.—Wiring diagram of the deaf-aid adaptor unit. When constructing the unit work to inside dimensions.](image-url)
Deaf-adapted volume control, and also to one terminal of the phone jack, that nearest to the end for preference.

The wire-end condensers are now placed in position, secured if necessary by a turn or two of tape or wedged with card. The wires from the choke end of these condensers are then brought to the nearest points of the switch and soldered together, forming a common anchorage for the other wire from the choke and the thin yellow lead from the transformer.

The other wire from the 0.1-mfd. condenser is lengthened and taken to contact 3, on the other side of the switch from that to which the choke is connected, and the lead from the 0.02-mfd. condenser similarly treated and soldered to contacts 4 and 6 on the same side as its companion. The common junction point of condensers and transformers is connected to contact 2 on the switch; the particular side does not matter since this is the normal response connection, but the side just dealt with is the nearest. The last step is the joining of the two central contacts of the switch together and to the remaining terminal of the jack, and the wiring is complete.

The finished unit should now be tested to ensure that the wiring is correct. The connections of the switch are the most confusing, since all the wiring is done with this upside down; in addition it may possibly be found that the volume control works the wrong way round; this does not really matter, but is more convenient to remember if a clockwise movement increases volume. The base is now fixed and the unit is ready for use.

Increasing Volume

The rise in volume will be found sufficient in nearly all cases, but where the user is very deaf, or the extension impedance is lower than 4 ohms and it is desired to increase the step-up still more, the higher ratio of the transformer may readily be brought into use by connecting the blue wire, in place of the red spot, to the potentiometer. It is not suggested that there is any need to mark the different settings of the tone control, as these are readily memorised, and the user will naturally turn to that which gives the best results and leave it at that. An "off" position is provided on the switch as there is one for each spare contact; this disconnects the phones but leaves the load still on the output valve, so that no damage to the latter can occur if the set is left on.

This design is not suitable for high-resistance extensions, and though it can be adapted to them it is not easy to give the needed ratio for the transformer since this will vary widely with the output valve employed and with the amount, if any, of negative feed-back used. If such modification is to be made, the volume control should have the value indicated in Fig. 2, while it may be possible to find a transformer of the right ratio in the type and size specified. If this is not possible then condenser isolation will have to be adopted, no other alteration in the values parallel.

External view of unit showing flex and phones in jack. Note the compactness of the unit as shown by comparison with the phones.

LIST OF PARTS

<table>
<thead>
<tr>
<th>Description</th>
<th>Make/Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Output transformer, ratio 35:1</td>
<td>Bulgin LF02</td>
</tr>
<tr>
<td>2 Microphone transformer, ratio 1:60</td>
<td>Bulgin LF64</td>
</tr>
<tr>
<td>3 2-pole six-way rotary switch</td>
<td>Bulgin 5x02</td>
</tr>
<tr>
<td>4 Volume control, 10 ohms, without switch</td>
<td>Bulgin VC80</td>
</tr>
<tr>
<td>5 Wire-end condenser, 0.1 mfd., tubular</td>
<td>Hunt's</td>
</tr>
<tr>
<td>6 Wire-end condenser, 0.2 mfd., tubular</td>
<td>Hunt's</td>
</tr>
<tr>
<td>7 Midget insulated jack</td>
<td>Igranic</td>
</tr>
<tr>
<td>8 Pair headphones, 1,000 ohms (or 4,000 ohms with earpieces connected in parallel)</td>
<td>Electrofax</td>
</tr>
</tbody>
</table>

Miscellaneous parts:

- 2 Bakelite knobs
- 2 yards of triple flex
- 3 Countersunk wood screw, 1 in. long
- 4 Countersunk wood screw, 1 in. long
- 1 Box, wood, 1 in. thick, inside size 3 in. X 4 1/2 in. X 5 1/2 in. with inside fitting lid at bottom
- 1 Piece of leatherette, 1 ft. square
- Tinned wire, sleeve, etc.
- Ebonite bush, 1 in. hole, 1 in. outside.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents.

Wartime Listening

I FEEL that a word of thanks is due to the contributor of the recent article explaining the best method of adapting our sets for headphone listening to meet the particu-
lar needs of wartime. Not the least valuable part of the article is that giving details of the simple home-made unit containing transformers, volume control, etc., that have been an ardent advocate of headphone listening for many months past and would venture to assert that, apart from any special wartime considerations, those who have never attempted any carefully planned head-
phone listening such as I indulge in, do not know what they are missing. I realise that the loud speaker is very necessary on certain occasions, and for certain types of trans-
mision, and I would not on any account sacrifice my own high quality amplifier and

Please order now

Readers are earnestly requested to instruct their local newsagents to reserve a copy of this journal for them regularly.

This is in order to facilitate distribution arrangements and avoid the risk of failure to obtain copies.

In the interests of the paper itself in these difficult times it is particularly hoped that regular purchase be made from the same newsagent or bookstall.

Please see the emergency order form inserted in this issue.

Many readers must have welcomed your recent headphone listening article, but there is another aspect of wartime listening on which a practical article would be welcome, and that is remote switching of the receiver. We have been told often enough how to connect up on any account for use in another room, and most people nowadays use this undoubted rein-
forcement to the pleasures of listening. It has hitherto not been worth while to arrange for switching the set on or off at the distant loud speaker, since more often than not it is the desire for a change of programme which causes us to journey to the set in the first room, and remote tuning con-
trol, even using push-button, has been too expensive for most of us. Nowadays there is an enormous number of people whose listening, in the absence of a good SW range to their sets, is confined to the B.B.C. Home Service. The provision of remote switching of the set from the distant loud-speaker point is simple and not expensive.

R. BLYTHE.
Exeter,

Norwich.

Wireless World
I AM very seriously perturbed over this business of electricity rationing, as it is liable to restrict my experimental activities very seriously indeed. I am, of course, a very great user of electricity both for laboratory and for domestic purposes. Since it is absolutely unthinkable that my laboratory work should suffer in any way, I have already, despite Mrs. Free Grid's protests, imposed severe restrictions on the use of electricity in my household for domestic purposes. I am myself setting a good example as I am writing these notes by the light of a guttering candle sitting in front of the cold ashes of a dead electric fire.

The petrol rationing is, of course, another wartime restriction which we must put up with as best we can, but it will undoubtedly do one very good thing, and that is that we will give great encouragement to the development of all-electric cars and motor cycles. An all-electric bicycle was actually launched in Holland some years ago, and in this country all-electric delivery vans are, of course, already being used in large numbers by many firms in urban areas, and the only thing which has prevented their further development is the absence of charging facilities, i.e., the lack of properly equipped garages where you can call for a few minutes and charge your accumulator just as you did your horses in the old coaching days. An accumulator is like a horse insomuch that it cannot be recharged with energy in a few minutes, but if such things as voltage, ampere-hour capacity and physical dimensions were standardised it would be but the work of a moment for a "trayful" of freshly charged cells to be slipped into the place of the discharged ones.

Naturally, the unthinking ones among you will ask sarcastically where the electric energy is coming from, as all consumption from the mains is, as I have already said, to be rationed. The answer has already been provided for you by the Editor of The Wireless World in the "Power from the Wind" article, published in the September 21st issue. It may be that there are some of you who may have considered the article as of only passing interest; possibly you may have even thought that it was merely a coincidence that it was published at the present juncture. I, who am in a much better position than you to read the Editor's mind, know far better, however. There is nothing to prevent each garage or charging-station erecting its own wind generator forthwith.

There is, of course, one rather obvious thing which apparently occurred neither to the author of the article nor to the Editor, and that is this. We were told in the article that the rule for wind is "the higher, the greater." It seems rather obvious, therefore, that, if a wind generator was placed on each of the barrage balloons, enough energy would be obtained to provide the whole of the industrial electrical requirements of the country, thus saving valuable coal. It is my intention to bring this matter to the attention of the Government forthwith, and as wind is closely related to hot air I have already written to my M.P. asking him to ventilate the matter in the House of Commons, and I would ask you similarly to enlist the aid of your own M.P. in this vital matter.

Somewhere in . . . .

I t is to be deplored that certain people of a thoughtless type are heading their correspondence "Somewhere in England." Not only do their carelessness give away the fact that they are in the United Kingdom and not on the Continent, but it even proclaims the particular section of the kingdom they are in. I mention this particular fact because I do not want you to glance at the illustration to this note and jump to the conclusion that I am, or have been, "Somewhere in Scotland." The land of Burns is by no means the only place in the world where they wear the kilt. It is not unknown in parts of Ireland, and right over the other side of Europe it is quite a commonplace dress, and is greatly favoured by certain Greek regiments.

It so happened that the other day duty called me to a certain place which we will designate "X" the only qualification being that it was a seaside resort. Having a few moments of leisure I wandered down to the sea front and was pleasantly surprised to find the promenade bandstand in full occupation, with a local Jack Hylton doing his best to instill some of the jazz drive into the dour-looking faces of the inhabitants. I sank thankfully into a deck chair, and was soon carried away by the lilts of a waltz, the joyous cadences of which contrasted strangely with the somewhat stern and set faces of the bandmen, who looked as if they would be more at home with the de profundis or something of that sort.

Now I have never claimed to possess any great musical knowledge, but I could not help observing that the efforts of the conductor were strangely out of synchrony with the music emanating from the bandmen's instruments. He seemed to be all the time lagging behind by about half a bar, and I remarked as much to the man in the next seat, who seemed, however, singularly uncommunicative.

Presently, the band relapsed into a dreary dirge reminiscent of the B.B.C. in its palmy days, and I donned the headphones of my vest-pocket portable in the hope that I might pick up some better fare from the B.B.C.'s Home Service. I was very astonished to find that the B.B.C. happened to be churning out the same tune, but my astonishment turned first to incredulity and then to wrathful realisation when the local band's further efforts also coincided with those of the B.B.C.

It was, of course, quite clear to me what was happening. The so-called band was merely a collection of local yokels suitably dressed up and endeavouring with dummy musical instruments to keep time with the B.B.C. programme which was actually being delivered by a concealed P.A. system in the roof of the bandstand. The uncommunicative person in the next seat, who turned out to be a member of the Town Council, eventually confessed the truth to me, and excused the deception on the ground that it was a wartime economy, and that as the local bandmen had all joined the colours, the Council were patriotically endeavouring to continue to give the visitors value for money.

It is my firm belief, however, that the war has nothing to do with it, and that the seaside resort in question, situated as it is in a notoriously parsimonious part of the country, never has possessed a band, and has for years past been saving money at the expense of its visitors, by means of this sorry subterfuge.
Switching on the News

DURING wartime the news bulletins and official announcements made by the B.B.C. acquire an added importance. The preoccupations and responsibilities of the listener are also increased, and we all of us sooner or later experience the annoyance of failing to hear at first hand a bulletin of more than usual interest.

The routine of switching in the set before the appointed time is one which fortunately we can delegate to a mechanical device. Time switches, although seldom seen, are in regular use in every large community for controlling shop-window displays, street lighting, water heating, etc. They are often installed in accessible places, and have to be built to work reliably for years without attention. They can be readily adapted for controlling wireless receivers, and although their price is comparatively high they cannot be bettered where long-term reliability is the first consideration.

Some few years ago there was a good selection of less expensive programme clocks on the market. These were produced specifically for controlling wireless sets, and were obtainable with clockwork or synchronous motors—usually of foreign origin. In the more leisurely atmosphere of that period they were regarded merely as a novelty, and in the absence of a steady demand have since almost disappeared.

Clockwork Movements

Limited stocks of one or two makes are still available, and the "Electro-Boy" handled by E. Siegrist (late Orel Micro Electric, Ltd.), 39 Berners Street, London, W.I., is an example. It is obtainable with a synchronous AC movement, or a 30-hour spring clock, the latter being suitable for the control of DC or battery sets. The clock face carries the normal 12-hour numerals with hour and minute hands, but the time settings are made on a 24-hour basis; there is a third hand and an additional outer scale for this purpose. Contacts are provided at 20-minute intervals round the 4-hour dial and are set up or cancelled by press studs in a rotatable metal bezel ring surrounding the dial. A button on the top of the clock sets the contacts alternatively for make or break, and an indicator at the back shows a white spot when the circuit is closed. It is possible to work to closer limits than 20 minutes by setting the clock 5 or 10 minutes fast or slow. Leads with plugs and sockets are provided for the mains or LT connections, and the internal switching arrangements are capable of breaking up hours (up to 12) are shown in a small window above the dial. It is necessary to calculate the time interval to the next news bulletin, and to set up this interval in hours and minutes on the "Chronostop" dial. When the dial returns to zero the switch is tripped and the clock movement is stopped positively. A lever at the side can be set to break instead of making the circuit if desired. The price of this switch is £3 7s. 6d.

Another interesting time switch obtainable from the above source is the "Chronostop." This is a miniature spring-driven clock movement housed in a black moulded case 2½ in. in diameter, and 1½ in. deep, with pins for plugging, fitting the standard domestic supply socket. Being spring-driven it is also suitable for controlling battery receivers. It is wound up by a dial calibrated in minutes, and for each complete turn of the knob the

AUTOMATIC TIME SWITCHES FOR CONTROLLING MAINS AND BATTERY SETS

Model E24 "Electro-Boy" time switch clock with 30-hour spring movement.

Sangamo Weston Type SSA time switch for 50 cycles AC mains

Switching intervals up to 12 hours may be set to the nearest minute with the "Chronostop" time switch.

Standard Time Switches

There are indications that more manufacturers are turning their attention to the development of time switches specially designed for wireless receivers. In the meantime time switches for lighting control, which are already a standardised product, may be regarded as the most reliable source of supply. In general, they are suitable only for controlling AC mains receivers, and their small-diameter 24-hour dials are intended for services in which an accuracy of setting to the nearest quarter of an hour is sufficient. With a little practice in adjustment, however, they can no doubt be made to function to closer limits.

In the Type SSA time switch, made by Sangamo Weston, Ltd., Cambridge Road, Enfield, Middlesex, the single-pole switch is designed to break 10 amps. at 200/250 volts, 50 cycles. The clock mechanism is driven by a self-starting synchronous motor with fuses in both poles. Spare
Inventors and the War

CHANGES IN PATENT LAW

CERTAIN important changes, arising out of the war, are foreshadowed in the Patents, Designs, Copyright and Trade Marks (Emergency) Bill recently presented to the House of Commons by the Attorney General.

Broadly speaking, they deal, first, with the position of enemy inventors who have already acquired patent rights in this country, or who seek to do so during the period of hostilities; and, secondly, with the difficulties of the British inventor who finds himself handicapped owing to war conditions in complying with the formalities to be observed in applying for a grant of Letters Patent.

It is common knowledge that, on the outbreak of war, all trading or other intercourse with the enemy is strictly forbidden, but the prohibition is to some extent relaxed in the case of matters relating to Patents, Designs, Trade Marks and Copyright.

Enemy Owned Patents

The first clause of the new Bill declares that, notwithstanding the provisions of the Trading with the Enemy Act, any licences issued under a patent shall not be held to be invalid simply because the patentee is an enemy; nor is any contract arising out of such licence held to be void owing to the fact that one of the parties to the contract is an enemy.

At the same time, the Comptroller of the Patent Office is given power, should the licensee under such a patent make application to him, either to revoke the enemy licence, or to vary the conditions attaching to the licence or to any contract made under it.

Any British or neutral manufacturer can apply to the Comptroller to be granted a licence to work German-owned patent; and if the Comptroller is satisfied that it is in the public interest that the patent should be exploited, and that the applicant is in a position to do so, he may grant a compulsory licence to him on any terms that he considers fit—irrespective of any other licence that may have been already granted by the enemy owner of the patent. But the Comptroller can revoke any such licence if it is afterwards shown to have been obtained by misrepresentation, or if the existing licensee fails to satisfy the reasonable requirements of the public for the patented goods at a reasonable price.

It is important to note that royalties (on a scale to be determined by the Comptroller) must be paid by any person who may obtain a licence to manufacture under an enemy-owned patent. They are not, however, paid direct to the enemy owner of the patent, but to an official who will be nominated by the Comptroller of the Patent Office. The moneys so collected, are, in effect, placed under the control of the Crown, leaving their final disposition to be determined when peace is declared.

Payment of Fees

Permission has been officially granted for the payment by British subjects of any fees that may arise under a German patent, or to maintain in force one already granted in that country. In the same way, authorised British agents may accept fees from German inventors, who wish either to apply for Letters Patent in this country, or to preserve any rights that may have already been acquired.

Any correspondence with the enemy, relating to such matters, must first be officially approved. For this purpose letters must be forwarded in the first instance to the Patent Office (enclosed in a stamped open envelope addressed to an intermediary in a neutral country) marked "Emergency Patent" and enclosing the circumstances. They should be addressed to: The Comptroller General, H.M. Patent Office, 25, Southampton Buildings, Chancery Lane, W.C.2, and may be sent at the cost of the sender.

Would-be patentees are warned that they should not disclose information relating to any invention concerned with "Munitions of War," as defined in the Official Secrets Act. They are also notified that the publication of accepted patents relating to subject-matter of war-like interest is likely to be suspended. Finally, it should be noted that it is necessary to obtain the approval of the Comptroller before proceeding with an application for a patent in any foreign country.

Extension of Time Limits

The Emergency Bill modifies the strict time limits which are normally enforced when an inventor is applying for patent rights. His complete specification, for instance, must, in the ordinary way, be filed not later than twelve months after his provisional, and renewal fees must be paid promptly as they fall due. And there are various other statutory time limits within which certain things must be done or the patent will lapse. The Comptroller is now authorised to extend these time limits, as he may think fit, provided he is satisfied:

(a) That the delay is due to the inventor or his agent—being on active service, or to other circumstances arising out of the state of war; or
(b) That owing to the war, the time limits normally imposed would operate unfairly to the interests of the inventor.

The last condition is particularly interesting. It is intended, among other things, to protect an inventor or agent having filed a provisional application, is prevented by war service from fully developing his ideas in the time normally allowed for putting in a complete specification. In such a case the usual renewal dates of the Office Board, and the inventor will be entitled to retain the original date of his provisional application so long as he files his complete specification a reasonable time after hostilities have ceased.

The Wireless Engineer

A TECHNICAL survey of the National Wireless Exhibition, the period of which at Olympia was unfortunately curtailed, is included in the October issue of The Wireless Engineer, which is published on the first of the month. An investigation of the screened loop type of receiving aerial as used in direction-finding and field-strength measurement is also described in another article.

A monthly feature of The Wireless Engineer, which is obtainable from book-sellers or the publishers, Dorset House, Stamford Street, London, S.E., price 2s. 6d., is the Abstracts and References section compiled by the Radio Research Board. In this section are given abstracts of articles on wireless and allied subjects published in the world's technical press.
Antiharmonic Filters

Their Uses in Reducing Radiation

By A. G. Chambers, A.I.W.T. (G5NO) and W. Bacon, B.Sc. (Eng.)

In a previous article, written by the first author, reduction in harmonic radiation from transmitters by careful design of the transmitter and its associated coupling to the aerial was discussed. The present article is intended to carry the suppression to a further stage by use of a filter.

A filter consists of a network of inductances and condensers which, when placed in a circuit, attenuates certain frequencies more than others. There are three general types: low, high, and band-pass, the first being the one in which we are at present interested. This type of filter passes the lower frequencies—in our particular case the fundamental transmitting frequency—but attenuates, or does not pass, frequencies higher than a predetermined cut-off value. These higher frequencies are, of course, the harmonics that we are setting out to suppress.

The low-pass, or $\pi$, filter may be modified to a filter in which one particular frequency is attenuated. This filter finds its use in very stubborn cases of interference in the television band, but it was felt that if the harmonics had already been reduced to a small amount the low-pass filter would remove the balance, which is infinitely more useful than the removal of one.

The transmission characteristic of this filter is shown in Fig. 1. It will be seen that the attenuation is a maximum at 42 Mc/s, this being the frequency at which interference is being experienced. The schematic diagram of this filter is shown in its fundamental form in Fig. 2. This, however, may be modified as shown in Fig. 3 for a balanced circuit.

These, and filters which follow, are for use only where the feeding system consists of transmission lines of known impedance, such as twin flex, cabtyre, open wire, or any of the commercial types now on the market. Fig. 4 shows how the filter is connected up to a transmitter.

The component values may be calculated from the following formulae:

$$a = \frac{1}{f_c}, \quad L = \frac{Z}{\pi f_c}, \quad C = \frac{1}{\pi f_c^2}, \quad m = \sqrt{1 - \frac{f_c^2}{f^2}}$$

$$L_1 = mL, \quad C_1 = \frac{1}{m^2} C, \quad C_2 = mC,$$

where $Z$ is the characteristic impedance of the line, $f_c$ is the cut-off frequency, $f_\infty$ is frequency of harmonic to be suppressed, or frequency of infinite attenuation.

Further details in design may be obtained from the new handbook published by the Radio Society of Great Britain.

The low-pass filter, which appears to be of greater value in that it suppresses all harmonics, should prove valuable to amateur transmitters operating on the lower frequency bands, where harmonics may be radiated, not only in amateur bands higher in frequency, but also at frequencies likely to interfere with commercial and other services.

The first filter of this type tried out took the form of Fig. 5. Although attenuation took place as expected, it was found not to be sufficient, so an extra section was added, as shown in Fig. 6.

Although this article must at the present time be regarded as purely academic interest, so far as amateur transmission is concerned, the subject it deals with is of considerable importance from many points of view.

This new filter, however, proved to be too critical to adjust. Component values had to be limited, or minus $\frac{1}{2}$ per cent. of the calculated figures for it to work well. It was realised that this would be an impracticable arrangement and that it was clearly desirable to have some type of filter the properties of which do not depend too greatly on the impedance into which it has to work.

Constant Impedance

This condition may be satisfied by choosing the component values such that at the working frequency there is a standing half-wave on the filter. If we imagine the filter to be a continuous length of line (instead of a number of lumped components), the current and voltage diagrams would be as below Fig. 7(a). By doing this the impedance is kept more or less constant, since the value of current and voltage at the input must be the same as the value of current and voltage at the output. (The voltage will be in opposite phase, but this does not matter.) The maximum value of these waves, however, depends upon the impedance into which the filter is working. If this is correct—i.e., equal to the characteristic impedance of the filter—there will be no standing
Anti-harmonic Filters—

A wave at all; as we proceed further and further from correct matching the wave becomes greater and greater. Under these conditions the filter will stand a considerable mismatch without seriously affecting the characteristic, which takes the form shown in Fig. 7(b).

This filter was built up and tried out on the 21-metre band. At a distance of about two miles the harmonic signal on 10 metres, originally QSA5 R7, was changed to QSA3 R2 with the filter inserted. At a distance of about 100 yards, on the television band, a QSA5 R7 signal was changed to QSA3 R4 when the filter was incorporated. It was felt, however, that the filter would be very much more effective at the lower frequencies, and that if interference to television alone is experienced, perhaps the first type of filter might prove to be the most effective.

![Fig. 7.—Diagram (a) shows current and voltage distribution along a half-wave line. The response curve (b) shows attenuation obtained with a filter of the type discussed in the text.](image)

For those who are interested in this latter filter the design formula now follow:

\[ L = \frac{2}{\omega} \quad \text{and} \quad C = \frac{2}{\omega Z_0} \]

where \( L \) = inductance in henrys, \( C \) = capacitance in farads, \( \omega = 2\pi \), where \( \omega \) is the operating frequency, \( Z_0 \) = line surge impedance.

**Design for 90-ohm Cable**

The cable used by the authors was cabtyre, which has an impedance between 75 and 100 ohms. A figure of 90 ohms was taken as a mean. The operating frequency of the transmitter was 44.560 k/cps.

We thus have:

\[ C = \frac{2 \times 10^{12}}{2\pi \times 14.05 \times 90 \times 10^6} = 250 \mu F \]

\[ L = \frac{90 \times 10^6}{2\pi \times 14.05 \times 10^6} \approx 1.02 \mu H \]

\[ C = \frac{250}{1.02} \mu F \]

It should be pointed out that screening is essential between coils, and it is advisable to screen the condensers, but this is not so important. The Q of the coils must be kept high, and the quality of the condensers must be of a high order, otherwise the cut-off of the filter will not be sharp.

In the filter built up, condensers used were of the sprayed mica type. The coils consisted of 10 turns, 3 in. diameter, 1/2 in. long, wound with 14 SWG copper wire. When placed in a copper box measuring \( 4 \frac{1}{4} \times 4 \times 3 \frac{1}{4} \), these had an inductance of approximately 1 µH.

The authors wish to express their thanks to both G5QN and G6FK for their kind assistance while making tests on harmonic suppression over the air.

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**Henry Farrad's**

**No. 39.—Unaccountable Motor-Boating**

All-Hallows School, Berkhamsted.

Dear Henry,

You remember last term I was making a great many changes in the apparatus? Since then I have had trouble with a push-pull amplifier I made for this. The circuit (enlisted) seems perfectly simple and straightforward, and I've been over it many times, checking it up some record-playing apparatus? Since then I have had trouble with a push-pull amplifier I made for this. The circuit (enlisted) seems perfectly simple and straightforward, and I've been over it many times, checking up some record-playing apparatus? Since then I have had trouble with a push-pull amplifier I made for this. The circuit (enlisted) seems perfectly simple and straightforward, and I've been over it many times, checking

... every component and the current in every circuit, and it is perfectly O.K. The transformers, for one, are not junk; on the contrary, due to a temporary relaxation of financial stringency they are extremely high-class ones, guaranteed balanced for push-pull. The valves are also well matched —37 and 39 mA. The trouble is motor-boating. It continues to motor-boat when the first valve is withdrawn, also (and much harder) when one of the push-pull valves is out. (Yes, Henry. I only did it for a moment or two, so the other valve wouldn't get damaged!) There is no decoupling, but then it oughtn't to be necessary, surely, with a well-balanced push-pull output. Especially when the first valve doesn't seem to be coming into it.

I'd swear there is nothing wrong with the thing; but perhaps you can see it straight away. If so, I'd be jolly glad if you let me know what.

Yours ever,

Tony.

What is the probable cause of the motor-boating, and how can it most simply be cured? Solution on p. 300.

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**National Wireless Register**

WILL any readers who completed the National Wireless Register form which appeared in The Wireless World and who have changed their addresses since sending in the form, please notify any such change at once to:

The Secretary,

Wireless Telegraphy Board,

c/o The Admiralty,

Whitehall,

London, S.W.1.

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This is the circuit diagram of Tony's amplifier.
FREQUENCY MODULATION IN U.S.A.

On a Commercial Basis

The first manufacturer to be granted a licence for the production of frequency-modulation transmitters and receivers is the International General Electric Company of Schenectady, U.S.A. It has been announced that the company is now placing on the American market three types of receivers for the reception of frequency-modulation transmissions.

The cheapest, which costs $60, is an 8-valve table model receiver exclusively for the reception of F.M. transmissions, and therefore covers the principal advantages of high-fidelity transmission. The possibility of the transmission of sound over a long distance becomes practical at the present time, and it is hoped will soon be available; these have a power of 250 watts, 1 kW, 10 kW and 50 kW.

Readers will remember that the principal advantages of frequency-modulation are reception of signals virtually free from atmospheric and man-made interference, and the possibilities of employing high quality, fidelity transmission. Transmissions from the 50-kW station of the inventor of the system, Major E. H. Armstrong, at Alipine, N.J., which uses a 400-ft. turptile aerial, are said to have a reliable range of over 100 miles. In addition to this station which serves the New York City area, there is now in operation a powerful station near Boston which serves the metropolitan area and also covers the eastern seaboard, was completed in Meriden, Conn. Early this autumn a powerful transmitter in Schenectady will also begin transmissions.

It is pointed out by Dr. W. R. G. Baker, head of General Electric's radio and television division, that for a long time some frequency-modulation will be included in receivers as just another band.

40-METRE BROADCASTING

UNABLE to find clear channels in the crowded short-wave spectrum, some of the belligerent powers have been operating transmitters in the only unoccupied frequencies available—the amateur bands. This follows the precedent adopted by the two sides in the Spanish Civil War. Nearly all of the bulletins emanating from Warsaw, and re-radiated by the B.B.C., have been transmitted on 7,190 Mc/s. As very little amateur transmission now exists in Europe—several neutral countries, as well as the belligerents, have closed their amateur stations—the 20- and 40-metre bands are virtually free of interference at the present time and are therefore ideally suited for emergency transmissions such as those from Warsaw.

THE RADIO

Meeting Increased Demands

REALISING the importance of radio in the national life—particularly in these days of war—The Radio Manufacturers' Association, after giving careful consideration to the problems with which the radio industry is faced, as a result of the present emergency, states that it is the intention of the industry to carry on to the best of its ability with the service which it is rendering to the community. Difficulties of an unusual kind have to be met, and it is inevitable that costs of production will tend to increase. It is unanswerable that this increase in production costs must be reflected in some rise in the prices of receivers and components, but it is agreed that such price increases as do occur shall be limited to meeting the extra charges which may be placed upon the industry.

INDUSTRY

Production Costs

Mr. SYDNEY EVERSHED

THE name of Mr. Sydney Evershed, who died on September 28th, will be remembered for his work in the detection of Moggies for the testing of electrical insulation. In 1903 he became joint managing director of Foggie & Vignoles, which position he relinquished on becoming chairman in 1924. He retired from the board in 1936.

COMMANDER OF THE "COU RAGEOUS"

CAPTAIN W. T. MAKEIGH-JONES, R.N., who it was learned with regret went down with his ship when the aircraft carrier, H.M.S. Courageous, was torpedoed on September 17th, served as a wireless officer on the staff of the Admiral, Second-in-command of the Grand Fleet, during the war of 1914-1918. He was qualifying as a torpedo officer at the outbreak of war in 1914, and he devoted himself to the study of wireless telegraphy, which was then a branch of the torpedo officer's activities. Prior to his promotion to captain in 1916 he served in the Signal Department of the Admiralty. An old friend and shipmate, writing in The Times, says of Captain Makeigh-Jones: "The wireless officer who once knew him as one on whom they could rely ever with confidence. We shall not often see his like again."

SETS FOR A.A. UNITS

IN reply to a question in the House of Commons, the Secretary of State for War announced that the trustees of the Nuffield Trust had agreed to provide a number of broadcast receivers for men in charge of anti-aircraft guns and searchlight sets in isolated places to receive the tedium of their duties.

The distribution of these receivers is being undertaken by the General Post Office, and is under the charge of the Post Office Director General.

Nevertheless, the cost of these receivers was so large that the Trust had to limit them to the few who have been appointed for the purpose. This, however, has not been largely for emergency use by licensed listeners.

COMMERCIAL STATIONS

In the interests of Luxembourg's neutrality and at the request of the Government of the Grand Duchy the management of Radio-Luxembourg is closing down the station. Its wavelength has been used during the war by a foreign station. It is learned that the International Broadcasting Company shall be requested to present continuing transmissions of music and news bulletins.

The outbreak of war brought into operation a war clause in all the broadcasting contracts between advertisers for programmes from the main commercial stations which provided for four weeks' notice of cessation.

DIRECTOR OF ARMY SIGNALS

LIEUTENANT-GENERAL SIR JOHN FOWLER, K.C.B., K.C.M.G., D.S.O., who died last Wednesday at the age of 75, will be remembered by the radio industry as a Wireless Engineer during the Great War for the part he played in the development of communication on the Western Front, where he served as Director of Army Signals in France from the mobilisation of the British Expeditionary Force until May, 1919, when it was in the R.E.s that he received his commission in 1886. When, after the War, the Royal Corps of Signals was formed he became its first Colonel Commandant.

EMERGENCY ADDRESSES

FURTHER additions to the list of emergency addresses published in our last two issues are given below.

BROADCASTING OF ENGINEERING TECHNOLOGY, "Sageleigh", St. George's Road, Reigate, Surrey. (Tel.: Redhill 1611.)

Chloride Electrical Storage Co., Ltd., 415, 417, 419, 421, 423 & 425, Great Portland St., W. Whitechapel Sales Department, 378, Kew Road, Richmond, Middlesex. (Tel.: Richmond 6060.)

London Radio Supply Co., "Beverley", Golders Green Road, N.W.11. (Tel.: West Hampden 2011.)

McMichael Radio, Ltd., 178, Goring, Berks. (Tel.: Great Bourne 2331.)

Marconi's Wireless Telegraph Co., Ltd., Great Yarmouth, Chelmsford, Essex. (Tel.: Great Yarmouth 6.)

Mollard Wireless Co., Ltd., 170, Richard Street, W. (Tel.: Hatfield 238.)

Mullard Wireless Service Co., Ltd., "Clevemore", Clive Road, Goring, Reading, Berks. (Tel.: Goring 88.)

National Broadcasting, Ltd., 16 & 18, West Street, Farnham, Surrey. (Tel.: Farnham 2515.)

Oxenden Wood Road, Reading Berks. (Tel.: Goring 88.)

Radio- Luxembourg Co., Ltd., All advertisers for programmes, will be required to provide programmes for the G.P.O. during the month of August 24, 1946. The approximate number of licences in force at the end of August was 9,044,100. An increase of 54,912 licences in force are issued during September, 1946. Of the licences in force are issued to blind persons. It will be interesting to see how many licences are issued during September. There have been extraordinary; it may be, however, that these have been largely for emergency use by licensed listeners.

DUBLINER

MR. W. H. GOODMAN, founder and managing director of the Dubliner Condenser Company (1923), has, in view of his slow recovery from his recent severe illness resigned the post of managing director. Mr. F. H. McCrea has been appointed in his place with Mr. John Goodman as deputy managing director. Mr. P. E. Courney is technical director.
READERS of The Wireless World include all grades from beginners to highly qualified radio engineers, and it would obviously be very tedious for the latter if all the technical terms in every article were explained on the spot so fully as to be intelligible to the former. In the more advanced articles it is necessary to assume a corresponding amount of technical knowledge. My own chief aim is to fill in the explanations that must be performed be "taken as read" in such articles. Criticisms and suggestions, by the way, are always welcome.

"The characteristic impedance of the aerial is of the order of 250 ohms, and, to avoid the losses which would result if this were connected direct to a 70-ohm feeder, a transforming device is required at the terminals."—(The Wireless World, August 31st, 1939, page 207.)

The above quotation appears to have been a stumbling-block to some, with whom I have a good deal of sympathy, because one can know quite a lot about resistance and impedance without being able to see how a cable of unspecified length can be said to be 70 ohms, or how an aerial consisting of a few yards of substantial copper wire cut into well-insulated sections can possibly have an impedance of 250 ohms.

The whole answer to this is rather a long story, which, to be properly told, inevitably demands the use of stabs and coshes and other strange tools used by highbrow mathematicians. I hope to shed some light on the subject without recourse to such desperate measures, but to do even that much in a reasonable space it is necessary to assume a clear knowledge of what impedance means in the ordinary sense—a combination of resistance and reactance, which in turn is of two opposite kinds, capacitative and inductive. This matter was dealt with in the issues dated June 23rd and 30th, 1938.

Before considering what "characteristic impedance" is, it will be helpful to prepare the ground by disposing of a comparatively simple idea—that of impedance matching. According to the quotation, there is an aerial of 350 ohms and a feeder (connecting line or cable linking the aerial to the receiver or transmitter) of 70 ohms, and it is implied that if these were directly connected to one another there would be losses. In order to pass the maximum power from one part of a system to another, it is essential for there to be no impedance at the points of connection. But because impedance is a complex thing let us talk about resistance instead. Fortunately, in many practical systems the impedance is nearly all resistance, so we won't go very far wrong. It is quite easy to prove the truth of the above equal-resistance principle by the use of algebra, but some people are more easily convinced by examples. To take one that is particularly simple because it is not even complicated by AC, suppose we have a 60-volt battery, with an internal resistance of 20 ohms. It is used to supply power to a circuit of which the resistance can be varied. The problem is to adjust the resistance so that the greatest power is obtained from the battery. Such a simple circuit hardly needs a diagram, but here it is in Fig. 1. The battery is represented by what is inside the dotted line—a resistanceless battery in series with a 20-ohm resistance, this figure representing a 1-ohm internal resistance per cell.

**Ohms Law Again**

To go to one extreme, let us make R equal to 0 (nil). By Ohm's Law the current is 
\[
\text{60 volts} \div \text{20 ohms} = 3 \text{ amps}.
\]

The voltage across R is, of course, nil, because it is a dead short-circuit. The power in watts is, therefore, \(3 \times 0\), or nil. Going to the other extreme, make R infinity, or, in other words, an open circuit. There is no current, and although the full 60 volts is maintained across the terminals, the wattage is again zero. Now try a shot in the dark—10 ohms. Total resistance, 20 + 10, 30 ohms. Current, 
\[
\text{60 volts} \div \text{30 ohms} = \text{2 amps}.
\]

Voltage across terminals, 2 (amps) \times 10 (ohms), 20 volts. Watts, \(20 \times 2\), 40. If you work out the result in the same way for a number of other values of R, such as 15, 20, 25, 30, etc., you can plot them as a graph (see Fig. 2). From this it can be seen that the greatest power—45 watts—is delivered to R when R is equal to the internal resistance of the battery—20 ohms. An equal amount of power is wasted in the battery, so the efficiency is only 50 per cent. This is not necessarily the most suitable condition for all purposes. One may care to have less power at a higher efficiency, in which case R is made more than 20 ohms. In fact, it can be said that one always does care to do so, because any ordinary battery would be destroyed in a very short time by the above treatment.

**Loudspeaker Matching**

Turning to a more interesting example, in which AC power is involved, consider the output valve in a receiver. It has internal resistance—the AC anode resistance—and it supplies power to a loudspeaker. The resistance of the valve is usually thousands of ohms; the loudspeaker coil may be only about 2 ohms of AC resistance. Actually, it varies quite a lot, according to the frequency, but let's neglect that. If the speech coil were connected directly to the valve, or through a 1:1 ratio transformer, the efficiency would be very low indeed, and nearly all the power would be wasted in the valve. It can be shown, either in the proper algebraical way or by drawing a graph in the same manner as for the battery, that the greatest power is put into the loud speaker when its resistance is the same as that of the valve. As it is generally impracticable to make it so, a sort of liaison officer is employed for bringing the two together in the right relationship. It is the output transformer, or, as it might appropriately be termed here, the impedance-matching transformer. I'm not going to be sidetracked into an exhaustive treatise on the theory of the
Characteristic Impedance—

transformers, however. Even if one's ideas on this subject are extremely elementary, they probably run to something like this: "A transformer is a thing for stepping voltage up and current down, or vice versa." Taking a definite example again, a 2:4 transformer with 100 volts applied to the primary gives 200 volts from the secondary, and if 10 amps flow in the primary the secondary supplies 2. The power is the same both sides, so it must be assumed that the transformer itself consumes no power. Actually, large power transformers are made that are better than 99 per cent. perfect; valve output transformers never reach this standard. But we are neglecting subsidiary effects of this sort. The important thing to notice is that a doubling of voltage is (by Ohm's Law) a doubling of resistance, and so is a halving of current. So when both things occur at once, the resistance is multiplied fourfold, or by the square of the step-up ratio. Therefore, if one wants to match an impedance of 1,000 ohms to one of 4,000 ohms, the correct transformer ratio is 1:4; but the square root of this, 1:2. To match a 7,200-ohm valve to a 2-ohm load, the correct transformer ratio is $\sqrt{7,200/2}$, which is 60:1.

Actually, this ratio is correct for getting the maximum power, but is rarely adopted, because it takes no account of distortion. The ratio giving the greatest output power for a limited amount of distortion is obtained by using the "optimum load resistance" stated by the makers, instead of the valve resistance. That, however, is by the way. The idea to grasp is that the 60:1 transformer makes the 2-ohm loud speaker look like 7,200 ohms to the valve, while it makes the valve look like 2 ohms to the speaker coil. Fig. 3 puts this in diagram form. The transformer itself has a very much higher impedance if nothing is connected to the other winding; in fact, if it were a perfect transformer it would have infinite impedance. But the load of 2 ohms connected to the secondary is the same as 7,200 ohms looking at it from the primary.

So far we have (I hope) assimilated (1) the necessity for matching the impedances of any two items which stand in the relation to one another of generator and load, and (2) the way in which impedances can be matched. If maximum power transference is the object, the impedances ought to be equal; but often there are overriding considerations, as we have seen.

Now we are ready to look at the original problem. A period will, however, be allowed for the fevered brow to cool in readiness for a renewal of the struggle.

To be concluded.)

HENRY FARRAD'S SOLUTION

(See page 290)

The general cause of motor-boating in amplifiers is, of course, the HT source having appreciable impedance and therefore varying in voltage in accordance with current variations in the output stage. These voltage variations are passed on to an earlier stage, amplified, and if in the right phase are liable to maintain the current variations continuously. When a filter condenser of large capacity is used across the HT source, it is only at very low frequencies—perhaps one or two cycles per second—that its impedance is high enough to cause this instability; hence "motor-boating."

One of the advantages of push-pull is that the currents in the two output valves are in opposite phase and neutralise one another so far as the HT source is concerned. This holds good only if the currents in the two valves are reasonably equal.

In the present case the first valve is not concerned in maintaining motor-boating, and one stage cannot do so on its own; therefore the feedback is occurring from the push-pull output stage, via the coupling condenser between the first two stages, to the grid of the second valve. Assuming that Tony's exhaustive tests, and the balancing of the transformers, can be depended upon, the output valves themselves must be unbalanced. The difference between 1.5 and 3.0 mA in anode currents is not enough to worry about; but equality of the anode currents ensures merely static balance, which is desirable for preventing iron-core polarisation, but is not the thing that matters in avoiding motor-boating. What is needed is dynamic balance, that is to say, equality of the variable part of the anode currents. For some reason or another this is seldom considered; it is, of course, possible for valves to have unequal mutual conductances, and thus to deliver unequal signal currents, the difference between which may be enough to cause motor-boating unless careful attention is paid to this.

Fortunately, there is an alternative to de-coupling, for as "Cathode Ray" has pointed out,* the by-pass condenser across the common bias resistor in the push-pull stage not only serves no purpose if the valves are balanced (for there is then no resultant signal current to be by-passed), but if they are not dynamically balanced it prevents them from being so. Suppose that the upper valve has a greater mutual conductance than the lower one. Then there is a surplus signal current in the common cathode circuit. If the by-pass condenser is omitted, this current flows through the resistor and causes negative feedback which tends to reduce the amplification of the upper valve. But as the lower valve is in opposite phase, the signal voltage across the resistor gives positive feedback to it, increasing its amplification. In this way the strong valve is weakened and the weak valve strengthened, and so the lack of dynamic balance is largely counteracted.

All that Tony has to do, therefore, is to remove the by-pass condenser.

*April 30th, 1937; see also "Electric Gramophone," May 11th, 1939.
AN INTERESTING SIDE OF GERMANY'S WAR PREPARATIONS

It seems generally agreed that victory in the present war, as in the case of the last one, will depend as much on the possession of material resources of various kinds as on military action. One of the principal materials required may be summed up in the word "fats." Germany realised the importance of fats long before the war began, and in her efforts to accumulate a store of this vitally necessary material used all the resources of science, including a novel application of wireless DF, which is dealt with in this article.

The connection between DF and fats may not seem apparent at first sight, and even when the word "whales" is mentioned it is probable that the average person will think only of the use of DF for the navigation of whaling ships in foggy weather, and will never even guess at the highly ingenious way in which DF was actually employed by the Germans in the catching of whales in fair weather as much as in foul.

Most people are aware that when the whale has been caught and killed it is necessary to cut the blubber off the carcass, and then treat it by boiling in order to extract the necessary oil. In certain whaling fisheries it is customary to store the blubber in tanks and bring it to shore at the end of the voyage for the necessary treatment. This method, however, is usually only employed in what may be termed short-voyage whaling principally in the Greenland seas. In the case of long-voyage ships, it is necessary to extract the oil on the actual ship, and this of course necessitates a great deal of work on board, and means that during the time a carcass is being treated the work of actual whale-catching is, of necessity, severely handicapped.

The Germans overcame this difficulty by fitting up large vessels of considerable tonnage—21,000 tons in the case of the latest types—as "factory" ships, in which the carcasses were treated. These floating factories did no actual whale catching, but were devoted to dealing with the carcasses caught by a fleet of eight whale chasers attending each mother ship. These whale chasers were quite small vessels, having a crew of only fifteen men...
Whaling and Wireless—in contrast with the 350 men carried by each factory ship.

The complete whale-hunting unit, comprising factory ship and attendant chasers, would be away from home for several months at a time. The procedure was that when a chaser successfully harpooned a whale, if the mother ship was far away for the whale to be towed to her, notification of the catch would be sent by her wireless, and she would proceed to its position to pick it up.

The chaser did not, however, stand by the carcass but continued with her business of whale seeking. The carcass would naturally drift, and it had not been for an ingenious employment of DF would in most cases have never been discovered by the mother ship. To avoid this probability of loss, a special automatic wireless transmitter was fixed to the carcass by the whale chaser before she left it. This transmitter continued to send a signal automatically over a considerable period of time, and by taking DF bearings on the signal the mother ship eventually located the carcass.

Installation Details

Each mother ship was fitted with a 100-watt Telefunken transmitter working on various wavelengths between 100 and 800 metres. Two Lorenz SW transmitters were also carried, and in addition, very comprehensive DF equipment was installed. The actual whale catchers were also equipped with a 100-watt transmitter and with a certain amount of DF gear, but carried no skilled operator, the duties of operating the radio usually devolving on the second mate. A skilled operator—cum-serviceman was employed on the factory ship, his duties including the servicing of the equipment on the catchers, and also the portable DF transmitters which were affixed to the carcasses of the whales.

The mother ship was also equipped with a comprehensive PA system for distributing ordinary broadcasting programmes, and also concerts of gramophone records throughout the ship. As the ships were away from home for several months at a time it was usual to carry a large collection of records. Broadcast programmes were also a feature of life on the small hunter boats.

Above Three Megacycles

CONDITIONS FOR SHORT-WAVE NEWS GATHERING

A KIND friend has sent me a cutting from the Barbados Advocate—adding that his thoughts on reading the article in question were more of sorrow—for radio manufacturers—than of anger.

It appears that a well-known British manufacturer claimed, as one of the outstanding points of his new receiver, now on sale in the West Indies generally, that it actually tuned down to the low wavelength of 18.5 metres!

The point, which is well known in the W. Indies, if not by cricket fans in this country, is that the B.B.C. broadcasts of the recent tour of the West Indian cricketers were received very well in the team’s home islands on GSJ 13.9 metres, but were inaudible on higher wavelengths.

What is true of daylight transmission to the W. Indies is even more true for daylight (especially midday) transmission to S. America and S. Africa and also to a very large extent to India and the East.

No receiver that does not tune down to 16 metres should be made available for export—and with advantage the limit could well be made as low as 13 metres. For export to Africa the limit should be definitely 13 metres, since even if the manufacturer thinks that the approaching sunspot minimum may come to his rescue and eliminate the 13-metre band for a few years, it is quite possible that this may not prove to be the case for midday transmissions to Africa.

Even for the home market the recently instituted NBC station WRCa on 21.63 Mc/s in the 13-metre band has decidedly changed the position here. This station, which appears to be using higher power on a European beam, has during the past week, on occasion, been a strong signal until 7 p.m. G.M.T. (All times given in these notes are G.M.T., which, I need hardly remind you, is one hour behind British Summer Time.) Conditions during the period under review from September 14th to 21st have been variable, with 11-metre (25 Mc/s) U.S. transmitters audible in the early evenings at the beginning of the week, but at 9 p.m. on September 20th, the only station audible was WGE by 9.53 Mc/s.

Another point of interest was the use by WzXE of his new call sign WCBX from September 15th onwards, and the reappearance of what appears to be deliberate jamming on Moscow, especially on the 12-Mc/s transmissions (25 metres) from this station.

To review the period in detail, both WNBI and WCBX were excellent all the afternoon and evening on Thursday, September 14th, and at 7.20 p.m. two 26-Mc/s “high-fidelity” broadcasters could be heard.

At the same time Friday evening “WzXE” could be heard on the 13-metre band, apparently having brought his old low power transmitter into service again, since the WCBX (ex WzXE) transmitter was also a strong signal at this time on 17.83 Mc/s. At 26-Mc/s station was also intercepted. A bad heterodyne was noticed on WCBX 17.83 Mc/s at 9.15 p.m., but the CIS transmitter was easily 100 per cent. intelligible; this heterodyne disappeared at 9.30 p.m.

Other strong signals were WNBI and WGEA; the usual English news was taken from WCBX on 17.83 Mc/s at 9.50 p.m. following the multi-lingual news in Polish, German, Italian and French.

At 11 p.m. on Monday, September 16th, WZIP Pittsburgh was a full loud speaker signal on 21.54 Mc/s in the 13 metre band, but WNBI and WCBX were also good signals on 17 Mc/s.

A further 13-metre signal appeared on “WzXE” again on 21.52 Mc/s and this station was just audible at 6 p.m., carrying the same programme as WCBX.

Early news of the Russian advance into Poland was obtained by WCBX at noon on Sunday (but actually the B.B.C. had announced it an hour before). For some days previously the news from CBS and NBC had clearly foreshadowed this move.

A report of forthcoming poor conditions was given by the rumble on both WNBI and WCBX’s carriers. This proved to be true and by 9 p.m. Sunday only 9 Mc/s remained as a useful DX band.

Conditions on Monday evening were much better again and from 6.45 p.m. the new WRCa on 21.63 Mc/s was an excellent signal, taking the English Hour with WNBI.

The outstanding station from the “programme interest” point of view on Tuesday and Wednesday evenings was, I think, the German Freedom Station, working on 40.9 metres (at the high-frequency end of the amateur band). It was an excellent signal in both occasions—with a man announcing “Deutsche Freiheitsender.” A phrase that particularly struck me on Tuesday came after a description of the devastation to Poland, “...und dieser man ist Hitler!”

Conditions deteriorated again badly on Wednesday evening, September 20th, and by 9.15 p.m. the only U.S. broadcaster audible was WGE by 9.53 Mc/s.

“ETHACOMBER.”
Accumulator Charging in the Wilds—

gradually dwindles, as does that of the dry cell.

A larger battery on the same lines was next made up, as shown in Fig 3, and this passed nearly 0.75 amp. on short-circuit, with 1.1 volt on open-circuit. The internal resistance is therefore about 1.3 ohms, and the output load is between 0.3 and 0.4 amp. With this current the voltage is about 0.5 per cell, and six cells in series would therefore be required to charge a 2-volt accumulator. By making up 12 cells and connecting them in 6-series 2-parallel, nearly an amper would be available for charging.

In the experiment this cell was left short-circuited for 24 hours, and at the end of that time the voltage on open-circuit was still about 1.1, and the current had slightly increased—no doubt owing to the formation of sulphuric acid, which lowered the internal resistance. At the time of writing it is still short-circuited, and no change is discernible. From the data given in old books, it is estimated that this cell has a capacity at the above rate of discharge of about 40 amper-hours, so that it could charge two 20-amper-hour accumulators.

Reasonable Cost

Costs seem to be reasonable. Commercial copper sulphate, known as “blue stone” or “blue vitriol,” is used in agriculture, and can be bought in 1 lb. packets for 4d. Commercial quality zinc sulphate costs 8d. a lb. About ½ lb. of each was used in making up the jam-pot cell, and to this must be added 2d. or 3d. for zinc and copper, the latter being practically everlasting. Probably 1d. would cover the cost of making the cell initially, and about 5d. replenishing the salts and zinc subsequently. Hence the cost per accumulator charge works out at about 1s. 4d. for a 20-Ah accumulator (capacity rated at 10-hour rate). These estimates are made, of course, with reserve, and are merely indications to encourage those who, with sunhats and dinner jackets, uphold the traditions of Empire and want to keep in touch with the homeland in romantic foreign parts. For those in the English countryside it would probably be cheaper to take the old accumulator in to the nearest town and have it charged at the local garage for a few pence.

The Gravity Cell description is simple enough to be understood, but for those used to accumulators and to whom primary batteries are museum curiosities, the following hints are offered.

The action in a Daniel cell is represented chemically by the equations

\[ Zn + H_2SO_4 + CuSO_4 \rightarrow ZnSO_4 + Cu + H_2 \]

The 1/2 in nacyl state goes to the copper plate which is surrounded by CuSO₄, and there it combines with the acid radicle forming H₂SO₄, and Cu is deposited on the copper plate. Now, H₂SO₄ violently attacks zinc unless it is chemically pure, but this pure state may be simulated by rubbing the surface of the zinc with mercury—a not inexpensive process.

Hence zinc sulphate is used as the exciting fluid, and no local action takes place. The chemical reactions with zinc sulphate are too obvious, and it seems probable that the cell only operates because of traces of free acid in the commercial salts used. This is borne out by the fact that Daniel cells can be made up with only water as the exciter, but such cells have to be frequently charged for some time before they operate efficiently. If any free acid is present, the hydrogen from it when it attacks the zinc combines with the copper sulphate to form fresh acid. It is extremely important that no copper sulphate reaches the zinc, and to avoid this in the Gravity type of cell, the construction is as shown, and the zinc sulphate, dissolved in water to form a saturated solution, is poured into the cell very gently so as not to disturb the copper sulphate crystals. A hydrometer syringe is handy for this operation. If the cell is made up complete in the dry state, with the electrodes and the copper sulphate crystals, and the glass-wool and paper soaked in the position, the addition of the sulphate solution only is required to make the cell ready. It is not, of course, transportable. If the initial current seems oddly low, the addition of a teaspoonful of dilute acid solution will reduce the internal resistance sufficiently for the proper current to be passed.

Random Radiations

By “DIALLIST”

A Friend in Need

We wireless folk usually manage to come across fellow enthusiasts, no matter where we may be. At the moment I’m billeted in a tiny village, which consists of the pub., two large farmhouses and a score of cottages, all clustering round the village green; there is also a delightful old vicarage close to the church, which is about a quarter of a mile away. I’ve been here nearly a week—on the outskirts of an English village. As the possessor of a mains short-wave set which can’t be used, because the electric lighting current is home-made and of the 50-volt DC variety, I was also dispensing my taintless fate when kindly providence came to my aid. I overheard two fellows discussing wireless, and gathered from what they said that one of them was almost as anxious as I was to do some short-wave listening. He had a battery “all-wave” receiver, but was lamenting that he found it extremely difficult to tune on its short-wave range. Rather diffidently, I joined in the discussion, and, when the opportunity arose, inquired if I might try the receiver as a possible remedy for his case. He, of course, “granted as soon as asked”; two minutes later we were on our way to the house where the set was installed, and when I mention that those two minutes were spent in ensuring that there were no hootpats, you’ll deduce that the house was not the vicarage. Arrived there I found a not very ancient receiver of a type that I’d handled several times before. It isn’t easy to tune on the 12-megacycle knot, and 15-megacycle bands; but old stagers like myself who cut their DX teeth on the extension-handled knobs of early straight short-wave sets have acquired as a result of long practice the knack of making hair’s-breadth movements of tuning controls.

Thrills

It wasn’t long before we had found a good selection of European stations and one or two American ones, and who was in joy it was to feel oneself in touch with the world again. If you’re used to being able to pick up SW stations at will, you don’t realise, until you have been deprived of them for a while, how much of my normal life the ability to hear news from all over the world had become. Perhaps in normal times it would not be so bad, for the newspapers supply one’s most urgent needs. But with the morning pages cut down to half their normal size and evening papers unobtainable, unless someone happens to have motored down from London and brought one with him, you feel that you have lost the contacts which sustain you. I can assure you that the first news bulletin in English from a far-away station, after such a period of deprivation and in such times as these, gives you a thrill nearly as great as that produced seasons ago by the hearing of your first transatlantic station.

A Selection

It was surprising to find comparatively little jamming on the short waves. The only undoubtedly genuine instance I came across occurred when the “Freiheitsender,” the much hunted “again the government” German radio station, was blotted out. But even that didn’t happen until the announce of the Freiheitsender had been telling those who run Germany where they got off—or rather where he hoped they would get off—for quite a considerable time. Then I was on news wave of the quelling remarkably straightforward and impartial. Some of the items from Berlin were comic in their exaggerations. It was amusing to find their accounts of a milk famine in Britain coming almost at the same time from our Ministry of Health for every household to drink more milk. I’d hoped to strike some of the tales from observers in European countries that are relayed by American short-wave stations, but there were none of them going at the time. Not much of a bag, the short-wave man may say. In a way it wasn’t: there was nothing worth entering in a SW log, for there were no notable captures; but I enjoyed the hour with the indifferent “all-wave” receiver as much as I’ve ever enjoyed any hour of my contacts with the normal world, and what a lot of luxury it is. My only regret is that my newly-made radio friend is but a bird of passage. He leaves the village to-morrow—and takes the set with him. I hope I’ll be able to find another enthusiast.

Carrying On

Take to the heart the advice to fill in an order form for The Wireless World. Last week I couldn’t get into the nearest town until Saturday. Arrived there I went into the first big newsagents I saw, slumped
Important Announcement

The **Wireless World** to be Published as a MONTHLY

After the present issue, this journal will appear as a monthly publication with more pages, and in a more compact size. The price will be one shilling.

The next issue will be on sale on Friday, October 20th, and thereafter the journal will be issued on the 20th of each month.

It is vitally important that a definite order should be given to newsagents, and a form for this purpose is inserted in this issue.

**NEW SUBSCRIPTION RATES, INCLUDING POSTAGE FOR HOME OR ABROAD:**

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No doubt many readers have been wondering what the position will be regarding the supply of components for home constructors. The demands of the Services naturally have priority, but when things have settled down it is reasonable to expect that the manufacturing resources of most of the leading firms will allow a sufficient margin to fulfil the needs of the home constructor.

In the meantime it is gratifying to learn that everything in the 1939/40 catalogue of A. F. Bulgin and Co., Ltd., is available. That being so, the amateur should not be held up for anything he may require to build or complete his own receiver.

The new list is even more comprehensive than usual and includes equivalent components for most of the products of the specialist firms. Its fully illustrated 128 pages contain much useful technical information. Copies are obtainable, price 3d., from Bulgin’s head office, Abbey Road, Barking.

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**Facsimile Transmitter.** This photograph shows the apparatus installed at station WLW, Cincinnati, U.S.A., for the transmission of “radio newspapers.” In the centre background is the scanner, with monitoring printer and oscilloscope in front and to the left respectively. Impulses from the scanner are passed to the line amplifier mounted in the rack on the extreme right, and the output of this amplifier is used to modulate the transmitter. Further monitoring is provided by the domestic broadcast receiver (extreme left) which operates a printer of the type designed for use in the home of subscribers to the facsimile service.
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Wireless World

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SUBJECT to our ability to obtain raw materials and meet restrictions which may be imposed, we will endeavour to maintain supplies of all our products. We feel sure that our many trade friends will appreciate that certain difficulties will arise, and we must, therefore, reserve the right to modify prices, if necessary, by any excess amount which we may have to pay for raw materials and for labour used.

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