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AND RADIO REVIEW
(17th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

FUNDS FOR THE NEW 5SW.

IN our editorial in the issue of October 23rd, we urged once again that some definite step should be taken towards establishing a satisfactory Empire Broadcasting service. We traced the history of the various stages by which 5SW was established on its present inadequate basis, and showed how hard a struggle it had been in the face of opposition or inertia to achieve even so poor a start as 5SW has proved itself to be.

Our editorial appears to have attracted immediate attention, for within a day or so a comment appeared in the daily Press suggesting that new plans were on foot at the B.B.C. in regard to Empire Broadcasting policy, although, on enquiry, we found that the Corporation was not prepared to say more than that the future of short-wave broadcasting from this country was being considered, and negotiations on the question were proceeding. Any news which indicates activity is better than no news, and so we look forward to some more definite announcement at an early date.

We have always questioned whether short-wave broadcasting to the Empire was legitimately a part of the activities of the British Broadcasting Corporation. Obviously, at the time that the proposal was first put forward, the B.B.C. appeared to be the most convenient authority to undertake the task, but they have not shown sufficient enterprise or interest in the project to entitle them to retain the control, unless they are prepared immediately to take some worth-while action in the matter.

The Empire Marketing Board.

We know that the excuse, if we may so term it, for inactivity on the part of the B.B.C. has always been that they have no authority for expending B.B.C. money on a short-wave Empire station, and that without money it is impossible for them to make progress. Various suggestions have been made as to who should bear the cost; the Colonial Office has been held responsible by some, whilst it has even been proposed that Colonial listeners themselves should contribute something by way of a licence fee for listening to the Empire station. But such proposals have not been developed, as no satisfactory case could be made out for them. One must look around to find some authority which could benefit directly from the establishment of an efficient service, and one comes to the conclusion that of the choice of authorities on whom the task of financing the short-wave service could be imposed, the most obvious is the organisation known as the Empire Marketing Board. This Department has as its object the development of trade within the Empire and, we understand, the financial grants which it receives can legitimately be expended on enterprises which stimulate inter-Empire commerce.

We cannot imagine for one moment that any objection would be raised to the Empire Broadcasting short-wave service being utilised to help in such an object as this. Market intelligence, talks on Empire development, and a hundred-and-one things which would go towards uniting more closely the units of Empire could all be justified. No one, we think, would quibble at the Empire Broadcasting service being put to such a use as this, particularly when by this means the problem of funds for programmes and the stations could be solved.

It is, perhaps, rather presumptious on our part to discuss what should be the policy of such an organisation as the Empire Marketing Board, but we would like to make it quite clear that the suggestion is one which is put forward in the honest belief that it may be helpful as a solution of the Empire Broadcasting impasse, whilst at the same time being directly beneficial to the cause which the Empire Marketing Board champions.

Interference From Brookmans Park

Some Hints on Improving the Performance of Existing Sets.

ALTHOUGH all the alarmist reports that have appeared in the daily Press need not be taken too seriously, it is now clear that many thousands of listeners in London and the Home Counties are seriously affected by the opening of the new 2LO, sometimes to the extent of being unable to receive even an alternative programme from Daventry 5GB. It will be small consolation to these sufferers to realise that the inauguration of the twin transmissions will intensify their troubles; in many cases there will be mutual interference between "London No. 1" and "London No. 2," and neither station will be received without a background of the other until their receiving apparatus is altered.

If it is admitted that the new scheme of transmission is beneficial to the majority, blame for this state of affairs must be laid to the general tendency to simplify broadcast receiving apparatus to a greater extent than is really permissible in view of the rather high standard of performance that is customarily expected. It is perfectly easy to produce a fool-proof and inexpensive set capable of receiving either of the twin stations only at a distance of even half a mile from Brookmans Park, but serious complications arise when a wider choice of programmes is demanded under such difficult conditions. Readers of this journal are in better case than the general public; since the Regional scheme was first proposed, special attention has been devoted in these pages to the question of eliminating interference. It has been made clear that, broadly speaking, exceptional selectivity is brought about by using tuned circuits of lower resistance than usual, or, better, by adding to the usual number of tuned circuits of average "goodness"; unfortunately, either procedure tends slightly to increase the complexity and cost of the receiver. Until ganged tuning becomes more popular and widely available, we must face the fact that many listeners (their number will increase as and when the Regional plan is extended to other areas) will have to master the niceties of handling a multi-control receiver. Approached in the right way, it is not a very difficult art to acquire.

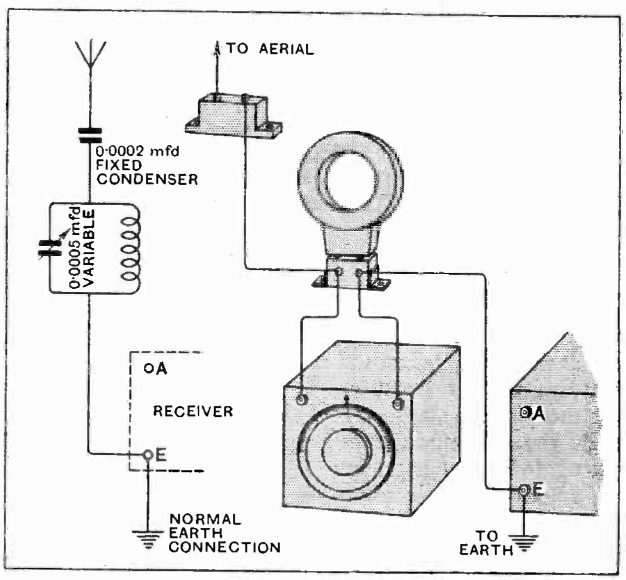


Fig. 1.—Theoretical and practical diagrams of a simple but effective aerial tuner. The coil must be mounted in inductive relation with the aerial-grid winding of the receiver.

It is admittedly none too easy to make internal alterations to an existing set, but fortunately it is possible to restrict the spreading of strong local signals by making comparatively simple external modifications and additions. All too often, many of the modifications that are customarily recommended add nothing to the *real* selectivity of the receiver, and are apparently more or less effective only because they reduce the signal input to the receiver. These methods have their uses, provided one does not expect too much of them, and realises that all signals, wanted as well as unwanted, will be reduced in strength. It is the purpose of this article to describe simple modifications whereby almost any set can be improved, and, as many readers will doubtless have non-technical friends

Interference from Brookmans Park.—
who are in difficulties, an attempt will be made to treat the subject in the simplest possible manner.

Before beginning to discuss the more helpful and important additions, it will be as well briefly to survey some of the minor alterations that can be introduced, and which contribute at least something to the overall selectivity of a receiver. The use of anode bend detection, if substituted for the more popular grid method, is certain to improve matters; not only does it impose less damping on the preceding tuned circuit (when matters are properly arranged), but its well-known lack of sensitivity to small signal voltages is of distinct benefit in eliminating a strong background of interference which might well be present when using the competing method of rectification.

Inherently Selective Circuits.

The selectivity of tuned circuits of the kind included in ordinary sets can always be increased by arranging to use a higher ratio of capacity to inductance than is usual—in other words, by using a comparatively small coil with a large tuning condenser. This plan can, in many cases, be tried without involving any serious changes; what one should do is to use the smallest coil which will enable the longest wavelength desired to be received with the particular value of tuning condenser fitted to the receiver. It may be added that this plan is generally most successful when applied to relatively simple detector-L.F. sets, and that in carefully designed receivers with H.F. amplification its inclusion is likely to give rise to an appreciable falling-off in range, and even in quality.

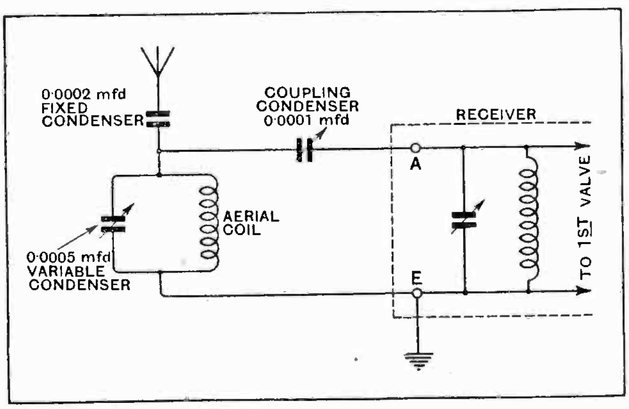


Fig. 2.—Circuit diagram of a capacity-coupled aerial tuner.

It will be generally appreciated that the design of an H.F. transformer is a compromise between the requirements of maximum amplification and selectivity, and that the designer's original conception of the best ratio between primary and secondary turns may now stand in need of some revision, in view of changing conditions. It is quite permissible to try the effect of removing a few primary turns; for information to the reduction in signal strength likely to be brought about by this alteration, the reader is referred to a recent article on the subject in these pages.[1]

Turning to the subject of alterations of the kind likely to effect a definite and clearly perceptible reduction of interference, mention must first be made of the somewhat drastic expedient of reducing aerial length. This is widely recommended nowadays, but it always seems to the writer to be illogical, as exactly the same effect can be obtained by reducing aerial coupling by inserting a small (preferably variable or semi-variable) condenser in the lead from aerial to set, by reducing the number of turns in the aerial circuit when an "aperiodic" coupling is used, or by varying the inductive relationship between aerial and secondary coils where provision for this adjustment is made. This plan enables the user to make full use of a long aerial when the set is used at times when the interfering station is silent, or when receiving wavelengths on which interference is not pronounced.

It cannot be denied that, to the non-technical user who has no knowledge of the technical details of his set, and has not access to a well-informed source of information, the rather wasteful expedient of actual amputation of the aerial wire is likely to meet the case well enough, but to be effective in difficult situations it must be carried to such lengths that the reception of distant stations becomes next to impossible. It should be made clear that, even in North London, almost any set except a portable is susceptible to this treatment, and, always provided that nothing more than the Brookmans Park alternative transmissions are desired, satisfactory results are attainable by making progressive experimental reductions in aerial length.

For some time past, writers in this journal have urged the desirability of reverting to the loosely coupled and separately tuned aerial circuit which has found a place, almost as a matter of course, in commercial apparatus since the earliest days of wireless telegraphy—long before the era of telephony. It is by no means difficult to add it to the majority of sets in the manner shown both diagrammatically and pictorially in Fig. 1. The coil, which must be of a size suitable for the wave-range to be received—a No. 60 will be suitable for the medium broadcast waveband when used in conjunction with a normal aerial and a 0.0005 mfd. tuning condenser—is mounted outside the receiver cabinet, and in such a position that it is in inductive relationship with the normal internal aerial coil: a spacing of several inches is generally necessary, and the correct position is best found by trial.

Continuously Adjustable Condenser-coupling.

A somewhat neater arrangement is made possible by using the capacity-coupled aerial tuner shown in Fig. 2, in which transference of energy from aerial to grid coil is controlled by a variable condenser. For this purpose, a capacity of something considerably less than 0.0001 mfd. is generally sufficient—a neutralising condenser will often do quite well—but the value shown is recommended where an aperiodic coupling arrangement is included in the set itself. Connections of the aerial tuner under these conditions are as shown in Fig. 3.

[1] H.F. Transformer Design, by A. L. M. Sowerby. *The Wireless World*, October 23rd.

Interference from Brookmans Park.—

It is essential that interaction between external and internal coils should be mainly through the coupling condenser, and any appreciable direct magnetic effect is to be avoided. To this end, it is desirable to interpose an earthed metal screen between the coils, or, best of all, to enclose the aerial tuner in a metal box. This plan has the advantage of neatness, as all the apparatus

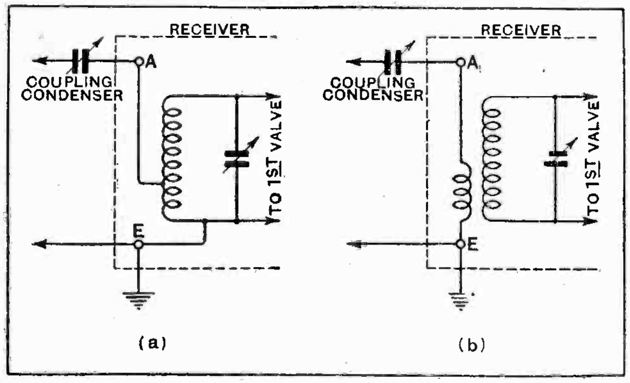


Fig. 3.—Internal connections of the tuner shown in the preceding diagram to (a) auto-transformer coupled aerial set and (b) magnetically-coupled "aperiodic" circuit.

—coil, tuning condenser, and coupling condenser—can easily be accommodated in a container measuring not more than 6in. cube.

It should be emphasised that it is risky to attempt to add either of these loose-couplers to any receiver, including a stage of H.F. amplification with an unneutralised three-electrode valve. Such sets depend for their stability to a great extent on the effects of aerial loading; this loading is largely removed when these devices are adjusted in an effective manner from the point of view of selectivity.

Another minor difficulty may be encountered where the set normally includes a directly coupled aerial, as shown in Fig. 2. In such cases, the inherent capacity of the aerial is added to that of the tuning condenser, and when it is removed the circuit will generally be incapable of being tuned over the broadcasting wavebands. The remedy is to fit suitable input coils.

How to Operate a Loose-coupler.

A still more ambitious loose-coupler is *The Wireless World* Selectivity Unit, described in the issue of April 25th, 1928; the circuit diagram of this device is reproduced in Fig. 4. It includes a standard "Everyman Four" aerial-grid coil, tuned by a variable condenser (C_1) of 0.00033 mfd. The coupling condenser (C_2) has a capacity of 0.0001 mfd. This unit is similar to the capacity - coupled aerial tuner shown in Fig. 3, and is connected to the aerial and earth terminals of the receiver in the same way.

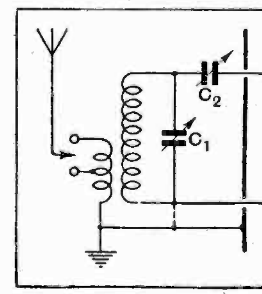
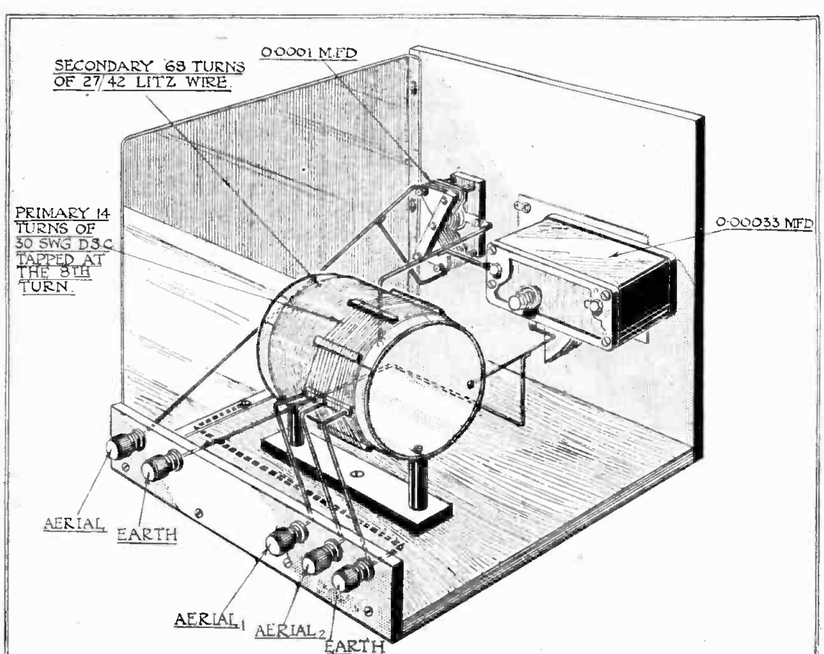


Fig. 4.—Circuit diagram of "The Wireless World" Selectivity Unit.

Some little trouble—but not more than can be overcome by assiduous practice—will be encountered by the less experienced when first operating a reacting detector set (without H.F. amplification) to which a two-circuit aerial tuner has been added. Receivers without feed-back to the input grid circuit are quite easy to work if one remembers that all the tuned circuits must be kept approximately "in step" while searching for signals; this is quite easy when a few "landmarks"—stations of which the wavelengths are known—have been found.

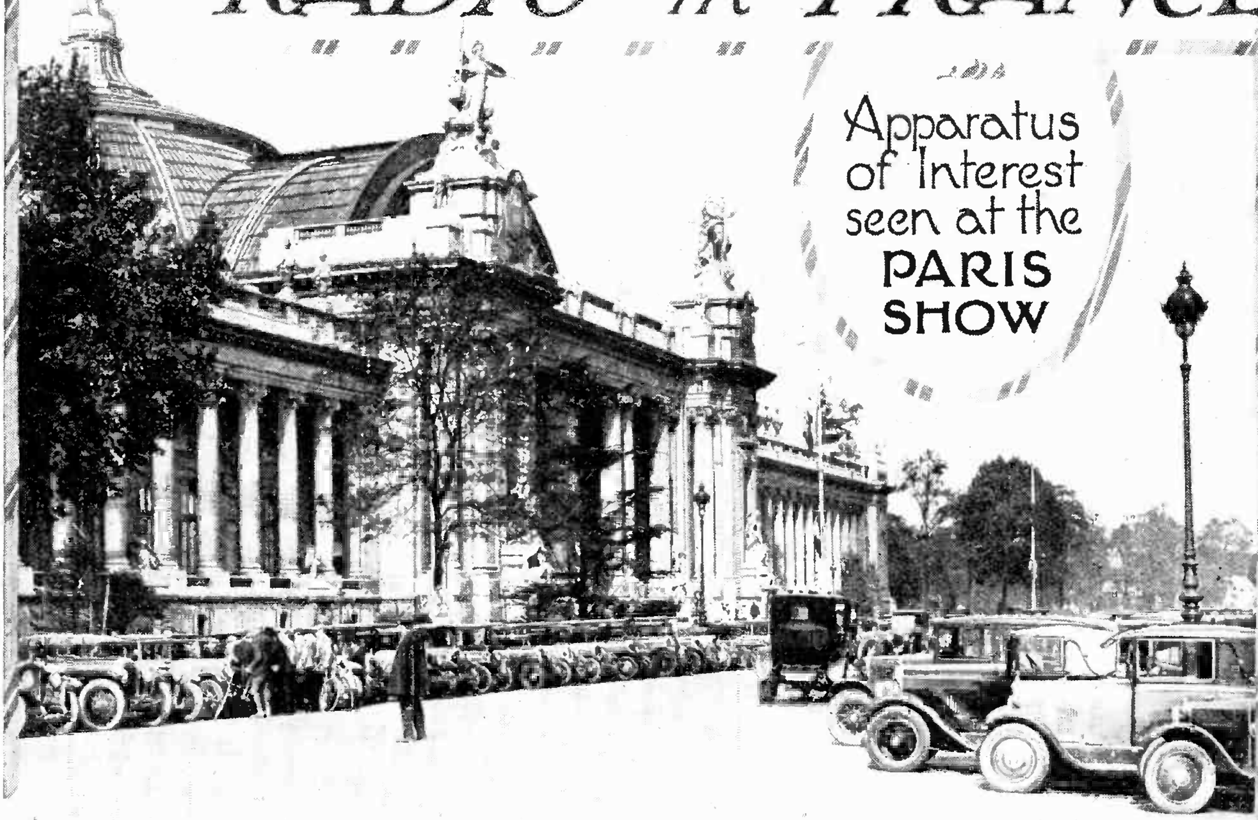


Disposition and wiring of components in "The Wireless World" Selectivity Unit. A vertical metal screen is fitted.

It is usual to recommend that the beginner should start operations with a very close coupling between aerial and secondary circuits, but it seems to the writer to be very doubtful if this is the best course, as "double-humped" tuning may be produced; this is most confusing, as a given transmission may be receivable at two distinct condenser settings.

Generally speaking, it is best to acquire experience of tuning when the local interfering station is silent, and to concentrate on a transmission providing a large but not overpowering input. If the suggestion offered in the preceding paragraph is adopted, the coupling will be made very loose by moving the aerial coil to a distance of several inches from the internal grid inductance, or, if a capacity-coupled circuit is used, by setting the control condenser at a very low value.

RADIO in FRANCE



Apparatus of Interest seen at the PARIS SHOW

By A MEMBER OF THE STAFF.

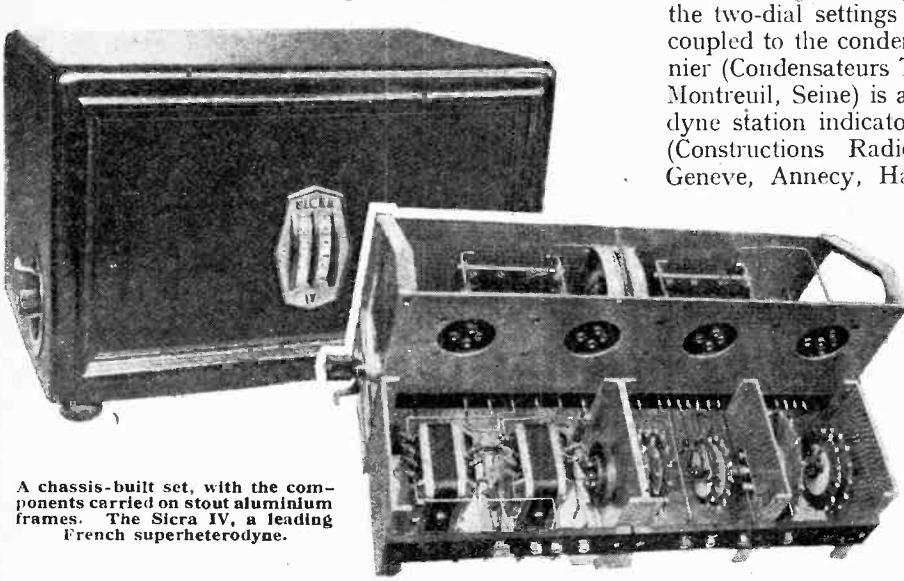
MY visit to this year's Paris Show has been a disappointing one. It was difficult to realise that twelve months had elapsed since I last toured the stands in the Grand Palais. The apparatus, in general, had undergone little or no change, and most of last year's designs still flourished. I was again greeted as I went from stand to stand by the pairs of tuning dials indicative of the superheterodyne. Not even the dials themselves had changed, so I set out in search of departures from these highly selective sets which seem to have assumed a life eternal.

My comments of last year on the survival of the superheterodyne brought forth much criticism from French readers, and three reasons were brought forward as to why the manufacturers in France favour this class of set. These reasons were (1) that the majority of listeners are not permitted to erect outdoor aerials, partly because of the unsightly effect and also owing to a fear of damage by lightning, a seemingly futile reason, (2) a high degree of selectivity was demanded, combined with the reliable reception of programmes from abroad, and (3) patent royalties, not being based on the number of valves, permitted of this class of multivalve receiver. None of these reasons seems sufficiently convincing, yet it is the third which contains the truth, for in France the master patents have not been administered in the same convenient manner as they have in this country, and neither are those all-important patents just expired or expiring, as is the case here. Unless the problems of patent administration and validity are quickly solved France will find herself hopelessly handicapped in the production of radio gear.

This universal production of superheterodyne sets is not the only point indicative of the radical difference existing between two almost adjoining countries. There are practically no portables, and the home constructor, as a class, is non-existent. There are no kit sets, neither are there specialised components for the amateur comparable with the extensive production of such apparatus in this country. Components are exhibited, yet with the exception of ingenious condenser mountings there is no single example of a component in which progressive design or invention is revealed. Components shown last year appear again this year without modification, and, in fact, there are not even copies of those many specially designed parts found on the British market and so essential to obtaining the best results. French components sell to the set manufacturer, and not

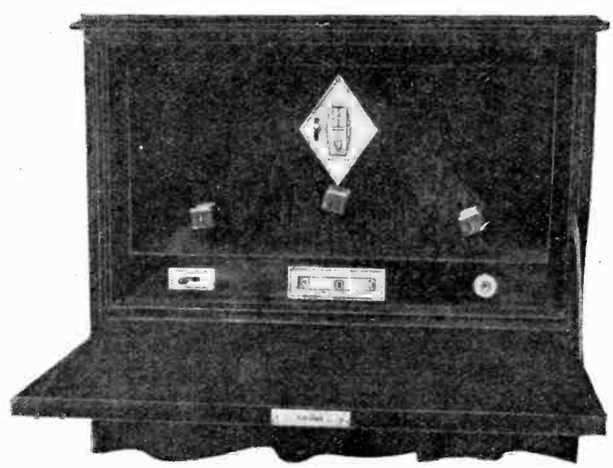
Radio in France.—
the amateur, so that high technical merit is probably overruled by economic requirements.

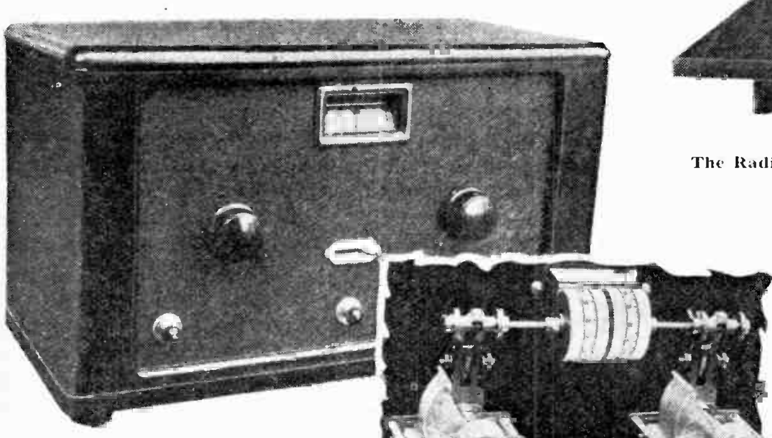
As a stand-to-stand report would resolve itself into describing a multiplicity of circuit combinations of the superheterodynes, a few outstanding points of design are all that will interest the English reader. Tuned H.F.


A chassis-built set, with the components carried on stout aluminium frames. The Sicra IV, a leading French superheterodyne.

stages preceding the first detector are now practically non-existent. A special two-grid type of valve is used in many of the sets as a first detector, as a means of combining the frequencies. As with the English receiver, two-wave ranges are invariably provided, a complicated switch being used to change the connections of frame, oscillator, and reaction. Screen-grid valves have in a few instances found their way into the intermediate amplifier, but as stable amplification already exists on the long intermediate wavelengths the advantages gained by the change are questionable. Long-wave intervalve couplings are, in almost every case, simple air core transformers of the fine wire aperiodic variety. In the majority of the sets a horizontal ebonite panel carrying the apparatus on the under side and the valve legs on the top is secured to the vertical front panel, behind which there is ample space to accommodate the two tuning condensers and the many forms of tuning indicators.

Last year I described some of these indicators, their action being based upon the graphical representation of the two-dial settings associated with pointers which are coupled to the condenser spindles. The Autorex Tavernier (Condensateurs Tavernier, 71, Rue François-Arago, Montreuil, Seine) is a typical example of a superheterodyne station indicator. Another model, the "Grillet" (Constructions Radio-electriques Grillet, Avenue de Geneve, Annecy, Haute Savoie), consists of a sliding indicator interlocked by rack work with the two condensers. Three separate slides are arranged in this model, and in moving from one to the other a wave-range switch and indicator are actuated. One of the most ingenious presented a rectangular screen on its front panel, and the operating of the knobs caused a spot of light to move to a predetermined point indicating the station required. Another useful form of station indicator is found in the "Cryptadyne VII" (Radio-Industrie Cryptadyne, 25, Rue des Usines, Paris). In this receiver a pair of dials are labelled with the stations in the long and short wave bands. These dials are interlocked with scales, which are viewed through apertures immediately adjoining the scales of the tuning condensers. In the apertures one reads the condenser settings required for the given stations.


The Radiola six-valve superheterodyne, possessing one of the most attractive of panel layouts.


The two tuning controls are here conveniently placed and operate a pair of indicating drums through a two-to-one pulley drive. The Strobodyne Biplex with Arena condensers.

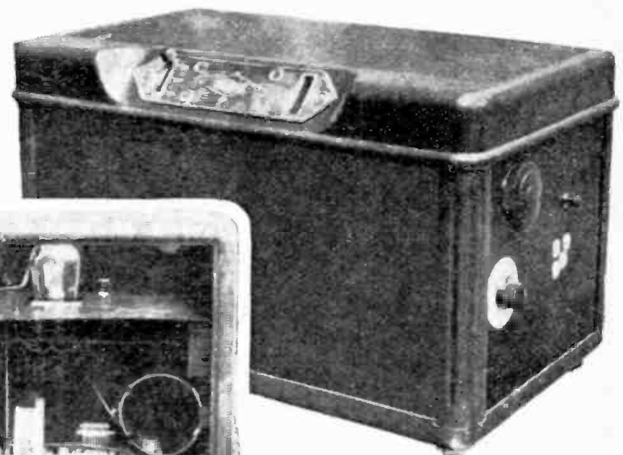
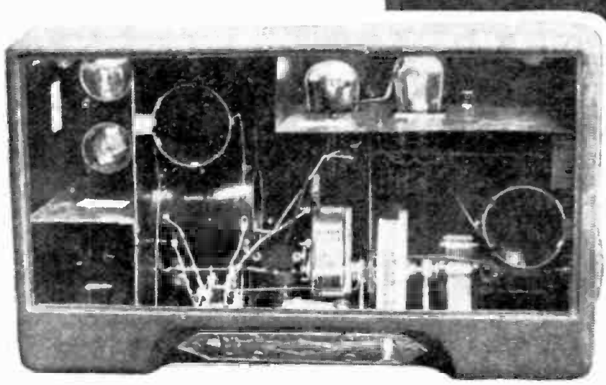
Output L.F. amplifiers incorporated in these superheterodynes did not include

Radio in France.—

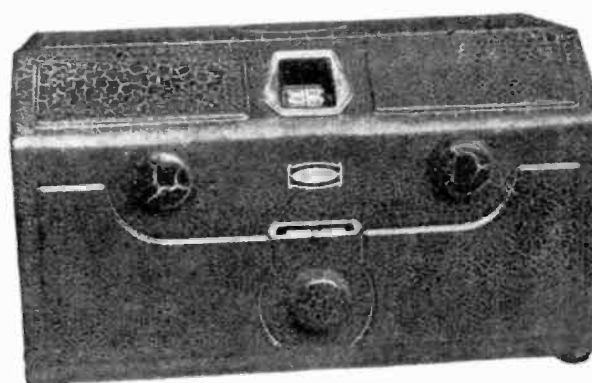
those refinements necessary for distortionless amplification, a circumstance suggesting that the superheterodyne principle itself does not permit of quality reception. Prices differ widely, varying in the ordinary cabinet models between about 1,000 and 3,000 francs.

In the search for receivers following British practice two examples were found upon which comment might be made. These are really up-to-date sets, embodying screen-grid and pentode valves and designed for all-mains operation. Both were three-valve sets, and obviously designed with a view to mass production. The "Ondia" (Le Matérial Ondia, 2, Route de Paris, Boulogne - sur - Mer), is beautifully finished in a pressed metal case, with drum dial exposed in an aperture on a top edge bevel. Being completely sealed I had no opportunity of examining the interior, but it was obvious from certain details in design that the manufacturers were in a unique position in the matter of mass production, and it transpired that their principal business was that of pressings and turned parts. This receiver, it is hoped, marks a turning point in French radio practice.

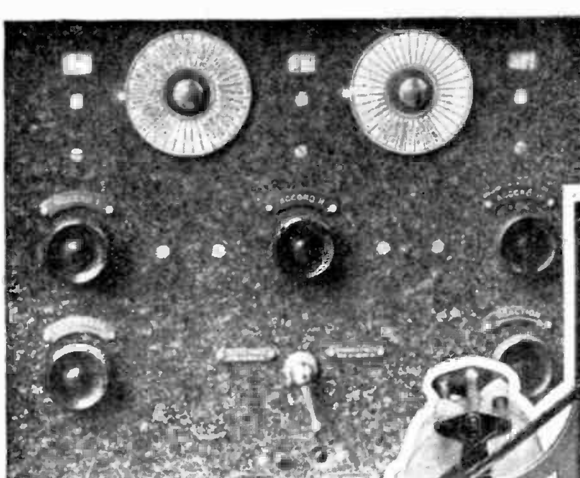
The other receiver, the "Hervor" (Etablissements Herbelot et Vorms, 13, Passage des Tourelles, Paris), is contained in a large pressed metal cabinet with rounded corners, following Philips' practice. Its three Philips' valves correspond with the S4V, the 164T, and the PM24A, provision being made to feed this output pentode with an anode potential of 300 volts. Complete with valves, the price of this set is about £20. It is interesting to note that the French sets designed for use with mains include a three-point connection to the supply, the extra lead being a tapping on the transformer primary to allow for voltage variation. In addition, the "Hervor" is fitted with a control to further compensate for differences in the potential of the mains.

A new receiver embodying screen-grid H.F. valve and high voltage pentode. The Hervor type A.4. It is A.C. mains operated.



Another new three-valve mains-operated set, the Ondia.

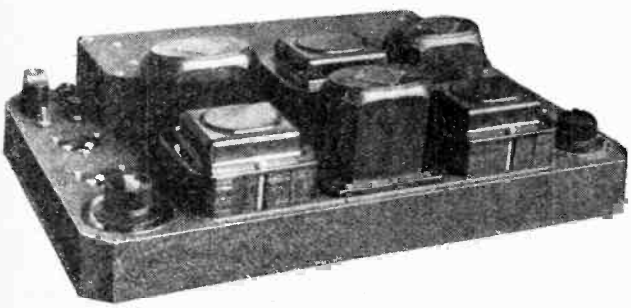



Typical tuning indicators, the Cryptadyne and the Autorex Tavernier.

Over 120 different models were counted on the stands of the set manufacturers, of which probably not more than five per cent. are of the mains - operated straight - circuit type.

Oxide-coated filaments are now used in most of the French valves, giving to them greatly improved performance. Certain of the manufac-

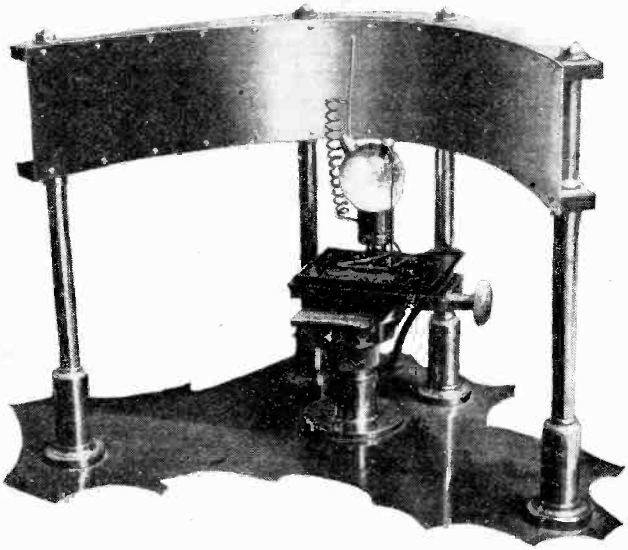
Radio in France.—turers limit their output entirely to triodes, but others include well-finished specimens of screen grid and pentode. Indirectly heated valves have also made their appearance. Those readers whose radio experience dates back to before broadcasting will remember how they depended upon France for their supply of valves, and, in particular, had a high opinion of valves bearing the name Métal and Fotos. During the intervening period these valves have not possessed the characteristics to be found in the British products, but now, I find, that by the use of the oxide-coated filament Métal and Fotos valves have been greatly improved. By way of example, the Métal type D.W.702 is a power output valve with an A.C. resistance of 2,250 ohms and an amplification factor of 7, so that the mutual conductance is no less than 3.2, while the permissible grid swing is nearly 30 volts. Its filament passes 0.23 ampere at 4 volts. Another output valve, the D.X.502, passes 0.15 ampere at 4 volts, and



A mains-operated low-frequency amplifier by La Construction Radioélectrique. The circuit is a push-pull arrangement using an anode potential of 400 volts.

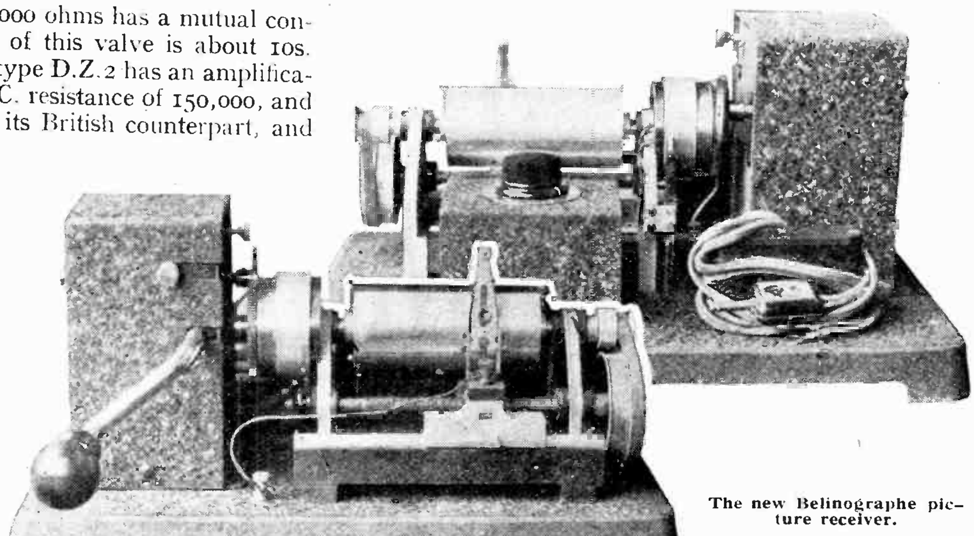
with an A.C. resistance of 2,000 ohms has a mutual conductance of 2.5. The price of this valve is about 10s. The Métal screen-grid valve type D.Z.2 has an amplification factor of 150, with an A.C. resistance of 150,000, and corresponds, therefore, with its British counterpart, and is priced at about 14s. A Métal pentode, the 3.D.X., which is known as the *tri-grille*, sells at 16s., has a mutual conductance of 1.8, and takes a maximum anode potential of 150, the grid bias being 10 to 12 volts.

Data given in respect of Fotos valves shows that many of the popular L.F. types have a mutual conductance of 2. The Fotos pentode has a mutual conductance of 1.8, and a maximum anode potential of 120, with a bias of about 7.5. This valve is priced at about 14s. 6d. Of similar price is the screen-grid valve with amplification factor and A.C. resistance of 150 and 150,000 respectively. When indirectly heated and having very similar characteristics, this valve is priced at 16s. There is another series of valves, bearing the name Visseaux, with characteristics and prices closely corresponding to those just mentioned (J. Visseaux, 87 and 91, Quai Pierre-Seize, Lyon).



An interesting ultra short-wave transmitter with reflector. (Ateliers J. Carpentier.)

Picture receivers for home use are the principal exhibit on the Belin stand. The Belinographe machines are fitted with driving clutch, catch and contacts, and closely follow standard practice. Traversing of the cylinder is obtained by an auxiliary shaft, and by means of a double pulley the rate of traverse may be readily adjusted to satisfy the standards of picture analysis adopted in the various systems. The price of the machine is about £20.



The new Belinographe picture receiver.

Moving-coil loud speakers are still little in evidence, the principal exhibitors being the French B.T.H. and the Stellor (Etablissements A. Charlin, 148, Avenue du Maine, Paris). A patent royalty is collected in France in respect of the moving-coil loud speaker, which is perhaps a contributory cause in restricting its popularity.

By Our Special Correspondent.

Those Land Lines.—A New Black List.—Regional Scheme Disclosures.

A Rumour Refuted.

Sunday, October 27th, was enlivened by the newspaper report that in the near future the B.B.C. would probably acquire its own cables for S.B. purposes. An astounding statement, which was instantly contradicted on enquiry at Savoy Hill. The Post Office maintains a jealous authority over all communications in this country, and considering the initial and upkeep costs of lines it is unlikely that any other organisation would covet the honour. (The cost of installing a modern cable with the necessary repeaters between London and Glasgow would amount to more than £400,000!)

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The Land Line Problem.

Nevertheless, mention of the land lines always gives rise to melancholy reflections in the minds of listeners who live beyond the service areas of 2LO and 5XX. No existing line is ideal for broadcasting purposes, and no amount of amplification *en route* can give Ireland or Scotland the quality of transmission which the pampered London listener has been led to expect as his birthright.

When the completed regional scheme holds sway every listener will be entitled to at least one direct wireless programme from his nearest transmitter.

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Hope for the North.

Meanwhile I hear that the Post Office (which, to its credit, has always striven to give the B.B.C. the best of the available lines) is taking broadcasting into account in the design of the latest cables. Before the end of the year Scottish listeners are likely to benefit from the opening of a new cable from Leeds, *via* Jedburgh, to Edinburgh, equipped with the most modern types of amplifier and capable of dealing with a much wider range of frequencies.

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German Enterprise.

Probably the best cables in the world for broadcasting purposes are those now in use in Germany. The German Post Office has worked hand in hand with the broadcasting authorities in the production of cables specially suitable for musical transmissions, and the result is the evolution of a new form of cable in the centre of which are several heavily insulated lines reserved exclusively for broadcasting purposes. It is stated that relays with the new cable, which runs from Berlin to Cologne, are singularly free from extraneous noises and distortion. The British Post Office is watching the experiment with interest, and it is highly probable that similar tests may be carried out over here.

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B.B.C.'s Birthday.

This year's broadcast birthday programme (from all stations on November 14th) is to be entitled "We are Seven." I understand that it is not intended to disguise the fact that the staff actually numbers 700. but is a reminder that this is their seventh anniversary.

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Tatsfield's Black List.

The Tatsfield receiving station of the B.B.C. has been conducting what might almost be called an inquest upon the remains of the Prague Plan. Ignoring the chaos in the Continental ether, the engineers have been concentrating on the interference caused to British stations, with "distressing disclosures." At the present time no fewer than ten Continental transmitters are heterodyning B.B.C. stations every night. Here is the black list:—Petit Parisien, Radio Vitus, Langenburg, Zagreb, Lyons, Simferopel (Russia), Moravska-Ostrava, Leipzig, Horby, and San Sebastian.

San Sebastian, by the way, is making honourable attempts to avoid Glasgow's wavelength, but seems unable to find a niche elsewhere.

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Regional Scheme Disclosures.

The Moorside Edge station is to have a bigger service area than Brookmans Park. This is one of a number of interesting official statements concerning the regional scheme made in the B.B.C. Year Book for 1930, which is timed to appear in a day or two.

The service area will be greater, partly on account of the longer wavelength—the highest medium wave available—and partly because the B.B.C. has been permitted to use masts 500ft. high, whereas owing to Air Ministry restrictions Brookmans Park has been limited to 200ft.

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The Unlucky Highlands.

When the London, Daventry and Northern regional stations are working it is estimated that a service of alternative programmes will be available to 75 per cent. of the population in the British Isles, leaving the remainder to be provided for by the Scottish and West Regional stations. The B.B.C. fear, however, that these two stations will have the hardest task, as they have to cover mountainous country. Indeed, it is frankly admitted that something like 2 per cent. of the population of Scotland will be left out in the cold. When the scheme is complete only 4 per cent. of the total population will be unable to get any alternative programme, and about 80 per cent. should be able to enjoy an alternative with the simplest receivers.

Regarding the completion of the scheme the writer says: "It is fair to give 2½ years more before everything is as it is planned to be."

FUTURE FEATURES.

London and Daventry.

NOVEMBER 11TH.—Armistice Day Service and "Journey's End."

NOVEMBER 14TH.—Peace Commemoration Dinner Speeches, relayed from the Guildhall.

Daventry Experimental (5GB).

NOVEMBER 11TH.—Service from the Cenotaph.

NOVEMBER 12TH.—Music by French Composers.

NOVEMBER 15TH.—"Une Voix dans le Desert." poem by Emile Cammaerts, music by Sir Edward Elgar.

Cardiff.

NOVEMBER 14TH.—"Empire Builders," the story of Bristol Merchant Venturers.

Manchester.

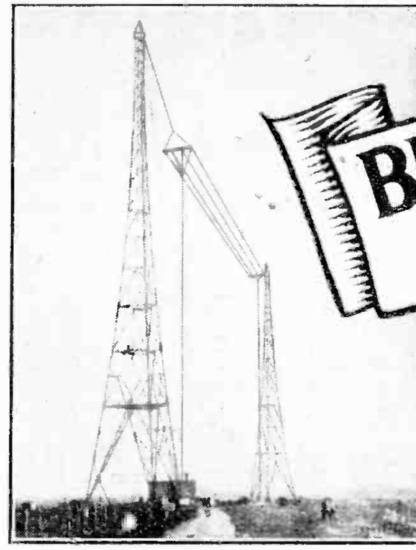
NOVEMBER 16TH.—Playwrights of the North.—7. "Mary's John," a comedy by Harold Brighouse.

Glasgow.

NOVEMBER 16TH.—"Weir of Hermiston." by Robert Louis Stevenson. dramatised by A. W. Yuill, adapted by Halbert Tatlock.

Belfast.

NOVEMBER 13TH.—An Irish and Scots Programme.



Kalundborg (Denmark).

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Explanatory Notes to the
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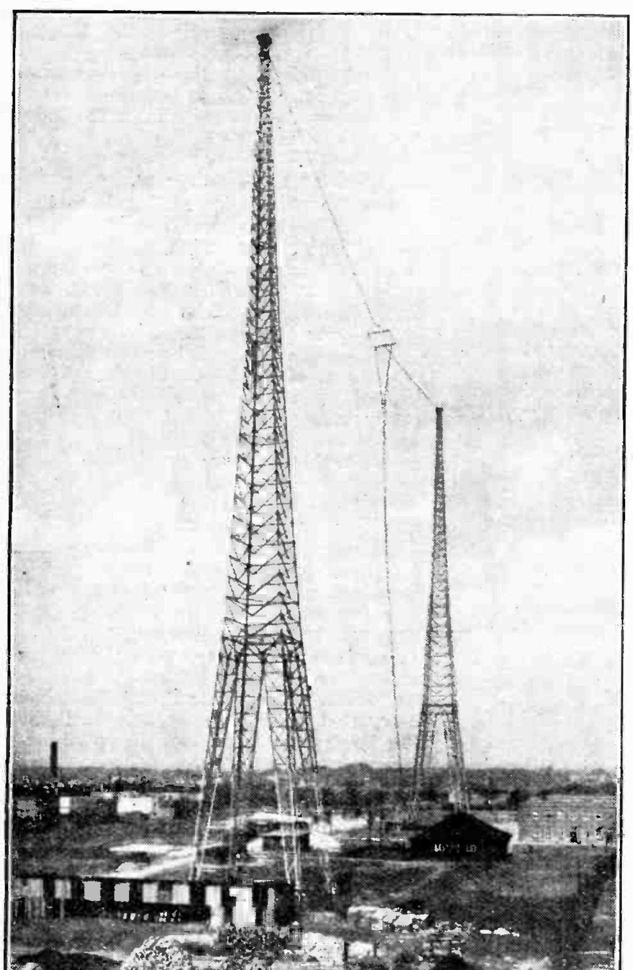
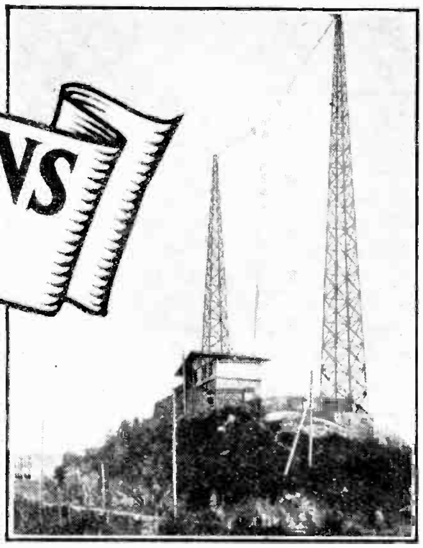
Station.		Kilowatts in Aerial.	Frequency in Kilocycles.	Wavelength in Metres.	Dial Settings.
Kovno (RYK)	Lithuania	7	155	**1935**	....
Huizen	Holland	6.5	160	**1875**	....
Lahti	Finland	40	167	**1796.4**	....
Radio Paris	France	12	174	**1724.1**	....
Zeesen	Germany	26	183.5	**1634.9**	....
Daventry (5XX)	Gt. Britain	25	193	**1554.4**	....
Moscow (Komitern)	Russia	12	202.5	**1481.5**	....
Eiffel Tower (FL)	France	12	207.5	**1445.8**	....
Warsaw	Poland	12	212.5	**1411.8**	....
Motala	Sweden	30	222.5	**1348.3**	....
Kharkov	Russia	4	230	**1304.3**	....
Boden	Sweden	0.6	250	**1200**	....
Reykjavik (*a*)	Iceland	5–7	250	**1200**	....
Stamboul	Turkey	5	250	**1200**	....
Kalundborg	Denmark	7.5	260	**1153.8**	....
Hilversum (*b*)	Holland	6.5	280	**1071.4**	....
Trondjhem (*a*)	Norway	1.2	280	**1071.4**	....
Basle	Switzerland	0.25	297	**1010.1**	....

Station.		Kilowatts in Aerial.	Frequency in Kilocycles.	Wavelength in Metres.	Dial Settings.
Leningrad	Russia	20	300	**1000**	....
Moscow (CCSP)	Russia	2	320	**937.5**	....
Moscow	Russia	—	364	**824.2**	....
Kiev (RA5)	Russia	1.2	375	**800**	....
Petrozavodsk	Russia	2	385	**779.2**	....
Ostersund	Sweden	0.6	389	**770**	....
Radio Geneva	Switzerland	0.25	395	**759.5**	....
Minsk	Russia	4	428	**700**	....
Lausanne	Switzerland	0.6	442	**678.7**	....
Freiburg	Germany	0.25	527	**569.3**	....
Hamar	Norway	0.7	527	**569.3**	....
Ljubljana	Yugoslavia	3	527	**569.3**	....
Smolensk	Russia	2	531.5	**564.4**	....
Augsburg	Germany	0.25	536	**559.7**	....
Hanover	Germany	0.25	536	**559.7**	....
Budapest (HAL)	Hungary	15–20	545	**550.5**	....
Sundsvall (SBD)	Sweden	0.6	554	**541.5**	....
Munich	Germany	1.5	563	**532.9**	....
Riga	Latvia	5	572	**524.5**	....
Vienna (Rosenhügel)	Austria	15	581	**516.4**	....
Archangel	Russia	1.2	585.5	**512.4**	....
Brussels	Belgium	1	590	**508.5**	....
Milan	Italy	7	599	**500.8**	....
Moscow	Russia	1.2	603.5	**497.1**	....
Oslo (*c*)	Norway	1.2	608	**493.4**	....
Prague (*c*)	Czechoslovakia	5	617	**486.2**	....
Gomel	Russia	1.2	621.5	**482.7**	....
Daventry (5GB)	Gt. Britain	25	626	**479.2**	....
Simferopol	Russia	1.2	630	**476.4**	....
Langenberg	Germany	15	635	**472.4**	....
Lyon la Dom	France	5	644	**465.8**	....
Zürich	Switzerland	0.63	653	**459.4**	....
Aix-la-Chapelle	Germany	0.25	662	**453.1**	....
Aalesund	Norway	0.3	662	**453.1**	....
Bolzano	Italy	0.2	662	**453.1**	....
Danzig	Danzig	0.25	662	**453.1**	....



General view of the Hamburg Station (Germany).

San Sebastian (Spain).

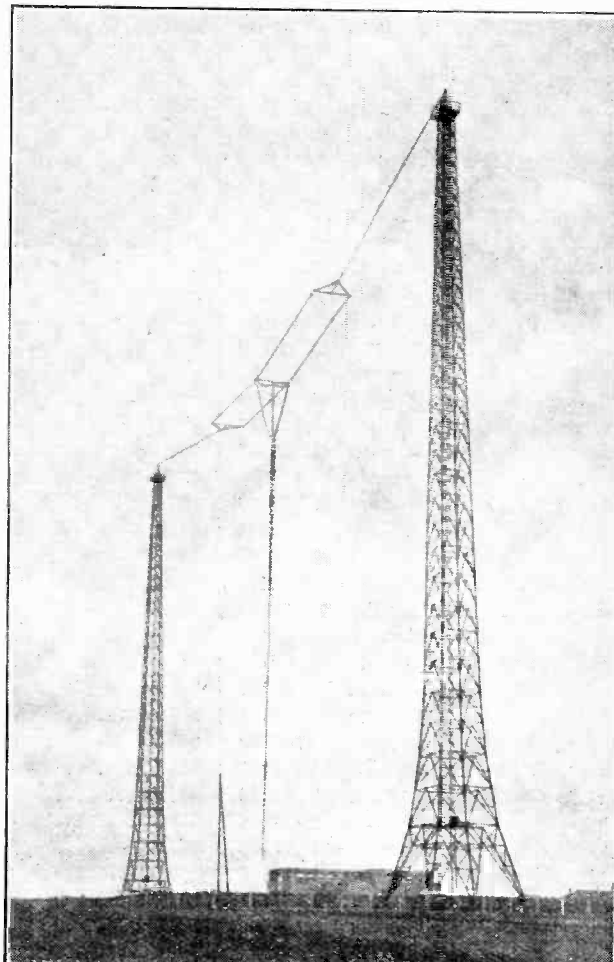


STATIONS ... OPE

Wavelengths.

: (a) to (k) will be found ...ls.

Station.	Kilowatts in Aerial.	Frequency in Kilocycles.	Wavelength in Metres.	Dial Settings.
Klagenfurt .... Austria	0.5	662	**453.1**	....
Porsgrund .... Norway	0.7	662	**453.1**	....
Salamanca .... Spain	1	662	**453.1**	....
Tromsoe .... Norway	0.1	662	**453.1**	....
Tammerfors .... Finland	0.8	662	**453.1**	....
Upsala .... Sweden	0.15	662	**453.1**	....
Moscow (SP) .... Russia	1	666.5	**450.1**	....
Paris (Ecole Sup're) .... France	0.8	671	**447.1**	....
Rjukan .... Norway	0.15	671	**447.1**	....
Rome (1RO)............ Italy	3	680	**441.2**	....
Stockholm (c) .... Sweden	1	689	**435.4**	....
Malmberget .... Sweden	0.25	689	**435.4**	....
Belgrade .... Yugoslavia	2.5	698	**429.8**	....
Kharkov .... Russia	4	702.5	**427**	....
Madrid (EAJ7).......... Spain	2	707	**424.3**	....
Berlin (Witzleben).... Germany	1.5	716	**419**	....
Dublin (2RN) ...... Irish F.S.	1	725	**413.8**	....
Rabat .... Morocco	10	727	**412**	....
Odessa .... Russia	1.2	729.5	**411.2**	....
Katowitz .... Poland	10	734	**408.7**	....
Berne............ Switzerland	1.2	743	**403.8**	....
Koursk .... Russia	1.2	747.5	**401.3**	....
Glasgow (5SC) ..... Gt. Britain	1	752	**398.9**	....
Bucarest .... Roumania	12	761	**394.2**	....
Fredriksstad .... Norway	0.7	761	**394.2**	....
Frankfurt-on-Main ... Germany	1.5	770	**389.6**	....
Wilno .... Poland	0.5	779	**385.1**	....
Genoa .... Italy	1.2	779	**385.1**	....
Dnepropetrovsk .... Russia	1.2	783.5	**382.9**	....
Radio Toulouse .... France	8	788	**380.7**	....
Artemovsk .... Russia	1.2	792.5	**378.5**	....
Manchester (2ZY) .. Gt. Britain	1	797	**376.4**	....
Hamburg .... Germany	1.5	806	**372.2**	....
Tver .... Russia	1	810	**370.1**	....
Paris (LL)............ France	1.5	815	**368.1**	....
Seville (EAJ5) .... Spain	1.5	815	**368.1**	....
San Sebastian (EAJ8) ... Spain	0.3	815	**368.1**	....
Nikolaiev.............. Russia	1.2	819.5	**366.1**	....
Bergen............... Norway	1	824	**364.1**	....
Stuttgart .... Germany	1.5	833	**360.1**	....
London (2LO) ..... Gt. Britain	30	842	**356.3**	....
Graz................. Austria	7	851	**352.5**	....
Algiers.... .... Algeria	—	852.6	**351**	....
Leningrad .... Russia	1.2	855.5	**350.7**	....
Barcelona (EAJ1) .... Spain	8	860	**348.8**	....
Brunn (d) ..... Czechoslovakia	2.4	878	**341.7**	....
Bremen (e) .... Germany	0.25	887	**338.2**	....
Brussels (No. 2) (f) ... Belgium	2	887	**338.2**	....
Ivan-Vornesensk .... Russia	1.2	891.5	**336.5**	....
Cadiz .... Spain	0.55	895	**335**	....
Posen................ Poland	1.2	896	**334.8**	....
Naples (1NA) .... Italy	1.5	905	**331.4**	....
Paris (Petit Parisien) ... France	0.8	905	**331.4**	....
Grenoble (PTT) .... France	—	914	**328.2**	....



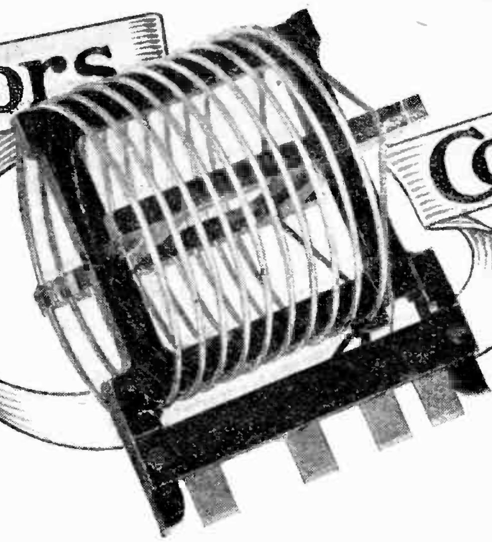
The masts and aerial system at Stuttgart (Germany).

Station.	Kilo-watts	Kilo-cycles.	Wave-length.	Dial Settings.
Breslau .... Germany	1.5	923	**325**	....
Falun .... Sweden	2	932	**321.9**	....
Göteborg .... Sweden	10	932	**321.9**	....
Dresden (*e*) .... Germany	0.25	941	**318.8**	....
Marseilles (PTT) .... France	0.5	950	**315.8**	....
Oviedo .... Spain	0.7	955.4	**314**	....
Cracow .... Poland	1	959	**313**	....
Cardiff (5WA) ..... Gt. Britain	1	968	**309.9**	....
Paris(Vitus) .... France	1	973	**308**	....
Zagreb .... Yugoslavia	0.7	973	**308**	....
Agen .... France	0.5	981.7	**305.6**	....
Bordeaux-Lafayette .... France	1	986	**304.3**	....
Aberdeen (2BD).... Gt. Britain	1	995	**301**	....
Hilversum (*g*) .... Holland	6.5	1004	**298.8**	....
Tallinn .... Esthonia	1.5	1013	**296**	....
Kosice .... Czechoslovakia	2	1022	**293.6**	....
Limoges .... France	0.5	1022	**293.6**	....
Lyons .... France	0.5	1029.3	**291.4**	....
Viborg .... Finland	0.4	1031	**291**	....
Bournemouth (6BM) Gt. Britain	1	1040	**288.5**	....
Bradford (2LS)..... Gt. Britain	0.13	1040	**288.5**	....
Dundee (2DE) ..... Gt. Britain	0.13	1040	**288.5**	....
Edinburgh (2EH) .. Gt. Britain	0.35	1040	**288.5**	....
Hull (6KH) .... Gt. Britain	0.13	1040	**288.5**	....
Liverpool (6LV) ... Gt. Britain	0.13	1040	**288.5**	....
Plymouth (5PY) ... Gt. Britain	0.13	1040	**288.5**	....
Sheffield (6FL) .... Gt. Britain	0.13	1040	**288.5**	....
Stoke-on-Trent (6ST)Gt. Britain	0.13	1040	**288.5**	....
Swansea (5SX)..... Gt. Britain	0.13	1040	**288.5**	....
Mont-de-Marsan .... France	—	1040	**288.5**	....
Montpellier .... France	0.2	1049	**286**	....
Berlin No. 2 (*e*) ...... Germany	0.5	1058	**283.6**	....
Innsbruck (*e, h*) ...... Austria	0.5	1058	**283.6**	....
Magdeburg (*e*) ...... Germany	0.5	1058	**283.6**	....
Notodden (*e*) .... Norway	0.05	1058	**283.6**	....
Stettin (*e*) .... Germany	0.5	1058	**283.6**	....
Uddevalla (*e*) .... Sweden	0.05	1058	**283.6**	....
Varberg (*e*) .... Sweden	0.3	1058	**283.6**	....
Copenhagen .... Denmark	0.75	1067	**281.2**	....
Bratislava .... Czechoslovakia	12.5	1076	**278.8**	....
Königsberg .... Germany	1.5	1085	**276.5**	....
Turin .... Italy	7	1094	**273.2**	....
Rennes (PTT) .... France	0.5	1103	**272**	....
Kaiserslauten (*e*) ..... Germany	0.25	1112	**269.8**	....
Hudiksvall (*e*)......... Sweden	0.15	1112	**269.8**	....
Norrköping (*e*) .... Sweden	0.25	1112	**269.8**	....
Trollhätten (*e*) .... Sweden	0.25	1112	**269.8**	....
Barcelona (EAJ13) (*i*) ... Spain	10	1121	**267.6**	....
Strasbourg .... France	0.1	1121	**267.6**	....
Lille (PTT) .... France	0.7	1130	**265.5**	....
Moravska-Ostrava C'choslovakia	10	1139	**263.4**	....
Newcastle (5NO) ... Gt. Britain	1	1148	**261.3**	....
Leipzig .... Germany	1.5	1157	**259.3**	....
Horby .... Sweden	10	1166	**257.3**	....
Toulouse (PTT) .... France	1.2	1175	**255.3**	....
Gleiwitz .... Germany	5	1184	**253.4**	....
Almeria (EAJ18) .... Spain	1	1193	**251.5**	....
Prague (No. 2) . Czechoslovakia	—	1202	**249.6**	....
Trieste .... Italy	—	1211	**247.7**	....

Station.	Kilo-watts	Kilo-cycles.	Wave-length.	Dial Settings.
Abo .... Finland	0.5	1220	**245.9**	....
Bloemendael (*j*) .... Holland	0.01	1220	**245.9**	....
Cartagena .... Spain	0.4	1220	**245.9**	....
Cassel .... Germany	0.25	1220	**245.9**	....
Eskilstuna .... Sweden	0.2	1220	**245.9**	....
Ghent .... Belgium	—	1220	**245.9**	....
Kiel .... Germany	0.25	1220	**245.9**	....
Kalmar .... Sweden	0.2	1220	**245.9**	....
Kiruna .... Sweden	0.2	1220	**245.9**	....
Linz .... Austria	0.5	1220	**245.9**	....
Pietarsaari .... Finland	0.25	1220	**245.9**	....
Säffle .... Sweden	0.4	1220	**245.9**	....
Schaerbeek .... Belgium	—	1220	**245.9**	....
Cracow .... Poland	1	1229	**244.1**	....
Belfast (2BE) ..... Gt. Britain	1	1238	**242.3**	....
Rjukan .... Norway	0.2	1247	**240.6**	....
Nimes .... France	1	1256	**238.9**	....
Nurnberg .... Germany	2	1256	**238.9**	....
Bordeaux (S-O) .... France	—	1260	**238**	....
Juan-les-Pins (Nice) (*i*) .. France	—	1265	**237**	....
Orebro .... Sweden	0.2	1265	**237**	....
Münster (*e*) .... Germany	0.5	1283	**233.8**	....
Lodz .... Poland	—	1283	**233.8**	....
Boras .... Sweden	0.15	1301	**230.6**	....
Hälsingborg .... Sweden	0.2	1301	**230.6**	....
Malmö .... Sweden	0.6	1301	**230.6**	....
Umea .... Sweden	0.2	1301	**230.6**	....
Biarritz .... France	1.5	1313	**228.4**	....
Cologne .... Germany	1.5	1319	**227.4**	....
Bucarest Univ. (*e*) .. Roumania	—	1328	**225.9**	....
Cork (6CK) .... Irish F.S.	1	1337	**224.4**	....
Luxembourg (*k*) . Luxembourg	3	1346	**222.9**	....
Helsingfors .... Finland	0.9	1355	**221.4**	....
Fécamp .... France	—	1364	**219.9**	....
Flensburg .... Germany	0.5	1373	**218.5**	....
Karlstad .... Sweden	0.25	1373	**218.5**	....
Ornsköldsvik .... Sweden	0.2	1373	**218.5**	....
Bjorneborg .... Finland	0.8	1373	**218.5**	....
Halmstad .... Sweden	0.2	1391	**216**	....
Warsaw (No. 2) ...... Poland	—	1400	**214**	....
Palermo (*f*) .... Italy	—	1410	**212.8**	....
Jassy Univ. (*e*)...... Roumania	—	1420	**211.3**	....
Beziers .... France	—	1420	**211.3**	....
Gävle .... Sweden	0.2	1470	**204**	....
Kristinehamn .... Sweden	0.25	1480	**202.7**	....
Jönköping .... Sweden	0.25	1490	**201.3**	....
Leeds (2LS) (*e*)..... Gt. Britain	0.13	1500	**200**	....
Karlskrona .... Sweden	0.2	1530	**196**	....

(*a*) = Projected.
(*b*) = After 6.0 p.m
(*c*) = Power to be increased to 60 kW.
(*d*) = Power to be increased to 35 kW.
(*e*) = Provisionally.
(*f*) = Under construction.
(*g*) = After 6.0 p.m.
(*h*) = Will work on 213 metres if 283 metres prove unsatisfactory.
(*i*) = Temporarily closed.
(*j*) = Sundays only.
(*k*) = Experimental.

RADIO Conductors Compared



How Electro-plating Affects High-frequency Resistance.

By W. H. F. GRIFFITHS, F.Inst.P., A.M.I.E.E.

AT the Radio Exhibition at Olympia the author noticed a display of low-loss inductance coils. They were of bright bare copper wire. A few of them were beautifully brightly finished—apparently silver-plated—but a notice in bold type proudly informed the enquiring visitor that " All coils are nickel-plated for short-wave work." The manufacturer had evidently seen such coils silver-plated and had made his coils bright also, but had forgotten not only that nickel is vastly inferior to silver, ordinarily, as a conductor, but also that it has para-magnetic properties which preclude its indiscriminate use at radio frequencies.

Although the average wireless amateur of to-day fully realises that " all is not gold that glitters," it is thought that a little information on the relative behaviour, at radio frequencies, of various conductors and the effect of electro-plating them with various other metals will be helpful to many, especially if expressed quantitatively. There are quite a number of simple problems encountered which demand a knowledge of radio-frequency conductivity.

Tinned Copper Wire.

Although at wavelengths round about 30 metres the resistance of a copper wire is increased from six to eight times its original value by nickel-plating it to a thickness of a few ten-thousandths of an inch only, tinning the same wire with a similar coating will only produce a 30 per cent. increase in its resistance, although the specific resistance of nickel and tin are of the same value. Many regard commercial tinned copper wire with the utmost suspicion and will not employ it despite the fact that soldering is greatly facilitated by its use. It can be stated, however, that the thickness of tin on the surface of this wire is such that it does not affect appreciably the resistance on wavelengths higher than 100 metres.[1] It is hoped that the comfort they derive from this statement will more than compensate for the shock of the blow to one of their pet theories.

Another interesting example of the importance of the knowledge of radio-frequency conductivity is that of the relative conductivity of copper and silver. It is generally supposed that silver is a much better conductor than copper, but even for direct current it is only about 6 per cent. better. At high radio-frequencies, on all but the finest wires, this advantage is reduced to 3 per cent. —there being virtually no difference between the two metals. This also, of course, applies equally to the relative effectiveness of copper- and silver-plating of conductors. A little greater advantage may be gained in the case of silver-plating copper coils due to the fact that the silver deposited is pure electrolytic metal, whereas the copper is hard-drawn and consequently impure. In this connection it may be of interest to note that the high-frequency resistance of a hard-drawn copper conductor is reduced by 2 per cent. or 3 per cent. by copper-plating.

Again, the difference in the conductivities of copper and aluminium is reduced at high frequencies. At ordinary frequencies aluminium is about 70 per cent. higher in resistance than copper, whereas at radio-frequencies a 30 per cent. increase only is produced by the substitution of the lighter metal. This fact combined with its low specific gravity makes aluminium suitable for such conductors as plates for variable condensers.

Just one other instance of the reduction in the resistance[2] of the higher specific resistance conductors at high radio-frequencies is to be found in the choice of aerial wire. A glance at any wire tables will show that phosphor-bronze has a D.C. resistance of five times that of copper, an increase which would make its use as an aerial a matter for serious consideration. At high radio-frequencies, however, this ratio is reduced to a little more than 2 to 1, and so the alloy (which has the advantage of a much greater tensile strength and much lower ductility than copper) may be employed without the introduction of serious loss in the aerial.

[1] Even at 30 metres the increase of resistance due to the tin may be only 5 per cent., and it is thus seen that the effect is almost negligible on all but the lowest wavelengths.

[2] In comparison with copper.

Radio Conductors Compared.—

High-frequency Resistance due to "Skin Effect."

It will be noticed from the figures of the above examples that the ratio of high-frequency resistances of two conductors is always approximately proportional to the *square root* of the ratio of their specific resistances.[3] This is because of the well-known "skin effect" of radio-frequency current conduction. The current which flows in a conductor at radio-frequencies only "flows" in the outer crust or "skin," and its value is therefore limited (or the resistance increased) by this restriction of area. Under these conditions the resistance of the conductor, or the current it will pass, will not be materially changed if the centre of the conductor is cut away, leaving only the crust or skin in the form of a tube. The amount which could be cut from the centre without affecting the value of current passing at any particular frequency is a measure of the increase of resistance of the solid wire, at that frequency, above its D.C. value.

In order to be used as a criterion of resistance increase in this way the amount of this superfluous "core" should be expressed as a percentage of the total cross-sectional area of the solid conductor. The percentage will be greater for higher frequencies and for conductors of greater cross-section.

[3] This is only true for conductors having unity magnetic permeability, as will be explained later.

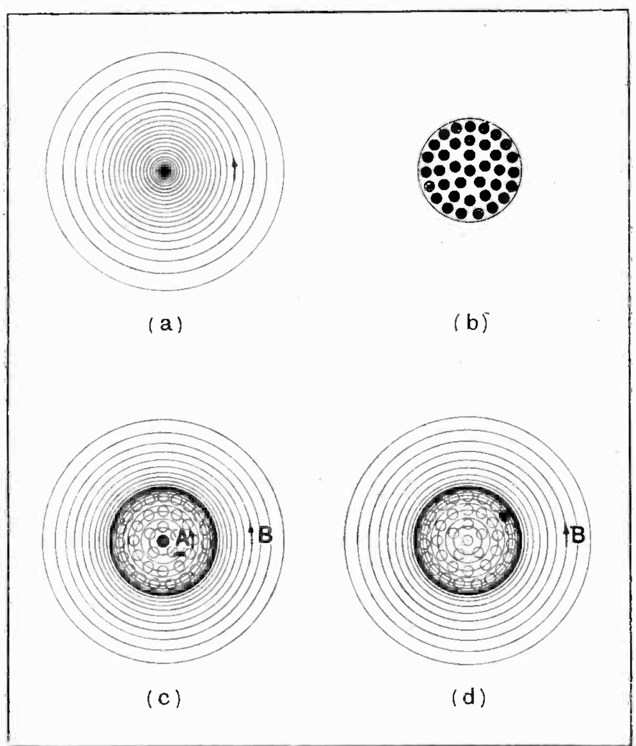


Fig. 1.—Illustrating skin-effect. (a) An alternating field of circular magnetic lines around a thin wire. (b) To explain the skin effect, a solid conductor can be considered as composed of a number of fine wires. (c) A fine wire at the centre of the conductor will have a field A inside the conductor and a field B outside. (d) A wire near the skin of the conductor will only have the field B linking with it.

A Simple Explanation of "Skin Effect."

In order to form some idea of the reason for this "surface flow" of high-frequency current, it is well to consider a conductor of circular cross-section and of large diameter—a copper rod. The reader will, of course, know that an alternating magnetic field is produced by an alternating current flowing in a thin wire—he will know also that this field takes the form of circular magnetic "lines" round the thin wire and concentric with it as shown in Fig. 1(a). This field, by virtue of the fact that it is linked with the current producing it, gives the conductor inductance L (even if it is a straight wire) an inductance which, at very high frequencies, gives to the wire a reactance (ωL) sufficiently high to limit the current flow as seriously as or sometimes more seriously than its resistance.

Now let a large-diameter copper rod be considered to be built up of a number of thin copper wires, say 1,000, of equal diameter, and packed tightly as shown in Fig. 1(b). If the conductor forms part of a D.C. or low-frequency A.C. circuit, each wire will conduct its proper $\frac{1}{1000}$ part of the total current carried by the complete conductor; the current through each wire being limited only by its resistance. If this composite conductor is made to form part of a radio-frequency circuit, however, the reactance of each of these fine wires becomes sufficiently high to share with its resistance in limiting the current flowing in it because reactance ($2\pi fL$) is proportional to frequency (f). The reactance of each fine wire is also proportional to its inductance (L) which is in turn proportional to the quantity of magnetic flux (or field) surrounding it.

It is obvious that a fine wire in the centre of the conductor shown in Fig. 1(c) will have surrounding it the magnetic field A inside the conductor as well as that of B on the outside. A wire on the outer skin of the conductor such as that of Fig. 1(d) will, on the other hand, have only the field B outside the conductor linking with it. It is easy to see, therefore, that the innermost thin wires will have a greater inductance than those near the surface. The current flowing in these innermost wires will therefore be less than that in the outer wires because of its greater limitation by their greater inductance and reactance. By this reasoning a simple idea of skin effect may be formed.

Properties of Iron and Nickel Wire.

Stated correctly, the current density rapidly diminishes towards the centre of the conductor, and in large-diameter conductors there is actually no current at all flowing in the centre of the wire at high frequencies. As one would expect, if the conductor is of high specific resistance then the diminution of current density towards the centre of the wire is less rapid, i.e., the "skin depth" to which the high-frequency current penetrates increases as the specific resistance of the conducting metal increases—as the square root of f as a matter of fact. The skin effect is less, due to the fact that the limitation of current by reactance is less important because the ratio of reactance to resistance is less due to the higher resistance.

There is obviously another property of the conductor which influences the skin depth—that of magnetic per-

Radio Conductors Compared.—
meability. Unless the conductor be of a para-magnetic material, such as iron, steel or nickel, its skin depth will depend (for a given frequency) entirely upon its specific resistance, since the permeability will be unity. But if the conductor be of one of the above-mentioned

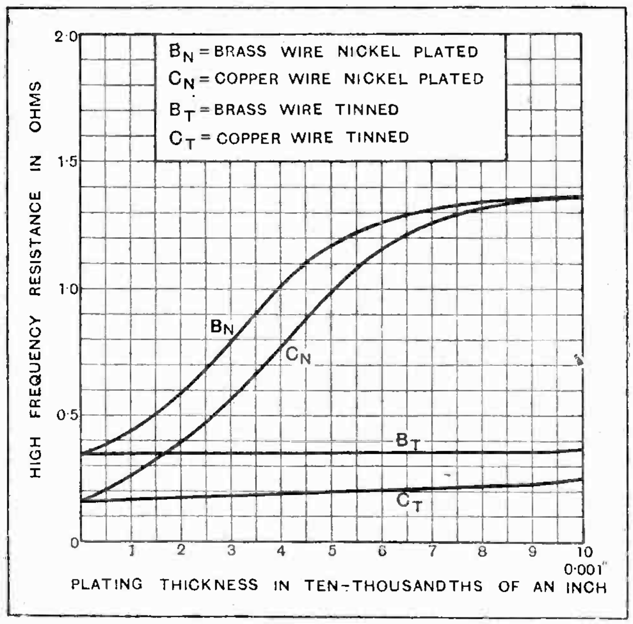


Fig. 2.—Curves showing the increase of resistance (at 30 metres) of brass and copper wires due to nickel-plating or tinning to various thicknesses. The wires were one yard lengths of 16 S.W.G. B_N is brass wire nickel-plated; C_N, copper wire nickel-plated; B_T, brass wire tinned, and C_T copper wire tinned.

magnetic metals, the skin depth to which high-frequency current will penetrate will be very much less. The reason for this is easily appreciated, because the magnetic field density inside the conductor will be much greater than that outside—greater by the value of the permeability of the conductor of course. This, in turn, causes a greatly increased magnetic linkage (inductance) at the centre of the conductor, or even at portions only just below the surface. It is due to this cause that the skin depth of a conductor, at a given frequency, is inversely proportional to the square root of the permeability of that conductor.

The Electro-plating of Conductors.

Thus it is seen that specific resistance is of less importance in radio-frequency conductors than in ordinary electrical circuits, but that iron, steel and nickel are to be avoided. Moreover, since the current at high radio-frequencies only penetrates into the skin of a conductor, it is obvious that in the case of electro-plated conductors it is the metal with which they are plated that determines largely the skin depth and resistance.

Wires of low resistance, such as copper, are rendered much less conducting by plating with high-resistance and permeable metals, such as nickel, and wires of high resistance and permeability are rendered much more conducting by plating with, say, copper. For short-wave circuits copper or brass parts and wires should never be nickel-plated for the purpose of finish unless the thickness of plating can be ascertained with accuracy. Copper or brass parts may be tinned, however, without greatly affecting their high-frequency resistance.

In Fig. 2 is shown the increase in resistance of one yard of 16 S.W.G. brass and copper wire, due to nickel-plating and tinning, to various thicknesses up to 1 mil. The measurements were effected at 10,000 kilocycles (30 metres), and the curves show well the great difference between the skin effect of tin and nickel, a difference which is practically wholly due to the para-magnetic properties of the latter, because the two metals are of roughly the same specific resistance.

A Costly Decimal Point.

The question of finish for short-wave coils of bare copper wire or braid always calls for much consideration, more especially as this has often to be done after the coil has been completed on its insulating former. Copper, if left exposed to the atmosphere, will tarnish very quickly. Lacquer cannot be applied readily after winding. Gilding the wire or braid prior to winding provides a very effective and enduring finish, but the specific resistance of gold is appreciably greater than that of copper, and the gold-plating thickness must, in consequence of this, be kept very thin.

For another reason—obviously that of cost—the quantity of gold deposited during gilding must be kept less than, say, one ten-thousandth of an inch. The author had occasion recently to have gilded some copper braid for short-wave coils, and through a misunderstanding, which amounted to the incorrect position of a

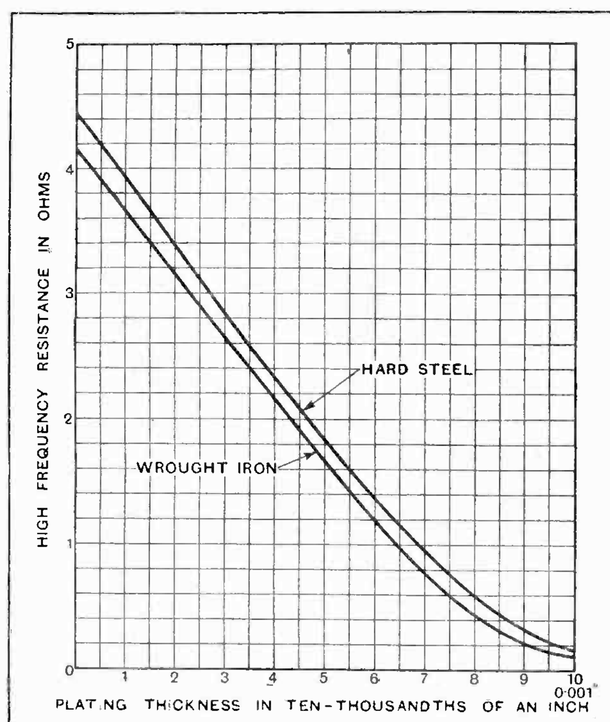


Fig. 3.—Curves showing the great reduction which is effected in the resistance of iron and steel wires at 30 metres by electro-plating them with various thicknesses of copper. The wires were one yard lengths of 16 S.W.G.

Radio Conductors Compared.—decimal point, the thickness of gold deposited was <0.001 inch, instead of <0.0001 inch.

A costly monument has thus been erected to remind those responsible of the effect of too heavily plating high-frequency copper conductors, for there is no use to which yards of heavily gold-plated braid can be put. Not only was the cost of gilding prohibitive, but the thickness of gold was sufficient to cause an increase of resistance greater than could be permitted in the coils of which the lowest possible power-factor was an essential quality.

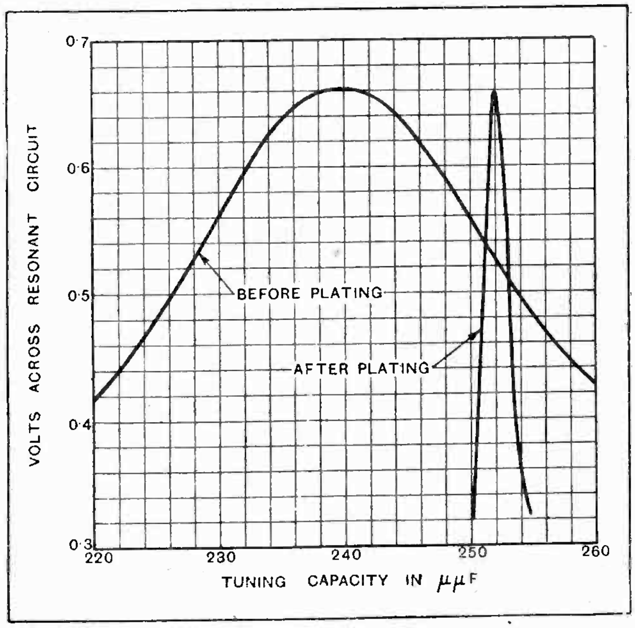


Fig. 4.—These experimentally obtained resonance curves show the extent to which the tuning of a single turn loop of 16 S.W.G. wrought iron wire is sharpened at 30 metres by electro-plating it with one-thousandth of an inch of copper. One yard of the wire was bent into a 9 in. diameter loop (with parallel ends) and tuned by a variable condenser of the capacity indicated.

The Use of Steel Wires as Conductors.

Iron, steel and nickel wires are tremendously reduced in resistance at high radio frequencies by a thin coating of copper. In Fig 3 is shown the reduction of resistance of a yard of 16 S.W.G. wrought iron and hard piano steel wire at 30 metres by copper-ylating to various thicknesses up to 1 mil., the approximate skin depth for copper at this frequency. The reduction of resistance effected by one thousandth of an inch of copper on the wrought iron wire is seen to be about 27 to 1, and the effect of such a reduction upon the tuning sharpness of a resonant circuit is shown by the comparative resonance curves of Fig. 4 for a circuit formed with this wire before and after plating. The length of wire was merely bent into a 9in. diameter loop and tuned by a variable condenser of about 240 $\mu\mu$F. at 30 metres. From Fig. 3 it is seen that with only one-thousandth of an inch of copper-plating on the iron and steel wires their resistances are reduced to the values of the solid copper wire of Fig. 2, proving that the skin depth of copper at 30 metres is of the order 0.001 inch. Where great rigidity or mechanical strength is desirable, it is thus possible to use steel wires as portions of radio-frequency circuits, providing they are thinly coated with copper.

CLUB NEWS.

New Society for Sevenoaks.

A Radio Society is now being formed in Sevenoaks. Readers of *The Wireless World* residing in that neighbourhood can obtain full particulars from Mr. E. M. Dent, Cornwall Lodge, Dunton Green, who is acting secretary (pro. tem.) or from Mr. R. Bernard, 42, High Street, Sevenoaks.

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At the Broadcasting End.

"The Maintenance of a Modern Broadcast Station" is the title of a lecture to be given by Mr. Noel D. Cumming at a meeting of the Institute of Wireless Technology to be held at 7 p.m. on Nov. 11th at the Engineers' Club, Coventry St., London, W. Those interested in the activities of the Institute should communicate with the Hon. Secretary, Mr. H. J. King, 71, Kingsway, London, W.C.2.

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Home-constructed Loud Speakers.

Several loud speakers of the linen diaphragm type constructed by members were demonstrated and compared at a well-attended meeting of the Southend-on-Sea and District Radio Society on October 18th. The tests were conducted by means of gramophone pick-up and radio reception. The two best, in the opinion of those present, were described by their constructors.

Hon. Secretary, Mr. F. J. Walker, Lynthorpe, Grange Gardens, Southend-on-Sea.

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Selectivity Problem in North London.

Now that Brookmans Park is transmitting the whole of the London programmes, listeners in the area covered by the Tottenham Wireless Society are experiencing difficulty in receiving the alternative programme from Daventry 5GB. In a topical lecture on "Selectivity and the Brookmans Park Transmissions" at the Society's last meeting, Mr. F. E. R. Neale gave valuable hints on improving selectivity and provided the theme for a rousing discussion. The lecturer condemned the use of a wave trap, although such a device would cut out all trace of the present transmissions. Within the next few months a second programme would be transmitted from Brookmans Park at a similar strength and a wave trap would be unable to cope with two such transmissions. The methods which the lecturer had found effective in this locality were the use of an ordinary loose coupled circuit with tuned aerial and secondary, and coil reaction, if used, operating on the secondary, or the employment of an extra tuned circuit, the aerial side of which was coupled to the aerial terminal of the set by a small neutrodyne condenser.

Hon. Secretary, Mr. R. C. A. Haynes, 159, Lordship Lane, N.22.

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Ilford and District Radio Society.

Wireless enthusiasts in the Ilford district who decide to join the Ilford and District Radio Society will be assured of a good programme during the coming months. A cinematograph lecture was given on October 24th by Messrs. Siemens Bros., the subject being Lamps, Batteries and Cables. A lecture on "Operation from A.C. Mains" will be contributed by the Marconiphone Co., Ltd., on December 5th.

Hon. Secretary, Mr. C. E. Largen, 16, Clements Road, Ilford.

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Television Explained.

"The Principles of Television" was the subject of a lecture given by Mr. J. Denton, A.M.I.E.E., at a meeting of the Muswell Hill and District Radio Society on October 23rd. By means of a very comprehensive series of lantern slides and some novel experiments with television apparatus members were able to gain an excellent insight into the work that had been accomplished in the television field.

Wireless enthusiasts in the district who are interested in the activities of the Society are invited to communicate with the Hon. Secretary, Mr. C. J. Witt, 39, Coniston Road, N.10.

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New Society in Sheringham.

The Sheringham and District Wireless Society, which has just been formed, is already in a flourishing condition with a membership of 60, including a number of ladies. Vacancies for new members still exist, however, and full particulars can be obtained from the Hon. Secretary, Mr. C. R. Hunt, Kensington House, Church Street, Sheringham. Meetings are held weekly in the British Legion Rooms, Church Street.

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Battery Eliminators.

Battery eliminators, a topic of special interest at the present time, was the subject of a lecture by Mr. Ingham, of Messrs. H. Clarke and Co. (Manchester), Ltd., given recently before Slade Radio (Birmingham). The various circuits involved were carefully described, and members were able to inspect one of the latest types of eliminator.

The fourth whist drive and dance, held on October 23rd, was attended by over 120 people. Forthcoming items in the syllabus include a visit to the Central Telephone Exchange on November 16th, and a visit to one of the City Electric power stations in the near future.

Full details regarding the Society's activities can be obtained from the Hon. Secretary, "Enville," Warren Road, Erdington.

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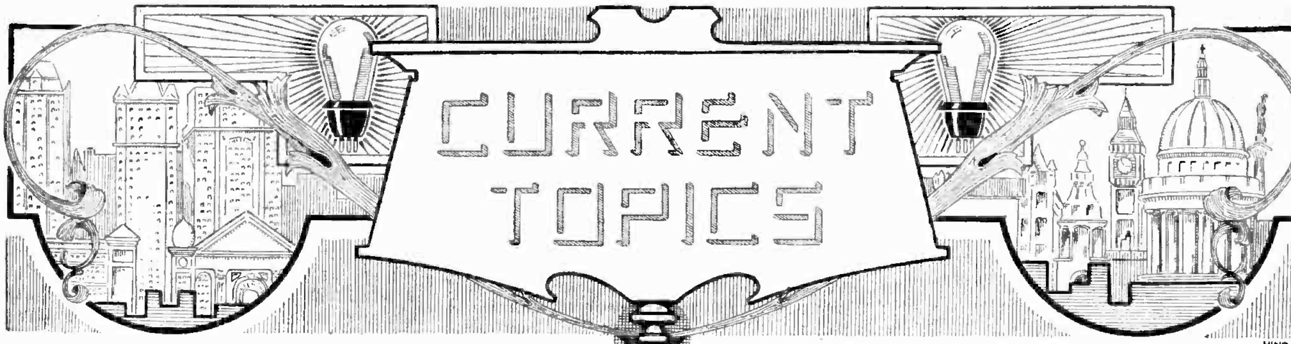
A New Moving-Coil Loud Speaker.

The Celestion "Celestrola" moving-coil loud speaker was demonstrated at a recent meeting of the Bec (Streatham) Radio Society. The model exhibited had a field winding which could be energised by a low-tension voltage of from 6 to 12 volts. Satisfactory results were obtained using a 3-valve receiver with screened grid H.F. valve, detector and 4-volt Pentode.

An attractive syllabus has been arranged for the coming weeks, and any new members will be heartily welcome.

Hon. Secretary: Mr. A. L. Odell, 171, Tranmere Rd., S.W.18.



Events of the Week in Brief Review.

LOOK YOU!

For the first time in the history of the National Eisteddfod of Wales wireless is to be included among the competition subjects. At the Eisteddfod to be held at Llanelly in August, 1930, a prize of £3 will be offered for the best home-constructed wireless receiver costing not more than £10.

The factors governing the choice of the winner will be quality of reception, workmanship, and value for money.

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DUTCH APPARATUS FOR SIAM.

An order has been placed by the Siamese Government with the Philips Radio Co. of Eindhoven, Holland, for a twin wavelength broadcasting plant at Bangkok which will transmit on 300 and 30 metres simultaneously.

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S.A. TO OUTWIT "PIRATES."

The ordinary methods having failed, the South African Government has decided upon a drastic measure to secure adequate revenue for the broadcasting services. According to *South Africa*, the Government have in view the abolition of the present licence fees, substituting a 25 per cent. duty on the importation of all wireless goods. While the Government will retain 3 per cent., the balance will in all probability be handed over to the African Broadcasting Company.

It is felt that a system on these lines will not only popularise wireless, but compel the erstwhile "pirate" to contribute indirectly to the broadcasting service or give up listening altogether.

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"WIRED RADIO" CAMPAIGN IN U.S.

"Wired radio" will shortly be a household term in America if success attends the plans of the new Wired Radio Corporation which is about to launch its scheme publicly at the Cleveland Electrical Exhibition.

The company will there display for sale a small box-shaped attachment, containing a frequency filter, which can be attached to any existing radio receiver and permit its owner a choice of three programmes sent over the ordinary electric light wires by three-phase high-frequency transmitters.

One of the inducements offered to the listener is the absence of all advertising matter in the wired radio programmes; it is also pointed out that the transmissions will be completely free from atmospherics and other forms of disturbance.

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SHUT THE WINDOW.

Burgomaster Max of Brussels has formulated a new bylaw forbidding the use of loud speakers at open windows.

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"FIFTY YEARS OF ELECTRICAL SCIENCE."

At the inaugural meeting of a new session of the Royal Society of Arts to be held this evening (Wednesday) at 8.30 at John Street, Adelphi, London, W.C.2, the Chairman of the Council, Mr. Llewelyn B. Atkinson, M.I.E.E., will give an address entitled: "Fifty Years of Electrical Science and Industry."

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NEW RADIO NAVIGATION SCHEME.

A development of the principle of the radio beacon in a manner which would enable ships and aircraft to follow routes plotted out for them from hour to hour while *en route* is contained in an invention submitted to the French Academy of Sciences by M. Guillaume Loth.

The invention, which is endorsed by General Ferrié, head of the French Army's wireless services, makes use of intersecting beams of Hertzian waves. When a vessel is likely to enter a stormy area the beam angles can be altered to indicate the safest route.

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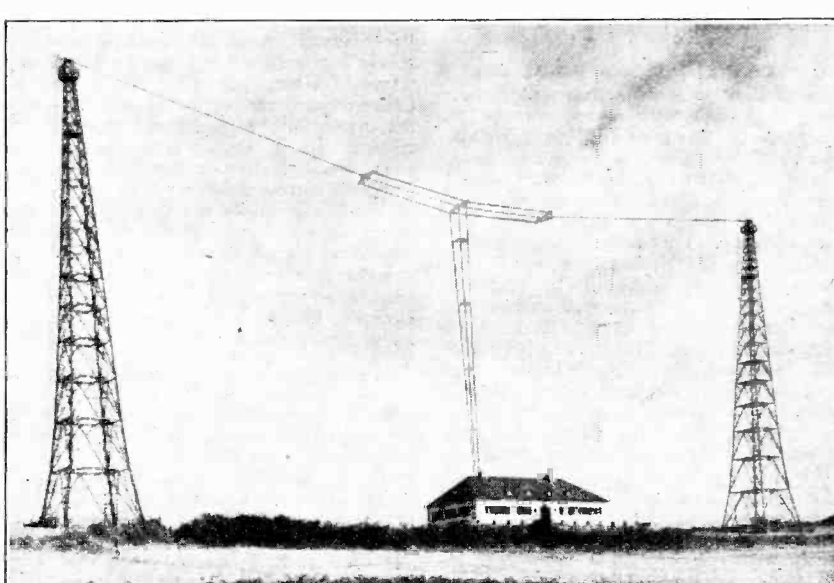
LISTENERS AND A GOVERNMENT STATION.

Last April, when annual wireless licences in Denmark expired, many listeners refused to renew their licences owing to the interference caused to broadcast reception from Copenhagen by the Government's own wireless telegraph and telephone station at Soro, which maintains a service between the mainland and the island of Bornholm. In response to the listeners' attitude, writes a correspondent, the Government has now decided to close down the Soro station and lay a cable to Bornholm.



A TYPICAL GERMAN RELAY STATION. Kaiserslautern, which relays a number of transmissions in turn, including those of Nuremberg, Augsburg and Munich. The common wavelength of 270 metres is used.

PITY THE MAN UPSTAIRS.

A bylaw proposed by the Hornsey Town Council aims at prohibiting the use of loud speakers in wireless shops if disturbance is caused to neighbours or to persons living over the shop.

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LADY WINS SET-BUILDING PRIZE.

Miss C. Martaki has won the First Prize (25 guineas) in Class 2 of the set-building competition organised in connection with the recent Manchester Wireless Exhibition. In Miss Martaki's set, the best among receivers designed specially for quality reproduction, the whole tuning arrangement consisted of a 40-turn coil and a single .00035 condenser. The wiring was well spaced on a baseboard over a yard in length and 10½in. in width.

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AMERICAN RADIO MERGER.

The biggest radio merger yet planned in America is to become effective as from January 1st, 1930, when the Victor Talking Machine Co., the Radio Corporation, the Western Electric Co., and the General Electric Co. will combine in the production and sale of radio equipment.

The central manufacturing plant of the organisation will be situated at Camden, and will employ 26,000 men. The total sales are expected to reach £100,000,000 a year.

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SUNBEAMS IN AUSTRALIA.

Shareholders in the Amalgamated Wireless Company of Australia are praising Marquis Marconi for his invention of the beam, which has brought them dividend warrants for the first time. After an interval of twenty-one months, the company has published its balance sheets for the past two years. They show profits of £47,000 and £80,000, and dividends of 6 and 8 per cent. respectively. It is considered beyond doubt that the new beam services are responsible for the company's changed fortunes.

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OLD TRANSMISSIONS RE-HEARD.

One of the "tallest" wireless stories on record is related with a due amount of scepticism in *Time and Tide*. It appears that in the early hours of a recent morning a listener endeavouring to get America was surprised to receive at exceptional strength a programme of classical music. This roused his curiosity, as American radio programmes at this time are usually devoted to classical music, and it was increased when he heard the items announced in English as spoken in England. He wrote down the particulars of the music performed with the object of identifying the transmitting station. The mystery deepened when he obtained proof that the programme had not emanated from any station working at the hour he heard it.

His astonishment may be judged when, after what must have been a weary search, he discovered that the programme tallied exactly with one broadcast from 2LO in 1927, two years previously!

Here indeed was an echo from the depths of space which might well frighten the boldest. For how many programmes could we endure twice?

"SELECTIVITY AND QUALITY."

It is regretted that a typographical error occurred in the article bearing the above title in last week's issue. On page 479, column 2, line 21, the figure for side-band variation is given as 15 per cent., whereas the correct figure is 52 per cent. The figures for the same circuit are given correctly in the table.

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HIGH-SPEED SPEECH.

Dr. Curt Stille, a well-known German engineer, who for some considerable time has been at work on apparatus for the electro-magnetic registration of sounds, is reported to have constructed a Press talking machine, writes a correspondent.

When connected to an ordinary telephone instrument, the apparatus registers all incoming communications, which in their turn can be amplified and reproduced as required through a loud speaker. The main advantage of the invention, however, lies in the fact that it permits a species of high-speed telephony. If, for instance, a Berlin news agency receives a telephoned bulletin lasting thirty minutes from, say, its Stockholm or Copenhagen correspondent, the entire message can be registered on a steel ribbon. Later, should it be necessary to pass the information on to Paris or London correspondents, the mechanical transmission can be speeded up, with the result that the message can be sent over the usual long-distance cables, and compressed into some six minutes' duration, thus effecting a considerable saving in expense. When slowed down the receiving apparatus gives an intelligible message.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 6th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. At the Institution, Savoy Place, W.C.2. Inaugural Address by the chairman, Captain C. E. Kennedy-Purvis, R.N.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture and Demonstration: "The Testing of the Modern Gramophone Pick-up," by Mr. F. N. G. Leevers.

Edinburgh and District Radio Society.—At 8 p.m. At the Royal Terrace. Query night.

THURSDAY, NOVEMBER 7th.

Ilford and District Radio Society.—At the Wesleyan Institute, High Road. Informal meeting. Junk Sale.

Slade Radio (Birmingham). At the Parochial Hall, Broomfield Road, Erdington. Talk on Electricity, by Mr. W. E. Chilvers. The Construction of S.G. Receiver Stage, by Mr. N. B. Simmonds.

TUESDAY, NOVEMBER 12th.

Ryde Radio Society.—At 8 p.m. At Mount House Hall, George Street, Ryde, I.O.W. Annual General Meeting.

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ARGENTINA TELEPHONES FOR B.B.C. PROGRAMMES.

A telephonic appeal from the Argentine for a development of the short-wave broadcasting service from Britain was made on October 25th, when Sir John Reith, Director-General of the B.B.C., received a telephone call from Buenos Aires *via* Berlin. Those engaged in the conversation at the Buenos Aires end were Mr. Hirst, of the Marconi Company; Mr. Barbara, manager of the River Plate Telephone Company; and Mr. Brumen, head of the English Speaking Radio Club of Argentina.

Mr. Brumen stated that plans were going forward for a new broadcasting station near Buenos Aires to serve programmes in English to the 100,000 English-speaking people of Argentina. Britishers in the Argentine were keenly interested in 5SW and looked forward anxiously for an extension of its service.

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FREE LICENCES FOR SICK POOR.

The Reich Broadcasting Society has announced that licence fees are to be remitted in the case of sick persons with limited incomes. Free licences have already been available in Germany to blind listeners and War invalids.

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BOOKS RECEIVED.

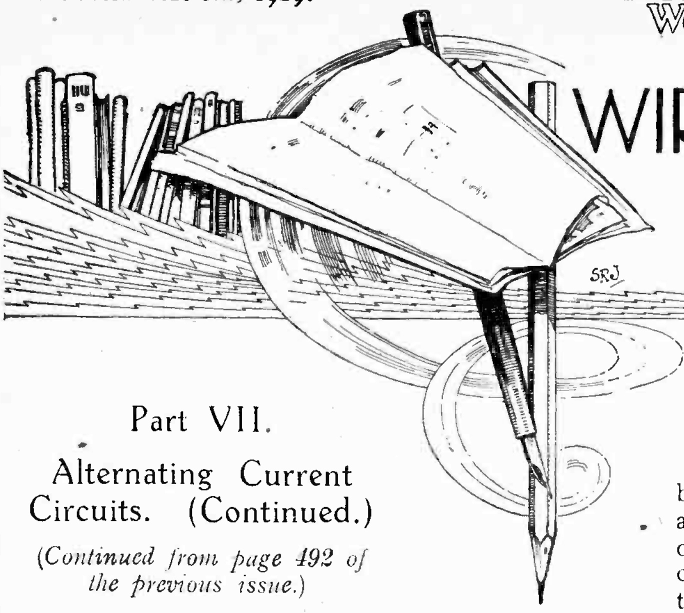
Telegraphy and Telephony, Including Wireless, by E. Mallett, D.Sc. (Eng.) London.—An introductory text-book to the science and art of the electrical communication of intelligence. Comprising line telegraphy for short and long lines; line telephony, including a chapter on manual and automatic exchanges; wireless telegraphy and telephony, and an appendix of mathematical formulæ and tables relating to the subjects dealt with. Pp. 413+ix with 287 diagrams and illustrations. Published by Chapman and Hall, Ltd., price 21s. net.

B.B.C. Year Book, 1930.—Including special articles on matters of broadcasting interest; events of the past year; the history of the old B.B.C. from November, 1922, to December, 1926; general articles on musical, educational, and dramatic broadcasting. Technical articles, tables and formulæ. Pp. 463 with numerous illustrations. Published by the British Broadcasting Corporation, London, price 2s.

Questions and Solutions in Magnetism and Electricity, by W. J. White, A.M.I.E.E. (Third Edition).—Consisting of the solutions to questions set by the Board of Education and City and Guilds of London Institute in Stage 1 of Magnetism and Electricity during the years 1907 to 1929. Pp. 178+32 with 97 diagrams. Published by Sir Isaac Pitman and Sons, Ltd., London, price 5s. net.

Wireless Transmission and Reception (Technical Pamphlets for Workmen, PW-C.1).—Revised edition, issued by the Post Office Engineering Department and comprising a brief summary of the general principles of wireless telegraphy, systems of generation and transmission (including telephony), reception, direction finding and instructions for the inspection of wireless stations by P.O. officers. Pp. 67, with 44 diagrams. Published by H.M. Stationery Office, price 6d. net.

Wireless Time Signals for the Use of Surveyors, by A. R. Hinks, C.B.E., M.A., F.R.S., Secretary R.G.S.—Comprising a list of the time signals transmitted from various stations in all parts of the world with introductory remarks on the nature of the signals and practical advice on their application to geographical surveys. Pp. 31, with map. Issued by the Royal Geographical Society and published by Edward Stanford, Ltd., London, price 3s.



WIRELESS THEORY SIMPLIFIED

Part VII.

Alternating Current Circuits. (Continued.)

(Continued from page 492 of the previous issue.)

By S. O. PEARSON, B.Sc., A.M.I.E.E.

WHEN learning the elementary laws of electricity we are shown that the power in a D.C. circuit is given in watts by the product of current and electromotive force. Then later we learn that the same laws apply to an A.C. circuit containing resistance only (see Part VI, last issue). Now we encounter the apparent paradox that when an alternating current is passed through a coil possessing inductance only no power whatever is absorbed! At first this discovery is rather disconcerting, but after a little consideration the reasons become fairly obvious.

In the first place, no heat can be generated where there is no resistance—this is a fundamental law. And yet it is equally true that at any instant the power is actually equal to the product of current and voltage at that instant in any circuit. The question is: What is becoming of the energy represented by this power if it is not being converted into heat? The answer lies in the fact that energy is required to build up a magnetic field and that this energy is all recovered by the circuit when the field dies away again. We shall now deal with this point in some detail because a clear understanding of it will enable the reader to follow more easily the workings of oscillating circuits—one of the main subjects we are leading up to.

The Effect of Phase Difference on Power.

Although there is no such thing as a perfect choking coil, that is, one without any resistance whatever, this condition can be fairly closely approached in practice. As before, we shall assume that we have a coil whose inductance is L henrys and whose resistance is zero. It was shown that for such a coil the sine waves of voltage and current are exactly 90° out of phase (or in quadrature), the current lagging behind the applied voltage. The current and voltage curves are shown in their correct relative positions in Fig. 1.

Suppose that the maximum value reached by the current every half cycle is I_m amperes. Over the first quarter cycle from O to P in the diagram the current builds up from zero to I_m in the positive direction, and a magnetic field is established, linked with the turns of the coil. It will be seen that during this first quarter cycle the current and voltage are both positive and therefore that energy is being put into the circuit. This is absorbed by the growing magnetic field, and when the current has reached the maximum value I_m the stored energy will be $\frac{1}{2}LI^2$ joules or watt-seconds (see Part V). Now during the next quarter cycle, from P to Q in the diagram, the current falls again to zero, the field collapses and the whole of the stored energy is given back to the circuit. Note that during this second quarter cycle the voltage is negative whilst the current is still positive although falling, showing that *power is being given out by the circuit.* As there is no resistance present the whole of this energy is returned to the source of supply.

Now consider the third quarter cycle, from Q to S in Fig. 1. During this time the current is building up again, but in the reverse direction, and energy is once more being expended in establishing the magnetic field. The current and voltage are now both negative and their product is therefore positive, proving that power is going into the circuit. Over the last quarter cycle from S to T we have the return of the energy as before.

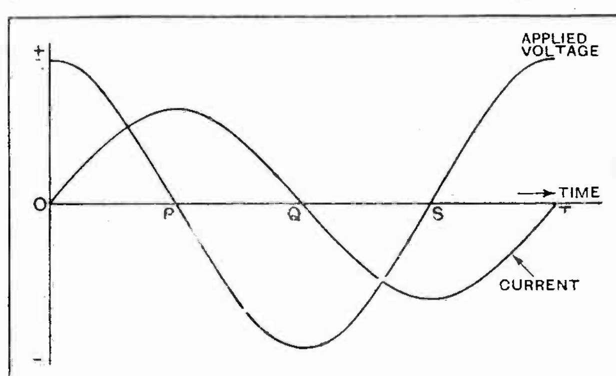


Fig. 1.—For a coil possessing inductance and no resistance the current and voltage waves are 90° out of phase. The average power consumed by such a coil is zero.

To sum up, then, it appears that when we drive an alternating current through a circuit possessing inductance only, we put a certain amount of energy into

Wireless Theory Simplified.—

the field and then withdraw the whole of it once every half cycle, no portion of it being lost as heat. *Thus the average power taken by a pure inductance in an A.C. circuit is zero.* In any circuit where the current and voltage are exactly a quarter of a cycle out of step the conditions are the same, and the average power is zero. It will be seen later that a condenser in an A.C. circuit behaves in the same way.

We have already likened inductance to the inertia or mass possessed by a heavy body, and we can now extend the analogy a little farther to explain the principle of the total return of energy as exhibited by a pure inductance. When a body is set in motion energy is imparted to it and stored as kinetic energy[1] (energy of motion), and when the body is brought to rest again the whole of this energy is withdrawn.

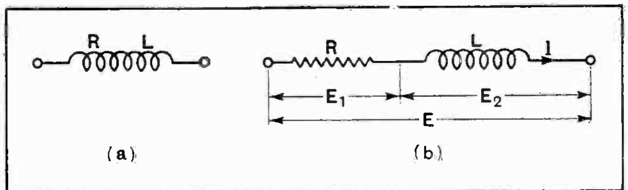


Fig. 2.—A coil possessing both inductance and resistance is equivalent to a pure resistance in series with a pure inductance.

As an example, consider the reciprocating piston of a steam engine. Assume that the steam has been cut off but that the engine is still running, driven by the momentum of the flywheel. At the beginning of a stroke the piston is accelerated, energy being imparted to it from the flywheel through the medium of the crankpin, connecting rod, etc. At about the middle of the stroke the piston reaches its maximum velocity, and beyond this begins to slow down again. Now if there were no friction between the piston and the cylinder walls (equivalent to no resistance in our electric circuit) the piston would tend to move forward, due to its own momentum, without loss of velocity. But it is constrained to slow down again by the crank, and in so doing it exerts a forward pull on the crankpin, so restoring the energy to the flywheel. Thus if the engine were quite frictionless it would go on running indefinitely without steam, the energy given to the piston over the first half of each stroke being recovered during the second half stroke. The same thing is happening in our circuit of pure inductance, where one cycle corresponds to one revolution of the engine crank so that one stroke of the piston represents one half cycle. Energy is given to the circuit and then totally withdrawn again once every half cycle.

Coil with Resistance and Inductance.

So far, we have considered circuits where either resistance or inductance existed alone. In actual practice an inductive coil is wound with wire which necessarily possesses resistance, and in the majority of cases the effects of this resistance are not negligible compared with the effects of the inductance. So now we must consider the behaviour of an inductive coil possessing both resistance R ohms and inductance L henrys, and in so doing we shall make full use of our previous discoveries.

When an alternating current is passed through such a coil its passage is impeded by the combined effects of the resistance and the reactance. It is the same current which simultaneously generates heat in the resistance and produces the magnetic field linked with the turns of the coil. Therefore a coil having resistance R and inductance L, as shown at (*a*) in Fig. 2, will behave in exactly the same way as a circuit consisting of a pure resistance R connected in *series* with a pure inductance of L henrys, as shown at (*b*) in the figure.

Let I amperes be the R.M.S. value of a current driven through the equivalent circuit (*b*) of Fig. 2, the frequency being f cycles per second. We shall set out to find in terms of R and L what voltage E will be required to drive this current through the circuit, and the easiest way to do this is to determine separately the voltages E_1 and E_2 necessary to overcome the resistance R and the reactance X respectively of the circuit, finally adding them together in the proper manner.

Applying Ohm's Law to the pure resistance R, we see that the necessary voltage for this part is $E_1 = IR$, *where E_1 and I are in phase.* The voltage E_2 required to drive the current against the back E.M.F. due to the effects of the inductance will be $E_2 = IX$ volts, where $X = 2\pi fL$ ohms (see Part VI, previous issue), and here the current lags behind E_2 by exactly 90°, i.e., *the voltage E_2 leads the current by 90°.*

It follows, then, that since E_1 is in phase with the current and E_2 is 90° out of phase, E_1 and E_2 will themselves be a quarter of a cycle out of step and can therefore be represented by two vectors OE_1 and OE_2 mutually at right-angles, the current vector being parallel to OE_1, as shown in Fig. 3. The total voltage E required by the complete circuit or by the coil of Fig. 2 (*a*) is therefore given by the length OE and not by the ordinary arithmetical sum of E_1 and E_2, as explained in Part IV of this series. From Fig. 3 we have

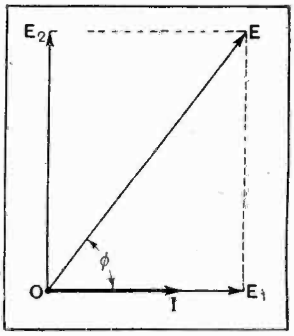


Fig. 3.—Vector diagram of circuit with inductance and resistance in series. OE_1= voltage used in overcoming the resistance. OE_2= voltage used in overcoming the reactance. OE= total voltage required to overcome the combined effects of resistance and reactance.

$$OE^2 = OE_1^2 + OE_2^2$$

whence $E = \sqrt{E_1^2 + E_2^2}$ volts

and substituting in this equation the values found above for E_1 and E_2 we get

$$E = \sqrt{I^2R^2 + I^2X^2}$$
$$= I\sqrt{R^2 + X^2}$$

volts, where $X = 2\pi fL$.

[1] If the mass of a body is M and its velocity V the kinetic energy is $\frac{1}{2}MV^2$. Compare this with $\frac{1}{2}LI^2$ for magnetic energy.

Wireless Theory Simplified.—

Modification of Ohm's Law.

The quantity $\sqrt{R^2+X^2}$ is the number by which the current must be multiplied to give the voltage, or by which the voltage must be divided to give the current. It is called the *impedance* of the coil or circuit and is usually denoted by Z. Since Z is the ratio of voltage to current it is expressed in ohms, and thus for an inductive circuit we have the relationship

$$I=\frac{E}{Z} \text{ amperes,}$$

where $Z=\sqrt{R^2+(2\pi fL)^2}$ ohms.

In an A.C. circuit, then, Z takes the place of R in Ohm's Law for a D.C. circuit. The impedance Z is the *total* opposition encountered by the current, being due to the combined effects of resistance and reactance. To obtain the impedance we must add the resistance and the reactance together as though they were two lines of lengths R and X respectively *at right-angles to each other*. If two lines *ab* and *bc* are drawn mutually at right-angles, the length of one being equal to R and the other being equal to X to some convenient scale as in Fig. 4, then *ac* will give the impedance to the same scale. Such a triangle is called the *impedance triangle* of the circuit.

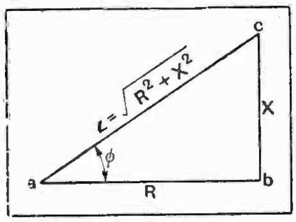


Fig. 4.—Impedance triangle of inductive circuit. R is the resistance, X the reactance, and Z the impedance of the circuit. ϕ is the angle of lag.

Angle of Lag in an Inductive Circuit.

We have found the relationship between the voltage and current as far as their magnitudes are concerned, but very often it is necessary to know how far out of step or out of phase they are. This can be found quite easily from the diagram of Fig. 3. It will be noticed that the current lags behind the applied voltage E by an angle which is less than 90°. This was to be expected because for a pure resistance there is no angle of lag and for a pure inductance the angle of lag is 90°, and therefore for a combination of both resistance and reactance the angle of lag must be less than 90° and greater than zero. Let ϕ denote the angle between E and I. Then $\cos\phi=\frac{OE_1}{OE}=\frac{IR}{IZ}=\frac{R}{Z}$. (In a right-angled triangle the *cosine* of one of the smaller angles is the ratio of the side adjacent to that angle to the length of the side opposite the right-angle.) Thus in the impedance triangle of Fig. 4 the angle of lag ϕ is the one lying between R and Z as shown.

Numerical Example.

Before discussing the power absorbed by this circuit a numerical calculation of the relationship between current and voltage will be helpful. Suppose, for example, that we have a low-frequency choke of 20 henrys inductance and 1,000 ohms resistance under working conditions connected in the plate circuit of a valve whose internal resistance (so-called impedance) is 3,000 ohms. It is desired to find the A.C. component of the current through the choke and the voltage across it when 10 volts (R.M.S. value) at 100 cycles per second is applied to the grid of the valve, the amplification factor being 5. This means that a voltage of $5\times10=50$ will be generated in the anode circuit. Neglecting battery resistance, the total resistance of the anode circuit will be $1{,}000+3{,}000=4{,}000$ ohms, and the reactance $2\pi fL=2\pi\times100\times20=4{,}000\pi$ ohms at 100 cycles.

The impedance of the complete circuit will thus be

$$Z=\sqrt{4{,}000^2+(4{,}000\pi)^2}$$
$$=4{,}000\sqrt{1+\pi^2}=13{,}200 \text{ ohms.}$$

The current $=\frac{E}{Z}=\frac{50}{13{,}200}=0.00379$ amp. or 3.79 milliamps.

The impedance of the choke alone is

$$Z_c=\sqrt{1{,}000^2+(4{,}000\pi)^2}=12{,}600 \text{ ohms,}$$

and so the 100 cycle voltage across the coil will be

$$E=IZ_c=0.00379\times12{,}600$$
$$=47.8 \text{ volts.}$$

(To be continued.)

TRANSMITTERS' NOTES.

Dutch Amateurs.

Through the courtesy of G 6PP we are able to give below a list of the licensed amateur stations in Holland which he had received from the QRA Manager of the N.V.I.R. :—

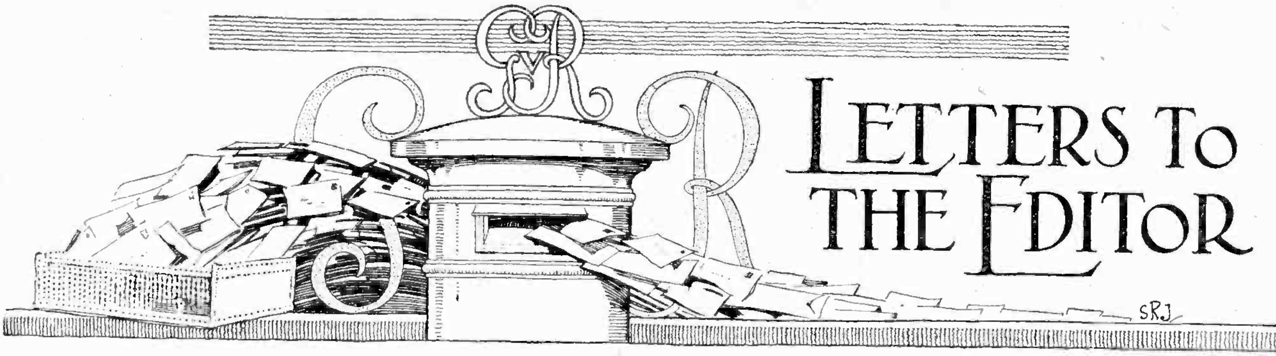
PAOAA Reserved for the N.V.I.R.
PAOAB Reserved for the N.V.I.R.
PAOAC Reserved for the N.V.I.R.
PAOAF Dr. K. Beintema, Petrus Hendrikszstraat 19A, Groningen.
PAOBG A. J. van Gilse, Obrechtstraat 212, The Hague.
PAOBP P. L. H. Beek, Gasthuisstraat 14, Venlo.
PAOBZ F. Brouwer, Beeklaan 216, The Hague.
PAOCA Ir. W. H. Moorrees, Crispijnsche weg 175, Dordrecht.
PAOCO C. C. Verbeek, Noordwijk Radio, Noordwijkerhout.
PAODA A. N. Dekker, v. Ewijksluis.
PAODM J. A. Hogesteeger, van Oosterzeestraat 81b, Rotterdam.
PAODW B. J. C. Pothast, Eemnesserweg 23, Laren (N.H.).
PAOFB J. Adama, Noordestationstraat 47, Groningen.
PAOFR F. Baron Sloet tot Everlo, Emmastraat 49, Hilversum.
PAOGA Th. C. van Braak, Halscheweg 462, Varsseveld.
PAOJR J. G. J. Ros, Spoorstraat 28, Hilversum.
PAOLY W. B. M. Blommaart, Wilhelminastraat 326, St. Jansteen (Z).
PAOMAR L. Lindeman, Maratakstraat 25, The Hague.
PAOML M. Leeuwin, Philips Radio Factories, Eindhoven.
PAONF N. Fonderie, Geestbrugweg 83, Rijswijk (Z.H.).
PAONWK J. van der Wijk, Fahrenheitstraat 370, The Hague.
PAOPG F. Dubel, Bronckhorststraat 11, Amsterdam (Z).
PAOQQ C. A. Gehrels, Nic. Beetstraat 92, Eindhoven
PAORA Ir. H. Lels, Dordrecht.
PAORZ C. Jobse, Stokroosstraat 5b, Rotterdam.
PAOSV A. O. L. Strijkers, Operator, Air Harbour Waalhaven, Rotterdam.
PAOTW Th. J. Wilmink, Groningen.
PAOVP L.L. van Praag, Tamarindestraat 84, The Hague.
PAOWIM W. H. Nowee, Eschdoornstraat 77, The Hague.
PAOWJ J. F. W. Jordans, Galileistraat 171, The Hague.
PAOWX A. E. Karsen, Mathenesserweg 121, Rotterdam.
PAOXH J. Hagenaar, Eindenhoutstraat 11, Haarlem.
PAOYY H. Pomes, Simonstraat 94, Delft.
PAOZK W. Keeman, Caen van Necklaan 227, Rijswijk (Z.H.).

QRA's Wanted.

VQ 1DZ.

New Call-Signs and Stations Identified.

G 6HR W. D. Keiller, 21, Newton Way, Cambridge Road, Edmonton, N. 18. (Change of address).
2BJG (ex BRS 204). A. E. Groom, 13, William Street, Luton, Beds (willing to stand by for any station on 10, 20, 40 or 160 metres by arrangement, and report on signals received).



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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

NON-RADIATING SETS.

Sir,—This letter is inspired by the fact that my attempts to receive the broadcast lecture given recently by Mr. H. G. Wells were frustrated by the heterodyne howls of neighbours who could not leave their receivers alone.

Some years ago a serious attempt was made to prevent oscillation by the prohibition of reaction. As everyone knows, that attempt had to be abandoned owing to the fact that reaction, either by the swinging coil or by capacity control, or disguised as H.F. transformers with an amplification of unity, was essential to obtain either sensitivity or selectivity. In other words, none but a receiver capable of passing back energy to the aerial was worth possessing. The introduction of neutralised H.F. amplifiers did little to alter the position owing to the fact that their users for the great part upset the neutralising condenser settings sufficiently to pick up carrier waves by heterodyning.

It seems to the writer that the advent of the screen grid valve has sufficiently altered the position to justify legislation to prohibit the use of receivers capable of energising the aerial and, it is suggested, that it would prove of considerable interest to obtain the views of your readers on this point.

Huddersfield. HENRY W. MOSS.

EMPIRE BROADCASTING.

Sir,—As you point out in your leader of October 23rd, what a splendid opportunity exists at the moment for a definite policy with *immediate action* in regard to Empire Broadcasting.

In the light of present technical knowlege there is no earthly, ethereal, or financial reason why arrangements for a twenty-four-hour Empire service should not be put in hand forthwith.

Your own endeavours, coupled with those of Mr. Gerald Marcuse, were very much appreciated by all your Overseas readers, as I found out on my tour to the Dominions in connection with Empire broadcasting.

Now that the project of Empire Free Trade is so very much to the fore, I would like to suggest that a committee be formed, sponsored by yourselves, whereby we should be in a position to answer any pertinent questions regarding a greatly extended broadcasting service within the Empire that may be put forward by responsible authorities.

It is not necessary to enlarge upon the assistance that would be given to the cause of Empire Free Trade by a really efficient Empire broadcasting service. H. ANTHONY HANKEY.

London, W.6.

B.B.C. TRANSMISSIONS.

Sir,—The letter regarding the B.B.C. tranmissions published in the October 23rd issue of *The Wireless World* was read by request at an open meeting of the Edinburgh and District Radio Society on Wednesday evening.

The observations of Mr. McCormack received so cordial an endorsement from every member present that I was asked to convey their appreciation to him through the medium of your valued periodical.

He summarised very tersely the points submitted by our council to the B.B.C. secretary last winter. I crave your permission to add the following comments.

The members of our society, about 100 in all, rank the "wireless link" transmissions as worse than tenth-rate—so bad in fact that they defy classification.

In the sweet by and by we are promised a Scottish regional station. And so there are probably at least two more years of land-line relays, two more years of continued depression for our excellent receiving sets.

In conclusion I submit the following questions:

1. Cannot the B.B.C. or the Post Office, or both, set about *immediately* improving, by extension or otherwise, their land-line service?

2. Will these land-line relays go on as merrily, even after the regional station is erected and in operation?

3. Or will the B.B.C. install, along with the mechanical and electrical apparatus of the new station, a resident body of artistes, musical and otherwise, equal to the best that London can provide? W. ANDERSON

(Chairman of Edinburgh and District Radio Society).

Edinburgh.

Sir,—I have read with very great interest the letter in the current issue of *The Wireless World* by Mr. K. McCormack, of Newcastle-on-Tyne, on the subject of B.B.C. transmissions. He stresses the very important fact, which is not, I think, generally recognised, that to obtain a perfect transmission the microphone must be near the transmitter.

I quite agree with his point that Daventry is a second-rate transmission, and remember five years ago the night on which 5XX transmitted from Daventry for the first time, being delighted with the increased signal strength but disappointed with the quality, which I did not think so good as previously received from Chelmsford, due, as I thought at the time, to the longer land-line. Long relays, though clear and distinct, are indeed of very poor quality, and it does not need the transmission of music to prove this, as it is apparent in the transmission of the speaking voice, and I could not help thinking as I listened to Mr. Shaw's broadcast 10 days ago from Plymouth, how much more real his voice would have sounded had he been broadcasting from 2LO.

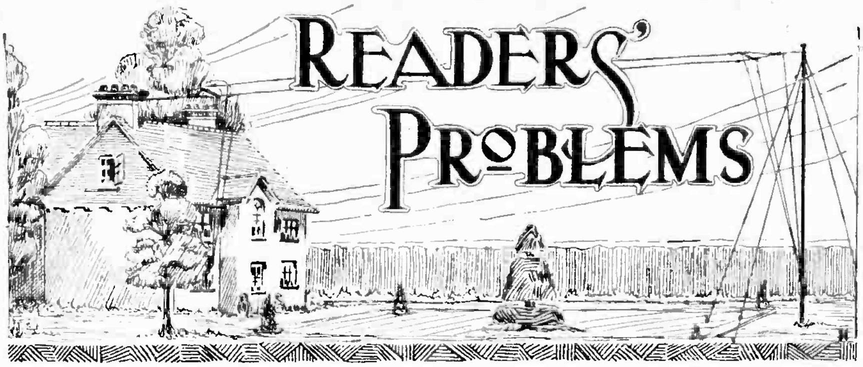
Unfortunately, there seems to be no remedy for this state of affairs, which is due to the fact that 75 per cent. of transmissions emanate from London, which city could hardly be in a worse position from a wireless point of view, being at one end of a long narrow island. E. P. HARDING.

Beverley.

SPARE APPARATUS.

It is regretted that by an oversight we omitted to include the address with the letter which was published appealing for spare wireless gear for the Society of Big Brothers in the East End. The address of the headquarters is St. Jude's Hall, St. Jude's Church, Old Bethnal Green Road, E.2.

Many readers have written asking for the address and offering to forward apparatus, and we have arranged to put them in touch with the Society.



"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

An Expensive Failure.

Can you tell me why the output valve of my . . . . . . receiver does not last more than a few weeks? Valve after valve has been returned to my dealer, who tells me that the manufacturers advise him that emission has failed, due to overrunning. An H.T. accumulator with a voltage slightly below the maximum recommended pressure of the valve is used, so there can be no question of my having exceeded the manufacturers' limit. To assist you in making a diagnosis it should perhaps be said that the set worked very well for about six months after it was purchased, but quality has been distinctly poor since the output valve trouble manifested itself. The fault does not lie in the batteries, as all voltages (H.T., L.T., and grid bias) have been checked with a voltmeter. L. P. W.

The set you are using includes resistance coupling in each of its L.F. stages, and we are fairly confident that the trouble will be traced to a disconnection in the grid circuit of the output valve; this would prevent the necessary negative bias from reaching its grid, and consequently anode current would be excessive, and the valve would quickly lose its emission.

It should be an easy matter to test through the circuit with a pair of phones and a dry battery, and we think that in all probability it will be found that the grid leak itself is at fault; it should be replaced by a new one.

RULES.

(1.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(2.) Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(3.) Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

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Portable Sets with Aerials.

At different times I have tried several commercial portables connected to an outside aerial in the manner provided by the manufacturers, and notice in every case that, used in this way, the sets are far from selective. Is there any way of overcoming this disadvantage? J. W. D.

Most portable receivers include either one or more stages of "aperiodic" H.F. amplification, which does not in itself contribute anything to their overall selectivity; it must not be forgotten that they are primarily designed for use with a frame, and it is hardly fair to expect them not to suffer from interference troubles when an outside aerial is added.

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Modernising the "Everyman Four."

Would it be possible to use the coils as specified for the "1930 Everyman Four" in the original set? I refer particularly to the long-wave windings; it would be an advantage to have H.F. magnification on this band. L. F. P.

The long-wave transformer described is unsuitable for use with a neutralised triode H.F. amplifier, and even if it were modified by adding a neutralising winding, we do not think that satisfactory results would be attained unless fairly sweeping modifications were introduced; it is not particularly easy to devise a set with a really efficient neutralised H.F. stage combined with waveband switching.

Raw A.C. for Filament Heating.

I believe that it is quite common practice nowadays to use ordinary battery valves with their filaments connected directly across the low-voltage winding of a suitable transformer in the output position of an "all A.C." receiver. Has this plan proved itself as being entirely satisfactory in practice? If so, I am thinking of incorporating it in my new set. R. P. S.

It may be stated definitely that a large number—perhaps the majority—of commercial A.C. sets include this arrangement, which, incidentally, has also been used in *Wireless World* sets. You need have no hesitation in adopting it.

o o o o

An Inexpensive Eliminator.

Will you please criticise my circuit diagram of an A.C. eliminator for the S.G. Regional receiver? I am going to use a Westinghouse H.T.3 metal rectifier, and, as you will see, have followed the general idea of the makers' recommended circuit, but have made provision for only one main output and a critically controlled voltage for the screening grid of the H.F. valve.

With a suitable mains transformer, an eliminator on these lines is stated to have a voltage output of 120 at 20 milliamps. I assume that this will be sufficient for the S.G. Regional receiver? S. C.

As the set in question is inherently free from interaction troubles, there is no reason why your proposed circuit arrangement (which is reproduced in Fig. 1) should not be entirely satisfactory, and the output from it should be quite sufficient for average requirements.

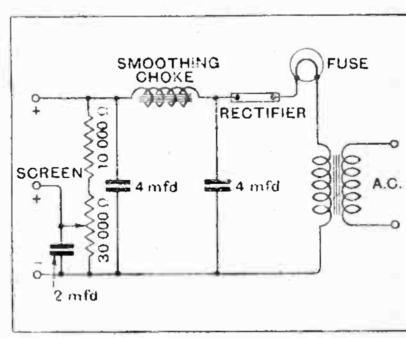

Fig. 1.—A simple eliminator circuit using a Westinghouse metal rectifier.

We would point out that, although your diagram is correct in essentials, the relative values of the resistances of the potentiometer for controlling screening grid supply are incorrect; you show both the fixed and variable elements as having a resistance of 30,000 ohms. With this combination it is impossible to obtain a supply voltage of more than 60 volts; this will be reduced if the circuit happens to consume an appreciable current. We suggest that the fixed resistance should be reduced to 10,000 ohms, and have shown this alteration on the diagram.

H.F. By-pass Condensers.

It is noticed that by-pass condensers of 0.1 mfd. are generally used in association with decoupling resistance in the H.F. circuits of receivers described in your journal. I take it that a somewhat lower capacity would be effective in a set designed only for the medium broadcast band; I have a number of 0.01 mica condensers; would these be suitable? A. F. E.

Yes. It is necessary that by-pass condensers in these circuits should have a negligibly low reactance over the band of frequencies covered by the receiver; in the case of a set with a maximum wavelength of, say, 600 metres this condition would be amply fulfilled by a condenser having a capacity of 0.01 mfd. The fact that your components have a mica dielectric is all to the good.

In Anticipation of Trouble.

I am about to build a new receiver, and am attracted by the design of "The Wireless World Kit Set." My problem is this: I live about twenty miles from the proposed Moorside Edge regional station, and am not sure whether the receiver will be sufficiently selective when the new twin transmitter starts operations. Will you give me your advice on this matter? T. B. A.

You can rest assured that the "Kit Set" will be sufficiently selective for use in your locality, even if radiation from the new twin station is greater than that from Brookmans Park. Even if the set were operated with optimum aerial coupling (from the point of view of signal strength), there should be very little "spreading" at a distance of twenty miles with a receiver of this type, and any tendency in this direction could be still further restricted by slightly loosening the coupling between open and closed circuits.

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A "1930 Everyman" Addition.

Will you please give me a diagram showing how a pick-up may be inserted in the detector grid circuit of the 1930 Everyman Four? I take it that this is the best position for the insertion of this additional piece of apparatus. E. P. M.

When the pick-up is placed in the detector grid circuit, it will be followed by three amplifying stages, and consequently the question of whether this is the best position for it depends on the sensitivity (or average voltage output) of the pick-up itself. In any case, this arrangement should work quite well, as the present post-detection volume control will be operative.

A suitable method of connection is shown in Fig. 2 (*a*); this offers the advantage that bias is automatically changed to suit amplifying or detecting conditions by operation of the switch.

It is possible to devise an even simpler form of connection by inserting the pick-up in the existing grid return lead (the lead between the low-potential end of the tuned circuit and the bias battery) and connecting a short-circuiting switch across it. Bias would, of course, be adjusted by operation of the potentiometer, and the H.F. valve would be turned off by means of its rheostat.

We would refer you to our reply to "T. C. A." in this issue.

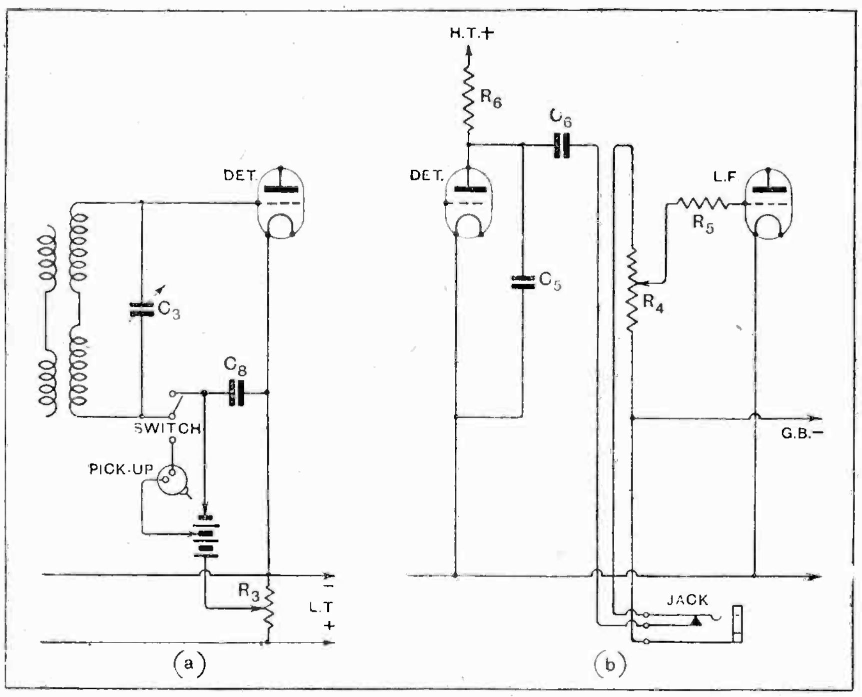

Fig. 2.—Alternative methods of connecting a pick-up to the 1930 Everyman Four. It may be inserted in (a) the detector grid circuit, or (b) the first L.F. amplifier grid circuit.

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Alternative Pick-up Connection.

Will you please show me how a pick-up may be connected in the grid circuit of the first L.F. valve of the 1930 Everyman Four, preferably by means of a plug and jack? If possible, I should like to use the present volume control resistance R_4 *for regulating intensity when the pick-up is in use.* T. C. A.

Provided your pick-up is moderately sensitive (see our reply to "E. P. M.") there should be no difficulty in connecting the pick-up in the manner you desire, and it will be possible to use the present grid input potentiometer as a volume control for both radio and gramophone reproduction.

Suitable connections are shown in Fig. 2 (*b*).

In the interests of economy it will be necessary to make some provision for breaking the filament circuits of H.F. and detector valves; this can be done by means of a pair of extra contacts on the jack, or by an extra single-pole switch, as you prefer.

FOREIGN BROADCAST GUIDE.

HUIZEN

(Holland).

Geographical position: 52° 18′ 00″ N. 5° 12′ 00″ E.

Approximate air line from London: 235 miles.

Wavelength: 1,875 m. Frequency: 160 kc. Power: 6.5 kw.

Time: Amsterdam (20 minutes in advance of G.M.T.).

Standard Daily Transmissions.

G.M.T. 10.10 sacred service; 11.40 concert; 13.40 schools; 16.40, 18.10 and 20.00 musical entertainments.

Male announcer. Call: *Hier Huizen*, with initials of society presenting radio programme. Announcements are made in the Dutch language only.

Time signals (Westminster chimes) are given almost hourly throughout the day.

Programmes are transmitted by N.C.R.V. (Netherlands Christian Broadcasting Company); K.R.O. (Catholic Broadcasting Company); V.P.R.O. (Protestant Freethinkers' Radio Association), these initials being associated with the call (q.v.).

Under the heading "Foreign Broadcast Guide," we are arranging to publish a series of panels in this form, giving details regarding foreign broadcast transmissions.

The Wireless World AND RADIO REVIEW (17th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

MECHANICAL MUSIC AND THE MUSICIAN.

THE very vexed question of whether broadcasting constitutes a menace to the professional musician has been a subject of discussion ever since broadcasting was introduced, and the fight between societies of musicians and broadcasting is still an undecided battle in this country. In America, where broadcasting had a considerable start over our own country, it had seemed that some sort of understanding between the musician and the broadcaster had been reached; but the arrival of the "talkies" and the great advances which have been made towards perfecting the gramophone record appear to have been watched with the greatest anxiety by professional musicians in the United States. Recently we have seen large advertising spaces in American newspapers taken by the American Federation of Musicians, with the object of trying to arrest the encroachment of mechanical music where it is feared the new art will oust the professional musician.

Some of the arguments put forward by the American Federation of Musicians do not seem to us to ring true, as, for instance, a statement that "The cultural menace of this movement to supplant Real Music with the flat, savourless monotony of Mechanical Music becomes apparent upon a moment's thought." Is it not the generally accepted view that broadcasting resulted in a vast extension of the musical public and an enlarging of the appetite of the world for music of all kinds?

The extension of the use of what is described as mechanical music must, we fear, result in less employment amongst individual *performing* musicians, but may not this prove to be only a temporary objection and not one which is likely to have any lasting effect to the detriment of music generally, nor to the disadvantage of the community, for surely the increased taste for music must stimulate the demand for *creative* musicians in every grade of the art.

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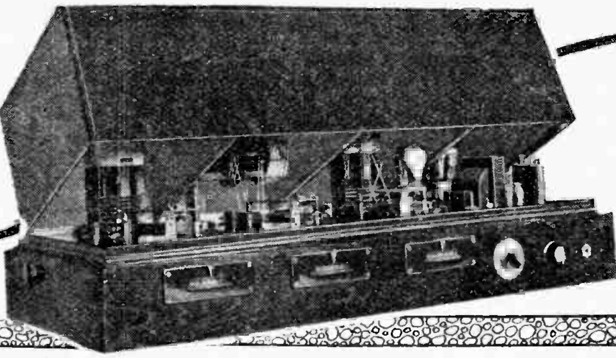
"THE WIRELESS WORLD" OLYMPIA SHOW COMPETITION.

WE are now able to announce the names of the winners of the prizes which were offered by *The Wireless World* in connection with our Olympia Show Competition. The prizes, it will be remembered, were to be awarded to the competitors who succeeded in correctly forecasting the outstanding single exhibit at Olympia, as decided by the majority of votes, and who also had the largest number of correct forecasts in the other classes of apparatus.

The first prize of £50 goes to Mr. A. Vernon, 214, Bradford Road, Manchester. The second prize, of a voucher for the purchase of apparatus to the value of £20 from firms who exhibited at the Olympia Show, is gained by Mr. Albert Maunders, 95, Bradshaw Street, Nelson, Lancs; whilst third, fourth and fifth prizes, of similar vouchers to the value of £15, £10, and £5 respectively, go to Mr. H. J. Whitehouse, 12, June Avenue, Bromborough, Cheshire; Mr. William M. Moore, 30, Mariners' Cottages, South Shields; and Mr. Walter R. Johnstone, 5, Linden Road, Levenshulme, Manchester. The winners have already been notified of their successes by letter.

Elsewhere in this issue, as we had previously announced, we illustrate and describe the apparatus which has gained the largest number of votes in each of the classes into which we divided the exhibits at Olympia as a whole, and we have made this an occasion for introducing photogravure reproduction to illustrate the apparatus, as we felt that the winning products merited some special distinction such as this method of illustration provides.

Notes on The New Kilo-Mag Four



Modifications to Suit Individual Requirements.

By H. F. SMITH.

BEFORE attempting to supplement the information already given on the subject of the new Kilo-Mag Four receiver,[1] it would seem advisable to deal with the highly topical question of selectivity—undoubtedly the burning problem of the hour to a great number of wireless users, and a matter of interest to the majority of listeners who look ahead, even though they may, at the moment, be unaffected by the changing technique of broadcast distribution.

The set as described seems to have proved itself to be sufficiently selective for use under average conditions, and experience has shown that it is hardly practicable to improve its performance in this respect without sacrificing H.F. amplification, increasing operating difficulties, or decreasing circuit resistance to a point where high-note loss becomes apparent.

When dealing with a receiver that is frankly designed for long-distance reception one naturally hesitates before suggesting any palliatives for interference troubles that will bring about any considerable reduction in sensitivity, but it must not be forgotten that the amplification provided is sometimes greater than can be conveniently handled, and it is with a clear conscience that one can recommend such practices as reducing the number of primary turns on the H.F. transformers. It is quite permissible to reduce the medium- and long-wave primaries to, respectively, 20 and 70 turns. It should be made clear that such a drastic reduction as this is seldom necessary, and that it is best to take off a few turns at a time. These should be removed from the ends of the winding nearest to the anode connection.

Mention was made in the descriptive article of the fact that interference can be lessened by moving medium- and long-wave aerial connections nearer to the earthed ends of the appropriate input coils. As a refinement, alternative connections may be provided.

Another way of increasing selectivity—but still at the expense of amplification and high-note retention—is offered by increasing the ratio of capacity to inductance in the tuned circuits. To make this alteration variable condensers of 0.0005 mfd. should be used, and a few turns should be removed from the aerial-grid coils and from the H.F. transformer secondaries.

[1] *The Wireless World*, August 14th and August 21st, 1929.

It is hardly suggested that the above rather drastic expedient should be applied to existing sets; instead of going to the expense of obtaining a new set of condensers it is certainly better to fit a loosely coupled and separately tuned aerial circuit, which is a real remedy as opposed to a mere palliative. This addition was mentioned tentatively in the earlier article; it can now be advocated without apologies, as there are definite signs that a general return to the two-circuit aerial tuner, consistently advocated by writers in this journal, is at last in sight.

Increasing Both Range and Selectivity.

There are several ways of making this addition to the receiver as it stands, and useful hints on the subject may be gleaned by studying the articles describing *The Wireless World* "Kit Set" (September 18th) and the 1930 Everyman Four (October 16th). Perhaps as suitable and convenient a method as any is that given in Fig. 1, which shows an arrangement with continuously variable capacity coupling. This requires the addition

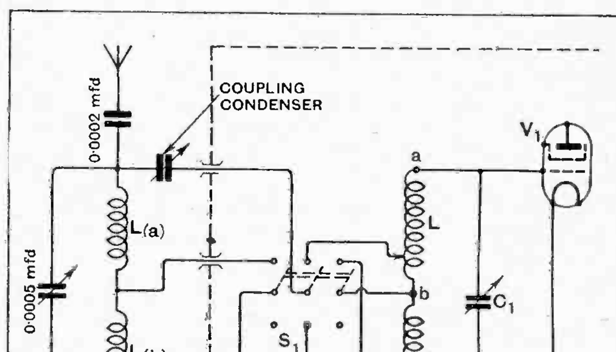


Fig. 1.—How to add a separately tuned aerial circuit: the medium- and long-wave aerial coils (L(a) and L(b)), and the extra condensers may be mounted outside the screening compartments.

Notes on the New Kilo-Mag Four.—of an extra pole to the existing wave-range switch S_1, but this component need not be replaced if interchangeable coils, mounted externally at the back or side of the cabinet base, are used in the aerial circuit. These extra inductances are marked L(*a*) and L(*b*) in Fig. 1, and may conveniently be constructed in the same way as those specified for the "Kit Set." The general arrangement of components adopted in this latter receiver may be imitated as far as possible, bearing in mind that the aerial tuning condenser, of 0.0005 mfd., must be of exceptionally small overall dimensions. The same applies to the coupling condenser, which may have a maximum capacity of 0.0001 mfd., with a small minimum value.

The spindles of these condensers may be mounted through either the front or left-hand side panel of the base compartment; in the latter position small edgewise dials should be used. Incidentally, it is here assumed that the set is (or will be) housed in a special *Wireless World* metal cabinet; although this course is to be recommended on the score of easy construction, it should be made quite clear that more conventional methods may be adopted, always provided that screening is adequate.

It is reassuring to have to report that the majority of constructors seem to have had no difficulty in getting the set into a state of satisfactory operation, and that puzzling faults have been few and far between. Where trouble is encountered, it is usually traced quite easily by systematic testing.

A Rapid Method of Fault-finding.

These tests may be made quickly by the stage-by-stage method. To assure oneself that the detector, its preceding H.F. transformer, and its succeeding L.F. amplifier are in order, the plate lead of the second H.F. valve should be removed, and the aerial joined to this lead through a 0.0001 mfd. fixed condenser. The receiver should now work as a simple detector-L.F. set, and, as such, would be expected to provide good signals from a local station. Both H.F. valves are either switched off or removed.

Carrying the test a step farther, the aerial wire (still *via* a fixed condenser) is transferred to the plate lead of the first H.F. valve, after disconnecting this lead from the valve cap. This gives us a medium-range H.F.-det.-L.F. combination, and good results will show that the second H.F. valve and its associated apparatus are in order. Obviously, then, failure to obtain the performance to be expected when the aerial is restored to its original position will indicate that the fault lies in the first H.F. valve or in the apparatus connected in one of its circuits, although, if instability is encountered under these conditions, the blame may possibly be allocated between the two H.F. stages—most probably to defective screening.

There seems to be some uncertainty as to whether the set can be used with the Mazda 215 S.G. valves, which came on the market shortly after it was first described. Although the characteristics of these valves are not quite in line with more conventional types, they can be used with complete satisfaction without any modification of the transformers, and they will afford a very high amplification. If 6-volt valves are used in the remaining positions, it is convenient to reduce the value of the rheostat R_9 to some 15 or 20 ohms, and, as a safety measure, to insert in series with it a semi-fixed resistance set at 13 ohms.

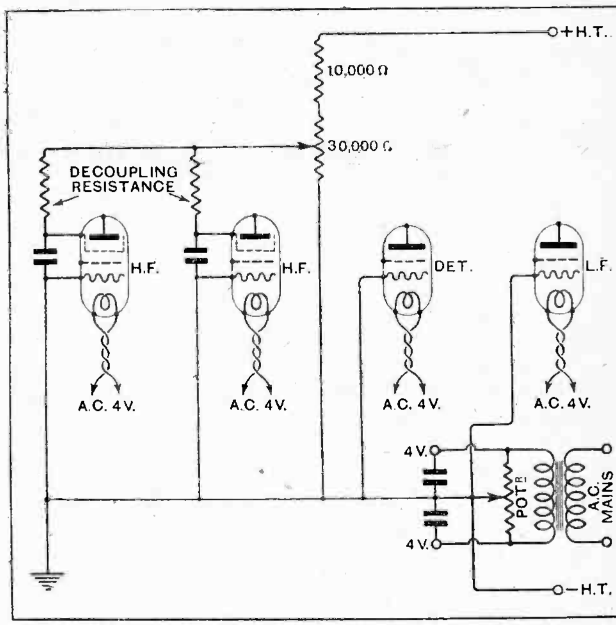


Fig. 2.—The Kilo-Mag Four receiver may be operated with A.C. valves without any alterations to its basic circuit. This diagram shows a suitable method of connecting heater and cathode circuits, and also a potentiometer arrangement for controlling screening grid voltage. Condensers across the low-tension potentiometer may be of 0.005 mfd.

The connection of a gramophone pick-up has already been described in the "Readers' Problems" section of *The Wireless World* of September 4th. There are several possible ways of making this addition; all that one has to do is to arrange to insert the pick-up in series with the detector grid circuit, and at the same time to make the appropriate reduction in negative bias. As a refinement, means can be provided for automatically switching off the H.F. valve filaments, but this operation can be carried out by means of the rheostat already fitted.

Two minor errors were allowed to pass into the original description; the writer takes this opportunity of apologising and again drawing the reader's attention to them. In the "List of Parts" the value of the variable volume-control resistance R_7 was given as 20,000 ohms. This should be 200,000 ohms. Referring to the practical wiring plan, there was a fairly obvious transposition of the reference lettering on each of the H.F. valve-holder filament terminals. The terminals "earthed" to the metal screening base should be connected to L.T. negative, and consequently should be lettered *r* and *t*; they are joined to the soldering tag on the jack frame by separate leads bearing corresponding identification marks. The remaining filament terminals should be marked *s* and *u* (instead of *r* and *t*), and are connected by flexible leads to the same terminal on the rheostat R_9.

My Household Set

A Switch=operated Receiver With Remote Control.

By CAPTAIN IAN FRASER, C.B.E.

A FEW months ago I built myself a new house. The opportunity was thus afforded and the excuse provided for the design and installation of a new wireless receiver. What did I really want?

I started listening before the War to the Eiffel Tower news and to ships. A set at Marlborough College, largely contrived from gas tubing, crystals and odd pieces borrowed from the "stinks" laboratory, formed the basis of my experiments. I listened to amateurs before broadcasting began, and have possessed or borrowed or made almost every possible kind of set. In my experience distant stations are amusing to "get" but seldom worth listening to, owing to incidental noises. I have come to the conclusion that the keen amateur should have a set for his own use, perhaps two or more if he can afford them, but that for his own sake and that of his family his household set should be separate and different. It is the household set I propose to discuss here.

For a residence in or near London such a set should, I think, receive 2LO and Daventry 5GB at full strength without the bother of tuning, and should come into operation by means of the pressing of a switch. If possible one switch button should operate "on," "off," and also the change from one station to the other.

The first problem was to devise this switching mechanism. Doubtless there are other methods of doing this job than that which I have chosen, but as it took me some time and two or three unsuccessful experiments and numerous enquiries before it was finished, it might be worth while describing it in detail.

The set is in a safe place in an out-of-the-way cupboard. This pleases the æsthetic eye, and prevents interested friends from tuning it in. The receiver feeds four loud speakers, and close to where these are located is a neat switchboard upon which are two controls. One is a press button to put the set on or off, and to change stations, and the other is a variable control for the volume of the particular loud speaker with which it is associated. A three wire lead-covered cable connects the loud speakers to the set. We shall call the three wires black, red and white, because it will facilitate explanation. Black and red are connected to the output side of an output transformer from the receiver. Their other ends are connected to the terminals of the loud speakers or to a second transformer, according to the type of loud speaker employed. White and red are the wires which operate the switching mechanism. The primary relay circuit consists of a nine-volt dry battery, the relay coil, the wires, red and white, and the press button. The armature operates an eight-toothed sprocket wheel, moving it one tooth every time the circuit is closed. On the sprocket wheel spindle is an ebonite rod or small diameter drum upon which are the necessary contacts for two switches.

The first switch is responsible for putting on the current to operate the set. Positions 2, 4, 6 and 8 of the ebonite rod make contact, and positions 1, 3, 5 and 7 make no contact. Hence, so far as this switch is concerned, successive presses upon the press button will put the receiver on and off from any remote control point indefinitely or, to be strictly accurate, until the dry battery runs down. It is to be noted in passing that the current is not flowing all the time in this switch circuit but only at the moment of operation, with a corresponding economy in the use of the dry battery.

The author photographed in his laboratory. Captain Fraser has been a leading amateur for many years and is a Past President of the Radio Society of Great Britain.

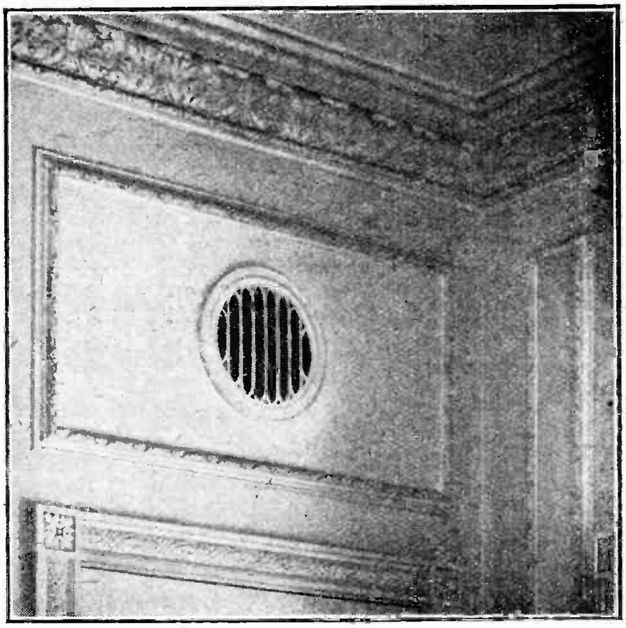
The other switch, mounted upon the same ebonite spindle, is used to operate the wavelength changing device. This is so arranged that with one press-button switch we get these results following successive pressings of the button: "on" London—"off" - "on" 5GB—"off"-"on" London—"off" - "on" 5GB—"off," etc., *ad infinitum*.

The switch I have described could probably be constructed to operate the set and the wave change directly, but there is not, I think, such a switch on the market, and I had to use a second stage of relaying or have a switch made. I chose the former course. I secured a remote control switch from Messrs. Gamages, which was a slight variation of their standard arrangement. It had larger silver contact points than is usual and two switches upon the spindle instead of one. I then ordered two relay switches from Messrs. Isenthal, consisting of

My Household Set.—
an armature carrying a mercury bottle, and operated by a magnet coil wound for 240 volts D.C. The switch that puts the set "on" and "off" is a single-pole mercury switch; the other, which changes the wavelength, is a two-pole mercury switch. The "on"-"off" switch is simply connected to the main supply to the set for H.T. and L.T.

The double-pole switch connects two independent 0.0003 variable condensers to the two existing tuning condensers of the set. The earthed sides of these condensers are permanently connected, and the high potential sides are the two which are switched. When the two independent condensers are brought in in parallel with the existing condensers the requisite increase of capacity and consequently of wavelength is made to raise the tuning from that required for 2LO to that appropriate for 5GB.

The more sensitive the receiver the more care would have to be taken not to let these added condensers and their connecting wires, etc., introduce unwanted capacities. I find no difficulty on this account, and the apparatus is instant and reliable in its operation.



The loud speaker in the drawing room. The instrument—a Rice Kellogg moving coil—is mounted in the wall, which is lined with tinned iron and finished off with cement. Baffle vibration is entirely absent.

The Isenthal relays are held on all the time they are operating and are using current therefore, but this is of the order of a few milliamps from the main and can be ignored. When twin transmissions from Brookmans Park begin we shall have two signals of equal strength coming from the same point, and it will be much easier to deal with this than with the alternatives of 2LO and Daventry Junior. Doubtless a single detector valve, without H.F. amplifiers, will suffice, and the double-mercury Isenthal switch described above, which is constructed for use as a double-pole double-throw switch, can be used for disconnecting one condenser tuned to the lower wavelength and connecting another tuned to the higher wavelength station.

The set I am now using works entirely from the mains except for a grid battery, and being of standard practice need not be described. The output is from three L.S.5.A. valves in parallel, and the H.T. is the full 240 volts less what is absorbed in smoothing, about 20 volts.

One feature of the installation which may be worth mentioning is the position of the loud speaker in the drawing-room. In my opinion horns are ugly and are best out of sight. I did not want a cabinet in this particular room. I preferred an R.K. moving coil, but it is a difficult instrument to mount in its baffle without being ugly, unless of course a really fine old cabinet is secured. As I was building a house the solution offered itself of putting it in the wall, and this was adopted. A ten-inch cone loud speaker was used. A hole twelve inches in diameter was cut in the wall between two rooms and lined with tinned iron and finished off with cement. The speaker is fixed in this, as the illustration shows. It has, of course, to be open at the back. This I thought at first might be a disadvantage as the loud speaker would necessarily have to be working in the two rooms at once, but in practice I have not found this a trouble. One of the rooms is a hall and not a sitting-room. The loud speaker could not be mounted in an outside wall, for the back being open the cone would get damp. I think the mounting in the wall is ideal. It is hardly noticed, and is not unsightly. It provides a very large baffle, which these loud speakers need to produce their best bass notes. There is, moreover, no cabinet booming or sympathetic vibration from the baffle which is so often noticeable with the R.K. in a box.

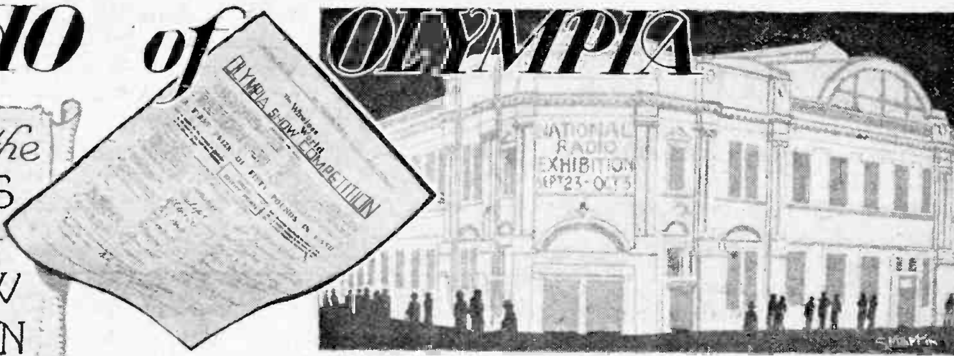
The individual control of each loud speaker for volume is very necessary. You cannot control the whole set without interfering with the volume at all loud speakers, and you may want silence momentarily or for some time at one speaker. Local individual control is afforded by a resistance varying with the loud speaker put across its movement or moving coil. In the case of the R.K. it is a ten-ohm rheostat of standard type.

"THE WIRELESS WORLD" BUYERS' GUIDE TO SETS.

Next week's issue will contain this annual feature. Readers desiring to select or make reference to specifications of any commercial set will find the Guide invaluable.

An ECHO of OLYMPIA

A Review of the APPARATUS Voted the Best in our SHOW COMPETITION



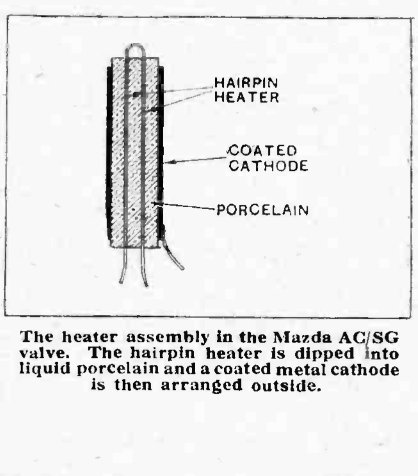
IN the following pages we illustrate and describe the apparatus which in the voting competition arranged by "The Wireless World" in connection with the Olympia Radio Show gained first place in the total of votes cast by our readers in each of the various classes into which we divided the Olympia Show exhibits as a whole. It will be recollected that readers were asked to vote for what they considered to be the outstanding single exhibit at the Show, and, in addition, to make their choice of apparatus in each of seven classes into which the exhibits at Olympia as a whole were divided. The classes were:—(1) Complete receivers of five valves or more. (2) Complete receivers of four valves or less. (3) Batteries of all kinds. (4) Mains supply units. (5) Loud speakers. (6) Valves. (7) Other apparatus not classified above; also amplifiers, component parts such as transformers, condensers, tuning coils, resistances, etc., etc.

The apparatus which gained these positions were, as already announced:—The outstanding single exhibit, the Mazda AC/SG valve, and in the various classes: (1) Burndept A.C.7 receiver. (2) Philips four-valve, all-electric receiver, No. 2,511. (3) Exide H.T. accumulator, Type WY.10. (4) Ekco combined A.C. eliminator. (5) Ferranti moving-coil loud speaker. (6) Mazda AC/SG valve. (7) Gambrell Novotone corrector. Elsewhere in this issue the announcement is made of the names of the readers of "The Wireless World" who have won the prizes in the ballot for their forecasts of the popular vote.

MAZDA A.C. SCREEN-GRID VALVE.

WHEN the screen-grid valve first made its appearance on the market somewhat wild claims were made concerning its performance as a high-frequency amplifier. Time proved, however, that as regards amplification little benefit was to be derived as compared with a well-designed balanced three-electrode valve. The reason for this was not far to seek. Stable amplification was limited to a comparatively low figure on account of the energy fed back through the anode-grid capacity of the valve.

Those who have built a set embodying the new Mazda AC/SG valve, which is a great advance over its predecessors, will agree that its position as winner both of class 6 and class 8 of the Competition is well merited. It is safe to say that with this valve a greater stage gain can be attained than with any other commercial valve existing. The inter-electrode capacity which has such an important bearing on stable amplification has been reduced to the remarkably low figure of 0.0045 $\mu\mu$F. by the expedient of arranging two screening grids in cascade. When extreme care is taken with external screening and when the tuning circuits are designed with low losses, a stage amplification of approximately 250 times can be obtained before the threshold of instability is reached. This performance is about six times better than that of the best neutralised triode. The valve is designed to be fed from A.C. mains, and has an independently heated cathode, but the heater consumption of 1 ampere is hardly in excess of the capabilities of the average L.T. accumulator, where the absence of lighting mains demands this form of L.T. supply.



The heater assembly in the Mazda AC/SG valve. The hairpin heater is dipped into liquid porcelain and a coated metal cathode is then arranged outside.

That the cathode has an equipotential surface (i.e., no voltage gradient) and no field around it, means that the electron flow is less restricted than in an ordinary filamented valve, and there is the further advantage in the valve under review of the "short-path" characteristic. The combined effect of these is a valve with an amplification factor of approximately 1,200 and an A.C. resistance of about 800,000 ohms under working conditions, giving a mutual conductance of 1.5 mA. volt.

In designing a suitable intervalve coupling for this valve one's thoughts naturally turn to the tuned transformer which has the advantage of preventing L.F. impulses from reaching the grid of the subsequent valve. To extract the maximum amplification from the valve in these circumstances it is necessary that the dynamic resistance of the primary of the transformer should be equal to the A.C. resistance of the valve, but up to the present it has

An Echo of Olympia.—

not been found possible to design a coil with a dynamic resistance greater than about half the A.C. resistance of the AC/SG. This would mean a step-down ratio which is unfortunately inconvenient in that the screen-to-anode capacity which is shunted across the primary winding would cause unwanted resonance and curtailment of wave range.

A compromise has perforce to be effected in the use of a one-to-one transformer. Where selectivity must be of the highest order due to the presence of a local powerful transmission it may be necessary to remove primary turns and sacrifice part of the amplification. For instance, with a three-to-one step-up transformer of *The Wirless World* type having sixty-eight turns of 27/42 Litz on a 3in. former an amplification of 160 times will be possible, while with a one-to-one ratio transformer of the same type a stage amplification of over 350 could be obtained. The latter figure, however, exceeds the threshold instability amplification of 250 mentioned earlier, so that neutralisation would be necessary. In this connection the reader is referred to *The Wireless World* Record III Receiver[1], in which an unprecedented stage amplification averaging 500 was obtained using an earlier form of the Mazda AC/SG valve. The choke-fed tuned-grid circuit which is equivalent to a one-to-one transformer is also suitable, and was employed in "The Flat Dwellers' A.C. Three" receiver,[2] which had a measured stage amplification of about 225 times.

The constructional details of the valve are interesting—particularly the cathode assembly. Instead of a separate heater and insulator the heater is dipped into a liquid porcelain "slip" to become coated with an adherent insulator. The cathode—a metal tube coated with the oxides of barium and strontium—which is arranged around the surface of the porcelain, can therefore have a small diameter and be of considerable length resulting in the watts dissipation per centimetre being small. By this means the control grid is kept cool, and grid emission—one of the chief bugbears in A.C. valves—is prevented. The heater is bent into the form of a hairpin and is thus non-inductive; this, together with the equipotential cathode, assists in the prevention of hum.

In designing a receiver with a large stage amplification it is advisable to return the cathode to the centre of the heater winding of the transformer and to pay special attention to decoupling and metal screening in three dimensions. The optimum anode voltage is 150, the screen voltage about 60, and the control grid voltage a little under a volt. The 0.9 volt bias cell developed by Messrs. Siemens for *The Wireless World* is suitable. A remarkable property of the duplex screening grid is to restrict the screen current to a small fraction of a milliampere—in fact, conditions may arise in which the screen current is negative.

With the advent of Brookmans Park it should be pointed out that the signal voltage which may be impressed on the grid of one of these screened valves may cause an excursion into the lower bend and to the region of grid current. Not only does this state of affairs cause distortion but selectivity is adversely affected. The implication is a volume control between the aerial and the first valve.

¹ See *The Wireless World*, September 4th and 11th, 1929.

² *The Wireless World*, May 1st and 8th, 1929.

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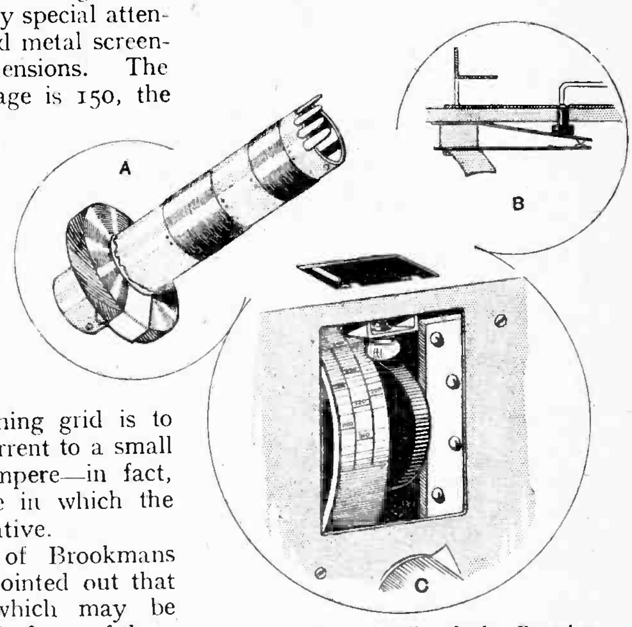
BURNDEPT A.C. SCREENED SEVEN.

THE Burndept A.C. Screened Seven has been specifically designed to meet the requirements of those who wish to receive broadcasting at a reasonable cost both as regards maintenance and initial outlay, and with the minimum of technical complication. Just as the Burndept Universal Screened Five may be regarded as a "sports" model for the enthusiast, so the A.C. Screened Seven fulfils the rôle of the "utility model," which can be relied upon to give a first-class performance in the hands of the layman.

By distributing the H.F. amplification over two stages it has been found possible with only one main tuning control to attain sufficient range and selectivity to guarantee the uninterrupted reception of all the stations worth receiving from a programme point of view. Under present conditions in the ether, this means a choice of at least ten or a dozen reliable alternative programmes from British and foreign stations.



Constructional details of the Burndept A.C. Screened Seven. A, anode circuit inductance unit; B, gramophone pick-up contacts operated through an ebonite button by the wave range switch arm; C, calibrated slow motion drum dial and indicator lamp.

The standardisation of A.C. mains supply for both H.T. and L.T. current not only reduces maintenance costs to a negligible figure, but also ensures a generous and constant output to the loud speaker. The push-pull output stage is, in fact, capable of supplying a volume adequate for most domestic requirements with an ample reserve of undistorted acoustic power.

On the production side considerable ingenuity has been displayed in the design of the metal screening chassis

An Echo of Olympia.—

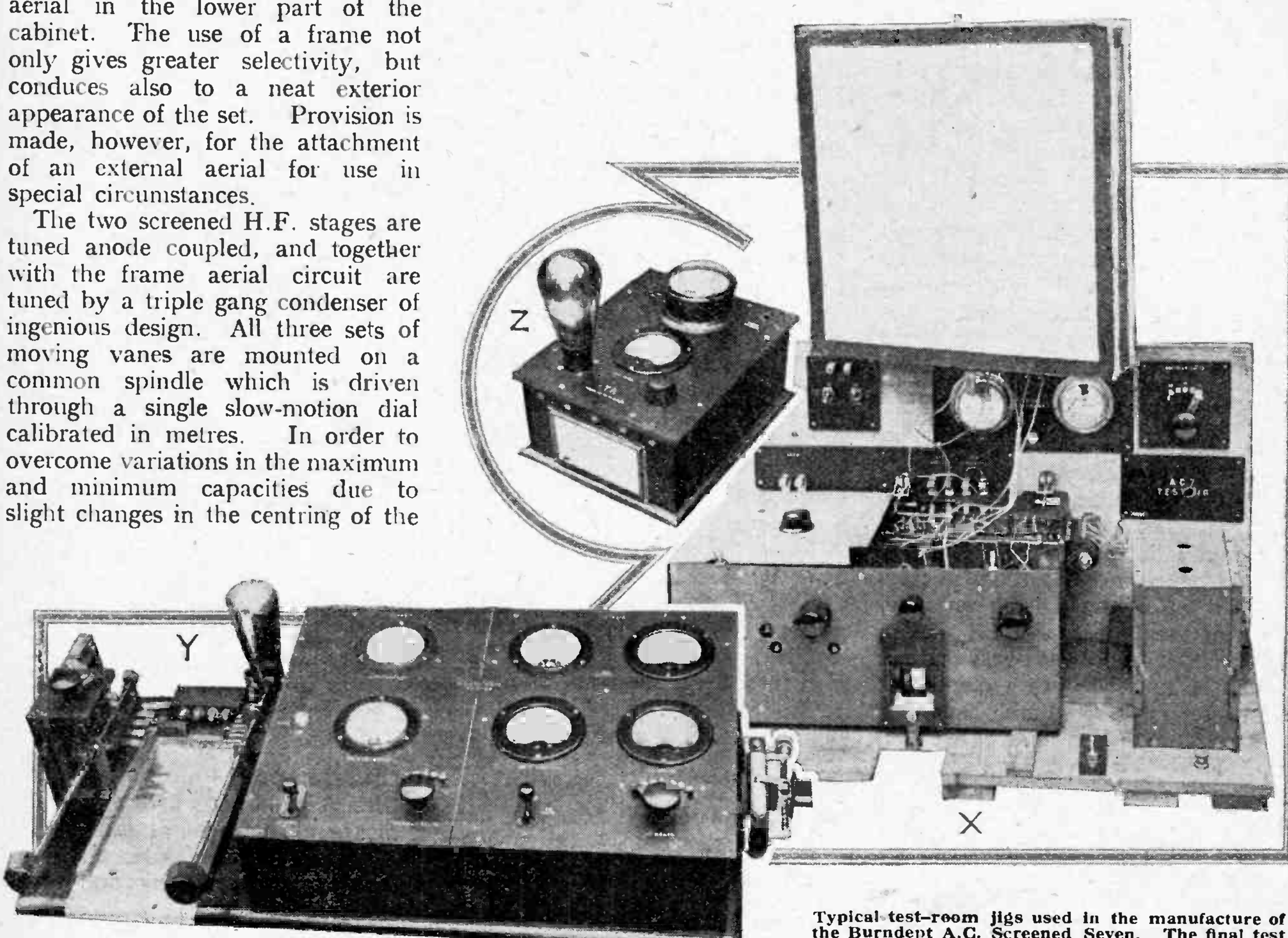
and the layout of parts. The A.C. Screened Seven is no mere adaptation of previous conventions in receiver design. Having settled on the functions which the receiver will be required to perform a completely fresh start has been made. Technical considerations have been studied in conjunction with production problems, with the result that the final design can be sold at a very reasonable price.

Energy is picked up on a frame aerial in the lower part of the cabinet. The use of a frame not only gives greater selectivity, but conduces also to a neat exterior appearance of the set. Provision is made, however, for the attachment of an external aerial for use in special circumstances.

The two screened H.F. stages are tuned anode coupled, and together with the frame aerial circuit are tuned by a triple gang condenser of ingenious design. All three sets of moving vanes are mounted on a common spindle which is driven through a single slow-motion dial calibrated in metres. In order to overcome variations in the maximum and minimum capacities due to slight changes in the centring of the moving vanes, double spacing has has been employed for both sets of plates. Accurate ganging is further simplified by dividing the wave range into three bands—two for medium waves and the third for long. A three-way rotary switch, with groups of contacts in each compartment of the condenser screening unit, short-circuits sections of the tuned anode and frame inductances not in use. The tuned anode coils are made by precision methods, and a continuous record in the form of a chart is kept showing variations in the inductance. The curve must fall between specified limits or production is stopped and the trouble investigated. Each section of the gang condenser is provided with small trimming condensers for bringing the minimum capacity up to the value for which the curvature of the vanes has been designed. In the case of the frame aerial circuit the trimming condenser is of slightly larger capacity, and is provided with a separate control on the front of the cabinet.

The H.F. stages are followed by an anode bend detector resistance-coupled to a first L.F. stage which is in turn coupled to the output valves through a Ferranti push-pull transformer. A push-pull output transformer feeds the double-diaphragm balanced armature loud speaker incorporated in the base of the cabinet, and terminals are provided for operating an external moving coil speaker if desired.

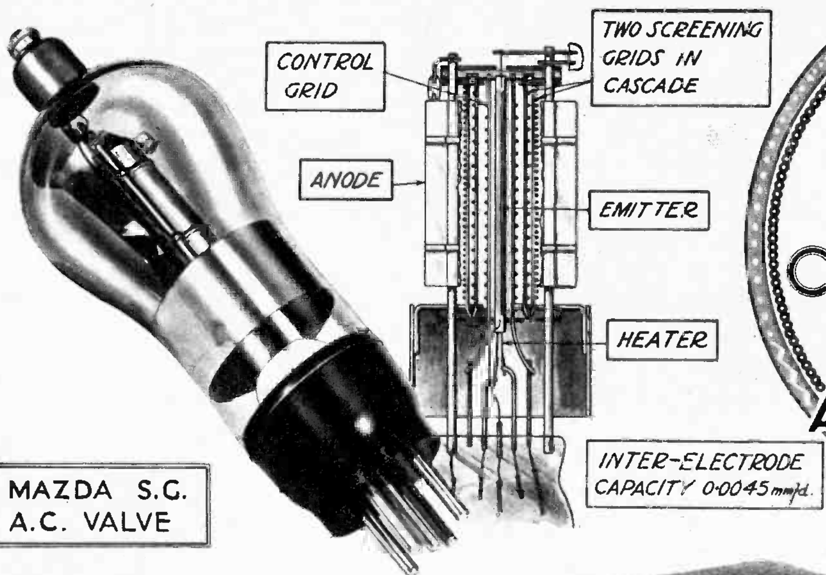
A gramophone pick-up can be connected to the detector input, and a fourth position on the wave range switch operates contacts which bring about the necessary changes in grid bias, etc. A system of resistances and condensers has been introduced at this point to suppress extraneous pick-up in the gramophone leads.



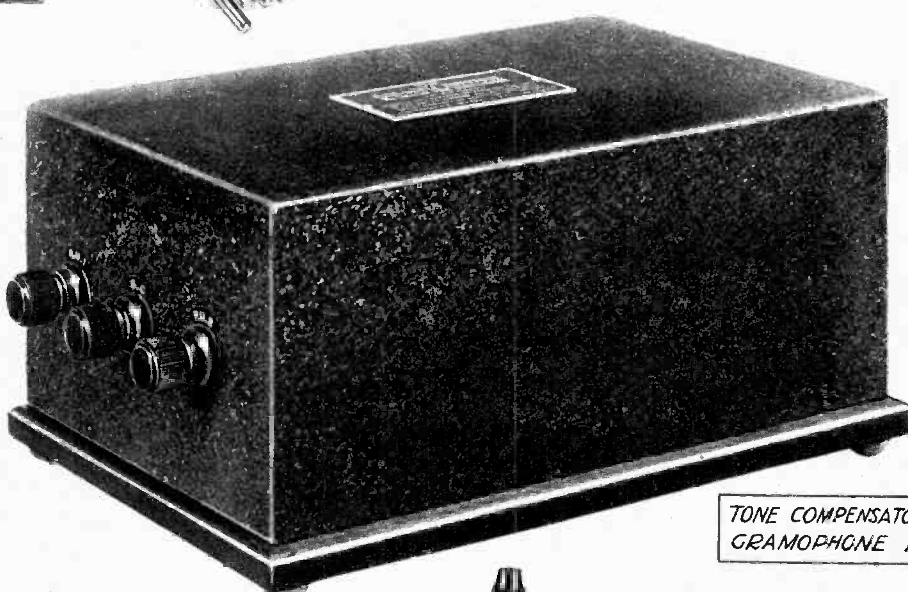
Typical test-room jigs used in the manufacture of the Burndept A.C. Screened Seven. The final test on signals before fitting the unit in its cabinet is carried out in jig X with the unit inverted and the loud speaker and frame aerial in the same relative position as in the final assembly. The output constants of the power unit are checked by means of the test panel Y; note contacts on extreme left for picking up connection with the terminal strips on the power unit. The unit Z is used for classifying and matching valves for the push-pull output stage.

All supply currents and potentials for working the receiver are derived from A.C. mains through a rectifier unit connected to the receiver chassis

The Wireless World and Radio Review
OLYMPIA COMPETITION WINNING APPARATUS

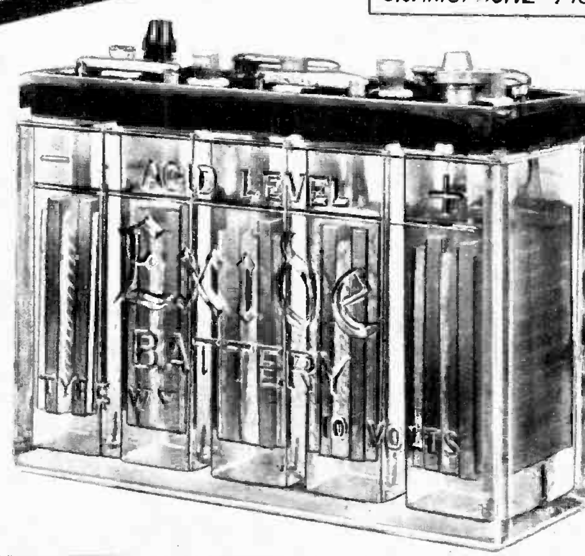


MAZDA S.G. A.C. VALVE

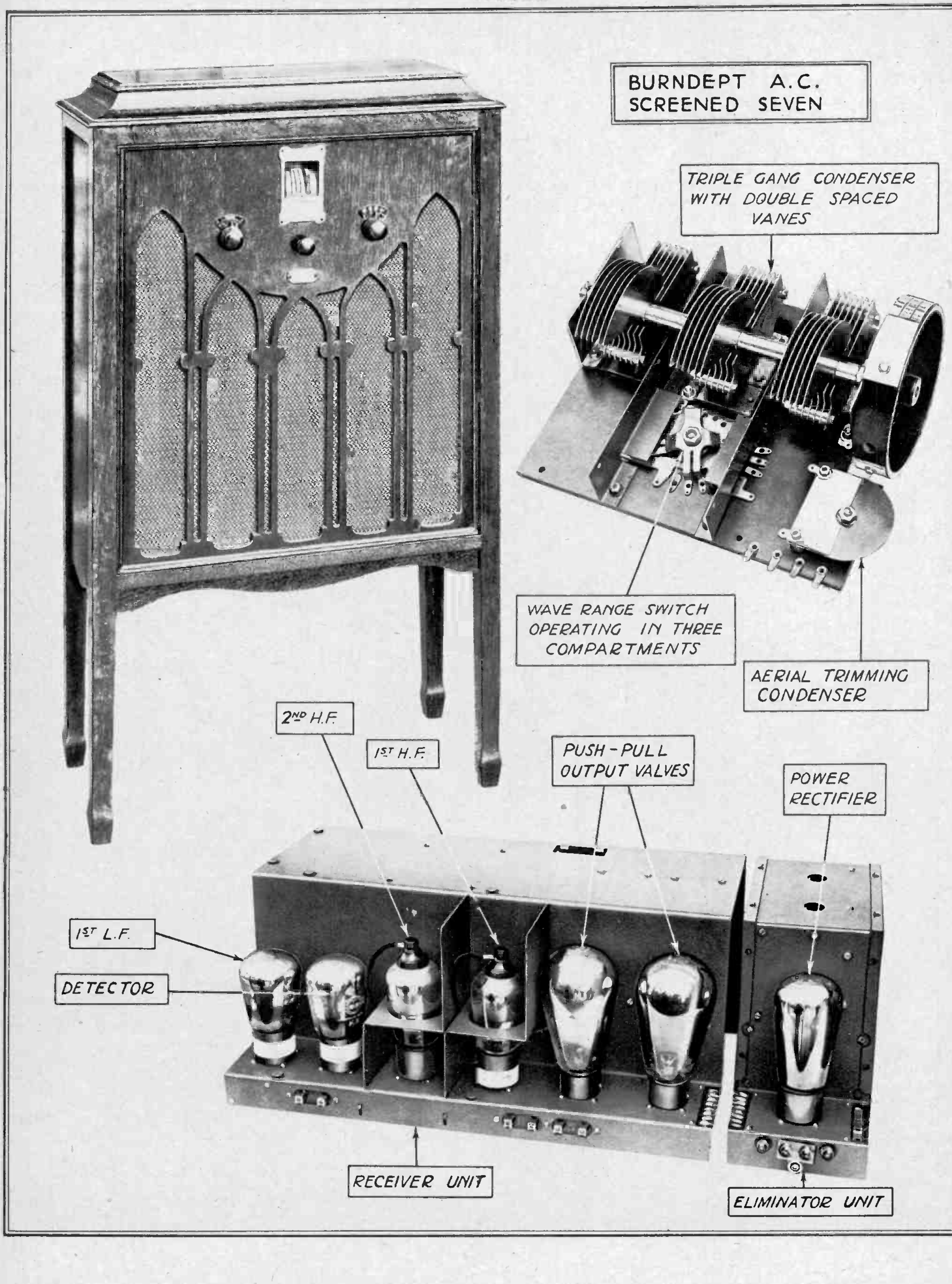


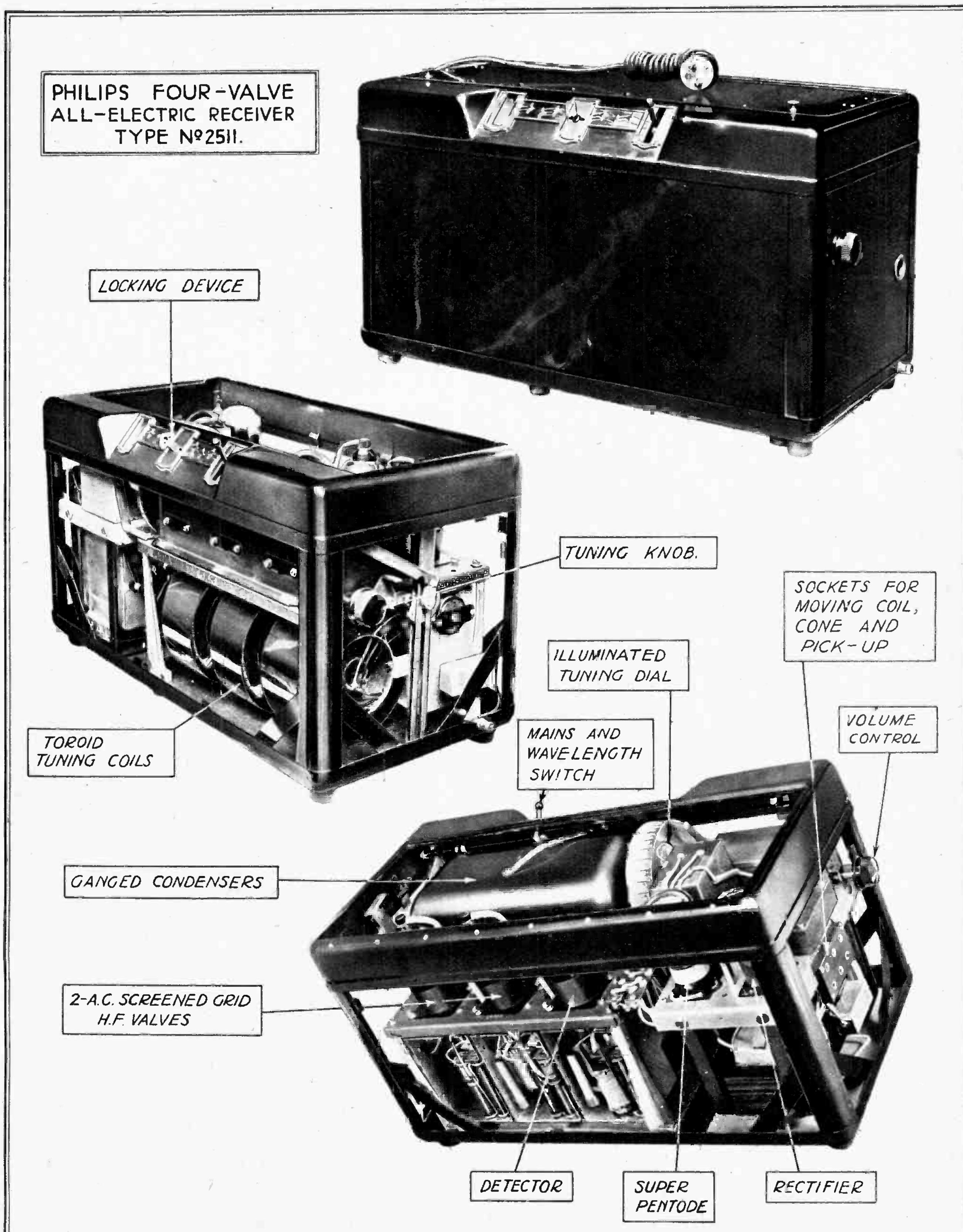
TONE COMPENSATOR UNIT FOR GRAMOPHONE PICK-UPS.

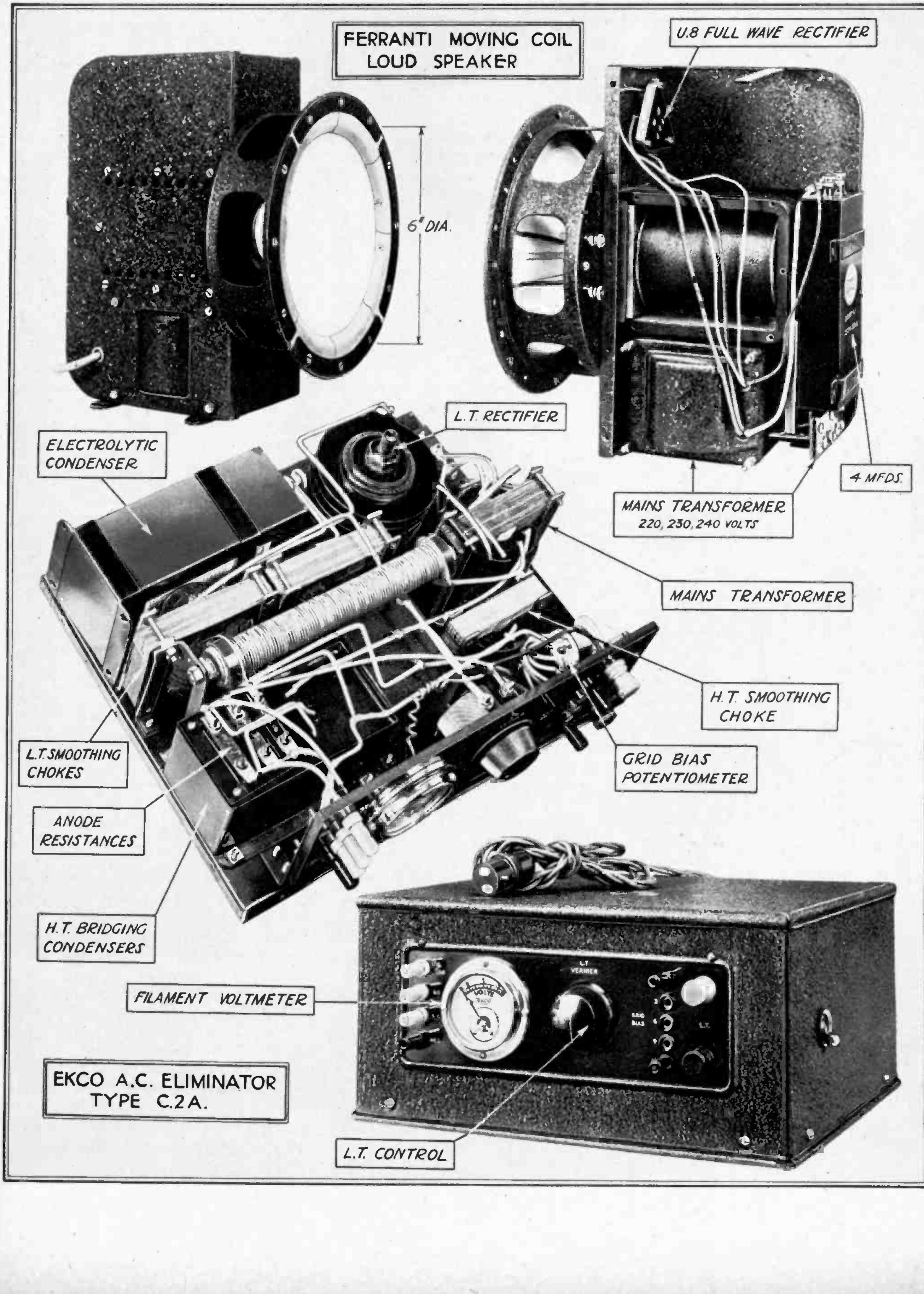
GAM-BRELL NOVOTONE.



EXIDE H.T. ACCUMULATOR TYPE W.Y.10.


BURNDEPT A.C. SCREENED SEVEN
TRIPLE GANG CONDENSER WITH DOUBLE SPACED VANES
WAVE RANGE SWITCH OPERATING IN THREE COMPARTMENTS
AERIAL TRIMMING CONDENSER
2ND H.F.
1ST H.F.
PUSH-PULL OUTPUT VALVES
POWER RECTIFIER
1ST L.F.
DETECTOR
RECEIVER UNIT
ELIMINATOR UNIT


PHILIPS FOUR-VALVE ALL-ELECTRIC RECEIVER TYPE Nº2511.
LOCKING DEVICE
TUNING KNOB.
SOCKETS FOR MOVING COIL, CONE AND PICK-UP
ILLUMINATED TUNING DIAL
VOLUME CONTROL
TOROID TUNING COILS
MAINS AND WAVELENGTH SWITCH
GANGED CONDENSERS
2-A.C. SCREENED GRID H.F. VALVES
DETECTOR
SUPER PENTODE
RECTIFIER


FERRANTI MOVING COIL LOUD SPEAKER
U.8 FULL WAVE RECTIFIER
6" DIA.
L.T. RECTIFIER
ELECTROLYTIC CONDENSER
4 MFDS.
MAINS TRANSFORMER 220, 230, 240 VOLTS
MAINS TRANSFORMER
H.T. SMOOTHING CHOKE
GRID BIAS POTENTIOMETER
L.T. SMOOTHING CHOKES
ANODE RESISTANCES
H.T. BRIDGING CONDENSERS
FILAMENT VOLTMETER
EKCO A.C. ELIMINATOR TYPE C.2A.
L.T. CONTROL

An Echo of Olympia.—through an eight-contact terminal bridge. The H.F. detector and first L.F. valves have indirectly heated filaments working at 4 volts, while the push-pull power valves have directly heated filaments at 6 volts. The difference in the voltage of the two filament circuits is made use of in illuminating the wavelength dial lamp, which also serves to indicate that the main current is switched on. The anode current is supplied through a full-wave valve rectifier, while grid bias is derived from a separate Westinghouse metal rectifier. The grid bias to the output valves is adjustable.

The receiver is absolutely silent in operation, and there is no trace of 50-cycle A.C. hum. The push-pull output helps considerably in this direction, as any residual hum after smoothing is cancelled out in this stage. The two P.625A valves are capable of an undistorted output of 1.5 watts, which is more than sufficient for ordinary domestic requirements. The quality with the standard loud speaker incorporated in the cabinet is good, and with an external moving coil it is excellent. The range and selectivity are comparable with a really first-class portable, and in the London area no trouble is experienced in receiving ten or a dozen foreign stations, including those on long waves. By close tuning of the dials this number could be considerably augmented. Daventry 5GB is quite free of any background from Brookmans Park, and there is no trace of the latter transmission on 261 metres, the wavelength allotted to the alternative station. The single dial tuning is, of course, simplicity itself, while the volume control, which takes the form of a potentiometer controlling the grid bias to the first H.F. valve is smooth in operation.

Through the courtesy of the chief engineer we have had an opportunity of seeing the methods employed in the production and testing of the A.C. Screened Seven. Press work plays an important part, not only in the formation of the metal chassis but also in the construction of small parts such as valve holders, and special plant has been laid down for dealing with the larger portions of the screening system. An imposing array of special test jigs have been developed for checking the electrical constants of such components as coils, variable condensers, and power transformers, while a special unit is used for matching the push-pull power valves. The final test on the complete chassis is made in an inverted position on a special jig with a standard loud speaker and frame aerial mounted above the chassis in the same relative position they would occupy in the cabinet. At this stage final adjustments are made to the trimming condensers of each tuned stage, and check readings are made of anode currents, etc. Each unit is required to pass further tests on actual signals, and is then ready for packing and despatch.

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PHILIPS FOUR-VALVE RECEIVER. Type 2511.

No possessor of this type of receiver will wish to disagree with the findings of the ballot in the class for receivers with less than five valves. The interest in the Type 2511 at the Philips stand this year gave a sufficient clue that it was a likely winner. In that it was the first all-mains-operated four-valve set, all-metal built, and constructed on mass-production lines, it rightly deserves a place among the winning sets. Its unique design, combined with remarkable performance, has earned the enthusiasm of the discriminating amateur to whom, this, the first technical description, may be of special interest.

Nothing of a technical nature is revealed externally, and the metal-bound cabinet with its bakelite panels and rounded corners will not offend in any surroundings, it being neither ornate nor ugly. Absence of complex controls is another of its good features, and while it is not disguised so as to lose its radio identity, the bewildering effect so often produced by a number of operating knobs is avoided. The finish is one which will not readily deteriorate, there being neither bright parts nor polished panels. There are but three controls, a single-geared tuning knob, a wave-change switch and a volume adjuster. Instead of the rotary controls appearing on the front panel as is so often the case, they are conveniently placed at opposite ends of the cabinet in order to provide convenient operation.

Technical knowledge is no aid to getting the most out of the set, as it is only necessary to rotate the single control tuning with one hand while the other hand maintains a critical regulation of volume. Test reveals that stations are to be found at every few degrees on the drum indicator. A transparent scale with lamp and hair line appears in the centre of the instrument behind a window on a narrow top bevel. The single lever switch which gives the two-wave ranges has, in addition to an " off " position, a setting that throws the gramophone pick-up into circuit. There is also a key which on one turn locks the lid and with a second turn locks the lever switch as well, so that the set cannot be turned on, while by means of an automatic locking bar the lid cannot be raised except when the switch is turned to the " off " position.

On raising the lid little is revealed other than the fact that there are two screen-grid stages with S4V valves, an indirectly heated detector—the 154V—power pentode, the new PM24A with a working anode potential of 300 volts and a Philips full-wave rectifier type 2505. Beyond this everything is sealed, though a good deal of information concerning the interior apparatus was to be gleaned from the exhibition model in which the side panels had been removed.

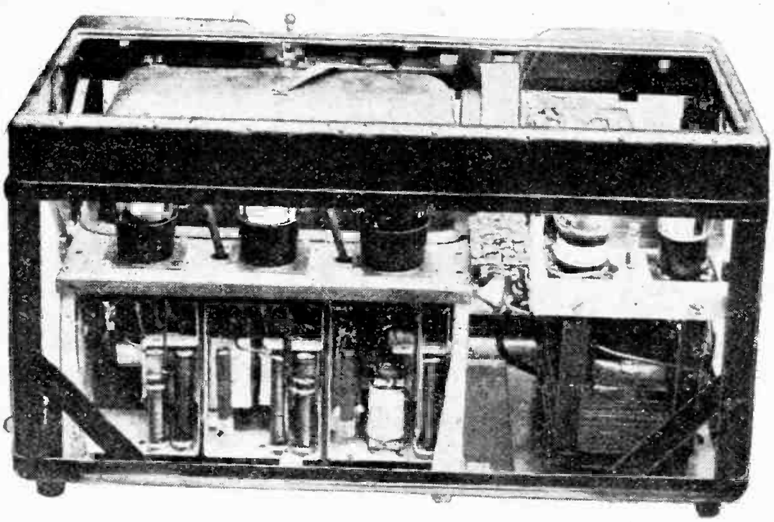
The three tuning condensers being ganged on to a common shaft need compensating for small capacity differences in the associated inductances and this is probably carried out by three screws, the heads of which are exposed through the screening and their settings held by red sealing wax. These screws must adjust auxiliary condensers in parallel with the tuning units and in that they are used to bring the stray parallel capacities up to a given value it becomes necessary that the variable condensers follow a logarithmic law and a simple test with a wavemeter confirms the use of log scale condensers.

Three sets of tuning coils of the

An Echo of Olympia.—toroid form are used in both the short- and long-wave sections and are assembled concentrically. As only three wires could be seen passing from each pair of coils it would seem that the circuits are tuned anodes, and while the form of inductances employed is known to be not the most efficient it is probable that with the aid of a small interelectrode capacity that the working condition approaches but never reaches the oscillating point. By this means the stage gain is particularly high and the overall resonance curve of the combined circuits would seem to be one which combines selectivity with quality. Bakelite formers give support to the toroid inductances and in that spaces exist between these concentric supporting tubes, complete screening must pass between the individual stages when the receiver is completely assembled. Change of wave range is probably effected by simply short circuiting the long wave coils and a bar switch connected by links to the front lever passes right along the tuned stages.

Resistances, wound mostly on glass tubes combined with small cylindrical condensers and large capacity condensers of the metal box type, are to be seen associated with each stage so as to give the necessary anode, screen and grid biasing potentials while avoiding feed-back through the common H.T. source in a manner no doubt very similar to that described not long ago in the pages of this journal.

The volume control knob is to be found at the eliminator end of the receiver and would seem, therefore, to be associated with the L.F. stage with which the eliminator appears to be combined, suggesting post-detector control. The instructional booklet, however, recommends the use of an external volume control when using the gramophone pick-up. This seems to make it clear that the volume control in the set precedes the detector. The component used for volume control is a wire-wound potentiometer giving a smooth and uniform regulation and is, no doubt, associated with one of the resistances used for grid biasing. Owing to the high anode voltage of the output valve an output transformer is fitted and by the use of two secondary windings high or low resistance loud speakers can be used. A tone-correcting condenser can be introduced and is combined with the two-pin loud speaker connector.



Philips receiver with side panel and screening covers removed. Biasing and anode feed resistances are associated with the tuning equipment contained in the screening compartments.

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EXIDE W.Y.10 H.T. ACCUMULATOR.

THIS is the latest addition to the Exide range of H.T. units, and made its first appearance on the occasion of the recent Radio Exhibition at Olympia. In designing this model, the Chloride Electrical Storage Co., Ltd., would appear to have appreciated the need for a reasonably priced unit, robust in construction and of sufficiently large capacity to cope successfully with the demands made on it by the average domestic receiver. In addition it performs this function with the minimum of attention, and, where facilities are available for trickle charging, provides a trouble-free H.T. supply for a lengthy period.

The W.Y.10 is a 10-volt unit consisting of five cells built into a multi-compartment glass container, each cell having a capacity of 7,000 milliampere hours. Assuming a normal discharge of 25 mA., a useful life of 280 working hours could be obtained on one charge. In general, the battery would be recharged about once every fortnight or so, as this will keep it in better trim than less frequent attention.

Each cell is fitted with an ebonite lid, sealed in position, a feature which materially assists cleaning, and at the same time makes for more robust construction. Inter-cell leakage is minimised by extending the moulded partitions to the top of the glass container and carrying the lead bridge pieces over the tops of the sealing lids. The two end lugs, carrying the positive and negative terminals, are provided with projecting pieces which fit into slots cut in the ebonite lid, holding them rigidly in position and thus preventing undue strain on the lugs, and incidentally the plates, when the terminal heads are screwed down tight.

These terminal heads are non-interchangeable, being fitted with screw shanks of dissimilar size, and to assist in distinguishing them the positive is hexagonal in shape while the negative is round with a milled edge. Batteries are usually located in an out-of-the-way corner, not too well lighted, so that the advantage of being able to distinguish the positive from the negative without recourse to illumination will be appreciated.

Since the function of an accumulator depends on electro-chemical action, it will be realised that the most important feature is the plates.

An Echo of Olympia.—
Furthermore, the design of these will be governed by the nature of the work the cells are required to perform.

In the Exide cells the plates are made of antimonial lead cast in grid form with the active material applied in the form of paste. The active material only does the work, the lead grid being a retainer and conductor. Porous ribbed wood separators fill the space between the positive and negative plates, and so prevent short-circuiting. This type of assembly is adopted in the W.Y.10 model.

The well-merited popularity enjoyed by Exide batteries among wireless users is the outcome of forty years' experience in the manufacture of the lead type accumulator. Research work is continuously going on with a view to future improvements, and every new idea brought to the notice of the company is very carefully examined.

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"EKCO" ELIMINATOR MODEL C.2A.

THIS unit is one of a series designed by Messrs. E. K. Cole, Ltd., to replace all batteries, including grid bias, and supply the receiver with power drawn from the electric mains. The model C.2A is for use on alternating current supplies of from 40 to 100 cycles periodicity, and can be obtained to suit all recognised standard voltages between 100 and 250. Since it is intended as a substitute for batteries, no alteration to the set is required.

The unit consumes 12 watts per hour, so that the running cost per 1,000 hours, assuming 6d. per unit as the price of electric current, would be approximately six shillings. Now, 1,000 hours represents, on an average of twenty-five working hours per week, a matter of forty weeks, so that running costs represent a very small fraction of the electricity account.

The model C.2A gives three H.T. voltages—one for the priming grid in screen-grid valves, a 60-volt supply for leaky grid detector valves, and 120-150 volts for the remaining stages in the receiver. A current of 20 mA. may be drawn from this tapping. Provision is made for low-tension current at 2, 4, or 6 volts, from 0.2 amp. up to 0.5 amp. In addition, grid bias from 1.5 volts to 12 volts, in five steps, is available.

Half-wave rectification, using a Westinghouse metal rectifier, is adopted for the H.T. supply, and a single choke and generous-sized condensers take charge of the smoothing. The detector voltage is fed through a series resistance, and a potentiometer arrangement, obtained by connecting two resistances in series, provides the voltage for the priming grid in the screen-grid H.F. valve. Grid bias is derived from a tapped resistance between the H.T. and the transformer.

For the L.T. supply a Westinghouse full-wave (bridge-type) metal rectifier is used. Two smoothing chokes of generous size and special large-capacity electrolytic condensers completely remove all ripple from the rectified A.C., and deliver to the L.T. terminals a steady current for the filaments of the valves. A variable rheostat controls the output, and a voltmeter gives visual indication of the voltage across the L.T. terminals.

The unit is enclosed in a stout sheet iron container with a brown crystalline finish. A small terminal is fitted for earthing the case, thus conforming to the recommendations of the I.E.E. as regards safety measures for domestic mains-operated devices.

A length of flex, terminating in a lamp adaptor, serves to connect the unit to the nearest convenient lampholder. According to the makers' instructions, the switches on the set should be left permanently in the "on" position. Switching on and off should be carried out by the mains switch on the unit, or the switch controlling the light point to which the unit is attached. By following this advice the condensers in the mains unit will not be left in a charged state, and it will be impossible to receive a shock, due to the retention of current in the large smoothing condensers, should, at any time, the wiring in the receiver require attention.

FERRANTI MOVING COIL LOUD SPEAKER.

OF the instruments which made their first appearance at Olympia the Ferranti loud speaker attracted its full share of attention. Here we have the final link in the endeavour made by the Ferranti Company to produce quality reception. Their careful study of circuit and transformer design in this connection gives to them the highest qualification for the production of a moving-coil loud speaker.

Models are available for both A.C. and D.C. field excitation, and in the former case the transformer and valve rectifier are carried in the loud speaker housing. As the valve used is a U8, a generous magnetising wattage is available which, combined with a small gap, produces a high flux density. A substantial copper plate screens the magnet winding from the moving coil as well as giving support to the centre pin. Instead of the field magnet taking the customary form of a hollow cylinder it is made of flat metal and is "U"-shaped. Ample cross section is obtained by this design with the added advantage that the heat produced in the magnet winding is carried away by the free circulation of air.

Eight segments of supple leather are assembled to give support to the cone, this being 6in. in diameter, a dimension which, it is to be noted, is slightly less than the customary one of 7in. or so. Centring is effectively carried out by a pierced card centred on the pole. A pressed metal cylinder supports the diaphragm, while a new departure in loud speaker construction generally is produced by metal stampings forming a housing enclosing field magnet and rectifier.

It is needless to add that by the simple process of aural test the performance of this new Ferranti product gives it a leading position among moving-coil loud speakers. It is fortunate that the popular vote should this year endorse the moving coil at a time when its general adoption is so rapidly growing.

GAMBRELL NOVOTONE.

IN spite of the enormous advance in the quality of gramophone records produced by electrical processes few will deny that broadcasting at its best still keeps a fair margin of lead over the gramophone in the matter of quality. Limitations in loud speakers and amplifiers, of course, affect both systems of reproduction, but the necessity for restricting amplitude at low frequencies definitely places the gramophone record at a disadvantage. Most modern pick-ups show a rising characteristic from 250 cycles downwards, but the compensation is in most cases inadequate and the lower frequencies are not present in their proper proportion. Similarly, there is in many cases a lack of brilliance in the upper register.

In the "Novotone," designed for Messrs. Gambrell Radio, Ltd., by Dr. N. W. McLachlan, we have a device which adequately compensates for these deficiencies in recording, and in the characteristics of pick-ups, amplifiers and loud speakers. For obvious reasons the exact nature of the device is not

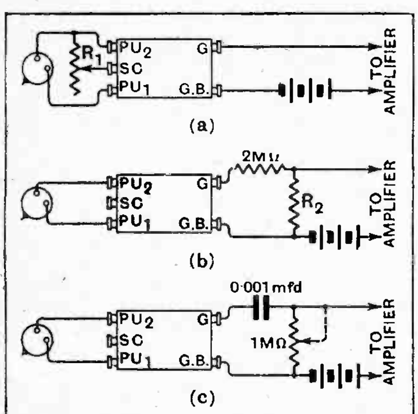


Fig. 1.—(a) Connections of scratch filter resistance R_1. (b) Potentiometer output circuit for reducing volume level. (c) Output circuit for reducing amplitude of low notes in special circumstances.

divulged, but its function will be properly understood if we regard it as a step-up transformer with a rather special frequency characteristic. The curves indicate that there is a general raising of the level of the input from the pick-up, while there is a marked increase in the amplitude of notes below middle C and another increase in the higher frequencies reaching a maximum in the vicinity of 4,000 cycles.

The rate of increase in amplitude of the low notes with decreasing frequency has been carefully calculated in relation to recording deficiencies and other practical considerations, with the result that the low note compensation will be found to be sensible correct for most exist-

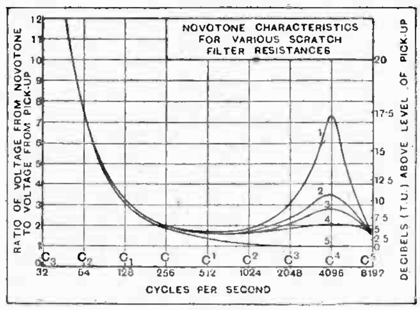


Fig. 2.—Curves for the circuit of Fig. 1(a) showing effect of scratch filter resistance R_1. Values of R_1 are as follows: 1, infinity (open circuit); 2, 50 ohms; 3, 30 ohms; 4, 15 ohms; 5, 0 ohms (short circuit).

ing records, pick-ups and loud speakers. Record surface scratch, however, sets a limit to the useful increase in amplitude at high frequencies, and the degree of scratch varies with different records. Accordingly, provision has been made for effecting a compromise between high-note amplification and scratch. This is effected by connecting a 50-ohm rheostat (R_1, Fig. 1 (*a*)) across terminals SC and PU_2; as the resistance is reduced in value, so the high note amplification, and hence scratch, is reduced. The effect of the resistance R_1 on the Novotone characteristic is clearly indicated in Fig. 2.

Many moving-coil loud speakers show a marked resonance in the region of 50-100 cycles. In these circumstances the increase in amplitude at low frequencies due to the Novotone would produce unpleasant results, if not actual damage, to the loud speaker. This difficulty is easily overcome by connecting a 0.001 mfd. condenser and a 1-megohm resistance between the Novotone and the grid and filament of the first amplifier as shown in Fig. 1 (*c*). The effect on the characteristic is shown in Fig. 3 (A).

Where the Novotone is to be used in conjunction with existing amplifiers the general increase in voltage may result in overloading. A potentiometer arrangement must then be inserted as in Fig. 1 (*b*). It is important that the total resistance across terminals G and G.B. should be not less than 3 megohms. One resistance may conveniently be given a value of 2 megohms, and the other, R_2, be given any value from 1 megohm upwards, depending on the volume required. Curve B (Fig. 3) was taken with 1 megohm in the position R_2. The dotted line is curve 1 of Fig. 2 drawn for comparison to the same scale.

The Novotone was tested under working conditions with a four-pole change-over switch arranged to connect the pick-up direct to the amplifier for purposes of comparison. Apart from the general increase in volume, which is almost equivalent to adding a further valve, the effect of introducing the Novotone is most striking. On orchestral records it is like switching on the double basses, while the pedal and bass notes of the organ and piano are reproduced with a richness and volume closely

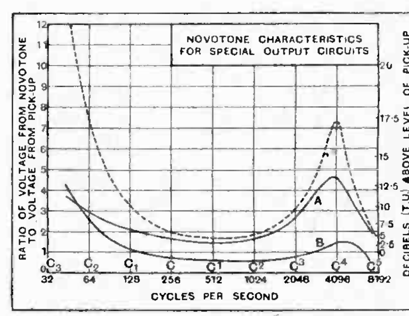
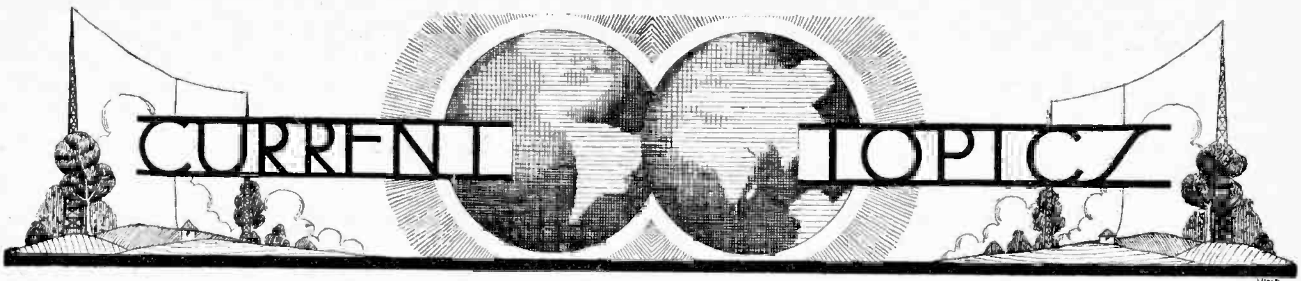


Fig. 3.—(A) Curve for circuit of Fig. 1(c) showing reducing in amplitude at low frequencies. (B) Curve for circuit of Fig. 1(b) showing general reduction in volume. The dotted line is curve (1) of Fig. 2 reproduced for comparison.

approximating to the original. The effect of the scratch filter and the special output circuit for modifying the low note amplification are also clearly demonstrated by the change-over switch arrangement.

There can be no doubt that anyone who has heard the Novotone demonstrated in this way would from that time onwards cease to be satisfied with gramophone reproduction by ordinary methods.



Events of the Week in Brief Review.

HENDON'S HOOK-UPS.

The Hendon Borough Council has decided that new houses on the Clitterhouse Estate are to be provided with hooks fixed in the gutter boards for the suspension of wireless aerials. Prospective tenants will be informed that, in the interests of tidiness, aerials will be permitted only if the hooks are used.

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AMERICA'S "FINEST PICK-UP" FROM HOLLAND.

For the first time in radio history a transmission from Holland was re-broadcast in the United States on October 26th. For forty-five minutes, beginning at 12 noon (E.S.T.) thirty stations associated with the National Broadcasting Company gave listeners a Dutch musical programme sent out from Huizen, PHI, operating on 16.88 metres, with a power of 40 kilowatts. The event was acclaimed as "the finest pick-up of a foreign programme ever accomplished in the United States."

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WIRELESS ABSOLVED.

The fallacy that wireless affects the weather has been given the *coup de grâce* by the French Academy of Sciences, which has endorsed the statements of M. Sanson, meteorologist of the Seine-et-Oise Department, who says: "The development of wireless broadcasting has produced absolutely no effect upon our climate in the past 20 years."

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THREAT TO INDIAN "PIRATES."

Radio "pirates" in India are shortly to have the shock of their lives, according to the Calcutta *Statesman*, which reports that the Post Office is about to initiate a campaign against the 10,000 persons in Calcutta alone who are known to be listening without licences. Hitherto, it is stated, the Post Office has been hampered by doubts about the exact legal position, but these have been entirely removed as a result of a case in the Alipore Court in which a "pirate" of high social standing has been fined 50 rupees, or in default, a month's imprisonment.

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HIGH-POWER BROADCASTING IN I.F.S.

It is understood that the Irish Free State Government will shortly invite tenders for the construction of a high-power broadcasting station with a service area covering the whole country. Although many recent contracts for electrical work in Ireland have gone to Swedish firms it is understood that the authorities are exhibiting a preference for British plant.

OFF DUTY DELIGHTS.

"La Maison des Gardiens de la Paix," a new home for the Paris gendarmes, has been equipped with a broadcast receiver, headphones being available for each bed.

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ESPERANTO.

The 22nd Universal Congress of Esperanto is to be held in Oxford during the first week of August, 1930. Methods will be considered for extending the use of Esperanto in broadcasting.

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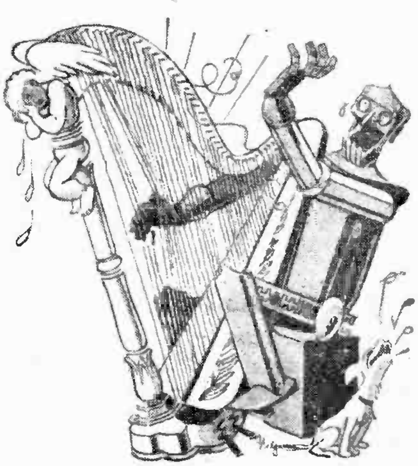
FRENCH PATENTS WARNING.

Bearing the title "For the Protection of the French National Market," a notice has been issued by the Compaigne Générale de T.S.F. Paris, declaring that no licence has been accorded to any foreign firm permitting the importation of wireless



THE ROBOT ENTERTAINER. A figure symbolising, in the eyes of the American Federation of Musicians, the "mechanical music" of broadcasting, the gramophone and the "talkies." The viewpoint of the professional musician is discussed in this week's Editorial.

apparatus employing the company's patents or those of the Société Française Radio Electriqué (Radiola), La Radiotechnique, G.E.C., Marius Latour, Bethenod, de Belleseize, Marconi, Telefunken, A.E.G., Siemens Halske, and Western Electric.

Traders are consequently warned that any infringement will lead to prosecution.

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G.E.C. *v.* MARCONI'S.

On Wednesday last, in the Chancery Division, Mr. Justice Eve gave judgment in favour of the General Electric Co. in cases brought by that company against Marconi's Wireless Telegraph Co. and Marconi's and the Marconi Osram Valve Co. respectively, on the question of whether the working agreement between the companies was coterminous with the ten years' lease of the G.E.C. valve factory at Brook Green.

His Lordship said the agreement was indefinite and was unlimited as to time. There was not a word in the document to indicate that any of the obligations undertaken by the contracting parties outside those embodied in the lease were to subsist only so long as the lease was running. The applicant company was, therefore, entitled to a declaration accordingly. The costs must be paid by Marconi's.

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NEW RADIO ERA FOR FRANCE?

Strong condemnation of State methods of handling broadcasting in France was contained in a speech delivered by the new Postmaster-General, M. Germain-Martin, a few days before he took office, writes our Paris correspondent. Speaking as a private individual, M. Germain-Martin deplored the evils of Post Office monopolies, which have proved so detrimental to private radio and the wireless trade. It is hoped that under the new Postmaster-General's guidance the forthcoming radio bill regularising French broadcasting will shortly become law.

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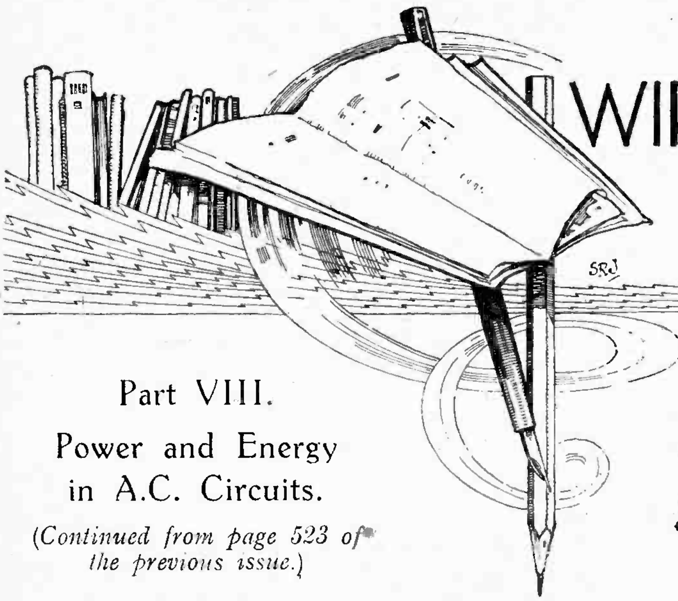
YOUR WIRELESS DIARY.

Every amateur must have wished at some time or another that he could carry a fund of wireless data "in his head." This being impossible in the majority of cases, the best substitute is a handy compendium of facts such as *The Wireless World* Diary and Note Book for 1930, published by *The Wireless World* and Messrs. Charles Letts and Company. The special features in the edition just published include: (1) Summary of regulations relating to amateur transmitting and receiving licences; (2) conversion tables (English measures to metric, etc); (3) the broadcasting stations of Europe, together with the principal short-wave stations; (4) typical wireless receivers and eliminators, with fourteen different circuits; (5) inductance, wavelength and capacity values; and (6) valve data, giving characteristics of standard valves.

Copies of *The Wireless World* Diary can be obtained from leading booksellers and stationers, or from the publishers, Iliffe and Sons Ltd., Dorset House, Tudor Street, London, E.C.4. The price, with cloth cover, is 1s. (postage 1d. extra), or with leather cover, pencil and season ticket window, 2s 6d., postage 1d. extra.



WIRELESS THEORY SIMPLIFIED

By S. O. PEARSON, B.Sc., A.M.I.E.E.

Part VIII.

Power and Energy in A.C. Circuits.

(Continued from page 523 of the previous issue.)

It will be remembered that, relating to alternating currents, the power absorbed by a simple resistance was found to be equal to the product of the R.M.S. values of the current and voltage, whereas for a pure inductance the average value of the power consumed was nil, no matter what the values of current and voltage might have been. In the former case the current and voltage were in phase, and in the latter 90° out of phase. It would seem reasonable to infer, then, that for a coil possessing both resistance and inductance, where the angle of lag of the current behind the voltage is between zero and 90°, the power absorbed will be somewhat less than the product of current and applied voltage.

Power and Angle of Lag.

This is actually the case, and so it is very important that we should know exactly how to determine the power in terms of the voltage, current, and angle of lag. Fig. 1 is a reproduction of Fig. 2 of the previous instalment, where (a) represents a coil of inductance L henrys and resistance R ohms, and (b) represents the equivalent circuit as explained previously.

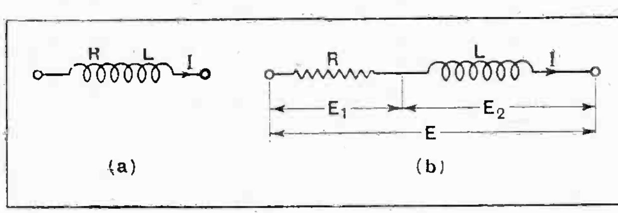


Fig. 1.—(a) Coil of resistance R and inductance L. (b) Equivalent circuit.

When a current is passed through the circuit, heat is generated in the resistance but no power is taken by the inductance. Thus the power taken by the coil (a) is exactly the same as the power taken by the resistance portion of the equivalent circuit (b), and can therefore be determined very easily. Let I amperes be the R.M.S. value of the current; then the average power in the resistance, and therefore in the whole circuit, is given by $P = I^2R = I \times IR$ watts. But we have already seen that for an inductive resistance the current is given by $I = \frac{E}{Z}$ amperes, where E is the applied voltage and $Z = \sqrt{R^2 + (2\pi fL)^2}$ is the impedance. Thus the power equation may be expressed in the form

$$P = \frac{E}{Z} \times IR,$$

or

$$P = EI \times \frac{R}{Z} \text{ watts.}$$

Power Factor of a Circuit.

This result shows that for an inductive coil the power is not given by merely multiplying the amps. and volts together; we must also multiply by the factor $\frac{R}{Z}$ if we want the true power consumed by the coil. Now $\frac{R}{Z}$, the ratio of resistance to impedance, is obviously less than 1, because Z is the combination of both the resistance and the reactance, and therefore the power in an inductive circuit is actually *less* than the product of amps. and volts. The product EI is only the *apparent power*, and the factor $\frac{R}{Z}$ by which we have to multiply it to give the real power is called the *power factor* of the circuit. The apparent power EI is expressed in *voltamperes*, not watts; but the true power is in watts.

We can conclude, then, that for any circuit in which the current and voltage are out of phase the power consumed is less than their product and a power factor must be used.

For the particular type of circuit depicted by Fig. 1 the power factor is given by $\frac{R}{Z}$, but there are other types of circuit having an angle of phase difference between the current and voltage waves, and therefore also having a power factor less than unity, but not given by $\frac{R}{Z}$. So we must express the power factor in a general way which can be applied to any circuit.

If we refer to the impedance triangle for the circuit

Wireless Theory Simplified.—

of Fig. 1, given in Fig. 2, we see that $\frac{R}{Z}$ is the cosine of the angle of phase difference between the current and the voltage, denoted by the angle ϕ of the triangle. So for any circuit whatever, the power factor is the cosine of the angle of phase difference, and the general expression for the power in an A.C. circuit becomes

$$P = EI \times \cos \phi \text{ watts.}$$

The previous discussions on the two special circuits containing resistance only and inductance only respectively enable us to visualise clearly what is happening in the present circuit where both resistance and inductance are present simultaneously. In the pure resistance circuit the whole of the energy put in is converted into heat and cannot be recovered, whereas in the circuit possessing inductance only any energy put in is stored in the magnetic field and the whole of it is recovered when the field collapses. Obviously in the combined circuit both of these effects will be present and the average power *must* have a value lying somewhere between zero and the product of amps. and volts.

During the time that the current is building up from zero to the maximum value some of the energy being put into the circuit is converted into heat in the resistance, the remainder going into the magnetic field as stored energy. During the next quarter cycle, when the current is falling again from the maximum value to zero, energy is being withdrawn from the field in the usual way, *but heat is still being generated in the resistance*, so that only part of the energy coming from the weakening field is given back to the source of supply. Nevertheless, we do get some of it back, and this explains the reason for the true power consumed being less than the product of current and voltage. A certain amount of energy is given to the circuit during the first quarter cycle of current, but a *portion* of this is recovered during the next quarter cycle, and so on.

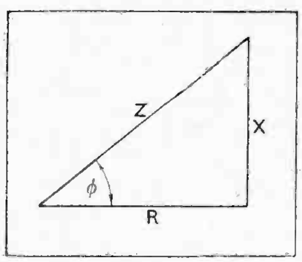


Fig. 2.—Impedance triangle for circuit of Fig. 1. The power factor of the circuit is $\frac{R}{Z}$ or $\cos \phi$. $X = 2\pi fL$ and $Z = \sqrt{R^2 + X^2}$.

Mechanical Illustration.

A frictionless crank and piston arrangement was cited for illustrating the action of a coil having inductance only, the whole of the energy used in accelerating the piston over the first half stroke being given back to the crank during the second half stroke as the piston was being retarded. This analogy can be extended to meet the conditions existing in a circuit with both resistance and inductance by taking friction into account.

Suppose that there is a considerable frictional resistance to motion existing between the piston and the cylinder wall. Over the first half stroke, as the piston is gaining velocity, the crank pin has to exert a force sufficiently great both to overcome the friction and to accelerate the mass of the piston. The energy used in overcoming the friction is converted into heat, raising the temperature of the piston and cylinder, the remainder being stored in the moving mass as energy of motion or kinetic energy. During the second half stroke, when the piston velocity is decreasing, the stored kinetic energy is given up by the piston as before, but there is still the frictional force to be overcome, with the result that only part of the kinetic energy is recovered and given back to the crank.

It will be seen that the analogy chosen to represent the happenings in our inductive circuit is very complete. Further consideration will show that even the phase relationship existing between the alternating force on the piston rod and the velocity of the piston is the same as that between the current and the voltage in the circuit. In future work we shall always liken inductance to inertia or mass and electrical resistance to frictional resistance. Further, it will be shown that capacity can be likened to elasticity or spring action, and the combination of these three will prove of great value in illustrating the behaviour of oscillating circuits.

Numerical Examples.

An inductive coil is one of the most important circuit components used in radio circuits, and therefore it will be helpful to give at this juncture one or two numerical examples on the calculation of current and power consumed by an inductive coil when an E.M.F. of known voltage and frequency is applied to it. In the majority of cases a D.C. component of current will be present as well as the A.C., but for the moment we shall assume that we are dealing with pure alternating current. Accordingly let us consider a coil whose resistance and inductance are known to be 10 ohms and 0.5 henry respectively, and that we require to find the current and power consumed when 100 volts R.M.S. value at a frequency of 50 cycles per second is applied to its terminals. At 50 cycles the reactance is $X = 2\pi fL = 2\pi \times 50 \times 0.1 = 31.4$ ohms. The impedance of the coil is therefore

$$Z = \sqrt{R^2 + X^2} = \sqrt{10^2 + 31.4^2}$$
$$= \sqrt{1{,}087} \qquad = 32.95 \text{ ohms.}$$

Thus the current is $I = \frac{E}{Z} = \frac{100}{32.95} =$ 3.04 amperes.

For a simple series circuit of this kind the power factor is $\frac{R}{Z} = \frac{10}{32.95} = 0.304$.

The power consumed is therefore

$$P = EI \times \text{power factor}$$
$$= 100 \times 3.04 \times 0.304$$
$$= 92.5 \text{ watts}$$

As there are no branches in the circuit and consequently only one value of current to deal with we can check this result by another method. This is done by calculating the power in terms of current and resistance, namely,

$$P = I^2R = 3.04^2 \times 10$$
$$= 92.5 \text{ watts, as before.}$$

Inductive Coil in Series with a Resistance.

Very frequently a circuit consists of an inductive coil possessing both resistance and inductance, connected in series with a non-inductive resistance. Knowing the voltage applied to the ends of the circuit, it is usually necessary to determine the voltage across the coil itself.

Wireless Theory Simplified.—

A typical example is that of a choke connected in the anode circuit of a valve.

In a previous example we considered this arrangement, but on that occasion the coil itself was assumed to have negligible resistance. As a rule, however, in practice the coil resistance cannot be neglected in this way, and so our previous treatment of the circuit must be extended to meet the new conditions.

Consider a circuit such as that shown in Fig. 3 (*a*)

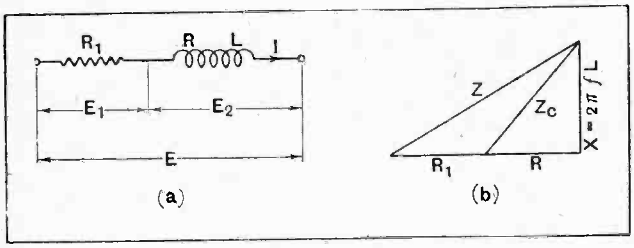


Fig. 3.—(a) Circuit consisting of a resistance R_1 in series with an inductive coil of resistance R and inductance L. (b) The impedances Z for the whole circuit and Z_c for the coil alone can be obtained from the impedance triangles.

where a non-inductive resistance R_1 is connected in series with a coil or choke whose resistance is R ohms and inductance L henrys. The total resistance of the circuit is $(R+R_1)$ ohms and its reactance $X=2\pi fL$ ohms where f is the frequency of the current in the circuit. Thus for the complete circuit the impedance will be $Z=\sqrt{(R+R_1)^2+X^2}$ ohms, whereas for the coil alone the impedance is $Z_c=\sqrt{R^2+X^2}$ ohms. If preferred, the numerical values of Z and Z_c can be found from the impedance triangles of Fig. 3 (*b*), in which case the diagram must be drawn to scale.

When a voltage E is applied to the ends of the circuit a current of $I=\frac{E}{Z}$ amperes will flow through it and the voltage across the coil itself will be $E_2=IZ_c$. Similarly the voltage across the resistance R_1 will be $E_1=IR_1$. From this it follows that the ratio of E_1 to E_2 is equal to the ratio of the external resistance R_1 to the coil impedance Z_c. *But the total applied voltage E is not equal to the arithmetical sum of E_1 and E_2* because these latter voltages are not in phase with each other—E_1 is in phase with the current as it is applied to a pure resistance, but E_2 leads the current by a considerable fraction of a cycle, as explained in Part VI. A numerical example will prove this.

Suppose that in the circuit of Fig. 3 (*a*) $R_1=5{,}000$ ohms, $R=1{,}000$ ohms and $L=10$ henrys, and that 100 volts (R.M.S. value) at a frequency of 50 cycles per second is applied to the ends of the circuit. Then the resistance of the complete circuit will be 6,000 ohms, and its reactance $X=2\pi\times50\times10=3{,}142$ ohms. The impedance $Z=\sqrt{6{,}000^2+3{,}142^2}=6{,}773$ ohms, and therefore the current will be $I=\frac{E}{Z}=\frac{100}{6773}=0.01476$ amp., or 14.76 milliamps

The impedance of the coil itself is

$$Z_c=\sqrt{1{,}000^2+3{,}142^2}=3{,}295 \text{ ohms},$$

and the voltage across it $E_2=IZ_c=0.01476\times3{,}295=48.64$ volts. Similarly the voltage across R_1 will be $E_1=IR_1=0.01476\times5{,}000=73.8$ volts.

It should be noted that although we have only 100 volts applied to the ends of the circuit there are 73.8 volts across the resistance R_1 and 48.64 volts across the coil. If we add these together arithmetically we get for their sum a value much greater than 100, namely, 122.4. This can be proved experimentally with a voltmeter. The reason is that E_1 and E_2 are out of step, and it is their *vector sum* which gives the total voltage across the ends of the circuit—the parallelogram method must be used, as explained in Part IV.

(*To be continued.*)

CLUB NEWS.

A Popular Visitor.

Captain Derek McCulloch, of the B.B.C., paid a surprise visit to the South Croydon and District Radio Society at their meeting on October 29th, bringing with him some special B.B.C. test gramophone records. The evening was devoted to comparative tests of various pick-ups which were connected in turn to the L.F. portion of the Club set.

The Society offers a warm welcome to new members.

Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, S. Croydon.

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All About Valve Manufacture.

The recently formed Sheringham and District Wireless Society is already showing signs of a flourishing future, the meetings being largely attended. On October 30th Mr. Carter, of the Mullard Wireless Service Co., Ltd., lectured on "The Radio Valve: What it Does and How it is Made." With the aid of an excellent series of thirty lantern slides, members were able to obtain an insight into the intricacies of valve manufacture and operation. Applications for membership will be gladly received by the Hon. Secretary, Mr. C. R. Hunt, Church Street, Sheringham.

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Metal Rectifiers on the Film.

The new constructional film entitled "Metal Rectifiers," prepared by the Westinghouse Brake and Saxby Signal Co., Ltd., will be shown at a meeting of the Bec Radio Society on November 19th, at the Bec School, Beechcroft Road, Balham, S.W.17. This film, which was recently described in *The Wireless World*, demonstrates very clearly the operation of various circuits embodying metal rectifiers. Non-members are invited to attend the lecture, and those interested are asked to communicate without delay with the Hon. Secretary, Mr. A. L. Odell, 171, Tranmere Road, S.W.18. The lecture will begin at 7.30 p.m.

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Wireless in the Mediterranean.

"Wireless in the Mediterranean" was the title of an entertaining lecture given by Captain Leonard Plugge at the last meeting of the Wembley Wireless Society. The lecturer illustrated his talk with a number of photographs taken during his tour.

An attractive syllabus has been prepared covering the winter months, and this will be sent to enquirers on application to the Hon. Secretary, Mr. H. E. Comben, 24, Park Lane, Wembley.

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The Social Side.

That the Muswell Hill and District Radio Society are as interested in the lighter side as well as the technical aspects of radio was amply proved by the success that attended their Radio Dance and Whist Drive, held on November 2nd. Music was supplied by a gramophone pick-up working through a large power amplifier running off a 400-volt generator, an LS6A valve being used in the last stage, driving a moving-coil speaker. The whole of the apparatus was installed by members, and functioned excellently during the whole period of the dance—some four hours. On the termination of the whist drive most of the card-players participated in the dance, which lasted until Big Ben struck the hour of midnight.

Hon. Secretary, Mr. C. J. Witt, 39, Coniston Road, London, N.10.

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Modernising Club Equipment.

The record of an excellent year's work was presented at the Annual General Meeting of the Tottenham Wireless Society on Wednesday, October 30th.

Mr. J. Burns reported that the Society's receiver had been modernised and equipped with an up-to-date eliminator, and that his Committee had undertaken to keep in repair the headphones used for the Prince of Wales Hospital. For the coming session Mr. O'Connor was elected Chairman and Mr. Bodemeaid was elected hon. secretary. It was announced that the Society's Cup and Shield for the most interesting lecture and demonstration given during the past year had been awarded to Mr. F. E. R. Neale.

New members will be welcomed at any meeting of the Society. These are held every Wednesday at 10, Bruce Grove, N.17. Hon. Secretary, Mr. Bodemeaid, 10, Bruce Grove, Tottenham, N.17.

Broadcast Brevities

By Our Special Correspondent.

The Silent Twin.—Birmingham's Protest.—Centralisation.

The Second Transmitter.

"Hands off the poor man's station!" exclaims a contributor to the Savoy Hill post-bag, decrying attacks on the Brookmans Park transmitter. No thoughts of the second transmitter disturb his rest, nor need they, for he has still a full month in which he may twiddle his cat-whisker without fear of interruption. Despite rumours, I am officially informed that No. 2 transmitter has not yet begun radiating, although the B.B.C. was strongly tempted to use it for a public experiment on Friday, November 1st.

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A Near Thing.

The temptation came when complaints were made that the concluding broadcast of the Delius Festival would be limited to 5GB. The B.B.C. was anxious to please those who thirsted for Delius, but 2LO's mixed programme of military band, Sir Oliver Lodge, and vaudeville was already printed and published.

Came a brain wave. "Inaugurate the second station with a surprise transmission of Delius!" said someone. Savoy Hill actually gave the idea a thought, but that was all.

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B.B.C. as Pamphleteers.

The great pamphlet campaign is considered by Savoy Hill to be responsible for the relatively small number of complaints regarding the change-over from Oxford Street to Brookmans Park. Since the new station took over 28,000 pamphlets of advice have been distributed, in most cases with beneficial results. One old lady wrote saying that she and her maid, after studying the pamphlet, "got" Brookmans Park on a crystal set after two wireless experts had failed. A less fortunate correspondent in North Wales said: "Since you have moved to Langham Place I have been unable to pick up Toulouse"

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A Painful Transition.

But for the fact that the B.B.C.'s task, like that of the tight-rope walker, is always fraught with peculiar difficulties, one might be tempted to say that the Corporation had arrived at a difficult stage in its career. The difficulties are certainly aggravated at the present moment, however, by the onset of the slow and necessarily painful period of transition from the original scheme of programme distribution to the regional scheme.

As each locality is forced to yield up its individual niche in the ether, Savoy Hill undergoes a barrage of complaints from honest licensees to whom platitudes of "the greatest good for the greatest number" variety are like red rags to a bull.

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Birmingham is Roused.

The biggest outcry just now comes from Birmingham, which incidentally has suffered a definite loss in broadcasting prestige ever since the local station closed down in favour of 5GB. Birmingham was patient, however, until a few weeks ago, when the unkindest cut of all came in the form of the threatened disbandment of the Birmingham studio orchestra. It is true that many of the displaced musicians can be absorbed by the National Symphony Orchestra, but this is essentially a London combination, and Birmingham sees the transaction as another sacrifice on the altar of centralisation.

FUTURE FEATURES.

London and Daventry.

NOVEMBER 18TH.—A National Lecture—Prof. G. M. Trevelyan: "The Historical Aspect of the Union of England and Scotland, 1707."

NOVEMBER 20TH.—"Typhoon," a play by Conrad.

Daventry Exp. (5GB).

NOVEMBER 19TH.—Students' Songs.

Cardiff.

NOVEMBER 20TH.—Concert by Victors at National Eisteddfod of Wales, Liverpool, 1929.

Manchester.

NOVEMBER 18TH.—Gilbert and Sullivan Programme.

Glasgow.

NOVEMBER 21ST.—Speeches by the Duke of Montrose and H.R.H. the Prince of Wales at Meeting of Scottish Branch of Royal National Lifeboat Institution, S.B. from Edinburgh.

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The "D.-G." Goes North.

The seriousness of the situation can be gauged from the fact that Sir John Reith, Director-General of the B.B.C., attended a private conference at Birmingham last week to discuss matters with the Midland musicians. The meeting was held behind closed doors, and at the time of writing no disclosures have been made concerning future policy.

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Dangers of Centralisation.

The case of Birmingham has been, or will be, repeated throughout the country as the tendency to centralisation becomes more apparent. The local aspirations of Aberdeen, for example, are served by a station director, an engineer or two, and a typist, the programme coming through the tap from Glasgow or London. Newcastle has just reduced its local staff. Glasgow's large orchestra is being transformed into an octette for use on odd occasions.

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Provincial Interests at Stake.

Are the provinces justified in protesting? The majority of listeners will agree that they are, in the sense that if the provinces fail to look after their own interests, nobody else will. While the gradual change to the regional system is in progress the B.B.C. will be tempted on grounds of expediency to provide mass-production programmes; the danger to the provinces is that when the change is complete the B.B.C. will stick to the same methods. If the provinces are wise they will keep on clamouring.

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Ulster in Trouble.

Strangely enough, while the cry in Great Britain is against centralisation. Northern Ireland is pleading for a little more. In the past fortnight Savoy Hill has received some bitter complaints from Belfast to the effect that the Ulster listener is left out in the cold.

It is alleged that 2BE works on a useless wavelength (242.3 metres); that half its radiation is wasted on the Irish Sea; and that the alternative programme from 5XX (when it *is* alternative) is unsuitable for Irish listeners.

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B.B.C.'s Reply.

In reply, the B.B.C. regrets that a change of wavelength is impossible at the present moment owing to the international situation, and points out that 5XX gives a reasonably good service to Northern Ireland. Until Ulster's high-power station is erected in two or three years' time it looks as if listeners will have to make the best of a bad job.

oooo

"Effects" by Gramophone.

Sound effects will contribute prominently to the realism in a programme entitled "Intimate Snapshots," to be broadcast on November 22 from 5GB.

Lance Sieveking, the author, takes as the central idea the theory that for many people life is a series of dull and often meaningless repetitions. His examples prove it and afterwards show the contrary.

The atmosphere of a tube station and newspaper office will be reproduced by means of gramophone records prepared on the spot.

THE WIRELESS SCHNEIDER TROPHY

By D'Orsay Bell M.A.

In Quest of the Short-wave Record.

IT is high time that radio learned the uses of publicity. How many people know anything about that most exciting international contest which has been going on now for several years—the struggle to break the short-wave record—or, if you prefer it, the race for the highest radio frequency? How many? I repeat. The answer is in the interrogative, and would remain so but for the fortunate chance that *The Wireless World* has commissioned me to look into the matter.

The race, under the present rules, did not begin till some years after the revolution in wireless caused by the introduction of the three-electrode valve. Before this, a few desultory flights had been made, with prehistoric machines of the spark type, producing heavily damped waves with little power behind them. Then came the valve—but also the War: people were preoccupied, the early valves had high inter-electrode capacities, and the pursuit of the ultra-shorts was shelved for a time. But nothing is safe for long from the restless researcher. By ingenious wangling of the circuits someone induced an ordinary valve to give a wavelength far, far shorter than any it had dreamed of giving. That started it: at once, all over the world, earnest workers went one better; no sooner had an American proudly announced the production of a three-metre wave than an Englishman replied by generating a two-metre one; a little later a German would write reams to describe his researches leading to the production of a one-metre wave, and before the ink was dry a Japanese would brandish a 90-centimetre wave. . . . And so began the race for the Wireless Schneider Trophy — so-called from the German word *schneider*, a cutter, because the idea is to cut off another centimetre or two.

"Nothing is safe for long from the restless researcher."

In spite of lack of publicity, marvellous progress has been made, especially in the last year or so. As a general rule, the valves used are more of the receiving than the transmitting type, so that the power behind the waves is not very great—often only one or two watts; but the waves are genuine, undamped waves, real "C.W." suitable for telephony and other modern usages; and the smallness of the power is largely compensated for by the efficiency of radiation. A recent record—I dare not say "the present record," because by now someone has probably stood a valve on its head and got a millimetre or two shorter—is 3.5 centimetres. This, I think, goes to Poland (Potapenko up). It is rather a remarkable thought that we now have a complete range of wireless waves, from the giants—measured in miles—used in long-distance commercial work down to this midget of about 1½in., all produced by the ubiquitous valve. Now just as you find stick-in-the-muds pompously demanding what is the good of these six-mile-a-minute aeroplanes and these four-mile-a minute motor cars, "for all practical purposes, hrrmph?" so you find them condemning the time and trouble spent on these ultra-shorts as being wasted on matters of "purely academic interest." It is worth while looking to see if they are any nearer the mark now than they were about the aeroplanes and motors.

I have already indicated[1] the extraordinary possibilities of waves of about 1 to 5 metres from a medical point of view, so I will not repeat myself. These same wavelengths seem very promising for communication of a certain kind—primarily, perhaps, for military purposes. With an input to the aerial of a tenth of a watt, signals have been obtained at loud speaker strength from an aeroplane twenty-two miles away; with one watt, telegraphy is possible from an aeroplane about eighty miles away. These ranges are nothing much compared with those obtained with ordinary "short" waves (400 miles with 2 watts to the aerial on a 50-metre wave, for instance), but the

[1] *The Wireless World*, 7th August, p. 134.

The Wireless Schneider Trophy.—

" ultras " have particular properties of their own which are likely to add to their value enormously. In the first place, they give complete freedom from atmospherics and from fading (since the Heaviside layer is not mixed up in their propagation), and—and this is where the German workers get excited—their range can quite definitely be limited. Travelling, like light, in straight lines, a ray of ultras reaches the horizon (as seen from its transmitting aerial) and passes on into oblivion in space, not clinging to the ground nor being reflected back to earth by an officious Heaviside layer. Signals from a 1-watt transmitter may be quite strong at the horizon, but a little farther on they will almost have vanished—and even the use of fifty watts instead of the one will make them carry hardly any farther.

You see the possibilities of such waves for military purposes—where interception (with subsequent decoding) is such a bugbear? Can you not picture the indignant enemy, with a loop aerial at the end of a stick, vainly trying to stretch high enough to capture the waves passing derisively over his head into the void? And the small size of the waves, too, makes them dirigible by quite reasonably small reflectors, so that they can be concentrated into a beam and sent in the required direction only. This becomes still easier as the wave gets shorter and shorter, and both Germans and French have had excellent results with waves of 20 to 40 centimetres, concentrated at the transmitter and collected at the receiver by parabolic metal mirrors. The Germans, in fact, have succeeded in telephoning on waves as short as 14 cms.—only over a mile or so, at present, but with ridiculously simple apparatus; and as the same special valve is used as transmitter and receiver this simple apparatus gives two-way telephony.

The water-diviner looking worried.

So you see these ultra-short waves are by no means just " highbrow " stunts. On the contrary, they are full of practical possibilities. At present they are in their infancy, and puny; but already the Americans are generating 4-metre waves with nearly a kilowatt behind them, using a big water-cooled valve; and no doubt very soon even the " centimetre " waves will have plenty of power. And nobody quite knows what will happen when we get " millimetre " waves—or less—with plenty of power behind them. Already Arkadiewa has produced waves less than a tenth of a millimetre long; that is to say, he has crossed well over the boundary line and invaded the country of the infra-red heat radiation. The Schneider Trophy does not go to him—his waves do not comply with the rules; they are not true " C.W.," but rather of the " whip-crack " type, produced by a weird and special form of spark; unsuitable for telephony and with very little power behind them. All the same, they are real waves; they can be concentrated by quartz lenses and reflected by concave metal mirrors only 6in. across. . . .

Radiant Heat by Radio ?

The whole subject teems with interesting undiscovered possibilities in all kinds of strange directions. Listen to this, for instance: a German researcher named Heinrich, playing about with short and ultra-short waves, glanced out of his window and saw a little crowd in the field outside, near his transmitting aerial. He soon saw that the crowd was watching a water-diviner, who was giving a demonstration of his art; he was also, Heinrich noticed, looking worried. But as Heinrich watched, the worried look vanished, and he went on quite happily with his demonstration; and Heinrich returned to his work. But as he again pressed the key, a sudden thought struck him, and he kept the key pressed and looked out of the window again. Sure enough, the diviner was looking worried again—more so than ever, for by this time he was nearer Heinrich's aerial. For it turned out, quite definitely, that whenever Heinrich pressed his key the water-diviner's hazel twig became seriously upset. So I will leave you now to face the very latest problems: (1) Can we transmit radiant heat from our wireless aerial? and (2) Is water-divining only another branch of radio?

TRADE NOTES.

The Six-Sixty Radio Co., Ltd., 122, Charing Cross Road, London, W.C.2, announce that they have moved to larger premises at " Six-Sixty House," 17-18, Rathbone Place, Oxford Street, London, W.1. The telephone numbers are Museum 6116-7.

oooo

Owing to expansion of business, the Lisenin Wireless Company, Connaught House, 1a, Edgware Road, Hyde Park, London, W.2, have acquired more commodious premises at 5, Central Buildings, High Street, Slough, Bucks. The telephone number is Slough 652.

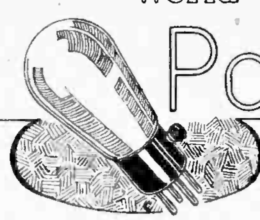
oooo

The Hendon Lamp and Accessories Co., Ltd., 104, Southampton Row, London, W.C.1, would be pleased to receive from radio manufacturers, particularly those making portable sets and battery eliminators, detailed particulars of their products.

oooo

The General Electric Co., Ltd., " Magnet House," Kingsway, London, W.C.2, have recently opened a branch office at 3, Campbell Street, Leicester. Mr. W. J. Hodgkins, of the Birmingham branch, has been appointed manager. The telephone number is Central 58776, and the telegraphic address " Electricity."

PENTODE POSSIBILITIES



Using the Pentode in Reflex Receivers.

EXCEPT for a few casual references, the writer has seen no mention of the fact that the pentode valve can well be used for purposes other than that for which it was originally designed. As a high-frequency amplifier, for example, the pentode will give, with the usual neutralised circuit arrangement, greater magnification than can be attained by any triode available. The heavy anode current drawn by the pentode renders its use for this purpose alone very uneconomical, but its ability both to amplify efficiently at high frequency and to handle power enough for working a loud speaker renders it the ideal valve for dual amplification in a simple reflex set. Those who have attempted to design a satisfactory reflex receiver will realise that in the pentode there is available, for the first time, a valve that can really " pull its weight " as dual amplifier.

Figure 1 shows a reflex circuit, employing a crystal detector, which has proved highly satisfactory in use. On the high-frequency side it is a quite conventional neutrodyne, except that the secondary of the high-frequency transformer T_1 is tapped in order that the requisite step-down to the crystal may be obtained. The transformer T_2 may have a high ratio without detriment to quality, as the impedance of the crystal is quite low. Messrs. Ferranti were good enough to make up for the writer an experimental model of their AF5 transformer with a 15 : 1 ratio and a 10 henry primary, and this has proved very satisfactory for the purpose. It is probable that they would supply this to order to anyone desirous of experimenting along the same lines.

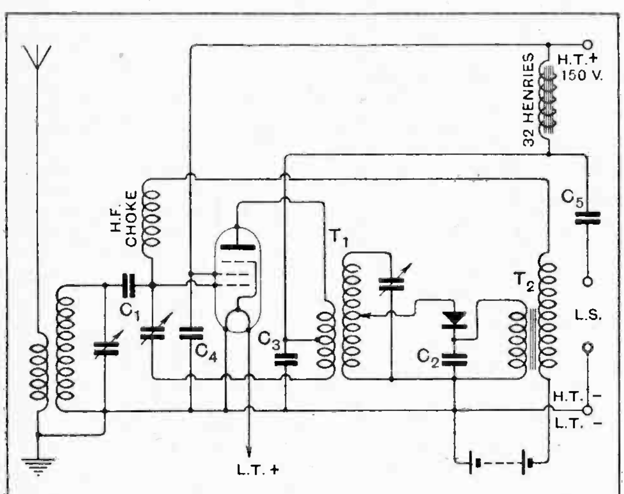


Fig. 1.—A one-valve pentode reflex circuit giving powerful loud speaker signals. The values of components are as follow: C_1, 0.0001 mfd.; C_2, 0.0003 mfd., need not be incorporated if already present in the transformer T_2; C_3, 0.001 mfd.; C_4 and C_5, 2 mfds. each; T_1, secondary 65 turns of 22 D.S.C. on 3in. former. Tapped 5, 10 and 20 turns from earth end. Primary and neutralising coil, each 28 turns of 40 D.S.C. overwound on ebonite spacers; T_2, high-ratio L.F. transformer.

From the secondary of T_2 the rectified signals are fed, through a radio choke, to the grid of the valve, the condenser C_1 serving to prevent a short-circuit of the low-frequency signals. Grid bias is provided through the transformer secondary and the radio-choke. Every crystal tried has been found satisfactory with the single exception of carborundum, which will not rectify efficiently the high voltages with which it has to deal in this set.

Overloading Troubles.

In common with all other reflex circuits, that of Figure 1 strongly resents overloading, which results, not in the mild distortion usual in " straight " sets, but in intermittent oscillation at low frequency lasting as long as the overloading persists. As soon as even the smallest degree of overloading is permitted, the loud speaker appears to reproduce all loud notes as toneless but most offensive grunts. It is absolutely essential, therefore, to limit the output from the valve to that which it can handle without any trace of the slight overloading that is usually permissible.

When a moving-coil speaker, which has a fairly low impedance to all audible frequencies, is in use, the pentode will accept far louder signals without overloading than when a speaker of moving armature type is chosen, for these offer a very high impedance to the upper range of speech frequencies. This alone would indicate that greater signal strength should be available before the " reflex grunt " makes its appearance if a moving-coil speaker is used, but there is still to be taken into account the enormously greater sensitivity of the moving-coil as compared with the moving iron. These two points together amply account for the observed fact that the reflex receiver shown produces a cheerful roar of first-class quality from any station within its range, provided that a moving-coil speaker is used, while with any other type of speaker signals have to be kept down to a miserable tinkle if good quality is to be maintained.

Eliminator for D.C. Mains.

A further development of the circuit is possible for those who are in possession of D.C. mains. With the aid of the eliminator shown in Figure 2 it is quite possible to dispense with both filament and anode batteries, lighting the filament of the valve *gratis* by putting it in series with the magnet of the moving-coil speaker. This must, of course, be chosen to pass, as a minimum, the current required by the pentode, and it is almost essential to employ, if only in setting up the eliminator, either a milliammeter at A or a voltmeter at V in conjunction with a variable resistance to ensure that the filament is

Pentode Possibilities.—correctly run. If the field magnet passes considerably more current than the filament requires, a 50-ohm rheostat may be used in the position R_1 to shunt away the excess from the filament, but if magnet and filament

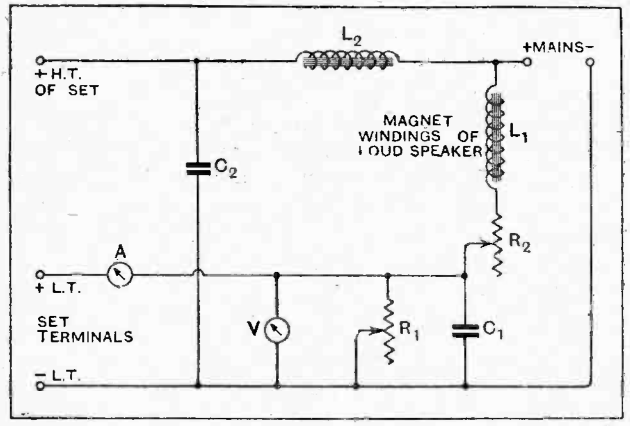


Fig. 2.—Complete eliminator for use on D.C. mains with the receiver of Fig. 1. A number of the components may be omitted except with the "roughest" of mains.

require about the same current, a series resistance at R_2 will be more suitable. Except perhaps for preliminary experiments, R_1 and R_2 will not both be required. If hum is experienced, an electrolytic condenser of 100 mfd. capacity or over may be tried at C_1, but it is not likely to be needed.

The H.T. supply circuit is simplicity itself, and need consist of no more than the single choke and condenser shown, together with any resistance that may be required to reduce the voltage at the anode of the valve to the maximum permitted by the makers. In many cases it will be found that the resistance and condenser will be sufficient, without the choke, to provide the very slight smoothing required. Owing to the crystal rectifier, hum is not likely to be troublesome, except when using very "rough" mains. The total consumption, including the speaker field, is about one-thirtieth of a unit per hour. As with every receiver driven by D.C. mains, safety condensers in both aerial and earth leads are absolutely necessary, though they are now shown in the diagrams.

In the form shown in Figure 1 the receiver is not difficult to set up and get into working order, especially as the screening required is not extensive. It has, however, the drawback that it will only receive the local station and 5GB with any certainty. Those who are fond of experimenting may like to try replacing the crystal with a valve detector using reaction. They are warned, however, that though there is no reason why such a combination should not, eventually, be persuaded to work satisfactorily, it may well prove too unruly for all but the most experienced and the most persevering.

A. L. M. S.

CORRESPONDENCE.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

THE REGIONAL SCHEME.

Sir,—With regard to the "regional scheme" it seems that the B.B.C. can only do one of two things :—

(1) Restrict their energies so that the listeners near their main stations are satisfied.

(2) Continue their forward policy to the ultimate benefit of the majority.

In my opinion the first would be contrary to all laws of progress, while the second is the one which has put this country into such an enviable position as it now holds in the radio world. It is no use putting the brake on progress.

Eastwood, Notts. L. W. GROVER.

Sir,—I disagree most strongly with your correspondent, Mr. Hobday, with regard to Continental programmes.

The sole reason why I invested in a screened-grid "three" was my inability to hear anything (worth wearing phones for) from the local station in the evenings, which is the only part of the day available for the average man. Week after week passes, and there is nothing but fifth-rate variety and jazz bands after 8 o'clock, a talk only of interest to a few people, or a scientific discourse so elementary as to be suitable for a kindergarten school.

How anyone can scan the programmes published by the B.B.C. in *World Radio* from such stations as Leipzig, Hilversum, Hamburg, Munich, Cologne, Turin, Toulouse, or Kalundborg, and say they are inferior to those printed in the *Radio Times*, passes my comprehension. Not only does the average orchestral concert contain better music, but it is better performed. Most of the great composers came from the "Continent," and the musicians of the Continent are best able to interpret their works.

Even the dance music from Germany or Denmark is played by ordinary orchestras, and is pleasant to listen to after the raucous blare, whine, and thump from 2LO, etc., etc.

If the Regional, or any other scheme, prevents me listening to foreign programmes, I shall turn my aerial into a saucepan-scourer and light my pipe with my licence. J. E. ROBERTS.

Streatham Hill, S.W.2.

Sir,—The correspondence you publish on the above subject prompts me to express another point of view.

I submit that (*a*) the regional scheme was never wanted, and (*b*) it is already out of date.

In regard to (*a*), if there had been any real demand for alternative programmes, the ridiculous system of sending out the same programme from 2LO *and* all the relay stations *and* 5XX, *and* to a large extent all the provincial main stations as well, would not have been allowed to continue, when 5XX could have been providing an alternative for the vast majority of listeners to all the other stations.

With regard to (*b*), it is obvious to the meanest intelligence that the ether is grossly overcrowded, and that sooner or later (and the sooner the better) there will have to be a drastic reduction in the number of wavelengths and stations in use in Europe. When that happens, since the only logical method of distributing wavelengths is more or less according to the *area* of the various countries (for the more sparse and scattered the population is the more necessary is an efficient broadcasting service—it is a mere luxury for town dwellers, by comparison), this country will have to put up with three or four exclusive wavelengths, and then the B.B.C.'s twin transmitters will be useless.

In the present state of affairs really high quality reproduction is unattainable, since even if the 9-kilocycle heterodyne note of the adjacent broadcasting stations are suppressed, one still gets interference from the side bands of these stations. It might, in fact, improve matters a little if no broadcasting were allowed to transmit any side bands above 8,000 cycles.

They would be no loss, since they cannot be received, and at least they would not encroach on the fundamental band of the next station. A. K. GORDON.

Crowborough, Sussex.

EMPIRE BROADCASTING.

Sir,—I have read with much interest the correspondence in your columns on the subject of Empire broadcasting, and the letter in your issue of September 11th, signed "Radiox," strikes me as very much to the point. As a Britisher, I appreciate the London programme more than any other, and I have formed a habit of rising at 2.30 a.m. to pick it up. Sometimes I find it repays the effort of early rising, but by no means always. It would, therefore, be most helpful to those situated 7 hours east of Greenwich if 5SW were to give at midnight a brief summary of the next evening's programme, and enable us to decide between sleep or listening.

I agree with "Radiox" that news items are badly wanted. The fifteen minutes' interval that takes the place of the news bulletin sends me back to bed disgusted on five nights each week. If the news bulletin does not affect the sales of newspapers at home, why should it affect the cable service?

Bankok, Siam. TYRO.

Sir,—I had been holding my hand to see what the opinions of other readers might be at the reopening of the 5SW question before expressing any ideas of my own. However, the rest maintaining silence for the moment, I feel I must make some comment on your editorial of October 23rd.

On a recent voyage to and from Australia I took some trouble to get information about the reception of 5SW and to make full notes on the reception of short-wave stations during the return voyage. The pivot of debate evidently no longer is whether or not there should be an Empire station, but rather whether there can be. You have suggested that any difficulty 5SW may have had in carrying out its responsible duties of broadcasting to the Empire is partly the fault of the engineers in charge of the station, and a correspondent suggests a wavelength change. (In passing I do not see how a listener in the Mediterranean, who is so very close to the splendid European medium-band transmissions, can demand a short-wave programme at all, or possibly criticise wavelength policy by results. Surely we can agree that 5SW need not consider listeners this side of Port Said or the Canaries.)

The case to be made is that there are considerable parts of the Empire in which reception having a good entertainment value is possible. I hope we shall hear what the listeners in remote parts have to say; I am prepared to open the discussion by denying the possibility in all but a very few parts of the world of regular reception of short-wave stations that would satisfy non-technical listeners.

To go on throwing Eindhoven at the B.B.C. is *vieux jeu.* During September, 1929, Eindhoven seemed only to be working once a week. If correspondents want a new brick, it is the Berlin station Königswusterhausen, broadcasting only a very few kilocycles from the Eindhoven frequency and seeming to have more power, better quality, and a better radiation system than the Philips station.

Within 5SW's first skip distance (this seems to be between 1,000 and 1,500 miles) the German station certainly was a revelation of what is possible near 32 metres; but we have agreed to discount short range reception. Between 2,000 and 5,000 miles, which of the two suffered the less from the high-speed fading that spoils reception was quite casual. At greater distances, most of my observations seem to be in favour of 5SW.

On most nights the log would run after this style for long-distance reception :—

Tuesday, September 17th, 1929. 27° S. : 12° E.

5SW.—Signal strength good at 8 p.m. (local time), but high speed fading violent. Signal strength increased though a little long period fading till about 11 p.m., when it was R7. Hardly worth listening to in spite of good strength.

KDKA.—10.20 weak, but readable and steady. Fading only slight.

Königswusterhausen.—8.30-10, high speed fading. R2.

The qualifying clause "in all but a very few parts of the world" was meant to apply to the reception of 5SW in the Far East along the China Coast. I am told that in those parts 5SW comes in before breakfast as satisfactorily as a local station. But do you want dance bands before breakfast?

Hampstead, N.W.3. M. A. SPENDER.

Sir,—On March 17th last I wrote to you *re* the information I had received from the B.B.C. on the subject of the suppression of the news bulletins. They explained that the news was not broadcast because 5SW was an experimental station only. I pointed out that 5GB is also an experimental station, yet the news is broadcast from it regularly. This letter you published.

In the number of *World Radio* for August 2nd, on page 156, in the centre column, occurs the following statement : "We receive frequent enquiries as to why the news bulletin is not transmitted from 5SW. All that can be said in this connection is that it is necessary to omit this item from 5SW transmissions for reasons which are at present beyond the control of the B.B.C."

Obviously the explanation given in their letter to me dated February 22nd could not be considered satisfactory, and it is therefore not surprising that they should now have published something very different by way of explanation.

It is not pleasant to think that any such body as the B.B.C. could even be guilty of want of good faith. Yet the facts as stated above can only tend to increase the suspicion and dissatisfaction felt by most overseas listeners in regard to everything connected with 5SW since it came into being.

Moreover, the explanation published in *World Radio* raises another point. The only control over the B.B.C. which is generally supposed to exist is that of the Government through the Postmaster-General. A question in the House ought to clear up the point of the objection of the Government to allowing the Colonies and Dominions to hear the Home news, and, if they have such an objection, on what grounds?

60° WEST.

B.B.C. TRANSMISSIONS.

Sir,—Surely it is time that criticisms as put forward by Mr. McCormack in your issue of October 23rd were brought to an end. As Mr. McCormack makes no reference, direct or indirect, to the removal of all sources of error in his set, he implies that all frequency distortion or attenuation occurs in the B.B.C. land lines and/or transmitters

If your correspondent is capable of

(*a*) The complete elimination of side-band cutting in his own receiver whilst avoiding radio interference,

(*b*) Accurately distinguishing between side-band cutting in his receiver and attenuation of the higher frequencies in the land lines,

he is well on the way to a perfect set, and many readers would like to know how (*a*) is achieved.

If and when this perfect set be proved to exist, so much will then depend on the method of reproduction that for the moment further comment is superfluous. Suffice it to point out that further definite proof of the perfect reproducer will be required before such criticisms are fair. As you, Sir, are aware, the human ear is so adaptable to varying conditions as to be quite unreliable as evidence of perfection, and gives but evidence of the personal preference of its owner.

Until such time as this perfection be proved to exist, surely it is better to make the best use of existing radiations. The B.B.C. will admit that their radiations are not perfect, but would also probably claim that they were at least as good as any set reproducing them. If proof, and not judgment by ear, were furnished of really serious defects in transmission, the Chief Engineer would doubtless take steps to rectify his errors.

As a minor point : we cannot all live in the "A" service area of Brookmans Park, and therefore we cannot all have the Queen's Hall concerts as "first class," direct or "local." We must therefore accept the next best thing. But why complain in the same letter of the "third rate" or "fifth rate" land line transmissions radiated from 5NO when admitting there are available the "second rate" transmissions of 5XX?

Yorkshire. FAIR PLAY.

READERS' PROBLEMS.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Valve Life.

It seems to be quite common practice nowadays to heat the filament of an output valve with raw A.C. at the correct voltage; I am told that the life of valves supplied in this manner is considerably less than when a battery is used. Can you confirm the accuracy of this statement, and also tell me if the falling-off, should it exist, is in any way serious? S. C. J.

It is regretted that we have no definite data on this matter, but it is to be assumed that the life of a valve fed with raw A.C. is somewhat shorter than with the alternative battery supply. We do not think that this effect is at all serious; indeed, any reduction in valve life is probably altogether insignificant.

○○○○

A Push-button Regional Receiver.

I am thinking of using up some spare parts for constructing a simple domestic set for reception of the alternative programmes from Brookmans Park (when they begin).

My two-H.F. set will be used on the outside aerial for distance reception, and it is proposed that the other receiver shall be connected and fed from an inside aerial. In order to have an ample margin of safety, it is proposed to use a single H.F. stage, from which no special attempt will be made to obtain maximum amplification. Will you please show me how a switching scheme for this stage may be arranged, in order that it will be possible to use pairs of semi-variable condensers tuned to the wavelength of the two transmissions? It seems that, after having once tuned the set, it should be possible to arrange matters so that either transmission can be received by manipulation of change-over switches, without any other external control beyond, of course, that for the filament circuit. T. F. S.

It should not be difficult to arrange a set on the lines you specify, particularly as no very great efficiency will be required at your distance from the regional transmitters. We suggest the arrangement shown in Fig. 1, in which C_1, C_2, and C_3, C_4 are, respectively, the condensers for tuning aerial-grid and H.F. transformer secondary circuits to the alternative wavelengths. These are thrown in circuit by means of the switches S_1, S_2; with a little care, these may be linked together mechanically and operated by a single knob.

As an additional refinement, it would be possible to arrange matters so that the filament circuit is "off" when the switch is in the central position.

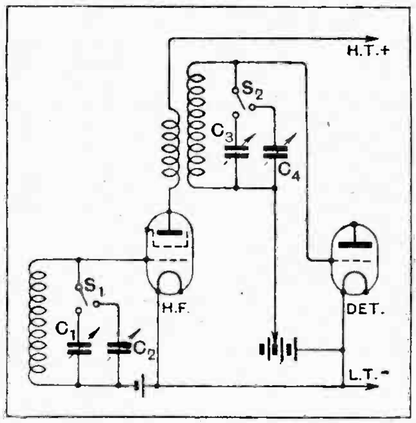


Fig. 1.—For reception of twin Regional transmissions: simple change-over switching.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

In our diagram we have shown an anode bend detector, but the scheme would be applicable to a set in which grid detection is used, although any attempt to include reaction would tend to complicate matters.

○○○○

Omitting Decoupling Resistances.

I have a Ferranti eliminator, which, as you will know, includes anode feed resistances for the various circuits; in these circumstances, would it be quite in order to omit the present decoupling resistances in the "1930 Everyman Four"? H. J. S.

In order to prevent the undesirable circulation of H.F. currents, we suggest that R_8 and R_9 should be retained. Otherwise your proposal is not open to criticism, although if you are attempting to obtain the very fullest magnification of which the receiver is capable, it might be desirable to leave a resistance of, at any rate, a few hundred ohms in the position at present occupied by R_{10} (in the detector anode circuit).

○○○○

An All-wave Frame Aerial.

Have you ever described the construction of a frame aerial for both medium and long broadcasting wavebands? If so, will you please refer me to the back number in which the description appeared? W. J. M.

Full details for constructing an all-wave frame aerial were given in *The Wireless World* for July 27th, 1927.

○○○○

Mounting an S.G. Valve.

Do you consider it better to mount a screen-grid high-frequency valve in a position where it is unaffected by the field surrounding the coils, or to arrange it in such a way that the grid and plate sections of the valve are in the corresponding screening compartments of the set? B. P. A.

Where but one H.F. stage is used, this is not a matter of any great importance, even when one is aiming at an exceptionally high magnification; but in the design of receivers with two or more H.F. stages it is usual practice to screen the valves from the apparatus associated with the tuned circuits.

Record III Modifications.

Would it be possible to use a P.625 valve in the output position of the Record III? I already have a valve of this type, and a power transformer with outputs of 4 volts, 6 volts, and 250 volts; the latter is for H.T. supply, of course, and the winding has a centre tapping.

If it is possible to use these components, will you please give me a circuit diagram of the modified filament and heater circuits?

F. McC.

There should be no difficulty in arranging matters so that your valve and transformer can be used. In Fig. 2 we give a suitable circuit arrangement; it will be noticed that a potentiometer and by-pass condensers are shunted across the low-tension output winding, which feeds the indirectly heated H.F. and detector valves.

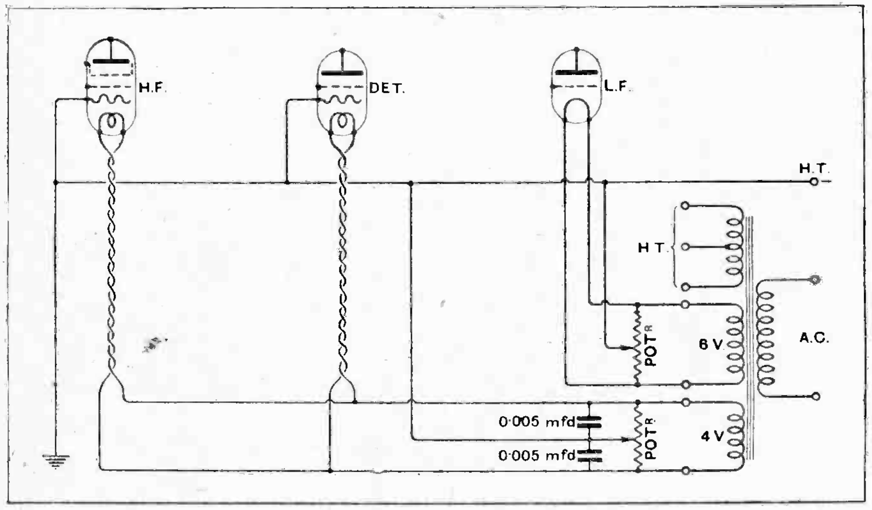


Fig. 2.—A satisfactory modification of the Record III, allowing the use of a directly heated valve in the output position.

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An Unstable Portable.

I am sending you the circuit diagram of my recently constructed four-valve portable, which is giving a good deal of trouble through lack of stability. Can you suggest a likely source of the trouble, or recommend any additions that can be made?

J. R. B.

From the information you give about your set, it is extremely difficult to help you. One naturally expects to encounter a good deal of trouble in obtaining complete stability in a portable receiver unless a well-tried design is followed, as it is inevitable that there will be a good many stray couplings; these must be found and removed, or, at any rate, their "sense" must be altered so as to produce an anti-reaction rather than a reaction effect.

It is noted that your set includes complete decoupling of the various H.F. circuits, and apparently thorough screening where necessary. Of course, we cannot say if the joints of the screening box are sufficiently well made, and we would advise you in the first place to look to this point.

A common source of trouble in portable sets is interaction between the loud speaker leads and the built-in frame aerial; in spite of fairly elaborate "H.F. stopping" precautions, a modicum of H.F. energy is often found in the former circuit.

We advise you to try the effect of connecting a by-pass condenser—of, say, 0.002 mfd.—between plate and anode of the output valve, and also to connect an H.F. choke between the plate of this valve and the loud speaker.

The Output Anode Circuit.

It is noticed that, although the majority of modern sets seem to have decoupling resistances and condensers in the anode circuits of H.F., L.F., and detector valves, no particular precautions seem to be observed in the case of the output valve. Would it not be an advantage to apply this method of preventing interaction in this case as well, particularly in view of the fact that the energy in this circuit is much greater than in any other, and presumably more likely to lead to trouble?

C. M.

We would point out in the first place that it is seldom practicable to add a resistance capacity filter in an output anode circuit, because the current is generally so great that a resistance of the value necessary for adequate decoupling would bring about an excessive drop in voltage. In any case, it must be remembered that the decoupling arrangements customarily recommended nowadays are "two-way" devices; not only do they deflect H.F. or L.F. energy from a common source of anode current supply, but they also prevent the feed-back of energy from the output circuit to the anode circuits of which they form a part, and, what is more important, they consequently prevent the passing back of energy to the grid circuits.

It may be added that the anode circuit of the last valve is almost completely decoupled when a choke filter arrangement is used. The same holds good with a push-pull arrangement.

o o o o

Long Waves for Long Range.

My advice has been asked regarding the choice of a four-valve set for use in Scotland in a district where I know from experience that Daventry 5XX transmisions provide the most consistently good signals.

It is observed that comparatively few commercial sets are designed for as good a performance on the long waves as on the medium band—I suppose because this is unnecessary in most districts. Can you refer me to any set likely to have a performance above the average as far as long-wave amplification is concerned, and which at the same time is easy to operate?

D. B. L.

Reception of long-wave signals is generally determined by the ratio of signal strength to atmospherics, and in any case it is, in a modern receiver, quite easy to get as much sensitivity as can ordinarily be usefully employed, although there are sometimes occasions where one can make use of a high degree of magnification. We suggest that you should consider the Pye Type 460 receiver, as this set includes long-wave circuits of unusually high efficiency.

FOREIGN BROADCAST GUIDE.

LAHTI

(Finland).

Approximate geographical position: 60° 25′ 38″ N. 28° 10′ 00″ E.

Approximate air line from London: 1,130 miles.

Wavelength: 1796 m. Frequency: 167 kc. Power: 40 kw.

Time · Eastern European (2 hours in advance of G.M.T.).

Relays programmes from Helsingfors (221 m.; 1355 kc.; 0.9 kw.).

Standard Daily Transmissions.

G.M.T. 05.15 morning health exercises; 07.00 and 11.00 sacred service (Sundays only); 12.30 concert (Sundays only); 17.30 or 18.00 opera or concert (daily); 19.45 news in Finnish and Swedish. Occasionally on Saturdays at 21.00 dance music.

Usually closes down at 21.00.

Lady announcer. Call (in Finnish): *Huomio! Huomio! taala Suomen yleisradio Helsinki-Lahti.* When Swedish transmissions are given: *Giv akt! Har Finlandsrundradio Helsingfors-Lahti.*

Time signal (at 17.00 G.M.T.): 1 stroke on a deep-toned bell.

Under the heading "Foreign Broadcast Guide," we are arranging to publish a series of panels in this form, giving details regarding foreign broadcast transmissions.

The Wireless World

AND RADIO REVIEW
(17th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

GUIDE TO RECEIVERS.

IN this issue we publish our fourth annual Buyers' Guide to Receiving Sets of To-day. This annual feature is not only becoming of the utmost value to would-be purchasers of complete sets, but it has the additional advantage that the publication of this information puts our readers *au fait* with the present tendency in design and indicates very clearly the types of receivers on which manufacturers are concentrating.

It is noticeable from the figures which this year's Buyers' Guide to Sets provides that the popularity of mains-operated receivers is increasing, whilst another point of interest is that the popularity of portable sets amongst manufacturers has about reached its zenith. By this we do not mean that the portable set is by any means a thing of the past, but that manufacturers, rather than develop new portables on the lines of those previously marketed, are designing sets which are self-contained except in so far as they require to be connected to the electric supply mains for operation. The new receiver has the advantage over permanently installed sets that it can be moved from one room to another, and is independent of an aerial.

The sets of to-day serve once more to emphasise the fact that receivers are designed to suit the valves which the valve manufacturers develop, and it would appear that at present, at any rate, it is the valve manufacturers and not the manufacturers of sets who set the pace and control the evolution of the wireless receiver.

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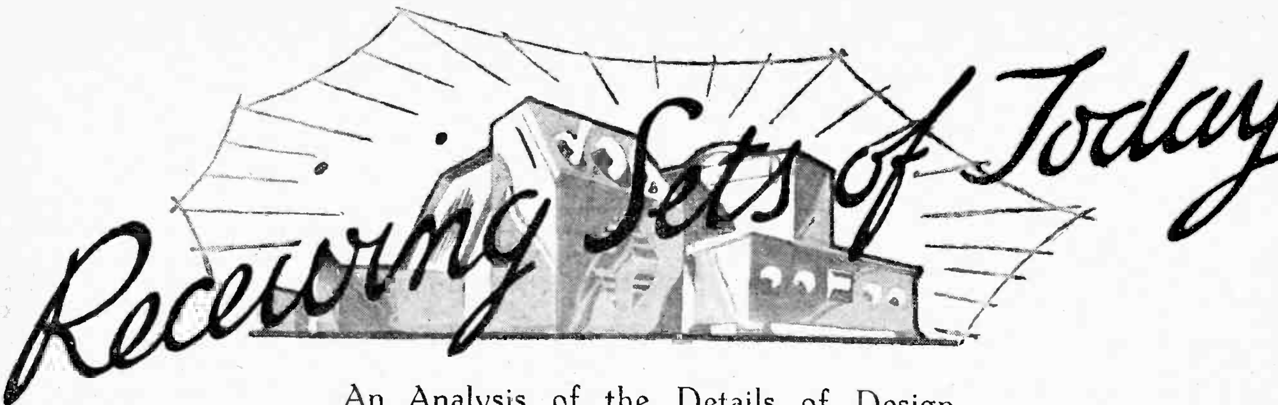
TELEVISION: A STATEMENT OVERDUE.

THE wireless picture transmissions which the B.B.C. have been conducting over an agreed period of twelve months have now come to an end and, according to our information, the B.B.C. has decided not to continue them because, in their opinion, there is not sufficient evidence of public interest.

Whilst it may be difficult to find a good reason for quarrelling with this point of view, yet we feel strongly that a blunder has been permitted somewhere because to us it seems unfair that a section of the public, however small, should have been induced to invest in the purchase of picture-receiving apparatus only to find, after a comparatively short run, the transmissions which could be picked up in this country on the instrument discontinued. We should, of course, be told that all purchasers of the apparatus were advised that the transmissions conducted by the B.B.C. were only experimental and their continuance could not be guaranteed, but how many people, we wonder, would have been prepared for such a decision as has now been made.

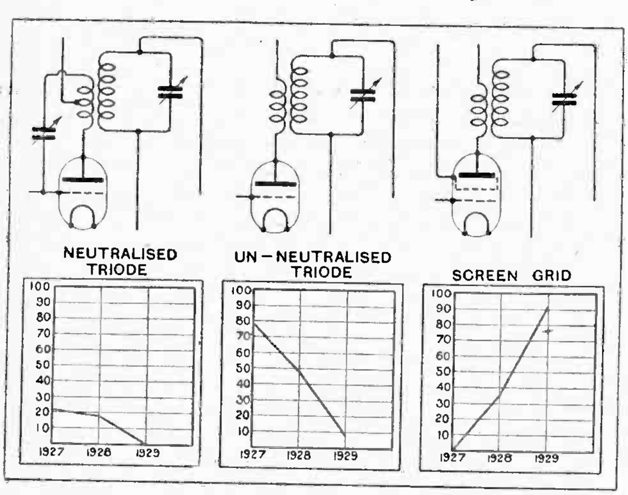
In the broadcasting of television experiments by the B.B.C. such as is now proceeding, we have another instance of questionable policy, but we feel that we should exonerate the B.B.C. from responsibility for both these enterprises, because if our information is correct, they were thrust upon them by the Post Office, because the Post Office was not prepared to grant independent experimental facilities to those concerns which were commercially interested in picture transmission and in television. How long, we wonder, will the B.B.C. television broadcasts continue? Is it not time that we had from some authority a general report and a statement of the number of persons who "look in" to these transmissions? The Television Society, which was formed some time back with the object of furthering the development of the technical side of the subject, might, we think, quite reasonably be regarded as a suitable body to form a committee to investigate the matter, provided this committee was chosen from amongst unbiased and unprejudiced persons.

Receiving Sets of Today

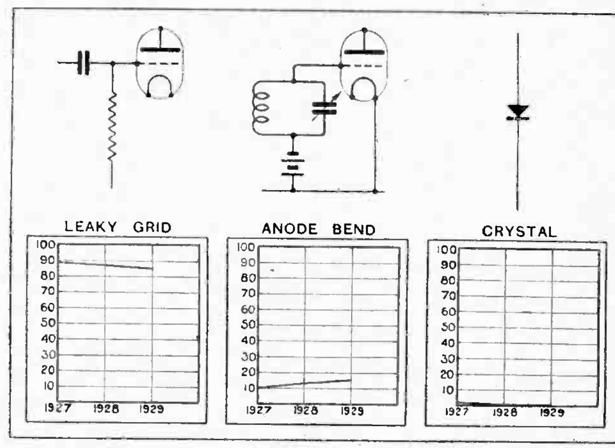


An Analysis of the Details of Design.

GREATER progress has been made over the past year than during any other similar period since broadcasting began. Periodically we say that radio receiver design is settling down, that the rate of progress is becoming slower and that there is shortage of new ideas. Then comes perhaps a small contribution to a temporarily standardised practice and a number of changes quickly follow. By way of example, we might quote the effect of the screen-grid valve, which when first introduced made but slow headway in spite of a manufacturing prejudice against the then adopted practice of using the neutralised triode. This journal did much to draw attention to that all-important property of the screen valve, the amount of residual capacity left after the introduction of the screening electrode and its effect upon amplification. It was shown numerically that a far greater degree of amplification could be obtained with the improved types of S.G. valves than by the alternative process of the neutralised triode. Confidence thus gained in the use of the S.G. valve has brought about its almost universal adoption. A moment's thought will reveal that this minor development has proved a starting-off point for a host of modifications in receiver design. Thus one S.G. stage effectively replaces two inefficiently-coupled triodes; two stable H.F. stages of enormous overall amplification is a new introduction, while complete screening, accompanied by all-metal construction throughout, is the recent trend. In fact, to the screen-grid valve can be attributed a drastic change in the appearance, general construction and operation of wireless sets and the performance expected of them. So absorbed are designers in carrying into effect these technical improvements that there is yet little evidence of the new conditions in the ether, occasioned by the regional scheme, having made their mark upon the build of our sets.



These graphs indicate a remarkable change in the method of H.F. amplification. The neutralised and un-neutralised triode have fallen from a combined total of 100% almost to extinction. In two years the use of the S.G. valve has risen to over 90 %.



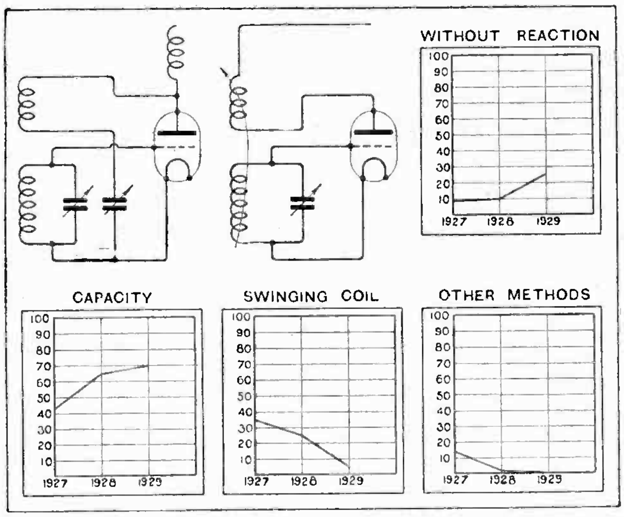
Three out of every twenty sets are fitted with anode bend detectors. A slight upward trend in the use of this form of detection is to be noted.

Three Hundred Sets Analysed.

In the following few pages are summarised the general details of design of the receiving sets obtainable to-day. As in other years, percentages have been determined from specifications as they are and not from the knowledge that many of the types will soon be passing to be replaced by more up-to-date models possessing details that would modify the figures. Our census is taken at a time of change, but, nevertheless, the upward and downward tendencies revealed can be accepted as a reliable guide, their significance being actually of greater

Receiving Sets of To-day.—

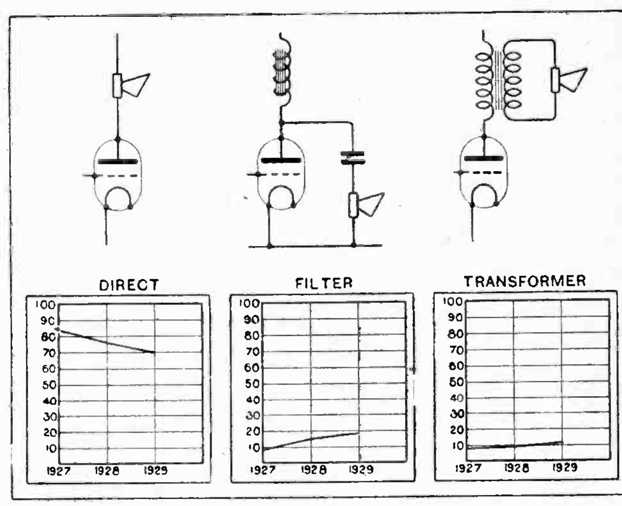
importance than is indicated. Data has been compiled, as far as is possible, in respect of some 300 sets, with the aid of information courteously furnished by the manufacturers, gleaned from trade lists, and in many cases actual scrutiny of the apparatus. Incidentally, the total number of sets is less this year than last, due to the withdrawal of obsolete types, many of which were superheterodynes, a reduction in the range of models, and, it is interesting to note, a slight falling-off in the number of set manufacturers.



Last year reaction was used in eighteen sets out of every twenty. Now reaction is only to be found in fifteen out of every twenty. The use of the capacity method of obtaining reaction is almost universal.

We will consider the receivers, item by item, from aerial to loud speaker. While it was confidently believed that as a result of the improving performance and rapid growth of the portable, combined with better and easier H.F. amplification, that the outdoor elevated aerial would disappear, there is, in fact, a slight percentage decrease in sets using entirely frame aerial. Regional conditions with generous signal strength over densely populated areas may modify this trend, and the decline in the use of the frame is probably due to the fall in the number of portables, with which it roughly numerically corresponds. It is probable, however, that the sensitivity-selectivity product for an outdoor aerial is better than for a frame when using a well-designed set embodying both filter and H.F. amplification. Among open aerial sets it is a growing practice to fit a small fixed capacity condenser in the aerial lead. This arrangement permits of the use of a single-coil aerial inductance in place of a transformer so that long- and short-waveband switching is simplified and some degree of selectivity achieved, together with an increase of signal voltage at the grid of the first valve. The reduction of aerial capacity provided by the series condenser simplifies ganging.

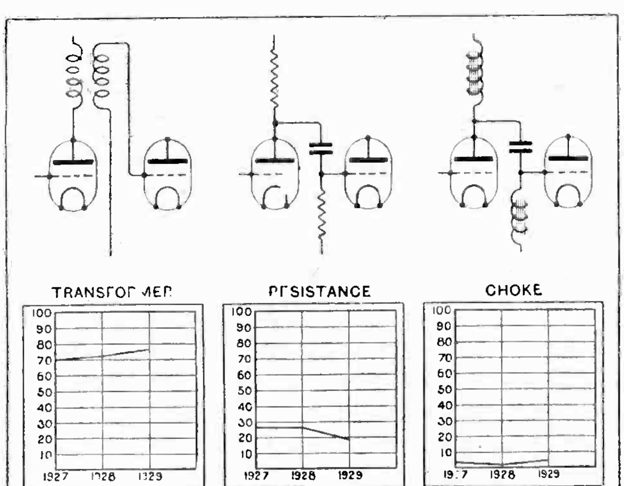
Whereas a year ago switching for long and short wavelengths was carried out by a variety of methods it has now become general practice to merely short-circuit a loading coil. Portions of both primary and secondary windings are short-circuited in the case of H.F. transformers, and no longer is the somewhat difficult arrangement of series-parallel switching favoured. No single example has been noted of the use of specially designed low-loss coils, and even in the newer sets fitted with tuned screen-grid stages the inductances are mostly of a type introducing appreciable H.F. resistance. Such resistance is perhaps of small account in view of the other losses present, and these are generally of no greater value than is just required to give stability.



Mains-operated sets are bringing about an increase in the provision of output filters and transformers.

In a few of the up-to-date multi-valve sets, including screen-grid stages, the interstage screening is fairly thorough, but its completeness is obviously determined as a result of experiment, and takes into account convenience of manufacture.

Associated with the H.F. stages, one notes the bold bid made in the recently introduced sets to provide

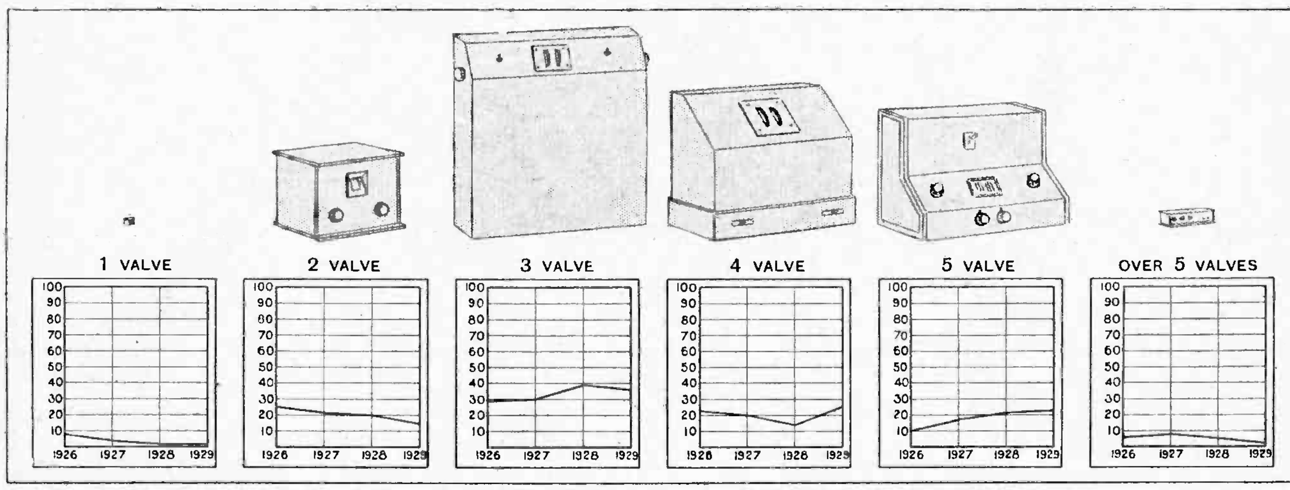


A small increase in the adoption of transformer coupling is due to a reduction in the number of L.F. stages and the increase in the use of the pentode.

Receiving Sets of To-day.—single dial tuning control demanding the ganged working of two or more tuning condensers. Some degree of flatness of tuning, combined with the precise matching of coils and condenser scales before assembly, would seem to be the system by which successful ganging is achieved. Trimming condensers, connected across the tuning condensers, are to be found in several sets, but their purpose can be merely that of bringing the stray parallel capacity up to a required minimum value being that on which the plate shape of the logarithmic scales were calculated. These trimmers do not compensate for lack of uniformity in the condensers themselves or differences in coils; they merely correct for circuit capacity differences. If, however, the coils are precisely matched and no provision is made for "slip ganging," logarithmic scales are not required, it merely being necessary to match the capacities, including stray capacity at all settings of the condensers. Ganging the condensers gives an apparent sharpness of tuning not it has dominated all other considerations of maintenance or performance. This feature is shared by the mains-operated receiver, and is combined with freedom from battery troubles and expense, while permitting of the use of valves of high performance and unrestricted as regards anode potentials and current. Thus there is an obvious prediction which an indication already confirms.

Fewer Sets with Reaction.

From the figures showing forms of detection one cannot overlook an increase in the use of anode bend detection, eve[illegible] though the advance is only small. Better H.F. amplifiers are largely responsible for the change, while the increased production of quality sets using perhaps a resistance-coupled L.F. stage has partly contributed. Regional conditions may further help the figure for anode-bend detection to advance, though the leaky grid method has many points in its favour, and will not fall back to any marked extent.



A slight decline in the manufacture of both two- and three-valve sets is offset by an increase in the number of receivers of four valves. There are contributory clauses which have combined to account for this change.

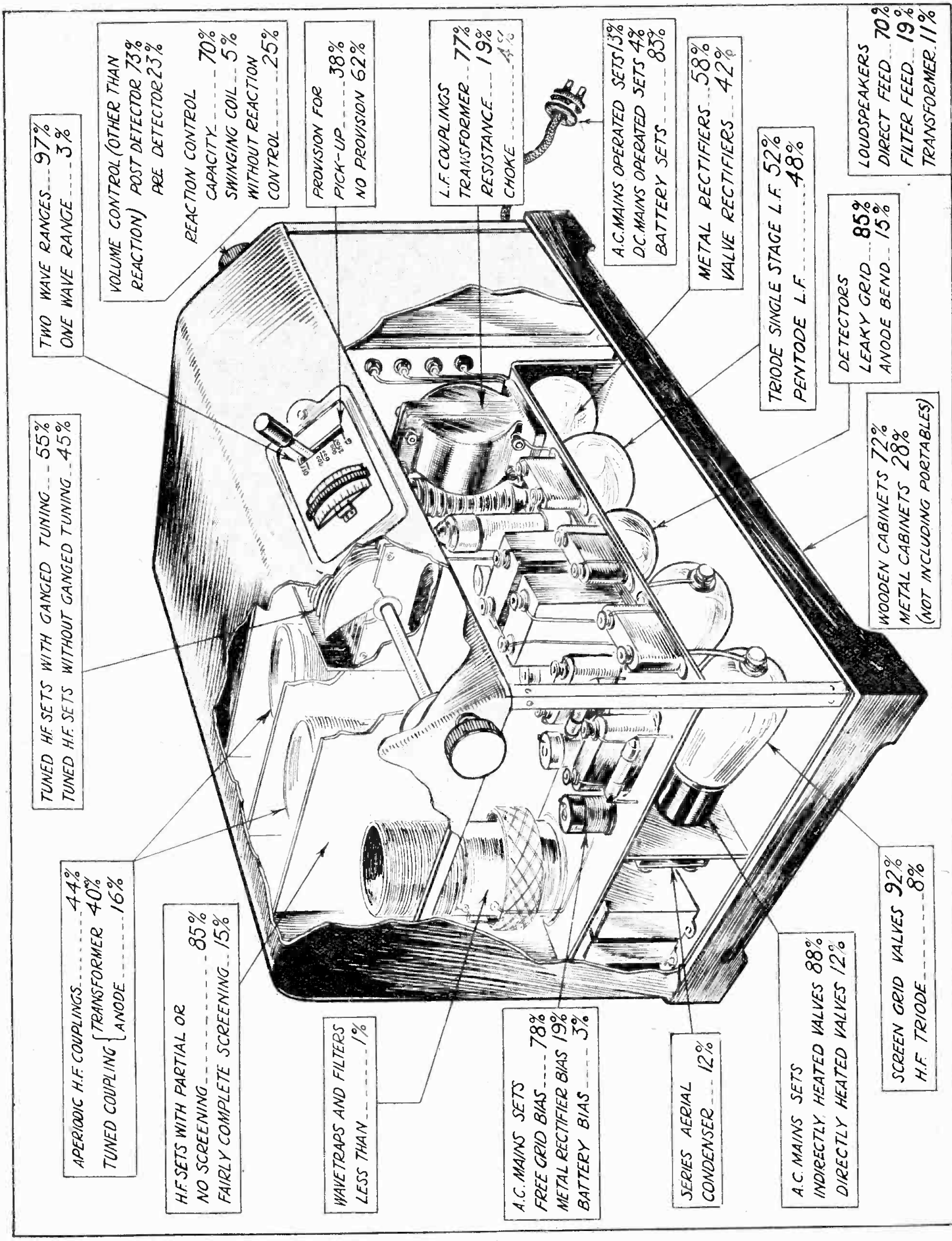
possessed by the individual stages, but it is possible that the production of a flat-topped resonance has been the aim in some of the sets in order to maintain a sufficient degree of selectivity without cutting down the sidebands, a necessary requirement for quality reception. Filters have not yet found their way into receivers of this class.

Aperiodic H.F. amplifiers are still to be found, but only in the older surviving portables. It cannot be denied that sets embodying two aperiodic stages have entirely satisfactory range-getting properties, but the amplification is essentially the result of a happy state of reaction control which this arrangement affords. The decline in the use of two aperiodic stages is marked, and is due partly to a preference for the single S.G. tuned amplifier and also to a decline on a percentage basis in the number of portables.

This latter observation is indicative of trend towards the replacing of the battery-operated portable by the all-mains set. Portables have appealed because they are self-contained, a feature so much sought after that

Reaction is to be found in 75 per cent. of the sets. This high figure is accounted for by the fact that it is provided in all two- and three-valve and portable sets. Here, again, can be seen the modifying effect of better H.F. amplification, in that this year's analysis reveals a very definite downward tendency in the use of reaction. It is, moreover, safe to forecast a rapid decline in the use of reaction under regional scheme conditions.

Little or no novelty has found its way into the L.F. amplifier, neither have the figures representing the types of intervalve couplings greatly changed. Increases in the use of anode bend detection and the production of expensive radio-gramophones might suggest a rise in favour of resistance coupling. On the other hand, the pentode valve has reduced the number of L.F. stages, while the input coupling is invariably a transformer. Although large sets are on the increase push-pull amplifiers have not grown in numbers. Parallel-connected output valves are included in the specifications of generous output amplifiers, and there are several examples of the use of pentodes in this way.



A modern receiver dissected to reveal present-day practice.

Receiving Sets of To-day.—

After more than a year of popular interest in the electrical reproduction of gramophone records we find but a small increase in the percentage number of sets in which provision is made for the use of a gramophone pick-up. The figure given owes its increase mainly to the newly created radio-gramophones. Omission of the provision for the use of a gramophone pick-up does, however, undoubtedly mar the selling potentialities of sets.

Mains-operated sets are but few in number, yet their rapid growth indicates that they will become as popular as the portable which they are tending to replace. Their circuit systems have been dealt with in the preceding analysis. Unlike the portable, where the design is a random process of trial and error, and where all the established theoretical considerations are seemingly contravened, the mains set rigidly embodies in every detail all the best and most advanced principles. Sets for D.C. supply represent a small portion only of the total number of mains sets, and there is no evidence that the manufacturers intend to give much attention to this class of receiver. The requirements of the listener with D.C. supply are met by using a battery set with L.T. accumulator and D.C. eliminator and cells for grid biasing. Both indirectly and directly heated A.C. valves are to be found in the A.C. sets, one of the reasons given for the use of the directly heated valves being the easy conversion to battery working. Grid biasing is obtained in the majority of A.C. sets by a voltage dropped across a resistance carrying the anode current, the circuit becoming complicated by the earthing of the spindles of the tuning condensers. It is due to grid biasing problems that directly heated (battery) valves are used in the output stages of the A.C. models, a separate winding being provided for the purpose on the mains transformer. There is a wider range of battery than indirectly heated valves suitable for the output and these valves operate without hum when heated with A.C.

There is an appreciable increase in the inclusion of generous output stages, this having come about by the need for good quality and large undistorted A.C. output with loud speakers of the moving-coil type.

Sets of to-day are less like an assembly of well-known components than in preceding years. If progress were to become less rapid, then the enthusiast would soon find himself in the position of being able to procure a set as good, and probably cheaper, than he could build. Marked changes are, however, taking place now as hitherto, centring chiefly around the application of valve development. A fact that must not be overlooked is that every set is, with perhaps one exception, British built. While this position is, of course, mainly due to the foresight of the manufacturers in the matter of the administration of patents, it could not have been maintained with inferior gear.

CLUB NEWS.

Visiting a Power Station.

Condenser manufacture was dealt with in an interesting way by Mr. Haywood, of the Dubilier Co., in a lecture before the Alma (Bermondsey) Radio Society at a recent meeting. On October 29th members paid a visit to the local power station, which is being entirely rebuilt. Under the guidance of the engineers the party obtained a clear insight into the latest practice in electrical power distribution.

Attractive items in the early future include a visit to the local telephone exchange and a lecture and demonstration by a representative of the Mullard Company.

Hon. Secretary, Mr. A. J. Hopkins, 41, Trafalgar Road, S.E.15.

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A Mystery Debate.

The Incorporated Radio Society of Great Britain announces that the proceedings at the meeting on November 22nd will take the form of a debate the subject of which will be announced from the Chair. The meeting will be held at the Institution of Electrical Engineers, Savoy Place, W.C.2, at 6 p.m.

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From Battery to Mains.

"All Mains Receivers," a topic of special interest at the present time, was the subject of a lecture given before the Tottenham Wireless Society on November 6th by the Society's Technical Officer, Mr. J. Burns. Additional interest was given to this lecture because Mr. Burns treated his subject from the point of view of the home constructor; a few weeks previously the Society had listened to a lecture on the same subject by a representative of a firm producing these all-electric receivers commercially. Having experimented for two years with this class of set, and having made most of his material himself, the lecturer was able to draw upon a useful fund of practical experience which proved specially valuable to those members who are now making a change from battery to mains drive.

Hon. Secretary, Mr. W. Bodemeaid, 10, Bruce Grove, N.17

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The "Hit and Miss" Method.

The time when it was considered wonderful to ring a bell across the width of a room by wireless was recalled by Mr. A. K. Bentley in delivering the Presidential address on "The Progress of Radio" at the meeting of the Radio Experimental Society of Manchester on November 8th. The speaker emphasised that progress in radio had not been achieved by "hit and miss" methods, and if amateurs were to assist in the forward trend of wireless they must take the trouble to learn something about elementary physics and maths. At the Society's meeting on Friday next, November 22nd, Mr. R. M. Kay, B.Sc. (Tech.), will lecture on "The Thermionic Tube in Uses other than Radio." Visitors will be cordially welcomed.

Hon. Secretary, Mr. L. Fox, 23, Yew Tree Avenue, Alexandra Park, Manchester.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 20th.

Edinburgh and District Radio Society.—At 8 p.m. At 16, Royal Terrace. Loud Speaker Night.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown N.10. Lecture and Demonstration: "Low-frequency Amplification." arranged by the Mullard Wireless Service Co., Ltd.

Queen's Park Radio Society.—At 8 p.m. At the Oddfellows' Hall, 593, Harrow Road, Paddington. Lecture by Mr. J. Josey.

THURSDAY, NOVEMBER 21st.

Ilford and District Radio Society.—Visit to Ilford Telephone Exchange.

Slade Radio (Birmingham).—At the Parochial Hall, Broomfield Road, Erdington. Junk Sale.

FRIDAY, NOVEMBER 22nd.

Incorporated Radio Society of Great Britain.—At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Debate (subject to be announced at meeting).

TUESDAY, NOVEMBER 26th.

Ryde Radio Society.—At 8 p.m. At Mount House Hall, George Street, Ryde, I.O.W. Lecture by Mr. R. M. Lucy (of Messrs. S. G. Brown, Ltd.).

Club Members as Critics.

A four-valve set alleged to be working unsatisfactorily was on view at the last meeting of the South Croydon and District Radio Society, and members felt it incumbent upon them to investigate the set to discover wherein it failed. A superficial inspection showed that the receiver was of the Everyman type, but here all resemblance stopped, for there were many radical alterations, particularly in the low frequency side. One "horrifying" feature, in the opinion of many present, was the inclusion of two resistance capacity stages instead of the conventional resistance coupling and L.F. transformer stages. The valves also came in for some caustic comment, but it can be said that the owner of the set, having had the courage to exhibit it, derived all the advice that he is likely to require for some time to come. Despite its imperfections, the maligned instrument provided good reception from the Continent as well as from Brookman's Park and 5GB.

Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, S. Croydon.

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Difficulties Discussed.

The advantages of an open night when members can discuss difficulties in an informal fashion was demonstrated at a recent meeting of Slade Radio (Birmingham), at which many members discovered that they were able to augment their general wireless knowledge by studying each others' problems.

Full particulars regarding membership and the forthcoming activities of the Society can be obtained from the Hon. Secretary, Mr. W. E. Chilvers, 110, Hillaries Road, Gravelly Hill, Birmingham.

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In a Valve Factory.

Secrets of valve manufacture were disclosed by Mr. Clarke, of the Mullard Wireless Service Co., Ltd., at a meeting of the Battersea and District Radio Society on November 1st. The interest aroused by this constructive lecture was proved by the animated discussion which followed.

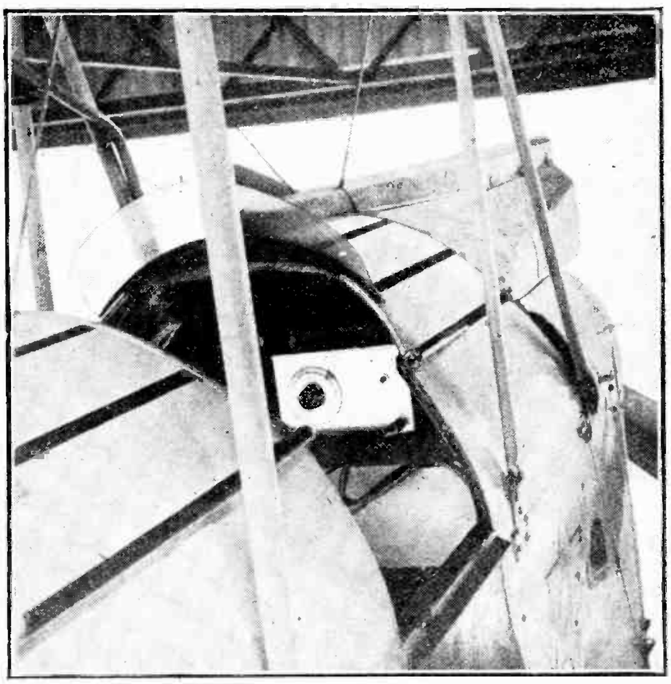
Meetings are held every Tuesday and Friday at 8 p.m. at the Battersea Men's Evening Institute, Latchmere Road, Lavender Hill, S.W.11. Hon. Secretary, Mr. H. E. Bottle, 27, Stormont Road, S.W.11.

Flying Lessons by Wireless

New Aids for the Aerial Novice at Heston.

WHEN the learner at Heston Aerodrome is up in the air alone, relying for the first time on his own skill and coolheadness, he is sometimes faced with a sudden yearning for human society. He places a new valuation on the services of his former companion, the instructor.

For many flying hours before he ventures out solo he is kept on leading strings. The machine used is of the Moth or Avian class of light aeroplane, the instructor occupying the front seat and the pupil the rear seat usually occupied by the pilot. Conversation between the two is carried out by means of a voice pipe system which consists of two speaking tubes, one from pilot to pupil, and the other from pupil to pilot, with a suitable by-pass connection at a point in its length whereby pilot or pupil can hear his own speech without impairing the hearing of the other. After the pupil has done the required amount of dual training and he is considered sufficiently far advanced to fly by himself he is allowed to take up the machine on his own, and it is at this point that wireless equipment is particularly useful. All previous instruction having been given by means of the voice pipe, the psychological effect on the pupil can be appreciated if, when on his solo flight, he is still enabled to receive necessary instructions in the familiar voice of his instructor should he show signs of nervousness or lack of control of the machine.



The cockpit of an instructional plane, showing the wireless receiver.

Aerial tuition at Heston is now being carried out with the aid of the G.A.6 light aircraft receiver, manufactured by Messrs. Alfred Graham. By means of the voice pipe attachment the output speech from this receiver is applied to the part of the voice pipe containing the by-pass tube, thus enabling the pupil to listen to the wireless reports or instructions without having to wear headphones.

The receiver operates from small aerials fixed between wing tips and tail in such a way that folding of the wings is not interfered with. Current is supplied from a small container holding the H.T. battery and an unspillable accumulator, connection to the set being made through armoured cable.

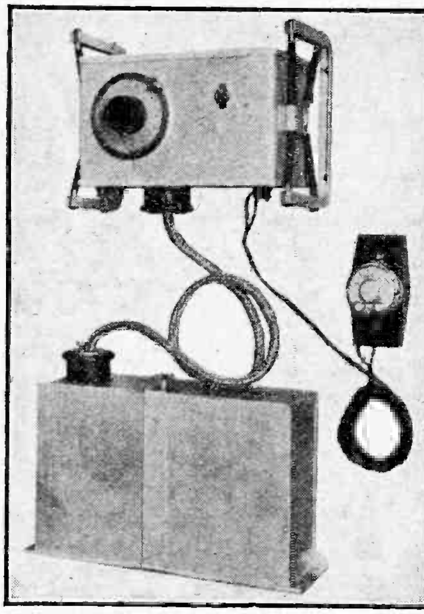
In the case of a fully qualified pilot this receiver is

Flying Lessons by Wireless.—
particularly useful for receiving meteorological reports. The voice pipe arrangement enables both pilot and passenger to converse together and also to hear wireless reports.

The total weight of the complete outfit is about 18 lb., and the aerial system does not detract from the manœuvrability or aerobatic performances of the machine.

With regard to the ground station used in conjunction with this receiver that fitted at Heston is the ½ kW. intermediate air-port transmitter manufactured by Messrs. Alfred Graham and Co., Ltd. This outfit consists of a transmitter working on 764 metres, the wavelength which has been sanctioned by the Air Ministry for light aircraft training and meteorological transmissions. The transmitter provides either C.W., I.C.W. or phone, telephony being normally used for communication with the machine.

The transmitter is situated in the control tower of the aerodrome, and when A.C. mains are available the entire outfit is run direct from the supply; thus there is no running machinery and no noise. As Heston Aerodrome is at present on a D.C. supply it has been necessary to use a rotary convertor. The auxiliary apparatus in addition to the main transmitter consists of a receiver covering all wavelengths from 200-20,000 metres, a heterodyne oscillator for use in the reception of C.W., and a speech amplifier unit which provides the modulation voltage from a standard Amplion microphone.



The entire equipment on the plane, shown in this photograph, weighs only 18 lb. The lower cabinet houses the batteries. The earphone on the right is applied to the instructor's speaking tube when the pupil is flying alone.

The aerial system consists of twin lengths of phosphor-bronze wire at a height of about 55 feet, one end being supported on a steel lattice spar and the other on a mast on top of the control tower.

With this arrangement it is possible to take a microphone on the roof of the control tower, from where a view of the entire aerodrome may be obtained and instruction be given for all positions of the machine. It is also possible to obtain a view of other machines taking off and landing, so that any necessary warnings may be given.

As an example of the value of the aircraft receiver for meteorological purposes, the experience of a flying visitor to the recent Newcastle-on-Tyne Air Pageant is worth quoting.

On the Sunday morning after the pageant it was desired to start the return journey to Heston Aerodrome, but the weather at Newcastle was impossible owing to a thick fog, rain and drifting smoke. Whilst waiting, however, to see if the weather would clear Croydon was tuned-in on the receiver while sending a message to a machine on the cross-Channel service, indicating that although weather round Newcastle was bad, at a few miles to the south there was little or no fog, with quite good flying conditions. Backed up by this news the pilot took off from Newcastle, and made a perfectly good return journey to Heston.

TRANSMITTERS' NOTES

Swiss Amateur Union.

A section of the International Amateur Radio Union has now been formed in Switzerland, under the presidency of M. H. Degler (HB9D), of the Radio Club of Zurich. The hon. secretary is M. W. Schneeberger (HB9G), whose station is at Fleurettes 20, Lausanne, and the traffic manager is M. Wuest (HB9C), also of Lausanne. Address communications to the U.S.K.A., Postfach, Zurich 20.

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R.S.G.B. Calibration Service.

Readers are reminded that calibration signals are transmitted on the second and fourth Sundays of each month, from Mr. G. W. Thomas' station, G5YK, at Cambridge, beginning at 10.00 G.M.T. with the call "RSGB RSGB DE G5YK," followed by a two-minute dash on 7050 kC. (42.55 metres). At 10.05 G.M.T. the call is repeated and is followed by a similar long dash on 7250 kC. (41.38 metres). The calibration transmission is preceded at 09.55 by the letter X, in morse, and a telephonic announcement that the service is about to begin, followed by a further announcement of the actual measured frequency of the two transmissions.

Reports Welcomed.

Mr. J. Armstrong, 109, Rupert Street, Bolton, Lancs, transmits on 169 metres, from his station G5XM, at midnight on Saturdays and 11 p.m. on Sundays, and on 42 and 21 metres between 8 p.m. and 10 p.m. during the week. He will be glad if anyone hearing these signals will kindly send him reports.

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New Zealand Stations.

The following list supplements and corrects that published in the "Radio Amateur Call Book" for September:—

Auckland District.

ZL1AB S. G. Waite, 54, Marlborough St., Dominion Rd., Auckland.
ZL1AZ J. R. Sherson, 14, Stanley St., Hamilton.
ZL1BL J. S. Lynch, Ngaruawahia.
ZL1FD F. R. Booth, 28, Rosstrevor St., Hamilton.
ZL1FE A. F. Wood, P.W. Station, Waihou.

Wellington District.

ZL2AH R. V. Roberts, 39, Scarborough Terrace, Wellington.
ZL2AL S. E. Brown, 32, Owen St., Wellington.
ZL2AS H. R. Boyle, Cunard Steamship Co., Ltd., G.P.O. Box 188, Wellington.
ZL2BC S. H. Perry, 89, Tiber St., Wellington.
ZL2GF J. O. Taylor, 248, The Terrace, Wellington.
ZL2GU J. C. East, 270, The Terrace, Wellington.

Canterbury District.

ZL3BD J. C. East, 326, Papanui Rd., Christchurch.
ZL3BF E. Prince, 76, Cobham Rd., Spreydon, Christchurch.
ZL3CB C. R. H. Taylor, 7, Rutland St., St. Albans.
ZL3CS E. B. Buckhurst, Jnr., 98, Office Rd., Merivale.
ZL3CY W. T. Smith, 28, Derby St., St. Albans.

Otago District.

ZL4AT J. Stone, 34, Grove St., Dunedin.
ZL4BM V. G. Whiteman, Puysegur Point Lighthouse, Otago.

New Call-Signs and Changes of Address.

G5VB A. F. Elton Bott, "Francisca," Barlow Rd., Hampton, Middlesex.
GI5WD W. S. Davison, 42, Eglinton St., Portrush, Co. Antrim. (Change of address).
G6SV M. Savage, 144, Hoppers Rd., London, N.21. (Change of address).
G6TX J. Fynn, 24, The Broadway, Woodford Green, Essex. (Change of address).

France.

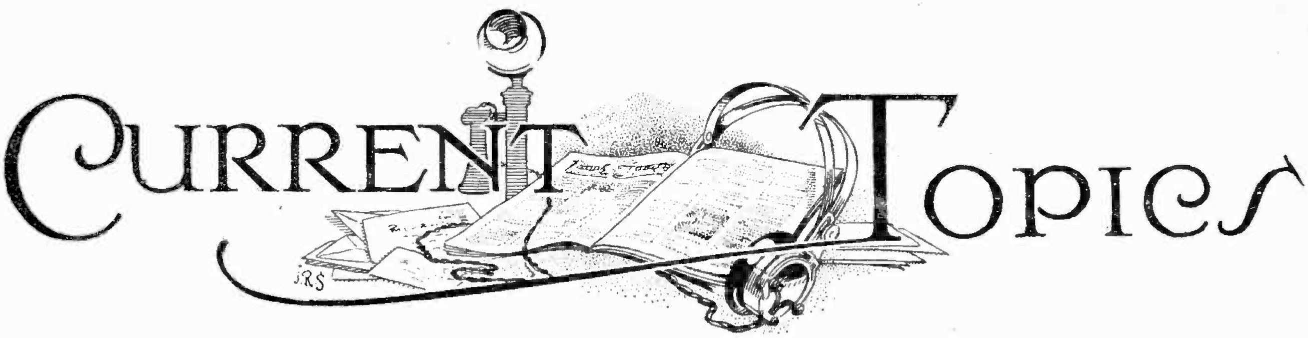
F8EX J. Denimal, 20, rue des Bouchers, Cambrai.
F8FP P. Moles, 17, rue Jean-Furguet, Bordeaux.
F8JF C. Pepin, 173, Bould. Péreire, Paris 17. (Change of address).
F8LN M. Raoult, Boite Postale, 4, Dinan. (Change of address.)

Sumatra.

PK4EO J. H. H. van Buijsen, c/o. Adm. de Deli Mij, Medan.

Madagascar.

FB8HL (Tananarive) is cancelled.



CURRENT TOPICS

Events of the Week in Brief Review.

VEST POCKET WIRELESS.

From Detroit comes the report that a pocket wireless set has been tested and found practicable for regular use by the local police. The set contains two valves, measures six inches by four inches, and is narrow enough to fit into a vest pocket. The aerial consists of a network of 175ft. of fine wire sewn into the back of the vest.

Tests are stated to have given clearly audible signals at a distance of seven miles from the Detroit police transmitter, KOP.

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DISCRIMINATING CRIMINALS.

Thieves who stole £80 worth of wireless goods from a Manchester shop last week had the choice of a wide range of sets, but selected only the latest models.

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EISTEDDFOD WIRELESS.

A reader writes to correct the statement in a recent issue that the wireless competition at next year's National Eisteddfod will be the first in the history of this event. A prize of £2 10s. was offered for a home-constructed wireless receiver in the Eisteddfod of 1925, though unfortunately there was only one entry!

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THE MONOPHONE.

Maj.-Gen. G. O. Squier, late of the U.S. Army, and famous for his inventions connected with "wired wireless," has won a decision at the U.S. Patent Office giving him priority in the invention of the "monophone." Using the ordinary telephone system, but not interfering with its normal functioning, the "monophone" provides subscribers with broadcast programmes on a frequency band "entirely above and out of the way of the band used by wired radio on power lines for broadcasting service."

Gen. Squier's claim is so broad that it is held to cover even "talking movies" in the house through a completely screened circuit with zero noise-level, due to the lead sheathing of the telephone cable.

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ANOTHER HEAVISIDE LAYER?

A woman applicant at Willesden Police Court recently complained that her neighbour's aerial was of the wrong wavelength, upsetting her washing and making it as black as soot.

THE WIRELESS LEAGUE.

Members of the Wireless League are cordially invited to attend the Annual General Meeting which will be held at the Royal Automobile Club, Pall Mall, S.W., on Friday, December 6th, at 3 o'clock. Sir Arthur Stanley will be in the chair.

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BEAM BROADCAST TO CANADA.

The Marconi-Mathieu multiplex beam service from Bodmin, operating at 16-575 metres, was used for relaying the broadcast of the Cenotaph service on Armistice Day to listeners in Canada, who heard the transmission from the broadcasting stations of the Canadian National Railways. On a previous occasion, when the beam station relayed the Thanksgiving Service in Westminster Abbey, Canadian listeners reported that the quality was equal to that of a first-class local broadcast.

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A BOOK OF VALVES.

To the student of modern valve design one of the most interesting publications of the moment is the new Osram Valve Catalogue issued by the General Electric Co., Ltd., Magnet House, Kingsway, W.C.2. In seventy-nine pages the whole range of Osram receiving valves is dealt with, each valve being illustrated and described. Characteristic curves and full working data are given in each case.

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ONE UNDER THE EIGHT.

There are 21,629,107 radio receiving sets in the world, according to the precise estimate of the Electrical Equipment Division of the U.S. Department of Commerce. The authors of this delicate computation state that there is one receiving set for every 12½ persons in the United States, one for every 53 in Europe, and one for every 88 in the world.

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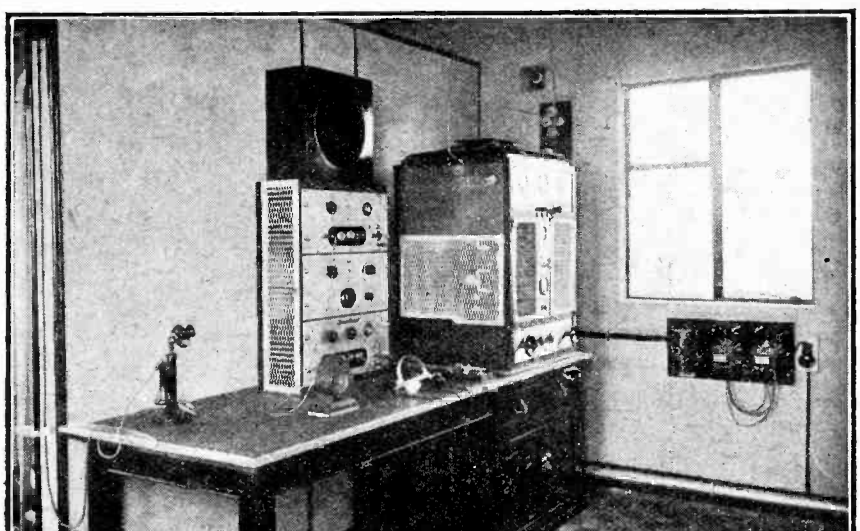
CLUB SECRETARIES, PLEASE NOTE.

For the benefit of radio societies and schools, the Marconiphone Company has prepared three interesting lectures, each illustrated by lantern slides, which are suitable for delivery by a society member. The subjects dealt with are: (*a*) Screen-grid valves and circuits; (*b*) A.C. valves and circuits; and (*c*) public speech and music amplifiers.

Particulars can be obtained from the Marconiphone Co., Ltd., Department I.D., 210-212, Tottenham Court Road, London, W.1.



FLYING LESSONS BY WIRELESS. The transmitter installed at Heston Aerodrome by Messrs. Alfred Graham for use in instructing solo fliers. The above photograph taken in the control tower, shows the transmitter on the right. The smaller panel on the left contains the receiver, heterodyne unit and speech amplifier.

BUYERS' GUIDE, 1929-30.

"The Wireless World" Reference List of Receiving Sets.

Manufacturer.	Name of Set.	Valves and Couplings. H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	Output.	Current Supply.	Gramo. Pick-up.	Price. £ s. d.	Remarks.
Adey Radio, Ltd., 99, Mortimer Street, London, W.1.	Adey One (*P*)	—	—	—	—	—	—	LG	—	—	—	—	—	B	—	4 2 6	Inclusive. Frame aerial incorporated, 7 lb.
,, ,, ,,	,, Two (*P*)	—	—	—	—	—	—	LG	Tr	P	—	—	Tr	B	PP	10 0 0	,, 16 lb.
,, ,, ,,	,, Three (*P*)	—	—	—	—	T	Ap	LG	Tr	P	—	—	—	—	—	12 12 0	,, Oak or mah. Lacquer £2 10s. extra, 16½ lb.
,, ,, ,,	,, Four (*P*)	—	—	T	Ap	T	Ap	LG	Tr	P	—	—	Tr	B	—	14 14 0	,, ,, ,, ,, ,, ,, 17 ,,
Aeonic Radio, 90, Regent Street, London, W.1.	A.C. Mains Radio-Gramo (*RG*).	—	—	—	—	—	—	*LG	—	*T	—	*T	Tr	AC	GP	50 8 0	Inclusive mah. or walnut.
,, ,, ,,	Suitcase 5 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	16 16 0	,, 15½ × 12⅝ × 8⅜in. 27 lb.
,, ,, ,,	Screened Grid 4 (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	19 19 0	,,
,, ,, ,,	Transportable 5 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	,, 16 × 15½ × 8in. 28 lb.
,, ,, ,,	Battery Driven Radio-Gramo (*RG*).	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	GP	26 5 0	,,
,, ,, ,,	All Mains S.G.4	—	—	—	—	*SG	TA	*LG	Tr	*T	Tr	T	D	AC	PP	26 5 0	,,
,, ,, ,,	Two Valve Mains "A.C."	—	—	—	—	—	—	*LG	Tr	T	—	—	D	AC	PP	12 15 0	,,
C. Creswick Atkinson, 35B, High Street, Bedford.	Nulli Secundus Rover, S.G.4 (*P*)	—	—	—	—	SG	TA	LG	—	T	—	T	D	B	PP	22 1 0	Inclusive. Suitcase, 10 × 12 × 15¾in., 28 lb.
,, ,, ,,	Nulli Secundus Universal Five (*P*).	—	—	T	TA	T	—	LG	—	T	—	T	D	B	PP	16 16 0	,, ,, ,, ,,
,, ,, ,,	Nulli Secundus All Mains Three (*P*).	—	—	—	—	SG	TA	LG	—	P	—	—	D	AC	PP	29 8 0	,, ,, ,, 35 lb.
Automatic Radio Mfg. Co., Gosford Road, Beccles, Suffolk.	Radiogramophone (*RG*)	—	—	—	—	—	—	LG	Tr	T	Tr	T	—	B	—	—	—
Avon Radio Mfg. Co., Long Ashton, Nr. Bristol.	Mains Three	—	—	—	—	—	—	*T	—	*T	—	T	D	AC	PP	20 0 0	Set and valves only.
,, ,, ,,	Mains Four	—	—	—	—	*SG	—	*T	—	*T	—	T	D	AC	PP	35 0 0	Set, valves and L.S. only.
Ernest J. Baty, 157, Dunstable Road Luton.	Baty Four	—	—	—	—	T	TG	LG	Tr	T	Tr	T	F	B, AC or DC	—	36 0 0	Complete installation.
S. W. Bligh, 1/2, North Lane, Canterbury.	S.G./3 Receiver	—	—	—	—	SG	TT	AB	RC	P	—	—	F	DC	PP	25 0 0	Including valves only; 2 Pentodes paralleled in output.
,, ,, ,,	Duovalve Pedestal	—	—	—	—	—	—	LG	Tr	T	—	—	F	DC	PP	10 15 0	Including batteries and valves.
Bowyer-Lowe Co., Ltd., Radio Works, Letchworth, Herts.	Portable V. (*P*)	—	—	T	RC	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	Inclusive. 18¾ × 14¼ × 8⅜in. 31 lb.
,, ,, ,,	Pentavox Three	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	10 0 0	Including valves and royalties.
,, ,, ,,	Radiogramophone (*RG*)	—	—	—	—	SG	TT	AB	RC	P	—	—	D or F	B, AC or DC	—	39 0 0	Battery model. Including valves and royalties.
																56 0 0	D.C. mains model. ,, ,, ,,
																65 0 0	A.C. ,, ,, ,, ,, ,,
,, ,, ,,	Pentavox Two	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	6 8 0	Including valves and royalties.
,, ,, ,,	Vox Populi III.	—	—	—	—	SG	TT	AB	—	P	—	—	F	DC	—	28 0 0	,, ,, ,, ,,
,, ,, ,,	,, ,, ,,	—	—	—	—	SG	TA	AB	—	P	—	—	F	AC	—	33 0 0	,, ,, ,, ,,
,, ,, ,,	,, ,, Four	—	—	—	—	SG	TT	AB	RC	T	Tr	T	D	B	PP	24 0 0	,, ,, royalties and frame aerial.
British General Mfg Co., Ltd., Brockley Works, Brockley, London, S.E.4.	3-valve Receiver	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	PP	15 0 0	Set and royalties only.
British Radio Gramophone Co., Ltd., 77, City Road, London, E.C.1.	"Rover" Super Screened 4 Transportable (*P*).	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B or AC	—	19 19 0	Inclusive. Oak Cabinet, 19½ × 14 × 9in. 26 lb.
																21 0 0	,, Mah. ,, ,, ,,
,, ,, ,,	"Rover" 5 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	PP	16 16 0	Inclusive, 19½ × 14 × 9in., 30 lb.
,, ,, ,,	Craigweil 3-valve Self-contained.	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	12 12 0	Including batteries, valves, L.S. and royalties.
,, ,, ,,	Craigweil Radiogramophone (*RG*).	—	—	—	—	SG	TT	LG	Tr	P	—	—	D	B	—	37 10 0	,, ,, ,, ,, ,,
S. G. Brown, Ltd., Western Avenue, North Acton, London, W.3.	3-valve S.G. Receiver, Types A and B.	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	12 7 6	Type A. Set and L.S. only. Mains model £20 10s.
																9 7 6	Type B. Set only. Mains model £17 10s.
Brownie Wireless Co. of Great Britain, Ltd., Nelson Street Works, Mornington Crescent, London, N.W.1.	Brownie 2-valver	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	2 10 0	Set only.
,, ,, ,,	Dominion Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	PP	5 17 6	,,
,, ,, ,,	,, Console	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	PP	9 0 0	Set and L.S. only.
Fred Bulmer, 4, Carlton Terrace, Scarborough.	Carlton S.G. III.	—	—	—	—	SG	TA	T	—	T	—	—	F	B	—	12 12 0	Including valves.
Bullphone, Ltd., 38, Holywell Lane, London, E.C.2.	Nightingale Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	9 0 0	Set complete.
,, ,, ,,	Screened Grid 3	—	—	—	—	SG	TT	LG	Tr	T	—	—	D	B	—	10 10 0	,, ,,
Burgoyne Wireless, Ltd., 34A, York Road, London, N.1.	"Screened Four" (*P*)	—	—	—	—	SG	TA	LG	RC	T	Tr	P	D	B	—	25 4 0	Inclusive. Hide suitcase, 15 × 15 × 9in., 30 lb.
,, ,, ,,	Pentode Model (*P*)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	P	D	B	—	19 19 0	,, Leather suitcase, 15½ × 12½ × 8in., 26 lb.
,, ,, ,,	All Mains S.G. Transportable (*P*).	—	—	—	—	SG	TA	LG	RC	T	Tr	T	D	AC	—	36 15 0	Including valves and royalties.

Burndept Wireless (1928), Ltd., Eastnor House, Blackheath, London, S.E.3.	Screened Four	—	—	—	—	SG	TA	LG	RC	T	Tr	T	D	B	PP	27 18 6	Including valves and royalties.
	A.C. Screened Seven	—	—	*SG	TA	*SG	TA	*AB	RC	*T	Tr	T	Tr	AC	PP	37 16 0	Oak ,, ,, ,, ,, Push-pull output stage.
																38 17 0	Mah. ,, ,, ,, ,, ,, ,, ,,
,, ,, ,,	A.C. Ethogram (RG)	—	—	*SG	TA	*SG	TA	*AB	RC	*T	Tr	T	Tr	AC	—	52 10 0	Oak ,, ,, ,, ,, ,, ,, ,,
																53 11 0	Mah. ,, ,, ,, ,, ,, ,, ,,
,, ,, ,,	Universal Screened Five	—	—	—	—	SG	TA	LG	RC	T	Tr	T	Tr	B or AC	PP	31 10 0	Battery model ,, ,, ,, ,, ,,
																40 19 0	Mains ,, ,, ,, ,, ,, ,,
,, ,, ,,	Ethogram (RG)	—	—	—	—	SG	TA	LG	RC	T	Tr	T	D	B	—	42 0 0	Oak. Complete, including royalties.
																44 2 0	Mah. ,, ,, ,,
,, ,, ,,	Screened Portable (P)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	PP	19 19 0	Inclusive. Leather suitcase 14¾×14¾×8in., 30 lb.
Burne-Jones & Co., Ltd., 296, Borough High Street, London, S.E.1.	A/C 2	—	—	—	—	—	—	*LG	Tr	*T	—	—	F	AC	PP	16 10 0	Including valves and royalties.
	Universal Three	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	18 0 0	,, ,, ,, ,, 15–2000 metres.
,, ,, ,,	Transportable (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	18 18 0	Inclusive.
,, ,, ,,	A/C 3	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	F	AC	PP	25 0 0	Including valves and royalties.
C. F. & H. Burton, "Progress" Works, Bernard Street, Walsall.	"Empire 3"	—	—	—	—	—	—	*LG	RC	*T	Tr	*T	D	AC	—	11 5 0	Including valves and royalties.
	,, ,,	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	—	5 10 0	,, batteries, valves and royalties.
Cantophone Wireless Co., 310, Regent Street, London, W.1.	Cantophone Radiogramophone (RG).	—	—	—	—	—	—	*LG	RC	*†	RC	*†	F	AC or DC	GP	89 5 0	DC model inclusive. † 4RC coupled LF stages.
																99 15 0	AC ,, ,, † ,, ,, ,,
																125 0 0	Double turntable model with "Fade-over" switch and 2 L.S.
,, ,, ,,	Cantophone "Junior" Radiogramophone (RG)	—	—	—	—	—	—	*LG	RC	*T	RC	T	F	AC or DC	GP	55 0 0	DC model inclusive.
																65 0 0	AC ,, ,,
,, ,, ,,	Cantophone 2-valve Portable (P).	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	10 10 0	Inclusive. Leather attaché case 12×9×5in. 10 lb.
Celebritone, Ltd., 72, Oxford Street, London, W.1.	Celebro (P)	—	—	T	Ap	T	Ap	AB	RC	T	Tr	T	Tr	B	—	12 0 0	Inclusive. Rexine suitcase. Hide 12s. extra.
Churchmans, Ltd., 79, Maidenburgh Street, Colchester.	New Mascot 330	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B or DC	—	10 10 0	Battery model, including batteries, valves and royalties.
																15 17 6	Mains ,, ,, valves and royalties.
,, ,, ,,	New Mascot 230	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	7 10 0	Including batteries, valves and royalties.
City & General Radio Co., Ltd., 46, Watling Street, London, E.C.4.	Radio-gram (RG)	—	—	—	—	—	—	*LG	—	*T	—	*T	Tr	AC or DC	GP	50 8 0	Inclusive. Parallel output valves.
,, ,, ,,	City Super 3	—	—	—	—	SG	TA	LG	Tr	P or T	—	—	D	B	PP	9 9 0	Including valves and royalties.
Classic Radio & Gramophone Co., Ltd., 25, Eccleston Street, London, S.W.1.	Ariel (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	Inclusive. Suitcase or cabinet 15½×12¾×8¼in. 25 lb.
Climax Radio Electric, Ltd., Haverstock Works, Parkhill Road, Hampstead, London, N.W.3.	Chello-Set	—	—	—	—	—	—	*LG	Tr	*P	—	—	—	AC	PP	9 17 6	Including valves and royalties.
E. K. Cole, Ltd., "Ekco Works," London Road, Leigh-on-Sea, Essex.	P.2	—	—	—	—	—	—	LG	Tr	P	—	—	Tr	DC	PP	12 17 6	,, ,, ,, ,,
	P.2	—	—	—	—	—	—	*LG	Tr	P	—	—	Tr	AC	PP	12 17 6	,, ,, ,, ,,
,, ,, ,,	SG.P.3	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	Tr	AC	PP	21 0 0	,, ,, ,, ,,
	SG.P.3	—	—	—	—	SG	TT	LG	Tr	P	—	—	Tr	DC	PP	21 0 0	,, ,, ,, ,,
Columbia Graphophone Co., Ltd., 92, Clerkenwell Road, London, E.C.1.	Radio Gramophone (RG)	SG	TT	SG	TT	SG	TT	AB	RC	T	Tr	T	Tr	AC	GP	126 0 0	Inclusive. Parallel output valves.
	Table Model 304	SG	TT	SG	TT	SG	TT	AB	RC	T	—	—	Tr	B, AC or DC	—	33 0 0	Mains models complete.
																27 0 0	Battery model complete.
,, ,, ,,	Columbia Portable 303 (P)	—	—	T	TA	T	Ap	LG	Tr	T	Tr	T	D	B	—	17 17 0	Oak. Complete. Adaptor supplied for conversion to mains.
																19 19 0	Leather cloth ,, ,, ,, ,,
Contal Radio, Ltd., 8, Spital Square, London, E.C.1.	Silvert Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	Tr	B	—	12 12 0	Inclusive. Suitcase 15½×13½×9¼in. 26lb.
	,, Four (P)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	Tr	B	—	18 18 0	,, 17½×15×7½in. 30lb.
Cooks Wireless Co., Ltd., C.W.C. Works, Ipswich.	C.W.C. Popular (P)	—	—	T	Ap	T	Ap	LG	—	T	—	T	D	B	—	16 10 0	Inclusive with turntable, 18×16×7½in. 26 lb.
	C.W.C. Radiogramophone (RG).	—	—	—	—	SG	TT	LG	—	T	—	P	D	B	GP	45 0 0	Including valves and royalties.
,, ,, ,,	C.W.C. Famous Five (P)	—	—	T	Ap	T	Ap	LG	—	T	—	T	D	B	—	21 0 0	Inclusive with turntable, 15×15×7½in. 28 lb.
S. Dagnall, Ltd., 420, Stratford Road, Sparkhill, Birmingham.	"S.D.L. Two"	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	—	——
	"S.D.L. Screened Three"	—	—	—	—	SG	TT	LG	Tr	P	—	—	D	B	—	—	——
Detex Distributors, Ltd., 66, Victoria Street, London, S.W.1.	Burlington (P)	—	—	T	Ap	T	Ap	LG	—	T	—	T	D	B	—	16 5 0	Inclusive. Suitcase 15½×13×8¼in. 25 lb.
Dorien Wireless Co., Ltd., 315, Regent Street, London, W.1.	Super Screened Four (P)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	19 19 0	Suitcase type, 30 lb.
Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3.	Westminster (PRG)	—	—	SG	TG	SG	Ap	LG	Tr	P	—	—	D	B	GP	30 0 0	Inclusive, 20×18×9½in. 58 lb.
	All Electric D.C.3	—	—	—	—	*SG	TT	*AB	Tr	*T	—	—	F	DC	—	25 0 0	Including valves and royalties.
	,, ,, A.C.3	—	—	—	—	*SG	TT	*AB	Tr	*T	—	—	D	AC	—	25 0 0	,, ,, ,, ,,
J. Dyson & Co., Ltd., 2, Coleman Street, London, E.C.2.	Godwinex Radiogramophone, Model N (RG).	—	—	—	—	*SG	TA	*LG	RC	*T	Tr	*T	F	AC	GP	55 0 0	,, ,, ,, ,, Frame aerial incorporated.
,, ,, ,,	Godwinex 5-valve, Model D (P).	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	PP	16 16 0	Inclusive.
,, ,, ,,	Godwinex 3-valve All Mains, Model O.	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	F	AC	PP	23 10 0	Including valves and royalties.
Eagle Engineering Co., Ltd., Eagle Works, Warwick.	Chakophone Junior Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	8 7 9	,, ,, ,, ,,
	,, Radiogramophone (RG)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	GP	31 10 0	,, ,, ,, ,,
,, ,, ,,	,, Junior Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	5 9 9	,, ,, ,, ,,
,, ,, ,,	,, Warwick Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	6 10 0	,, ,, ,, ,,
,, ,, ,,	,, ,, ,, Pedestal	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	8 5 0	,, ,, ,, ,,
,, ,, ,,	,, ,, ,, A.C. All Mains.	—	—	—	—	—	—	LG	Tr	T	—	—	F	AC	PP	15 15 0	,, ,, ,, ,,
,, ,, ,,	,, ,, Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	PP	16 16 0	Inclusive. Walnut cabinet 17×13×7in. 34 lb.
,, ,, ,,	,, ,, Junior Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	14 14 0	,, ,, suitcase 17×9×12in. 26 lb.
,, ,, ,,	,, ,, ,, Four (P)	—	—	T	Ap	T	Ap	LG	Tr	P	—	—	D	B	—	13 13 0	,, ,, ,, ,, ,,

ABBREVIATIONS.—*RG* = Radio Gramophone. *P* = Portable. *Valves:* **SG** = Screen Grid. **TG** = Tuned Grid. **T** = Triode. **P** = Pentode. * = Directly or Indirectly Heated Mains Valves. *Coupling:* **TA** = Tuned Anode. **TG** = Tuned Grid. **TT** = Tuned Transformer. **Ap** = Aperiodic. **RC** = Resistance. **Tr** = Transformer. **Ch** = Choke. *Method of Rectification:* **AB** = Anode Bend. **LG** = Leaky Grid. *Loud Speaker Feed:* **D** = Direct. **F** = Filter. **Tr** = Transformer. *Current Supply:* **B** = Batteries. **AC** or **DC** = Mains Unit, Incorporated. *Gramophone Pick-up Arrangements:* **GP** = Pick-up included. **PP** = Provision for Pick-up.

Buyers' Guide, 1929–30.—

Manufacturer.	Name of Set.	Valves and Couplings. H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	Output.	Current Supply.	Gramo. Pick-up.	Price. £ s. d.	Remarks.
Edison Bell, Ltd., 62, Glengall Road, London, S.E.15.	All Mains Radio-Gram (RG)	—	—	—	—	*SG	TT	*AB	RC	*T	Tr	*T	Tr	AC	GP	65 0 0	Including valves and royalties. D.C. model with rotary converter, £19 extra.
,, ,, ,,	Bijou Two	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	3 12 6	Set only.
,, ,, ,,	Pedestal Three	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	PP	9 12 6	,, and L.S. only.
,, ,, ,,	Compact Three	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	PP	7 10 0	Oak. Set and L.S. only.
																8 8 0	Mah. ,, ,, ,,
																10 10 0	Lacquer ,, ,, ,,
,, ,, ,,	Homestead Three	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	PP	6 7 6	Oak. Set only.
																7 0 0	Mah. ,,
																8 8 0	Lacquer ,,
,, ,, ,,	Maison S.G. Three (P)	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	PP	8 10 0	Set only, 18×15×7½in. 35 lb.
,, ,, ,,	Regent Four	—	—	—	—	T	TT	AB	RC	T	Tr	T	D	B	—	20 0 0	Oak. Set only.
																22 10 0	Mah. ,,
,, ,, ,,	Console Four	—	—	—	—	T	TT	AB	RC	T	Tr	T	D	B	—	16 16 0	Oak. Set and L.S. only.
,, ,, ,,	Picnic Portable (P)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	—	16 16 0	Inclusive, 13½×13½×10in. 26 lb. De Luxe finish, £1 1s. extra.
Edison Swan Electric Co., Ltd., 1A, Newman Street, London, W.1.	3-valve Battery Receiver	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	9 12 6	Including valves and royalties.
	,, All Electric Receiver	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	F	AC or DC	PP	21 0 0	,, ,, ,, ,,
,, ,, ,,	All Electric AC Transportable (P).	—	—	—	—	*SG	TA	*LG	RC	*T	Tr	*T	D	AC	PP	31 10 0	Inclusive. Oak cabinet 13½×13½×9⅝in., 1 watt AC output.
,, ,, ,,	B.T.H. 4-valve	—	—	SG	TA	SG	TA	LG	Tr	T	—	—	D	B	—	21 0 0	Including valves and royalties.
Electric Lamp Service Co., Ltd., 39/41, Parker Street, London, W.C.2.	Stal (P)	—	—	T	RC	T	Ap	LG	Tr	T	Tr	T	D	B	—	13 13 0	Inclusive. Oak cabinet 16×8×12in. 26 lb.
Ellancee Radio, Ltd., Shardlow, Nr. Derby.	Ellancee Standard Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	7 1 1	Including valves and royalties.
	,, ,, Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	10 12 0	,, ,, ,, ,,
,, ,, ,,	,, S.G. Three	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	9 9 0	Set only.
,, ,, ,,	,, Radiogram (RG)	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	GP	22 0 0	Inclusive.
Elven Mains Receiver Co., 34, Church Street, London, W.8.	Elven Mains	—	—	—	—	—	—	*LG or AB	Tr	T	—	—	D	AC or DC	—	12 10 0	Including valves and royalties.
,, ,, ,,	Elven Mains Portable (P)	—	—	—	—	SG	TA	LG	RC	T	Tr	T	D	AC or DC	PP	28 7 0	Inclusive, 17×17×7in. 30 lb.
Empire Electric Co., 10, Fitzroy Square, London, W.1.	Metropolis Portable (P)	†	—	†	—	†	—	LG	—	P	—	—	D	B	—	31 10 0	Inclusive. Suitcase 13×12×5in. 22 lb. † 5-valve Super-Het.
,, ,, ,,	,, Table Grand	†	—	†	—	†	—	LG	—	P	—	—	D	B	—	31 10 0	,, † 5-valve Super-Het.
Falk, Stadelmann & Co., Ltd., 83/93, Farringdon Road, London, E.C.1.	Efescaphone "Waterloo" de Luxe.	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	D	AC	—	25 0 0	Including valves, L.S. and royalties.
,, ,, ,,	,, ,, ,,	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	20 10 0	,, batteries, valves, L.S. and royalties.
,, ,, ,,	Efescaphone "Waterloo"	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	12 0 0	Set and royalties only.
,, ,, ,,	,, "Repton"	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	8 15 0	,, ,, ,,
,, ,, ,,	,, "New Wolfe"	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	—	6 2 6	,, ,, ,,
,, ,, ,,	,, "Eton"	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	D	AC	—	22 0 0	Including valves and royalties.
,, ,, ,,	,, "Ascot" (P)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	21 0 0	Inclusive. Leatheroid suitcase 16¾×15¼×10in.
																23 0 0	,, Hide ,, ,, ,,
Jonathan Fallowfield, Ltd., 61/2, Newman Street, London, W.1.	Corner Cabinet Radio-Gram (RG).	—	—	—	—	SG	TT	LG	Tr	T or P	—	—	D	B	GP	40 0 0	Including batteries, valves and royalties.
Ferranti Ltd., Hollinwood, Lancs.	A.C. 31	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	Tr	AC	PP	26 0 0	Including valves and royalties.
A. G. Franklyn, Pegasus Works, Camden Terrace, Leeds.	Pegasus Scout (P)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	PP	17 17 0	Inclusive, 16×16×8in. 28 lb.
	,, Radiogramophone (RG)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	GP	31 10 0	,,
Gambrell Radio, Ltd., Buckingham House, Buckingham Street, London, W.C.2.	All Electric Two	—	—	—	—	—	—	LG	Tr	T	—	—	F	AC or DC	—	13 15 0	D.C. Model, including valves and royalties.
																17 10 0	A.C. ,, ,, ,, ,,
	,, ,, Three	—	—	—	—	SG	TA	LG	Tr	P	—	—	F	AC or DC	PP	22 0 0	D.C. ,, ,, ,, ,,
																25 0 0	A.C. ,, ,, ,, ,,
,, ,, ,,	,, ,, Transportable (P)	—	—	—	—	SG	TA	LG	Tr	P	—	—	F	AC or DC	PP	29 0 0	D.C. ,, inclusive.
																32 0 0	A.C. ,, ,,
,, ,, ,,	,, ,, Four	—	—	—	—	SG	TA	LG	Tr	P	—	—	F	AC or DC	—	33 5 0	D.C. model, including valves and royalties, 2 pentodes in parallel.
																39 15 0	A.C. ,, ,, ,, ,,
,, ,, ,,	Radio Gramophone (RG)	—	—	—	—	—	—	LG	Tr	P	—	—	F	AC or DC	GP	59 17 0	D.C. Model, inclusive. Oak, 2 pentodes in parallel.
																61 19 0	,, ,, ,, Mah. ,, ,,
																67 4 0	A.C. ,, ,, Oak ,, ,,
																69 6 0	,, ,, ,, Mah. ,, ,,
,, ,, ,,	,, Novotone (RG)	—	—	—	—	SG	TA	LG	Tr	P	—	—	F	AC or DC	GP	72 9 0	D.C. ,, ,, Oak ,, ,,
																64 11 0	,, ,, ,, Mah. ,, ,,
																84 0 0	A.C. ,, ,, Oak ,, ,,
																86 2 0	,, ,, ,, Mah. ,, ,,

Garnett, Whiteley & Co., Ltd., Lotus Works, Mill Lane, Liverpool.	Lotus S.G.P. All Mains	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	D	AC	PP	21 0 0	Including valves and royalties.
,, ,, ,,	,, ,, Battery Model	—	—	—	—	SG	TT	LG	Tr	P	—	—	D	B	PP	13 15 0	,,
,, ,, ,,	,, Portable (P)	—	—	SG	Ap	SG	TA	LG	Tr	P	—	—	D	B	—	19 19 0	Inclusive. Suitcase 13¾×15¼×12¾in. 35 lb.
,, ,, ,,	,, All Mains Transportable (P)	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	D	AC	—	25 4 0 26 5 0	Inclusive. Oak. ,, Mah. or walnut.
General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.	Gecophone Two-valve All Electric.	—	—	—	—	—	—	*LG	Tr	T	—	—	F	AC	—	15 0 0	Including valves and royalties.
,, ,, ,,	,, Three-valve ,,	—	—	—	—	*SG	TA	*LG	Tr	T	—	—	F	AC	—	25 0 0	,,
,, ,, ,,	,, ,, ,, ,, ,, (P)	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	F	AC	—	28 0 0	Inclusive 11¼×17×17¼in. 40 lb.
,, ,, ,,	,, S.G. Four (P)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	24 3 0	,, leather case, 10¼×15¼×15⅜in. 35 lb.
,, ,, ,,	,, S.G. Three	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	18 18 0	Including batteries, valves and royalties.
,, ,, ,,	,, "World Wide" S.G.4	—	—	SG	TT	SG	TT	AB	Tr	T	—	—	D	B	—	28 0 0	,, ,, ,,
Gent & Co., Ltd., Faraday Works, Leicester.	Radiomatic Pentode	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	PP	20 16 0	Including valves and royalties. ,,
,, ,, ,,	,, All Mains 2-valve	—	—	—	—	—	—	*LG	Tr	P	—	—	Tr	AC	PP	11 10 0	,, ,, ,,
,, ,, ,,	,, ,, ,, S.G.P.	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	Tr	AC	PP	20 0 0	(Approximate) ,, ,, ,,
,, ,, ,,	,, Radiogramophone (RG).	—	—	—	—	*SG	TT	*LG	Tr	T	Tr	T	Tr	AC	GP	55 0 0	Inclusive. LS 6a output and moving coil.
F. E. Godfrey, 3, New End, Hampstead, London, N.W.3.	Radiogramophone (RG)	—	—	*SG	TT	*SG	TT	*AB	Tr	*T	RC	T	Tr	AC or DC	GP	From 120 0 0	,, L.F. valves in push-pull following detector.
Gollings & Ayres, 21, The Broadway, Bedford.	Wellington V. (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	15 0 0 15 15 0	Inclusive. Oak or Suitcase. ,, Mah.
,, ,, ,,	,, Radio Gram (RG)	—	—	—	—	*SG	TA	*AB	RC	*T	Tr	T	Tr	AC	GP	60 0 0	,,
Gould, Harper & Co., Tatnam Road, Poole.	Melo Melodia Three	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	9 5 6	Including valves and royalties.
,, ,, ,,	,, ,, ,,	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	5 10 0	Set and royalties only.
Graham Amplion, Ltd., St. Andrew's Works, Slough.	Amplion Radiogramophone (RG).	—	—	—	—	*SG	TA	*LG	RC	*T	Tr	T	F	AC	GP	120 0 0 125 0 0	Inclusive. Oak. Paralleled output stage. ,, Mah. ,, ,,
,, ,, ,,	,, Standard Mains	—	—	—	—	*SG	TA	*LG	RC	*T	Tr	T	F	AC	PP	50 0 0	,, Paralleled output stage. ,,
,, ,, ,,	,, 4-valve	—	—	—	—	SG	TA	LG	RC	T	Tr	T	F	B	PP	25 0 0	
J. G. Graves, Ltd., Westville, Durham Road, Sheffield.	"Vulcan" 3 S.G.	—	—	—	—	SG	TT	LG	Tr	T	—	—	D	B	—	12 2 3	Complete receiving equipment including royalties.
,, ,, ,,	,, 2	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	7 10 0	
A. W. Griffin & Co., Ltd., Old Factory, Bates Hill, Redditch.	Terralto 2-valve	—	—	—	—	—	—	LG or AB	Tr	T or P	—	—	D	B	—	3 17 6	Set only. ,, ,, ,, ,,
,, ,, ,,	,, 3-valve	—	—	—	—	SG	TT	LG or AB	Tr	T or P	—	—	D	B	—	5 17 0	,, ,,
Halcyon Wireless Co., Ltd., 313/319, Regent Street, London, W.1.	De Luxe S.G.4 (P)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	29 8 0	Inclusive. Suitcase 16×15×10¼ in. 33 lb.
,, ,, ,,	,, Cabinet 5 (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	33 12 0	,, Walnut cabinet 18¼×14¼×8½in. 40 lb.
Harlie Bros., Balham Road, Lower Edmonton, London, N.9.	Harlie Radio-Gramophone (RG).	—	—	—	—	—	—	LG	Ch	T	Tr	T	Tr	AC or DC	GP	From £118 to 152 10 0	,, Output 2 LS 5a valves in parallel.
Harmony, Ltd., Great Portland Street, London, W.1.	Harmony (P)	—	—	T	Ap	T	Ap	AB	RC	T	Tr	T	Tr	B	—	14 14 0	,, Suitcase 14½×12×8½in. 27 lb.
Hart Collins, Ltd., 38A, Bessborough Street, London, S.W.1.	"Passport" Mains Transportable (P).	—	—	—	—	*SG	TA	*LG	Tr	*T	—	—	F	AC or DC	PP	32 10 0	Including valves and royalties.
,, ,, ,,	"Passport" 4-valve S.G. de Luxe (P).	—	—	—	—	SG	TG	AB	Tr	T	Tr	T	D	B	—	23 10 0	Inclusive. Walnut suitcase 14¾×12×8½in 25 lb.
,, ,, ,,	"Passport" 4-valve S.G. (P).	—	—	—	—	SG	TG	AB	Tr	T	Tr	T	D	B	—	21 5 0	,, Hide ,, ,, ,,
E. R. Harveyson, Hatherton Terrace, Hendon Lane, London, N.3.	Minstrel (P)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	16 16 0	Inclusive, 15×13¾×7¼in. 24 lb.
W. J. Henderson & Co., Ltd., 351, Fulham Road, London, S.W.10.	Pedestal Radio-Gramophone (RG)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B, AC or DC	GP	40 0 0 49 15 0 57 15 0	Inclusive. Battery model, frame aerial incorporated. ,, D.C. Mains ,, ,, ,, ,, A.C. ,, ,, ,,
,, ,, ,,	Type S. (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	26 5 0	,, Mah. cabinet, 17¼×13×10in. 31 lb.
,, ,, ,,	,, P. (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	24 5 0	,, ,, ,, 14½×13¼×7½in. 24½ lb.
,, ,, ,,	,, T. (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	17 17 0	,, Suitcase 9¼×15×12½in. 28 lb.
,, ,, ,,	,, U. (P)	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	11 11 0	,, Fabric covered cabinet 8¾×8×12in. 19¾ lb.
Holt & Crompton, 196, Shaftesbury Avenue, London, W.C.2.	Lion "Cub" (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	,, Walnut or mah. cabinet 16¼×11¾×7¾ in. 26 lb.
,, ,, ,,	,, "Monarch" (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	25 4 0	,, ,, mah. or fabric-covered cabinet 16¾×12¾×8in. 32 lb.
Igranic Electric Co., Ltd., Elstow Works, Bedford.	Short Wave Screened Grid Receiver.	—	—	—	—	SG	TA	LG	Tr	P	RC	T	D	B	—	34 16 0	Including valves and royalties, 10–85 metres.
,, ,, ,,	Short Wave Neutrosonic Receiver.	†	—	†	—	†	—	†	—	†	—	†	D	B	—	28 7 0	Oak, including valves and royalties. Mah. £3 extra. † 6-valve Super-Het.
,, ,, ,,	AC/3 Cabinet Model (RG).	—	—	—	—	*SG	TA	*LG	Tr	T or P	—	—	F	AC	GP	48 10 0	Oak inclusive. Mah. £3 extra.
,, ,, ,,	AC/3 Table Model	—	—	—	—	*SG	TA	*LG	Tr	T or P	—	—	F	AC	PP	25 0 0	Oak, including valves and royalties. Mah. £1 extra.
,, ,, ,,	Neutrosonic de Luxe Radio-Gramophone (RG).	†	—	†	—	†	—	†	—	†	—	†	F	AC	GP	114 10 0	Oak inclusive. Mah. £3 extra. † 8-valve Super-Het.
,, ,, ,,	Neutrosonic Seven Table Model.	†	—	†	—	†	—	†	—	†	—	†	D	B	PP	52 0 0	Including valves and royalties. † 7-valve Super-Het.
,, ,, ,,	Neutrosonic Seven Transportable Model (P).	†	—	†	—	†	—	†	—	†	—	†	D	B	—	69 0 0	Inclusive. Leatherette cases. † 7-valve Super-Het.
,, ,, ,,	Universal Receiver (P)	—	—	SG	TG	SG	AP	LG	RC	T	Tr	T	D	B	—	33 2 6	,, Suitcase.

ABBREVIATIONS.—*RG* = Radio Gramophone. *P* = Portable. *Valves:* **SG** = Screen Grid. **TG** = Tuned Grid. **T** = Triode. **P** = Pentode. ***** = Directly or Indirectly Heated Mains Valves. *Coupling:* **TA** = Tuned Anode. **TG** = Tuned Grid. **TT** = Tuned Transformer. **Ap** = Aperiodic. **RC** = Resistance. **Tr** = Transformer. **Ch** = Choke. *Method of Rectification:* **AB** = Anode Bend. **LG** = Leaky Grid. *Loud Speaker Feed:* **D** = Direct. **F** = Filter. **Tr** = Transformer. *Current Supply:* **B** = Batteries. **AC** or **DC** = Mains Unit, Incorporated. *Gramophone Pick-up Arrangements:* **GP** = Pick-up included. **PP** = Provision for Pick-up.

Manufacturer.	Name of Set.	Valves and Couplings. H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	Output.	Current Supply.	Gramo. Pick-up.	Price. £ s. d.	Remarks.
Itonia Gramophones, Ltd., 58, City Road, London, E.C.1.	Screened-Grid IV. (*P*)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21 0 0	Inclusive, hide suitcase.
	Autocrat V. (*P*)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	16 16 0	,,
,, ,, ,,	Screened-Grid IV. Radio-gramophone (*RG*).	—	—	—	—	—	—	—	—	—	—	—	—	—	—	39 18 0	,,
W. H. Janes, 202, Dale Street, Chatham.	Janettephone 2	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	12 0 0	Including batteries, valves, L.S. and royalties.
	,, S.G.3	—	—	—	—	SG	TT	LG	Tr	T	—	—	Tr	B	—	24 0 0	,, valves, eliminator, L.S. and royalties.
Kolster-Brandes, Ltd., Cray Works, Sidcup, Kent.	KB 161—KB169	—	—	—	—	*SG	TT	*LG	Tr	P	—	—	D	AC	PP	17 10 0	Including valves and royalties.
	KB103—KB156 (*P*)	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	—	18 18 0	Inclusive, oak or leather case 17×16¾×9¾in. 36 lb.
,, ,, ,,	KB163	—	—	—	—	SG	TT	LG	Tr	P	—	—	—	—	PP	10 15 0	Including valves and royalties.
,, ,, ,,	Brandesets IIIA and IIIB	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	7 10 0	IIIA oak, including valves and royalties.
																8 17 6	IIIB ,, ,, ,, ,, with battery compartment.
,, ,, ,,	KB Radio Gramophone (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	T	—	—	D	AC	GP	49 10 0	Including valves and royalties.
,, ,, ,,	KB.182 ,, ,, (*RG*)	—	—	—	—	SG	TT	LG	Tr	T	—	—	D	B	GP	39 10 0	,, batteries, valves and royalties.
S. A. Lamplugh, Ltd., Kings Road, Tyseley, Birmingham.	Silver Ghost A.C. S.G.3	—	—	—	—	*SG	—	*LG	—	*T	—	—	D	AC	—	27 10 0	Inclusive.
	,, ,, Chassirad Popular III.	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	4 15 0	Set and royalties only.
,, ,, ,,	Silver Ghost Popular III.	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	5 7 6	,, ,, ,, ,,
,, ,, ,,	,, ,, Standard III.	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	7 2 6	,, ,, ,, ,,
Eric J. Lever (Trix), Ltd., 8/9, Clerkenwell Green, London, E.C.1.	Trix Five (*P*)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	PP	17 17 0	Set and accessories only. Walnut or mah. cabinet, 17×15¾×8½in. 30 lb. Special adaptor for use with Mains.
,, ,, ,,	,, Two (*P*)	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	10 10 0	Set and accessories only. Leather cloth suitcase 13½×13½×7in. 16 lb.
,, ,, ,,	,, Portette (*P*)	—	—	—	—	—	—	LG	—	—	—	—	—	B	—	5 15 6	Complete with headphones, leather cloth case 8×6×6in. 6½ lb.
,, ,, ,,	,, All Mains 3	—	—	—	—	—	—	*AB	RC	*T	Tr	*T	F	AC	PP	18 10 0	Inclusive.
,, ,, ,,	,, Radio Gram "A" (*RG*)	—	—	—	—	—	—	*AB	RC	*T	Tr	*T	F	AC	GP	47 5 0	,,
Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex	S.G.3	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	8 0 0	Set and royalties only.
	Lissenola Five (*P*)	—	—	T	TT	T	Ap	LG	Tr	T	Tr	T	D	B	PP	19 19 0	Inclusive. Hide, oak or mah. suitcase.
																16 16 0	,, Leather cloth suitcase.
,, ,, ,,	,, Radio Gramophone 1/S.G. (*RG*).	—	—	—	—	SG	TA	LG	Tr	P	—	—	Tr	B, AC or DC	GP	From £30 to £70	,,
,, ,, ,,	,, Radio Gramophone 2/S.G. (*RG*).	—	—	SG	TA	SG	TA	LG	Tr	P	—	—	Tr	B, AC or DC	GP	From £30 to £70	,, Pentodes in parallel in moving coil models.
Liverpool Radio Supplies, 64, Myrtle Street, Liverpool.	Uniflex 3	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	F	AC	PP	18 0 0	,,
	,, 5 (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	PP	15 0 0	,, Oak or mah. cabinet 18¾×17×8in. 28 lb.
Loewe Radio Co., Ltd., 4, Fountayne Road, Tottenham, London, N.15.	R.O.433	—	—	—	—	—	—	LG	—	†	—	†	D	B	PP	3 10 0	Including valve and royalty, capacity controlled reaction. † Triple valve.
,, ,, ,,	O.E.333	—	—	—	—	—	—	AB	—	†	—	†	D	B	PP	3 3 0	Including valve and royalty. No reaction. † Triple valve.
London Electrical Co., 1, Sherborne Lane, King William Street, London, E.C.4.	Lecodyne G.4 (*RG*)	—	—	—	—	SG	TT	LG	RC	T	Tr	T	D	B	GP	19 19 0	Including batteries, valves, L.S. and royalties.
	,, G.3. (*RG*)	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	GP	14 14 0	,, ,, ,, ,, ,,
	,, 1930M.M.	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	—	8 0 0	,, valves and royalties.
Loudspeaker Co., Ltd., 38, Palmer Street, London, S.W.1.	4-valve S.G. Transportable (*P*)	—	—	—	—	SG	Ap	LG	Tr	T	Tr	T	Tr	B	PP	36 15 0	Including valves, L.S., royalties and A.C. or D.C. eliminator 18×17×8in. 32 lb.
Claude Lyons, Ltd., 76, Old Hall Street, Liverpool.	Lyons-Ferranti 5-valve	—	—	—	—	SG	TT	AB	Tr	T	Tr	T	Tr	B	PP	27 10 0	Including valves and royalties. Push-pull L.F. A.C. model £10 10s. extra, D.C. model £7 extra.
,, ,, ,,	Chronicle-Lyons 8-valve Super-Het.	†	—	†	—	†	—	†	—	†	—	†	F	B	PP	33 10 0	Including valves and royalties. † Super-Het. A.C. model £10 extra, D.C. model £7 extra.
M.P.A. Wireless, Ltd., Radio Works, High Road, Chiswick, London, W.4.	All Electric Three	—	—	—	—	*T	TT	*AB	Tr	P	—	—	F	AC	PP	26 5 0	Including valves and royalties.
L. McMichael, Ltd., Slough, Bucks.	Screened Dimic 3	—	—	—	—	SG	TG	LG	Tr	P	—	—	F	B	PP	19 19 0	Including valves and royalties, with special provision for eliminator.
,, ,, ,,	,, ,,	—	—	—	—	*SG	TG	*LG	Tr	T	—	—	F	AC	PP	29 8 0	,, ,, ,, ,,
,, ,, ,,	Super Range Transportable Four. (*P*)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	27 6 0	Inclusive. Table model with special adaptor for eliminator
,, ,, ,,	Super Range Four (*P*)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	23 2 0	Inclusive. Leather suitcase 15¾×15×9in. 30 lb. with special adaptor for eliminator.
,,	Super Screened Four (*P*)	—	—	SG	Ap	SG	TG	LG	Tr	P	—	—	D	B	—	36 15 0	Inclusive. Walnut case 18×15¾×7in. 35 lb. with special adaptor for eliminator.

Marconiphone Co., Ltd., 210/212, Tottenham Court Road, London, W.1.	Model 23	—	—	—	—	•	—	LG	Tr	T or P	—	—	D	B or AC	—	10 2 3 16 4 3	Battery model including valves and royalties. A.C. model
,, ,, ,,	,, 23A	—	—	—	—	—	—	LG	Tr	T or P	—	—	D	B or AC	—	12 13 3 18 19 3	Battery ,, ,, ,, L.S. and royalties. A.C. ,, ,, ,, ,,
,, ,, ,,	,, 34 (S/W.)	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	—	22 10 0	Including valves and royalties, 12–3,000 metres.
,, ,, ,,	,, 39	—	—	—	—	SG	TA	LG	Tr	T or P	—	—	D	B or AC	PP	13 0 0 21 0 0	Battery model, including valves and royalties. A.C. ,, inclusive.
,, ,, ,,	,, 44	—	—	SG	TA	SG	TA	AB	RC	T or P	—	—	D	B or A.C.	—	22 10 0 30 0 0	Battery model, including valves and royalties. A.C. ,, inclusive.
,, ,, ,,	,, 47	—	—	—	—	SG	TA	AB	RC	T	RC	T	D	AC	PP	24 0 0	Inclusive.
,, ,, ,,	,, 45 (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	18 18 0	,, Oak cabinet 14×14½×7¾in. 28 lb.
,, ,, ,,	,, 56	SG	TA	SG	TA	SG	TA	AB	RC	T or P	—	—	D	B or AC	PP	30 7 0 35 0 0	Battery model. Including valves and royalties. A.C. ,, Inclusive.
,, ,, ,,	,, 61	SG	TA	SG	TA	SG	TA	AB	RC	T	RC	T	D	B	—	52 10 0	Set and royalties only, dials calibrated in wavelengths.
,, ,, ,,	,, 82	†	—	†	—	†	—	†	—	†	—	†	D	B	—	53 0 0 70 17 6	,, ,, ,, ,, † 8-valve Super-Het. With complete equipment.
Montague Radio Inventions & Development Co., Ltd., 117/119, Regent Street, London, W.1.	Beethoven S.G. Super Four (P).	—	—	T	Ap	SG	TA	LG	Tr	P	—	—	D	B	—	26 5 0	Inclusive. Walnut cabinet 19×14½×9in. 34 lb.
	,, Q.C.R. (P)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	22 1 0	,, Hide attaché case 9¼×14½×9in. 26 lb. With special reaction.
National Electric Co., Ltd., 10/14, Beak Street, London, W.1.	De Luxe 5 (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	15 15 0	Inclusive. 8×12×16½in. 27 lb
Neophone Engineering Co., 8, Garrick Street, London, W.C.2.	Neophone A. (P)	—	—	T	—	T	—	LG	—	T	—	T	D	B	—	15 15 0 16 5 0	Set complete less royalties. Oak 15½×13×9¼ in. 28 lb. ,, ,, ,, ,, Mah. ,, ,, ,,
C. H. P. Nutter, 245, Selhurst Road, South Norwood, London, S.E.25.	Mains Three (RG)	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	F	AC	GP	36 15 0	Inclusive.
	Standard Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	9 9 0	Including batteries, valves, L.S. and royalties.
Ormond Engineering Co., Ltd., Ormond House, Rosebery Avenue, London, E.C.1.	Suitcase Four (P)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	16 16 0	Inclusive, 16¾×13×9in. 28 lb.
	,, Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	15 0 0	,, ,,
	Five Valve Cabinet (P)	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	15 0 0	Oak ,, 18⅜×14½×8½in. 30 lb. Mah. or walnut 15s. extra.
Orth-o-Dyne Radio & Electric Co., 63, Shaftesbury Street, London, N.1.	Orth-o-Dyne Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	PP	16 16 0	Inclusive. Hide suitcase 15½×13×10½in. 30 lb.
	,, Transportable (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	15 15 0	,, Mah. cabinet 14¾×14½×8½in. 28 lb.
Pandona, Ltd., 184, Ashton Road, Birmingham.	Pandona Radio-Gram. S.G. IV. (RG)	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	Tr	B	GP	From 44 2 0	Inclusive. Provision for Mains Unit.
,, ,, ,,	Pandona Radio-Gram V. (RG)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	Tr	B	GP	From 42 0 0	,, ,, ,, ,,
,, ,, ,,	Pandona Screen Grid Four (P).	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	D	B	—	18 18 0	Including valves and royalties. Leather suitcase 17×16×8in. 30 lb.
,, ,, ,,	Pandona Portable Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	Including valves and royalties. Polished walnut case 17×13×7in. 28 lb.
Partridge, Wilson & Co., Loughborough Road, Leicester.	Davenset Transportable Five (P).	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	18 18 0	Inclusive. Walnut cabinet 15½×15¾×8in. 24 lb.
Alfred Pearson, 80A, Newland Avenue, Hull.	"Perakon"	—	—	—	—	—	—	*LG	Tr	P	—	—	F	AC	—	12 10 0	Including valves and royalties.
	,,	—	—	—	—	SG	TT	*AB	Tr	P	—	—	F	AC	—	16 15 0	,, ,,
"Phantestra" (Renn's Gramophone & Wireless), Ltd., 2/4, Tottenham Road, Dalston, London, N.1.	Radio-Gramophone (PRG)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	GP	24 3 0	Inclusive. Oak. 11×18×15¾in. 40 lb.
	Phantestra Five (P)	—	—	T	Ap	T	Ap	LG	RC	T	Tr	T	D	B	—	15 15 0	,, ,, 10×15¾×12in. 27 lb.
,, ,, ,,	Phantestra Home Model (RG).	—	—	SG	TA	T	Ap	LG	RC	T	Tr	T	F	B, AC or DC	GP	37 10 0 42 0 0	Battery model, inclusive. Mains models ,,
,, ,, ,,	Phantestra S.G.3 (RG)	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	GP	26 5 0	Inclusive.
	Renntestra S.G.3	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	PP	26 5 0	,, with mechanical gramophone.
Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2.	Type 2501	—	—	—	—	*SG	TA	*LG	Tr	P	—	—	D	AC	—	16 10 0	Inclusive, for use with H.T. mains unit.
,, ,, ,,	,, 2802	—	—	—	—	SG	TA	LG	Tr	T	Tr	P	D	B	PP	30 0 0	,, 10–2,400 metres.
,, ,, ,,	,, 2502	—	—	—	—	SG	TA	LG	Tr	P	—	—	D	B	—	15 0 0	,,
,, ,, ,,	,, 2511	—	—	*SG	TA	*SG	TA	*LG	Tr	P	—	—	Tr	AC	PP	37 10 0	,,
,, ,, ,,	,, 2515	—	—	—	—	—	—	*LG	Tr	P	—	—	Tr	AC	PP	12 10 0	,,
,, ,, ,,	,, 2514	—	—	—	—	SG	TA	LG	Tr	P	—	—	Tr	AC	PP	23 0 0	
C. Haddon Poupard & Co., Ltd., Thermion Works, Ilford, Essex.	Thermion Auto Electrical Gramo-Radio (RG).	—	—	—	—	SG	TA	AB	RC	T	Tr	T	Tr	AC or DC	GP	From 57 15 0 to 120 15 0	Inclusive. Paralleled output stage.
,, ,, ,,	Thermion All Electric	—	—	—	—	—	—	AB	Tr	T	—	—	Tr	AC or DC	PP	—	,, ,, ,,
,, ,, ,,	Thermion Five (P)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	PP	22 1 0	Inclusive. Walnut attaché case.
Power Equipment Co., Ltd., Kingsbury Works, The Hyde, Hendon, London, N.W.9.	Kingswan 3 (P)	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	9 9 0	Inclusive. Fabric covered case 22 lb.
Precision Radio Mfg. Co., Ltd., Board School Road, Woking, Surrey.	Screened Grid Four Transportable (P).	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	PP	26 5 0	Including valves and royalties.
,, ,, ,,	Radio Three	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	PP	6 10 0	Set only.

ABBREVIATIONS.—*RG* = Radio Gramophone. *P* = Portable. *Valves*: **SG** = Screen Grid. **TG** = Tuned Grid. **T** = Triode. **P** = Pentode. * = Directly or Indirectly Heated Mains Valves. *Coupling*: **TA** = Tuned Anode. **TG** = Tuned Grid. **TT** = Tuned Transformer. **Ap** = Aperiodic. **RC** = Resistance. **Tr** = Transformer. **Ch** = Choke. *Method of Rectification*: **AB** = Anode Bend. **LG** = Leaky Grid. *Loud Speaker Feed*: **D** = Direct. **F** = Filter. **Tr** = Transformer. *Current Supply*: **B** = Batteries. **AC** or **DC** = Mains Unit, incorporated. *Gramophone Pick-up Arrangements*: **GP** = Pick-up included. **PP** = Provision for Pick-up.

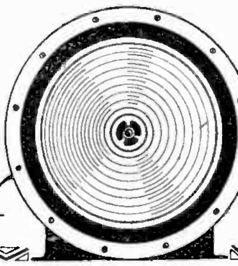
Buyers' Guide, 1929–30.—

Manufacturer.	Name of Set.	H.F.	Coupling.	H.F.	Coupling.	H.F.	Coupling.	Det.	Coupling.	L.F.	Coupling.	L.F.	Output.	Current Supply.	Gramo. Pick-up.	Price. £ s. d.	Remarks.
Pye Radio, Ltd., Radio Works, Cambridge.	Type 25/C. (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	23 10 0	Inclusive. Walnut cabinet 15×15×7in. 26 lb. Provision for A.C. eliminator.
,, ,, ,,	All Electric Three	—	—	—	—	*SG	TT	*AB	Tr	*T	—	—	F	AC	PP	25 0 0	Including valves and royalties.
,, ,, ,,	Screened Grid Four	—	—	—	—	SG	TT	AB	RC	T	Tr	T	F	B	PP	19 10 0	,, ,, ,, ,,
,, ,, ,,	Presentation Two	—	—	—	—	—	—	LG	Tr	T	—	—	—	B or AC	PP	12 10 0 17 10 0	Inclusive. Battery model. ,, Mains ,,
,, ,, ,,	Popular Two	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	4 17 0	Set and royalties only.
Quadruple Valve Co., Ltd., 1, Hood Street, Northampton.	"Really Portable" (*P*)	—	—	T	Ap	T	Ap	LG	—	†	—	†	D	B	—	12 12 0	Inclusive, 16×14×4in. 17 lb. † Multiple valve as Det 2 L.F.
Radiocraft Supplies, Ltd., Arcade, Walsall.	"Peter Pan"	—	—	—	—	—	—	LG	Tr	P	—	—	D	B	—	6 15 0	Including batteries, valves a ndroyalties.
	Screened III.	—	—	—	—	SG	TT	LG	Tr	P	—	—	D	B	PP	12 10 0	,, ,, ,, ,,
Radio Gramophone Development Co., St. Peter's Place, Broad St., Birmingham.	Type D.C. G5 (*RG*)	—	—	—	—	—	—	—	—	—	—	—	—	DC	GP	75 0 0	Inclusive, Oak. 5 valve set with generous power output.
,,	D.C. D6 (*RG*)	—	—	—	—	—	—	—	—	—	—	—	—	DC	GP	75 0 0	,, ,, 6 ,, ,, ,, ,, ,, ,,
,,	D.C. D7 (*RG*)	—	—	—	—	—	—	—	—	—	—	—	—	DC	GP	125 0 0	,, ,, 7 ,, ,, ,, ,, ,, ,,
Radio Instruments, Ltd., 12, Hyde Street, London, W.C.1.	Transportable All Elec. 3(*P*)	—	—	—	—	SG	TG	LG	Tr	P	—	—	Tr	DC	—	30 0 0	Including valves and royalties.
	,, ,, ,, (*P*)	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	Tr	AC	—	30 0 0	,, ,, ,, ,,
Read & Morris, Ltd., 81, Castle Street, London, W.1.	D.C. Simplicity Four	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	F	DC	PP	32 0 0	Inclusive.
	Lone Star Overseas Four	—	—	—	—	SG	TT	LG	Tr	T	Tr	T	F	B or AC	PP	28 0 0 48 0 0	Battery model. Set and royalties only. Mains ,, inclusive.
Read Radio, Ltd., 32, Newman Street, London, W.1.	"Reaco" (*P*)	—	—	T	—	T	—	LG	—	T	—	T	Tr	B	—	13 13 0	Inclusive. Oak cabinet 11×16×8in. 22 lb.
Rees Mace Mfg. Co., 39A, Welbeck Street, London, W.1.	Gnome (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	19 19 0	Inclusive. Leather attaché case 13×11×6in. 20 lb.
	Twin Grand (*P*)	—	—	SG	TT	SG	TT	LG	Tr	T	Tr	T	D	B	PP	37 16 0	,, Mah. cabinet 20½×19½×8in. 42 lb.
	,, Baby (*P*)	—	—	SG	TT	SG	TT	LG	Tr	T	Tr	T	D	B	PP	35 14 0	,, ,, ,, 15×15×9in. 32 lb.
,, ,, ,,	Medium Four (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	PP	23 2 0	,, Leather attaché case 16×13×9in. 29 lb.
,, ,, ,,	Tourist Seven (*P*)	†	—	†	—	†	—	†	—	†	—	†	D	B	PP	40 19 0	,, ,, ,, ,, 17×14×9in. 35 lb. † 7-valve Super-Het.
Rialton Radio, 21A, Barbican, London, E.C.1.	Radiogramophone (*RG*)	SG	—	SG	—	SG	—	AB	Tr	T	—	—	Tr	B, AC or DC	GP	89 5 0 110 5 0	Battery model complete. Push pull output stage. Mains models ,, ,, ,, ,,
,, ,, ,,	"Melba" (*P*)	SG	—	SG	—	SG	—	LG	Tr	P	—	—	D	B, AC or DC	PP	From 42 0 0	Inclusive. Walnut, mah. or leather cabinet 17×18×10in. 40 lb.
,, ,, ,,	Screened Grid Portable (*P*)	—	—	SG	Ap	T	Ap	LG	Tr	P	—	—	D	B, AC or DC	PP	19 19 0	Inclusive. Battery model, oak, mah. or leatherette case, 15×12½×10in. 24 lb. Mains models £5 5s. extra.
,, ,, ,,	Junior Portable (*P*)	—	—	T	Ap	T	Ap	LG	Tr	P	—	—	D	B	—	16 16 0	Inclusive. Oak, mah. or leatherette case 14×12×9in. 20 lb.
Rolls-Caydon Sales, 77, Rochester Row, London, S.W.1.	Phantom Regional Screened 4 (*P*)	—	—	SG	Ap	SG	TA	LG	Tr	P	—	—	D	B	—	44 2 0	Inclusive.
,, ,, ,,	Portable Screened Four (*P*)	—	—	—	—	*SG	TA	*LG	—	*T	—	*T	D	AC	—	36 15 0	,,
,, ,, ,,	Radio-Gramophone (*RG*)	—	—	*SG	Ap	*SG	TA	*LG	Tr	P	—	—	F	AC	GP	75 12 0	,,
Rooke Bros., Ltd., 55, Cardington Street, London, N.W.1.	Faradex Five (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	PP	16 16 0	,, Leather case 15½×12½×8¾in. 28 lb.
	,, S.G. Four (*P*)	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	18 18 0	,, ,, ,, 17×13×10in. 32½ lb.
Royal Radio Co., 4/5, Dorset Mews North, London, N.W.1.	Five Valve (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	Inclusive. Fabrikoid suitcase 15½×12½×9in. 24 lb. Built-in wave trap.
,, ,, ,,	Screened Four Transportable (*P*)	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	PP	19 19 0	Inclusive. 15×15×8in. 28 lb.
,, ,, ,,	Radio Gramophone (*RG*)	—	—	—	—	*SG	TT	*LG	Tr	*T	—	—	F	AC or DC	GP	50 8 0	,,
,, ,, ,,	Screened Four (*P*)	—	—	—	—	SG	TA	LG	RC	T	Tr	T	D	B	—	18 18 0	,, Leatherette suitcase 15½×12½×9in. 26 lb.
T. W. Rutter, 3, St. James' Road, West Croydon.	"Personic V." (*P*)	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	16 16 0	,, Mah. cabinet 14½×8½×7in. 31 lb.
Saxon Radio Co., Henry Street Works, South Shore, Blackpool, Lancs.	Saxon S.G. Four	—	—	—	—	SG	TA	AB	RC	T	Tr	T	D	B	—	17 0 0 23 15 0	Including batteries, valves and royalties, stand model. ,, ,, ,, L.S. and ,, pedestal ,,
,, ,, ,,	Saxon All Electric Three	—	—	—	—	—	—	*AB	RC	*T	Tr	*T	D	AC	—	18 7 6 25 17 6	,, valves and royalties, stand model. ,, ,, L.S. and ,, pedestal ,,
,, ,, ,,	Saxon 3-valve	—	—	—	—	—	—	LG	RC	T	Tr	T	D	B	—	From 6 10 0 From 14 10 0	Set and royalties only, stand model. ,, L.S. and ,, ,, pedestal ,,
James Scott & Co., Allscott Radio Works, Chapel Street, Dunfermline.	Allscott 4-valve (*P*)	—	—	—	—	SG	TG	LG	Ch	T	Tr	P	D	B	—	22 10 0	Inclusive suitcase 17×15½×10½in. 29 lb.
	,, VI.	—	—	SG	TG	SG	TG	LG	Ch	T	Tr	T	Tr	B, AC or DC	PP	49 10 0 37 10 0	Mains models, including valves and royalties. Push-pull output. Battery model ,, ,, ,, ,, ,,

James Scott & Co., Allscott Radio Works, Chapel Street, Dunfermline —*continued.*	Allscott IV.	—	—	—	—	SG	TG	LG	Ch	T	Tr	T	F	B, AC or DC	PP	32 10 0 22 10 0	Mains models, including valves and royalties. Battery model ,, ,, ,, ,,
,, ,, ,,	,, III.	—	—	—	—	*SG	TG	*LG	Tr	P	—	—	F	ACand DC	PP	26 10 0	Including valves and royalties.
,, ,, ,,	,, III.	—	—	—	—	SG	TG	LG	Tr	P	—	—	D	B	PP	16 0 0	,, ,, ,, ,,
,, ,, ,,	,, IIIB.	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	9 0 0	,, ,, ,, ,,
,, ,, ,,	,, III. Radio-Gram. *(RG)*	—	—	—	—	SG	TG	LG	Tr	P	—	—	F	B, AC or DC	GP	37 0 0	,, ,, ,, ,, Oak battery model.
																50 0 0	,, ,, ,, ,, ,, Mains models.
																39 10 0	,, ,, ,, ,, Mah. battery model.
																52 10 0	,, ,, ,, ,, ,, Mains models.
,, ,, ,,	,, IV. Radio-Gram. *(RG)*	—	—	—	—	SG	TG	LG	Ch	T	Tr	T	F	B, AC or DC	GP	70 0 0 75 0 0	,, ,, ,, ,, Oak. ,, ,, ,, ,, Mah.
,, ,, ,,	,, VI. Radio-Gram. *(RG)*	—	—	SG	TG	SG	TG	LG	Ch	T	Tr	T	Tr	AC or DC	GP	93 10 0	,, ,, ,, ,, Oak. Output valves in push-pull.
																98 10 0	,, ,, ,, ,, Mah. ,, ,,
Selectors, Ltd., 206/207, Bedford Avenue, Slough Trading Estate, Slough, Bucks.	Attaché Portable 4-valve *(P)*.	—	—	—	—	SG	—	LG	Tr	T	Tr	T	D	B	PP	33 12 0	Leather attaché case 15¾ × 13 × 8¾in. 26 lb.
	" Cabinet Four " *(P)*	—	—	—	—	SG	—	LG	Tr	T	Tr	T	D	B	PP	33 12 0	Mah. cabinet 17 × 15¾ × 8in. 26 lb.
,, ,, ,,	" All Electric "	—	—	—	—	*SG	—	*LG	Tr	*T	Tr	*T	†	AC	PP	57 15 0	Including valves, L.S. and royalties. † Filter transformer.
,, ,, ,,	" Selector-Vox " *(RG)*	—	—	—	—	*SG	—	*LG	Tr	*T	Tr	*T	†	AC	GP	157 10 0	Inclusive. † Filter transformer. Output valves in parallel.
Sloan Electrical Co., Ltd., 8/12, Golden Lane, London, E.C.1.	" British Five " *(P)*	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	13 15 0	Inclusive. Mah. cabinet 13¾ × 13¼ × 8¼in. 25 lb.
Stratton & Co., Ltd., Balmoral Works, Bromsgrove Street, Birmingham.	Eddystone Scientific Four S/W.	—	—	—	—	SG	TT	LG	Ch	T	Tr	T	D	B	PP	27 0 0	Including valves and royalties. 16-550 metres.
Symphony Gramophone & Radio Co., Ltd., 23/24, Warwick Street, London, W.1.	Radio-Gramophone de Luxe *(RG)*.	—	—	—	—	*SG	TA	*AB	Tr	P	—	—	Tr	AC or DC	GP	115 0 0	Including valves and royalties. Push-pull output. With record compartments £10 extra.
	Radio-Gramophone *(RG)* .	—	—	T	AP	T	Ap	LG	Tr	T	Tr	T	D	B, AC or DC	GP	From 37 16 0 to 47 5 0	Battery model inclusive. D.C. model £4 4s. 6d. extra. A.C. model £6 6s. extra.
,, ,, ,,	Symphony Portable *(P)* ..	—	—	T	Ap	T	Ap	LG	Tr	T	Tr	T	D	B	—	17 17 6	Inclusive. Mah. cabinet 16 × 12¾ × 8¼in. 30 lb.
W. W. Taylor, 20, Brook Street, London, E.C.4.	" Omnivox " 2-valve *(P)* .	—	—	—	—	—	—	LG	Tr	T	—	—	D	B	—	8 0 0	Including batteries and valves. Mah. case 12 × 12 × 7in. 22 lb.
Tulsemere Mfg. Co., 1/7, Dalton Street, West Norwood, London, S.E.27.	" Tannoy " R-2	—	—	—	—	—	—	*LG	Tr	*T	—	—	D	AC	—	10 10 0	Complete. All Mains.
Tutills, Ltd., 7/9, Swan Street, Manchester.	" Tinol R.G." *(RG)*	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	Tr	AC or DC	GP	65 0 0 55 0 0	A.C. model inclusive. D.C. ,, ,,
Ultra Electric, Ltd., 661/663, 843/845, Harrow Road, London, N.W.10.	Air-chrome S.G. IV. *(P)* ..	—	—	—	—	SG	TG	LG	Tr	T	Tr	T	D	B	—	21 0 0	Inclusive. Hide suitcase 13 × 13 × 7½in. 30 lb.
	,, ,, V. *(P)*	—	—	T	Ap	T	Ap	LG	Tr	T	RC	T	D	B	—	16 16 0	,, Rexine ,, 13 × 13 × 9in. 30 lb.
Universal Gramophone & Radio Co., Ltd., Ryland Road, Kentish Town, London, N.W.5.	" Truvox " Baby Grand *(RG)*.	—	—	—	—	SG	TA	LG	Tr	T	—	—	D	B	GP	33 15 0	Inclusive. Oak.
	,, Concert Grand *(RG)*	—	—	—	—	SG	TA	AB	RC	T	Tr	T	F	B	GP	51 0 0	,, ,,
	,, ,, ,, *(RG)*	—	—	—	—	*SG	TA	*AB	Tr	*T	—	—	F	AC or DC	GP	65 15 0	,, ,,
Varley, 103, Kingsway, London, W.C.2.	Console Radio Gramophone *(RG)*.	—	—	—	—	T	TG	LG	Tr	P	—	—	Tr	DC	GP	70 5 0	Including valves and royalties.
,, ,, ,,	,, ,, ,, *(RG)*	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	Tr	AC	GP	70 5 0	,, ,, ,, ,,
,, ,, ,,	Upright Radio Gramophone *(RG)*.	—	—	—	—	—	—	LG	Tr	P	—	—	Tr	DC	GP	32 18 0	,, ,, ,, ,,
,, ,, ,,	,, ,, ,, *(RG)*	—	—	—	—	—	—	*LG	Tr	*T	—	—	Tr	AC	GP	32 18 0	,, ,, ,, ,,
,, ,, ,,	All Electric Two	—	—	—	—	—	—	LG	Tr	P	—	—	Tr	AC or DC	PP	17 11 0	,, ,, ,, ,,
,, ,, ,,	,, ,, Three	—	—	—	—	T	TG	LG	Tr	P	—	—	Tr	DC	PP	27 5 0	,, ,, ,, ,,
,, ,, ,,	,, ,, ,, ...	—	—	—	—	*SG	TG	*LG	Tr	*T	—	—	Tr	AC	PP	27 5 0	,, ,, ,, ,,
Watmel Wireless Co., Ltd., Imperia Works, High Street, Edgware, Middlesex.	Orthotone Imperial Radio-Gram *(RG)*.	—	—	—	—	—	—	*LG	Tr	P	—	—	Tr	AC	GP	28 7 0	,, ,, ,, ,,
	" Imperial Two "	—	—	—	—	—	—	LG	Tr	P or T	—	—	D	B	PP	4 2 6	Set and royalties only.
,, ,, ,,	" ,, Three "	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	PP	8 0 0	,, ,, ,, ,,
,, ,, ,,	Orthotone Radio-Gram *(RG)*	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	GP	26 5 0	Including batteries, valves and royalties.
Whittingham Smith & Co., Portadyne Works, Chase Estate, Park Royal, London, N.W.10.	Portadyne S.G. Four *(P)* ..	—	—	—	—	SG	TA	LG	Tr	T	Tr	T	D	B	—	23 2 0	Inclusive. Attaché case 14¾ × 13¾ × 10in. 30 lb.
	,, Super Five *(P)*......	—	—	T	Ap	T	RC	LG	RC	T	Tr	T	D	B	—	19 19 0	,, Morocco attaché case 10¾ × 15 × 14in. 28 lb.
	,, Table Grand *(P)* ...	—	—	T	Ap	T	RC	LG	Tr	T	Tr	T	D	B	—	26 5 0	,, Oak or walnut cabinet 21¾ × 11 × 15in. 32 lb.
Wholesale Wireless Co., 103, Farringdon Road, London, E.C.1.	Sensitite	—	—	—	—	—	—	AB	RC	T	Tr	T	F	AC	—	16 16 0	Including valves and royalties.
World's Wireless Stores, Grosvenor Road, Wallington.	Miracle Super Three	—	—	—	—	—	—	LG	Tr	T	Tr	T	D	B	—	9 18 0	Inclusive.

ABBREVIATIONS.—*RG* = Radio Gramophone. *P* = Portable. *Valves:* **SG** = Screen Grid. **TG** = Tuned Grid. **T** = Triode. **P** = Pentode. * = Directly or Indirectly Heated Mains Valves. *Coupling:* **TA** = Tuned Anode. **TG** = Tuned Grid. **TT** = Tuned Transformer. **Ap** = Aperiodic. **RC** = Resistance. **Tr** = Transformer. **Ch** = Choke. *Method of Rectification:* **AB** = Anode Bend. **LG** = Leaky Grid. *Loud Speaker Feed:* **D** = Direct. **F** = Filter. **Tr** = Transformer. *Current Supply:* **B** = Batteries. **AC** or **DC** = Mains Unit, Incorporated. *Gramophone Pick-up Arrangements:* **GP** = Pick-up included. **PP** = Provision for Pick-up.

The Moving Coil Speaker and its Equivalent Circuit



The Relationship Between the Mechanical and Electrical Systems.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

THE coil-driven loud speaker is a mechanical device propelled by electric currents. It can be divided into two basic systems (1) a purely mechanical system, (2) a purely electrical system. The mechanical system causes sound to be radiated, whilst the electrical system supplies the energy necessary for this to be accomplished. By virtue of this relationship there is a definite connecting link between the mechanical and electrical systems. The object of this article is to indicate the interaction of the two systems and to give a diagram by means of which the combined performance can be visualised by aid of an equivalent electrical circuit.[1]

Taking the mechanical circuit, we have the arrangement of Fig. 1, which is equivalent to a mass *m* attached to a weak spring S, as shown in Fig. 2. The mass, whose effective value is *m*, corresponds to the diaphragm, whilst the spring corresponds to the diaphragm support. This is assumed to be elastic, and allows the diaphragm a fair amount of axial motion with but little constraint. Under this condition the natural axial frequency of the diaphragm (when the coil circuit is open) will be from 5 to 15 cycles per second. When the diaphragm vibrates there is a certain amount of resistance offered by the air, due to the generation of sound waves. Also, there is a loss in the diaphragm. These resistance effects impose a certain amount of damping on the mass *m*, i.e., it is not absolutely free to move with the spring.

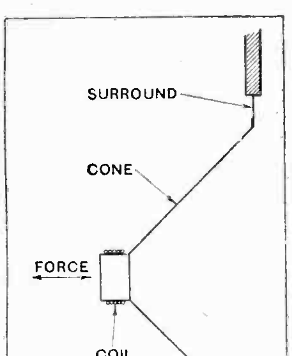


Fig. 1.—Diagram showing mechanical arrangement of coil and cone.

The electrical circuit is illustrated in Fig. 3. The coil is situated in a strong radial magnetic field. When the coil is fixed in position so that it cannot move, the electrical circuit is the simple form shown in Fig. 4, where the coil merely has an inductance L_0 and resistance R_0 commensurate with the number of turns and the effect of the iron of the magnet.

[1] For complete theory see *Philosophical Magazine* Supplementary Number, June, 1929.

Now we have to combine the systems of Figs. 2 and 4. An alternating current will cause the coil to vibrate in the magnetic field. Since the coil cuts the field, an electromotive force is generated which tends to oppose the current in the coil. A small fraction of this e.m.f. is associated with the energy converted into sound. This will be evident from the following: The sound energy or power (whichever we like to consider) is derived primarily from the electrical circuit. Electrical power is the product of e.m.f. and in phase current. If, therefore, the coil current is *i* and the *corresponding* back e.m.f. (in phase with *i*) induced due to the motion of the coil is *e*, the power radiated as sound is *ei*. It should be observed that the current and e.m.f. are in phase, i.e., their maximum values occur simultaneously. This value *e* is one component of the back e.m.f., but there is another and a larger component which does no useful work. It merely reduces the value of the current at low frequencies, which is unfortunate.

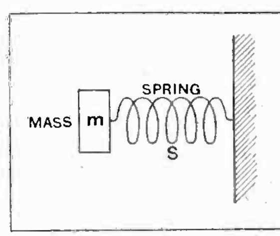


Fig. 2.—Simple mechanical equivalent diagram for arrangement of Fig. 1 assuming the cone to move as a whole.

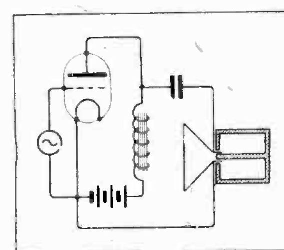


Fig. 3.—Diagrammatic arrangement of coil and power valve.

If the coil were stationary there would be no induced back e.m.f., so that the simple arrangement of Fig. 4 does not represent the actual state of affairs. We have to incorporate in our electrical circuit something which accounts for the back e.m.f. The analysis leading to the final result is

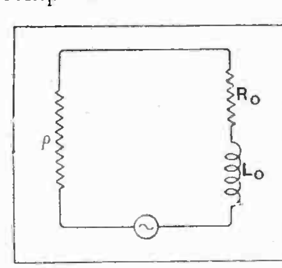


Fig. 4.—Showing equivalent valve circuit when coil is prevented from moving. The coil is represented by an induction L_0 having resistance R_0. The internal A.C. resistance of the power valve is ρ.

The Moving-coil Speaker and its Equivalent Circuit.—

beyond the scope of this journal,[2] but we are not precluded from discussing the result. In Fig. 5 we have an electrical circuit[3] which behaves in the same manner as the moving coil of Fig. 4. Suppose we select a certain frequency, say 500 cycles, then by properly choosing C_m and R_m the current in the system will be identical with that through the moving coil at 500 cycles. R_m is the electrical resistance corresponding with the mechanical resistance to the motion of the diaphragm. The power loss in $R_m = i^2R_m$, and this is the energy radiated as sound. The condenser C_m may appear extremely peculiar, but it is merely an electrical artifice which has the same effect in reducing the current at low frequencies as the back e.m.f. due to the motion of the coil.

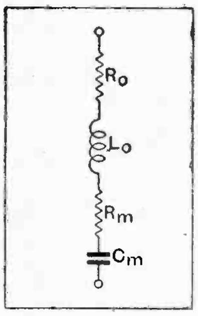


Fig. 5.—Equivalent circuit of moving-coil loud speaker when the diaphragm is in action. R_m is the acoustic radiation resistance. C_m is the motional capacity. Both R_m C_m are due to the back e.m.f. induced by the motion of the coil in the magnetic field.

Moreover, in Fig. 5 we have an electrical circuit in which the mechanical and electrical systems of the coil drive are represented. By its aid we can study exactly what will happen at various frequencies without considering the mechanical aspect of the problem at all.

There is a variation in the components R_m C_m according to the frequency, but we need not enter into such details here. The action of the coil in motion can also be represented by the equivalent circuit of Fig. 6. In this case the condenser C'_m and resistance R'_m are in parallel and have different values from R_m and C_m.

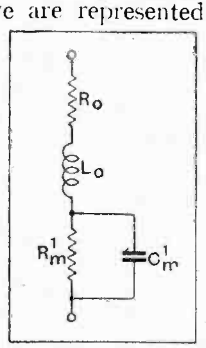


Fig. 6.

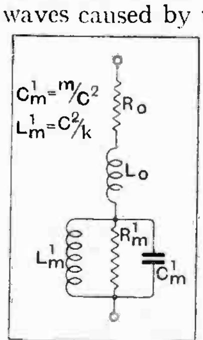


Fig. 8.

Fig. 6.—Alternative equivalent circuit of coil-drive loud speaker in action. R'_m and C'_m are now in parallel.
Fig. 8.—Circuit of coil-drive loud speaker, where the inductance, capacity and resistance equivalent to the motion of the coil are in parallel. L'_m does not vary with the frequency, until the diaphragm stops moving as a whole.

Hitherto we have considered cases where the frequency of the coil current is well removed from the natural frequency of the diaphragm on its support, viz., 15 cycles. When the frequency approaches 15 cycles it is clear that the amplitude of motion increases, due to mechanical resonance. This condition is not represented in Fig. 5, so that an additional electrical quantity is required to give the complete equivalent circuit.

In Fig. 5 it was essential to introduce a condenser C_m to represent the effect of the back e.m.f. due to the motion of the coil. We now have to represent the elastic effect of the surround, for C_m reduces the low-frequency currents, and therefore the axial movement of the diaphragm is also reduced. But the elasticity of the surround increases the amplitude of motion near 15 cycles, so that it gives the effect of an increase in current. Now we know that an inductance tends to neutralise the effect of a condenser. Moreover, we require an inductance to complete the equivalent electrical circuit for frequencies in the neighbourhood of 15 cycles. This has been added to Fig. 5, with the result exhibited in Fig. 7. Clearly the effect of the inductance L_m is to counteract the influence of the condenser C_m, so that the amplitude of motion is increased. Another method of representing the complete circuit is illustrated in Fig. 8. The inductance L'_m, capacity C'_m and motional or radiation resistance R'_m are now in parallel. The resonance frequency of the surround is identical with that of L'_m C'_m.

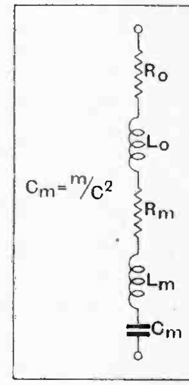


Fig. 7.—Equivalent circuit of coil-drive loud speaker in action at frequencies in the neighbourhood of the surround resonance. L_m is due to the elasticity of the surround and varies with the frequency.

The value of $C'_m = m/C^2$ where m is the effective mass of the diaphragm. This includes the added mass due to the sound waves caused by the motion. C is the product of the total length of wire on the coil and the strength of the radial field. $L'_m = \frac{C^2}{k}$ where k is the force required to move the diaphragm through an axial distance of 1 cm. against the supporting material.

In this discussion the diaphragm has been assumed to move as a whole at all frequencies. We know this does not hold in practice,[4] so that modifications will be required to cope with frequencies above about 200 cycles (depends upon size of diaphragm). These equivalent diagrams are extremely useful in studying the principle of the coil-driven loud speaker, since the complete outfit is reduced to an electrical circuit.

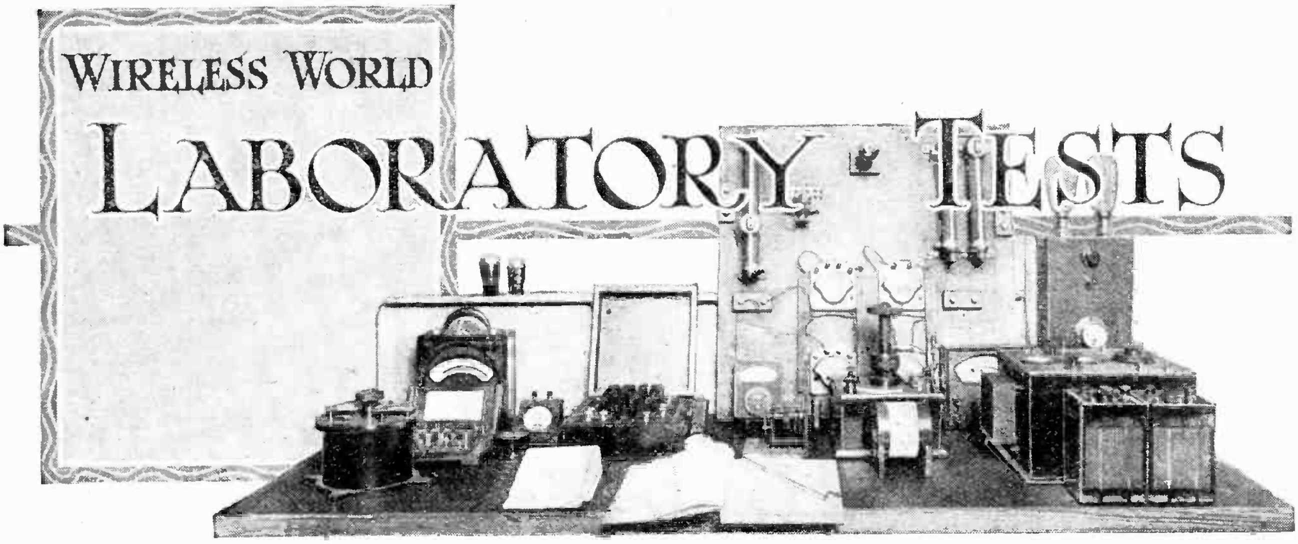
The values of L'_m, C'_m, R'_m, etc., will depend upon the size of the diaphragm, the mass of the coil, the number of turns on the coil, the strength of the magnetic field and the flexibility of the support. If the reader knows these factors for his own loud speaker he will be able to set down numerically its equivalent circuit. Of course, when resonances occur there will be a variation in the equivalent circuit. However, enough information has been given to introduce the subject to the reader who desires to have a deeper insight into the action of his loud speaker.

Incidentally, it is of interest to observe that Fig. 8 covers the case of a reed driving a rigid disc.

[2] See *Philosophical Magazine*, loc. cit.

[3] In Figs. 5 to 8 the equivalent circuit is shown with open ends. In practice, of course, the circuit is completed through something else. When transformer coupling is used, the secondary of the transformer is connected to the ends of the equivalent circuit. On the other hand, when a high-resistance coil is used, the circuit is completed through the valve and choke-condenser combination.

[4] See *The Wireless World*, July 10th and 17th, 1929.

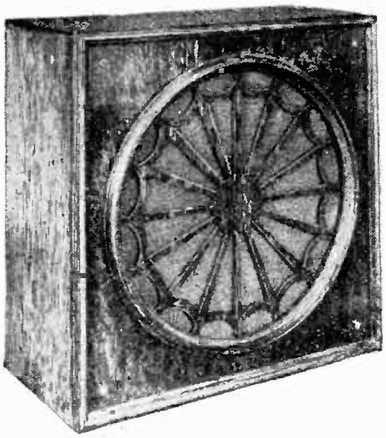


A Review of the Latest Products of the Manufacturers.

"ARBE" LOUD SPEAKER.

This is a cabinet cone instrument fitted in a case of generous size and pleasing finish. It is acoustically open at both back and front, a feature which attributes in measure to the good performance exhibited on test. The movement is an Ormond four-pole unit with adjustment, and this drives a 12in. cone.

Specially prepared material, somewhat resembling buckram in appearance, is used for the diaphragm. The periphery of the cone rests lightly against pads of felt; the driving mechanism being partially relieved of the cone's weight by holding this, at two points, by rubber clamps.



"Arbe" cabinet cone loud speaker.

A practical test, using a straight line amplifier, showed that over the major part of the audible scale the response was fairly even, but with a slight tailing-off at the higher frequencies. The middle register is well brought out, and the bass is in evidence but not unduly so, although the reluctance to bring out the treble in correct proportion gives the impression that the bass is emphasised unduly. However, this is an aural illusion not substantiated by test.

The instrument is sensitive to weak inputs and can be driven at ample volume for average-sized rooms with a medium-size power output valve. The D.C. resistance of the windings on the unit is 2,000 ohms.

This loud speaker is available in either an oak case or a mahogany cabinet; the prices being £3 10s. and £3 15s. respectively. The makers are The "Arbe" Radio Manufacturing Co., 25, Meredith Street, St. John's Street, London, E.C.1.

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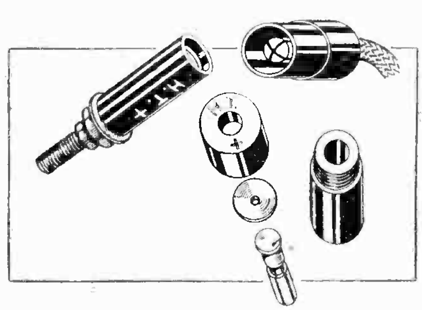
BELLING-LEE SAFETY CONNECTORS.

Messrs. Belling-Lee, Ltd., Queensway Works, Ponder's End, Middlesex, have for long specialised in the manufacture of insulated terminals particularly suitable for use where high anode potentials are employed. The latest addition to their wide range of connectors is a plug and socket having all "live" metal parts protruding from the panel adequately protected by insulating material.

The construction of these insulated H.T. plugs and sockets is shown clearly in the accompanying drawings. The socket is fixed to the panel, or terminal strip, and the completely insulated plug terminates the flex lead. Soldered connections are dispensed with and provision is made to grip the outer covering of braided silk, or cotton, thereby giving a tidy appearance to the leads. The price of the plug and socket is 9d., or they can be purchased separately, the panel portion costing 4d. and the flex connector 6d.



Details of the Belling-Lee insulated H.T. plug and socket.

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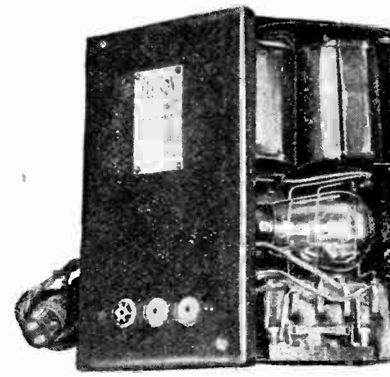
ELLISON H.T. ELIMINATOR.

This model has been designed for use on 200-volt 50-cycle supply mains, and gives two output voltages. That marked H.T.+1 is adjusted to suit the requirements of most detector valves, and H.T. +2 is intended to supply the remaining valves in the set. A series resistance absorbs the excess voltage at the detector tapping, so that it is a simple matter to change this for one of different value, should this be necessary in any particular case.



Ellison A.C. H.T. eliminator, Model P.1.

Full-wave rectification is adopted, using a Marconi or Osram U.5 valve. At the time of test the mains voltage was 210, and this gave 5.5 volts across the valve's filament. This is slightly higher than the optimum voltage for this valve, but on a 200-volt supply it should prove about correct.

Each unit is accompanied by an instructional leaflet giving, in addition, a table of the voltages obtained under varying load conditions. These, together with the measured output voltages, are tabulated below.

H.T. + 2 Tapping.

Current in Milliamperes.	Makers' Voltages.	Measured Voltages.
5	200	215
10	182	195
15	170	175
20	150	159
25	135	142
30	120	127
35	107	115
40	85	106

The slight differences are accounted for, of course, by the higher mains voltage at the time of test.

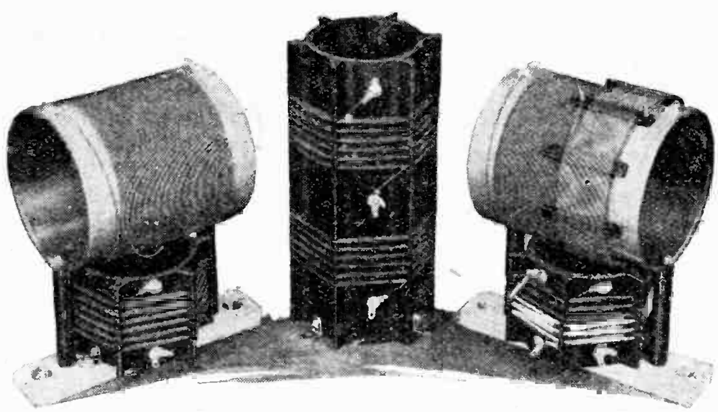
The detector supply (H.T. +1) is given as being measured with a load of 20 mA. on the H.T. +2 supply. Reproducing these conditions we obtained the following voltage readings :—

H.T. + 1 Tapping.

Current in Milliamperes.	Makers' Voltages.	Measured Voltages.
0.5	120	140
1.0	95	116
1.5	65	75
2.0	45	42

The unit was then given a practical test using a four-valve set (1-v-2). It was satisfactory in every respect; not the slightest trace of hum being noticed. We can confidently recommend this model.

The makers are the Ellison Manufacturing Co., Ltd., Dragon Works, Harrogate, and the price, including valve, is £6.



Set of "Berclif" coils for the 1930 Everyman Four receiver made by Simmonds Bros.

1930 EVERYMAN FOUR COILS.

Those constructors contemplating building the 1930 Everyman Four receiver may be interested to learn that a set of coils for this receiver has recently been placed on the market by Messrs. Simmonds Bros., Shireland Road Smethwick, Staffs. These are offered at 57s. the set.

We have had samples sent to us for examination, and find that the coils comply with the specification given, and we believe they will be found satisfactory in every respect.

The workmanship is of a high order. Spacing of coils and sections are correct. A slight deviation has been made from the published description, this being the foreshortening of the spacers carrying the primary winding on the medium-wave H.F. transformer. Since this is a constructional detail of no particular importance, it will not affect the efficiency of the coils. We can confidently recommend them to all prospective constructors of this receiver.

Ferranti A.F.6 transformer. It has a step-up ratio of 1.7.

A NEW FERRANTI TRANSFORMER.

There is evidence to show that the present trend in design of receivers favours an increase in the number of H.F. amplifying stages with a reduction in the L.F. amplification.

Since most new designs show one low-frequency amplifier only after the detector, it is but natural that attention should be directed towards obtaining the maximum amplification from that stage.

Messrs. Ferranti have accordingly developed a special transformer—the A.F.6—with a ratio of 1 : 7. It has a slightly better characteristic than the A.F.3, when used with a suitable valve, and, of course, the amplification is very much greater. Needless to say, it should be preceded by a leaky-grid detector valve, as the primary impedance is hardly of sufficient magnitude to enable the best to be obtained with anode bend detection.

The amplification afforded by a combination of grid detector, A.F.6 transformer, and a super-power output valve, with a good mutual conductance, will compare favourably with that generally associated with a pentode output stage.

The makers are Messrs. Ferranti, Ltd., Hollinwood, Lancashire, and the price is 30s.

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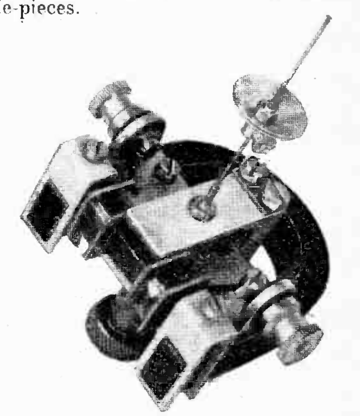
"STORK" LOUD SPEAKER UNIT.

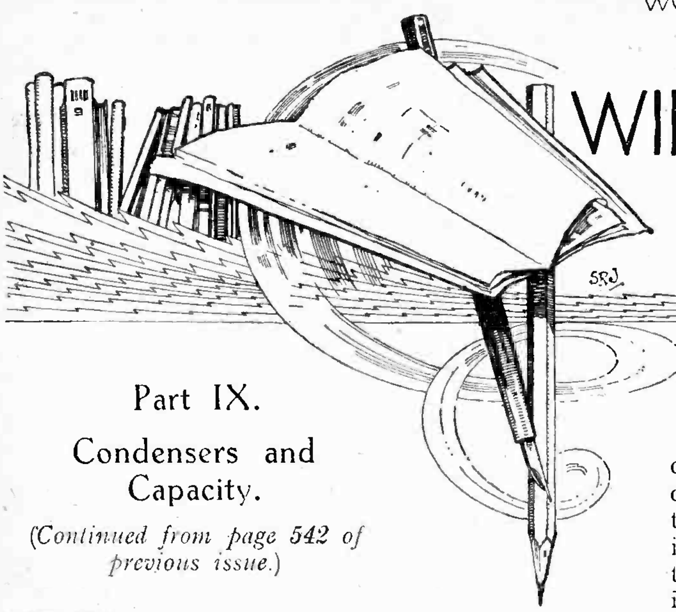
The "Stork" loud speaker unit is a product of the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2, and is the same movement as fitted to their cabinet loud speakers of the same name. It is now being offered as a separate unit for home construction at the attractive price of one guinea. It is for use with cone diaphragms. The movement is of the single-acting reed type, with the armature fixed at one end. An adjusting screw is fitted to regulate the clearance between the armature and the laminated pole-pieces.



G.E.C. "Stork" cone loud speaker unit. A single acting reed movement with adjustment.

A practical test was made, using a good cone diaphragm and a suitable baffle. On the whole the response was very good indeed; the frequency range, with normal electrical inputs, being from about 150 cycles to 5,000 cycles. There were sundry minor resonances—probably reed resonances, since this is fairly rigid—between 5,000 and 3,000 cycles, but these were not unduly marked. Otherwise the response was fairly constant over the audible band covered, but there was a noticeable tailing-off below 200 cycles.

The measured D.C. resistance of the windings was found to be 420 ohms. It is possible to connect the loud speaker direct in the H.T. supply lead to the last valve, even though a super-power type is fitted, without serious voltage drop. A choke-condenser filter, or transformer, output arrangement would be preferable, if this can be fitted conveniently.



WIRELESS THEORY SIMPLIFIED

Part IX.

Condensers and Capacity.

(*Continued from page 542 of previous issue.*)

By S. O. PEARSON, B.Sc., A.M.I.E.E.

WE now come to the third and last "constant" of the electric circuit, namely, capacity. As the name implies, the capacity of any part of a circuit is the extent to which a "charge" or quantity of electricity can be stored or accumulated in that part. It is the capacity for storing electricity in a stationary (electrostatic) state under a given electrical pressure or voltage. In just the same way the capacity of a compressed-air cylinder could be expressed as the amount of air it would hold under a given pressure. That component of the electric circuit which is designed expressly for the purpose of producing this effect of capacity is called a condenser.

In order to understand clearly the effects of capacity, especially in an A.C. circuit, it is necessary to know exactly what capacity is and how it arises.

It was pointed out in Part I (September 25th issue) that a current of electricity could be looked upon as a stream of electrons passing from atom to atom along a conductor, the stream being continuous so that electrons were not accumulated at any point in the circuit. Under the heading of capacity, however, we encounter entirely new conditions, namely, where electrons are transferred from one part of a conducting system to some other part of the same system in which there is no complete or closed circuit for a continuous stream of electrons to flow round.

Direction of Flow of Electrons.

But before proceeding farther a word is necessary regarding the direction of flow of electrons moving round a circuit carrying a current. It was explained in Part I that a free electron is a minute negatively charged "particle" which can be moved by the action of an electromotive force. The central positive charge of each atom of matter is not mobile in this way and cannot be separated from the atom of which it forms the nucleus. Thus a current of electricity is a stream of electrons moving in the opposite direction to that normally chosen to indicate the direction of flow of current. This fact is plainly illustrated by the action of an ordinary valve, where the current in the plate circuit is always taken as flowing from the positive terminal of the H.T. supply to the plate and thence through the vacuum to the filament. But we actually know that the electrons representing the current are given off or emitted by the hot filament and are collected by the plate and so move the other way round the circuit. In the early days of electricity, before the discovery of the electron, it was thought that both kinds of electricity moved round the circuit in opposite directions and the choice of the positive direction was quite an arbitrary one. In the light of the electron theory the choice has turned out to be very unfortunate, and the reader should bear in mind that when a current flowing through a circuit has its direction indicated by an arrow the actual direction of motion of the electrons representing that current is opposite to that indicated by the arrow. For most purposes this distinction is not necessary, but it is for our present purpose of considerable help in elucidating problems of capacity.

The Nature of Capacity.

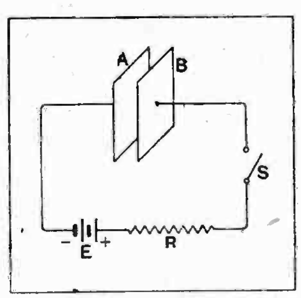


Fig. 1.—Simple parallel plate arrangement for illustrating the action of a battery and condenser.

Suppose that two flat metal plates A and B of equal size are placed parallel to each other, but not touching, as shown in the upper part of Fig. 1, and that they are electrically insulated from each other, the medium between them being air. Between A and B is connected a circuit consisting of a battery E, a resistance R and a switch S. In the figure the negative pole of the battery is shown connected to plate A.

Providing the switch S has not been closed no potential difference or voltage will exist between the plates (they could be momentarily joined together with a piece of wire to ensure this). This means that each plate carries an equal number of free electrons. If the plates are at zero potential with respect to earth the negative electrons on each are present in just sufficient numbers to neutralise completely the positive charges at the centres of the atoms and leave the plates as a whole electrically neutral. Now consider what happens

Wireless Theory Simplified.—

when the switch S is suddenly closed. The battery will immediately try to drive a current round the circuit, but owing to the gap between the plates no continuous current will be able to flow. Nevertheless, the tendency is for the battery to drive electrons round the circuit in a clockwise direction, and so, on closing the switch, electrons will immediately be drawn off from plate B, passed through the battery, and piled up on plate A. As soon as any electrons are taken from plate B those left are insufficient to neutralise completely the positive charges at the centres of the atoms, and *so plate B acquires a positive potential.* The extra negative electrons which are driven on to plate A will give the latter a negative potential, as there will then be more than sufficient to neutralise the positive nuclei of the atoms.

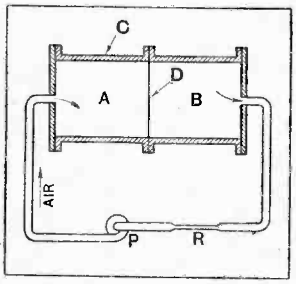


Fig. 2.—Air cylinder and fan pump system explaining in mechanical terms the action of a condenser. A diaphragm D divides the cylinder into two equal compartments A and B.

The initial rate at which the electrons are taken from B and put on to A by the action of the battery will depend on the E.M.F. of the battery and the resistance R of the circuit, because the stream of electrons flowing from B to A constitutes an electric current. But once this current has started the potential of B is becoming more positive and that of A more negative, that is to say, a potential difference is building up between A and B in such a direction as to oppose the action of the battery. Thus as time progresses, after closing the switch, the current, or rate of transfer of electrons, becomes rapidly less and ceases altogether when the potential difference between the plates has reached a value equal to the E.M.F. of the battery. Under these conditions plate A is charged exactly to the same potential as the negative pole of the battery, and B to that of the positive pole. We see, then, that the current obtained is only a momentary or transitory one which passes *from plate A to plate B* according to the usual notation although the electrons are moved from B to A.

An Analogy.

Before discussing the magnitude and time of duration of the charging current it will be helpful to consider a suitable mechanical analogy. The electric circuit of Fig. 1 can be represented by the cylinder and pipe arrangement shown in Fig. 2. An airtight cylinder C is divided into two equal compartments A and B by a diaphragm D. Compartment A is connected by means of a pipe to the output side of a fan pump P of the type used in ordinary vacuum cleaners, compartment B being connected to the input or vacuum side. The whole system is assumed to contain air at the normal atmospheric pressure when the pump is stationary, so that each compartment holds an equal weight of air, which corresponds to the electrons in the electric circuit. One of the pipes has a constriction R representing the resistance of the electric circuit.

If the fan pump is suddenly started it will immediately begin to draw air from compartment B and transfer it to A. The result is that the pressure in B begins to fall and that in A to rise, just as in the electric circuit the potential or electrical pressures of the plates were changed. In the same way the current of air through the pipe diminishes as the pressure difference between compartments A and B rises and will cease altogether when the difference of pressures in the two compartments is exactly equal to the pressure exerted by the pump. A continuous stream of air cannot flow on account of the dividing diaphragm in the cylinder corresponding to the gap between the plates of the electric circuit.

As regards the air system it is quite obvious that energy is required to change the pressure levels of the compartments of the cylinder as described, and that energy is stored in the cylinder. If the motor driving the pump is switched off the air will immediately commence to rush back from A to B and so tend to drive the fan in the reverse direction. The amount of energy stored will depend on the capacity of the cylinder and the difference in pressure between the two compartments.

Electric Field.

Now, in exactly the same way, energy must be stored somewhere in the electric circuit of Fig. 1 when the electrical pressure between the plates A and B is raised, because during the time that the plates are being charged the battery is driving a current against an opposing pressure quite apart from that due to the resistance of the circuit. This energy is stored in the space between the plates. The ether there has been subjected to a sort of strain and is trying to recover—it makes practically no difference whether there is air or a vacuum between the plates.

The space where the ether is strained in this way is called an electric or electrostatic field, and its presence can be very easily detected experimentally. If a small light body such as a pith ball, suspended on a silk thread, is charged positively and then dangled between the plates it is definitely attracted towards the negative plate A and repelled from the positive plate B, showing that there are lines of force stretching from one plate to the other. These lines of force are quite different from those of magnetism; they are produced by electrons at rest, whereas the magnetic lines were produced by electrons in motion, that is, by an electric current.

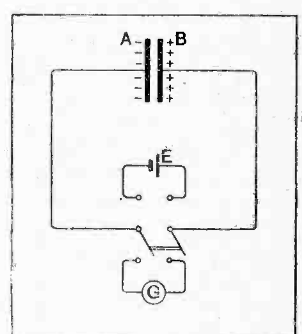


Fig. 3.—Circuit for charging a condenser and then discharging it through a galvanometer.

The electrostatic strain set up in the ether by the charges on A and B is a sort of elastic one tending to return the potentials of the plates to their original common level. If we disconnect the plates from the

Wireless Theory Simplified.—

battery and then join them to the terminals of a sensitive galvanometer the latter will give a momentary deflection indicating that the excess negative electrons on plate A have rushed back and made good the deficiency on B. Our simple condenser has been discharged and the energy which it possessed dissipated in the resistance of the circuit connecting A to B. The switching arrangement for the experiment is shown in Fig. 3.

Definition of Capacity.

When the switch is closed the initial value of the charging current will be $I=\frac{E}{R}$ amperes, because at the start there is no back pressure exerted by the condenser. But as the voltage across the condenser builds up it

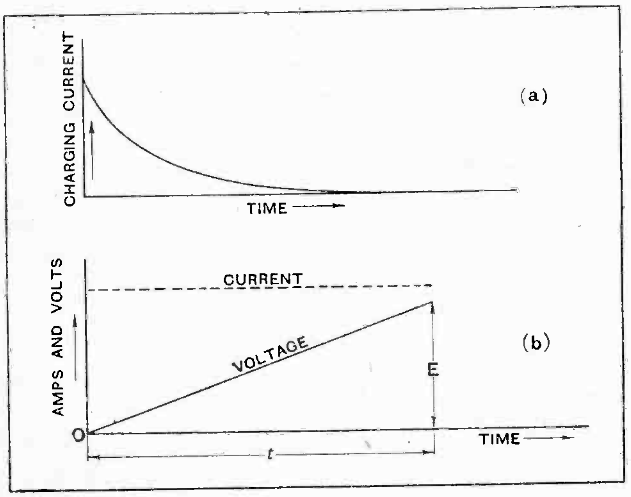


Fig. 4.—(a) Curves showing how the charging current dies away under normal conditions. (b) Conditions existing when the charging current is controlled and kept constant. The voltage across the condenser rises at a uniform rate.

opposes more and more the action of the battery, and so the value of the charging current diminishes as time progresses. If e is the voltage across the condenser at any instant the current at that instant will be $i=\frac{E-e}{R}$ amperes, and so the charging current will die away according to a definite law. The current would actually die away in the manner indicated by the curve of Fig. 4 (*a*). However, it would help us to give a simple definition of the capacity if we could arrange to maintain the charging current *constant* at the initial value throughout the charging period. This could be done theoretically by reducing the variable resistance R in Fig. 3 at a uniform rate from the initial value to zero during the charging period. Under these conditions the voltage across the condenser would rise at a uniform rate, as shown in Fig. 4 (*b*).

Suppose, then, that with a steady charging current of I amperes the potential difference between the condenser plates reaches a value of E volts in a time of t seconds. Now, the product of the current I and the time t is the *quantity of electricity* transferred from one plate of the condenser to the other. From this *the capacity can be defined as the quantity of electricity or "charge" required to change the potential difference between the plates by one unit of E.M.F.*

Practical Units of Capacity.

When the charging current I is in amperes and t is in seconds the quantity of electricity or "charge" is expressed in *coulombs*. The capacity in the practical system of units is expressed in *farads*. A condenser is said to have a capacity of one farad if the potential difference between the plates is raised by one volt when a quantity of electricity equal to one coulomb is put into it, or when a charging current of one ampere flowing for one second changes the potential difference between the plates by one volt.

Thus if a current of I amperes flowing for t seconds raises the potential difference between the plates from zero to E volts the capacity of the condenser will be

$$C=\frac{It}{E}=\frac{Q}{E} \text{ farads}$$

where Q stands for the charge in coulombs or ampere-seconds.

The farad is a very large unit indeed. If a condenser of one farad capacity were charged to one volt, on being discharged through a resistance it would give out one ampere for one second or the equivalent. If charged to 180 volts it would be capable of giving out the equivalent of one ampere for three minutes! It would require an enormous condenser to give such a performance. Thus in general practice the capacity of a condenser is expressed in *microfarads* (mfd.), meaning millionths of a farad. But when making calculations relating to condensers farads must be used in all the ordinary formulæ; to convert from microfarads to farads we must divide by 10^6 or one million. Very often in wireless work capacities are expressed in *micro-microfarads* (m.mfd. or $\mu\mu f$) or millionths of a microfarad.

(*To be continued.*)

CATALOGUES RECEIVED.

The Igranic Electric Co., Ltd., 149, Queen Victoria Street, London, E.C.4.—Descriptive folder of Screened Grid Short-Wave Receiver; a four-valve set covering wavelengths from 10 to 85 metres and employing H.F. amplification.

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The Lisenin Wireless Company, 5, Central Buildings, High Street, Slough, Bucks.—Illustrated folder of Wander plugs, spade terminals and insulated mains connectors.

The Edison Swan Electric Co., Ltd., 123-5, Queen Victoria Street, London, E.C.4.—Illustrated catalogues of Ediswan mains- and battery-operated receivers; mains accessories; components, and a 58-page valve book containing curves and descriptive matter dealing with every new Mazda valve. Also general radio catalogue and descriptive folders of "Tungar" battery chargers.

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Messrs. Ferranti, Ltd., Hollinwood, Lancashire.—Descriptive catalogues of A.C. and D.C. measuring instruments, push-pull transformers, anode feed units, and illustrated leaflets dealing with motor car battery charger and radio switches. Descriptive folder of moving-coil loud speakers.

BROADCAST BREVITIES

By Our Special Correspondent.

New Wavelength for 2LO ?—Scottish Regional Sites.—Test Relays from Germany.

A Dilemma.

B.B.C. engineers are in a dilemma regarding the opening of the second station at Brookmans Park. For a reason which remains obscure, there is an insistent demand in some quarters that the regular London programme, *i.e.*, 2LO's, should go out on the shorter wavelength of 261 metres, allowing the hitherto silent twin to carry out its tests on 356.3 metres.

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To Wake Up the Public?

This would be the best way to proceed if the B.B.C.'s intention is to wake up the public to the realities of the regional scheme, especially in view of the likelihood that the tests with the new transmitter will be limited to news, talks, and poetry readings! In the scramble for new coils and condensers the listening public would begin to see the scheme from a fresh angle.

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Nervousness.

This hesitancy in regard to wavelength is symptomatic of a growing nervousness at Savoy Hill over the behaviour of twin stations on the same site. The B.B.C.'s experience in this direction is mainly theoretical, being based on low-power radiation tests with the mobile transmitter. The case of 5XX and 5GB working on the same site can hardly be called a parallel one, for here the frequency separation is 433 kC., whereas the London Regional transmitters will have a separation of little more than 300 kC. with higher power also to be reckoned with.

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Protracted Test Period.

As to the date on which the alternative tests will start, even the Chief Engineer expresses uncertainty. It is practically settled, however, that the experiments will take place during ordinary broadcasting hours over a period of at least two months. Assuming that the fun begins before the end of December, we shall have the season of spring and portable sets upon us before London Regional is functioning normally.

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Scottish Regional Excitement.

Captain Eckersley has caused a flutter in official dovecotes by a statement in a speech at Edinburgh last week. The ex-Chief indicated that a site has already been selected for the Scottish Regional station at Larbert, midway between Glasgow and Edinburgh. As a matter of fact, no decision has yet been arrived at. The B.B.C. mobile transmitter has roamed over most of the country in the neighbourhood mentioned, and three possible sites are now being considered. Larbert is one of them, but the most favoured is a spot to the east of Falkirk.

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A Question of Money.

It will be a pity if announcements regarding the Scottish Regional raise false hopes. Many listeners in Scotland have been expecting that their new station would be ready by the end of 1930. If the work were begun at once there would be no technical bar to such a happy event, but there are grave financial obstacles. The Northern Regional must be paid for this year, and the B.B.C. will require more instalments of licence revenue from the Post Office before the Scottish Regional can be completed.

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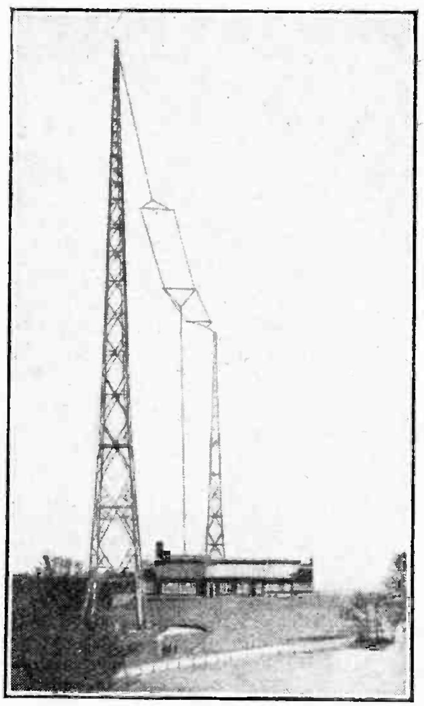

A FAMOUS DEUTSCHLANDER. The Langenberg transmitter photographed from an unusual angle. With the aid of its relays, Langenberg serves nearly all Western Germany. It also succeeds in heterodyning 5GB!

Relays from Germany.

Three experimental relays from the Continent are to be included in the programmes early in the New Year. The first, I understand, will take place on or about January 3rd, when Germany's new cross-country landlines will be put to the test in a relay from one of the eastern transmitters, probably Königswusterhausen.

The programme value of these relays will also be considered. The first will comprise classical music; German light music and vaudeville will be featured in the other relays.

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Suffocation in the Studio.

Few broadcast artists deserve to be suffocated in the studio. Yet this fate nearly overtook a well-known performer at Savoy Hill recently when he strayed too near a ventilating tube which had been cleaned with paraffin. He is only just recovering from an illness which has lasted for weeks.

The problem of studio ventilation will be one of the first considerations of the designers of Broadcasting House, Portland Place. Entirely new methods are to be tried, as it is realised that the present system at Savoy Hill is hopelessly inadequate.

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Au Revoir, Sir Walford.

All classes of listeners—highbrow, lowbrow, technical, constructional, and the rest—will miss the weekly talks of Sir Walford Davies. There is something arresting in Sir Walford's microphone manner which compels one to listen, whether interested in music or not. Most of us will be glad that the well-known "Good-night, listeners all!" on December 31st will be only in the nature of an *au revoir*.

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Cinema Assists Broadcast Artists.

Anthony Hope's play, "The Prisoner of Zenda," will be broadcast from 2LO on December 20th. The adaptation for the microphone is the work of Holt Marvell, who has conceived the idea of arranging a special show of Rex Ingram's film version for the artists who are to take part in the broadcast to enable them to "absorb" the atmosphere of the story.

CORRESPONDENCE.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

ANODE FEED.

Sir,—Much print has been used in the last year or so in an effort to popularise the "anode feed" scheme. Admittedly it has great advantages over the "common" potentiometer, and it has enabled "Mr. Everyman" to use modern valves to a fairly good advantage, but in my opinion better advantages are to be gained by using a potentiometer for each valve. The cost of wire-wound potentiometers, such as Truevolt and Varley type, is little over that of fixed resistances, and among the advantages of this scheme are :—

(1) Voltage more constant in spite of anode current fluctuations.

(2) Change of valve involves a simple adjustment instead of the purchase of a new anode resistance.

(3) In the case of A.C. H.T. eliminators the small but constant load on the transformer secondary safeguards the components from harm should the valve filaments be unlighted from any cause while the elimination is under load.

I have used this scheme in several cases when "motor boating" has occurred, in spite of the anode feed scheme, with complete success.

I would be interested to know of other readers' opinions on this scheme. A. NEWMAN.

THE REGIONAL SCHEME.

Sir,—Re your editorial and correspondents' comments on the regional scheme.

I, too, have thought the B.B.C.'s policy may have, in part, provided for "wipe-out," so as to limit stations received to those at home; but surely, to be effective, there must be a full and adequate programme provided by them!

At present my sixty-one stations have been reduced to fifty-nine, and should Tweedledee cause a further reduction no more serious and the B.B.C. not extend its Sunday programme, I will continue my naughtiness in tuning in gay foreigners—particularly on Sundays.

I remove headgear to Iliffe and Sons Ltd., the gay foreigners and the frame aerial. HENRY J. BELL.

Wendover, Bucks.

NON-RADIATING SETS.

Sir,—May I add my name to that of Mr. Henry W. Moss? Re-radiation from other receiving aerials is the biggest trouble I have to contend with from a wireless point of view. A man may not go about the streets interfering with the business or pleasure of other people, and neither should he be allowed to do it by radio.

I use a moving-coil loud speaker capable of excellent reproduction, but if there is anything on worth hearing I have to switch off in disgust at the distortion introduced by "silent point" oscillators and the howls of the actual heterodyners. I heartily agree that the use of reacting detector, or any other set capable of energising the aerial should be made illegal. Administration of the law would not entail great expense, as complaints alone would be sufficient indication of offenders.

If the business was sufficiently stressed in journals, members and officials of radio societies and readers of technical magazines could get together and probably demand it. Also, why not go a step in the right direction and stop set designers and radio manufacturers from the practice of publishing diagrams of cheap (?) receivers capable of re-radiation. I am aware some cheap outfits for local stations only are always in demand, but one generally finds the owners trying to get America at full L.S. strength. Let us hear more views and get the whole miserable business stopped once and for all. JOHN ROE.

Sheffield.

Sir,—I have a great deal of sympathy with your correspondent, Mr. Henry W. Moss, being like him a sufferer from the howls emanating from my neighbour's set next door.

I think something should be done to curtail the activities of the oscillating individual: at present the measures taken by the Post Office are not drastic enough. If reaction was prohibited entirely I am afraid many worthy people in humble circumstances would be tied down to the local B.B.C. programme owing to the high prices at present prevailing for screen grid receivers. I am convinced from my own experience that reaction, if properly used, should cause practically no interference to neighbouring receivers. It is the selfish person who wants more service from his small receiver than it is capable of giving, and I hope steps will be taken before long to put a stop to this great nuisance. HUGH McNEICE.

London, S.E.6.

Sir,—I have read with interest Mr. H. W. Moss's letter in your issue of the 6th inst. on the subject of radiating receivers.

I do not agree with Mr. Moss's view that the advent of the screen-grid valve has sufficiently altered the position to justify legislation to prohibit the use of receivers capable of energising the aerial.

The most popular type of set at present in use in this country appears to be the straight three-valver, which depends on the critical adjustment of reaction for its sensitivity and, in some measure, its selectivity.

I quite agree that the universal adoption of the screen-grid valve would solve the problem of oscillation very satisfactorily, but a great number of the sets at present in use could not be modified to include a screen-grid valve with its attendant elaborate screening.

It would mean that a large percentage of people now obtaining satisfactory reception on a straight three-valver would either have to do away with the reaction that is so essential to them, or, alternatively, modify their receivers at considerable cost.

I have been using a four-valver incorporating one screen-grid valve, anode-bend detector without reaction, and two R.C.C. stages of low-frequency amplification, for about a year, and this gives me all I need in selectivity, volume, and sensitivity, but its cost is in no way comparable with that of a straight three-valver. HARRY W. DALY.

Goodmayes, Essex.

GRAMOPHONE PICK-UP DESIGN.

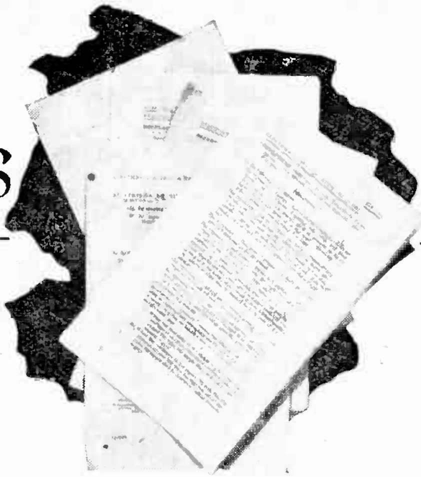
Sir,—Mr. F. L. Devereux, in dealing with the above subject in a recent issue of *The Wireless World*, mentions that serious amplitude distortion is caused by a single-acting type of pick-up, and further mentions that the single-acting type has given place to the differential or double-acting type.

While this is obviously theoretically correct, the fact remains that in practice the amplitude distortion (due to the square law mentioned) is of no importance when compared with the mechanical controlling factors, such as mass of the reed, moment of inertia, restoring force, etc., which of course were also mentioned in the article.

It is not difficult to find amongst commercial pick-ups differential types with a response curve definitely inferior to that of a single-acting type. I believe I am correct in stating that the new Marconiphone pick-up employs a reed in which the whole of the flux passes through it, and the curve of this pick-up is unquestionably good. The same principle would seem to be involved in the case of a loud speaker movement, when mention can be made of the Amplion Lion speaker. Here again the performance is definitely superior to that of many balanced armature systems. The predominating factors in both cases are mechanical rather than electrical. If the same desirable mechanical conditions were combined with a balanced electrical or rather magnetic, system, then the results might possibly be even slightly better. My own experience in the design of pick-ups during the last three years clearly indicates that the predominating controlling factors are mechanical rather than magnetic, and this certainly seems to be borne out by the examples mentioned above. PAUL D. TYERS.

Watford.

Supply Regulations and Mains Sets



The Mutual Obligations of Set User and Supply Company Explained.

IT would probably not be far wrong to assume that daily close upon one hundred wireless receivers are connected to public electricity supply mains for the first time. Some of these sets have been designed and built expressly to operate either partially or wholly from mains, while others have been converted from battery-driven receivers by the addition of various parts collectively called an eliminator or mains unit. In both these classes there is a further sub-division of "bought," *i.e.*, completely finished, equipments and "home-built" or "home-made" apparatus in which the various parts have been collected together and assembled by an amateur.

There is every reason to believe that, with the improving discernment in the matter of quality of reproduction on the part of the general public, at no distant date practically all stationary receivers will be mains operated, so that a few notes on the legality of the use of public mains will not be out of place.

Board of Trade Regulations.

To begin with, let us consider how supply authorities are regulated. Before a company or a borough council may proceed to excavate the public roads for the purpose of laying mains, it has to obtain parliamentary powers. The granting of such powers virtually gives a company a monopoly within a prescribed area, and in order to prevent the abuse of such a monopoly the company is governed by certain Acts, notably the Electric Lighting Acts of 1882 and 1899, and a set of Board of Trade Regulations. In general, the Regulations are of more interest to the consumer than the Acts. The concern to which powers have been granted is referred to in the Acts as an Undertaker.

The Board of Trade Regulations (now called the Regulations of the Electricity Commissioners) are expressly headed as being:—

(*a*) For securing the safety of the public, and

(*b*) For ensuring a proper and sufficient supply of electrical energy.

They are obtainable on demand at the price of sixpence per copy by a consumer from the Undertaker in whose area of supply he resides, and are the only legal Regulations governing that supply. They may also be obtained with certain blanks left in the final clause, which makes them specific to an undertaking, from H.M. Stationery Office.

Now to deal with the Acts and Regulations as they affect the consumer who wishes to use power from the mains to operate his wireless receiver. Although it can be assumed that anyone who is contemplating the use of supply mains to drive his wireless set has already a supply (and a supply company is bound by section 27 (i) of the 1899 Act to give and maintain a supply subject to certain conditions), it must be assumed that the addition of a mains-driven wireless set to his power-consuming appliances is such a serious matter in the eyes of the supply company as to warrant reconsideration of the original agreement for the supply of electricity to that particular premises.

The only technical condition under which a company may refuse supply to a consumer is when there is found to be a leakage of more than 1/10,000th part of the maximum supply current on his (the consumer's) wiring and apparatus, and in so refusing the company is bound, under penalty, to call attention to the consumer that he may, if he doubts its tests, on payment of a fee, have the tests carried out by a Board of Trade inspector. This is covered by Regulations 29, 30, and 31.

D.C. Mains and Condenser Tests.

Sections 27 (4) of the 1899 Act refers to the use of any lamp or burner (electric motors were not even legislated for in those days) in a manner calculated to interfere unduly or improperly with the efficient supply to any other body or person as a good and sufficient reason for the refusal on the part of the company to supply. In view of the contacts or fuses mentioned in Regulation 26 and the leakage specification in Regulation 29 of the Board of Trade, the foregoing clause does not appear to have any very specific meaning. A possible case coming under this clause might occur if a consumer installed a piece of apparatus which took a very heavy momentary current, say, once every second, the current being just of insufficient duration to blow his main fuses, but sufficient to cause an unpleasant flicker in the illumination of the lamps on neighbouring premises. This state of affairs is not likely to occur in a wireless receiver.

With regard to the current leakage referred to above, this can be prevented with certainty in an A.C. set operating off A.C. mains by the use of a transformer with adequate

Supply Regulations and Mains Sets.—insulation between the primary and all other windings, and in a D.C. set by the use of a good condenser in the earth lead, together with a further condenser in the aerial lead if series tuning is not being used and the aerial insulation is not above suspicion. The recognised standard test for the insulation value of first-class British-made apparatus intended to be used on supply mains is the application of 2,000 R.M.S volts A.C. of commercial frequency, *e.g.*, 50 cycles for one minute between conductor and earth. This test is not really as severe as it sounds, and there should be no difficulty in insulating transformer primary windings to pass it when all other windings are earthed; in fact, there are certain intervalve transformers whose insulation is sufficiently good to withstand this voltage. There must, however, be very few condensers at present in earth leads which are able to pass this test, and in view of the size and cost of a condenser of this grade it is doubtful whether a company could be considered as reasonable in demanding compliance in this respect.

Protection from Shock.

The Regulations, beyond stipulating the maximum permissible leakage on a consumer's system, do not mention insulation value. As regards its own network, the company is only bound to test a new low or medium pressure (*i.e.*, voltage) main at its working pressure, or not less than 200 volts before being put into service. Even on high-pressure work the company is only called upon to test at 50 per cent. over working voltage for one hour. The corresponding up-to-date test in the British industry is $2\frac{1}{4}$ times working voltage, plus 2,000 for one minute, and certain manufacturers test at three times working voltage for this time.

There remains a further direction in which legislation might be expected, namely, in the protection from shock. Now it is one of the rather remarkable facts that in the matter of Regulations dealing with installation work, an Englishman's home has remained his castle for such a long time. The Institution of Electrical Engineers has prepared an excellent set of wiring Regulations which are revised from time to time to keep up with modern developments and the introduction of new and better materials. Quite recently much work has been done to produce a specification covering the essential points in eliminator design, but although these Regulations may be referred to by consulting engineers, buyers, insurance companies, etc., as indicating a certain standard of excellence, they do not appear to have any legal significance as far as the house is concerned. On the other hand, an insurance company, say, might refuse to accept as a fire risk a building in which the electrical installation fell below the standard set by the I.E.E. Regulations.

What are the regulations governing the connecting of a wireless receiver to the mains? The endeavour in this article has been to make clear the position of both the user of the mains operated set and the electricity supply company and to outline the restrictions and obligations imposed.

To sum up this section of the article, there seems to be no valid ground on which supply may be refused to a mains receiver which does not actually produce a leakage to earth from either mains greater than the prescribed amount.

We come now to the question as to where the owner of a mains-driven wireless set stands when it is decided to change over the mains from D.C. to A.C., and it is unfortunate that at present the legal position is still obscure. From enquiries made, it is understood that the matter will eventually be fought out by means of a test case.

Much consternation was created in the electricity supply world by a letter which appeared in the correspondence columns of this journal some years ago now, in which a resident in one of the towns on the Northern outskirts of London expressed satisfaction at the treatment received from the supply company, who provided him with a complete A.C. eliminator (possibly then worth ten pounds) when they converted their network in that particular area from D.C. to A.C.

Most supply authorities who have had to face a change-over have accepted the moral obligation to render sets connected to their mains suitable for the new supply, but the method adopted has had to vary with individual sets. The obligation is generally considered to consist of leaving the control of the set unchanged.

Variation in Supply Voltage.

In some cases, only an H.T. eliminator is supplied, or possibly a metal rectifier for battery charging. In general, no difference is made between home-built and professionally built sets, but the new H.T. eliminator will probably only supply semi-smoothed current, reliance being placed on the smoothing apparatus of the original D.C. arrangement to complete the process. This seems quite reasonable, and it must be remembered that this modern development of mains-driven wireless receivers presents a very difficult and costly problem to supply authorities whose area happens to be mainly residential.

Before completing this article, mention should be made of a direction in which a number of supply authorities fail badly. This is in the matter of pressure at the consumer's terminals. By Board of Trade Regulation, the total permissible variation in supply voltage at the consumer's terminal is 4 per cent. up or down, but it is within the writer's experience to have his mains voltage vary by as much as 12 per cent. down on a cold winter evening, and 10 per cent. up on a bright Sunday morning.

Such a wide variation, which, of course, affects the filament brilliancy of the rectifying valves in the mains units, as well as their anode supply volts, and, therefore, produces somewhat of a square law effect, can be the cause of much trouble in a high-class receiver.

There are two remedies, first, to use a transformer with a tapped primary, which will allow for compensation to be made by means of a multi-way switch, and, secondly, to complain to the supply company, who cannot ignore such matters.

READERS' PROBLEMS.

J.R.S.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Plug-in Coils for the Aerial Circuit.

I am making up a receiver on the general lines of "The Wireless World" Kit Set. Will you please tell me if there is any reason why ordinary plug-in coils should not be used for aerial circuit tuning? C. W. N.

Commercial plug-in coils can certainly be used in the open circuit, although there would hardly be room for them in a set having the same layout as that described and illustrated. The coils should be mounted with a reasonable spacing between them, and if they are placed coaxially in inductive relationship interconnection should be such that one winding forms a continuation of the other.

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Mains Safety Precautions.

I am told that a set operated from the mains should not be directly earthed in the usual manner, and in consequence am surprised to find that there is a metallic connection between the aerial and earth terminals of my new receiver. Would you recommend the fitting of an external earth condenser as a safety precaution? E. F. E.

This depends on whether your supply is A.C. or D.C. If the former, it may be stated definitely that no series condenser is necessary, as the set will be effectively isolated from the mains by a double-wound transformer. We expect that your mains are of this type, but if you have a D.C. supply, the condenser should be added, unless the aerial-grid transformer has separate windings. If it has, and if the insulation between these windings is adequate, the set will be quite safe, in spite of the fact that a test will show continuity between aerial and earth terminals.

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Needle Scratch.

I have recently converted my set for gramophone reproduction, and notice that there is excessive needle scratch. This is not due to the pick-up itself, as the same instrument functions quite satisfactorily and without serious extraneous noises when used on a radio-gramophone belonging to one of my friends.

Can you suggest a probable cause of the trouble? S. G. T.

Excessive scratch is often brought about by misalignment of the pick-up carrier, and we believe that attention to this detail will overcome, or at any rate mitigate, your trouble.

An accumulation of dust in the record grooves generally brings about a similar effect, and if you have not already done so we suggest that you will find it worth while to obtain a proper cleaning brush.

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Coils and Convolutions.

I am winding a pair of H.F. transformers on similar lines to those described for the "Record III," but, due probably to the fact that a different method of construction is adopted, have become confused both with regard to the method of connecting the various windings and their direction.

I think that part of my trouble is due to the fact that the drawings show sectional windings, which are possibly easy enough to follow when copying the exact design, but are confusing in my own case. Would it be possible for you to give me a rough sketch showing these points in simplified form? L. W. B.

We hope and think that this matter will be made clear to you by a consideration of Fig. 1, which shows all the windings for both medium-wave (M.W.) and long-wave (L.W.) windings.

Confusion is most likely to arise when dealing with the neutralising sections, particularly with the single turn used for the medium band. It is convenient to consider these windings as continuations of the primaries wound in the same direction, and, in an attempt to make this matter more clear, we have shown by a dotted line an imaginary continuation between the two coils, although in actual fact there is no direct electrical contact. It makes no real difference, either to the direction of winding or to the ultimate connections of the various ends, whether the coils are in the form of single-layer solenoids or in sections.

Primary, secondary, and neutralising coils are connected in series, and arrangements are made to short-circuit all the latter when receiving on the medium band.

In our drawing, external connections are indicated by lettering corresponding with that appearing in the diagrams of the original article.

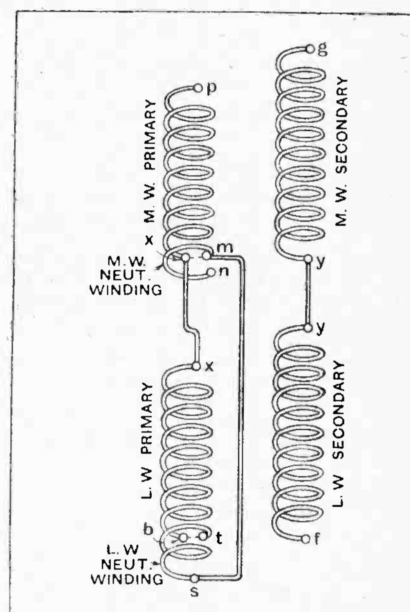

Fig. 1.—Sketch showing arrangement of combined medium- and long-wave transformers for the "Record III." Special attention should be paid to the direction of windings and connections of the neutralising coils.

RULES.

(1.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(2.) *Queries must be written on one side of the paper, and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(3.) *Designs or circuit diagrams for complete receivers cannot be given: under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(4.) *Practical wiring plans cannot be supplied or considered.*

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

H.T. Supply for the 1930 Everyman Four.

With a view to equalising the discharge of the cells in my 180-volt accumulator H.T. battery, I should like to arrange matters so that the necessary voltage-dropping devices are included in the set, in order that only one positive H.T. connection to the battery need be made.

I already have a 50,000-ohm. wire-wound potentiometer, and take it that this component will be suitable for making critical adjustment of screening grid voltage. E. B.

A skeleton circuit diagram showing the necessary modifications to the anode circuits is given in Fig. 2; your present potentiometer will do quite well for regulating screen voltage, but will pass a rather heavier current than is absolutely necessary, and some economy may be effected by inserting in series with it a fixed resistance of about 50,000 ohms at the H.T. positive end.

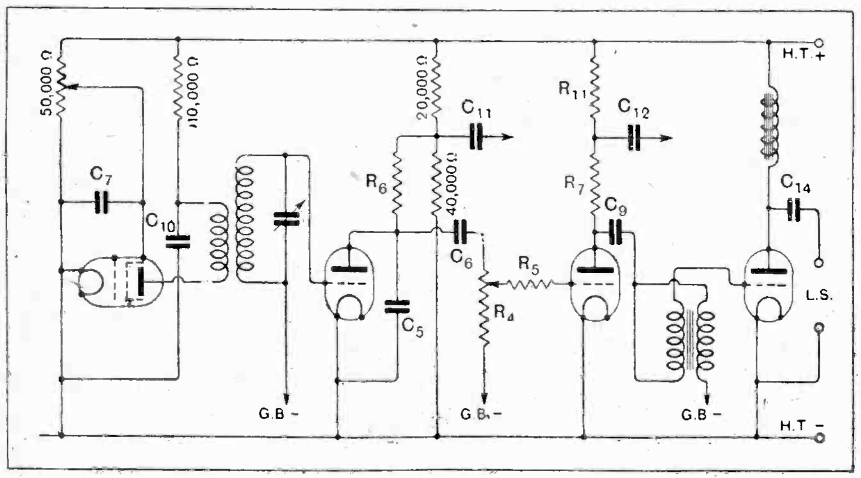

Fig. 2.—The 1930 Everyman Four arranged for a common H.T. supply, with voltage-regulating devices included in the receiver.

We have shown a potentiometer feed for the anode bend detector; this is not essential, but is distinctly to be recommended where a considerable voltage is to be absorbed.

Regarding the resistance in the H.F. valve anode circuit, we have shown a value of 10,000 ohms; this will be approximately correct for the majority of present-day valves, but a value of 20,000 ohms might possibly be necessary. In any case, the exact value of this resistance can be calculated with the help of the information provided by the manufacturers of your valve.

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An Up-to-date All-wave Four.

Will you tell me if a modernised version of the New All-Wave Four has yet been described in your journal? R. C. J.

We have not published any specific information on altering this set, but it can be safely assumed that any modifications would be almost exactly similar to those found to be desirable in moderning the Everyman Four. The 1930 Everyman Four, described in our issue of October 16th, may equally well be considered as a "this year's model" of the All-Wave Four.

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Condensers Out of Step.

I have been considering the design of the "Record III" receiver with a view to "lifting" several of its features for my own receiver, which is in course of reconstruction. One point puzzles me: is it not a fact that the variable condensers C_2 and C_3 cannot possibly operate in step with each other? I say this because their capacities are identical, whereas the inductance of the coils across which they are shunted is different. If this is correct, do you consider that the lack of synchrony is a serious disadvantage? M. C. S.

What you say is quite correct, but in a highly specialised design of this sort it would be a difficult matter to arrange for synchrony, and in view of the fact that the tuning of the H.F. coupling is comparatively broad, the point cannot be considered as of any great importance.

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Tuning Intervalve Couplings.

I notice that, in tuning H.F. coupling transformers, it seems to be common practice nowadays to use condensers with a capacity of not more than 0.0003 mfd., whereas a year or two ago capacities of 0.0005 mfd. were generally employed. Why is this? J. W.

By maintaining a comparatively high ratio of inductance to capacity, magnification is increased, and side-band attenuation is reduced. Both these factors are to the good, but unfortunatly circuits designed on this plan tend to be less selective; this difficulty is nowadays overcome by providing more selective input arrangements than hitherto.

Single H.T. Supply.

Is there any objection to increasing the values of the decoupling resistances in the 1930 Everyman Four, so that a common voltage may be applied to all the anode circuits from an accumulator H.T. battery? E. T. C.

As far as the anode circuits of the H.F. and first L.F. valves are concerned, this plan is quite in order. There would be no serious disadvantage in applying it to the detector valve if the voltage to be absorbed in the resistance is not very great; but it would be better, both for this circuit and for the screening grid, to include a potentiometer rather than a simple series resistance.

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Filament Transformer Output.

I have a step-down low-tension transformer with a rated output of 8 amperes at 4 volts; would it be quite safe to use it in the construction of a three-valve A.C. set, for which the total current consumed by the heaters would be only 3 amperes? T. S. W.

This depends on the voltage regulation of your transformer, and we would not like to offer a definite expression of opinion. Unless the regulation is good, the voltage will rise considerably if the load imposed on the secondary is considerably less than that for which it is apparently designed. We suggest that you should consult the makers.

FOREIGN BROADCAST GUIDE.

RADIO PARIS

(France).

Geographical position: 48° 50′ N. 2° 20′ E.

Approximate air line from London: 214 miles.

Wavelength: 1,725 m. Frequency: 174 kc. Power: 12 kW.

Time: Greenwich Mean Time.

Standard Daily Transmissions.

6.45 and 7.30 a.m. Physical Exercises (ex. Sunday); 8 a.m. news; 12.30 concert; 15.45 concert; (Sundays: 15.30); 18.30 gramophone records; 20.15 or 20.30 main concert.

Male announcer: *Allo! Allo! Ici Emissions Radio Paris de la Compagnie Francaise de Radiophonie.*

Opening signal: Several strokes on gong, followed by Westminster chimes, the latter repeated before all main transmissions.

Time signal: Twelve short sharp dashes, the last one indicating half or full hour.

When closing down the announcer's last words are: *Bonsoir Mesdames, Bonsoir Mesdemoiselles, Bonsoir Messieurs,* usually followed by the "Marseillaise."

Under the heading "Foreign Broadcast Guide," we are arranging to publish a series of panels in this form, giving details regarding foreign broadcast transmissions.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

THE THIRST FOR POWER.

AT the recent Conference at The Hague the International Consultative Committee which deals with the technical aspect of radio communication classified the wireless wavelengths and also made the decision to limit the broadcasting energy of telephony transmitters to 100 kW. It would seem that having once set this enormous power as a maximum this is being regarded as the ultimate goal to which the broadcasting organisations of Europe should aim, without consideration of whether or not it is for the ultimate benefit of listeners in general. Some short time ago, writing under the title of "The Battle of the Giants," we pointed out the unfortunate effects which appeared to be inevitable as a result of individual European States acquiring higher powered broadcasting transmitters.

Far from curbing the ambitions of some countries to install giant transmitters, the recent decision at The Hague tends to support this race for power, and it does not require much imagination to visualise the increasing difficulties in the way of distribution of broadcasting services in the near future as the number of giant transmitters increases.

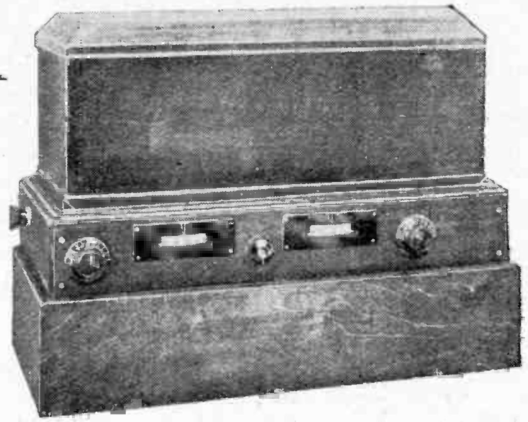
In the earlier days of broadcasting, both in the United Kingdom and on the Continent, the pioneers were satisfied with the erection and operation of stations providing from 1 to 1½ kW. in the aerial. Germany, we believe, was the first country to increase the power of its stations, and still to-day has retained 4 kW. transmitters as a general standard. As other countries in Europe began to put up broadcast transmitters their inclination was to copy or improve upon the example set by Germany, and so 5 and 10 kW. transmitters became quite usual. The schemes which have now been put forward by some of the principal European countries for improvements in their broadcasting organisation all call for higher power transmitters. Germany has until recently implied that the range of the German broadcasting stations was adequate for her requirements, but latterly this view has been modified and a reorganisation of the German broadcasting system is, we understand, now contemplated, having as its object the establishment of a number of transmitters of very much higher power.

Shouting One Another Down!

The German scheme is to install the new high-power stations as additional to the present transmitters and to combine them into groups, the lower-power transmitters operating on national common wavelengths with the high-power station of each group. In view of the energy which Germany has already shown in the development of her broadcasting system there seems little reason to doubt that we shall shortly be faced with a position where the German transmitters will once more dominate Europe and stimulate other States to follow her example.

These changes are coming about in spite of the fact that the insensitive crystal receiver is dying out and being replaced by valve sets which are capable of satisfactory reception over greater distances without so much necessity for high power at the transmitting end. The higher the power of a station, generally speaking, the more costly is its construction, and consequently the harder would it be to bring about a modification of the European broadcasting system in favour of lower power when at a later date the need for some such change becomes urgent. So far our own reception of the British broadcasting transmissions has not been seriously interfered with, but, as the giant stations rise up nearer and still nearer to our shores, it seems inevitable that we shall no longer be able to remain indifferent to the menace.

Wireless World Kit Set A — Mains Model



Minor Circuit Alterations.

Constructing the Eliminator.

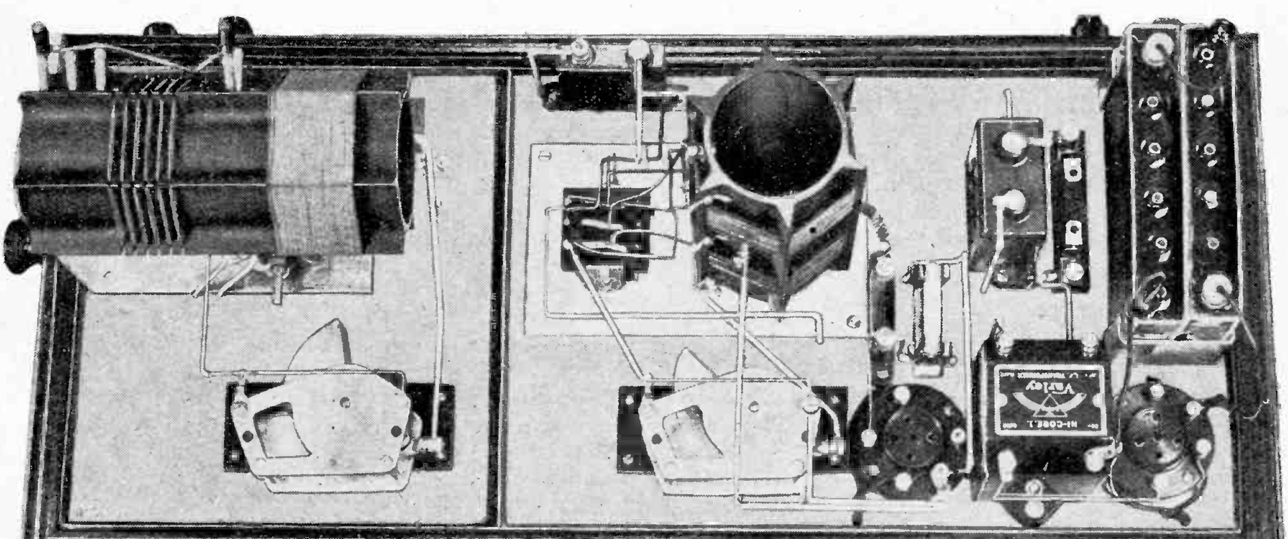
THE following design is given in response to numerous requests from readers for an A.C. version of the "Kit Set" described in the issues for September 18th and 25th.

Essentially the circuit remains the same. It has been found that the turns given for the tuning coils and H.F. transformer function equally well with indirectly heated valves. The only alterations are concerned with the method of volume control, the biasing of the detector valve, and the loud speaker feed. With A.C. valves, of course, the filament control of the screen-grid valve as a means of volume control must be abandoned. Its place is taken in the present design by a potentiometer arrangement controlling the potential of the screen-grid. For this purpose a 50,000-ohm moulded resistance is used in conjunction with a variable wire-wound resistance of maximum value, 25,000 ohms. This ensures that the maximum screen-grid potential specified by the valve makers is not exceeded, and at the same time gives an exceedingly smooth control of volume from zero upwards.

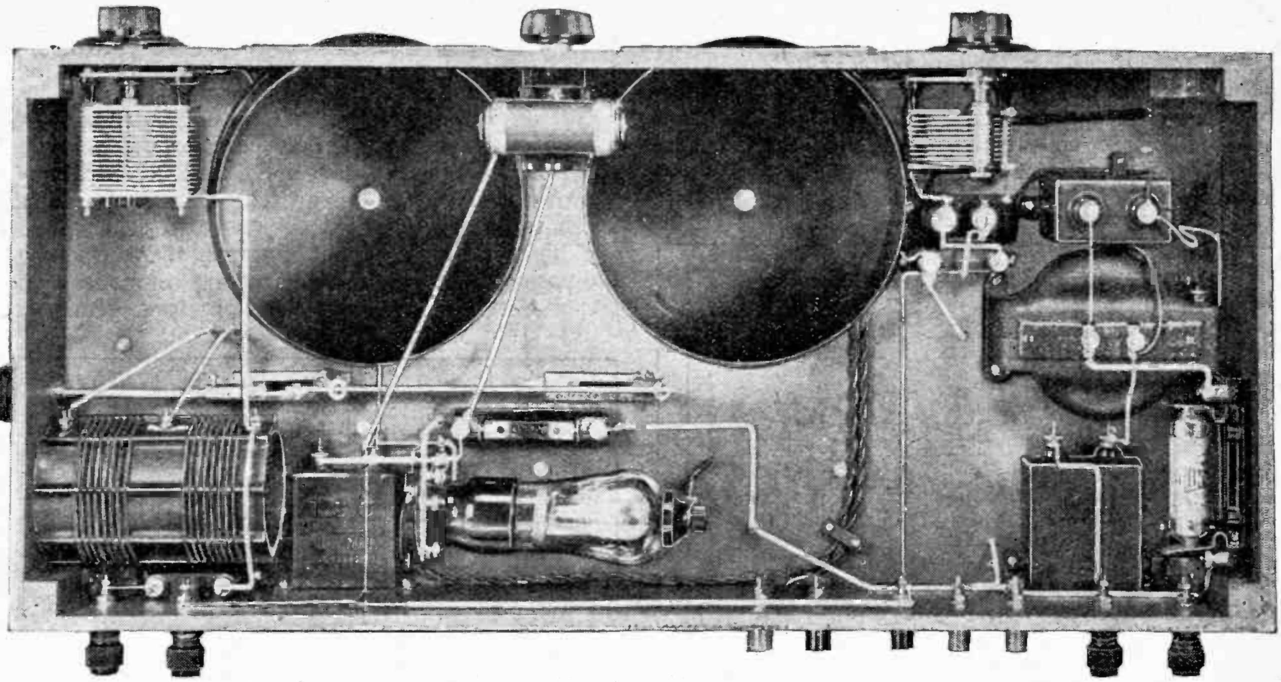
The resistance values in the circuit are suitable for valves in the Marconi series with indirectly heated filaments. The first valve is an M.S.4, the detector an M.H.L.4, and the power valve an M.L.4.

By a merciful dispensation, grid current starts in the M.H.L.4 with the grid slightly negative. If the anode potential is kept between 50 and 75 volts it is possible to work this valve as a leaky grid detector with the grid returned to cathode, i.e., with zero grid bias. This conveniently solves what would otherwise be a troublesome problem; there is no further need for the grid potentiometer specified in the original design, neither do we require a separate cell for positive bias.

The M.L.4 is an output valve of the same calibre as the P.625, and is capable of driving a moving-coil loud speaker. The filter feed circuit was introduced primarily with the object of keeping strong L.F. currents out of the eliminator, but it also serves the useful purpose of by-passing the steady anode current of about 18 mA. from the loud-speaker windings.



Plan view with valves removed. The grid bias batteries are now mounted inside the right-hand compartment.



View underneath the base showing choke filter output circuit and shrouded terminals for connections to the eliminator.

Some revision of the anode feed arrangements has been found necessary. There are still two positive H.T. tappings in order that additional smoothing may be provided for the detector. Connections between the receiver and the eliminator are made through shrouded plugs and sockets instead of terminals, so that if the eliminator is inadvertently switched on with the leads disconnected no damage can result through short-circuiting.

The eliminator is built in a simple tinned-iron case, details of which are given in Fig. 6. The base is of three-ply covered with tinned iron lapped over the edges. The cover pushes down over the edges of the base and is secured at one corner by a length of 2B.A. screwed rod and in the diagonally opposite corner by a wood screw driven into the edge of the vertical sub-panel supporting the mains transformer. This transformer is mounted horizontally, and the end carrying the terminal strips is supported from the base by small brass feet, one of which is used for earthing the core to the metal base. Although a five-pin horizontal valve holder similar to that used for

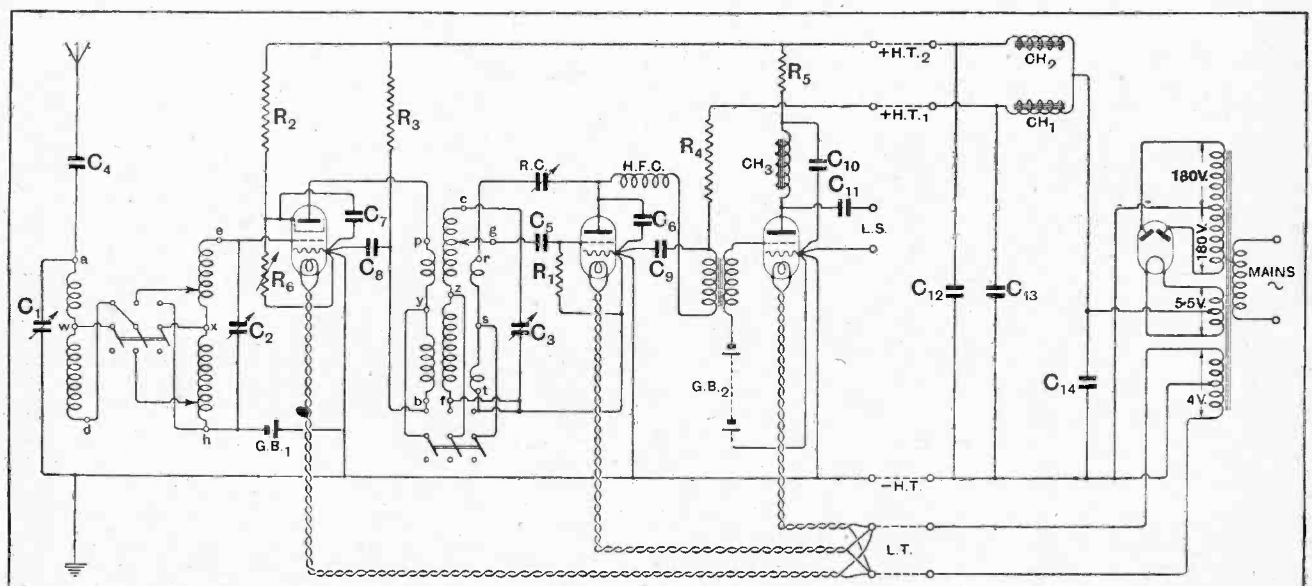


Fig. 1.—Complete circuit diagram of receiver and eliminator unit. C_1, 0.0005 mfd.; C_2, C_3, 0.0003 mfd.; C_4, 0.0002 mfd.; C_5 0.0003 mfd.; C_6, 0.0001 mfd.; C_7, C_8, 0.1 mfd.; C_9, C_{10}, C_{11}, 2 mfds., C_{12}, C_{13}, 2 mfds. (500v. A.C. test); C_{14}, 4 mfds. (500v. A.C. test); R_1, 2 megohms; R_2, 50,000 ohms; R_3, 600 ohms; R_4, 50,000 ohms; R_5, 1,000 ohms; R_6, 25,000 ohms maximum; CH_1, 110 henrys; CH_2, CH_3, 32 henrys.

The Wireless World Kit Set A.C. Mains Model.—
the screen-grid valve has been specified, only four of the contacts are utilised, the centre one being ignored.

Current from the A.C. mains is fed to the Parmeko Type No. 2 A/2 transformer, which provides windings giving 180+180 volts for rectification by a full-wave U5 valve, 5.5 volts for heating the U5 filament and 3 amps at 4 volts for the indirectly heated receiving valves.

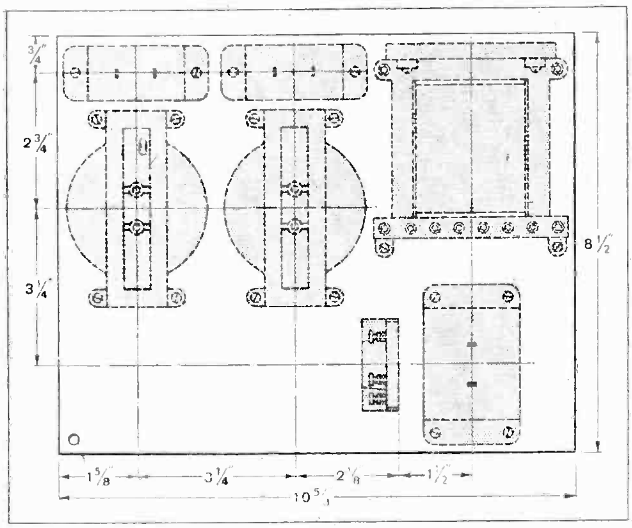


Fig. 2.—Layout of components in eliminator unit.

After rectification the H.T. current is smoothed first by a 4 mfd. condenser tested at 500 volts A.C. and designed to work on 250 volts A.C., and then divides through a 32-henry choke to the H.F. and output valves and through a 110-henry choke to the detector. Additional smoothing is provided on the receiver side of each choke by 2 mfd. condensers, also rated for a working voltage of 250 A.C. To avoid the possibility of shocks in the event of any fault developing in the eliminator, the transformer core and the common negative lead are bonded to the case at E (Fig. 3). No switch or fuses have been included as a switch on the eliminator itself leaves the mains leads live. The set should be switched off at the main, and the fuses associated with the power point should be reduced to 1 or 2, and at the most 5 amps.

The disposition of the eliminator unit is left to the discretion of the reader. It may be concealed behind the set or mounted in a sub-base under the receiver cabinet as shown in the title of this article. Details of a suitable sub-base are given in Fig. 7.

With regard to the layout of parts in the receiver itself, the position of all the more important components associated with the H.F. and detector stages remain unchanged, the majority of the alterations being confined to the output end of the receiver. The grid bias batteries are now mounted inside the screening box to leave room for the output choke and feed condenser underneath the base. The on-and-off switch is omitted from the front panel, and a 25,000-ohm Varley "Power" resistance takes the place of the filament rheostat. Incidentally, the 25,000-ohm resistance is the last component to be fitted. After the wiring underneath the base has been completed the condenser tuning dials are fitted, and then finally the Varley resistance. It will be necessary to remove the perforated cover, which would otherwise project below the base.

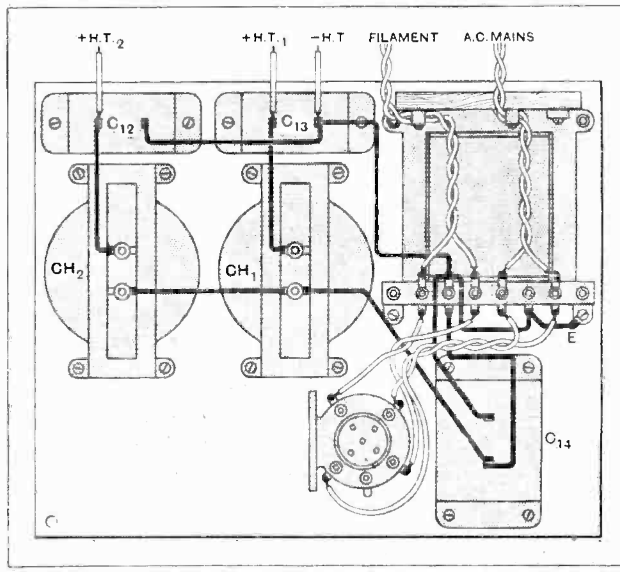
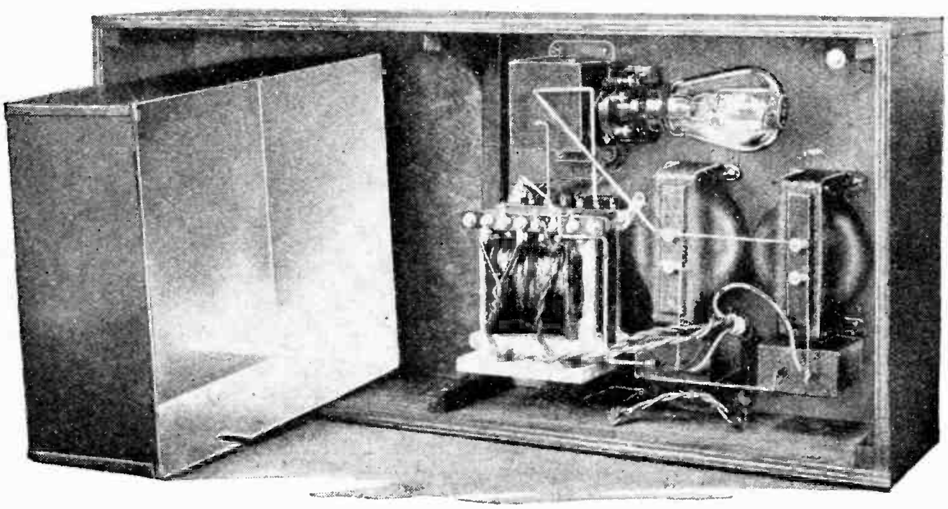


Fig. 3.—Wiring diagram of eliminator unit.

The measured output H.T. voltage from the eliminator when working into a load equal to that of the receiver, turned out to be



Eliminator with cover removed showing method of mounting in suggested sub-base.

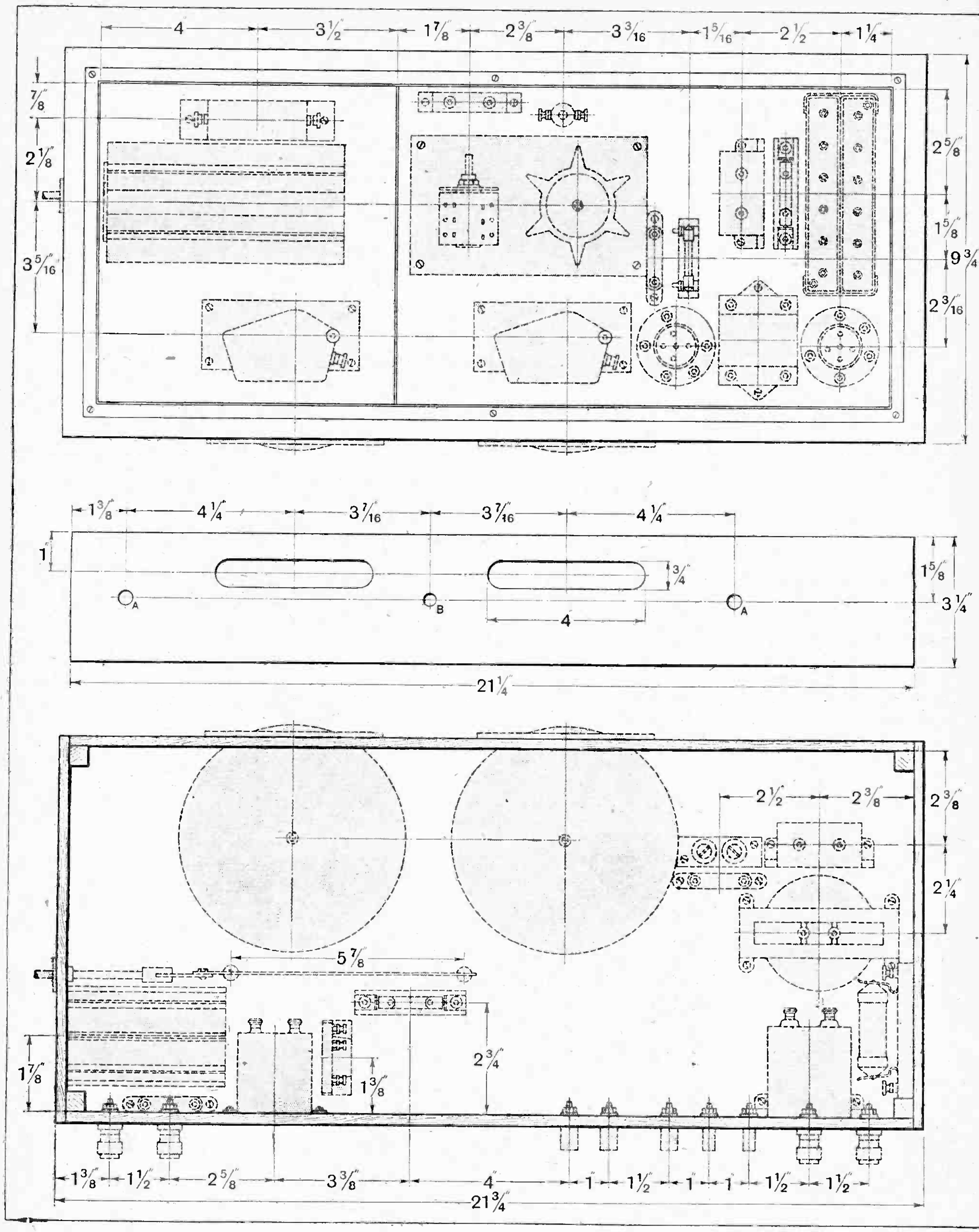


Fig. 4.—Dimensioned layout of components above and below the receiver panel. A = 3/8in. dia.; B = 5/16in. dia.

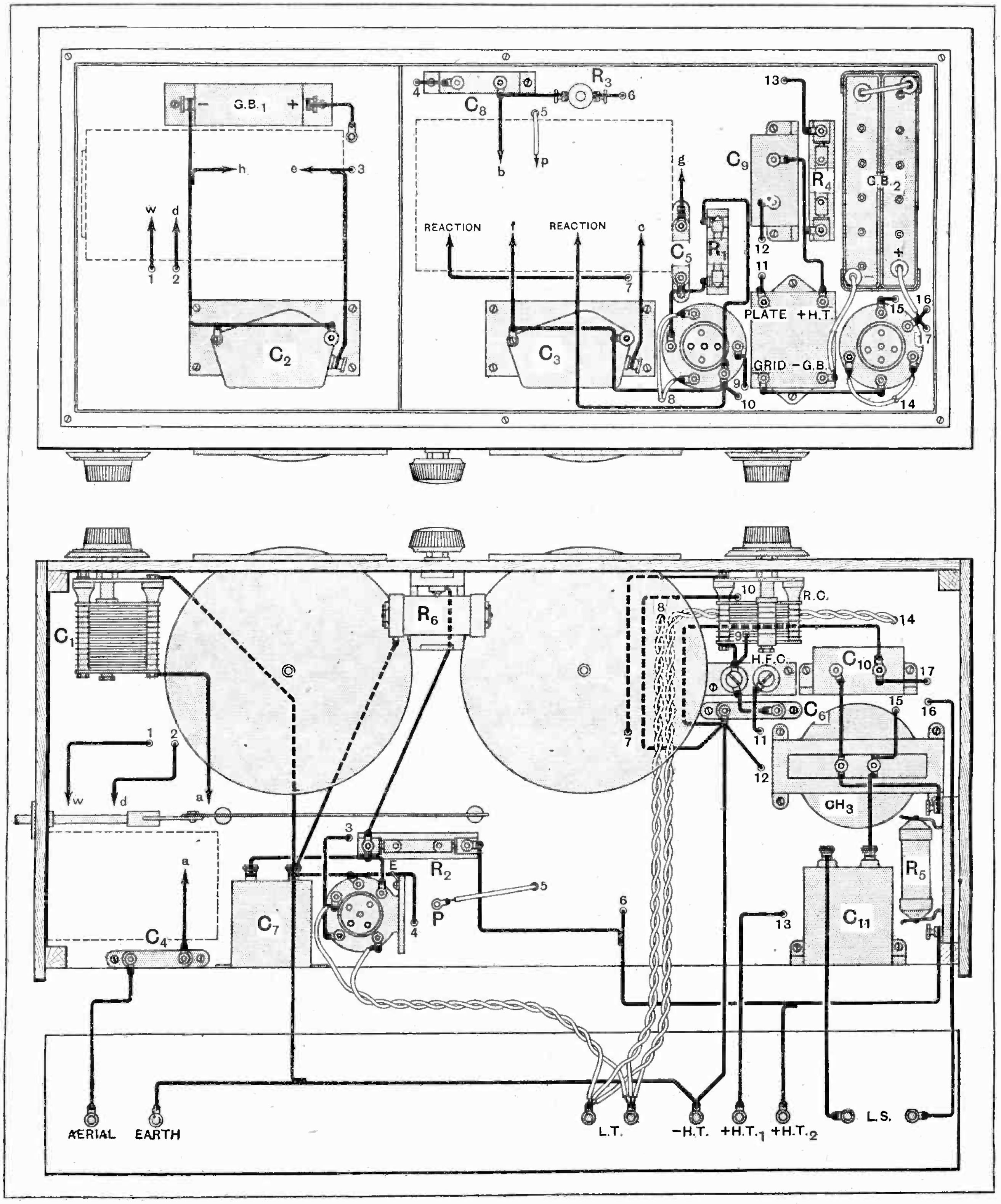


Fig. 5.—Complete wiring diagram of receiver. Wires passing through the base are identified by corresponding numbers, and connections to the coil units are indicated by letters corresponding to the coil details on page 262 of the September 18th issue. The common negative lead is earthed to the metal base at E through one of the fixing screws of the S.G. valve holder.

LIST OF PARTS.

1 Kit Set cabinet (Ritho).
3 Kit Set coils complete (Wearite).
2 Variable condensers, 0.0003 mfd., Type No. 3 (Polar).
1 Variable condenser, 0.0003 mfd. (Utility " Mite " miniature plain).
1 Variable condenser, 0.0005 mfd. (Utility " Mite " miniature plain).
1 Pair dials and Escutcheon plates (B. & J.).
2 Valve holders, 5-pin, baseboard mounting (W.B.).
2 Valve holders, 5-pin, Universal (W.B.).
1 Fixed condenser, 0.0001 mfd., mica (T.C.C.).
1 Fixed condenser, 0.0002 mfd., mica (T.C.C.).
1 Fixed condenser, 0.0003 mfd., mica (T.C.C.).
2 Fixed condensers, 0.1 mfd., 400 volts D.C. test (T.C.C.).
3 Fixed condensers, 2 mfd., 400 volts D.C. test (T.C.C.).
2 Fixed condensers, 2 mfd., 500 volts A.C. test, 250 volts A.C. working
1 Fixed condenser, 4 mfd., 500 volts A.C. test, 250 volts A.C. working (T.C.C.).
2 Moulded resistances, " Met-Vick," 50,000 ohms, and holders (Ediswan).
1 Anode resistance, 1,000 ohms, and holder (Ferranti).
1 Decoupling resistance, 600 ohms (Wearite).
1 Grid leak, 2 megohms (Ediswan).
1 Porcelain base for above (Bulgin).
1 Power potentiometer, 25,000 ohms (Varley).
1 H.F. choke, Binocular Junior (McMichael).
1 S.G. cell, 0.9 volt (Siemens).
2 Grid bias batteries, 9 volts (Ever-Ready).
1 Intervalve transformer (Varley, " Nicore 1 ").
2 L.F. chokes, 32 henrys (Pye).
1 L.F. choke, 110 henrys (Pye).
1 Mains transformer, Type No. 2, A/2 (Parmeko).
1 Rectifier valve, U.5 (Marconi).
1 MS4 valve (Marconi).
1 MHL4 valve (Marconi).
1 ML4 valve (Marconi).
4 Ebonite shrouded terminals (Belling-Lee).
5 Safety plugs and sockets (Belling-Lee).
4 Wander plugs (Belling-Lee).
Wire, Sistoflex, twin flex, lamp adaptor, screws, etc.
Material for eliminator, screen and sub-base.

Approximate cost, including valves, £19.

In the "List of Parts" included in the descriptions of ***THE WIRELESS WORLD*** receivers are detailed the components actually used by the designer, and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

189 volts. With this voltage on the anode of the M.L.4 output valve a bias of -18 volts is not quite enough.

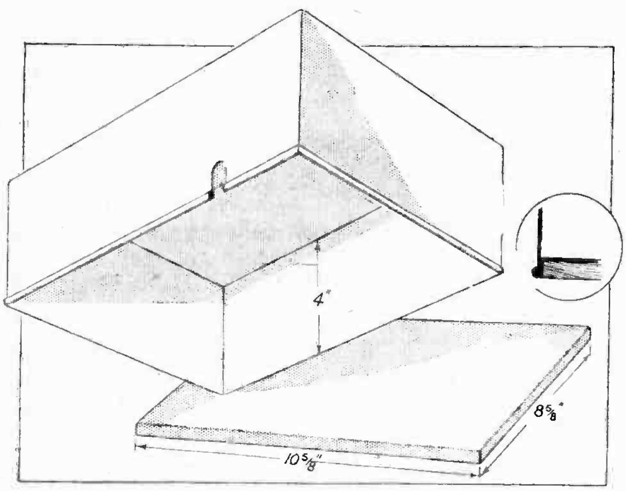


Fig. 6.—Leading dimensions of tinned-iron case for eliminator unit. The base is a piece of three-ply wood with the metal lapped over the edges. The leads are bound with insulating tape or sleeving and passed through a slot in the cover.

Accordingly a 1,000-ohm resistance has been introduced in the anode circuit. This in conjunction with the D.C. resistance of the chokes reduces the voltage on the anode to about 165, for which a bias of -18 volts is suitable. At the same time, the 1,000-ohm resistance and its by-pass condenser assist in smoothing and provide a measure of decoupling for the last stage in addition to that provided by the choke-feed output.

For a full description of the method of tuning, the reader is referred to the article on page 307 of the September 25th issue. With the A.C. valves specified, the performance is quite equal to the standard set by the original set. There is a slight tendency to instability towards the bottom of the long-wave range which suggests a revision of the long-wave primary turns. It is simpler, however, to reduce the screen-grid volts slightly, and this can be done without serious detriment to range or quality.

The eliminator, even when mounted immediately below the receiver, functions without the slightest trace of hum, and there is the same absence of background noise as in the original battery model.

The values of resistance specified for the screen-grid potentiometer give a range of 0 to 63 volts for the screen-grid potential. For screen-grid valves requiring a higher potential a Varley resistance of maximum value 30,000 or even 50,000 ohms should be used.

With a 50,000-ohm resistance in series with the detector valve a measured anode current of 2.8 mA. was obtained with the particular valve used showing the anode volts to be 49; a convenient value for grid rectification with zero grid bias. A higher anode voltage and $+1\frac{1}{2}$ volts grid bias were tried, but without any definite improvement in efficiency.

This receiver is available for inspection at the Editorial Offices, 116-117, Fleet Street, London, E.C.4.

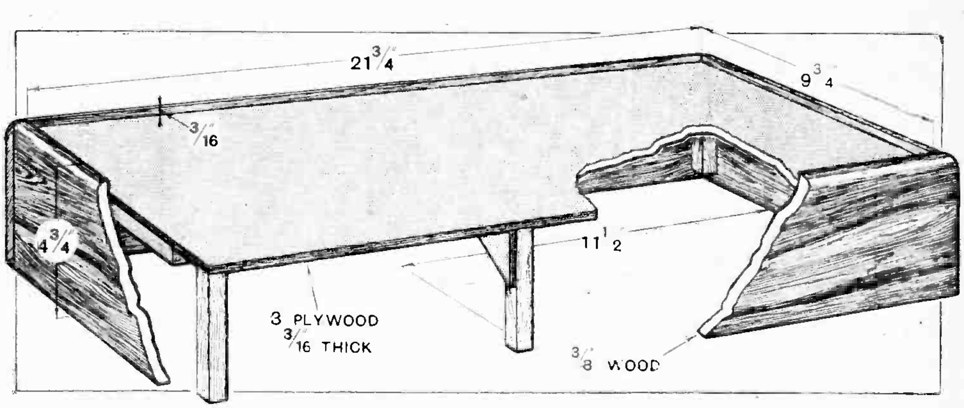
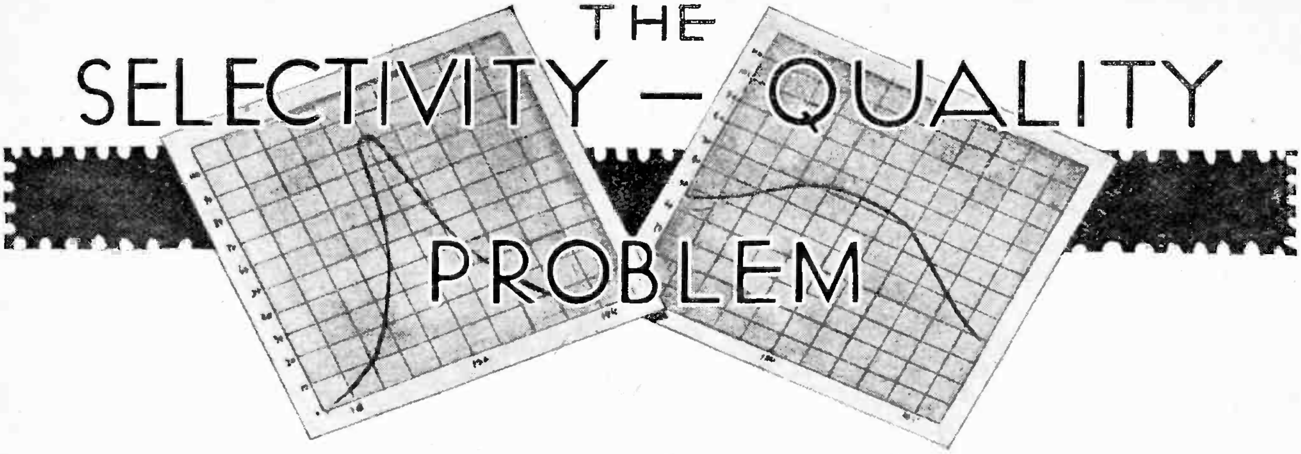


Fig. 7.—Suggested sub-base for housing the eliminator underneath the receiver.



THE SELECTIVITY — QUALITY PROBLEM

A Useful Hint on the Controlling of an Anode-Bend Detector.

By BERTRAM HOYLE, M.Sc.

Briefly the object of this article is to demonstrate how to obtain better quality from a receiver adjusted to a state of "apparent selectivity"; which, if obtained in the usual "wireless" way, and without due regard to circuit conditions, would lead to a distressing lack of high notes.

THERE is a distinct indication in modern wireless receiver design of a tendency to follow one of two divergent policies. One is to design a very perfect musical reproducer, which has of necessity to sacrifice extreme selectivity and range, making it more or less a local station and 5XX set with nearly perfect side-band retention. The other is to design a wireless set from the point of view of obtaining most broadcast transmissions in Europe, both musical and otherwise, and that has a selectivity such that it can tune in to the centre of a distant transmission situated some 8 or 10 kc. away from some much more powerful transmission and still leave no background of the latter.

A wireless set in which this is brought about by virtue of its highly selective tuning apparatus must of necessity, completely cut out all the side-band frequencies approaching 5,000 cycles. This causes the distant station to take on quite an unnatural tone; boominess being a mild description of the malady, especially if on a coil-driven loud speaker. There must be many potential set builders who are divided in their choice between the two limiting types of set above mentioned.

The writer, whose chief aim is good-quality music, favours the type of set employing two screened-grid H.F. stages (one tuned-anode, one transformer stage), anode-bend detector and two low-frequency stages.

Fig. 1 indicates the essential parts of the detector and associated circuits and their constants. Scientific wiring is used for all H.F. and L.F. components. Decoupling resistances and condensers are inserted at all danger points.

High notes are well retained by employing only medium-loss coils in the H.F. part of the set, so that there is no great selectivity. The PM6D valve worked with low anode resistance also helps in the retention of high notes together with as small a capacity from anode to negative filament as practicable, such as 0.0001 mfd., or less in the case of really strong transmissions. Low notes are generously provided for by the use of a 0.1 mfd. mica feed condenser to the grid of a P625 as the penultimate valve. This valve is made to work at 250 volts with 20 mA., and has a specially constructed choke giving

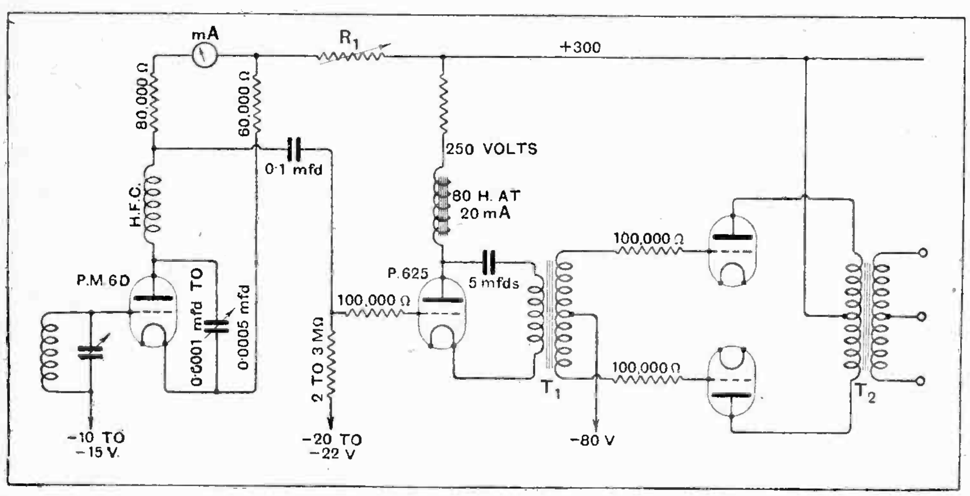


Fig. 1.—Suggested detector and L.F. stages of receiver designed for quality reception. Suitable values are given, but decoupling and filament wiring is omitted.

The Selectivity-Quality Problem.—

80 henrys at 20 mA. in its anode circuit. The fact that this choke is run well off the saturation point[1] and the transformer (a Ferranti AF5C) carries no magnetising current again helps in low-note retention.

To revert to the point of these notes, namely, high selectivity with good quality. The writer, in using this set at first, definitely did not attempt to listen to stations of good strength, with only 10 kc. separation, as there was sufficient overlap to cause trouble, the H.F. coils as already mentioned being made purposely not low-loss coils. Neither is the set used on any transmission that may be weak at the time that it is wanted. There are now many strong stations rather closely placed on the long-wave band which would be well worth listening to at times; but the selectivity demanded is such that their quality is impaired by the time they are tuned in.

To take a concrete example, Berlin, Konigswusterhausen 183.5 kc. (1,634.9 metres) is received in England at very considerable strength, but is only separated by 9.5 kc. from Daventry 5XX, which is immensely stronger.

By putting up the detector bias and by close adjustment of the voltage applied to the detector from the potentiometer (R_1 in Fig. 1), a state of affairs can be reached where there is a very definite cut-off of all signals below a certain strength. This means that on tuning in to Berlin, say, on this none-too-selective receiver, the signal strength (in tune with Berlin) is B, and the strength of Daventry at this tune point is C (Fig. 2). A suitable bias and characteristic to enable the desired cut-off to be obtained is revealed in Fig. 3.

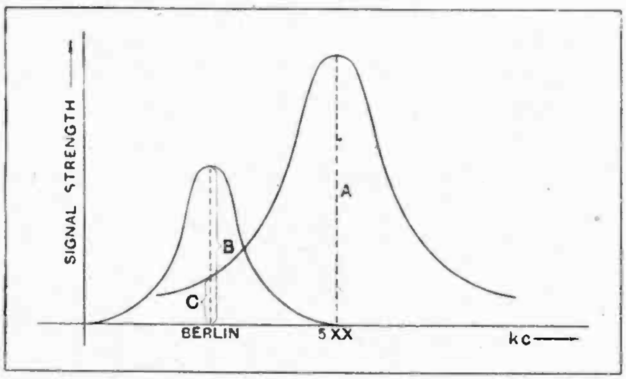


Fig. 2.—Comparative strengths of 5XX(A) and Berlin(B) at point of maximum tuning. The strength of 5XX when the circuit is tuned to Berlin is represented by C. This interference must be rejected by the detector.

In the example chosen the strength of signal C from 5XX is insufficient to reach the rectification point of the characteristic in use; whilst the strength of that from Berlin is B, and is made sufficient to reach a reasonably straight part of the characteristic to be rectified. To do this requires a not very selective set, with two good H.F. stages and fairly strong transmissions to work on, and a fine control of detector volts. Then if the fringe of an unwanted station gives a strength C (Fig. 2), whilst the wanted one gives a strength B several times greater, it is quite easy to obtain the clear, crisp quality usually associated with a non-selective set, combined with a high order of "apparent" selectivity.

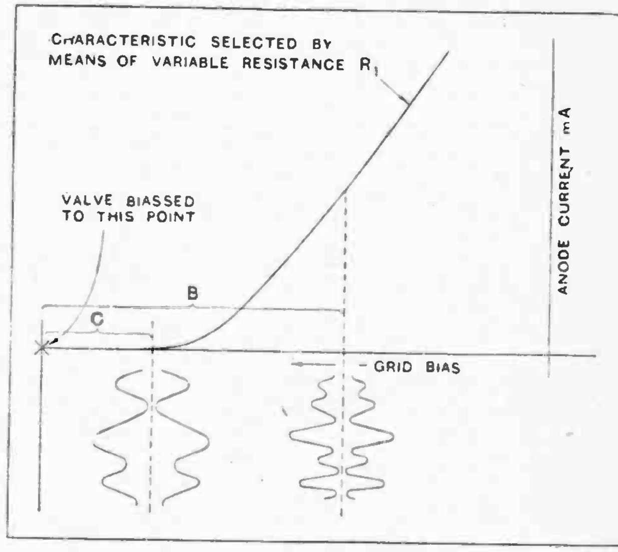


Fig. 3.—The weaker interfering signal C is removed by increasing the value of grid bias or alternatively decreasing the anode circuit.

The chief drawbacks to making use of this device are:

(1) That it is another knob to control, and it tunes rather critically.

(2) That the set when left in this condition is insensitive unless all tuning dials are critically operated together.

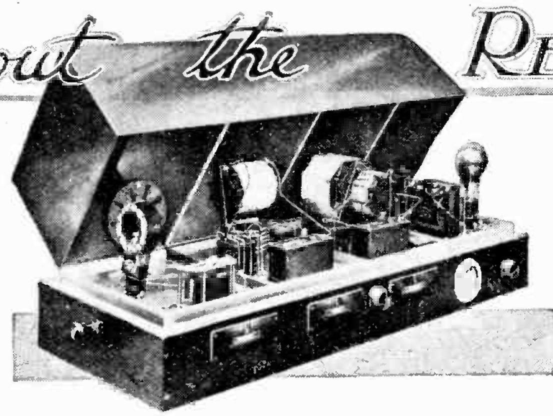
Normally, if any two dials get near a station's setting something is heard of it, and one can proceed to get it easily. Very close logging would be necessary if much use were to be made of the method. Using the PM6D and a bias of – 15 to – 18 volts enables one up to keep up the detector anode voltage to about 150, which gives a very straight line characteristic and, therefore, excellent purity when signals are put on to it.

Those who would like to obtain better quality from stations otherwise too close together in wavelength to permit of it being accomplished without too highly selective coils and circuits, should try a few experiments on the above lines of using variable bias and H.T. voltages, reducing the H.F. selectivity if necessary to regain the high notes.

[1] The choke contains 3½ lbs. of copper and 11 lbs. of iron.

NEXT WEEK'S ISSUE will include a number of specially written articles dealing with the problems of amplification and distortion. A VALVE DATA SUPPLEMENT which accompanies the issue will prove of particular value at the present time owing to the many changes recently made by the valve manufacturers. Previous valve data supplements have been extremely popular and the new method of presentation now being adopted includes practical information helpful to the amateur so that this reference chart becomes indispensable in the selection and operation of valves.

More About the RECORD III



Operating Notes and Hints to Constructors.

By
H. F. SMITH.

THE builder of a set like the Record III[1] gets something more than the mere satisfaction of attaining the maximum sensitivity from its single high-frequency stage. Until the price of screen-grid valves reaches an appreciably lower level than that prevailing to-day, the single high-efficiency stage is likely to appeal, not perhaps so much on the score of reduced initial outlay as on the question of upkeep cost. No one should belittle the advantages of the multi-stage cascade high-frequency amplifier, but there are several reasons against its general adoption in this country—particularly in cases where other and perhaps simpler methods will yield the desired results.

No published receiver design can ever fully meet the precise requirements of everyone who may consider its main features to be attractive, and consequently it will be as well to devote a few words to modifications—permissible and otherwise. At the outset it should be made quite clear that anything approaching a sweeping alteration should be introduced with some hesitation and only if one has considerable experience. Liberties cannot be taken with impunity with a "500 times" H.F. amplifier; this holds good particularly with regard to screening, which can hardly be less complete than that of the original model, although there are admittedly other ways of carrying out this important part of the construction. At a pinch, it would be possible to dispense with a completely closed compartment for the aerial coils and their tuning condenser, but there remains the chance of undesirable interaction between these coils and those parts of the H.F. anode circuit—including the valve anode itself—which are of necessity exposed.

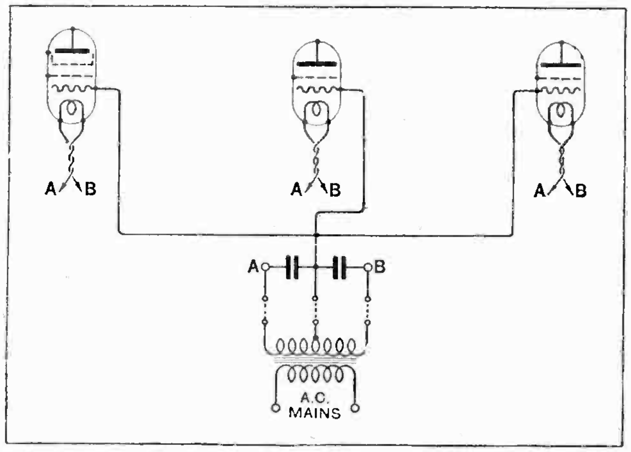


Fig. 2.—The cathode potentiometer (R_5 in the original diagram) may be omitted if a centre-tapped low-tension transformer is used.

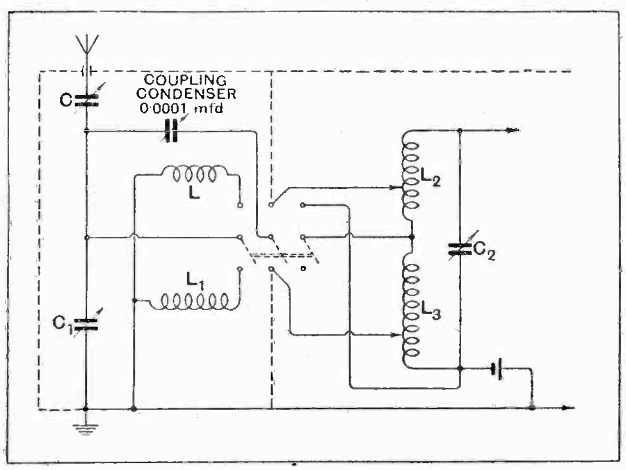


Fig. 1.—Aerial coupling may be continuously varied by the capacity-control method without any serious complication of the circuit arrangement.

Problems of Selectivity.

In order to provide high amplification without serious sideband cutting, the constants of the tuned intervalve circuit are such that this part of the receiver contributes less than usual towards its overall selectivity. This is inevitable, but, thanks to the provision of a separately tuned aerial circuit, the set is not particularly prone to interferences, and is, indeed, well above the average standard in this respect. In difficult situations, and when working on a wavelength close to that of a nearby station, it is a good plan to reduce aerial coupling (by moving the tap connection nearer the earthed end of the secondary coil) to a value rather less than that providing loudest signals.

In some cases it will be considered worth while to make provision for continuously variable aerial coupling, although experience shows that it is often wise to defer

[1] *The Wireless World*, September 4th and 11th, 1929.

More About the Record III.—

this alteration till some practice has been had in the operation of the simpler semi-fixed coupling as described. Closed and open circuits may be linked through a small variable condenser in the manner familiar to most readers: this arrangement is much simpler than the alternative of using swinging coils, and does not greatly complicate the set. A suitable form of connection for continuously variable capacity coupling is given in Fig. 1, from which it will be observed that one pole of the wave-range switch is omitted. If a control condenser of the conventional capacity (0.0001 mfd.) is used, it will be necessary to move the taps on the secondary coils L_2 and L_3 towards their high-potential ends in order that sufficiently close coupling may be effected under all conditions.

Provided that a coupling condenser of sufficiently small overall dimensions is chosen, it may be mounted on the front panel, between the dials of C_2 and C_3.

Instead of picking up an artificial centre point on the heater transformer secondary by connecting the cathodes to a potentiometer slider it is quite permissible to use a centre-tapped winding in the manner shown in Fig. 2. The bridging condensers of 0.005 mfd. (C_{11} and C_{12}) used with the original arrangement must be retained, and should be mounted in the set itself rather than in the eliminator, in order to avoid long leads; this will necessitate a three-wire cable between receiver and external transformer.

Questions are sometimes asked as to the percentage of sideband loss at given audio-frequencies; unfortunately, anything in the nature of a definite reply is quite out of the question, as everything depends on how the input filter circuit is operated. Adjusted to the best advantage, there need be no appreciable loss; indeed, by very skilful operation it is possible to give emphasis to upper sideband frequencies. To make the best use of this valuable feature of the receiver, it is easiest first to tune in the desired signal with the loosest possible coupling between open and closed circuits, and then to tighten the coupling until tuning is appreciably broadened. If detector overloading is produced, a certain measure of control is afforded by reducing the capacity of the semi-variable aerial series condenser, afterwards retuning the open circuit. Incidentally, selectivity can be controlled to a certain extent by this adjustment, which should not be forgotten when interference cannot be cut out by methods already discussed.

It has already been stated that a very simple eliminator is suitable for supplying the set with high-tension current, thanks to the comparatively elaborate decoupling devices and to the fact that a single L.F. valve with a choke filter output is used. Tests have been made by introducing artificial resistance and inductance common to all anode circuits, and it has been found impossible to provoke either H.F. or L.F. oscillation. Of course, this is apart from the question of smoothing; reasonable precautions must be taken to obviate hum, but the receiver is not particularly prone to trouble from this source, partly because it includes H.F. transformer coupling.

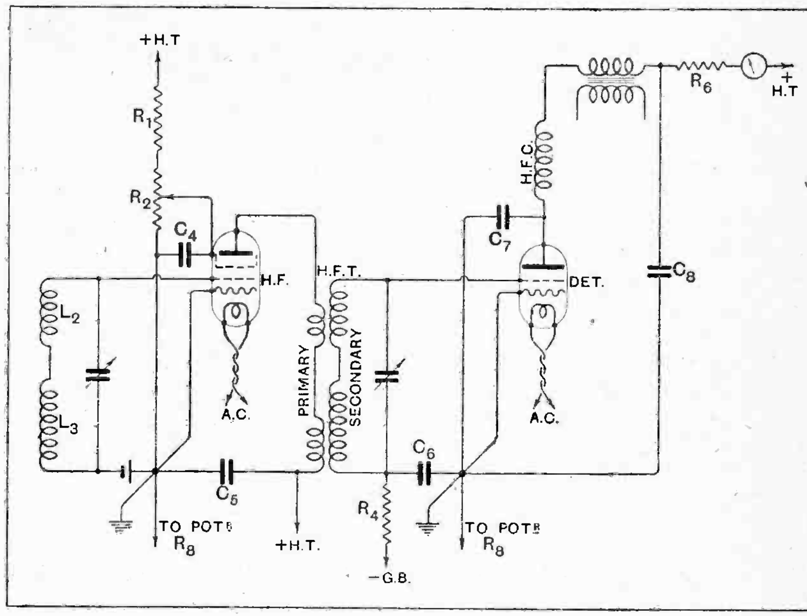


Fig. 4.—Danger points in wiring. Anode, screening grid, and grid oscillatory circuits are "returned" to the earthed cathode terminal of their own valve.

A suggestion for a suitable H.T. eliminator is given in Fig. 3. Here it is assumed that the power transformer will include a low-tension winding for feeding the heaters, as this is the most economical procedure except where an existing high-tension eliminator can be used.

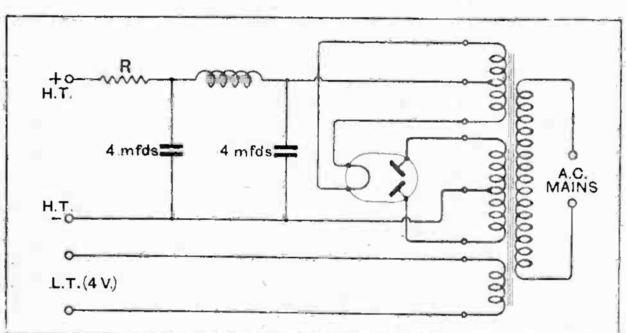


Fig. 3.—A simple eliminator suitable for the Record III. The value of the voltage-absorbing resistance R will depend on the rectified output and the H.T. current consumption of the receiver.

Safeguarding the H.F. Valve.

In the original article it was suggested that a common voltage of anything up to 180 might be applied to the receiver: it should, perhaps, be pointed out that this is rather in excess of the maximum specified for the H.F. valve by its makers, but, as the current consumed by a screen-grid valve is largely determined by screening grid voltage, this was not considered to be of great importance. To be on the safe side, there is no harm in substi-

More About the Record III.—tuting a voltage absorbing resistance of appropriate value for the 600-ohm decoupling resistance R_3 in cases where the maximum pressure is appreciably in excess of 150 volts. As an alternative, a separate high-voltage feed may be provided for the output valve.

Attention has already been directed to the need for thorough screening. Decoupling, or the isolation of individual oscillatory circuits, is almost as important, particularly in a high-magnification mains-fed receiver, and attention is drawn to Fig. 4, which shows how the high-frequency oscillatory components of plate and screening-grid circuits are deflected back to the cathode of the valve concerned. Similarly, it is vital that exposed grid and plate leads of H.F. and detector valves should be as short as possible, and it is for this reason that the connecting wires are passed through holes in the metal base immediately above their terminals.

Checking Transformer Windings.

The H.F. transformer windings are of necessity somewhat complicated, and, in the event of failure to balance the set, suspicion will naturally be directed to the connections of the neutralising coils. The writer can hardly do better than refer those who are in difficulties with regard to this admittedly rather bewildering business of multi-section windings to a simplified sketch in the "Readers' Problems" section of last week's *Wireless World*, which should make the matter quite clear.

While on the question of neutralising, an apparent inconsistency in the design should be explained. It may logically be asked why a balancing arrangement is provided on the long-wave side, although the "goodness" of the coils for this wave-band is admittedly no better than that of those used in other sets that need no adventitious aid to stability. The explanation is simple. A feed-back path is provided through the medium-wave balancing winding and its associated condenser; this cannot be avoided unless a rather complicated addition to the present switching is made, and consequently it was considered simpler to balance on both wave-bands.

Any difficulty in getting the receiver into a state of satisfactory operation is likely to have its source in the H.F. amplifier, but, due to the use of a "decapped" detector, it is inconvenient to test this valve by the method of substitution. In the event of trouble, it is useful to remember that the detector and L.F. amplifier can readily be tested by removing the flexible lead from the H.F. valve anode and joining this wire to the aerial *via* a 0.0001 mfd. fixed condenser. With this connection, the set should function as a detector-L.F. combination.

Several readers who require a somewhat less ambitious receiver have asked for suggestions as to how the set under discussion may be "tamed." After a careful study of the technical considerations leading up to the main features of its design, it will be generally agreed that any sweeping alterations to this end are impracticable, and in such cases it seems wisest to recommend an A.C. version of *The Wireless World* Kit Set.

Regulating Screening Grid Voltage.

In the published "List of Parts" the value of the "Truvolt" wire-wound potentiometer (R_2) for controlling screening grid voltage was given as 50,000 ohms. This was used in the original model, but, in the interest of easy adjustment, it was considered advisable to replace this by a value of 25,000 ohms; this appears in the inscription under Fig. 7. Incidentally, the setting of screening grid voltage is fairly critical. This adjustment can be made very accurately with the help of the detector anode milliammeter. The best procedure is to work on strong local signals, with either grid or plate circuits of the H.F. valve detuned to avoid any stray reaction effects. The potentiometer is then adjusted for maximum deflection of the meter, which will indicate that the applied pressure is correct for maximum magnification.

AN IMPORTANT ANNOUNCEMENT.

COMMENCING with the December 4th issue the price of *The Wireless World* is to be 4d. instead of 3d.

This bare announcement is made by our publishers, but we feel that our readers may, quite naturally, expect to be taken a little more into our confidence and be told why it is that we ask them to pay 1d. more for their wireless journal in future.

The reasons for the increase will, we believe, be appreciated with very little explanation by our readers who have watched the rapid developments of wireless both in theory and in practice. The design of a receiver a year or two ago was at the most a matter of two or three weeks' work, the construction was comparatively simple and no great amount of theoretical investigation or measurement was involved. But to-day the position is very different, requirements of modern receiver design necessitating many weeks of careful laboratory measurement and investigation before the finished design is arrived at and the receiver ready to be constructed in *The Wireless World* workshop. The same view must be taken in regard to the preparation of theoretical articles, whilst *The Wireless World* alone amongst its contemporaries conducts a free technical information department for the benefit of its readers. These are all factors which have to be reckoned in the increased cost of production of the paper. If the standard which *The Wireless World* has set itself is to be maintained steadily in the future, and if *The Wireless World* is to continue to be right up to date in everything appertaining to its subject, then we hope our readers will not feel aggrieved when they are asked to contribute a very small individual amount towards the increased expense of production.

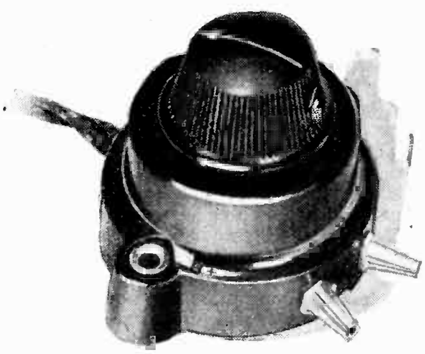
The extra 1d. may seem so trifling a sum as to be of no consequence, but, whilst to the individual reader the 1d. is but a small increase, yet to the publishers it means a substantial contribution towards meeting the additional expenditure involved when each 1d. is multiplied by the figure representing the average weekly circulation of the paper.

LABORATORY TESTS.

A Review of Manufacturers' Recent Products.

"ELECTRAD" TABLE TONATROL.

This device consists of a variable high resistance connected across output terminals and loud speaker leads. Measurements showed that the resistance was continuously variable from 0 to 25,000 ohms. The contact travels over a wire track consisting of separate loops, each making contact with the resistance element. Wear on the track is practically non-existent, and it should maintain a constant resistance throughout. A flexible two-way cord is provided for attachment to the output terminals on the set, and two small spring contact sockets serve to make connection with the leads from the loud speaker or telephones. These should be finished off with pin terminals of suitable diameter.



"Electrad" table Tonatrol for use with telephones, loud speaker or gramophone pick-up.

The device is of American origin, and is marketed by The Rothermel Corporation, Ltd., 24-26, Maddox Street, Regent Street, London, W.1, at 10s. 6d.

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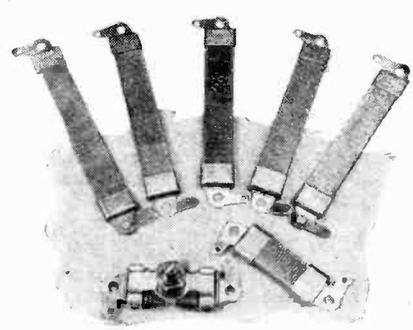
CLAROSTAT "HUMDINGER" AND STRIP RESISTORS.

The "Humdinger" is a potentiometer device with an adjustable centre tap, and has been designed to provide a ready means of obtaining a connection to the electrical centre of the filament, or heater, winding on mains transformers not having a centre-tapped coil. The adjustable moving contact gives a variation in resistance of approximately 60 per cent. either side of the actual centre point. For example, the sample tested was a 200 ohms resistance, nominal and measured, the variable contact giving a change of 62 ohms from the nominal centre to maximum movement in one direction, and 60 ohms change from the centre to the stop in the other direction; this variation being more than sufficient for all practical purposes. These resistances can be employed also as semi-variable potentiometer devices for obtaining "free" grid bias.

"Humdingers" are available in twelve resistance values ranging from 6 to 500 ohms, the price being 4s. in each case.

The fixed resistors are wound on thin strips of insulating material, neatly finished with end caps and provided with fixing holes and soldering tags. These vary in length according to resistance value. They are wire-wound, and available in values of from 1 ohm to 5,000



"Clarostat" wire-wound resistors. The "Humdinger" can be identified by the variable centre tap.

ohms, and a 10,000-ohm unit is in production.

Some samples were measured, and the values found to be very close to the makers' rating.

CLAROSTAT STRIP RESISTORS.

Nominal Value.	Measured Value.	Percentage Error.
1 ohm	1 ohm	—
200 ohms	198 ohms	−1.0%
1,000 ,,	1,020 ,,	+2.0%
1,200 ,,	1,179 ,,	−1.8%
1,500 ,,	1,580 ,,	+5.3%
1,800 ,,	1,840 ,,	+2.2%
2,000 ,,	2,020 ,,	+1.0%

We understand that prices have not yet been fixed, but particulars can be obtained from Messrs. Claud Lyons, Ltd., 76, Old Hall Street, Liverpool.

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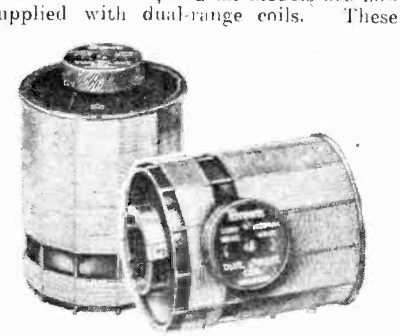
NEW COILS FOR THE BROWN KIT SETS.

It will be recalled that on the last occasion we described the kit sets introduced by the well-known firm of loud speaker manufacturers, S. G. Brown, mention was made that interchangeable coils were fitted. Subsequently, a slight modificaton was made, and all models are now supplied with dual-range coils. These



New dual-wave coils for the Brown kit sets. Change-over switches are carried on the formers.

are wound on formers of the same type as used in the earlier models, the non-reversible base fitting being retained.

It is therefore a simple matter to replace the original coils by the new type, and this can be done without disturbing a single wire in the set. The change-over switches are carried on the coil formers, and, being placed in an accessible position, render change from medium to long waves a relatively simple matter.

The makers, Messrs. S. G. Brown, Ltd., Western Avenue, North Acton, London, W.3, are prepared to exchange the original coils for a set of the new style.

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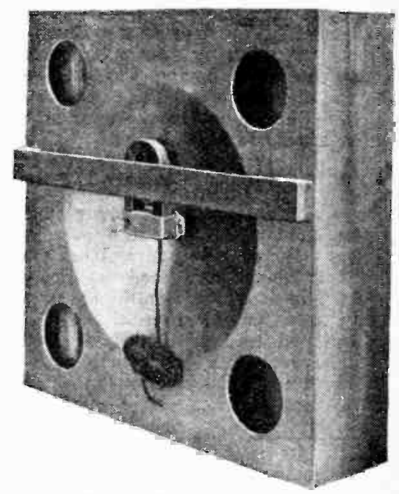
"LINCONE DUPLEX" CHASSIS.

These chassis are supplied by the Bristol Wireless Company (Wholesale), Radio House, Queen's Road, Bristol. Double

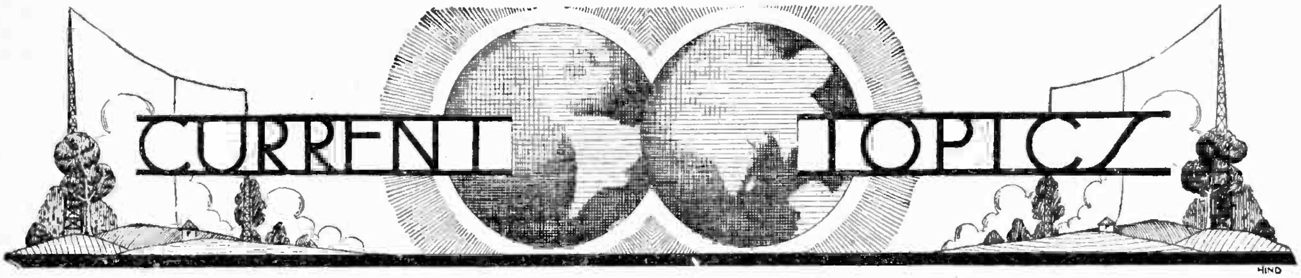


Rear view of the "Lincone Duplex" chassis with the unit in position.

cone linen diaphragms are used, these being mounted with their apices adjacent. The movement recommended is a "Blue Spot" unit, type No. 66K, with adjustment.

The chassis sent in for test measured 18in. × 18in. × 5in. deep, the front cone being 16in. in diameter, and the back cone 12in. On test, the response was found to be very good indeed, frequencies from 300 up to 5,200 cycles being well brought out. There was practically no noticeable resonances between these two limits. There was a slight reduction in the output from 4,500 cycles down to 3,000 cycles, but between 3,000 and 300 cycles the normal level was again attained. Below 300 cycles sundry peaks were noticed; however, these were not unduly accentuated, and should not give an artificial base.

The price of this sized chassis is 22s. 6d. and the unit 25s. A larger chassis measuring 24in. × 24in. × 5in. costs 32s. 6d. "Lincone" chassis built into cabinets are available also. The prices of these models are £4 in oak and £4 10s. in mahogany.



Events of the Week in Brief Review.

WHERE LISTENING IS COMPULSORY.

The Vaud (Swiss) Council of State has made an Order whereby apprentices living beyond a certain distance from a technical school must listen to broadcast courses. Communes affected by the Order are to be provided with Government receiving sets. There will thus be little opportunity to play wireless "truant."

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AMATEUR TRANSMISSION INCREASING.

The French transmitting fraternity, as represented by the Reseau des Emetteurs Français, is rejoicing over a big increase in new members during the past year. The roll now includes 1,100.

British amateur transmitters number approximately 1,800.

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POLICE RADIO NETWORK FOR LONDON ?

Plans for equipping all police stations in the London Metropolitan area with wireless transmitters and receivers are, it is stated, being considered by Scotland Yard. The apparatus would be used principally for communication with the wireless-equipped cars of the Flying Squad, which have proved their worth with the limited radio facilities already available.

The scheme provides for a wireless network embracing the whole of the Metropolis with wireless links to the most important provincial centres. The provision of a special police radio branch is being discussed.

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HOME CONSTRUCTORS' SHOW IN MOROCCO.

Morocco's first wireless exhibition, to be strictly limited to the products of amateurs, will open its doors at Casablanca on Saturday next, November 30th. All entrants will be required to make a sworn declaration that the exhibits are home-made. Prizes will be awarded for crystal, straight valve, and superheterodyne sets.

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IRISH RADIO SUCCESS.

The recent Dublin wireless exhibition made a poor start, the attendances being disappointingly low. Before the end of the week, however, public enthusiasm grew to such an extent that the show was transformed into a success, all previous shows being outstripped both in attendance and business transacted.

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OLD AGE PENSIONERS MUST PAY.

In the House of Commons recently the Postmaster-General, Mr. Lees-Smith, said that the Broadcasting Committee of 1925 had considered the question of granting free wireless licences to old age pensioners, but had recommended that this concession should be made to blind persons only. He did not feel justified in asking Parliament to grant any similar concessions to other classes of the community.

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THEORY MADE EASY.

The first five articles on "Wireless Theory Simplified," by S. O. Pearson, B.Sc., which have appeared weekly in *The Wireless World*, were discussed at the last meeting of the Tottenham Wireless Society. General appreciation was expressed regarding the usefulness of the articles, and it has been decided to make them the basis of discussion at future meetings.

The series is proving of special value to many experimenters and constructors who have little opportunity to study wireless theory as presented in the average text-book. A useful aid towards deriving the maximum value from the articles is Mr. S. O. Pearson's "Dictionary of Wireless Technical Terms," which was first published in weekly instalments in *The Wireless World*, and is now obtainable in pocket-book form at 2s., or post free from our publishers at 2s. 2d.

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NAVAL WIRELESS TELEGRAPHY.

At a meeting of the Wireless Section of the Institution of Electrical Engineers on Wednesday next, December 4th, at the Institution, Savoy Place, W.C.2, a paper will be read on "Naval Wireless Telegraphy Communications." The authors are Mr. G. Shearing, B.Sc., and Capt. J. W. S. Dorling, R.N.

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BROADCASTING BATTLE IN FRANCE.

Two rival schools of thought produced a checkmate at the French National Broadcasting Congress, which met in Paris on November 14th, 15th and 16th, with the object of influencing the coming legislation for establishing broadcasting on a new basis.

The public debates were marked by lively skirmishes, writes our Paris correspondent, the outcome being the dignified withdrawal of the minority party, which stands for State control. Those who remained to continue the discussion were divided into two groups, both striving for "controlled liberty," but each giving the term a different meaning. One faction, representing the trade, would like the present Bill passed in its entirety, as safeguarding national interests through the ministrations of a National Broadcast

SWEDEN'S "DAVENTRY."—A picturesque glimpse of the 30kW. broadcasting station at Motala, which distributes the Stockholm programme over the greater part of Sweden on a wavelength of 1,345 metres.

Bureau similar to the B.B.C. The partisans of the alternative scheme of "controlled liberty" aim at a National Bureau, the members of which would not be nominated by the Government, but elected by popular vote, representing various public authorities, intellectual and manual workers, trades unions and similar bodies.

It is doubtful whether this unsatisfactory gathering will influence subsequent events. The only point on which unanimity was reached was that the present broadcasting position is "lamentable."

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CREATING WANDERLUST BY WIRELESS.

A mobile short-wave transmitter was used in a new experiment made on Sunday last by the French "Office National de Tourisme" in an endeavour to stimulate touring. A representative of the organisation motored through several delectable districts of "La Belle France" and at a preconcerted time set his short-wave transmitter in operation and broadcast an alluring account of the places he had visited. The transmission was picked up on a receiver on the outskirts of Paris and relayed to Paris PTT.

The test was a precursor of a special series to be started early in 1930.

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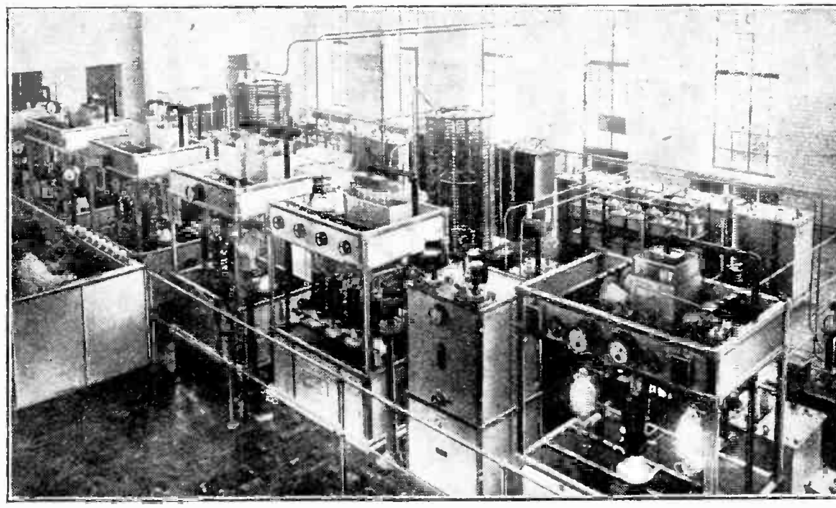
RADIO SOCIETY'S £350 HOSPITAL GIFT.

When the Duchess of York visited Southend on November 12th to lay the foundation stone of Southend's new £200,000 hospital and to receive purses of donations for the funds, the Southend and District Radio Society presented a purse containing an undertaking to equip the hospital throughout with wireless at an estimated cost of £350. In addition, a second purse was given containing nearly £5, the proceeds of a collection at a recent meeting of the society.

It is of interest to recall that the society equipped the present hospital of hundred beds at a cost of over £120 and maintains the whole installation free of all cost and responsibility to the authorities. Every bed has its pair of telephones, and the children's wards and staff sitting-rooms all have loud speakers—eight in all.



MOTALA'S BRITISH-MADE TRANSMITTER. The transmitting hall of Sweden's high-power station. The equipment was manufactured by the British Marconi Company at Chelmsford.

"CRYSTAL GLOBE" RECEPTION.

A "crystal globe" moving picture receiver which picks up wireless film transmissions and simultaneously projects the pictures on a screen is described by the Washington correspondent of *The Daily Telegraph*. The inventor, Dr. Vladimir Zworykin, research engineer for the Westinghouse Electric Company, employs a cathode-ray valve which takes the place of the normal glow valve, scanning disc and motor. The valve is cone-shaped with a flat end upon which the transmitted picture appears.

SHORT-WAVE BROADCASTING STATIONS OF THE WORLD.

Arranged in Order of Wavelength and with Usual Times of Transmission.

Station.	Frequency in Kilocycles.	Wavelength in Metres.	Kilowatts in Aerial.	Times of Transmission (G.M.T.).
Motala, Sweden	3,033	98.9	—	Stockholm Programme
7RL, Copenhagen ("Popular Radio" Experimental).	3,561	82.24	—	Mon., Fri. 23.00
8KR, Constantine, Algeria.	3,750	80	—	Mon., Fri.
OHK2, Vienna	4,285	70	—	Sun. 17.00
AFK, Döbintz, Germany	4,434	67.65	5	Mon., Wed., Fri. 10.00 and 18.00
W8XF, Cleveland, Ohio (short-wave of WHK)	4,550	66.04	0.5	—
W2XBA, Newark, N.J. (short-wave of WAAM).	4,603	65.18	0.5	—
W8XK, East Pittsburg, Pa. (short-wave of KDKA)	4,800	62.5	—	—
Paris, Radio LL	4,918	61	—	12.30
Khabarovsk, Russia	4,990	60.12	20	—
Prague, Czechoslovakia	5,172	58	—	—
AGJ, Nauen, Germany (occasionally)	5,291	56.7	—	—
Rugles, Eure France (Journal des 8)	5,455	55	—	22.00
AFL, Bergedorf, Germany.	5,769	52	3	—
AIN, Casablanca, Morocco	5,882	51	—	—
EAJ25, Barcelona (Radio Club), Spain	6,000	50	—	Sat. 16.00
RFN, Moscow	6,000	50	—	Tues., Th., Sat. 12.00
W2XBR, New York (R.C.A.) (short-wave of WBNY).	6,020	49.83	1	—
W9XF, Downer's Grove, Ill. (Gt. Lakes Radio Broadcasting Co.)	6,020	49.83	5	—
W2XAL, Coytesville, N.J. (short-wave of WRNY, Experimenter Pub. Co.)	6,040	49.67	0.5	—
W8XAL, Harrison, Ohio (short-wave of WLW and NBC Crosley Radio Corporation)	6,060	49.5	0.25	00.00 (Ex. Fri. and Sat.)
W9XU, Council Bluffs, Iowa (short-wave of KOIL)	6,060	49.5	0.5	—
W3XAU, Philadelphia, Pa.	6,060	49.5	0.5	—

Station.	Frequency in Kilocycles.	Wavelength in Metres.	Kilowatts in Aerial.	Times of Transmission (G.M.T.).
UOR2, Vienna	6,072	49.4	0.4	—
W2XCX, Kearney, N.J. (short-wave of WOR)	6,080	49.34	0.5	—
W9XAA, Chicago, Ill. (Federation of Labour)	6,080	49.34	0.5	—
W6XAL, Westminster, Cal. (Pacific-Western Broadcasting Federation)	6,080	49.34	15	—
W3XAL, Bound Brook, N.J. (R.C.A.)	6,100	49.18	20	—
W2XE, Richmond Hill, N.Y. (Atlantic Broadcasting Corporation, short-wave of WABC)	6,120	49.02	5	23.00
W8XK, Pittsburg, Pa. (Westinghouse Electric)	6,140	48.86	20	—
I1AX, Rome (Via Savoia 80)	6,667	45	—	—
XC51, San Lazaro, Mexico	6,818	44	—	07.00 and 19.00
D4AFF, Coethen, Germany	6,881	43.6	—	—
1MA, Rome	6,896	43.5	—	Sun. 16.00
EAR110, Madrid (Assoc. Nee de Radio-eschucas)	6,977	43	—	—
6AG, Perth, West Australia	7,142	42	—	10.30 and 15.00
Paris (Radio Vitus)	7,316	41	—	19.30
YR, Lyons	7,463	40.2	—	16.30
DOA, Döberitz, Germany	7,500	40	—	17.00
PCL, Kootwijk, Holland (League of Nations' Services to America)	7,730	38.8	25	15.00
JHBB, Ibarakiken, Japan	8,000	37.5	—	—
EATH, Vienna	8,108	37	—	—
HS4PJ, Bangkok, Siam	8,108	37	0.2	Tues. and Fri. 13.00 and 18.00
W2XAC, Schenectady, N.Y. (G.E.C.)	8,696	34.5	—	—
2BL, Sydney	9,230	32.5	—	—
FLJ, Issy-les-Moulineaux, Paris (Time Signals)	9,230	32.5	7	07.56 and 19.56
HB9OC, Berne, Switzerland	9,375	32	—	—
D7MK, Copenhagen ("Radioposten")	9,380	32.05	—	Tu. and Fri., 23.00
Posen, Poland	9,434	31.8	0.25	18.20
Paris (Exper.)	9,479	31.65	2	21.00
Lyngby, Denmark	9,494	31.6	1	18.00
3LO, Melbourne, Australia (temporarily closed)	9,503	31.55	—	—
W9XA, Denver, Colorado (short-wave of KOA, G.E. Co.)	9,530	31.48	0.75	—
W2XAF, Schenectady, N.Y. (short-wave of WGY, G.E. Co.)	9,530	31.48	40	23.00
PCJ, Eindhoven, Holland (Philips Lamp Works, Transmitter at Hilversum)	9,554	31.4	25	Thurs., Fri. 19.00 Sat. 02.00
Zeesen, Germany	9,560	31.38	—	19.00
W3XAL, Bound Brook, N.J. (R.C.A.)	9,570	31.35	20	—
W8XK, East Pittsburg, Pa. (Westinghouse Electric)	9,570	31.35	20	—
2FC, Sydney, Australia	9,590	31.28	—	—
LGN, Bergen, Norway	9,600	31.25	—	—
7LO, Nairobi, Kenya Colony	9,677	31	—	16.00
W2XAL, New York (short-wave of WRNY, Experimenter Publishing Co.)	9,700	30.91	0.5	00.00
Agen, France	9,756	30.75	—	Tu. and Fri. 21.00

Station.	Frequency in Kilocycles.	Wavelength in Metres.	Kilowatts in Aerial.	Times of Transmission (G.M.T.).
CRJX, Winnipeg, Canada	11,718	25.6	2	22.30
W3XAL, Bound Brook, N.J. (R.C.A.)	11,720	25.6	20	—
5SW, Chelmsford (B.B.C. Experimental)	11,751	25.53	15	12.30 and 19.00 (Ex. Sat. and Sun.)
W9XF, Downer's Grove, Ill. (Gt. Lakes Radio Broadcasting Co.)	11,800	25.42	5	—
W9XAA, Chicago, Ill. (Federation of Labour)	11,840	25.36	0.5	—
W8XK, Pittsburg, Pa. (Westinghouse Electric, relays KDKA)	11,880	25.25	20	—
Oporto, Portugal (Apollo Theatre, Exp.)	12,000	25	—	12.00, 19.00 and 22.00
K1XR, Manila, Philippine Islands	12,240	24.5	—	18.30
W6XN, Oakland, Calif. (Short-wave of KGO, G.E. Co.)	12,850	23.35	5	17.30
W2XO, Schenectady, N.Y. (Short-wave of WGY, G.E. Co.)	12,850	23.35	—	Tues., Thurs., Sat. 17.00
Vienna (Ravag)	13,513	22.2	0.24	—
W3XAL, Bound Brook, N.J. (R.C.A.)	15,130	19.83	20	—
W8XK, Pittsburg, Pa. (Westinghouse Electric)	15,210	19.71	20	—
W6XAL, Westminster, Calif. (Pacific Western Broadcasting Federation)	15,250	19.67	15	—
W2XAD, Schenectady, N.Y. (G.E. Co., short-wave of WGY)	15,340	19.56	25	17.00
Lyngby, Denmark (Exper.) (Power will be increased to 10 kW.)	15,789	19.6	1	—
PCL, Kootwijk, Holland (League of Nations' Services before 3.0 p.m.)	16,304	18.4	25	11.00
W2XK, Schenectady, N.Y. (G.E. Co., short-wave of WGY)	17,300	17.31	25	Tues., Thurs., Fri. 17.00
AGC, Nauen, Germany	17,441	17.2	—	—
HS1PJ, Bangkok, Siam	17,751	16.9	20	Sun. 12.00 and 18.00
PHI, Huizen, Holland	17,769	16.88	40	15.00
W9XAA, Chicago, Ill. (Federation of Labour)	17,780	16.87	0.5	—
W3XAL, Bound Brook, N.J. (R.C.A.)	17,780	16.87	20	—
PLF, Bandoeng (Malabar), Java	17,850	16.8	30	13.00
PCK, Kootwijk, Holland	18,404	16.3	—	06.00
PLE, Bandoeng, Java	18,820	15.94	—	12.40
Nancy, France	19,351	15.5	—	21.00
Buenos Aires	19,973	15.02	—	—
W9XF, Downer's Grove, Ill. (Gt. Lakes Radio Broadcasting Co.)	21,500	13.95	5	—
W6XAL, Westminster, Calif. (Pacific Western Broadcasting Federation)	21,500	13.95	15	—
W3XAL, Bound Brook, N.J. (R.C.A.)	21,500	13.95	20	—
W8XK, Pittsburg, Pa. (Westinghouse Electric)	21,540	13.93	20	—

BROADCAST - BREVITIES.

By Our Special Correspondent.

The Silent Carrier.—A Breakdown.—European Relay Network.

Warming-up the Twin Transmitter.

Wordless whispers are already issuing from the twin transmitter at Brookmans Park, which is now sending out an unmodulated carrier wave every evening from seven o'clock till eleven on its allotted wavelength of 261.3 metres. I understand that comparatively low power is being used, certainly not more than 5 kilowatts.

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Interlopers Not Wanted.

Since no real testing is being carried out, one may well ask why Tweedledee is wasting its fragrance on the desert air. I can suggest a probable explanation. Owing to the limitations of the Prague Plan there are a number of foreign transmitters wandering forlornly up and down the wavelength scale in search of a vacant spot. The wavelength of 261.3 metres has been granted exclusively to Britain, but a homeless foreigner, finding that wavelength out of use, would probably acquire and hold it on the principle that possession is nine points of the law. Whether or not this explains the silent transmission, the B.B.C. would do well to keep it going until the tests begin.

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Brookmans Park Breaks Down.

Meanwhile it is my sad duty to record the first breakdown at Brookmans Park. This occurred on November 18th, 1929, at 1.52 p.m., when a burnt-out meter stopped transmission for three minutes. How many listeners noticed the break?

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"Bed Sit" Sufferers.

Visits to the homes of listeners who have complained of inability to hear Brookmans Park on a crystal set have convinced the B.B.C. engineers that the greatest sufferers under the new regime are dwellers in bed sitting-rooms, the majority of these being unable to erect an outside aerial or to afford anything more expensive than a crystal set.

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Retailers and Aerials.

Other crystal users with facilities for erecting outside aerials have been subjected to a new form of victimisation by the less reputable members of the wireless trade. In these cases the retailer has refused to erect an outside aerial unless the customer agrees to purchase a valve set, the excuse being that a crystal set will be useless even with the new aerial.

The crystal user may well question the value of an outside aerial!

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From the Savoy Hill Post Bag.

"Brookmans Park is said to be a wipe out. It is a wash out."

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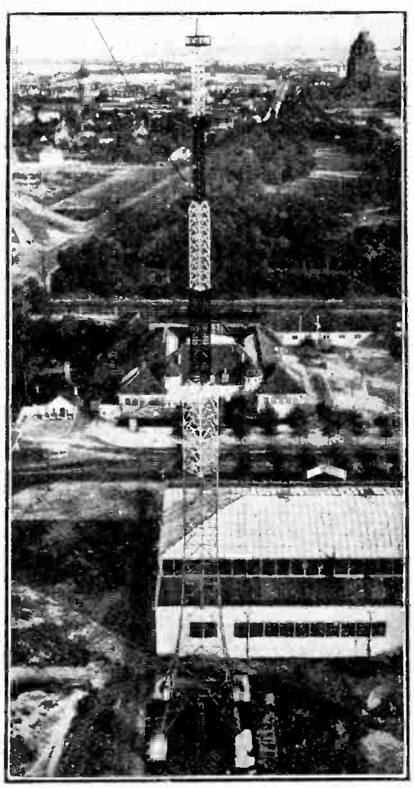
Relaying from the Continent.

The relay of Strauss's "Salome" from Cologne on Friday next must not be associated with the special relay tests to which reference was made in these columns last week. The experiments beginning in January next will employ for the first time a new set of trans-Continental landlines which are under test by the German Post Office.



LEIPZIG.—An impressive view of the southern mast photographed from the top of its neighbour. In the right background is the Leipzig War Memorial.

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A European Network?

The aspirations of the long-distance listener are certainly not being considered by the B.B.C. or any other European broadcasting authority; on the other hand, ambitious schemes are afoot for the development of a European network of relays not unlike the "Red" and "Blue" networks in America. Broadcasting organisations on both sides of the Channel are now casting fond eyes on the project for a new Anglo-Belgian cable to be completed in two or three years' time. This cable will embody the latest improvements in amplifiers and repeaters, so that we may hope that the time will come when a landline broadcast will give us a reasonable band of musical frequencies.

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Neck to Neck

In a recent issue it was stated that the increase in the number of licensed German listeners in the last quarter amounted to 16,941. According to an official at Savoy Hill, the increase in British licencees during the same period amounted to 17,025.

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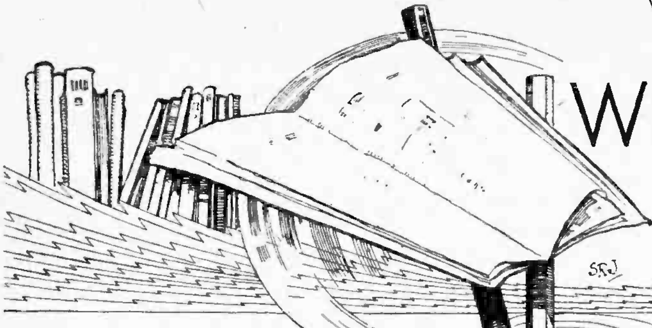
Radio Week in Bristol.

Bristol Radio Week will be held from December 8th to 14th. On the first day Sir Thomas Beecham conducts the National Orchestra of Wales, the concert being relayed to 5WA from Park Hall, Cardiff.

A Sailors' and Soldiers' Night, arranged in conjunction with the British Legion, will be relayed from Colston Hall on December 9th.

On December 12th "Smooth Crossing," a new play in one act by Mr. Froom Taylor, will be presented by Bristol's Little Theatre Company, and relayed to the Cardiff station.

Mr. Winston Churchill will be installed as Chancellor of Bristol University on December 13th. It is expected that his address will be relayed to Daventry 5XX as well as to Cardiff.



WIRELESS THEORY SIMPLIFIED

Part X.

Condensers and Capacity.

(*Continued from page 574 of the previous issue.*)

By S. O. PEARSON, B.Sc., A.M.I.E.E.

NOW that the fundamental principle of condenser action has been described the various factors upon which the value of the capacity depends must be enumerated. If the two parallel plates A and B, representing the elementary condenser discussed in the previous issue (Part IX), and illustrated there in Fig. 1, are brought closer together, it will be found that the capacity is increased. In reducing the distance between the plates the length of the electrostatic lines of force has been shortened. The result is that a given potential difference between the plates is capable of driving more lines of force across the shortened gap in much the same way that a battery will drive more current through a resistance wire if the latter is shortened. The electrostatic field has been *condensed* into a smaller space and intensified, resulting in increased capacity. Hence the name "condenser."

By discharging a simple parallel plate condenser through a suitable galvanometer it can be shown that the momentary deflection is inversely proportional to the distance between the plates, assuming the same initial voltage between them in every case. This is only true provided the distance between the plates is small compared with their dimensions, because if they are far apart the lines of force will spread out at the edges and so upset the inverse proportionality. We see, then, that the capacity varies inversely as the distance between the plates when they are moderately close together.

Now since the capacity is evidently proportional to the number of electrostatic lines crossing from one plate to the other for a given potential difference, it is fairly obvious that the capacity can also be raised by increasing the area of the *opposed surfaces* of the plates, in the same way that the current given by a battery can be raised by substituting a wire connected between its terminals by another of larger cross-sectional area.

We see, then, that the capacity of a condenser with air as the medium between the plates can be altered either by changing the distance between the plates or by varying the effective area of opposed surfaces. For mechanical reasons an ordinary variable air condenser as used for tuning purposes employs the latter principle. A number of interleaved small plates are used instead of two large ones, also for mechanical reasons. They are divided into two groups insulated from each other, one fixed and the other movable at will, and the movable ones can be shaped to give any desired relationship between angle of rotation and capacity, e.g., square law, straight line frequency, etc.

Effect of the Dielectric on the Capacity.

There is yet another very important factor upon which the capacity of a condenser depends besides the dimensions of the plates and their relative positions, and that is the nature of the dielectric between the plates. Most solid insulating materials allow lines of electrostatic force to pass through them much more easily than air or a vacuum. Therefore, if a condenser with air as the insulating medium between the plates has the air replaced by some solid insulating material, or *dielectric* as it is called, the number of lines passing between the plates for a given potential difference will be increased, with consequent rise in the capacity. For instance, if a condenser with air dielectric has the air replaced by mica the capacity will be increased about six times. The number of times by which the capacity is increased when the air is replaced by some other medium is called the *permitivity* or *dielectric constant* of the new medium. Strictly speaking, the comparison should be made with a vacuum, but as air has a permitivity very nearly equal to 1, the above statement is sufficiently accurate for our purpose and is more practical. An older name for permitivity was "specific inductive capacity."

Mica has a permitivity of about 6, depending on its quality. It is extremely interesting to note that ice at a temperature of $-13.5°$ Centigrade has the enormously high permitivity of 22,000!

Fixed Condensers of Large Capacity.

Although it is not a very practicable proposition to use a solid dielectric for condensers where the capacity is to be continuously variable, a solid dielectric is almost always employed in condensers of fixed capacity. For small fixed condensers mica is usually employed between two sets of interleaved sheets of tinfoil or copper-foil. In condensers of large capacity, however,

Wireless Theory Simplified.—

say from half a microfarad upwards, the dielectric usually consists of a special kind of paper. A long strip of the paper is coated on both sides with a conducting material by a special process, the best known being the Mansbridge process. A margin of uncoated paper is left at each edge. The strip is then rolled up so as to occupy a suitably small space and enclosed in a container, one terminal being connected to each coating.

Obviously it is most important that the dielectric used should be a really good insulator, otherwise the charge will " leak " from one set of plates to the other through the dielectric, and the condenser would behave as though it were shunted by a resistance of high value. Air is the best in this respect (except, of course, an absolute vacuum), and among solid dielectrics mica is one of the best. Mica has the further advantage that it can stand a much higher voltage across a given thickness without breaking down compared with most other materials. Air insulation is broken down by high voltages much more easily than most solid dielectrics.

If two or more condensers are connected in parallel as shown in Fig. 1, the resultant capacity C will be simply equal to the sum of the individual capacities, because the effect is exactly the same as increasing the area of opposed surfaces. For the group of Fig. 1, then, we have $C = C_1 + C_2 + C_3$. Note that this is the same law as for resistances in *series*.

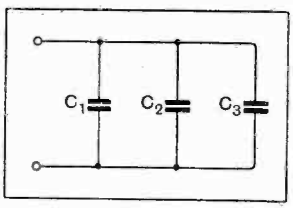


Fig. 1.—For condensers in series the total capacity is equal to the sum of the individual capacities.

When condensers are connected in series the resultant capacity is found by applying the same rule as for resistances in *parallel*. For instance, if we connect three condensers whose capacities are C_1, C_2 and C_3 in series, as shown in Fig. 2, the resultant capacity is given by $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$.

The reason for this follows from the fact that in charging a single condenser, the quantity of electricity gained by one plate is exactly equal to that lost by the other. The same law applies to the series arrangement, so that equal charges must move from plate to plate throughout the series; in other words, each condenser will be given the same charge, Q, irrespective of its size. But the voltage across each will not be the same, being inversely proportional to the capacity for a given charge. Thus, if the voltages across the three condensers of Fig. 2 are V_1, V_2 and V_3 respectively when the charge of each is Q coulombs, the total voltage between the end of the series will be $V = V_1 + V_2 + V_3$.

But from the definition of capacity $V_1 = \frac{Q}{C_1}$, $V_2 = \frac{Q}{C_2}$, $V_3 = \frac{Q}{C_3}$, and $V = \frac{Q}{C}$, where C is the resultant capacity.

Hence $\frac{Q}{C} = \frac{Q}{C_1} + \frac{Q}{C_2} + \frac{Q}{C_3}$, or $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$.

From this it is clear that the resultant capacity must be less than that of the smallest condenser in the series.

The Energy Stored in a Condenser.

It was shown previously that when a condenser is charged—that is, when a potential difference is applied between the plates—energy is stored in the electric field between them. Just as energy was found to be necessary to build up a magnetic field, so energy is required to build up an electrostatic field, no matter whether the field is produced in a vacuum, in air, or in any other dielectric, solid or liquid.

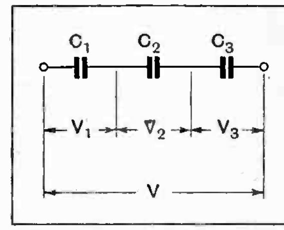


Fig. 2.—Condensers in series. The resultant capacity is given by $\frac{1}{C} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$

It is a very simple matter to determine the amount of this energy in terms of the capacity of the condenser and the voltage between the plates. As explained in the previous part, suppose that the charging current is maintained at a constant value of I amperes during the charging period by reducing the series resistance in the circuit at a uniform rate from the initial value to zero during this time. Then, since the electrons are being transferred from one set of plates to the other at a steady rate, the voltage across the condenser will build up at a uniform rate. Suppose further that the charging period lasts for *t* seconds. These conditions are shown by the graphs of Fig. 3.

It is clear that the *average* value of the voltage across the condenser during the charging period will be $\frac{1}{2}$E volts, and in driving the current I against this opposing voltage an average power of $\frac{1}{2}$EI watts will be expended on the condenser for *t* seconds. The energy consumed in charging it is equal to the product of average power and time exactly as in the case of the inductive coil, and so the energy required to build up the electric field will be $\frac{1}{2}EI \times t$ watt-seconds or joules. But the product of current and time is the quantity of electricity or " charge " Q coulombs which has been transferred. Hence the stored energy = $\frac{1}{2}$EQ joules.

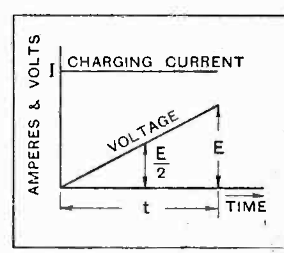


Fig. 3.—Diagram for showing that the energy stored in a condenser is given by $\frac{1}{2}CE^2$, where C is the capacity and E the voltage.

Now the capacity of the condenser was defined as the quantity of electricity required to produce a change of one volt between the plates; in other words $C = \frac{Q}{E}$ farads (see previous part), whence $Q = CE$. Substituting this value of Q in the expression for stored energy above, we get

stored energy $W = \frac{1}{2}CE^2$ joules.

It should be noted that the expression is of the same form as $\frac{1}{2}LI^2$ for the energy stored in a magnetic field. The latter gives the energy in a field due to electrons in motion (current), whereas the former relates to the kind of field produced by electrons at rest but under the influence of an electrical pressure or voltage.

Wireless Theory Simplified.—

The action of a condenser can be likened to that of a spring in mechanics. Suppose that we take an ordinary spiral or helical spring and suspend it by one end from a rigid support so that it hangs vertically downwards. If now a gradually increasing force is applied to the lower end so as to extend it downwards, then, by a very well-known law of mechanics, the extension will be exactly proportional to the applied force. Let F be the force required to extend (or compress) the spring through a distance D (we need not concern ourselves with the units. Then $\frac{F}{D}$ is the force required to produce unit extension of the spring, and this value may be called elasticity or stiffness of the spring. It should be realised that elasticity means the extent to which a body *resists* bending or distortion of any kind or the extent to which it resists compression.

Let S denote the stiffness of the spring, so that $S = \frac{F}{D}$ whence $D = \frac{F}{S}$; or, in words, the displacement is proportional to the applied force and inversely proportional to the stiffness.

As the spring is extended the applied force increases from zero in direct proportion to the displacement until it reaches the value F, when the extension is D. Thus the average value of the force is $\frac{1}{2}F$. Now, in mechanics, work done or energy consumed is equal to the product of the force acting and the distance through which it acts; so the work done in extending the spring will be $\frac{1}{2}F \times D$, and substituting for D the value $\frac{F}{S}$ found above we get: energy stored in spring $= \frac{1}{2}F \times \frac{F}{S} = \frac{1}{2}\left(\frac{1}{S}\right)F^2$.

Comparing this expression with that for the energy contained in a charged condenser, namely $\frac{1}{2}CE^2$, we see at once that they are alike in form, only the symbols used being different. F stands for the mechanical force and E for the electromotive force; in the formula for the spring $\frac{1}{S}$ takes the place of the capacity C of the condenser, or, by inverting each of these, we can say that $\frac{1}{C}$ in the one case corresponds to S in the other. Putting this into words, it means that *the reciprocal of the capacity of the condenser corresponds to the stiffness of a spring.* The stiffer the spring the smaller will be the deflection and the smaller the energy stored in it for a given applied force; the *lower* the capacity of the condenser the smaller the amount of energy stored for a given electromotive force.

In case any reader should consider this rather detailed comparison between a condenser and a spring unnecessarily long and tedious, it should be explained here that this has been done purposely in preparation for further discussion relating to oscillating circuits. Inductance has already been likened to inertia or mass, and both of these analogies will be made full use of later.

Magnetic and electric fields are produced in the ether and are modified by the presence of certain materials. They are, however, of fundamentally different natures—it may be said that inductance is to the ether what mass is to material, and the reciprocal of capacity is to ether what elasticity or stiffness is to material.

(*To be continued.*)

CLUB NEWS.

Power from the D.C. Mains.

Owing to the fact that Muswell Hill and District Radio Society has D.C. mains it is a matter of difficulty economically to obtain both H.T. *and* L.T. from the electric supply. Mr. L. Hartley, B.Sc., A.I.C., however, gave some useful information at a recent meeting of the Society as to the best means of overcoming this problem. A high-power amplifier driving a moving-coil speaker was demonstrated, and, despite the fact that all current was derived from the D.C. mains, practically no hum could be heard either with or without speech or music. The wattage consumption, too, was commendably low. Particular emphasis was laid on the need for an efficient smoothing circuit, as the local mains are notorious for their very pronounced ripple.

Hon. Secretary, Mr. C. J. Witt, 39, Coniston Road, N.10.

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Transmitting with Low Power.

The problems of radio transmission from the amateur's point of view were dealt with in a lecture given by Mr. L. C. Holton at the last meeting of the North Middlesex Radio Society. Mr. Holton began by enumerating the desirable features of an amateur 10-watt transmitter. These were flexibility of wavelength, transportability, and accuracy of adjustment. These remarks were illustrated by the Society's portable transmitter, which was described as very nearly ideal for small power. On larger powers, however, slightly more robust components are desirable, and a description was given of the speaker's proposed new installation, the skeleton of which was exhibited.

Hon. Secretary, Mr. E. H. Laiser, 7a, Station Road, N.21.

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High Impedance or Low?

"My Ideal Resistance Capacity Coupled L.F. Amplifier" was the title of an address given by Mr. C. N. Fairweather at the last meeting of the South Croydon and District Radio Society. The speaker asked what should be the correct valve for a resistance capacity coupled amplifier, a question which was answered in more ways than one and proved a subject for debate. A strong section of the meeting maintained that one of a very high impedance was essential. With this valve having an amplification factor of as much as 30 or 40 the final amplification would be considerable, and as such was thought to be an advantage. A stronger section of the meeting, however, insisted that a high-magnification valve was completely wrong in every respect. The protagonists of this point of view used the blackboard to demonstrate that a valve of this type would play havoc with the cherished high notes.

Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

FORTHCOMING EVENTS.

WEDNESDAY, NOVEMBER 27th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture and demonstration: "Mains-operated Receivers," by Mr. A. J. Hall, of Philips Lamps, Ltd.

Queen's Park Radio Society.—At 8 p.m. At The Oddfellows' Hall, 593, Harrow Rd., W.10. Lecture: "H.F. Amplifiers, with Special Reference to Peaked Amplifiers for the Regional Scheme."

Edinburgh and District Radio Society.—Lecture: "Photo Electric and Selenium Cells," by Dr. Childs.

THURSDAY, NOVEMBER 28th.

Slade Radio (Birmingham).—At the Parochial Hall, Broomfield Rd., Erdington. Annual General Meeting.

TUESDAY, DECEMBER 3rd.

Ryde Radio Society.—At 8 p.m. At Mount House Hall, George St. Lecture and demonstration by Mr. R. Garside (of Messrs. Ferranti, Ltd.).

The Television Society.—At 8 p.m. At the Engineers' Club, Coventry St., London, W. Lecture (with lantern slides): "The Problem of Synchronisation in Picture-Telegraphy and Television," by Mr. G. Priechenfried. (Non-members' tickets obtainable from the Secretary, 4, Duke St., Adelphi, W.C.2.).

New Headquarters.

The Queen's Park Radio Society has now changed its place of meeting to the Oddfellows' Hall, 593, Harrow Rd., Paddington. Meetings are held regularly on Wednesdays at 8 p.m., and visitors are cordially invited. The winter programme includes many attractive items. Hon. Secretary, Mr. H. F. Murfett, 12, St. John's Road, Wembley.

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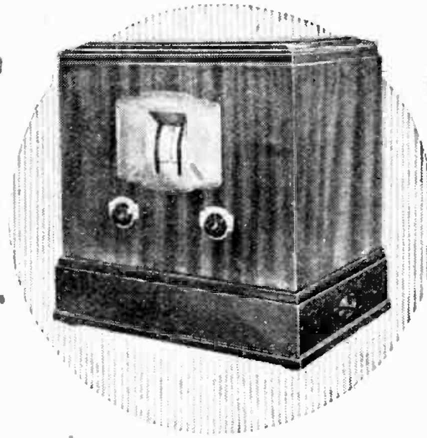
Screened Grid Operation Explained.

In a lecture at the last meeting of Slade Radio (Birmingham), Mr. N. B. Simmonds aroused special interest by discussing the H.F. and detector stages of the Society's screened grid receiver. Valve characteristics and all details of the circuit were fully explained in a manner which prompted members to incorporate a screened grid stage in their own sets. The annual general meeting of the Society will be held on Wednesday, November 27th, when it is hoped that all members will be present. Full details of the Society may be obtained from the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

BROADCAST RECEIVERS



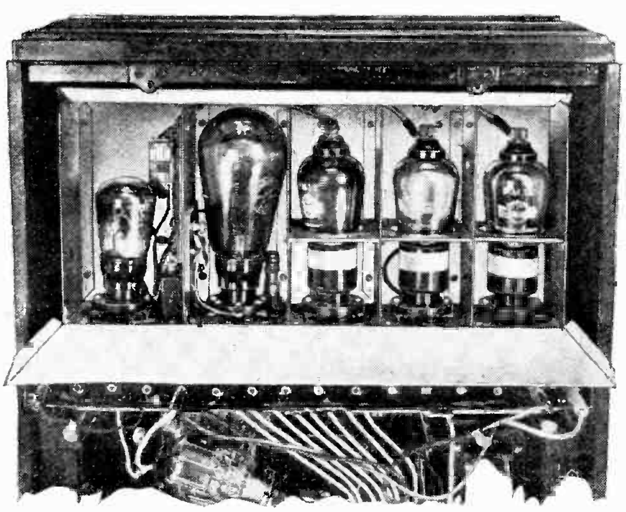
Columbia ALL ELECTRIC MODEL 304

A Selective Long-Range Receiver

Representative of Modern Practice.

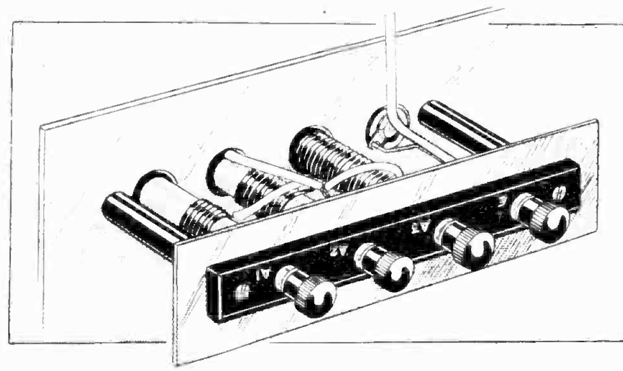
THE entry of the Columbia Graphophone Co., Ltd., into the radio industry was an event of considerable importance, and the receivers exhibited at Olympia were the subject of much discussion and favourable comment. We have now had an opportunity of testing one of the No. 304 table models, and the results are fully in keeping with the efficient appearance of the layout. There can be no doubt that Columbia sets bear all the marks of the thoroughbred, and the 1930 models can definitely be placed among the best half-dozen makes at present on the market.

Although three distinct types are available for operation from batteries, A.C. or D.C. mains, the receiver section is the same in each case and is housed in an aluminium screening box occupying the upper half of the cabinet, the space below being devoted to rectifying and smoothing gear. Valves with directly heated filaments have been standardised throughout, and although this somewhat complicates the problem of filament supply from A.C., the advantages from the production point of view are obvious. The standardised receiver chassis can be manufactured on mass-production lines and then taken from store and equipped either with battery, A.C. or D.C. mains supply according to fluctuations in the demand.



Interior view of valve compartments; the three right-hand compartments house the H.F. valves, while the detector is on the extreme left.

The screening box is well designed both from the electrical and maintenance point of view. The valves which, incidentally, are selected and graded by the makers, are isolated in separate cubicles at the back of the box, to which access is gained by lifting a top lid and dropping the hinged back. Horizontal screens are fitted in the three H.F. valve compartments to prevent electrostatic coupling between the grid and anode circuits, while the leads to the anode terminals at the top are, for a similar reason, shrouded in spiral wire armouring. While the aluminium screening looks after stray electrostatic couplings, magnetic coupling is minimised by the use of binocular or astatic inductances throughout.



Aerial terminal strip and wire-wound series condensers.

The aerial may be connected to three alternative terminals provided with series condensers of graduated capacity.

Ganged H.F. Circuits.

There are three stages of H.F. amplification, with screen-grid valves and transformer coupling. By distributing the H.F. amplification over three stages a high overall figure is obtained without any tendency to instability in individual stages. Further, the overall selectivity can be made very high without appreciably cutting side bands and the higher audio-frequencies. The tuning condensers are ganged in pairs, and the two drum dials are mounted side by side in an escutcheon plate on the front of the cabinet. The left-hand drum controls the aerial and first H.F. circuit, which is comparatively flatly tuned. The remaining H.F. circuits are more selective, and are controlled by the right-hand drum. A

Broadcast Receivers—Columbia All Electric Model 304.—

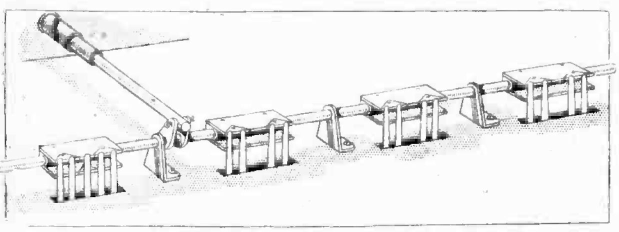
friction device couples the two drums, which, once set, can be moved together over the whole of both long- and short-wave ranges. All the contacts for wave-range switching are assembled on a horizontal shaft running underneath the chassis. A rocking motion is imparted to this shaft by the "Selector" knob on the front panel, which actuates a spiral-slotted sleeve.

Mullard P.M.12 screen-grid valves are used for all three H.F. stages, and some idea of the overall amplification obtained can be gathered from the fact that the anode bend detector, an Osram L.210, is biased to 16 volts negative. The H.F. amplification is sufficient to feed a considerable voltage to the detector even from distant stations, and it is found that resistance coupling between the detector and a P.625 output valve gives all the low-frequency amplification necessary to supply a moving-coil loud speaker. Stray H.F. currents are kept from the grid of the power valve by a series resistance of the Loewe vacuum type. A five-pin valve holder is now fitted for the output stage, and the centre socket is supplied with the necessary positive potential so that a pentode may be used if desired. In the D.C. mains model the loud speaker terminals are supplied through a transformer in accordance with I.E.E. regulations. In all other cases the loud speaker is connected directly in the anode circuit of the last valve.

Volume Control.

The volume control takes the form of a resistance regulating the filament current of the first H.F. valve. The regulating resistance is in the form of a potentiometer in order to keep the load on the filament circuit constant. By confining the volume control to the first H.F. valve and keeping the second and third valve filaments at normal temperature, distortion due to progressive rectification is avoided.

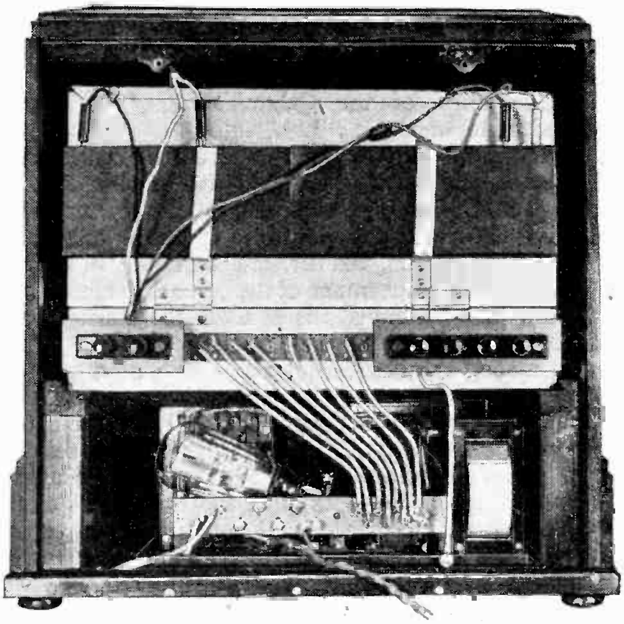
The particular model tested was equipped for A.C. mains, and is especially interesting on account of the arrangements for heating the valve filaments. The 2-volt filaments of the three H.F. valves and the detector are supplied with direct current through a Westinghouse



Wave-range switch mechanism. The contact blades protrude through slots in the aluminium screen and are short-circuited by contacts mounted on paxolin insulating strips.

metal rectifier, a smoothing choke, and electrolytic condenser, while the P.625 is heated with raw A.C. from a separate winding on the mains transformer. High-tension current is derived through a U.5 full-wave rectifier, and the usual smoothing chokes and condensers.

The receiver was tested within sight of the Brookmans Park aerials (5¾ miles, to be exact), using an outdoor aerial 75ft. in length. With the aerial connected to terminal A_1 (the smallest series condenser) the tuning drums were first adjusted in step, when it was found that the wavelength figures on each dial exactly coincided on both wave ranges. This setting was maintained over the whole of both ranges, and although a slight improvement seemed to result from readjusting the relative setting at the top of each range, the difference was not sufficient to justify frequent alterations. With the dials properly adjusted, at least 30 stations were received on the short waves at good loud speaker strength and without mutual



Rear view of the Columbia A.C. Model 304 G, showing grid bias battery mounting and leads between receiver unit and eliminator.

interference. One can state without exaggeration that it is difficult to find any space on the dial unoccupied by some British or Continental transmission. Yet the selectivity is distinctly above the average. Bearing in mind the size of the aerial and the distance from Brookmans Park, the selectivity may be judged from the following facts: The London transmission was inaudible outside the band 275-390 metres, and 5GB occupied only 10 metres on either side of its normal wavelength. Using a shorter aerial, the width of these interference bands could be considerably reduced without appreciably restricting range.

The first impression on switching over to long waves was the entire absence of mush and background noise usually experienced on this wave band. All the high-powered stations came in with remarkable volume and clarity. The selectivity, however, was not of such a high order as on the short wave range. No difficulty was experienced in receiving Radio-Paris clear of 5XX, but Königswusterhausen, between these two stations, could only be heard during intervals in the 5XX programme. It was noticed, also, that Brookmans Park was forcing itself through in the lower part of the dial up to about 1,000 metres. Here, again, a shorter aerial would undoubtedly effect a cure.

Broadcast Receivers—Columbia All Electric Model 304.—

The smoothing arrangements in the A.C. eliminator do their work well, and there is no trace of 50-cycle hum or any other extraneous noise.

The volume control is smooth and noiseless in operation, but in the receiver tested its action was restricted for most stations to approximately one-third of the total movement. With Brookmans Park accurately in tune, however, the remaining two-thirds could be usefully employed. A rearrangement of the resistances in the potentiometer scheme, so as to distribute the control more evenly over the range of movement available, would be a welcome detail improvement.

As is only to be expected, in an instrument emanating from a firm of long standing in the art of acoustic reproduction, the quality of reception is beyond reproach.

The price of the battery model is £27. The A.C. and D.C. mains models are both priced at £33.

"WORLD BROADCASTING" FROM GERMANY.

GERMANY'S short-wave "world" broadcasting station at Königswusterhausen (Zeesen) has now begun testing. In external design the short-wave plant strongly resembles the Telefunken Company's standard long-wave transmitters for wireless telegraphy, while in technical construction it is similar to that of the two high-power short-wave transmitters used on the Nauen-Buenos Aires service.

The new transmitter has a single wire aerial about 180ft. long, which is suspended from one of the masts of the long-wave plant. The mean aerial energy, i.e., carrier wave without modulation, is 8 kW., and the wavelength is 31.38 metres.

The transmitter consists of seven units, with crystal modulation on the first. The short-wave is obtained by making use of the harmonics of a comparatively low frequency in the crystal-controlled oscillator. Suitable filters and amplifiers in the ensuing stages produce the desired reduction of wavelength and power when the final stage is reached.

The valves in the individual stages are accordingly arranged to give a successive increase in power. The first stage functions with one valve of the power-amplification type, while the second stage embodies a small transmitting valve of the 0.75 watt class. Two similar valves in parallel make up the third stage, and three in parallel comprise the fourth stage. The fifth stage contains a single transmitting valve of average power (about 1,500 watts), and the succeeding stage contains two valves of the same type in parallel. The seventh and final functions with two 20 kW. water-cooled valves in push pull. Modulation on the well-known grid principle takes place in the sixth stage with the aid of three modulating valves connected in parallel.

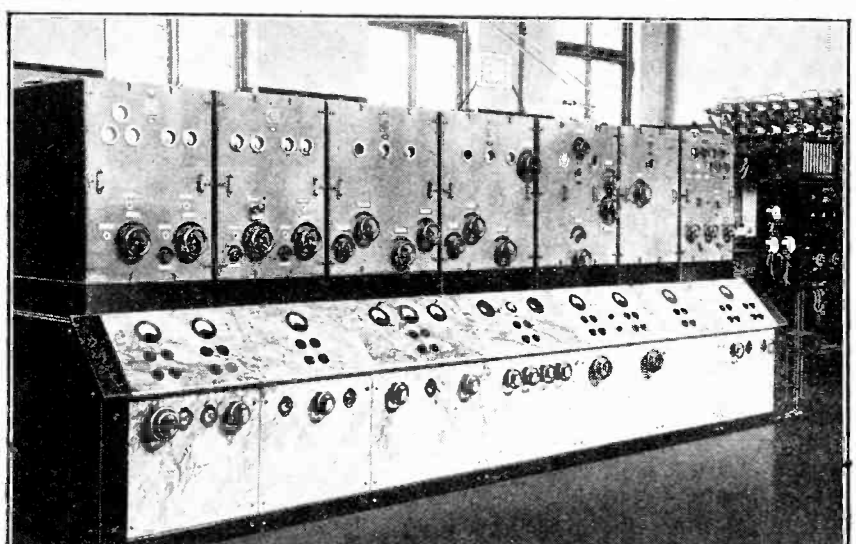
This arrangement of valves, of course, necessitates separate supplies of power. A high-tension D.C. dynamo of 50 kW. 10,000 volts is used for feeding the anodes in the last stage; the valves in the fifth and sixth stages are fed by means of a 4,000-volt D.C. machine of 5 kW. In the second, third and fourth stages the anode current is supplied from a common source, viz., a 2,000-volt D.C. dynamo of 2 kW., whilst the crystal stage is fed by a 220-volt machine. For filament heating in all except the last stage a 20 v. 2 kW. D.C. generator is used. A 40 v. 5 kW. generator heats the water-cooled valves in the final stage.

The filaments of the modulating valves are heated by an alternator of high periodicity. Grid bias for the water-cooled valves in the last stage needs to be of a high value, taking into consideration the size of the valves and the high anode current, and is supplied by a special converter of 750 v. 2 kW.

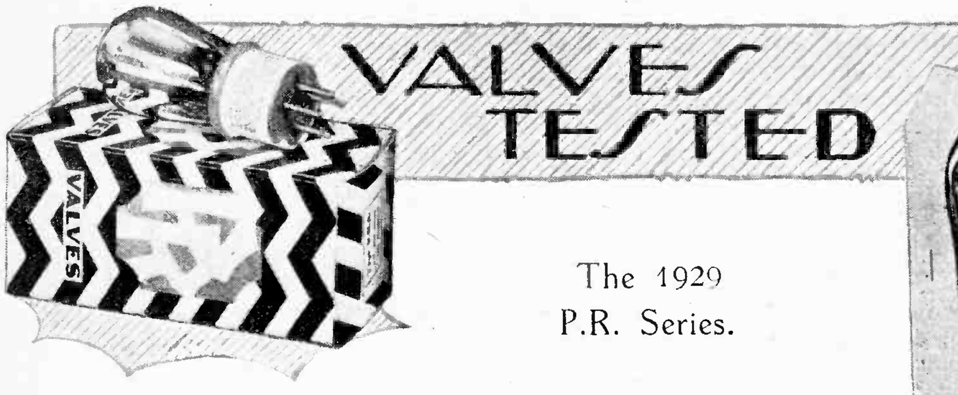
All machines are started by means of push-buttons on the switchboard, which is built into the lower portions of the transmitting panels. The supply current for the converter is derived from the transformer already in use at the station connected with an overhead electrical distribution system.

Besides the actual transmitter there is also a low-frequency amplifier dealing with the speech currents arriving from the land line, and the anode circuit of this amplifier is fed by an additional small converter.

The entire installation is equipped with measuring apparatus enabling the performance of every portion of the transmitter to be checked.



ZEESEN'S NEW SHORT-WAVE TRANSMITTER. Working on a wavelength of 31.38 metres and a power of 8 kW, this crystal-controlled station represents Germany's latest contribution to world broadcasting.



Valves Tested

The 1929 P.R. Series.

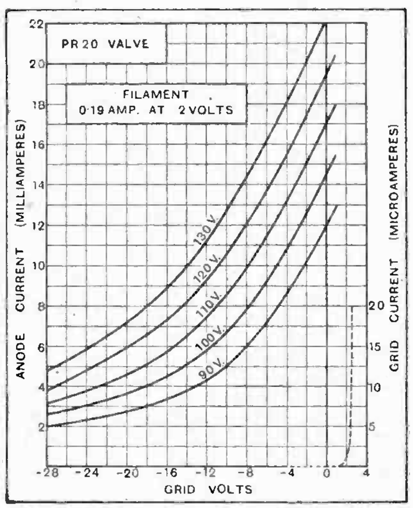
THESE valves are made by Messrs. Peter Russell, 14, Newgate Street, London, E.C.4, and are supplied with 2-, 4- and 6-volt filaments. Each class consists of four distinct types, viz., H.F. and Det., R.C., L.F. and power. The prices of these valves are very reasonable, being somewhat lower than usual. The H.F., R.C. and L.F. types are priced at 3s. 6d., and the power valves at 6s. 6d. each. Super-power valves are made in the 2- and 4-volt ranges only; they are offered at 10s. 6d. each.

The Two-volt Range.

The valves in this range are numbered P.R.2, 3, 4 and 20. The P.R.2 is an H.F. and Detector valve, the P.R.3 an L.F. amplifier, the P.R.4 a high-impedance valve for R.C. coupling arrangements or anode-bend rectification, and the P.R.20 a power output valve. A sample of each of these valves was tested and the characteristics measured. These results are tabulated below, the makers' figures being given also, as a basis for comparison.

With one exception, the measured values agree sensibly with the makers' rating. The sample P.R.4 tested would appear to be a faulty specimen.

A full set of curves was taken of the P.R.20, the power valve of this series, and from these some useful information can be gleaned.



Average values under normal working conditions: A.C. resistance, 4,600 ohms; amplification factor, 3.1, and mutual conductance, 0.67 mA/volt.

Under working conditions, with 120 volts on the anode and –10.5 volts grid bias, the average A.C. resistance was found to be 4,600 ohms, the amplification factor 3.1, and the mutual conductance 0.67 mA. per volt. Grid current did not start until the grid was given a positive bias of 1.5 volts. The characteristics, particularly with low anode voltages, show a pronounced curvature, so that in the interests of quality of reproduction it would be advisable to apply slightly less negative bias than a casual examination of the curves would lead one to believe is the optimum value. The following values are suggested:—

P.R. 20.

H.T.	Grid bias.	Anode current.
100	– 7.5 volts	8.2
110	– 9 ,,	9.2
120	– 10.5 ,,	10.2
130	– 12 ,,	11.2

P.R. 2-VOLT VALVES.

	Makers' Rating.			Characteristics measured at H.T. = 100 v. G.B. = 0.		
Type.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance.
P.R. 2	28,000	13	0.46 mA/v.	33,300	20	0.6 mA/v.
P.R. 3	15,000	8	0.58 ,,	10,000	9	0.9 ,,
P.R. 4	60,000	32	0.53 ,,	33,400	11.8	0.35 ,,
P.R.20	7,000	6	0.86 ,,	4,700	3.8	0.8 ,,

When this valve is used in the output stage of the set the loud-speaker could be connected direct in the anode circuit. Dry-cell H.T. batteries may be used economically, since the anode current is well within the capacity of the larger sizes to supply.

There is a super-power valve in this series, namely, the P.R.120. A sample was not available for test, but the makers give its characteristics as: A.C. resistance, 3,800 ohms; amplification factor, 4; and mutual conductance 1.05 mA. per volt. The price of this valve is 10s. 6d.

The Four-volt Range.

This class contains a similar number of valves as in the 2-volt

Valves Tested.—

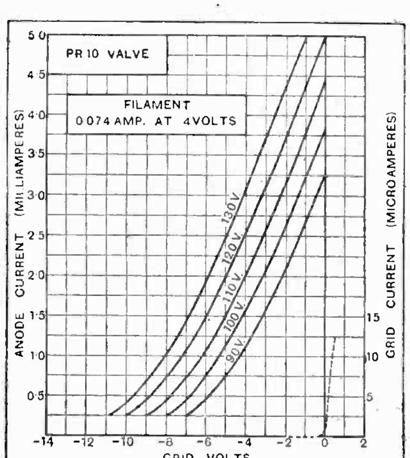
series. They are numbered P.R.9 (H.F. and Det.), P.R.10 (L.F.), P.R.11 (R.C.), and P.R.40, the power valve. In addition, a super-power type is available, the P.R.140. One sample each of the first four mentioned was submitted for test, the measured characteristics being tabulated below:—

P.R. 4-VOLT VALVES.

	Makers' Rating.			Characteristics measured. at H.T. = 100 v. G.B. = 0.		
Type.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance.
P.R. 9	24,000	14	0.58 mA/v.	77,000	20	0.26 mA/v.
P.R.10	15,000	8.7	0.58 ,,	18,000	11	0.6 ,,
P.R.11	65,000	40	0.62 ,,	71,000	25.6	0.36 ,,
P.R.40	8,000	6	0.75 ,,	3,570	4	1.1 ,,

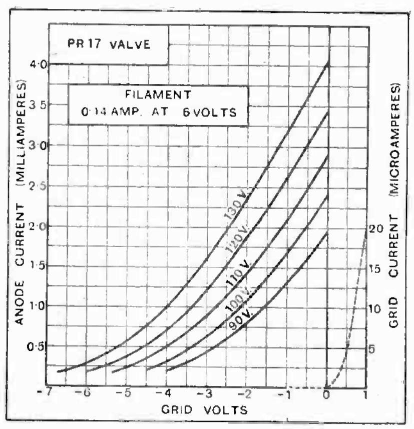
A full set of curves was taken of the P.R.10, the L.F. valve, as it is a representative specimen and showed a mutual conductance very close to that of the makers' rating. This will make a good first stage L.F. amplifier, and can be followed by a transformer, as the anode current is relatively low. Under normal working conditions, with 120 volts H.T. and $-4\frac{1}{2}$ volts grid bias, the anode current will be of the order of 2.3 mA. only. The A.C. resistance remains unchanged as compared with that at 100 volts H.T., but the amplification drops to 9.5. The result is a slight lowering of the conductance, from 0.61 to 0.52 mA. per volt.

The P.R.9, which is the H.F. valve, could be used in a neutralised high-frequency stage, or as a leaky grid detector. As a grid detector, with the grid leak returned to a point of positive potential, an anode voltage of about 60 to 80 volts would be about correct. The anode current will be relatively low, less than 2 mA. probably, so that it could be followed by transformer-coupling. The specimen tested was not a good sample, so that precise figures cannot be given.



Average values under normal working conditions: A.C. resistance, 18,200 ohms; amplification factor, 9.5, and mutual conductance, 0.52 mA/volt.

The P.R.40 power valve takes about the same anode current as its 2-volt counterpart, and dry-cell H.T. batteries will prove economical in this case also.

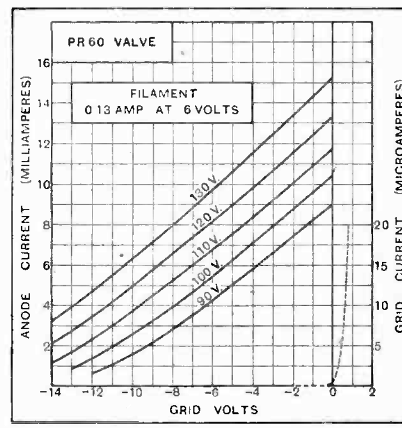


Average values under normal working conditions: A.C. resistance, 25,000 ohms; amplification factor, 16.6, and mutual conductance, 0.68 mA/volt.

The Six-volt Range.

These valves are numbered P.R.17, 18, 19 and 60, and comprise H.F. and Det., L.F., R.C. and power. A super-power type is not listed.

The P.R.17 is an optional H.F. or detector valve, and could be used in a neutralised H.F. stage. In this case the best operating conditions would be 120 volts H.T. and $-1\frac{1}{2}$ volts grid bias. As a leaky grid detector about 60 to 80 volts H.T. would be required, and the grid given a small positive potential. It is suggested that a potentiometer is used, as the positive potential obtained by returning the grid leak to the positive L.T. would be somewhat excessive. The anode current can then be kept below 2 mA., and transformer-coupling could be used between the detector and the following valve.



Average values under normal working conditions: A.C. resistance, 8,000 ohms; amplification factor, 6, and mutual conductance, 0.75 mA/volt.

The P.R.60 is a power valve suitable for use in the last stage where moderate volume is required from the loud speaker. This may be connected direct in the anode circuit of the valve, since the H.T. current is not on the high side. Under normal working conditions this will be about 6 mA.—that is, assuming 120 volts H.T. and grid bias of -9 volts. The valve falls within the ordinary power category, and costs 6s. 6d.

P.R. 6-VOLT VALVES.

	Makers' Rating.			Characteristics measured at H.T. = 100 v. G.B. = 0.		
Type.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance.
P.R.17	24,000	17	0.7 mA/v.	20,500	16	0.78 mA/v.
P.R.18	15,000	9	0.6 ,,	27,000	8	0.31 ,,
P.R.19	80,000	40	0.5 ,,	40,000	21	0.51 ,,
P.R.60	8,000	6	0.75 ,,	7,150	6.15	0.86 ,,

CORRESPONDENCE.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

TELEVISION.

Sir,—In reading Mr. Bradford's letter in your issue of August 28th on Mr. Samuel Izenstark's prophecy of television sets being installed in 14 million homes in America *by now*, the exact position can be deducted from an extract of Dr. Lee De Forest's article, "The Reminiscences of a Radio Pioneer," from September's issue of the American wireless magazine, *Radio News* :—

"To my mind, we are entering a new era in radio—television. In time sight will come to join hearing in the complete home entertainment *via* the air. There are many problems in television. Our present efforts are not to be compared with the perfection of present broadcasting, but rather with my own crude attempts at broadcasting back in the days of acousticon microphones, carbon arcs and the phone receiver and microphone method of coupling. C. Francis Jenkins, pioneer in the field of television, has already made notable progress. . . .

"The vacuum tube (valve) is going to play an important role in television. Indeed, but for the audion, television would be quite impossible; for let us not forget that the principles of present-day television date back several decades, but the fine means of applying those principles have been missing. We had the theory but not the practice until now. I look forward to remarkable audion developments, with tubes of tremendous amplification factors so as to handle the delicate television impulses without distortion. The problem of distortion must always be a far more serious one in reproducing the television image than in reproducing the tone picture, for the eye is far more critical than the ear. Therefore, I envisage audions of enormous amplification possibilities, used sparingly—not many stages of amplification—so as to reduce distortion to a minimum. I look forward to more powerful light sources than the present neon lamps. I expect intricate methods of dividing the television image into a large number of sections for simultaneous transmission and assembly, for greater detail. All these things are quite possible and probable, but it takes time, effort, and much money."

I trust this will interest everyone whose thoughts are turning to the prospects of television in the near future.

Croydon. H. GRAHAM MALLETT.

THE B.B.C.

Sir,—In view of the inauguration of the Regional Scheme and the absence of any appreciable criticism of the recent activities of the B.B.C., presumably due to the triumph of hope over experience, I should like, as a not very satisfied listener, to make the following suggestions in the hope that they may be of interest not only to other listeners but also to the B.B.C. itself.

First, with regard to programmes, these may presumably be considered as fairly satisfactory as a whole, but the following alterations would be definitely advantageous, at least to provincial listeners, for, after all, everyone does not live in London. Occasionally some programme worth listening to might be put on from, say, about 6.30 until 9, and the conglomeration of talks relegated to later in the evening. It should be observed that people in the North of England usually rise and go to bed at least an hour earlier than is common in London, and consequently the general tendency for the parts of the programme that are thoroughly worth listening to to be put on very late is troublesome to anyone living in the provinces.

This state of affairs may possibly be remedied when the Regional Scheme is fully in operation.

The next point about programmes is that it is devoutly to be hoped that all the regional stations will not broadcast the London programme. I know that this is not supposed to be the intention, but I am merely going by my experience up to the present, which shows, for example, that Manchester and nearly all the northern stations regularly broadcast little else but London programmes after 9 o'clock almost every evening, with the result that with the average set only the London programme can be received, as 5XX always broadcasts the London programme, and 5GB is not as a rule easily receivable. With a reasonably good set, of course, one can tune in the Continent and not be dependent on the B.B.C., but this is not a satisfactory state of affairs, particularly bearing in mind that one has to pay one's licence whether listening to the B.B.C. or otherwise.

On the technical side of broadcasting there seems to be room for some improvement in the following direction : it seems that it would be much better if the degree of modulation used by all stations could be the same, or at least could be the same for broadcasts of a similar general character, and, although there may be some very serious technical obstacles in the way of doing this, I should like to be informed as to what they are, as most people know the perfect detector has not yet arrived and each kind of detector functions most efficiently with a certain definite amount of modulation.

This difference in modulation makes it very difficult to make accurate comparisons of the quality of the broadcast from different stations, and, of course, this may be the intention.

Referring to the broadcasts of gramophone records, it is to be hoped that the B.B.C. can afford to put aside an amount equivalent to that provided by comparatively few licences, to enable them to install electrically operated turntables and good pick-up devices, so as to avoid the amount of scratch that is put over, but most especially so that the turntable motors do not run down in the middle of records, as has frequently happened in the past.

A further matter that might be considered in connection with the broadcast of gramophone records is that it should not be necessary for distressing overloading at the transmitting end to occur with any particular record before adjustments are made at the transmitting end so that the broadcast is in order, but apparently in this particular direction the B.B.C. facilities are no better than those of the ordinary experimenter. Of course, it may be that gramophone records are considered to be beneath the dignity of proper attention when they are broadcast, but owing to the facility whereby records can be used to provide a really attractive programme, this surely should not be the case.

Manchester. J. BAGGS.

Sir,—I have been an enthusiastic wireless "fan" since the year "dot," and am, of course, much interested in your editorials and the correspondence about the regional scheme. I think your opposition to Brookmans Park is badly founded, inasmuch as your main argument appears to be that it interferes with those who wish "to receive transmissions from abroad which they have hitherto enjoyed. Are you suggesting then, that the B.B.C.'s first consideration should be to facilitate foreign transmissions being received in this country? I should have thought that the correct policy is to give as good a service as possible, in this country, of British broadcasting. If the main consideration is to be whether or not the "reacher out" is to be inconvenienced, then surely the B.B.C. ought to close down altogether!

Then, again, I disagree with you about the "enjoyment" of foreign programmes. My own set is reasonably up-to-date—it is one of your own excellent designs—and I can get, practically any night now, from 10 to 15 foreign stations at reasonable strength on the loud speaker. My experience of "foreign listening" compels me in honesty to say that the "enjoyment" of foreign transmissions is an absolute myth, and I feel almost sure that there is not 1 per cent. of your readers who can honestly put their hands on their hearts and say that they really and truly "enjoy" these awful noises—transmission *plus* mush *plus* atmospherics *plus* heterodynes *plus* fading *plus* morse. I grant the "fascination" of reaching out, but utterly deny the "enjoyment" of the results.

No Sir! The "fascination" of reaching out is the *last* thing the B.B.C. should take into consideration.

Chipstead, Surrey. A. W. SCOTT.