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EDITORIAL COMMENT

Quality of Reception

Dangers of Sidetracking

TALKING the other day to a designs engineer, we were very interested in a point of view he put forward that in the present trend of development of receivers for broadcast reception it was necessary to keep in mind all the time the primary purpose of a broadcast receiver, lest the designer should be too much influenced by the many diversions which may tend to lead him astray from the main goal.

The purpose of the broadcast receiver is primarily to reproduce as faithfully as possible the performances at the microphone.

All sorts of devices are now available to the designer which are in the nature of refinements but which do not necessarily contribute anything to the improvement of quality of reception and may even mar the capabilities of the receiver unless they are most judiciously introduced. The link between transmission and reproduction at the loud speaker may be likened to a main road, and all the modifications such as AVC, push-button tuning, tone control, tuning indicators, and other devices may be regarded as branch roads which, however attractive in themselves, may tend to divert attention and result in neglect of the main highway.

The risk of this situation arising is probably greater to-day than at any time in the history of receiver development, because there is so much competition amongst manufacturers to introduce new features to their sets and at the same time to insure that no gadgets introduced by competitors are missing from their own receivers. The salesman will tell us that it is the new features in wireless sets which help to sell them to-day and that the public seem more concerned to know whether these are incorporated than to have assurances as to the quality of reproduction of the instrument.

We do not for one moment suggest that these refinements and additions should not be introduced ; on the contrary they serve a most useful purpose in simplifying control and generally adding to the convenience and efficiency of receivers. But they are only worth while if their incorporation does not result in any compromise with quality of reproduction, which should always remain the main goal of the receiver designer.

Television Sets

No Compromise with Reliability

WE recently referred on this page to the responsibility resting with the manufacturers in any attempt made to popularise television reception by cheapening the receivers. We were urging the desirability of agreement amongst manufacturers to standardise their respective television models as far as possible so as to reduce costs without incurring a risk that unreliable instruments would be distributed to the public.

We believe, however, that manufacturers will find a means of producing television for the public at a much lower cost than at present, by employing a smaller tube and consequently a smaller picture. Such sets are, in fact, already being talked about and should they appear will do much towards popularising television, without being in any way inferior in the matter of reliability. Small sets of this kind would bring television within the reach of many who could not otherwise afford it, yet the larger sets will still be sought after by those who can afford them because of the pronounced advantages of the larger picture.

Modern Iron-Cored Coils

THE USE OF SIRUFER PRESSED IRON-DUST CORES

CONSIDERABLE development has taken place in iron-cored coils for use at radio frequencies and in this article some details are given of the types used in Germany. One of the greatest advantages of this type of coil is the ease with which an inductance trimmer can be obtained, and in many of the cores described provision is made for such adjustment.

FOR some years iron-cored coils have been used in radio-frequency circuits and have achieved a considerable measure of popularity. As compared with the older and still widely used air-cored coils, one of their chief advantages lies in their considerably greater efficiency for a given physical size. This advantage is considerable in the commercial field where space is at a premium. It is, of course, only obtained when the iron-cored coil is properly designed, for when it is not it may be much worse than an air-cored coil.

In Germany a large amount of work in the development of iron-cored coils has been carried out by Siemens and Halske, who are represented in this country by Siemens-Schuckert of 30-34, New Bridge Street, London, E.C.4, and the pressed iron-dust cores produced by this firm are known under the trade name of "Sirufer." The data on these cores which is included in this article is available through the courtesy of Messrs. Siemens-Schuckert.

The quality of a coil is represented by the symbol Q which is numerically equal to the ratio of reactance to series resistance ($=\omega L/R$), and the higher the value of Q, the greater is the selectivity of the circuit of which it forms a part. For a given value of inductance the amplification obtainable from a valve and tuned circuit also increases with the Q of the coil.

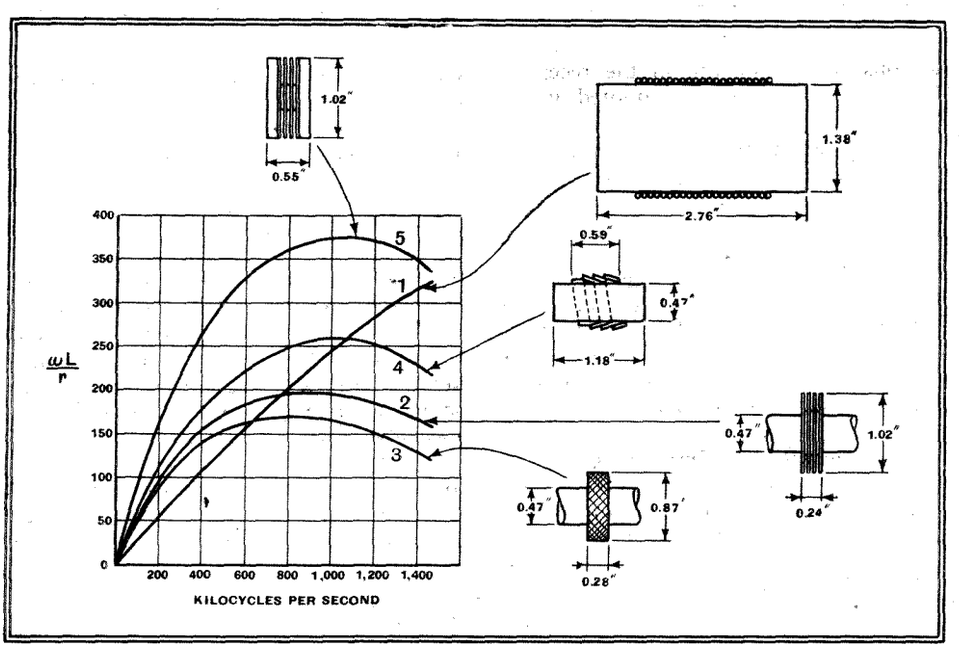


Fig. 1.—The curves show the efficiency (Q) of various types of coils. Curve 1 is for an air-core solenoid, while curve 2 shows the performance of a sub-divided slot-wound coil, again with an air-core. A cross-winding gives the results of curve 3, and an oblique winding gives curve 4. The improved results with a sub-divided slot-wound coil with a bobbin-type iron core are well brought out by curve 5.

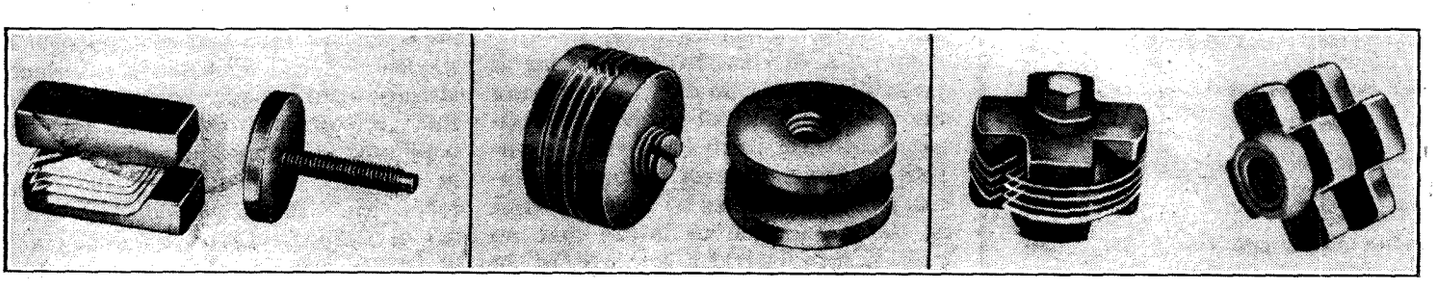
The series resistance of an air-cored coil consists of several components. There is first the DC resistance, which is independent of frequency; secondly there is a component which varies as the square of frequency and which is made up of two parts, commonly known as the skin effect and the proximity factor. The first of these is a form of eddy-current loss which results in the current flowing chiefly in the outer layer of the conductor, while the second represents an additional loss due to the interaction between the different turns of a coil.

To keep the first component low, the wire diameter should be as large as possible; but to keep the second effect at a minimum stranded wire should be used with as fine strands as possible for a given wire section. In addition the self-capacity must be low and all dielectrics of as good quality as possible.

Coil Performance

The curves of Fig. 1 are representative of good air-cored coils of various winding styles. Curve 1 is for a single-layer coil of fairly large size which has a self-capacity of only 3.45 $\mu\mu$F. Curve 2 shows the performance of a slot winding with a Trolitul former; the self-capacity of 4.13 $\mu\mu$F. is again low. Curve 3, for a cross or Universal-wound coil, shows a considerably poorer performance and a high self-capacity—about 12.6 $\mu\mu$F. Much better results are obtained with an oblique winding, curve 4, and the best of all with an iron-cored coil, curve 5.

The losses in iron-cored coils are similar to those found in air-cored types, but there are additional components due to the core. The core introduces losses in three ways. There is firstly the hysteresis loss, which depends chiefly on the intensity of the



(a) (b) (c)

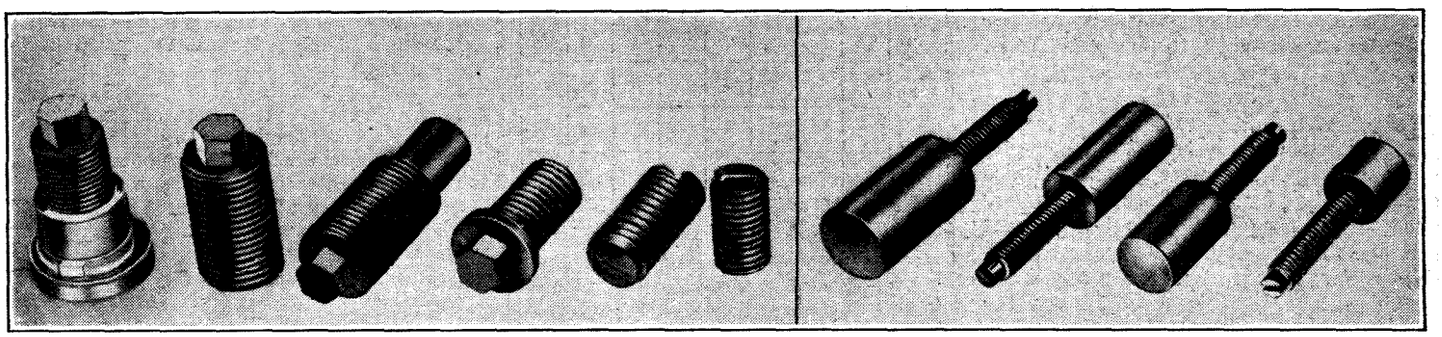
Fig. 2.—A typical series of iron-cores is shown in this photograph. At (a) there is depicted an H-core with separate inductance trimmer plate, and at (b) and (c) the bobbin and reel type cores. These have a centre-screw for inductance adjustment.

Modern Iron-Cored Coils—

field and the characteristics of the iron; it is proportional to frequency. The second way in which the core introduces losses is through the magnetic flux lagging behind the magnetic force which produces it. This is again proportional to frequency.

One big advantage of iron-cored coils lies in the ease with which it is possible to vary the inductance over a small range by a mechanical change in a part of the core. This is particularly valuable as it enables an inductance trimmer to be easily arranged which can be used for matching coil, (b), is also available with the hexagon-type adjustment.

There are many occasions when high-efficiency cores of this type are unnecessary and a core proper without end-cheeks can then be adopted. The usual procedure is to wind the coil on a former in which a



(a) (b)

Fig. 3.—A group of simple cores for use with cross-wound coils is shown at (a); the cores are threaded so that they can be screwed into the coil former for inductance adjustment. Plain cores fitted with brass fixing screws are shown at (b).

The third source of loss is due to eddy currents in the core and these losses are proportional to the square of frequency, and represent the principal part of all the iron losses.

Since the iron-cored coil has all the forms of loss of the air-cored type in addition to its core losses, it may be asked how it can be better. If the normal losses were equally present in both types, of course, an iron-cored coil would inevitably be worse than an air-cored one. They are not, however. Because of the iron core much less wire is needed to obtain a given inductance than with an air core, and this alone means a big reduction in the copper losses. Consequently, the losses common to both types are greatly reduced with an iron core and with proper design the additional iron losses are smaller than the improvement, with the net result of a better coil.

The optimum permeability for a powdered-iron core depends on the operating frequency and upon the kind of stranding of the wire, decreasing with frequency and with an improvement in the conductor. The precise effect is that while the iron losses increase with permeability, the copper losses decrease, and the best results are obtained when the two factors balance. For the medium waveband the optimum permeability is about 3 to 4.

the coils while they are in the receiver. The precise arrangement adopted varies with the type of core.

One of the earliest types of core was that shown in Fig. 2 (a). The core is of H shape and the effective permeability, and hence the inductance of the coil, is varied by moving the tuning disc in relation to the core. The disadvantages of this scheme are that only a small change of inductance can be secured, the change is not proportional to the alteration in the position of the disc, and the mounting of core and disc must be rigid.

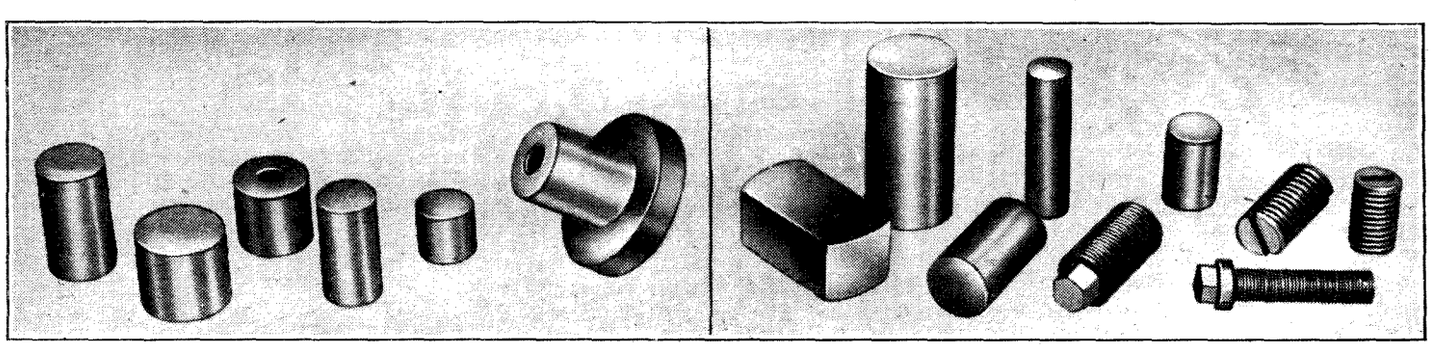
Inductance Trimming

These difficulties are overcome in the bobbin and cross-reel type cores, Fig. 2 (b) and (c). As the name implies, the reel-core consists of a centre-core with end cheeks moulded in one piece of powdered iron. The inside of the core is threaded and a rod of powdered iron can be screwed in for inductance adjustment. The cross-core, (c), is of similar construction; the end cheeks, however, are not circular but in the form of a cross. The centre-screw for inductance adjustment has a hexagon head for a spanner instead of a saw-cut for a screwdriver. This core is more convenient when many leads must be brought out of the coil. The bobbin

suitable core is placed. Threaded cores are available which can be screwed into the coil if a thread is cut on the inside of the coil former. A number of these cores is shown in Fig. 3 (a), and in (b) appear plain cores with a threaded brass end screw. With both types the inductance is readily adjusted by screwing the core further into the coil. When this inductance adjustment is unnecessary, plain solid or hollow cores are used, or cores with one flange (mushroom-type). A selection of these appears in Fig. 4 (a), while in (b) are shown a number of cores made of an iron specially developed for short waves.

Apart from efficiency, the material used for the cores must have good mechanical strength in order to stand up to the stresses which occur during mounting and in the set itself. With Sirufer material this is achieved by the selection of suitable binding media as well as by shaping the cores correctly. Good thermal constancy is another requisite of the core. Mechanical alteration of the core does not occur for temperatures up to 65 deg. C., and with certain cores up to 120 deg. C.

It is obviously important that the temperature coefficient should be low, otherwise day-to-day inductance variations will occur. With Sirufer iron it is exceedingly small and negative. A further requirement is that the permeability should not



(a) (b)

Fig. 4.—Where inductance adjustment is not needed plain or mushroom cores can be used as shown at (a). For short-wave work a number of special cores is available (b).

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change with time. Actually the variation found over long periods is less than 0.1 per cent. The permeability should also be unaffected by a direct current flowing through the core. Tests with a bobbin-type core and a 200 μH coil show an increase of permeability of 0.05 per cent. for a DC change of 10 mA. through the coil. Certain Sirufer coils are unaffected by tropical conditions.

Screening

Iron-cored coils have a much smaller stray field than air-cored types, and it is consequently possible to use a relatively smaller screening can without any great sacrifice in efficiency. The enclosed and semi-enclosed core types naturally have an advantage in this respect over the simpler bar-cores, and the effect of a screen is well brought out by the curves of Fig. 5. These show the Q-value of a coil with a roller-type core unscreened and fitted in cans of 48 mm. and 32 mm. diameter. In general, it is advisable to maintain a clearance of at least 15 mm. between screen and core.

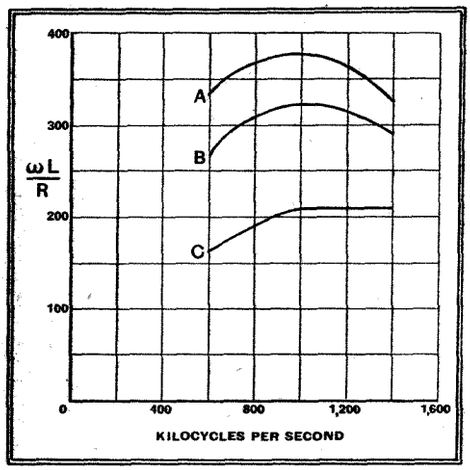
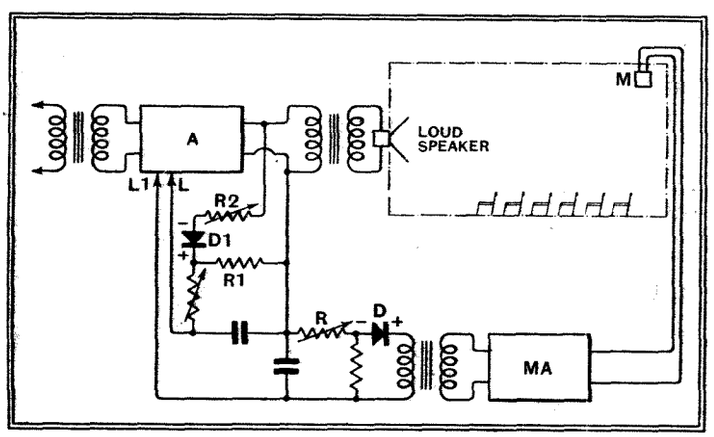


Fig. 5.—The effect of a screening-can on an iron-cored coil is brought out by these curves. Curve A shows the performance of an unscreened coil with roller-type core, while B and C show the effect of using cans of 48 mm. and 32 mm. diameter respectively.

AVC by Applause

"Shouting Down" the Audience

Method of controlling output of PA system by noise in auditorium.



IN a public-address system, where the orator faces his audience in person, he can wait for any applause or laughter to subside, or he can shout down that or any other interference, as he thinks fit. But if a loud speaker is being fed from a "talking film" in a cinema theatre, or is being used to relay a broadcast programme in a concert room or lecture hall, prolonged laughter or applause usually has the effect of "swamping" whatever is being said for the time being. Of course, it is possible to increase the volume, whilst the interference lasts, by manual control, but this is more or less of a makeshift.

A more ingenious idea is to utilise the "noise" produced by the audience as a means for controlling the output from the speaker, so that the latter automatically "rises to the occasion" and continues to make itself heard through the prevailing uproar.

The arrangement shown in the figure (Patent No. 485005) has recently been designed for this purpose. The loud speaker is energised, say, from a talking film, through an amplifier A. Suspended from some suitable point in the auditorium is a microphone M, which is used to provide an AVC voltage for supervising the output from the speaker. The sounds picked up by the microphone are fed to an amplifier MA, the output from which is rectified at D, and the resulting voltage fed through a variable resistance R to a biasing resistance R1.

The microphone M will, of course, pick up the normal sounds emitted from the loud speaker, and since this should produce no "regulating" effect one way or other, it is necessary to use a balancing voltage. This is applied from the loud speaker through a shunt circuit containing a resistance R2, detector D1, and the common resistance R1. The "balancing voltage" from the loud speaker is, in practice, made somewhat larger than the normal pick-up voltage from the microphone so as to avoid any tendency for the system to "sing" and so boost the loud speaker unnecessarily.

As soon as any prolonged laughter or applause occurs, the microphone voltage builds up across the resistance R2 in excess of the "balancing" voltage, and applies an AVC bias through the leads L, L1 to the grid of one of the valves in the amplifier A. The output from the loud speaker increases accordingly until the disturbance dies down, whereupon normal conditions are restored.

Science for the Citizen. By Lancelot Hogben. Illustrated by J. F. Horrabin. Pp. 1120 with 479 figs. George Allen and Unwin, 40, Museum Street, London, W.C.1. Price 12s. 6d.

THOSE who have read Professor Hogben's "Mathematics for the Million" will expect much from "Science for the Citizen," nor will they be disappointed, for it is even better and more interesting than its predecessor.

It is impossible to give any real idea of the book from a mere list of contents; it is sufficient to say that it is divided into parts dealing respectively with Astronomy (including mechanics and especially clocks), Chemistry, Engineering (or the production and utilisation of power), Biology, and Psychology. This whole outline of modern science is displayed against a social background; if one can attempt to summarise a thousand pages in a few lines, Professor Hogben's thesis is that science should not be viewed as a collection of abstruse theorems to be accepted without argument from implicit trust in their inventors (history shows that such theories rarely endure unmodified for more than a generation or two, and are often completely exploded in less than a hundred years); it is rather the sum total of experimentally determined facts, collected and intelligibly classified as in a card index, to which the theories are the "guide cards," and in the main useful, or potentially useful, for the improvement of the standard of life and for the increase of the comfort and security of mankind.

The facts of science are not to be believed as an act of faith, or from reverence for traditional authority; they are based on the results of experiments which anyone can repeat for himself (given sufficient skill). Indeed, many of the experiments illustrated by Horrabin are seen to demand little specialised ability and the minimum of apparatus, so that they could be performed by any (and doubtless will be performed by many) intelligent schoolboys.

The reader will find that he is adopting the scientific habit of mind, he is shown how to think for himself (which is, or should be, the whole object of education), and he will learn that it is not necessary to believe, without thinking, everything he may read, whether it be an advertisement or a piece of skilfully camouflaged official government propaganda.

The whole book can be read and understood without any previous mathematical or scientific training; it is written for, and will be enjoyed by, "the man in the Tube," no less than by the trained scientist, who should read it for the knowledge he will gain of other branches of science as well as for its entertainment value. Even the politician could understand and profit by it, if he would, although, as Professor Hogben says, (with honourable exceptions) "English politicians are probably the most expensively uneducated class of people alive at the present day."

C. R. C.

Linearity and Negative Feedback

HOW AMPLITUDE DISTORTION IS REDUCED

By J. H. REYNER, B.Sc., A.M.I.E.E.

DESCRIBING investigations made with the help of a cathode-ray tube into the extent by which amplitude distortion can in practice be reduced by means of negative feedback.

THE improved frequency response which is obtainable with a negative feedback amplifier is well known, but the question of amplitude distortion does not seem to have received the same attention. The author was recently called upon to produce an amplifier with negligible amplitude distortion and phase shift at frequencies between 50 and 1,000 cycles. Preliminary experiments indicated that while ordinary straightforward methods gave a reasonable approximation to the conditions required, the results just fell short of the completely distortionless amplification which was demanded.

Attention was therefore directed to the use of negative feedback, for one of the catchwords of this system of amplification is that the gain obtained is substantially independent of the valves or even of the amplifier itself, and is merely a function of the percentage feedback. If this is the case, then theoretically it should be possible to use quite a bad amplifier and still obtain satisfactory results, and the question to be determined was whether this apparently ideal state of affairs could be achieved in practice or whether, as is usually the case, there was some unsuspected limitation lurking unseen.

It may be said at the outset that the experiments did bear out the theory but that, equally to be expected, there was a limitation which requires to be appreciated if the proper results are to be obtained. Let us examine very simply the theory of a negative feedback amplifier. If the normal amplification of the amplifier is A, and we feed back from the output to the input a small portion of the output voltage, say, β, the gain of the amplifier as a whole will be reduced (assuming that the feedback is negative, i.e., in such a direction as to reduce the amplification). Consequently, in order to obtain the same output as before the input must be increased by this amount βE, E being the output voltage. The effective input voltage becomes $e+\beta E=$

$$\frac{E}{A}+\beta E = E\left(\frac{1}{A}+\beta\right).$$

The effective gain of the amplifier therefore is:

$$\text{Gain} = \frac{1}{\frac{1}{A}+\beta} = \frac{A}{1+\beta A}$$

This can be rewritten in the form

$$\text{Gain} = \frac{1}{\beta} \cdot \frac{1}{\left(1+\frac{1}{\beta A}\right)}$$

and it will be clear that if the product βA is several times greater than one, the second term under the brackets becomes practically zero, and the gain of the amplifier becomes simply $\frac{1}{\beta}$.

Now, this is the condition of affairs for true negative feedback working. The amplification obtained is simply the inverse of the amount of energy fed back. If 1/100th of the output voltage is fed back to the input then the amplification overall is 100, *provided that the product βA is large compared with unity.*

It is this proviso which constitutes the limitation already mentioned. Let us take, for example, an amplifier with a normal gain of 1,000. For the product βA to be large compared with unity, β must be of the order of 0.01 to 0.005. If β is 0.01, however, the gain of the amplifier is only 100, so that we have obtained our independence of valves and circuit conditions at the expense of 9/10ths of the gain.

If it is permissible to increase the input, then this method is quite satisfactory, and the first test made was to verify whether the negative feedback really did behave in accordance with theory. A simple amplifier of the type shown in Fig. 1 was used. It consists simply of two resistance-coupled triodes, the circuit being normal in every respect with the exception of the fact that the customary by-pass condensers across the bias resistors had been omitted.

Actually this omission of the by-pass condenser in itself introduces a small amount of negative feedback round each stage, but the extent of this is comparatively small in view of the low values of the bias resistors. The bias on the second valve was really too low, resulting in appreciable overloading of this valve under normal working conditions, but for the purposes of the experiment this was an advantage, since it gave a readily observable distortion which should theoretically be cancelled out by the negative feedback.

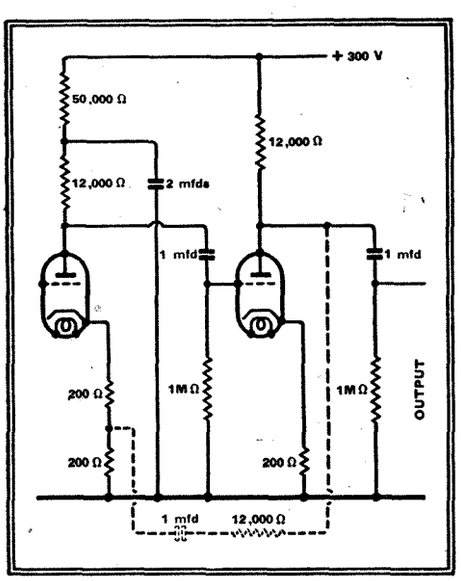


Fig. 1.—Circuit of experimental amplifier; negative feedback connections shown in dotted lines.

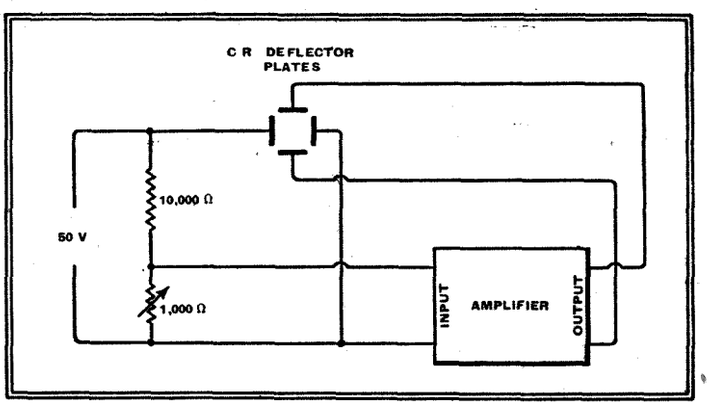


Fig. 2.—Circuit for producing phase ellipse.

For the observation of the distortion a cathode-ray tube was set up to record the phase ellipse, as shown in Fig 2. An input of about 50 volts was applied to the X plates and a small fraction of this input was applied to the input of the amplifier and the output then applied to the Y plates. Under these conditions a distortionless amplifier of no phase shift will show a diagonal line on the screen. If this line is perfectly straight there is no amplitude distortion, whereas curvature at any part indicates departure from strictly linear amplification. If there is any phase shift between input and output, the spot does not follow the same course on its go and return paths but traces out an ellipse, the eccentricity of which is a measure of the phase shift. If there is a 90 deg. phase shift, the pattern on the screen is no longer a diagonal line but becomes a complete circle, and in fact a few minutes of phase shift (i.e., a small

Linearity and Negative Feedback—

fraction of one degree) can easily be detected by this method.

The heavy line in Fig. 3 shows the trace obtained from the amplifier of Fig. 1. It will be seen that there is no phase shift but that there is a very definite amplitude distortion shown by a marked curvature at one end of the line actually produced by the second valve running into grid current.

A small amount of negative feedback was then applied to the amplifier by connecting up the circuit shown dotted in Fig. 1. With the arrangement shown, β was approximately 0.0035, a value which made the product βA equal to 3 for the particular amplifier in question.

Though this is not really large compared with unity, it is approaching the division where this state of affairs is obtained, and the conditions give a fair approximation to true negative feedback. It was found that the input had to be increased practically ten times in order to obtain the same output, and the dotted line in Fig. 3 shows the trace on the tube with ten times the input and the negative feedback circuit in operation. It will be noted that though the output is actually slightly greater than before, the amplitude distortion has almost entirely disappeared. There is a very slight curvature still at the extreme bottom end of the line.

Harmonic Distortion

As a matter of interest, Fig. 4 is introduced to show the original waveform plotted out against a time base in the more usual form, and the flattening of the bottom halves of the waves can clearly be seen in the no-feedback condition corresponding to something like 15 per cent. of harmonic distortion, whereas with the feedback the waveform is a pure sine wave.

The fact that the gain had been reduced so heavily was a disadvantage for the particular circumstances. The normal solution would be to add a further stage of amplification giving a gain of approximately 10 or even more, since it is always possible to increase the feedback with still further improvement in the performance. With a further stage, of course, feedback would have to be introduced into the grid circuit and not in the cathode circuit in order to maintain the correct phase of the feedback, but in the particular circumstances it was desired to limit the stages to two if possible.

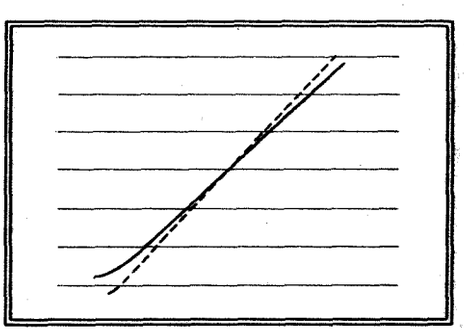


Fig. 3.—Improvement in linearity with negative feedback, as shown by traces on a CR tube. The full line represents normal conditions, while the dotted line shows improvement with feedback β=0.035; input increased ten times.

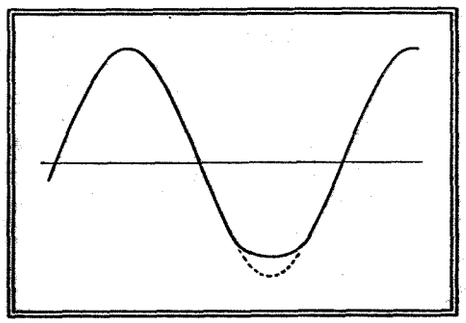


Fig. 4.—Waveform of Fig. 3, showing flattening of bottom peak. Dotted line shows true sine curve.

It was decided, therefore, to reduce the negative feedback slightly, thereby increasing the gain of the amplifier, and at the same time to improve the performance of the amplifier itself, so that the amount of correction required from the negative feedback would be lessened. This was done by increasing the bias on the second stage, not by increasing the cathode resistance itself but by feeding more current through the existing 200 ohm resistor by means of a shunt circuit from the h.t. line. Increasing the bias resistance would have reduced the amplification of the second valve because of the negative feedback around that stage alone, whereas by passing more current through the bias resistor the increased bias was obtained without this disadvantage.

The feedback was then reduced to 0.0017 approximately (i.e., about half its previous value) and the experiment repeated. It was found that although the amplifier was no longer a strictly negative feedback arrangement, since βA was not large compared with unity, being now about 1.5, yet sufficient correction was being introduced to ensure a practically straight line on the tube, now that the overloading on the second valve had been minimised, and actually the amplifier was left in this condition.

Conclusions

In brief, the experiment showed conclusively that if the amplifier is properly designed in the first place to comply with the true conditions for negative feedback, then the individual valves need not be particularly carefully chosen or even correctly operated, since any distortion will be almost entirely compensated for by the negative feedback.

No detailed tests were made during this investigation as to the frequency response of the amplifier other than checking that up to 1,000 c/s the phase distortion was still negligible. It is worth noting, however, that at the frequencies of the order of 4,000 c/s a considerable phase angle was observed. This was due to the fact that phase shift was taking place in the amplifier itself with the result that the phase angle of the voltage fed back was no longer correct. This is a matter, however, which could easily have been compensated for in the feedback circuit itself, and was only because the amplifier was not running under conditions of full negative feedback.

Television Programmes

An hour's special film transmission intended for the industry only will be given from 11 a.m. to 12 noon each weekday.

Sound	Vision
41.5 Mc/s	45 Mc/s

THURSDAY, AUGUST 4th.

3-4.15, "Laburnum Grove," an adaptation of the play by J. B. Priestley.

9, "Sweet Jam," instrumental session directed by Eric Wild. **9.15,** Gaumont-British News. **9.25,** Cartoon Film. **9.30,** "Exhibition," a panorama of exhibitions from Paris, 1797, to Glasgow, 1938. **10,** News Bulletin.

FRIDAY, AUGUST 5th.

3, "Charivari"—the Panache Company in three items from their repertoire. **3.25,** Gaumont-British News. **3.35,** Cartoon Film. **3.45-4.5,** "In the Dentist's Chair," the thriller by Anthony Armstrong.

9, Golf Demonstration, by Ernest Bradbeer. **9.15,** British Movietonews. **9.25,** Cabaret. **10,** News Bulletin.

SATURDAY, AUGUST 6th.

3, Health and Beauty—demonstrations by Punella Stack and members of the Women's League of Health and Beauty, in the grounds of Alexandra Palace. **3.20,** Cartoon Film. **3.25,** Starlight. **3.35,** British Movietonews. **3.45,** "Sweet Jam" (as on Thursday at 9 p.m.).

9, "Laburnum Grove" (as on Thursday at 3 p.m.). **10.15,** News Bulletin.

SUNDAY, AUGUST 7th.

8.50, News Bulletin. **9.5,** Les Sylphides, in Ballet. **9.35,** Film. **9.45-10.15,** Television Spelling Bee, IV.

MONDAY, AUGUST 8th.

3, O.B. from Wembley of the European Swimming Championships. **3.20,** Eric Wild and his Band. **3.40,** O.B. from Wembley, continued.

9, "Is Life Worth Living?" an extravaganza by Lennox Robinson. The action takes place in Inish, a small seaside town in Ireland. **10.15,** News Bulletin.

TUESDAY, AUGUST 9th.

3, O.B. from Wembley of European Swimming Championships. **3.20,** "Rococo." **3.40,** O.B. from Wembley, continued.

9, Starlight. **9.10,** "Ann and Harold," Episode V. **9.30,** Cartoon Film. **9.35,** British Movietonews. **9.45,** Eric Wild and his Band. **10.5,** News Bulletin.

WEDNESDAY, AUGUST 10th.

3, O.B. from Wembley of European Swimming Championships. **3.20,** Starlight. **3.30,** Crime Clues. **3.40,** O.B. from Wembley, continued.

9, Comedy Cabaret, including George Robey and Charlie Higgins. **9.40,** Gaumont-British News. **9.50,** Music Makers. **10,** News Bulletin.

The Wireless Industry

A LEAFLET dealing with the Simmons vibrator-rectifier HT supply unit describes models for 2-, 4- and 6-volt accumulators. Copies are obtainable from the makers, Simmons Bros., 38, Rabone Lane, Smethwick.

W. T. Henley's Telegraph Works Company, Ltd., has declared an interim dividend on the ordinary stock of 5 per cent. (less income tax) to be paid on October 1st, 1938.

Home Recording

Part IV—Surface Noises —Playback Needles

By HUMFREY ANDREWES, B.Sc., A.M.I.E.E.

IN this article the author first discusses the precautions and conditions to observe in order to produce a recording having a low surface noise. Playback needles are then dealt with, and finally attention is given to the recording head characteristics.

IN the previous article of this series the cutting stylus was discussed and the methods of testing it outlined, but before leaving this subject it might perhaps be not out of place to discuss this matter further, as it has an important bearing on the next point of discussion, namely, that of surface noise.

In commercial wax recording it is normal practice to adjust the recording head so that the sapphire stylus is vertical—that is, at right angles to the wax blank. In the directly recorded version this condition should also be aimed at, as the shape of the groove will then be most satisfactory and surface noise be at a minimum. Unfortunately, with some recording machines and with some types of cutting stylus this is not possible, and the stylus must be set at an angle so that it is trailing slightly. Experience shows that small variations in the angle between the stylus and the blank do not have any appreciable effect on the resulting record, but the trailing angle should never exceed ten degrees, and the stylus should never be allowed to "dig" into the record—that is to say, be allowed to meet the disc in front of the normal angle.

In the early days of the development of direct recording a trailing angle was essential to successful cutting, as otherwise the stylus tended to chatter and produced a whistling noise when cutting. As a general rule it is safe to say that unless a silent cutting action is obtained it will be impossible to obtain a silent or reasonably silent playback. Occasionally, however, the condition will arise when the cut will sound slightly noisy, but the replay will be practically silent, and the author has always assumed that this is due to the fact that the noisy or serrated surface is at the top of the groove, and therefore not reproduced by the replay needle.

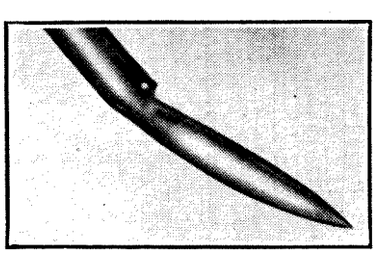


Fig. 1. A needle with the point bent as shown in the above enlarged view is known as a trailing replay needle.

An important adjunct which no serious experimenter can do without is a small microscope or "loop," such as is used by the entomologist. To obtain the best from any recording machine it is essential that the groove in the disc should be examined in this way, and excellent magnifying glasses specially designed for the purpose are available for as little as five shillings, and they will prove a very good investment. Without such a device it is impossible to check not only the depth and character of the groove but also the accuracy of tracking, etc. It is always a good plan to examine immediately after cutting any recording made, as, by making a habit of this, faults can be more quickly observed and cured.

The surface, or ground noise, of directly recorded records can be of many different types. As a general rule if a good type of disc is used this noise is of a high-pitched, hissing nature, and should be negligible with a properly cut groove. When, however, the hissing noise becomes excessive the cutting stylus should first be examined, as this is the most likely source of trouble. Sometimes it will be found that the extreme point of the stylus will have been broken off, probably by meeting some piece of hard foreign matter in the disc or perhaps due to the fact that it was allowed to fall too suddenly on the disc. This latter point is, by the way, an important one, and it is only by constant practice that the experimenter can learn the art of lowering the cutting stylus on to the disc quickly and yet gently so that the point will not be damaged.

Sometimes the point of the stylus may not be broken, but a burr will form on the cutting edge, and this will cause the cut to be noisy. On examination under a magnifying glass it will be seen that the groove is serrated as though by a high-frequency modulation.

Stylus Adjustment

If the cutting stylus is found to be satisfactory but the cut still noisy the angle of the stylus to the disc should be examined. Too great an angle of "trail" will cause excessive surface noise, and, alternatively, if the stylus is "digging," a low-frequency rumble may be produced due to the stylus chattering. Also, if the stylus is set at too great an angle on the cutting face—that is, to a radius of the disc—the surface noise will also increase. A variable "swishing" noise is usually due to an uneven depth of cut. This may be caused either by an unevenness of the disc or by the fact that the cutting head is too tight in its pivots and cannot follow accurately the small variations in the flatness of the disc. This trouble may sometimes be traced to a piece of foreign matter under the disc or rubber mat on the recording turntable.

Surface noise can also be due to the material of the disc itself, and some types of disc are susceptible to variations of humidity, and if allowed to get too dry will have excessive surface noise when cut. This difficulty can be overcome by exposing them to a humid atmosphere for a period. Some other types tend to harden with age, and this will also cause excessive surface noise. Perhaps the most frequent cause of trouble with discs is the presence of small pieces of hard foreign matter on the surface of the coating material. Discs should always be carefully examined, as it is so easy for an important recording to be completely ruined if the point of the stylus is removed in the first half inch of a record by particles of grit embedded in the surface.

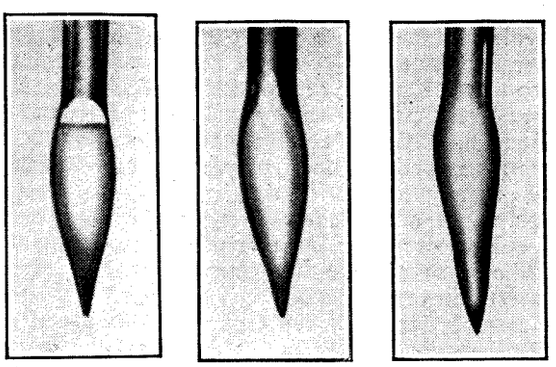


Fig. 2. Enlarged views of various types of trailing replay needle which are often used with directly recorded discs, and particularly in the case of the self-hardening kind, in order to avoid undue wear and possible damage to an unrepeatable recording.

Low-frequency rumblings may sometimes be heard superimposed on the normal surface noise, and these are usually due to vibration or gear noises. It is emphasised that care must be taken over the examination of the disc and the point of the cutting stylus if the full advantage is to be obtained of one of the directly recorded disc's great virtues, namely, the low level of surface noise. Under favourable conditions a much better pianissimo in music can be obtained than with the commercial shellac pressing, and although it is doubtful whether the record will be quite as loud, it is probable that the range in decibels between the loudest and the

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quietest passage that can be recorded is greater. It is also interesting to note that shellac pressings made from directly recorded masters can also have a low surface noise level although it is usually

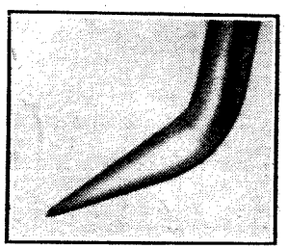

Fig. 3. This kind of trailing needle has a point bent at a very acute angle and is best suited for use with pick-ups in which a straight needle would be nearly vertical to the disc.

higher than that of the original master for obvious reasons.

We turn now to the question of playback needles. As explained in an earlier article, owing to the nature of the material of the directly recorded disc it is not normally possible to use the ordinary straight steel needle in the pick-up or sound box. It must also be remembered that as the groove is V shaped and not rounded at the bottom, as in the case of the shellac pressing, there is a tendency for a sharp needle to jam in the groove and cause excessive friction. A sharp needle will also tear the surface of the disc if it does not actually pull the replay table up to a standstill. Special needles have therefore been developed for replay, and these are usually of the "trailing" type. Figs. 1, 2, and 3 show enlarged views of different types of such needles. The needle is so shaped that when inserted correctly in the needle holder it is inclined at a smaller angle to the record than the normal straight needle, and as it has also a blunter point the drag on the record is very much less, and hence the relatively soft record can be played on the ordinary reproducer without any other alteration. A number of different shapes is available, but the action of all is the same.

Pick-up Adjustment

The weight on the point of the needle for different makes of pick-up and sound box varies considerably, and cases are sometimes met where even with a trailing needle the record will not play and the turntable comes to a standstill when the needle is inserted in the first groove. In such cases either the weight of the pick-up must be reduced by the use of a counterbalance weight or spring, or a thorn or fibre needle must be used. It may sound extraordinary, but often the author has found that by oiling the motor of the replay table the difficulty is overcome, as it is an unfortunate fact that although the gramophone enthusiast will religiously put oil in the sump of his car it never occurs to him that his gramophone motor also requires oiling occasionally.

The thorn or Burmese Colour needle is much used by enthusiasts, and although it has a falling frequency characteristic which must be compensated for electrically, it has the great advantage that it does not appreciably wear the record like a steel needle, and where records are made which are of historic interest, or which cannot be readily repeated, such needles should certainly be used. These needles must be carefully sharpened, and a special tool is available for the purpose.

Owing to its size and shape the frequency characteristic of the trailing needle is obviously not as good as the straight, sharp-pointed needle. It is possible to overcome this difficulty, however, by reducing the weight on the point of a straight needle, either by counterbalancing or by using a light pick-up. Care must be taken in doing this, as if the weight is made too light the reproduction of the low frequencies will be affected as the needle will tend to jump and will not follow the grooves accurately. One type of counterbalance weight is shown in Fig. 4. The weight may be adjusted by moving it on the screwed rod until the best position is found. With such an arrangement ordinary straight steel needles may be used and an improved frequency characteristic obtained. Long-playing needles may be used quite satisfactorily with this arrangement. Other methods of counterbalancing will obviously occur to the experimenter and it is unnecessary to labour the point further.

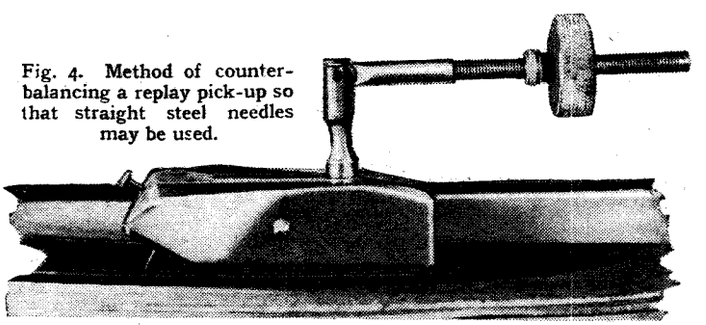

Fig. 4. Method of counterbalancing a replay pick-up so that straight steel needles may be used.

One or two makes of blunt straight needles have also been produced which may be used with an uncounterbalanced pick-up, and this solution may perhaps appeal to many. In an emergency when no special needle is available it is also possible to blunt an ordinary needle by playing a shellac pressing first and then using it for the direct record without, of course, removing it from the needle holder.

A point which should also be borne in mind is the remarkable variations in the frequency characteristic of pick-ups that can be obtained by varying the shape and size of the replay needle. It is too often assumed that the shape of the characteristic curve depends on the electrical and mechanical constants of the pick-up itself and will be the same for any type of needle. In the case of one particular pick-up on which the author was making a series of measurements, with one type of trailing needle the curve was found to be reasonably flat up to about 3,000 cycles and then gradually dropped as the frequency increased. On replacing the needle by another of about the same length but different shape the curve was found to have a violent rise between 2,000 and 3,000 cycles, everything else being kept constant. Variations in extreme high frequency response occur also with different types of needle and it is worth while to experiment to find the best needle for the particular type of disc that is being used.

We now come to a very important part of our subject and one which is the deciding factor in the success of all direct recording apparatus, the recording head or cutter as it is sometimes called. Owing to the peculiar characteristics of direct recording blanks the frequency response curve of the recording head must be somewhat different from that commonly used for wax recording. At first sight it would appear desirable that the curve of the head should be as flat as possible, but two important factors make a considerable divergence from such a curve necessary.

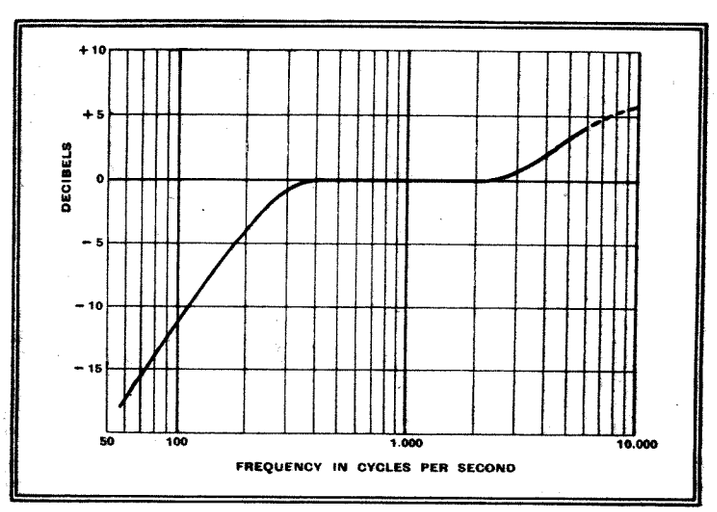

Fig. 5. Overall characteristic curve of cutting head and amplifier required to produce a good direct recording.

In the first place it will be remembered that it has already been explained why the constant velocity type of recording could not be used over the whole frequency range. It was also explained that it is normal practice to use the constant amplitude type of recording from the lowest

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frequency to be recorded up to about four hundred cycles. This necessitates the first divergence from a flat curve. Secondly, it has also been explained that owing to the nature of the material used for the direct recording discs there is a considerable loss in the reproduction of the higher

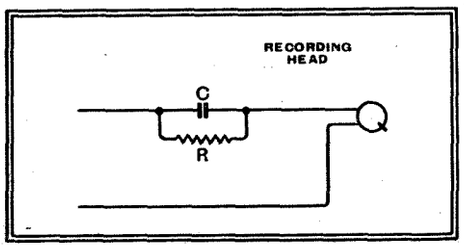


Fig. 6. Circuit of a simple fixed bass attenuator.

frequencies from about three thousand cycles onwards, although the amount of the loss and the frequency at which it becomes apparent varies considerably with different types of disc and is also dependent on the shape of the playback needle.

In our preliminary consideration of this part of the subject we will assume that the playback pick-up is perfect, as although we shall find later that this is alas far from true it is possible to introduce correction for the pick-up at a later point. We therefore see that we require a curve for our recording head which has a shape approximately as shown in Fig. 5. This curve shows that the constant amplitude law is used from the lowest frequency up to four hundred cycles and that the constant velocity law is then used from four hundred to about three thousand cycles, and that after this frequency an approximation to the constant amplitude law is again followed. The exact shape of the curve naturally varies for different recording apparatus, but most authorities are, the author believes, agreed that the shape should follow generally that shown. It is not, of course, at all easy to make a recording head that follows exactly any law arbitrarily laid down in this way, but there are certain variations which it is very advisable for the experimenter to avoid.

Frequency Correction

In the first place it is very important that the output circuit, feeding the recording head, from the amplifier should be so designed that the first part of the curve shown in Fig. 5 is followed fairly accurately. This is not a difficult matter and is usually done by introducing an attenuator network between the amplifier and the recording head. This attenuator is sometimes called the fixed bass attenuator. This attenuator may, of course, be introduced at any point in the amplifier chain, but if the monitor loud speaker is also connected to the output of the main recording amplifier it is usually most convenient to connect the fixed attenuator in the actual leads to the recording head. It may be mentioned at this point in the discussion that the author has always found it a good plan in designing recording amplifier equipment to treat each part separately as far as frequency characteristics are concerned, as it is much easier to determine and correct the characteristic of each individual part separately, rather than correct the complete equipment as a whole.

A simple type of fixed bass attenuator circuit is shown in Fig. 6. To determine the values used in such an attenuator, one method is to assume that without it the curve of the recording head would be approximately flat and then knowing the output impedance of the amplifier calculate the values of the condenser C and the resistance R so that at four hundred cycles the impedance of C is negligible compared with R or the output impedance, but that as the frequency falls the impedance of C rises and so the voltage across the recording head falls until a point is reached where the impedance of C is large compared with R. After this point no further attenuation takes place. This calculation will then give a rough guide to the values which may be tried.

Some modification will probably be necessary in practice as the impedance of the recording head varies with frequency and will therefore have to be taken into account. When the values for an experimental attenuator have been determined it can be very readily checked by using the Buckmann-Meyer image. This method of checking recording head characteristics will be dealt with fully in a subsequent article and will not, therefore, be considered further here. By this method, however, the design of the fixed bass attenuator can readily be adjusted until the desired response curve is obtained.

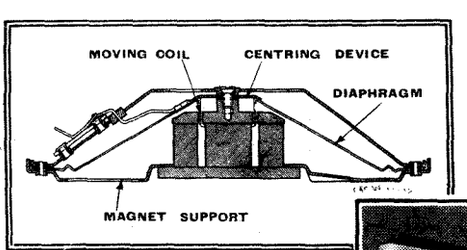
In setting up a recording machine and head it is very desirable that the fixed bass attenuator should be adjusted at an early stage in the experiments as otherwise very misleading results will be obtained. The incorrect design of this part of the equipment will inevitably lead to serious distortion, as if the attenuation is not sufficient there will be a danger of one groove running into the next, and even if this does not occur the peaks of the waves will certainly be cut off. Secondly, as the impedance of most recording heads falls rather rapidly at the lower end incorrect attenuation will lead to distortion in the output stage of the amplifier due to mismatching. For this reason also it is desirable to insert the attenuator between the output stage of the amplifier and the recording head rather than earlier in the system. Where more than one recording machine is used with the same amplifier, as is normally the case, the same fixed bass attenuator may be used for both recording heads.

Before leaving the subject of the fixed bass attenuator it may be of interest to give one design which has been used by the author. The output stage in this particular instance consisted of two Mullard valves, Type DO24, connected in parallel, and the values apply, of course, to any amplifier having a similar output stage. With a well-known make of recording head it was found that suitable values for the condenser C and the resistance R (Fig. 5) were 0.25 microfarad and 2,000 ohms respectively. A curve taken with these values was found to follow very closely the theoretical curve.

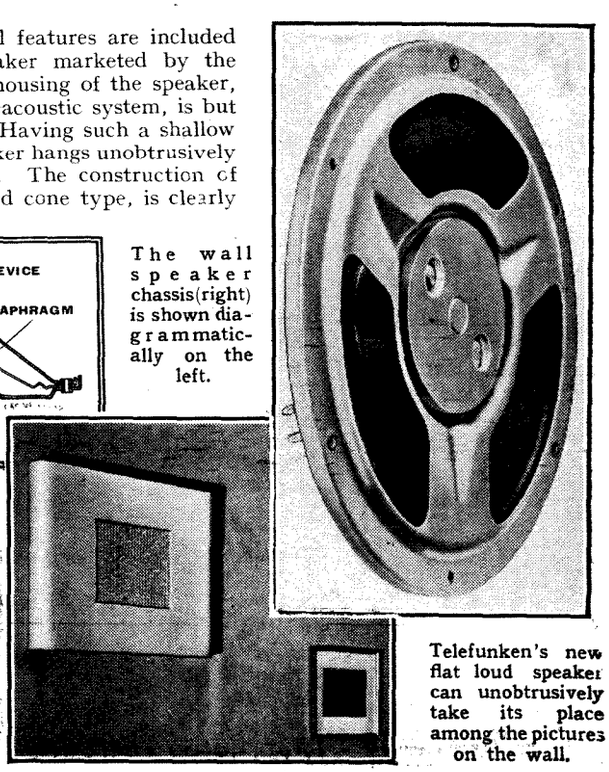
TELEFUNKEN WALL LOUD SPEAKER

Case Supplies Acoustic Correction

SOME interesting constructional features are included in a new flat wall loud speaker marketed by the German Telefunken firm. The housing of the speaker, which is an essential part of the acoustic system, is but 5 cm. deep and 50 cm. square. Having such a shallow back-to-front dimension the speaker hangs unobtrusively on the wall or from the ceiling. The construction of the unit, which is of the inverted cone type, is clearly shown in the accompanying sketch, the Oerstit permanent magnet being mounted inside the cone, which is about 15 cm. in diameter, making the total depth of the unit but 43 mm. Tests show that the shallow casing illustrated provides better bass response from this particular speaker than a conventional open baffle when placed near a wall.



The wall speaker chassis (right) is shown diagrammatically on the left.



Telefunken's new flat loud speaker can unobtrusively take its place among the pictures on the wall.

Choosing the New Set

LAST week I tried to offer a little consolation to those who cannot find the price of a new set. This week's talk is intended for those who, in reality or imagination, are going to Radiolympia, their local exhibition, or the dealer's shop, to buy. Or at least to choose. The choosing is better than the actual buying, if buying is interpreted to mean nothing more than drawing a cheque in full payment or signing a hire-purchase agreement on the dotted line.

I like to do as much as possible of the selection on paper. The presence of a salesman at my elbow completely destroys my sense of judgment and fills me with irritation, leading in extreme cases to the verge of homicidal mania. There may be a notice, "Walk In—No Obligation to Buy," but the feeling is inescapable that even if the dealer is not actually rubbing his hands and murmuring obsequious sales talk in my ear he is watching from some dark corner, and my powers of concentration fade away. There is always a chance at the Exhibition, if you go late, when the salesmen are suffering from clergyman's sore throat and have eyes for nothing but the clock, and if you discard any appearance of prosperity, that you will be able to examine at least the externals of the models in peace. But earlier in the day, although there is less risk of having one's hands trodden on by the crowd, it is practically impossible to pause near an exhibit for more than a few moments without attracting the attention of one of the staff and hearing him drawl, "Can I interest you in this, Sir?" Whenever that happens I always utter a hearty "No!" and walk over to the stand opposite.

Judging Dispassionately

Evidently my feelings in the matter are shared by many, for I invariably notice that a large proportion of the public studiously avoid the sight of any of the actual exhibits, and concentrate on the printed descriptions of them, which they collect in large bags. I imagine that, like me, they take them home, lock the door, disconnect the bell, take the 'phone off the hook, and settle down to study them without fear of interruption.

In this peaceful and dispassionate atmosphere they can then eliminate in the first round all those makes that are described in vague generalities such as "Amazing," "Years Ahead," "Perfect," "Magical," and so on, or that devote most of the space to pictures of actresses or bathing belles or persons in immaculate evening dress. Having disposed of what is either palpably untrue or irrelevant, they can consider those that are informatively and reasonably described. It is unfortunate that the radio industry in general still withholds such information as would make it easy to compare one with another. This is in strange and regrettable contrast to the conduct of car manufacturers, who supply definite figures stating maximum speed, petrol consumption, acceleration, gear ratios, steering lock, etc.

However, many of the radio firms tell you whether they give triode, tetrode, or pentode output, whether or not there are such facilities as gramophone and extension speaker sockets, what sort of push-button tuning, if any, is provided, whether or not an external aerial is intended, what is the weight for carrying about, what sort of tuning scale is fitted, what precautions, if any, are taken to prevent cabinet resonance, and so on.

What to Look for at a Demonstration

If by examining these, in relation to prices, one can narrow the selection down to two or three, the best thing then is to make actual trials of these favoured few in an equally unprejudiced setting, by getting them on approval. There may be some reluctance on the part of your dealer to arrange this, and, if so, it is probably not without just cause, as certain depraved persons are known to abuse on-approval facilities, and the innocent suffer by their sins.

By "CATHODE RAY"

Supposing that this difficulty arises or that preliminary demonstrations are needed for narrowing the choice, it is desirable to have a clear idea of what to look for from a demonstration, or it will only leave one more unsettled than before. At best a demonstration in a shop or exhibition is not nearly so satisfactory as on the home ground. The surroundings are so different as to make direct comparison, even by an experienced judge, almost impossible. The dealer or exhibitor has some advantages, having control of the staging with some scope for concealing defects. On the other hand, he usually has disadvantages in the sites most often available, for they may be noisy both acoustically and electrically, and this spoils results more than is generally realised.

If there is severe electrical interference, there is not much chance of demonstrating station-getting. Sometimes even Droitwich is crackled out. But what is a drawback in one respect is useful in another, by enabling the sets to be compared for their ability to cope with interference. If the supply is AC, try each set with the mains plug reversed, as sometimes this makes quite a difference. It is not fair to say that because reception is unsatisfactory at the demonstration it will be so at home, but if set A gives less noise on a certain station, other things being equal, than set B, it is reasonable to judge that it is better protected against electrical noise. It is necessary to listen carefully to the quality of reproduction at the same time, because an apparent improvement in set A may be due merely to a lack of high-note reproduction. Listen particularly to the crispness and clearness of speech. Variably selectivity and tone control are helpful in making the best of reception conditions, but comparison of noise-filters must be made with volume and tone adjusted as nearly as possible equal. An alternative test of screening against interference, available for external aerial sets, is to disconnect the aerial entirely, putting it well away from the aerial socket. Even if the set is a sensitive superhet, all reception should cease, except perhaps from local stations.

Acoustical noise, almost inevitable in a shop or exhibition, is even more misleading. A background of noise may not be loud enough to force itself on the consciousness, yet quite enough to reduce the apparent output power by about nine-tenths. It affects quality of reproduction, too. So if the demonstrator pleads some consideration for this he is not just making excuses.

Tone, or "quality," is important, though sometimes one wouldn't think so. Here a lot depends on the programme. Occasionally, through bad lines or technical hitches, even the local programme is not good enough for a careful test. And sometimes the balance and control, with all respect to the B.B.C., is less satisfactory than at other times. In general, avoid outside broadcasts, gramophone records, and sponsored programmes. Speech should be clear and not boomy. A good test is to go into another room and decide whether it sounds like a human voice or a foghorn. Mr. C. H. Middleton shows up the whoomphers; he should sound quite natural, if a trifle low. The distant test is applicable to music, too; it reveals resonances more cruelly than close-up listening. Hear an organ, or full orchestra with drums, at full volume. During loud passages with plenty of bass do the high notes sound harsh with a sort of juddering effect? This is a sign of intermodulation distortion.

Assuming a good-sized outdoor aerial is available, tune to the strongest station. Then open the aerial switch, or disconnect the aerial just enough to leave a small amount of capacity coupling. Background noise will come up, of course; but if the AVC is effective the volume will not

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drop very greatly. The tone should be compared, and if with the aerial connected there is a perceptible roughness not present with it off, it is a sign that the pre-detector valves are unable to handle a strong carrier wave without distortion.

A battery set with QPP output should be listened to at very low volume as well as at full. And it is wise to get the dealer to measure the total HT current. It is no use expecting a really good performance without paying for it in current, of course, but a drain of 20 milliamps. or more is excessive for any standard battery and for any normal modern receiver. Some of the smaller superhets take no more than 10 mA, and straight sets less still.

A Convenient Test

Tests of selectivity vary according to district. The favourite test in the London region is Deutschlandsender on 1571 metres. If it can be received without interference from Droitwich and Radio Paris when those stations are working, one can unreservedly admire the selectivity, but strongly suspect that it is achieved at the expense of fidelity. This is not necessarily so in the case of a skilfully handled frame-aerial receiver with which advantage is taken of the directional properties. But if you want distant stations without interference *and* local stations without distortion the only solution is variable selectivity. Though so exceedingly desirable, it is better to do without variable selectivity at all rather than get a bad specimen of the species. A bad specimen is one which when operated varies the tuning as well. A slight amount of variation in *volume* must be expected, but only a slight amount. Tune in a station carefully with maximum selectivity. Then change to minimum selectivity, and slowly turn the tuning control a little to each side. If one side yields a distinct tuning peak, whereas the other side falls away, you have in front of you a perversion of a good idea. Pass on! The test is much easier to perform when some sort of tuning indicator is provided, of course.

To judge selectivity generally, a run should be made over the whole tuning scale after dark, with full aerial. This reveals any superhet whistles, too. Station heterodyne whistles (unchanged in pitch by the tuning control) are bound to exist if the receiver approaches the high fidelity standard; they can be softened by tone control or variable selectivity. There are very few superhets indeed that yield no tunable whistles at all, but in some of the better examples only one comparatively feeble and inoffensive specimen can be discovered. Assuming the usual 465-kc/s intermediate frequency, special attention should be given to two and three times this frequency on the medium waveband—930 and 1395 kc/s or 322 and 215 metres. Some of the cheaper superhets with no preselector RF stage radiate seriously and may even lay the owners open to proceedings by the G.P.O. To check this, tune a neighbouring receiver to North Regional (when working) and sweep over the long waveband with the suspected receiver. It is only reasonable that the two sets should be at least a few yards apart.

Talking about wavebands, accuracy and clearness of tuning scale is a feature of practical importance; so is ease of tuning, particularly on the short wavebands. And controls generally should work smoothly and quietly. A pet dislike of mine is a volume control in which all the useful range of control is cramped into a small part of the rotation because the remainder corresponds to grossly excessive volume. It is due to wrongly adjusted AVC delay voltage. Volume should be smoothly controllable from zero to a little beyond the useful maximum.

If you mean to use a gramophone pick-up—or if it is a radio-gramophone you are examining—look for a reasonable agreement between radio tone and gramophone tone. Sometimes the natural difference due to recording deficiencies and radio sideband loss is not properly compensated by the designer.

Hum is seldom troublesome in these days when large electrolytic condensers are cheap, but if it can be heard at all in the usual sort of showroom where dead quietness is unobtainable it is liable to show up badly at home. If short waves are included, try to find a strong station as near the shortest wave-end as possible. This is usually the most searching test for *modulation* hum, audible only when the carrier wave is tuned in.

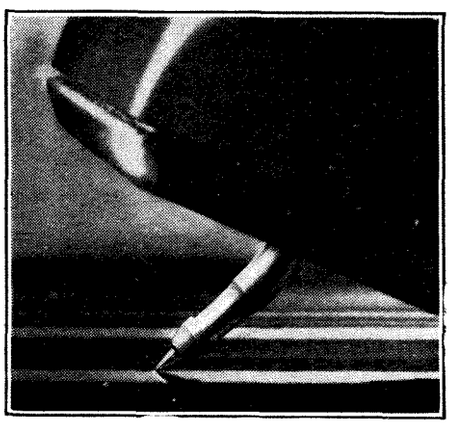
If each of the foregoing suggestions is applied, with an entirely satisfactory issue, then you have a very fine set and a very patient dealer, and are to be congratulated if it were not for the certainty that after you have thus taken infinite pains over a careful and systematic selection the wife will come along and for some frivolous reason reject it out of hand.

HIGH-POWER MOBILE P.A. The latest Easco public address van, designed for use at outdoor gatherings, is equipped with a bank of loud speakers that can be swung in any direction, or, alternatively, detached in a few moments for installation at a point remote from the vehicle.

"Walco" Sapphire Needle

PRODUCED in the U.S.A. this gramophone needle is now available in this country through R. A. Rothermel, Ltd., Canterbury Road, London, N.W.6. The price is 12s., but as it is capable of at least 2,000 playings before the wear approaches that of a steel needle after only one playing, it is well worth the money to those who appreciate good quality in gramophone reproduction. It should prove of special interest to those who possess an automatic record changer.

The sapphire point, which is ground and polished with the aid of a projection micro-



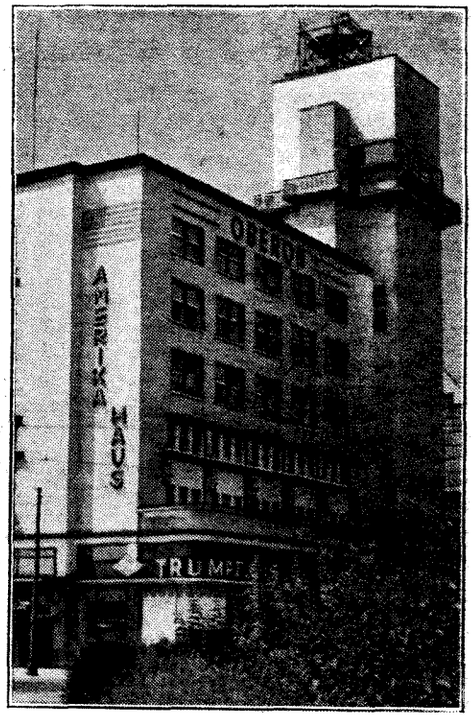
In this photograph the "Walco" sapphire needle is shown about three times its actual size.

scope, is set in a non-magnetic aluminium stylus. A trailing angle of 20 deg. has been adopted as a good average for pick-ups of different types, and with this the upper limit of frequency response is about 5,000 cycles. While this ensures that needle scratch will be kept under control and that acetate records will be kindly treated, it is likely that better results from the point of view of frequency response will be obtained from shellac records with a straightened needle, provided that the needle track alignment is correct and the weight on the point does not exceed 2 or 2½ ounces. We understand that arrangements have been completed to supply straight needles at the same price when these are specially ordered.

Aerial Couplings

IN these days of anti-interference aerials set manufacturers are paying more attention to aerial couplings; separate primary windings are often provided for each waveband. Anyone more familiar with the older and less complicated methods may do well, when tracing faults, to bear in mind that an aerial coupling that has developed a fault only on one band can give quite puzzling symptoms. Where, for instance, the medium-wave setting is below par but reception of local stations is still possible, while other bands are normal, removal of the aerial may not appreciably reduce signal strength on the band in question. One particular case in mind is where the aerial and earth plugs had been inadvertently connected to the supply mains (this, incidentally, should not be possible in a well-installed set). The result was that the medium-wave coupling coil had fused, leaving no external indication of discontinuity.

NEWS OF



BERLIN'S NEW TELEVISION STATION, in the Amerika Haus, is being fitted with a unique type of "umbrella" aerial on the tower of the building.

HIGH-DEFINITION TELEVISION IN GERMANY

A Test Period to Begin

IT would appear from an article by the German Post Office in the Official Party Organ last week that on August 5th, the opening day of the Berlin Radio Exhibition, will be sounded the death knell of Germany's low-definition (180 lines) television. On that day a three months test period of transmissions on 441 lines interlaced 50 frames will begin at the conclusion of which Berliners will be informed of the cost of the television licence. It will by that time be just two years since the opening of the B.B.C.'s high-definition service from Alexandra Palace.

The new transmitter, the power of which is not disclosed by the German Post Office, has been installed in the Amerika Haus, a tall building on one of the highest spots in the city. This overlooks the Adolf Hitler Platz in the West End near the Broadcasting House and the 400ft. Radio Tower, which has been used for the 180-line transmissions.

Berlin's new television studio is circular in construction with a large plate-glass window covered by heavy curtains. At irregular intervals round the walls are spaces for five "sets" with banks of lights, the two cameras, being on trolleys in the centre, can be panned from one scene to another.

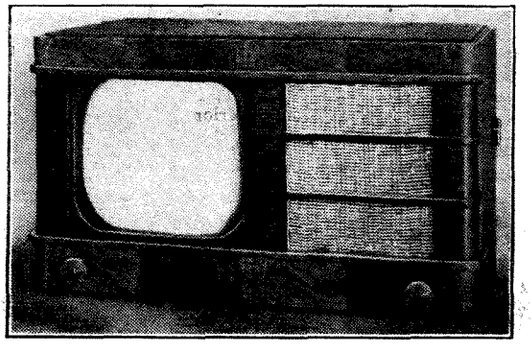
The new station, together with those to be erected, probably before the 1939 Exhibition, on the Brocken and on the Feldberg near Frankfurt-on-Maine, will provide a television service for about 25 per cent. of Germany's population.

The public viewing booths in Berlin and the one in Potsdam will remain open so that those who are not in a position to buy the new receivers, which will make their début at the radio show, will be able to enjoy the new service.

POST OFFICE AND B.B.C. IN CAR RADIO CAMPAIGN

IT is computed that a modest 45,000 cars are equipped with radio, and the Post Office and the B.B.C. would like to see this number increased to a quarter of a million within the next year. One scheme under discussion is the introduction of special programmes for car users. Many ideas for such a series will suggest themselves, from hints to picnickers to traffic warnings and route recommendations supplied by the motoring organisations.

"Take your radio with you" will be the slogan, and the time may come when a radio outfit is as important an item in a car's equipment as the speedometer and the petrol gauge.



ONE OF THE FIRST television receivers, Fernseh A.G., to be available for the German public at the Berlin Radio Exhibition. It gives an image of 23 x 20 cm. (approx. 8 x 10 in.) and is expected to sell at Rm. 800.

MARCONI MEMORIAL AT LAVERNOCK

Commemorating the First Transmission Across Water

ALTHOUGH the actual site of the memorial to be erected by the Rotarians of Cardiff, Barry and Penarth to commemorate Marchese Marconi's first successful transmission across water, has not yet definitely been fixed, the War Office, according to *The Western Mail*, has granted permission for it to be placed on their grounds at Lavernock Fort. The proposed site will be near the spot where Marconi's aerial was erected, the iron support of which may still be seen. Any who may wish to contribute towards the cost of this memorial are invited to send a subscription to Mr. H. Howell, Manager, Barclay's Bank, Barry Dock.

The memorial will take the form of a granite block, one of the plaques of which will be inscribed with the following:

"Near this spot on May 18, 1897, were received from the island of Flat Holm, the first successful wireless signals to be sent over water by Guglielmo Marconi. His experiments were conducted with the assistance of George S. Kemp, in the presence of Lord Kelvin, Sir William Preece, and Principal Viriamu Jones.

"'I am happy if by any efforts of mine I have been able to make some contribution towards international sympathy and understanding.—Senatore Marconi.'"

THE ELECTRICAL MEGAPHONE is a popular medium for public address in Germany. The Philips' equipment, shown here, operates from an amplifier, which, together with the batteries in a carrying case, weighs 17½ lb. This may be slung from the shoulder so that the operator can move about freely. The microphone is located at the base of the speaker and the apparatus is actuated by a trigger control in the butt.

VOLKSEMPFANGER

Germany's New Cheap People's Set

FOLLOWING the production of over 3,000,000 People's Sets, the German radio authorities, as announced in these pages last week, have decided to produce a cheaper model. A first series of 200 of these two-valve all-mains receivers complete with loud speaker, will become available at the Berlin Radio Exhibition at Rm.35.

The set is designed for operation on any voltage between 110 and 240, power consumption being 15 watts at 240 volts, and proportionately less at lower voltages. A double valve with two electrode assemblies and a common heater is employed. It is called the VCL11 and requires 50 mA at 90 volts for the heater. The rectifier valve is known as the VY2.

The receiver has been built on the cheapest possible lines with a strong regard for the prescriptions of the "Four-Year Plan," which demands that the use of metals coming from abroad must be avoided. By the use of pressboard it has been possible to dispense with the usual metal chassis and generally the amount of copper wire and iron used has been reduced by some 75 per cent. The valve sockets are riveted on to the chassis, thus saving the cost of a holder.

Although much smaller than the original People's Set, the new edition will give quite a number of stations on a good aerial; measurements show that it is actually 50 per cent. more sensitive than its forerunner.

The receiver can either be purchased for cash or by deferred payments spread over a period of eighteen months. For needy persons a special fund has been set aside by the authorities to assist them in the purchase of a receiver.

It is rumoured that the Post Office will consent to a lowering of the licence fee to half (one mark) for a certain class of needy person, provided the total of such does not reach 10 per cent. of the licensed listening public.

THE WEEK

QUIET SWITCHING IN THE CONTROL ROOM

Result of Using Talk-Back Speakers

LISTENERS have recently remarked upon the "slickness" with which one transmission is dove-tailed into another by the control engineers at Broadcasting House. It often happens that an announcer in London takes listeners over to Midland or Scottish Region without any perceptible break in transmission.

This is made possible by the increasing use of talk-back speakers in the various Regional centres and the technique is similar, but on a larger scale, to that used in multi-studio production of radio drama. And this has led to the suggestion of a programme which may replace the "Round the Empire" feature at Christmas, in which all the B.B.C. studios throughout the country join in a composite production. If the producer were really ambitious, he could split up the component parts of orchestra and choir so that every studio in the country supplied its quota to the entertainment. From the technical point of view, it would be an interesting experiment.

TELEVISION IN NEW B.B.C. BUILDING

THE new extension to Broadcasting House, to which reference was made in these columns last week, will help to terminate the present congestion and mild chaos in the rehearsal of television programmes. The new extension in Portland Place will contain ample room for television rehearsals and, moreover, it is likely that certain of the programmes may be performed there, to be sent "down the pipe" to Alexandra Palace. At present the productions staff at Alexandra Palace are let loose on London daily, to carry on rehearsals anywhere where a group of players can be accommodated with comparative freedom from interruption.

MORE ABOUT RADIOLYMPIA

AN idea is prevalent that the "Come and Be Televised" feature at Radiolympia will be confined to a closed-circuit. This is not the case, so there is nothing to prevent viewers in Brighton or Southend from seeing their loved ones at Olympia. Visitors will, of course, have to be made up for the *ordeal*, but this will probably be one of the major attractions.

Mr. C. H. Middleton, the famous gardening broadcaster, will be televised every morning in the second week of the Exhibition and a special reconstruction of the Television Garden in Alexandra Park will be set up in the Olympia studio.

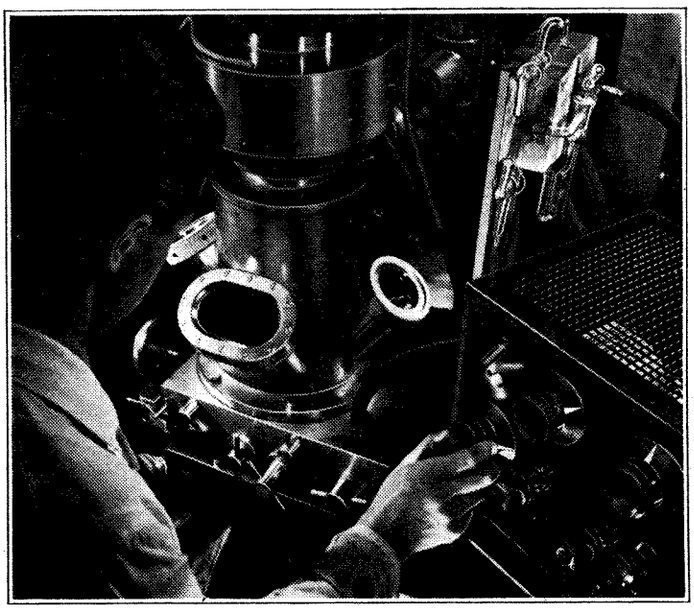
THE HENRY WOOD JUBILEE

SIR HENRY WOOD completes his fiftieth year of conducting and of musical service to the nation next October, and his jubilee is to be celebrated by a Jubilee Concert in the Royal Albert Hall on Wednesday, October 5th.

The proceeds of the concert will go to the endowment of beds in London hospitals, for orchestral musicians. Saturday is the opening night of the forty-fourth season of Promenade Concerts from the Queen's Hall, London, and during the interval at 9.35 p.m. listeners will hear Sir Henry's voice for the first time, when he broadcasts an appeal for donations to this endowment scheme.

GERMAN RADIO EXHIBITION

THAT the international importance of wireless is fully appreciated by the German Government is indicated by its treatment of the wireless exhibition to be held in Berlin from August 5th (Friday) to the 21st. The opening ceremony, which is to be broadcast from German stations at 11 o'clock in the morning, is to include addresses by Herr Goebbels, Minister of Propaganda, and Dr. Lippert, Oberbürgermeister of Berlin.



THE ELECTRON MICROSCOPE which has a number of advantages over the optical microscope for many purposes is benefiting from the intensive research on cathode-ray tubes and associated apparatus for television purposes. In fact, it may be said that recent improvements in the electron microscope could not have reached their present stage except for the research which television has promoted. The picture shows a highly developed electron microscope recently demonstrated by Siemens of Berlin.

FROM ALL QUARTERS

Unlicensed Car Radio

THE first person to be prosecuted in this country for using a car radio receiver without a licence was at Evesham, Worcester, last week, fined 10s.

Have You Heard This One?

A NEW Finnish short-wave broadcasting transmitter at Lahti has been operating for some time with an aerial power of 1 kW on 9,500 kc/s (31.58 m.); 11,780 (25.47 m.; 15,190 (19.75 m.). It broadcasts the same programme as the 150-kW long-wave (1,807 m.) station at Lahti. The Finnish Broadcasting Company would appreciate any reports of reception, which should be addressed O.Y. Soumen Yleisradio A.B., Helsinki, Suomi, Finland.

House of Lords Microphone

A MICROPHONE is to be fitted over the Cross Benches in the House of Lords. It will serve twelve earpieces in the Strangers' Gallery and, if satisfactory, the system will be extended.

Engineering Training

THE next session of the Marconi School of Wireless Communication, Chelmsford, begins on September 12th. Students are accepted for courses (including, in suitable cases, post-graduate courses) in various branches of radio engineering.

Five-metre CW Experiments

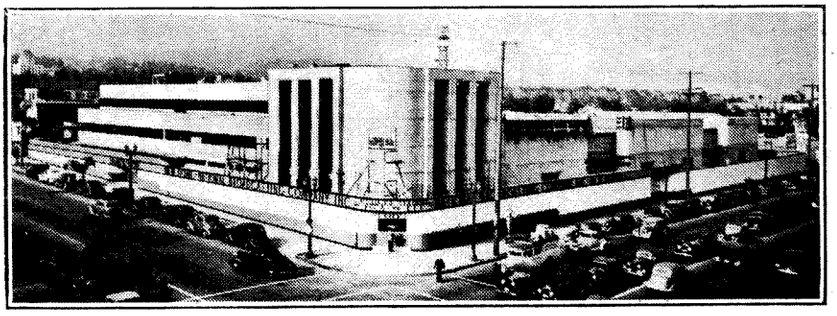
READERS with five-metre receivers are asked to report to Mr. J. H. Cant (G6FU), of 7, Elthruda Road, Lewisham, London, S.E.13, reception of his CW transmissions on 56.292 Mc/s. Operating times (BST) are: weekdays, 9 p.m. onwards; Sundays, at intervals throughout the day from 10 a.m. The experiments are being conducted in the course of investigating the propagation of these ultra-high frequencies. Reports will be acknowledged by QSL and, incidentally, postage refunded.

New North Sea Beacon

IT was stated at a recent meeting of the River Tyne Improvements Commission that discussions on the question of erecting a radio beacon at the mouth of the River Tyne are now approaching a successful termination.

Discussion Groups for Unemployed

REPRESENTATIVES of unemployed occupational clubs in the North of England attended a conference organised by the Yorkshire Unemployment Advisory Council in Sheffield last week. The chief object was to foster the development of listening discussion groups and the meeting was attended by a B.B.C. representative who read a previously broadcast speech which was experimented with by the delegates, as a subject for discussion.



HOLLYWOOD RADIO CITY. With the exterior of N.B.C.'s new Hollywood Building nearing completion, work on the construction of the studios is going rapidly ahead. The official inauguration is scheduled for the early "fall."

How a Receiver is Designed—XXI

Developing a High-Quality Communication

IN the last article in this series we dealt with the general arrangement of the tuning system, and it will be remembered that we are intending to cover the band of 60-0.14 Mc/s in eight ranges. For what may be conveniently termed the ultra-short waves, although it extends to a rather longer wavelength than is usually described by this term, a small capacity variable condenser is to be used and three ranges cover this portion of the band. For all other wavelengths a standard 500$\mu\mu$F. condenser is to be used. The small condenser will be in parallel with it, however, and so can be used for band-spread on the short waves.

The Effects of Unwanted Capacity and Inductance at U-H F

The general scheme is outlined in Fig. 23, which shows the coupling between the RF and frequency-changer valves together with the oscillator circuit. For clarity only one set of coils is shown connected to each switch, but in practice all the blank contacts will naturally have coils connected to them. The accompanying table gives inductance and capacity values calculated from the usual formulæ.

It might be thought that we have nothing to do now but build coils to these values and to construct the apparatus. This is actually what we have to do, but we shall be optimistic in the extreme if we expect the gear to work correctly right away. Even if we are lucky enough to choose the primary windings correctly, and we have not yet even considered these, we shall only obtain the correct tuning ranges if our estimates of the stray capacities are reasonably accurate, or at any rate not too low, and if the inductance of the wiring is negligible compared with the inductance of the coils.

It might be said that the right course would be to measure the stray capacities and wiring inductances. Unfortunately, however, they depend upon the components used, their layout, and the arrangement of switching and screening. Consequently, we cannot take measurements until we have built the gear. Before we build even the most tentative tuner, however, we must know at least the number of bands, for this will affect its dimensions. We must remember, too, that it is little use building a rough "lash-up" job; an experimental tuner must be built as carefully as the final product if any measurements on it are to be of use to us.

We cut through this vicious circle by adopting the course of estimating the stray capacities and ignoring the wiring inductances and so calculate the circuit values given in the table on the next page. Knowing that they are based on an estimation, however, we must be prepared to find that modifications will be needed when the tuner is tried out. Indeed, as we have ignored wiring inductance, we know that on the ultra-short-wave ranges modification will be necessary.

It is on the highest frequency range that the greatest difficulties are likely to be met, and it is possible that if our estimations are much out that it may not be possible to tune to 60 Mc/s! In estimating the stray capacities we have tried to take doubtful figures on the high side rather than the low, so that any errors would lie in the direction of making our estimated capacities too high rather than low. If we are wrong, and the capacities turn out lower than we expect, it will not matter, for we can always bring them up to our estimate by screwing up the trimmers a little. If we are out in our estimation the other way, however, it will be difficult to reduce the actual capacities.

At this point it is as well to remember that the stray capacities are inevitably larger in a multi-band set than in one covering a single band only. The switches add unwanted capacity, and connecting leads are longer and so have a higher capacity to earth. Furthermore, components must be placed closer to one another if the whole tuner is to be of reasonable dimensions, and this again increases stray capacities. With care it would probably be possible to reduce the stray capacities to two-thirds, or even one-half, of the figures given in a single band tuner.

We must, therefore, take these figures as the minimum below which it is unlikely that we can reduce the stray capacities appreciably, and we can now turn to the question of wiring inductance. It is not always realised that the wiring possesses inductance, but it does in a measure which is very important on ultra-short waves. A figure of 0.2 μH. has been quoted as the average wiring inductance for the average short-wave set. If our wiring inductance is actually this, it means that we must make our coils 0.2 μH. lower in inductance than the figures of our table. The

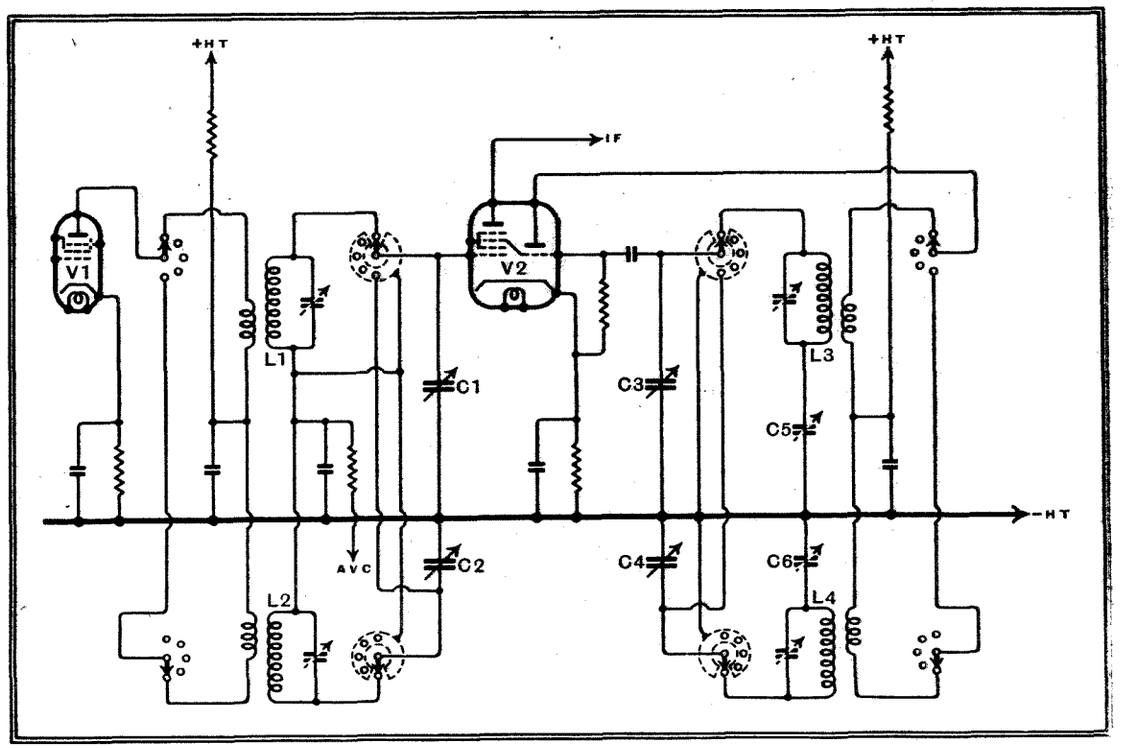
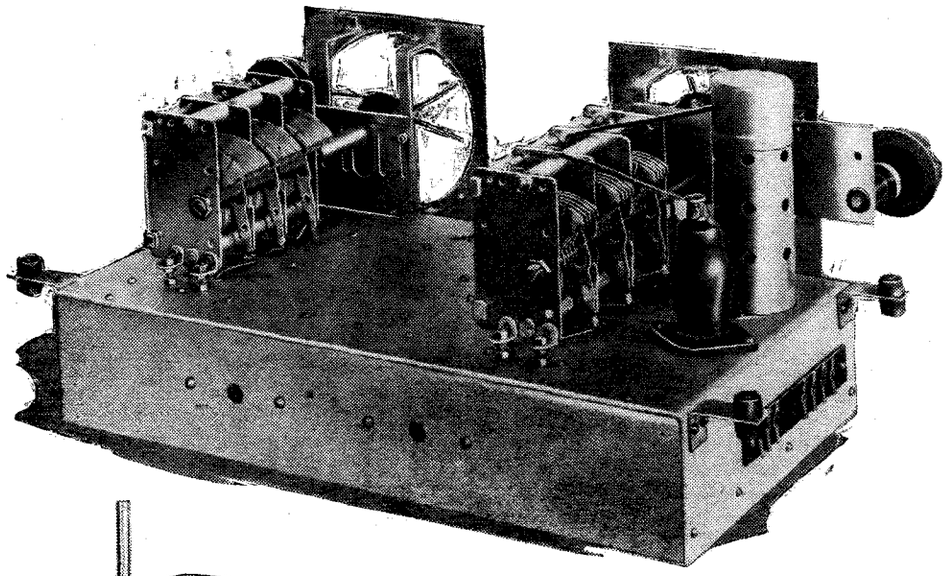
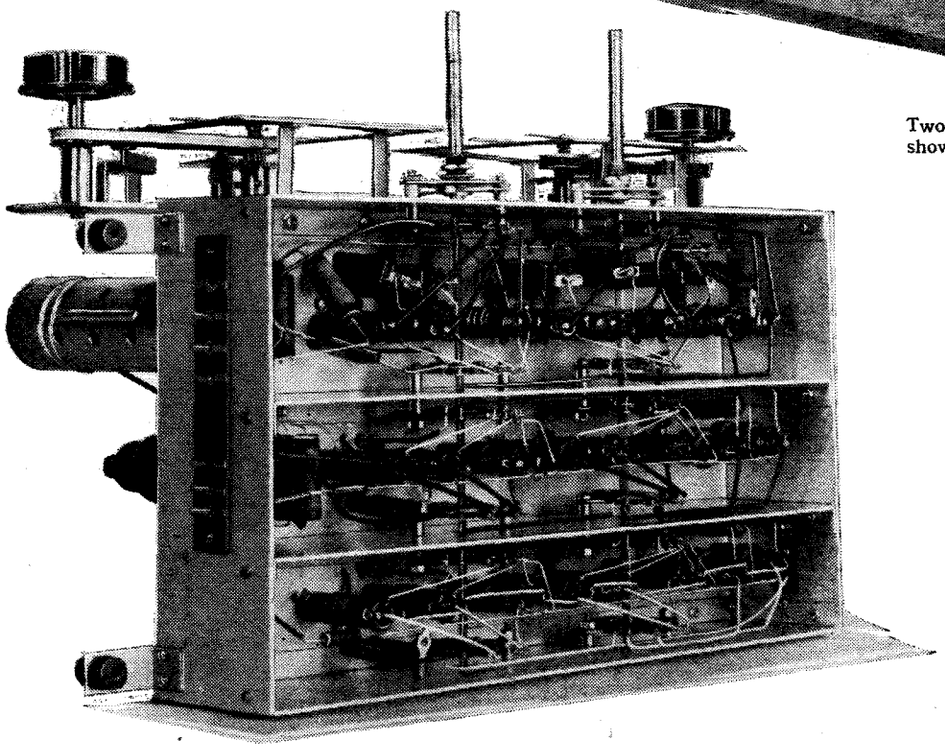


Fig. 23.—This diagram shows the tuning system. C1 and C3 are two sections of a small capacity gang condenser and C2 and C4 are two sections of a large capacity condenser. C5 and C6 are the oscillator padding condensers.

Receiver

THE general arrangement of the proposed tuning system was discussed in the last article, and the limitations imposed by stray circuit capacities and the inductance of the wiring are treated here. It is shown that they may seriously limit the maximum frequency which can be received.





Two views of a multi-range tuner unit. The underview shows the coils in place but before the trimming condensers have been fitted.

difference is negligible on medium and long waves, and small on short waves.

On range 1, however, 0.2 μH. is a little higher than the total inductance needed! In other words, *our coil will disappear, and the wiring alone will provide more inductance than we want.* This is a most unsatisfactory condition, and it shows why it may not prove possible to fulfil our wishes and tune to 60 Mc/s In actual fact, it will not be possible to do so unless we can reduce the stray capacities or the wiring inductance.

It is only on Range 1 that the wiring inductance is supremely important, for on all other bands it can be corrected by reducing the coil inductance, and we shall still have most of the inductance in the coil. Obviously, the first thing to do is to use the shortest possible leads, and the mechanical layout must be arranged to give this. Again, however, we see that the multi-band tuner is not as good as the single-range one. The switches themselves lengthen the leads directly and also indirectly, for they must be placed in relation to other controls so that at the least the knobs do not foul one another!

It is thus clear that the multi-band set has an inherently lower upper-frequency limit of operation than the single-band type. With the latter not only can the wiring inductance be made lower, but it is, in any case, less important, because the lower stray capacities make it possible to use a higher total inductance. The difference is actually very marked in practice, and it is quite possible in a single band set to use a coil of, say, 6 turns on a $\frac{1}{2}$in. former, whereas in a multi-band set 2 to 3 turns may be all that can be used to tune to 7 metres. Of course, there is a limit, set by stray capacity and wiring inductance, to the lowest wavelength of a single-band set, and below about 3-4 metres it is necessary to use special valves of the acorn type to reduce capacity and *internal* lead inductance.

The single-band set, however, although better than the multi-band over its limited range, is less generally useful, and most people will consider the latter more suitable for their requirements. We now see, however, that we may be obliged to accept a somewhat poorer performance on ultra-short waves, because of the lower L/C ratio, than if we built a highly specialised single-band tuner. The loss in performance will not be as great as one might expect, however, because the low input impedance of the valves at high frequencies does not damp circuits of low L/C ratio as heavily as those of high ratio.

The main point at which a sacrifice may be found lies in the fact that we may be unable to meet the conditions initially laid down of a tuning range extending to 60 Mc/s (5 metres). In saying that it is not meant that it is impossible to build a multi-range set tuning to this frequency. If one is quite unlimited in the choice of components and can have special switches and condensers made to suit one another, it is possible to reduce both capacity and inductance below the figure obtainable with standard parts. In our case we are limited to components available on the retail market, save for coils and chassis,

ESTIMATED CIRCUIT VALUES

Range.	Frequency.	Signal-Frequency Circuits.				Oscillator Frequency Circuit.		
		V. Cond. Min. $\mu\mu$F.	V. Cond. Max. $\mu\mu$F.	Stray Cap. $\mu\mu$F.	Inductance. μH.	Stray Cap. $\mu\mu$F.	Inductance. μH.	Padding Cap. $\mu\mu$F.
1	60–39	8	60	30.5	0.1835	30.5	0.181	...
2	40–26.1	8	60	30.5	0.412	29.97	0.4065	2,840
3	27.6–18	8	60	30.5	0.87	30	0.855	1,300
4	20–6.87	13.5	525	55	0.927	59.6	0.836	6,620
5	8–2.75	13.5	525	55	5.8	58.7	4.82	3,310
6	3.5–1.2	13.5	525	55	30.25	66.1	20.5	1,270
7	1.455–0.5	13.5	525	55	175	95.5	67.8	732.5
8	0.406–0.14	13.5	525	55	2,250	141.8	220	256

How a Receiver is Designed—

which are of relatively simple mechanical construction and so can be made without the need for laying down any special manufacturing plant.

The net result of all this is that it is impossible to say beforehand what the highest operating frequency will be. All we can do is to arrange the layout and to choose our components to give the lowest stray capacities and wiring inductances and then to use the smallest coils which will give a good performance over the tuning range. The highest frequency (lowest wavelength) will then be settled, and we can do nothing more about it.

The actual figure must be determined experimentally, and if it does prove impossible to reach 60 Mc/s, it will probably pay us not to worry about getting as near to it as we can, but to concentrate on getting a good performance up to a little over 45 Mc/s, the frequency of television sound. There is nothing of any interest between television sound and the amateur band of 58-60 Mc/s.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Quality

THE efforts of Mr. T. J. E. Warburton to decry the quality of British broadcasting seem to become more and more ludicrous.

Would it be such a "strange coincidence" to find that various commercial receivers lacked high-note response? The cry for years past has been "Selectivity," and very few commercial receivers have any sort of high-note response other than through amplitude distortion either deliberately introduced or incidental to pentode output valves and speaker resonances, the fidelity of the ultimate result being largely dependent on the price paid for the apparatus. Your correspondent should hear some of the more important British orchestral broadcasts reproduced by real high-quality apparatus capable of dealing fairly with, say, 10,000 c/s. If his hearing is as good as he thinks it is, he should not find the broadcasts "muffled."

If Mr. Warburton hears just the right amount of "top" from the Continent, one is driven to the conclusion that his aural response curve must be considerably down at the upper end and, in consequence, the over-modulated screechings which emanate from a number of stations on the other side of the Channel are more to his liking than the home-produced output. The present writer knows of a case where a "peaking" AF transformer was used in preference to a "straight-line" coupling for precisely this reason.

Lastly, in the final paragraph of Mr. Warburton's last letter, he "misses the boat" entirely. In the type of broadcast mentioned it is possible for the announcer's mike to be dead while the orchestra mikes are still "on" and if an announcement is made under these conditions it will be picked up by the distant mikes only and will accordingly sound "miles away." Increasing the modulation depth is hardly the remedy for that!

Canterbury. H. J. LAYZELL.

The Acoustic Labyrinth

IN your issue of June 2nd, 1938, you publish an article by Lawrence G. Snell entitled "The Acoustic Labyrinth." Inasmuch as no mention was made either of the origin of the device described or of previous publication concerning it, the following additional information together with some criticism of the article is offered.

The labyrinth loud speaker system was the subject of U.S. Patent No. 2,031,500 granted me Feb. 18th, 1936, and assigned to the Stromberg-Carlson Telephone Manufacturing Co., Rochester, N.Y. I have described the device quite fully in a paper published in the October, 1936 issue of the Journal of the Acoustical Society of America and also in an article which appeared in the April, 1937, issue of "Electronics."

In general, the description of the operation of the labyrinth system given in Mr. Snell's article appears to follow closely the above mentioned publications. There are some particular statements, however, which seem to be incorrect. Figure 2 and its accompanying description indicate that the wave motion in the tube is transverse whereas the essential action of the labyrinth depends entirely upon longitudinal wave motion. Furthermore, the statements in the text regarding phase relations at the ends of the tube can apply correctly only in the case of longitudinal waves. The arrows showing the relative direction of motion of the air particles should be parallel to the tube axis rather than perpendicular as shown. One wonders what meaning to attach to the arrowed line marked "one-half cycle."

The casual reader might receive the impression from the statements concerning an ideal infinite baffle that the latter is the entire answer to low frequency radiation difficulties. As a matter of fact, even with an infinite baffle the relation of the diaphragm radius to the wavelength strictly limits the radiation resistance. The bass boosting property of the labyrinth, however, offsets this loss to the extent of providing a useful extension downward of the frequency range, followed by a sharp cut-off.

It is stated that the tube is analogous to a transmission line terminated in a *fixed* resistance. In the acoustic case, however, the resistance at the open end varies as the square of the frequency when the opening is small as compared with the wavelength, as is the case over the frequency range wherein effective radiation is obtained from the open end of the labyrinth.

It can be inferred from Mr. Snell's article that the length of the labyrinth passage is the only important dimension affecting the operation of the device. The area and shape of the cross-section also have a significant influence. If the area be made too small with respect to that of the diaphragm, the impedance at the back of the latter becomes a high capacitive reactance at low frequencies. The bass response then suffers for two reasons; first, because the added acoustic stiffness effectively raises the natural frequency of the diaphragm system, and, second, less sound is transmitted through the tube in the phase-reversal range. The shape of the cross-section is effective in that it determines the area of sound absorbent material per unit of tube length. The adjustment of these factors may best be accomplished in practice through a combination of response measurements, acoustic impedance measurements and listening tests.

It is gratifying to note the satisfactory results obtained with the described labyrinth system as they correspond with our own experience.

BENJ. OLNEY,
Director of Research,
Stromberg-Carlson Telephone Manufacturing Co.

Rochester, New York.

[The curve in Fig. 2 of the original article is a graphical representation of the longitudinal wave in the tube; the arrows do not indicate the actual movement of air particles but may be regarded as ordinates on the same scale as the curve.—ED.]

Trade Evils

ONCE again our friend "Free Grid," in the July 7th issue, probes at the root of one of our several "trade evils." But to this one there *is* an answer, and, furthermore, one which can be taken advantage of by both employer and service engineer.

The National Radio Engineers' Association exists to help good employers and good engineers to contact each other.

The Fellowship Diploma of the Association is the hall-mark of a radio service engineer; it proves that the holder is a man who *can* do the job and who is entitled to a satisfactory remuneration, and, in addition, he is worth this to an employer, because customer-satisfaction and general prestige inevitably follow from a job well done.

In addition to these services, the Association assists the man who is keen but not yet fully experienced by means of lectures, demonstrations, discussions, etc.

I shall be glad to assist any employer who requires a satisfactory engineer if he will write to me at Royal London House, Finsbury Square, E.C.2.

REG. A. LOADER,
Hon. Secretary,
National Radio Engineers' Association.

Off the Beaten Track

WITH reference to "Diallist's" paragraph entitled "Off the Beaten Track" in your issue of July 14th, as a jungle man whose short-wave experience dates from the old Chelmsford days I can offer a solution of your correspondent's difficulties in the matter of LT supply.

The 40-AH accumulator usually supplied with battery sets is useless to the jungle man in remote parts. Its capacity is too small, and it upsets too easily. Instead, I recommend the use of a big 6-volt American car battery, with the cells joined in parallel to give a 2-volt battery of very large capacity.

I, too, was engaged in forest work, in Northern Siam, which involved long journeys with elephant transport. I used a four-valve all-wave receiver of British make, the LT consumption of which was 0.6 ampere, and I seldom failed to pick up the Empire programmes at fair loud-speaker

strength. My accumulator never failed me.

For obvious reasons, I do not support your suggestion of emptying the acid into bottles for safe transport. I always chose a reliable coolie to carry my accumulator, which balanced the receiver and loud speaker on his pole. When deep rivers had to be crossed the whole outfit was handed to the elephant rider to hold. I had a special box for the large Hellesen HT battery, which was carried on the elephant.

The usual plywood cabinet supplied complete with batteries inside is of little use for the jungle. It does not stand the tropical heat and damp, and it is far too cumbersome. I prefer to have the receiver in a metal case, as damp-proof as possible, and the other accessories separate.

Bournemouth. R. OGLE.

Records

PLEASE allow me the privilege of using your columns to thank the gentlemen who were so kind as to suggest lists of "high-quality" gramophone records. I personally am very pleased with those I have tried.

I feel sure I must be voicing the wishes of many of your readers in asking those gentlemen to continue their kind offices to their fellow-men by sending in further lists for our delectation.

Also, I think Mr. Hill should be thanked for his helpful letter *re* pick-ups for high-quality reproduction. J. BENNETT.

London, S.W.19.

Empire Reception

IT is with a good deal of concern we have read the letter in the July 14th issue of *The Wireless World* by "Heptode."

Whilst we are not in a position to argue on the B.B.C. Empire service, we strongly dispute his statement that "No British set sold at £12, or even up to twice that price, could give a comparable performance under Empire conditions"—that is, in comparison with American sets at about $60.

This firm has been exporting throughout the East for some time and has met with considerable success in competition with the American types quoted, including much higher-priced instruments.

Our standard receiver (price U.K. £12 12s.) was designed to suit the export market, and it fills every requirement put forward by "Heptode" in his recent article on this subject.

As we are aware, other British makers are also obtaining a considerable business abroad, including Malaya; it appears that "Heptode's" letter was based on conditions at least twelve months ago, as it certainly does not reflect the present position.

The expression of such mistaken opinions, especially in a journal so widely read as *The Wireless World*, cannot but do considerable harm to British manufacturers in the foreign market.

For Ambassador Radio Gramophones,
F. H. BEAUMONT,
Brighouse, Yorks. Chief Engineer.

RECEPTION IN THE TROPICS. Effectiveness of the aerials used by our readers seems to vary more or less in proportion to their distance from the main centres of broadcasting. This fine aerial, belonging to a reader in Malaya, is slung at a height of 50ft. above ground on a 27ft. lattice mast mounted on a 23ft. building.

Slow-speed Disc Recording

I WOULD appreciate the courtesy of your columns to discuss several points raised by a perusal of Mr. H. W. Dawes' article on "Slow-Speed Discs" in *The Wireless World* for July 7th.

First, why does the author confine his remarks to aluminium blanks? By so doing he gives the impression of a tacit recommendation for this type of blank. Admittedly, the plain aluminium-alloy blank has its uses, e.g., experimental discs, where its cheapness is an attraction. In fact, a selected aluminium-alloy blank or preferably a surfaced aluminium blank such as the Phonodisc, when handled by an experienced recordist, will produce a satisfactory permanent direct recording, but for the beginner better results can be assured with one of the many coated or composition type blanks now available (see "Table of Recording Blanks," *The Wireless World*, May 19th).

Secondly, referring to the table showing the tangential needle velocities or linear track speeds at different groove locations. The figures shown are only arbitrary and approximate, and it might interest readers to calculate their own figures for given diameters and record speeds, so I append the necessary formula:

$$V = \frac{\pi D}{60} N \quad \ldots\ldots\ldots\ldots\ldots (1)$$

where V = Needle velocity in inches per second.
D = Diameter in inches.
N = Rotational speed in r.p.m.
π = 3.1416.

and, of course, the equation to obtain the wavelength is

$$\lambda = V/F \quad \ldots\ldots\ldots\ldots (2)$$

where λ = Groove wavelength.
V = Needle velocity (obtained from formula (1)).
F = Frequency in cycles per second.

Thirdly, Mr. Dawes states that "if the needle is sharp no difficulty is experienced in reproducing these (high-frequency) modulations." To make this statement more exact and to dispel an erroneous idea still propagated occasionally, I would like to explain that the factor determining whether a specific high frequency can be reproduced with a certain needle is not, as was the old belief, so much dependent on the groove-wavelength relative to the size of the needle-tip, but is controlled more by the *radius of curvature* of the modulated groove and the *radius of curvature* of the needle-tip. Thus, so long as this condition holds, i.e., the radius of curvature of the groove is greater than the radius of the playback needle-tip, the high-frequency modulations will be reproduced. The reason for the foregoing is that at any given distance from the centre of a disc the wavelength is inversely proportional to frequency, when cutting at constant velocity, so as the frequency increases so the number of times that the groove crosses the mean line in a given distance increases in proportion. Therefore, with maximum lateral amplitude a frequency is eventually reached at which the modulated groove crosses the mean line practically at right angles, and thus the wavelength is so small, as compared with the amplitude, that the needle-tip cannot follow such a steep wave-front. So the limiting steepness for accurate tracking is an angle from 40 to 45 degrees between the direction of the groove at any position and its mean line.

Fourthly, Mr. Dawes says in his article that, although the ideal alignment of a playback pick-up would enable it to traverse a radius of the blank, this scheme is not practical owing to the need for a feed screw and gearing. These latter are not necessary as a radial tracker using a slide rod with sleeving, small wheels or ball-bearings, is a practical proposition and provided adjustments are made so that the transverse movement is free and smooth, the force exerted by the grooves of the revolving record will take the pick-up across satisfactorily.

In conclusion, I pass on a few hints that I hope will assist beginners to make good recordings. In my opinion Mr. Dawes would have been wise to have mentioned that a primary requisite for satisfactory slow-speed and normal recording is a first-class motor, for without this the quality of all the other components will be nullified. The main requirements of a good motor are (a) high torque giving speed stability with varying loads and consequent freedom from "wows" and "flutter" in recordings, and (b) negligible mechanical noise and undesired motion that might be transmitted to the turntable as vibration. If an AC synchronous and gearless motor is not employed it is advisable to take particular notice of the type of drive fitted, e.g., (a) endless linen or rubber belt, (b) internal or external rubber-roller rim drive, and (c) steel ball friction and gear drives. If (a), check for proper tension to prevent slippage, and with (b) avoid flats on the rubber roller, and with (c) endeavour to get high-grade gears and/or a mechanical filter system. One of the best tests for a motor is to make a piano recording with it and listen on playback for such defects as "whine," etc.

For those recordists without AC mains or a suitably marked stroboscope for 33⅓ r.p.m. work, the following method of speed checking may prove useful. The method may seem obvious but I have found that it is new to some amateurs.

33⅓ revolutions per minute.
therefore 100 revolutions in 3 minutes,
so 50 revolutions in 1½ minutes,
or 25 revolutions in 45 seconds.

N.B.: When checking the speed by placing a slip of paper under a record on the turntable begin counting from 0, not 1.

Finally, remember that the speech-to-noise (S/N) ratio is the important factor in high-quality recording, and so try always to put a high-level on the blank. Of course, this high-level input must be undistorted and care must be taken not to overcut or produce "echo" effects.

DONALD W. ALDOUS.

Ilford, Essex.

Random Radiations

Dry Battery Valves

IT rather surprises me that the new series of American valves designed to draw their filament heating current from dry batteries should be rated at 1.4 volt. In the past I have conducted a good many tests on large-capacity Leclanché cells both dry and wet, giving them the kind of loads that they would receive from 5-valve sets fitted with these valves; loads, that is, of 0.25 ampere. My experience is that with most of these cells it didn't take many four-hour running periods with twenty-hour rests between them to bring the EMF well below the 1.4-volt mark. I don't mean that they would register under 1.4 volt at the *beginning* of, say, the fourth or fifth run; after twenty hours of rest a cell with a respectable depolariser picks up wonderfully. You may, in fact, find that day after day a cell when first put on load again shows very nearly 1.5 volt. But as day follows day there is a bigger and bigger drop in the first half-hour under load and it is not very long as a rule before a cell is showing between 1.2 and 1.3 volt at the end of the fourth hour. It may maintain an "end-voltage" that lies between those figures for some considerable time; then comes a rather quicker falling off.

A Way Out

Perhaps the best way of running such valves from dry cells would be to use a pair of cells with a double-pole change-over switch so that they could be brought into use turn by turn. If you use a cell for only two hours at a time and then give it a rest of twenty-two hours, the drop in the EMF wouldn't be nearly so serious during each period of reception and the cell would have a fine chance of recuperating. I should say that two cells used in turn for two hours a day would last a good deal longer than a pair of which the first was worked for four hours a day until replaced by the second at the end of its useful life. I haven't actually tried the experiment, but knowing something of the little ways of dry cells I am pretty sure that it would work out in the way suggested.

An Economy Tip

INCIDENTALLY, there's one simple method of prolonging the useful life of dry cells, which may come in handy whether you use them for wireless purposes or for running electric bells and so on. Often these cells give out because the paste electrolyte has become insufficiently active through saturation. When a cell runs down, remove the paper or thin cardboard covering of the can and pierce a goodly number of holes through the zinc. Stand your cell in a jampot containing a strongish solution of sal-ammoniac and water and leave it for some hours to give the new electrolyte plenty of time to soak in. I have often obtained as much as an extra twenty-five per cent. in the working life of a cell in this way.

Are We Changing?

BY the way, four working hours a day for radio batteries under "intermittent" test is a figure that was selected a good many years ago because it was then believed that the average listener used his receiver for about that time each day. Whether

By "DIALLIST"

there is or is not such a person as the average listener is open to argument, but we won't discuss that. What I am wondering is whether four hours a day still represents about the amount of use that most people make of their sets. Apart from medium-wave and short-wave long-distance reception, to which I devote a good deal of time, I find that my listening to the broadcast programmes has tended to become a great deal more selective. As I live in the country (where the last evening papers available only contain the cricket scores up to the tea interval in the stop-press column) I always listen to one or other of the news bulletins if possible. Commentaries on national and sporting events are other certainties if I am at home and have the time. I confess that I hardly ever listen to the whole evening programme from the local National or Regional. Usually I look through the programmes at breakfast-time and make a note of anything that I specially want to hear.

What's Your Average?

That doesn't mean that I don't make much use of the wireless set. On the contrary, I think mine is at work nearly, if not quite, as much as ever it was. But if I want a whole evening's entertainment nowadays, I don't listen, as I said, to one station all the time; I probably take items from both the Regional and the National, and from several foreign stations as well. I wonder very much if most listeners find that they are developing the same kind of

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, AUGUST 4th.

Nat., 6.25, Dorothy Manley and Myers Foggin at two pianofortes. 8, Scrapbook for 1914. 9.5, Radio Roadhouse. 9.55, The English Abroad—R. Colling Pyper protests.

Reg., 6.20, Lew Stone and his Band. 7, Week-end Walks in London—5. 8, Beethoven's Ballet "Prometheus" played by the B.B.C Orchestra (C), conducted by Sir Adrian Boult. 9.5, A Sentimental Journey Through France.

Abroad.

Radio-Paris, 8.15, Ravel Festival Concert relayed from Vichy.

Vienna, 8.30, Act II "Tannhäuser," opera (Wagner), relayed from the Salzburg Festival.

FRIDAY, AUGUST 5th.

Nat., 7.15, Louis Levy presents "You Shall Have Music." 8, Chopin Recital by Iso Elinson. 8.40, "The Midnight Sun," a fantastical comedy. 9.45, "Up Against It."

Reg., 6, Arthur Courtney at the B.B.C. Theatre Organ. 8, Jay Wilbur and his Band. 9.15, Variety from Bristol.

Abroad.

Deutschlandsender, 11 a.m., Opening of the Fifteenth Radio Exhibition in Berlin.

Radio Normandie, 9, "The Desert Song," operetta (Romberg).

Vienna, 9 Salzburg Festival Relay.

SATURDAY, AUGUST 6th.

Nat., 7.20, Lew Stone and his Band. 7.55, Opening Night of the Forty-fourth Season of Promenade Concerts, conducted by Sir Henry Wood, from the Queen's Hall, London. 10.30, Hal Kemp and his Orchestra, relayed from New York.

Reg., 8.30, Variety. 9.45, Promenade Concert, Part II. 10.30, Atlantis, the Lost Continent.

Abroad.

Eiffel Tower, 8.30, Concert from the Casino, Vichy.

Milan I, 9, "Tosca," opera (Puccini).

SUNDAY, AUGUST 7th.

Nat., 10.45 a.m., Albert Sandler and his Orchestra. 5.55, "Rosalind in Arden," scenes from Shakespeare's "As You Like It."

Reg., 5.35, Is that the Law? 7.20, Troise and his Mandoliers, with Don Carlos. 9.5, "The River Thames." 9.50, B.B.C. Theatre Organ.

Abroad.

Vienna, 8, "Where the Lark Sings," operetta (Lehár).

Radio Paris, 8.15, "The Damnation of Faust," opera (Berlioz) from the Casino, Vichy.

MONDAY, AUGUST 8th.

Nat., 7, Bungalow Club. 7.45, Billy Mayerl, pianoforte. 8, "The Hell With It"—an anthology of American humour. 8.30, Promenade Concert (Wagner), Part I. 9.45, The Hon. Harold Nicolson reviews The Past Week.

Reg., 8, Band Waggon Selection. 8.45, Commentary on European Swimming Championships from Wembley. 9, B.B.C. Ballroom. 9.45, Promenade Concert, Part II.

Abroad.

Leipzig, 7, Salzburg Festival: "Fidelio," opera (Beethoven).

Radio Paris, 8.45, César Franck-Debussy Festival, from Vichy.

TUESDAY, AUGUST 9th.

Nat., 6.30, Clarence Raybould conducts B.B.C. Orchestra (C). 7.30, "On Trek"—carrying listeners over the Veldt into the legendary country of King Solomon's Mines.

Reg., 8, Promenade Concert, Haydn-Mozart. 9.40, B.B.C. Theatre Orchestra.

Abroad.

Eiffel Tower, 8.30, Symphony Concert, with Fournier, 'cello.

Vienna, 12 midnight to 3 a.m., Vienna Chamber Orchestra, conducted by Rudolf Pehm.

WEDNESDAY, AUGUST 10th.

Nat., 6.25, Mendelssohn Recital by Betty Humby, pianoforte. 7, Talk by Lynn Ungoed-Thomas on the Matrimonial Clauses Act, 1937. 8, Promenade Concert. 9.40, Talk by J. Wentworth Day: "Flight Over Egypt."

Reg., 6.45, Amateur Photography—III, Talk by F. J. Mortimer, Editor of *Amateur Photographer*. 8, Revival of the musical play, "At Your Service, Madam." 9, Barnum, the Greatest Show on Earth. 9.45, Café Collette.

Abroad.

Berlin, 8.15, "Let Youth Have Its Fling," relayed from the Radio Exhibition.

Brussels I, 8.30, Symphony Concert, with Arthur Rubinstein, pianoforte.

habits and, if so, whether, taking it by and large, their average time for the twenty-four hours has grown, decreased, or remained much the same as ever it was. There are bound, of course, to be very large differences between individuals. I know, for example, people whose sets are in action for ten or twelve hours a day, week in and week out. And I have come across others who probably don't indulge in more than an hour's listening a day. The bulk of wireless users are a long way from these extremes. I have a feeling that in the typical household from five to six hours a day is not very wide from the mark. I am not suggesting that families as a whole spend that amount of time round the loud speaker; different members use the set at different times.

Pitcairn Island

IT was good to see in the *Daily Telegraph* a timely letter from "G6AC" about the unsatisfactory state of radio-receiving equipment in Pitcairn Island. He points out that the only receiving gear they have was subscribed for and presented to them by American people. I believe that their transmitter came from the same source, and I do know that when I hear it at work it is almost always in communication with American amateurs. The reason for this is, presumably, that the transmitter is not sufficiently powerful to be sure of establishing communication regularly with this country. As "G6AC" rightly says, it is up to us to see that the island, which is one of our possessions, is better equipped in the matter of wireless. He makes the very good suggestion that the Government might well establish a permanent meteorological station there. Reports from such a station would be of very great assistance to both ships and aircraft, and a station of the kind would keep lonely Pitcairn in continual communication with the rest of the world. The islanders have a hard-enough time of it, dependent as they are for so many of their supplies on the rare visits of ships. Good wireless equipment would bring much happiness into their lives.

Expectation . . . Realisation

HAD you been told ten years ago that by the present year of grace a high definition television station would have been in action for some little time, serving an area containing some ten million inhabitants, you would, I think, have imagined a good hundred thousand people using their televisors day by day and being thrilled by the wonderful things that they saw. Had you been asked just what they were going to be shown on their viewing screens, I wonder what your forecast would have been. It's curious to notice how often people express the keenest desire to see by television things that wouldn't interest them for more than the briefest of moments if they did see them. The other day, for instance, a musical friend who lives in Lancashire was bemoaning the fact that there were still no signs of a Manchester television station. "Wouldn't it be grand," he said, "to see Sir Adrian Boult conducting the Queen's Hall Orchestra? . . ." Would it? I can't myself imagine anything much duller than an orchestra and their conductor appearing on the viewing screen for, say, an hour on end. And hasn't Sir Adrian himself driven the last nail into the coffin of such suggestions at a recent interview? "We musicians," he said, "aren't good-looking enough to be televised"! He went on to tell his interviewer that when an opera was televised it was found necessary to have two separate casts—the singers who were heard and not seen, and the actors who were seen but not heard. It's undoubtedly true that many people don't in the least know what they want from television and that they would be bored stiff if they were given a dose of their own suggestions put into practice.

Still Wondering

Some time ago I wrote that I wasn't certain that even those who are running the television transmissions were sure of their ground. And I don't quite believe that they are yet working on the right lines. A great deal of progress has been made and is being made, but we still seem to me to lack something. We have the geniuses who developed and perfected the technical side of television: what hasn't yet come our way is the genius who will show us what to do with television now that we've got it. Doubtless, he will arise some time, and when he does television's leap to popularity is likely to be spectacular.

News from the Clubs

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne.

On July 11th a paper was read on behalf of Mr. E. H. Page, of S. G. Brown, Ltd., on the famous Type A adjustable reed headphones, a pair of which were demonstrated.

Edgware Short-Wave Society

Headquarters: Constitutional Club, Edgware.
Meetings: Sundays at 11 a.m. and Wednesdays at 8 p.m.
Hon. Sec.: Mr. F. Bell, 118, Collin Crescent, London, N.W.9.

On June 30th G6PM described and demonstrated his 25-watt transmitter. On July 6th G2AI continued his lecture on the second stage of his transmitter. On July 9th a party of members visited Battersea Power Station. On July 13th a junk sale was held, at which £9 was realised.

Future arrangements, the dates of which will be announced later, are a visit to Rugby, an R.S.G.B. film night, a question night and a competition night. The Sunday meetings are suspended until September.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

The recent 2.5 metres Field Day, held in the Dorking district, was very successful. It is hoped shortly to arrange some visits to places of scientific interest. The committee are now very busy arranging the programme for next winter.

Slade Radio

Headquarters: All Saints' Parochial Hall, Bloomfield Road, Slade Road, Erdington, Birmingham.
Meetings: Alternate Thursdays at 8 p.m.
Hon. Sec.: Mr. G. C. Simmonds, 38, Rabone Lane, Smethwick, Birmingham.

The programme for the remainder of the summer is as follows:—

Aug. 11th.—Demonstration and practical discussion of commercial and other test apparatus. Members having representative test gear are asked to bring it with them.
Aug. 21st.—Direction-finding test.
Aug. 25th.—To be announced later.
Sept. 8th.—Lecture on "Avo" Service Equipment by Mr. S. Wilkins.
Sept. 22nd.—Lantern lecture by a representative of the G.P.O. entitled, "Round the World by Radio Telephony."
Sept. 24-25th.—Midnight direction-finding test.

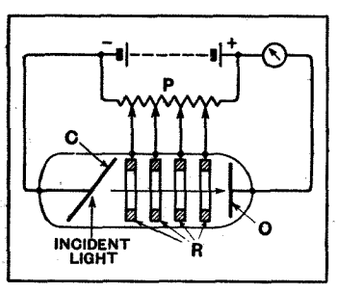
Recent Inventions

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

PHOTO-ELECTRIC CELLS

IN a photo-electric cell containing traces of gas, it is possible to obtain a considerable amplification of the electrons emitted from the photo-sensitive cathode owing to the ionisation of the positive ions present. This effect naturally increases with the voltage applied across the anode and cathode of the cell, but a limit is set by the fact that voltages in excess of a given amount are liable to cause "sparking," which may persist after the ray of light has been cut off, so that the response is no longer quantitative and in any case shortens the life of the cell.

As shown in the drawing, the photo-sensitive cathode C is



Method of using a photo-electric cell containing traces of gas.

separated by some centimetres from the output electrode O, and the intervening space is occupied by a series of "ring" electrodes R carrying graded voltages which are tapped off from a potentiometer P. An external magnetic winding (not shown) keeps the emitted stream central and prevents electrons from straying on to the glass walls of the tube. The graded electric field from the rings R produces maximum ionisation of the contained gas without "sparking."

Marconi's Wireless Telegraph Co., Ltd., and E. W. B. Gill. Application date November 6th, 1936. No. 484310.

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HIGH-FREQUENCY TRANSMISSION LINES

WAVES of the order of centimetres can be made to travel without attenuation through a "line" or tube containing insulating material. The transfer of energy from point to point along the insulator resembles more closely the passage of an electromagnetic wave through the ether than the ordinary go-and-return flow of an electric current through a conducting circuit. Such a feed line is known as a "dielectric guide," and the invention is concerned with the provision of impedance elements for "loading" and otherwise modifying the flow of energy so as to give the line a high or low band-pass characteristic.

When the guide consists of a single metallic tube having a core of air or other dielectric there will be a certain amount of "flow" in the outer sheath, and this provides an element of inductance. The tube is also broken at intervals by flanged "gaps" which have the effect of a capacity. The combination of the two gives the required "filter" action so that the line favours the transmission of waves of a given frequency.

Standard Telephones and Cables, Ltd. (assignees of S. A. Schelkunoff). Convention date (U.S.A.), December 4th, 1936. No. 483540.

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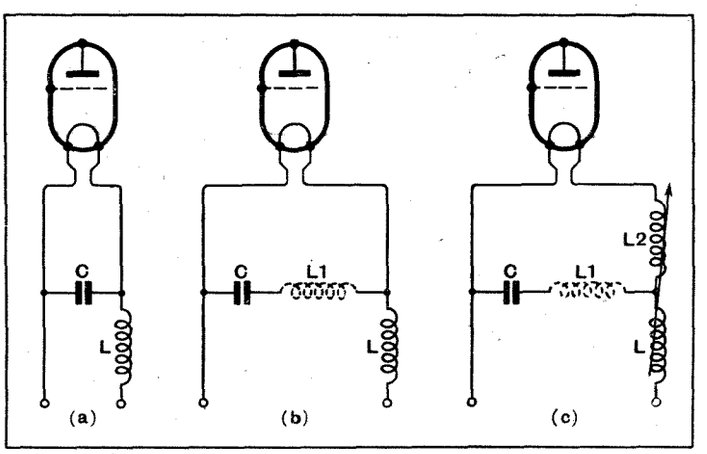
DE-COUPLING CIRCUITS

THE figure (a) shows a well-known method of de-coupling or isolating the filament of a valve from alternating currents. The series inductance L combined with a shunt capacity C provides an AC path of low impedance to the currents it is desired to exclude. When high-frequencies are concerned, however, the capacity branch begins to develop inductance due to its leads, so that, in effect, the circuit changes into the one shown in (b). The "developed" inductance, which is indicated in dotted lines at L1, is now responsible for inducing an undesired AC voltage across the filament.

The principle of the invention, which is of wide application, is shown in (c). A second inductance L2 is inserted in series with the original inductance L, and the two are coupled together in such a way that the resulting mutual inductance reflects a new voltage into the shunt path. This can be adjusted until it exactly counterbalances that produced by the capacity C in series with the "inherent" inductance L1. A zero-impedance shunt path for the undesired currents is thus restored.



Filter circuit to prevent unwanted RF voltages reaching the filament of a valve.

Marconi's Wireless Telegraph Co., Ltd., and E. E. Zepler. Application date 5th November, 1936. No. 484487.

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PHOTO-ELECTRIC AMPLIFIERS

THE ordinary photo-electric cell is of high impedance, and it should, therefore, for efficient operation, be coupled to an amplifying valve having the same characteristic. Under these conditions, any grid current that may flow, no matter how minute, will develop a high voltage across the input circuit. This, in turn, tends to charge-up any stray capacities that may exist, say, between the leads from the grid leak resistance and those from the secondary of the transformer supplying the filament-current and electrode potentials. Such voltages tend to oppose or nullify the output current from the photo-electric cell during one half of each cycle of the supply voltages.

According to the invention this disadvantage is avoided by interposing a space-charge grid between the control grid and the cathode of the amplifying valve. The first grid is so connected to the AC supply that it becomes negatively charged during the half-cycle the control grid is made positive, and, therefore, acts to prevent the flow of electrons into the external circuit. In other words, it cuts the grid current down to zero, and so prevents any undesirable charging-up of the external leads.

The British Thomson-Houston Co., Ltd. Convention date (U.S.A.) September 19th, 1936. No. 483538.

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WIRELESS NAVIGATION

AN aeroplane can steer a straight course in fog by flying along the centre or overlapping part of two radio beams, one of which is modulated by Morse "dashes," and the other by "dots." Along the central zone these two merge into a single unbroken note, but any deviation of the machine either to port or starboard is indicated by the signal breaking-up, either into dashes or dots as the case may be. In practice the signals are applied to an indicator of the centre-zero type, in which "dashes" deflect the needle in one direction and "dots" in the other.

The difficulty is that the movement of the needle tends to "flicker" under the repetition either of a series of dots or of a series of dashes, and this may produce uncertainty in the mind of the pilot.

To avoid this the incoming signal is fed to the indicator through a transformer with a split secondary. One secondary feeds the needle winding directly, and the other reaches the field winding through a valve and a delay circuit. Owing to the lag so introduced the initial deflection of the indicator needle is "held," free from flicker, in the correct direction for all types of signal.

Radio Transmission Equipment, Ltd., and C. E. G. Bailey. Application date, February 11th, 1937. No. 483768.

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WITH the aid of a frame aerial a pilot can "home" on to a distant beacon station by maintaining what is, in effect, the line of minimum signal strength. He must "test" this from time to time by swinging the aerial, first to one side and then the other, of the critical line. The directive response should be sensitive, though it made too critical it becomes difficult to hold the craft on its course. Actually, the best "angle of tolerance" for the minimum position is found to be between one and two degrees.

In practice the sensitivity will vary with the prevailing field-strength (that is, with the distance of the craft from the transmitter) and tends to become too critical at short distances.

The invention discloses a method of applying automatic volume control so as to maintain the directional sensitivity constant throughout the whole range of reception. With this object in view, the pick-up voltage from the frame is applied to the receiver through a pair of push-pull valves, one or other of which is effective according to the position of a reversing switch. The A.V.C. voltage is derived from the rectified current fed to the indicator, and is applied to the grid of the particular push-pull valve which is at the time in action.

Telefunken Ges. für drahtlose Telegraphie m.b.h. Convention date (Germany) September 14th, 1936. No. 484774.

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength (Stations with an Aerial Power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Ankara (Turkey)	152		1973.5	5
Kaunas (Lithuania)	153		1961	7
Hilversum (No. 1) (Holland)	160		1875	10-150
Radio Romania (Romania)	160		1875	150
Lahti (Finland)	166		1807	150
Moscow (No. 1) (U.S.S.R.)	172		1744	500
Paris (Radio Paris) (France)	182		1648	80
Istanbul (Turkey)	185		1622	5
Irkutsk (U.S.S.R.)	187.5		1600	20
Deutschlandsender (Germany)	191		1571	60
National (Droitwich)	200		1500	150
Minsk (U.S.S.R.)	208		1442	35
Reykjavik (Iceland)	208		1442	16
Motala (Sweden)	216		1389	150
Novosibirsk (U.S.S.R.)	217.5		1379	100
Warsaw (No. 1) (Poland)	224		1339	120
Luxembourg	232		1293	150
Moscow (No. 2) (U.S.S.R.)	232		1293	100
Kalundborg (Denmark)	240		1250	60
Kiev (No. 1) (U.S.S.R.)	248		1209.6	100
Tashkent (U.S.S.R.)	256.4		1170	25
Bergen (Norway)	260		1153.8	20
Oslo (Norway)	260		1153.8	60
Vigra (Aalesund) (Norway)	260		1153.8	10
Leningrad (No. 1) (U.S.S.R.)	271		1107	100
Tromsö (Norway)	282		1065	10
Tiflis (U.S.S.R.)	283		1060	35
Moscow (No. 3) (U.S.S.R.)	300		1000	100
Saratov (U.S.S.R.)	340		882.3	20
Finmark (Norway)	347		864	10
Archangel (U.S.S.R.)	350		857.1	10
Rostov-on-Don (U.S.S.R.)	355		845.1	20
Budapest (No. 2) (Hungary)	359.5		834.5	18
Sverdlovsk (U.S.S.R.)	375		800	40
Banska-Bystrica (Czechoslovakia)	392		765	15–30
Boden (Sweden)	392		765	2.5
Voronezh (U.S.S.R.)	413.5		726	10
Oulu (Uleaborg) (Finland)	431		696	10
Ljubljana (Yugoslavia)	527		569.3	6.3
Viipuri (Finland)	527		569.3	10
Bolzano (Italy)	536		559.7	10
Wilno (Poland)	536		559.7	50
Budapest (No. 1) (Hungary)	546		549.5	120
Beromünster (Switzerland)	556		539.6	100
Radio Eireann (Ireland)	565		531	100
Klaipeda (Lithuania)	565		531	10
Palermo (Italy)	565		531	3
Stuttgart (Germany)	574		522.6	100
Alpes-Grenoble, (P.T.T.) (France)	583		514.6	20
Madona (Latvia)	583		514.6	50
Vienna (No. 1) (Germany)	592		506.8	100
Athens (Greece)	601		499.2	15
Rabat (Morocco)	601		499.2	20
Sundsvall (Sweden)	601		499.2	10
Florence (No. 1) (Italy)	610		491.8	20
Brussels (No. 1) (Belgium)	620		483.9	15
Cairo (No. 1) (Egypt)	620		483.9	20
Kouibyshev (U.S.S.R.)	625		480	10
Christiansand (Norway)	629		476.9	20
Lisbon (Portugal)	629		476.9	20
Tröndelag (Norway)	629		476.9	20
Prague (No. 1) (Czechoslovakia)	638		470.2	120
Lyons (P.T.T.) (France)	648		463	100
Petrozavodsk (U.S.S.R.)	648		463	10
Cologne (Germany)	658		455.9	100
Jerusalem (Palestine)	668		449.1	20
North Regional (Slaithwaite)	668		449.1	70
Sottens (Switzerland)	677		443.1	100
Belgrade (Yugoslavia)	686		437.3	20
Paris (P.T.T.) (France)	695		431.7	120
Stockholm (Sweden)	704		426.1	55
Rome (No. 1) (Italy)	713		420.8	100
Hilversum (Jaarsveld) (Holland)	722		415.4	17
Kharkov, (No. 1) (U.S.S.R.)	722		415.4	10
Madrid (EAJ2) (Spain)	731		410.4	3
Seville (EAJ5) (Spain)	731		410.4	5.5
Tallinn (Estonia)	731		410.4	20
Munich (Germany)	740		405.4	100
Marseilles (P.T.T.) (France)	749		400.5	100
Katowice (Poland)	758		395.8	12
Scottish Regional (Burghead)	767		391.1	60
Scottish Regional (Westerglen)	767		391.1	70
Stalino (U.S.S.R.)	776		386.6	10
Toulouse (P.T.T.) (France)	776		386.6	120
Leipzig (Germany)	785		382.2	120
Barcelona (EAJ1) (Spain)	795		377.4	7.5
Lwów (Poland)	795		377.4	50
Welsh Regional (Penmon) (Anglesey)	804		373.1	5
Welsh Regional (Washford)	804		373.1	70
Milan (No. 1) (Italy)	814		368.6	50
Bucharest (Romania)	823		364.5	12
Bodö (Norway)	823		364.5	10
Stavanger (Norway)	832		360.6	10
Kiev (No. 2) (U.S.S.R.)	832		360.6	35
Berlin (Germany)	841		356.7	100
Sofia (Bulgaria)	850		352.9	100
Valencia (Spain)	850		352.9	3
Simferopol (U.S.S.R.)	859		349.2	10
Strasbourg (France)	859		349.2	100
Poznań (Poland)	868		345.6	16
London Regional (Brookmans Park)	877		342.1	70
Graz (Germany)	886		338.6	15
Linz (Germany)	886		338.6	15
Helsinki (Finland)	895		335.2	10
Hamburg (Germany)	904		331.9	100
Dniepropetrovsk (U.S.S.R.)	913		328.6	10
Toulouse (Radio Toulouse) (France)	913		328.6	60
Brno (Czechoslovakia)	922		325.4	32
Brussels (No. 2) (Belgium)	932		321.9	15
Algiers (Algeria)	941		318.8	12
Göteborg (Sweden)	941		318.8	10
Breslau (Germany)	950		315.8	100
Paris (Poste Parisien) (France)	959		312.8	60
Odessa (U.S.S.R.)	968		309.9	10
Northern Ireland Regional (Lisnagarvey)	977		307.1	100
Bologna (Radio Marconi) (Italy)	986		304.3	50
Torun (Poland)	986		304.3	60
Hilversum (No. 2) (Holland)	995		301.5	10-60
Bratislava (Czechoslovakia)	1004		298.8	13.5
Chernigov (U.S.S.R.)	1013		296.2	4
Midland Regional (Droitwich)	1013		296.2	70
Barcelona (EAJ15) (Spain)	1022		293.5	3
Königsberg (No. 1) (Heilsberg) (Germany)	1031		291	100
Parede (Portugal)	1031		291	5
Leningrad (No. 2) (U.S.S.R.)	1040		288.5	10
Rennes-Bretagne (France)	1040		288.5	120
West of England Regional (Washford)	1050		285.7	50
Bari (No. 1) (Italy)	1059		283.3	20
Paris (Radio Cité) (France)	1068		280.9	2
Tiraspol (U.S.S.R.)	1068		280.9	10
Bordeaux-Lafayette (France)	1077		278.6	60
Madrid (EAJ7) (Spain)	1095		274	5
Vinnitsa (U.S.S.R.)	1095		274	10
Kuldiga (Latvia)	1104		271.7	25
Naples (Italy)	1104		271.7	10
Melnik (Czechoslovakia)	1113		269.5	100
Nyiregyhaza (Hungary)	1113		269.5	6.25
North-East Regional (Stagshaw)	1122		267.4	60
Hörby (Sweden)	1131		265.3	60-100
Genoa (No. 1) (Italy)	1140		263.2	10
Trieste (Italy)	1140		263.2	10
Turin (No. 1) (Italy)	1140		263.2	7
London National (Brookmans Park)	1149		261.1	20
North National (Slaithwaite)	1149		261.1	20
Scottish National (Westerglen)	1149		261.1	50
Košice (Czechoslovakia)	1158		259.1	10
Monte Ceneri (Switzerland)	1167		257.1	15
Copenhagen (Denmark)	1176		255.1	10
Nice-Côte d'Azur (France)	1185		253.2	60
Coblenz (Germany)	1195		251	2
Frankfurt (Germany)	1195		251	25
Freiburg (Germany)	1195		251	5
Trier (Germany)	1195		251	2
Moravská-Ostrava (Czechoslovakia)	1204		249.2	5
Lille (Radio P.T.T. Nord) (France)	1213		247.3	60
Rome (No. 2) (Italy)	1222		245.5	60
Gleiwitz (Germany)	1231		243.7	5
Görlitz (Germany)	1231		243.7	5
Cork (Ireland)	1235		242.9	1
Saarbrücken (Germany)	1249		240.2	17
Riga (Latvia)	1258		238.5	15
Burgos (Spain)	1258		238.5	20
Nürnberg (Germany)	1267		236.8	2
Radio Mediterranée (France)	1276		235.1	27
Aberdeen	1285		233.5	1
Klagenfurt (Germany)	1294		231.8	5
Vorarlberg (Germany)	1294		231.8	5
Malmö (Sweden)	1312		228.7	2.5
Bremen (Germany)	1330		225.6	2
Flensburg (Germany)	1330		225.6	2
Hanover (Germany)	1330		225.6	2
Stettin (Germany)	1330		225.6	2
Dublin (Ireland)	1348		222.6	0.5
Genoa (No. 2) (Italy)	1357		221.1	5
Milan (No. 2) (Italy)	1357		221.1	4
Warsaw (No. 2) (Poland)	1384		216.8	7
Lyons (Radio Lyons) (France)	1393		215.4	25
Radio Normandie (Fécamp) (France)	1411		212.6	15
Vaasa (Finland)	1420		211.3	10
Kaiserlautern (Germany)	1429		209.9	2.5
Paris (Eiffel Tower) (France)	1456		206	7
Bournemouth	1474		203.5	1
Plymouth	1474		203.5	0.3

SHORT-WAVE STATIONS OF THE WORLD

Arranged in Order of Frequency and Wavelength (Stations with an Aerial Power of 20 kW. and above in heavy type)

Station.	Call Sign.	mc/s.	Tuning Positions.	Metres.	kW.
Amateurs	.....	1.71	.....	174.63	—
		to		to	
		2.00		150.00	
Amateurs	.....	3.50	.....	85.71	—
		to		to	
		4.00		75.00	
Bombay (India)	VUB2	4.90	.....	61.00	10
Delhi (India)	VUD2	4.99	.....	60.06	10
Bandoeng (Java)	PMY	5.15	.....	58.30	1
Caracas (Venezuela)	YV5RC	5.80	.....	51.72	1
Vatican City (Vatican State) ...	HVJ	5.97	.....	50.26	15
Mexico City (Mexico)	XEBT	6.00	.....	50.00	1
Pretoria (South Africa)	ZRH	6.00	.....	49.96	7
Montevideo (Uruguay)	CXA2	6.00	.....	49.96	5
Havana (Cuba)	COCO	6.01	.....	49.92	2.5
Podebrady (Prague) (Czechoslovakia)	**OLR2A**	6.01	.....	49.92	30
Sydney (Canada)	CJCX	6.01	.....	49.92	1
Zeesen (Germany)	**DJC**	6.02	.....	49.83	5–40
Podebrady (Prague) (Czechoslovakia)	**OLR2B**	6.03	.....	49.75	30
Boston (U.S.A.)	**W1XAL**	6.04	.....	49.67	20
Miami (U.S.A.)	W4XB	6.04	.....	49.67	5
Daventry (Gt. Britain)	**GSA**	6.05	.....	49.59	10–50
Cincinnati (U.S.A.)	W8XAL	6.06	.....	49.50	10
Philadelphia (U.S.A.)	W3XAU	6.06	.....	49.50	10
Lima (Peru)	OAX4Z	6.08	.....	49.33	15
Hong Kong (China)	ZBW2	6.09	.....	49.26	2.5
Capetown (South Africa) ...	ZRK	6.10	.....	49.20	5
Bound Brook (U.S.A.)	**W3XAL**	6.10	.....	49.18	15–35
Chicago (U.S.A.)	W9XF	6.10	.....	49.18	10
Belgrade (Yugoslavia)	YUA	6.10	.....	49.18	1
Daventry (Gt. Britain)	**GSL**	6.11	.....	49.10	10–50
Wayne (U.S.A.)	W2XE	6.12	.....	49.02	10
Montevideo (Uruguay)	CXA4	6.12	.....	49.98	1
Jelöy (Norway)	LKJ	6.13	.....	48.94	1
Havana (Cuba)	COCD	6.13	.....	48.92	1
Pittsburgh (U.S.A.)	**W8XK**	6.14	.....	48.83	28
Winnipeg (Canada)	CJRO	6.15	.....	48.78	2
San Jose (Costa Rica)	TIPG	6.41	.....	46.80	2
Riobamba (Ecuador)	PRADO	6.61	.....	45.31	2
Radio-Nations (Switzerland) ...	**HBQ**	6.67	.....	44.94	20
Amateurs	.....	7.00	.....	42.86	—
		to		to	
		7.30		41.10	
Radio-Nations (Switzerland) ...	**HBP**	7.80	.....	38.48	20
Sofia (Bulgaria)	LZA	8.46	.....	35.44	1.5
Budapest (Hungary)	HAT4	9.12	.....	32.88	6
Havana (Cuba)	COCH	9.43	.....	31.80	1
Madrid (Spain)	EAR	9.49	.....	31.62	10
Rio de Janeiro (Brazil)	PRF5	9.50	.....	31.58	12
Melbourne (Australia)	VK3ME	9.50	.....	31.58	5
Bangkok (Siam)	HS8PJ	9.50	.....	31.58	5
Mexico City (Mexico)	XEWW	9.50	.....	31.58	10
Lahti (Finland)	—	9.50	.....	31.58	1
Daventry (Gt. Britain)	**GSB**	9.51	.....	31.55	10–50
Montevideo (Uruguay)	CXA8	9.51	.....	31.55	2.5
Skamlebaek (Denmark)	OZF	9.52	.....	31.51	6
Paris (Radio-Mondial) (France) ...	**TPB11**	9.52	.....	31.51	25
Pretoria (South Africa)	ZRH	9.52	.....	31.50	7
Hong Kong (China)	ZBW3	9.52	.....	31.49	2.5
Jelöy (Norway)	LKC	9.53	.....	31.48	1
Schenectady (U.S.A.)	**W2XAF**	9.53	.....	31.48	25
Tokio (Japan)	**JZI**	9.54	.....	31.46	50
Zeesen (Germany)	**DJN**	9.54	.....	31.45	5–40
Podebrady (Prague) (Czechoslovakia)	**OLR3A**	9.55	.....	31.41	30
Bombay (India)	VUB2	9.55	.....	31.41	10
Schenectady (U.S.A.)	W2XAD	9.55	.....	31.40	18
Sourabaya (Java)	YDB	9.55	.....	31.40	1
Zeesen (Germany)	**DJA**	9.56	.....	31.38	5–40
Lima (Peru)	OAX4T	9.56	.....	31.37	10
Millis (U.S.A.)	W1XK	9.57	.....	31.35	10
Manila (Philippine Isles)	KZRM	9.57	.....	31.35	1
Daventry (Gt. Britain)	**GSC**	9.58	.....	31.32	10–50
Lyndhurst (Australia)	VLR	9.58	.....	31.32	1
Philadelphia (U.S.A.)	W3XAU	9.59	.....	31.28	10
Sydney (Australia)	**VK2ME**	9.59	.....	31.28	20
Perth (Australia)	VK6ME	9.59	.....	31.28	2
Huizen (Holland)	**PCJ**	9.59	.....	31.28	60
Delhi No. 2 (India)	VUD2	9.59	.....	31.28	10
Moscow (U.S.S.R.)	**RW96**	9.60	.....	31.25	20
Capetown (South Africa)	ZRK	9.60	.....	31.25	7
Sourabaya (Java)	YDB	9.61	.....	31.20	1
Rome (Italy)	**12RO3**	9.63	.....	31.13	25
Lisbon (Portugal)	CS2WA	9.65	.....	31.09	2
Buenos Aires (Argentine Republic) ...	LRX	9.66	.....	31.06	10
Havana (Cuba)	COCQ	9.74	.....	30.08	1
Lisbon (Portugal)	CSW3	9.74	.....	30.08	5
Havana (Cuba)	COCM	9.83	.....	30.51	1
Madrid (Spain)	**EAQ**	9.86	.....	30.43	20
Marapicú (Brazil)	**PSH**	10.22	.....	29.35	12
Bandoeng (Java)	PMN	10.26	.....	29.24	1.5
Ruysselede (Belgium)	ORK	10.33	.....	29.04	9

Station.	Call Sign.	mc/s.	Tuning Positions.	Metres.	kW.
Buenos Aires (Argentine Republic) ...	LSX	10.35	.....	28.99	12
Taihoku (Japan)	JIB	10.53	.....	28.48	10
Bandoeng (Java)	PLP	11.00	.....	27.27	1.5
Lisbon (Portugal)	CSW2	11.04	.....	27.17	5
Radio-Nations (Switzerland) ...	**HBO**	11.40	.....	26.31	20
Warsaw (Poland)	**SPD**	11.53	.....	26.01	20
Motala (Sweden)	SBP	11.70	.....	25.63	0.75
Winnipeg (Canada)	CJRX	11.72	.....	25.60	2
Paris (Radio-Mondial) (France) ...	TPA4	11.72	.....	25.60	12
Huizen (Holland)	**PHI**	11.73	.....	25.57	25
Boston (U.S.A.)	**W1XAL**	11.73	.....	25.57	20
Havana (Cuba)	COCX	11.74	.....	25.55	1
Daventry (Gt. Britain)	**GSD**	11.75	.....	25.53	10–50
Podebrady (Prague) (Czechoslovakia)	**OLR4B**	11.76	.....	25.51	30
Zeesen (Germany)	**DJD**	11.77	.....	25.49	5–40
Lahti (Finland)	—	11.78	.....	25.47	1
Boston (U.S.A.)	**W1XAL**	11.79	.....	25.45	20
Tokio (Japan)	**JZJ**	11.80	.....	25.42	50
Zeesen (Germany)	**DJO**	11.80	.....	25.42	5–40
Vienna (Germany)	OER3	11.80	.....	25.42	1.5
Rome (Italy)	**12RO4**	11.81	.....	25.40	25
Daventry (Gt. Britain)	**GSN**	11.82	.....	25.38	10–50
Wayne (U.S.A.)	W2XE	11.83	.....	25.36	10
Lisbon (Portugal)	CWS4	11.84	.....	25.34	5
Podebrady (Prague) (Czechoslovakia)	**OLR4A**	11.84	.....	25.34	30
Zeesen (Germany)	**DJP**	11.85	.....	25.31	5–40
Daventry (Gt. Britain)	**GSE**	11.86	.....	25.29	10–50
Pittsburgh (U.S.A.)	**W8XK**	11.87	.....	25.26	24
Paris (Radio-Mondial) (France) ...	**TPB7**	11.88	.....	25.24	25
Paris (Radio-Mondial) (France) ...	TPA3	11.90	.....	25.21	12
Moscow (U.S.S.R.)	**VZSP3**	12.00	.....	25.00	20
Reykjavik (Iceland)	TFJ	12.23	.....	24.52	7.5
Warsaw (Poland)	SPW	13.63	.....	22.00	2
Amateurs	.....	14.00	.....	21.42	—
		to		to	
		14.40		20.84	
Radio-Nations (Switzerland) ...	**HBJ**	14.53	.....	20.64	20
Moscow (U.S.S.R.)	**RKI**	15.08	.....	19.89	25
Zeesen (Germany)	**DJL**	15.11	.....	19.85	5–40
Vatican City (Vatican State) ...	**HVJ**	15.12	.....	19.84	25
Paris (Radio-Mondial) (France) ...	**TPB6**	15.13	.....	19.83	25
Boston (U.S.A.)	**W1XAL**	15.13	.....	19.83	20
Daventry (Gt. Britain)	**GSF**	15.14	.....	19.82	10–50
Bandoeng (Java)	YDC	15.15	.....	19.80	1.5
Tokio (Japan)	**JZK**	15.16	.....	19.79	50
Skamlebaek (Denmark)	OZH	15.17	.....	19.78	6
Daventry (Gt. Britain)	**GSO**	15.18	.....	19.76	10–50
Hong Kong (China)	ZBW4	15.19	.....	19.75	2.5
Lahti (Finland)	—	15.19	.....	19.75	1
Zeesen (Germany)	**DJB**	15.20	.....	19.74	5–40
Pittsburgh (U.S.A.)	W8XK	15.21	.....	19.72	18
Huizen (Holland)	**PCJ2**	15.22	.....	19.71	60
Paris (Radio-Mondial) (France) ...	TPA2	15.24	.....	19.68	12
Boston (U.S.A.)	**W1XAL**	15.25	.....	19.67	20
Daventry (Gt. Britain)	**GSI**	15.26	.....	19.66	10–50
Wayne (U.S.A.)	W2XE	15.27	.....	19.65	10
Zeesen (Germany)	**DJQ**	15.28	.....	19.63	5–40
Buenos Aires (Argentine Republic) ...	LRU	15.29	.....	19.62	7
Daventry (Gt. Britain)	**GSP**	15.31	.....	19.60	10–50
Schenectady (U.S.A.)	W2XAD	15.33	.....	19.57	18
Zeesen (Germany)	**DJR**	15.34	.....	19.56	5–40
Budapest (Szekesfehervar) (Hungary)	HAS3	15.37	.....	19.52	6
Hicksville (U.S.A.)	W2XGB	17.31	.....	17.33	5
Hong Kong (China)	ZBW5	17.75	.....	16.90	2.5
Zeesen (Germany)	**DJE**	17.76	.....	16.89	5–40
Wayne (U.S.A.)	W2XE	17.76	.....	16.89	10
Paris (Radio-Mondial) (France) ...	**TPB3**	17.76	.....	16.88	25
Huizen (Holland)	**PHI2**	17.77	.....	16.87	25
Bound Brook (U.S.A.)	**W3XAL**	17.78	.....	16.87	15–35
Daventry (Gt. Britain)	**GSG**	17.79	.....	16.86	10–50
Buenos Aires (Argentine Republic) ...	LSY3	18.11	.....	16.56	5
Radio-Nations (Switzerland) ...	**HBH**	18.48	.....	16.23	20
Bangkok (Siam)	HS8PJ	19.02	.....	15.77	5
Zeesen (Germany)	**DJS**	21.45	.....	13.99	5–40
Daventry (Gt. Britain)	**GSH**	21.47	.....	13.97	10–50
Schenectady (U.S.A.)	W2XAD	21.50	.....	13.95	18
Wayne (U.S.A.)	W2XE	21.52	.....	13.94	10
Daventry (Gt. Britain)	**GSJ**	21.53	.....	13.93	10–50
Pittsburgh (U.S.A.)	W8XK	21.54	.....	13.93	6
Daventry (Gt. Britain)	**GST**	21.55	.....	13.92	10–50
Amateurs	.....	28.00	.....	10.71	—
		to		to	
		30.00		10.00	
London Television (Sound)	.....	41.50	.....	7.23	3
London Television (Vision)	.....	45.00	.....	6.67	17
Amateurs	.....	56.00	.....	5.35	—
		to		to	
		60.00		5.00	
Amateurs	.....	112.00	.....	2.67	—
		to		to	
		120.00		2.50	

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EDITORIAL COMMENT

Television in the Cinema

What Form Would it Take?

CONSIDERABLE publicity has recently been given to various statements made regarding the potentialities of television in cinemas to provide public entertainment. This has quite naturally provoked much discussion, particularly in technical circles. Many of those who know the present limitations of television, and particularly of large-screen television when considered as a direct comparison with normal cinema projection, feel that we are still a long way off any television demonstrations in the cinema of a standard which would appeal to the general public except as a novelty.

Copyright considerations debar the B.B.C. from authorising the reception of their television transmissions for public exhibition, and we believe that great obstacles will lie in the way to any endeavour to overcome this ban so as to permit the B.B.C. transmissions to be shown in picture theatres. This leads us to the assumption that those who talk confidently of the future of television in conjunction with the cinema must have in mind originating their own programme material for the purpose. It can hardly be imagined that the proposal would be to establish television transmitting stations to transmit by a wireless link to individual theatres, because a monopoly has been vested in the B.B.C. and it seems extremely unlikely that the Postmaster-General could, even if he wished to do so, be authorised to grant commercial licences for television transmissions.

It remains, therefore, for us to assume that the intention would be to originate the programme material and transmit it by suitable telephone lines to individual cinemas. A system organised on this basis would make it possible to dispense with the duplication of films and film projection apparatus in individual theatres, and for the entire programme to be sent out simultaneously to many theatres from one point of origin. In such circumstances it would be possible, in addition to transmitting the film reels providing the bulk of the programme, to send out pictures of sporting events and other matters whilst they were actually taking place. If these events occurred at times inconvenient for cinema audiences it would still be possible for news reels of these events to be communicated to individual cinemas with considerably less delay than must occur at present.

Present Difficulties

Two serious objections to this arrangement, however, at once suggest themselves. News reels as at present put over in cinemas have to be elaborately edited in order to get the present amount of variety into a comparatively short space of time. Few audiences would tolerate sitting through the length of a news reel as originally taken by the ciné camera, and if television were the medium of transmission this difficulty would be a serious obstacle to contend with. Again, with a single point of transmission any failure at the transmitting end would affect all cinemas at once, whereas under the present arrangement of distribution of films, interruptions in the programme are localised.

It is difficult to see, therefore, in the absence of any new evidence, that there is justification at this stage of development for supposing that television will revolutionise the ability of the cinema theatre to entertain its patrons.

The Wobbly Oscillator

MAGNETIC CONTROL FOR FREQUENCY MODULATION

By J. H. REYNER, B.Sc., A.M.I.E.E.

IT is now generally recognised that the cathode-ray gear, in conjunction with a "wobbly" oscillator, is virtually essential for the correct alignment of receivers employing circuits with band-pass characteristics. In this article is described a novel method of introducing the necessary frequency variation by changing the permeability of the iron-dust core on which the oscillator coil is wound.

ONE of the most useful accessories in a modern test room or laboratory is a frequency modulator in association with a cathode-ray oscillograph for showing resonance curves on the cathode-ray screen and thereby obtaining instantaneous visual indication of the alignment of the various circuits in a receiver.

The method by which this is accomplished is well known. A radio-frequency oscillator operating at the frequency of the circuits under test is caused to vary in frequency, by a small amount on either side of the normal value, at a fairly rapid rate. In the process of this variation the frequency applied to the tuned circuit under examination will sweep through a range, during which the response, i.e., the voltage developed across it, will rise to a maximum at the resonant point and then fall away again.

If we can cause the spot on a cathode-ray tube to move in a horizontal direction in such a manner that its position at any instant is proportional to the frequency

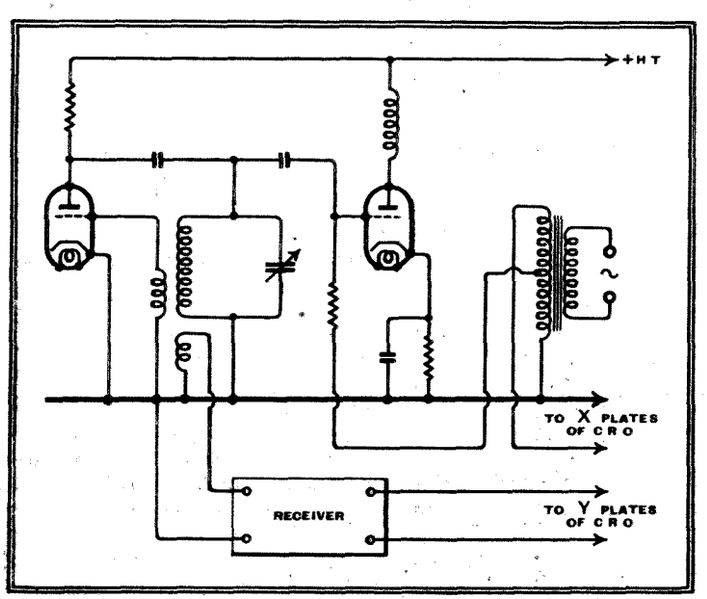

Fig. 1.—Skeleton circuit of simple frequency modulator.

and at the same time produce a vertical deflection which is proportional to the voltage developed across the tuned circuit under test, then it will be clear that the spot will trace the resonance curve on the circuit, and if the rate at which the frequency is modulated is sufficiently rapid (e.g., 25 or 50 times per second) the various traces will all be superposed on one another to give the impression of a stationary picture. As the circuit is tuned, the shape of the picture will alter, and it is obvious that the method is of considerable convenience, particularly in dealing with band-pass circuits where there are two tunes which each interact on one another, rendering the correct adjustment of the tuning to give the required double-hump effect a matter of great difficulty without some such aid as that under discussion.

Various methods have been used for producing the frequency modulation and linking this with the horizontal deflection on the cathode-ray tube. The method which is usually adopted is to employ a circuit in which, over a small range, the frequency is proportional to the voltage applied to some part of the circuit. For example, one may use a valve with some suitable load in its anode circuit connected across the oscillating circuit. The effective shunt capacity introduced by this valve will depend upon its effective amplification, and if this can be varied, as, for example, by altering the grid bias, then we have the necessary frequency modulation. The grid bias may be varied by applying a suitable 50-cycle voltage superposed on the steady grid bias, and the same voltage (stepped up if necessary) can be applied to the horizontal deflecting plates of the cathode-ray tube, the general arrangement being illustrated in Fig. 1.

There are various practical difficulties in the successful achievement of the required results. Two of the most important are:—

(*a*) Obtaining sufficient sweep, i.e., sufficient change in the frequency of the oscillator.

(*b*) Ensuring that the change in frequency is reasonably proportional to the voltage applied to the circuit.

The second point is important, as if the frequency modulation is not linear there will be distortion of the resonance curve shown on the screen, which may be very misleading, indicating faults in the tuning system under test which are not really present. It should be made clear that we are concerned with proportionality between applied voltage and frequency. The manner in which we cause the voltage to vary is immaterial, provided we apply an exactly similar voltage to the cathode-ray tube. In other words, we can either use ordinary AC for producing the frequency modulation, or we could, if desired, use a saw-tooth voltage such as is produced in the time base of an ordinary oscillograph, and in some instances the time base voltage itself is used for the frequency modulation.

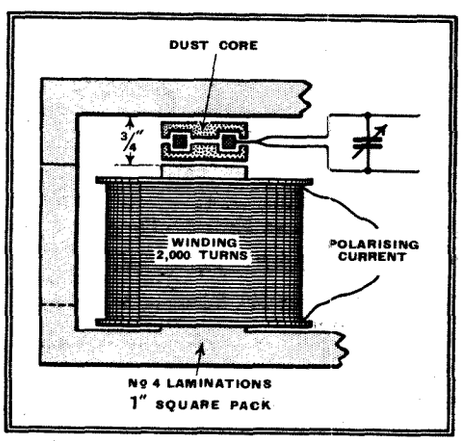

Fig. 2.—General arrangement used in tests.

Magnetic Tuning Variation

It has been intimated that with ordinary methods of operation the two desirable features mentioned above are not too easy of attainment. A short while ago L. de Kramolin described in these columns a method whereby the tuning of a circuit using a coil wound on a radio-frequency dust core could be altered by varying the steady flux through the core."[1]

In the article in question the arrangement was applied to remote-control tuning in a radio receiver, but it will be clear

[1] *The Wireless World*, February 24th and March 3rd, 1938.

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that it offers possibilities as a method of frequency modulation, and a number of tests have been carried out to decide upon its suitability for this purpose.

The first investigation was to determine the extent of the frequency variation obtained and in particular to see how linear was the relationship between frequency and flux. A coil consisting of 60 turns on a pot type of radio core was located in the air gap of a magnet system, as shown in Fig. 2. The coil was tuned with a variable air condenser in the usual manner, and having chosen a suitable frequency the condenser was left set and the current through the coil varied.

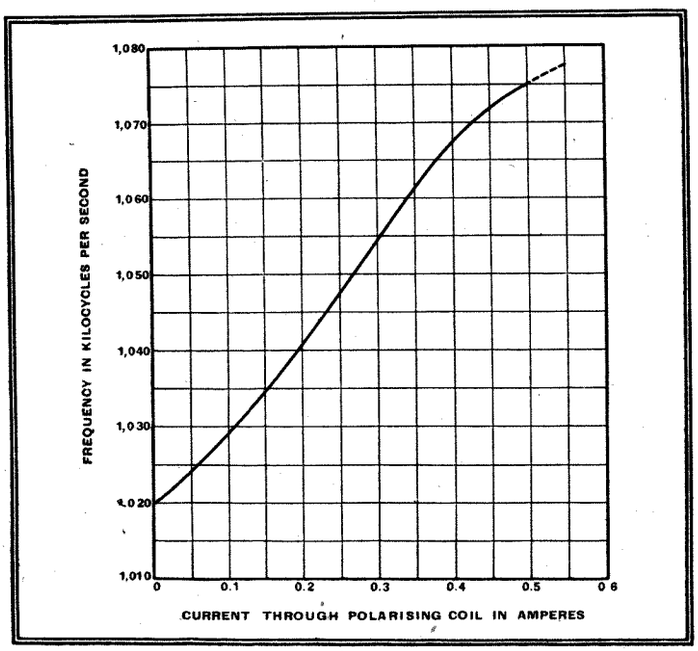

Fig. 3.—Variation of frequency with polarising current.

Fig. 3 shows the variation in frequency in terms of coil current, and it will be seen that the relationship, although not absolutely linear, is reasonably straight and actually appreciably more linear than is usually the case with valve control methods. It will be seen that the change in frequency produced is 50 kc/s in one megacycle, and this does not by any means represent the limit, as will be seen later.

The next point to be decided was the manner in which the current was to be varied. The most satisfactory procedure from theoretical considerations is to operate the control from the same time base as is used to sweep the cathode-ray spot across the screen. The voltage developed by this time base in the cathode-ray outfit being used was therefore fed to an amplifier, and the anode current was passed through the magnetising coil of the frequency modulator. Unfortunately, the method proved uneconomical, for, although the watts dissipation is quite small, the volt/amps. required are very large, and the amplifier valve needed to deliver the necessary current would be of such a size as to render the method impracticable.

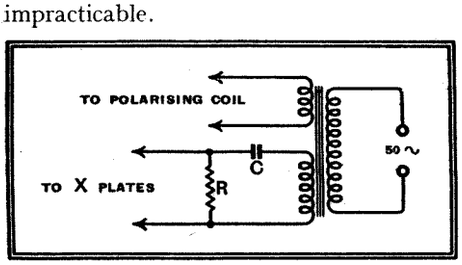

Fig. 4.—50-cycle sweep circuit. The network CR corrects for the 90 degrees phase lag of the current in the polarising coil.

The obvious alternative is to obtain the sweep from the AC supply. AC was therefore obtained from a transformer, as shown in Fig. 4, one winding feeding the current to the frequency modulator and the other winding supplying the voltage to the X plates of the cathode-ray tube. Since the current in the coil lags 90° behind the voltage it is necessary to introduce a phase-shifting network, as shown, to advance or retard the phase of the voltage applied to the cathode-ray tube.

This arrangement operated satisfactorily so far as the sweep and amplitude were concerned, but had two defects. In the first place, since the polarisation of the iron is not dependent on the direction of the current we obtain two images, one on each side of the centre line as in Fig. 5. This is not a serious trouble, since the voltage applied to the X plates may be increased so that the second image is off the tube. Unfortunately, each of these images is itself double because the hysteresis of the iron causes the patterns traced on the "go" and "return" paths to be displaced from one another. Moreover, the use of two separate windings, one for producing the modulating current and the other for providing the scanning voltage, is not desirable as there may be slight differences in waveform which cause distortion of the characteristics. A better way is to insert a load resistance in series with the polarising coil, as shown in Fig. 6, and this method has a further advantage that it reduces the hysteresis trouble to some extent, though a double image still remains.

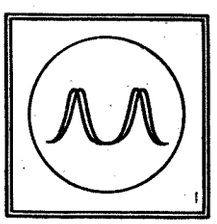

Fig. 5.—Double image with hysteresis effect produced by the Fig. 4 circuit.

Obviously, one way of removing the double image is to black out the tube on the return half-cycle so that it only shows a trace on the forward stroke. The use of a saw-toothed waveform, of course, produces a very similar effect because the flyback is so rapid that the trace made by the spot is practically invisible. The introduction of some black-out device, however, is an extra complication and not always convenient, since it involves interference with the oscillograph itself.

Uni-directional Polarising Current

It was, however, found that by working from zero current up to a peak and down again the hysteresis effect was practically non-existent. This was achieved by inserting a rectifier in series with the polarising coil, as shown in Fig. 7. This only passed current in one direction, the current rising to a maximum at the peak value of the applied AC and falling to zero again and passing no current at all during the negative half-cycle. The deflection of the spot on the cathode-ray tube was obtained by picking voltage off a resistance in series with the coil so that the movement of the spot was again proportional to the current, which, as found right at the outset, was proportional to the frequency within fairly close limits.

Under these conditions it was possible to obtain a sweep which was substantially linear over a range of 130 kc/s at a mean frequency of 1,000 kc/s, which is more than enough for most purposes.

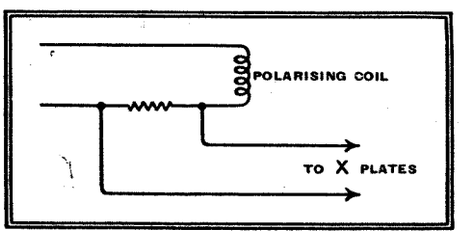

Fig. 6.—Improved method of feeding X plates.

Attention was then turned to the application of this arrangement to higher and lower frequencies. At 7 megacycles it was found that the frequency change for the same change of magnetising current was practically the same percentage, actually a little more, the change being from 6.9 to 8.8 megacycles. This opened up possibilities of obtaining sweeps comparable with the television band-width for the investigation of IF amplifiers for television purposes. Unfortunately, however, beyond this point the effectiveness of the iron fell off rather considerably, and at 17 megacycles it was not possible to obtain a sweep of more than some 50 kc/s. This, of course, is still quite satisfactory for ordinary radio purposes, and, indeed, the arrangement was still operating at 25 megacycles.

There was, however, evidence of very rapid failure of the mechanism at these high frequencies. The point is one which requires further investigation, and probably with the use of better iron and perhaps better arrangement of the polarisation it would be possible to obtain a satisfactory result.

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Conversely, the sweep is somewhat reduced as one reduces the frequency range. Operating at a mean frequency of 150 kc/s, the frequency change over the linear range was only 12 or 13 kc/s, which is barely sufficient for many purposes. Here, again, there is need for more detailed investigation.

To sum up, the method offers certain advantages over the usual procedure in that it provides a much wider linear sweep and would appear much the same in cost. The fact that over a wide range of frequency the application of a given control voltage produces a more or less constant percentage change of frequency may have some application, particularly if improved technique enables the method to be employed at television frequencies.

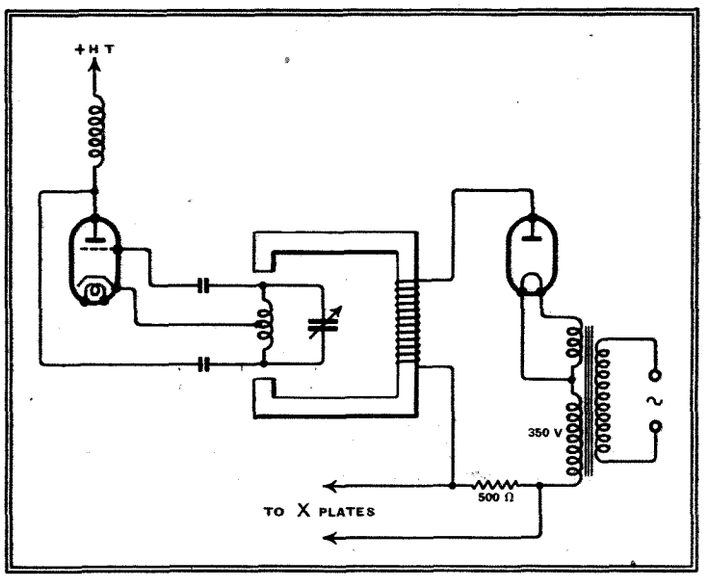


Fig. 7.—Final arrangement of the magnetic modulating system described.

Relaying Television Programmes

A LONG-REACH SYSTEM

ALTHOUGH the normal service area of short-wave television coincides with the so-called "line of sight"—which means an average radius of, say, 25 miles from the transmitter—reception over twice that distance is now commonplace. The fact, for instance, that the Boat Race was clearly seen at Ipswich—some 70 miles away from Alexandra Palace—indicates what can be done when atmospheric conditions are favourable. It also suggests that it might be possible to transmit over such distances consistently.

The variable factors to be taken into account are (a) the elevation and state of ionisation of the atmospheric layers which bend the signals out of the straight-line path down to the receiver, (b) the distance between the transmitter and receiver, (c) the wavelength of the transmitted wave, and (d) its inclination to the earth. Suppose (b) to be fixed by locating the receiver at some definite point, beyond the normal optical range. There is no method yet known for controlling (a), though it is possible to regulate both (c) and (d) and in this way to offset the effect of atmospheric fluctuations.

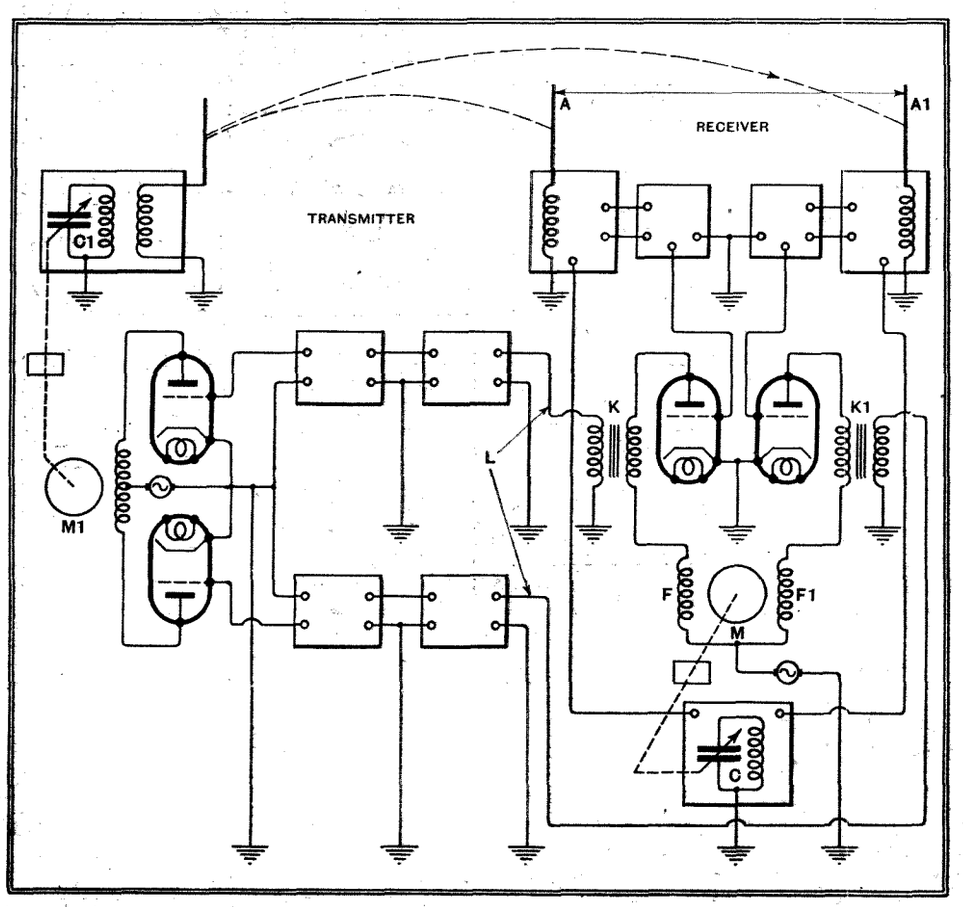
The refraction of a wireless wave by an ionised layer is very much on all fours with the refraction of light by a prism. In the latter case the wavelength, as well as the angle of incidence, determines the direction of the emerging light, the short blue waves, for instance, being bent more sharply by a prism than the longer red waves.

The problem of extending the effective range of a television transmitter has recently been tackled on these lines by Dr. Zworykin, the object being to distribute signals from a main transmitter to one particular distant receiver, which forms part of a relay station used to re-radiate the programme locally.

The usual method of relaying is by special HF transmission lines, designed to transmit a frequency band of over 2,000,000 cycles without attenuation. But such cables are very expensive, and in cases where a large body of water, or a mountainous district, intervenes, it may not be possible to use them as a connecting link. Dr. Zworykin therefore prefers to radiate the programme to be relayed through the ether, and to employ special means for offsetting attenuation due to atmospheric changes. For this purpose he links the transmitter to the receiver by an inexpensive telephone line, through which the frequency of the transmitted wave is automatically adjusted from time to time so as to maintain the programme service no matter what atmospheric conditions may prevail.

As shown in the drawing, the receiver is provided with two aerials A, A1, which are preferably spaced some wavelengths apart in the line of the distant transmitter. If changes occur in the ionisation or level of the reflecting layer, one of the aerials, say A, will receive stronger signals than A1. This causes a current to flow through the field-coil F of a motor M which adjusts the tuning of a local heterodyne circuit C. The same control current is simultaneously fed through a transformer K via the connecting line L to the transmitter, where it sets a circuit C1 to the same frequency through a motor M1.

The transmitter and receiver are thus automatically kept in tune with each other, in spite of changes in the working wavelength. The alteration in wavelength is made such as to keep the "skip distance" constant, in spite of changes in the level or refractive index of the ionised layers. Instead of altering the frequency of the transmitted wave, the same automatic "monitoring" system can be used to alter the inclination of the transmitting aerial, and therefore the angle at which the outgoing wave is originally radiated.



WIRE AND WIRELESS: Illustrating the use of a landline link for variation of wavelength at both transmitter and receiver to suit prevailing conditions.

Home Recording

By HUMFREY ANDREWES, B.Sc., A.M.I.E.E.

Part V—Frequency Correction and Optical Examination of Results Obtained

IN this article the author discusses the characteristics of the recording head and amplifier, then describes how a record can be examined and faults detected by means of reflected light. The construction of the cutting head is dealt with, also the methods of monitoring.

IN the last article in this series the general requirements of the recording head of a direct recording system were discussed, and the methods of obtaining the desired curve at the lower end of the frequency spectrum were considered. The reasons and desirability of employing the constant amplitude system from a frequency of about 400 cycles downward has been fairly fully discussed and we may therefore now turn our attention to the upper frequency portion of the characteristic. Here opinions differ, and in considering the recorder head curve we should also really take into account the characteristics of the reproducing, or play-back, amplifier and pick-up

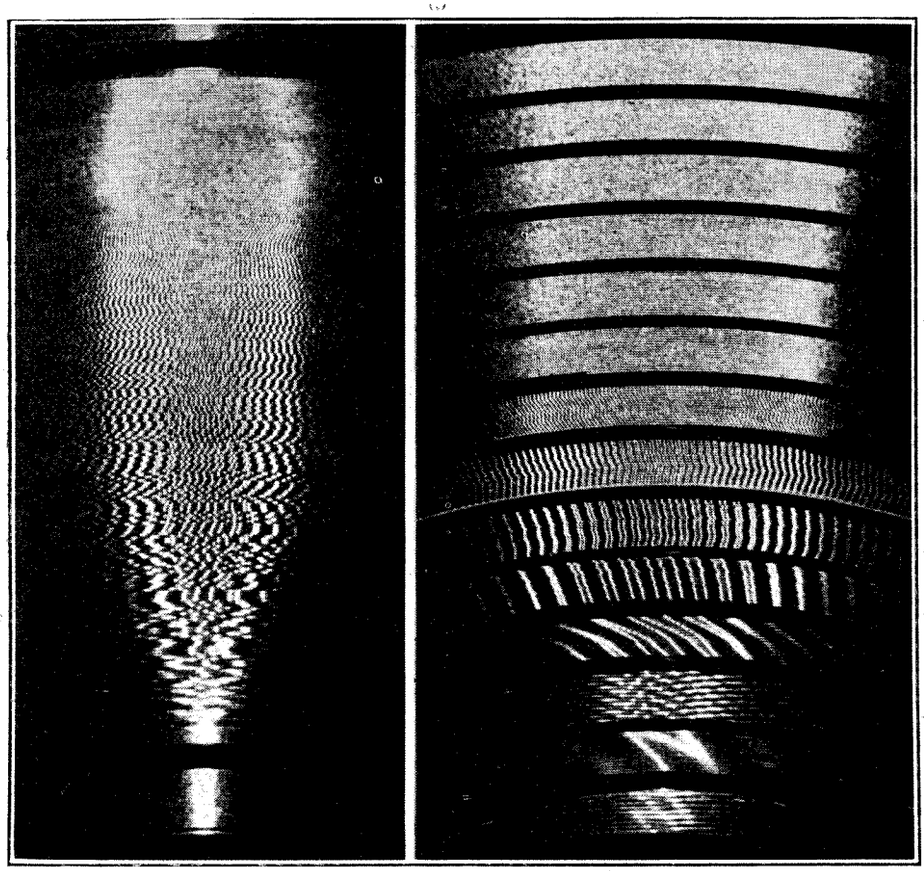
One method which has been largely used with great success where both the recording and reproducing systems are both controllable is to arrange the curve of the recording head and associated amplifiers so that the recording curve rises 6 db per octave from 1,000 cycles, and then correct in the reproduction to compensate for this rise. This method has the great advantage that it materially reduces surface noise, which is, of course, initially low, and under such conditions a recording of a broadcast programme is practically indistinguishable from the original. Unfortunately for the experimenter such requirements involve rather more elaborate amplifiers and associated equipment than are, perhaps, within their means, and therefore some less-complicated arrangement will have to be evolved.

As a general rule the writer has found that quite satisfactory results may be obtained using a curve having the normal rise from 25 to 400 cycles and which then remains substantially flat from 400 cycles to about 2,000 cycles, then rises slowly to a maximum at between 4,000 to 5,000 cycles and then gradually drops again, the maximum point being about 6 db. up on the level at 1,000 cycles. This is, of course, only one curve which may be used, but the following variations which are often met with in practice should be avoided if possible. A violent resonance or sudden rise in the curve is undesirable, as this always leads to an accentuation of a small band of frequencies and gives very unsatisfactory results if such a resonance falls between 3,000 and 5,000 cycles.

A rise in the curve at about 500 cycles is also undesirable and usually indicates that the bass attenuator is incorrectly adjusted or that the recording head is mismatched to the output stage of the amplifier. A sharp resonance at about 2,500 cycles or 3,000 cycles is commonly met, and this gives a quality to speech which has been very aptly described as "icky." A resonance in the recording head which occurs above 4,000 cycles can often prove of advantage in improving the reproduction of the upper frequencies, provided it is not too violent or spreads over too narrow a frequency band. The general characteristic of a recording head may be varied considerably by altering not only its electrical features but, more readily, by altering the mechanical damping of the moving system. Before considering the effects which may be produced it is, perhaps, not out of place to examine first some of the methods normally employed in testing a recording head.

One method, which can be used by the experimenter and does not involve elaborate or costly apparatus and has the advantage that the whole of the recording and reproducing system may be checked, has been described in *The Wireless World* in some detail and need not therefore be dealt with again here.*

Another method, however, which is perhaps in some respects simpler, is to utilise the Buckmann-Meyer Image effect. This is sometimes also referred to as a "curve." For a detailed description the reader is referred to the original paper by Buckmann and Meyer in the *Elektrische Nachrichten Technick*, April, 1930. Briefly it was observed by the above investigators, and proved mathematically, that if a parallel beam of light is allowed to fall on a gramophone disc on which has been recorded a simple sine wave of given amplitude and frequency, and if the reflection of light from the disc is observed under specified conditions, then a bright band of light may be seen on the disc and



(a) (b)

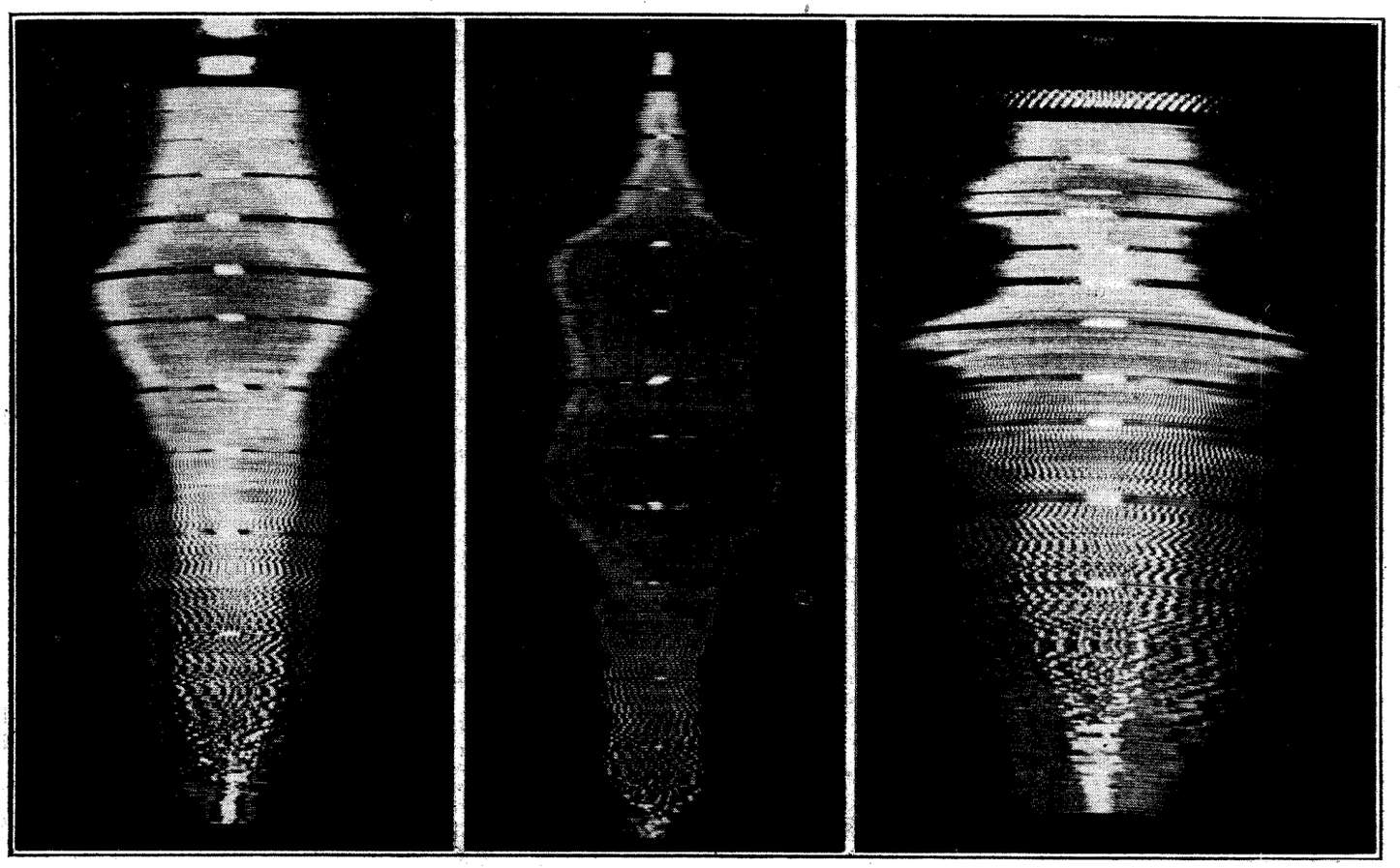
Fig. 1. Buckmann-Meyer Image photographs of (a) H.M.V. gliding tone record and (b) Decca constant frequency record.

* Fidelity of Disc Recording. F. N. G. Leevers, *The Wireless World*, March 19th, 1937.

the width of this band of light is proportional to the product of the amplitude of the sine wave and its frequency. By viewing a gliding frequency recorded with the apparatus under test, we have a simple method of checking its characteristic.

It is not possible in the present series of articles to discuss the Buckmann Meyer effect in detail, and readers who are interested in the mathematical proof should study the original paper. In this paper it is also explained that under the conditions specified the width of the band of light observed is also independent of the diameter of the recorded spiral, as the radius of curvature of the recorded wave increases as the diameter of the spiral decreases. It will be seen therefore that the Buckmann Meyer Image gives us a very simple and convenient method of obtaining fairly accurately the characteristic curve of the recording head optically without actually reproducing the recorded disc. Not only can the general shape be observed but also resonances, etc., can also be examined.

It is, of course, possible to obtain a permanent record of curves made in the above way photographically, and the accompanying illustrations show some of the effects which may be obtained. It has been found that sunlight is the most satisfactory for good photographs, and the pictures shown here took some little time to obtain, as one is unfortunately dependent on the weather, and, as might be expected, a dull, rainy period set in immediately after the discs had been made. In some of the images illustrated it will be noted that breaks occur at regular intervals, and these are used to mark the frequency of the recorded wave so that the point at which different effects occur may be noted. The writer has found it a useful plan to make a break at every thousand cycles from the highest frequency to be examined down to 1,000 cycles, and then at more frequent intervals, depending on the point to be brought out.



(a) (b) (c)

Fig. 2. Image photographs of discs made with three recording heads of different characteristics as described in the text.

In obtaining the curves shown the recording head was fed from an amplifier which was known to have a sensibly flat frequency characteristic, and the input voltage to the amplifier was kept constant throughout the frequency sweep. To obtain a curve similar to that normally plotted for recording heads, or pickups, the rate of change of the frequency of the recorded wave should, of course, follow a logarithmic law, but the apparatus available did not, unfortunately, permit of this being done, which fact must be taken into account in examining the illustrations.

Visible Distortion

Fig. 1 shows (a) the image of a commercial gliding frequency record on a shellac pressing and (b) a series of fixed frequencies. It illustrates the extreme accuracy of the recording. In Fig. 2 (a), (b) and (c), curves of three direct recording heads are shown. It will be noted that the recording head shown in Fig. 2 (a) has the best characteristic as there are no violent resonances, the curve being very smooth and having a maximum velocity/amplitude at about 5,000 cycles. It is also possible, of course, to measure the sensitivity of a recording head, or, rather, compare the sensitivity with some standard which may be arbitrarily fixed, and the author has found that in many cases a measurement of the light band width at 1,000 cycles under fixed conditions is a quick and useful guide when experimenting with different types of recording head.

Figure 3 (a) shows the effect of the fixed bass attenuator, and it will be clearly seen that in the case of this curve where the bass attenuator has been incorrectly adjusted the band width does not decrease according to the correct law.

It is also possible to observe wave form distortion introduced by amplitude distortion by means of the Buckmann Meyer Image, and this is illustrated in Fig. 3 (b). Here a tuned circuit was connected across the recording head which was deliberately designed to produce amplitude distortion, and which was adjusted to approximately 1,800 cycles. The frequency sweep is in this case from 5,000 cycles to 1,000 cycles. It will be noted that the Image becomes asymmetrical about a radial centre line, and also that a faint white line appears diagonally across the image. Both the white line and the asymmetry indicate amplitude distortion, and this may be easily confirmed by examining the reproduced wave

Home Recording—

form with a Cathode Ray Oscilloscope.

Fig. 3 (c) illustrates how a valley in the curve may be observed. In the particular case chosen the effect was produced by means of a tuned circuit in the amplifier adjusted to approximately 800 cycles.

Having now considered very briefly the general shape of the characteristic curve which is normally considered desirable for a direct recording cutter head and methods which may be used to observe the curve so obtained it may, perhaps, be useful at this point to consider the general construction of the head itself.

As a general rule the balanced armature type of movement is used, although there are of course a number of different arrangements. Essentially the stylus is mounted at one end of an armature which oscillates between pole-pieces of a horse-shoe magnet. The armature is mounted between pivots, and in many types damped mechanically by means of rubber pads inserted between the ends of the pole-pieces and the armature. To obtain a reasonably flat characteristic the damping usually has to be considerably greater than that used for the balanced armature pick-up, and its adjustment is fairly critical. In some cases the pole-pieces are made adjustable, and the damping varied by moving the pole-pieces towards or away from the end of the armature. Naturally the degree of damping materially affects the power required to drive the armature, and varies from one or two watts to as much as ten. To the experimenter with suitable workshop facilities an interesting experimental field is opened, and a balanced armature loud-speaker movement can be used as a basis for the construction of a recording cutter head.

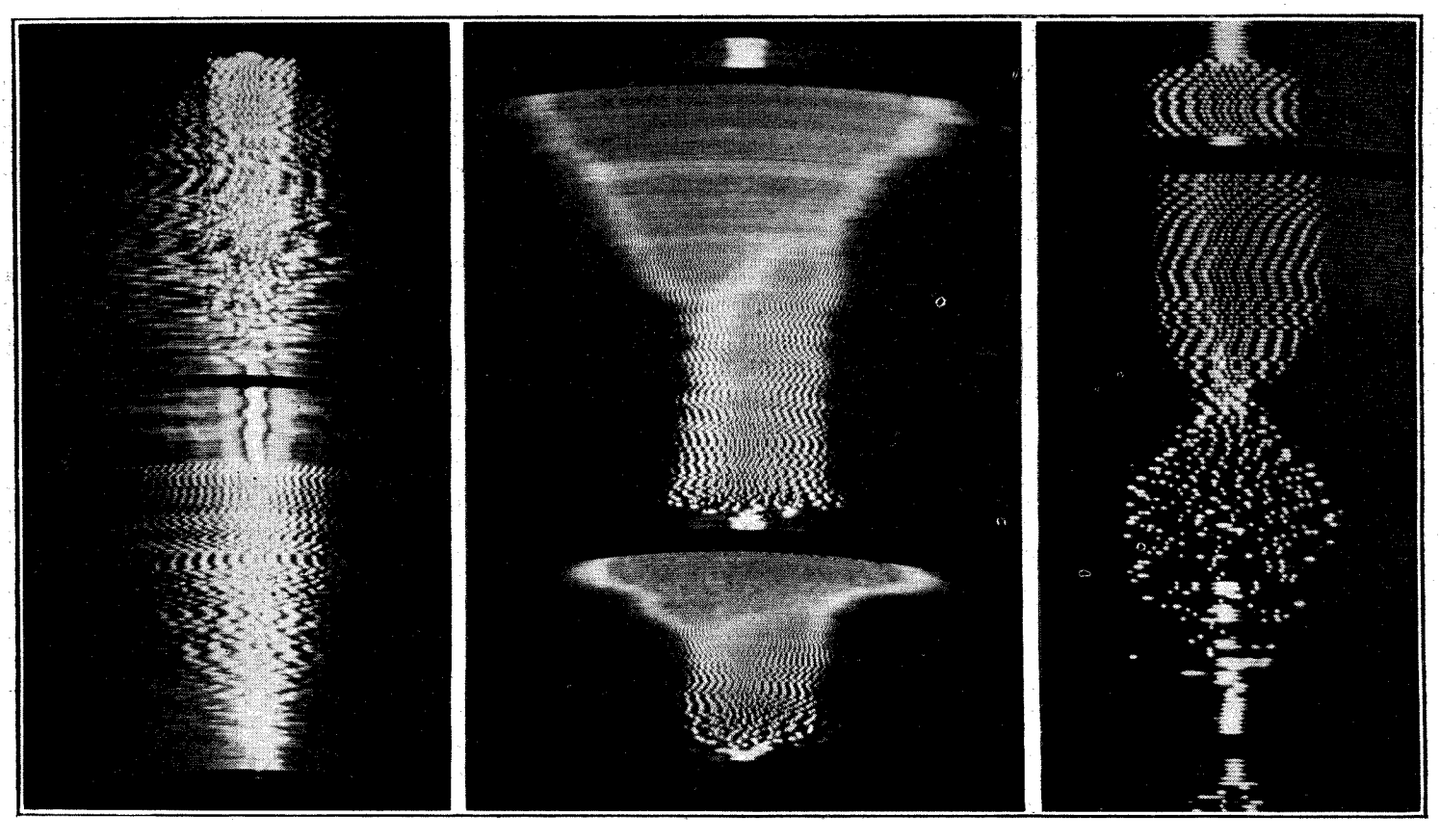
In considering the methods of feeding the recording head from the amplifier a number of different factors must be taken into consideration. In fixing the size of the output stage the peak watts required must first be considered. Some recording heads only require about two or three watts, but others require considerably more, and unless cost is a primary consideration it is advisable to use a nominal 10-watt output stage. This may consist of two valves of the 5-watt class, such as the Mullard DO24 or Marconi PX25 connected either in push-pull or parallel.

Monitoring

The recording head may be connected either through a transformer or direct via a suitable coupling condenser, but in either case care must be taken that the matching is as good as possible as it should always be remembered that distortion due to incorrect matching is much more easily detected from a record than when the recorded item is listened to at first hand through the monitor loud speaker. Unless a separate amplifier is used for replay the recording head should be connected to the output stage through a switch as, apart from the fact that its load should be removed from the amplifier during the replay of the record, it is always good practice to start a record with at least two unmodulated grooves, and therefore the recording head must be connected after the recording machine has been started unless, of course, the record is to start with a "fade-in." Where continuous recording is to be undertaken, that is to say, when an item lasting for more than about four minutes is to be recorded and more than one or two twelve-inch records used, two recording machines must of course be available. A two-way recording head switch is required, preferably with a parallel position in the centre. This switching arrangement also allows the two machines to be used simultaneously in order that two copies of a record may be made at once, provided of course that the output of the amplifier is adequate.

Before leaving the subject of the recording head and its characteristic curve it may be well to emphasise in this very brief survey that after the complete equipment has been set up and adjusted it is very desirable to test with a variable-frequency audio oscillator, or a modulated RF input, the complete circuit from the audio input terminals, whether these are the connections to the microphone or the detector of a radio unit, as the Meyer Image obtained will then give a true representation of the performance which may be expected so far as recording is concerned, and we may then treat the reproduction problem separately.

While on the subject of the output circuit it may not be out of place to consider methods of monitoring during recording. Apart from the volume indicator which may be used to measure the voltage applied to the recording head, although in many cases it would be more accurate to say "give an indication of the voltage



(a) (b) (c)

Fig. 3. Image photographs showing (a) the effect of fixed bass attenuator, (b) waveform distortion produced by an 1800 c/s filter joined across cutting head, and (c) effect of an 800 c/s filter.

Home Recording—

applied to the recording head," some audible form of monitoring is naturally rather essential. In many cases most, if not all, of the available output of the last stage of the amplifier is required to feed the recording head, and therefore the connection of a monitor loudspeaker to the amplifier as well may lead to overload. The simplest and perhaps the cheapest way to overcome this difficulty is to connect a pair of headphones to the output, either by means of a transformer or through a suitable attenuator, so that a reasonable level may be obtained. Another more elaborate but far more satisfactory method is to construct a single-stage monitor amplifier having an output of a few watts and connect this to the output of the main recording amplifier through a suitable volume control. This method has the great advantage that, first, a loud speaker may be used without imposing any extra load on the recording amplifier, and secondly, the loud-speaker volume may be adjusted to any required level independently, and even during a recording. It is the opinion of the author that the use of headphones for monitoring has great advantages in certain circumstances, as it is much easier to concentrate on a particular programme where some intricate piece of recording is to be attempted when external sounds in the room are largely cut out. Headphones are strongly to be advocated for domestic reasons when recording work is undertaken at a late hour at night.

Readers' Problems

A Selection of Queries dealt with by the Information Bureau, and chosen for their more general interest, is published on this page.

Grid Bias

A READER has noticed that if he removes the RF valve grid bias plug from the battery and joins it to the GB + plug the set is very much more sensitive, yet only the correct amount of grid bias was hitherto being used.

Details of the set, or of the RF valve, are not given, but we think it is possible to give an explanation for the effect noticed. The RF valve used probably requires, according to the maker's instructions, $-1\frac{1}{2}$ grid bias, but if our querist will again examine the valve data slip he will see that this is for an anode voltage of 150 and a screen potential of 70 or 75 volts.

In all probability a 120-volt HT battery is being used and the screen grid lead is plugged into the 60-volt socket as being the nearest to the recommended value. Under these conditions the valve will not need the full $1\frac{1}{2}$ volts grid bias, but probably only half this amount for correct operation with the reduced voltages. With $-1\frac{1}{2}$ volts it is over-biased.

As $1\frac{1}{2}$-volt charges are the smallest that can be made with an ordinary grid battery it will be necessary to use a potential divided in order to obtain anything less than $1\frac{1}{2}$ volts grid bias.

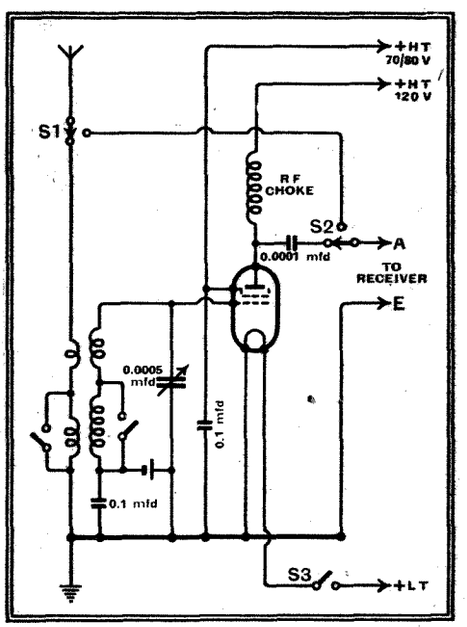
One method is to join a 50,000-ohms potentiometer across one or two cells of the grid battery and connect the RF grid bias lead to the moving contact. Any value of grid bias from a fraction of a volt to the total voltage of the cells across which the potentiometer is bridged will then be available.

Improving Receiver Performance

WISHING to improve his reception of distant stations, many of which are too weak to listen to on the loud speaker, a reader proposes to add another AF amplifier to the set, and asks our opinion on the suggestion. The set is battery operated and consists of one RF stage, a grid detector with reaction, and two AF amplifiers, both resistance-capacity coupled.

We do not care for the idea of adding an extra AF stage to a set already including two such amplifiers. It would be far better to attempt to increase the gain of the existing AF stages, which can be done quite simply by making one intervalve coupling a transformer, the best position for it being between the third and fourth valves.

If an extra valve be employed, then it should be an RF and not an AF stage, as this will amplify the signal without materially increasing the background noise, whereas an AF stage will amplify both signal and noise proportionately. Furthermore, as an extra tuned circuit will be required, the selectivity of the set will also be improved.



RF pre-amplifier for adding to an existing set to improve its performance.

An RF pre-amplifier can be made up as a separate unit, and thus no alteration is needed to the existing set. One advantage of this is that if no improvement results with the initial test, the cause must be in the additional equipment, and tracing the failure will not be a difficult matter. One still has a workable set for immediate use should it be necessary to make a few modifications to the RF unit.

A circuit for such a unit is given in Fig. 1, and switches are included to bring it into use when required. It can thus be left permanently connected to the receiver.

Low-capacity switches must be used, and S1 and S2 in particular ought to be separate units, though they can be ganged and all of them operated by a single control.

Short-wave Reception

A READER using one of the early *Wireless World* superheterodynes and wishing to listen to short-wave stations suggests removing the long-wave coils, as this band holds little interest for him, and replacing them by a set of short-wave coils. He asks for advice on the proposed changes.

There is a lot to be said both for and against this idea, and whilst it could, of course, be made workable, we fear that a considerable amount of experimental work will be needed before entirely satisfactory results are obtained.

It would be far better to devote the time to building a good short-wave converter, using comparatively small-capacity condensers, and thus enabling the short waves to be tuned-in in a reasonably easy manner.

A set of the kind in use should be able to supply filament current and HT for one more valve, and the short-wave frequency changer, with its coils, switching and condensers, can be made up as a separate unit.

If a little more elaboration is required, then the short-wave unit can have an RF stage, which will be a worth-while addition, but with two extra valves it may be necessary to use a small separate transformer to heat their filaments. In any case, the few milliamps of HT can be taken from the main set.

Communication Receiver

WE are asked to explain in what respects a communication receiver differs from any other set, such as an all-wave receiver, in which provision is made for receiving short waves.

An all-wave receiver, as is now generally known, is essentially a broadcast set, and it is not intended to be used for the reception of any other kind of wireless signal. On the other hand a communication set is not designed primarily for broadcast reception, but for that of wireless signals generally, though the particular type of communication receiver to which our querist refers will give as good a performance on broadcast as any other set.

Communication sets provide continuous tuning from about 9 metres, or lower, up to 550 or 600 metres, but it is unusual for a long-wave range to be included.

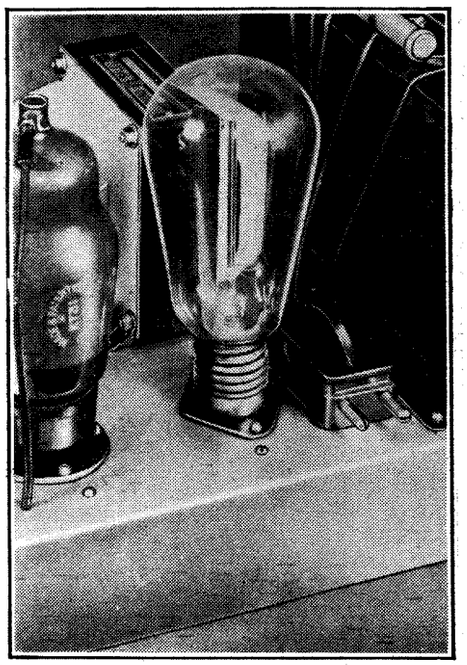
A beat frequency oscillator is embodied for the reception of CW signals, and many of them embody a crystal filter giving very high selectivity for this form of reception. Some also include an IF selectivity control which enables the band width to be widened to give high quality reproduction on telephony transmissions and on broadcasting. Another special feature is a signal strength indicator, generally in the form of a meter having a calibrated scale.

In view of the very high selectivity which the crystal filter provides, special tuning arrangements have to be made, and a subsidiary, or band-spread tuning system, is always included in these sets.

Stabilising Power Supplies

I. THE BARRETTER—

And How It Functions



By D. A. BELL, B.Sc.

CONSTANCY of power supply has long been essential in measuring instruments and laboratory appliances; it is now becoming a matter of importance in many broadcast receivers. One of the most popular methods of stabilising a power supply derived from the mains is described in this article.

ELECTRICAL energy from the mains is cheap compared with that from either dry batteries or accumulators; and with the widespread standardisation of 230-volt 50 c/s mains, the occasions when one is unable to obtain a connection for mains-driven apparatus are few. But for the more refined types of apparatus the public mains have the serious disadvantage of being liable to sudden fluctuations in voltage. An accumulator will maintain practically constant voltage over 80 per cent. of its discharge, and even dry batteries (provided they are not overloaded) suffer only a small and steady decline of voltage while in use. But even very good supply mains, where the voltage may never vary more than 4 per cent. on either side of its normal value, may quite probably jump suddenly from one extreme to the other; in such a case there is an instantaneous shift of 8 per cent., a change which would take some hours to occur with a battery supply.

This has long been recognised as a troublesome effect to be combated in laboratory instruments, such as valve voltmeters, apparatus for amplifying direct currents and voltages, etc. But it is only recently that there has been a likelihood of the trouble becoming apparent to the ordinary user of radio apparatus in two different cases. The first example is in the all-wave superheterodyne receiver, for, unless the designer has exercised great skill in working out the oscillator used for frequency changing, its frequency is likely to shift with variations in anode or filament voltages, and by an amount which may necessitate retuning at the higher frequencies. The second example is in the television receiver; here there is a slight risk that when receiving very weak signals the adjustment of the synchronising may be dependent upon mains voltage.

So we may expect to see a gradual increase in the use of devices for stabilising power supplies in commercial broadcast and television receivers in proportion as the apparatus is called upon to satisfy more exacting performance specifications. The simplest device is the *barretter*, whose function is to maintain a constant current in spite of changes in applied voltage; it works equally well on AC and DC. In construction a barretter consists of a filament of iron wire enclosed in an atmosphere of hydrogen, and its mode of action can be understood from a study of the effect of temperature on the resistance of metallic conductors.

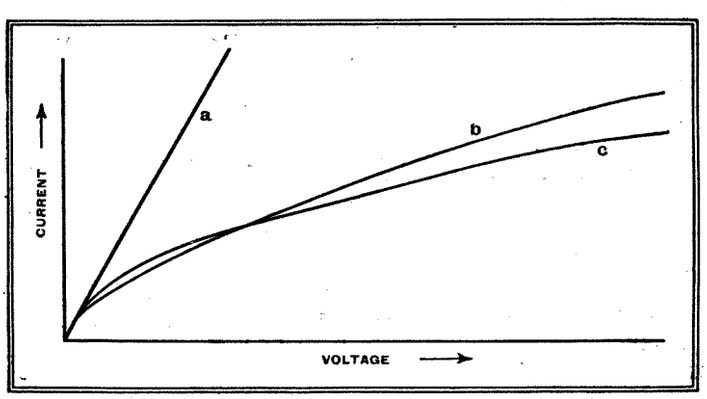


Fig. 1.—Voltage/current characteristics of three different conductors; these graphs show the effect of temperature, (a) being cold and (b) and (c) being hot.

Suppose we take four wires, one each of copper, tungsten, iron and eureka, all of them having a resistance of 100 ohms at freezing point (0 deg. C.); then at boiling point (100 deg. C.) we shall find that the resistances of the first three have changed a great deal, the new values of all four being: Copper, 142.8; tungsten, 151; iron, 162; and eureka about 100.1. It does not matter whether the wires are heated internally or externally; so that if we steadily increase the voltage applied to a conductor, as soon as the current is great enough to make the conductor appreciably hot its resistance rises, and the current through it then increases less rapidly than the applied voltage. This is illustrated by Fig. 1, which shows current plotted against voltage for three different conductors: (*a*) a cool-running resistance, (*b*) a "tungsten" filament electric lamp of the vacuum type, (*c*) a "tungsten" filament gas-filled electric lamp. (The "tungsten" filament is, of course, not pure tungsten, but an alloy with other metals which has been found by the manufacturers to be stronger and generally more satisfactory than the pure metal. This is mentioned because an alloy usually differs from the pure metal in resistance, and even more so in the temperature coefficient of resistance; the figures given in tables for pure tungsten cannot, therefore, be applied to numerical calculations on "tungsten" filament lamps.) It will be noticed that the flattening out of the current curve is greater for the gas-filled lamp than for the vacuum lamp.

Barretter Characteristics

Returning to the barretter, it can be seen from the figures that were quoted above that iron is a suitable material for a current-limiting resistance working on this principle, for it has one of the highest rates of increase of resistance with temperature in addition to a fairly high specific resistance. Hydrogen is chosen for the gas filling because it is a very good conductor of heat, besides being free from chemical action on the iron filament. The completed barretter has a characteristic which shows a nearly constant current over a voltage

Stabilising Power Supplies—

range of about 3 : 1, as shown in Fig. 2. The resemblance of the first two-thirds of this characteristic to that of the gas-filled lamp (Fig. 1, curve (*b*)) is easily seen.

In "universal" and DC mains receivers the use of a barretter in series with the valve heaters, in place of a simple voltage-dropping resistance, may be regarded as normal practice to-day. One of its advantages is that it avoids the necessity for change of tapping in order to adjust the receiver for mains of different voltages between, say, 190 and 260. It also tends to be more compact than a resistance of similar wattage, since its filament runs at a high temperature; but it must not be forgotten that it is actually dissipating the same power, and therefore requires good ventilation to avoid damage either to itself or to neighbouring components. A typical example of the use of a barretter in this way is to be found in the "DC Quality Amplifier" (*The Wireless World*, February 24th, 1938).

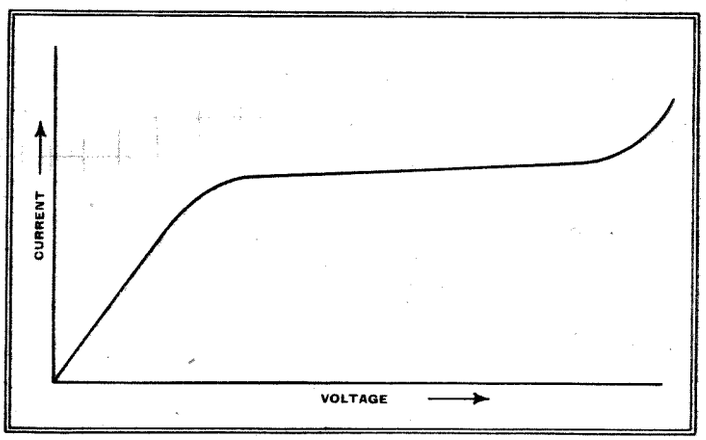


Fig. 2.—Showing how current through a barretter is maintained sensibly constant over a wide range of working voltages.

The action of a barretter seems at first rather mysterious, for its purpose is to maintain constant current, and this it is supposed to do owing to the fact that an increase of voltage causes its temperature, and therefore resistance, to rise rapidly; but its temperature can only increase as a result of a greater current flowing through it, and this increase of current we want to avoid. The fundamental point to consider, however, is that the heat lost from the iron wire by cooling must always be equal to the heat generated in the wire by the current. The factor which helps is, then, that the heat generated is proportioned to the square of the current and to the resistance of the wire, and as the resistance is increasing with the current, the heat generated is proportional to the *n*th power of the current, where *n* is quite a substantial number. Consequently, the change of perhaps 5 per cent. in current, which is permissible over the working range of the barretter, can produce a very much larger change, of the order of 100 per cent., in the temperature and resistance of the barretter filament, and this suffices to keep the current variation down to its low value over a good range of applied voltage. It is only over a certain temperature range, however, that there is a suitable relation between heat input and output. Both above and below this range (which is just below red heat) the current increases more or less in proportion to the applied voltage.

How Many Miles?

By T. S. E. THOMAS, B.Sc., Ph.D.

IT sometimes happens that the radio experimenter wishes to find his distance from some foreign broadcasting station. When the two places are less than, say, 1,000 miles apart this can be done by the well-known method of measuring the distance on a map with a ruler and converting to miles with the scale given on the map. If, however, the two places are in different continents, the distance as found by this method may not be even approximately correct. The error is caused by the unfortunate fact that it is impossible to make an accurate representation of an appreciable fraction of the earth's spherical surface on a flat map.

The shortest distance or "bee line" between two points on the surface of a sphere such as the earth is the arc of a circle known as the "great circle" which passes through the two points and has its centre at the centre of the sphere. When a large globe is available the shortest distance may be obtained from the length of a stretched string joining the two places on the globe, the length being converted to miles with the scale of the globe. If, however, a globe is not available then the only means of finding the great circle distance is by the aid of a formula used in spherical trigonometry.

The formula may be expressed in the form:

$$2\cos C = [1+\cos(b-b')]\cos(a-a') - [1-\cos(b-b')]\cos(a+a'),$$

where a, a' are the latitudes and b, b' the longitudes of the two places and C the great circle arc (in degrees).

When only an approximate estimate of the distance is needed the numerical calculations involved are unnecessarily tedious and can be avoided by the use of a nomogram which was devised by d'Ocagne and is reproduced here. Although the nomogram appears more complicated than the simple types in common use for radio calculations, the steps in the graphical solution of the formula can be easily followed with the help of the illustrative diagram. The steps are:—

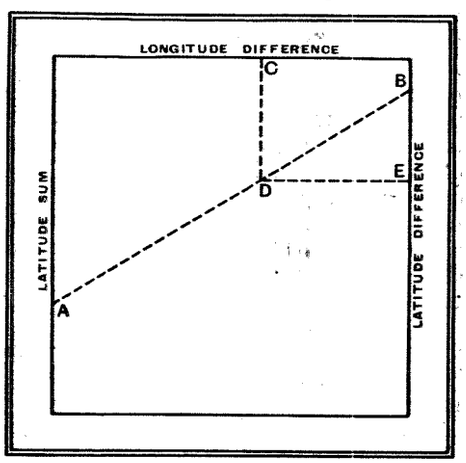
(1) Find the latitudes a, a' and the longitudes b, b' from an atlas or gazetteer and then find the sum $a+a'$ and the difference $a-a'$ of the latitudes, also the difference $b-b'$ of the longitudes.

(2) On the nomogram join with a straight line AB the points defined by $a+a'$, $a-a'$ on the opposite scales. A transparent straight edge is suitable for this purpose.

(3) From the point C on the longitude difference scale corresponding to $b-b'$ draw a perpendicular to the scale, meeting AB at D. Through D draw a perpendicular to the great circle arc scale which meets it at E. (Two sets of perpendicular lines at 5° intervals are drawn on the nomogram.) The scale reading at E is the length in degrees of the great circle arc joining the two places. (The latitude difference and great circle arc scales are identical numerically.)

(4) The length in degrees of the arc is converted into miles by referring to the double scale, which merely represents the relation 1 degree = 69 miles.

Two values of the longitude difference are possible: the one less than 180° is always used. When the two places are in different hemispheres the smaller latitude is taken to be a negative quantity, so that $a+a'$ is now numerically less than $a-a'$.



Showing procedure for obtaining from the nomogram the great circle arc between two positions.

EXAMPLES:

(1) Find the great circle distance between London and Tokyo. (London: Lat. 51° 30′ N.; Long. 0°. Tokyo: Lat. 35° 43′ N.; Long. 139° 44′ E.)

We have latitude sum 87° 13′; latitude difference 15° 47′, and longitude difference 139° 44′ E. By using nomogram we get great circle arc 86° and great circle distance 5,930 miles.

(2) Find the great circle distance between London and Buenos Aires. (London: Lat. 51° 30′ N.; Long. 0°. Buenos Aires: Lat. 34° 25′ S.; Long. 58° 15′ W.)

In this case, latitude sum is 51° 30′ + (−34° 25′) = 17° 5′, and latitude difference 51° 30′ − (−34° 25′) = 85° 55′; also longitude difference is 58° 15′. From the nomogram we get great circle arc 100° and great circle distance 6,900 miles.

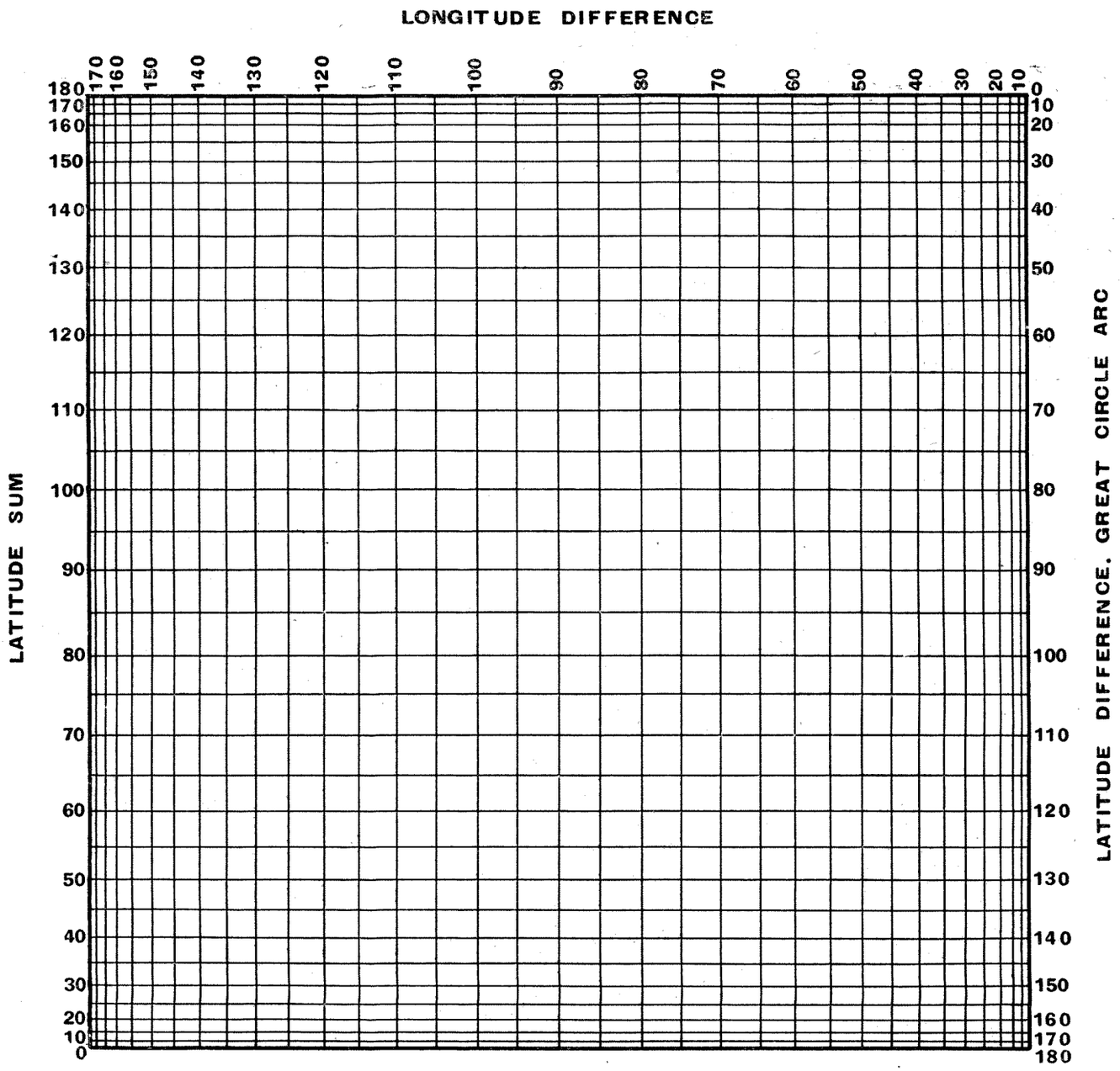
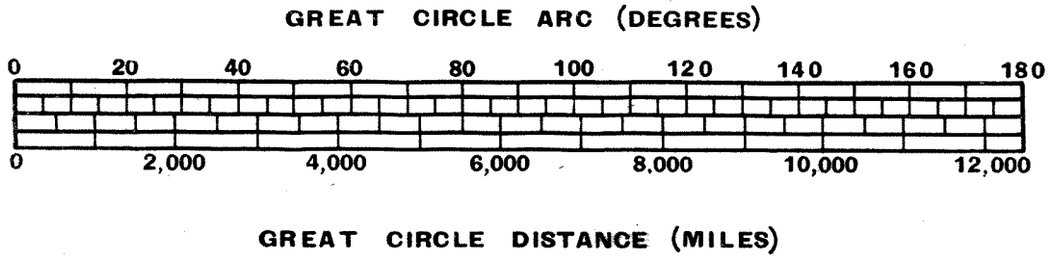


CHART FOR ASCERTAINING GREAT CIRCLE DISTANCES

The "bee-line" distance between widely separated points on the earth's surface is often required for wireless purposes, but by ordinarily available means it cannot be obtained with reasonable accuracy. The use of this chart enables the number of miles to be read off directly from the scale below with a minimum of trouble.



B.B.C. AND ULTRA-SHORTS

High-fidelity Prom. Relays

LOVERS of high-fidelity reception have frequently asked whether the Promenade Concerts were to be accorded the same treatment as the Toscanini Concerts, namely, their transmission by the television "sound" transmitter at Alexandra Palace. It will be remembered that the B.B.C. gave no guarantee or even hint that the experiment would be repeated; in fact, it was announced that the arrangements were "special and exceptional."

The Wireless World understands, however, that the whole question of ultra-short relays came up for reconsideration by the authorities a few days ago, and that, as a result, parts of each of the Promenade Concerts are being relayed on the television sound channel from 8 to approximately 9 p.m., when the normal television programme begins. This arrangement will be suspended during the special Radiolympia transmissions. The decision will, it is thought, also affect other programmes in the very near future.

With the hoped-for increase in the sale of television sets this autumn it is realised that a new section of the public will have access to the ultra-short-wave band. It has, however, to be remembered that the Alexandra Palace transmitter is intended primarily for a television service and to overload it with other work would be uneconomic. General relays should, therefore, be strictly rationed and, of course, restricted to periods which would not encroach on the service for which it was built.

AUSTRALIAN SCHOOL BROADCASTING

Exclusively Educational Stations?

IT is reported in the lay Press that the Australian Broadcasting Commission is considering the erection of broadcasting stations to be devoted exclusively to educational broadcasts intended for the back-blocks. We were informed by the London representative of the Australian Broadcasting Commission that while the Commission has always been alive to the possibilities of educational broadcasts, no such scheme as that outlined above has been contemplated.

At present a great number of educational broadcasts are given under the School Broadcasting Scheme. These programmes are radiated from twenty stations, covering the major portion of the six States.

It is expected that school broadcasting will come up for consideration by the new Commission which will be appointed in October.

RADIOLYMPIA TELEVISION SCHEDULE

THE television transmissions specially designed for demonstration purposes at Radiolympia this year are timed as follows:—

12 noon	—	1 p.m.
3.30	—	4 p.m.
6.30	—	7.15 p.m.
8.30	—	9 p.m.

This is with the exception of the opening day, August 24th, when the transmissions will not begin until 3.30 p.m. The programmes are in addition to the usual daily transmissions at 3 p.m. and 9 p.m., and they will be produced at Olympia in the glass-walled studio which will enable the public to see artistes at work before the cameras as well as the transmitted picture on the viewing screens of the demonstration receivers.

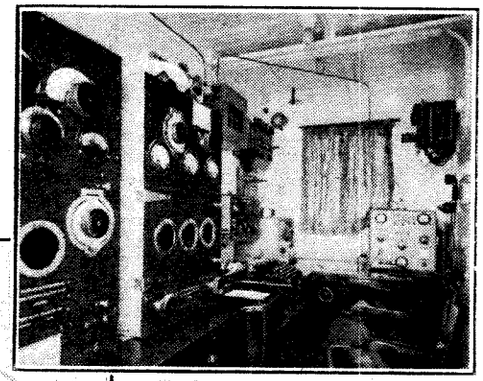
NEWS OF

MODERN YACHT'S WIRELESS INSTALLATION

FEW yachts have been fitted with such comprehensive wireless equipment as Mr. Bernard Docker's 834-ton *Shemara*, built by Thornycroft and Company. The apparatus, installed by the Marconi Company, permits of world-wide telegraphic communication and radio telephonic communication over several hundred miles. For telegraphic purposes the apparatus consists of a ½-kilowatt CW/ICW installation. There are two transmitters, one Type 381, covering 600-800 metres, and the other Type 398, covering 16-40 metres in four ranges. The medium-wave transmitter can be relied on for a working range of up to 1,000 miles. The associated receiver, Type 352A, which is capable of receiving spark, ICW, CW and telephony signals, covering the extremely wide range of 15-20,000 metres.

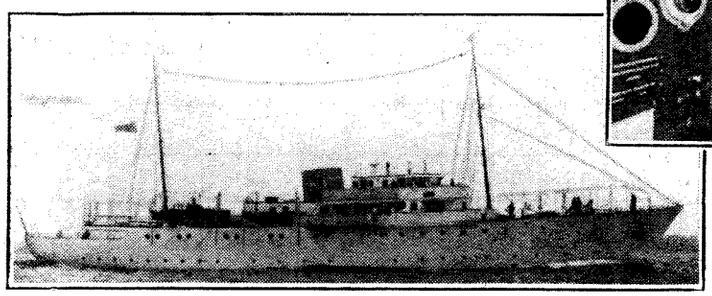
In addition, a radio telephone transmitter, Type TW12, which is capable of emitting signals within the small craft radio waveband of 100-250 metres, is installed. The robustness and utility of this instrument is instanced by the fact that it is of the type with which the Marconi Company has equipped many trawlers. The associated receiver, Type 394A, covers 100-2,000 metres, which, in addition to embracing the small craft and marine mobile bands, enables meteorological reports transmitted by various British and Continental stations to be received. This equipment also permits of two-way conversation with the Post Office shore stations and other ships.

A direction-finder, Type 579, has been fitted having a performance and degree of precision equal to that of apparatus used in transatlantic liners. A Marconi Echometer is also fitted, together with an automatic recorder which, when switched on, plots a permanent and continuous record of the contours of the sea bed. When a continuous record is not required the depth can be seen on a visual indicator by means of a "peak" of light flashing on a graduated scale.



ELABORATE WIRELESS EQUIPMENT has been fitted in the new luxury motor-yacht *Shemara*, the wireless room of which is shown, right.

(Photos.: Courtesy of "Yachting World")



BROADCASTING IN MADRAS

Short-wave Village Receivers

A UNIQUE feature of the broadcasting development in the Madras Presidency, where a short-wave station was recently opened, is the installation by the Government of Madras of short-wave receivers for villages over a large area. The use of village receivers for short-wave listening is a new development, for it is only by the use of such a service that communities at such distances as 300 miles away from the transmitter can be served satisfactorily during the summer months when atmospherics are at a minimum.

Consistent with the principle of development adopted by All-India Radio, the Madras centre includes a low-power medium-wave station (0.25 kW) and a 10-kW short-wave station. The medium-wave station is situated in Egmore, Madras, where are also the studios and offices, whilst the short-wave station is some six miles south of the city at Guindy. The medium-wave transmitter gives a reliable service for the city, whilst the short-wave station covers the Presidency, which is approximately 1,000 miles from north to south and 500 miles across from coast to coast.

SNOWDON 56 MC/S TESTS

IN view of the interest taken in the recent 56 Mc/s tests from Snowdon, Mr. David S. Mitchell, GW6AA, will be carrying out a further series on September 9th, 10th and 11th. Incidentally, the last two dates coincide with the GW 56 Mc/s Trophy Contest.

Times (B.S.T.) of operation will be as follow:—

Friday, September 9th, (20.30-21.30 CW only.)		19.30-22.30
Saturday, September 10th, (14.30-15.30 CW only.)		12.00-23.30
Sunday, September 11th, (14.30-15.30 CW only.)		09.30-20.00

Schedules with stations over eighty miles distant are wanted, and all reception reports will be appreciated and acknowledged by Mr. David S. Mitchell, GW6AA, The Flagstaff, Colwyn Bay, North Wales.

In addition to other aerials a bi-directional beam array, consisting of eight vertically-stacked di-poles, fed in phase, will be used. This will be directed along a line drawn from Sligo, I.F.S., to South Foreland, Kent, and should effectively cover Dublin, Shrewsbury, Wolverhampton, Birmingham and Coventry. It is hoped that as many stations as possible along or near this line will co-operate.

While on Snowdon Mr. Mitchell will be pleased to listen for any station on 112 or 224 Mc/s, and to reply on 56 Mc/s.

THE WEEK

WIRELESS PIONEERS

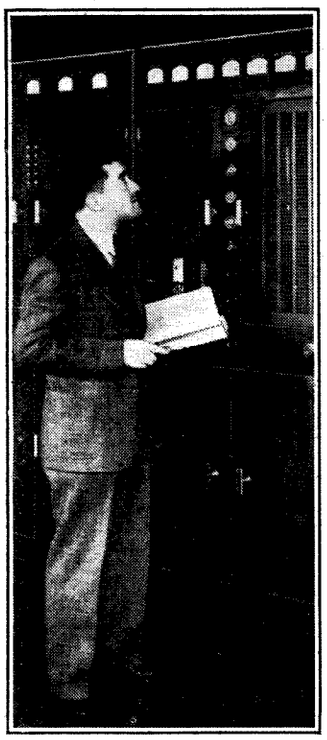
After Forty Years of Service

AUGUST, 1938, marks the completion of forty years' service in the Marconi Company by two of the best-known living wireless engineers. Mr. P. W. Paget and Mr. C. E. Rickard joined the company in 1898 as technical assistants to the late Marchese Marconi, and they are respectively the second and third engineers of the company to complete forty years in its service, the first being Marconi himself, who died on the fortieth anniversary of its foundation.

They have been closely associated with such historic experiments as the transmissions from the Needles wireless station in the Isle of Wight and at Bournemouth in 1898, and three years later with the work in Newfoundland which resulted in the reception of the first wireless signals across the Atlantic.

Mr. Paget was intimately associated with Marconi in his experiments for some time after that date, and when the engineering staff of the Marconi Company increased in size he continued until quite recently to carry out valuable work in other departments of the company. He enters upon his retirement with the good wishes of his many friends throughout the world.

Mr. Rickard, who will continue in the company's service, has in later years been associated with the development of wireless services in all parts of the world. He has taken part in practically every international conference on wireless matters and his friends wish him many years of continued service.



A FIFTY-KILOWATT medium-wave transmitter has been built for the Teatro Colon in Buenos Aires, primarily for the purpose of bringing opera into the homes of listeners. The transmitter, which was built by the Compania Standard Electrica Agentina, is the first high-power station outside the U.S.A. to use the new high efficiency Doherty amplifier developed by the Bell Laboratory. Mr. Doherty is shown standing beside the amplifier unit. The aerial, a shunt-excited earth vertical radiator, 778ft. high, is the highest of its type in the world.

B.B.C. MOBILE FILM UNIT

Not to Rival News Reels

WATCHERS on the terrace at Alexandra Palace last week saw the arrival of the B.B.C.'s latest outfit on wheels—a mobile film unit comprising camera, sound head, and all the necessary equipment for making "shorts" and general interest films for television purposes. We understand, however, that there is no intention to rival the news reel companies, even if this were possible, which it is not. The intention is simply to improve the already existing arrangements for gleaning short lengths of film for inclusion in television plays. The addition of sound equipment is a useful innovation. Hitherto it has been necessary to rely on records for effects and "noises off."

TWO FAMOUS VOICES

AT the time of going to press the advance programme schedule of the B.B.C. brings two of the most famous radio personalities on to the air next Sunday at the same time.

Christopher Stone, most popular B.B.C. speaker of his day, appeals on behalf of the Sussex Diocesan Association for Deaf and Dumb at 8.45 p.m. in the National programme. On the Regional wavelength at that time C. H. Middleton, who is undoubtedly Christopher Stone's successor in the public esteem, will be appealing for funds for the Swiss Cottage School for the Blind.

Whether this "clashing" of personalities is intentional or not, it is surely an outstanding example of mismanagement.

HIGH-POWER STATION FOR ICELAND

THE beginning of the month saw the inauguration of the new 100-kW long-wave Marconi broadcasting station at Reykjavik. The opening ceremony was witnessed by H.R.H. Crown Prince Frederik of Denmark, and the station, working on 1,442 metres, was started up by H.R.H. Crown Princess Ingrid.

An order for the erection of a 1-kW relay station to operate on a medium wavelength has been placed by the Icelandic Government. It is to be installed at Eidar, on the east coast of Iceland, and will relay programmes radiated from Reykjavik.

WIRELESS APPRENTICES IN THE ARMY

OF the 2,428 apprentices now undergoing various courses of specialised training in the Army, 212 of them are at the Wireless Training Centre, Catterick. Of this number 107 are taking a course as instrument mechanics or component makers, 70 are training as operators, and 35 as electricians and part assemblers.

An exhibition illustrating the type of work which apprentices are put to was opened last week at Charing Cross Underground Station, London. It will remain open until August 13th.

FROM ALL QUARTERS

Radio Sofia: New SW Transmitter

BULGARIA is suspending transmissions from its short-wave station, LZA, at Sofia, which works on 35.44 metres, preparatory to the inauguration early next year of a new 20-kilowatt transmitter. The present 1.5-kW plant, it is understood, will be used for wireless telegraphy.

Short Waves Replace Cables

IN the Scandinavian Post Office's original scheme for its extensive expansion of the inter-State telephone services it was proposed to lay new cables between Denmark and Sweden and Denmark and Norway. It has, however, been found that the cost will be much less and that the 'phone rates can be reduced by some 50 per cent. if short-wave telephone links are used instead of the proposed cables.

Golden "Mike" for Radio Operator

THE traditional gold watch is out-dated for presentation purposes, at least as far as radio achievements are concerned. Richard R. Stoddart, the N.B.C. engineer who accompanied Howard Hughes on his recent round-the-world flight, was, on July 26th, presented with a gold microphone at a luncheon in his honour at Radio City, New York. In addition, Mr. Stoddart was handed an illuminated scroll citing his achievements in radio and aviation.

I.W.T. PRESIDENT. For the third year in succession Mr. Sydney A. Hurren, head of the Department of Radio Technology at the Northern Polytechnic, London, has been nominated for election as President of the Institute of Wireless Technology.

Finnish Television

FOLLOWING the decision of the Finnish Government to undertake the arrangement of the next Olympic Games contests, the Finnish broadcasting organisation, Suomen Yleisradio, is taking a greater interest in television. It is rumoured that it is negotiating with a German firm for the installation of a television transmitter and the provision of a number of television rooms (Fernsehstuben) in various parts of Helsingfors.

Listen for These

THE Oxford University Expedition in Greenland may be heard on the 20- and 80-metre amateur bands using the call-sign OX7OU. Readers' reception reports may be addressed to Mr. Andrew Croft, Leckhampton House, Cambridge. Signals emanating from an American Expedition in the Belgian Congo are also being radiated on the same wavebands with the call-sign OQ5ZZ.

2½-metre Experiments

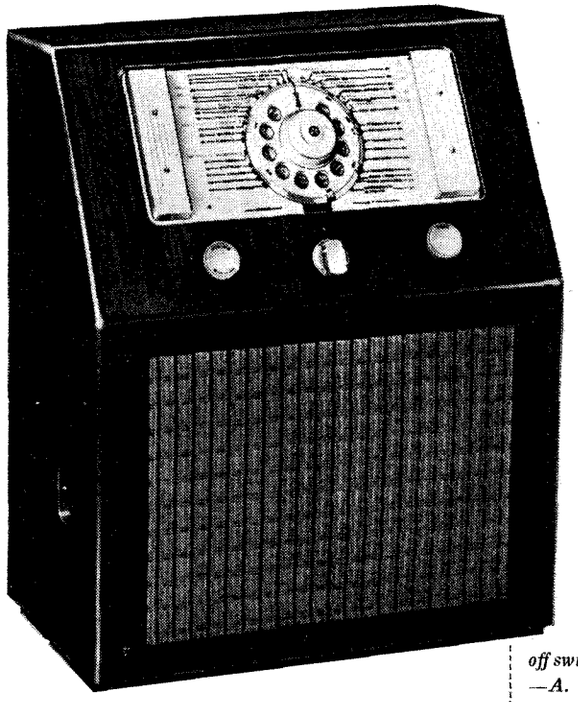
MR. J. N. WALKER, G5JU, of Bristol, is attempting to organise a 112-megacycle (2½-metre) link-up of interested amateurs. Those who contemplate either transmission or reception on this ultra-high frequency should communicate with Mr. Walker at 4, Frenchay Road, Bristol.

B.B.C. Theatre Organ

IT is fitting that, prior to his relinquishing on November 1st the position of Staff Theatre Organist, Reginald Foort has written a booklet describing in a very pleasant and non-technical manner "one of the grandest and most versatile and satisfying organs in the world"—to use his own words. This well-illustrated 16-page booklet, "The B.B.C. Theatre Organ," is published by the B.B.C. at 1s. Incidentally, tonight (Thursday), at 9.30, National listeners will be given a demonstration by Foort of the apparently inexhaustible variety of sounds which can be produced from the instrument.

Cossor MODEL 397

A Well-Designed Chassis Incorporating a Mechanical Station Selector



FEATURES.—***Waveranges.*** *—(1) 16-52.5 metres. (2) 195-560 metres. (3) 810-2085 metres.* ***Circuit.***—*Var-mu pentode RF ampl.—triode-hexode frequency changer—var.-mu pentode IF ampl.—double-diode-triode 2nd det., AVC rect. and 1st AF ampl.—triode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) "Teledial" station selector and slow-motion tuning control. (2) Volume. (3) Waverange. (4) Tone and var. selectivity. (5) Mains on-off switch.* ***Price.***—*11½ guineas.* ***Makers.***—*A. C. Cossor Ltd., Highbury Grove, London, N.5*

THE tuning dial is the feature which attracts first attention in this receiver. Its appearance is striking and its functional design includes many original ideas in addition to the now almost universal feature of automatic tuning.

Ten settings are provided by the telephone-type dial, giving a choice of eleven stations, since Luxembourg on long waves and London Regional on medium waves are arranged to coincide. These stations, together with Droitwich and the Nationals, are adjusted at the works and the remaining seven settings are left to the customer or his dealer. A station name sheet is supplied from which discs may be cut for insertion under celluloid covers in the finger-holes.

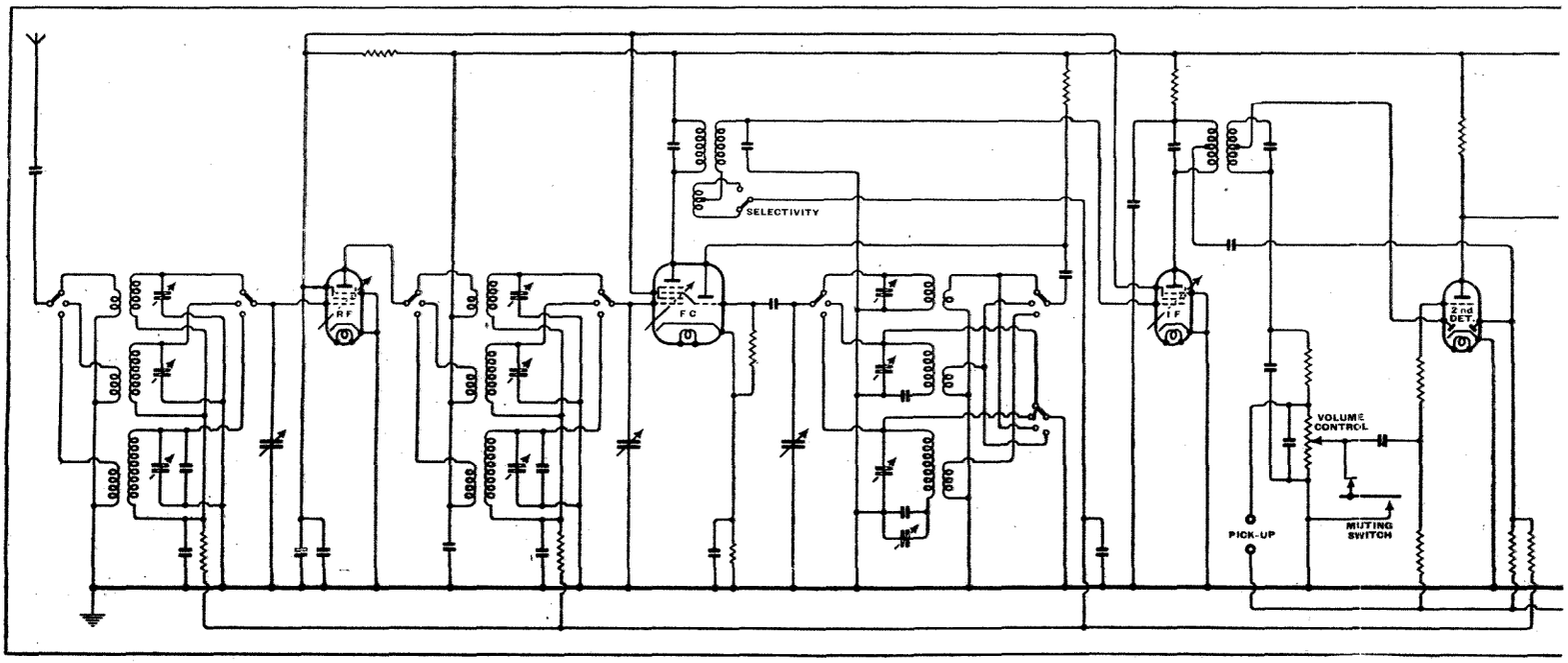
The selector does not call for separately adjusted trimmers, but works on the principle of locating the main tuning condenser at predetermined points by adjustable spigots on the arms of a selector plate. The act of depressing the arms also mutes the receiver so that intermediate stations are not heard when passing from one setting to another. The dial is geared to reduce its 300-degree rotation to the 180 degrees required by the condenser and is also provided with an auxiliary slow-motion drive for fine tuning on short waves or for general listening. The ease with which the "Teledial" can be switched from one part of the scale to another when using the set as an ordinary receiver is a welcome relief from the comparatively laborious rotation of the conventional two-speed drive.

More than forty medium- and long-wave station names are marked on the rectangular space surrounding the dial. Indirect illumination is provided by pilot lamps under detachable shields at each side. No wavelength scale is provided, but the wavelength of each station is given alongside its name, and interpolation is easy if intermediate settings are required at any time. The range of adjustment given to each finger-hole is sufficient to overlap its neighbours and a key is provided for setting to any of the stations falling within its territory.

On the short-wave range no wavelength or frequency scale as such is provided, but the amateur and broadcast bands are indicated and each is sub-divided arbitrarily into from 10 to 40 "degrees." Thus one might log a station as "37 on the 40-metre amateur band"—a very practical, if unconventional, method and one which should go a long way to ease the difficulties of those in search of entertainment on a waveband devoted mainly to commercial traffic.

When so much trouble has been taken over what may be termed an external feature, it is very gratifying and somewhat unusual to find that the circuit and chassis show a corresponding advance in design. This receiver can justly claim to be included in that select group of sets which we would describe as "finished de-

The circuit includes an RF stage and two degrees of selectivity are provided in the IF amplifier. The automatic tuning device being essentially mechanical does not show in the circuit diagram.



signs." So many sets give good promise by high sensitivity or pleasing quality of reproduction and then disappoint by placing a self-generated whistle on one's favourite station, or by too limited an AVC action on short waves. The Cossor Model 397 makes no such reservations, and after working systematically through the usual series of tests we were still able to maintain our first favourable impressions.

The quality of reproduction has that clarity which one always associates with a triode output valve properly biased and matched, and is notable for a remarkably fine bass response, which reason says must be artificial in a table model, but which is, nevertheless, very acceptable to the ear. The volume control is well graded and there is a tone control combined with the variable selectivity switch for those who require something less than a just balance between high and low notes.

Negligible Interference

Reception on the medium-wave band is as clear and bold as the tuning dial itself. There are no self-generated whistles either from second-channel interference or from overloading of the frequency-changer on the local station. Selectivity permits an approach to the London Regional within 1½ channels on either side at a distance of 15 miles, and the sensitivity is exceptionally good. On long waves the Deutschlandsender is not only clear of interference from its neighbours in wavelength but is lifted by the AVC to a comparable volume level without undue background noise. A good signal-to-noise ratio and AVC much above the average are appreciated best of all on the short-wave range where signals are steadier and more serviceable than usual. During the period of our test, atmospherics were bad, and the short-wave range was often the most pleasant to explore. Second-channel repeat points are absent, even at the lower end of the scale.

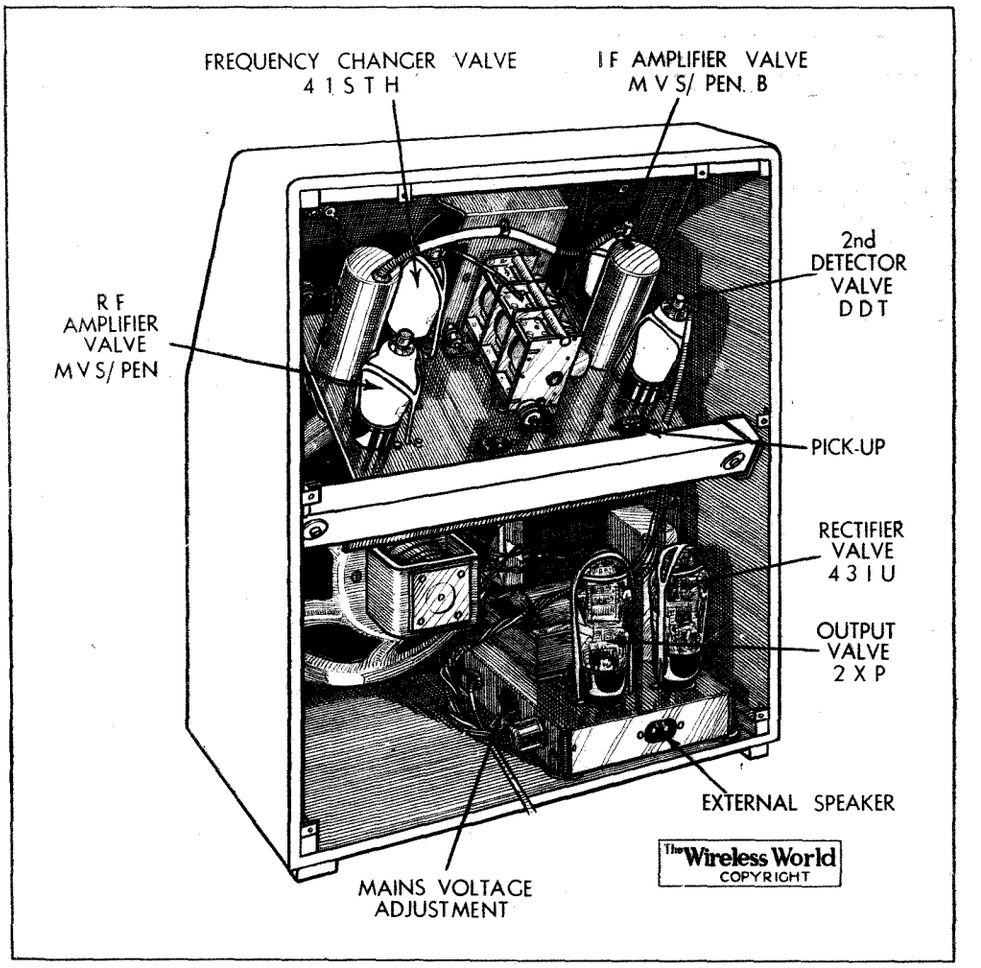
Looked at from every angle, this is undoubtedly one of the best sets which Cossor have turned out, and may well prove a landmark in the history of the firm's development.

The performance is to some extent accounted for when we look into the circuit diagram and the specification of components. Separate tuned transformers with optimum coupling on each waveband precede the RF amplifier, which is tuned-transformer coupled to a triode-hexode frequency-changer. There are thus two tuned circuits before the frequency-changer, which accounts for the good signal-to-noise ratio and low second-channel interference. The oscillator section of the main tuned condenser has vanes specially shaped to avoid the necessity of a padding condenser on short waves. An unusual form of switching is associated with the oscillator circuit, and some of the reaction coils, as well as the tuned circuits not in use, are short-circuited. In the short-wave coils the turns are located on grooved formers to ensure frequency stability, and a new type of moulding material has been adopted for the purpose.

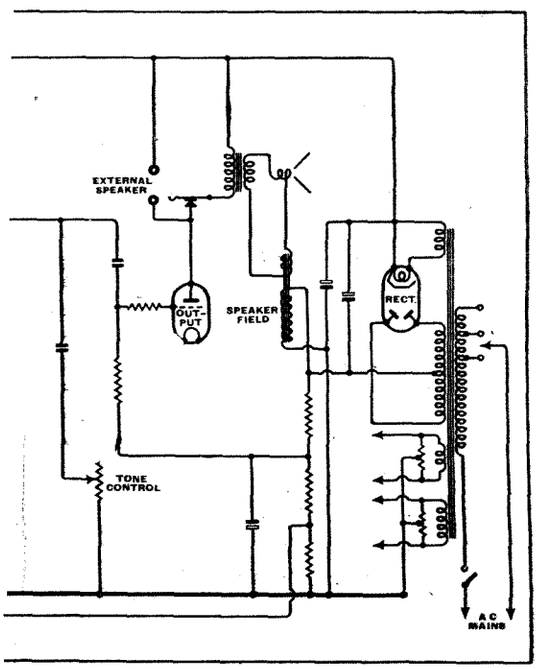
In the IF stage, frequency stability has again been given careful consideration, and permeability-tuned, iron-cored coils are used in association with fixed silver-sprayed mica condensers. Two degrees of selectivity are provided by the well-tried method of switching in a third circuit to modify the coupling. Both input and output IF transformers are adjusted simultaneously at the works by means of the latest Cossor double-beam, cathode-ray tube. The output IF transformer is centre-tapped on both primary and secondary to match the loading of the AVC and signal diodes, and the muting switch associated with the "Teledial" is connected to the grid circuit of the triode amplifier portion of this valve. Resistance-capacity coupling is used between the first AF stage and the 2XP triode output valve.

Unit construction has been adopted, and the power pack and output stage are mounted as a separate unit below the receiver chassis proper. In the latter the tuned coils are also assembled in units comprising the aerial, RF coupling and oscillator circuits. The cabinet is well finished, and its shape lends itself to a good layout for the loud speaker and the two chassis from the acoustic point of view.

Sockets are provided for the attachment of a gramophone pick-up, and there is a switch-type extension loud-speaker plug which may be used to cut off the internal loud speaker if desired. As the jack switch breaks the HT supply it is important that this should not be inserted unless an external loud speaker is connected.



A 10-inch loud speaker gives excellent quality of reproduction aided by the cabinet design and the damping afforded by the triode output stage.



Things to Come

THOUGHTS ON THE RADIOLYMPIA AFTER NEXT

By "CATHODE RAY"

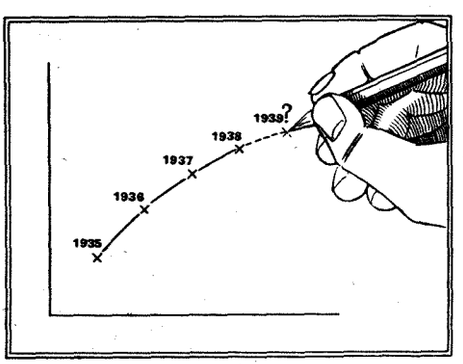
VERY soon now you will be hearing all about the trend of design as reflected in the exhibits at Radiolympia. There will be reports of what has actually been accomplished in preparation for the coming season. Another point will be plotted on the graph of progress, allowing the curve to be extended for another twelve months.

When a curve has been found to have a certain trend there is a temptation to think it is bound to go on a little farther in the same direction. Balloons can be sent up to measure the temperature at increasing heights, and from these readings a graph of temperature against height shows a downward trend. By extending the curve a little way beyond the height point to which balloons can ascend, the temperature at still greater heights can be known. Known? Guessed at! Not an entirely wild guess, for there is at least a probability that it will continue in a similar way for at least a little distance. But it might suddenly reverse. How many people have been caught this way with share prices? Just hold on till the price goes up a little bit more before selling! And a horse that has won this and that and the other is *bound*, by all the rules of form, to win the next race. Perhaps!

So extrapolation (as this extension is called) is thoroughly unsound practice. And as it is therefore universally popular I propose to indulge in it a little.

In the first era of broadcast receivers they consisted of miscellaneous boxes and batteries and horns strung together with wires. In the second, now on, they have been tidied up into neat cabinets containing everything. I have a conviction that the third will be the built-in era.

In the early days, *operation* of the receiver was everything. One spent hours at the knobs. It was almost an unknown thing to leave them and sit back and enjoy the programme. Things have already moved on so far from this that the time spent in turning the one remaining tuning knob from National to Regional is a bore, and in the coming season probably every maker will be offering sets with push-button tuning. Soon the general public will no more expect to have to devote even a few seconds' attention to getting the desired programme than they expect to have to adjust the electric light switch with some care in order to turn it on. The programme is everything, and the means of getting it are taken for granted. There will be enthusiasts, of course, just as there are still keen motorists who do their own tuning for speed; but the great majority have no desire to know the intimate details of either carburettors or frequency-changers.



Can we safely apply the principles of extrapolation to forecasting radio progress?

The next step? Remotely controlled built-in equipment for domestic broadcast reception

So instead of radio being something tacked on to the house as an afterthought it will be taken for granted. In pre-war days, after you had paid an incredibly stiff price for a car the salesman got a voluminous notebook and pencil and said, "Now, Sir, what about lamps, horn, spare tyres, tools, pump, repair outfit, etc.?" And the selected accessories were duly clamped on to any convenient projections of the vehicle. Now, of course, these and many more often used items are built into the original design. And in taking over a house one does not expect to have to install lights and water pipes and drains and so forth.

A good reason for radio having hitherto been a loose accessory is that it has been evolving too rapidly to risk building-in. But during the last year or two there has been less revolutionary change. So far as appearance is concerned it has solidified into a rather expressionless form resembling a tombstone or (as "Diallist" has aptly pointed out) a gas fire. The proper form for radio has been argued over and over again with no very satisfactory conclusion. Is not the lesson that it is meant to have no characteristic or individual form but is really part of the structure of the house? Some receivers already go so far as to have no dial tuning at all; only a row of buttons. These can just as well be let in flush with the wall, like modern lighting switches.

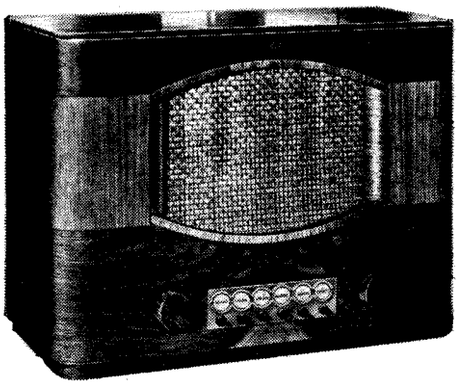
And talking about lighting, what would we think of neighbours who said of electric light: "This is a fine thing, let us have it all concentrated in one room; when we want light we will come into this room, and, anyway, perhaps enough of it will stray out to give a little light in the other rooms if we put in enough 100-watt lamps and leave the door open"? Yet that is how the majority still treat radio, though it costs less to have a built-in extension wire and a loud speaker than to have light extended from one room to another. The less important rooms can have less expensive speakers, of course, just as they have less expensive lighting fittings.

The receiver can be in any convenient place, like a fuse and distribution box. Already remote control of switching on and off is quite cheap, and each speaker can have its volume control. Remote control of station selection is not quite so satisfactory; it can be done, but it is expensive. Seeing what has already been accomplished there seems to be no reason to doubt that this problem, too, can be solved if the design and production people have a mind to.

It looks as if radio may more and more resemble telephone equipment, with relays, automatic dials, multi-core wiring, and standardised switches and units. And

Things to Come—

when built-in equipment has become general, unless any extrapolation-upsetting developments occur, a permanent dwindling in receiver sales is to be expected. The radio industry is slow to learn the lesson that a continuous and rapid expansion of output is not one of the fundamental principles. The last season has been disastrous for some firms. But already there is a definite tendency in business to look on radio as one of many domestic electrical needs. Not only so, but it is becoming just one of many *electronic* applications. There is a vast potential market for industrial and other applications of the electronic devices that were invented for, or at least greatly stimulated by, radio—valves, cathode-ray tubes, photo-cells, etc.



"No tuning dial; only a row of buttons." One of the new Invicta sets.

A considerable number of radio manufacturers have abandoned their original object entirely; and others, including some of the best-known names, now make in addition electric fires, refrigerators, irons, washing machines, telephones, and other things. So it may be that in years to come radio will lose its status as a separate industry.

There is one extrapolation-upsetting element already here. Where can television be fitted into this shape of things to come? A possibility, not quite minute enough to be neglected, is that it will prove to be a huge fiasco, not justifying the great expense necessary to keep it going. At the other extreme there is the belief that in time it will entirely oust blind radio, just as talkies have supplanted silent films. A middle view envisages both systems continuing side by side, like motor cars and push bikes on the roads. The motor vehicle, although it has developed enormously, has not only failed to supersede those propelled by direct human effort; it has not prevented them from increasing in numbers. Television . . . but I think I have speculated enough already to-day!

Demonstrations at the Show

TECHNICAL details of the arrangements made for demonstrations of broadcasting and television reception on the stands at the forthcoming Olympia exhibition have now been announced by the Radio Manufacturers' Association. The aim has been to simulate actual reception conditions, controlled only to the extent of preventing the cacophony which would result from unfettered reception. For this purpose transmitting and relay equipment is being installed, and standardised signals are being distributed by co-axial cables to the exhibitors' stands which are being equipped with outlet points simulating normal receiving aerials.

Television System.—Under normal conditions the television programme will be relayed from Alexandra Palace, the signals being picked up by an aerial (dipole with reflector) on the roof of Olympia, and amplified in a broad-band power amplifier, the output of which is distributed on the basis of one cable to each stand taking the programme. There will also be a small television transmitter, modulated by signals from the Radiolympia studio.

The outlets on the stands will be unbalanced concentric cables with a characteristic impedance of the order of 90 ohms, and the signal will be of the order of 20 millivolts for full white picture.

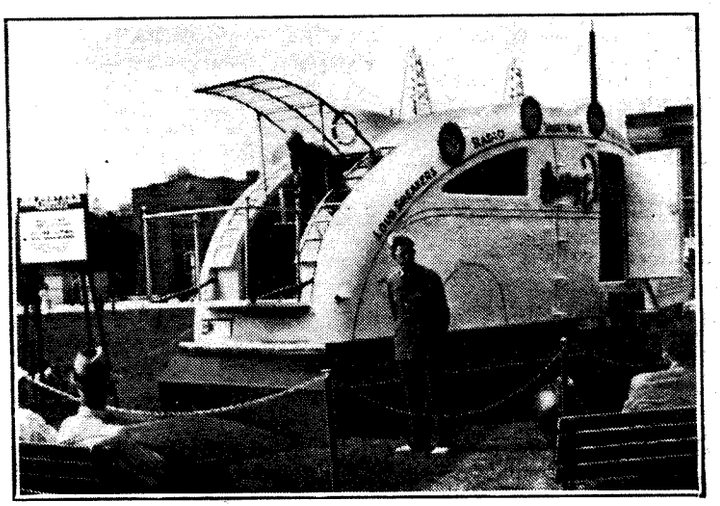
Medium-wave System.—Two medium-wave transmitters will be provided, taking the same basic programme, which will normally be the sound part of the television programme; when this is unsuitable, or when there is no television programme, the transmission will consist of either a B.B.C. Regional or National programme, or else of suitable gramophone records. The two medium-wave transmissions will be:—

Radiolympia Local on 800 kc/s (375 metres) with an intensity of approximately 20 millivolts; this is a high-fidelity transmission, the frequency-characteristic of the whole system being flat within 1 db from 30 to 12,000 cycles, and the harmonic distortion being less than 3 per cent. for 90 per cent. modulation.

Radiolympia Distant on 895 kc/s (335 metres) with an intensity of approximately 2 millivolts. This transmission will be accompanied by two others, to simulate typical adjacent-channel interference; these will be some 30 db lower in intensity and spaced 9 kilocycles above and below the carrier.

These two transmissions will be distributed by means of broad-band power amplifiers, feeding a system of co-axial cables, from which the various stands are "teed-off," the outlets on the stands having attenuators and networks to minimise the risk of interference being carried by the feeder system from one stand to another, and also to give the correct output level and impedance; this latter corresponds to the recommendations of the R.M.A. Set Testing Sub-Committee.

These two signals *only* will be distributed on the medium wave-band; it may be possible to receive other stations on some receivers; but, according to the R.M.A. statement, reception of other stations will imply either an accidental set of conditions or else a bad receiver.



News from the Clubs

Brentwood and District Radio Society

Hon. Pub. Sec.: Mr. A. H. S. Scott, 2, Norfolk Street, London, W.C.2.

The Society held their first DF field day on July 24th. Members of the Ilford, Southend and Romford Societies participated, several well-known amateurs being present. At the subsequent tea, the cup was presented to the winner, G6CT, of Southend. It is hoped that the Essex societies will combine to hold several joint field days in the future.

Romford and District Amateur Radio Society

Headquarters: Y.M.C.A., Red Triangle Club, North Street, Romford.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. R. C. E. Beardow, 3, Geneva Gardens, Chadwell Heath.

The Society has now settled down at the new headquarters, and the first evening was spent doing Morse practice and making final arrangements for the district DF field day, three teams for which have been entered from the club.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne.

At the July 25th meeting Mr. F. G. Wingfield explained the Society's five-metre transmitter, which was designed and built by himself. The transmitter consists of a "6A6" tuned plate-tuned grid oscillator which is choke-modulated by a "6L6G," HT being obtained from an "80" rectifier. Later Mr. G. Catt gave an account of the super-regenerative quench receiver, and demonstrated a three-valve model of his own.

A PRIVATE MOBILE STATION

A WELL-KNOWN Canadian sports commentator, Harry Foster, is now using a mobile studio, which has been designed specially for him by a radio engineer, Howard R. Hilliard. This £3,000 unit, the interior of which is lined with acoustic board backed by spun glass, is fitted with a 32-watt public address amplifier, the output of which is fed to Celestion loud speakers set in the side of the van, and a broadcast line amplifier, which has four low-impedance inputs. The output from the 14ft.-long studio, which includes a piano and has accommodated a choir of sixteen voices, can be simultaneously fed to the PA amplifier and the line amplifier. For ease of manipulation all the controls are located in the front of the car.

The unit has its own power supply, which is driven from the engine of the car. The rating is 400 watts, the normal voltage being 110.

First Steps to Transmitting

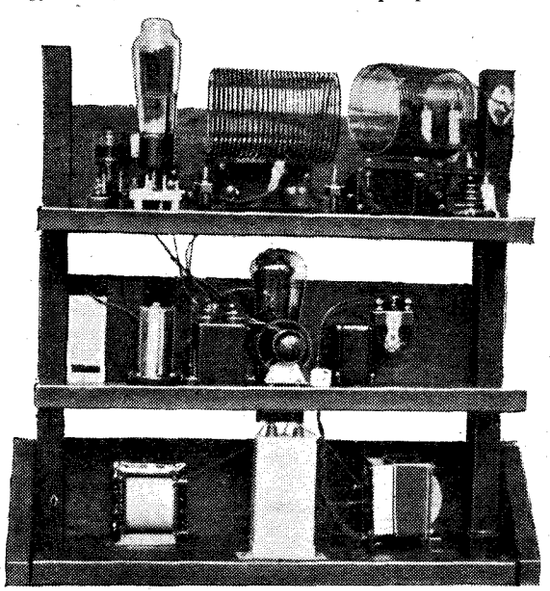
By H. B. DENT, G2MC

A corner of Amateur Transmitting Station G6DH.

OBTAINING A LICENCE—AMATEUR WAVEBANDS—SPECIAL CODES

AS a pastime, wireless transmission offers an attraction that few, if any, other hobbies can rival, for it enables a close and often intimate contact to be made with others having the same interest in all parts of the world. Friendships are made and endure, cemented by the common bond of radio, yet the people concerned may never meet face to face.

There are no national or linguistic barriers, for in amateur circles a language understood by all is employed which, though basically English, would probably cause some distress to students of etymology. Nevertheless, it serves its purpose quite well, even though it has many shortcomings.



A simple two-valve transmitter designed for both telephony and telegraphy that was described in *The Wireless World* of June 11th, 1937.

Of those who listen extensively on the short waves many, no doubt, wish that they also could take an active part, especially when an operator of an amateur station is heard exchanging ideas or describing some new aerial system recently installed, and which has probably made a marked improvement in the signal strength, with another perhaps several thousands of miles away.

Fortunately, in this, as in many other countries, amateurs are permitted to install and operate wireless transmitters, but only under licence by the competent authority, who in Great Britain is the Postmaster-General.

For obvious reasons, indiscriminate use of wireless transmitters could not be allowed, especially as the short waves are now so fully occupied by essential Government and commercial services. Amateurs are restricted to certain narrow bands of wavelengths and the limits laid down must not be exceeded. Encroachment on other people's territory is one of the worst offences an amateur can commit.

A fairly good knowledge of the operation of a wireless transmitter is necessary before a licence to radiate signals will be granted. On the other hand, permission to build and experiment with transmitting equipment can be obtained if a non-radiating aerial is employed.

This might be regarded as the first step, as it enables the beginner to acquire the necessary skill and to familiarise himself with the equipment before actually going "on the air."

Of course, every applicant should have in mind some definite line of experimental work. If it can be carried out without the need to radiate a signal the licensing authority might decide that an AA (artificial aerial) permit will suffice.

The design of transmitting aerials and directional arrays of small physical dimensions offers a field for useful amateur activity, while circuits of high efficiency giving the maximum amount of radio-frequency energy in the aerial for a given input power would make a useful contribution to the general fund of knowledge.

The ultra-high frequencies are as yet an unknown quantity, and the amateur might usefully employ his time in investigating the propagation of waves, aerial design and other matters in connection with this part of the radio spectrum.

The authorities require fairly full details of the actual experiments it is proposed to undertake before issuing a licence to transmit. For permission to use a radiating aerial it is necessary to possess a good knowledge of the morse code, and each applicant has to pass a test at 12 words per minute.

There is a good and sound reason for this. Although only telephony transmissions may be contemplated, the ability to read morse is essential, for should one's signals be causing interference with any Government or commercial station operating on the short waves, the affected station might find it necessary to acquaint the amateur station with the facts by radio. As the majority of such stations are not equipped for telephony any message of this kind would be sent out in morse.

Even were no such stipulation made, the amateur in his own interests should know the morse code, as a very large number of amateurs eschew telephony and carry out all their tests on CW. Furthermore, it is simpler and cheaper to build a CW transmitter than one for telephony.

Initial Outlay

The financial aspect of transmission may have to be taken into account, and it will be encouraging to those who are attracted by the subject to know that a simple low-power transmitter for CW operation of, say, 10 watts input, can be built for about £6, or even less by adapting any suitable receiving-type components for the purpose.

If telephony is required the cost will be greater, although there are some modulation systems that do not add much to the cost of the equipment. A telephony transmitter need not cost more than about one and a half to twice the price of a simple CW set.

These must be regarded as minimum prices, for if the very best materials are used the cost can be anything the builder likes to make it.

Since there is so much to learn regarding the correct operation of a transmitter, the

First Steps to Transmitting—

beginner would be well advised to become thoroughly acquainted with the subject by making all the initial experiments and tests with a non-radiating aerial. As already stated, it is first necessary to obtain a licence from the P.M.G.

A call sign is allotted but without the international prefix G, and it consists of three letters preceded by a figure. The call sign allotted to holders of a full licence comprises a figure and two-letter combination with, of course, the country of origin prefix.

For the AA licence (artificial aerial) an annual fee of 10s. only is required, and the applicant does not have to pass a test in morse.

The annual fee for a radiating aerial licence is £1, and 5s. has to be paid to cover the Post Office expenses of the morse test. This permits the use of a power of 10 watts, which is the power input (anode volts × anode current) to the valve or valves delivering the RF oscillations to the aerial. Under certain conditions the use of more than 10 watts is allowed, but this privilege is generally only granted after some experience has been had with the low-power apparatus.

The normal transmitting licence covers the use of wavelengths of the order of 160, 42 and 21 metres, but by special permission of the Postmaster-General the 5- and 10-metre wavelengths may also be used. There is also an 80-metre waveband in which amateur stations are allowed to transmit, but for this special permission has to be obtained.

The full extent of these wavebands is given in the following table. These are a shade narrower than those assigned by international agreement, there being a restriction of 5 kc/s each end on the 1.7, 3.5 and 14 Mc/s bands and 10 kc/s on the 28 and 20 kc/s on the 56 Mc/s bands.

These wavebands are harmonically related, a very convenient arrangement as the beginner will find when he commences to design a transmitter for use on two or more of the amateur frequencies.

The fact that the even harmonics will fall within amateur territory is of interest, but it does not mitigate the offence of knowingly radiating harmonics yet taking no action to suppress them. For it must not be overlooked that if the even harmonics are being radiated there is the likelihood that the odd ones are present also, and these will *not* fall in the amateur bands.

Every experimental transmitting station must possess apparatus for the correct measurement of frequency, and the possession of a quartz crystal with a certificate stating its frequency is obligatory. This crystal must have its fundamental frequency, or one of its harmonics, within the band on which transmission is to be effected.

The crystal could be embodied in a wavemeter, but most amateurs prefer to use it actually to control the frequency of the transmitter, as by this means constant monitoring is unnecessary.

Telephony or CW transmissions may be made on the four lower frequency wavebands, and certain conditions are imposed relating to the use of a pure DC supply for the anodes of the valves.

On the two higher frequency bands, viz., 10 and 5 metres, tone modulation as well as the other two systems may be employed.

Many abbreviations are used in amateur circles in order to avoid sending lengthy messages in morse. Use is made of the International Q Code, and a few of the more useful of these and their meanings are given on this page.

International Q Code.

Abbreviation.	Meaning.
QRA	My station is located at.....
QRB	My distance from you is.....
QRG	I am transmitting on a wavelength (or frequency) of .....
QRJ	Your signals are too weak to read.
QRK	I am receiving very good signals.
QRM	Reception is marred by interference
QRN	Atmospherics are very bad.
QRS	Please send slowly.
QRT	I am now closing down.
QRU	I have nothing (more) for you.
QRZ	You are being called by .....
QSA	The strength of signals is 1.....5.
QSD	Your signals are difficult to read.
QSH	I will acknowledge your message.
QSO	I am in communication with ....

If the abbreviations are followed by an interrogation mark they become questions having the same general meaning.

Another set of abbreviations used extensively by amateurs is the RST Code, which is employed in reporting on the reception of CW transmission. This is a figure code and conveys a wealth of information in the shortest possible manner.

RST Code.

Intelligibility. R.

1. Audible but unreadable signals.
2. Signals occasionally readable.
3. Signals readable with difficulty.
4. Good readable signals.
5. Readable without any difficulty.

Signal Strength. S.

1. Signals just audible.
2. Too weak to understand message.
3. Clear signals but very weak.
4. Fair and readable signals.
5. Moderately strong transmission.
6. Good signals.
7. Clear and strong signals.
8. Transmission very good.
9. Extremely strong signals.

Quality of note (tone). T.

1. Raw AC tone.
2. Rough signals poor smoothing.
3. Fair tone but inadequate smoothing.
4. Rough DC tone.
5. Fair DC tone but prominent key thumps.
6. Fair DC note.
7. Pure DC tone but noticeable key thumps.
8. Steady DC note.
9. Pure crystal control DC note.

The intelligibility, or R, abbreviations are also used in reporting on telephony signals. The same meanings apply only the figure is preceded by the code letters QSA.

One example will suffice to show the great saving in transmitting time by the use of this code. A station might send this cryptic morse message . . . hr ur sigs RST 459. . . . Interpreted it means, "I am receiving good readable signals of moderate strength with pure crystal-controlled DC tone."

Thus with fourteen characters a message is conveyed that if sent in full would require the use of 80.

As the morse code has been printed in *The Wireless World* on several occasions, it will not be reproduced here.

WAVEBANDS ALLOCATED TO AMATEUR USE.

Designation Band.	Frequency in kc/s.	Wavelengths in metres.	Remarks.
1.7 Mc/s.	1720— 1995	174.4 —150.4	Normal amateur band.
3.5 „	3505— 3630	85.6 — 82.7	Special experimental band.
	3690— 3945	81.4 — 76.2	Shared with other services.
7 „	7005— 7295	42.83 — 41.13	Normal amateur band.
14 „	14005—14395	21.42 — 20.84	Normal amateur band.
28 „	28010—29990	10.71 — 10.003	Special experimental band.
56 „	56020—58500	5.36 — 5.13	Experimental, television and amateur.
	58500—59980	5.13 — 5.00	Experimental and amateur.

TELEVISION PROGRAMMES

An hour's special film transmission intended for the industry only will be given from 11 a.m. to 12 noon each weekday.

THURSDAY, AUGUST 11th.

3, European Swimming Championships: O.B. from Wembley. **3.20,** "King of the Congo": An epic of the jungle by Roger MacDougall. **4-4.20,** O.B. from Wembley, continued.

9, "Banana Royal"—revue. **9.30,** British Movietonews. **9.40,** Film: "White Magic." **9.45-10.5,** "Rococo"—one-act comedy by Granville Barker.

FRIDAY, AUGUST 12th.

3, European Swimming Championships: O.B. from Wembley. **3.20,** Comedy Cabaret, including George Robey and Charlie Higgins. **3.50-4.10,** O.B. from Wembley, continued.

9-10.30, "Who Killed Cock Robin?" a play by Elmer Rice and Philip Barry. Cast includes Rosalyn Boulter and A. Bromley Davenport.

SATURDAY, AUGUST 13th.

3, European Swimming Championships: O.B. from Wembley. **3.20,** "Banana Royal" (as on Thursday at 9 p.m.). **3.50-4.10,** O.B. from Wembley, continued.

9, "King of the Congo" (as on Thursday at 3.20). **9.40,** British Movietonews. **9.50,** Telecrime No. 1, "The Backstage Murder," by Mileson Horton and H. T. Hopkinson.

SUNDAY, AUGUST 14th.

8.50, News Bulletin. **9.5-10.30,** "The Student of Prague"—Operetta Film.

MONDAY, AUGUST 15th.

3-4.30, "Who Killed Cock Robin?" (as on Friday at 9 p.m.).

9, Cabaret, including Nina Devitt, and the Arnaut Brothers. **9.40,** British Movietonews. **9.50,** Music Makers: Rawicz and Landauer. **10,** Interval Music. **10.25,** News Bulletin.

TUESDAY, AUGUST 16th.

3, Cabaret (as on Monday at 9 p.m.). **3.40,** British Movietonews. **3.50,** Music Makers.

9, "Thank you, Mr. Ghost"—play. **9.35,** Patrick Bellew with Leslie Mitchell, in "Cartoonist's Corner." **9.45,** Shove Ha'penny. **9.55,** Cartoon Film. **10,** Music Makers, Eileen Joyce. **10.10,** Interval Music. **10.25,** News Bulletin.

WEDNESDAY, AUGUST 17th.

3, Wilfred Walter in original sketches. **3.10,** Cartoon Film. **3.15,** Hogarth Puppets. **3.25,** Gaumont-British News. **3.35,** Little Show.

9, Harry Roy and his Band. **9.30,** Cartoon Film. **9.35,** British Movietonews. **9.45,** Marcella Salzer—One Woman Revue. **10,** Interval Music. **10.25,** News Bulletin.

Random Radiations

By "DIALLIST"

Avian D-F

THE recent reports from Nantes that carrier pigeons seemed dazed and completely lost their bearings when in the neighbourhood of a huge dump of scrap-iron are in some ways very surprising. It seems to be recognised that the natural direction-finding apparatus which forms part of the carrier pigeon's make-up (though just what part it is no one knows for certain) is thrown out of gear when the bird is fairly close to a transmitting station that is in action; this was demonstrated by experiments made some years ago both in France and Australia. But I don't remember having seen it suggested before that large masses of iron could have similar effects. Such effects can't, I am sure, be always observed. Pigeon flying is a popular diversion in the Sheffield district, where gigantic slag heaps, containing goodness knows what quantity of iron, are features of the countryside. Wasn't it accepted that poor radio reception in Sheffield at the time when the Manchester station supplied the North with the B.B.C. programmes was due largely to the girdle of such slag heaps round the city? You may remember that it was so difficult to hear Manchester well that a relay station had to be installed for Sheffield.

Worth Trying

It would be interesting to try the effects of an electro-magnetic field on that curious insect, the Oak Eggar moth. If, as I have done dozens of times as a boy, you catch a female of the species, put her into a little cage and place her outside a window, males will arrive in a very short time, even though the nearest place where the moths are found is a considerable distance away. Henri Fabre proved in this way that the males would come from places up to five miles distant. He found, too, if I remember rightly, that the males lost the power of locating a distant female if the antennæ were removed. If that is so, "antenna" was a good word to choose for the radio aerial! I don't now live in a locality where the Oak Eggar is found; but if any amateur transmitter of an experimental turn of mind (and what amateur transmitter is not?) has his home in a district where the moth is to be captured, he might find it interesting to discover whether the males come to a caged female, placed near his aerial, when his transmitter is not at work and are unable to find the lady when it is radiating. The experiment may have been tried already, but I don't fancy it has.

Midland Television

THERE have been strong rumours of late that the G.P.O. and the B.B.C. between them are to start television transmissions shortly from both Birmingham and Manchester. One thing that one may feel pretty sure of is that "shortly" *doesn't* mean in a matter of weeks or anything of that kind. It takes some time to manufacture and install a high-definition transmitting plant. But, of course, the B.B.C. does own the Baird plant at the Alexandra Palace. I don't know whether it could be converted as a whole for the E.M.I. interlaced system, but much of it, one would think, should be usable as it stands. The speech transmitter would presumably need no alteration and all the generators and other expensive pieces of apparatus are there asking for work. Manchester seems less likely than Birmingham as the site of a television station. It's true that the coaxial cable goes to both, but Manchester seems to keep it fully employed for the telephone service. In any event, stations erected outside London will have to be content for some time with relaying the A.P. programmes. There isn't the money yet for regional studios and programmes.

An Alternative

The German high-altitude television transmitter on the Brocken has proved to have such a long range that it has been suggested that we might do worse than erect our first station outside London at some point in the Pennines. It should not be difficult to discover good spots by means of a mobile ultra-short-wave transmitting outfit and it might be possible to find a location for a permanent television station that would serve a very large part of the Midlands. It has already been demonstrated that a sensitive receiver can bring in the television transmissions at a distance far beyond those thought possible only a year or so ago. But the snag is that such a receiver can be used only in places that are far from roads carrying much motor traffic; otherwise its sensitiveness proves its undoing by picking up so much interference that sound and vision alike are spoilt. If only it were a punishable offence for cars to radiate interference we could use sensitive receivers, and it might be found that surprisingly few television transmitters located in high-lying places would serve the greater part of the country.

Afloat

THESE notes are written aboard a yacht. The wireless has just announced that the previous day was the hottest of the year and that even warmer weather is expected. When you're on the water with a good breeze blowing and your clothing consists of a shirt and a pair of trousers, heat-wave talk from ashore leaves you cold. Wireless has proved a godsend. The other evening we thought of starting on a longish run

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, AUGUST 11th.

Nat., 7, "At Your Service, Madam," musical play. 8.5, "Scarecrows," play. 8.45, Promenade Concert. 9.30, A Tour Round the B.B.C. Theatre Organ.

Reg., 6.50, The National Town Criers' Championship from Bridport. 8, Sid Millward and his Band. 8.30, Round the Concert Parties—Broadstairs.

Abroad.

Berlin, 8, Salzburg Festival, "Figaro," opera (Mozart).

Vienna, 8, "Berlin, 1838–1938," Gala variety from the German Radio Exhibition.

FRIDAY, AUGUST 12th.

Nat., 8, "The Barber of Bagdad," comic opera, words and music by Peter Cornelius. 9, Louis Levy presents "You Shall Have Music." 9.45, "Adrift on a Seaplane Float," talk by Captain N. Macmillan.

Reg., 8, Variety from Southampton. 8.30, Three Sea Plays—No. 3, "H.M.S. Q5." 9, Beethoven Promenade Concert. 9.35, Speedway Racing from Bristol.

Abroad.

Hamburg, 8.15, Lehár Concert.

SATURDAY, AUGUST 13th.

Nat., 5, Jack Hylton and his Band. 6.30, Talk on Sailing, by Michael Bratby. 7.15, Ben Oakley and his Orchestra. 8, Promenade Concert, with Lamond, solo pianist.

Reg., 8, European Swimming Championships, Commentary from Wembley. 8.30, Sing-Song, including Tommy Handley, Bertha Wilmott and George Robey.

Abroad.

Munich, 4–9.40, "The Valkyrie," opera (Wagner) from the Bayreuth Festival.

Radio Eireann, 8.20, Choose Your Announcer, finals in the competition.

SUNDAY, AUGUST 14th.

Nat., 4, Harriet Cohen, pianoforte. 6.20, "Siegfried," Act II of Wagner's opera from the Bayreuth Festival. 9.5, Songs of the British Isles. 10.5, Experimental Hour: "Job to be Done," a Symphony of Industrial America.

Reg., 6.30, Band of H.M. Royal Horse Guards. 7.10, Orchestre Raymonde. 9.5, French Chamber Music.

Abroad.

Radio-Paris, 8.15, "Il Trovatore," opera (Verdi) from Vichy Casino.

Vienna, 8.10, Verdi and Puccini Concert by Vienna Philharmonic.

MONDAY, AUGUST 15th.

Nat., 7, Bungalow Club. 7.45, Eddie Carroll, pianoforte. 8.25, Wagner Promenade Concert. 9.45, The Hon. Harold Nicolson talks on The Past Week.

Reg., 8, Lew Stone and his Band. 8.50, "The Police Would Like to Meet Them," comedy. 9.30, "Speed"—tunes in fast tempo. 9.45, General Release: Songs from Current Films.

Abroad.

Vienna, 7.10, "Don Giovanni," opera (Mozart).

Kalundborg, 8.20, Italian Opera Music.

TUESDAY, AUGUST 16th.

Nat., 7.20, Eddie Carroll and his Orchestra. 8, Experimental Hour (as on Sunday at 10.5). 8.30, Seaside Nights—Margate.

Reg., 8, B.B.C. Theatre Organ. 8.20 and 9.50, Tchaikovsky Promenade Concert. During the interval, "I Knew a Man"—Thomas Hardy, talk by Edwin Stevens.

Abroad.

Brussels II, 9, Selection "Lohengrin," opera (Wagner).

WEDNESDAY, AUGUST 17th.

Nat., 7, By Act of Parliament—talk by Lynn Ungoed-Thomas on the Shops (Sunday Trading Restrictions) Act. 8, Brahms Promenade Concert—Solomon, solo piano.

Reg., 8, Variety from Oxford. 8.30, "Coronation Scot," the story of its journey by way of London, Midland, North and Scottish Regions. 9.15, Louis Levy presents "You Shall Have Music."

Abroad.

Luxembourg, 7.30, Film and Operetta Airs.

Radio-Paris, 11, Two plays in Esperanto.

Random Radiations—

through the night. But the weather forecast said fog, so we decided to play safe, though fog seemed the last thing to expect. The fog duly came up in the small hours and at seven o'clock in the morning visibility was a matter of yards. As we should have had one rather tricky bit of navigation even in clear weather on our night run, we were not sorry that we pinned our faith to the weather man of the wireless and stayed at anchor.

Battery Progress

THE other day when I had finished a series of tests on some standard-capacity dry high-tension batteries, it occurred to me to compare the records of modern batteries with those of identical tests made eleven years ago. At that time there was not such a thing as a 120-volt battery generally available. In the standard-capacity size the usual range was 36 volts, 60 or 66 volts and either 99 or 108 volts. At the prices then prevailing a best-quality 120-volt standard-capacity unit, had there been such a thing, would have cost from 20s. to 24s. There were others at lower prices, but their performances were vastly inferior. I remember one such, which was announced to be "specially designed for loads of 10 milliamps and over." With a nominal load of 10 milliamps it ran down, under test, to one volt per cell in eleven days at 3 hours a day! Comparison of the records of modern batteries with those of yesteryear shows that very great progress has been made. You can now buy batteries every bit as good as those of ten or eleven years ago at about one-third the price.

The Elephant Problem

YOU may remember the case I described a week or two back of a forestry official in Burma who had to use primary cells for filament heating and was sorely puzzled to know what to do when on tour, as the swaying gait of transport elephants meant that it was impossible to avoid spilling a good deal of the electrolyte in the course of a day's travelling. Actually he was using wet "air-cells." I wondered whether it wouldn't be possible to pour off the solution into bottles, putting it back into the cells each evening. I was not sure, though, whether the porous carbons, which enable the air to act as depolariser, would or would not be injured if transported in a dry state. One firm of air-cell makers tells me that its product would not suffer; another says that it would not like its carbons to be treated in his way. The latter firm suggests that the cells should be transported full and that they should be topped up each evening to make up for what was spilt during the day. All very well for the cells, but what about the elephant? I don't know how repeated drenchings with sal-ammoniac solution would affect an elephant's proverbially thick skin. If he didn't like the treatment his habit of never forgetting might be awkward.

Funny Names

IF your name happens to be Marjoribanks or Wymondham or Dalziel the odds are that you will be getting an enquiry from Broadcasting House as to the way in which you pronounce it. It seems that they have found that there are many names which are pronounced in several different ways by various owners of them, and the idea is to compile a kind of proper-name dictionary showing the accepted pronunciation and its possible variations. Something of the kind seems to be needed, for there is apparently no fixed pronunciation in many instances. I remember being astonished during the Christmas Day broadcast two or three years ago at hearing a Scottish farmer introduced as Mr. Menzies, pronounced just like that. I knew that mere Southrons might call it that, but I'd no idea that it was ever called anything but Ming-is in Scotland. Later I enquired, and was told that in certain parts of Scotland (Angus, I think) the pronunciation according to the spelling is not unusual. The B.B.C. enquiry should reveal some interesting results, though I shouldn't be surprised if it produces a few leg-pulls.

Common Nouns, Too

There is, I hear, quite a drive to improve pronunciation in the B.B.C.'s various studios. It isn't only proper names that are concerned, but common nouns and ordinary words as well. One thing that I as a Northerner have never been able to understand is the apparent toleration by the authorities of that loathsome R inserted between a word ending in A and a following one beginning with a vowel. I don't think there is anything in the way of speech—particularly broadcast speech—that offends my hearing quite so much as a sentence such as "Monicar and Phyllidar are thrilled at the idear of visiting Corsicar and Majorca." Yet how often does one hear these horrors not from visiting speakers but from permanent announcers, who are supposed to be chosen because of their unexceptionable pronunciation of the English tongue! I do hope that somebody will go for those awful r's; personally, I'd much rather have dropped h's!

A Weak Spot

WHY is it, I wonder, that the volume control should still be the Achilles' Heel of so many wireless sets? There's no doubt that it is and that it's not only in the cheaper sets that it's a weak spot. Just the other day I was handling a receiver for which a friend paid a good price. Though it is only 8 months old the volume control has already become "gritty." It is unpleasant to use now and before so very much longer a renewal will simply have to be made. Some makers contend that the volume control is so much used, that, being a delicate component, its life cannot be a long one. To that I'd be inclined to reply that, as most listeners use one or other of the local stations for ninety per cent. of their entertainment, the average volume control doesn't get all *that* much use. And should it be a delicate component? I don't see why it should, for when all is said and done, it's nothing but a variable resistance. After all these years of wireless receivers it is surely about time that the ordinary set was fitted with a volume control with a life as good as that of its other mechanical components. Don't you think so?

"COLLARO" AUTOGRAM

ONE of the most interesting items in the 1938-9 Collaro programme recently announced is the "Autogram" portable record changer. This makes use of the bridge-type changer mechanism, which plays eight 9in., 10in. or 12in. records in any order, and it can be obtained with a driving motor for AC or AC/DC operation.

The carrying case measures 18in. × 16in. × 10⅝in. and a recessed three-point plug and socket are provided for connecting the output from the pick-up to the amplifier or receiver. With magnetic pick-up the complete AC unit sells for 9 guineas, while the AC/DC model costs 10 guineas. A crystal pick-up may be supplied in either model for an additional charge of 18s.

Frequency Control with Quartz Crystals

THE Bliley Electric Co., of Erie, Pennsylvania, U.S.A., has issued a 28-page booklet describing the application of quartz crystals for frequency control of RF oscillators and for use in filter circuits where very high selectivity is required.

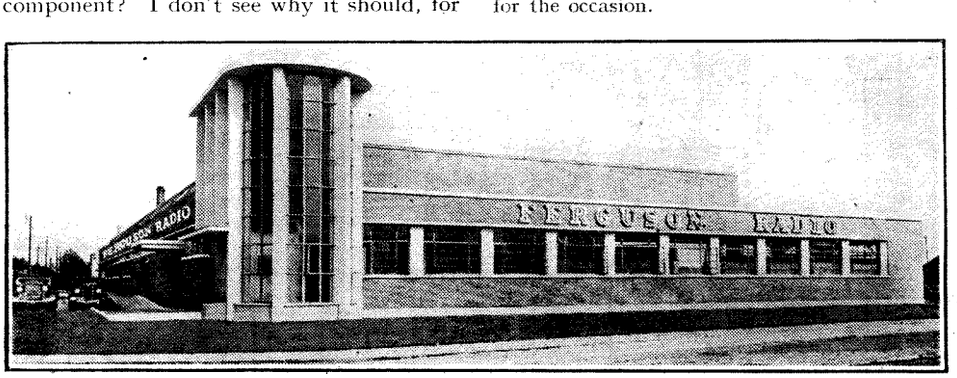
Several new kinds of crystal units, developed especially for use in amateur ultra-high-frequency transmitters, are also described, and the booklet contains a wealth of valuable information on this and the many other uses of the crystals. It is well illustrated with circuit diagrams.

Copies can be obtained from Radiomart G5NI (B'ham), Ltd., 44, Holloway Head, Birmingham.

The Wireless Industry

THE new catalogue issued by Webbs Radio, of 14, Soho Street, Oxford Street, London, W.1, is an exceptionally well prepared and informative publication dealing with short-wave and "communication" receivers, transmitting and short-wave components, etc. A useful chart shows the appropriate connections to both sides (upper and lower) of Amercan-type valve-holders.

The Marconiphone Company, which carried out the arrangements for sound amplification at the unveiling of the Villiers Bretonneux War Memorial by H.M. the King, expresses itself as extremely well satisfied with the service rendered by the large battery of Exide accumulators which was especially transported to France for the occasion.



1,000 SETS A DAY. The new Ferguson Radio factory, Cambridge Arterial Road, Enfield, has just started production. It has a floor area of 30,000 sq. ft., and is stated to have an output capacity of 1,000 sets per normal working day.

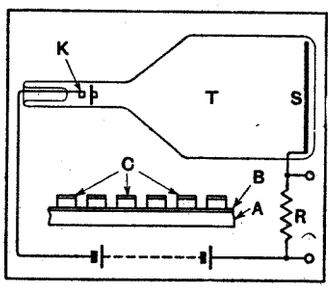
Recent Inventions

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

TELEVISION TRANSMITTERS

A "MOSAIC" screen, as used in television "cameras," is made by first depositing on a transparent sheet A of mica or the like, a thin layer B of transparent conducting material, on which small particles C of a light-sensitive substance, such as selenium, are deposited. The selenium may, for instance, be forced through the interstices of a finely meshed grid, which is afterwards removed.

A screen S, prepared in this manner, is mounted inside a



Details of mosaic screen for use in television camera CR tube.

cathode-ray tube T. The picture to be transmitted is focused upon it, and then scanned by the electron stream from the gun K of the tube. The signal voltages are developed across a resistance R.

Baird Television, Ltd., and D. M. Johnstone. Application date November 5th, 1936. No. 484575.

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TELEVISION RECEIVERS

THE invention is concerned with means for separating the picture signals from the line and frame synchronising impulses, and the two last-mentioned impulses from each other. In ordinary practice, there is a tendency for the framing frequencies to fall into step with the line frequencies, and although this is not so objectionable in "straight" scanning because it can only occur at the end of a framing period, it cannot be tolerated in "interlaced" scanning where the framing signals occur in the middle of a line.

As shown in the drawing, the incoming signals are applied at I to a double diode D, the rectified voltage across the load resistance R being led away at G to the control grid of the cathode-ray tube. The input signals are also applied to a second diode D1, which is so biased that the picture signals are blocked out. The more-negative synchronising impulses, however, pass through.

The "line" impulses build-up across the resistance R1 and are passed at L to the corresponding oscillation-generator. The "framing" impulses appear across the resistance R2, and are passed to a rectifying valve V through a condenser K and resistance R3, which together have a time-constant of the order of one-third of a line interval. In addition the valve V is so biased that it becomes conductive only at the end of a framing impulse, and not to a line impulse. The output from the valve V is passed at F to the oscillation-generator which controls the framing.

Murphy Radio, Ltd., and H. A. Fairhurst. Application date 4th November, 1936. No. 484412.

o o o o

PREVENTING SECONDARY EMISSION

ALTHOUGH secondary emission may be a desirable factor in certain types of tube, such as the electron multiplier, it is definitely out of place in the ordinary "straight" amplifier. It can usually be prevented by coating the grid and anode with substances such as carbon, and certain metallic oxides. But if the valve has an oxide-coated cathode, the usual covering of soot tends to increase secondary emission, instead of preventing it, owing, it is thought, to the effect of small particles of Barium which are thrown off from the cathode on to the other electrodes, where they appear to promote emission.

According to the invention the required coating of soot is deposited on to the electrodes in question by immersing them in a smoky flame, preferably from burning turpentine. The advantage of this method is said to be due to the fact that the coating is not so "smooth" as that obtained in other ways. It therefore presents a surface into which any Barium particles can sink deep enough to be rendered inactive.

N. V. Philips Gloeilampenfabrieken. Convention date (Holland) March 24th, 1936. No. 484748.

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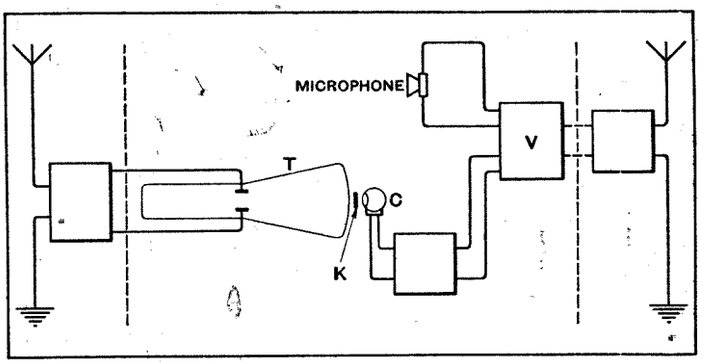
MODULATION CONTROL

WHEN monitoring the modulation of a broadcast transmitter, by manual control, it is often difficult to forestall "blasting" owing to the delay (sometimes amounting to two or three seconds) which elapses before the overload becomes evident to the supervisor. Sometimes, too, the result of "percussion" effects in



Automatic monitor to prevent over-modulation in a transmitter.

an orchestra—which last only a fraction of a second—is sufficient to trip a circuit breaker without warning, and so put the transmitter temporarily out of action.

According to the invention, supervision is effected, automatically and instantaneously, by applying a voltage derived from the signals to a cathode-ray tube T, so that the length of the light-trace formed on its fluorescent screen measures the percentage modulation. An opaque screen K protects a photo-electric cell C from the fluorescent screen until the light-trace exceeds a certain length. As soon as this occurs, the cell C comes into action and automatically cuts down the output from the microphone amplifier V.

Marconi's Wireless Telegraph Co., Ltd., and O. E. Keall. Application date 5th November, 1936. No. 484488.

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CATHODE-RAY TUBES

RELATES to cathode-ray tubes of the kind in which the picture to be televised is first focused on to a "mosaic" screen, which is then scanned by an electron stream. The object of the invention is to increase the intensity of the electrostatic field in the vicinity of the screen by placing a fine wire-mesh grid close to the mosaic screen. The grid, which carries a high voltage, serves to collect and remove the electrons emitted by the action of the light, without, however, at the same time disturbing the accurate movements of the scanning stream.

The wire-mesh grid is assembled over the screen in the process of manufacture, and the photo-sensitive "mosaic" of silver and caesium is then deposited by evaporation through the mesh of the grid. In this way, the sensitive layer is formed into the desired "mosaic," whilst the shadow thrown by the grid does not reduce the electron-emission produced by the image of the projected picture.

Fernseh Akt. Convention date (Germany) November 14th, 1935. No. 484913.

o o o o

RECEIVING SETS

A VISUAL tuning indicator, of the miniature cathode-ray type, is mounted in the centre of the latticed grille of the loud speaker, on the front panel of the cabinet. The glow-tube is housed inside a small conical casing, which is coaxial with the conical diaphragm of the loud speaker, and is supported by radial brackets from the frame.

In this position the indicator acts as a kind of "baffle" which serves to "balance" the acoustic response of the loud speaker and ensures a more even distribution of the high notes and the low.

Pilot Radio Corporation. Convention date (U.S.A.) November 12th, 1935. No. 485007.

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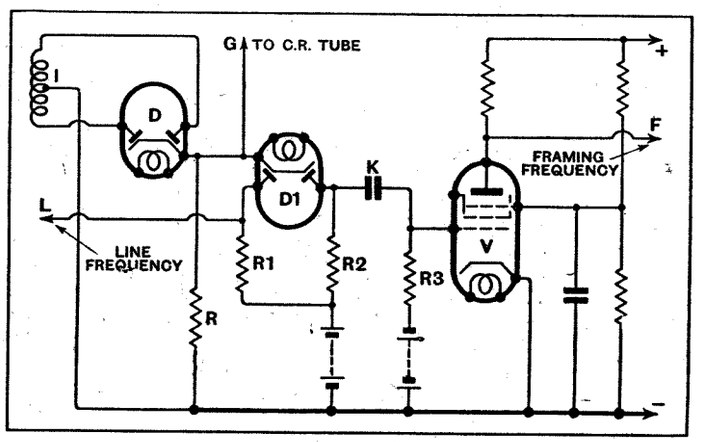
MODULATING SYSTEMS

THE kind of distortion that is caused by the ordinary non-linear type of modulator, is avoided by using a "square-topped" form of wave as a carrier instead of the more usual sinusoidal wave.

This is stated to give excellent results even when used with a valve or other modulating impedance which has not an ideal straight-line characteristic. The theory of the invention is fully developed and set out mathematically in the specification.

The General Electric Co., Ltd.; L. I. Farren; and E. P. George. Application date December 22nd, 1936. No. 484824.



Method of separating synchronising impulses in television receiver.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Decline in Listening

Are Talks Too Generalised ?

WHEN broadcasting started it was naturally the aim of the B.B.C. to interest as large an audience as possible and in consequence the policy of the programme compilers was to avoid specialising. No doubt they endeavoured to make every programme of rather popular appeal. This tradition has been maintained and even now we constantly hear it said that B.B.C. programmes, particularly talks and educational matter, are too superficial in their treatment to interest listeners of average education.

We are inclined to think that the falling off in interest in listening to-day may be due, in some measure, to the efficient way in which the B.B.C. in the early days carried out its policy of stimulating individual thought amongst the listening public and encouraging serious study or the reading of the more serious type of book. It would be quite easy to imagine that the listener of some years ago would to-day have to thank broadcasting for having started his interest in some subject which he has since followed up and studied to a point where he now regards his time as far too valuable to be spent listening to what he has come to regard as the superficial treatment of subjects by the talks department of the B.B.C.

Has the time perhaps come when the B.B.C. should specialise a great deal more and give us talks appropriate for the listener more advanced in his subject, instead of continuing to pursue a popular policy which means that serious subjects are treated only in an elementary way?

Specialised talks should not be allowed to creep into the programmes unannounced. The date and time should be made known well in advance and should be communicated to any specialised journals whose readers would be interested to hear them.

We would sum up our view by the suggestion that the B.B.C. should continue introductory talks expressly intended to stimulate listeners to further study, but should drop those talks which are only elementary and of the type readily available in print, in favour of talks more advanced and original in subject matter.

The Show

Technical Prospects

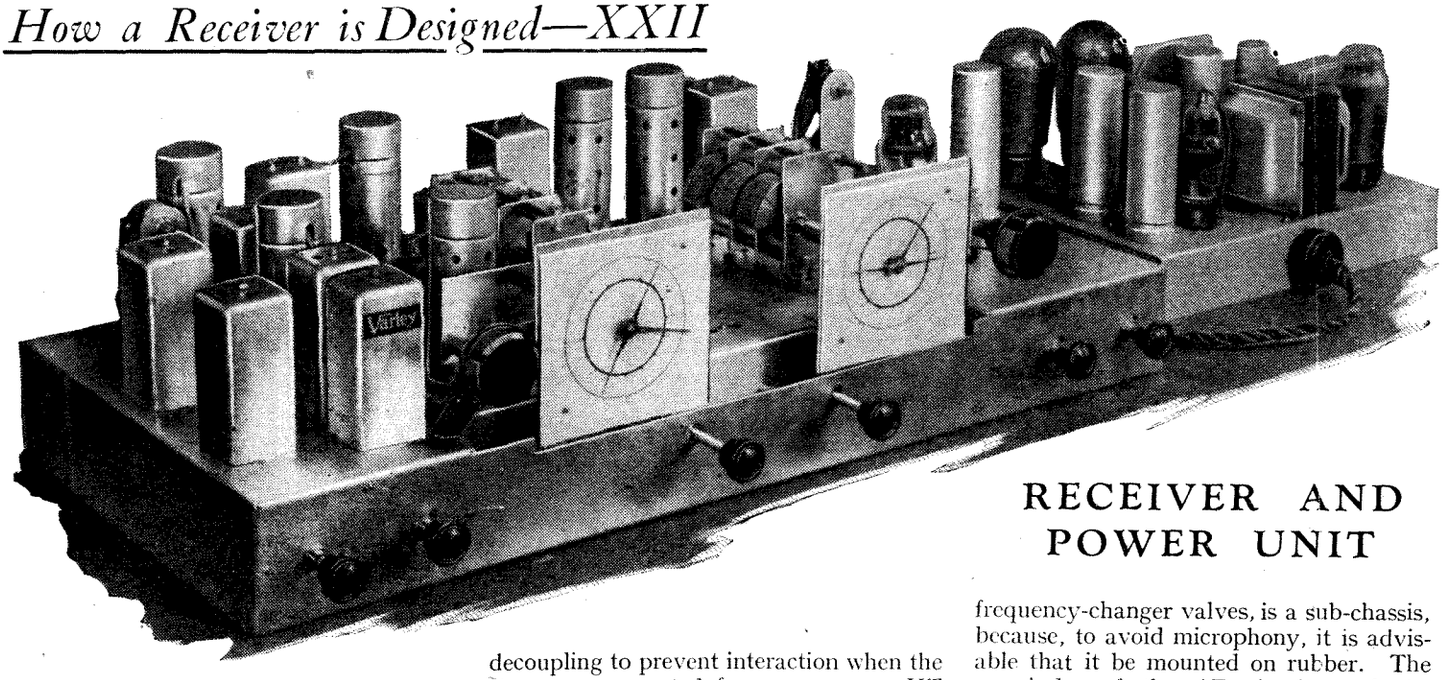
A WEEK from to-day the annual Radio Exhibition will be in full swing. At last intelligent persuasion has prevailed, and the Radio Theatre is to disappear. It will be replaced with a glass-sided television studio which will enable the public to watch the process of transmitting an actual programme from the Studio. Facilities are also being given for both television and sound broadcasting to be demonstrated on the stands.

A music section is this year added to the Exhibition, but for the purpose of our own review of the Show we shall, as in the past, confine our Report, which will appear next week and in the following issue, to matters of wireless interest featuring particularly new technical developments.

Present indications are that this will be a show of more than ordinary interest from the technical point of view. Whilst the majority of receivers may not show revolutionary improvements, yet push-button tuning, which has been most skilfully added as a new feature of the modern set, will intrigue both the electrical and mechanical enthusiast.

Television receivers will be shown at prices which should prove tempting, not only because they are lower than those prevailing hitherto as a result of larger production, but also because these price reductions have been carried out without sacrificing reliability, and probably represent the maximum value in television for a long time to come.

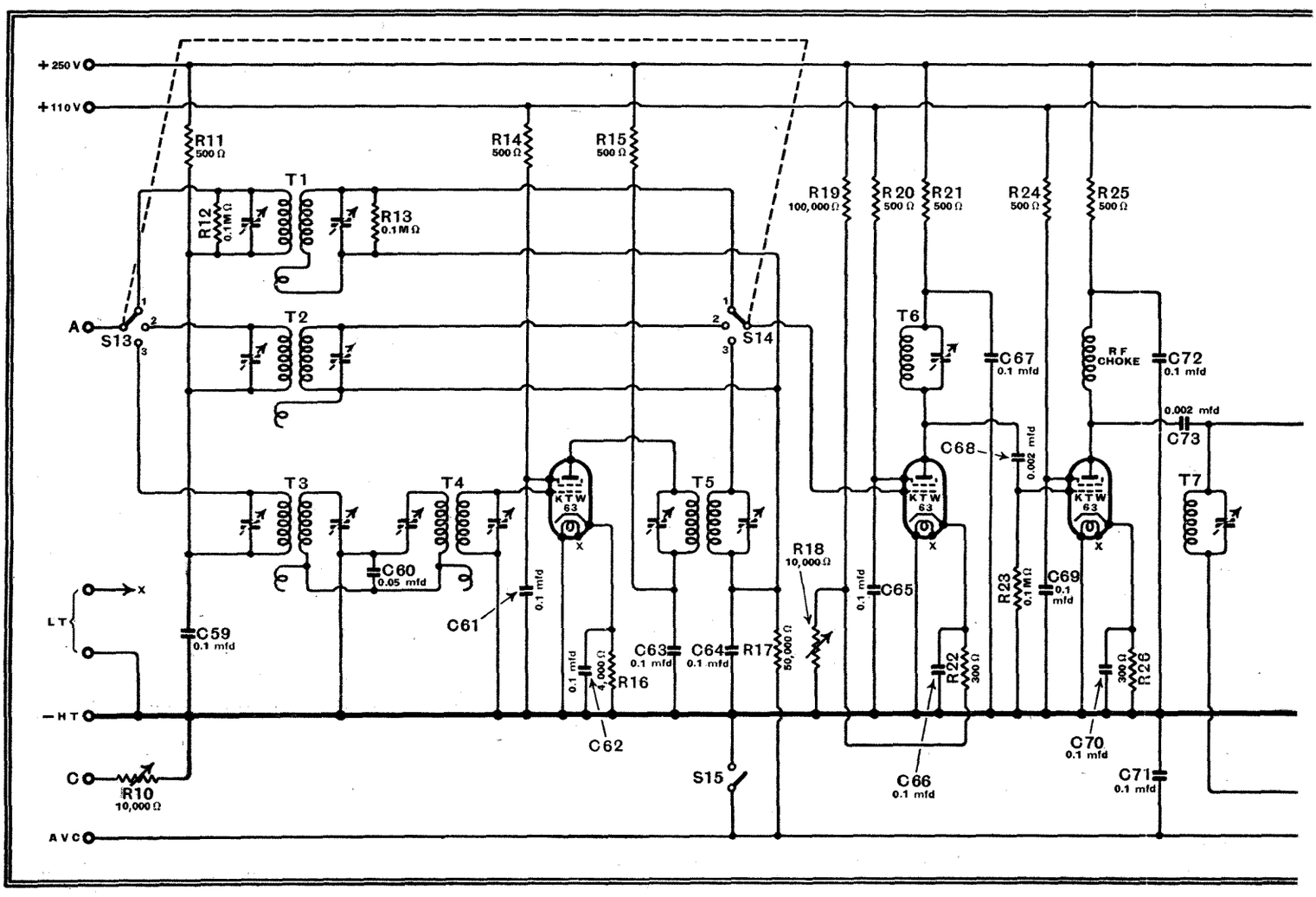
How a Receiver is Designed—XXII



RECEIVER AND POWER UNIT

HAVING discussed in previous articles the details of the individual stages of the receiver, we are now in a position to put the stages together and to consider the arrangement as a whole. Most of the modifications introduced are obvious and straightforward, such as the inclusion of decoupling to prevent interaction when the stages are operated from a common HT supply, and this will readily be seen from an inspection of the circuit diagram of Fig. 24, which shows the completed circuit of the IF amplifier, the detector, and early AF circuits.

In constructional form this portion of the equipment is built on a single chassis, and the tuner, which includes the RF and frequency-changer valves, is a sub-chassis, because, to avoid microphony, it is advisable that it be mounted on rubber. The remainder of the AF circuits and the power supply are built on an entirely separate chassis, since the equipment would become unwieldy if everything were on a single chassis. Considering Fig. 24, the switches S13 and S14 control the selectivity. In position 1 the IF transformer T1 forms the coupling between the frequency-changer and the first IF valve.



The Wireless World Communication Receiver

IN this article the circuit diagrams of the complete equipment subsequent to the tuner are given, and points are discussed which arise through the union of the various stages—stages which have been treated in detail in the earlier articles of this series. Manual gain controls, AVC and BFO on-off switches, and the mains equipment are described

This transformer has tightly coupled coils and the circuits are damped by the resistances R12 and R13 to prevent a double-peaked resonance curve being obtained. This position of the switch corresponds to low selectivity and is for use chiefly in local station reception and on the ultra-short waves.

In position 2 the transformer T2 comes into circuit. This is undamped and has coils coupled slightly below optimum so that a fairly high degree of selectivity, with moderate sideband cutting, is obtained. This gives a degree of selectivity which will be used perhaps more than any other, since it is suitable for general listening on the broadcast band and also for short-wave reception. In the third position of the switches the three transformers T3, T4 and T5 come into circuit and an additional valve. This is the condition of high selectivity. The transformers are all undamped and are loosely coupled and the valve is included, not to increase the overall sensitivity of the receiver, but to make up for the losses which would otherwise be introduced by so many tuned circuits. The valve is actually biased back to limit its gain, as will be seen by the fact that the cathode bias resistance R16 has a value of 4,000 ohms.

Detector and BFO Circuit

In this position of the switches a very considerable degree of sideband cutting takes place, but this is inevitable when high selectivity is necessary. In general, this position of the selectivity switch will be used only when it is desired to listen to a station which is suffering from an unusual amount of interference. For instance, Deutschlandsender can be received clear of Droitwich and Radio Paris in the London area, which cannot be done at low or medium selectivity. On short waves, too, especially for morse reception and telephony reception in the amateur bands, high selectivity is needed.

Following the selective circuits come the two IF stages. The first of these has a tuned anode coupling with damping provided by the 100,000-ohm resistance R23. The second stage is choke coupled to the tuned circuit feeding the detector and the low input impedance of the detector provides the necessary damping. The detector circuit is of entirely conventional design, save that, in the interests of quality, the load resistance R29 is given the low value of 50,000 ohms. This results not only in an unusually low amount

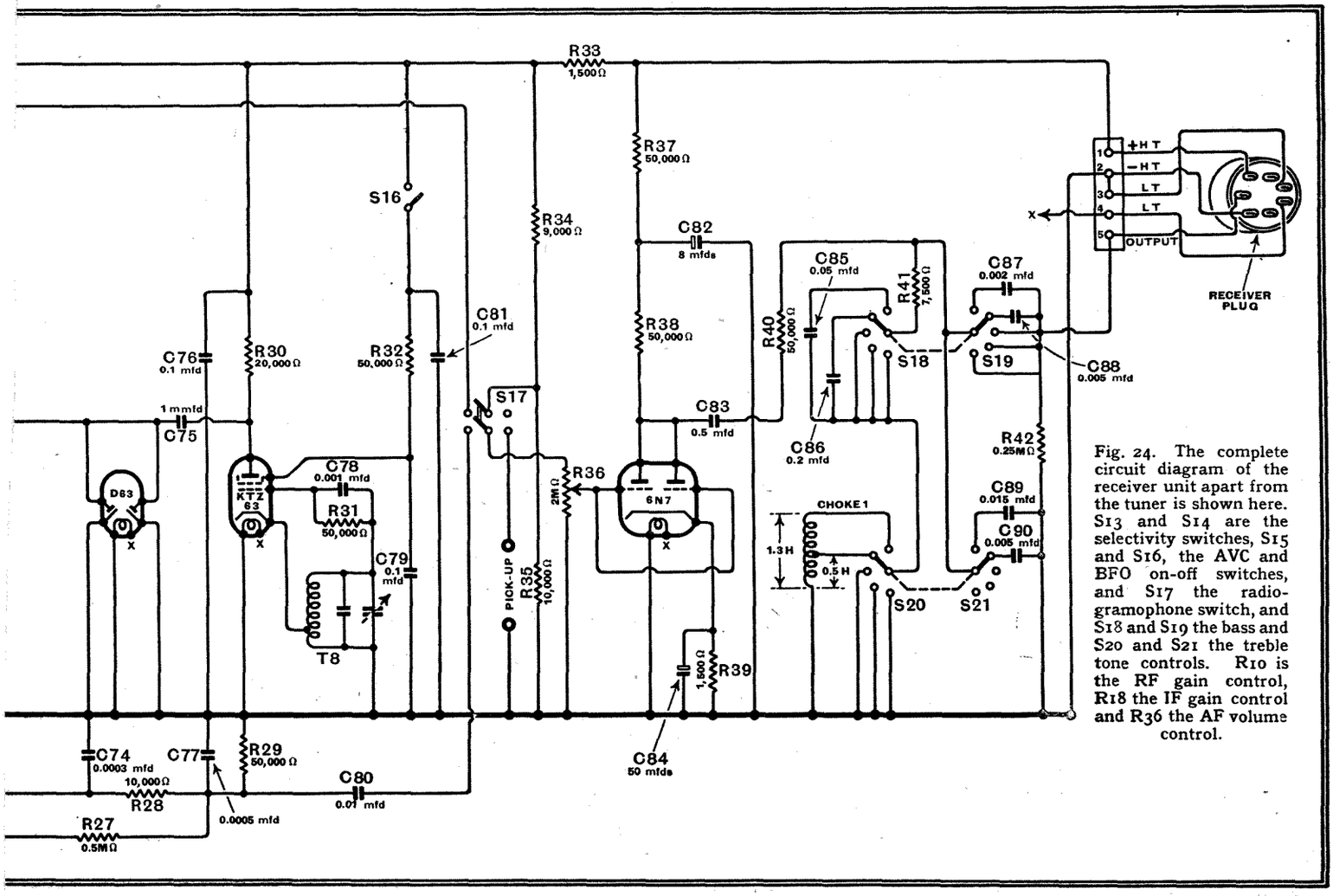


Fig. 24. The complete circuit diagram of the receiver unit apart from the tuner is shown here. S13 and S14 are the selectivity switches, S15 and S16, the AVC and BFO on-off switches, and S17 the radio-gramophone switch, and S18 and S19 the bass and S20 and S21 the treble tone controls. R10 is the RF gain control, R18 the IF gain control and R36 the AF volume control.

The Wireless World **Communication Receiver—**

of frequency distortion, but also in the detector being capable of dealing with much deeper modulation than usual before amplitude distortion occurs.

The beat-frequency oscillator is of the electron-coupled type with the screen, control grid and cathode acting as the oscillator electrodes in the Hartley circuit. The anode of the valve is coupled to the detector input via the 1 $\mu\mu$F condenser C75. The detector also provides non-delayed AVC, which is applied to the first IF stage and also to the RF and frequency-changer valves in the tuner. The switch S16 in the HT lead to the BFO screen enables the oscillator to be thrown in and out of circuit as required. As AVC is ineffective when the oscillator is functioning, and tends only to maintain the receiver at a constant low sensitivity, it must be cut out when the oscillator is operating. This is done by the switch S15, which is linked with S16, and short circuits the AVC filter condenser C71 when the oscillator HT supply is applied to the valve. The short circuit is, of course, removed when the HT supply is broken.

The removal of AVC necessitates the inclusion of a manual pre-detector gain control, and this is also very desirable in a sensitive receiver such as this, even when AVC is operating. In fact, two-manual controls are desirable, one controlling the RF gain and the other the IF gain. These are, of course, in addition to the usual AF volume control. Three gain controls are thus included in the receiver—RF, IF and AF controls. The main purpose of the AF control is naturally the usual one of controlling the volume from the loud speaker. The other controls have for their main purpose the adjustment of the operating conditions to suit the signal.

The Gain Controls

On short waves, for instance, it is usually desirable to have as much RF gain as possible in order to maintain the optimum signal/noise ratio for the weak signals often encountered. The IF gain control should then, in general, be adjusted to give the minimum gain consistent with good reception. In general, it is found that the best reception, especially when searching for signals, is secured with the RF control at maximum and the IF control at a setting some way below maximum. If signals are so weak that the full IF gain is necessary, then the signal/noise ratio becomes poorer, but it is, nevertheless, useful to have this gain in hand to meet the requirements of poor conditions, and it also helps in giving a reserve of amplification upon which AVC can work.

Where signals are strong, as on the broadcast band, then it is easily possible to have too much RF amplification, and if this occurs, overloading of the frequency-changer may result with the consequent production of whistles. For this reason it often happens that on the medium and long wave bands it is better to reduce the RF sensitivity and, if signals are very weak, to increase the IF gain. In general, however, signals on these bands are so much stronger than on short waves that no more IF gain is needed, in spite of the reduced RF gain; consequently, the signal/noise ratio remains remarkably good.

Turning now to the AF circuits the switch S17 immediately following the detector permits a change-over from radio to gramophone to be made, and on gramophone breaks the screen circuits of the early stages to prevent any break-through of radio signals. The first AF valve functions to give a low gain and tone control. This is arranged by means of the four switches which are ganged in pairs to give bass and treble tone controls, and are independent of one another. Each has five steps, giving two degrees of bass and treble cut, and two degrees of bass and treble lift.

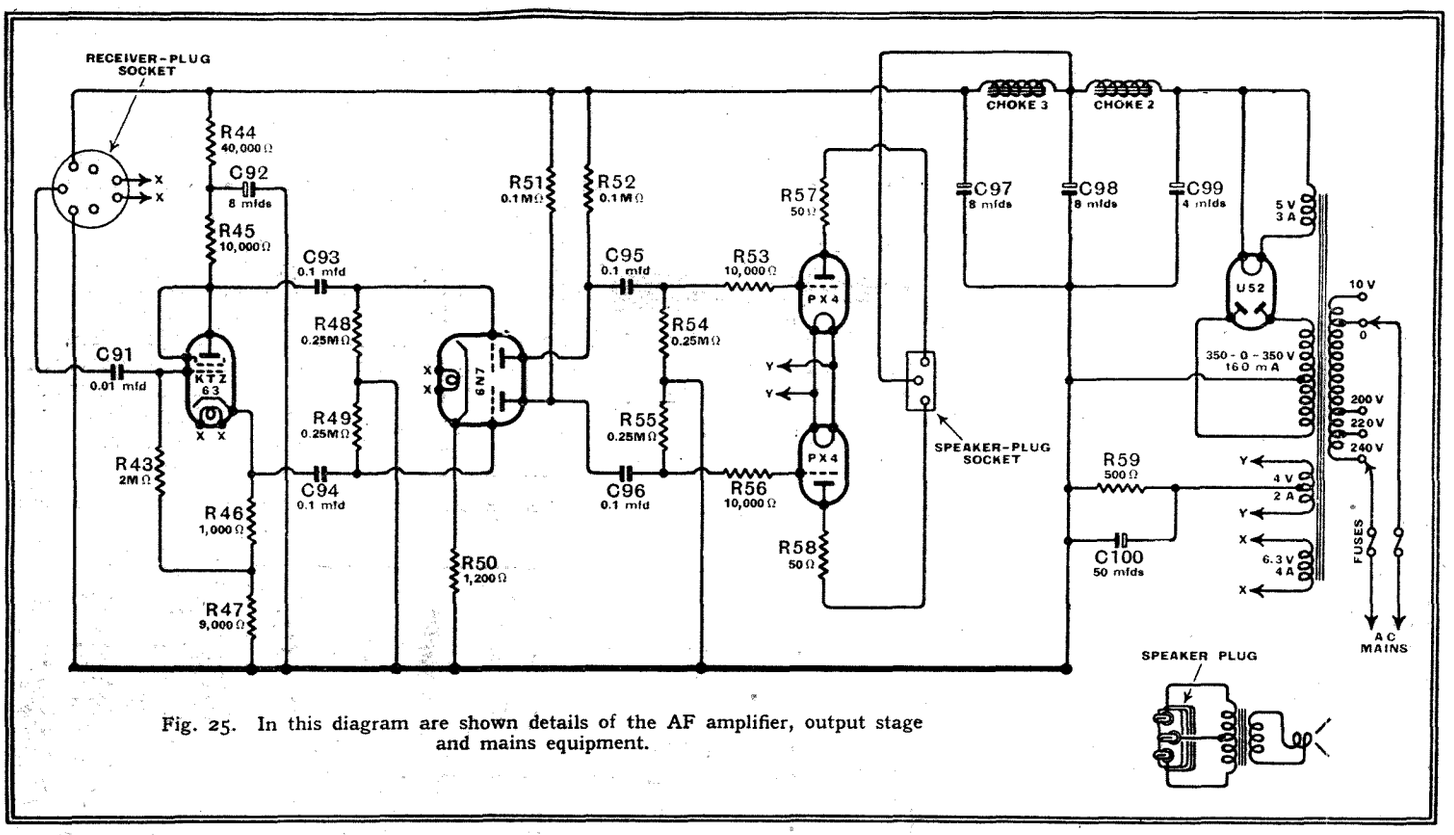


Fig. 25. In this diagram are shown details of the AF amplifier, output stage and mains equipment.

Following this stage we come to the phase-splitting valve in the power unit, the circuit of which appears in Fig. 25. This valve is a tetrode having screen and anode strapped so that it functions as a triode. Equal resistances are joined in the anode and cathode circuits so that equal outputs in opposite phase are secured across each. The valve gives a total effective gain of rather less than twice. Following this a resistance-coupled push-pull AF stage is used and the valve employed is one of the American double triodes. Apart from this, however, the circuit is entirely straightforward and the output stage with two PX4 valves in push-pull follows. This stage is operated in class A and gives an output of some seven watts into a load of 8,000 ohms.

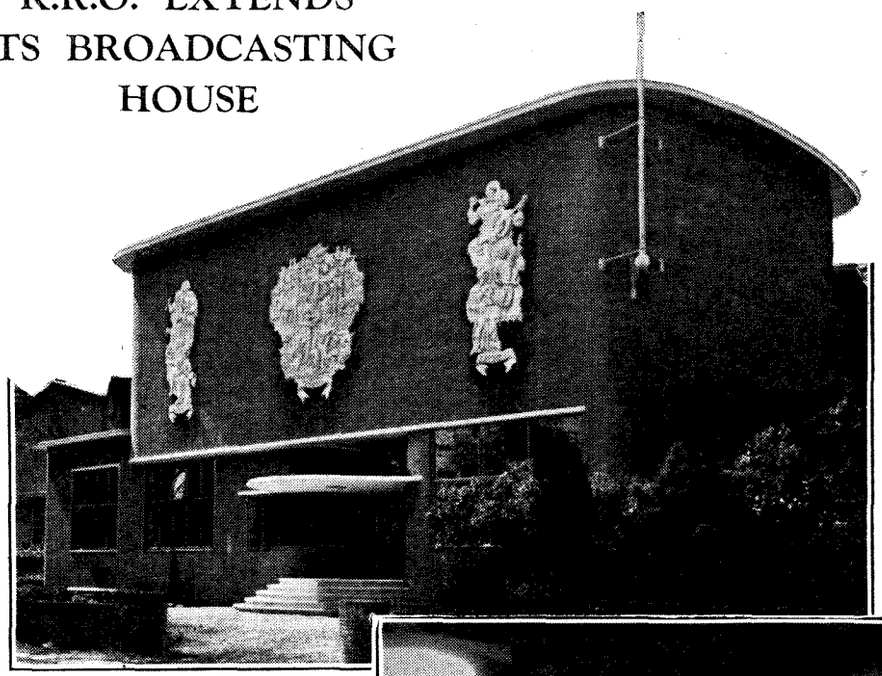
The total HT supply is approximately 160 mA. at 350 volts, and a heavy-duty rectifier is consequently necessary. The U52, which is rated for 250 mA., is therefore employed; it has a 5-volt filament and the mains transformer consequently bears windings of 5 volts for the rectifier,

The Wireless World **Communication Receiver**—4 volts for the output valves and 6.3 volts for all other stages. For smoothing a single 10 H choke in conjunction with the 8-mfd. electrolytic condenser C98 is used. This smooths the total current and the output stage is fed directly after this choke. The smoothing, however, is inadequate for the earlier stages, so the current for these valves is further smoothed by the second choke Ch2 and condenser C97. After smoothing, a potential of slightly under 350 volts is available, and the AF valves are fed from this through their coupling and decoupling resistances. For the earlier stages, however, a potentiometer is connected across the HT supply comprising the resistances R33, R34, R35, and at the tapping points supplies at 250 volts for the valve anodes and at 100 volts for the valve screens are available.

The arrangement of the tuner together with its constructional details will be dealt with in the next article, and subsequently the construction of receiver and power unit will be treated.

New Studios at Hilversum

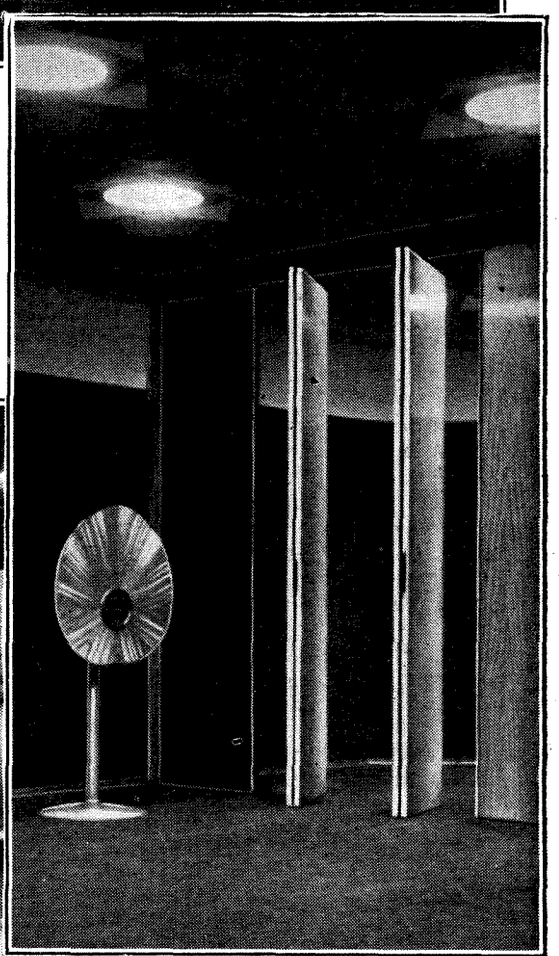
K.R.O. EXTENDS ITS BROADCASTING HOUSE

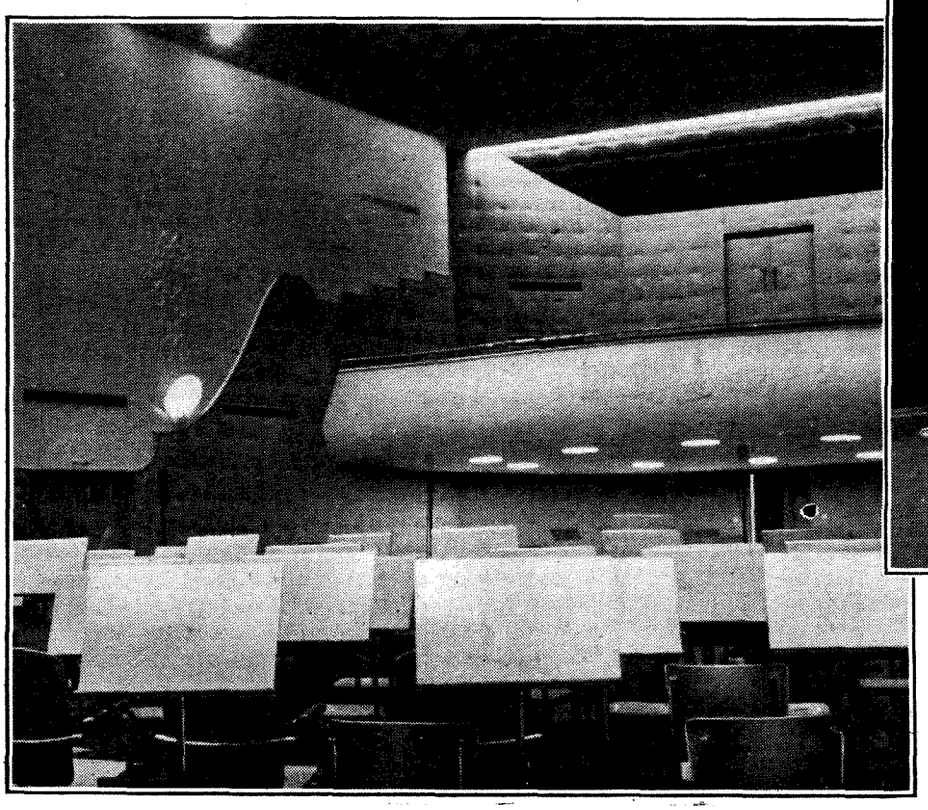


THE Roman Catholic broadcasting organisation of the Netherlands, K.R.O., Katholieke Radio Omroep, recently opened an extension, seen on the right, to its original Broadcasting House, which was actually the first of its kind to be built in Hilversum. The extension includes a concert hall with a capacity of approximately 3,500 cubic yards, and studios for drama, talks, chamber music and effects.

There being four big broadcasting companies in the Netherlands, but only two wavelengths (1,875 and 301.5 metres) available, the companies have to share the wavelengths and supply only half a week's programmes.

The main control room, the apparatus for which, together with the recording gear, was supplied by Philips, can handle two programmes simultaneously, one on the broadcast band and one on short waves for the Dutch East Indies.





The dramatic studio, the doors of which can be revolved, have on one side sound-absorbing material whilst on the other they are hard and resonant. The ceiling, as in the large orchestral studio, shown on the left, is composed of cork pyramids. Note the heart-shaped baffle loud speaker (used throughout the building). The walls of the large studio do not form a rectangle, thus avoiding sound reflection.

Sensitivity Levelling

OBTAINING THE DESIRED PERFORMANCE ON ALL WAVEBANDS

By N. H. BROWNE

IT does not necessarily follow that equal sensitivity on all wavebands is desirable in a multi-range receiver. The question of appropriate sensitivity ratios is discussed and practical methods of attaining these ratios are described.

IN designing a radio receiver it is usual to regard its sensitivity as the starting point, and, having decided what this is to be, the broad outline of the receiver is laid down. It is apparent that the sensitivity cannot, however, simply be stated as so many microvolts input for a certain output when the carrier is modulated at a certain percentage. If the description is to be complete, the frequency, or frequencies, at which the measurements are made must also be stated. Fortunately, a publication of the Radio Manufacturers' Association, entitled "Specification for Testing and Expressing the Overall Performance of Radio Receivers," specifies certain frequencies at which these measurements are to be made, and comparison between different receivers thus becomes possible.

Experience and a study of measured field strength shows that on the MW and LW bands a sensitivity of 60 microvolts (μV.) is adequate for an output of 500 milliwatts, whilst on the SW band (16-50 metres) a sensitivity of the order of 20 μV. is desirable. From measurements made on a fairly normal aerial in the London area there are few stations on the MW and LW band that do not produce inputs of at least 300 μV.

The sensitivity figures given, i.e., 60 μV. for MW and 20 μV. for SW, refer to an average domestic receiver of the better class. A typical example is the supersonic heterodyne receiver shown in the block diagram, Fig. 1.

It might be argued that the best procedure is to make the sensitivity as high as possible at any point, but there are disadvantages to this scheme. With a SW sensitivity of 20 μV., a MW and LW sensitivity of 2-5 μV. would result, and this calls for some sort of inter-station muting device, since the receiver noise, even assuming a situation where there was very little noise from external sources, would be objectionable.

It would appear then that for a receiver to behave like the domesticated animal it is intended to be, a MW and LW to SW sensitivity ratio of approximately one-third is desirable, whilst in actual practice, unless some steps are taken to even things out, this ratio is likely to be ten to one. Whilst it is admitted that the suggested ratio of one-third is somewhat arbitrary, there is a certain amount of theoretical backing to be found in the fact that the effective first-circuit noise (by effective is meant that due to valve plus circuit), is approximately of this ratio, or perhaps a little higher (between four and five). Such a MW/SW sensitivity ratio as suggested would give the same amount of inter-station noise on both the wavebands.

The question of sensitivity variation over any particular band is not considered here, as it is outside the scope of this article, and in the better-class receiver various artifices are resorted to to keep this fairly constant.

Our problem is how to alter the sensitivity on various bands to obtain the levelling effect suggested. This is not quite so easy as would first appear to be the case. For example, the RF gain might be reduced by making the circuit Q lower, but this would affect the selectivity and make the signal-to-noise ratio worse. In general, anything which reduced the gain between the aerial and mixer grid would tend to make signal-to-noise ratio worse. A method which has been used with partial success is to alter the bias on the RF and IF valves by using different values of cathode-bias resistors on different wavebands. But unless the number of stages so controlled is large, which means a complicated switch, a very large value of cathode-bias resistor is required, and this tends to spoil the AVC action on the stage.

There is, however, one method which has recently been investigated which

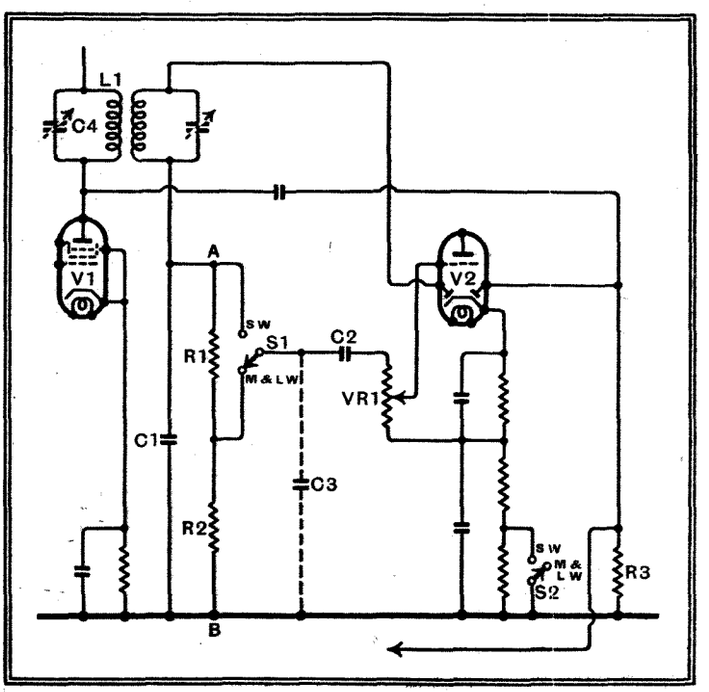


Fig. 2.—A method of providing the appropriate sensitivity on various wavebands.

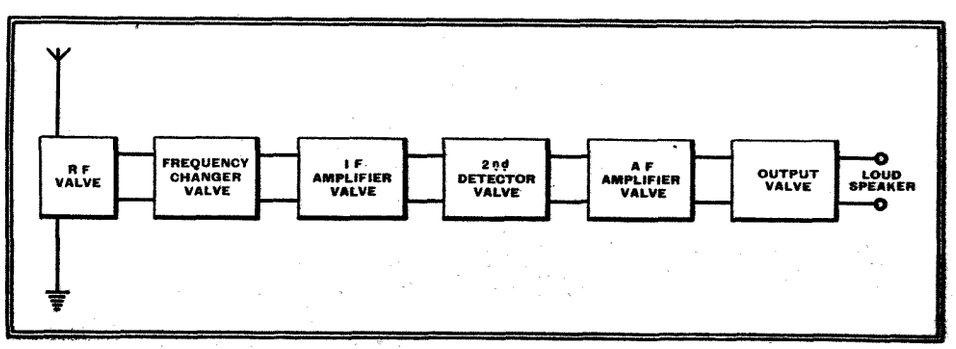


Fig. 1.—Block diagram of a superheterodyne receiver of the type under consideration. The second detector and AF amplifier valves are often combined in a single envelope.

Sensitivity Levelling—

suffers from none of the disadvantages previously mentioned and possesses certain advantages.

Referring to Fig. 2, it will be seen that the resistors R1, R2 comprise the speech diode load, and that the output to the AF amplifier is taken from alternative points on this load. The switches S1 and S2 are mechanically coupled together so that the delay voltage on the AVC diode is increased on the MW band. This is necessary, as otherwise the AVC would prevent the output from the speech diode rising to a sufficiently high level to load fully the output stage.

Noise Unaffected ; Distortion Reduced

This arrangement gives at least two major advantages and a probable third.

(1) The sensitivity of the receiver is levelled on different wavebands without reducing the signal-to-noise ratio, which is nearly always the case with other methods.

(2) The diode distortion is reduced on the bands where the sensitivity is reduced.

Advantage (1) requires no comment, but (2) requires some explanation. The diode distortion is reduced in two ways: (*a*) The working point of the diode is very much higher, i.e., the carrier voltage applied to the diode is high. Reference to a family of curves for a typical diode will show that the DC output voltage is not directly proportional to the applied voltage below a certain value. This means that when the carrier voltage is small quite low modulation percentages swing the diode down into the non-linear portion of its characteristic. By making the carrier voltage high very much higher percentages of modulation are necessary before this occurs. (*b*) The AC-to-DC load ratio is improved. By the expression AC and DC loads is meant the impedance between the points A and B which is presented to a generator of alternating current as compared to one generating DC. It is readily seen that the presence of C1, VR1, and C3 makes the impedance to AC lower by an amount dependent upon the frequency of the supply.

It has been shown in a great number of articles that this ratio should be kept as near unity as possible. Unless very special measures are taken, which are usually attended by their difficulties, this is not easy to achieve. In the circuit shown the values have been chosen so that on the SW band a typical practical arrangement results.

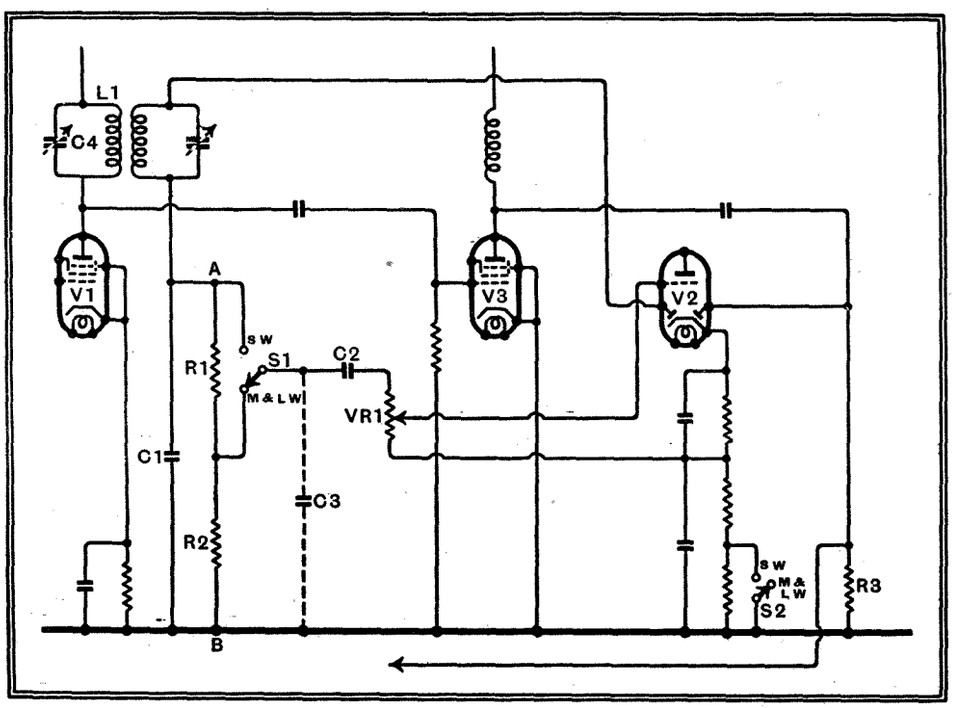


Fig. 3.—Method of interposing a buffer valve (V3) for avoiding distortion due to the delayed AVC system.

The values are as follows:—

R1 + R2 = 0.5 Megohm.
C1 = 50 $\mu\mu$F.
C2 = 0.01 μF.
VR1 = 1 Megohm.
C3 = 20 $\mu\mu$F.

C3 is the capacity thrown across the diode load by the screened lead to the volume control, which is nearly always necessary. The capacity given (20 $\mu\mu$F) corresponds to quite a short lead about 6in. long, and in the case where it becomes most necessary, that is, when the volume control is external to the receiver proper, as, for example, in a number of commercial designs of floor models, may very likely be as high as 60 $\mu\mu$F.

If we compare the AC-to-DC load ratios for the SW and MW bands we shall see that a worth-while improvement has been achieved.

Using a modulation frequency of 6,000 c/s, which is probably the upper limit which is necessary in this type of receiver, we find that on the SW band 52 per cent. modulation can be handled, while on the MW band the figure is 75 per cent. Actually this is fairly safe, for if we arrange to prevent the percentage modulation rising above this value by side-band cutting in the tuned circuits of the receiver the overall response would only be about 2.5 db. down at this frequency.

The third advantage mentioned is that the AVC characteristic over the working range is improved, since the high delay voltage prevents operation until the bend of the curve becomes much sharper.

Having taken so many pains to make our speech diode reasonably distortionless, it is unfortunate that the circuit shown in Fig. 2 can still produce distortion on all bands unless additional precautions are taken. Distortion can be produced by the delay on the AVC diode. A full description of this effect is given by K. R. Sturley in *The Wireless World* of December 23rd, 1937. To reduce this effect the AVC diode load R3 would have to be large compared with the impedance of the tuned circuit L1, C4. Another method is described by F. T. Lett and the Gramophone Company in British Patent No. 444,391, filed July 17th, 1934.

The safest way to avoid this type of distortion, however, is to use, in all cases where it is possible, a "buffer" stage between the speech and AVC diodes in the manner shown in Fig. 3.

Although the arrangement has only been shown in Fig. 1 for three bands, it is obvious that the methods employed can be extended to any number of bands required.

The writer is indebted to the Gramophone Co., Ltd., in whose laboratories the measurements were carried out, for permission to publish this article.

Home Recording

IN this, the concluding article of a series, the author explains the reason why a volume indicator is almost indispensable for recording and deals with the effects produced by "over-recording." Amplifiers, tone control and advice on the procedure in recording are also discussed.

By HUMFREY ANDREWES, B.Sc., A.M.I.E.E.

Part VI.—Monitoring and Tone Control

IN the last article of this series it will be remembered that the recording cutter head and its characteristics were discussed in a general manner. No mention, however, of the voltages to be encountered was made, and in considering the next point in our discussion, namely, volume indicators, the peak voltage across the recording head must be carefully considered. The peak voltage which the output stage of the amplifier has to give in order that the resultant record may be of reasonable level must be determined for the particular equipment which is being used and varies in practice from about 50 volts to about 150 volts, but it is difficult to give definite figures on this point. Perhaps the most common form of volume indicator is the familiar rectifier voltmeter, and although it has a number of disadvantages it is extremely compact and reliable. It must be realised when using an instrument of this type that a true indication of the peak voltages cannot be obtained by watching the movements of the needle owing to the inertia of the moving parts. Such instruments can be obtained with different degrees of damping, but the normal damping used is probably the best and when one has become accustomed to the particular instrument employed the imperfections of the method are not as serious as might at first be thought. There are a number of other kinds of volume indicator suitable for this purpose. In one form a valve voltmeter of the slide-back type is used and the degree of slide-back adjusted so that the peak voltage only is read on the milliammeter in the anode circuit of the valve. This method gives a good estimate of the peak voltages but of course does not give any indication of the general level of a programme. The neon tuning indicator may also be pressed into service as this has the advantage of having no mechanical inertia, but it is unfortunately rather unreliable in action; on the other hand, it has the advantage of cheapness. The "Magic Eye" tuning indicator may also be used, but this has rather a small "scale" and would be tiring to watch for any length of time. One volume indicator which should certainly be mentioned, although for economic reasons it can hardly be considered practical for the experimenter, utilises a large number of neon lamps connected in the anode circuits of a series of acorn-type valves arranged with gradually increasing bias so that as the applied voltage increases the bias of each valve is successively overcome and the neon lamp in its anode circuit lights. The neon lamps are arranged in a row so that the effect is a line of light of variable length. This arrangement is very successful in practice and has been developed by one of the large film recording companies.

It is hardly necessary to emphasise that the frequency characteristic of the volume indicator should be carefully checked, as this instrument is used not only to monitor a recorded item but also for checking the characteristics of the amplifying equipment as well.

While on the subject of the peak voltages applied to the recording head it may not be out of place to discuss briefly the subject of over-recording. It should naturally be the aim of the experimenter to so adjust the controls on his amplifier that no overload, either in the amplifier or recording head, occurs during a record. The former can be avoided by correct design of the amplifier. Where over-recording occurs, however, as it inevitably must do when items are recorded which have not been carefully rehearsed, or where the experimenter's friend who is "helping" him suddenly comes up unexpectedly to the microphone, it is interesting and sometimes expensive to examine the effects which are produced.

When the amplitude of the recorded wave exceeds the normal maximum which is allowable there will naturally be a tendency for one groove to run into the next, but in practice this does not usually occur. Instead, owing to the restriction of the damping on the armature of the recording head, the peak of the wave is cut off with the resultant distortion of the waveform. There will also be a tendency to the production of the "echo effect." This last is the result of the groove before, or immediately after the groove in which excessive amplitude has taken place, becoming distorted, with the result that in the case of speech particularly the modulation of the groove in front will be heard as well as the modulation of the groove which is being played. This "echo" is, of course, much more noticeable if the tracking is not even and the grooves come too close together at regular intervals. As regards the effect of distortion due to short peaks of over-recording it will be observed that these are far more noticeable on certain types of recorded items, although naturally every effort should be made to avoid all peaks of this kind. With speech and certain types of dance music it is often difficult to hear the distortion, whereas in the case of a recording of a solo piano the slightest tendency to over-recording is most obvious, and this effect is even more emphasised in the case of a harp, which is perhaps the most difficult solo instrument to record really satisfactorily.

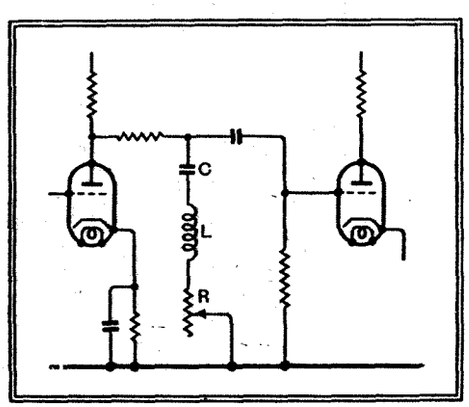


Fig. 1.—Simple tone control circuit imparting a rising characteristic to both bass and treble.

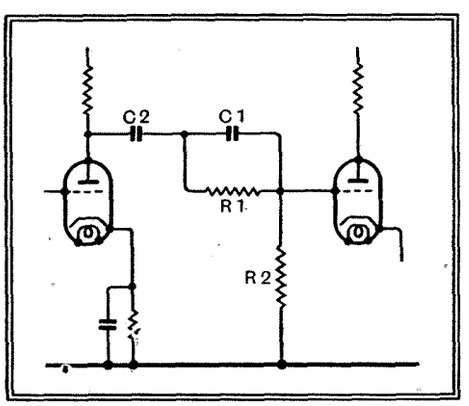


Fig. 2. — Another form of tone control giving a rising characteristic to the amplifier at the higher audio frequencies.

Turning now to the question of amplifiers for direct recording, little need be said on this matter as standard practice may well be followed. The author has found it advantageous to use a main recording amplifier of moderate gain and sensibly flat characteristic, which includes the output stage feeding the recording head or playback loud speaker, and then introduce any "electrical cooking" independently rather than incorporate fixed compensating circuits to adjust the characteristic of the main amplifier. There are a number of ways of achieving the same ultimate result. High- and low-frequency adjustable attenuators are highly desirable and these can follow conventional practice, while for recording some form of high frequency tilting circuit should be used.

Home Recording—

Fig. 1 shows a simple circuit which may be used for obtaining a rising characteristic. A tuned circuit L, C is connected across the anode circuit of a valve and the values are adjusted so that this circuit tunes to about 1,000 cycles. A variable

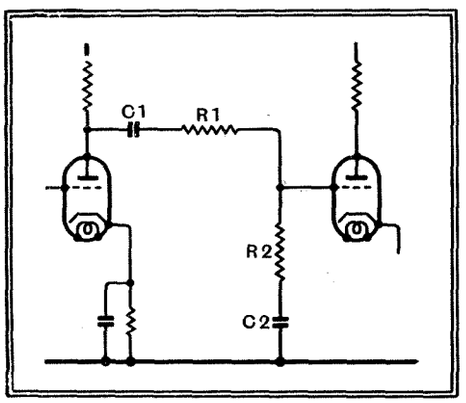


Fig. 3.—By suitable choice of values this circuit can be made to have a rising bass characteristic. In practice R2 and C2 will, of course, have a high resistance grid leak joined in parallel.

resistance R is connected in series with the tuned circuit, so that in effect the tuned circuit depresses the curve at 1,000 cycles, the amount of depression depending on the value of the resistance.

The value of the resistance R may be adjusted so that, for example, a loss of 6 db. in the gain of the stage to which it is connected results and the values of L and C may be chosen so that this depression of the curve of the stage is either relatively sharp or may extend over several thousand cycles. Then provided there is sufficient gain in the amplifier as a whole the effect produced is to lift the bass and treble so giving the amplifier a rising characteristic at each end of the audio scale. If only a rising high-frequency curve is desired the rise at the lower frequencies may be prevented by using a small coupling condenser in the stage to which the tuned circuit has been applied. This method of obtaining either a rising bass or high-frequency response in an amplifier has, however, one serious disadvantage, and this is that it usually results in waveform distortion at frequencies to which the tuned circuit is adjusted. Naturally, the amount of distortion depends on the value of the resistance R and the L/C ratio of the tuned circuit, but although the curve of an amplifier with such an arrangement may appear at first sight to be exactly what is required for direct recording, an examination of the waveform with a cathode-ray oscilloscope will cause disillusionment.

Treble Boost

Fig. 2 shows a well-known circuit which can be used to good effect in obtaining the rising characteristic so often required. In this case the normal grid leak of an RC coupled stage takes the form of a potentiometer made up of the resistances R1 and R2, and the condenser C1 is connected in parallel with R1, C2 being the normal coupling condenser. The value of C1 is so chosen that at low frequencies, and up to the frequency at which it is desired that the curve should start rising, its impedance is high compared with R1. As, however, the frequency rises the value of the impedance of C1 drops and hence the value of the ratio R2/R1 plus R2 rises so that a rising characteristic curve for the stage is obtained. The amount of rise can, of course, be controlled by adding a variable resistance of a suitable value in series with C1.

In a similar manner a rising bass curve can be obtained by using a circuit such as Fig. 3. In this case the condenser C2 has a negligible impedance compared with that of the resistance R2, as the frequency falls to the point where it is desired that the curve shold rise. At still lower frequencies the value of the impedance of C2 becomes appreciable and is therefore added to R2 to give the required rise. Again, the amount of the rise can be controlled by introducing a variable resistance in parallel with C2.

These two simple fundamental circuits can obviously be elaborated, and, if suitable values are chosen and combined together, the calculation of the values to give any desired degree of rising curve is a relatively simple matter involving no great strain on the experimenters' mathematical powers.

Any comprehensive form of tone-control can be employed in the recording amplifier, and one that will answer our purpose admirably was described in *The Wireless World* of June 16th, 1938, in the article "Developing a High-Quality Communication Receiver."

Fig. 4.—Control panel of a large recording amplifier used by the author. Four calibrated fading and mixing circuits are embodied which are controlled by the four large knobs at the base of the amplifier.

Probably the most satisfactory arrangement for recording is to build up a separate one- or two-stage amplifier incorporating such a tilting circuit, and also the usual attenuators so that it may be inserted in front of the main amplifier and may then be used for correcting either microphone, pick-up or radio inputs. With simple apparatus it is not difficult, and well worth while to calibrate the tilt and attenuator controls in loss and gain in db. at some fixed frequency, and the trouble taken in doing this will be well repaid when it is desired to check frequency characteristics quickly.

Before leaving the subject of amplifiers one important matter must be mentioned. At some point in the system it is practically essential for serious work that a calibrated fader should be introduced. Each individual amplifier may have its volume or gain control, but these are not necessarily the most suitable for use as a means of monitoring a programme or item to be recorded. There are a number of well-known makes of fader on the market and these can be obtained already calibrated in decibels loss. Such faders are calibrated in loss as the minimum position is, at least, supposed to be infinity attenuation. The author has found that this is not always the case. A good calibrated fader is, however, rather an expensive item, and the cheap volume control normally used on a radio receiver may be successfully pressed into service if carefully selected and having a logarithmic law. Provided a reasonably large dial is used, such a control may be calibrated in db. by a very simple process. The fader to be

Home Recording—

calibrated is placed across the input of an amplifier fed from some constant frequency source, such as an oscillator, or pick-up with a constant frequency record. The output of the amplifier is measured by means of a volume indicator or voltmeter, which need not necessarily be calibrated.

The input to the amplifier, which must also have a separate gain control, is adjusted so that there is considerable gain in hand. With the fader to be calibrated adjusted to maximum a suitable reading is obtained on the output meter, and the fader control then turned until the reading is half the original value. This operation represents a loss of 6 db. at the fader and a calibration mark is made. The gain of the amplifier is then readjusted so that the original output reading is obtained and the fader then turned until the output meter again reads half the original voltage and in this way a further 6 db. loss obtained. Thus a series of points or marks on the fader scale are obtained, each 6 db. apart, resulting in the complete scale being calibrated over its useful range. This range is not usually more than about 35 to 40 decibels, but this is more than sufficient for most recording work.

An example of a four-way mixer utilising faders calibrated on this method is shown in Fig. 4. The accuracy of the logarithmic law of the volume control used may be checked in this way, and a number may have to be tried before a smooth scale is obtained. It will also be found very helpful in recording work to use a large knob for such a fader and the position and comfort when it is in use are also points to remember, as many a record has been spoilt by the awkward placing of the controls of the apparatus.

Reproduction

In recording work it is useful to provide two input circuits to the main amplifier, with a change-over switch so that a quick change may be made from recording to replay without altering the settings of the controls of the individual circuits. As has been mentioned in an earlier article, it is also very desirable to standardise replay conditions, and such a switching arrangement makes this possible. It is important that the relative level of a recording may be checked immediately after the recording. Here again the calibrated fader is extremely useful. The author has found that a disc on which is recorded a constant 500-cycle note very useful for checking the constancy of pick-up output and amplifier gain from day to day. Such a disc may also be used for "wow" tests.

The subject of microphones is one on which much has been written, and there is little to add as far as their special application to direct gramophone recording is concerned. At the present time carbon, crystal, ribbon, and moving-coil microphones are available, and the range both in price and quality is considerable. In some cases the sensitivity is such that the microphone may be connected via its transformer to the main amplifier, but in many cases a separate microphone or "A" amplifier is necessary. Here again standard practice may be employed, and no particular precautions need be observed in the design of such apparatus for recording work.

On the subject of pick-ups much has already been written, and the experimenter will have his own particular preferences. It should be emphasised that a pick-up having a fairly light weight on the needle is desirable, particularly if straight needles are to be used. In choosing a pick-up for reproducing directly recorded discs, it is advisable to check not only the frequency response, but also the tracking and amount of needle damping. It has been stated recently in an article in an American magazine in reference to the reproduction of records, with much truth, that the ear is the final critic of reproduction, and if the measurements for a given "set-up" say the results are good but the ear says they are bad, they are bad.

Finally, a word must be said on the general layout of the apparatus and procedure when recording. Convenience and physical comfort are too often forgotten. Particularly when experimental work is being carried out, it is important that all parts of the recording machine should be readily accessible, as some of the adjustments require delicate handling. In laying out the apparatus avoid doubling back the circuit, as this is one of the easiest ways to instability. Pick-up and cutter-head leads, if the recording machine is used also for playback, should be kept separate and screened from one another. If the output of the amplifier is on the right-hand side of the chassis keep the recording machine on the same side. Attention to small points such as these in the original layout will save a lot of trouble at a later stage. Where two machines are used for continuous recording they should be kept as close together as possible, as one machine may require attention while the other is being loaded. Always try and have at least two unmodulated grooves at the beginning of a record. This gives the record a professional touch and makes for a much more satisfactory replay. Good breaks between records can only be obtained by experience, and a knowledge of the material which is being recorded is almost essential. If the reader wants to try something really difficult let him attempt a continuous recording of an orchestral work which he has never heard before, following a full score, and keeping two machines working satisfactorily.

Radio Frequency Electrical Measurements. By Hugh A. Brown. 2nd edition. Pp. 384+xvi. Published by McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 24s.

THE aim of this book is not only to describe the theory of various methods of measurement, but also to treat the more practical aspects of the arrangement and use of the gear, to warn the operator of the more likely sources of error, and to give an indication of the accuracy of the results obtainable. In all this the author succeeds admirably, and the book is consequently of unusual interest to those who are unfamiliar with the practical side of measurement and who are consequently liable to fall into all sorts of traps.

The first chapter of no less than 92 pages deals with the measurement of circuit constants, and capacity, inductance, and RF resistance of condensers and coils are treated. Both resonance and bridge methods are dealt with in detail.

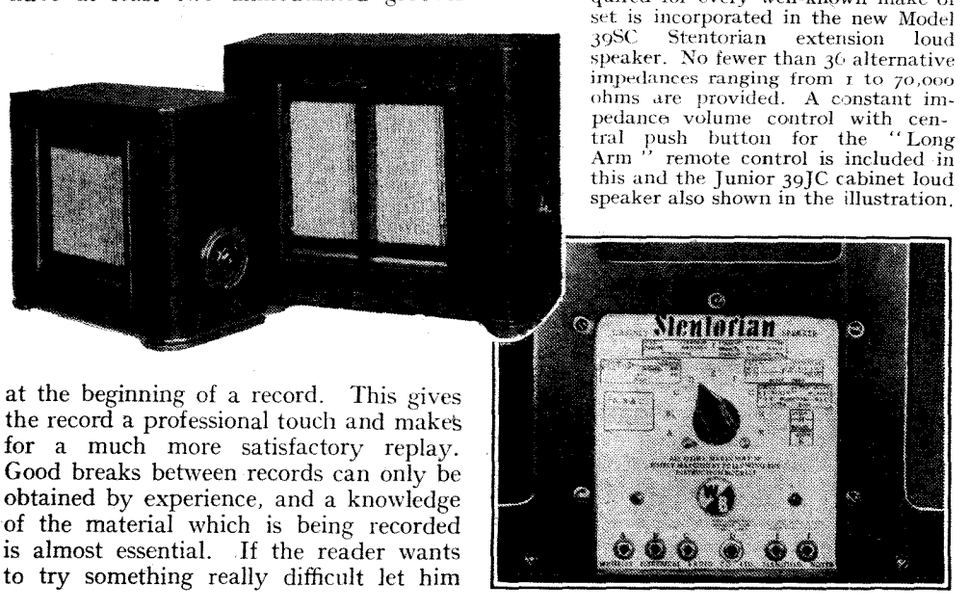
In the second chapter the measurement of frequency is dealt with. Simple methods are discussed as well as the more accurate systems, such as those using a low-frequency oscillator and harmonic generator. Lecher wires, CR tube systems, and frequency bridges receive considerable attention. The measurement of aerial constants has a chapter to itself, as also has the subject of the determination of field strength. Valves are dealt with in Chapter V, and in the next chapter, a long one, voltage, current, and power measurements. Valve voltmeters and RF attenuators are discussed in detail.

When dealing with the measurement of wave form it is natural that predominance should be given to cathode-ray methods, but several other methods are considered. The book concludes with a description of methods of measuring modulation, receiver performance, and piezo-electric effects.

The book is well printed and bound, and is unusually free from errors. W. T. C.

FROM THE W.B. RANGE

AN ingenious matching device with direct indication of the setting required for every well-known make of set is incorporated in the new Model 39SC Stentorian extension loud speaker. No fewer than 36 alternative impedances ranging from 1 to 70,000 ohms are provided. A constant impedance volume control with central push button for the "Long Arm" remote control is included in this and the Junior 39JC cabinet loud speaker also shown in the illustration.



Stabilising Power Supplies

II—The Constant Voltage Transformer

SPECIALLY designed transformers, depending for their action on the principle of magnetic saturation, may be used to counteract fluctuations in mains voltages in the manner described in this article.

By D. A. BELL, B.A., B.Sc.

THE barretter, which was discussed in the first of these articles, has inherently a low power efficiency; for any increase of applied voltage must result in an increase of power dissipated in the barretter itself equal to the whole of the additional power fed into the system. If one has to reduce voltage by means of some form of series impedance in an AC circuit, the use of a reactance (choke or condenser) gives less power loss, and therefore less surplus heat generated also, than the use of a resistance; it is therefore natural to seek some automatically variable reactance, which for alternating current will be the counterpart of the barretter resistance in maintaining constancy of power supply. The usual device is a special type of transformer, which, however, delivers constant voltage, in contrast to the barretter's constant current.

Most readers of *The Wireless World* have seen a "B-H" curve (or hysteresis curve) for a specimen of iron, such as is reproduced in Fig. 1, but how many realise that it is usually measured by means of the circuit of Fig. 2? The iron

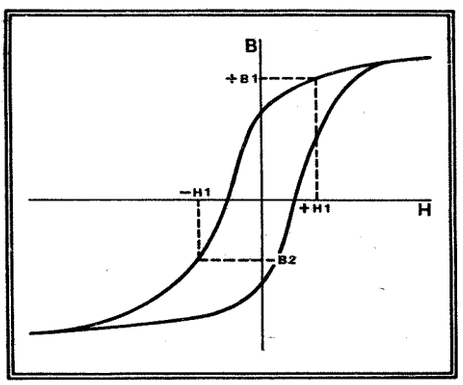


Fig. 1. A typical magnetic hysteresis curve.

is made up into a circular core, on which are wound two coils P and S; current from the battery, which can be adjusted by a variable resistance and measured on the ammeter A, flows through the coil P, and sets up a magnetising force ("magnetomotive force" is the technical term) which is denoted by the symbol H. This causes a magnetic flux, denoted by B, to be set up in the iron; whenever B changes, an EMF proportional to its *change* in magnitude is induced in coil S, and measured by the resulting discharge through the galvanometer G. Thus on working the reversing switch S, the galvanometer will indicate a change of flux, say from $+B_1$ to $-B_2$, corresponding to the reversal of magnetomotive force from $+H_1$ to $-H_1$; by varying the current to give different values of H, one can plot out the whole B-H curve. (It is best to make each observation by going up to saturation in one direction, then reducing H to the desired value and reversing. This ensures keeping on the main hysteresis loop, whereas one would otherwise traverse small loops within it.)

Now it does not need much stretch of the imagination to see that the battery and reversing switch might be replaced by a source of alternating current, and the galvanometer by an AC instrument; we should then call the iron ring with its two windings P and S a "transformer"; Coming back to our B-H curve in Fig. 1, it will be seen that beyond a certain point, usually referred to as the saturation point, increase of H does not appreciably affect B; by making H large enough, therefore, we can arrive at a point where further increase of the primary current has little effect on the peak current delivered by the secondary. But this is usually not sufficient, for we need to limit the *power* delivered from the secondary, and that will increase with increasing input to the primary even though the peak value of the secondary wave-form is limited.

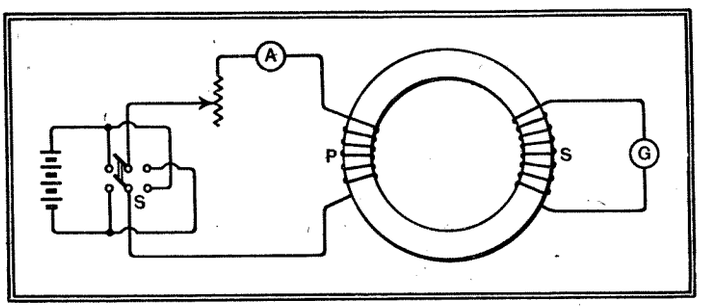


Fig. 2. Circuit for obtaining the curve of Fig. 1.

Comparing Figs. 3a and 3b, which might be taken as crude representations of primary and secondary wave-forms respectively at two amplitudes, it will be seen that although the secondary wave-form has had the peaks chopped off at the higher voltage, its waves are broader; they rise rapidly to the limiting voltage and remain there for a time, instead of only just reaching it at the peak as sine waves do so that their effective value (or "root mean square" value) is greater than that of the sine wave of the same height. Consequently, this system of simple saturation does not give constant output.

Incidentally, another difficulty would appear if a saturated transformer were made up exactly as shown in Fig. 2. As soon as any load is connected across S, the load current flowing in this coil will set up a de-magnetising force and so lower the flux through S, and hence the voltage at its terminals. If a transformer is to have good regulation, this effect must be counterbalanced by an increased flux derived from the primary winding; this is produced by the increased primary current which flows in an ordinary transformer when the load is applied. But as drawn in Fig. 2, the primary and secondary windings are separated by long lengths of iron which are supposed to be saturated in the first place, and therefore will not be able to carry extra flux when it is needed for the loaded secondary. In practice, therefore, primary and secondary would be wound one over the other, or closely side by side, on the same limb of the core to reduce magnetic leakage. Leakage of magnetic flux is naturally most likely to occur when the iron core is worked in the saturation region, since the iron then does not offer an easy path for stray flux, and apart from the possibility of bad regulation, any leakage is a very objectionable feature in radio and similar work. In fact, the chief difficulty in using constant voltage transformers is that the leakage field is liable to cause bad hum pick-up, especially as it is rich in harmonics. Screening helps, but since working the core at saturation inevitably involves heavier iron losses than usual, ample allowance must be made for cooling. There is also the danger of mechanical hum in the core, and if the screen-

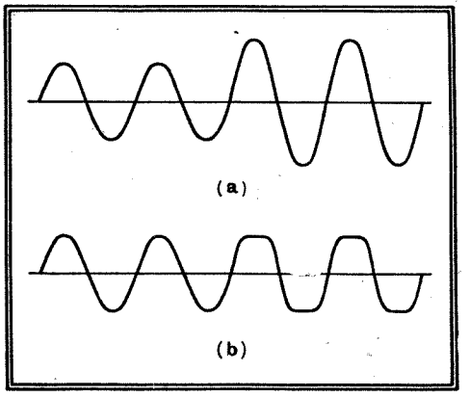


Fig. 3. Primary (a) and secondary (b) wave-forms of a saturated transformer.

Stabilising Power Supplies—

ing case has sheet iron panels, they must be very rigidly braced to avoid audible vibration in the magnetic field.

It should perhaps be pointed out that whereas the B-H curve gives a relation between secondary *voltage* and primary *current*, we are in practice concerned with the relation between the secondary voltage and primary *voltage*. In a transformer which had no primary leakage reactance and no primary resistance, the primary current could increase to immense values when the primary voltage rose above the saturation value, and thus produce sufficient flux to maintain a constant ratio of secondary to primary voltage; but a real transformer always has a certain amount of impedance in the primary, which limits the primary current and hence the secondary voltage.

Voltages in Opposition

Although the simple saturated transformer does not give constant effective secondary voltage, it does give a secondary voltage which tends to increase less rapidly than the applied primary voltage when saturation is reached, as shown in the top curve of Fig. 4. Suppose now we connect in series with the secondary of the saturated transformer the secondary of an unsaturated transformer of lower voltage and connected in such a sense that the two secondary voltages are in opposition.

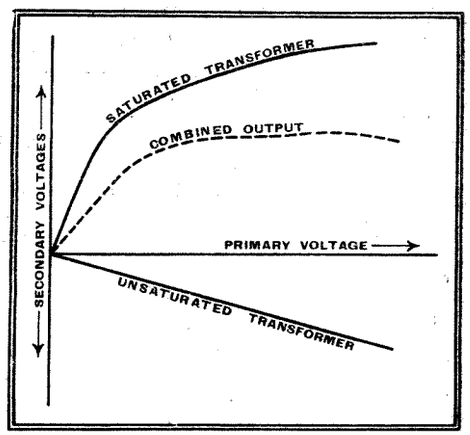


Fig. 4. Outputs of saturated and unsaturated transformers singly and in combination.

Then we might expect something like the dotted line of Fig. 4, which represents the difference between the secondary voltages of the saturated and the unsaturated transformers and is practically constant over a certain region.

Unfortunately for the transformer designer, this simple arrangement (as illustrated in Fig. 5) does not work out so easily. The trouble is that the difference in the saturation conditions of the two transformers causes a difference of phase between the two secondary voltages so that we cannot perform a simple subtraction of one from the other. In fact, it may be found that the combination of the two is very little more constant than the saturated transformer alone.

Two new principles are therefore brought in: (a) phase-correction, and (b) the use of an external reactance in series with the saturated transformer. Fortunately, a single fixed condenser provides the means of satisfying both; it is usually connected in series with the saturated transformer, as shown in Fig. 6, and alters the phase of the output from this transformer so that the secondary voltages of the two transformers are more nearly in true opposition, especially at high input voltages. In addition, as the input voltage rises, the saturated transformer tends to become of lower impedance (as it becomes more fully saturated), so that a greater proportion of the input voltage is developed across the fixed impedance of the condenser and a less proportion across the decreasing impedance of the transformer. Thus, the primary of the saturated transformer gets less than its proportionate share of any rise in voltage and the current in it is prevented from rising rapidly.

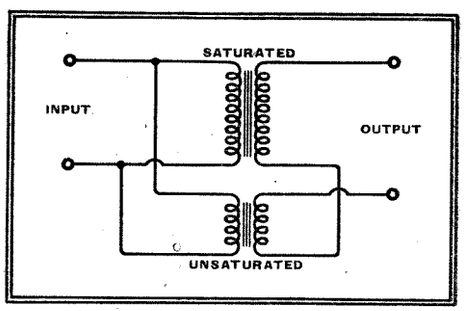


Fig. 5. Interconnections of saturated and unsaturated transformers.

In this system we have made the output voltage of the saturated transformer higher than the desired output voltage of the whole system and balanced it by connecting in series opposition the secondary of the unsaturated transformer. Every extra volt in this balancing process thus involves taking the secondary current through a doubly increased number of turns of wire (extra turns on the saturated and turns on the unsaturated transformer), so that to minimise copper losses this balancing process must be restricted to as small a fraction as possible of the total output voltage. Moreover, the reactances (both external condenser and leakage) used in conjunction with the saturated transformer tend to cause bad regulation, so that there is little margin to spare for bad regulation due to secondary resistance. It is therefore important to make the saturated transformer do the greatest possible amount of controlling on its own, i.e., the top curve in Fig. 4 must be made to bend over as far as possible towards the horizontal. Consequently, it may be worth while to make comparatively "tricky" adjustments, such as bringing the condenser near series resonance with the primary of the saturated transformer at low voltage, but allowing the reduced inductance of the primary winding on heavier current to take it away from resonance as the applied voltage rises; this gives the voltage a greater boost at low inputs. There is, however, a danger in this, for the voltage across the condenser rises in proportion to the approach to resonance and may therefore rise far above the mains input voltage, particularly when there is little load on the transformer secondary to damp this

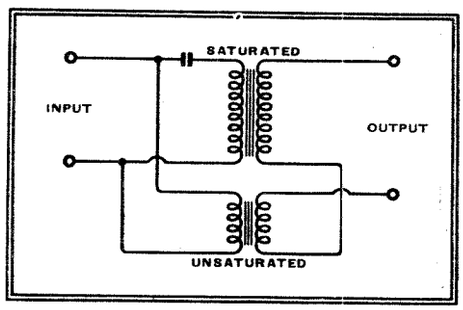


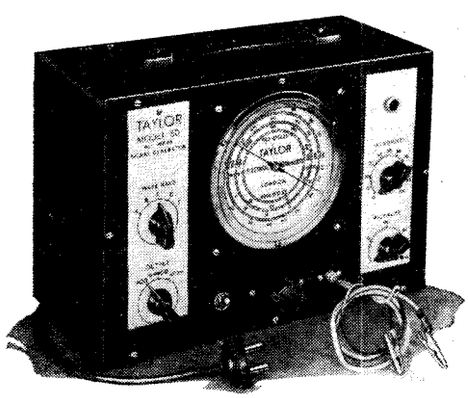
Fig. 6. The use of a fixed condenser for phase correction.

partially tuned circuit. The condensers used in this type of equipment commonly have an AC working rating of two or three times mains voltage.

These are the general principles involved in constant voltage transformers. But since both phase and magnitude of the component secondary voltages are varying with the applied voltage and depend upon both the magnetisation characteristics of the iron used and the leakage reactances (the latter are always difficult to calculate), it is not practicable to give constructional details or formulæ.

TAYLOR SIGNAL-GENERATOR

PRODUCED by Taylor Electrical Instrument Co., of 77a, Queen Victoria Street, London, E.C.4, the Model 50 Signal-generator covers 100 kc/s to 50 Mc/s in six bands. The dial is calibrated in frequency and on five bands—100 kc/s to 23 Mc/s—the fundamental oscillator output is used, but on the sixth the second harmonic.



The Taylor Model 50 Signal-generator

An output amplitude control is provided in the form of a continuously variable control which can be used in conjunction with a multi-way switch. The output itself is available through a screened lead terminating in spring clips.

A separate valve is used as an AF oscillator, and generates a 400 c/s audio-frequency which is available directly at the output, if required, or can be used for modulating the RF oscillator. The AF oscillator can, of course, be switched off when an unmodulated RF output is needed.

The equipment is contained in a metal case measuring 12in. × 8in. × 5½in. and it weighs 10½lb. It is black crackle finished. Three models are available, for AC, AC/DC, or battery operation. The price is 8½ gns.

NEWS OF THE WEEK

TELEVISION O.B. AERIAL

Another New Unit for Alexandra Palace

FOR the past two months the B.B.C. have been using, as a temporary arrangement, an old fire escape for erecting the television O.B. transmitting aerial. It has now taken delivery from Merryweather and Sons, the well-known fire engineers, of an all-enclosed vehicle with an extensible ladder permanently mounted and carried on the roof when travelling. This ladder, which is capable of being erected in an almost vertical position to a height of 80ft., was first used last week during the O.B.s of the swimming championships at the Wembley Stadium.

The ladder is in four sections, but is provided with rungs in the top section only, as it is intended that the aerial (which, together with its lead-in cable, is carried inside the car) should be fixed before the ladder is extended to its working height.

The erection of the ladder, which is mounted by means of trunnions at the apex of an "A" frame secured to the main car chassis members, is carried out by power from the car engine through the medium of a take-off union from the gear box. This is transmitted to the hoisting mechanism at the rear of the vehicle where controls are provided. To avoid damage by high winds, guy ropes are provided which are secured to the ground by means of substantial screw pickets.

The London television station is now well equipped with O.B. apparatus, for it has two complete units of three vehicles each, a film unit and the "escape" aerial.

O.B. Developments

After Radiolympia big developments may be expected in the O.B. side of television, which is undoubtedly the direction in which television will most quickly gain the attention of the public. With the two mobile units in commission, it will be possible to include two or more widely varied O.B.s in one programme from different parts of London.

Among the events scheduled for the autumn will be a return visit to the Pinewood Film Studios on September 23rd and 24th to show the filming of scenes from the "Mikado," the first Gilbert and Sullivan opera to be filmed. Towards the end of the month one of the mobile units will go to Imber Court to show how police horses are trained. Hampton Court will be visited for a romantic and historical feature early in October, and later in the month viewers will be given a visual description of one of the mobile television units.

N.P.L. DIRECTORSHIP

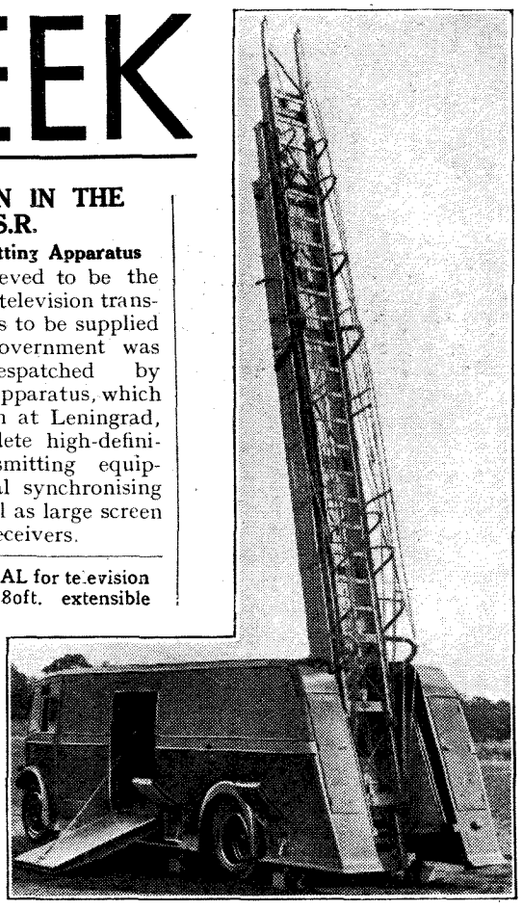
FOR reasons of ill-health Professor R. H. Fowler, O.B.E., M.A., F.R.S., who, as was announced in our issue of June 9th, was appointed Director of the National Physical Laboratory, has decided not to accept the post. No further appointment has yet been made.

NEW CENTRAL CONTROL ROOM, which is nearing completion at Alexandra Palace, will be the nerve-centre of television broadcasts. It will handle the outputs from the two studios as well as those coming from the O.B. units.

TELEVISION IN THE U.S.S.R.

British Transmitting Apparatus

WHAT is believed to be the first British television transmitting apparatus to be supplied to the Soviet Government was last week despatched by Scophony. The apparatus, which is for installation at Leningrad, comprises complete high-definition film transmitting equipment and special synchronising apparatus as well as large screen high-definition receivers.



"ESCAPE" AERIAL for television O.B. unit. The 80ft. extensible ladder is shown partly extended. To give stability when the aerial is erected the vehicle is fitted with four screw jacks, three of which can be seen in position. The door, when opened, forms a ramp for removing cable drums.

NEWS BULLETINS BACK

The French Government Temporise

THE fury of controversy aroused in France over the shortening of times allocated to broadcasting news bulletins has already occupied considerable space in these pages, but a further step in the argument is marked by the decision of Poste Parisien and other private stations that the broadcasts in question should be reinstated, but only between noon and 1 o'clock each day.

This minor concession to the general demands of public and Press is satisfactory to nobody, and nine of the leading dailies are continuing the war with a view to hastening the return of the old hours. The Prime Minister pointed out the experimental nature of the arrangement, and promised a thorough investigation into its results.

THE INDUSTRY IN INDIA

SIR THOMAS AINSCOUGH'S survey of the import trade of India for the year ending March 31st, 1938, shows an advance in the wireless trade from 26,925 to 29,567 receivers.

The United States still dominates the trade in receivers, but it is of interest to note that the United Kingdom takes a prominent place among the countries benefiting from the increased demand for transmitting and electrical apparatus.

B.B.C. RECEPTION REPORTS

Verification Cards Not Used

MANY overseas listeners are still unable to see why the B.B.C. is disinclined to check up reception reports and send verifications to listeners who claim to have picked up one or more of the Daventry transmitters in remote parts of the world, since it is done by most of the other countries with short-wave stations.

It has to be remembered that many of the Daventry transmissions are relayed by local stations. They may not necessarily be "local stations" to listeners sending in reports prepared in the perfectly honest belief that the transmission was picked up direct. But often these relays reach distant spots at much greater strength than the original signal.

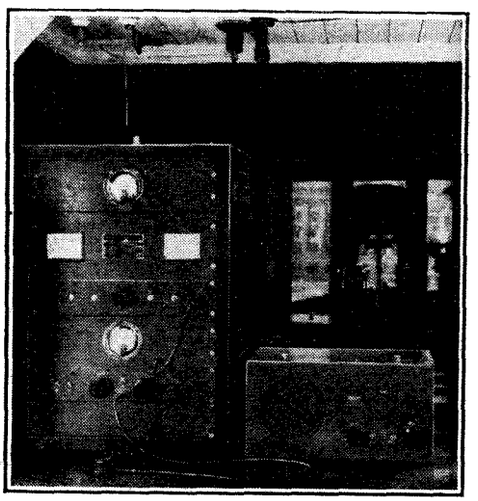
Nevertheless, the B.B.C. is always glad to have reception reports from listeners abroad, and acknowledges them without delay, besides dealing with any technical questions which may be raised.

RADIO ON CANADIAN LAKE FREIGHTERS

A LARGE number of Canadian lake freighters do not, because of their size, come within the law requiring ships to carry radio equipment and a wireless operator, with the result that quite a number have been lost

News of the Week—

in past years during the late autumn storms. Compact radiophone transmitters developed by the Canadian Marconi Company have now been installed on a large number of these vessels. These do not require the attention of a full-time radio operator, but can be handled by the captain, who can thereby keep in constant touch with any of the seven Great Lakes coastal stations installed by the Canadian Government. The apparatus, which works on 184 metres (1.630 kc/s) and is fitted in the pilot house, is installed by the Marconi Company on an annual rental basis.



SIMPLICITY IS THE KEYNOTE of this installation in one of the Canadian Great Lakes freighters. On the left is the transmitter, with the hand-microphone lying on the table before it, and, right, is the receiver with built-in loud speaker.

HILL-SIDE LISTENING GROUPS

Wireless for America's Isolated Communities

THE problem of organising listening centres for the isolated hill people of Eastern Kentucky, U.S.A., was attacked in 1933 by the University of Kentucky, which, with the co-operation of N.B.C. and other educational broadcasting groups, succeeded in placing wireless receivers in twenty-seven isolated communities.

Miss Judith Waller, Educational Director of the N.B.C. Central Division, who recently made a personal inspection of the listening centres, discovered many interesting effects which broadcasting exercises over the people. They prefer symphony music to their native hill billy swing; they unanimously follow news bulletins; and they find an Oxford accent completely unintelligible.

Each group is in the charge of a "listening director," who receives guidance as to the choice of forthcoming programmes from General Supervisor Miss Corsia Whitaker, who each year spends a week with every one of the communities.

Arriving by all conceivable kinds of conveyance, the listeners come from twenty-five to thirty miles to hear programmes and audiences number anything from 2 to 75 people.

ADVICE FOR LISTENERS ABROAD

IT is thought that, with our wide circle of readers abroad, it would be well for us to mention that the B.B.C. have now prepared a 12-page booklet entitled "Reception of B.B.C. Programmes Abroad." Letters from all parts of Europe are frequently being received by the B.B.C. asking for advice about the reception of British programmes, and it is with a view to helping the writers of such letters to obtain the best possible results, that this booklet has been prepared. It deals briefly with the receiver and the aerial and earth system, and in the appendix gives some guiding principles on the choice of wavelengths for day and night reception.

AMATEURS' WORK APPRECIATED

IT is pointed out by *Electrical Communications* that in spite of the increasing pressure of national and international requirements, the frequency bands allocated to wireless amateurs remain substantially those originally allocated at Washington in 1927. This can be regarded as an appreciative recognition of the value of experimental work in the field of wireless.

It is stated that there are approximately 70,000 amateur and experimental radio stations in the world, 50,000 of which are located in the United States of America.

BROADCASTING ESPERANTO

PEACE, politics and Esperanto probably benefit more from wireless than most other causes to-day, and listeners in all parts of the world were able, by means of two outstanding wireless events, to take some part in the thirtieth Universal Esperanto Congress recently held in London. Fifteen hundred representatives from thirty countries attended the celebrations, and part of the opening ceremony was recorded by the B.B.C. for Paris PTT, and broadcast from that station on the following day.

Congratulatory telephone messages between Esperanto representatives in Australia and the President of the League in London were transmitted from the Melbourne and Sydney broadcasting stations. Reception was reported to be very good.

FROM ALL QUARTERS

Italian Radio Development

SIGNOR MUSSOLINI had a conference with the chiefs of Italian radio, and made investigations into the current development of the service. As a result of this, twenty-one local stations, using a power of about 200 watts each, are to be erected in localities where reception from existing stations is unsatisfactory. The completion of the present programme will provide Italy's 800,000 listeners with fifty stations having a total power of 935 kW.

Radio-Paris Storm Damage

THUNDERSTORMS experienced in France during last week resulted in severe damage to one of the insulators of the Radio-Paris State broadcasting station. Whilst repairs were being effected the station closed down from 6 a.m. to 5 p.m. on Wednesday of last week.

One in Five Owns a Receiver

WIRELESS licence figures in Sweden on June 30th stood at 1,156,781, or 184.1 per thousand inhabitants. In Stockholm the number was 247.2 licences per thousand.

Education on the Short Waves

THE New York City Board of Education has requested permission for the installation of a short-wave station to radiate its special scholastic programmes. This is in addition to its existing station, WNYC, which is working on the medium waves.

French Radio Expands

ALL French manufacturers of wireless apparatus have been asked to make themselves known to the State Broadcasting Service in order that a complete official list of them can be drawn up. It is said that this information is being sought preparatory to the issuing of invitations for tenders for the supply of a large number of new broadcasting installations.

At the B.A. Meeting

A SPECIAL studio has been fitted up in Emmanuel College, Cambridge, for the use of the speakers who are to give four broadcast talks for English listeners on the British Association meeting, which opened yesterday, August 17th.

Italian People's Set Fiasco

ACCORDING to *Popolo d'Itlaia*, sales of the People's Receivers in Italy have proved a fiasco. Radio dealers will not keep them because they have little profit on them, and in private houses few of the sets are to be seen. A demand is put forward that dealers should be obliged to keep a number of the receivers in stock.

Nottingham Radio Exhibition

TELEVISION is to be the main feature of the Nottingham Radio Exhibition, which will be revived this year from September 7th to September 14th at the Greyfriars Hall, Nottingham. Although the North is certainly vision-conscious, there is still no plan to provide them with a television service.

Electrical Megaphone for Brighton Police

THE Philips electrical megaphone which was illustrated in these pages on August 4th, is now being used experimentally by the Brighton Police for "pedestrian control" at busy crossings in the town. The apparatus is entirely portable and can be easily carried by the operator.

Index and Binding Case

THE index for Volume XLII of *The Wireless World*, January to June, 1938, is now ready and may be obtained from the publishers at Dorset House, Stamford Street, London, S.E.1, price 4d. post free, or, with binding case, 3s. 1d.

TELEVISION has been a big attraction at the Berlin Show, which closes next Sunday (August 21st). The stage, which can be seen by visitors, is shown during one of the performances.

The Berlin Show

GERMANY'S NATIONAL EXHIBITION REVIEWED BY OUR SPECIAL CORRESPONDENT

THIS year's Show is divided, as is customary, into two parts, a trade section and a section intended for the general public. In the latter are to be found a complete broadcasting installation, the Post Office exhibit, including the "wired wireless" relay system, television, and a special exhibit entitled "Physics in Broadcasting." Comparatively few components for the home constructor are being exhibited. In the trade section five Austrian firms are exhibiting for the first time.

The leading features of this year's Show are a general lowering of prices, better external appearance, improved quality of reproduction, due mainly to the use of negative feedback, and the greater use of dual loud speakers. In the larger sets it is not uncommon to find an 18-watt output valve, and it is interesting to note that in these large sets considerable use is made of "quiescent" principles, which are almost universal in the case of the smaller type of set. Another common feature this year is the use of a rectifier in DC sets, thus converting them to the universal type. About two-thirds of all the big receivers embody automatic tuning correction. Press-button tuning is used this year by several firms.

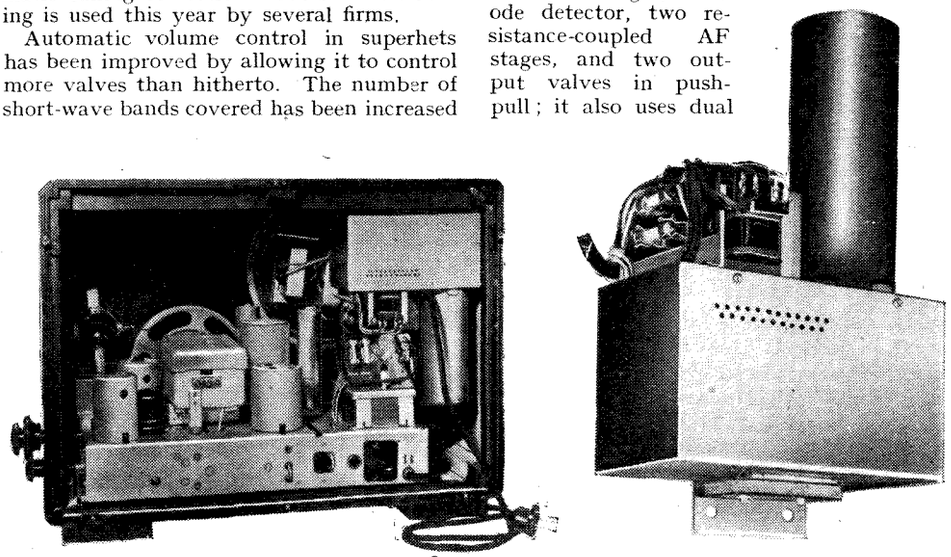
Automatic volume control in superhets has been improved by allowing it to control more valves than hitherto. The number of short-wave bands covered has been increased and, in the case of one receiver, provision is made for the ultra-short waveband.

A noticeable feature is the almost exclusive use of wooden cabinets. The well-known "People's Receiver" appears this year in a new form with moving-coil loud speaker at a price of 65 RM. In addition to this, there is a new popular receiver known as the "German Small Receiver" this costs only 35 RM. While the "People's Receiver" has three valves, this instrument has only two, a regenerative triode followed by a pentode. Another noteworthy point is that for the first time all-metal valves are being exhibited, those shown being made by Telefunken and Valvo.

The regenerative-detector type of receiver, which is still very popular in Germany, has fallen in numbers compared with last year. This year it is fitted with a form of aerial coupling which varies automatically with the wavelength. In addition, this type of set has, in the case of almost all makes, negative feedback and, in some cases, an input band-pass filter. The number of TRF receivers with one RF stage has increased, and in most cases reaction is fixed.

Prices of the simple regenerative detector receivers range between 120 and 140 RM., while the TRF receivers cost between 146 and 200 RM. Most of the AC receivers have a corresponding universal model, many of them with an auto-transformer with only one winding, which acts as a choke on DC mains. This year, as last year, the Siemens "Chamber Music" receiver is the most outstanding "straight" set; it uses nine valves, consisting of three RF stages, a diode detector, two resistance-coupled AF stages, and two output valves in push-pull; it also uses dual loud speakers and costs 1,614.30 RM.

A modern German radiogram layout: the Telefunken "Sessel-Phono-Super 876."

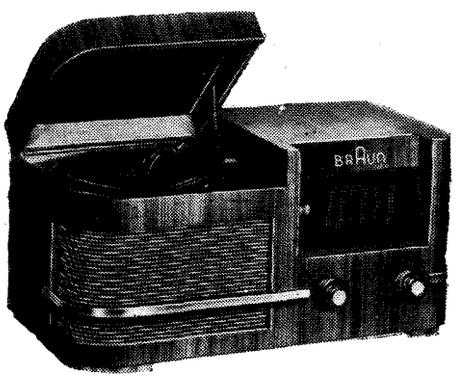


The "Amatus" DC receiver, fitted with rectifier unit for operation on AC. An enlarged view of the Körting adaptor unit employed is shown on the right.

The small three-valve superhet has almost completely disappeared this year, while there are very few of the four-valve type. The "small" superhet this year usually has five valves and costs from 200 to 250 RM. It has from five to seven tuned circuits and possesses one, and often two, short-wave bands. In almost every case it has variable selectivity and negative feedback. In the case of some makes, notably Körting, Mende, Philips and Sachsenwerk, a rectifier unit can be connected to the AC models to enable them to be used on DC mains.

In the 250-300 RM. price class come the six-valve superhets; in these short-wave reception is dealt with more effectively than in the five-valve type, and the same remark applies to the AVC system. As a general rule, the extra valve is added to the IF amplifier, but in the Blue Spot, Detewe, Körting, Nora, and Saba models it is used as a signal-frequency amplifier. All the six-valve superhets have negative feedback, variable selectivity, multi-band short-wave reception, and a tuning indicator.

The larger superhets have anything from seven to fifteen valves and up to ten tuned circuits. Prices range between 300 and 600 RM. The AEG Super 108 WK, the Blue Spot types 9 and 11 W78, the Körting Transmare 39, the Stassfurt Imperial 159, and the Telefunken 8001 WK all have push-pull in the output stage and all have dual loud speakers except the Stassfurt, which has three. The latter receiver has fifteen valves and costs 1,980 RM. It is, however, a radiogram. The AEG Super 88 and 108 WK, the Sachsenwerk-Olympia 390 WK and the two Telefunken receivers, 898 WK and 8001 WK, have automatic tuning correction, while the Blue Spot 11 W78, the Körting Transmere 39, the Radione 6039A, the Stassfurt-Imperial 159 and the Loewe-Opta 839W also have press-button tuning.



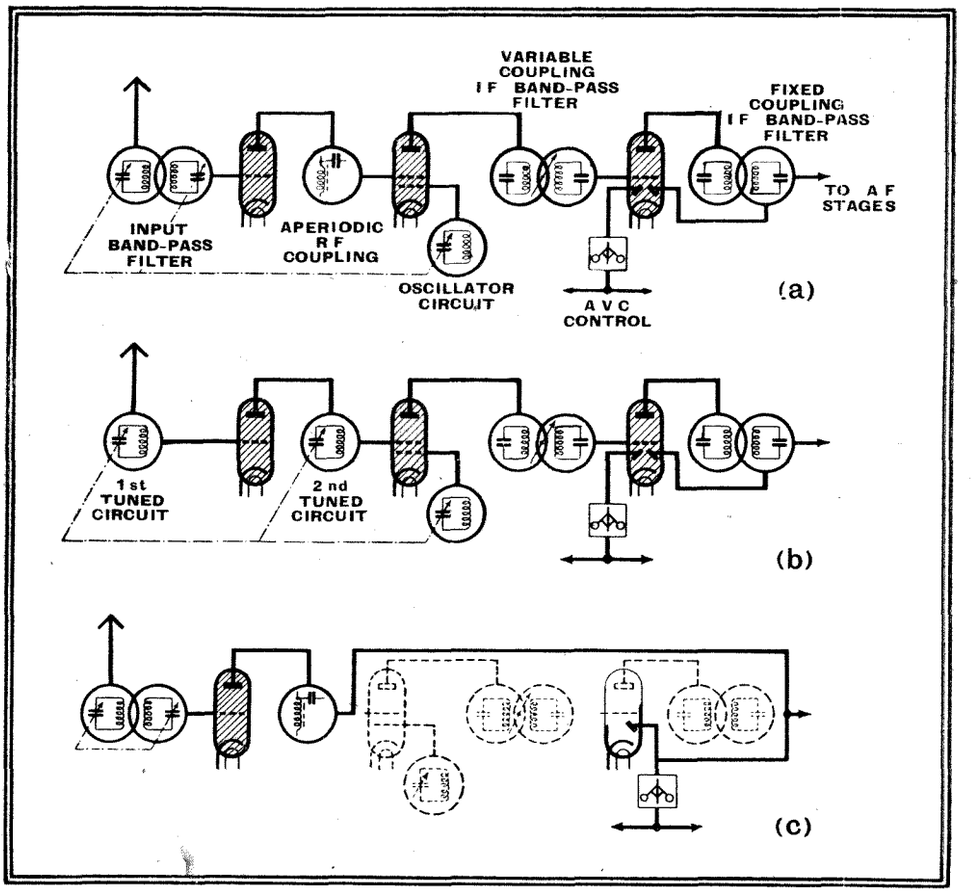
A compact table radiogram: the Braun "Phono-Super 639."

The Berlin Show—

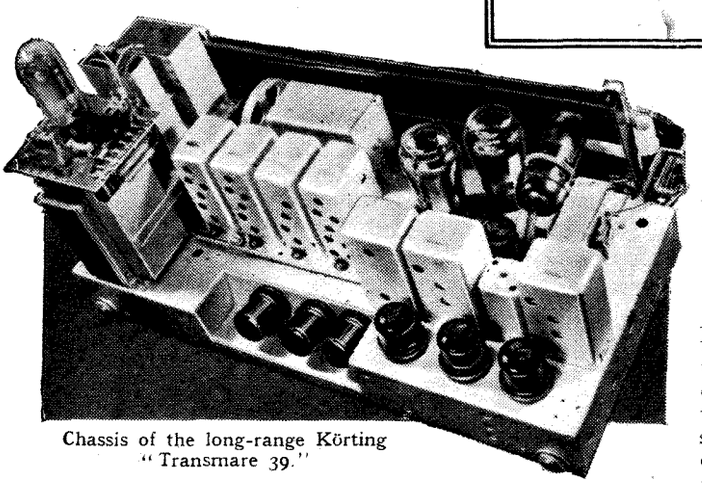
Only about seven makers have universal models of their big superhets: of these only the Loewe receiver has automatic control and only the AEG Universal 97 GWK has dual loud speakers. The circuit arrangement of the big superhet is almost always one signal-frequency stage, one frequency changer, one or two IF stages, a diode detector, and one or two resistance-coupled AF stages. Push-pull is usually, but not always, employed in the output stage.

Turning to battery receivers, it will be found that, in addition to the regenerative and TRF types usually found in Germany, there are also superhets with from four to six valves and six or seven circuits at prices ranging between 205 and 233 RM. The Blue Spot battery receiver has two loud speakers and practically all makes have variable selectivity. The Nora B68 has the additional refinement of negative feedback. Braun and Körting show similar receivers in portables.

There is a large number of radiograms, ranging in price from about 310 RM. for the cheapest of the Braun models, a six-valve table instrument for AC, up to the 1,614.30-RM. Siemens "Chamber Music" receiver. Of the medium-price models Stassfurt has four, ranging from 478 to 685 RM., all with dual loud speakers. The low-priced Telefunken-Phono 875 ("Zeesen") costs 374.75 RM. for the AC model and 402 RM. for the universal type.



Input circuit matching to the different wavebands in the Körting "Supra-Selector 39." (a) Medium and long-wave distant reception (b) Short-wave distant reception. (c) Medium and long-wave local reception.



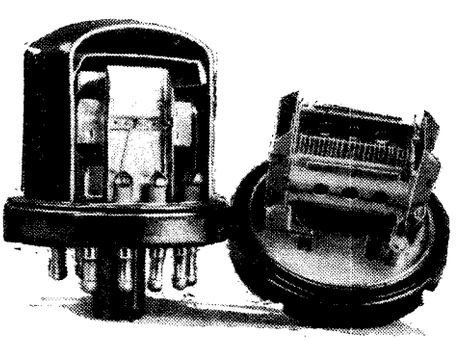
Chassis of the long-range Körting "Transmare 39."

Another interesting radiogram in the medium-price class is the Telefunken-Phono 876, with six valves and seven circuits.

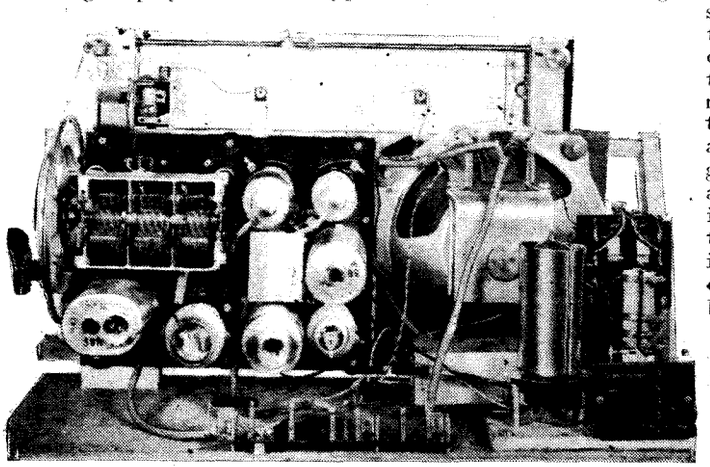
There are several receivers in what may be called the "special feature" class. Among these is the AEG Super 88, an eight-valve nine-circuit receiver in which automatic volume control is made particularly effective by using no fewer than four valves for the process. The press-button tuning of the Philips Aachen-Super D58 has ten buttons, which can quickly be adjusted by the layman to ten chosen stations. Two additional press buttons allow the motor to be used for coarse tuning to other stations, the final adjustment being made by hand.

Among the loud speakers Siemens offer an interesting arrangement of three instruments suspended from a ceiling pendant like hanging lamps. The sound is reflected on to the ceiling by a shell hanging below them. From the ceiling it is evenly diffused throughout the room. Telefunken show a new moving-coil instrument described as a "flat loud speaker," which is designed specially for mounting in the wall. Its overall depth is only 5 cm., this reduction in size being accomplished by mounting the driving unit in front of the diaphragm.

New valves are to be seen in great numbers. A notable example is the duo-diode EB11, which has two separate cathodes and is a metal valve intended for special circuits. Among others are the EBC11, a duo-diode triode, also metal, which is intended chiefly for use as a "driver" valve, and the EBF11, a duo-diode-pentode with variable-mu characteristics. This latter valve is intended for use in an IF amplifier and has varying screening grid bias to permit of its being employed in a new type of AVC circuit which depends for its action on the curvature of the characteristic becoming less as the screen grid voltage is raised; for strong incoming signals the curvature is required to be slight, and this is obtained by arranging matters so that the AVC control voltage acting on the control grid also raises the voltage on the screen grid in the desired proportion, the usual screening grid potential divider being replaced by a series resistance.



New metal-envelope pentode with specially rigid electrode supports. The three holes in the anode are for viewing during assembly.

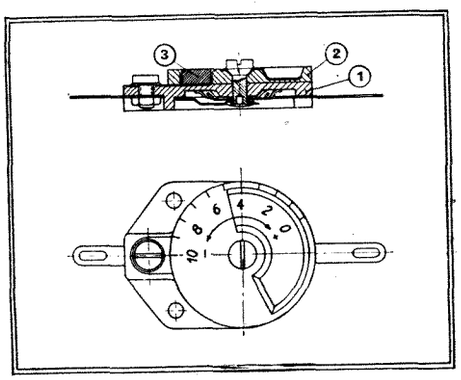


Telefunken-Super GWK "Zeesen" with vertically mounted chassis.

The Berlin Show—

Other valves include the ECH11, a metal triode-hexode frequency-changer with improved AVC characteristics and very modest requirements in the matter of oscillator voltage. The EF11 is a metal variable-mu RF pentode, and the EF12 a new all-metal constant-mu RF pentode, and the EF13, a variable-mu RF pentode for signal-frequency stages.

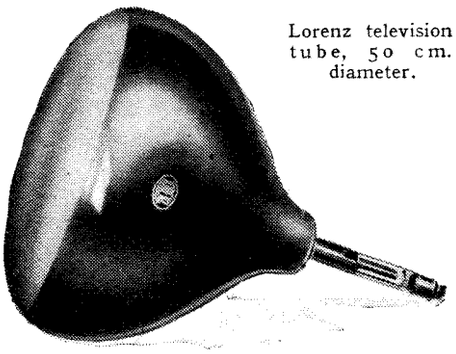
Also new are the EFM11, a combination of tuning indicator and variable-mu AF valve, and the EL11 and 12, which are 9- and 18-watt output pentodes the latter with greatly augmented slopes. In some of the new RF valves the customary grid connection from the top is done away with, this being made possible by the use of the new metal envelope. Austrian valves are included in this year's Show.



Adjustable trimmer condenser with Calit and Condensa dielectrics: not affected by temperature variations. 1—Calit stator, 2—Calit rotor, 3—fused-in insert of Condensa.

Among the accessories the new Telefunken condenser microphone is of interest. It has straight characteristics between 40 and 10,000 c/s, obtained by the use of a diaphragm only 5 mm. in diameter made of very thin aluminium foil and lacquered on both sides. The diaphragm is built into a case which also contains the amplifier valve.

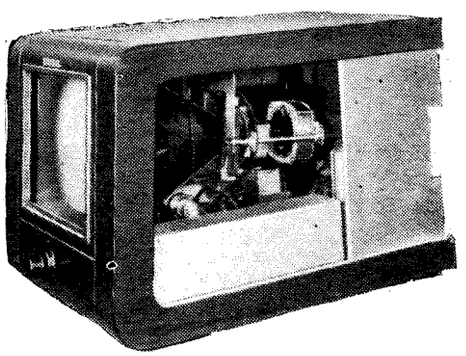
The RF iron-core material made by Görler, under the name "Amenal," is of special interest. The permeability of



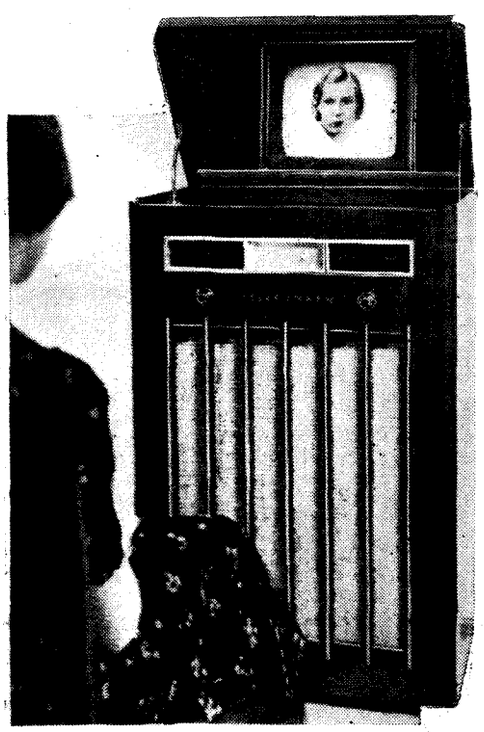
Lorenz television tube, 50 cm. diameter.

"Amenal N" is stated to make it suitable for frequencies of from 100 to 5,000 kc/s, while "Amenal K" is intended for values between 3,000 kc/s and 50 Mc/s. Other "mixes" for lower frequencies are produced. "Amenal" consists of finely divided iron highly compressed and then fired.

Hescho offer adjustable disc trimming condensers which do not vary with temperature owing to their being constructed from a combination of Calit and Condensa, which have opposing dielectric constant temperature characteristics.



The new Telefunken table television receiver TF1 (open).

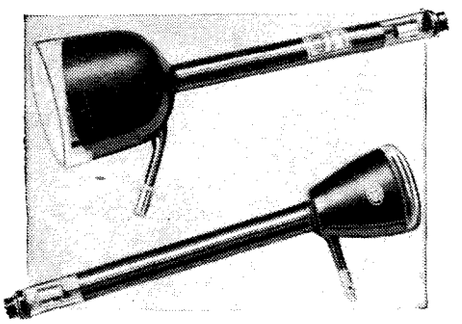


Telefunken television receiver FEVI.

Television

Turning to television, Lorenz exhibits a home receiver giving a 23 × 20 cm. picture. Pre-set tuning is used. A combined Lorenz-Fernseh apparatus for specially high performance embodies an ordinary broadcast receiver and a television sight and sound receiver, including a 50-cm. cathode-ray tube mounted vertically and giving an indirectly viewed picture 37.5 × 32 cm. in dimensions. Lorenz have also improved their last year's home-projection receiver, which now gives a 50 × 60 cm. picture. Another Lorenz production is a new projection receiver giving a picture which can be viewed either from behind on a ground-glass screen or else projected on to a screen having a surface of 4 square metres in area. For testing and measuring purposes Lorenz have developed also a special portable receiver divided into two separate units. Tekade show this year a cabinet receiver with a cathode-ray tube of 40 cm. diameter, giving a picture of 27 × 30 cm.

Telefunken exhibit a mass-produced version of the experimental "block" receiver shown last year; this is for use as a receiver unit in conjunction with a communal aerial system with a common pre-amplifier. The same firm shows a big cabinet receiver carrying in its lid a mirror which can be set at four different positions to suit the eye level of the viewer. The cathode-ray tube has a diameter of 35 cm. and gives a 21 × 26 cm. picture. The new Telefunken



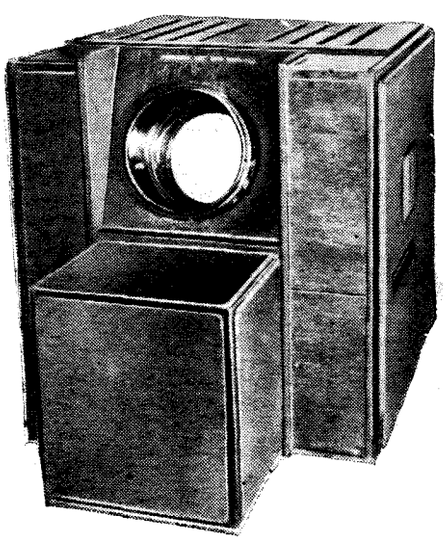
Lorenz television projecting tubes for public and home projection.

table model TF1, which has eight valves, is for vision only, the sound programme being received through a separate broadcast receiver.

For large projected pictures Telefunken offer a special receiver using a mirror lens of long focal length instead of an ordinary lens, so that the projector can be at a suitable distance from the screen and does not get in the way of the viewers. The pictures are about 2.2 × 2.5 metres in size.

Fernseh show a specially efficient big-picture receiver giving an image of 3 × 3.6 metres. This firm supplies a special projection screen with very marked narrow-angle reflection properties.

For home reception Fernseh offer a cabinet receiver Type DE6, into which a Blue Spot superhet can be inserted to form a combined broadcasting-cum-television equipment. They also show a specially small home receiver, DE7, embodying a "straight" broadcast set. This combination gives medium- and long-wave broadcast reception, ultra-short-wave sound programme and television pictures of 20 × 23 cm. in dimensions. In addition they are exhibiting a home-projection receiver which also covers the ordinary broadcasting wavebands.



Fernseh large-picture projection receiver.

RANDOM RADIATIONS

By "DIALLIST"

Pitcairn's Wireless

A READER is kind enough to send me very full particulars of the transmitting and receiving gear which was presented to the Pitcairn Islanders by Americans. The plant is quite an elaborate one, consisting as it does of a transmitter working on 600, 40, or 20 metres CW or 'phone and a 4-valve battery receiver tuning continuously from 10 to 3,000 metres. The measured carrier output of the transmitter is 80 watts for CW and 60 watts for telephony. There is, however, one statement of my correspondent's which doesn't quite fit in with recent newspaper reports of the sending of supplies to Pitcairn. He states that both transmitter and receiver derive their power from two 6-volt 300-ampere-hour accumulators, connected in series and charged by a windmill charger which has a rate of 8 amperes for a wind-speed of 20 miles an hour. On the other hand, newspaper reports mention that a consignment of supplies is on the point of being despatched from Balboa (Panama Canal Zone), and that these include drums of petrol for the electric generator. It is suggested that the wireless station is unable to work at the moment owing to lack of petrol. I should have thought that a wind-charger and a HT generator operated from accumulators would be much more useful than a petrol-driven generator, since there is no regular shipping service to the Island. Possibly a spell of calm weather and not lack of petrol has caused the transmitting plant to close down.

America and Television

FROM an American reader I have received a strong protest about my recent note on the belittling of Britain's achievements in the field of television by some leading lights in American wireless and by some of the periodicals of that country. My correspondent seems to be much more concerned with the past than with the present, and accuses us of going off at half-cock eight or ten years ago. He bases that accusation largely upon the vapourings of irresponsible journalists with little technical knowledge, who did at that time burst into ridiculous headlines suggesting that every problem in television had been solved and that it might be only a matter of months before viewers in the Antipodes could "look in" on events taking place in the Home Country. That attempts were made to commercialise television in this country long before it was ready for anything of the kind no one could or would deny. But when I spoke of belittling (I used the word advisedly, though it seems to stick in my correspondent's gizzard) I was referring not to the "ballyhoo" of years long gone by, but to the sound and solid achievements of British television since the opening of the high-definition transmitter at the Alexandra Palace. It is definitely unfair to suggest, as some Americans have done, that the range of the Alexandra Palace transmissions is very limited, that reception within the service area is nothing to shout about, and that there have been none but mediocre achievements on the part of the television programme department.

Facts are Facts

What I do claim for British television is just this. We were first in the field with regular high-definition programmes; the transmission of both vision and the accompanying sound are of a very high order technically and reception of them is excellent; the service range has proved to be considerably larger than the 25 miles originally expected; the programme department, which had to break entirely new ground, has given a good account of itself in the day-by-day broadcasts and has many outstanding feats to its credit. Operas, ballets, plays, cabaret shows, and variety programmes are all successfully televised. Outside broadcasts have included the Coronation procession, the Lord Mayor's Show, the Boat Race, the Association Football Cup Final, the Derby, Test Match cricket, athletic sports meetings at the White City, swimming championships at Wembley, and a whole host of other thrilling and important "actualities." Could any other country show anything approaching this record? My correspondent, who is stationed in Central America, makes a great point of the fact that he has questioned many British folk living in the same part of the world on their return from leave in this country and that not one of them had seen television during his stay here. They need not have gone far to look for it! Apart from private houses, there are daily demonstrations in London's big stores and wireless shops, and even in the little country town in which I live television is to be seen for the asking.

Motor Car Interference

MANY readers have been kind enough to send me particulars of their experiences regarding interference from motor car ignition systems with short-wave reception. You may remember that I referred in a recent issue of *The Wireless World* to the contention by a Lancashire correspondent that the field of such interference extends to a height of at least 60 feet, instead of the 25 to 30 feet usually accepted as the limit. The letters that I have received raise some very interesting points. One comes from a technical man who has been con-

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, AUGUST 18th.

Nat., 7.30, "The Pig and Whistle," a truly rural episode. 8, "The Three-Cornered Hat," musical comedy. 9.15, Famous Fusses, 1—"Women Awheel." 10.5, A.R.P. Talk on "Your Doubts and Difficulties."

Reg., 7, Week-end Walks in London Kensington and Chelsea. 8, Promenade Concert. 9.40, Cabaret from Torquay, including Oliver Wakefield.

Abroad.

Rome Group, 9, "Parisina," opera (Mascagni) conducted by the composer.

FRIDAY, AUGUST 19th.

Nat., 7.15, Band of the Royal Military College, Sandhurst. 7.25, Peter Yorke and his Orchestra. 8.20, Beethoven Promenade Concert.

Reg., 8, Talk by Lord Ponsonby on "Being Up-to-Date." 8.20, Variety from Birkenhead. 9.5, "The Three-Cornered Hat."

Abroad.

Paris PTT, 8.30, Concert from the Casino, Vichy.

SATURDAY, AUGUST 20th.

Nat., 11.25, a.m.—6, Series of seven relays from the Oval of the Fifth Test Match between England and Australia. 8, Variety, including Collinson and Dean. 10.5, Up Against It, talk—"Captured by Cannibals."

Reg., 3, Jack Payne and his Band. 6.30, George Elrick and his Music-makers. 8, Promenade Concert. 10.30, Benny Goodman and his Orchestra, relayed from Atlantic City, New Jersey.

Abroad.

Oslo, 8, "The Tales of Hoffmann," opera (Offenbach).

SUNDAY, AUGUST 21st.

Nat., 12, Turner Layton, songs at the piano. 3.30, Reginald Foort from the Paramount Building, New York. 5.20, The Grinke Trio. 9.5, Songs from "A Princess of Kensington," comic opera.

Reg., 5.40, Troise and his Mandoliers. 6.35, David Wise, violin. 6.55, "Epic of Eyam," a play by Phyllis Crawford, based on Derbyshire legends. 10.5, Fact or Fiction—The Loch Ness Monster.

Abroad.

Munich, 8.30, "La Rondine," opera (Puccini).

Brussels, 9—10.30, Concert from the Casino, Knocke, with Grace Moore (soprano).

Rome Group, 9, "Rigoletto," opera (Verdi).

MONDAY, AUGUST 22nd.

Nat., 1.20, and 6.25, Test Match Commentaries. 7, Bungalow Club. 7.45, Charlie Kunz. 8, Wagner Promenade Concert. 8.55, Sydney Kyte and his Band.

Reg., 7, Close to Earth, talk by Henry Williamson. 8, "Paradise Isle." 9.35, Promenade Concert, Part II.

Abroad.

Warsaw, 7, "Der Rosenkavalier," opera (Richard Strauss) from the Salzburg Festival.

Radio-Paris, 8.45, Maurice Ravel Concert from the Casino, Vichy.

TUESDAY, AUGUST 23rd.

Nat., 1.20 and 6.25, Test Match Commentaries. 7.15, Selections from "Rhythm Express" with Ben Frankel and his Orchestra. 8.30, Seaside Nights—Clacton.

Reg., 6, Band of H.M. Royal Marines. 8, Promenade Concert. Part 1—Sibelius. 9.35, Helen Perkin, pianoforte.

Abroad.

Berlin, 7, "Falstaff," opera (Verdi) from the Salzburg Festival.

Luxembourg, 9, "Tristan and Isolde," opera (Wagner).

WEDNESDAY, AUGUST 24th.

Nat., 1.30 and 6.25, Test Match Commentaries. 7, The Education Act, talk by Lynn Ungoed-Thomas. 7.30, "Princess Charming," musical romance. 8.45, Bach Promenade Concert.

Reg., 8.30, "Cabaret Cruise," relay from Television Studio at Radiolympia. 9.45, Sing-song from the Lark Hill Territorial Camp. 10.5, Cabaret from Bournemouth, including Ronald Frankau, Jeanne de Casalis and Leonard Henry.

Abroad.

Deutschlandsender, 8.10, Spanish-Hungarian Evening from Wiesbaden.

cerned with the installation of many anti-interference aerials intended for both short-wave and television reception. His experience is that an aerial of suitable kind 40 feet in height and out of the line of vision to passing traffic below is 90 per cent. effective so long as a well-designed low-impedance lead-in is used. There was, for example, very little car-ignition interference with television when using a 45-foot aerial even in a part of London so traffic-ridden as Charing Cross Road. Others tell me of interference that is consistently bad with aerials up to 100 feet in height. I am inclined to believe that in most, if not all, of these cases it is the lead-in which is responsible for pick-up. Careful design is necessary here and proper installation is essential. By no means all "low impedance" transmission lines are free from pick-up, and often a screened line is necessary. I am still not convinced that pick-up of car interference by the horizontal portion of the aerial can take place in the ordinary way at heights much greater than about 40 feet, even at close quarters to a stream of traffic. There are, though, one or two makes of motor vehicle whose ignition systems radiate so strongly that they may cause interference with aerials of greater height than this.

The Hill Problem

Another problem raised was that concerning the greater degree of interference caused by cars going up-hill than by those travelling down-hill or on the level. Several correspondents suggest that the trouble is due to the increased number of sparks produced when the car is in low gear. As one reader puts it, "The increased number of sparks means that, though their actual power is not increased, there is more of them and less of the signal to be heard." There is a good deal in that; and even if the driver of the car does not actually have to change down for the hill, it may still be true. If you are driving a moderately powered car you naturally rush your hills by stepping on the accelerator and increasing the revolutions just before you come to an upward slope. Going down-hill, on the other hand, you reduce the pressure on the accelerator, and, though the momentum of the car is pushing it round, the engine may be "revving" rather more slowly.

Nearly Caught!

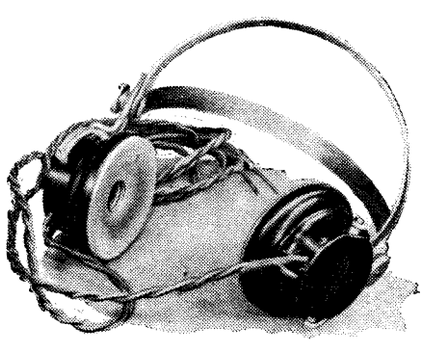
THE other day I was somewhat puzzled over the queer behaviour of a receiver; in fact, I very nearly fell into one of those booby traps in the way of faults that are popularly supposed to be reserved for the beginner at wireless. In the middle of an item the set produced an outburst of thumps, crackles and bangs, and then continued to bring in the local station at a fraction of its normal volume. A hearty smack or two administered to the chassis produced further horrible noises and then a return to normal volume. Loose connection somewhere? Faulty volume control? I was at first inclined to suspect the latter, for attempts to push the volume-control knob in or out, or to move it laterally, caused a return of the noises. I was just about to disconnect the set and to put it on to the bench for examination when I happened to notice the real cause of the trouble. I make considerable use of crocodile clips, since they make it so easy to change over from one set to another. In this instance both the aerial and the earth leads were connected in this way to bare metal plugs pushed into the sockets. One of the plugs had turned, allowing the aerial crocodile clip to come within a tiny fraction of an inch of that attached to the earth lead. The least jarring caused the two to come into contact with one another and to earth the aerial. And how many times have I impressed upon beginners that the first thing to do when the set won't behave properly is to see that the aerial isn't earthed? I expect, though, that you've been caught in some such way before now.

A Step Forward

CONGRATULATIONS to the B.B.C. for having arranged to relay on the television sound wavelengths part of the Promenade concerts now running. I am sure that they will come as an eye-opener (or should I say an ear-opener?) to musical folk who are not yet acquainted with the amazing quality of reproduction that is possible by wireless when transmission and reception take place on the ultra-short waves. I hope that the idea will be extended and that the process of doing so may be a rapid one. It would be a very fine thing if the whole of the National programme were relayed as a matter of course on 41.50 megacycles, and I can't call to mind anything more likely to popularise the television receiver. In fact, I can quite imagine musical people buying suitable receivers whether or not they are particularly interested in the actual television transmissions.

High-quality Earphones

CONSIDERABLE modifications and improvements have been made in the design of the special earphones marketed by Marconi-Ekco, and the frequency response for all practical purposes is now from 50 to 8,000 c/s.



Marconi-Ekco Type TF.442 moving-coil earphones.

A convex duralumin diaphragm with flexible surround is driven by a moving coil consisting of aluminium ribbon wound on edge. The field magnet is of cobalt steel, and the impedance of the coil for matching purposes is 24 ohms at 400 c/s and 30 ohms at 4,000 c/s.

Tests made by comparing aurally the output of the phones with the sound field from a calibrated moving-coil loud speaker indicate that the maker's claim of uniformity within ±10 db between 100 and 6,000 c/s is justified. The maximum deviation takes the form of a rise between 3,000 and 4,000 c/s, and a fall above 5,000 c/s, which was continued to 10,000 c/s, the upper limit of the test. A cavity resonance was noted, which, for the operator in question, had a frequency of 7,800 cycles.

For general broadcast listening the Type TF.442 earphones are better than any we have so far tested, and their superiority is most evident in the excellence of the bass response below 100 c/s and the absence of harmonic generation at all levels which are below the threshold of feeling. This level is reached with an input of 500 milliwatts, and 3.0×10^{-12} watts produces a sound pressure equivalent to the threshold of hearing (0.0002 dyne/cm²).

The weight of 9 ounces per earpiece is not excessive, and with the well-shaped sponge rubber earpads the headphones can be worn for long periods without discomfort. They are consequently well suited for monitoring purposes in broadcast stations as well as for the medical profession for measurements on the acuity and quality of hearing.

The price is 4 guineas for the single earpiece, or £9 for the double set with adjustable head band. Enquiries should be sent to Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2.

Wharfdale Langham Cabinet Loud Speaker

WITH reference to the report which appeared on page 70 of our issue of July 28th on the Langham Cabinet loud speaker manufactured by Wharfdale Wireless Works, it should be pointed out that this speaker has been made in accordance with Post Office Specification No. WB5, for which a provisional patent has already been taken out by Messrs. West and McMillan, of the Post Office Research Station.

CLUB NEWS

Southend and District Radio and Scientific Society

Hon. Sec.: Mr. J. M. S. Watson, 23, Eastwood Boulevard, Westcliff-on-Sea.

On August 21st the Society is participating in a field day organised by the Murphy Radio Society of Welwyn Garden City. On August 28th the Society will hold a field day of its own at Battlesbridge, the wavelength used for the DF being 155.8 metres. Test transmissions in connection with this field day will take place on August 25th and 27th from 10.45 to 11.15 p.m., the call-sign used being G5QK.

Those interested in these two field days are asked to write for full particulars to the hon. secretary.

The Sussex Short-Wave and Television Club

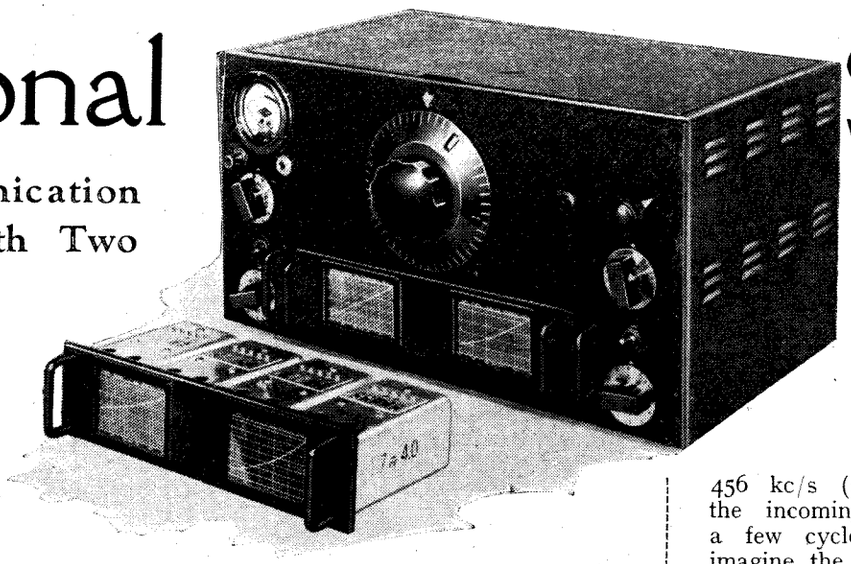
Joint Hon. Secs: Mr. C. J. Rockall, "Aubretia," Seafield Road, Rustington; Mr. E. C. Cosh, "Anslyn," Mill Road, Angmering.

An Extraordinary General Meeting of the West Sussex Short-Wave and Television Club was held on July 19th when the following resolution was passed: "That the West Sussex Short-Wave and Television Club be disbanded and that a new club be formed to be known as the Sussex Short-Wave and Television Club—the new club to assume the assets, liabilities and membership of the West Sussex Short-Wave and Television Club."

Arrangements are well in hand for the winter programme. Headquarters will be opened shortly.

National Senior HRO

A Communication Receiver with Two RF Stages and Outstanding Selectivity



FEATURES: ***Waveranges.***—*(1) 1.7-4.0 Mc/s. (2) 3.5-7.3 Mc/s. (3) 7.0-14.4 Mc/s. (4) 14.0-30.0 Mc/s.* ***Circuit.***—*1st RF ampl.—2nd RF ampl.—1st det.—osc.—1st IF ampl. and crystal filter—2nd IF ampl.—2nd det., AVC and 1st AF ampl.—pentode output valve. Beat frequency oscillator.* ***Controls.***—*(1) Tuning. (2) RF gain. (3) AF gain. (4) Selectivity. (5) Crystal filter phasing and on-off switch. (6) Beat osc. switch and pitch control. (7) HT switch. (8) AVC on-off switch. (9) Meter switch.* ***Price.***—*£49 15s. (with four coil units but without loud speaker or power supply unit).* ***Authorised Distributors.***—*The Quartz Crystal Co., Ltd., 63 & 71, Kingston Road, New Malden. Raymart, G5NI (Birmingham), Ltd., 44, Holloway Head, Birmingham. Claude Lyons, Ltd., 76, Old Hall Street, Liverpool, 3.*

SINCE its introduction over three years ago in the United States, there has been little change in the main specification of this receiver. Recently the signal meter dial has been provided with internal illumination, iron-cored coils have been adopted in the IF stages, and these are the only changes which have been found necessary to keep pace with developments since the set made its first appearance.

It is one of the few superheterodyne receivers going down to 10 metres which have two RF stages tuned on all wavebands. Apart from the increased sensitivity and signal-to-noise ratio which such an arrangement promises there is the question of image or second-channel interference, and in our opinion this contribution to the exceptionally high selectivity of the HRO receiver is alone sufficient justification for the additional complication.

This is not really serious in a receiver of this type, for plug-in waverange coils eliminate the problems of switching two RF stages and confer added circuit efficiency at all frequencies. Further, they permit a simple electrical band-spreading arrangement which gives a much more open scale than most purely mechanical arrangements are capable of producing.

Electrical Band Spread

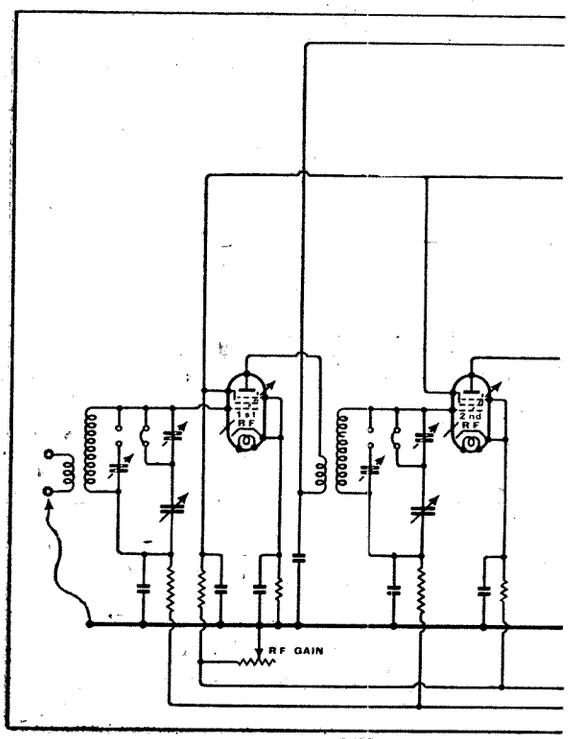
To change from normal tuning over a given coil range to band spread, it is necessary to transfer set screws in the coil contact plates to vacant places in adjacent plates. This has the effect of introducing a small padding condenser (normally short-circuited) in series with the section of the main condenser to reduce its tuning range and of connecting a parallel trimmer to bring that limited range to any desired part of the scale.

Coil units are sent out with calibration curves for normal tuning "coverage" and for the band-spread adjustment which is set to cover one of the two amateur bands included in each range. Some observations made on the 40-metre amateur band were instructive. This congested region (7 to 7.3 Mc/s) was extended to occupy 400 of the 500 divisions available on the main tuning dial and each amateur telephony station with its side bands occupied 10 divisions, or approximately 3 inches length of scale. Each division was equivalent to 750 *cycles*, and it was found possible to estimate settings to a tenth of a division or 75 cycles.

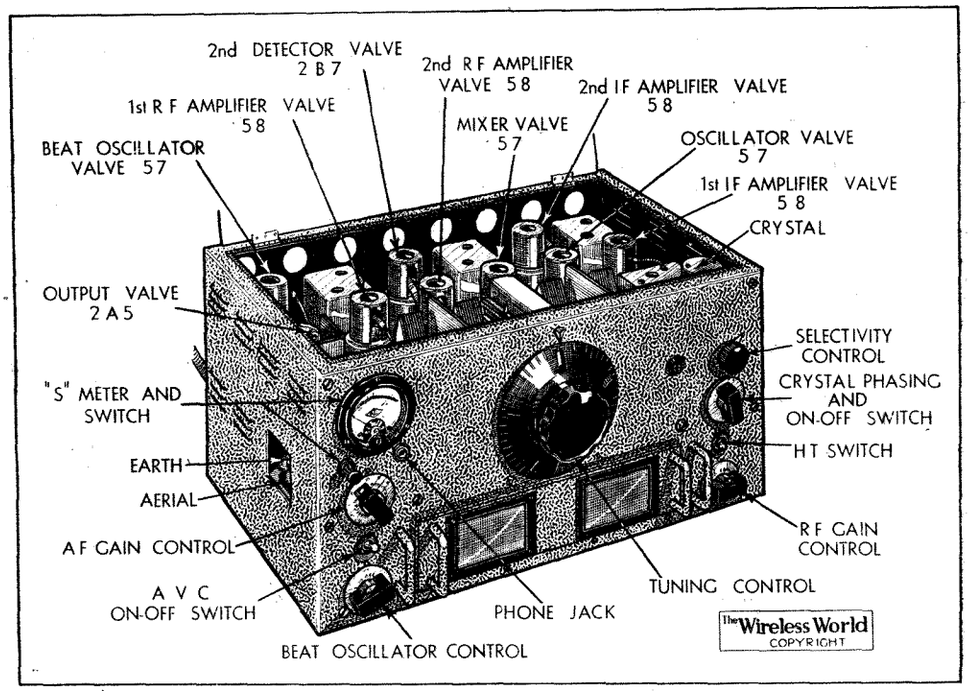
Readers who may be inclined to smile indulgently at this splitting of hairs underestimate the stability and selectivity of the receiver. The crystal filter band-width is less than 100 cycles and there are occasions when a still higher reduction gear and smaller subdivisions of the scale would be acceptable. The sharpness of tuning is such that true "single-signal" reception is possible. Unless the intermediate frequency produced by tuning-in the incoming signal is within a few cycles of the resonance frequency of the crystal filter (456 kc/s) the note produced by beating with the local CW oscillator will be very feeble. When the resulting IF hits off the crystal frequency a very strong response is obtained and its pitch will depend on the setting of the beat oscillator. The pitch can now be varied to suit the phones or loud speaker without diminishing its strength by varying the beat oscillator control. The pitch could also be changed by altering slightly the tuning, but this would result instantly in an enormous loss of strength. It follows that to get an appreciable audible response from any signal (1) the local oscillator must be off zero beat, i.e., at some frequency other than 456 kc/s (2) the IF resulting from the incoming signal must be within a few cycles of 456 kc/s. Let us imagine the beat oscillator to be 1,000 c/s off tune from the crystal and see what happens as we pass through a station. A feeble high-pitched note is heard descending in pitch until 1,000 c/s is reached when it rings out strongly only to fall back to its original weak condition as the pitch falls below 1,000 c/s. After passing through zero the note rises again, but this time as it passes through 1,000 c/s there is no increase of strength.

The receiver would thus be able to discriminate between stations separated by more than 100 cycles or so, i.e., the width of the selectivity curve of the crystal. In practice the beat note of the interfering station, although weak, might still be distracting to an operator, and this is where the phasing control comes in. This is a bridge circuit capable of balancing out any one frequency other than that

The RF tuned circuits are shown connected for normal tuning. Transference of the shorting screws to the left-hand pairs of contacts introduces a series padding condenser and an extra trimmer for band-spread tuning.



to which the crystal is tuned, and in the HRO receiver it worked perfectly on a pair of CW stations which were eventually found working close enough in frequency for the test to be really convincing. The fact that more than one range had to be employed to find the necessary conditions is, in itself, a testimony to



Interchangeable coil units with calibration curves for normal and band-spread tuning and slow-motion dial with an equivalent length of 12ft. are notable mechanical features of the National Senior HRO

absence of second channel interference and oscillator harmonics which would otherwise have provided plenty of examples.

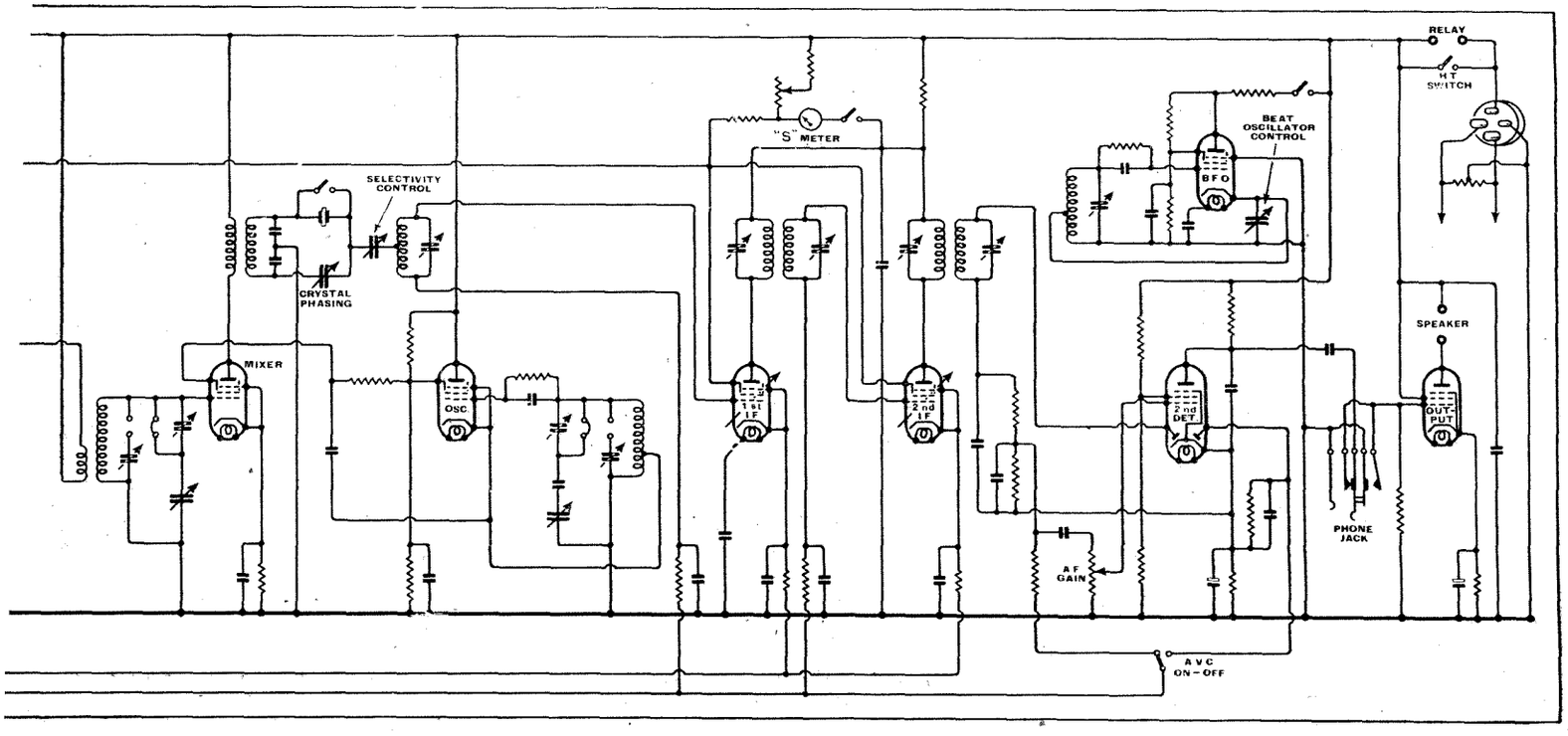
When the receiver is worked at its maximum sensitivity and selectivity there is a tendency to blurr Morse signals due to the "ringing" of the crystal filter. Reduction of the RF gain which also controls the IF amplification will generally effect a cure, and the trouble can always be eliminated by turning down the selectivity control, which takes the form of a capacity in the coupling to the secondary of the first IF transformer. Even at minimum selectivity the HRO receiver will put to shame the average all-wave superheterodyne, yet quite workable quality is available on telephony with the crystal in circuit and selectivity reduced. Under these conditions an excellent signal-to-noise ratio is obtained; without the crystal in circuit the background noise is not less than average, even when the usual experiments with the proportion of RF to AF gain have been made.

The stability both from the point of view of hand capacity and constancy in the local oscillator is exceptional, as it must be in a receiver which provides by its own selectivity, searching tests for both these qualities. Sensitivity is in excess of the degree which can be usefully employed under average conditions of background noise level. As an indication of the capacities of the set in this direction it was found that with AVC working and the RF gain at maximum 2XAD was received at full volume with the AF gain control at 2 on a scale of 10.

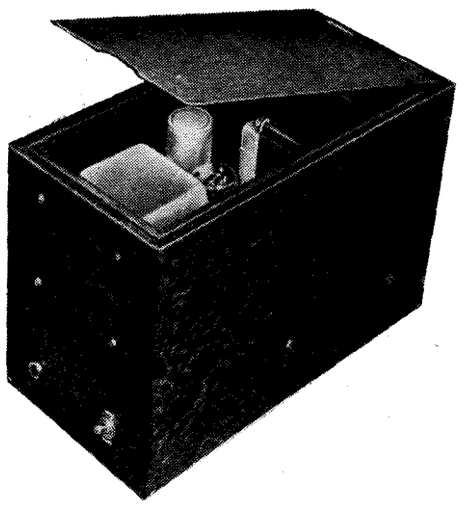
The set is equipped with all the usual refinements of a high-grade communication receiver such as optional AVC, a switch with relay extension terminals for breaking the HT line during transmitting periods, etc. The connections of the signal-strength meter are interesting. This meter forms the indicator of a bridge, three elements of which are fixed. The fourth consists of the anode circuits of the valves controlled by AVC. The meter is brought to zero by adjusting the RF gain control, which not only brings the AC resistance of these valves to a predetermined value, but also adjusts the RF and IF gain to fit the meter scale. A curve showing the relation between the "S" scale and microvolts input is included in the instruction book.

From the mechanical point of view, the instrument is beautifully turned out. The coil units and their contacts slide into the partitioned housing with an easy yet positive action. The waverange sub-divisions are a little unusual, but the frequency overlaps have been chosen to cover each amateur band so that one coil can be connected for normal tuning and the next for band spread on any given band.

The tuning drive and dial are the highlights of the mechanical design. Totally



National Senior HRO—
enclosed worm gearing, spring loaded to take up wear and backlash, drives the condenser through 180 degrees with ten revolutions of the dial. The numbering of the divisions on the dial is viewed through apertures at every ten divisions, and by an ingenious gearing device the numbers are changed progressively as the dial is turned, so that direct reading from 0 to 500



The power supply unit made by the Quartz Crystal Co., Ltd., is housed in a metal cabinet finished to match the HRO receiver.

is possible. The effective scale length is 12ft.

In the interests of thermal stability no power supply is built into the receiver. Incidentally, the oscillator coils are mounted at the lowest possible point in the base of the chassis out of convection currents from the valves. A separate power pack specially designed for this receiver is available, price £4 10s., from the Quartz Crystal Co., Ltd., 63 and 71, Kingston Road, New Malden, to whom we are indebted for the loan of the Senior HRO receiver for test.

UNBIASED

By FREE GRID

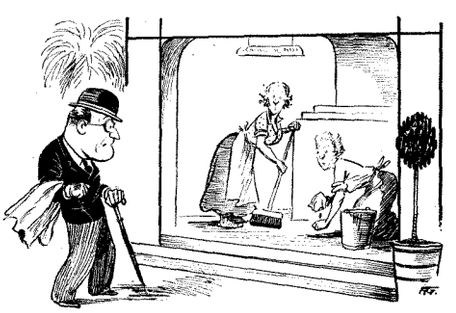
Radiolympic Anticipations

THANK you one and all for the kindly sympathy you displayed during Mrs. Free Grid's recent psychological disturbance in which, as I detailed in the July 21st issue, she suddenly commenced to take an altogether unreasonable interest in wireless. As I say, I thank you for the sympathy although by some strange kink of human nature it appeared to be for Mrs. Free Grid rather than myself.

The trouble has been cleared up now and she is, I am glad to say, her normal irascible self once again. The trouble was not, however, correctly diagnosed by any of the learned pedants of Harley Street whom I consulted. They all disagreed with each other and are, I believe, still quarrelling over the matter. No, the trouble was cured by one of yourselves who signed himself by the appropriate name of "Rectifier," although, if I am any judge of handwriting, Portia would have been a more apt signature both on the grounds of sex and sagacity.

Briefly, the trouble was diagnosed as a natural reaction against "hat-starvation," which is apparently first cousin to the well-known "night-starvation." At any rate, as soon as I supplied the remedy in the shape of a blank cheque all interest in wireless miraculously ceased. That little matter being disposed of, we can now get on to the more serious things of life.

There are, as most of you have read, to be changes at the Exhibition this year, including an attempt to make wireless receivers the central feature of the exhibition instead of subordinating them to the claims of variety shows and other panderings to the depraved tastes of a certain type of visitor. I sincerely hope that this year there will also be a serious attempt made to get everything ready for the opening hour. Things have been getting better in this respect of late years, and it is a far cry to the opening scenes of a few years ago when all that the early visitors, including myself, could see on the stands was a collection of charladies in various



Early birds.

stages of decrepitude clearing up the mess left by the stand-builders.

Another point is that I hope the doors will open promptly at 11 a.m. Last year this was not so, and there was some slight delay which led somebody in the crowd with memories of the closing day of the preceding year's Show, when "house full" boards had to be displayed for a while during the evening, to enquire whether this was again the reason for the hold-up. Unfortunately, one of the Olympia janitors, with a misguided sense of humour, answered in the affirmative, and this led many of the patiently waiting crowd to wend their way homewards once more. For a moment, in fact, I almost decided to go home myself.

A Laboratory Epic

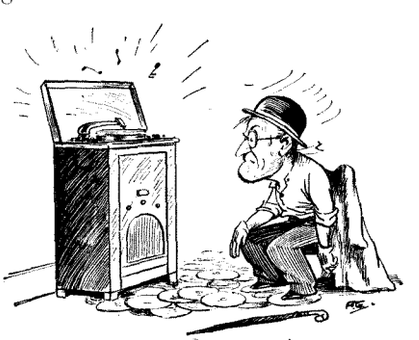
I MUST apologise for the fact that my customary scientific notes have failed to appear during the past two weeks, but it is indirectly all the fault of a manufacturer who has turned out a semi-permanent "needle" for use in gramophone pick-ups. The immediate cause of the trouble was a reader who sent one of these devices to me asking me to verify the maker's claims, but obviously if the thing had never been made the reader could not have sent it to me and so the manufacturer is really to blame.

The needle was of sapphire and was stated to be capable of at least 2,000 playings without any appreciable wear being apparent. Naturally, such a statement requires very careful verification, and I at once agreed to carry out the job of doing it. Now a "playing" takes about four minutes, and 2,000 of these means 8,000 minutes or about one hundred and thirty hours. There must, of course, be a few seconds occupied every time a record is changed and this all mounts up, and I could well see that if the maker's claims were justified a solid week of continuous night and day labour lay in front of me.

However, I did not anticipate that I should be compelled to spend more than a few hours in my laboratory as I expected the needle to show signs of ruining the record through wear by that time. Consequently, I did not make the careful preparations in the matter of supplies of food and other more necessary refreshments which I should otherwise have done.

All went well for the first day; in fact, things went exceptionally well as Mrs. Free Grid got so exasperated at hearing the same record over and over again that she sent out and bought me a fresh supply, and I was therefore able to replenish my record library which had suffered sad depletion as the result of a recent dispute I had with some cats who were carrying out their midnight yodellings outside my window.

Unfortunately, the musical tastes of Mrs. Free Grid and myself do not coincide, and so although I gained in the quantity of my records I did not do so in quality. However, a gift horse must not be looked in the mouth nor a gift record in the label. As the first night wore on and the needle still continued to keep its end up I mentally anathematised the manufacturer. On the second day I began to grow really irritable, and eventually as the week dragged on I fell into that dull apathetic stupor which is displayed by a goldfish swimming round and round a glass bowl, always endeavouring to get to the end.



The labours of Hercules.

The net result of my week of testing is that it is I rather than the needle which is worn out, but lest the manufacturer in question should grow too jubilant about it I may tell him here and now that I have by no means finished my tests yet and intend to resume as soon as I have had a brief holiday.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Indoor or Frame Aerial?

IN Mr. Strafford's article in *The Wireless World* for July 14th he gives the results of experiments comparing the EMF's picked up by a frame aerial (untuned) and various lengths of indoor aerial, i.e., he compares the "effective heights." However, he has taken no account of their respective impedances, which, it is evident from first principles, will vitally affect the current and/or power which can be obtained from them. Moreover, in all practical cases of broadcast receivers, the question of possible ganging errors through reactance reflected from the different types of aerial catered for must be taken into account as the principal factor limiting the gain from an elevated aerial.

Thus, the only practical criterion which can be used as a basis of comparison for a frame aerial and an elevated aerial is the ratio of *voltage obtained at the grid of the first valve* to the field strength: we may call this factor V/E.

Now this V/E is easily calculated for a frame aerial of known dimensions, turns and Q: it is, in fact, equal to the "effective height" $\frac{2\pi nA}{\lambda}$ multiplied by the circuit Q. For an elevated aerial we must know the aerial coupler gain (i.e., the ratio of the volts at the grid to the aerial EMF) and multiply this by the effective height of the aerial. Now the gain of an aerial coupler suitable for a broadcast receiver depends upon many complex design considerations; the figures (8 to 4) given in the table will probably be agreed by designers as a good average for the given Q figures when testing with a low capacity (0.0001 to 0.00015 mfds.) dummy aerial corresponding to the average indoor aerial (assuming some spacing off from the walls).

By way of example, we will retabulate the results of Mr. Strafford's comparison in the light of these considerations. We assume:

1. Q is 100 on MW and 60 on LW for both coil and frame, this again being a figure which may be regarded as representative.

2. The frame taken is 18in. square, and it is assumed that, as in Mr. Strafford's experiments, the field is not appreciably reduced by any large sheets of metal in the immediate vicinity of the frame.

3. As to the effective height of the indoor aerial, if we take Mr. Strafford's figures for ratio of effective heights in conjunction with the calculated figures for the frame aerial, we arrive at a figure of approximately 0.1m. (for around 25ft. length), which corresponds well enough with the writer's own experience.

	Frame Aerial.		Indoor Aerial.	
	Effective Height.	V/E.	Effective Height.	V/E.
200m.	0.05m.	5	0.1m.	0.8
500m.	0.02m.	2	0.1m.	0.5
1,500m.	0.025m.	1.5	0.1m.	0.4

Thus the table gives the somewhat startling results that, although the ratio of effective height varies from 2:1 to 5:1 in favour of the indoor aerial, the useful sensitivity factor, V/E, gives a ratio of over 4:1 in favour of the frame.

However, it may be admitted that Mr. Strafford's frame is considerably larger than that found in many portables: for some midgets, for example, the V/E factor would be only of the order of $\frac{1}{8}$ of the above, owing to smaller size, lower Q, and screening by adjacent metal, each of these points contributing a loss of some 2:1. On the other hand, aerial coupler gains are often limited to figures lower than those quoted (from considerations of whistles, etc.).

As to the question of electrical interference, Mr. Strafford found an improvement of some 2:1; if he had fitted an electrostatic screen he could have observed a further improvement of from two to ten to one, depending upon the nature of the noise field and the elaborateness of the screening employed.

To conclude, enough has been said to indicate that, at any rate for the case of a good class full-size portable with screened frame, both signal strength and signal/noise ratio are likely to be really noticeably better than with a similar receiver using an indoor aerial.

M. V. C.

Cambridge.

British Sets Abroad

WE should like to associate ourselves with the opinion expressed by your correspondent in the August 4th issue concerning British sets for the export market.

From the orders and enquiries we receive for condensers to meet severe tropical conditions, it is apparent that British manufacturers are not only doing good business in this direction, but they are fully aware of the special climatic conditions which have to be dealt with.

This very proper attitude will ensure the marketing of efficient and trouble-free apparatus under exacting conditions and provide a ready outlet for British-made sets for the future, as well as the immediate present.

For The Telegraph Condenser Co., Ltd.,
W. F. TAYLOR,
London, W.3. Sales Manager.

Tone-arm Settings

IN an article entitled "Slow Speed Discs," published in *The Wireless World* for July 7th, 1938, the conditions for the best setting of a gramophone tone-arm are incorrectly given. For a 12in. tone-arm working between diameters of 16in. and 7½in. the pivot should be situated 10.68in. from the centre of the record. If the needle holder is correctly set at the outer radius with this arrangement it is also correct at the inner radius, and the maximum error amounts to 2° 10′. By twisting the needle holder through 1° 5′ in the proper direction this error is halved.

The method to be used for the calculation of these details is described in an article of mine in the "Journal of Scientific Instruments," Vol. IX, No. 9, September, 1932, and also in Wilson and Webb's "Modern Gramophones and Electrical Reproducers," published by Messrs. Cassell and Co.

Derby. F. RECORD.

[EDITORIAL NOTE. — This letter has been shown to the author of the original article, who makes the following comments.]

I QUITE agree with Mr. Record's remarks regarding a 12in. tone-arm, but would point out that in my article on "Slow Speed Discs" the drawing of Fig. 4 is not intended to give the correct position of the tone-arm, but rather to show the ideal tracking movement of the pick-up needle point.

It should also be noted that no measurements were given, apart from the minimum length of tone-arm, owing to individual requirements of each playback machine varying according to different lengths of tone-arm.

Should the length of tone-arm vary as much as only a ¼in., then Mr. Record's measurements, as given for a 12in. arm, will not be accurate, and suitable adjustments will be found necessary.

I apologise if Mr. Record has been misled by my drawing, and hope that this explanation will clear the matter up.

H. W. DAWES.

Television Programmes

Sound 41.5 Mc/s — Vision 45 Mc/s

THURSDAY, AUGUST 18th.

3, Catch-as-Catch-can Wrestling. **3.20,** British Movietonews. **3.30,** Cabaret.

9, Speaking Personally. **9.15,** Gaumont-British News. **9.25,** Cartoon Film. **9.30,** "The End of the Beginning," a farce by Sean O'Casey. **10,** Interval Music. **10.25,** News Bulletin.

FRIDAY, AUGUST 19th.

3-4.15, "Is Life Worth Living?" an extravaganza by Lennox Robinson. The action takes place in Inish, a small seaside town in Ireland.

9, "Accent in America," Alistair Cooke talks his way from Maine to Texas. **9.10,** The Hogarth Puppets. **9.25,** British Movietonews. **9.35,** A Little Show. **10,** Interval Music. **10.25,** News Bulletin.

SATURDAY, AUGUST 20th.

11.30 a.m.-**12.30** p.m. O.B. from Kennington Oval of the Fifth Test Match.

2.30, O.B. from the Oval. **3.30,** Dennis van Thal and his Orchestra. **3.45-4.30** and **6-6.30,** O.B.'s from the Oval.

9, Catch-as-Catch-can Wrestling. **9.20,** Gaumont-British News. **9.30,** Cabaret. **10,** Cartoon Film. **10.5,** Wilfrid Walter in Sketches. **10.15,** Interval Music. **10.25,** News Bulletin.

SUNDAY, AUGUST 21st.

8.50, News Bulletin. **9.5-10.30,** Leon M. Lion in "Libel," a play by Edward Wooll.

MONDAY, AUGUST 22nd.

11.30 a.m.-**12.30** p.m. O.B. from the Oval.

2.30 O.B. from the Oval. **3.30,** Marcella Salzer, One-Woman Revue. **3.45-4.30** and **5.45-6.30,** O.B.'s from the Oval.

9, Starlight. **9.10,** Film. **9.20,** Facets of Syncopation. **10,** Interval music. **10.25,** News.

TUESDAY, AUGUST 23rd.

11.30 a.m.-**12.30** p.m. O.B. from the Oval.

2.30, O.B. from the Oval. **3.30,** Gaumont-British News. **3.40-4.30** and **5.45-6.30,** O.B.'s from the Oval.

9, "The Late Christopher Bean," a play. **10.15,** Interval Music. **10.25,** News Bulletin.

WEDNESDAY, AUGUST 24th.

Radiolympia Opens.

11 a.m., Film. **11.30** a.m.-**1** p.m., O.B. from the Oval. **2.15,** O.B. from the Oval. **3.15,** Eagles, Bird Display by C. W. R. and Esmund Knight. **3.30-4,** "Cabaret Cruise."* **4.30,** O.B. from the Oval. **5.30,** Film. **6.0,** O.B. from the Oval. **6.30,** Film. **6.45,** "Queue for Song."* **7.15-7.30,** Forecast of Fashion.* **8.30,** "Cabaret Cruise."* **9,** "Coffee Stall." **9.25,** Cartoon Film. **9.30,** Eagles. **9.45,** British Movietonews. **9.55,** Mark and Michel Hambourg. **10.5,** Interval Music. **10.25,** News Bulletin.

* Items from the studio at Radiolympia.

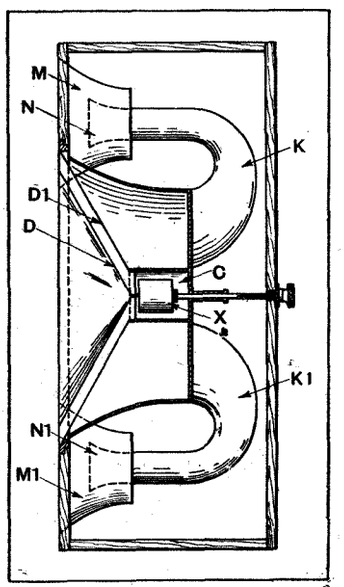
Recent Inventions

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

LOUD SPEAKERS

THE speaker shown is designed to make use of the sound-waves radiated from the back of the instrument.

The movement X, which is coupled to the conical diaphragm D in the ordinary way, is enclosed in a metal cup C, which carries at its forward rim a second cone D1.



Method of utilising sound waves from back of loud speaker diaphragm to reinforce front radiation.

This lies parallel with the first cone, and is driven by it through the intervening air space. The walls of the cup C and the back of the cone D1 form a collecting chamber, which receives the "back radiation," and passes it through two conduits K, K1 to mouthpieces M, M1, which lie flush with the front face of the cabinet. The conduits end in nozzles N, N1, from which the mouthpieces M are separated by an annular space.

R. R. Glen. Application date October 7th, 1936. No. 484704.

o o o o

MAGNETRON VALVES

THE split-anode type of magnetron valve is widely used for generating and amplifying frequencies of the order of 100 megacycles. To provide sufficient power, it is desirable that there should be a large emission of electrons from the cathode. But since this, in turn, means that the cathode is subjected to considerable bombardment by the "returned" electrons, it is not practicable to use "composite" or oxide-coated cathodes. If bright-emitter cathodes are used, they do not last long, since they must be made of comparatively short length in order to keep the air-gap of the external field-magnet as small as possible.

According to the invention, a thoriated-tungsten cathode is used, and is operated at a temperature sufficient to produce a definite space-charge of electrons. The space-charge protects the wire from destructive bombardment, and so gives it a long working life. The total electron-emission from the cathode should exceed the mean anode-current, under normal working conditions, by a factor of about three in order to maintain the protective space-charge.

The M-O. Valve Co., Ltd., and E. C. S. Megaw. Application date March 23rd, 1937. No. 484944.

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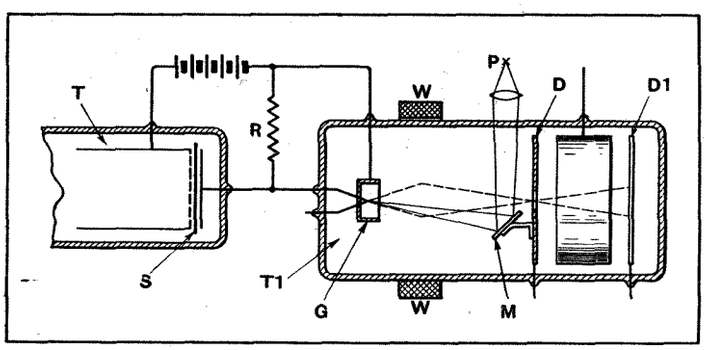
AMPLIFYING TELEVISION SIGNALS

THE output from a television transmitter of the Iconoscope type is amplified by an electron-multiplier, the object being to secure a high ratio of signal-voltage to the so-called Schrott effect.

As shown, the discharge current from the mosaic-cell screen S of an Iconoscope tube T flows through an external resistance R, the resulting voltage being applied to the control grid G of a cathode-ray tube T1. Since the Schrott effect of a thermionic (or heated) cathode is high, the electron stream for the tube T1 is produced by a ray of light from a source P, which is reflected on to the photo-electric cathode of the tube T1 by a mirror M. The electrons produced are focused by an external winding W, and pass through a central aperture in a disc electrode D. Here the stream enters a part of the tube where secondary emission takes place by repeated impacts between the electrodes D and D1. Incoming signals applied to the control grid G serve to modulate the amplified current taken off from the output electrode D1.



Electron amplifier for use with Iconoscope-type television tube.

Fernseh Akt. Convention date (Germany) November 9th, 1935. No. 484598.

o o o o

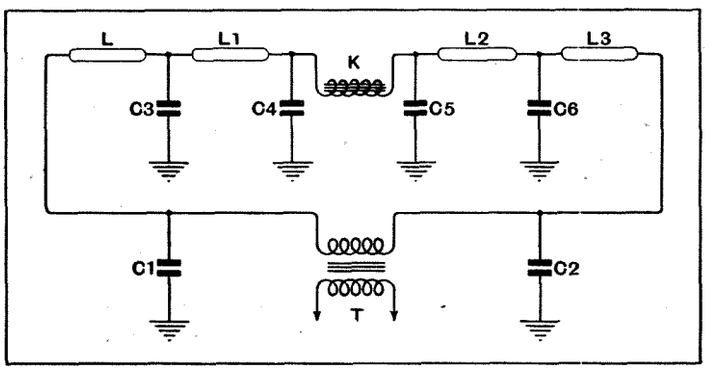
"STATIC" ELIMINATORS

THE neon lamps used for display signs and "flashing" advertisements are a frequent cause of "static" interference with broadcast reception. A typical installation of four lamps L - - -L3 is shown in the Figure, all fed in series from the supply transformer T. The lead-covered supply-leads have shunt capacities to earth, as shown at C1 - - - C6, and a choke K, of from 20 to 50 henrys, is usually inserted to prevent the radiation of RF oscillations.

This remedy is not so effective as it might be. The reason is that when the shunt capacities are distributed as shown, there are a number of independent circuits, such as L, C1, and C3 in series; L1, C3, and C4 in series; L2, C5, and C6 in series; and L3, C6, and C2 in series, all of which include very little inductance. They are therefore liable to be the seat of high-frequency oscillations.

According to the invention, the choke K is replaced by a number of separate chokes, one inserted between the supply transformer and L; a second between L1 and L2; a third between L2 and L3; and a fourth between L3 and the near end of the supply transformer. In this way each of the oscillatory circuits in question is loaded with sufficient inductance to prevent them from radiating short-wave energy.

The General Electric Co., Ltd., and J. B. L. Foot. Application date February 4th, 1937. No. 484524.



RF oscillation suppression equipment for neon sign lighting.

WIRELESS DIRECTION-FINDERS

SIGNALS picked up on a frame aerial are combined with those picked up on a vertical or non-directional aerial, the voltages being rapidly switched-over, or reversed in phase, so as to give a direct and visual indication of the direction of a distant transmitter.

The frame aerial is coupled to one grid, whilst the vertical aerial is coupled to a second grid of a multi-grid valve. The latter grid is, at the same time, back-coupled to a third grid of the same valve so as to generate a local oscillation of, say, 100 cycles. This serves as an electric switch to reverse the phase of the aerial voltage, so as to produce two "over-lapping" heart-shaped curves which give a "zero" reading on the indicator when the frame aerial is in the standard "minimum" position, and a "positive" or "negative" deflection when the frame is turned to right or left, respectively.

Standard Telephones and Cables, Ltd., and C. W. Earp. Application date, November 6th, 1936. No. 484590.

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SOUND AND VISION RECEIVERS

IN a superhet receiver, a single local-oscillator is used for heterodyning both the picture signals and the accompanying sound. Owing to the wide band of frequencies to be handled, it is difficult to use tuned couplings, and better results are obtained by replacing them by low-pass filters. On the other hand, this does not give a satisfactory output of the vision signals after rectification.

According to the invention, the combined intermediate-frequency signals are fed to a low-pass amplifier, which has a band-pass output for passing the vision signals to a rectifier which forms the whole, or a substantial part, of the matching termination for the output circuit. The low-pass amplifier is also provided with a rejector circuit, which diverts the sound signals into a different amplifying-channel, and at the same time serves to cut out "static" interference.

W. S. Percival. Application date November 2nd, 1936. No. 484404.

The Wireless World

THE PRACTICAL RADIO JOURNAL

28th Year of Publication

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Editorial Comment

The Show

Catering for a New Market

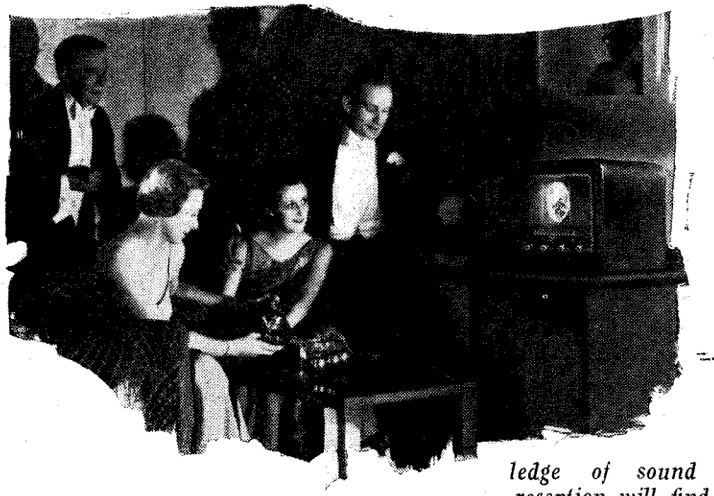
IT has been obvious for some time that wireless licences cannot possibly continue to increase in number at the rate to which we have grown accustomed during the last dozen years or so. Consequently the broadcast receiver industry has now to devote much of its energy to catering for the replacement market, and this tendency is particularly noticeable at the present Olympia Exhibition.

Push-button tuning offers an attraction to the man in the street which it is thought will be so obvious as to constitute in itself in many cases a sufficient reason for buying a new set. Perhaps an even better reason for doing so is to be found in the fact (to which a relatively negligible amount of publicity has been given) that technical features that began to be introduced into receivers some five years ago in a more or less imperfect and experimental state have now been thoroughly tested, and have only survived in their best and most dependable form. If we are to accept the view that the average domestic receiver is five years old, it would seem that the time is certainly opportune for it to be replaced.

There is hardly any exaggeration in saying that in the sphere of broadcast receivers the centre of interest has been allowed to drift from the electrical to the mechanical aspect of design. Though willing to admit the usefulness of push-button tuning, we feel that many of our readers will join with us in regretting that this feature has been allowed for the moment rather to overshadow more basically important matters of electrical interest. After all, "circuital" finality has not yet been reached. All praise is due, however, to the designers of many of the push-button sets for the ingenuity they have displayed.

The pains that have been taken to devise a scheme for distributing radio-frequency signals for demonstration purposes to the stands at Olympia are to be commended, though at the time of writing it is not possible to comment on the success of the venture, which offers for the first time in the history of the Show at least some possibility of making reasonable comparisons between one set and another. It has been suggested that the selectivity test made possible by the "Radiolympia Distant" signal, with its accompaniment of weaker jamming signals spaced 9 kc/s each side of the carrier, is one that the cheaper and simpler type of set can hardly be expected to survive. However, a test so unexacting that every set could pass it with flying colours would be no test at all, and would do nothing in educating the uninformed visitor to the Show in the attractions and advantages of the more refined type of receiver.

There has been much loose talk on the cheapening of television receivers, and insufficient emphasis has been laid on the fact that, generally speaking, the now low-priced sets are small-screen models. Actually there has been comparatively little real reduction in price, and any such reduction can hardly be anticipated unless some radical and quite unexpected new technique is developed. Television to-day offers remarkably good value for money, especially when the amount of free installation and other service that goes with many of the sets is taken into account.



The A.B.C

A SIMPLE EXPLANATION OF HOW IT WORKS

MOST readers with an elementary knowledge of sound transmission and reception will find in this article the supplementary information necessary to an understanding of the functioning of television. The subjects dealt with include the necessity for scanning, the method of synchronising pictures and the functioning of the "Emitron" camera.

THE present high standard of television is not, as some people seem to think, the result of some new fundamental scientific discovery. The cause for wonder lies rather in the ingenuity with which so many known physical phenomena have been brought together into a workable scheme, remarkable alike for its reliability and refinement of performance.

Between the aerials of the television transmitter and receiver the electrical impulses equivalent to vision do not differ essentially from those which carry sound. They manifest themselves as variations in the strength (modulation) of a wireless wave of fixed wavelength, and can be detected and reduced to a form capable of producing fluctuating light by receivers similar to those which produce the currents in the loud speaker of a broadcast set.

In the studio, light from the subject is allowed to fall on a substance such as potassium or caesium, which has the property of liberating electrons under the influence of light in the same way that the filament of a valve gives off electrons when heated. Collected together, these electrons form a current which, when amplified, may be used to modulate the transmitter.

Electricity into Light

At the receiving end the equivalent change of current could be reconverted into light by the filament of a lamp or a neon tube, but for television a more sensitive method is employed. It is the converse of that manifested in the photo-electric cell. The substance used for coating the end of the television tube is one which gives off light when bombarded by electrons. The stream of electrons (cathode rays) for this purpose is produced by a valve filament. The electrons can be increased or decreased in strength, crowded into a narrow pencil and deflected from side to side by the attraction or repulsion of suitably placed electrodes or magnets. The intensity of light on the screen is, in fact, governed by applying the modulation in the wave coming from the television station to the grid of the cathode-ray tube.

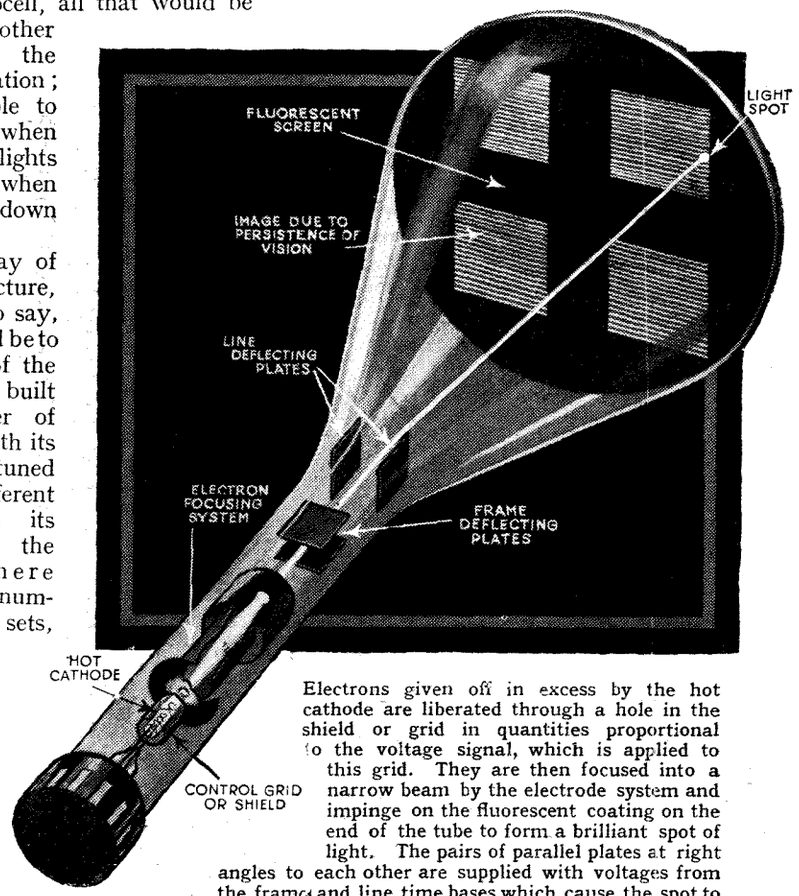
By these means we can faithfully reproduce a rise or fall in the intensity of light at the studio, but that is very far from being able to see in detail what is actually taking place there. If we were to focus a sharp image of the scene on the plate of the photocell, all that would be registered at the other end would be the *average* illumination; we should be able to tell, for instance, when some of the floodlights were turned off or when the station closed down for the night.

The simplest way of sending a picture, simplest, that is to say, in principle, would be to throw an image of the scene on a screen built up of a number of photocells, each with its own transmitter tuned to a slightly different wavelength from its neighbours. At the receiving end there would be a similar number of receiving sets, each with its lamp, neon tube or cathode-ray tube grouped in the same order as the cells at the transmitter to form a picture screen. Unfortunately, more than 200,000 transmitters would be required to send a picture of equal definition to that at present sent out.

How then does the single transmitter at Alexandra Palace manage to do the work so successfully? Simply by refusing to try to send out the whole of a picture simultaneously and by concentrating on one small spot at a time in rapid succession until the whole field of view has been covered. It does this in a systematic order, starting from the top left-hand corner and moving at constant speed in a line across to the right, then flicking back rapidly to the left and starting a fresh line immediately below, just as a reader might scan the pages of a book. The signal it sends out is a continual tale of light or dark or the shades between.

At the receiving end the spot of light generated on the fluorescent screen by the pencil of cathode rays follows a similar course, and its brightness depends upon the modulation in the transmitted wireless wave, which in turn is decided by the brightness of the particular part of the picture which the transmitter is "seeing" at that moment.

The astounding thing about television is that there never is a picture on the



Electrons given off in excess by the hot cathode are liberated through a hole in the shield or grid in quantities proportional to the voltage signal, which is applied to this grid. They are then focused into a narrow beam by the electrode system and impinge on the fluorescent coating on the end of the tube to form a brilliant spot of light. The pairs of parallel plates at right angles to each other are supplied with voltages from the frame and line time bases which cause the spot to scan the fluorescent screen from left to right in successive lines from top to bottom of the picture.

# of Television

screen at the receiving end. If you stop a home ciné projector you arrest the action but retain the view, and this is often done for comic effect. But if a television set could be suddenly stopped in the same way, all you would see would be a bright spot about the size of a pinhead on a perfectly black background. The spot would be intense and if allowed to remain stationary for long would "burn" the screen.

The success of television by present methods depends entirely on a defect of the eye known as persistence of vision. The retina goes on telling the brain that a light is shining for about 1/10 second after the light is cut off. An intermittent light begins to lose its flicker above 10 flashes per second, and since the television picture as a whole is changed twenty-five times a second (fifty times with interlaced scanning) the eye cannot follow the course of the spot, which makes 405 lines in every picture, and could, if put to it, make about 100,000 flashes in 1/25 second. The final picture is drawn on the retina of the eye, and some inkling of the truth of this statement may be gained by moving the head quickly from side to side or up and down, without looking directly into the screen, when a glimpse may be obtained of the composite structure of the picture.

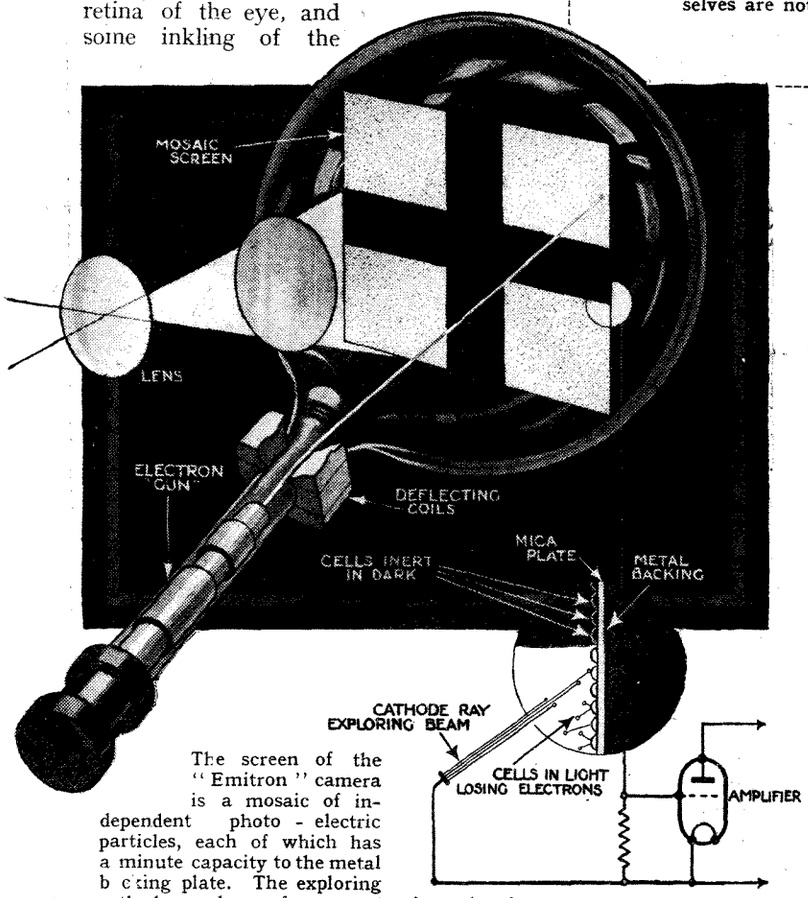
The technique of scanning is essentially the same at transmitter and receiver, and is best understood by considering the receiving end first. Since the beam in the cathode-ray tube is composed of electron particles each carrying a negative charge, it can be deviated from its original straight path by passing it between parallel plates. If one plate is made positive and the other negative the beam will be deflected towards the positive plate and away from the negative. The deflection will be proportional to the voltage between the plates, and if the voltage can be made to increase at a constant rate the spot at the end of the beam will trace a line across the fluorescent screen. This is accomplished in the receiver by the "line time-base" valve, which charges a condenser at constant speed up to a voltage equivalent to full deflection of the spot to the right of the picture and then suddenly discharges it, causing it to fly back to the start of the next line.

Another pair of plates is similarly supplied with voltage from the "frame time-base" running at a much lower speed. These plates are fixed at right angles to the "line" pair, and cause a downward movement of the spot so that each successive line is displaced a little farther down the picture. In the E.M.I. system, double spacing of the lines is employed and the picture is traversed twice before a frame is completed, the second scanning interlacing the lines of the first.

The electron beam in the tube can be controlled by magnet coils instead of electrostatic plates, and nowadays magnetic deflection is generally used. Essentially the two methods are the same, and we have chosen electrostatic deflection as it is easier to illustrate diagrammatically.

At the transmitting end an electron beam is also used to scan or explore the changing image of the scene thrown on the screen of the "Emitron" camera. It follows the same path as the beam at the receiving end, and by virtue of its negligible inertia is controlled with the same instantaneous response to the deflecting voltages or magnetic fields. In the case of the camera an additional property—its ability to carry a current—is made use of. Being a stream of electrons, it is, in fact, a current without a conductor.

The cathode-ray beams in the "Emitron" camera (right) and the cathode-ray tube at the receiver (left) follow parallel courses in analysing and tracing out the picture. In practice the beams themselves are not visible.



The screen of the "Emitron" camera is a mosaic of independent photo-electric particles, each of which has a minute capacity to the metal backing plate. The exploring cathode-ray beam forms part of a closed circuit, and in restoring the electrons lost by those cells, under the influence of light a current pulse is generated in the grid circuit of the amplifier.

Light into Electricity

The screen upon which the image found by the camera lens falls is covered by a mosaic layer of minute particles of actively photo-electric material. The formation of this layer, which is deposited on a mica plate, is a triumph of technical skill, for each particle is insulated from its neighbours and acts as an independent photo-electric cell. The mica is backed by a metal plate, which forms a common condenser electrode to all the particles in the mosaic.

When light falls on a group of the particles in the mosaic they lose negative electricity by giving off electrons and gradually acquire a positive charge with respect to the back plate. When the electron beam passes over this particular spot in the course of its scanning travels it neutralises the charge on the cells, and in so doing causes a sudden current pulse to pass to the back plate, which is connected to the grid of an amplifying valve mounted inside the camera head. Elements of the mosaic in dark parts of the

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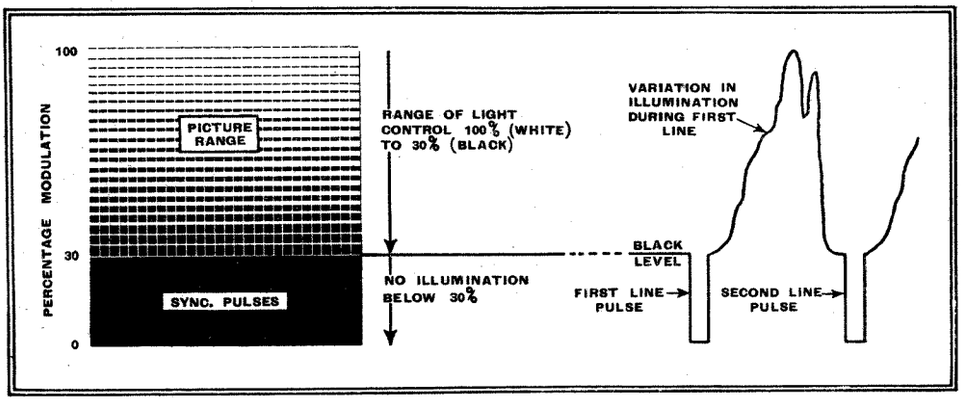
picture do not change their charge through the loss of the electrons, and so do not cause the charging current when the beam passes over them. It will be appreciated that the passage of the beam over the screen obliterates the electrical picture at each frame, and prepares it for a rearrangement of charges if there has been any movement in the subject since the last frame was transmitted.



Graphical representation of the allocation of the available modulation of 100 per cent. between the picture and synchronising signals.

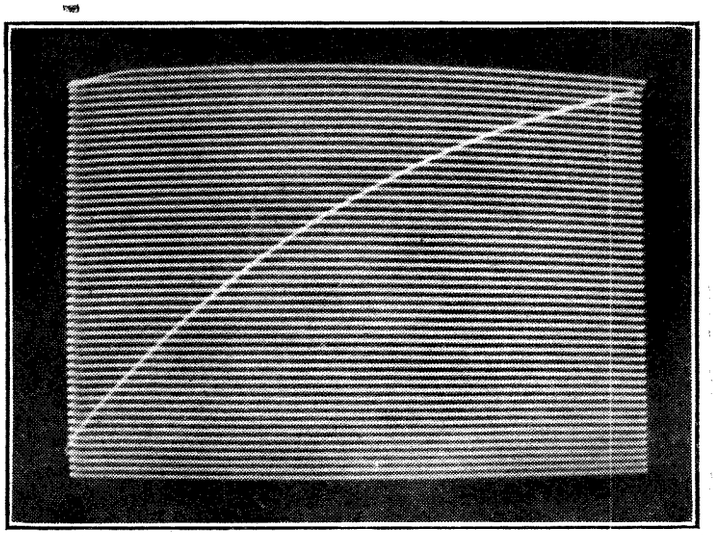
We said earlier in this article that the electron beams in the "Emitron" camera and in the cathode-ray tube at the receiving end follow the same course in tracing out the picture. They do not do this of their own accord, but must be locked together by synchronising signals. Pulses for this purpose are sent by the transmitter to the camera as well as to the receiving station at the end of each line and again at the bottom of each frame. Circuits are included in the receiving circuit to separate line and frame "sync" pulses and to prevent mutual interaction between the picture and the synchronising processes. To facilitate separation of these two functions the first 30 per cent. of the possible 100 per cent. modulation of the carrier wave can be varied without producing any effect on the television screen, and "sync" pulses are transmitted by reducing the modulation from 30 per cent. —the black level on the picture—to zero for a period equal to $\frac{1}{6}$ of the duration of a line. The frame "sync" pulse extends over about ten lines and the line pulse is kept going within this period.

Action of the Time Bases

In the time bases the growth of the charge on the condenser, if allowed to continue indefinitely, would in due course cause the anode of the gas-filled triode to which it is connected to flash over and empty the condenser, reducing its voltage to the initial value. The valve can be made to discharge before this saturation point is reached by applying a positive voltage to the grid. This is supplied by the "sync" pulse, which is thus able to trigger the time base exactly at the right moment.

No attempt is made to keep the "sync" pulses off the control grid of the cathode-ray tube, since they serve the very useful purpose of keeping the grid below the "black" level during the fly-back period. This is chiefly of advantage in the case of the frame fly-back which can be plainly seen in the "raster," or faint network of lines produced by the uncontrolled time bases, when the station has closed down.

It would require a long series of articles to do justice to the wealth of ingenuity which has gone to the perfecting of detail both in transmitters and receivers, but the foregoing covers most of the essentials of the system as a whole.



Actual photograph of the path of the light spot in a television tube. The line spacing has been increased for clarity. The frame fly-back is visible because the time base is not under the control of the transmitter. Actually it starts in the bottom right-hand corner, but a line fly-back has carried it to the left while it has travelled vertically four or five lines.

Television Programmes

Vision	Sound
45 Mc/s	41.5 Mc/s

THURSDAY, AUGUST 25th.

11 a.m., Demonstration Film. **12-1,** Come and be Televised*. **2.30,** Starlight, Leonard Henry. **2.40,** Haute Ecole, horse riding in Alexandra Park. **3,** Facets of Syncopation. **3.30,** 167th edition of Picture Page*. **4.30,** Nancy Logan, songs at the piano*. **4.40-5,** Haute Ecole. **6.30,** Queue for Song*. **7,** Forecast of Fashion*. **7.15-7.30,** Films. **8.30,** 168th edition of Picture Page*. **9,** "The Rivals," play by Richard Brinsley Sheridan. **10.15,** Interval Music. **10.25,** News.

FRIDAY, AUGUST 26th.

11 a.m., Demonstration Film. **12-1,** Come and be Televised*. **2.30,** O.B. from Regent's Park Zoo. **3,** "The End of the Beginning," a farce. **3.30-4,** Queue for Song*. **4.30-5,** Zoo O.B. **6.30,** Cabaret Cruise*. **7,** Cruising Fashions*. **7.15-7.30,** Film. **8.30,** Queue for Song*. **9,** Gillie Potter. **9.10,** Alfredo and his Gipsy Orchestra*. **9.40,** News Film. **9.50,** James Stevens—poetry. **10,** Interval Music. **10.25,** News.

SATURDAY, AUGUST 27th.

11 a.m., Demonstration Film. **12-1,** Come and be Televised*. **2.30,** Zoo O.B. **3,** Tour de Farce. **3.30,** Cabaret Cruise*. **4.30-5,** Zoo O.B. **6.30,** Queue for Song*. **7,** Forecast of Fashion*. **7.15-7.30,** Films. **8.30,** Cabaret Cruise*. **9,** Cabaret Cartoons. **10,** Interval Music. **10.25,** News.

SUNDAY, AUGUST 28th.

8.50, News. **9.5,** Starlight—Yvonne Arnaud. **9.15,** Cartoon Film. **9.20-10.35,** "Charles and Mary," a play based on the lives of the Lambs, by Joan Temple.

MONDAY, AUGUST 29th.

11 a.m., Demonstration Film. **12,** C. H. Middleton in The Garden*. **12.15-1,** Come and be Televised*. **2.30,** Zoo O.B. **3,** Jack Hylton and his Band. **3.30-4,** Queue for Song*. **4.30-5,** Zoo O.B. **6.30,** Cabaret Cruise*. **7,** Cruising Fashions*. **7.15-7.30,** Films. **8.30,** Queue for Song*. **9,** Jack Hylton and his Band. **9.30,** Starlight. **9.40,** Demonstration of Ballroom Dancing. **9.55,** Cartoon Film. **10,** Interval Music. **10.25,** News.

TUESDAY, AUGUST 30th.

11 a.m., Demonstration Film. **12,** C. H. Middleton*. **12.15-1,** Come and Be Televised*. **2.30,** Cookery Demonstration. **2.40,** Zoo O.B. **3.10,** Coffee Stall. **3.30-4,** Cabaret Cruise*. **4.30-5,** Zoo O.B. **6.30,** Queue for Song*. **7,** Forecast of Fashion*. **7.15-7.30,** Films. **8.30,** Cabaret Cruise*. **9,** News Film. **9.10,** Alfredo and his Gipsy Orchestra*. **9.40,** "Brigade-Exchange," play. **10.15,** Interval Music. **10.25,** News.

WEDNESDAY, AUGUST 31st.

11 a.m., Demonstration Film. **12,** C. H. Middleton*. **12.15-1,** Come and be Televised*. **2.30,** Zoo O.B. **3,** Cabaret Cartoons. **3.30-4,** Queue for Song*. **4.30-5,** Zoo O.B. **6.30,** Cabaret Cruise*. **7,** Cruising Fashions*. **7.15-7.30,** Film. **8.30,** Queue for Song*. **9,** Catch-as-Catch-can wrestling. **9.15,** Jane Carr*. **9.25,** News Film. **9.35,** Tour de Farce. **10,** Interval Music. **10.25,** News.

* Items from the studio at Radiolympia.

Frequency Control with Quartz Crystals

WE have been asked by Radiomart, G5NI (Birmingham), Ltd., of 44, Holloway Head, Birmingham, to state that the booklet describing the application of quartz crystals for frequency control referred to on page 131 of our August 11th issue can only be supplied on the receipt of 7½d.

Theory into Practice

I.—SELECTION AND ARRANGEMENT OF COMPONENTS

By R. H. WALLACE

FROM the circuit diagram we obtain the values of the components required and, generally, the particular valves round which the set has probably been designed; the value of a resistance or choke is, however, rarely enough fully to specify it, and the interrelation of the components is also important. With a resistance one has to consider whether to use a composition or a wire-wound type; the watts to be dissipated, if not given on the circuit diagram, are readily calculated from the valve currents and should be first determined. Then the position in the set must be considered. If the resistance is for voltage-dropping only then it need not be non-inductive, and any type is suitable; economy will probably decide in favour of the composition variety if the resistance is 50,000 ohms or over, unless the rating is over 5 watts. If under 20,000 ohms and with a low rating the wire-wound type of resistance might be chosen, as its value is more stable and the rating can be slightly exceeded without risk if good cooling is provided. Resistances of small dissipation and high value require such fine wire that they are readily damaged, unless of the protected kind. One advantage of the wire-wound resistance is that failure is sudden, whereas the composition type may, if overloaded, rise permanently in value to several times its nominal resistance. Such a fault is in many cases difficult to diagnose; on this account the rating of this type should not be exceeded.

Composition or Wire-wound Resistances?

Where the resistance must be non-inductive, as is the case with grid leaks in all stages, RF stopping resistances and the potential dividers of the RF amplifier, then it is wise to adhere to the carbon or metallised kinds, as even supposedly non-inductive wire-wound ones do not retain this property at the higher frequencies. There are certain occasions when a tubular wire-wound component can be used also as an RF choke, as its inductance is enough for some short-wave circuits. The strip type of resistor is appreciably less inductive than the tubular sort.

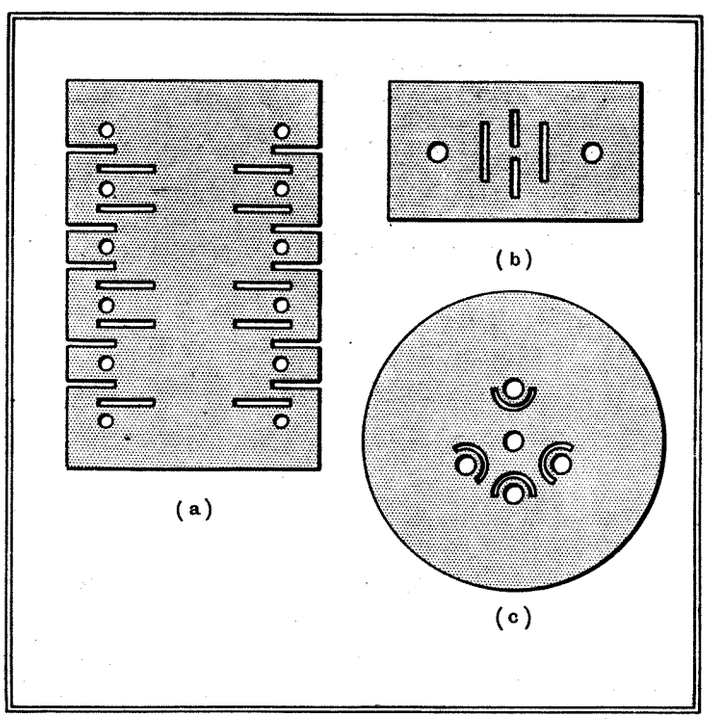
The components associated with a diode or grid detector should be considered as forming part of both the RF and AF sections of the receiver, and should therefore be non-inductive.

In the AF amplifier such details as the resistances for preventing parasitic oscillation must be connected directly to the anode or grid terminal of the valve-holder concerned, and the same applies to those in the RF side of the set; non-inductive components are valueless if several inches of lead intervene between the part to be protected and the resistance concerned, and the higher the frequency the more necessary these precautions. A point that should not escape notice is that the temperature coefficients of the two types are opposite; that of wire is positive while composition has a negative coefficient; it follows therefore that a potential divider where the two are used will have a tapping ratio that varies with the current and the ambient temperature. Except in very special cases where this can be turned to account, potentiometers should be wholly of one or the other material.

IN translating a theoretical design into a practical set many points arise in regard to the particular type of component to be used, and its disposition on the chassis. The consideration of these in relation to heat dissipation and to mechanical stability have already been dealt with in earlier articles and in this one and its sequel some of the electrical details will be treated.

Variable resistances, whether wire-wound or carbon, constitute one of the minor plagues of the designer's life. If the contact pressure is heavy, rapid attrition of the element takes place, while if this pressure is light the component tends to become noisy. By using a multiple stud switch and separate resistances for each step, one can avoid these troubles, but the result is not a compact assembly, and the cost puts this kind rather out of reach, except for large amplifiers and talkie apparatus.

Turning now to condensers, there is nowadays such a wide choice that the decision is sometimes an embarrassing one. In the RF amplifier fixed condensers below 0.01 mfd. should have mica or ceramic dielectric; the latter is preferable for the smaller ones, especially for short-wave work, as its temperature coefficient is very small. Mica, being a natural product, varies considerably in its properties, and the best makes are worth the extra cost. All the decoupling condensers throughout the RF amplifier must be non-inductive, but paper types are quite suitable for the larger capacities as long as this is guaranteed. As in the case of resistances, the leads to condensers should be very short or the good done by fitting a non-inductive component will be nullified; not more than one or two inches of wire ought to be used. Condensers of the early stages of a receiver are prone to capacity pick-up from other parts of the wiring, none of which should be led near them. To avoid excessive stray capacity, no grid or coupling condenser should be nearer than half an inch from a metal chassis.



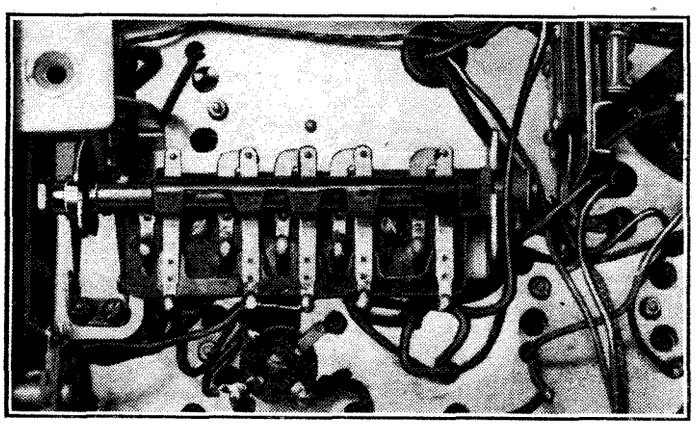
Reducing surface leakage by means of slots: (a) increasing the length of the surface path between rivets on an assembly board; (b) terminal mount for high voltages; (c) valve holder with high insulation between pins.

Electrolitic condensers used in the detector cathode circuit, or any other place where they may have to by-pass RF currents, will probably need a small non-in-

Theory into Practice—

ductive type connected in parallel. The writer has known several cases where detector stages were not stable until this was done, the residual inductance of the electrolitic type being evidently not small enough.

The losses in an air-spaced condenser, being confined to the supporting insulators, are smaller than with any other type, but the condenser is bulkier for the same capacity, and its stray capacity to earth and the other wiring is greater, so that it is not always possible to use this kind in compact sets. The higher the frequency the better does it show up and the more necessary it becomes to have as many air-spaced condensers as possible. Tuning condensers will naturally be of this type in all but the smallest sets, and the performance of the intermediate-frequency circuits is nearly always improved, both in efficiency and constancy, by their use.



The use of two separate assembly strips for the switch contacts considerably increases the length of the surface path in the "open" position; observe also the use of rubber grommets where high potential leads pass through the chassis.

The stability of the tuning condensers is of great importance, as the detuning of one of the circuits by a very small amount will lower the overall amplification of the amplifier by more than the amount due to ordinary incidental losses. In buying tuning condensers this point should be borne in mind and care taken that rigidity has not been sacrificed by undue reduction in the strength of the supporting insulators.

Low Leakage Essential

In the AF amplifier the coupling condensers of resistance-capacity stages must have very high leakage resistance, or the bias on the grid may be altered. If paper types are used they should have a high insulation value, and this is helped by using no larger a value than is necessary for the response required.

Tuning coils vary with the wavelength, from honeycomb and section wound for the longer, via the single-layer solenoid for medium wavelengths to the air-supported coils of a few turns used on the ultra-short-wave band. The kind of insulating material used for coil formers affects the self-capacity of the coil, and it is generally considered better not to impregnate the coil after winding, as any varnish used can hardly fail to raise the dielectric constant of the covering, and hence the self-capacity. In the case of coils for the very highest frequencies silver plating is a neat and efficient finish. It is preferable not to use insulating lacquers as they raise the losses.

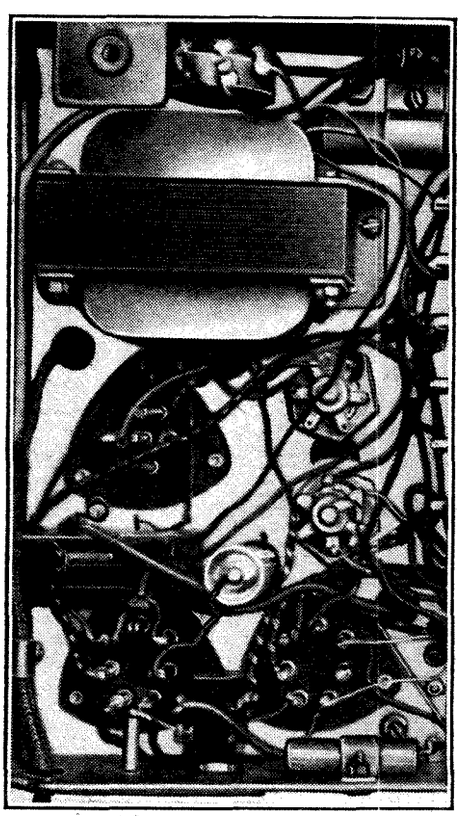
In the case of RF chokes there is again a wide divergency, according to the wave-band involved. Coils of the highest inductance should be selected for use in the IF stages of superheterodynes, and at least 0.25 henry should be used. Lower values (around 0.1 henry) will be suitable for the anode circuits of triode grid detectors, but in both these positions the choke ought to be screened, and to keep the self-capacity at a low value it is much better if the windings are sectionalised. For use at the higher frequencies miniature section-wound types, unscreened, but on low-loss formers, are preferable, while for the really short wavelengths, single-layer chokes of small dimensions on ceramic formers are almost a necessity. At the ultra-short end of the spectrum a few unsupported turns formed in the lead provides all the inductance that is needed.

Each component of the set has fields, either magnetic or electric, associated with it, and these will link with those of other components and cause interaction; whether this is harmful or not will depend on the gain between the two points concerned. Naturally feed-back across two or more stages is especially serious, hence the arrangement of the chassis should be such that the output and input sections are well spaced, as less screening will then be needed.

Generally speaking there is the choice between the individual screening of the various components or the inclusion of the separate parts of the circuit in different sections of the chassis; in almost all cases the latter is the better method, as there is less modification of the characteristics of the components and better cooling, while at the same time a great deal of screening of the wiring is avoided. In the design of screening boxes a very close electrical contact along the seams, where these are unavoidable, is necessary, and it is better to solder or spot weld at a number of points where the material will permit this; when holes are needed to permit the passage of wires through the screen then it is better to make a few small ones than one larger one and especially to avoid the use of long slots. Where it is desirable to give ventilation but preserve screening then the use of wire gauze is recommended; so far as electrostatic pick-up is concerned gauze is, in nearly all cases, fully as efficient as a solid sheet, provided that the wires are all bonded together at the edges—a run of solder will ensure this. Ventilation is especially needed for the oscillator stages of superheterodynes, to prevent excessive drift of tuning, and gauze windows will help considerably in this. As regards the material of which the screens are made, the best, save for silver, is copper, and the next in order of efficiency is aluminium, but it is often cheaper to use steel of a greater thickness, and this has a much higher inductive screening effect. The only precaution that is necessary is to make really good electrical connections at all points of contact with the chassis, and this is much easier if the latter is plated with some conductor than if it is cellulosed.

Low-frequency Screening

The provision of satisfactory screening against magnetic interaction at audio-frequencies, and especially at the low hum frequencies, is more costly, and it is cheaper and better to position the parts so that the linkage is at a minimum in the absence of screening. For instance, RF chokes and those associated with tone-control devices are particularly liable to this trouble, and orientation of them in respect to the mains transformer and smoothing choke will generally be of advantage. Astatic windings help a lot to preserve a low hum level, and with the higher amplification of microphone circuits it is necessary not only to screen the whole of the leads, but also, in most cases, to



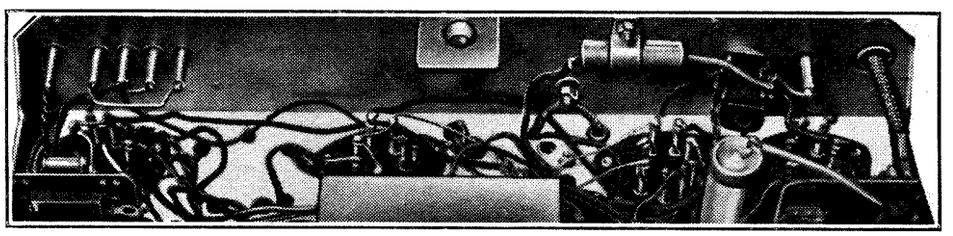
Leakage path to earth of valveholders is increased by the spacing of the fixing rivets well away from the valve pins, made possible by the special shape of the holder plate.

Theory into Practice—

enclose the microphone transformer in a cast-iron case at least ¼in. thick, or a correspondingly thinner Mumetal screen.

Feed-back at audio-frequencies is more often due to inductive than to capacitative interaction, and the amplification at AF being less than at radio frequencies, it is more easily avoided by careful positioning and the use of short leads. The author would put in a special plea for the thorough filtering of the IF or RF signals after the detector, since instability is often traced to leakage back of these from the audio stages of the set.

The better the low-note response of the set the more likely is AF feed-back to take place, and the more will the hum frequencies be passed on to the speaker. Even if this is not audible the presence of



The use of several separate small assembly boards and disposition of the larger components at the most suitable points reduces wiring and helps to prevent interaction by increasing the distances between various parts of the circuit.

these notes will tend to cause overloading of the output stage and so is undesirable.

The advantages of the double-deck construction, possible with console models, in separating the power equipment and speaker field from the earlier stages of the amplifier are considerable, and almost a necessity for luxury sets with good low-note response combined with very low hum levels. The use of this form of cabinet makes possible the provision of comprehensive tone control and the associated high-inductance chokes without noticeable pick-up of hum, a very difficult matter in a compact set. The axes of the transformers on the lower deck should be horizontal so as to reduce the vertical fields to the smallest value possible.

Insulating Material

Having dealt with leakage by induction and capacity interaction, there is yet another form of leakage to be considered, namely, that through or along the insulators of the set. With the majority of receivers, and except for the high voltages used in television, the insulation should be such that there will be negligible leakage through the various insulators, but this will not be so in the case of surface currents along the material when the receiver is dusty and the atmosphere is humid. Good design must allow for the worst of such conditions likely to occur, and this is why, at least in part, construction to tropical specifications is so much more expensive.

The surface leakage varies somewhat with the material and to a greater extent with the nature of the surface, since a polished one will afford much less opportunity for dust to settle, naturally the insulation cannot exceed that of the same length of air, but will rarely approach this unless dust is completely excluded, so that an improvement in the design of the component can afford a considerable increase in the insulation resistance. Often this can be done at little or no increased cost, as illustrated in the diagram.

It is the writer's opinion that a minimum surface path of ¼in. for each 250 volts is necessary with the best insulators, and under normal conditions; there are points in the set where this is rather on the low side. A place where special care is needed is the spacing of the grid and anode connections of resistance-capacity-coupled valves; here quite a small leak can have serious results. With transformer coupling the grid is almost short-circuited to earth, so far as DC voltages are concerned, and a small leakage will not vary the potential of the grid with respect to the cathode by an appreciable amount. In the RC coupled stage this is not so because of the grid leak, and such a leak as might occur between an anode and grid resistance on the same assembly strip may not only cause distortion, but, in the case of power valves, may decrease the valve life. A leakage path of 100 megohms with an anode voltage of 200 will raise the potential of a grid with a leak of one megohm by two volts; that is to say, the grid bias will be lessened by that amount, so the seriousness of the matter will be apparent. Similar remarks apply to valveholders, where again care in design can give long leakage paths with little or no increase in cost.

In the case of switches distinction must be made between those which deal with power applications in the set and the more numerous ones which are concerned with RF and AF currents. Both these kinds need just as good insulation as the valveholders and condensers, and, in addition, the losses will be decreased in proportion as the stray capacity in the switch is reduced, so that this should be as low as possible. The modern disc or wafer type of switch is eminently suitable for tuned-circuit use, and if the higher frequencies are to be dealt with it should have ceramic insulation; the contacts should be silvered. Similar considerations apply to radio-gramophone switches, and these should always be mounted near the valve to whose grid they are connected, the motion being transmitted, if necessary, by some mechanical device. These methods were dealt with in an earlier article and enable the switches to be placed so that short leads are ensured, while, at the same time, permitting a convenient arrangement of controls. In the case of controls of high-voltage apparatus, such as television sets, the spindles should have insulating couplings inserted between the control knob and the component to avoid risk of shock.

With power switches the problem is somewhat different, and arcing is one of the chief troubles. It is not, perhaps, always realised that the synthetic resin products are liable to a defect called "tracking," which is the formation of a low-resistance, almost conducting, path after an arc has been struck across the surface. If these materials are used, then the design should be such that any arc produced is not along the surface of the material, and rather more than the usual allowance for surface leakage should be made. The provision of ample contact surfaces is essential to reduce local heating, and to assist the insulation to retain its efficiency. Porcelain, where it can be used, or Steatite products, are especially suitable for switches of this type.

It is not possible, within the limits of an article, to deal more fully with the various components, each of which might well form the subject of an article itself, but it is the hope of the writer that some of the more important points have been dealt with and the first principles indicated.

BAIRD TELEVISION

AT a recent demonstration of Baird Television receivers the performance of their models reached a high standard. Receivers with 9in. and 12in. tubes gave bright pictures with extremely good detail and good synchronising.

The projection model, however, was outstanding in giving a good black-and-white picture with a tinge of sepia. The brightness, although lower than that of the small-tube models, was excellent, and even with a 24in. by 19in. picture it was found unnecessary to view in complete darkness. Even with quite a large amount of room lighting, the performance was exceedingly good.

A 5in. cathode-ray tube is used and the picture is projected on to the screen by means of an f/2 lens. Controls have been reduced to the minimum of a contrast control and sound volume control, and the broadcast receiver included is of the press-button type. The receiver is priced at 150 gns.

Voigt Loud Speaker Demonstration

DURING the period of the exhibition at Olympia demonstrations of the Voigt loud speaker will be given at 2, Beaconsfield Terrace Road, London, W.14, between the hours of 11 a.m. and 1 p.m., and again from 3 p.m. to 10.30 p.m. A high-grade gramophone reproducer will be available, and anyone interested may take his own test record during the morning periods and hear it played through the equipment.

Among new loud speaker units which will be shown is one giving fully distributed radiation without serious loss up to 10,000 cycles, and suitable amplifiers and a 7-metre quality receiver will also be available.

The Wireless World

How a Receiver is Designed.—XXIII.

Communication Receiver

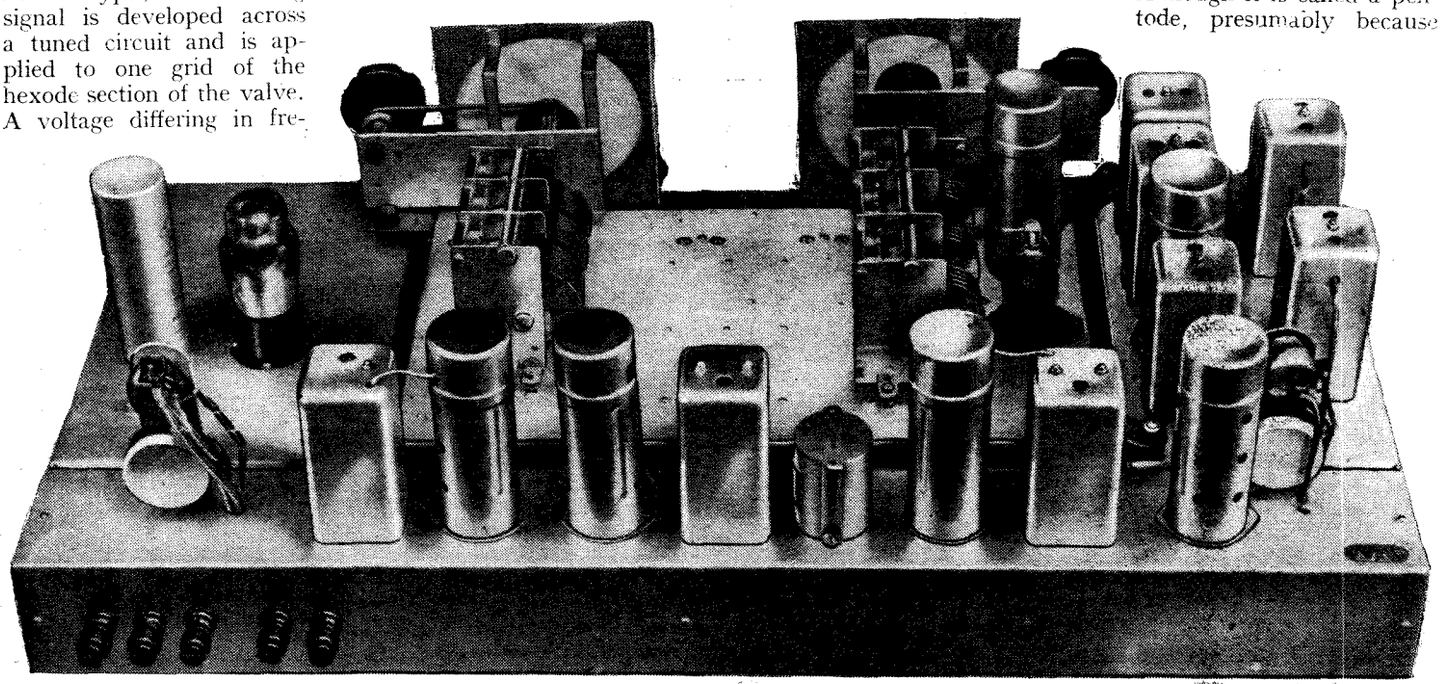
IN this article appears the first part of the constructional details of "The Wireless World" Communication Receiver, the design of which has been dealt with in earlier issues. The receiver covers 5.2-2,000 metres in eight bands and has three degrees of selectivity, manual RF and IF gain controls are fitted, AVC and the beat-frequency oscillator can be switched in and out at will, there are independent bass and treble tone controls, and push-pull resistance coupled AF amplification is used. The output is 7 watts.

ALL-WAVE TUNING SYSTEM

WHATEVER the wavelength of the incoming signal, the IF and AF amplifiers described last week function in the same way and remain unmodified. They constitute, in fact, a receiver built to receive signals on 465 kc/s only, and for general reception the tuning system must pick out the desired signal and convert it to this frequency.

The frequency-changer is of the triode-hexode type; the incoming signal is developed across a tuned circuit and is applied to one grid of the hexode section of the valve. A voltage differing in frequency by 465 kc/s is applied to another grid, and as a result of the mixing action in the valve a signal of 465 kc/s appears in its anode circuit. The triode section of the valve is used as an oscillator to generate the voltage required for frequency-changing.

If the frequency-changer were ideal, nothing more would be needed and we should have two tuned circuits only—one tuned to the incoming signal, and the other, for the oscillator, to a frequency 465 kc/s higher. A frequency-changer, however, introduces more valve hiss than an amplifier, and it is capable of producing output at the intermediate frequency in many different ways in addition to the correct one. Such spurious responses cause stations to be tunable at more than one dial setting, and if there are many stations they cause "superheterodyne" whistles.



A rear view of the complete receiver showing the tuner floating in the cut-out in the main chassis. The IF amplifier is in the foreground of the picture.

These unwanted responses must be avoided by the use of adequate pre-selection; in other words, sufficient selectivity must be provided at signal frequency. For this the circuits must be reasonably good and the ganging must be accurate. On the broadcast bands a single tuned circuit is often sufficient, but two are better, and two are almost essential on short waves. On ultra-short-waves more than two tuned circuits are desirable, but it is rarely possible to use more, largely for economic reasons. Fortunately, signals in general are so weak that the lower effective pre-selection causes little trouble; only on very strong signals indeed are repeat points noticeable.

We decide, therefore, to use two signal-frequency tuned circuits, and this fits in well with the measures which we must take to keep valve hiss at a minimum. As the frequency-changer introduces more hiss than an amplifier, it must be preceded by an amplifier giving sufficient gain to make the frequency-changer noise negligible in comparison with its own noise. Furthermore, the valve used in the amplifier must be chosen for minimum hiss.

Fortunately, a single stage will provide all the gain needed, and our two tuned circuits are consequently employed in the input to this valve and for the coupling between it and the frequency-changer. The valve we choose is one of the new low-noise RF pentodes—the EF8. Although it is called a pentode, presumably because it fulfils the usual function of an RF pentode, it is really a hexode.

The essential details of the switching and method of tuning have already been described, and we can turn right away to Fig. 26, which shows the complete circuit diagram of the tuner. Eight wavebands are provided with two gang condensers and two waveband switches. For ultra-short-wave reception, which in this case is taken to cover 5.2-16 metres, switches

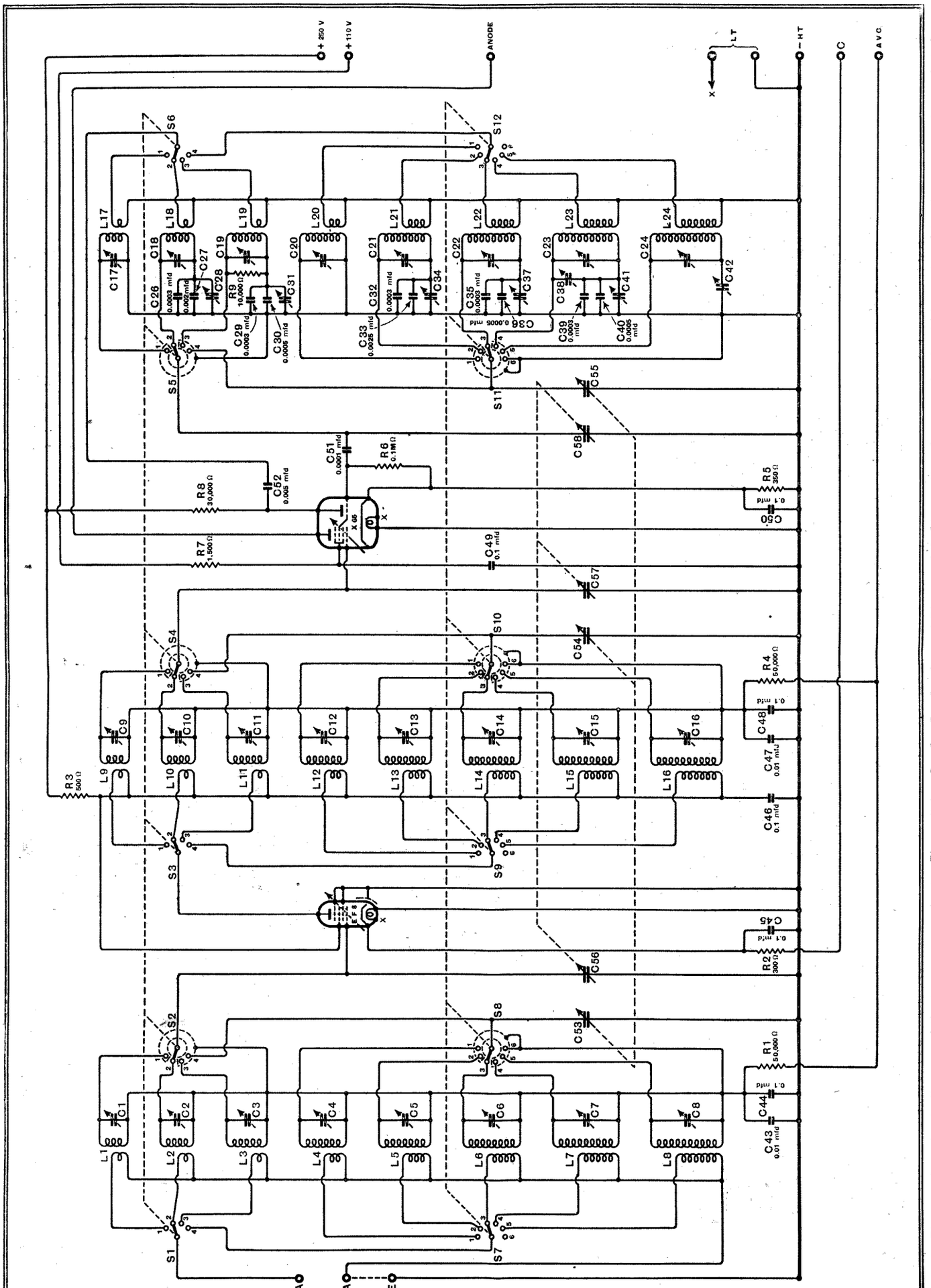
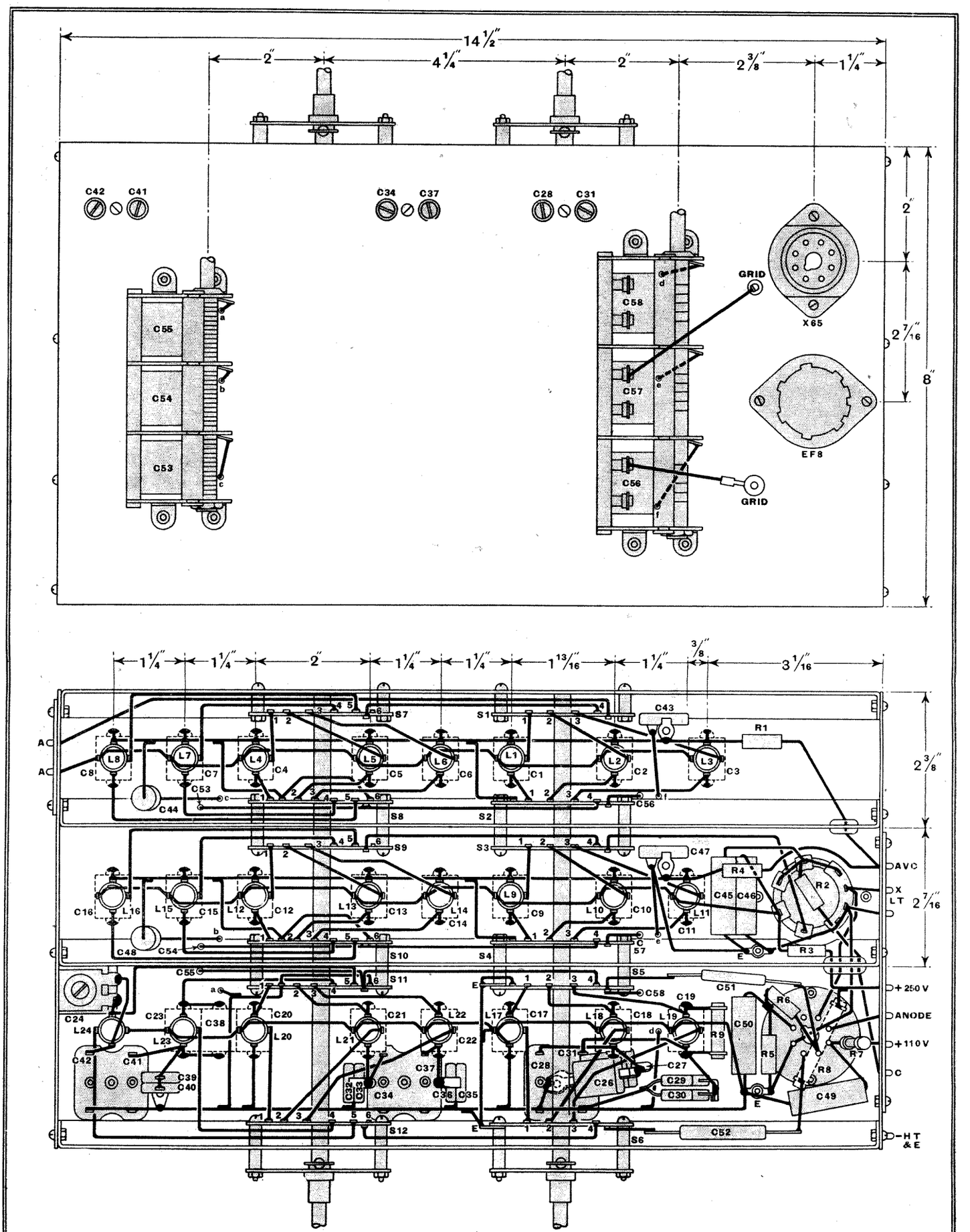


Fig. 26.—The complete circuit diagram of the tuner appears here. The switches S1, S2, S3, S4, S5, and S6 control the three ultra-short wavebands which are tuned by the gang condenser C56, C57 and C58. The remaining switches control the other five bands which are tuned by the larger gang condenser C53, C54 and C55. The other condenser is then available for band-spread.

THE TUNING UNIT



The layout and practical wiring diagram of the tuner chassis.

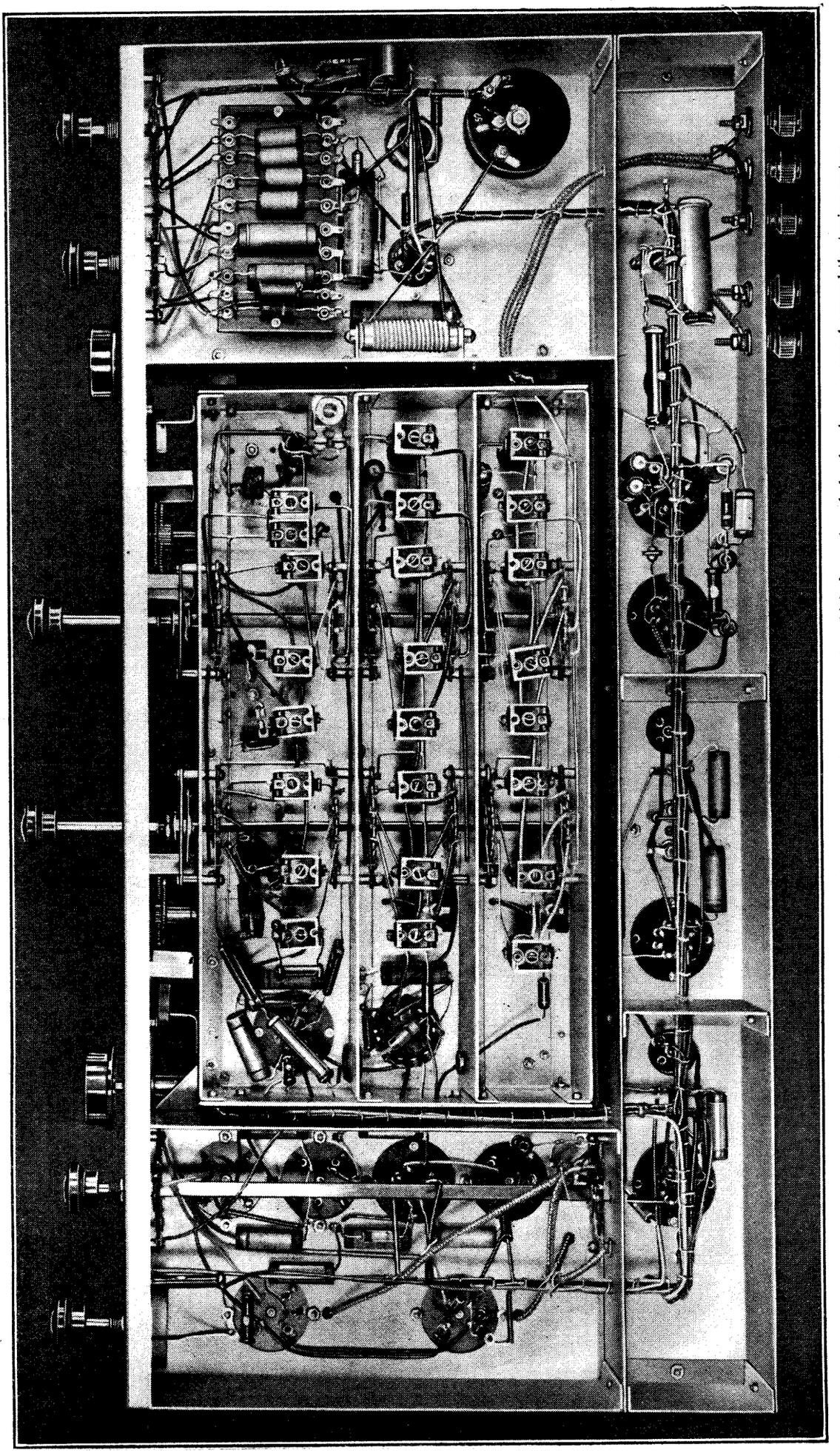
The Wireless World
Communication Receiver—

S7, S8, S9, S10, S11, and S12 are all in position 6, and the other switch bank is set to position 1, 2 or 3, according to the particular band required. Tuning is then carried out on the dial controlling the small 60-$\mu\mu$F. condensers C56, C57 and C58. The other tuning control has no effect.

For all higher wavelengths S1, S2, S3, S4, S5 and S6 are set to position 4, and the other switch bank set to the required one of the five bands. These bands extend upwards from about 15 metres, and three of them are conveniently termed short-wave bands, although one of them extends up some distance into the medium waveband. This is because the medium waveband proper does not tune down as far as usual, but stops at about 220 metres, because it extends up to 600 metres at the other end instead of the usual 550 metres.

On all of these five bands tuning is carried out on C53, C54 and C55, the other condenser being set at zero. This is important. If it is not set at zero the tuning ranges will be abnormal, since on these bands the two condensers are in parallel. The small condenser is not without its uses, however, for on short waves it can be used as a bandspread condenser, and this makes tuning considerably less critical.

Examination of Fig. 26 will show that the circuit is quite straightforward, and, apart from the duplication of variable condensers and switches, follows normal practice. AVC is applied to both RF and FC valves through the 50,000-ohm resistances R1 and R4 the decoupling condensers

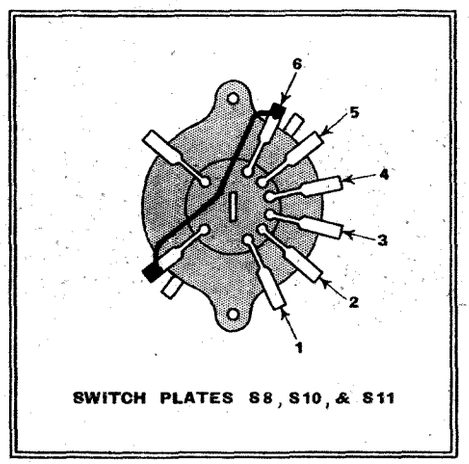


In this photograph of the underside of the receiver it will clearly be seen how the different units which form the whole chassis are grouped around the tuning system.

The Wireless World **Communication Receiver**—

are duplicated, since they form part of the tuned circuits. In the first circuit, for instance, a 0.1 μF. condenser, C44, is used, and is intended chiefly for the long, medium, and longer short waves. It is shunted by the 0.01-μF. mica-type condenser C43, since this is more effective on ultra-short waves. Similarly, in the intervalve circuit two condensers, C46 and C47, are used.

Each signal-frequency coil assembly has two windings—the tuned secondary and a primary. On short and ultra-short waves all windings are solenoids, and on most bands the primary and secondary are interwound; on the higher wavelengths, however, the primaries are overwound on the earthy ends of the secondaries. On the medium waveband the tuned windings are of the machine-wound two-bank type, and the primaries are similarly wound and suitably spaced. The so-called large primaries are not used because of the risk of break-through of signals operating at the intermediate frequency, for on the medium waveband large primaries usually resonate around 465 kc/s. On the long waveband, however, the possibility of this trouble arises with small primaries, and large primaries are accordingly used here. Each of the



Face-view of the switch plates, showing the cross-connection.

sixteen signal-frequency coils has its own parallel trimmer mounted on the coil itself.

Turning now to the oscillator, the arrangement is very similar, but the reaction coils are in most cases wound with resistance wire to reduce any chance of parasitic oscillation. The inductances are smaller than those of the signal-frequency circuits, and, in addition to the parallel trimmers, padding condensers are included on six of the eight bands. On bands 1 and 4 the capacity required is so large that it has a negligible effect and it can be omitted.

The parallel capacity on band 7 (medium waves) is larger than can be obtained in one of the small trimmers used in the other circuits; two are accordingly connected in parallel, and it is intended that one be screwed up fully and the other only used for adjustment. On long waves still more capacity is needed, and here a different type of trimmer proves suitable.

The padding capacities in most cases consist of two fixed and one adjustable condenser is parallel. Two fixed condensers are used merely because the required value is non-standard.

In the drawings which accompany this

THE LIST OF PARTS REQUIRED FOR BUILDING "THE WIRELESS WORLD" COMMUNICATION RECEIVER

TUNER

1 Set of 24 coils — **Sound Sales SCR1-24**
1 Variable condenser, 3-gang, 0.0005 mfd. — **Polar C1703**
1 Variable condenser, 3-gang, 60 mmfds. — **Polar C1705**
2 Dials, geared slow motion — **Peto-Scott**
1 Valve holder, 8-pin, octal type — **Clix V4**
1 Valve holder, 8 contact — **Bulgin VH24**
24 Trimmers, 30 mmfds. — **Eddystone 1023**
1 Trimmer, 160 mmfds. — **Bulgin CP2**
1 Double trimmer, 150-550 mmfds. — **Polar 55**
2 Double trimmers, 250-650 mmfds. — **Polar 66**
1 Valve screen, small octal type — **B.T.S.**
1 Grid clip, octal type — **Bulgin P96**
1 Plug top valve connector — **Belling-Lee 1175**
Fixed condensers:
3 0.0005 mfd., mica — **T.C.C. "M"**
5 0.0003 mfd., mica — **T.C.C. "M"**
1 0.0001 mfd., mica — **T.C.C. "M"**
1 0.0025 mfd., mica — **T.C.C. "M"**
1 0.002 mfd., mica — **T.C.C. "M"**
1 0.005 mfd., mica — **T.C.C. "M"**
2 0.01 mfd., mica — **T.C.C. "M"**
6 0.1 mfd., tubular — **T.C.C. 341**
Resistances:
1 300 ohms, ½ watt — **Erie**
1 350 ohms, ½ watt — **Erie**
1 500 ohms, ½ watt — **Erie**
1 1,500 ohms, ½ watt — **Erie**
1 10,000 ohms, ½ watt — **Erie**
2 50,000 ohms, ½ watt — **Erie**
1 100,000 ohms, ½ watt — **Erie**
1 30,000 ohms, 1 watt — **Erie**
Chassis, fitted with switches and knobs, complete with screws, etc. — **B.T.S.**
Miscellaneous: — **Peto-Scott**
2 Lengths systoflex, 1 oz. each Nos. 18 and 22 tinned copper wire, etc.
Valves:
1 X65 — **Osram**
1 EF8 — **Mullard**

RECEIVER

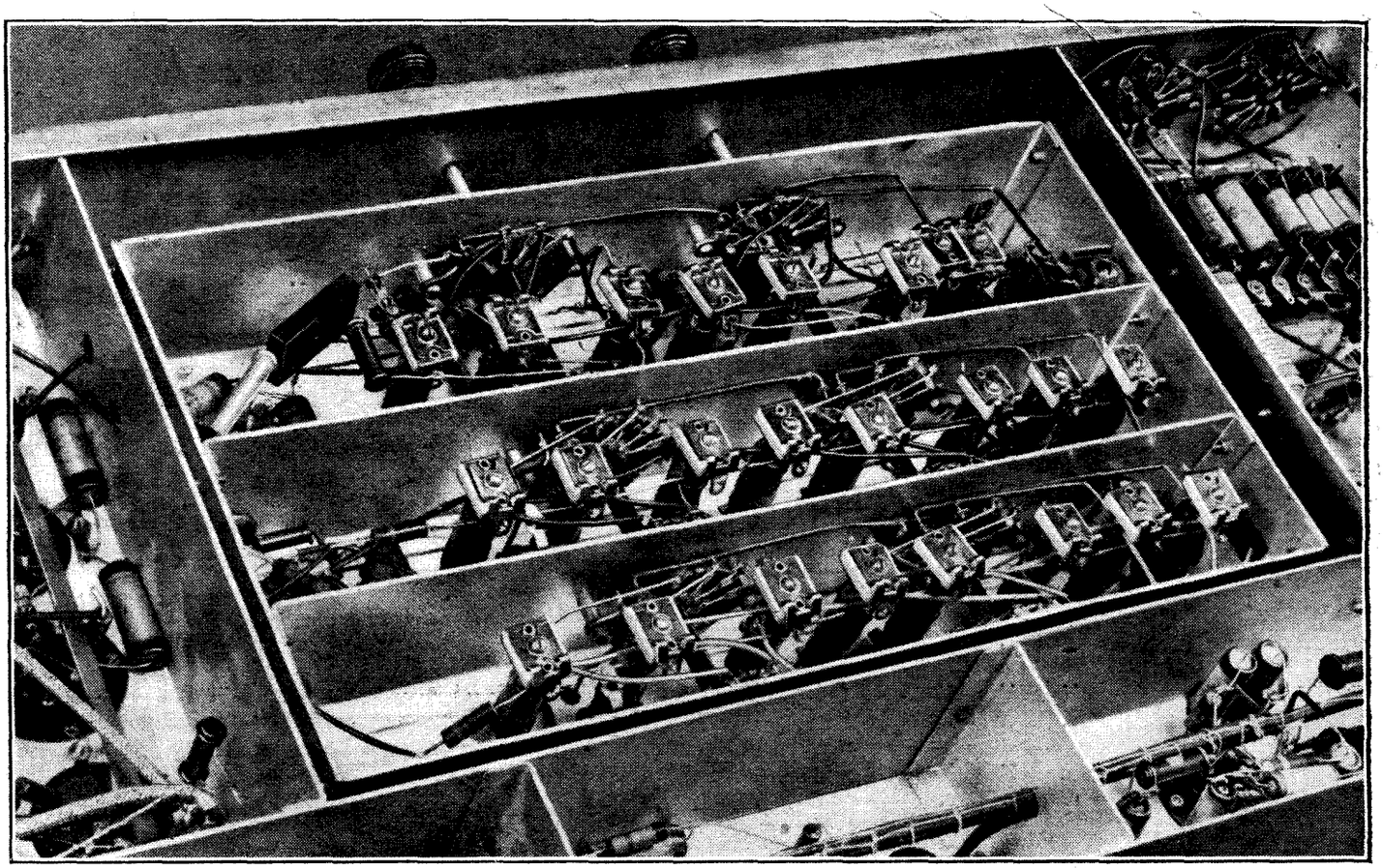
5 IF transformers, 465 kc/s — **Varley BP124**
1 Inter-IF coupler, 465 kc/s — **B.T.S. WW/IFA**
1 IF-Det. coupler, 465 kc/s — **B.T.S. WW/IFB**
1 Coil assembly — **B.T.S. WW/BFO**
2 DP switches, 5-way, with knobs and locators — **B.T.S. C125**
1 3-way locator plate with 9¾in. drive bar, 2 switch banks, 2-pole 3-way and knob — **B.T.S. B123**
2 Potentiometers, wire wound, 10,000 ohms — **Reliance TW**
1 Potentiometer, tapered, 2 megohms — **Reliance SG**
1 Switch, rotary type, DPDT — **Bulgin S114**
1 Switch, rotary type, DPST — **Bulgin S115**
4 Shaft couplers — **Bulgin 2005**
2 10½in. lengths and 2 11in. lengths ¼in. rod — **Bulgin**
1 Resistance group board, 10-way — **Bulgin C32**
6 Valve holders, 8-pin, octal type — **Clix V4**
5 Valve screens, small octal type — **B.T.S.**
4 Grid clips, octal type — **Bulgin P96**
1 Correction choke, 1.3 H. — **B.T.S. WW3**
1 Connector, 5-way — **Bryce 5C4**
1 Plug, 7-pin — **Bulgin P37**
5 Knobs (black), ¼in. — **B.T.S.**
Fixed condensers:
1 0.0003 mfd., tubular — **T.C.C. 451**
1 0.0005 mfd., tubular — **T.C.C. 451**
2 0.005 mfd., tubular — **T.C.C. 451**
1 0.002 mfd., tubular — **T.C.C. 451**
1 0.01 mfd., tubular — **T.C.C. 451**
1 0.015 mfd., tubular — **T.C.C. 451**
2 0.05 mfd., tubular — **T.C.C. 341**
14 0.1 mfd., tubular — **T.C.C. 341**
1 0.2 mfd., tubular — **T.C.C. 341**
1 0.5 mfd., tubular — **T.C.C. 341**
1 50 mfds., 12 volts, electrolytic — **Dubilier 3016**
1 8 mfds., 500 volts, electrolytic — **Dubilier 0281**
1 1 mmfd., ceramic — **T.C.C.**
4 Panel bushes, ¼in. bore — **Bulgin 1048**
Resistances:
2 300 ohms, ½ watt — **Erie**
7 500 ohms, ½ watt — **Erie**
1 1,500 ohms, ½ watt — **Erie**
1 4,000 ohms, ½ watt — **Erie**
1 7,500 ohms, ½ watt — **Erie**
1 10,000 ohms, ½ watt — **Erie**
1 20,000 ohms, ½ watt — **Erie**
6 50,000 ohms, ½ watt — **Erie**
2 100,000 ohms, ½ watt — **Erie**
1 250,000 ohms, ½ watt — **Erie**
1 500,000 ohms, ½ watt — **Erie**
1 100,000 ohms, 1 watt — **Erie**
1 10,000 ohms, 2 watts — **Erie**
1 9,000 ohms, 3 watts — **Erie**
1 1,500 ohms, 20 watts — **Bulgin PR6**
5 Terminals, ebonite shrouded, A(2), E(1), PU(2) — **Belling-Lee "B"**
1 RF Choke — **Bulgin HF10**
3 Lengths screened sleeving — **Goltone**
Chassis and Panel, complete with screws, etc. — **B.T.S.**
Miscellaneous: — **Peto-Scott**
6 lengths systoflex: 2 ozs. each Nos. 18 and 22 tinned copper wire, etc.
Valves:
1 KTZ63, 3 KTW63, 1 D63 — **Osram**
1 6N7 — **Premier Supply Stores**

POWER UNIT

1 Mains transformer, Primary 200-250 volts, 50 c/s., screened. Secondaries: 4 volts, 2 amps., C.T.: 6.3 volts, 4 amps; 5 volts, 3 amps; 350-0-350 volts, 150-160mA. — **Savage WW51**
1 Choke, 10H., 150 mA., 100 ohms — **Sound Sales 10/250/H**
1 Choke, 20H., 50 mA., 400 ohms — **Bulgin LF14S**
2 Valve holders, 4-pin (without terminals) — **Clix Chassis Mounting Standard Type V1**
1 Valve holder, 7-pin (without terminals) — **Clix Chassis Mounting Standard Type V2**
3 Valve holders, 8-pin, International octal type — **Clix V4**
Fixed condensers:
1 0.01 mfd., tubular — **T.C.C. 451**
4 0.1 mfd., tubular — **T.C.C. 341**
3 8 mfds., 500 volts, electrolytic — **Dubilier 0281**
1 4 mfds., 500 volts, electrolytic — **Dubilier 0283**
1 50 mfds., 50 volts, electrolytic — **Dubilier 3004**
Resistances:
2 50 ohms, ½ watt — **Erie**
1 1,000 ohms, ½ watt — **Erie**
1 1,200 ohms, ½ watt — **Erie**
1 9,000 ohms, ½ watt — **Erie**
3 10,000 ohms, ½ watt — **Erie**
2 100,000 ohms, ½ watt — **Erie**
4 250,000 ohms, ½ watt — **Erie**
1 2 megohms, ½ watt — **Erie**
1 40,000 ohms, 1 watt — **Erie**
1 500 ohms, 20 watts — **Bulgin PR2**
1 Fused mains input connector with 2 amp. fuses — **Belling-Lee 1114**
1 Plug and socket, 3-pin — **Belling-Lee 1119**
1 Grid clip, octal type — **Bulgin P96**
Chassis, complete with screws, etc. — **B.T.S.**
Miscellaneous: — **Peto-Scott**
3 lengths systoflex, 1 oz. No. 20 tinned copper wire, etc.
Valves:
2 PX4, 1 KTZ63, 1 U52 — **Osram**
1 6N7 — **Premier Supply Stores**

The Wireless World **Communication Receiver**—article the construction and wiring of the tuner are clearly shown, and the importance of following them in detail must be emphasised. It is too often the habit to think that as long as the correct points are joined, nothing else matters, but in actual fact the length and position of leads become increasingly important as the operating frequency increases. Remember that the inductance of the wiring is appreciable—on band 1 it probably exceeds the inductance of the coil! To use long leads here would be equivalent to winding the coil with too many turns.

A receiver built to the design described in this series of articles is to be seen on "The Wireless World" Stand (No. 6) at the Olympia Show.



In this underview of the tuner the arrangement of the coils and switching can clearly be seen. The RF section is in the middle with the oscillator compartment at the back (front of tuner).

There are other things, too. The precise points for earth connections must be retained. A common earthy bus-bar is used in each compartment; it is quite satisfactory to return each circuit to convenient points along it, but do not return different earthy leads from one circuit to different points. All earthy leads from any one short-wave circuit *must* be returned to the same point on the bus-bar.

The temptation to err will occur in the oscillator circuit where a bus-bar connects all the variable padding condensers, while the fixed padding condensers are mounted between the coils and the bus-bar. The neatest wiring job is obtained by taking these condensers to points on the bus-bar immediately opposite the appropriate coils. Experience shows that the padding capacity is almost completely ineffective if this is done. It is most important that all the padding condensers in one circuit be returned to the bus-bar at one and the same point.

The construction of the tuner is by no means difficult, but care must be taken. Awkward leads, such as the earthing wires to some of the switch plates, should be connected before the coils are mounted, and the fitting of the gang condensers should be left until the end is neared. All connections within the tuned circuits should be made with No. 18 wire, but the more conveniently handled No. 22 is suitable for the other circuits, including the connections to the primaries.

(Further details on the construction of this receiver will follow in next week's issue.)

News from the Clubs

Romford and District Amateur Radio Society

Headquarters: Red Triangle Club, North Street, Romford.
Meetings: Tuesdays at 8 p.m.
Hon. Sec.: Mr. R. C. E. Beardow, 3, Geneva Gardens, Chadwell Heath.

Recent activities have included participation in the DF competition organised by the Brentwood Society and a technical "bee" in which questions were asked and were answered by members called upon to do so. The Club ran a stall at a recent fête at which the funds were augmented by a competition in which participants had to guess the length of wire upon a conical former.

Newcastle and District Short-wave Club

Hon. Sec.: Mr. K. Scott, 1, Farquhar Street, Newcastle-on-Tyne, 2.

The Club has now decided to devote all its attention to short-wave work, and a full programme is being arranged for next winter. A meeting will be held at the Hon. Secretary's address at 6 p.m. on September 4th, at which anybody interested will be welcomed.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Edmans, 72a, North End Road, London, W.14.

Visits have been arranged to Beckton Gas Works, The Royal College of Surgeons, the Main London Telegraph Office of Cables and Wireless, Ltd., and the Battersea Power Station.

It may be possible to find room in the parties for one or two non-members. Readers who would care to join any of them should apply to the Hon. Secretary stating in which visit they are interested. Applications will be dealt with in strict rotation.

Weymouth and District Short-wave Club

Headquarters: 15a, Hope Street, Weymouth.
Meetings: Wednesdays at 8 p.m.
Hon. Sec.: Mr. E. Kestin, 55, St. Mary Street, Weymouth.

Club news is radiated from G2XQ on 160 metres at 10 a.m. and from G8WQ (the club's HQ) on 20 metres at 10.30 a.m. every Sunday. Reports will be welcomed.

On August 10th, a visit was paid to the G.P.O. USW station at East Chaldon, where communication is carried on with Guernsey. It is interesting to note that signals from the Alexandra Palace, 120 miles away, have been received at this station.

A field day is to be arranged shortly.

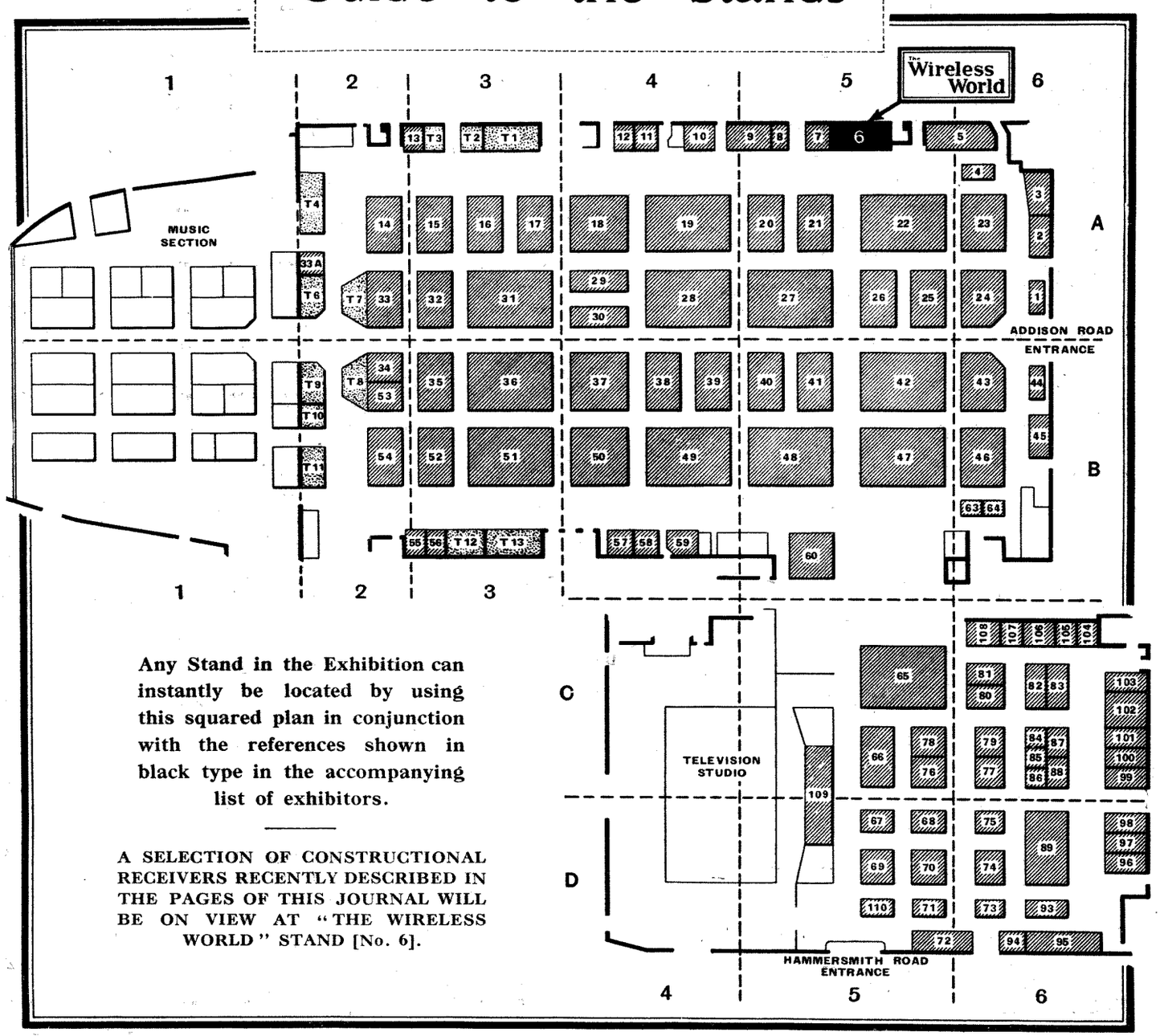
Exhibitors at Olympia

ALPHABETICAL LIST WITH STAND NUMBERS AND REFERENCES TO THE PLAN ON THE OPPOSITE PAGE

Name.	Stand.	Reference.
Armstrong Manufacturing Co. .. .. .. 100, King's Road, Camden Town, N.W.1.	88	C 6
Automatic Coil Winder & Elec. Equip. Co., Ltd. Winder House, Douglas Street, S.W.1.	21	A 5
Autotrope, Ltd. .. .. 4, Bruton Street, Berkeley Square, W.1.	79	C 6
Baird Television, Ltd. .. .. Worsley Bridge Rd., Lower Sydenham, S.E.26.	19	A 4
Balcombe, A. J., Ltd. .. .. 52–58, Tabernacle Street, E.C.2.	40	B 5
Beethoven Electric Equipment, Ltd. .. .. Chase Road, North Acton, N.W.10.	38	B 4
Belling & Lee, Ltd. .. .. Cambridge Arterial Road, Enfield, Middlesex.	4 & 5	A 6
Bird, Sydney S., & Sons, Ltd. .. .. .. Cambridge Arterial Road, Enfield, Middlesex.	102	C 6
Britannia Batteries, Ltd... .. .. .. Union Street, Redditch, Worcs.	52	B 3
British Belmont Radio, Ltd. .. .. .. 4–5, Ridgemount Street, W.C.1.	23	A 6
British Mechanical Productions, Ltd. .. .. 79A, Rochester Row, S.W.1.	107	C 6
British Pix Co., Ltd. .. .. Pix Works, Lillieshall Road, S.W.4.	82	C 6
British Rola Co., Ltd. .. .. Minerva Road, Park Royal, N.W.10.	108	C 6
British Tungsram Radio Works, Ltd. .. .. West Road, Tottenham, N.17.	20	A 5
Brown Bros., Ltd.. .. .. Great Eastern Street, E.C.2.	T. 13	B 3
Bulgin, A. F., & Co., Ltd. .. .. .. Abbey Road, Barking, Essex.	72	D 5
Burndept, Ltd. .. .. Light Gun Factory, Erith, Kent.	43	B 6
Bush Radio, Ltd. .. .. Power Road, Chiswick, W.4.	28	A 4
Carr Fastener Co., Ltd. .. .. Finsbury Court, Finsbury Pavement, E.C.2.	98	D 6
Celestion, Ltd. .. .. London Road, Kingston-on-Thames, Surrey.	95	D 6
Chloride Electrical Storage Co., Ltd. .. .. Clifton Junction, Nr. Manchester.	15	A 3
Cole, E. K., Ltd. .. .. Ekco Works, Southend-on-Sea, Essex.	48	B 5
Cosmocord, Ltd. .. .. Cambridge Arterial Road, Enfield, Middlesex.	67	B 4
Cossor, A. C., Ltd. .. .. Cossor House, Highbury Grove, N.5.	42	B 5
Davies, D. M. (Slough), Ltd. .. .. .. Trading Estate, Slough, Bucks.	13	A 3
Davis & Timmins, Ltd. .. .. Brook Road, Wood Green, N.22.	96	D 6
De la Rue, Thos., & Co., Ltd. .. .. .. 90, Shernhall Street, E.17.	11	D 4
Dew, A. J., & Co., Ltd. .. .. 32–34, Rathbone Place, W.1.	T. 6	A 2
Dibben, Horace, Ltd. .. .. 34, Carlton Crescent, Southampton.	T. 3	A 3
Dubilier Condenser Co. (1925), Ltd. .. .. Ducon Works, Victoria Rd., North Acton, W.3.	69	D 5
Dynatron Radio, Ltd. .. .. Perfecta Works, Ray Lea Road, Maidenhead, Berks.	1 & 44	A 6 & B 6
E.M.I. Service, Ltd. .. .. Sheraton Works, Hayes, Middlesex.	60	B 5
Eastick, J. J., & Sons .. .. Eelex House, 118, Bunhill Row, E.C.1.	T. 8	B 2
East London Rubber Co., Ltd. .. .. .. 29–33, Great Eastern Street, E.C.2.	T. 9	B 2
Edison Swan Electric Co., Ltd. .. .. .. 155, Charing Cross Road, W.C.2.	18	A 4
Everett, Edgecumbe & Co., Ltd. .. .. Colindale Works, Hendon, N.W.9.	55	B 3
Ferguson Radio Corporation, Ltd. .. .. 105–109, Judd Street, W.C.1.	32	A 3
Ferranti, Ltd. .. .. Radio Works, Moston, Manchester, 10.	14	A 2
Fuller Accumulator Co. (1926), Ltd. .. .. Woodland Works, Chadwell Heath, Essex.	57	B 4
Garrard Engineering & Manufacturing Co., Ltd. Newcastle Street, Swindon, Wilts.	25	A 5
General Electric Co., Ltd., The .. .. .. Magnet House, Kingsway, W.C.2.	39 & 49	B 4
Goodmans Industries, Ltd. .. .. .. Lancelot Road, Wembley, Middlesex.	3	A 6
Gramophone Co., Ltd. .. .. 98–108, Clerkenwell Road, E.C.1.	47 & M. 1	B 5 & A 1
Heayberd, F. C., & Co. .. .. 10, Finsbury Street, E.C.2.	2	A 6
Higgs, Charlton (Radio), Ltd. .. .. .. Edward Street, Dudley Hill, Bradford.	85	C 6
High Vacuum Valve Co., Ltd. .. .. .. 111–117, Farringdon Road, E.C.1.	103	C 6
Hobday Bros., Ltd. .. .. 21–27, Great Eastern Street, E.C.2.	T. 12	B 3
Hunt, A. H., Ltd. .. .. Bendon Valley, Garratt Lane, Wandsworth, S.W.18.	12	A 4
Invicta Radio, Ltd. .. .. St. Andrew's Road, Cambridge.	17	A 3
Kolster-Brandes, Ltd. .. .. Cray Works, Sidcup, Kent.	41	B 5
Linkafone, Ltd. .. .. 118, Hill Road, Pinner, Middlesex.	84	C 6
Lugton & Co., Ltd. .. .. 203, Old Street, E.C.1.	T. 7	A 2
McMichael Radio, Ltd. .. .. Wexham Road, Slough, Bucks.	24	A 6
Manufacturers' Accessories Co. (1928), Ltd. .. 85, Great Eastern Street, E.C.2.	T. 10	B 2
Marconi-Ekco Instruments, Ltd. .. .. Electra House, Victoria Embankment, W.C.2.	33	A 2
Marconiphone Co., Ltd. .. .. 210-212, Tottenham Court Road, W. 1.	54 & 65	B 2 & C 5
Masteradio, Ltd. .. .. 1, Newton Street, High Holborn, W.C.2.	86	C 6
Morris & Co. (Radio), Ltd. .. .. .. 167, Lower Clapton Road, E.5.	74	D 6
Mullard Wireless Service Co., Ltd. .. .. 225, Tottenham Court Road, W.1.	29, 30 & 99	A 4 & C 6
Murphy Radio, Ltd. .. .. Broadwater Rd., Welwyn Garden City, Herts.	27	A 5
National Band Gramophone Co. .. .. 22-23, Clerkenwell Close, E.C.1.	T. 2	A 3
New London Electron Works, Ltd. .. .. East Ham, E.6.	34	B 2
Philips Lamps, Ltd. .. .. 145, Charing Cross Road, W.C.2.	51	B 3
Pilot Radio, Ltd. .. .. 87, Park Royal Road, N.W.10.	37	B 4
Plessey Co., Ltd. .. .. Vicarage Lane, Ilford, Essex.	71	D 5
Pye, Ltd. .. .. Radio Works, Cambridge.	31	A 3
Radio-Aid, Ltd. .. .. 45, Duke Street, W.1.	94	D 6
Radio Gramophone Development Co., Ltd. .. Globe Works, Newtown Row, Birmingham, 6.	36	B 3
Radio Society of Great Britain .. .. .. 53, Victoria Street, S.W.1.	10	A 4
Regentone Products, Ltd. .. .. .. Worton Road, Isleworth, Middlesex.	45	B 6

Name.	Stand.	Reference.
Rose, Norman (Electrical), Ltd... .. .. 43, Lamb's Conduit Street, W.C.1.	87	C 6
Rothermel, R. A., Ltd. .. .. Rothermel House, Canterbury Road, N.W.6.	80	C 6
Scophony, Ltd. .. .. Thornwood Lodge, Campden Hill, W.8.	22	A 5
Scott Insulated Wire Co., Ltd. .. .. .. Queensland Works, Westmoreland Rd., N.W.9.	8	A 5
Selecta Gramophones, Ltd. .. .. .. 81, Southwark Street, S.E.1.	T. 11	B 2
Siemens Electric Lamps & Supplies, Ltd. .. 38–39, Upper Thames Street, E.C.4.	16	A 3
Steatite & Porcelain Products, Ltd. .. .. Stourport-on-Severn, Worcs.	76	C 5
Sterling Batteries, Ltd. .. .. Sterling Works, Dagenham, Essex.	59	B 4
Stratton & Co., Ltd. .. .. Eddystone Wks., Bromsgrove St., Birmingham.	77	C 6
Tannoy Products .. .. Canterbury Grove, West Norwood, S.E.27.	70	D 5
Telegraph Condenser Co., Ltd. .. .. .. Wales Farm Road, North Acton, W.3.	81	C 6
Telegraph Construction & Maintenance Co., Ltd. Telcon Works, Greenwich, S.E.10.	78	C 5
Thompson, Diamond & Butcher .. .. 34, Farringdon Road, E.C.1.	T. 1 & T. 2	A 3
Tucker, George, Eyelet Co., Ltd. .. .. Cuckoo Road, Birmingham, 7.	58	B 4
Ultra Electric, Ltd. .. .. Western Avenue, Acton, W.3.	50	B 4
Vacuum Science Products, Ltd. .. .. 166, Weir Road, Balham, S.W.12.	105	C 6
Vidor, Ltd... .. .. West Street, Erith, Kent.	46	B 6
Westinghouse Brake & Signal Co., Ltd. .. .. 82, York Road, King's Cross, N.1.	35	B 3
Weston Electrical Instrument Co., Ltd. .. Cambridge Road, Enfield, Middlesex.	83	C 6
Whiteley Electrical Radio Co., Ltd. .. .. Victoria Street, Mansfield, Notts.	26	A 5
Wingrove & Rogers, Ltd. .. .. .. Arundel Chambers, 188–189, Strand, W.C.2.	106	C 6

Guide to the Stands



Any Stand in the Exhibition can instantly be located by using this squared plan in conjunction with the references shown in black type in the accompanying list of exhibitors.

A SELECTION OF CONSTRUCTIONAL RECEIVERS RECENTLY DESCRIBED IN THE PAGES OF THIS JOURNAL WILL BE ON VIEW AT "THE WIRELESS WORLD" STAND [No. 6].

Olympia Show Report

IN the following pages we give a classified description of the newer productions of the British broadcast industry as shown at Olympia. Readers will find that, so far as "sound" receivers are concerned, developments are largely directed towards greater ease of control, and also that those technical features that were introduced in more or less experimental form a few years ago have been improved, generally in the direction of greater simplicity and consequently improved reliability. In the field of television, one of the highlights of the show is the introduction of small-screen televisors. Components and accessories are dealt with under appropriate headings in this Report, where the latest productions of these branches of the industry are described.

NEW PRODUCTIONS IN ALL BRANCHES OF THE INDUSTRY

The New Receivers

FOR the convenience of readers, the new receivers chosen for inclusion in this report have been classified into price categories. It should be realised that in many cases where table models are described there are also consoles and radio-gramophones with a similar chassis, sometimes modified by the fitting of an output stage of higher power and a larger speaker. Occasionally the number of valves as given will not agree with that of the manufacturers' specification, as we do not include power rectifiers, tuning indicators, etc., in the total. Universal AC/DC versions of many of the AC mains sets are available.

Mains-driven Sets

UNDER 8 GUINEAS

One of the lowest-priced sets in the Show is the Belmont Midget, Model 550, a universal AC/DC straight set at £4 4s. Another midget by the same firm costs £6 19s. 6d.

The Beethoven Baby Push-button Superhet at 7½ gns. is an example of the modern tendency to dispense entirely with the tuning dial, push-button control being used entirely for the selection of the six stations for which adjustments are provided. This is a self-contained AC mains set operating on a frame aerial and the circuit comprises seven stages with three valves plus a power rectifier.

Another example of the "all push-button" receiver is the Invicta Model 520, which has no tuning knob. A choice of two long-wave and four medium-wave stations is provided by manipulation of the buttons, the other controls being for tone and volume-on/off. The set costs £7 19s. 6d.

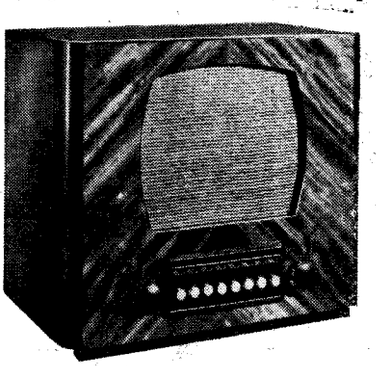
Cossor straight TRF receivers for AC and AC/DC are sold at 6 gns., and the same firm has produced an all-wave superheterodyne model with triode output at the extremely low price of 7 gns.

A straightforward but sound specification without "frills" is the basis of the G.E.C. AC5, a two-band AC superheterodyne, fitted with international-type valves, which costs only £7 19s. 6d.

8-12 GUINEAS

Mechanical push-button tuning with easy access to the adjustments from outside the cabinet is employed in the Alba "Prestotune" superhet, a three-band set which costs 10 gns. for AC and 11 gns. for AC/DC; it is also available as a radio-gramophone. A basically similar system of tuning is employed in the Burndept Model 299, which gives continuous wavelength coverage from 13.5 to 2,000 metres (except 580-750) in four steps.

Choice of fully automatic or combined automatic-manual control is given in two new Bush models. The push-button set, which is a compact four-valve superhet operating with a frame aerial, employs

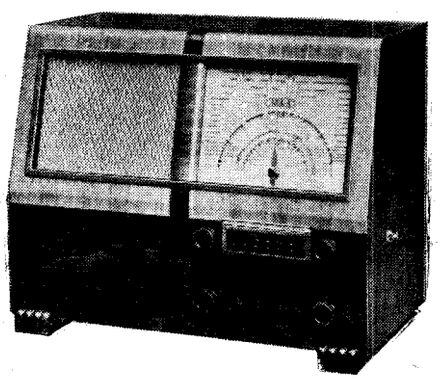


Push-button tuning only: Bush Model PB50.

variable permeability for pretuning the required stations. Wave-changing is automatic and the range of frequencies covered by each button circuit, though naturally limited, is amply wide. This set costs 9½ gns.; the companion model, with a similar system of pre-set tuning and the addition of manual tuning, costs 10½ gns.

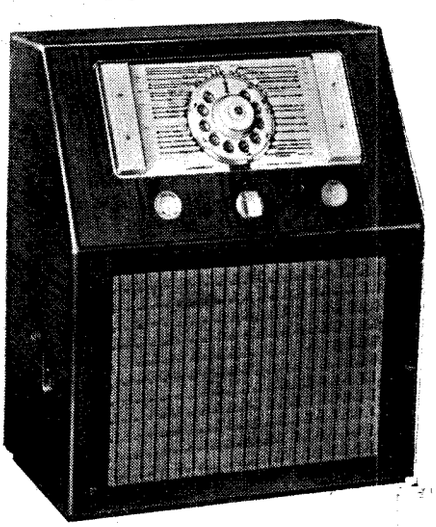
A system of automatic tuning that is similar, at any rate externally, to the dialling mechanism of the familiar automatic telephone is employed in one of the new Cossor sets which was recently reviewed in these pages. Permeability variation is the principle on which the automatic tuning system of the lower-priced Ekco press-button sets work. These superheterodynes, which cover three bands, cost 10½ gns. for AC and 11 gns. for AC/DC.

Higgs Radio are showing a four-valve, two-band superheterodyne for AC at £9, and an all-wave model with a pre-set tuning system, compensated against frequency drift, at £11 19s.



Alba Presto-tune Model 90.

Automatic waveband selection is combined with press-button tuning in the new Ferguson sets. Model 771 gives a choice of two long-wave and five medium-wave pre-set stations, and is a three-band AC superheterodyne providing an output of 4½ watts from a beam power valve; the price is 11½ gns.

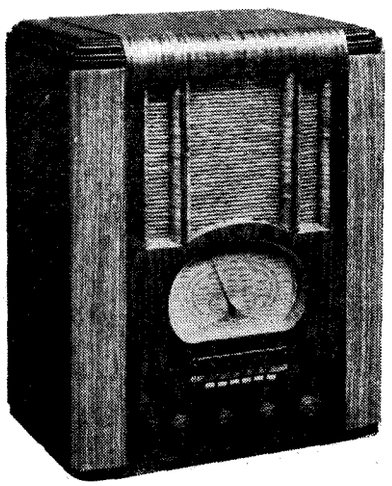


Cossor Model 397 with "Teledial" station selector.

In the "46" group, which comprises the lower priced Murphy mains sets, the table model costs £9 10s. for AC and £9 15s. for AC/DC. This is the three-band superheterodyne; console and radio-gramophone models are also produced in this series.

Olympia Show Report—

Mechanical operation of the push-button tuning system through a cam is employed in the Pilot Model BT530, a three-band superhet on which the station



Pilot Model BT530.

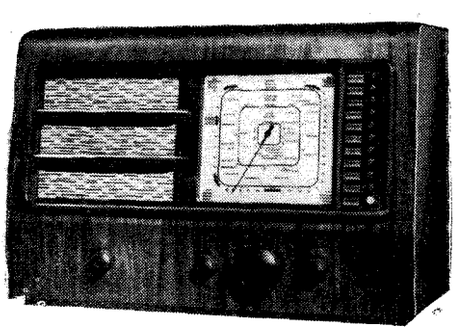
selection adjustments can easily be made from the front of the cabinet. The price is 12 gns., an extra half-guinea being charged for the AC/DC version. "Piano tuning" included in other Pilot models operates by pressure of a key.

In the Pye Model 830 push-button tuning only is employed, without any manual control. This set gives a choice of seven stations and has a four-position speech-music tone control. The price is 9 gns.

A purely mechanical tuning system of the telephone dial type, which allows the selection of adjacent-channel stations if desired, is employed in the Belmont Model 570 at 10½ gns. Three wavebands are covered and in the interests of stability all fixed condensers in the RF unit are of the silvered mica type. An alternative system of automatic tuning effected by means of permeability variation is employed in another Belmont model at 11½ gns.

OVER 12 GUINEAS TO 16 GUINEAS

An output of 8 watts, fed to twin tone-compensated loud speakers, is provided in the new three-band Beethoven model, which costs 15½ gns. This is a table model; the Cossor Type 538, also a three-band superhet, is a radio-gramophone, fitted with 10in. speaker, induction motor, turntable and pick-up. Complete in a big upright cabinet, this model costs 16 gns.

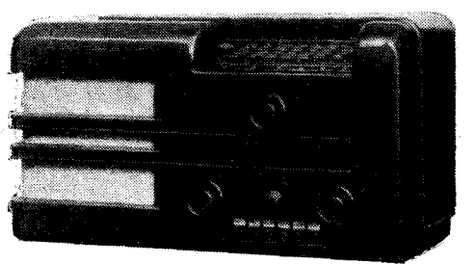


Ekco motor-tuned 8-stage superhet.

The system of motor tuning employed in the Ekco 12½-guinea model is similar to that found in the more expensive Ekco sets, but it does not provide automatic waveband selection or "motor cruising." Refinements include AFC as an adjunct to the operation of the tuning system, negative feedback over two stages, three-band wavelength coverage, and the generous number, for its type, of eight tuned circuits.

A useful feature of the G.E.C. "Touch-tune" press-button tuning system is that a button cannot be fully depressed unless the wave-change switch is in the appropriate position for the corresponding station required. This system is employed in a three-band superhet at 12½ gns.

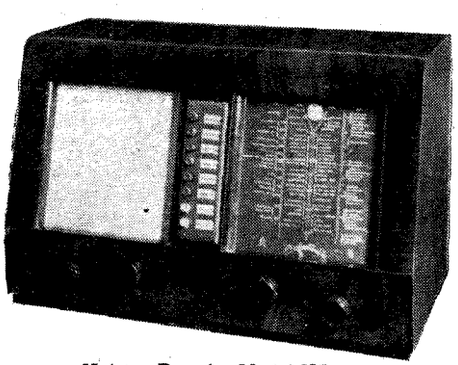
In the lower-priced H.M.V. press-button sets a system of pre-tuned circuits is employed; Model 658, a 3-band superhet at 13½ gns., offers the choice of six stations and includes automatic wave-changing—a valuable feature for the unskilled (or thoughtless) user.



Ferranti "Prestune" receiver.

The "Prestune" system included in the Ferranti Model 514 PB at 14½ gns. gives a choice of six stations. This is a three-band set with the relatively high output of 4 watts, which is also available without press-button tuning at 13 gns.

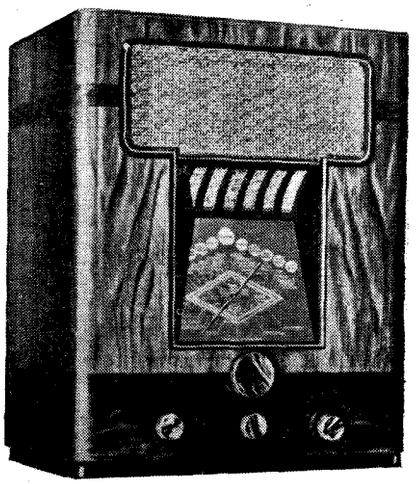
Automatic waverange changing is one of the features of the Kolster-Brandes



Kolster-Brandes Model KB740.

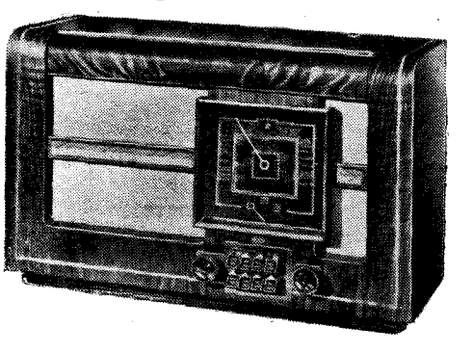
KB740, a three-band superhet with four valves, plus a rectifier. A choice of six medium-wave and two long-wave stations are given by the automatic tuning system. Another Kolster-Brandes model in this price category is the seven-valve KB750, without automatic tuning, but with four wavebands (starting at the unusually low wavelength of 11.5 metres) 8 watts output and a signal-frequency RF stage.

Selection of stations by means of a switch (as opposed to the more conventional push buttons) is employed in the Invicta Model 500; three medium-wave and two long-wave stations can be selected by this means; four wavebands are covered and the set costs £13 19s. 6d.



Invicta Model 500.

One of the most ingenious of mechanical push-button systems is that employed in the Mullard MAS24. The buttons actuate a sliding sleeve-action ganged condenser, of which each unit comprises a pair of meshing brass-strip spirals. The eight stations provided by the automatic system can be easily pre-tuned from the front of the cabinet. Negative feedback is another feature of this set, which for AC costs 13½ gns., or 14½ gns. with a built-in converter for DC.



Mullard push-button superhet. Type MAS24.

Choice of six stations is given by the pre-set push-button tuning system of the Marconiphone Model 855, which is a three-band superheterodyne costing 13½ gns. Motor-tuning models are also shown at rather higher prices.

Philips push-button system: removable cover on button gives access to pre-set tuning adjustment.

Olympia Show Report—

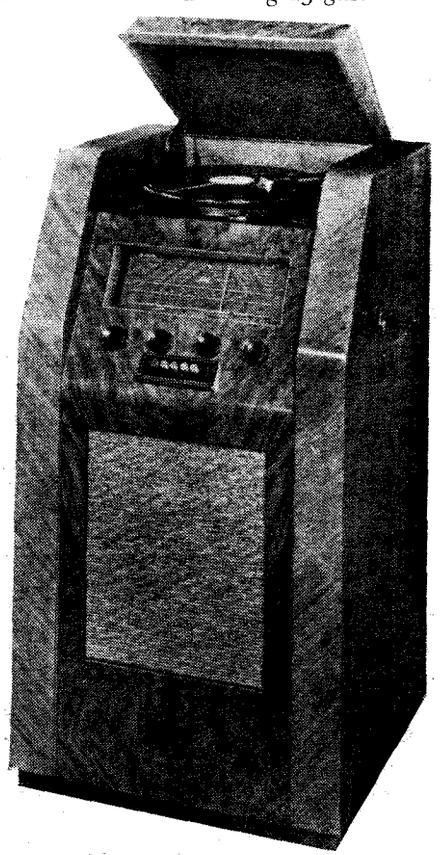
In the majority of mechanical push-button systems it is necessary to translate the to-and-fro movement of the button into a rotary movement of the condenser spindle. No such link mechanism is called for in the Philips direct-action system, which is designed around a radically new non-rotary condenser. The mechanism, whereby the amount of interleaving of the condenser electrodes is made to correspond with the capacity setting needed for the desired station, is simple but highly ingenious. This feature is included in a three-band superhet with 4 watts output (negative feedback), costing 13½ gns.

A large console model sold at a low price is the Ultra 205, a 7-stage 3-band superhet with push-button tuning and a rated output of 8 watts, which is priced at 13½ gns. A DC model costs 1 gn. extra, while a radio-gramophone on similar lines is priced at 20 gns. Provision for easy adjustment by the user of the pre-set tuning system is a feature of Ultra sets.

In the Vidor nine-valve four band superheterodyne at 13 gns. the exceptionally high output of 18 watts is provided by a pair of beam power valves.

OVER 16 GNS. TO £30

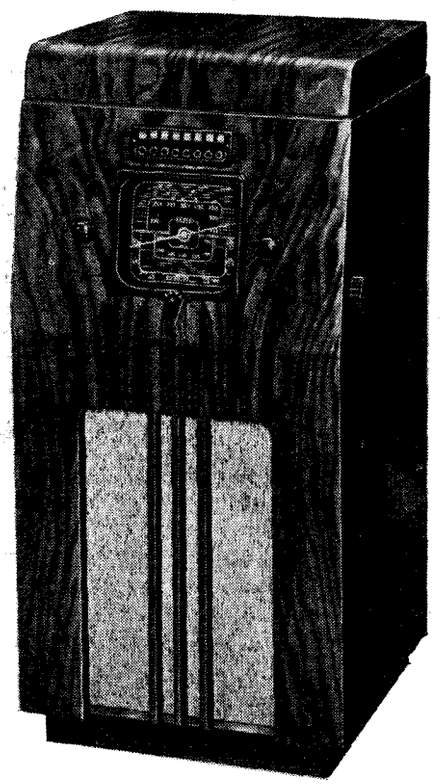
An 8-valve straight TRF circuit is used in the Dynatron "Ether Duke" model, a 2-band set with variable selectivity available in various forms as a radio-gramophone, a radio console and a table model, the last-mentioned costing 23 gns.



G.E.C. "Touchtune 5" radio-gramophone.

The most elaborate of the Ekco table models is the motor-tuned PB199, which covers three wavebands. The press-button tuning system provides automatic waveband switching, and is assisted by automatic frequency control. The set, which costs 18½ gns., has a signal-frequency stage; negative feedback is included, and an output of 6 watts is obtainable from a beam power valve.

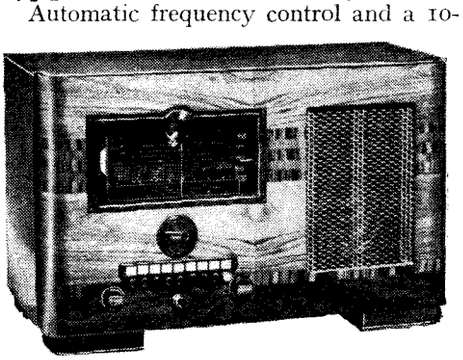
An alternative to push-button station selection is to be found in the 6-way switch which makes the appropriate circuit alterations for the desired stations in the G.E.C. "Selectalite 6." The circuit is a 5-valve superheterodyne arrangement with an RF stage and a beam power valve giving 6 watts output. Four medium-wave and one long-wave stations can be tuned in on the switch; the sixth position gives manual operation. The price of this receiver is 16½ gns.



Ultra push-button radiogram, Model 206.

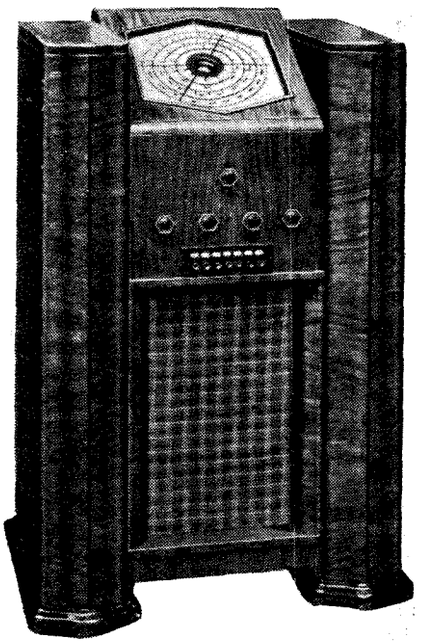
A waverange of from 13-2,000 metres is covered by the new H.M.V. Model 657, which includes a motor tuning system giving eight stations; another button actuates the change-over from manual to automatic operation. Frequency stability is assured by the use of air-dielectric trimmers in the oscillator circuit. This set costs 17½ gns.

Automatic frequency control and a 10-station motor-tuning system are included in the Ferguson 773 AC Console at 20 gns. This is a 5-band 12-valve receiver covering three short-wave bands, including television sound. Beam power valves in push-pull are used in the output stage.



Marconiphone motor-tuned superhet, Model 853.

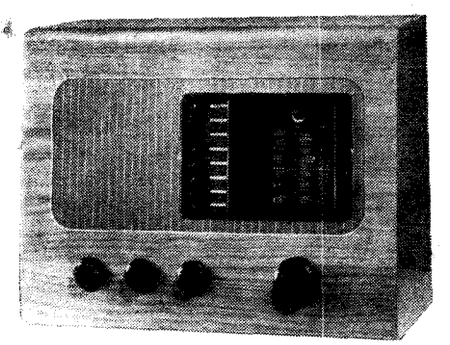
The Higgs Radio Console model, a four-valve AC set covering wavelengths from



Higgs Radio Console receiver.

13 metres upwards, has a signal-frequency stage, push-pull output, and a pre-set drift-compensated push-button system; it costs £26.

Model 52, the first Murphy push-button set, has many unusual features, and may be considered in many ways as a successor to the A36, as it has a similar band-spreading and double frequency-changing arrangement on short waves. As compared with the earlier receiver, gain is stated to be improved, as is signal/noise ratio and image suppression. There is no



Murphy Model 52, with short-wave band-spreading and push-button selection.

risk that an unskilled user will forget the wave-change switch, as the buttons appropriate to any setting of the latter are the only ones to become visible. Any of the official short-wave bands can also be selected by buttons; output is 5 watts, and the price is £18 10s.

A choice of eleven stations is given by the motor-operated push-button system fitted in the McMichael Model 382, an 11-stage AC superhet at 18½ gns., which in-

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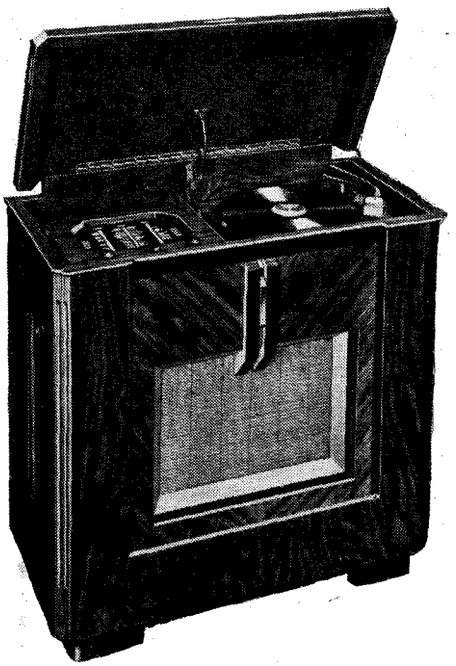
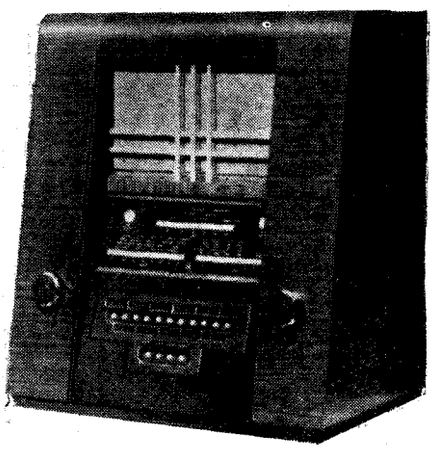


McMichael 20-guinea radiogram.

cludes such features as AFC, 4-position tone control, 5-watt output, and an 11-stage circuit. There is also a new low-priced AC radio-gramophone at 20 gns.; this is an 8-stage, 3-band set giving 5 watts output and fitted with a 4-position tone-control switch and a tone-compensated volume control.



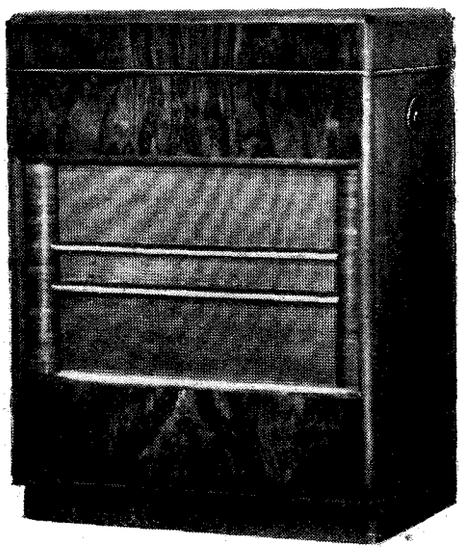
Pye Model 806.

Automatic switching of the mains supply is a feature of the push-button tuning system in the Pye Model 806. The action of pressing the appropriate button switches on the set and tunes in the desired station. This 3-band AC set costs 16½ gns.

OVER £30

Provision for the automatic changing of no fewer than 33 records, 10in. or 12in., or both mixed, and for playing on one side or on both sides, is provided in the fully automatic Autotrope radio-gramophone. On the radio side there is an elaborate superheterodyne chassis with signal-frequency RF amplification, 2-stage IF amplifier and push-pull output. Wavelengths from 12.25 metres upwards are covered in five stages.

The most ambitious of the Dynatron sets is the "Ether Empress" radio-gramophone, of which the circuit is switched from "straight" for local-station reception to superheterodyne for long-distance work. This 18-valve chassis has independent bass and treble tone control, variable selectivity, tunable whistle filter (controlled from front panel), multiple loud speakers and an automatic record changer. This model, with a rated output of 15 watts, costs 115 gns.; with Voigt loud speaker as a separate unit the price is 155 gns. A rather less ambitious Dynatron set, which, however, contains many of the features of the "Empress," is the 65-guinea "Prince" radio-gramophone.



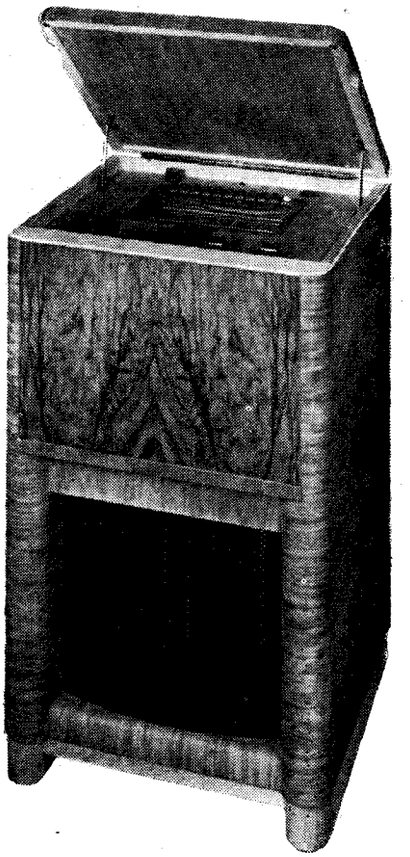
Dynatron "Ether Empress" radio-gramophone.

An automatic record changer is included in the Burndept all-wave radio-gramophone, which covers a waverange of 13.5-2,000 metres in four bands. The set is fitted with a 12in. speaker.

Three valves are employed in the automatic frequency control device of the H.M.V. Model 659 Console, a highly developed 10-valve set at 31 gns. One of these AFC valves acts as a discriminator amplifier, another as a rectifier, and the third as the frequency-control proper. The motor-operated auto-tuning system gives a choice of ten stations, and the waverange covered is from 13.5 to 2,000 metres. Variable selectivity and an output of 8 watts are among the features of the set. Similar arrangements are found in the auto-radiogram Model 664 at 54 gns.

The Marconiphone Model 866 high-fidelity automatic radio-gramophone has a combined variable selectivity and brilliance control, with ASC as part of the automatic tuning system, which is motor-operated. Four wavebands are covered.

Though primarily designed for quality reproduction, the Murphy "40" series includes provision for short-wave reception with electrical band spreading. Variable selectivity allows the useful audio range to be carried up to 8,500 c/s and the output is rated at 12 watts. The console model in which these features are included costs £35, and a somewhat similar set in the form of an automatic radio-gramophone costs £85.



HMV 10-valve console.

This year Model 1295 is the most ambitious of the many highly developed sets shown by R.G.D. This model is an auto-changing radio-gramophone with a resistance-coupled push-pull amplifier giving an output of 12 watts. Four wavebands are covered, and among the refinements to be found are contrast expansion, an acoustic labyrinth for improving bass reproduction and motor-driven push-button tuning in conjunction with AFC. The 14-button system controls both station and waveband selection and the feature has been

R.G.D. 75-guinea radio-gramophone.

carried to its logical conclusion by making provision for remote control. The price of this model is 95 gns.; the automatic and remote tuning features are included in other sets at lower prices.

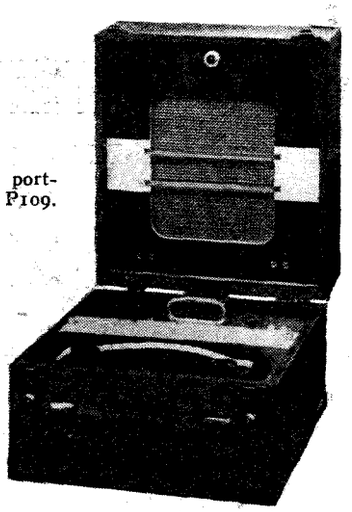
BATTERY RECEIVERS, PORTABLE AND FIXED

Iron-cored coils are used throughout in the Alba 4-valve 4-band superheterodyne, which has a pentode output valve. The price is 8½ gns., without batteries.

One of the comparatively few superheterodyne portables is the new model Burndept at 8 gns. complete. It employs a more or less standard circuit arrangement with an octode frequency changer and a pentode output valve. Weight is 20 lb., and the controls are conveniently disposed on the top of the cabinet, where they are protected by a lift-up flap. There is also a 4-band open aerial superheterodyne at the low price of £8 5s. complete, which covers wavelengths between 13.5 and 2,000 metres.

Permeability pre-set tuning is employed for the automatic tuning system of the 3-band Ekco battery superheterodyne. Although the frequency range covered by permeability tuning on any one circuit is necessarily somewhat limited, matters are so arranged that the choice of pre-tuned stations is virtually unrestricted, there being ample overlap. Wave-changing is automatic, so far as press-button tuning is concerned.

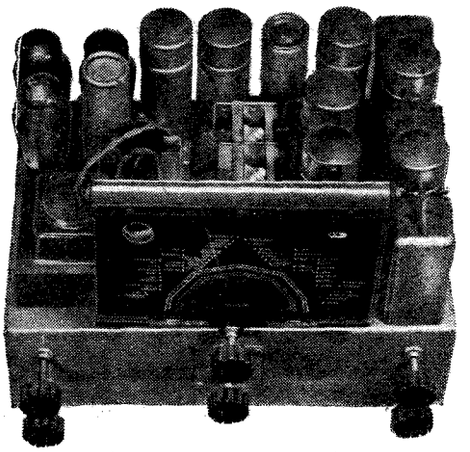
"Touchtune" tuning, as described in the section of this report devoted to mains sets, is employed in the G.E.C. battery superheterodyne at 13 gns. This is a 5-valve 3-waveband set with two Osram KT2 valves in push-pull in the output stage.



Beethoven portable Model P109.

An economy switch is a useful feature of the new H.M.V. "Economy 4," an 11-guinea superhet in which the operation of the switch reduces the normal HT consumption of about 8 mA. to 4.5 mA. for low-volume listening. The modern tendency to use automatic bias in battery sets is exemplified in this receiver, as it is in the Kolster-Brandes KB720, a 4-valve superhet with 7 tuned circuits and pentode output.

The latest McMichael frame aerial portable, the "Bijou" model, employs an RF-Det.-2 AF circuit and embodies an unusual tuning system, in which the usual knob is replaced by a knurled cylinder carried on a transverse spindle. The cylinder is rotated with the finger tip, the drive being transmitted to the variable condenser through appropriate gearing. This set, which is of compact dimensions, weighs 22 lb. and costs 8 gns. Turning to open-aerial sets there is the McMichael Model 388, an all-wave superhet with push-button tuning selling at 14½ gns. A 4-position tone control giving the appropriate frequency characteristics for various conditions of reception is included. The switch positions are marked "normal," "high-fidelity," "foreign," and "bass." In the last-mentioned position the lower register is accentuated.



Armstrong all-wave chassis with 10-watt push-pull output stage.

A speech output of 400 mW. for an HT consumption of 8 mA. is given by the new Marconiphone battery superheterodyne, which covers three wavebands and embodies a change-over switch whereby HT consumption may be approximately halved when full volume is not required.

A cylindrical alphabetical tuning scale, certainly one of the most practical aids to station finding, is included in the Murphy Model 47 battery superhet, which has QPP output and costs, without batteries, £11 10s. A 4-band model including the waverange 70-200 metres (yachts, long amateur band, etc.) costs £11 15s.

Reflexing of the IF stage is employed in the Mullard MBS6 battery superheterodyne at 8 gns., without batteries. The IF valve also serves as an AF amplifier.

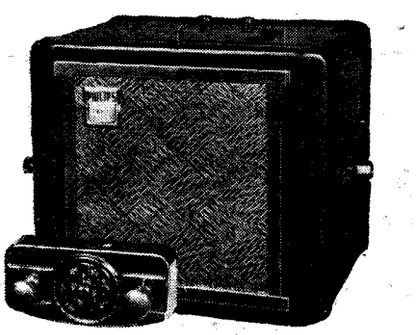
A successor to the well-known "Baby Q" is to be found in the new Pye portable at 8 gns., complete with batteries and waterproof carrying case. This set is of the modern lightweight type weighing 17½ lb., and employs a straight circuit with QPP output. The control panel is safeguarded from harm by a locking cover working on the roll-top desk principle.

Vidor Portable No. 2 is a low-priced straight set of the compact suitcase type, selling at £5 19s. 6d., complete with batteries. The circuit is a straight RF-Det-AF arrangement of 3 valves. A superheterodyne model costs 8 gns.

SPECIAL-PURPOSE RECEIVERS

Armstrong chassis suitable for building into the purchaser's own cabinet, etc., are available in various forms. The smallest is a 7-stage all-wave chassis with iron-cored coils and push-button tuning. This set costs £7 19s. 6d., with valves and speaker. The largest Armstrong chassis is a 10-valve model, covering 5 wavebands with 2 IF amplifiers, variable selectivity and RCC push-pull output; the price is 17 gns., with valves.

Ferranti car radio is designed for easy installation in the typical British car; it employs a 6-valve circuit and gives an output of 2½ watts; consumption from the car battery is about 36 watts; both 6- and 12-volt models are available. A Ferranti roof aerial has been introduced.



Philips Motoradio (built-in speaker model) showing control head.

Philips "Motoradio" sets have recently been improved by the provision of larger pick-up and the reduction of background noise. Consumption of battery current has also been reduced. Models with self-contained or separate speakers are available.

Television Receivers

ON the introduction of television, most receivers included a 12in. cathode-ray tube giving a picture of some 10in. by 8in. Last year also such receivers were in the majority, but there was evidence of a trend towards smaller pictures, since quite a number of sets included 9in. tubes. There were also, it is true, a few examples of projection apparatus giving pictures of some 20in. by 16in., but the general tendency was clearly shown to lie in the direction of smaller pictures.

This year sees an acceleration of the progress in this direction. Nearly all the new sets have tubes smaller than 9in. In general, firms have retained their existing models with 9in. or 12in. tubes unaltered, but have introduced new models to extend their range, and these new models have 7in., 6in., or 5in. tubes.

To those who criticise the "standard" 10in. by 8in. picture as being too small, this will seem a retrograde step, but it is done to reduce the price of the apparatus.

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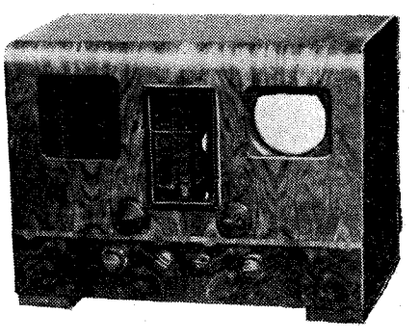
A reduction in picture size means quite a big saving in cost; the tube is cheaper and is smaller physically so that it can be accommodated in a smaller cabinet, again saving cost. With a small picture equivalent brightness can be obtained at a lower voltage, and not only is this advantageous in itself, but also indirectly through reducing the deflecting power needed from the time-bases. Furthermore, if advantage is taken of the smaller tube size to reduce the deflecting angle, the time-base power can be still further reduced.

The saving effected by all these points has enabled the price of television equipment with a 5-in. tube to be brought down to about one-half of that with a 12-in.



The Marconiphone Model 706 television and all-wave sound receiver. A 5-in. tube is used.

A good example of one of these small sets is the Marconiphone Model 706, which is essentially the same as the H.M.V. Model 904; both sets are priced at 29 gns., and have a 5-in. tube giving a picture of 4¾in. by 4in. The picture is black and white. In addition to television, sound reception on short, medium and long wavebands is provided.

The receiver is a superheterodyne with one RF stage, triode-hexode frequency-changer, and one IF stage. For general sound reception this IF valve feeds a duo-diode-triode detector, AVC, and AF valve, which in its turn is followed by an output tetrode.

For television the first three valves are still used, but the coils, including the IF couplings, are changed by switching, and the output of the IF valve is taken to a separate IF amplifier used only for television. A total of three IF stages is used on vision, and the first two stages, as well as the RF and FC valves, are common to sound and vision. The television sound signal is picked out after the second IF stage, and feeds the duo-diode-triode of the standard sound receiver.

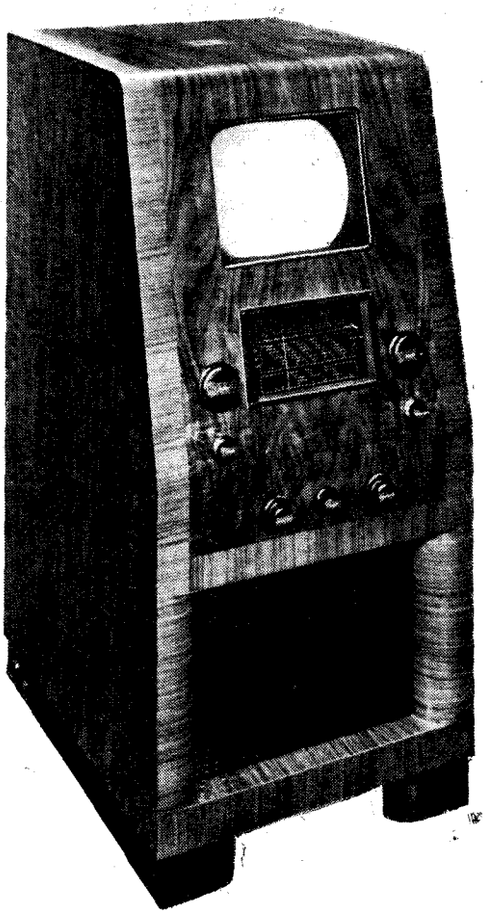
The vision output of the third IF stage is taken to an anode-bend detector which feeds the CR tube directly and also the amplitude filter for sync separation. This contains two valves, a diode and an RF pentode.

Magnetic deflection is used, and the time-bases consequently generate a saw-tooth current output. Hard valves are used throughout, the oscillators being of the squegging type. Four valves are used in the time-bases, the line and frame output stages being a tetrode and a triode respectively. There are two rectifiers, one for the general HT supply and the other for the tube. When sound reception only is required, the purely television equipment is switched off.

The television tuning is entirely preset, no controls being provided. The television controls include brilliance and contrast, frame and line hold, and focus on the panel, and rear adjustments for picture height and width.

Larger receivers marketed by these firms are very similar in general design but differ somewhat in detail. The H.M.V. Model 905 and Marconiphone Model 707 differ only in having a 7-in. tube; they are priced at 35 gns. and the picture size is 6¼in. by 5in. In the Marconiphone Model 709, however, the receiver is somewhat different. This equipment, which in common with the H.M.V. Model 907 is priced at 45 gns., has a 9-in. tube with a picture size of 7½in. by 6in.

For vision there is one RF stage, followed by a triode-hexode frequency-changer, three IF stages, detector, and one VF stage. The sound signal is picked out after the second IF stage and taken to the detector of the broadcast set. For general broadcast reception, the 1st vision IF valve is switched over to act as IF amplifier, and is preceded by a triode-hexode frequency-changer. Two

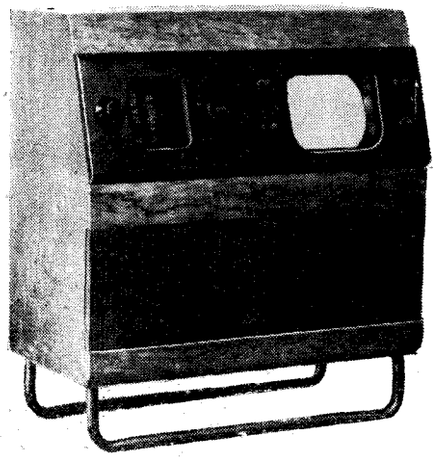


The H.M.V. Model 907 vision and all-wave sound equipment with a 9-in. tube.

valves are used for sync separation, and there are four valves in the time-bases.

The well-known 12-in. tube models are retained, and there is a projection type giving a picture of 22in. by 18in., which is priced at 200 gns.

The lowest priced of the Murphy receivers is the Model A56V at £30, and



The Murphy Model A58V television receiver. A 9-in. tube is used and there is an all-wave broadcast set.

it is unusual in that it has a 9-in. tube giving a picture 7½in. by 6in. It is, however, for television only and no broadcast set is included. One RF stage is used, and this valve, together with the frequency-changer, handles both sound and vision signals. In the sound channel there is one IF stage, a duo-diode-triode, and an output pentode, while for vision there are three IF stages, diode detector, and one VF stage. A duo-diode is used for sync separation, and in the time-bases gas-triode oscillators are used with pentode amplifiers.

The tube is magnetically focused and deflection is also arranged magnetically. There are three rectifiers for HT supply, the tube being operated at 4,500 volts. The tube is viewed directly. The model A58V at £45 consists of essentially the same vision equipment with the addition of an all-wave broadcast receiver. The model A42V, with a 12-in. electrostatic tube, is retained.

The Pye model 815 is unusual in that a straight receiver is used. For vision, band-pass couplings are used with a band-width of 3 Mc/s. Gain control is effected by varying the suppressor grid voltage of the RF valves in order to reduce the effects of the control on the tuned circuits and to maintain the total drain on the HT supply at a more constant level. A full-wave diode detector is used with direct coupling to the CR tube. The sound channel is also a straight set with two RF stages and a diode detector directly coupled to the first AF stage. This valve is arranged to have a sharp cut-off, and with the direct coupling adopted ignition interference is reduced.

Two RF pentodes—one for line, the other for frame—are used as sync separators with direct coupling from the detector. Magnetic deflection is used, and the line time-base consists of a blocking oscillator followed by an output valve transformer-coupled to the deflecting coils. A similar arrangement is used for

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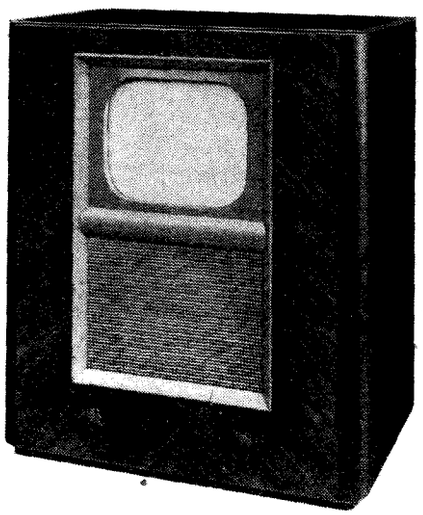
frame scanning, but using a triode-hexode. The triode functions as a blocking oscillator and the hexode as the output valve. The picture size is $7\frac{1}{8}$in. by $5\frac{3}{4}$in.

Another receiver produced by this firm



The Baird table model T20 receiver for television and its accompanying sound.

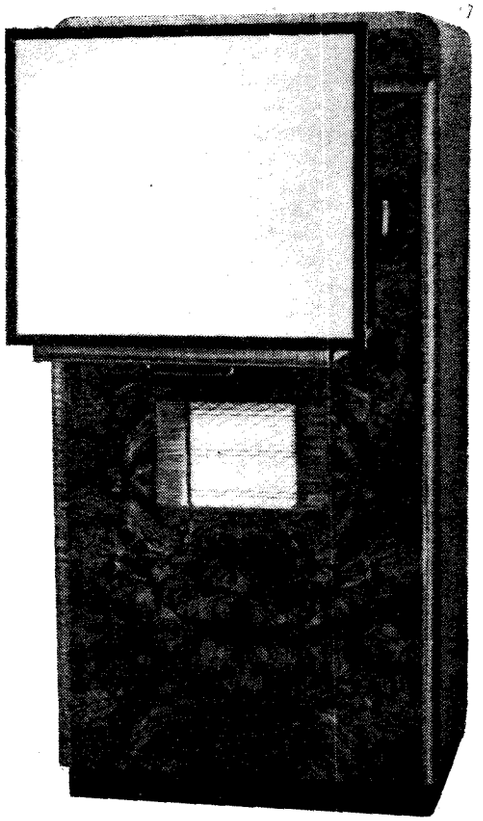
is the model 817 with a picture measuring 4in. by $3\frac{3}{8}$in. It is very similar to the model 815, but the band-width is $2\frac{1}{2}$ Mc/s, and the sound receiver consists only of RF and detector stages, its output being arranged for connection to the pick-up terminals of any broadcast set. For the line-scan a triode-tetrode is used, the tetrode functioning as an output valve, and for frame-scan a triode-hexode. Other models include these vision receivers as well as a broadcast receiver.

Baird equipment has magnetic deflection, and the smallest type is the T20 at 35 gns. for the table model. The picture size is $7\frac{3}{4}$in. by $6\frac{1}{4}$in. and it is for television only. A larger set with a 12in. tube is the T18 at 44 gns.; this includes an all-wave broadcast set. There is also a projection model, the T19, with a picture 18in. by 15in., which can be increased to 24in. by 19in. with a separate screen. This is priced at 150 gns.

Although general, the cathode-ray tube is not universal, for Scophony show mechanical receivers. The Home Receiver gives a picture 24in. by 20in. The light source is a mercury lamp, and the control is by the supersonic light relay reproducing 200 picture elements simultaneously. Scanning is carried out by special forms of mirror drum. This firm also has the "Junior Public Viewing Projector," giving a picture 6ft. by 5ft.

A similar receiver is shown by E. K. Cole, and is known as the Ekco-Scophony Home Model ES104. A mercury-lamp light source is used, consuming 300 watts, and its output is focused on to the light control cell for modulation. After this it passes to the high-speed scanner and thence to the low-speed scanner, and so to the screen. The receiver is a straight set with four RF stages; diodes are used for detection and sync separation. A total of 39 valves, including the mercury-lamp, is used, and the consumption is 1 kilowatt.

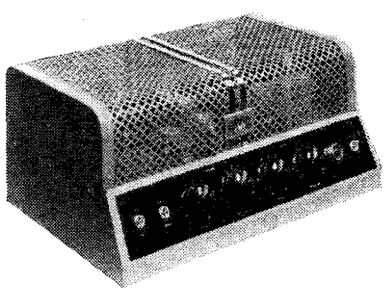
Philips have a large-screen model of the projection CR tube type. A 4in. tube is used, and the picture is projected on to a screen 18in. by $14\frac{1}{2}$in. by an f/1.9 lens. The tube is operated at 25,000 volts, and the equipment costs 120 gns.



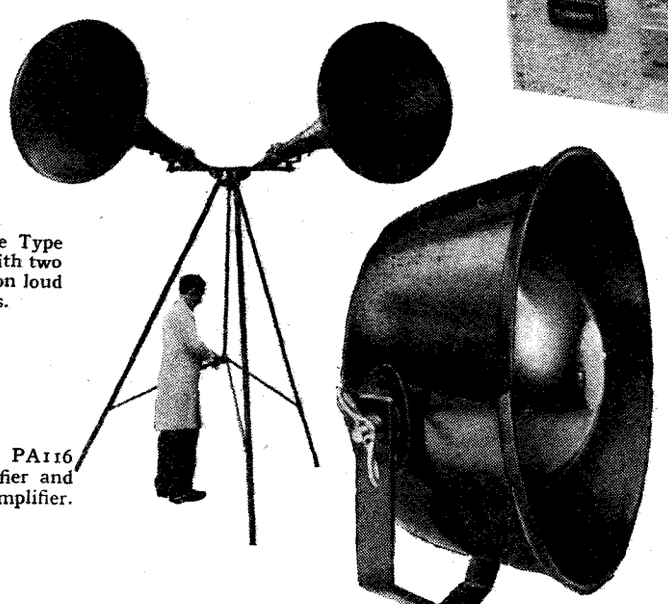
The Scophony Home Television Receiver giving a picture 24in. by 20ins.

Loud Speaker and PA Equipment

APPARATUS for sound reinforcement forms a substantial part of the exhibit of E.M.I. Service, Ltd., and ranges from complete portable band-amplifying equipment to high-powered horn loud speaker assemblies for outdoor work. A comprehensive range of microphones includes the Marconi-Reisz and a moving-coil type with a response of 60-8,000



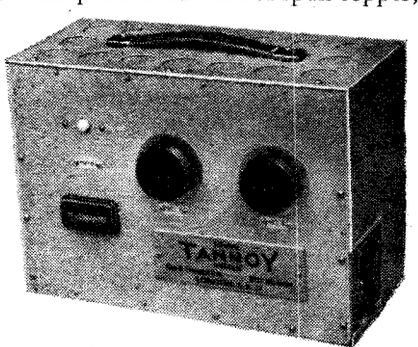
E.M.I. Service Type PS71 tripod with two PS51 projection loud speakers.



E.M.I. Service PA116 10-watt amplifier and microphone amplifier.

cycles, costing £7 9s. Several new amplifiers are shown and one of the most interesting is the PA 115, which has an output of 10 watts and costs £7 9s. A suitable microphone amplifier for use with this chassis costs £7 19s., or the two may be purchased as a combined unit with controls.

A large proportion of the equipment shown by Tannoy is new this year. Among amplifiers the Type 230 12-watt mobile unit is designed for operation from a 12-volt car battery and the metal case measures $19 \times 9\frac{1}{2} \times 9$ inches. The Types 220 and 210 for universal mains operation are housed in cases of the same robust type and deliver 20 and 10 watts respectively.



Tannoy Type 230 12-watt amplifier.

Tannoy Type 313 "Co-Ax" loud speaker.

The Tannoy "Co-ax" loud speaker is a bowl-shaped folded horn of spun copper, which is suitable for a variety of PA applications, including attachment to the front of patrol cars. It may be actuated without intermediate amplifiers by the new "Power-Microphone," which is capable of modulating directly currents of up to 4 or 5 amps.

Microphones operating on the piezo-electric principle have for many years been a speciality of R. A. Rothermel, Ltd., and this year the range has been extended by

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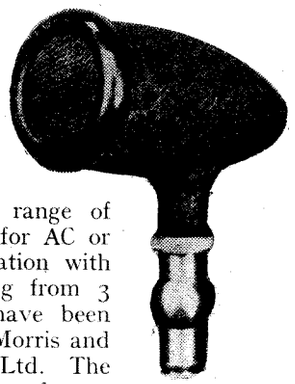
the addition of new Junior, Lapel and Bullet types.

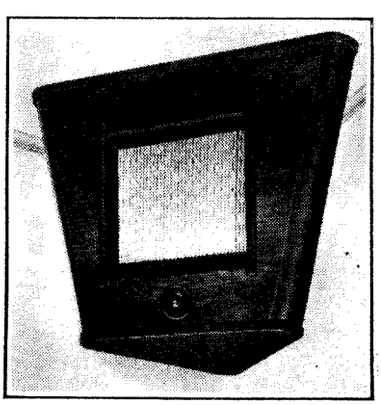


Rothermel-Brush bullet-type crystal microphone.

A complete range of PA amplifiers for AC or universal operation with outputs ranging from 3 to 60 watts have been developed by Morris and Co. (Radio), Ltd. The prices range from £2 15s. to 15 guineas and with the exception of the 3-watt models, all are fitted with universal output transformers. The gain in all cases is sufficient for operation from low-level crystal and velocity microphones. Most of the models have two- and three-channel input circuits and tone controls are also provided.

Loud speakers produced by the recently combined resources of the Celestion and Magnavox concerns are shown on the stand of Celestion, Ltd., and certain models will be distributed to the wholesale and retail trades by Cyril French. These will include the "Sixty-Six" and "Duode 33," and the range of chassis and cabinet models, which includes the Junior and Standard 8, Junior and Standard Auditorium PM chassis. A new design, the "55," with a large field magnet and 12-inch curvilinear cone is shown for the first time. A high flux is maintained in a much larger gap than usual, and particular attention has been given to the maintenance of a uniform bass response.

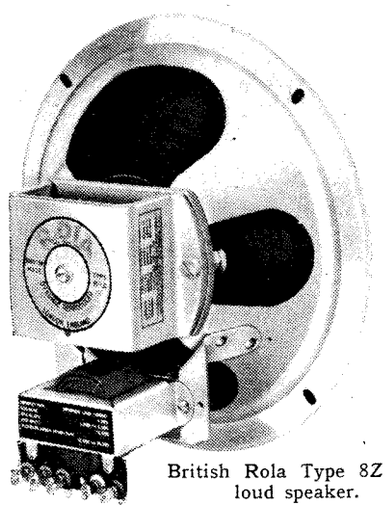
The Stentorian range of loud speaker chassis, shown by the Whiteley Electrical Radio Co., Ltd., is continued with minor modifications. In the new range of cabinet extension loud speakers incorporating these chassis some very interesting designs are to be found. In one case the unit is concealed in the upright supporting member of an occasional table, and in another the loud speaker is



W.B. Stentorian pendant loud speaker.

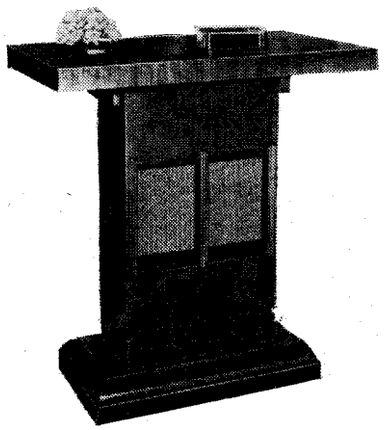
mounted below the table surface in a satin-finished walnut coffee table. When fitted with the "Long Arm" remote control, these novel extension loud speakers cost 4 gns. and 5 gns., respectively. In the W.B. pendant model, at 49s. 6d., the chassis is mounted in a triangular cabinet which may be suspended from the picture rails at the corner of the room. Extension loud speakers in well-proportioned cabinets of the more conventional type are shown with switching arrangements indicating the correct setting for every well-known make of receiving set.

No fewer than eighteen different designs are included in the programme of the British Rola Co., Ltd., and the majority are made completely dustproof by a form of construction which entirely excludes foreign matter from the air gap. Energised and PM models of each type are shown and the magnet systems of the types 8Z and 10Z are of interest for the fact that the active material is concentrated in the centre pole. The well-known G12 and F742 units are continued, and the "Roma" and "Rex" cabinet extension speakers incorporating the 8Z unit are provided with universal matching connections.



British Rola Type 8Z PM loud speaker.

The B.T.H.-R.K. Senior loud speakers (Ediswan), which are available in permanent magnet or energised form, are fitted with curved-sided cones designed to produce sub-harmonics, and a specially designed coil former which does not change its shape under the influence of heat or humidity.



W.B. extension loud speaker incorporated in an occasional table.

On the Goodman's stand, apart from the 10-inch and 12-inch speakers with dual exponential cones, the interest is chiefly in PA reproducers. The "Duplex Horn" and "Concentric Diffuser" types are shown and a new 12-inch permanent magnet model capable of handling 20 watts.

Under the heading of public address equipment may be included the intercommunication systems for use in large factories and departmental offices. In the Ediswan "Loud-speakerphone" a master unit costing £9 14s. 6d. is capable of working from one to six extension units, the price of which is £1 19s. 6d. each. The master unit is AC mains operated and consumes about 40 watts.

In the Model PA, produced by Linkafone, Ltd., flexibility has been given first consideration and the unit can be used for radio diffusion as well as for "paging" in hotels. It costs £55, and the price of the extension units is 3 guineas each, but installations can be hired for 7s. 3d. per week and 5d. per extension unit. Less comprehensive models are also available at prices down to 14 guineas.

Test and Service Apparatus

THE apparatus that is shown at Olympia and which is broadly classified as test equipment can actually be divided into two main classes. In the one we have testing sets developed primarily for the use of service engineers, while in the other can be included the precision type of equipment which, for want of a better description, can be termed laboratory apparatus.

The former does not require to have such a high standard of accuracy as the latter, its main features being portability, reliability and ease of operation, as well as reasonable cost. The latter is essentially high-grade precision measuring apparatus and, consequently, the price is inclined to be somewhat high.

Means for carrying out a rapid but comprehensive test on every valve in general use is of vital importance to the service man and, in a lesser degree, to the radio dealer also. Apparatus of this kind is well represented in the Show. A fine example of compactness coupled with versatility is the Avo valve tester, for which a new universal-type valve panel has just been introduced. Hitherto there were two valveholder panels which would probably have to be further augmented as new valves made their appearance.

The new panel replaces the older ones, and it only requires to be fitted with one of each type of valveholder, as the connections to the sockets can be rearranged to suit any valve for which a holder is fitted on the panel by means of an ingenious system of selector switches. This

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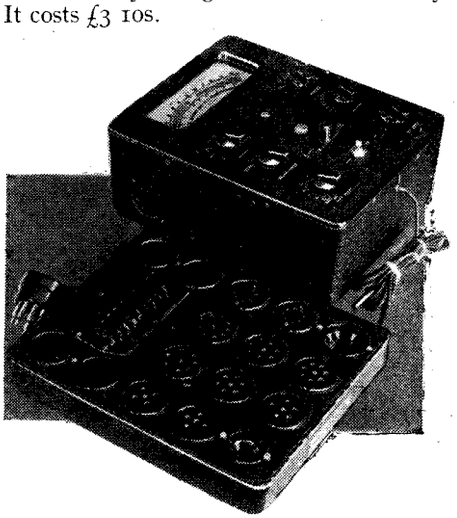
panel costs £3 3s., and the data book supplied gives the selector switch combinations for over 1,000 valves. The complete valve tester including the new Universal panel costs £12 12s. The feature of this test set is that it gives the condition of the valve in terms of mutual conductance with the optimum operating voltages on all electrodes.

The Avo all-wave oscillator, though quite reasonable in price, for it costs £9 9s. as a portable battery model and £10 10s. mains operated, is claimed to have an accuracy better than one per cent. throughout. It is directly calibrated in kilocycles and covers a range of 95 kc/s to 80 Mc/s. Calibrated attenuators are fitted and the RF output can be modulated by a 400 c/s audio oscillator. The output from this oscillator may also be used independently for testing audio equipment.

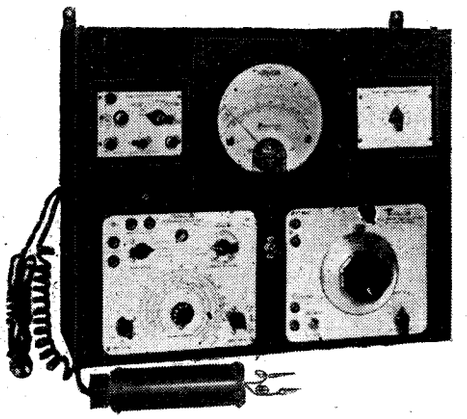
A new instrument has been added to the Avo range of test sets. This is developed from the DC Avo Minor, being of the same size and appearance, but it has an internal resistance of 20,000 ohms per volt. This means that only 50 microamps are required for a full-scale deflection. This is one of the current ranges, the other being 250 microamps full scale, so that for current measurement it is a super-sensitive microammeter. Six voltage ranges are provided, the lowest being 0-2.5 volts and the highest 0-1,000 volts D.C. Resistance up to 50 megohms can also be measured by using an external battery. It costs £3 10s.



Avo valve tester with the new Universal panel.

A super-sensitive multi-range measuring instrument that can be used either separately or arranged to form the nucleus of a more comprehensive test set for servicing wireless receivers is shown by Weston. It is known as the Model E.772 Analyzer and has AC and DC ranges for voltage and current as well as providing facilities for the measurement of resistances. The most sensitive current range is 0-100 microamps DC. On the DC voltage ranges the resistance is 20,000 ohms per volt, and the price is £16 16s. There are also a host of accessories for use with this meter to extend its scope to the testing of valves, etc.

Everett Edgcumbe are showing the full range of Radiolab servicing apparatus to which has been added a receiver test panel, which consists of their All-Purpose



Radiolab receiver test panel.

Tester fitted with a large 6in. scale on the meter, the All-Wave Oscillator and the Workshop Test Set. This combination of instruments is assembled on a strong steel panel fitted with brackets for mounting on the test bench. It is intended for AC mains operation and includes all the necessary equipment for complete overhaul of a wireless set.

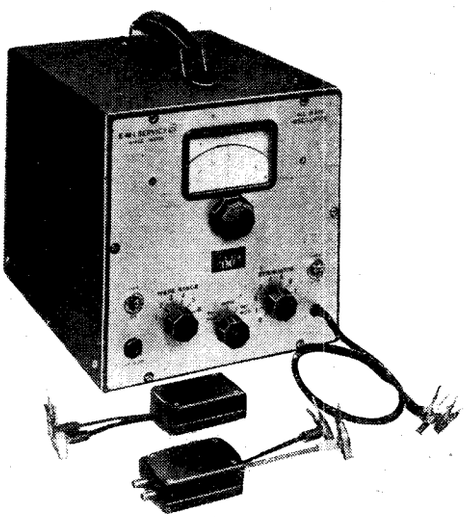
A capacity and resistance bridge and two signal generators designed for receiver testing are shown by A. H. Hunt. Norman Rose are also catering for the service engineer, and their equipment, though very reasonable in price, has a very good specification. For example, the Lilliput valve tester, a very compact instrument, enables every type of valve in general use to be tested for emission, inter-electrode insulation, etc., while it can be used also as a circuit continuity tester. It costs only £4 17s. 6d. This firm is also showing another test set described as the Tech Valve Tester, which gives an indication of the state of a valve based on mutual conductance measurements. There is a combination test set comprising several of their standard instruments arranged for the complete overhaul of a receiver.

Some exceptionally well made and workmanlike instruments are to be seen on the E.M.I. Service stand. There is a new all-wave oscillator which covers a range of 60 Mc/s to 86 kc/s (5 to 3,500 metres). It has six waveranges and charts calibrated for the individual ranges of each instrument in metres and kilocycles are supplied. An audio output at 400 c/s is available for testing AF equipment, or the audio oscillator can be employed to modulate the RF output. Special precautions have been taken to prevent RF leakage, especially at the higher frequencies, so that the attenuator shall function satisfactorily over the full frequency range. Mains-operated and battery models are available, their prices being £15 12s. 6d. and £12 12s. respectively.

There is a bridge-type capacity measuring set designed for operation from the 50 c/s mains. Mica, paper and electrolytic condensers from 10 m-mfds. to 80 mfds. capacity can be measured with a high degree of accuracy and at the same time the power factor is given, as one of the adjustments for balance is a phase angle corrector. Provision is made for insulation testing up to 500 volts DC as well as for the measurement of the leakage current in electrolytic condensers.

A set of four specially prepared gramophone records that demonstrates almost every type of electrical interference that may be heard in an average receiver and then gives advice regarding its probable cause and how to cure it has been made especially for servicing work. These cost 15s. the set.

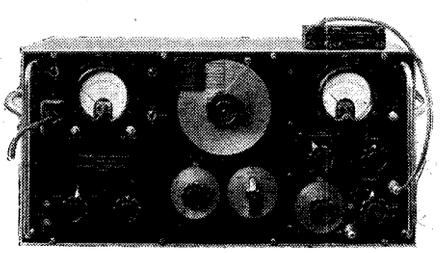
Included in the E.M.I. Service equipment is a CR oscillograph which is fitted with a 3in. "hard" tube. It embodies two time-base oscillators with a range of



E.M.I. Service all-wave oscillator.

20 to 15,000 c/s, "X" and "Y" plate amplifiers, and it can be used for the investigation of the wave-form of time-base oscillators in television receivers.

Some fine examples of precision laboratory test apparatus are to be found on the stand of Marconi-Ekco Instruments. All the apparatus is of outstanding quality and finish. There are three standard signal generators, one the Type TF.144, which has a range of 25 Mc/s to 20 kc/s, the Type TF.430 with a range of 50 Mc/s to 55 kc/s, and one for the ultra-high frequencies. The frequency range is not the primary difference between the two first-mentioned models, as they differ in many other and far more important respects. The Type TF.430 has an RF amplifier after the oscillator, which completely iso-



Type TF430 Standard-signal generator made by Marconi-Ekco Instruments.

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lates it from the output attenuator network. No such refinement is included in the Type TF.144, nevertheless no appreciable change in oscillator load should occur owing to the careful design of the attenuator.

Both models are fitted with separate 400 c/s modulating oscillators, though external modulation can be employed if desired. A special feature of these signal generators is the precaution that has been taken to prevent RF leakage. The coils are assembled in a separate metal case which forms part of the oscillator unit, and the whole oscillator unit is screened. Then the whole set is enclosed in a perfectly screened metal carrying case; thus triple screening is employed.

Both these models are arranged for optional battery or mains operation.

The ultra-short wave signal generator follows the same general form of construction as the other two models, but its range is 150 Mc/s to 20 Mc/s, i.e. 2 metres to 15 metres. In view of the very high frequencies involved the RF oscillator uses an acorn valve. Internal modulation is provided.

The universal Impedance Bridge is a self-contained instrument for the measurement of capacity, resistance and inductance. Actually three different bridge circuits are employed, the internal changes being made automatically by a single switch. Measurements are made at 1,000 c/s, the internal generator being a microphone hummer. The range is 0-100 henrys; 0-100 mfds. and 0-1 megohm. In each case five steps cover the full range, so that the scale lends itself to quite accurate interpretation.

In addition, coil magnification, "Q," from 0-100 as well as condenser loss, can be measured. Normally, high-resistance headphones will be used with this bridge, but an external visual indicator can be supplied.

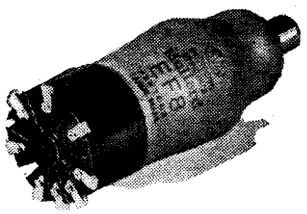
Other Marconi-Ekco test instruments that will interest the radio engineer are an output power meter, a beat frequency oscillator, valve voltmeters and a noise meter, the last-mentioned by virtue of its utilisation of radio technique. These represent only a few of the many measuring instruments made by this firm.

Shown by Morris and Co. (Radio), Ltd., is a new 10-guinea Premier 3-inch cathode-ray oscillograph. The time-base covers 15 to 30,000 cycles and vertical and horizontal amplifiers are included. There are the usual controls of focusing, intensity and displacement, and either internal or external synchronisation.

Electronic Devices

THE year's development in valves has, as usual, resulted in an increase in the number of types and also rather unexpectedly an increase in the valve bases.

Mullard have introduced the "E" series of valves. These have 6.3-volt 0.2 amp. heaters in most cases and side-contact bases of the Continental type. The range is a complete one, including all the normal types, such as RF pentodes, triodes, diodes, output pentodes, rectifiers, heptodes, and so on. It does, however, include one valve of a type not to be found in other ranges. This is the EF8.



Mullard low-noise RF pentode, EF8

Officially described as a low-noise RF pentode, the valve is actually a hexode, since it includes an extra grid between the control and screen grids. The purpose of this grid is to introduce a beam formation into the electron stream so that the electrons can pass between the wires of the screen grid without striking them. The result is a great reduction in screen current and improvement in the signal-noise ratio.

This firm has also introduced some midget valves for use in deaf aids. The DAS1 is a tetrode with top anode connection and a mutual conductance of 0.58 mA/V, while the DAS3 is a triode of AC resistance 7,600 ohms and mutual conductance 0.62 mA/V. The valves have a special 4-pin base, a diameter of 16 mm., and an overall length of 69 mm.

Osram also have introduced midget valves, the S12, H12 and L12. Of these

Osram KTZ41 television RF pentode with mutual conductance of 12 mA/V.

the first is a tetrode and the others are triodes. Their filaments are rated at 2 volts 0.05 amp. A new battery duo-diode-triode is to be found in the range of ordinary battery valves—this is the HD23—and there is also the X23 battery triode-hexode for superheterodyne frequency-changing.

The range of 6.3-volt valves has been extended by the addition of a low-resistance triode, the L63, and there is a new AC/DC output tetrode entitled KT33.

Of especial interest to designers of PA equipment is the DA250. This is a triode for 250 watts anode dissipation, and a pair in Class AB1 push-pull will give an output of 400 watts. In Class AB2 push-pull—that is, with some positive drive—a pair will deliver no less than 800 watts output.

Another new valve of rather especial interest is the KT8. This is similar to the KT66, but has a 7-pin base and a top-anode connection; moreover, it is rated for 600 volts anode potential with 300 volts on the screen grid. The mutual conductance is 4.5 mA/V. Used as a transmitting RF amplifier, an output of 25 watts can be obtained at 60 Mc/s and 43 watts at 20 Mc/s. Because of its top-anode connection, the valve should also prove useful for the output of the line time-base in television equipment. It is priced at 22s. 6d. Another transmitting valve is the DET14, which is rated for 55 watts dissipation. It is a triode and is suitable for operation up to 120 Mc/s.

Mazda now have ranges of 4-volt mains valves and 2-volt battery valves with an octal base. This is not the same octal base as that adopted by other firms. Among the more interesting types are the SP41 and SP42. The SP41 has a mutual conductance of 8.5 mA/V with grid-earth and anode-earth capacities of 11 $\mu\mu$F. and 4.75 $\mu\mu$F. respectively. At 45 Mc/s the input resistance is 2,200 ohms. The SP42 is a similar valve, but rated for 100 volts on the screen and intended for use in a VF stage. This firm also has an indirectly heated voltage-doubler rectifier. This is the UD41, and it consists of two rectifiers in one envelope with the anode of one internally connected to the cathode of the other. With 500 volts RMS input an output of 1,240 volts DC at 20 mA. can be obtained.

The Osram television valve is the KTZ41—a tetrode rated for 250 volts anode and screen potentials. With a bias of −1.5 volt the mutual conductance is no less than 12 mA/V. A new diode, the E922, has also been produced for the detector of television receivers.

Mullard have a valve of the secondary-emission multiplier type with a mutual conductance of about 20 mA/V. This is the EE50 and is of special construction, the usual base being absent.

In addition to their well-known ranges with the standard British bases and with the American Octal-base, Tungsram now have a series of valves with the Continental side-contact base. The range is the "E" series, and the EF6 is recommended for short-wave work by virtue of its low capacity and high impedance. The input capacity is given as 5.4 $\mu\mu$F., and the output as 6.9 $\mu\mu$F., while at 60 Mc/s the input resistance is as high as 9,000 ohms. The mutual conductance is 2 mA/V.

Of particular interest to transmitters is a valve which can operate up to 270 Mc/s. It is the OQQ 50/1500—a triode with grid and anode brought out directly through the glass to reduce capacities to a minimum. It is rated at 50 watts with 1,500 volts anode potential.

Cossor have extended their range of 0.2 amp. AC/DC valves by the 202SPB and 202VPB RF pentodes. The former is the "straight" valve and the latter the variable-mu. Both these valves have top-grid connectors, but the 202VPB has a counterpart with a top anode—the 202VP. A directly heated output triode with a filament taking 2 amps. at 2 volts is now

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available. This is the 2XP, and it takes an anode current of 50 mA with 300 volts HT supply.

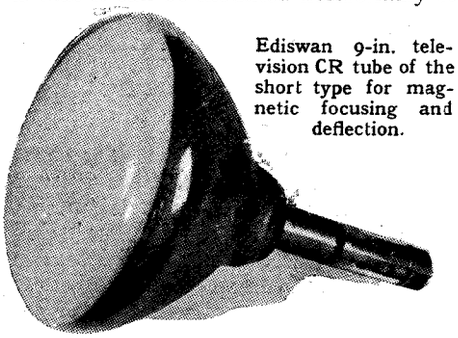
Hivac have introduced a high-voltage half-wave rectifier for use with cathode-ray apparatus. It is the HVU1 and is priced at 15s. 6d.; it is rated for 3mA at 6,000 volts. Gas-triodes for saw-tooth oscillators are now produced by this firm. There is the GR1 for television purposes—it is argon filled and priced at 20s.—and the GR2 mercury-filled valve for oscilloscope use.

Cathode-ray tubes are now a product of this firm, and two types are listed. The CR3 has a 3-in. screen and a 7-pin base. The screen is green, and two of the deflector plates are internally connected to the third anode. It is priced at 42s. A similar tube—the CR3A—has a blue screen, and all deflector plates are brought out to the 9-pin base; it costs 47s. 6d.

Cathode-ray tubes of various types are shown by Vacuum Science Products, and of especial interest is a 10-in. tube which is priced at 7 guineas. It is obtainable for either electrostatic or magnetic focusing.

In general the new cathode-ray tubes for television are magnetic types, and they are usually much shorter than their predecessors. The Mazda tubes have only grid, cathode with its heater, and anode for an electrode assembly, focusing and deflection being accomplished by means of externally mounted coils. Mullard tubes, however, have two anodes, the first of which operates at about 100-250 volts, while the second is rated for 4,000-8,000 volts, according to the type of tube. These tubes are available with screen diameters of about 9in., 12in., and 15in.

The advantage of the new short tube is that it can be mounted horizontally for

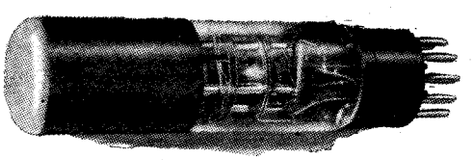


Ediswan 9-in. television CR tube of the short type for magnetic focusing and deflection.

direct viewing in a cabinet of only moderate depth. Its disadvantage is that as the deflection angle is greater, the output of the time-bases must be greater.

Because of this, Cossor have adhered to the normal tube length in their new magnetic types, and the tubes of Vacuum Science Products, referred to above, are actually longer than many of the so-called normal types, the increase in length being made to reduce the scanning power needed.

Apart from television tubes, Cossor, Ediswan, and Mullard have a wide range of small types for oscilloscopes. G.E.C. have also a 1½-in. screen tube, the 4051,



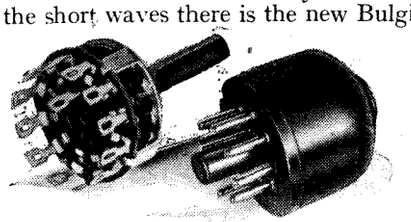
Osram 4051 CR tube for oscilloscope use.

and a 2½-in. model, the 4052. These are for quite low-voltage operation, the 4051 functioning successfully off only 350 volts.

Components and Accessories

WIRELESS components being comparatively small items physically do not usually attract the same attention as a complete set, and a quick survey of the Show might lead to the erroneous conclusion that the home constructor is not very well catered for. Actually, the amateur set builders' interests are particularly well looked after for it only needs a visit to Bulgin's stand, for example, to find ample evidence of this fact.

It is impossible to describe even briefly in the space available here all the latest additions, for there are no fewer than 260 new components awaiting the visitor's examination. If one is mainly interested in the short waves there is the new Bulgin



Bulgin 12-way miniature rotary switch and "octal" cable plug.

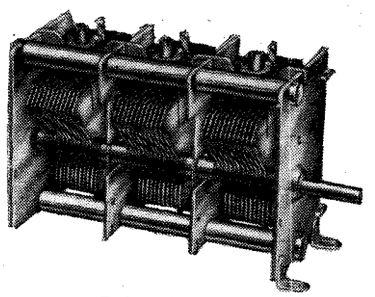
range of low-loss variable condensers in capacities of from 15 m-mfds to 160 m-mfds and assembled on ceramic plates. Prices are quite reasonable, varying from 3s. 6d. to 5s. each.

Then their range of condenser drives includes some new models, one such being a dual epicyclic drive having a ratio of 6 to 1 and embodying a vernier motion of 36 to 1 when it is rotated for a certain distance in the opposite direction.

Push-button switches in six- and eight-way types for pre-set tuning systems or motorised tuning are again new items, and their prices range from 8s. 6d. to 10s. 6d. per unit. If one is interested in the more ordinary systems of wave change, some new pattern rotary switches, capable of accommodating 16 contacts on a single switch, are included in the Bulgin range.

Many amateurs have been turning their attention to the derivation of HT for operating either a home broadcast set, a portable or portable transmitting equipment from an LT battery. A vibrator can be used for this purpose and arranged to convert the low-voltage DC into a high-voltage AC supply by means of a transformer, the AC then being rectified by contacts on the vibrator. Some new models of this style of unit are to be seen on Bulgin's stand for operation on 4, 6, 12 or 32 volts as well as the special transformers required. Prices range from 17s. 6d. to 20s.

Ordinary variable condensers of the two- and three-gang pattern have not undergone any marked change this year. There are a few new models admittedly, but on the whole the products of the well-known firms such as Wingrove and Rogers (Polar), for example, remain substantially the same. Minor improvements have, of course, been introduced where experience has shown them to be worth while. Changes merely to say "this is a new model" have not been made.

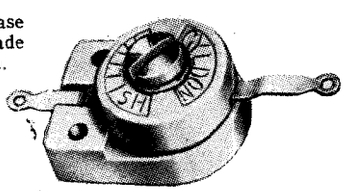


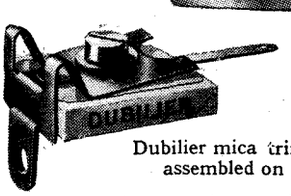
Latest pattern Polar three-gang condenser.

Specialised-type condensers, such as those used by amateurs in short-wave transmitting apparatus, are being shown this year by Sydney S. Bird (Cyldon). These have wide spacing between vanes, and there are models for 2,000, 3,000 and 5,000 volts working. Capacities range from about 0.0001 to 0.001 mfd. Some fine examples of this class of condenser are also to be found on the Eddystone stand.

The development of the push-button tuning system using pre-set condensers has necessitated some very careful attention to the design of the condensers as they obviously must be perfectly stable in use. Some mica-dielectric models mounted on ceramic will be seen on the Cyldon stand. They take the form of single as well as banks of condensers suitably assembled for push-button control. The maximum capacity of a single unit ranges from 30 m-mfds to 1,000 m-mfds. These condensers can also be used for trimming in ordinary circuits.

Ceramic-base trimmer made by Cyldon.





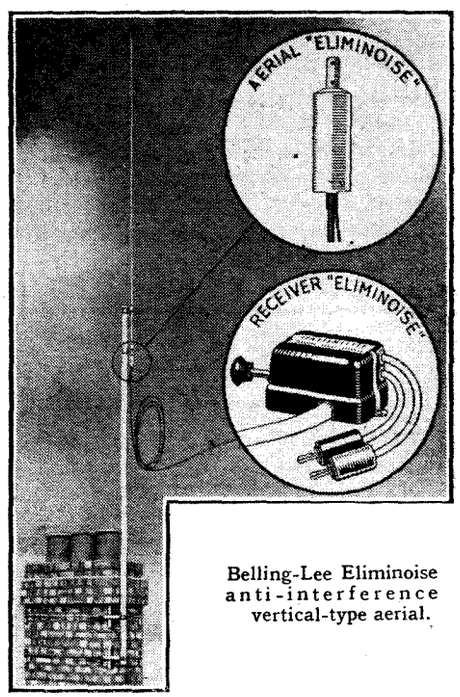
Dubilier mica trimmer condenser assembled on ceramic base.

Dubilier has an interesting selection of both mica- and air-dielectric trimmers. Again the question of stability once adjusted has entered into the design. Their metallised mica trimmers are shown in two sizes, viz. 5-20 m-mfds and 5-40 m-mfds. Another interesting Dubilier product is a stable air-dielectric trimmer with a cera-

Olympia Show Report—

mic body. It is made in sizes of 1-6 m-mfds, 1-12 m-mfds and 1-20 m-mfds, the prices being 2s. 6d., 3s. and 3s. 6d. respectively. This firm also show some new mica-dielectric trimmers in dual pattern on a ceramic base. Condensers of this kind are shown also by Bulgin, Cyldon, Hunt and Polar.

As usual, Dubilier has a most extensive range of new and improved condensers, all of which fully justify a description if only space would allow. Mention must be made, however, of their new surge-proof dry electrolytics. Rated for 500 volts DC peak working, they will withstand momentary surges of much higher potential yet the prices are quite reasonable, viz., 4s. and 4s. 6d. for a 4-mfd and 8-mfd respectively in cylindrical case. Waxed carton models are 1s. cheaper. There are also some new Dubilier dry electrolytics of 4 and 8 mfds, in the cylindrical cases, but of much smaller physical size (height) than was customary for this pattern a year ago.



Belling-Lee Eliminoise anti-interference vertical-type aerial.

Surge-proof wet electrolytic condensers obtainable from the T.C.C. for some time past are now being shown in dual capacity styles of 8-8 and 8-16 mfds, and, in addition, this feature has been extended to their dry variety. In this style condenser there are some new models styled "Midget" and "Minor"; these being 8 mfds in capacity, but of much more compact construction than the equivalent rated condenser made hitherto. Tubular-case and wax-carton styles are shown for working voltages of 500 DC, but which are capable of withstanding short-period surges at 600 volts DC.

T.C.C. ceramic precision condensers in disc and cup styles and in capacities of from 2 to 100 m-mfds will henceforth be available to the amateur set maker at reasonable prices.

Dry batteries of all kinds are well in evidence this year, the variety of sizes in what all battery makers describe as their "replacement" series is a good indication if one is needed that this form of power for a wireless set is still very popular. Likewise, there is an equally large selection of LT batteries. Among the firms catering for the battery-set user may be mentioned Britannia Batteries (Pertrix), Drydex and Exide, G.E.C., Fuller, Siemens, Sterling Batteries and Vidor.

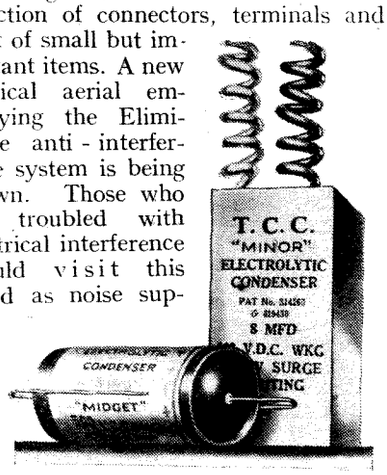
Those who from choice use batteries but have electric supply available will find a long range of battery chargers on Heayberd's stand. Models for both HT and LT, including large capacity car starter batteries, are being shown as well as models for the battery service station.

Whilst on the subject of HT supply, attention might be drawn to the extensive range of metal rectifiers shown by Westinghouse. There are models for high- and low-voltage rectification as well as units for incorporating in rectifier-type measuring instruments. This firm's exhibit will hold much interest also for the battery service station engineer in view of the large selection of chargers they have on the stand.

A firm whose products will be familiar is Morris and Co. as they are showing a representative selection of Premier components and accessories. The transmitting amateur in search of a modulation transformer or a high-voltage mains transformer will find a visit to this stand quite profitable. Short-wave equipment is also a speciality of this firm.

Another exhibit that will interest the short-wave experimenter is that of the Telegraph Construction and Maintenance Co., where some new low-impedance aerial-feeder cables in concentric and parallel-wire pattern are being shown.

Belling and Lee as usual have a big selection of connectors, terminals and a host of small but important items. A new vertical aerial embodying the Eliminoise anti-interference system is being shown. Those who are troubled with electrical interference should visit this stand as noise suppression is a subject in which they specialise, and many new methods of treatment have now been evolved.



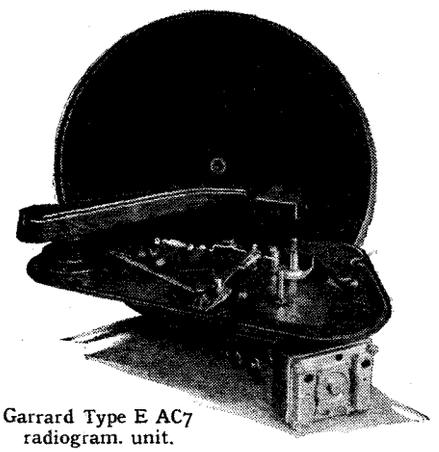
T.C.C. "Midget" and "Minor" dry electrolytic condensers.

Among the newer short-wave components that Eddystone are showing this year is a flexible cable coupling designed for operating volume controls and similar forms of variable components where a straight, stiff shaft is not possible. It will actually drive through an angle of 90 degrees. They now have a series of knobs and dials for transmitters, a very compact and ingenious air-dielectric trimmer and transmitter formers and bases.

Since all amateurs are keenly interested in the apparatus used by fellow experimenters, a visit to the stand of the Radio Society of Great Britain will not only enable them to examine some fine pieces of amateur gear, but they will find many kindred spirits gathered round this natural focal point of amateur radio.

GRAMOPHONE ACCESSORIES

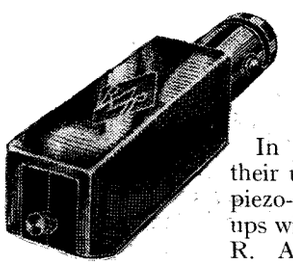
The new Type E AC7 radiogram. unit shown by The Garrard Engineering Co., Ltd., is mounted on a simple base-plate and incorporates a frictionless automatic switch and a compact pick-up with moulded bakelite tone arm. Screened output leads are fitted as standard and the price of the complete unit is 52s. 6d.



Garrard Type E AC7 radiogram. unit.

Playing desks for converting table model sets to radiogramophones are shown by Cosmocord in a wide variety of types, including pedestal models. The turntable and pick-up are housed in a concealed recess with a hinged flap which draws the mechanism forward when opened. The Model 25 magnetic pick-up has been improved and now costs 25s., and a new crystal pick-up with an output of 3.6 volts at 1,000 cycles has been introduced.

Portable gramophone conversion units and a wide variety of table and cabinet models constitute the exhibit of the National Band Gramophone Co. Prices range from £3 19s. 6d. for the portable unit, to 23½ guineas for the Model 95 cabinet with Garrard automatic record changer.



Rothermel-Brush replacement crystal pick-up head.

In addition to their usual series of piezo-electric pick-ups with tone arms, R. A. Rothermel, Ltd., are showing a group of replacement heads which includes special models for the Collaro and Garrard automatic record changers and one for general replacement purposes.

Negative Feedback

WHAT IT IS, and WHY IT IS USED

By "CATHODE RAY"

SINCE I last dealt with this subject it has attracted a much bigger audience, and many who have come in late and missed the beginning are in rather a muddle about it and are asking who this negative feedback fellow is and why he keeps coming into the picture. He is such an interesting and versatile character as to be too much to discuss in a single article, so this one will attempt no more than a general idea of what negative feedback is and why it is used, leaving till next week some practical information on how to apply it.

Although superhets have made the use of reaction in receivers almost obsolete I suppose everybody knows what it is. Part of the output from a valve is coupled or fed back to the input in such a way as to reinforce it and so add to the amplification, in the same way as compound interest keeps on increasing the value of the original capital. Reaction also adds to the selectivity, because whichever frequency is already amplified most is naturally the one that benefits most by the reaction process, so that in tuned circuits the response to the wanted frequency is increased, whereas the amplification of other frequencies is already so small that the addition of reaction has little effect. The resonance peak is therefore increased and sharpened (Fig. 1).

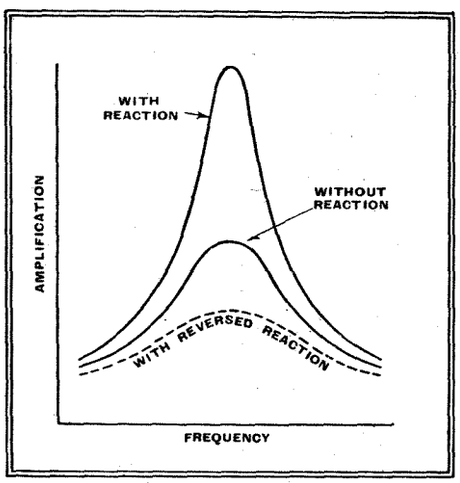


Fig. 1.—The well-known effect of reaction, or positive feedback, is to increase amplification and sharpen resonance peaks. Negative feedback, therefore, may be expected to do the opposite, giving improved frequency characteristics to audio amplifiers.

Now in audio-frequency (AF) amplifiers it *may* be desirable to boost the amplification, but with modern valves there is generally no difficulty in getting all that one wants without any such help; in fact, there is often more than one knows what to do with. On the other hand it is most important to check any tendency towards a resonant peak, as the object is to get the same amplification at all frequencies. If reaction, or *feedback*, is applied in the opposite or *negative* direction, so as to reduce amplification instead of increasing it, it is natural to expect any peaks in the amplification curve to be flattened, giving less distortion.

This is actually what happens, and if one is prepared to sacrifice some amplification the distortion can be reduced. To maintain the amount of amplification required to get full volume it must first be increased so as to stand the application of negative feedback. It may seem a silly proceeding to increase amplification in order to bring it back to the original amount by throwing the surplus away, but, as I have just implied, amplification is plentiful and cheap, whereas freedom from distortion is worth paying something for. If a very high standard of quality is aimed at it may be cheaper to use ordinary components giving a lot of amplification and to cut the surplus down by negative feedback than to exclude distortion by very careful and expensive design, which generally means sacrifice of amplification anyway.

In case any readers are not satisfied with the "anti-selectivity" explanation just given, here is something more definite. Suppose the box in Fig. 2 contains an amplifier giving a gain of 12 times. That means that for every one signal volt applied to the input twelve are given from the output, up to the limit imposed by the power the valve can handle. In Fig. 2(a) it is shown with 2 volts in and 24 out. Now suppose that a certain fraction of the output is fed back to the input by some such connection as that shown in Fig. 2(b). If the fraction is $\frac{1}{4}$ (usually described as 25 per cent. feedback) then the voltage fed back to the input is $-\frac{24}{4}$ or -6 volts, the minus indicating that it is in opposition. In order to maintain the same output the input must be increased from 2 to 8 volts, the difference of 6 being necessary to neutralise the -6 fed back. Although the amplifier itself works just as before (a fact that is often overlooked) the addition of the feedback connection may be thought of as reducing the amplification from $\frac{24}{2}$ (or 12) to $\frac{24}{8}$ (or 3).

Now suppose that owing to imperfection in the amplifier the gain at the extreme frequencies is down to a half normal, or 6. The effective gain when 25 per cent. feedback is applied can be worked out in the same way. Take any signal voltage, say 2 again; then the output is 2×6, equal to 12. A quarter of this is fed back; -3 volts. Total input therefore 5 volts; and effective gain, output divided by total input, is $\frac{12}{5}$, or 2.4 (Fig. 2(c)). Instead of being half normal, or 6 decibels loss, as in the original amplifier, this is $\frac{2.4}{3}$, 0.8 normal, or only 2 decibels loss. In the same way any peak that may exist in the amplifier is flattened down.

Reducing Amplitude Distortion

So *frequency distortion* can be substantially reduced by negative feedback. Worse forms of distortion arise when the output is not exactly proportional to the input. This is called non-linearity or amplitude distortion, and is invariably present in some degree because no real

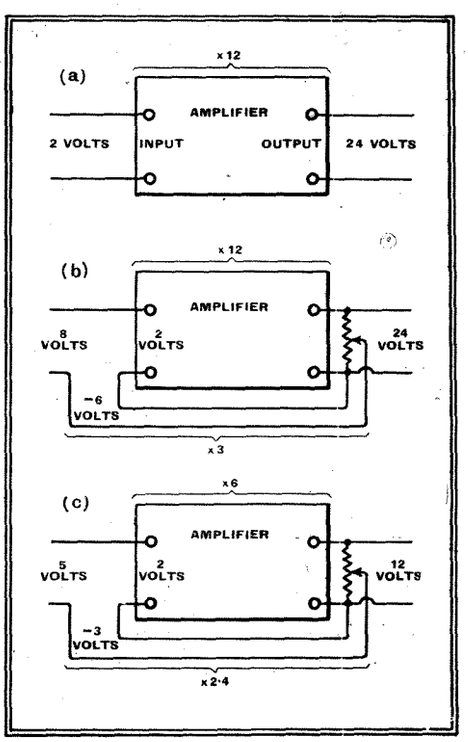


Fig. 2.—The action of negative feedback is illustrated by a simple numerical example. (a) shows an amplifier without feedback, having a voltage amplification of 12 times. (b) shows the same amplifier with feedback; the amplifier itself still magnifies by 12, but including the feedback loop the overall amplification is down to 3. If the gain of the amplifier is altered to 6 the overall gain with feedback is 2.4, a comparatively smaller loss.

Negative Feedback—

valve characteristics are perfectly straight. Transformer couplings are also liable to the same defect, especially at very low frequencies.

The baleful results of non-linearity have been freely discussed in the correspondence columns, and although there is some difference of opinion about the relative offensiveness of harmonics and intermodulation products, it is agreed by all that the distortion consists of the production by the amplifier of tones that were not present in the original signal.

Supposing that the amplifier in Fig. 2 generates what for brevity I shall call harmonics equal to 10 per cent. of the output, which you remember is 24 volts. The output of the amplifier without feedback therefore contains 2.4 volts of harmonics, which can be regarded as being introduced in series with the output of the amplifier, as indicated in Fig. 3(a); as only distortion voltages are now being shown and the input is assumed distortionless it is marked as zero volts. Now when feedback is applied the effect is a little less simple to work out than the previous examples, but readers should be able to follow it quite easily by examining Fig. 3(b). The output is unknown for the moment so we call it x. A quarter of x is fed back negatively, and is then amplified to the extent of $\times 12$, so the output from the amplifier is now the original 2.4 volts of distortion minus $3x$ volts of feedback and amplified distortion; and we already know this combined result is equal to x. Hence the very simple little equation written below the diagram which shows that the effect of feedback is to cut amplitude distortion to a quarter of its original amount, which, incidentally, is the same extent to which amplification is cut (Fig. 2(b)). The same arguments hold good for anything generated *within* the amplifier, such as valve noise or hum.

Constancy of Output

Negative feedback is really beginning to look quite interesting; are there any more things it does? Well, it follows from Fig. 2 that if anything happens that tends to alter the amplification—mains or battery voltage variations, or valve replacements—the alteration is much less in amplifiers where feedback is employed. The example of Fig. 2 shows that with the amount of feedback specified a change in amplification of 50 per cent. is reduced to a change of 20 per cent. That is not especially useful in ordinary domestic receivers, but it may be very valuable in laboratory apparatus or telephone repeaters.

There is still another result of negative feedback, which is the one it is most commonly used for in the radio and allied trades. It is the change in the apparent internal resistance of the valve from which the feedback is derived, and is almost invariably adopted for reducing the resistance of a pentode or tetrode output valve so that it tends to suppress loud-speaker resonances like a triode. Another beneficial result, not so well known, is that it compensates for changes in output load, so that extension loud speakers can be plugged in without noticeably reducing the volume from the one already connected.

In a general sort of way this is not difficult to understand, for if you imagine the amplifier of Fig. 2 to be feeding a certain load resistance, and then that load resistance to be reduced by connecting other loads in parallel with it, the output voltage will tend to drop. But if negative feedback is in use, any such reduction in output voltage causes a proportional reduction in feedback and a rise in amplification that raises the output voltage and partly neutralises the tendency to drop. Similarly if the load is reduced or removed altogether the rise in output voltage is checked by the increased feedback. A system in which the output voltage changes very little when the load resistance varies a lot is one in which the internal resistance is low. An example is the public electricity supply system. The feedback circuit shown tends to give the same sort of characteristics.

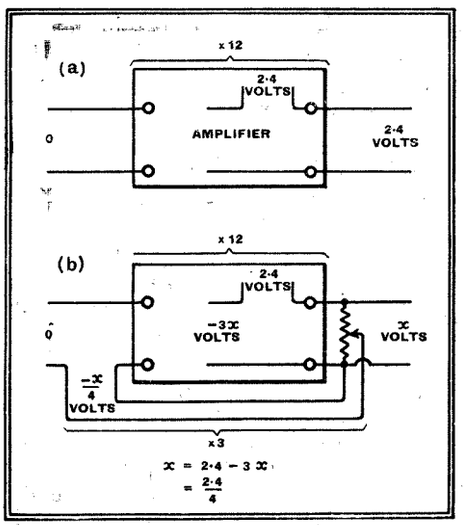


Fig. 3.—Amplitude distortion, hum, or noise occurring in the amplifier, can be represented by a voltage introduced in series with the output. Ten per cent. distortion (compare Fig. 2) is shown at (a). When feedback is used the distortion is reduced in the same proportion as the amplification (b).

There are other ways of connecting a feedback circuit, and although they all have the same sort of effect on amplification and distortion they have opposite effects on input and output resistance. In Figs. 2 and 3 the feedback is drawn off in parallel from the output and applied in series with the input. If it is taken off in series with the output (Fig. 4) it obviously does not work at all unless some load is connected to the output. If a very low load resistance is connected the feedback voltage is large, and the output voltage is reduced. So it acts in just the opposite way to the parallel connection, and tends to maintain the output *current* constant rather than output *voltage*. This is obviously equivalent to a system with a very *high* internal resistance. Whether it is a good thing or not depends on circumstances, but for loud speakers it is generally bad because a very high resistance valve fails to damp out cone resonances.

Easy Tone Control

There is still another way in which negative feedback is sometimes employed. Up to the present we have assumed that the feedback circuit itself is free from any form of distortion. As it contains no valves or transformers there is generally no question of amplitude distortion. But if condensers or inductances—things that vary in impedance according to the frequency—are included, the amount of feedback will depend on frequency too. For example, suppose a condenser is shunted across the part of the potentiometer that taps off the feedback. At low frequencies the condenser may make negligible difference, but at the high frequency end of the scale it may reduce the percentage feedback. The result is to give a lift to the treble end of the frequency characteristic. By using suitable components it is possible to employ negative feedback as a very flexible sort of *tone control*.

Of course, this is only one side of the story. There are practical difficulties in applying negative feedback, but these will be left to the next article, which will also include simple formulæ for quickly working out how to produce a desired amount of effect.

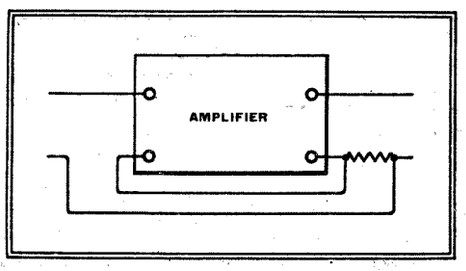


Fig. 4.—An alternative method of providing feedback is from a resistance in series with the load instead of a potentiometer across it.

In the meantime the following results of negative feedback can be remembered:—

If a simple resistance feedback circuit is used—

(1) amplification is reduced

(2) all forms of distortion are reduced

(3) internally generated noise or hum is reduced

(4) variability of amplification with change of valves or supply voltages is reduced.

If a circuit containing capacities or inductances is used—

(5) tone control can be obtained.

If the feedback is tapped off in parallel with the output load—

(6a) the apparent internal resistance of the output valve is reduced.

If it is tapped off in series with the load

(6b) the apparent resistance is increased.

Secrets of the Show

AN IMPORTANT DISCLOSURE

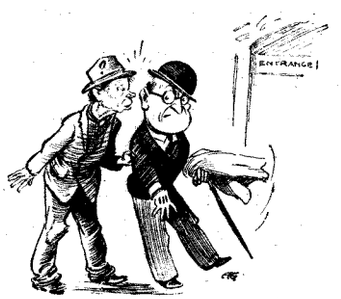
By FREE GRID

AS this issue of *The Wireless World* will appear the day after Radiolympia opens it will be obvious to all of you that I shall not have had time to make that thorough and searching examination of the exhibits and the exhibitors which I always like to do on your behalf before committing my views to paper. I quite realise, of course, that if I so desired I could have had an extensive pre-view of the Show before the public was admitted, but this did not fit in with my ideas at all. I like to visit the Exhibition as an ordinary member of the public when the red carpets have all been put away in favour of the coconut matting, as it is only in this manner that I am able to get at the real truth about things.

Consequently I am not giving you this week any details of what is to be found there, although, fortunately, by a pure stroke of luck, I find myself in a position to reveal to you the reason behind one of the mysteries which this year's visitors will find at Olympia, namely, the seemingly first-rate quality which is being put out by the sets on show there which, as you will probably have heard rumoured, are actually being demonstrated this year.

Fidelity Filters

Many of you have in all probability noticed the extremely poor quality which the B.B.C. transmitters seem to be putting out of late. I first noticed it a week or two ago and forthwith disembowelled my set, but was unable to trace the fault, and as I found the same poor quality on another set, I wondered if something were amiss with the local station on which I had been testing the set, but to my surprise none of the other B.B.C. stations was any better.



"I was just about to enter Olympia"

Naturally I at once concluded that it must be a fault in my set after all, and I was about to begin to disembowel it once more, when it occurred to me to tune in a Continental station, and to my surprise quality was perfectly normal. In brief, none but B.B.C. stations was affected, and I was just going to write a paper on this newly discovered "effect" for the purpose of reading it before a certain learned society of which I am a Fellow, when, quite by chance, I discovered the cause.

I was, as a matter of fact, just about to enter the Olympia Exhibition when I was stopped by a ragged-looking down-and-out who was at one time a well-known salesman employed by one of our great wireless manufacturers, but had lost his job through attempting to give an intelligent answer to a technical enquirer at last year's show. He asked me in a hoarse whisper whether it was worth a few coppers to learn something of interest, and upon my assenting he led me to a greasy-looking fish-and-chip restaurant somewhere in the back streets bordering on Olympia. As soon as we were safely ensconced in the low-down dive and had commenced our piscatorial repast, he commenced to unfold a truly astonishing story.

He first asked me if I had noticed the extremely poor quality of the B.B.C. transmissions lately, and as soon as I said yes, he asked me if I had any idea of the reason. I naturally commenced to give him a précis of the paper I was preparing for the learned society, but he cut me short with a somewhat contemptuous laugh. It appears from what he tells me that the poor quality is part of a back-door agreement between the B.B.C. and our wireless manufacturers. The distortion, so my informant told me, is being deliberately introduced so that listeners will become dissatisfied with the performance of their receivers, and therefore be in the right mood to be persuaded to decide upon a new one at Radiolympia.

This year, my informant said, a radio- as well as an audio-frequency signal is being supplied to the stands at Radiolympia, but it will be found that the new models do not reveal the poor quality of the B.B.C. transmissions. As it is known exactly what distortion the B.B.C. are introducing, it is obviously easy to design a filter unit to give exact correction, and this is the reason why all the new sets appear to give such vastly superior results when demonstrated to you in comparison with your old one. Of course, the new sets will not be sold with the filter unit, but by the time they are installed in your house the B.B.C. transmissions will have returned to normal.

Needless to say, I was extremely gratified to receive this very important piece of information, and have rewarded my informant accordingly, using certain influence I possess in finding him a position in the Intelligence Department of the War Office to which his espionage talents seemed to be suited. As for the information itself, it is invaluable coming as it does at the beginning of the Show like this, and I intend to make very diligent enquiries into this apparent breach of trust by the B.B.C. What they get out of it I don't know, as their Charter prevents their receiving any pecuniary *quid pro quo* from the manufacturers.

Mention of the Intelligence Department has, by what I believe psychologists call the theory of opposites, reminded me of the people on the Exhibition stands who answer enquiries. I have been told on what is quite reliable authority that this year manufacturers have made a great innovation in this respect, and have staffed their stands with people who have been specially trained to answer questions.

This information may mean anything or nothing, of course, as the question answerers may only be ex-political orators. However, I am intending to give them the benefit of the doubt, and have prepared a special list of test questions which I intend putting to them. Most of the questions are, as a matter of fact, extracted from a recent set of examination papers prepared for candidates aspiring to a science degree at one of our most ancient seats of learning, and so there will be no unfairness about them.

"Specially trained to answer questions"

Wait and See

With regard to the rumours that each stand is to be fed with a RF as well as an AF signal this year, and that sets are to be actually demonstrated, I prefer to say nothing until next week. You will, I feel sure, appreciate the fact that there are so many wild rumours flying about that it is difficult to separate fact from fiction. One rumour which has reached me, for instance, is to the effect that all sets are to be individually tested before they leave the factory, and the old system of supplying one or two "defective" models to listeners before permitting them to have the working one is to be finally abandoned. Needless to say, I can hardly credit such wild and revolutionary statements as this, and that is why I prefer to say no more until next week.

NEWS OF THE WEEK

RADIOLYMPIA

Television the Focal Point of the Show

ON entering Radiolympia, one is struck with the spacious appearance of the show as compared with previous years. Each stand is very much larger, and this is undoubtedly due to the introduction of demonstration television receivers on the stands themselves, and not in the special booths as last year. The quality of the pictures shown on the demonstration receivers is excellent, and should do much to convince the hesitant buyer that television is beyond the experimental stage.

The principal attraction of the show to the general visitor is the television studio. This is almost twice as large as those in general use at Alexandra Palace, and is fitted with four separate "sets." Visitors gain a very good view of the artistes at work, for three sides of the studio are glass.

Every endeavour is being made by the B.B.C. to render the public "television conscious," as is evidenced by the talk which was broadcast by the Deputy Director-General the day before the opening of the show.

VALVE PRICE REDUCTIONS

IMMEDIATELY prior to the Olympia Exhibition reductions in the prices of many valves were announced, the reductions being operative from August 15th, 1938. Brimar, Cossor, Ever-Ready, Ferranti, Marconi, Mazda, Mullard, Osram and Philips valves are affected.

Battery screen-grid types are in general reduced from 11s. to 9s., duo-diode-triodes from 9s. to 7s. 6d., frequency-changers from 14s. to 10s. 6d., while QPP output valves come down from 17s. 6d. to 12s. 6d.

Among mains valves there is a reduction of 2s. in the price of many RF pentodes, and of 3s. in the case of output pentodes. Frequency-changers become 11s. 6d. instead of 15s. Triodes of the 15-watt class are now 9s., and many output pentodes and tetrodes become 10s. 6d. The largest reductions are in some of the heavy-duty rectifiers, which are now 15s. instead of 25s.

TELEVISION STANDARDISATION

THE French Minister of Radio's announcement that the system of transmission employed by the television service in France will remain substantially unaltered until July 1st, 1941, should be a great stimulus to receiver sales in that country. The year 1941 will mark a vital period in the progress of television, for it may be remembered that the guarantee given by Major Tryon, Postmaster-General, concerning the stability of the present system of B.B.C. transmission, will expire in January of that year.

THE INTERFERENCE NUISANCE

Australia Takes Action

WHILE Britain still shilly-shallies with the question of interference legislation, Australia is taking active steps. It is understood that the Commonwealth P.M.G. has investigated the Government powers to deal with sources of electrical interference with radio reception, and has discovered that existing statutes provide all that is necessary to deal effectively with the situation.

Is it possible that our own P.M.G. might make a similar discovery?

MUSIC PRODUCTIONS UNIT

Conveying the Opera House Atmosphere to the Listener

THE B.B.C. Music Productions Unit, which was formed last winter, includes engineers as well as musicians, and readers will probably remember the technical excellence of the performances of "Manon," "The Bartered Bride," and "Faust," for which the unit was responsible. Special attention is given to the placing of microphones in order to convey the impression that the operas really are being acted, and not merely sung in concert versions.

During the autumn quarter the unit will produce two full-length operas in English in St. George's Hall, which provides the singers with something of the atmosphere of the opera house.

SATURATION POINT IN U.S.A.

IN Milwaukee, Wisconsin, 99 per cent. of the families possess wireless receivers—that is, according to investigations made by advertising authorities, which show that 82 per cent. of America's 26,666,500 homes are radio-equipped. This follows the statement published by *Radio Retailing* to the effect that when 81.99 per cent. of the homes in U.S.A. owned receivers, saturation point would be reached.

PARLIAMENTARY BROADCASTS

Success of New Zealand Experiment

THE suggestion that debates in the House of Commons should occasionally be broadcast has frequently been made. There would be many obstacles to overcome, not the smallest of these being the opinion of the M.P.s themselves, who, apparently, still retain something of the tradition of secrecy which obtained a century or so ago.

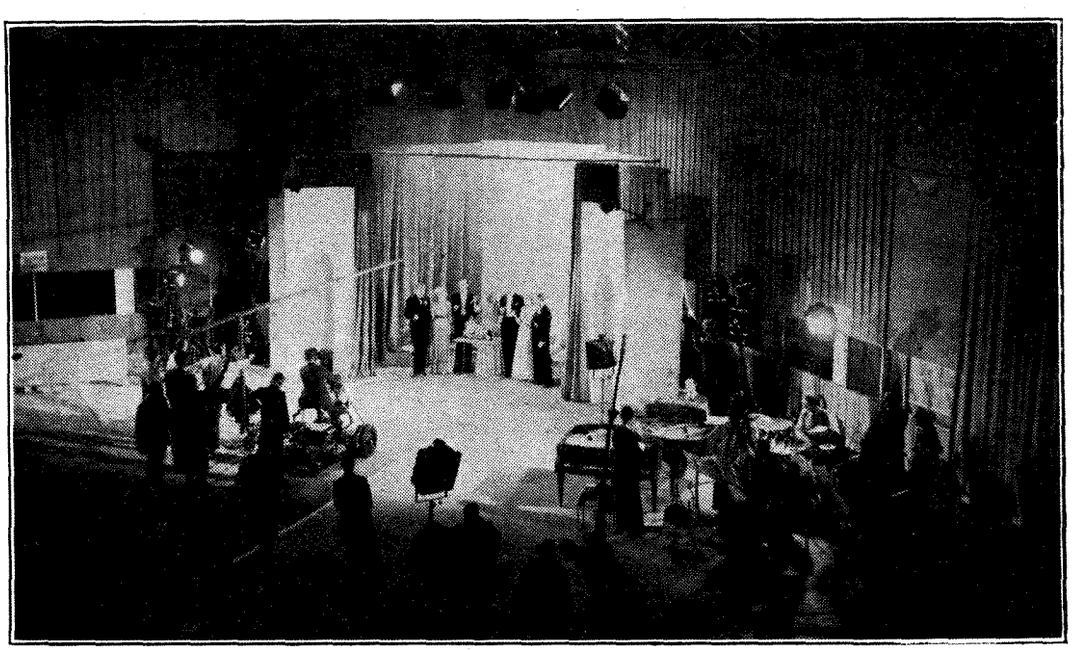
The difficulties have apparently been successfully surmounted in New Zealand, where the proceedings of the House of Representatives have been broadcast for several months past.

As is suggested in *The Nottingham Guardian*, it is not improbable that such broadcasts would do something to promote public interest in Parliament and to increase the identification of Parliament with the people.

It is claimed in New Zealand that the Parliamentary broadcasts, which frequently occupy several hours of the day's programmes are very popular.

NORWEGIAN "ALL-PEOPLES' SUPERHET"

A 2-VALVE regenerative receiver was put on the Norwegian market some time ago with the support of the State



THE FOCAL POINT of the Radio Exhibition is television. The glass-walled studio gives visitors to the show a very good idea of working conditions during a normal broadcast. Times of transmission from the Radiolympia Studio are given in the Television Programmes on page 160.

News of the Week—

broadcasting organisation in order to lower the general price level of receivers and to increase the number of licences. This, however, seems to have been something of a failure.

Norwegian manufacturers have now pooled their resources to produce a superhet to be known as the "Folkesuper," which is expected to sell at from 180 to 200 kroner (£9—£10).

SYNCHRONISED TRANSMITTERS

CONSTANCY of oscillator frequency between the synchronised B.B.C. transmitters radiating the London, North and Scottish programmes can be maintained to 1 part in 1,000,000, but until recently it was considered that any increase in the power of London and North Nationals might cause intermittent or constant interference between them. On August 9th their power of 20 kW each was raised to 40 kW. No phase distortion has been reported, and the desired effect for a better service for the areas covered by the stations has been effectively accomplished.

ALPINE NETWORKS

FRENCH Alpine guides are at present discussion the possibilities of establishing a network of wireless transmitter-receivers in the more remote mountain refuges to make it possible for climbers to summon assistance in cases of emergency.

These discussions follow the decision taken by the Post Office to install wireless equipment in the recently completed refuge, located 1,472ft. below the 15,782ft. summit of Mont Blanc, and it is hoped that the scheme will receive the support of clubs associated with climbing.

FROM ALL QUARTERS

Calcutta on Short Waves

THE opening of the Calcutta short-wave broadcasting station of All-India Radio by the Prime Minister of Bengal, Mr. Fazl ul Huq, on August 16th, brings the number of transmitters in operation to twelve, eight of which have been inaugurated during the past eight months. The station VUC2, working with a power of 10 kW, will transmit from 8 to 10 a.m. (B.S.T.) on 9,530 kc/s (31.48 metres), and from 12.30 to 6 p.m. (B.S.T.) on 4,880 kc/s (61.48 metres).

Radio Entertainment Tax

A TAX of 1 per cent. of their value is to be levied on wireless receivers installed in taverns and other places of public recreation in Germany. Apparatus in factories, hairdressers' establishments, and so on, will not be taxed.

Mobile Radio's New Use

FIVE New York telephone exchanges were recently put out of action when a workman inadvertently pierced several telephone cables with a compressed air drill. To alleviate the difficulties of hospitals and other important public institutions, which were deprived of the use of their telephones, twenty police cars equipped with short-wave wireless apparatus controlled from four principal stations were used to relay the more urgent messages.

British Association Meeting

LORD RAYLEIGH'S presidential address at the opening of the British Association meeting last Wednesday was mainly concerned with natural vision and vision aided by science. During the course of his address he made frequent reference to the progress of television and the various applications of the Iconscope.

Australia Enjoys Test Match via Hong Kong

AUSTRALIAN reception of the Fourth Test Match broadcasts from Daventry appears to have been patchy. In Perth listeners were well served by their own National relay of Howard Marshall's description from Daventry, and a few stalwart souls picked up Daventry direct, but according to reports from Sydney the best ball-by-ball commentary was heard from ZBW, Hong Kong, on 31.41 metres.

The Radio Service Engineer

A CAMPAIGN is being launched by Electrical Trades Union, 11, Macaulay Road, Clapham Common, S.W.4, to organise radio service engineers. The object will be to improve and standardise the status of the service man.

Controlling the Ether

CONTROL of secret wireless transmitting stations and more comprehensive policing of the ether, figure among the revised counter-espionage services outlined in a note circulated by the Minister of the Interior to all authorities concerned in the control of foreigners in France.

The New D.G.

AN interesting sidelight on the character of the New Director-General of the B.B.C. is that he wishes to be known to the staff as *Mr.* Ogilvie, not Doctor or Professor, though he is entitled to both prefixes.

African Relay Station

THE 30-kW station now in the course of construction near Tunis will relay all French national transmissions in Northern Africa. It will pick up programmes for retransmission at a receiving station about 1½ miles away and a studio has been hired in Tunis itself, which is fourteen miles from the transmitter. In the absence of suitable cables, programmes from Paris will be transmitted across France and the Mediterranean to Tunis by short waves.

Daventry Serves the World

THE B.B.C. has received a pat on the back from China. Writing in a Shanghai paper, a correspondent refers to the thoughtfulness of the British broadcasters in changing their Daventry wavelengths to suit listeners in the Far East at different times of the year. "The advertising stations in America," he remarks bitterly, "do not change their wavelength in this way to benefit reception here."

Another Noise By-law

UNDER a new by-law in Dunstable operators of excessively-loud speakers are liable to prosecution if the nuisance continues for a period of more than two weeks after the receipt of a complaint which has to be signed by only three affected neighbours.

Commercial v. National Broadcasting

THE National Broadcasting Service of New Zealand was severely criticised during a recent broadcast talk given by a director of one of the commercial broadcasting stations. The references were such that Parliamentary action has been urged in what is felt to be a gross misuse of the station's broadcasting licence.

Disaster in Denmark

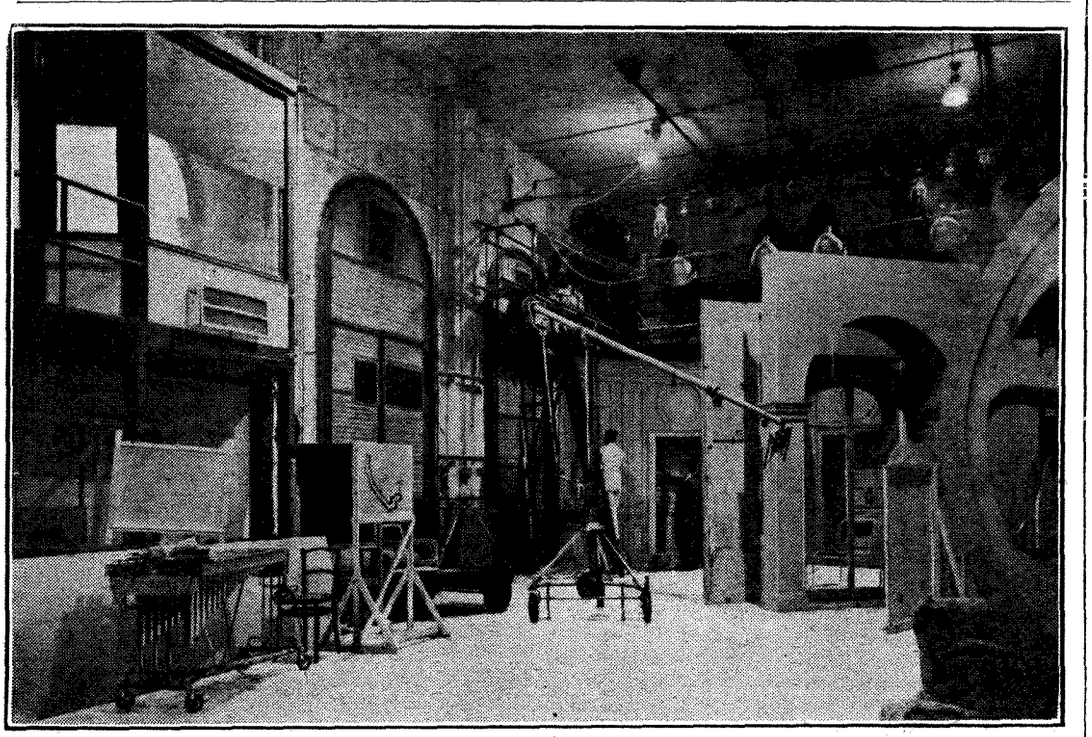
THE production of the new season's receivers in Denmark has, we understand, been severely retarded by a serious accident at the Torotor variable condenser factory when a giant pressing machine crashed through one of the floors causing damage to several departments.

University Radio Workshop

THE New York University Radio Workshop is completing a six weeks' summer course designed to give practical training to persons interested in broadcasting as a career. The students represent many trades and professions.

Operators on Air Routes

NEGOTIATIONS opened in London last week between the Radio Operators' Union and Imperial Airways with the object of establishing a standard table of conditions and rate of pay for operators working on air routes. An exactly similar scheme has already been arranged between British Airways and the R.O.U.



A SECOND TELEVISION STUDIO for regular use is now nearing completion at Alexandra Palace. Originally built for the Baird intermediate film system, it is being remodelled and fitted with "sets" and will be in regular use by the middle of October. The new central control room, which was illustrated last week, has observation windows in both studios, thereby permitting the combination of the output of the two studios in one programme.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

A Standard Specification

"CATHODE RAY'S" statement in the issue of August 4th, "It is unfortunate that the radio industry in general still withholds such information as would make it easy to compare one (set) with another," is straight to the mark.

Would it not be possible for the industry to issue a standard specification which would cover, *inter alia*, the provision of certain information on the receiver name-plate?

The following list is not complete, but indicates the main lines of the suggestion:

(1) Power consumption in watts (for mains sets).

(2) Sensitivity in RF microvolts at an agreed wavelength, percentage and frequency of modulation to give an agreed sound level from the loud speaker.

(3) Overall frequency characteristic within ± so many db. between agreed top and bottom frequencies with tone or selectivity control in the optimum position.

(4) Selectivity in db. down at agreed kc/s separation from the tuning point with selectivity control in optimum position.

(5) Sound level in phons for an agreed harmonic content at an agreed frequency or, alternatively, perhaps "Cathode Ray" would devise an intermodulation test between two frequencies.

It will be noticed that the above avoids:

(a) The number of valves or stages which is really irrelevant except as regards maintenance.

(b) The "undistorted" power output, which is misleading as long as acoustic efficiencies of loud speakers vary over a ratio of about 10 to 1.

If the information required were found too unwieldy for a name-plate, possibly a suitable classification into groups could be devised which would indicate by a letter or letters the information within certain limits.

As "Cathode Ray" points out, the motor industry is not afraid of using technicalities, especially in the booklets provided with the cars, and the radio industry would do well to follow suit.

The case in favour would be very strong if manufacturers would agree to supply information under the same headings.

Dublin. B. MACQUILLAN.

"Debunking Intermodulation"

Sir,—In the absence of the further "fire" desired by "Cathode Ray" in his article on intermodulation we feel called upon to contribute a second salvo.

First as regards the effect of "masking" upon the relative audibility of the different harmonics. We are afraid that "Cathode Ray's" figures must have gone astray somewhere since we cannot relate to them any of Wegel and Lane's data, or, for that matter, to common experience. It seems possible that he has confused "Sensation Level" with "Intensity Level" in the calculation of harmonic percentages. But apart from this point, which may make 10 or 20 db difference, the case which he chooses to quote is not a representative or normal one, for 80 db Sensation Level at 200 c/s corresponds to 95 db Loudness Level, which is more than "fairly loud," and, in fact, would require about 100 watts of undistorted power fed to an efficient MC speaker placed at 6ft. from the listener.

Figures extracted from Harvey Fletcher's "Speech and Hearing" for this case, and also for a more representative case, are given in the accompanying table.

Harmonic Order	Minimum Audible Harmonic Percentage	
	200 c/s. 80 db.SL	400 c/s. 60 db.SL
2	4.5	3.0
3	3.2	1.0
4	3.0	0.4
5	2.8	0.18
6	2.5	0.09
7	2.0	0.05

From a comparison of similar tables covering the range of 200-1,000 c/s and −40 to −10 db intensity levels (relative to $i\mu W/cm^2$ and not to 1 dyne/cm^2 as stated by mistake in our last letter), we have arrived at a weighting characteristic, which does not differ materially from that given for 400 c/s; this weighting is used in the distortion meter referred to.

Returning from the solid land of measurable quantities to the "thin ice" of musical appreciation, we were perhaps making a debating rather than an unbiased point in our reference to the rarity of flute and drum duets: while this remark, taken literally, is quite correct, we agree that this and similar combinations are often heard in orchestral works, but usually only in the presence of other instruments, which will, however, increase the masking of the intermodulation tones. As mentioned in our previous letter, the case of a large amplitude very low note plus a small amplitude middle high note is one of the two special cases where intermodulation tones are more audible than harmonics, and we cannot, therefore, be accused of "failing to explain Cathode Ray's" experiment. Similarly our remark that "the relative discord of the intermodulation products from the two tones of a simple musical interval is only slightly greater than that for a harmonic of a single tone" is quite correct: however, we should not include a very large frequency interval such as that between the fundamental and the eighth harmonic in our definition of "simple," although this is, perhaps, a matter of opinion.

In our last letter we raised the point that subjective intermodulation tones are formed in the ear: "Cathode Ray," however, will not allow this argument, and gives as his "fundamental rule" that the reproduction of the apparatus must be *identical* to the original. Now there is, of course, no question or possibility of obtaining *zero* distortion: the only requirement is to limit the distortion to a level at which it is inaudible, and this level is *entirely* and *only* dependent upon the ear mechanism: the level is determined by (a) the "ordinary masking effect," attributable to the fact that resonators in the ear adjacent to the one resonating to the applied frequency are also partially excited, and (b) the production of subjective harmonics and intermodulation tones; this will also give in our case a masking effect.

We are not suggesting that intermodulation is unimportant. We do, however, suggest that probably less useful information is obtainable by making the suggested single intermodulation test on a receiver under arbitrary conditions than by a normal measurement of harmonics, up to the 5th or 7th, or by the quicker method of using a weighted distortion meter.

Since the foregoing remarks were written another contribution to the controversy has been made by Mr. Harries. We would like to clarify a vital point upon which he has misunderstood our earlier letter.

We had evidently not made it sufficiently clear that our weighting was based upon the *known* figures (e.g., of Harvey Fletcher) for masking of any tone, such as a harmonic or an intermodulation tone, by another tone, i.e., upon scientifically measured figures for minimum audible distortion of any given type. Our difficulty in accepting Mr. Harries' conclusions is precisely that by programme listening methods alone it is not possible to arrive at any quantitative conclusions: the results depend upon the listener's judgment in hundreds of comparisons which must cover all passages in all types of programme, all degrees of non-linearity, and at all output levels: as far as the evidence published in his paper went, we felt that Mr. Harries had not been able to touch more than the fringe of this very difficult problem: even the results of the almost impossibly laborious investigation as outlined above would still need support from the more limited but *quantitative* results obtainable from deductions from masking experiments.

M. V. CALLENDAR, M.A.,
G. F. CLARKE, B.Sc.,
Research Dept., Pye, Ltd.

Cambridge.

Empire Reception

MR. BEAUMONT quite justifiably criticises the remark he quotes from my letter in your issue of July 14th. This rather sweeping remark was made in ignorance of his firm's products, and should have been qualified by some reference to the time which had elapsed since I left Malaya. I returned four months before writing the article which began this correspondence.

In my last letter I mentioned the names of half a dozen of the leading American manufacturers who were supplying the requirements of Empire listeners. Let us hope that some Empire readers will soon be able to write and quote an equal number of British manufacturers who are successfully meeting this competition.

I look forward to being able to inspect the Ambassador and other new British receivers suitable for Empire use at Radiolympia. "HEPTODE."

Plymouth.

Random Radiations

By "DIALLIST"

The Show's the Thing

AS I write these notes there are still a few days to go before the Exhibition opens, but when you read them you will either have paid your first visit to the 1938 Radiolympia or will have been able to study the first reports on the exhibits. I am sure you will vote it a pretty show, taking it all round. If you are a genuine radio enthusiast (and as a reader of *The Wireless World* you are sure to be that), you won't shed any tears over the absence of the theatre, but will welcome the full-dress television studio which replaces it. I'm particularly interested in seeing how the new arrangement of supplying radio-frequency signals of two different kinds to the stands is going to work out. In theory it should give one some chance of judging the performance of receivers both on the local station and on a good foreigner. But the welter of sound from the various stands may be such that you don't get a real chance of estimating the quality, the freedom from background noises, and so on.

The Hiss Problem

One of the defects of the superhet has always been its liability to hiss when the volume control is turned well up—some of them do so when it's in almost any position. Hiss is extremely annoying, and it can be a real nuisance when you want to use the set in a very sensitive condition for the capture of weak and distant stations on the medium waves or the short waves. I've handled sets whose hiss became so pronounced before the volume control was near the all-out position that it was easy to pass right over stations that weren't coming in strongly. A continuous high-pitched noise is very tiring to one's hearing apparatus, and I imagine that what happens is that, owing to its unpleasant effects, the ears temporarily lose their acuteness, and so fail to detect the tiny sounds by which weak transmissions announce their presence.

A Step Forward

Last season some manufacturers were so carried away by the desire to produce high amplification at signal-frequency or intermediate frequency that they didn't pay much attention to hiss. I am glad to see that this year new valves are announced which are claimed to be freer from hiss than any high-mu. types that we have had before. I haven't yet had the opportunity of trying out a set in which they are used, though I hope to do so soon. Whether or not they fully carry out the claims made for them, they do, at any rate, prove that makers are taking steps to tackle the hiss problem.

The Aerial's Influence

One thing that has always surprised me is the small stress laid by so many manufacturers on the influence of the aerial on reception. In the books of the words which accompany receiving sets you will find rather vague statements such as "A good aerial about 60ft. in length and as high as possible should be used," but you won't find as a rule any hints on what constitutes a good aerial or any explanation of the effective height of an aerial. I have often seen it stated that between eighty and ninety per cent. of the receiving aerials in use in this country are hopelessly inefficient, and from what I notice of aerials as I move about the country I should say that this wasn't an over-statement. The influence of the aerial on the noisiness or otherwise of a superhet. is enormous. Like myself, I expect you have come across sets which you know to be capable of good performance hissing like serpents when bringing in even the local station. A few more feet of effective height or rather better insulation would make all the difference.

A Great Improvement

THOUGH it is not an ideal time, it is a great improvement to have the third news bulletin now at 9.40, instead of 10 o'clock. The B.B.C. was reluctant to make the change, but such was the volume of complaints that they received about putting the third bulletin on to 10 o'clock for the summer months that they had to make it willy nilly. One hopes that in future years they will stick to 9 o'clock for both summer and winter. The records of relay exchanges show that there is always a very heavy load for the 9 o'clock news bulletin and there is no question that it is a time which suits the great majority of people better than any other for the night news.

Alterations in France

Talking of news bulletins reminds me that there have been considerable changes in that direction at the French broadcasting stations. Not so long ago there was hardly any time during broadcasting hours at which one wouldn't find one or other of the French stations giving out news. The position became perfectly absurd and the newspapers began to find themselves dis-

Broadcast Programmes

FEATURES OF THE WEEK

THURSDAY, AUGUST 25th.

Nat., 6.25, "Hunted by Kurds," talk by Oliver Locker-Lampson on a journey across Russia. 7.30, Louis Levy presents "You Shall Have Music." 8.15, "Squaring the Circle," a farce of contemporary Russia.

Reg., 6.30, "Queue for Song," from the television studio at Radiolympia. 8.55 and 9.55, Promenade Concert. 9.40, "Clouds Hill," talk by E. M. Forster on the Dorset home of Lawrence of Arabia.

Abroad.

Radio-Paris, 7, "Figaro," opera (Mozart).

FRIDAY, AUGUST 26th.

Nat., 6.30, Decorating the Outside of the House, talk for the amateur by W. P. Matthew. 7.30, "On Trek," another African bush programme. 8, Beethoven Promenade Concert. 10.5, Up Against It.

Reg., 3.30, "Queue for Song," from Radiolympia. 8, George Scott-Wood and Six Swingers. 8.45, "Princess Charming," a musical romance. 10.20, Act III of Wagner's "Tannhäuser," from Salzburg.

Abroad.

Brussels II, 6.30, Sacred Indian Songs of 1,000 B.C.

Beromunster, 7, "Tannhäuser," opera (Wagner) from Salzburg.

SATURDAY, AUGUST 27th.

Nat., 4.15, Commentary on Motor-cycling (500 Race) at Donington. 5.15, Henry Hall and his Orchestra. 7.20, Jack Payne and his Band. 8, Spain—both sides of the line. 8.20, Promenade Concert.

Reg., 3.20, Schubert Recital by Alec Rowley and Edgar Moy on one piano. 8, Excerpt from the Arcadian Follies, Blackpool. 8.30, Sing-Song, including Leonard Henry, Bertha Willmott, and Flotsam and Jetsam.

Abroad.

Radio-Paris, 5, "La Petite Fadette," opera for children (Miollis)

Munich, 8.35, "Friedestag," opera (Richard Strauss).

SUNDAY, AUGUST 28th.

Nat., 1.30, The Avalon Quartet (vocal). 4.40, Clive Richardson and René Pougnet at two pianos. 6.15, 'Cello Recital by Emanual Feuermann. 9.5, Mendelssohn in England, musical biography.

Reg., 5.30, Troise and his Mandoliers. 6.50, Alfredo Campoli and his Orchestra. 9.5, The Birmingham Repertory Company in "The Romantic Young Lady."

Abroad.

Cologne, 8.10, "The Merry Widow," operetta (Lehár).

Hamburg, 8.10, "Martha," comic opera (Flotow).

MONDAY, AUGUST 29th.

Nat., 7, The Bungalow Club. 7.45, Billy Thorburn, pianoforte. 8, Wagner Promenade Concert. 8.55, Louis Levy presents, "You Shall Have Music." 9.45, The Past Week.

Reg., 6.25, Eugene Pini and his Tango Orchestra. 7, "Close to Earth," talk. 8.30, "Queue for Song," from Radiolympia. 9, "The Clancy Name," a play.

Abroad.

Paris PTT, 11.30, Two Plays in Esperanto.

TUESDAY, AUGUST 30th.

Nat., 6.30, Sonata Recital by Albert Sammons, violin, and William Murdoch, pianoforte. 8, Stand and Deliver, a history of English highwaymen. 8.30, Seaside Nights—Scarborough.

Reg., 3.30, "Cabaret Cruise" from Radiolympia. 8, Mozart-Haydn Promenade Concert. 9.35, Variety from Cheltenham Spa. 10, Speed, programme of tunes in fast tempo.

Abroad.

Munich, 9.20, Herman Zilcher's Fourth Symphony conducted by the composer.

WEDNESDAY, AUGUST 31st.

Nat., 7.30, Dave Frost and his Band. 8, Brahms Promenade Concert. 8.50, Mr. Gillie Potter—talk. 9, Concert Party from the Isle of Wight.

Reg., 7, By Act of Parliament, talk by Lynn Ungoed-Thomas. 8, At the Pig and Whistle, another rural episode. 8.50, The Streets of Bristol, No. 1.—A Visit to King Street.

Abroad.

Vienna, 7, "Fidelio," opera (Beethoven) from Salzburg.

Luxembourg, 10.5, Concert of music by English composers.

tinctly hard hit. As a result of strong representations to the authorities, the number of news bulletins that any station may broadcast has been very much curtailed, which is as it should be. There has been some grumbling amongst listeners, as was to be expected; but there is no doubt that the new regulations have come to stay. It certainly isn't for broadcasting to usurp functions of the morning and evening papers.

Brighton Does It Again

THE Brighton Police Force was one of the first in this country, if, indeed, it wasn't *the* first, to make extensive use of wireless for enabling headquarters to keep in touch with constables on their beats. The Brighton authorities have now found another useful application for the radio valve, this time in conjunction with microphone and loud speaker. At some dangerous corners in the town police are stationed, provided with special equipment which ought to be very effective. The instrument, which is light enough to be carried in one hand, consists of a combined microphone-amplifier-megaphone, the necessary batteries being stored in a small satchel with a shoulder-strap. Should any pedestrian start crossing the road carelessly or not along the dotted lines, the stentorian voice of the law bids him think again. A first-rate idea which ought to be most useful in preventing accidents.

An Amazing Difference

IF I wanted to demonstrate to an unbeliever in the simplest, shortest and most effective way the superiority of ultra-short-wave sound reproduction over that obtainable on the medium or the long waves, I should ask for only one demonstration to be given. This would be the reception of the same fanfare of trumpets, first from a local medium-wave station and then from the Alexandra Palace transmitter. You have no doubt heard such a fanfare from a medium-wave station and have thought that it sounded pretty good. It does; but it isn't quite the genuine article. Could you hear the same thing immediately afterwards as a genuine high-fidelity transmission from the Alexandra Palace you would be amazed. I think that I have only once heard it in this way, and it has stuck in my memory as one of the most majestic and beautiful things that I have ever heard from a loud speaker.

Do They Want Quality?

Sometimes, though, I wonder whether the man in the street really cares the proverbial two hoots about quality of reproduction. In summer time you get pretty good opportunities of hearing your neighbours' sets at work as you sit in your garden or take your walks abroad. Of course, it isn't fair to judge the quality of reproduction from a distance, though you can do so as you pass by wide-open windows. I should say that nearly half the superhets that one hears are mistuned. In most instances this is due to the fact that the owners are incapable of spotting the right adjustment by ear. In a certain few mistuning may be done deliberately as an act of self-defence against the boominess and throatiness of the receiver. One finds battery sets distorting horribly owing to the semi-run-down condition of their HTB's and their owners apparently quite unaware that there is anything wrong with them. And I think that if you ask a radio dealer he will be more likely than not to tell you that the majority of his customers prefer what they call a set with a mellow tone—in other words, one which is almost entirely bereft of "top."

Some Certainly Do

Whether or not your average listener has any yearnings after good quality of reproduction there are certainly a great many people who want the very best that can be obtained. Their position in the past has been none too happy. Manufacturers, led away by the lure of the low-price market, have tended to produce receivers suitable for popular demands. If the majority demanded an instrument with no "top" and full of booms and thuds they had to be given what they asked for. From the manufacturer's point of view the man who wanted first-rate quality tended to be classed as something of a freak who was hardly worth catering for. One hopes that quality will receive more attention this year. In the past we have had the peculiar anomaly that a large part of the cost of receiving sets went towards making them capable of bringing in foreign stations, over which the average user probably spent no more than ten per cent. of his listening time, and that only a small amount was available for improving the reception of the local stations, to which ninety per cent. of listening time is devoted.

DIRECTION FINDING

A Comprehensive Manual

A THIRD edition of Keen's well-known book on wireless direction finding* has just been issued by our publishers. For many years this comprehensive manual has been regarded as the standard work on the subject, and the new edition, which has been considerably enlarged and completely revised, should be of value to all who are concerned in any way with this specialised branch of radio technology. Though largely written from the point of view of the engineer, the scope of the book is a wide one, covering the requirements of telegraphists and others responsible for use and maintenance of apparatus rather than for its design and installation. Treatment of the subject is descriptive rather than mathematical, and both principle and practice are thoroughly covered.

Much new matter is included in the present edition, and the real position regarding "blind landing" systems for aircraft—a matter about which there are many misconceptions—is made clear. Similarly, short-wave direction finding is another comparatively new subject to which a considerable amount of space is now devoted. Visual (as opposed to aural) indications of bearing are not entirely novel, but the sections dealing with the use of CR tubes and of television technique for this purpose are also new.

What may be described as the non-radio sections of the book, dealing with matters of Navigation, Map Projection and Field and Nautical Astronomy, are of obvious importance to those who have to apply wireless bearings to the navigation of ships and aircraft. These matters are of equal importance to engineers and others responsible for installation and calibration of DF stations, and the information here presented in concise form and from the wireless man's specialised point of view will save much searching through textbooks covering the various subjects.

* "Wireless Direction Finding," by R. Keen, B.Eng. Pp. 800, with 500 illustrations. Price 25s. net; by post, 25s. 9d. Published by Iliffe and Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

The Radio Laboratory Handbook, by M. G. Scroggie, B.Sc., A.M.I.E.E., which has just been issued by the publishers of *The Wireless World*, Iliffe & Sons Ltd., at 8s. 6d., is the only authoritative handbook on the equipment of a wireless laboratory. It should be particularly valuable to students and teachers in technical colleges, for, although it covers all that is necessary for advanced work and should, therefore, appeal to laboratory engineers, the standard of knowledge assumed is by no means too high to render the book unsuitable for the keen amateur.

The publishers have also just issued a fourth edition of the **Wireless Servicing Manual,** by W. T. Cocking. This manual, price 5s., which is a reliable, practical guide on servicing for both amateur and professional, has been thoroughly revised and enlarged by some 50 pages.

THE WIRELESS INDUSTRY

THE NATIONAL RADIO AND TELEVISION SERVICE COMPANY, of 155-7, Great Portland Street, London, W.1, is shortly to enter the manufacturing side of the industry with a series of components, receivers and PA equipment. The trade service section and American components department will carry on as before.

R.M. Electric, Ltd., has taken showrooms at 3, Hammersmith Road, London, W.14 (opposite Olympia), for the period of the Show.

Copies of the RCA Receiving Tube Manual, which contains 192 pages of working data relating to American valves, as well as four chapters on valve functions, are obtainable for 1s. 8d., post free, from Holiday and Hemmerdinger, 74, Hardman Street, Deansgate, Manchester, 3.

The many uses of the Clix Switch Plug Unit, which, though originally intended for extension speaker switching, has a number of other applications, are described and illustrated by circuit diagrams in a pamphlet issued by British Mechanical Productions, Ltd., 79a, Rochester Row, London, S.W.1. Copies will be sent free to readers.

The permanent PA installation recently fitted at Exeter Airport comprises a 50-watt amplifier, feeding 8 speakers. Grampian apparatus is employed.

Alexander Black, Ltd., has issued a leaflet describing the hire service for sound amplifying equipment that is conducted by this firm. Charges for large and small PA vans for various periods have been fixed.

Leyland Radio Transport Company, 6, Rue Marbeuf, Champs-Elysées, Paris (8e), have been appointed agents for Ekco testing and measuring equipment in France.

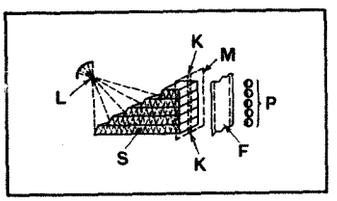
Masteradio, Ltd., of Newton Street, High Holborn, London, W.C.2, has issued a book on the installation of car radio receivers. Copies (price 1s.) are available on the firm's stand (No. 86) at Olympia.

Recent Inventions

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

SCANNING FOR TELEVISION

INSTEAD of using a rotating disc or other moving device for scanning, a ray of light from a rapidly interrupted source L is passed through a stationary stack S of glass plates. These are of different lengths and introduce a progressive lag or delay, so that each flash from the lamp L emerges, not simultaneously, but



Scanning system using stack of glass plates to break up light beam.

broken up into a series of separate "spots." To increase the length of travel through the glass, and therefore the lag effect, the light is made to travel in a zigzag path by internal reflection, as shown in dotted lines, thus reducing the size of the stack required.

The emerging ray, now broken up into a succession of spots, passes through a slot K in a screen M, which is moved transversely across the face of the film to be televised. The light then energizes a series of photo-electric cells P, which may be replaced by a photo-sensitive "mosaic" screen.

At the receiving end, a similar scanning device is used, in combination with a lamp which is "flashed" at the same speed as the lamp at the transmitter. The resulting signals are passed on to the viewing screen through a rotating shutter, which is driven by the alternating current used to supply the flashing lamp.

O. Von Bronk. Application date, October 8th, 1936. No. 484706.

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CATHODE-RAY TUBES

THE usual control-grid or Wehnelt cylinder of a cathode-ray tube is replaced by a hollow cone, arranged with its larger end close to the anode, and its smaller end near the cathode.

It is stated that the electric field between the inner surface of the hollow cone and the nearby anode is substantially zero, particularly towards the narrow end of the cone. For this reason any signal voltage applied to the conical grid will exercise a more decisive control than usual upon the stream. At the same time, the distribution of the field between the anode and the larger end of the cone is such as to concentrate the stream along the centre axis, thus causing a larger number of electrons to be drawn through the aperture of the anode towards the fluorescent screen.

Ferranti, Ltd., and J. C. Wilson. Application date November 16th, 1936. No. 485111.

TUNING CONTROL

IN systems of automatic tuning, the action of the "control" is confined to correcting an initial setting or approximate tuning, and the action in automatic selectivity-control is of the same "marginal" kind. Both refinements serve no useful purpose when the tuning of the set is being changed over from one station to another.

According to the invention, the main tuning-control knob switches out the "automatic" control as soon as it is operated by hand, and restores it when the "inter-station" movement is finished. The loud speaker may simultaneously be disconnected, so as to "mute" the set, a visual tuning-indicator being brought into circuit meanwhile. Alternatively, these various operations may be effected by a deliberate push or pull on the manual control knob.

L. L. de Kramolin. Convention date (Germany), August 13th, 1935. No. 485285.

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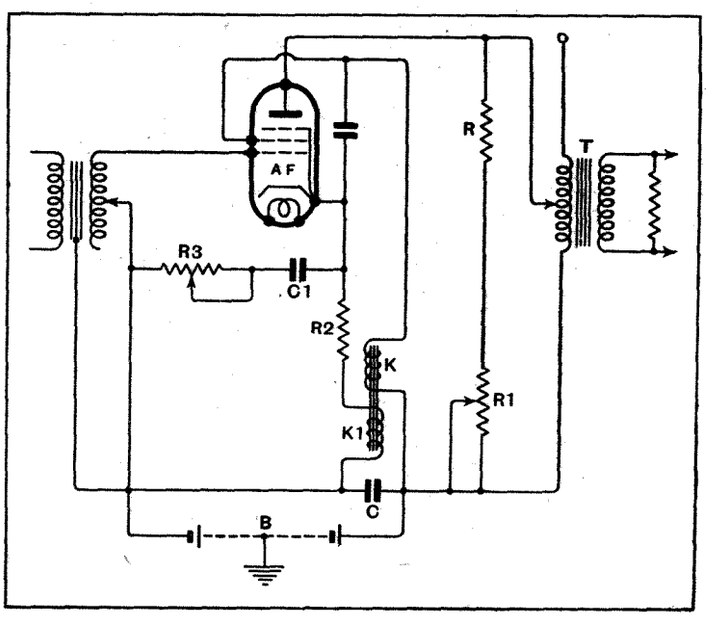
NEGATIVE FEED-BACK

THE pentode amplifier shown in the drawing allows the use of a variable amount of negative feedback (sufficient to give a wide range of gain-control) without varying the bias on the control grid, or affecting the output capacity of the amplifier, or reducing



Negative feed-back circuit which does not affect the power output capability of the valve.

the undistorted power it is capable of delivering.

The output circuit consists of two branches, one containing the series resistances R and R1, and the other the primary of the output transformer T. The screen grid is fed from the HT source B through a choke K.

The DC plate current returns to the cathode through the choke K1 and resistance R2, and provides a steady biasing voltage for the control grid. The alternating component from the anode returns through condensers C and C1 and a variable resistance R3, which is adjusted to regulate the negative or gain-reducing feed-back applied to the grid. The impedance of the chokes K, K1 is made sufficiently high to prevent any appreciable shunting of the alternating currents used for the negative feed-back.

Standard Telephones and Cables, Ltd., and J. O. Smethurst. Convention date (U.S.A.), March 30th, 1937. No. 484980.

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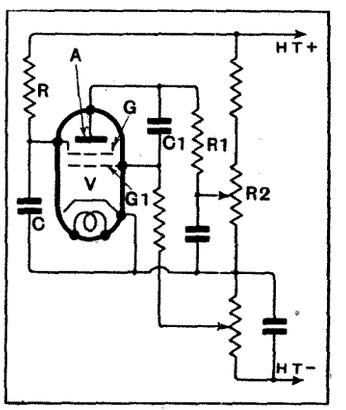
TIME-BASE CIRCUITS

SAW-TOOTHED oscillations, as used for scanning in television, are produced by a valve in which at least a part of the discharge stream is due to secondary emission.

As shown in the drawing, the condenser C is charged comparatively slowly through a resistance R from a source HT, and is rapidly discharged through a "hard" valve V of the screen-grid type. As the condenser charges up, a point comes when the voltage on the screen grid G initiates a current from the cathode to that grid. The anode A is coated with a substance promoting secondary emission, and as soon as the first electrons reach the anode, a secondary stream commences between the anode and the screen grid. This, in turn, produces a flow in the external circuit containing the resistances R1 and R2. The resulting voltage drop across R1 applies a positive charge to the control grid G1, over the condenser C1, and this further accelerates the electron flow through the valve. The result is that the main condenser is discharged in an "impulsive" manner to give a rapid "flyback" stroke.

As the voltage across the condenser C sinks to zero, the secondary stream from the anode A to the screen grid G falls off, thus transferring a negative pulse to



Saw-tooth oscillation generator using a "hard" valve.

the control grid G which rapidly restores the valve to its non-conducting state.

Standard Telephones and Cables, Ltd., and D. H. Black. Application date, November 16th, 1936. No. 485120.

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AN ELECTRON MICROSCOPE

AN image of the object to be magnified is first projected by X-rays (or ultra-violet light) on to the photo-electric cathode of a cathode-ray tube. The electrons liberated from the cathode are then passed through an electron-optical "lens" (such as an external magnetic coil), which throws an enlarged image on to the fluorescent screen of the tube.

In order to increase the illumination of the final image, particularly when very high magnification is desired, the fluorescent screen is replaced by a photo-electric "mosaic" screen, similar to that used in the Iconoscope television transmitter. This produces an electric image of "point charges" which are not, of course, directly visible. They are now scanned by an electron stream, and the resulting output currents are fed to the control grid of a second cathode-ray tube, which is energised from the same time-base as the first. The second tube is fitted with a fluorescent screen on which the final image is shown at a high level of illumination.

Zeiss Ikon Akt. Convention date (Germany), October 2nd, 1936. No. 485264.