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Wavelength Allocation in Europe.

THE Annual Conference of the International Committee of Radio Communications, which this year is meeting at Copenhagen from May 27th to June 8th, should prove to be an interesting session which will serve once more to focus the attention of those concerned in broadcasting development in Europe on the problems arising out of the multiplicity of stations. The International Committee will seek to find a solution to these difficulties.

The present meeting is intended to pave the way for an International Conference which it is proposed to hold in Madrid next year for the purpose of putting through international agreements on questions affecting broadcasting development.

The Copenhagen Conference is to bring to the attention of engineers recent advances in radio technique, especially where these are applicable to broadcasting, but most interesting of all is the intention of the Committee to discuss the possibility of widening the broadcasting band and opening up more long-wave channels to accommodate high-power stations. It will probably be recommended that extended use should be made also of the short waves, even to the ultra shorts below 10 metres, in view of the success of the tests which have recently been carried out in Germany.

A New Long-wave Station?

From our own point of view, one of the most interesting results of the Conference may be to facilitate the allocation of an additional long wavelength for this country so that we may have an alternative programme to our present 5XX, on the lines which have been frequently recommended by us.

It is not surprising that opinions appear to be fairly unanimous that the importance of broadcasting justifies an extension of the channels available so as to allow for the inclusion of more stations. Shipping and other services have been comparatively little interfered with in their allocation of wavelengths since the days of spark transmitters, yet improvements both in transmitting and receiving gear should have enabled these services to operate within much closer limits, and their allocation of wavebands would to-day appear to be excessive.

A New Superheterodyne.

It is, perhaps, opportune at a time when so much attention is centred around the need for selectivity in receivers and the growing interest in foreign reception, that in this issue we describe a new superheterodyne which we can confidently put before our readers as being of outstanding merit. We would strongly recommend every reader who has not previously handled a superheterodyne receiver, or may have used one of obsolete or indifferent design, to construct this set, which has been most carefully planned with the object of giving the utmost efficiency both as regards selectivity, range and quality, whilst ensuring that, provided the building instructions are correctly followed, the constructor will have no difficulties to contend with

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REALISTIC REPRODUCTION

Hints on Quality Reception.

BROADCASTING is to-day used chiefly as a source of entertainment, and if the full enjoyment is to be extracted from it the reproduced version must be as near to the original as possible. That it should be capable of giving high quality, therefore, is the most important point in a receiver, and it is the purpose of this article to indicate the methods by which a really high standard of fidelity can be reached.

Of all the different forms which distortion may take, that known as amplitude distortion is the most unpleasant and the most common. It consists of the introduction of alien frequencies in the sound output, and it is due to some non-linearity in the apparatus; it is readily recognisable, for it makes the reproduction sound harsh, and it is most evident with large volume.

The power valve is the commonest source of this type of distortion, and a milliammeter connected in the anode circuit will not fail to show it up. For perfect reception the needle should remain quite steady during even the loudest passages of music, but it is rarely possible to attain this perfection, and a small amount of needle-flickering on very loud passages can be tolerated. Such a milliammeter is a very necessary piece of apparatus, and it should be in the possession of every experimenter; without it, it is hardly possible to adjust a receiver so that it is free from amplitude distortion.

The meter should be connected in circuit at the points marked "X" in Fig. 1, and the valve-operating conditions altered until the needle remains steady. The H.T. voltage should always be the maximum rated value for the particular valve in use, and the grid bias should be adjusted until the needle-flickering is at a minimum. The effective load impedance of the loud speaker also has a large effect upon amplitude distortion,[1] and in the case of a small triode valve it should always be about twice the internal valve resistance, whilst with a large triode output valve it may be from three to four times the valve's impedance.

THE average present-day receiver gives immensely superior reproduction to that of a few years ago, but nevertheless it still introduces an appreciable amount of distortion. A very large proportion of this distortion is quite unnecessary, and can be eliminated by the careful choice of the circuit, components, and operating conditions. Most of the factors affecting the quality of reproduction are well known, but in spite of this they are often ignored. Many valuable suggestions are made in this article indicating the points in a receiver where distortion is most likely to occur.

The Power Output.

The value of power output which is desirable is a matter of very considerable importance, since a fair degree of sound output from the speaker is necessary in order to obtain realistic reproduction. This output cannot be obtained from small valves without amplitude distortion, and it becomes necessary to use a valve or valves with not less than 200 volts for the H.T. supply in order to get first-class quality. The power output necessary depends upon the loud speaker efficiency, the volume required, the size of the room in which the speaker is to be used, and the efficiency with which the receiver amplifies low notes.

No general figure can be given, therefore, but it is usually accepted that one watt, or perhaps a fraction over a watt, is required for the best reproduction in a room 16ft. by 15ft. by 9ft. high, when a speaker of average efficiency is run at comfortable volume from a receiver which gives full amplification of the lowest notes. Where less volume is needed, as in a smaller room, an output of 600 to 800 milliwatts is often sufficient, but in very large rooms more than 2 watts may be necessary. In view of the volume which can be obtained from portable receivers, which rarely have an output greater than about 300 milliwatts, these figures may appear excessive, but it should be

[1] "Matching Valve and Loud Speaker," by A. L. M. Sowerby, *The Wireless World*, May 28th, 1930.

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remembered that they are for best quality, and that the criterion is no overloading on even the loudest passages of music.

The average power in speech is about 10 micro-watts, and if we decide that the weakest orchestral passage is to be reproduced at one-fifth of this volume we need a sound output of 2 micro-watts; or, with a speaker of 1 per cent. efficiency, an output from the receiver of 200 micro-watts. The volume variations of an orchestra, however, may be 6,000 to 7,000 times, or even more,

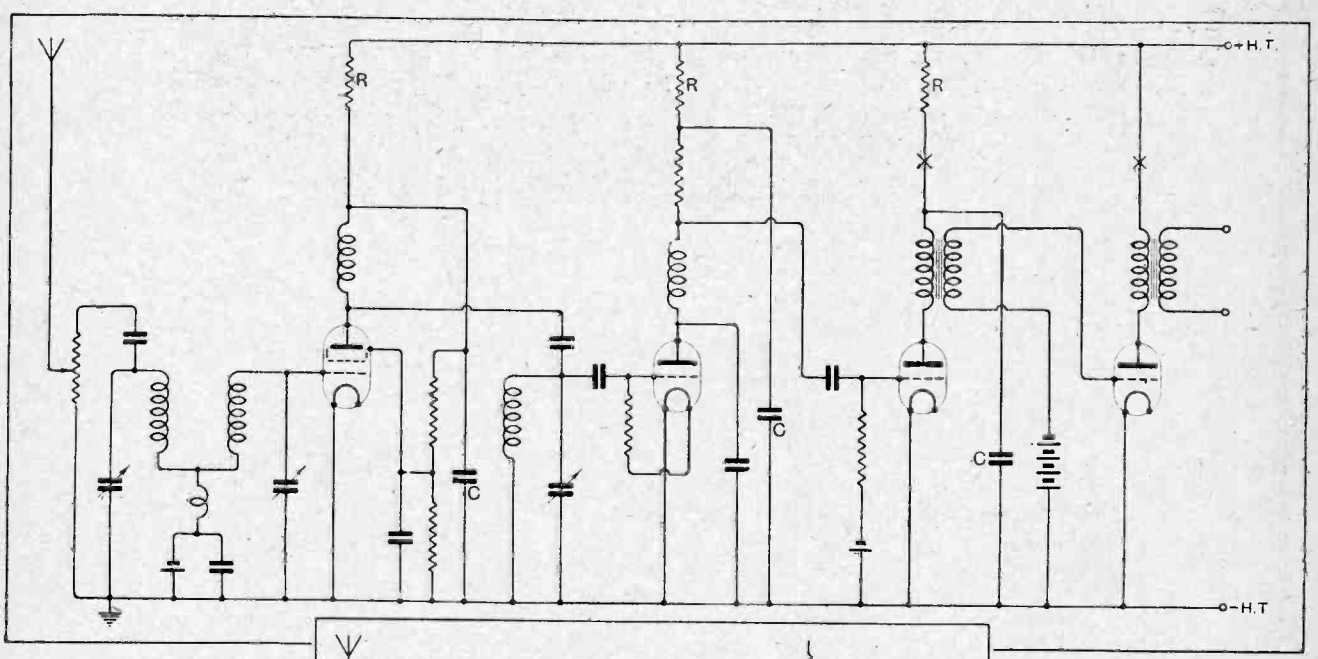

Fig. 1.—The circuit diagram of a typical receiver of the better class. Ample decoupling is provided by the resistances R in the H.T. circuits and the by-pass condensers C shunted to the filament leads.

and it is necessary for the loudest sound to be reproduced without distortion. The maximum output, therefore, must be 7,000 times 200 micro-watts, or 1.4 watts.

A single pentode valve will give an output of this order, but if triodes be preferred it will probably be the most economical to use two valves in push-pull. The choice between the two types of valve is often difficult, and which is the superior is a question which can be hotly debated. There is very little to choose between them on a quality basis, provided that each be properly adjusted; the pentode has the defect that it tends to accentuate resonances in the loud speaker, but it makes a better high-frequency response available. It usually requires a good deal of adjustment before the best results can be obtained, however, while a triode can be relied upon to give first-class quality without any critical adjustment.

The Early Stages.

By the choice of a suitable valve, amplitude distortion in the output stage can be eliminated, but care must be taken that the earlier stages do not introduce it. Many power valves need quite a large signal voltage for their operation, and this may be sufficient to overload the L.F. valve From all points of view it is usually the most satisfactory to use a low-gain L.F. stage with a small power valve of high mutual conductance. A valve of the M.L.4 type, for instance, is very satisfactory preceding an output stage which consists of two P.X.4 valves in push-pull.

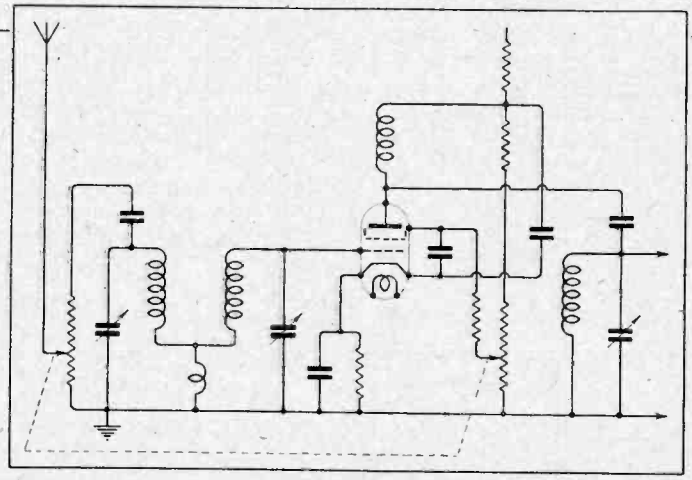

Fig. 2.—The combination of an aerial input control with a screen grid potentiometer offers one of the most satisfactory methods of volume control. Provided that the values are chosen correctly to suit the circuit used, it is quite distortionless.

Amplitude distortion can be introduced not only by the valves, but also by iron-cored transformers and chokes; and this is particularly likely to be the case where a transformer follows a valve passing a high anode current. The risk of such distortion is small with well-designed components, but it can be made negligible by adopting the resistance-condenser feed circuit for the intervalve coupling.

The detector will certainly introduce amplitude distortion unless it be carefully designed. Anode-bend

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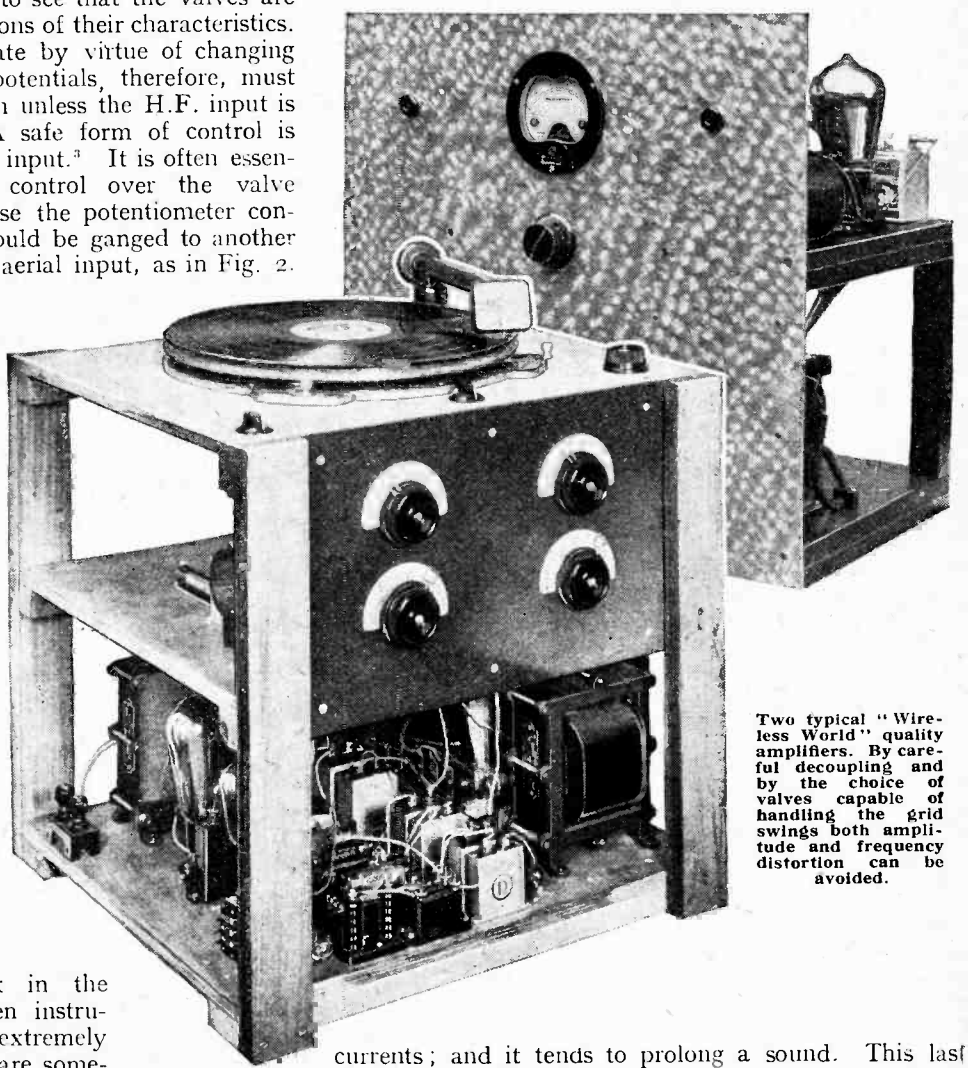
rectification is not satisfactory where the best quality is desired, and the power grid detector must be used. Little need be said about its adjustment here, for it has been very fully dealt with in *The Wireless World*.[2] It is important, however, to avoid detector overloading as the distortion is very noticeable; detector underloading, on the other hand, although it theoretically introduces distortion, is not nearly so important, and quite large departures from the optimum conditions can be made without any noticeable deterioration in quality.

Overloading in the H.F. stages must be avoided, and so care should be taken to see that the valves are operated upon the linear portions of their characteristics. Volume controls which operate by virtue of changing the grid-bias or screen-grid potentials, therefore, must be looked upon with suspicion unless the H.F. input is controlled simultaneously. A safe form of control is one operating upon the aerial input.[3] It is often essential, however, to have some control over the valve amplification, and in this case the potentiometer controlling the screen voltage should be ganged to another potentiometer controlling the aerial input, as in Fig. 2. There is little risk of such a ganged control giving rise to distortion; for, while the reduction in screen volts operates to reduce the voltage-handling capacity of the valve, so the input voltage is reduced by the aerial control.

Frequency Distortion.

So much has been written about frequency distortion, and the necessity for an even response curve between the limits of 50 and 5,000 cycles, that little need be said here. It is readily possible to build an L.F. amplifier which meets the most stringent requirements, and by the use of band-pass filters the high-note loss in the tuning circuits can be kept as small as desired. The loud speaker is undoubtedly the weakest link in the chain, but a carefully chosen instrument is capable of giving extremely good results. Most speakers are somewhat weak in the bass register, below about 60 cycles, and it is sometimes helpful to increase the amplification of these frequencies above normal. This may readily be done with the resistance-condenser fed transformer circuit by choosing a value for the feed condenser such that it resonates with the transformer primary at a frequency between 40 cycles and 60 cycles.[4] When this is done an extra careful watch should be kept upon the output valve, as the input at low frequencies will be even larger than usual, and overloading will occur somewhat more readily.

L.F. feed-back and motor-boating must be avoided like the plague; not merely because the sound of motor-boating is itself unpleasant, but because any tendency towards it causes considerable distortion. This distortion is of two kinds; it alters the frequency characteristic, chiefly at low frequencies, for it may increase or decrease the bass, depending upon the phase of the feed-back currents; and it tends to prolong a sound. This last effect is not noticeable on a sustained musical note, but it may become very evident on music in which there are sudden changes in volume, such as in the piano or in staccato playing on the violin; in other words, L.F. feed-back has a very bad effect upon the reproduction of transients.



Two typical "Wireless World" quality amplifiers. By careful decoupling and by the choice of valves capable of handling the grid swings both amplitude and frequency distortion can be avoided.

It is by no means difficult to eliminate feed-back by adopting the anode feed-scheme of H.T. feed supply,

[2] "Power Grid Detection," *The Wireless World*, May 7th, 1930; "Choosing a Detector Valve," November 26th, 1930; "Comparing Detector Valves," April 22nd, 1931.

[3] "Controlling Volume," *The Wireless World*, Feb. 25th, 1931.

[4] "The Parallel-fed L.F. Amplifier," by F. Aughtie and W. F. Cope, *The Wireless World*, December 11th, 1929.

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in which each valve is isolated from the others by resistance R and condensers C, as shown in Fig. 1. It is sometimes necessary, however, to use a somewhat higher H.T. voltage in order to compensate for the voltage-drop in the resistances, but this is rarely troublesome in a mains-operated receiver.

Transients.

Now, all frequency characteristics are taken in the steady state, that is, they are applicable accurately only to the amplification of pure sustained notes. Music, however, is largely made up of transients, of sudden and abrupt changes of volume, and it is well known that electrical apparatus responds quite differently to this state. The average loud speaker is an extraordinarily poor reproducer of transients, and the receiver itself will introduce a large amount of distortion.[5]

It is this distortion which renders the reproduction of noises so difficult, but while it is at present impossible to obtain anything approaching perfect reproduction of transients, matters can be improved to some extent at least. If we study the conditions necessary for the good amplification of transients we find that in a resistance-coupled L.F. stage it is necessary to employ a large-value coupling condenser together with a high-resistance grid-leak. Similarly, in a choke- or transformer-coupled stage, the inductance must be very high and the valve must have a very low internal A.C. resistance.

[5] "Transients in Loud Speakers and Amplifiers," by Dr. N. W. McLachlan, *The Wireless World*, August 7th and 14th, 1929; "The Distortionless Amplification of Electrical Transients," by C. W. Oatley, *Experimental Wireless*, May, 1931.

Now, a 0.005 mfd. condenser and a 2 meg. leak or a 100-henry transformer with a 10,000-ohms valve will reproduce down to 50 cycles quite perfectly in the steady state and no improvement is needed. If now we change the coupling condenser to 0.1 mfd. we find a distinct improvement in quality, provided that we are not troubled with grid blocking, even though the transmission contains no notes of lower frequency than 50 cycles. With a transformer-coupled stage, also, we find that the substitution of an instrument with a primary inductance of 200 henrys, together with a valve of some 5,000 ohms resistance, gives better quality.

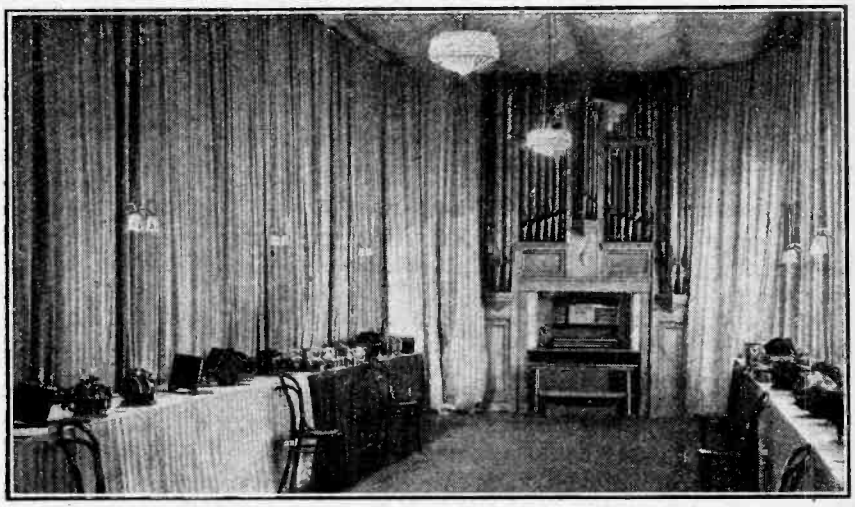
This change can only affect the transient reproduction, and so we reach the conclusion that, although the speaker itself may badly distort transients, improvements in the receiver are quite noticeable. It is well known that it is not always the speaker with the best steady state frequency characteristic which gives the most pleasing results, and it is believed that the reason for this is bound up with the question of transients.

It will be seen, therefore, that the primary requisite for the attainment of realistic reproduction is the elimination of amplitude distortion, and, secondly, the provision of a good, steady state frequency characteristic. If the best possible quality be desired it is necessary to go somewhat farther and to design the amplifier so that it will give as little distortion as possible on transients. This may be done by so designing it that it has a very good high-frequency characteristic and that it will respond in the steady state down to 20 cycles or so, while extreme care must be taken to avoid L.F. feed-back. The loud speaker should be chosen with care, and the best results are undoubtedly obtained with a really good specimen of the moving-coil type, although there are many examples of the reed-driven variety which are only slightly inferior.

A WELL-EQUIPPED DEMONSTRATION THEATRE.

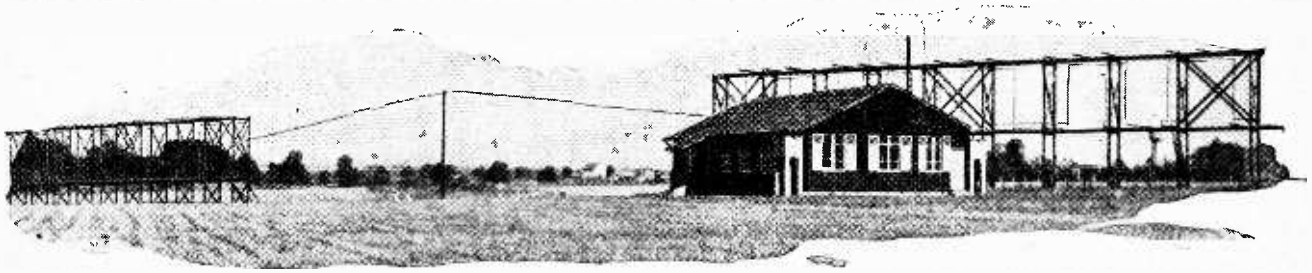
IN order that customers may have an opportunity of making a direct comparison between electrically-reproduced organ records and the real thing, Messrs. W. Bayliss, Ltd., Sheepcote Street, Birmingham, have installed recently a two-manual pipe organ in the demonstration room at their works. Behind the organ is a large baffle carrying four moving-coil loud speakers of different diameters and characteristics. Each loud speaker unit is fed with a selected band of frequencies through its own amplifier, the combination giving reproduction of extraordinary power and realism. The reproduction of pedal notes is quite equal to the standard set by the pipe organ both in quality and volume, whilst the treble is no less effective.

The room, which has a total length of 115ft., is heavily draped to deaden reflection from the walls. Bayliss converters and components are on view, and in the near future it is hoped that arrangements will be made to display the products of other firms, in order that visitors to the Midlands may have an opportunity of hearing demonstrations under ideal conditions. A private car park is available for the use of visitors.



Showrooms of Messrs. W. Bayliss, Ltd., in which a two-manual pipe organ has been installed for comparison with electrically-reproduced gramophone records.

NEW TELEPHONY SYSTEM



Short-wave Single Side-band Duplex Working.

THE "single side-band" system of telephony was first applied some years ago to carrier communication on wire lines, its chief advantage in this connection being that twice as many speech channels can be put into the same total band width as when using direct modulation with both side-bands. Since that date it has also been applied with considerable success to radio telephony on long wavelengths, in particular to the long-wave New York—London commercial telephone circuit.

With the high-power water- or oil-cooled thermionic valves now in use, the factor limiting transmitter output is the peak current or peak voltage on the plates of the valves in the last stage of the transmitter. When this condition applies, it can easily be shown that, for a given peak power, an antenna gain in signal-to-noise ratio of at least 9 decibels is obtained by using the single side-band system, as compared with the use of transmitted carrier and two side-bands.

A further advantage, important in the case of a high-power transmitter, is the reduction of the power consumed when the carrier is suppressed. The anode currents are quite small in the absence of modulation, rising to peak values at intervals during speech, and giving an average power consumption considerably less than that of the transmitted carrier method, where the anode currents do not change during modulation.

A DESCRIPTION of the apparatus used in a recent demonstration witnessed by a member of the staff of "The Wireless World" and given publicly at the experimental station of the Matériel Téléphonique at Trappes, near Paris, by engineers of that company in co-operation with engineers of the International Telephone and Telegraph Laboratory through the Radio Station of the Spanish National Telegraph Company, of Madrid.

Difficulties of Application to Short-wave Work.

The single side-band method has never previously been applied commercially to short wavelengths. The reason for this delay in what might seem to be an obvious application of the older art to the wavelengths now in use is probably two-fold. In the first place, at any rate until recently, the saving of band width has not been a very important consideration on short wavelengths. The second reason has been the great technical difficulty involved in producing local oscillators which, while re-supplying the carrier frequency at the receiver would be sufficiently steady in frequency to synchronise with the suppressed carrier at the transmitter. If the re-supplied carrier frequency differs from the original carrier by more than about 20 cycles per second, noticeably bad quality results, even when judged by the standards of "commercial" speech. At the longer wavelengths the synchronising problem presents no difficulty, necessitating merely a precision of one part in 3,000. On a wavelength of 15 metres, the precision required amounts to one part in one million, a degree of frequency stability which is difficult to obtain on a "commercial" basis, even when using the most modern methods hitherto known.

Fading.

(1) Short-wave fading may be divided roughly into two types: Synchronous fading, in which the rise and fall in amplitude of all frequencies throughout the particular band is simultaneous.

(2) Selective fading, where the rise and fall in amplitude at the various frequencies in the range considered is more or less random.

With synchronous fading, without a local carrier oscillator, the extent of the resulting fade of the audio-frequencies is double that when a local carrier oscillator is used, the fading being expressed in decibels.

This is a fairly important advantage, although not so great as might at first appear. Modern practice in short-wave receiver design is such that the synchronous fading is already very largely taken care of by the use of some kind of automatic gain control.

It is, however, during selective fading that the suppressed carrier method gives the most noticeable improvement, for by the older method the carrier-frequency would fade out almost completely for intervals of time sometimes approaching half a second, while the side-bands remained.

Synchronising "Pilot" Wave.

The problem of sufficiently good synchronisation between the suppressed carrier at the transmitter and the local oscillator at the receiver, is one of the major problems involved.

The method adopted in the new equipment for solving the difficulty is that of transmitting a continuous

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radio-frequency "pilot wave" in addition to the speech side-band. This pilot is used at the receiver to synchronise the frequency of the local oscillator, automatically using purely electrical methods. The pilot frequency lies some 400 cycles outside the speech side-band, which has a breadth of some 3,000 cycles. This avoids any appreciable increase in total band width. The band width of the pilot itself is of the order of 30 cycles so as to cater for a maximum sudden fluctuation of ±15 cycles of the carrier frequency in a period during which the synchronising circuit has not had time to take up a new stable position.

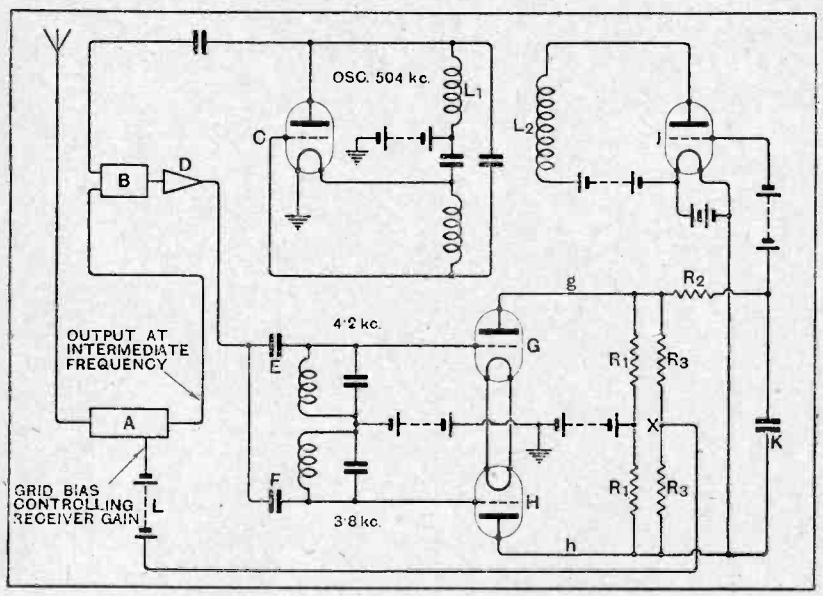

Fig. 1.—A circuit indicating the method of utilising the pilot wave from the transmitter in restoring the suppressed side-band at the receiver.

Avoiding Background Noise.

The peak voltage of the pilot is considerably below that of the side-band, to avoid reducing the power available for the side-band. As the energy in the background noise is proportional to the band-width, the level of the pilot has been fixed at 20 decibels below the side-band to have the same signal-to-noise ratio. As the latter ratio must be 10 to 15 decibels for reasonably good speech, it is evident that the pilot will also be received under conditions in which the background noise does not prevent its utilisation.

As regards the time constant of the frequency control circuit, the upper and lower limits are set by the following considerations. From the point of view of commercial speech the maximum deviation in frequency between the suppressed carrier and the local oscillator at the receiver must not exceed 20 cycles per second. The maximum time that the pilot is likely to fade out due to selective fading is about half a second, during which time the local oscillator must not drift more than 20 cycles per second from the suppressed carrier frequency. This fixes the upper limit for the rate of frequency control at 40 cycles per second per second. The lower limit is given by the maximum rate of drift of the suppressed carrier-frequency which in modern transmitters will not exceed 10 cycles per second per minute.

The method used is shown in Fig. 1. The coupling between L_1 and L_2 is less than unity, so that if the plate-filament resistance of valve J is varied, the effective inductance of L_1 (the tuning inductance of valve C) will be varied. Actually, the valve J has a low plate-filament resistance, which gives a change of about ±5 per cent. using a mean frequency of 500 kilocycles, which is amply sufficient. The method of control of the valve J is as follows: "A" represents the high-frequency amplifier, first beating oscillator, first detector, and first intermediate amplifier of the receiving set.

The resulting output at 500 kilocycles is applied to the rectifier B in combination with a little of the output of the synchronised oscillator C at which the average frequency is set (504 kilocycles); the output of rectifier B is passed through the low-frequency amplifier D, which has a resonance point at 4 kilocycles. The output of D is coupled loosely and equally to the two circuits E and F, tuning to 4.2 and 3.8 kilocycles respectively. The latter tuned circuits are connected, as shown, to the grids of the balanced rectifier system GH. The resonance curves of E and F are adjusted so that at exactly 4 kilocycles the losses due to the two circuits are equal and at a value of about 8 decibels greater than the losses at the resonance points. If, then, the frequency of C is exactly 504 kilocycles, equal voltages will be applied to the grids of E and F, thus giving zero potential difference between the two plates of G and H.

When C differs from the incoming pilot by exactly 4 kilocycles, the potential difference between the plates of G and H is applied between the grid and filament of the control valve J, the plate coil of which is coupled to the resonant circuit of C. Assume, now, that for some reason the beat note between C and the pilot signal becomes slightly greater than 4 kilocycles; the plate current of rectifier G will now exceed that of H, thus increasing the negative grid bias on valve J, raising its resistance, and hence lowering slightly the frequency of C, by this means tending to restore the beat note between C and the pilot to its original value of 4 kilocycles. The essential principle of the synchronising action will now be evident; in practice, it has been found easily possible by this circuit to cause the oscillator C to follow variations of the pilot signal amounting to plus or minus 5 kilocycles, the resulting beat note never differing by more than 20 cycles from the normal value of 4 kilocycles. Fig. 1 also explains how the time constant is introduced into the frequency control circuit. The resistance R_2 is of the order of 5 megohms, and condenser K about 20 microfarads, giving a time constant of 100 seconds between impulsive voltage fluctuations across GH and the grid filament of J.

In practice, it is, of course, impossible for the charac-

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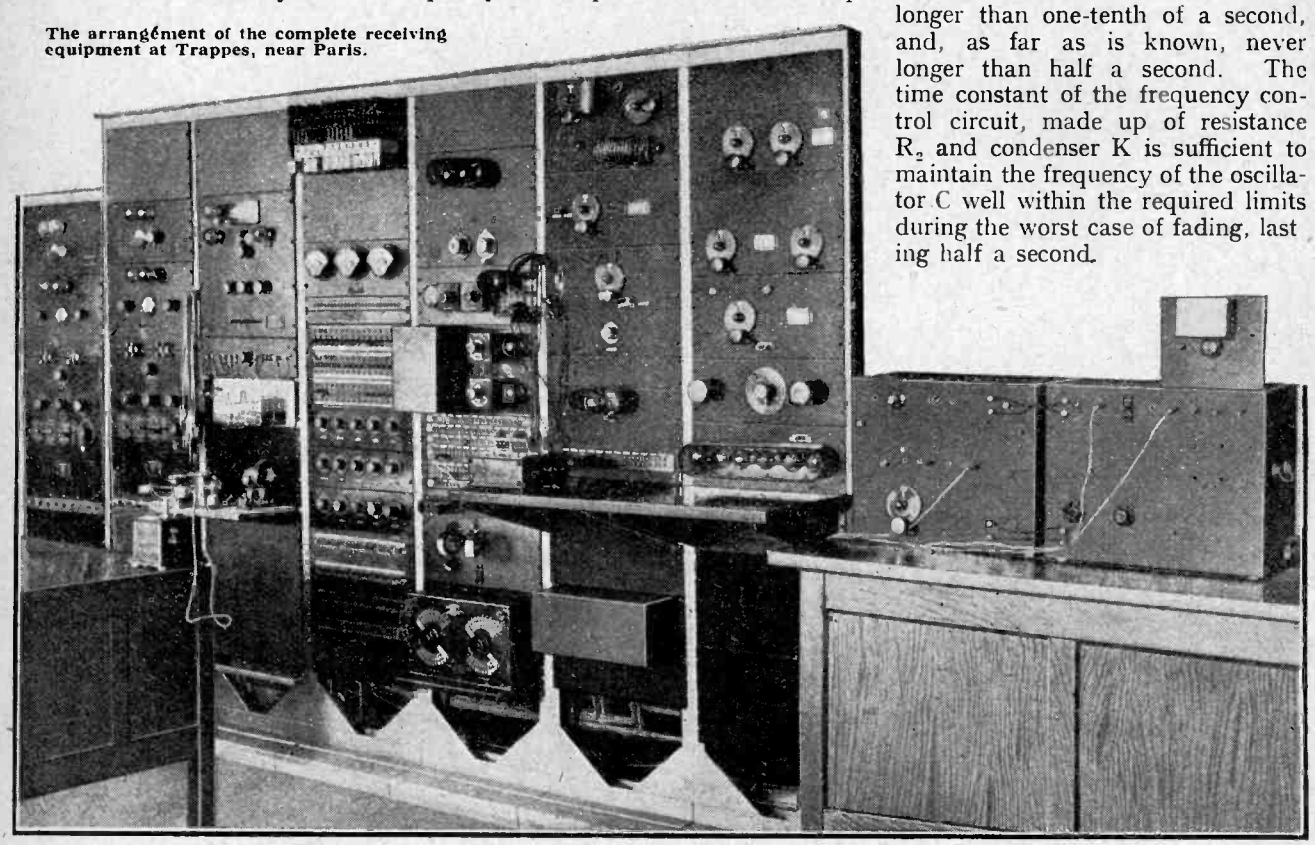
teristics of valves G and H to be really similar; in other words, if the plate currents are exactly equal for one particular case in which the voltages across E and F are equal and at a certain level, the outputs of the rectifier valves will not balance exactly when the voltage level on the grids is altered, although these two voltages may still be equal. Further, if exactly similar valve characteristics were obtainable, the precise balance condition between the two plate currents could never be used in practice. Some voltage difference is always necessary between G and H in order to give the desired frequency change on oscillator C. If, now, the frequency remains unchanged, but the level of the pilot signal is increased, as occurs during fading, the potential difference between *g* and *h* will be increased correspondingly, with the resulting tendency to change the frequency of C; i.e., the frequency of C will depend to some extent not only on the frequency of the pilot signal, but also on its amplitude—a quite undesirable effect. To overcome this difficulty, due to the above two causes, an automatic gain control has been added.

It is only necessary for a potential difference corresponding to the amplitude of the pilot signal (and not its frequency) to be used to control inversely the gain of the receiver in such a way that a very small change in this potential difference makes a considerable change in gain. To achieve this result in the circuit of Fig. 1 the resistance R_3 is added, and the potential of the mid-point X will be the average between that of *g* and that of *h*.

When the beat is in the region of 4,000 cycles, therefore, at which point *g* and *h* change inversely and almost equally with frequency change, the voltage of X will depend almost entirely on the amplitude of the pilot, and not on its frequency. X is connected to the battery L, which is used more or less to counterbalance the anode voltage of the rectifier valves, thus providing a suitable controlling grid bias for one or more valves of the receiver. By this means, when the pilot signal changes from a value only just above the noise level up to a level of 60 decibels above this point, the 4-kilocycle volts applied to the grids by E and F only change by about 10 per cent. The time constant of this automatic gain-control circuit is made short enough to follow the most rapid type of fading met with in practice.

It is now evident that it is only when the pilot falls below the noise level that continuous control of the local oscillator is lacking. The pilot at the receiver has rarely been found in practice to fall below the noise level for longer than one-tenth of a second, and, as far as is known, never longer than half a second. The time constant of the frequency control circuit, made up of resistance R_2 and condenser K is sufficient to maintain the frequency of the oscillator C well within the required limits during the worst case of fading, last ing half a second.

The arrangement of the complete receiving equipment at Trappes, near Paris.



Design of Complete Receiver.

Having now synchronised sufficiently accurately, the next question is the design of the receiver, which is shown in general outline in Fig. 2. It is clear that an ideal single side-band receiver should take account of the accurate frequency control available to reduce the band width passed by the speech circuits to the theoretical minimum of about 3 kilocycles. This can be done most conveniently by using the triple detection type of receiver, the first intermediate frequency being of the order of, say, 500 kilocycles, and the second intermediate frequency in the region of 50 kilocycles.

New Telephony System.—

The first beating oscillator is controlled by a crystal, the second oscillator being controlled automatically by the pilot signal in such a way that the resultant second intermediate frequency never varies by more than 20 cycles.

The band filters at 500 kilocycles have a margin of plus or minus about 4 kilocycles in addition to the width of the side-band plus pilot, thus giving a total band width of about 12 kilocycles; the final and high degree of selectivity is obtained by a band filter at the second intermediate frequency (50 kilocycles). As the side-band frequencies at this stage have been properly stabilised, this second band filter can be accurately adjusted to cut off at exactly the points required to pass the side-band only. The receiver actually used in the tests described here is of such a design that the second intermediate frequency is, however, in the region of 20 kilocycles rather than 50, merely because 20-kilocycle apparatus was immediately available.

The next consideration in designing the complete receiver is the question of eliminating, as far as possible, the fading of the output speech. As has been remarked before, short-wave fading may be divided roughly into two classes: synchronous and selective. During selective fading, in general, the average level throughout the whole side-band does not change considerably, and the gain of the receiver, therefore, should remain constant. When, on the other hand, synchronous fading appears, it is necessary to change the gain of the receiver inversely, and automatically to compensate this.

To minimise both the selective fading (in general of short period) and the synchronous fading (of longer period) two automatic gain controls are used, one of very short-time constant for the pilot channel only, as explained above, and the other of a time constant of the order of 30 seconds or more for the speech and the pilot channel; a fairly smooth speech level is found to result.

This type of smoothing is not perfect, however, as the assumption that the synchronous and selective types of fading have different time periods is by no means always true. The constants are not, in every case, of the optimum values, but are determined by the apparatus that was immediately available. The action of the automatic gain controls consists simply of a rapid increase in grid-bias voltage on a detector or amplifier in the earlier stage of the receiver whenever the D.C. output of the final detector to be controlled exceeds a predetermined limit. Such a change in grid bias reduces the gain of the valve in question until the final level is again at the correct value. In each case, between the output detector and the valve of which the gain is being controlled, there is inserted a time constant circuit of a value suitable to the particular function desired. The circuits A shown in Fig. 2 are built up in three sections in order to give a correct curve of output voltage against time, which is more suitable than can be obtained with a single section.

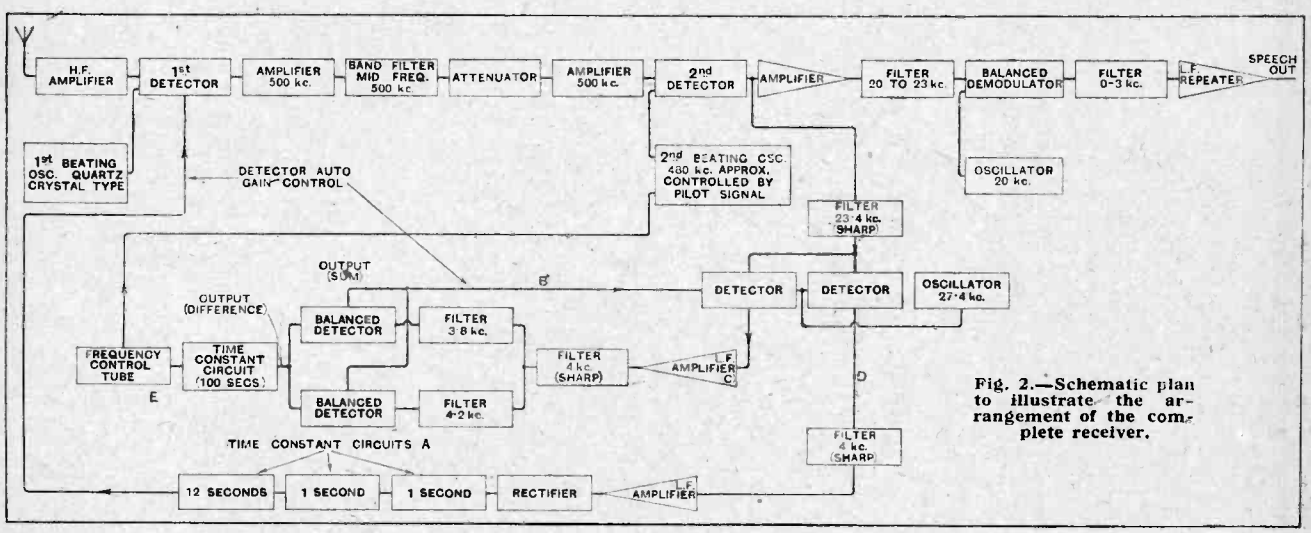


Fig. 2.—Schematic plan to illustrate the arrangement of the complete receiver.

Tests Carried Out.

During the period from April, 1930, to March, 1931, single side-band tests have been carried out over the following three links:—

(*a*) Buenos Aires to Madrid.

(*b*) Local tests at Madrid (Pozuelo to Grinon—80 kilometres).

(*c*) Madrid-Paris.

During the tests the correct synchronising action never ceased for periods longer than about a quarter of a second, and the re-supplied carrier frequency never differed by more than 6 cycles per second from the suppressed carrier. The received quality was always as good as that obtained from the double side-band, and very definitely better during bad selective fading conditions.

Speech was used at regular intervals throughout all the tests, and the results showed a perfectly commercial circuit with good quality throughout the whole period, with no interruption whatever. It was actually unnecessary to touch the receiver at all throughout the tests, except for the preliminary tuning each night.

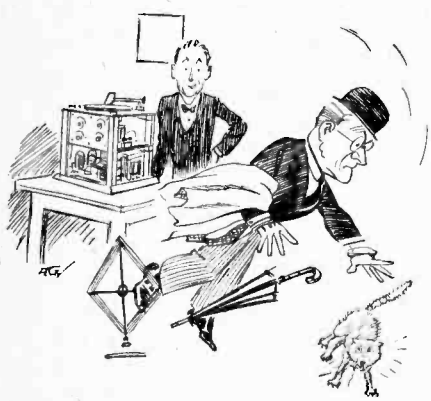
The results obtained clearly show that a system of single side-band working that is applicable commercially to short-wave links has been evolved.

Unbiased by Free Grid

Transmitters Never at Fault.

I was listening the other day, in company with a native of old Castile, who has recently been compelled to leave his country for (it is alleged) his country's good, to a gramophone record of the Prince's speech at the opening of the Buenos Aires Exhibition, and the reply of the Argentine President. My Castilian friend remarked that the Prince's pronunciation of Spanish was considerably better than that of the President's. This statement rather startled me at first, and I began to wonder whether the grid-biasing arrangements of the recording amplifier at Buenos Aires had not gone wrong at the moment the President commenced to speak, thus giving my friend a false idea concerning his pronunciation of Spanish, which was, after all, the man's native language.

I put this point to my friend, but he quickly explained that the brand of Spanish spoken in South America bears no more resemblance to the language "as she is spoke" by the well-educated native of Spain than the language of the U.S.A. does to the King's English. This goes to show that things are not always what they seem, and it is not always our receiver or loud speakers that are at fault. I have even heard it said that when the B.B.C. piano sounds like a Jew's harp it is just possible that the B.B.C. transmitter is responsible and not our sets. In fact, as one well-known radio engineer with war-time experiences still fresh in his memory said to me rather profanely the other day: "Our Johnny seems to be the only one in the whole company who is in step."



A furtive frame aerial.

This remark, however, savoured too much of iconoclasm for my liking, and I was constrained to rebuke him, pointing out that he was in some danger of having his receiving licence cancelled. He immediately retorted that he had already returned it to the Post Office, together with the H.F. and detector part of his equipment, asking the P.M.G. to break the news gently to the B.B.C. and to say that the L.F. part of his set was being retained for gramophone work; such men are impossible, and I did the only thing possible in such circumstances—shook the dust of his den from my feet, stumbling over a furtive frame aerial as I went.

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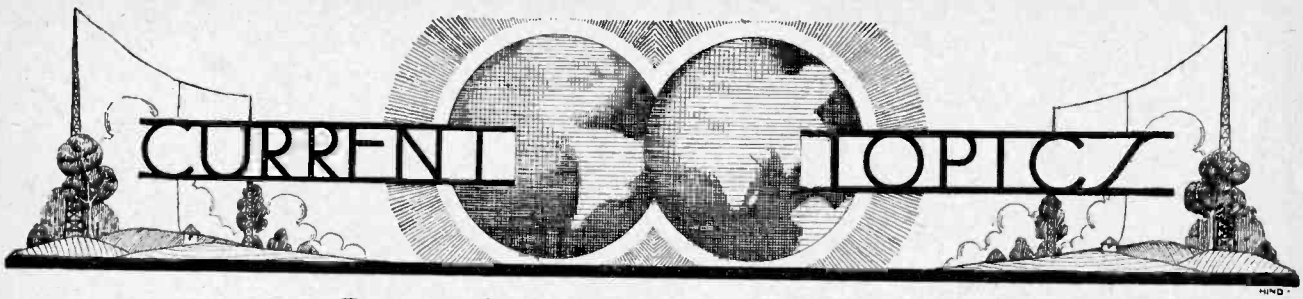
The M.C. in Agony.

I notice that in all the sixpenny stores the ordinary clock-work "cacophone" which was normally employed in years gone by at the gramophone—save the mark—counter has gradually given place to the "all-electric" variety, which, unfortunately, can be productive of an even more Bartokian effect than its "acoustic" predecessor. Seriously speaking, though, the music (*sic*) from some of these "all-electric" reproducers of gramophone records is simply dreadful, and resembles the noise produced from the mechanical monstrosities employed on Hampstead Heath on Bank Holiday. All that is visible to the eye, of course, is the gramophone turntable, the pick-up and the loud-speaker baffle. Now, I notice that the pick-up employed is invariably of a good make—nearly always the same make, by the way—and, therefore, the trouble must lie either with the amplifier or with the loud speaker.

As already mentioned, one can see only the baffle of the latter instrument, but, judging from the painful noise emitted, a moving-coil loud speaker is probably employed, because, as readers of *The Wireless World* know full well, not even the worst horn loud speaker of 1922 vintage can sound so awful as a *bad* moving-coil instrument, or a good one fed from a bad amplifier. Indeed, the sound of a moving-coil loud speaker in agony is one of the most heart-rending things I know and would make even a hardened trombone player green with envy.

Envy.

When in one of these establishments the other day the noise was more than usually distressing, and, my curiosity being piqued, I approached the damsel in charge, asking that I might be permitted to look at the amplifier. My request was scornfully refused, nor did she unbend when I tried to influence her by telling her how I had once paid 50 cents for the privilege of being rushed up in an express lift—sorry, elevator—to the 54th floor of her employer's head office. I can only hope, therefore, that this paragraph catches the manager's eye and that he may remedy matters in order to save the good name of electrical reproduction being dragged through the mud. At present the noise would bring a blush of shame to the brazen cheeks of a jazz-band conductor.



Events of the Week in Brief Review.

A RADIO AUCTION.

Broadcasting station KMTR at Los Angeles plans to hold a radio auction. A new telephone switchboard is being installed so that bids can be accepted at the rate of 1,000 per minute.

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ULTRA-SHORT-WAVES IN HAWAII

The ultra-short-wave movement has reached the mid-Pacific. We hear that the Mutual Telephone Company of Hawaii has begun the construction of a radiotelephone system which will link the islands on a wavelength around 5 metres.

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WIRELESS AS ANÆSTHETIC.

Broadcast reception is frequently used in hospitals in this country and America as a mild "anæsthetic" in minor operations, the patient's attention being distracted from the surgeon's knife. And now the authorities in the police clinic at Rome have installed a special receiver for this purpose. We note that headphones are employed, presumably in order that the surgeon's attention shall not be diverted from his knife.

Not even a radio fanatic would care to carry scars which he could attribute to the excellence of the broadcast programmes.

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RADIO ARREARS IN RUSSIA.

Whatever its success in other directions, the Soviet Five Year Plan appears to be unable to cope with its own standard of radio set production. According to a newly issued survey for the Two-Years' period ended in October last, only 1,267,000 radio receivers were in use in Russia, compared with the 2,500,000 which had been planned. Nor is production yet overtaking arrears, for, according to the latest figures, only about 65 per cent. of the 150,000 sets to be added between October 1st and January 1st were actually delivered.

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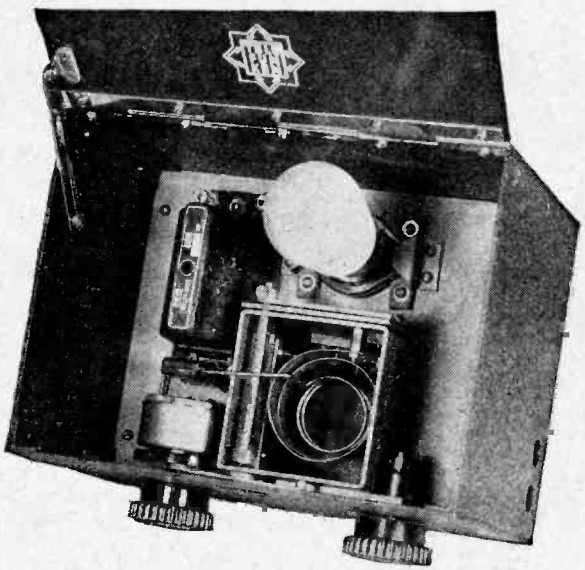
DATES FOR YOUR DIARY.

The exhibition season is still a long way off, but the dates of the two biggest shows in Britain are already fixed. The Olympia Exhibition will be open from September 18th till September 26th. The Manchester Show in the City Exhibition Hall has been fixed for October 7th to 17th.

THE BLIND LISTENER.

The British "Wireless for the Blind" Fund, for which H.R.H. the Prince of Wales pleaded so eloquently at the dinner of the Clothworkers' Company on Wednesday last, still requires a sum in the neighbourhood of £13,500 if it is to achieve its object—the provision of wireless sets to the 7,000 blind persons in this country who are still without this vital link with the outside world.

Contributions should be sent to the Fund at 226, Great Portland Street, London, W.1.



ULTRA-SHORT-WAVE RECEPTION. A Telefunken receiver for home reception of the ultra-short-wave transmissions now being conducted in Berlin and elsewhere. A description of the experimental transmissions for the reception of which this receiver has been designed, was given in our issue of May 20th. The receiver illustrated is intended to be connected to a standard amplifier or to a broadcast receiver at the terminals ordinarily employed for connection of the gramophone pick-up.

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FOR THE IRISH BLIND.

The success of the "Wireless for the Blind" Fund in Great Britain has stirred the imagination of the Irish public, and we learn that steps may be taken to start a Fund in the I.F.S.

Our contemporary, *The Irish Radio News*, remarks that the money necessary to supply every blind person in Ireland with a wireless set would not be very great, especially if the calculations brought into consideration the projected high-power broadcasting station.

PENALTIES OF PIRACY.

Our esteemed contemporary, *The Indian Radio Times*, announces that correspondents should not expect prompt replies if they do not quote their licence numbers. This is much more tactful than saying that pirates must wait.

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STILL THEY COME.

Following fast on the heels of Mr. John W. Elwood, vice-president of the American National Broadcasting Company, are Mr. William S. Paley, president, and Mr. Lawrence W. Lowman, supervisor, of the Columbia Broadcasting System. These gentlemen will sail for Europe on Saturday, June 6th, with the same intention, viz., to carry out a survey of European broadcasting.

The moment seems appropriate to repeat the remarks we made during Mr. Elwood's recent visit. If the forthcoming tour is for the purpose of extending international friendship through radio we offer the visitors a warm welcome; our attitude would be different if there were any suggestion of swamping Europe with American advertising.

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THE SILENCE OF KUKU.

A first-class mystery has developed on the American amateur transmitting channels regarding the whereabouts of KUKU. This is the call-sign of Mr. J. W. Newell, the radio amateur who accompanied the expedition to the Matto Grosso jungle region of Brazil. Since February last KUKU has been transmitting glamorous accounts of the adventures of the expedition, which is collecting natural history data for the University of Pennsylvania, and many of these vivid stories have been relayed by KDKA for the benefit of American listeners at large.

The series came to an abrupt end early in April with this message from Newell, addressed to the American Radio Relay League:—"To date we have two live jaguars, one anaconda, one ant-eater, two monkeys, parrots and mosquito birds. It is just possible that I may be compelled to leave here . . . as I have been feeling pretty low. The doctor advises it. Anyway, don't ever come to Matto Grosso!"

Nothing has been heard from KUKU since.

FRANCO-ITALIAN RADIO RIVALRY.

France's enterprise in the matter of short-wave broadcasting to her colonies has not gone unwatched in Italy, and it is hardly surprising that the Italians are now determined to connect up with their colonies by means of the short-wave link.

Unfortunately atmospheric conditions are not apparently favourable for direct communication between Italy and her colonies in Africa, and it is now realised that if the inhabitants of Eritrea and Somaliland are to keep in close touch with the Motherland, special "relay posts" will be necessary. We learn that a group of Government engineers are already on their way to Asmara (Eritrea) to construct an experimental relay station.

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NORTHERN INDIA'S FIRST BROADCASTERS.

Our recent quotation from the *Allahabad Pioneer* to the effect that the university in that city inaugurated the first broadcasting experiment in Northern India on March 9th last, has evoked a reply from a Lahore enthusiast, Mr. B. J. Silver. "For the sake of historical accuracy," he writes, "I would point out that the first pukka broadcasting in North India was started, and is still being carried on, by the Lahore Radio Club. We have a licence to use 100 watts and a wavelength of 340 metres. Regular transmissions are radiated, and we have had reports of reception up to 1,500 miles away. This is purely an amateur effort and receives no licence fees. Lahore will shortly duplicate its programme on 21 metres. Allahabad is working on 150 metres."

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"AUDIBLE JOURNALISM" IN U.S.

Once more Mahomet must go to the mountain, this time in the shape of the American newspaper interests, who are making determined efforts to "capture" broadcasting stations which have threatened to swallow up their advertising revenue. According to our Washington correspondent, the papers realise that they have little chance of obtaining permission to erect new stations, consequently their labours are directed towards acquiring existing plant.

The Federal Radio Commission has generally been favourably disposed towards newspaper ownership of stations, probably because the newspapers are almost invariably the leaders of popular opinion in their respective communities. The new movement is said to be inaugurating an era of "audible journalism."

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"THE VATICAN MYSTERY."

Recently we printed, with reservations, the "alleged schedule" of HVJ, the Vatican short-wave station, which, according to many amateurs, did not appear to be working with any regularity. A definite timetable is now observed, however, and we are indebted to the Rev. G. H. J. Horan, of the Observatoire de Ksara, Libau, for a very detailed account of the station's activities.

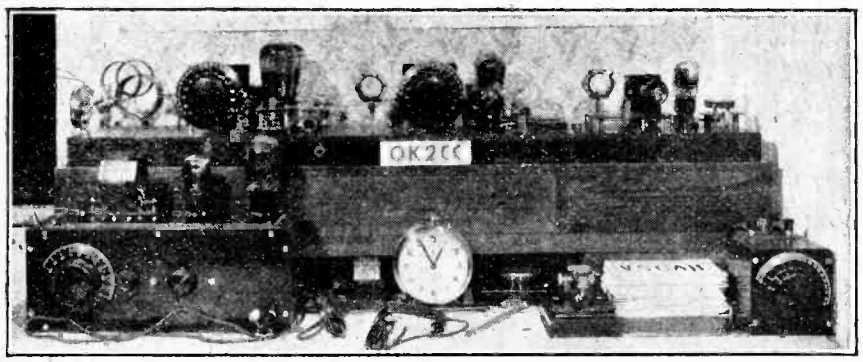
The present schedule is as follows (all times G.M.T.) :—

Week-days: 10.00 to 10.30, telephony on 19.84 metres; 10.30 to 11.00, telegraphy on 19.84 metres; 19.00 to 19.30, telephony on 50.26 metres; 19.30 to 20.00, telegraphy on 50.26 metres.

Sundays and Feast Days: 10.00 to 11.00, telephony on 50.26 metres.

Part of the evening week-day transmissions are given in Latin and Italian and part in various other languages, as follows :—

Tuesday : English.
Wednesday : Spanish.
Thursday : French.
Friday : German.
Saturday : Various other languages.



SHORT WAVES FROM CZECHO-SLOVAKIA. This compact little transmitter is owned by Mr. J. Pavlicek of Znojmo, and is often heard by British amateurs on 42 and 21 metres with a good crystal-controlled note. An input of 20 watts is used.

SPONSORED PROGRAMMES: AN AMERICAN VIEW.

While Sir John Reith's forceful speech in New York in favour of the B.B.C. system of broadcasting has received a "good Press" in this country, less attention has been paid to the challenging reply of Major-Gen. Charles Saltzman, chairman of the Federal Radio Commission, who also spoke at the conference of American educational associations.

"After listening to the advertising matter in the programmes of some stations I have heard," said General Saltzman, "there is a bond of sympathy between me and these old veteran *literati* who love to write to the newspapers in the interest of the general uplift. Even a person so callous as a radio commissioner can sympathise with them. But why doesn't the Federal Radio Commission do something about it?

"The answer is that the Radio Act says that 'Nothing in this Act shall be understood or construed to give the licensing authority the power of censorship over the radio communications or signals transmitted by any radio station.'

"The average broadcaster to-day is much in the position of a storekeeper. The storekeeper keeps on his shelves the goods that the people want to buy. In general, the broadcaster puts on the air the kind of programmes his listeners wish to hear. If you are tired of the advertising of beauty parlours or filling stations, or the merits and price of the last consignments of prunes, you can censor that programme by turning the dial to another station. If excessive and objectionable advertising causes a large number of his hearers to tune in another station, the effect will be magical on the broadcast owner."

To which we would merely add that the listener's powers of discrimination are unfairly taxed when all the stations are tarred with the same brush.

TRANSMITTERS' NOTES.

The W.A.C.s.

We understand that there are now 570 amateur transmitters in all parts of the world who have gained the coveted distinction of the W.A.C. (Worked All Continents) certificate, and of this number there are four only—one each in England, Ireland, Belgium and Australia—who have successfully communicated by radiotelephony with all the six continents.

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New Call-Signs and Changes of Address.

G2FY	H. M. Yells, 93, St. Julians Farm Road, London, S.E.27.
G2MC	T. L. McCormick, Maxton, West Parade, Bexhill-on-Sea.
G2YA	J. A. Yeats, 68, Bonaccord St., Aberdeen.
G5GS	W. Grieve, Summerford, Station Rd., New Waltham, Grimsby, Lincs (Change of address).
G5IZ	W. S. Brook, Crag View, Mavis Lane, Cookridge, Leeds.
G5NI	W. H. D. Nightingale, 20, Weoley Hill, Selly Oak, Birmingham (transmitting on 14 mC. and will welcome reports from countries outside Great Britain).
G5PX	J. Partington, Moston, Hutton Ave., Ashton-under-Lyne.
G5YN	E. Y. Nepean, Westleigh, Warminster, Wilts (Change of address).
EI7D	E. R. Mellon, 5, Templemore Ave., Rathgar, Dublin, S.2, I.F.S.
2AJC	J. H. Payton, 39, Penton Place, London, S.E.17.

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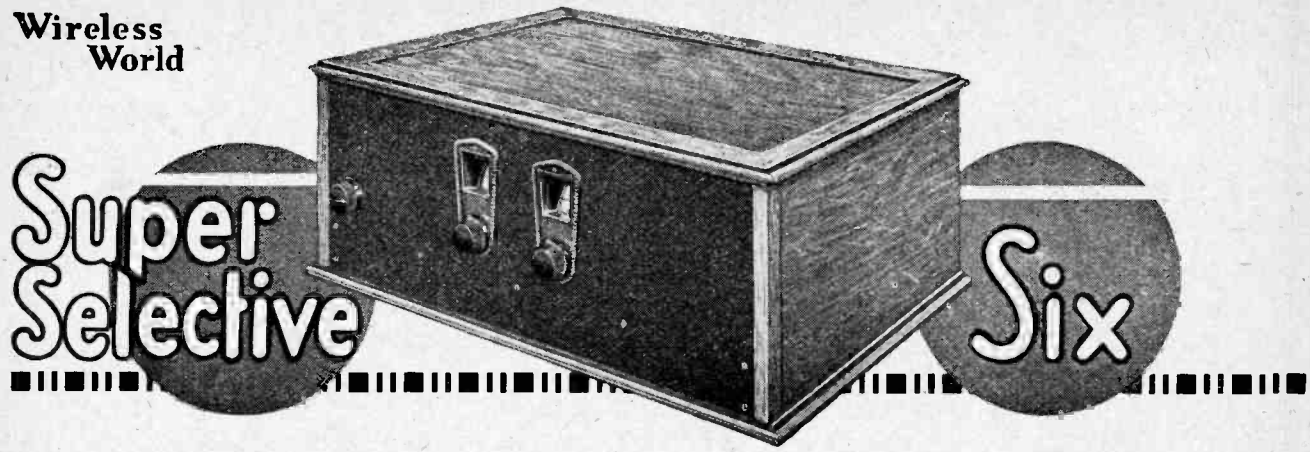
A Correction.

In the list of new call-signs and changes of address on page 516 of our issue of May 13th, Mr. C. F. Scruby's call-sign was inadvertently given as G5YW; this should read G5YU. Mr. W. Hibbert's call-sign is 2AYB (not 2AYE), and his correct address is 42, Bushey Wood Road, Totley Rise, Sheffield.

Wireless World



A.C. Band-pass Superheterodyne. A High-quality Long-range Receiver for Modern Conditions.

By W. T. COCKING.

THE primary requisite of a long-range receiver is that it should possess a very high degree of selectivity, and this is particularly the case when it is to be used within a short distance of a high-power transmitter. With the usual tuned H.F. receiver it is very difficult to obtain freedom from interference and a high standard of fidelity in the reproduction unless a large number of tuned circuits be used. The set then becomes both expensive and difficult to construct, while the initial adjustments become tedious if the original design is in any way departed from. The only alternative is the superheterodyne, with which an extremely high degree of selectivity can be obtained with the greatest ease and without loss of quality.

Although the superheterodyne is far-famed as possessing the highest selectivity and sensitivity of any type of receiver, it is often considered to be both difficult to construct and tricky to operate, and it has a poor reputation as regards the quality of reproduction. These criticisms do not apply to the modern receiver, however, for its construction is considerably easier than that of a straight H.F. set, and it is capable of giving an equally high standard of quality. On one point only is it inferior to a ganged H.F. set, and that is in its ease of operation. At the present time there are of necessity two tuning controls in the superheterodyne, since the ganging of the oscillator circuit to the pre-detector circuits has not yet been made simple enough to be employable in home-constructed receivers.

SPECIFICATION.

Five valve superheterodyne.
All A.C. mains operation with valve rectification.
Two tuning controls.
Band-pass tuning.
Ganged waveband switching.
Dual ganged volume control.
New non-radiating frequency changer.
Special circuit for cutting out long-wave interference.
Power grid detection.
Pentode power output of 1,900 milliwatts.
Special tuned smoothing circuit.
18 kc. selectivity on powerful local stations.

The Frequency Changer.

It has been shown in recent articles that a single stage of intermediate-frequency amplification will give ample sensitivity, provided that an outdoor aerial be used. In order to avoid the cross-modulation troubles introduced by an H.F. amplifier preceding the first detector it is necessary to dispense with such amplification and to design the frequency changer so that it is non-radiating.[1] This has been accomplished in the receiver described in this article, and the complete circuit diagram is shown in Fig. 1; excluding the mains rectifier, only five valves are used, as first and second detectors, oscillator, intermediate-frequency amplifier, and power output, so that the old criticism of the superheterodyne, that it employs an excessive number of valves, no longer holds good.

An AC/HL valve is used as the oscillator, and it has its anode circuit tuned in order to keep the harmonic generation low.[2] It is coupled to the anode circuit of the first detector, with the result that radiation is prevented and the coil switching is considerably simplified. The reaction coil, in the grid circuit of the oscillator, is so positioned with respect to the tuned coils that a single make-and-break-switch serves for waveband switching.

The AC/SG first detector is biased to act as an anode-bend rectifier, and is preceded by a two-stage band-pass filter for the signal-frequency tuning circuits. Inductive coupling is used in this filter in order to prevent long-wave interference when receiving on the medium waveband, and, for the same reason, the acceptor circuit (L_4, C_4) is included to prevent trouble on the 1,000/2,000 metres waveband.[3] The filter coupling is so arranged that

[1] "Frequency Changers," *The Wireless World*, May 6th, 1931.
[2] "The Frequency Changer of the Super-Het." by A. L. M. Sowerby, *The Wireless World*, October 29th, 1930.
[3] "The Selectivity of the Superheterodyne." *The Wireless World*, May 13th and 20th, 1931.

"Wireless World" Super Selective Six.—

a double-peaked tuning curve is only just obtained and the selectivity is at its highest, in order to reduce second-channel interference to a minimum. A special method of coupling is employed in which the actual coupling does not need to be altered when changing from one waveband to the other; the switching, therefore, is simplified to two make-and-break switches in the coil bases. These are linked with the oscillator-coil switch, and operated by a single control knob.

It has been found that it is difficult to obtain perfect ganging with "Aperiodic" aerial coupling, and so the aerial is connected to the primary of the filter through a 50 mmfd. condenser (actually two 0.0001 mfd. in series, C_5 and C_6). Trimmers built in on the two-gang condenser C_1, C_2, allow of the two filter circuits being matched, and, once set, the ganging holds well on both wavebands.

The I.F. Amplifier.

Two intermediate-frequency transformers are used, one as the coupling between the first detector and the AC/SG I.F. valve, and the other as the coupling between the I.F. stage and the second detector. Each transformer consists of two circuits tuned to 110 kc. and coupled together to form a band-pass filter; there are, therefore, four tuned circuits in the I.F. amplifier. Each coil has a small adjustable condenser in parallel so that exact resonance can be obtained, and the coupling between the pair of coils in each transformer is also adjustable. By this means it is possible to obtain complete control over the selectivity and quality; in practice, therefore, each circuit is tuned to resonance, and the coil couplings adjusted to give the best compromise between selectivity and quality for the particular loud speaker used.

The second detector is of the power grid type, employing an AC/HL valve with a standing anode current of 4 mA. Although this anode current may seem on the low side, the output is ample fully to load the output stage, and the low current has the advantage of permitting full de-coupling to be obtained economically. A low-pass filter, consisting of a high-inductance H.F. choke Ch_1 and two 0.001 mfd. condensers C_{18} and C_{19}, is fitted to prevent the I.F. currents from reaching the L.F. circuits, and its use is essential. It is important to note that the components of this filter must be fitted as close as possible to the detector valve-holder, in order to prevent stray couplings with other parts of the receiver, otherwise there may be instability.

The L.F. Circuits.

The L.F. inter-valve coupling is by means of a resistance-condenser-fed transformer with a step-up ratio of 4-1; the resistance R_{12} has the usual value of 20,000 ohms, but the condenser C_{21} has a capacity of only 0.05 mfd. This resonates with the transformer primary of 130H. at a low frequency, and results in notes in the neighbourhood of 60 cycles being amplified more than notes of a higher frequency. This is an advantage, since the efficiency of most loud speakers drops off in this region. At frequencies below 60 cycles the amplification drops rapidly, and as a result the effects of feed-back from the output stage are greatly reduced and less de-coupling is needed. A 20,000 ohms

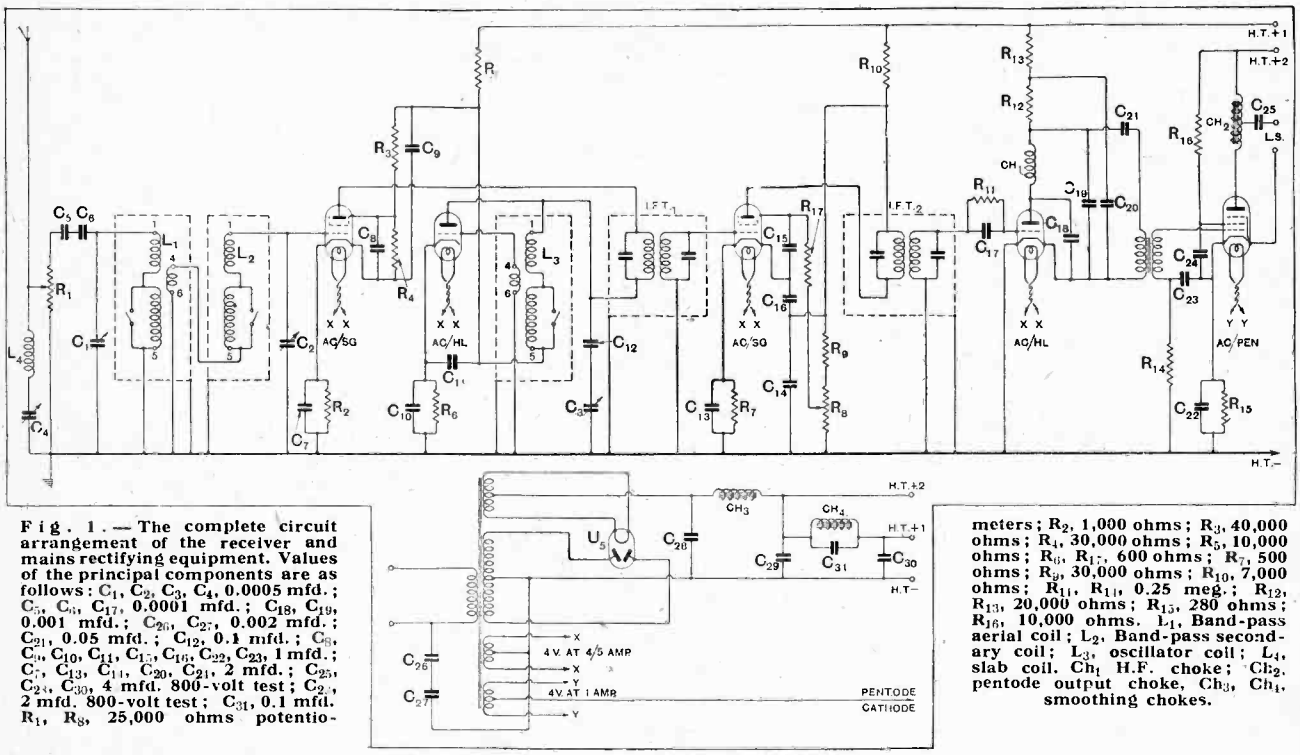


Fig. 1.—The complete circuit arrangement of the receiver and mains rectifying equipment. Values of the principal components are as follows: C_1, C_2, C_3, C_4, 0.0005 mfd.; C_5, C_6, C_{17}, 0.0001 mfd.; C_{18}, C_{19}, 0.001 mfd.; C_{26}, C_{27}, 0.002 mfd.; C_{21}, 0.05 mfd.; C_{12}, 0.1 mfd.; C_8, C_9, C_{10}, C_{11}, C_{15}, C_{16}, C_{22}, C_{23}, 1 mfd.; C_7, C_{13}, C_{14}, C_{20}, C_{21}, 2 mfd.; C_{25}, C_{24}, C_{30}, 4 mfd. 800-volt test; C_{29}, 2 mfd. 800-volt test; C_{31}, 0.1 mfd. R_1, R_8, 25,000 ohms potentiometers; R_2, 1,000 ohms; R_3, 40,000 ohms; R_4, 30,000 ohms; R_5, 10,000 ohms; R_6, R_{17}, 600 ohms; R_7, 500 ohms; R_9, 30,000 ohms; R_{10}, 7,000 ohms; R_{11}, R_{11}, 0.25 meg.; R_{12}, R_{13}, 20,000 ohms; R_{15}, 280 ohms; R_{16}, 10,000 ohms. L_1, Band-pass aerial coil; L_2, Band-pass secondary coil; L_3, oscillator coil; L_4, slab coil. Ch_1 H.F. choke; Ch_2, pentode output choke, Ch_3, Ch_4, smoothing chokes.

"Wireless World" Super Selective Six.—

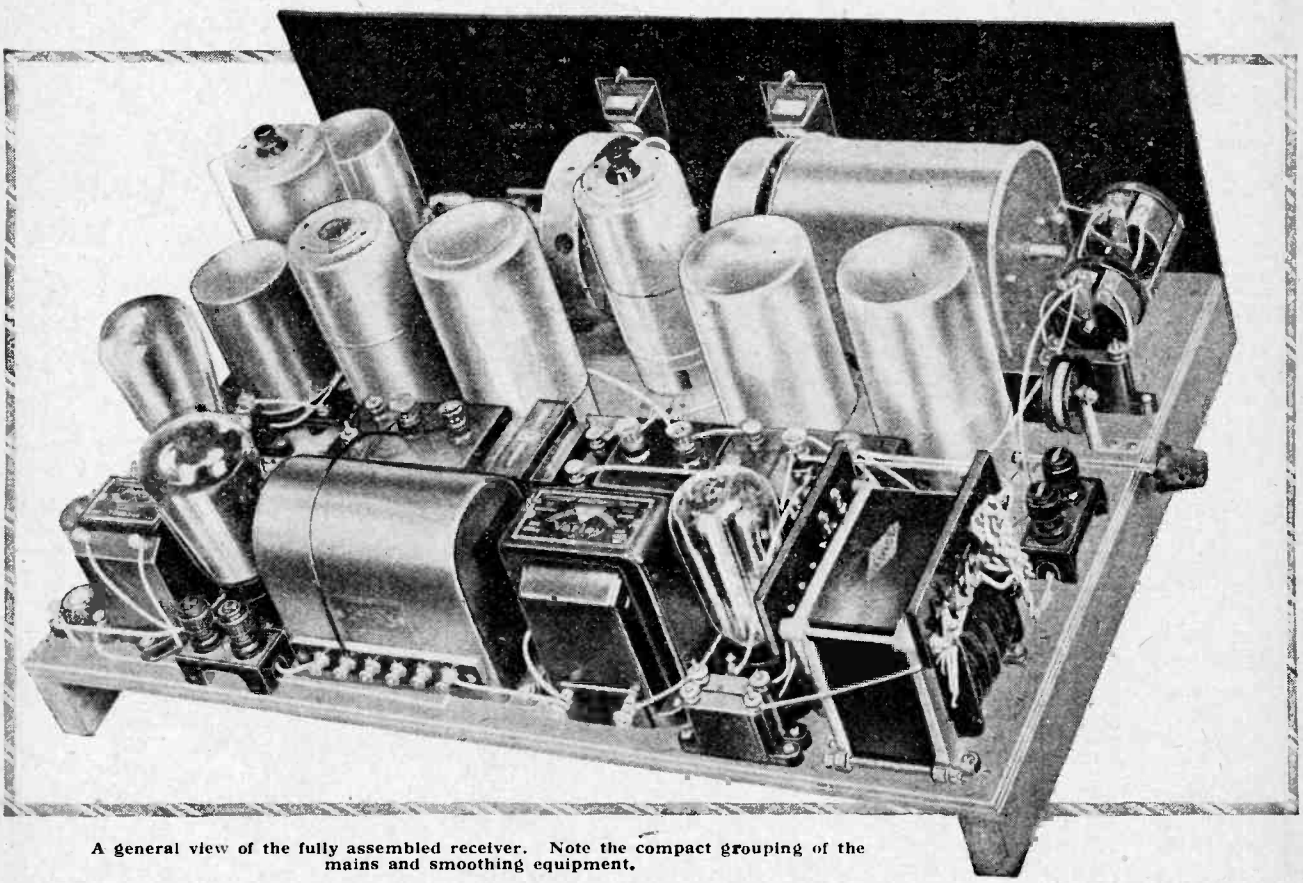
resistance R_{13} and a 2 mfd. condenser C_{20} are used for de-coupling in the detector stage.

A pentode valve has been chosen for the output stage, since it combines high efficiency with a large output, and it also has the characteristic of accentuating the upper audible frequencies. The power output is 1,900 milliwatts when the load impedance is 8,000 ohms, and it is very important that the load impedance should be correct. A tapped output choke, therefore, is used as an auto-transformer, and as four asymmetrically disposed tappings are provided it is possible to obtain as many as nine different ratios, ranging between 1-1 and 5-1, by reversing the connections to the two outer ends of the choke. With the average speaker the ratio is so chosen that the load impedance is correct at low frequencies, and this is most easily done by means of a milliammeter connected in the pentode anode circuit. If the needle kicks upwards when the valve overloads, the load impedance is too low and a larger ratio should be used; on the other hand, if the needle kicks downwards, the load impedance is too high and a lower ratio is required. When the correct ratio is found the meter needle usually wobbles about its steady position when overloading occurs.[4]

The Power Supply.

The mains transformer has windings giving 4 volts at 4/5 amperes for the first four valves and any dial lights, 4 volts at 1 ampere for the pentode, 5 volts at 1.6 amperes for the U.5 rectifier filament, and 275-0-275 volts at 60 mA. for the H.T. supply. In order to avoid trouble from that form of modulation hum due to H.F. currents in the mains a 0.001 mfd. condenser is connected between one side of the mains and earth. It is important to note that, as the ordinary type of condenser is not rated for working on 240 volts A.C., two condensers C_{26} and C_{27}, each of 0.002 mfd., are used in series for safety's sake.

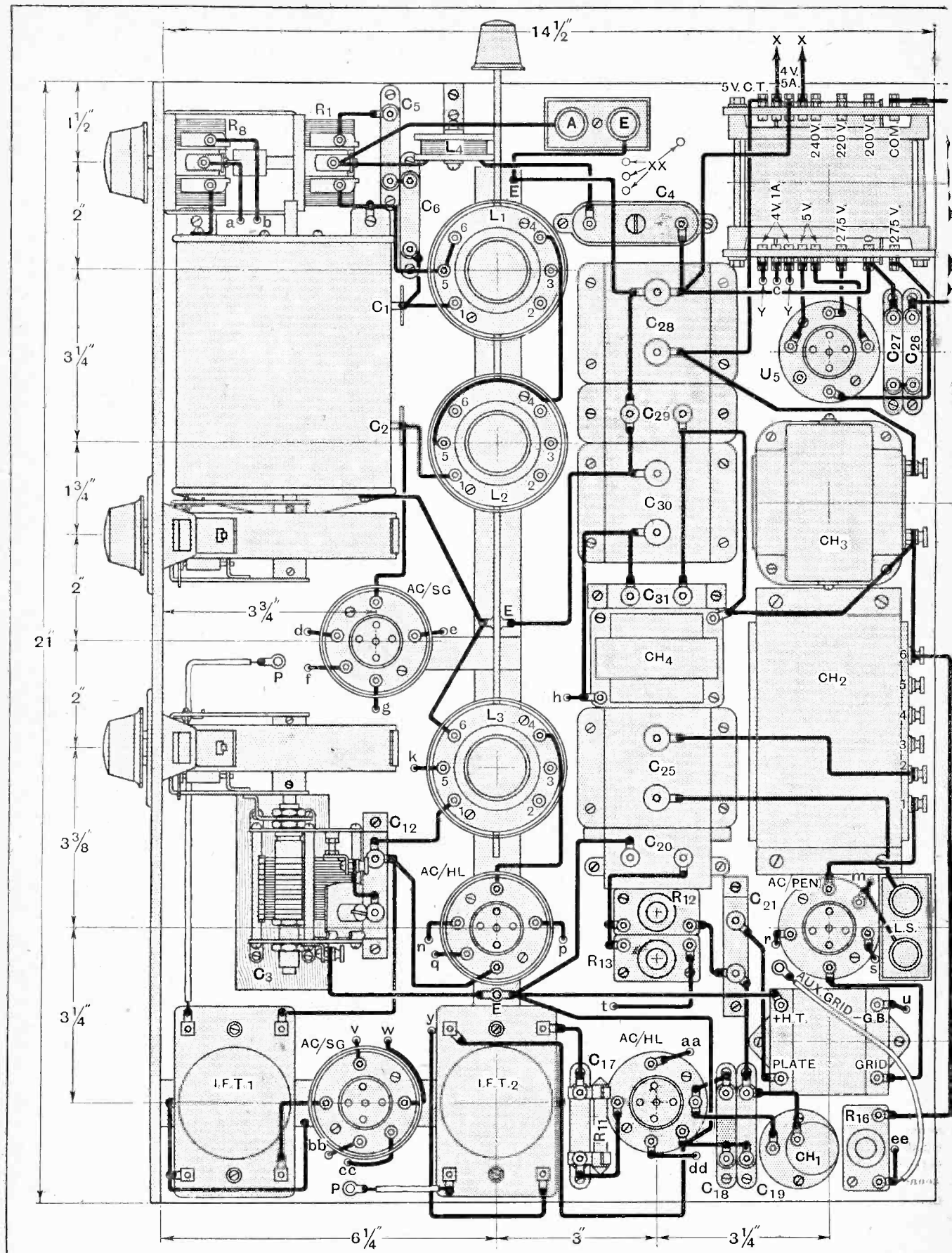
The current for the whole receiver is smoothed to the degree necessary for the output stage by the choke Ch_3 and the 2 mfd. condenser C_{29}, and the pentode H.T. supply is then tapped off. The current for the remainder of the set passes through the choke Ch_4, which has in parallel with it a condenser C_{31} of 0.1 mfd. The combination forms a parallel resonant circuit tuned to 100 cycles, which is the main hum frequency, and greatly assists in smoothing.[5] As the circuit is tuned it is important that no change should be made in the choke inductance without a suitable change in the shunt capacity, otherwise the resonance frequency of the parallel circuit will be altered and the smoothing become ineffective.

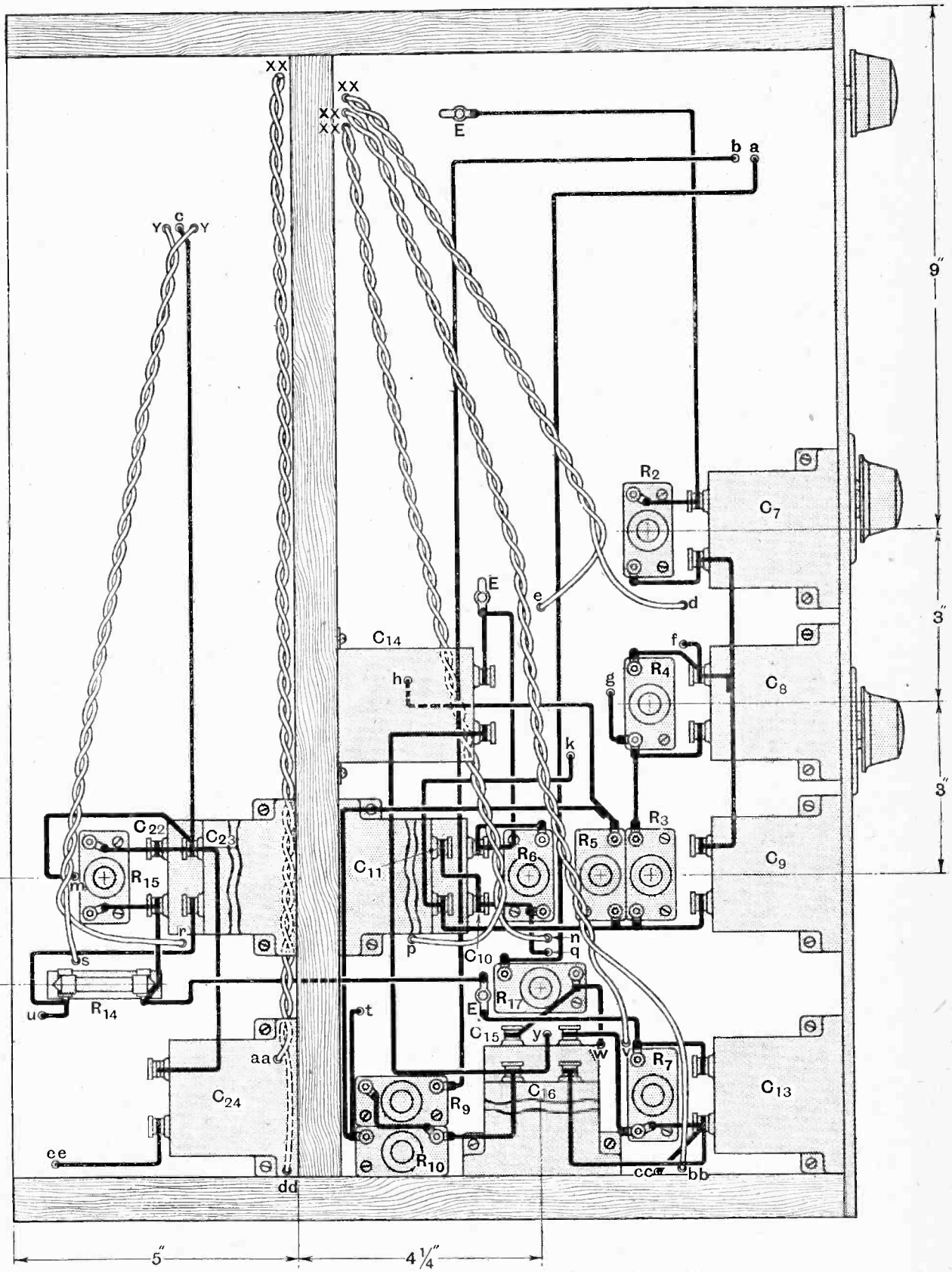


A general view of the fully assembled receiver. Note the compact grouping of the mains and smoothing equipment.

[4] "The Pentode and Power Output," by E. Yeoman Robinson, *The Wireless World*, July 23rd, 1930.

[5] Smoothing, *The Wireless World*, November 19th, 1930.





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LIST OF PARTS REQUIRED.

1 Mains transformer, primary 240 volts 50 cycles, secondaries 275–0–275 volts 60 mA, 2.5–0–2.5 volts 1.6 amp., 4 volts centre-tapped 5 amps., 4 volts centre-tapped, 1 amp. (Parmeko).
1 L.F. choke (Varley D.P.12).
1 L.F. transformer (Varley Nicore 1).
1 L.F. choke, 20/30 henrys (R. I. Hypercore).
1 H.F. choke (Wearite H.F.O.).
1 Pentode output choke (Atlas C.P.S.).
1 Two-gang condenser, 0.0005 mfd., and drum dial (Polar Tub).
1 Variable condenser, 0.0005 mfd., and drum dial (Polar Universal).
2 Grid leaks, 0.25 megohm (Ediswan).
1 Porcelain grid leak holder (Bulgin).
3 Fixed condensers, 0.0001 mfd. (T.C.C., Type 34).
2 Fixed condensers, 0.001 mfd. (T.C.C., Type 33).
2 Fixed condensers, 0.002 mfd. (T.C.C., Type 33).
2 Fixed condensers, 0.1 mfd. 400 volts D.C. test (T.C.C., Type 50).
1 Fixed condenser, 0.05 mfd., 400 volts D.C. test (T.C.C., Type 40)
8 Fixed condensers, 1 mfd., 400 volts D.C. test (T.C.C., Type 50).
4 Fixed condensers, 2 mfds., 400 volts D.C. test (T.C.C., Type 50).
3 Fixed condensers, 4 mfds., 800 volts D.C. test (T.C.C., Type 80).
2 Fixed condensers, 2 mfds., 800 volts D.C. test (T.C.C., Type 80).
1 Pre-set condenser, 0.0005 mfd. maximum (Polar).
1 Resistance, 1,000 ohms to carry 1 mA. (Watmel).
2 Resistances, 600 ohms to carry 8 mA. (Watmel).
1 Resistance, 500 ohms to carry 5 mA. (Watmel).
1 Resistance, 280 ohms to carry 35 mA. (Watmel).
1 Resistance, 10,000 ohms to carry 5 mA. (Watmel).
1 Resistance, 10,000 ohms to carry 12 mA. (Watmel).
2 Resistances, 20,000 ohms to carry 5 mA. (Watmel).
1 Resistance, 7,000 ohms to carry 8 mA. (Watmel).
2 Resistances, 30,000 ohms to carry 3 mA. (Watmel).
1 Resistance, 40,000 ohms to carry 3 mA. (Watmel).
6 5-pin A.C. valve holders (W.B.).
3 Valve screens (Colvern).
2 I.F. transformers, 110 kc. (Colvern).
1 Twin volume control potentiometer, 25,000 ohms (Colvern).
1 Aerial band-pass coil and screen (Watmel).
1 Secondary band-pass coil and screen (Watmel).
1 Oscillator coil and screen (Watmel).
4 Ebonite shrouded terminals (Belling-Lee).
2 Terminal mounts (Belling-Lee).
1 Mains plug, 5 amps.
1 Bakelised panel, 21 × 8 × ⅜ in.
Sleeving, copper foil, wire, screws, etc.
1 Baseboard, 21in. × 11½in.
15in. half-round brass rod for switch ganging.
1 Slab coil.
1 Cabinet (Camco).

This list gives the actual components used in the construction of the set. There are certain instances where alternatives of other manufacture may be introduced, but readers must take into account the quality and suitability as regards dimensions when adopting a substitute. In addition to the sources of supply mentioned, other manufacturers are specialising in the production of components of similar type which are suitable for use in the building of this receiver.

Throughout the receiver the circuits are well de-coupled, and by-pass condensers are taken to the valve cathodes. An exception occurs in the case of the I.F. valve, where a 1 mfd. condenser C_{16} is connected between the de-coupling resistance R_{10} and cathode, and a 2 mfd. condenser C_{14} between the same resistance and earth. This method of connection affords greater freedom from feed-back and can be recommended with confidence.

In every case grid-bias is obtained by means of a resistance inserted in the cathode lead of each valve. The bias of each valve, therefore, is separately determined by the resistance and the anode current of that valve; and alterations can be made to one valve without affecting another. With modern valves it has been found that this method is no more likely to introduce hum than that in which bias is obtained by the voltage drop along a resistance in the common negative H.T. lead, and it considerably simplifies both the wiring and the decoupling.

Every effort has been made to avoid the use of a high resistance in the grid circuit of the H.F. valves, since it has been found that such a resistance tends to accentuate valve noise, and, at the same time, it renders the bias voltage uncertain. This last effect, of course, is only found with indirectly heated valves, and it is due to grid current, some trace of which is nearly always flowing.

In a powerful receiver of this nature the problem of volume control is considerable. Any method which operates by virtue of an alteration in the valve voltages is open to suspicion on the grounds of quality; on the other hand, controls which operate only upon the aerial input do not usually have a wide enough range and do nothing to reduce valve noise.[6] Two volume controls are used in this receiver, one operating upon the aerial input and the other upon the screen voltage of the I.F. amplifier. It has been found that this dual control introduces no distortion, provided that both controls are operated together. The reason for this is that as the screen volts are lowered, and the voltage-handling capacity of the valve is reduced, so the aerial control operates to reduce the voltage which the valve is called upon to handle. Two 25,000 ohms wire-wound potentiometers R_1 and R_8 are used; they are mounted upon a common, but insulated, spindle and are operated by a single control knob; they afford an amply sufficient control to reduce a strong local station to a whisper. As the connection between the screen-grid of the I.F. valve and the volume control is of necessity rather long a 600 ohms resistance R_{17} is inserted close to the valve in order to avoid feed-back.

(To be concluded.)

[6] Controlling Volume, *The Wireless World*, February 25th, 1931.

BOOK RECEIVED.

Electric Clocks, by F. Hope-Jones, M.I.R.E., F.R.A.S.—Since the early days of the time signals from the Eiffel Tower spark transmitter the subject of accurate timekeeping has held a special interest for wireless enthusiasts. This book can be confidently recommended to those who seek an insight into the problems underlying the design of high-grade time-pieces. The history of the development of the pendulum clock and the application of electrical methods of impulsing and winding is given in full detail, and the author's analysis of the mistakes of early inventors and their subsequent elimination make absorbing reading.

Some idea of the high standard of accuracy of modern electrically driven astronomical clocks may be gained from the account in the concluding chapters of the Shortt Free Pendulum clock. This clock has now been standardised in many observatories throughout the world, including Greenwich, and is capable of keeping time to less than one second in a year.

The author, whose experience of electric clocks is of thirty-five years' standing, has produced a book which is likely to remain the standard work of reference on the subject for many years to come.

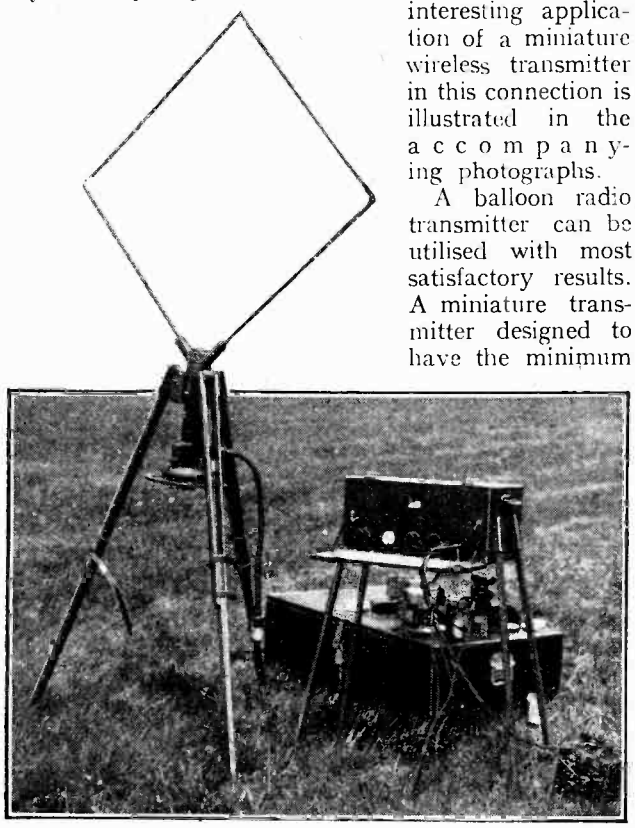
There is a foreword by Sir Frank Dyson, the Astronomer Royal, and the book runs to 261 pages, with 127 line drawings. The publishers are the N.A.G. Press, Ltd., 26-34, Old Street, London, E.C.1, and the price is 12s. 6d.

Tracing Balloon Drift by Wireless

A Miniature Transmitter Weighing Only One Pound.

SMALL balloons have long been of great service in meteorological investigations, as, with their assistance, recording barometers, thermometers, and other instruments can be allowed to ascend in the air and, on returning to earth, deliver up a record of atmospheric changes during the ascent. The recognised system is for the balloons to bear the address to which they should be returned, and a reward is offered to the finder who passes back the instrument. The greatest use of these investigations into the upper layers of the atmosphere is in connection with aviation, to ascertain the velocity and the direction of upper winds, when it is customary to allow balloons to ascend and to follow their flight visually. The objection to this method at once arises when it is desired to make investigations other than in daylight and when there may be any fog or mist affecting visibility. An interesting application of a miniature wireless transmitter in this connection is illustrated in the accompanying photographs.

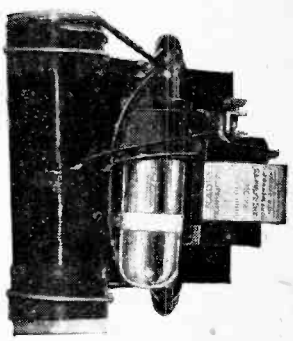
A balloon radio transmitter can be utilised with most satisfactory results. A miniature transmitter designed to have the minimum possible weight and capable of working off a battery for, say, a couple of hours, is attached to the balloon and then sent aloft, and direction-finding apparatus follows it in its course by receiving the signals which it transmits, in place of uncertain visual observation.



Direction-finding receiving gear used to follow the balloon transmitter in its course.

Meteorological Investigation for Aircraft.

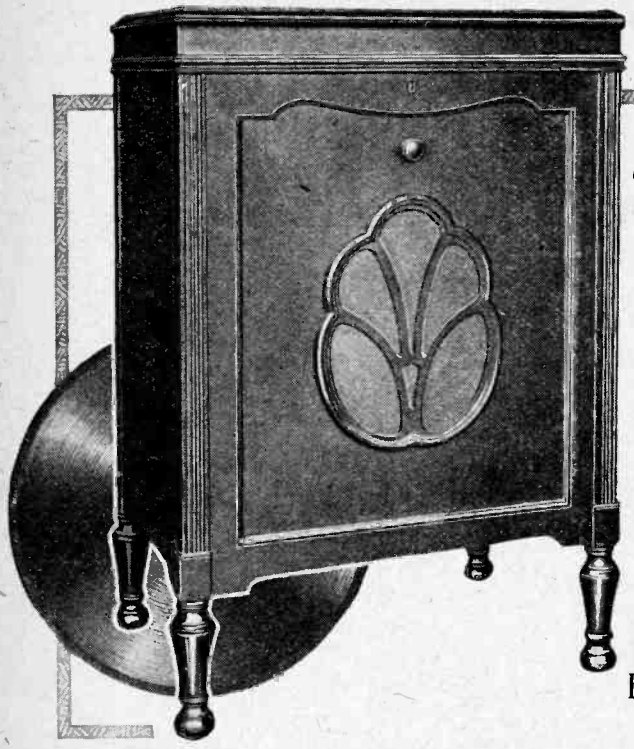
The little instrument illustrated is employed by the American Signal Corps. The total weight of the transmitter is approximately 1 lb., and the current necessary is supplied from dry batteries. At the moment of releasing the balloon the battery is connected up and the transmitter starts, the signals being receivable up to a distance of about 30 kilometres. The aerial is the wire which connects the transmitter to the balloons, and the wavelength used for the experiments is 130.5 metres, this wavelength being specially reserved for meteorological investigations of this nature.

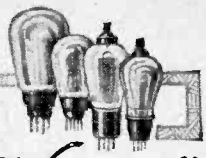


The miniature transmitter which is suspended from the balloons.

If a number of direction-finding sets are used to follow the transmitter, very accurate determinations of the position of the balloons in the upper atmosphere at any moment can be obtained.

The reason for using several small balloons rather than one large one is that a hydrogen-filled balloon, when reaching a high altitude, will burst, owing to the rarefied atmosphere, and, with a cluster of balloons, as shown in the photograph, it can be arranged that one will burst earlier than the others, when the weight of the suspended transmitter will then cause the unit to descend gradually, the remaining balloons acting as a parachute to permit the transmitter to land on earth again without damage.





"His Master's Voice" RADIO-GRAMOPHONE

D.C. MAINS MODEL 521

SPECIFICATION

GENERAL: For D.C. mains supplies, 190-250 volts. Operated with open external aerial.

CIRCUIT: Two H.F. stages followed by grid detector; parallel-fed transformer coupling to pentode output valve; series-connected filaments. Transformer output to moving-coil loud speaker.

CONTROLS: Single-knob control of three tuning condensers; combined radio and gramophone volume control; combined on-off, wave-range and radio-gramophone change-over switch.

High-quality Gramophone Reproduction and Long-range Radio Reception Combined.

A WIRELESS receiver and an electrical gramophone are so ideally suited for combining into a single instrument that the view is sometimes expressed that ultimately neither piece of apparatus will exist as a separate unit. Whether this be true or not, it is all to the good of broadcasting in general that the great gramophone manufacturing concerns should have directed their wholehearted efforts towards the production of dual-purpose outfits. By doing so they have undoubtedly introduced into our fold, from among their supporters, a number of people who would otherwise have stood aloof.

In the process of combination no compromises have been introduced into the design of the H.M.V. direct-current radio-gramophone. Judged either as a reproducer of records or of radio signals, it is well capable of holding its own with anything, and, in every essential detail, leaves no grounds for unfavourable criticism.

Pre-detection Volume Control

The basic circuit arrangement follows closely that of the A.C. mains model recently described in these pages. Although intended for operation with a comparatively short external aerial, it is found that an improvised and obviously inefficient collector will provide enough signal pick-up to satisfy ordinary needs. Two H.F. stages are included, the valves being coupled by choke-fed tuned grid circuits; there is no reaction in the usual sense, but the H.F. amplifier can be brought into a state of self-oscillation by adjustment of the volume control, which varies screening-grid voltage.

Next comes a grid detector, coupled by a resistance-fed transformer with a high step-up ratio to a pentode output valve. A moving-coil loud speaker with a mains-energised field is fitted, and is supplied through a step-down transformer. Across the primary winding of this instrument is connected a resistance-capacity tone corrector, while its secondary is shunted by a load resistance to prevent the development of high anode voltages when the speaker is temporarily disconnected.

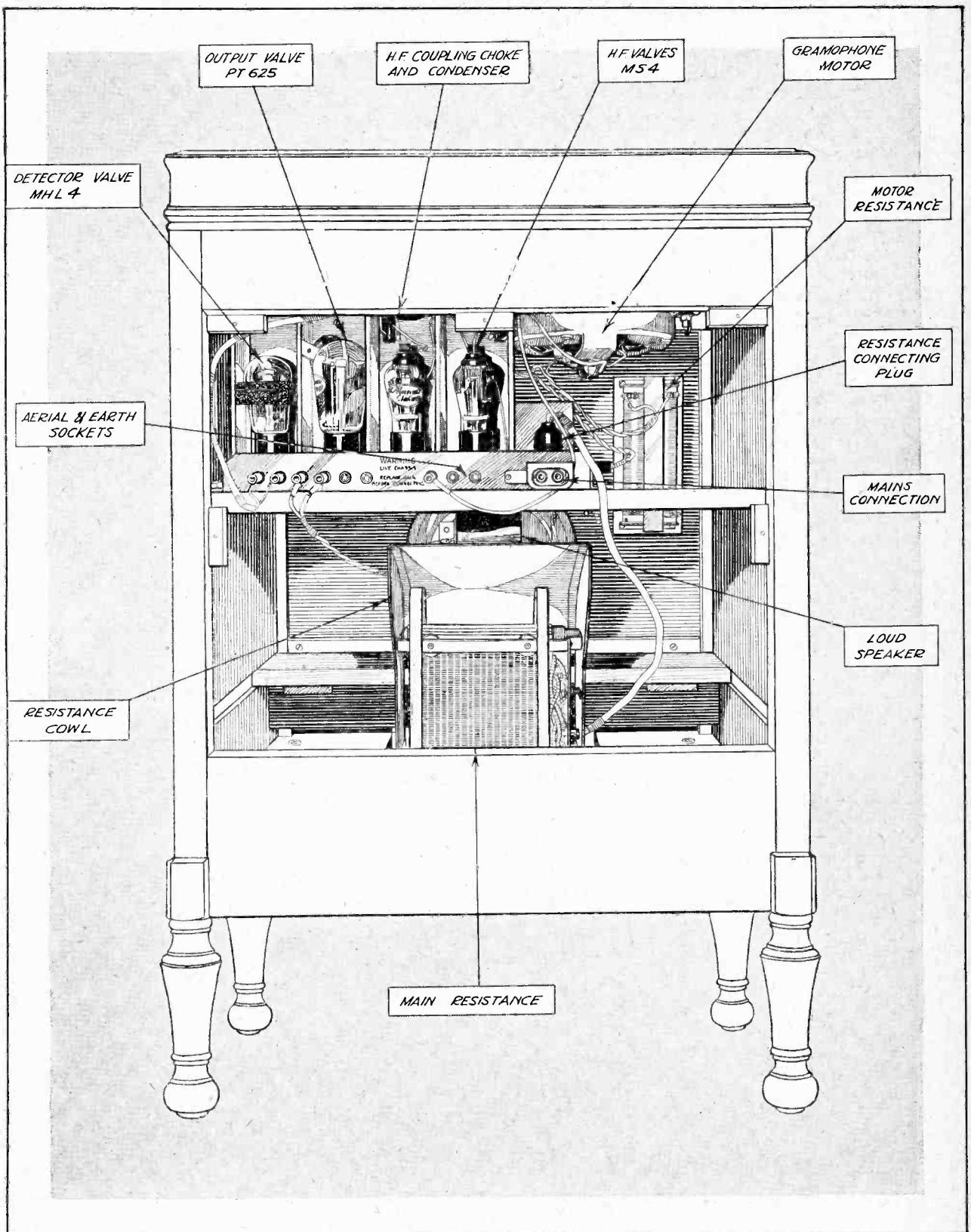
Filament current supply arrangements are always interesting in a D.C. mains set. In this instance, indirectly-heated valves of the A.C. type, with their heating elements wired in series, are used for H.F. amplification and detection, while the output pentode, also connected in series, is directly heated. As this valve consumes only 0.25 amp. against 1 amp. for the others, its filament is shunted by a resistance to pass the surplus current. A high-capacity condenser, in conjunction with the loud speaker field winding, which may be inserted in either positive or negative leads, provides smoothing for this circuit.

Anode current supply for all valves is arranged on conventional lines, with a carefully proportioned smoothing system and feed resistances where necessary.

Grid bias voltage for the H.F. valves is developed across a resistance in their common cathode lead; a similar method is applied to the detector, which, though working with a zero grid when acting as a rectifier, is negatively biased for gramophone amplification. Voltage for the pentode grid circuit is obtained by using the potential drop across the first three valve heaters.

Volume control for radio reception is effected by variation of screening-grid voltage, as already mentioned, and a potentiometer for regulating pick-up output to the L.F. amplifier is mounted on the same spindle.

All external parts such as aerial, earth, and pick-up are completely isolated by condensers from mains voltages, and so the instrument may be operated with complete safety when joined to either negatively or positively earthed mains supplies. Grid and anode



Rear view showing interior of cabinet. Note anti-microphonic packing for the detector valve.

A 29

"His Master's Voice" Radio-gramophone.—

return leads are in most cases connected to the metal chassis, which is in consequence "live," but it is insulated from true earth by a large condenser. As a further safety measure, matters are so arranged that the mains connection must be interrupted before the cabinet back can be removed.

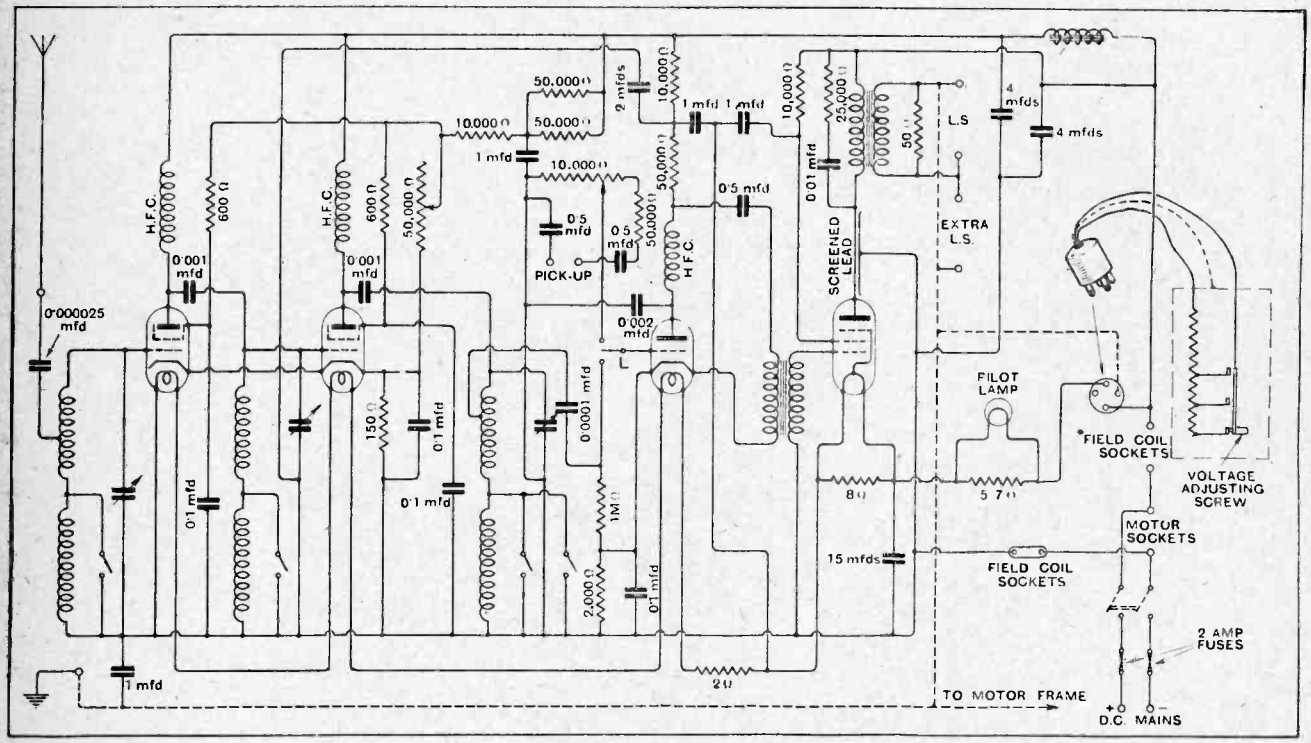
An inverted metal tray forms a basis for the chassis: on its upper side are mounted screening boxes containing the various components as well as the ganged condenser assembly, while wiring is concentrated in the base. Cadmium-plated steel, which is rustless and of good appearance, is used almost exclusively.

A pilot lamp serves to illuminate the condenser drum, which is directly calibrated in wavelengths. Drive is

230 watts, and so a single unit of electricity will feed the set for over four hours.

All controls work in an unexceptionable manner, and operation could hardly be simpler; indeed, the non-technical user can, after a few minutes' tuition, obtain almost as good results as an expert.

In view of this ease of operation, one could forgive a certain mediocrity in performance, at any rate with regard to sensitivity and selectivity. But there is no need to exercise such toleration; on both counts the set is outstandingly good. Choice of programmes is exceptional, and is even wider than one might be justified in expecting from a receiver with two H.F. stages. Selectivity is so high that interference, except of the entirely unavoidable sort, is hardly ever troublesome.



Complete circuit diagram. Alternative connections for the loud speaker field coil are provided in the negative and positive mains leads.

transmitted to the linked rotors through a tensioned cord; this works very smoothly and without backlash.

Excepting the volume control knob, which is on the cabinet front, all controls are mounted on the top panel; this is covered by a sound-proof lid, which effectually prevents any noise from the pick-up being heard.

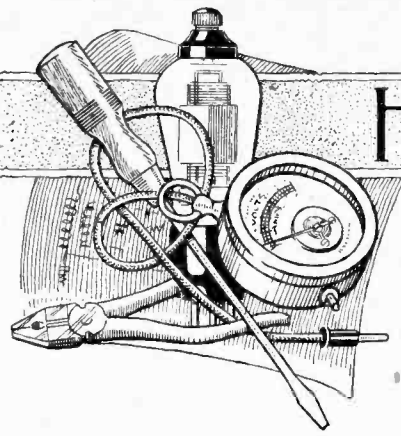
Space does not permit of a full description of the many other points of interest, but some at least must be mentioned. Excess mains voltage is dissipated by a series of asbestos-wire woven mats, which are properly mounted under a cowling arranged to eject heated air through the back of the cabinet. A sponge-rubber packing block, fitted round the detector valve, is found to be most effective in absorbing microphonic noises. The loud speaker cone diaphragm is of metallised fabric. Consumption of energy from the mains averages about

Reproduction is of such pleasing quality that one becomes oblivious of the fact that it is second hand. To convey this sense of realism must surely be the final aim of every designer, and provided this impression is as successfully conveyed as in the present case, all criticism is disarmed. There may be a slight over-emphasis of the lower register, particularly of broadcast matter, but it is not of the objectionable nature that produces "boominess"; rather does it give a richness of tonal quality that is generally appreciated.

The instrument is made by The Gramophone Company, Ltd., 363-367, Oxford Street, London, W.1, and, at 48 guineas complete, is moderately priced. Should the user's supply system be altered at any time, conversion for A.C. mains operation can be effected at a reasonable inclusive charge.

Next Week's Review:—EKCO A.C. MODEL 312.

Practical Hints & Tips



Simplified Aids to Better Reception.

SIDE CONTROL KNOBS.

IN spite of the fact that they are included in one or two highly successful receivers, condenser control knobs mounted at the side of the cabinet do not seem to appeal to the majority of amateur or professional set designers. It is the purpose of this note to urge the point that, if this method of mounting the tuning and reaction condensers happens to fall in well with any particular layout, there is not the slightest objection to it, from the point of view of easy operation. One may even go so far as to say that it has certain advantages of its own.

Provided that the knobs are mounted at a suitable height—and there is considerable latitude in this matter—it will be found that their manipulation may be carried out in a perfectly natural way. Due to the fact that the wrist and forearm are supported by the table, adjustments may be made with extreme accuracy, and without the minor contortions that are so often necessary when the condenser spindles are at right angles with the front panel.

Naturally, it is not suggested that ordinary indicating dials should be mounted on the side of the cabinet; this would be hopelessly inconvenient. The advantages of this method of tuning cannot be appreciated properly unless graduated edgewise drums (which are readily obtainable) are fitted; the ordinary type of graduated scale would be almost invisible.

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MATCHING SCREENED COILS.

When discussing the matching of tuning coils in this section of *The Wireless World* for May 13th, it was assumed that the windings would be unscreened, or, rather, that they would be tested in an unscreened state. It almost follows nowadays that coils for inclusion in a "ganged" receiver will either be enclosed in metal compartments or mounted in individual containers; this tends rather to complicate the issue, as however accurately inductance values may be matched with the coils "in air," there is some risk of upsetting matters when they are brought into proximity with masses of metal.

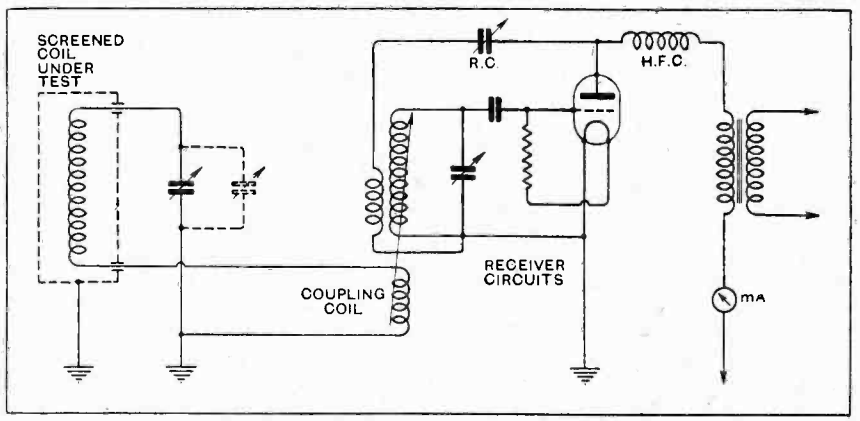

Fig. 1.—A coupling coil connected to a screened inductance for purposes of matching.

It is probably easiest to match unscreened coils, and it is quite safe to do this provided they are ultimately mounted so that all are affected to the same extent by adjacent metal work. In practice, it is found that, if coils of the same physical dimensions are symmetrically mounted under "pots" of the same size, matching will not be affected.

If it is preferred to match the coils in their final form—in screens—the absorption method already described will be quite effective, provided a coupling coil of three or four turns is connected in series, as shown in Fig. 1.

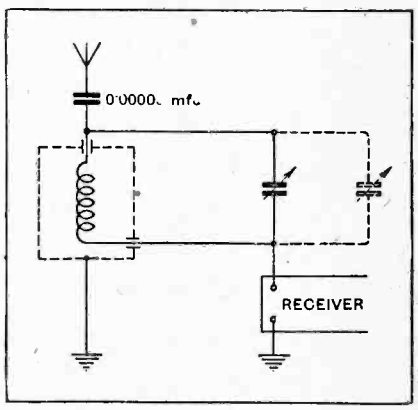

Fig. 2.—One of the simplest methods of matching screened coils.

With a certain amount of skill and patience, coils may be matched with surprising accuracy without the help of a measuring instrument of any kind. Several methods will suggest themselves, but it seems probable that the principle of connecting the coils to be tested as part of an acceptor circuit, working with a broadcast receiver of almost any type, is the most generally convenient. Connections are as shown in Fig. 2; the procedure is to adjust each coil so that it resonates with exactly the same value of parallel capacity. The receiver itself is previously tuned to a fairly strong transmission and resonance of the external circuit is indicated by maximum reduction of inconing signals.

BROADCAST BREVITIES

By Our Special Correspondent.

Statistics Run Riot.

The most remarkable computation in a batch of statistics I have received from the B.B.C. is that if the central tower of Broadcasting House held its total capacity of 1,700 persons for one 12-hour day, the amount of perspiration given off would be approximately one ton.

Fortunately the ventilating system will feed the tower with fresh air at the rate of 134 tons per hour.

oooo

Keeping Cool.

Special measures will be taken to keep the tower cool in summer time, it being calculated that under ordinary conditions the temperature on a typical summer day would rise to about 12 deg. above that prevailing outside.

Figures are not yet prepared concerning the amount of gas which will be given off in the talks studio.

oooo

A Mile of Corridors.

Here are some figures which may be worth noting. The building contains 2,630,000 bricks and weighs 24,000 tons, while the amount of material excavated below that level exceeded 43,000 tons.

An artiste who lost his way would be able to walk through a mile of corridors before finding himself at the point where he started, but the monotony of the journey would be broken by 1,250 stairs. Moreover, he would have the opportunity of looking through 7,500 panes of glass and turning the handles of 800 doors.

oooo

The Waiting Cashier.

One of the first officers to leave Savoy Hill for Portland Place will be the cashier, whose attendance seems to be indispensable immediately a studio is put into use. The B.B.C. believes in "paying on the nail," the rule being to hand the artiste his or her cheque immediately a performance is completed.

In certain, but rather rare, cases the cheque is required before the artiste will consent to face the microphone.

oooo

Northern "Nat."

There seems to be genuine satisfaction in regard to the modest test transmissions by Northern National on 301.5 metres. The majority of reports are quite favourable.

Northerners have, of course, been given every opportunity to prepare themselves for these transmissions, but I am inclined to accept the view of a Manchester friend who declares that the listeners in the north are, and have always been, more "radio conscious" than listeners in any other area.

oooo

Another Pamphlet.

"We take naturally to wireless," he affirms, "and an extra high-power station doesn't worry us. After all, we've always got Mühlacker."

For the sake of the few who are not so highly developed, wirelessly speaking, the B.B.C. have produced a pamphlet entitled "Selectivity," containing notes on the special problems encountered in the North, but really applicable to any wipe-out area on earth.

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For Motor Cyclists.

A running commentary on the Senior T.T. races in the Isle of Man will be relayed to National listeners between 12.45 and 1.45 p.m. on June 19th.

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A Gramophone Expert.

Mr. Owen Mase, the new assistant director of music, will take over much of the important detail work which has hitherto kept Dr. Boult from devoting the whole of his energies to orchestral work and programme arrangement.

Mr. Mase has been with the B.B.C. for three or four years, and during recent months has done much to improve the technique of gramophone recitals. A few weeks ago he showed me his latest design for the ideal studio gramophone, an arrangement closely resembling an office desk in weathered oak with a turntable to the right and left and a sloping reading board in the middle just under the microphone.

oooo

Disappointment for Russia.

By the way, Dr. Boult's much-talked-of visit to Russia to conduct at the Baku orchestral festival is "off," at all events for the present. A request came through the other day from the concert agency in Vienna asking Dr. Boult to postpone the trip till July or August, but the B.B.C. are not likely to be able to spare their director of music at a time when the winter programmes are just coming up for consideration. It looks as if the Russians will have to wait another twelve months.

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Portraying a Revolution.

The first English example of the reporting in radio form of contemporary events furnishes a new type of programme entitled "The Spanish Crisis," which is to be broadcast on June 11th. It is the joint work of E. A. Harding and John Watt.

The events of the revolution are marshalled in sequence. The story of this thrilling chapter of Spanish history opens with the elections in March and includes the story of the departure of King Alfonso and his family.

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Setting a Standard for School Receivers.

Some rather startling contrasts are expected at the demonstrations which the B.B.C. are staging in the Edinburgh studio on Friday next, June 5th. The intention is to provide educational authorities with a standard by which they can judge the quality of reception obtained in the Scottish schools. Official sets which, presumably, will be beyond reproach will be placed side by side with specimens lent by certain of the schools now taking the B.B.C. educational talks.

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The Average School Set.

It would be a good thing if similar demonstrations could be given in other parts of the United Kingdom. To judge from reports I have received, the present standard of reception in British schools is lower than that demanded by the average home listener—a deplorable state of affairs when we consider that class listening under the best conditions must impose a considerable strain on the attention of young children.

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Modern Music Let Loose.

Members of the B.B.C. Symphony Orchestra are now taking their summer holidays in relays, but I hear that all the 114 performers will be back in time for the International Festival of Contemporary Music on July 27th and 28th at the Queen's Hall.

The National Chorus will also take part in the Festival, which is being held in London and Oxford. Modern music has its value in small doses, but I am glad that Oxford is sharing the burden.

FUTURE FEATURES.

National (261 and 1,554 metres).

JUNE 7TH.—"The Son of God Goes Forth to War." Music of War, Peace and Thanksgiving from the Oratorios.
JUNE 8TH.—Vaudeville programme.
JUNE 10TH.—"King John" (Shakespeare).
JUNE 11TH.—"The Spanish Crisis": The story of Spain's bid for a Republic.
JUNE 12TH.—"Our Town." A revue by L. du Garde Peach.
JUNE 13TH.—Aldershot Command Searchlight Tattoo, from Rushmoor Arena, Aldershot.

London Regional.

JUNE 7TH.—Orchestral programme from Park Lane Hotel.
JUNE 8TH.—"King John."
JUNE 9TH.—"La Traviata," Act I, from Covent Garden.
JUNE 12TH.—Cabaret programme of gramophone records.
JUNE 13TH.—"Our Town."

Midland Regional.

JUNE 7TH.—Religious service from Birmingham Cathedral.
JUNE 10TH.—"Nine-Thirty Novelties" (Number Five).

North Regional.

JUNE 8TH.—A broadcast from H.M.S. "Helicon."
JUNE 9TH.—"George Stephenson," a Radio Chronicle play by Edwin Lewis.

West Regional (Cardiff).

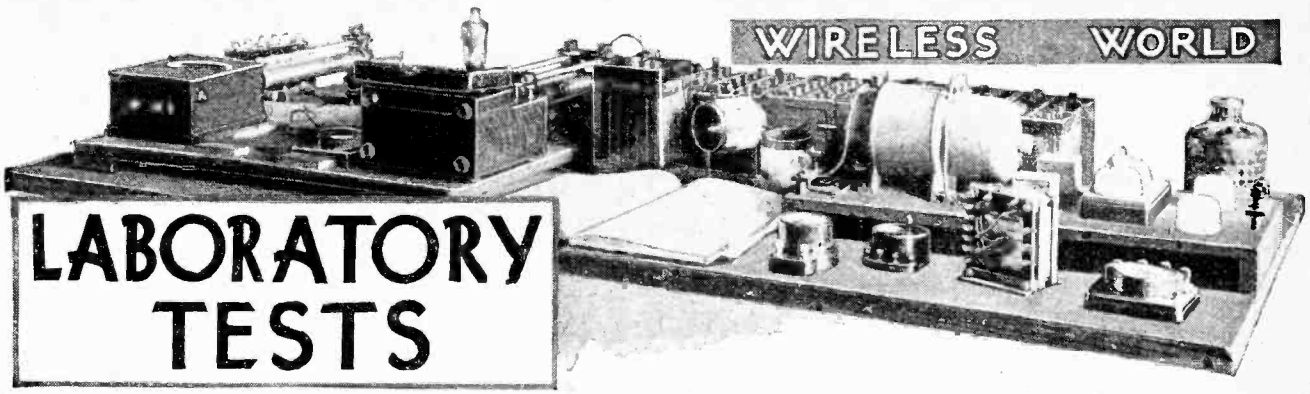
JUNE 12TH.—Speeches at the National Allotment Society's Dinner, relayed from the Town Hall, Bridgwater.

Glasgow.

JUNE 7TH.—Annual Church Parade of the Glasgow Auxiliary Forces, from St. Andrew's Hall.

Belfast.

JUNE 8TH.—"Neighbours' Childer," a County Antrim Comedy, by J. H. McIlveen.



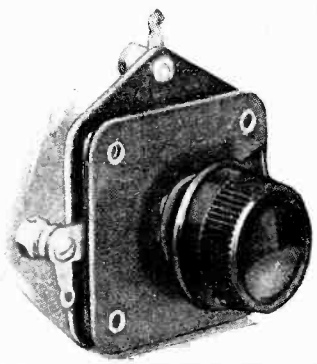
LABORATORY TESTS

A Review of Manufacturers' Recent Products.

NEW LOTUS DIFFERENTIAL CONDENSER.

This is a new component developed especially to meet the demands of those requiring a more compact condenser than the Lotus standard differential model. Thin hard-tempered brass is employed for the vanes, and the best-quality paxolin for the dielectric.

To assure a smooth action and to counteract any tendency towards binding, the two sets of fixed vanes are arranged on a floating mounting. Positive connection is made to the moving vanes by



New Lotus solid dielectric differential condenser with floating stators.

a multi-stranded phosphor-bronze pigtail. A single-hole fixing bush is fitted, and a number of insulating washers provided for use where a metal panel is used and the requirements of the circuit demand that the rotor should be fully insulated.

The production models will be made in sizes of 0.0003 mfd. and 0.0001 mfd. each side, and the price is fixed at 3s. in each case. An early sample sent in for test had a nominal capacity of 0.0004 mfd., which when measured was found to show a minimum capacity of 6 micro-mfds. each side, the two maxima being 0.000384 mfd. and 0.000386 mfd. respectively. In addition to affording a smooth action, the floating arrangement of the stators undoubtedly contributes to the extraordinarily close agreement of the capacities on each side of the condenser. One may reasonably expect that the production models will bear the same relationship to their nominal capacities as the sample treated by us, and we can confidently recommend this new Lotus product as affording good value for money.

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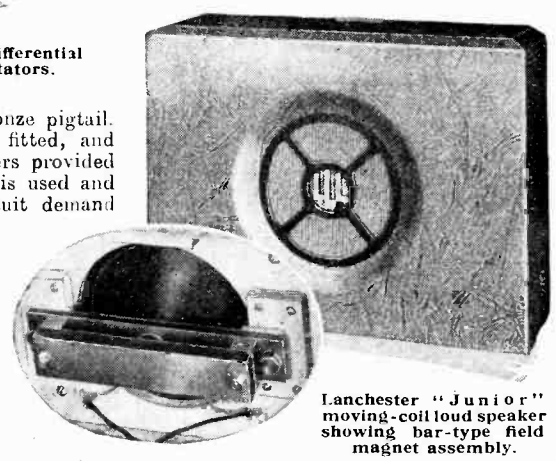
LANCHESTER "JUNIOR" LOUD SPEAKER.

This miniature moving-coil instrument has a shallow-angle diaphragm only 4½in. in diameter. It carries a low-resistance speech coil, and a step-down transformer is necessary between the loud speaker and the output valve.

The permanent field magnet is of unconventional design, and consists of a bar magnet with one pole in the centre and opposite poles at each end. A soft iron centre core is tapped into the centre bar, and the circuit is completed by soft iron spacing-pieces at each end.

By comparison with balanced armature moving-iron instruments, the sensitivity is poor, but the response is free from the



Lanchester "Junior" moving-coil loud speaker showing bar-type field magnet assembly.

numerous sharp resonances often found in loud speakers of the latter type. The output is slightly higher between 1,500 and 2,500 cycles than elsewhere, but otherwise is sensibly uniform between 50 and 6,000 cycles, and the reproduction, if not of very great volume, is well balanced.

The makers are Messrs. Lanchester Laboratories, Ltd., Spring Road, Tyseley, Birmingham, and the price is 48s. The chassis alone costs 28s.

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VARLEY CONSTANT SQUARE PEAK COIL.

Of the various devices known for enhancing selectivity without impairing the quality of reproduction few can claim

New Varley constant peak tuning inductance covering both medium and long waves.

equality with the band-pass method of tuning. The latest development in this direction is the Varley Constant Square Peak Coil, which embodies the basic principles of the "mixed" filter with constant peak separation described in *The Wireless World* dated February 18th last.

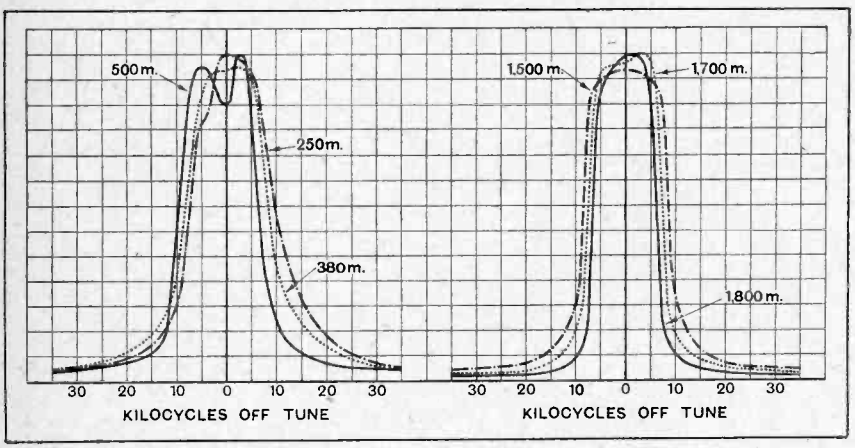
Incorporated in the design of this coil is a negative inductance coupling of 1.9 μH for the medium waveband and 80 μH for the long waveband; the coupling capacity has a fixed value of 0.04 mfd. The condenser, which must be non-inductive, is not incorporated in the coil, and must be purchased to comply with the requirements of a "mixed" filter circuit, but it may be omitted where a plain inductive coupling only is required.

The waveband switching is arranged so that the step-up ratio between primary and secondary is a constant of the order

of 1 to 3.5 on both wavebands. When the coils are tuned by 0.0005 mfd. condensers the wave ranges of the unit are 220 to 600 metres and 1,000 to 2,300 metres respectively.

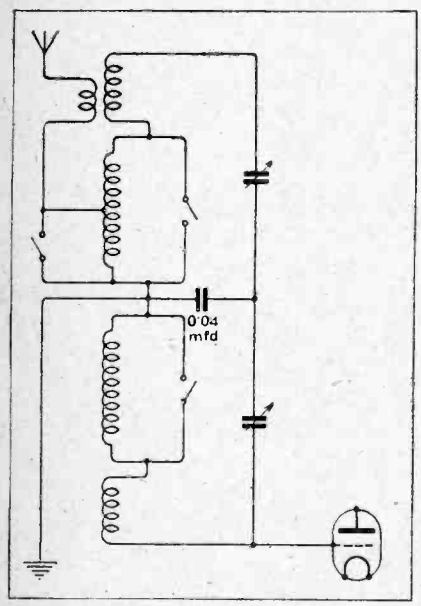
It is a very versatile component, since it can be used as an aerial coil in sets embodying H.F. stages, or in the simple detector-L.F. receivers, and for the last-mentioned type reaction can be employed without upsetting the peak separation. Owing to the nature of the windings, it is possible to utilise the aerial coil as a reaction winding; thus the efficiency of the device is not impaired by the presence of an idle winding when reaction is not required.

The coil and its associated condensers do not require screening, but it is essential to screen adequately all other coils and condensers in the set when H.F. stages are used.



Measured resonance curves of the Varley constant square peak coil.

Assuming that the high-frequency resistance of each tuned circuit is 9 ohms at 500 metres and 12 ohms at 300 metres,



Circuit arrangement of the new Varley band-pass filter.

the theoretical peak separations are 8.3 kc. and 8.4 kc. respectively at these wavelengths.

The makers are Varley (Oliver Pell Control, Ltd.), 103, Kingsway, London, W.C.2, and the price is 15s.

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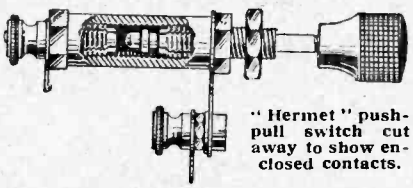

"Hermet" push-pull switch cut away to show enclosed contacts.

"HERMET" PUSH-PULL SWITCH.

A neat single-contact switch operating on the push-pull principle has been introduced recently by D.X. Coils, Ltd., 542, Kingsland Road, London, E.8. It embodies several novel features; the contacts being totally enclosed in an insulated tube measuring 1in. long by $\frac{3}{8}$in. in diameter, thus excluding all dust and ensuring permanent cleanliness.

Good electrical contact is assured by fitting two split collets—one for the back contact and the other integral with the single-hole fixing bush—these grip the plunger firmly, but allow freedom of movement without demanding undue force. Indeed, the action is delightfully smooth and has the advantage that the actual contacting parts are self cleaning.

The price of the switch is 1s. 3d.

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"ATLAS" OUTPUT CHOKE. Model CP311.

Designed for use in the output stage, this L.F. choke is provided with five tappings, giving the choice of various output ratios from which it should be possible to choose the optimum for practically all combinations of valve and loud speaker impedances.

In common with the majority of "Atlas" components, the choke is totally enclosed in an olive green case, and the terminals are located in an accessible position. Some measurements were made of the inductance when various amounts of D.C. were passed through the winding. These are given below :—

Clarkes' "Atlas" tapped output choke, model CP311.

D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.	D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.
0	1.09	30.8	40	1.195	29
10	1.09	30.8	50	1.24	28
20	1.13	30.3	60	1.28	27.3
30	1.16	29.8	—	—	—

From the above figures it can be seen that the inductance is not influenced to any appreciable extent when passing up to 60 mA. of D.C., and the component may be classified as a constant inductance L.F. choke. Its D.C. resistance is 400 ohms.

The makers are H. Clarke and Co. (Manchester), Ltd., Atlas Works, Old Trafford, Manchester, and the price is 21s.

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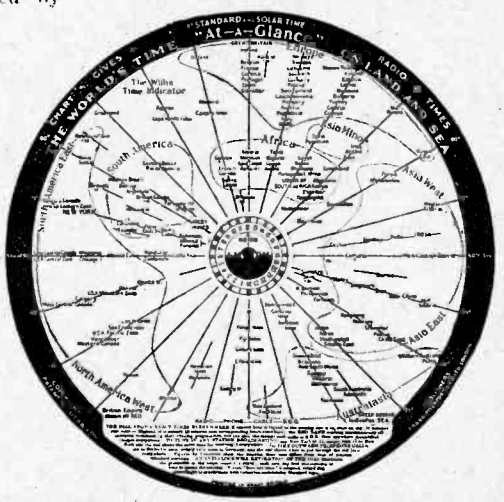
WORLD TIME INDICATOR



This useful device has been described in detail in our issues of May 8th, 1929, and May 13th, 1921. The new circular pattern is shown above. These are now manufactured by Messrs. F. Pitchford and Co., Ltd., Well House, Well Street, London, E.C.1. Price 1/- each.

Letters to the Editor.

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

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

EMPIRE BROADCASTING.

Sir,—I have been absent from this country, having made a tour of the West Indies during the last four months, and while there carried out investigations for a well-known trade paper on radio conditions.

There is no doubt that the pig-headed authorities here do not realise the need—and an urgent one—of a super-power Empire short-wave transmitter of not less than a hundred kilowatts actual output.

The West Indians are very proud of this country, and always refer to it as "home," even though they have never set foot here, and deplore the fact that they are compelled to listen to Dutch and American stations.

The stuff put out by 5SW is a disgrace; gramophone records can be had anywhere, while Mrs. Grundy ought to be pensioned off. They want a one hundred per cent. news service and really good programmes, and sent out at hours to suit *them*, not us.

The cost—of course this is the usual State policy—"how cheap and how dear." Well, never mind the cost, its prestige, efficiency, and let the world know that we are interested in our outlying possessions, and far more important, that it is a pleasure to have a link for far-off Britains. I felt cut off out there, and if a visitor on pleasure bent gets the blues, how about the residents? J. P. J. CHAPMAN.

Bournemouth.

AMATEURS AND BROADCASTING.

Sir,—Your correspondent, Mr. J. L. Roe (G2VV), asks for readers' views on the subject of Sunday broadcasts in relation to amateur transmissions.

I am inclined to think that the majority of real wireless enthusiasts, appreciating the valuable experimental work that has been done by many amateur transmitters, would willingly forgo the possibility of Sunday morning broadcasts in order to leave a clear field for the amateurs' activities.

Incidentally, it seems inevitable that whenever the amateur transmitters accomplish any really valuable pioneer work in revealing the possibilities of any particular waveband for, say, long-distance communication, they are promptly rewarded for their pains by being crowded out of that waveband to make room for other stations conducting important wireless services of various kinds that want to take advantage of the possibilities revealed by the amateurs!

That is certainly what has happened on the short waves. When the amateurs were no longer free to roam at will over the medium waveband (as in the early days of wireless), owing to the rapid development of broadcasting and the consequent rapid increase in the number of broadcasting stations monopolising the medium wavelengths, the very short waves that were allotted to the amateurs were believed to be of little use for reliable long-distance work. But the amateurs, in making the best of what seemed to be a bad job, revealed the hitherto undreamed-of possibilities of wavelengths below 100 metres by accomplishing on them some really amazing feats of communication over vast distances with low power.

As a result the short waves have now become the chief medium for important long-distance communication of all kinds; but the amateurs themselves, who did so much of the pioneer work on these wavelengths, are being squeezed into narrower and narrower wavebands as the number of powerful commercial stations, long-distance public telephone services, etc., using the short waves, increases by leaps and bounds.

It certainly seems rather rough luck that the scope of the amateurs' activities should be curtailed still more by the extension of broadcasting into the present silent period on Sunday mornings, since that period (as Mr. Roe points out) is the only time during which many amateurs can work around 160 metres without causing interference with broadcast reception.

London, S.W.18. W. WILLIS OLIVER.

INEXPENSIVE QUALITY.

Sir,—Your correspondent, Mr. Hartley, in his recent letter on reproduction raises various interesting points as to what is required for good quality. His counsel of perfection, however, is a little too perfect to be capable of practical realisation as yet, and it appears that some kind of compromise is necessary; and, since the final critic is the ear, the direction of this compromise should be dictated by its properties.

The shortcomings of a loud speaker and amplifier come under three rough headings: (1) frequency distortion, (2) amplitude (or harmonic) distortion, and (3) resonance, and the behaviour of the ear towards the three respective types is interesting. As to the first, the ear is amazingly insensitive to changes of intensity (two decibels is inaudible), and very large changes in the relative output at different frequencies pass quite unnoticed, provided the change is continuous and gradual over a large band of frequencies.

Little need be said about amplitude distortion, which is due to the unsymmetrical treatment of the positive and negative halves of the wave. Five per cent. second harmonic is usually considered the maximum permissible, and, although some moving-iron speakers are prone to this trouble, the usual source is in the amplifier, particularly the detector, intervalve transformer, and output valve.

It can be avoided by power-grid detection, resistance-capacity coupling at a generous H.T. supply to the last valve. Most moving-coil speakers do not give trouble unless they are run at very large volume indeed. Thus, although very little (e.g., five per cent.) amplitude distortion is permitted by the ear, its avoidance is not a matter of very great difficulty.

With regard to resonance the position is quite different, as the ear is very sensitive to it and the loud speaker very prone to it. A well-designed amplifier, properly decoupled, should be quite free from resonance, and only the loud speaker need be considered. Roughly speaking, the more sharply tuned the resonance the worse it is, whilst its position in the frequency scale has a great effect upon the ear's response to it. Resonances at either extreme of the scale can sometimes be used to make up deficiencies. There is another important effect of resonance which is often overlooked, namely, the ringing or sustaining effect it has, which may be so bad as completely to obliterate the difference between *pp* and *ff*. A cheap and very nasty loud speaker emits an almost constant volume of noise, whilst the intensity level of the original may alter in the ratio of several hundreds to one. Any loud speaker containing resonances must give this effect, its magnitude depending on the sharpness and relative height of the peaks.

Now, Dr. McLachlan has shown that even that paragon of virtue, the moving-coil speaker, only operates by reason of resonances in the coil and diaphragm, which, although perhaps not well marked, are the sole means whereby any sound at all is radiated at the higher frequencies. In fact, the moving-coil speaker owes its superiority over other types to the fact that its resonances are roughly of equal height, fairly damped, and spread roughly over the whole band of frequencies. The difficulty of *pp* and *ff* still remains, though not so markedly as in the older types of speaker.

With these considerations in mind, and the loud speaker at South Kensington as an inspiration, one is driven to the large horn type of speaker as the best way out. It has one disadvantage which is sometimes prohibitive, namely, its size, but here again the ear helps us and compromise is possible. I have recently constructed a 12ft. logarithmic horn speaker with a cut-off at 70 cycles, employing a home-made moving-coil unit, which is very satisfactory.

The response curve (calculated) falls away to nothing at 70 cycles, and gradually tapers off in the extreme treble, e.g., 6,000 to 8,000 cycles, due to the weight of the diaphragm, which has been reduced to 0.6 gram. There also should be no amplitude distortion, at least for inputs up to 2 watts A.C.

Since the horn imposes on the diaphragm a larger resistance (e.g., non-reactive) load at all frequencies above the cut-off, there are no resonances due to the cause. Any due to the coil and diaphragm must be very high and are very severely damped by the horn. Thus the ear is not offended by resonance, and *ff* and *pp* are reproduced in a manner unapproached by any ordinary speaker. The most delicate music sounds really delicate, and at low intensities one gets an impression of distance which is very pleasant. Even at full bore the sound never gives the impression of coming from the mouth of the horn, as it does from an ordinary speaker, and in the dark the effect is very realistic. A slight lack of bass is naturally apparent, but what bass there is is very free from boom, and the general effect is good.

The set has a power-grid detector, resistance-coupled to a power pentode. The sensitivity is about the same as the ordinary moving-coil speaker. If anyone is interested in the practical details I should be very pleased to show it to them almost any evening.

P. S. VERITY.

Blakesley Lodge, Sunbury-on Thames.

READERS' CORNER.

A Section Devoted to the Enquiries and Personal Experiences of Readers.

BELOW we publish a further selection of replies to enquiries which appeared in our issue of April 29th, and also replies to new questions which were included in our issue of May 13th. The numbers in every case refer to the number allotted to the original enquiry.

(2) Standard Telephones and Cables, Ltd., advise that they have a stock of WECO valves, the price being 8s. 6d. each.

(3) "I cannot say that I entirely agree with many of the records given. Several of them are old acoustic records with which it would be impossible to test a radio gramophone. The acoustically recorded records cannot reproduce anywhere down as low as fifty cycles, as in the electric recording, neither can they reproduce anything as high as five thousand cycles. Therefore, they cannot make fair test records.

"I give the following, as test records used by gramophone firms with whom I have been connected.

"The Gramophone Company—'His Master's Voice'—use records :—

DB.962. Ava Maria. Gota Ljungberg. (For high notes and wear.)

D.1428. Bach's Toccata and Fugue in D minor. Philadelphia Symphony Orchestra. (For bass and volume.)

D.1296. Hungarian Rhapsody No. 2. Philadelphia Symphony Orchestra. (For general testing.)

D.1934. Gopak. The London Symphony Orchestra. (For general testing.)

"The Columbia Graphophone Company use records :—

DX.42. Light Cavalry. Overture. The Court Symphony Orchestra. (For constant speed.)

L.2182. Symphony No. 5. Tschaikowsky. Part 13. (For bass and volume.)

DX.10. Hungarian Rhapsody (Liszt), No. 2. The New Queen's Hall Orchestra. (For high notes and record wear.)

9690. Mr. Cinders Selection. Debroy Somers' Band. (For general testing.)

"These records, I think you will find, give every phase for testing a radio gramophone." D. A. W.

(5) "My own experience on test with a Marconiphone '560' receiver is that the machine made by the M-L Magneto Syndicate, Ltd. Coventry, is silent both mechanically and electrically.

"From their advertisement the M-L Magneto Syndicate, Ltd., claim their machines to be in use by the Gramophone Co., Columbia, Marconiphone, etc., and also the G.P.O., the Air Ministry, and the B.B.C." W. M. D.

(6) "Reference 'A. L. B.'s' (Lisbon) enquiry for a radio engineering correspondence school, I can recommend from personal experience 'The Technological Institute of Great Britain,' Temple Bar House, Temple Bar, E.C.4.

"Books and all papers remain the property of the student, and guidance is freely given during a course. Fees are reasonable." N. G. L. W.

"I can recommend 'A. L. B.' to the British Institute of Engineering Technology, address as advertised in *The Wireless World*. This is most up to date, and the tutors are qualified engineers." S. G.

"If 'A. L. B.' writes to the I.C.S. Offices at London, mentioning Stanton M.E.C. 404050, they will send full particulars of wireless course.

"I am a student myself, and can recommend theirs as being an excellent course." A. N. S.

"I can thoroughly recommend your correspondent 'A. L. B.,' of Lisbon, to enrol with the British Institute of Engineering Technology, Ltd., Shakespeare House, 29-31, Oxford Street, London, W.1.

"The B.I.E.T. have several courses in wireless engineering, and I am sure that one or other of these would suit 'A. L. B.'

"I am at present enjoying a course in electrical engineering from these people, and I must say that I am thoroughly satisfied in every way with their service. The personal interest which they take with each individual student, the extremely reasonable fees, which can be spread over long periods if required, and the result of exams at which their students sit—100 per cent. passed in the A.M.I.E.E. in 1930—I am sure make it impossible to find a better school for your correspondent." N. J. S.

"I can personally recommend the International Correspondence Schools, Ltd., Kingsway, London, as reliable in their wireless course; have been studying under their tuition since November, 1930, and am delighted with them. Shall be pleased to offer any information." MEQ/425403.

"In reply to 'A. L. B.,' of Lisbon, whose query appears in *The Wireless World*, I can thoroughly recommend the Radio Engineering Course of the Technological Institute of Great Britain (T.I.G.B.), whose address is Temple Bar House, Temple Bar, E.C.4." F. W. F.

(7) "I have had personal experience of reception of G5SW and many other short-wave stations, both broadcast and commercial; would recommend your correspondent to take out a receiver embracing short and long ranges, a Burndept 'Empire Screened Four' gave highly satisfactory results from G5SW during my three years' stay in that country. There are, of course, extremely bad patches, such as the Dead Sea region, but no European ever lives there." H. M. A.

"The writer has had considerable experience of reception of 5SW in Palestine and Egypt. The answer to 'J.S.'s' question is :—

"Yes, decidedly worth while. A simple three-valver is adequate. The McMichael 'Screened Dimic Three' is a suitable commercial receiver which has been successfully used there." F. S. A.

The following additional enquiries have been received :—

(9) "P. J. W."—Can any reader recommend circuit for four-valve vertical portable set. S.G., H.F., Det., 2L.F.?

(10) "S. G."—I would like to hear from readers who have used the "Varsity" pick-up as sold about a year ago. Number valves, volume control, tone-arm, etc.

(11) "N. G. L. W."—Does any reader know whence porcelain or good low-loss material valve holders and such-like components may be obtained from standard stock?

Enquiries or replies suitable for this section should be forwarded to the Editor, the envelopes being marked "Readers' Corner." Enquiries and replies must be very brief.

READERS' PROBLEMS

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Power Transformers.

On measuring the various outputs of my home-constructed power transformer (made in accordance with instructions published in your journal), it is found that the H.T. voltage is almost exactly right, but the pressure existing across the L.T. terminals is about 15 per cent. below the rating. The transformer has been carefully wound with the wire of the gauges specified, but I have used enamel insulation for the L.T. section.

We can only suggest that, due to the use of enamelled wire, there are one or more short-circuited turns in the low-tension winding.

It is usual to specify that double-cotton covering should be used for heavy-gauge windings, as it is less likely to give trouble, particularly when the wire is taken round acute bends.

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Free H.T. Volts.

Being engaged in planning a set for use in a car fitted with a 12-volt accumulator, I was interested in a reply to a reader in your issue of May 13th. Instead of using the surplus 10 volts (2-volt valves are to be used) as suggested by you, would it not be possible, by suitable arrangement of the H.T.-L.T. interconnections, to add this surplus voltage to that of the H.T. battery, and thus reduce its bulk?

Yes; the surplus voltage may be used to augment the pressure of the H.T. battery if connections are made in the manner shown in Fig. 1. You will see that the voltage-reducing resistance R (of which the value is calculated in the usual way) is inserted in the positive L.T. lead, and H.T.– and L.T.+ are joined together.

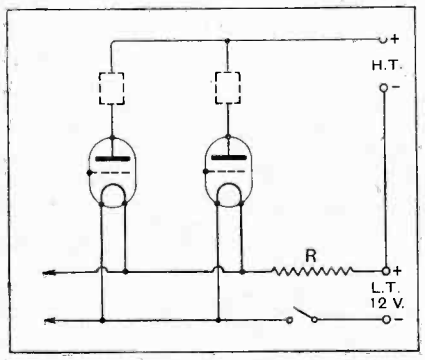

Fig. 1.—Surplus L.T. voltage developed across the resistance R is additive to the H.T. battery pressure.

A Substitute for Voltage Measurements.

My H.T. voltmeter has a comparatively low resistance, and this, I suppose, is responsible for the fact that when this instrument is used to measure the various anode voltages in the set, readings are obviously quite inaccurate. Instruments of sufficiently high resistance for this purpose seem to be expensive. Do you think it would be worth my while to get one?

This is a difficult question to answer definitely; it is always useful to have the fullest and most accurate knowledge possible of the various voltages existing in a receiver, but we would point out that even the most expensive moving-coil instrument will not be capable of measuring without an appreciable error the voltage applied to, say, the screening grid of a modern mains-operated valve.

A good substitute for a high-resistance voltmeter is a milliammeter, preferably with two or three ranges. It is almost as helpful to know the current flowing in the circuit as to know the voltage applied to it.

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Damaging Valves.

It has been stated in your journal that if the grid bias circuit of an L.F. valve be interrupted for any length of time, it is probable that the valve will be seriously damaged. I am wondering whether my own first-stage L.F. amplifier, which was inadvertently left working for about an hour with an "open" grid circuit, is likely to have suffered any harm. Now that the bias circuit has been restored, the receiver seems to work as well as ever, and the anode current of the valve, on measurement, proves to be about normal for its class.

Strictures against breaking the grid circuit apply more particularly to an output valve of very low impedance. It is true that serious damage may be done to a valve of this type if it is allowed to operate for any length of time with an open grid circuit, or even with insufficient negative bias.

A valve of comparatively high impedance, such as is generally used as a first-stage L.F amplifier, is not so likely to be harmed, and in any case its anode circuit will generally include a sufficiently high resistance (in the form of a coupling device, a decoupling resistance, or both) to prevent any dangerous rise of current.

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Asymmetrical Filter Tuning.

Although results are satisfactory enough, the constant-width capacity-coupled filter of my short-range detector-L.F. set does not seem to be behaving normally. I am enclosing a resonance curve showing ganged condenser dial readings plotted against downward changes in detector anode current; although special facilities for doing this sort of work are lacking, I think it may be taken that this curve gives a very good idea of what is happening.

Can you tell me why the "humps" are not of equal height, and also why the sides of the curve are not of equal steepness?

I am reasonably certain that the tuning of the two circuits is accurately "ganged."

A curve such as that you show (reproduced in Fig. 2) is invariably produced when the two component circuits of a filter are loaded to an unequal extent. It may be that there is a high series resistance or parallel leakage in one or other of the circuits, but we think it more likely that damping is due to external causes.

It may be that the load imposed by the detector is very much greater than that due to the aerial; in this case a remedy would be afforded either by increasing aerial coupling, by tapping down the detector-grid connection, or by applying reaction.

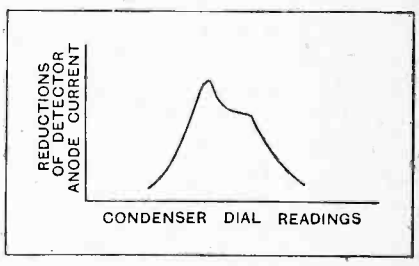

Fig. 2.—Uneven peaks in the resonance curve of a filter caused by unequal loading.

If aerial loading is excessive, this can, of course, be reduced by loosening coupling.

It is possible that if detector reverse reaction feed-back is responsible, a cure could be effected without impairing quality of reproduction to any noticeable extent by connecting a larger condenser between anode and filament of this valve.

Winding Filament Transformers.

In "The Wireless World" for April 8th you describe the construction of a filament-heating transformer, but I am not quite clear regarding all the dimensions of the bobbin on which the windings are supported. What is the correct spacing between the cheeks?

The width of the space available for the windings is one inch, as the bobbin cheeks are spaced by that amount.

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Automatic Bias Conversion.

Having fitted an H.T. eliminator to my receiver (previously battery-operated) with very satisfactory results, I should now like to add automatic bias for the H.F. and detector valves; there is a considerable surplus H.T. voltage over and above the requirements of the valves in use.

Total anode current consumption amounts to 22 milliamps., and the output valve requires a bias of 20 volts. I have a 1,000-ohm "strip" resistance, and should like to use this if it is suitable. A circuit diagram of my set is enclosed; will you please advise me as to the simplest way of making the necessary alterations for "free" bias?

We have redrawn the circuits of your receiver that are affected by the proposed alteration, and have shown a simple method of obtaining automatic bias. The 1,000-ohm resistance mentioned will be fairly suitable, but, when connected in the position shown, a bias voltage of 22 will be developed across it. Accordingly, example, that a bias potential of 11 volts will be obtained if the grid return lead be joined to the centre point of the resistance, and so on.

You do not say what type of H.F. valve is in use, but in any case it will require quite a small bias voltage, and accordingly its grid return lead will be tapped to a point only slightly removed from the "positive" end of the resistance.

o o o o

Loss of Range.

I am not quite satisfied with the sensitivity of my newly constructed receiver. Home-made coils, which follow fairly closely specifications given in recent issues of your journal, are used. Although a band-pass input filter is included, I have not thought it necessary to include an input volume control, as excessively strong signals are seldom receivable in this locality. Instead of fitting a variable aerial coupling device, I have inserted a condenser of 0.0001 mfd. between the aerial and a tapping point on the coil. Do you think that this could be improved upon?

If the aerial tapping on your input coil is arranged in the usual way, so that about 25 per cent. of the total number of turns are included in the aerial circuit, it is certain that the use of a series aerial condenser of as low a value as 0.0001 mfd. will bring about quite a serious loss of signal strength. You will be able to check this point by the simple expedient of short-circuiting the condenser, but, after doing this, it must be

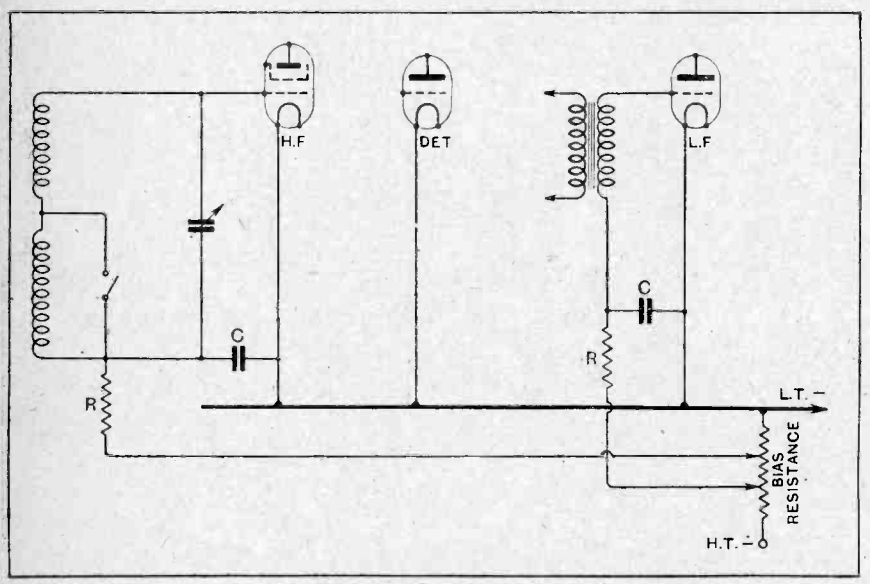

Fig. 3.—Automatic bias connections applicable to an existing receiver. Decoupling resistances R and by-pass condensers C may have values of about 100,000 ohms and 2 mfds. respectively.

a tapped connection should be made for the grid return lead of the output valve; this tapping will be quite near the "negative" end of the resistance, along which the potential drop may be considered as increasing in a linear manner, provided the component is wound in the usual way. By this we mean, for remembered that the tuning of the associated circuit will be altered.

Assuming that maximum sensitivity is desired, and that there is no pressing need for extremely high selectivity, the series aerial condenser might well be abandoned, or, at any rate, a considerably larger value be substituted.

FOREIGN BROADCAST GUIDE.

KOSICE

(Czechoslovakia).

Geographical position: 48° 35′ N., 21° 12′ E.

Approximate air line from London: 962 miles.

Wavelength: 293 m. Frequency: 1,022 kc. Power: 2.5 kW.

Standard Time: Central European (coincides with B.S.T.).

Standard Daily Transmissions.

07.00, B.S.T., relay of concert from Carlsbad (Sun.); 09.00, sacred service (Sun.); 12.30, midday concert; 19.00, main evening programme; 22.00, dance music (relayed).

Man announcer. Announcements are made in the Czech and Slovene languages but also, at times, in Magyar, Polish, Roumanian, German and French.

Opening Call: *Radio Journal Kosice* (phon: *Koshitsay*); during intervals, *Hallo Kosice.*

Interval Signal: Loud metronome (80 beats per minute).

Closes down with the words: *Radio journal dobrou noc* (good night).

Relays: Prague, Brno, Bratislava and Moravska Ostrava.

Restricted Wave Range.

Can you suggest a reason why my recently constructed "two-H.F." receiver will not "tune down" to wavelengths below about 250 metres? Ganged tuning with 0.0005 mfd. condensers is employed, and the coils are similar to those generally specified for use with variable condensers of that value. On the medium band the maximum wavelength is about 600 metres—not more.

Undoubtedly, the stray capacities associated with the various tuned circuits are excessively high. Possibly your trimming condensers are all set at an unnecessarily high value, and it may be possible to reduce all of them to an equal extent, retaining correct "ganging." You should, if necessary, also try to reduce the amount of transferred aerial and detector valve capacity.

o o o o

Ignoring Plate Voltage.

In the "Hints and Tips" section of "The Wireless World" for May 13th it was stated that the current consumption of a pentode could be adjusted by variation of the screening grid-feed resistance. In cases where a surplus anode voltage exists would it be safe to control the operating conditions of the valve in this manner without taking into account the actual anode voltage that may be applied?

Generally speaking, yes. Provided that the combined currents passed in the anode and screen circuits do not exceed the manufacturers' rating, anode voltage may be ignored (within reasonable limits) without risk of damaging the valve.

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The Amateur's Part in Wireless Development.

A VERITABLE hornet's nest has been disturbed by a reader, Mr. F. G. Kay, who contributed a letter to our Correspondence columns in the issue of May 27th, for by every post since the appearance of that issue we have been receiving letters condemning Mr. Kay's attack upon the amateur. Mr. Kay's letter was written in reply to a communication from another reader, who complained that if the hours of broadcasting on Sundays were to be extended the amateur would be squeezed out of what little time he at present has for experimental work when broadcasting stations are silent.

The paragraph in Mr. Kay's letter which would seem to be mainly responsible for the outburst reads: "I must deal with the astonishing statement that 'hams'' researches have brought about the present-day high technique of radio. This is untrue. The broadcasting companies, the Government, and the big commercial firms are the only people who have made radio what it is to-day."

Either Mr. Kay is extraordinarily ignorant of the history of the development of wireless, or else he must have written that paragraph with his tongue in his cheek, intending to see how far the ire of the amateur would be roused. We incline to the latter explanation of his motive, for it is difficult to believe that so provocative a statement would be risked without first ascertaining, from reference to earlier records, whether the views put forward could be substantiated in the face of the facts.

If Mr. Kay will refer to the issue of *The Wireless World* for October 10th, 1923, he will find on page 50 an expression of opinion with regard to the amateur by Dr. W. H. Eccles, F.R.S., who, as a professional engineer with a world-wide reputation, requires no introduction to our readers. Dr. Eccles' statement reads: "It seems probable that if we could estimate the minor improvements of apparatus and conveniences attached to modern commercial apparatus, it would be found that the contributions of the amateur would outweigh those of the commercial designer.

"We may go farther, and say that many of the great advances in wireless have been initiated by the amateur, and that most of the early steps in the inception of the subject were taken under the stimulus and guidance of men who were neither telegraphists nor engineers, but merely lovers of the infant science."

In the face of this statement, which we feel sure Dr. Eccles would be prepared to substantiate, it seems unnecessary to make any attempt to detail the vast number of amateur exploits and inventions, many of which are duly recorded in *The Wireless World*, and have so largely contributed to the present state of development of the science, nor is it necessary to explain that a very high percentage of amateurs who have been absorbed into the wireless industry of this country, America, and elsewhere, owe their introduction to the commercial side entirely to their own personal achievements and to the degree of proficiency attained as amateurs.

In This Issue

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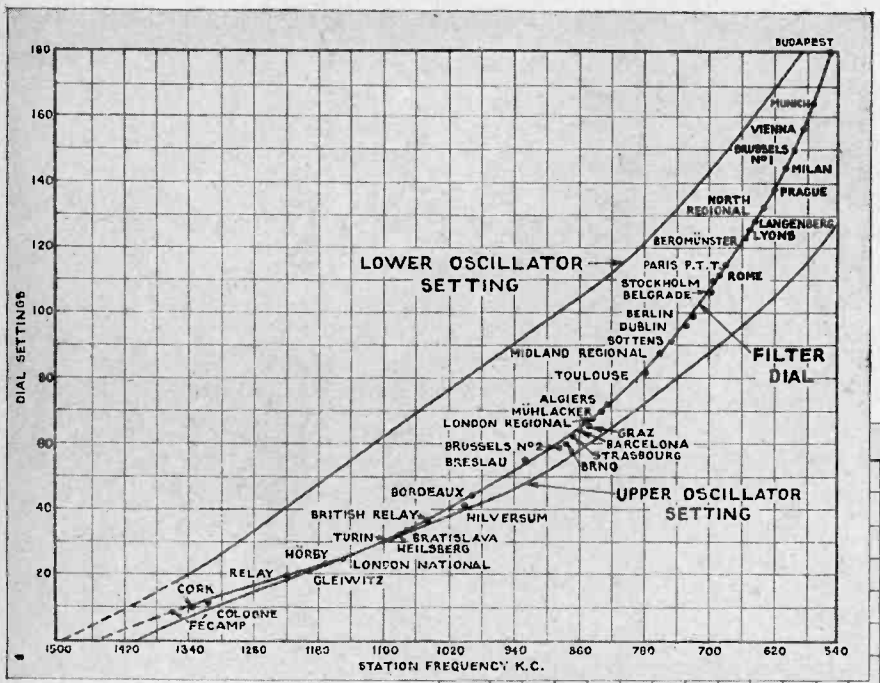
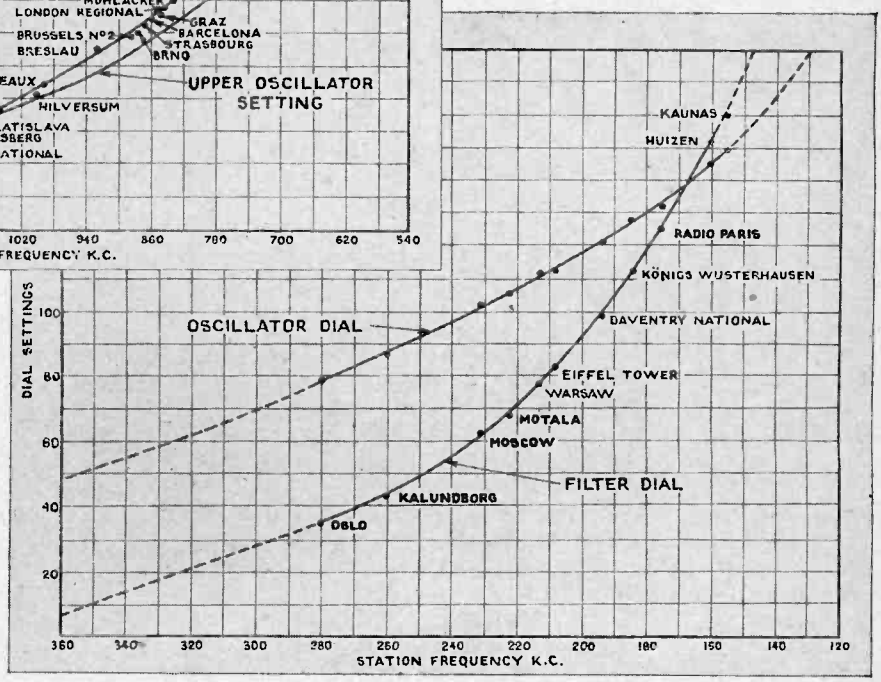
NEW VALVES.
A NEW DEVELOPMENT IN POWER GRID DETECTION.
CURRENT TOPICS.
EKCO A.C. RECEIVER MODEL 312.
UNBIASED OPINIONS.
BROADCAST BREVITIES.
TESTING WIRELESS RECEIVERS.
CORRESPONDENCE.
PRACTICAL HINTS AND TIPS.
LABORATORY TESTS.
READERS' PROBLEMS.

Super-

A.C. Band-pass Sup Lor

(Concluded from page 602 of previous issue.)





Constructional Notes, Testing and Operating.

By W. T. COCKING.

THE construction work involved in building this receiver is not at all difficult, and consists in the assembly of manufactured components. The slab coil L_4, however, may have to be home made, but it can easily be constructed by winding 550 turns of No. 36 D.S.C. wire in a grooved former of the dimensions shown in the sketch of Fig. 2. The layout is straightforward, and all the components can be screwed down before the wiring is started. The connections should be made with No. 20 tinned copper wire run in insulating sleeving, but for the heater wiring either separate leads should be run from the transformer to each valve, or thicker wire, No. 16, should be used.

Valve screens are fitted to the two A.C./S.G. valves, and also to the A.C./H.L. oscillator, and the earth connection to these is most conveniently made by placing strips of copper foil beneath the valve-holders. Care should, of course, be taken to see that the foil does not make contact with the valve sockets. The screening boxes containing the coils are earthed in the same manner; there is no necessity for earthing the switch rod, however, as this is earthed automatically in each screen when the coil is screwed down.

Care should be taken to mount the three coils (Fig. 3) in line, if not supplied on a metal base-plate, so that the half-round length of brass rod will operate the switches smoothly. Since all the components are insulated from the panel (Fig. 4), it can be of any desired material. The drum dials, however, are mounted upon it, so a material should be chosen that will not warp and which is stiff, otherwise trouble may be encountered from slip and backlash in the tuning controls.

When all the connections have been made, the wiring should be carefully checked and the valves inserted. Mazda A.C./S.G. type are used for the first detector and the intermediate frequency amplifier, A.C./H.L. type for the oscillator and second detector, and an A.C./Pen. for the output stage. The mains rectifier is an Osram U.5.

Initial Adjustments.

There are a number of adjustments which will be necessary before the operation will be at its best, and these are most conveniently classified as follows, in the order in which they should be carried out.

(1) I.F. tuning.

(2) Choke output ratio.

Selective Six

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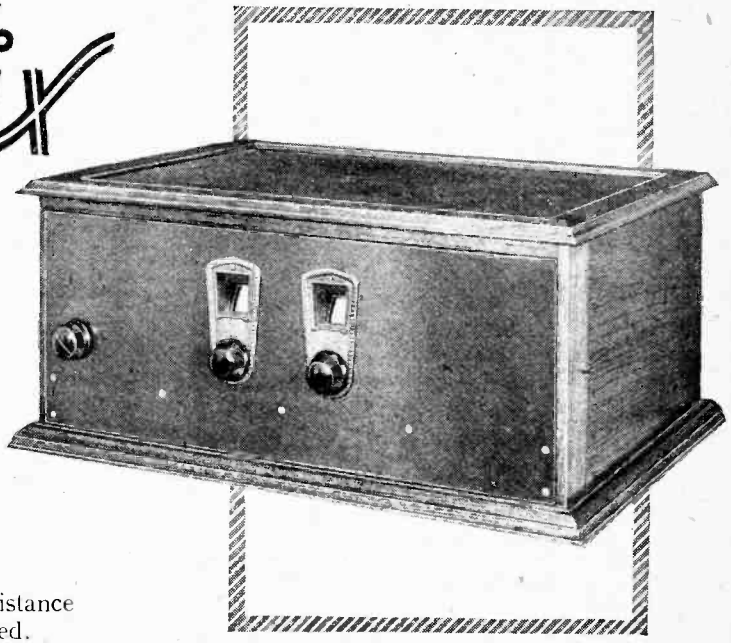


(3) I.F. transformer coupling.
(4) Band-pass filter ganging.
(5) Acceptor circuit adjustment.

With an average speaker the ratio on the output choke should be about 1.5-1 at first, and a weak signal should be tuned in. If a sufficiently weak signal cannot be heard, the local will do, but the volume control must be turned well down. The coils in the I.F. transformers should be placed at nearly their full distance apart, and the condensers across them adjusted.

Should screw adjustments be fitted use an ebonite rod or insulated driver. The condenser in the grid circuit of the second detector should be adjusted first, and then the one in the anode circuit of the screen-grid valve. Next comes the one in the grid circuit of this valve, and, lastly, the one in the anode circuit of the first detector. Having adjusted each one in turn, they should be gone over again, and the adjustment will then hold.

No attention should be paid to the quality during this process, and it will be a normal state of affairs for the tone to be very boomy. The output choke tapping should next be adjusted to suit the particular loud speaker which is to be used, and again this must not be adjusted on the score of tone, but to the tapping which gives the greatest freedom from amplitude distortion. As explained earlier, this is most easily accomplished with the aid of a milliammeter, but if this be not available, it is not difficult to find by ear the ratio with which blasting is at a minimum.

The Adjustment for Quality.

The tone should next be adjusted; the two coils in the first intermediate frequency transformer should be so placed that they are approximately $\frac{7}{8}$in. apart, and the coils in the second transformer should be slid together until the quality is at its best. The nearer the coils are together the better will the high notes be reproduced, but the poorer will be the selectivity. It will usually be necessary, therefore, to make a compromise between selectivity and quality, and this is easily carried out to suit any particular conditions. It should be noted, however, that it is not advisable to place the coils very close together, as not only will the loss in selectivity be very great, but the high notes will be passed more efficiently than the low, and the reproduction will become too high-pitched.

It will be noticed that no tone control has been fitted to the pentode valve, as it is intended that this control should be effected by the position of the intermediate frequency coils. The positions of the coils, therefore, will depend upon the speaker used, and one which is efficient in reproducing high notes will allow of greater selectivity being obtained than one which is deficient in the upper register.

The ganging of the input filter should next receive

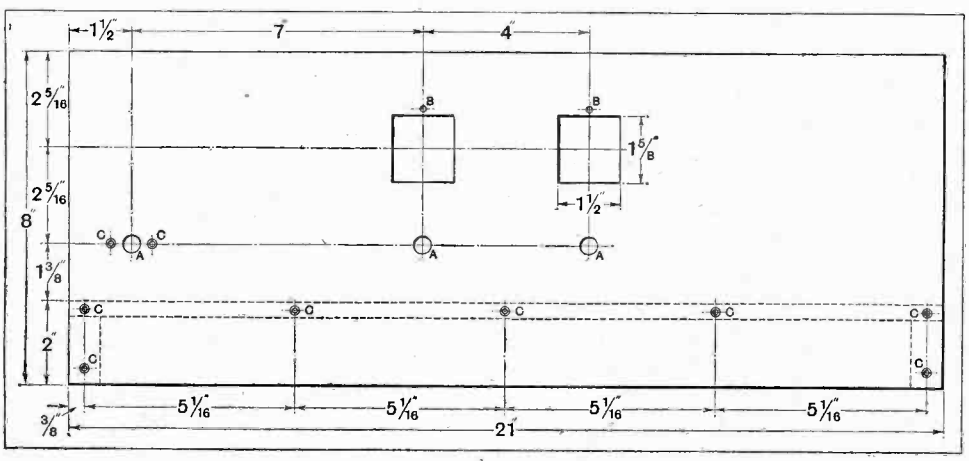
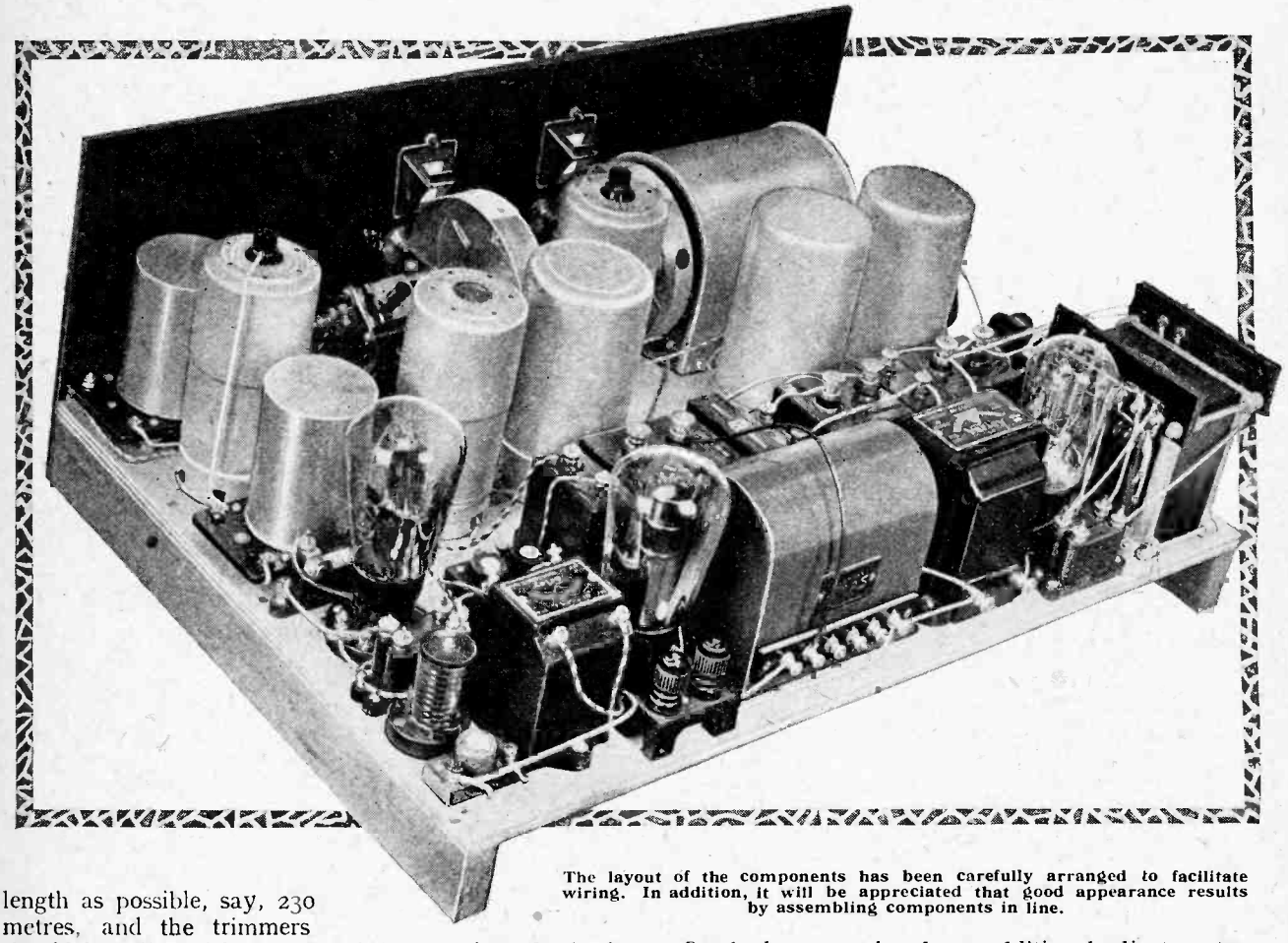


Fig. 4.—Drilling details of the front panel. Sizes of holes A, 7/16in.; B, 5/32in.; C, ⅛in. and countersunk.

Super-Selective Six.—

attention. Even with these condensers unganged, many stations will be receivable, but the full signal strength and freedom from second channel interference will not be obtained until they are correctly adjusted. The trimming should be carried out on as short a wavelength as possible, say, 230 metres, and the trimmers should be adjusted by means of the star-shaped wheels on the gang condenser. In the original receiver the first trimmer was fully unscrewed, while the second was screwed nearly home.



The layout of the components has been carefully arranged to facilitate wiring. In addition, it will be appreciated that good appearance results by assembling components in line.

Operation.

All adjustments have now been completed for the medium waveband, and it should be possible to receive any station which is not spoilt by background noise, heterodyning, spark interference, second channel or beat interference, and which is not nearer than 18 kc. to the local. No difficulty should be found in tuning, provided that it is remembered that most stations can be received at two different settings of the oscillator dial. The calibration charts of the original receiver are given in title illustration for the medium and long wavebands respectively, and these should be of assistance in locating the dial settings when first operating the set. At the extreme ends of the tuning dial on the medium waveband a station can only be received at one setting of the oscillator condenser, and on the long waveband there is again only one dial setting.

The accuracy with which the receiver will reproduce these dial settings will depend upon how closely the construction follows that of the original, and also upon the capacity used in the trimmers. As little capacity as possible should always be used, otherwise the tuning range is restricted.

On the long waveband one additional adjustment may be required. If it be found that a C.W. telegraphy station causes interference with all long-wave stations, *and that its note changes with the setting of the oscillator condenser,* long-wave interference is creeping in. The trouble is due to a station working on a frequency equal to, or nearly equal to, the intermediate frequency, and the compression-type condenser C_4 should be carefully adjusted until the interference vanishes. The adjustment is quite critical, and should not weaken the strength of the desired signal at all. If a weakening of signal strength is found, however, it shows that the condenser C_4 has too small a capacity, and the acceptor circuit is tuned, not to the intermediate frequency, but to the signal frequency.

The receiver has been tested within nine miles of Brookmans Park, and the stations marked on the calibration curves were all received on the loud speaker. It is possible to receive Algiers without a trace of the London Regional, but Mulhacker cannot be received without some interference. Sottens can be received, but

Super-Selective Six.—

the Midland Regional occasionally breaks through; the interference, however, is not sufficient to eliminate this station from the list of those which can be received well enough for a programme to be enjoyed.

VOLTAGE AND CURRENT READINGS.

Valve.	Anode Volts.	Screen Grid Volts.	Grid Volts.	Anode Current.	Screen Current.
Output AC/Pen.	236	196	10	27.5	4.8
2nd detector AC/HL	120	—	—	4	—
I.F. amplifier AC/SG	180	76	3	5.1	—
1st detector AC/SG	156	52	3.2	8.5	—
Oscillator AC/HL	156	—	4.2		

Voltage across C_{28}	280	Current through Ch_3	50 ma.
Voltage across C_{29}	256	Current through Ch_4	20 ma.
Voltage across C_{30}	248		

All readings taken with the volume control at maximum, oscillator condenser at 180 degrees on the medium waveband, and aerial and earth terminals short-circuited.

When the band-pass filter is tuned to a powerful station, it will be found that it can be heard at *four* settings of the oscillator condenser. The two outer settings only are the correct ones, and the other two are due to harmonics of the oscillator beating with harmonics of the local. No attempt should be made to use these harmonics, as this will lead to considerable distortion. These harmonics only become noticeable when the input circuit is tuned to the local, and so, when searching for distant stations, care should be taken to see that it is tuned to its correct frequency, otherwise avoidable interference will be experienced.

A table is given showing the actual measured voltages and currents at various points, so that the receiver may be checked if suitable instruments be available. It should be noted that probably no set will give exactly the same figures, due to variations in the valves and components. The meter also has an effect upon the readings obtained, and that used

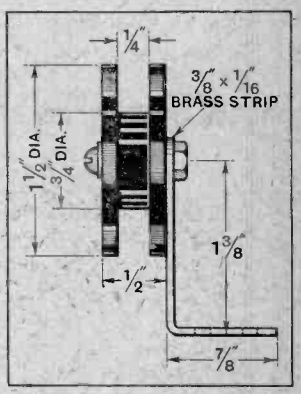
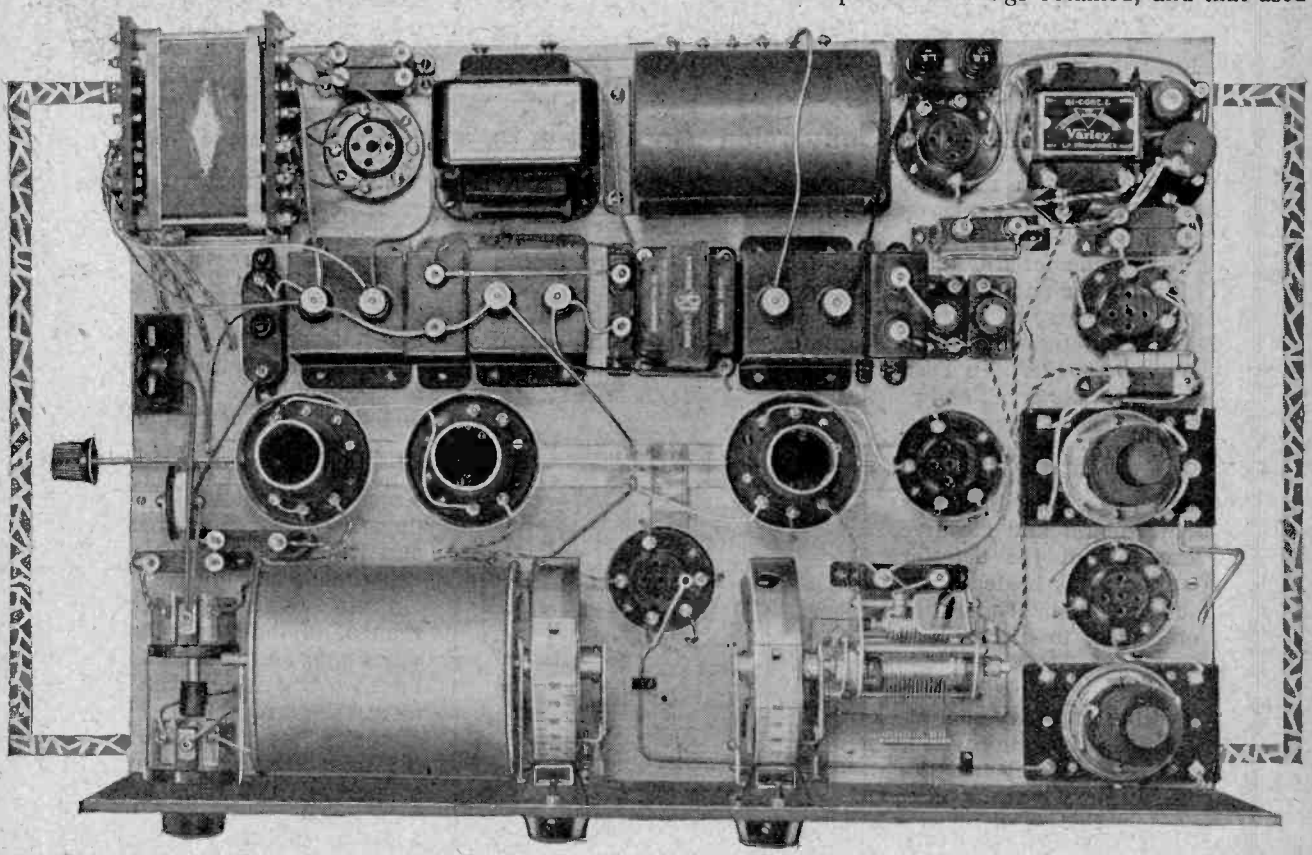


Fig. 2.—Constructional details of the small spool-wound coil L_4 which is connected to the aerial circuit. It may be turned from ebonite, built up from small ebonite discs or improvised from any small bobbin that may be to hand.



Plan view with coil and valve covers removed. A copper foil strip is run beneath the coils if they are of a type not already assembled on a rigid metal baseplate. It will be noticed that a foil strip is likewise run between the two intermediate couplings and the valve that is between.

Super-Selective Six.—

for these measurements had a full scale deflection of 400 volts for all H.T. and screen voltages. The meter for the pentode grid bias had a scale of 100 volts, and

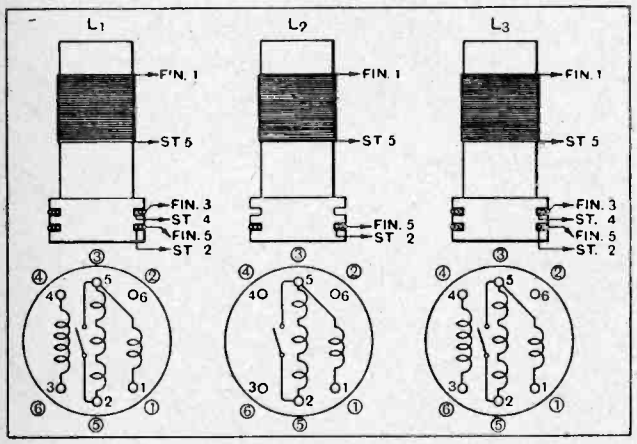


Fig. 3.—Arrangement of the coil windings showing the internal connections to the terminals. The precise windings will vary according to the diameter of the former, its proximity to the screen and the arrangement of the sections. Terminal numbers are here indicated conforming to usual standard practice, while the corresponding numbering actually adopted on the particular coils used and as shown in the theoretical and practical circuit diagrams is also given.

for all other bias voltages of 10 volts. In every case the full scale current consumption was 1 mA. A meter taking a greater current will show a lower voltage, and vice versa.

While it is assumed that coils made to the requirements of this set may be procured, details are given showing the arrangement of the windings and the terminal connections. The precise number of turns used in the several sections will vary, of course, in accordance with the diameter of former used and the proximity of the screening. It is important that the direction of coupling of the divided winding arranged to produce the inductively coupled band-pass filter shall be correctly followed. Fig. 3 shows the end connections of the coils assuming that the same direction of winding is maintained throughout. Again it will probably be beyond the facilities or skill of the reader to construct his own intermediates, but it might be mentioned that each coupling consists of a pair of tuned circuits, comprising a coil of mean diameter of about 1¼in. and consisting of some 500 turns of No. 36 enamelled wire. The tuning condensers have a maximum value round about 0.0003 mfd., producing a frequency when the coil is screened and allowing for stray capacities of 110 k.c. Provision is made to vary the selectivity of the intermediate couplings by adjusting the position of the upper coil, while the necessary limited variation of the tuning condensers is effected by rotating the clamping screws. It should be noted that earth connections are made to the screening containers of the intermediate couplings.

A GRAMOPHONE ADAPTOR.

Method of Conversion Applicable to any Receiver.

OCCASION sometimes arises to connect a gramophone pick-up to a receiver in the design of which no provision is made for this addition, and of which the circuit details are not known, or where wiring is so inaccessible that internal alterations cannot readily be made. In such cases results—generally good, and at the worst quite tolerable—can almost always be obtained by suitably joining the pick-up volume control potentiometer, in series with a bias battery, between grid and negative filament terminals of the detector valve. If an indirectly heated valve be used, the low-potential connection is made, of course, to the cathode terminal.

This method involves no alteration of wiring, and the necessary connections can always be improvised. Consideration of a typical grid detector circuit will show that the pick-up, connected in this way, will be shunted by the grid condenser, but, as has been pointed out in these columns, the presence of this small parallel capacity will seldom impair reproduction to any noticeable extent, although it may possibly do so when an electrical bass resonance has deliberately been introduced into the pick-up design.

If this capacity is found to be harmful, or if anode bend detection, which renders the scheme more or less impracticable, is included, other means of connecting the pick-up must be devised. By isolating the detector valve grid pin from its corresponding socket, and arranging matters so that existing connections to its filament and anode pins are retained, the necessary alterations may obviously be made quite independently of whatever may be included in the normal grid circuit.

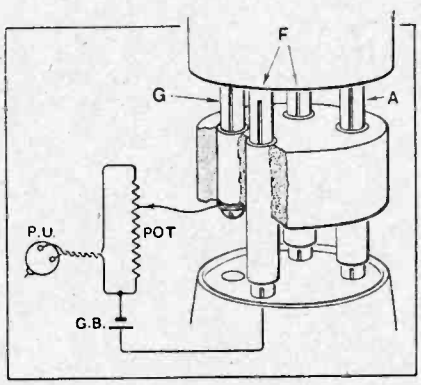


Fig. 1.—Construction of a gramophone adaptor for interposing between a valve and its holder. The grid pin is entirely isolated from internal wiring, but connections to the remaining electrodes are unchanged.

To do this an adaptor on the lines indicated in the sketch may be constructed or obtained. This component is inserted between the valve and its socket, external connection being made as shown.

Brass valve sockets with threaded shanks, of the type popular a few years ago, and still obtainable from most wireless dealers, can sometimes, after a slight reduction of their shank diameter has been effected with a file, be used as adaptors without any supporting material; this applies only when modern valve-holders, with spring sockets, are fitted in the receiver. Connection to the grid pin can be made through a similar socket having a shortened shank.

SO many new valves have recently been produced by the leading makers that readers will welcome a list of their characteristics classified under various headings. Apart from tremendous improvements in the standard of performance—shown by a glance at the mutual conductance columns—the list reveals some remarkable innovations. The new types include a valve primarily designed to combat the cross-modulation evil, special power grid detectors of high sensitivity, and, in the output series, two valves with the remarkable slope of 7·5.

NEW VALVES

Some Characteristics of Leading Makes and Notes on their Use.

ABOUT this time of the year quite a large number of new valves appear on the market in readiness for next season's receivers. It is thought, therefore, that many readers will welcome the publication of a list of the more important new products of the leading valve makers. The data given may be taken as an interim report between the supplementary data sheets issued by this journal at the end of each year. Only new valves are included or types of which the characteristics have been radically altered.

There are important developments in every category. In the screen-grid series we find that a determined effort has been made to tackle the serious problem of cross-modulation by a reduction in working impedance and by developing the H.F. screened pentode. Inter-electrode capacities are even lower than what appeared last year to be the irreducible minimum, and mutual conductance—in general, a measure of efficiency—has increased in one case to the remarkable figure of 4 mA. per volt. Neither are such developments confined to the H.F. amplifier. An examination of the list of miscellaneous valves from which detectors will be chosen will show that there are specimens specially designed for power grid detection with slopes of 4 and even 5, while amplification factors of 70 and 80 for impedances of less than 20,000 ohms are now obtained.

In the output class no less important are the improvements. Mutual conductances are soaring higher and higher—the figure of 7.5 being reached in the case of two A.C. valves. This must constitute a record. The mutual conductance column makes interesting reading, as none of the new power valves has a slope less than 3.5 and the majority fall between 4 and 6.

A New Standard of Performance.

When it is realised that only a year or two ago the slope of a typical power valve was 2 and its sensitivity,[1] measured as undistorted A.C. milliwatts per volt squared input, about 0.8, it will be appreciated that quite a new standard of performance has been set. The sensitivity of a number of the latest valves under discussion reaches the enormous figure of 6.

With regard to pentodes, a careful study of the latest additions will make it abundantly clear that little development has taken place in the battery-fed variety. The small triode output valve sells at about half the price of its pentode counterpart and is very nearly as efficient. On the other hand, the number of high-voltage pentodes for mains operation is increasing

[1] Reference to published valve data shows that a typical triode output valve of 18 months ago would require a grid swing of about 22 volts to give 400 milliwatts. Sensitivity = $400/22^2 = 0.8$.

SCREEN-GRID VALVES.

Type.		Filament. Volts.	Filament. Amps.	Max. Anode Voltage.	Optimum Screen Voltage.	Average Anode Current (mA.).	Amplification Factor.	A.C. Resistance (Ohms).	Mutual Conductance (mA./Volt).	Anode-Grid Capacity ($\mu\mu$F.).	Price.
Cossor	MSG-HA* ..	4.0	1.0	200	80	2	1,000	500,000	2.0	0.001	25/-
	MSG-LA* ..	4.0	1.0	200	80	5	750	200,000	3.75	0.001	25/-
	MS-PEN-A***	4.0	1.0	200	150	10	320	80,000	4.0	0.0045	27/6
Marconi and Osram.	S 21	2.0	0.1	150	70	3	220	200,000	1.1	0.005	20/-
	S 22†	2.0	0.2	150	75	3.5	350	200,000	1.75	0.005	20/-
Mazda	DC/SG** ..	6.0	0.5	200	75	3.6	1,000	360,000	2.8	0.003	25/-

* With indirectly heated cathodes for A.C. mains. ** With indirectly heated cathode for D.C. mains. *** H.F. screened pentode for H.F. amplification and power grid detection (for A.C. mains). † Available July 1st, 1931.

MISCELLANEOUS VALVES.

(A.C. resistances greater than 7,000 ohms.)

Type.		Filament.		At Zero Grid Volts and 100 Volts H.T.			*A* Max. Anode Volts.	*B* Grid Bias (*for A*).	Average Anode Current (*for A and B*) (mA.).	Price.
		Volts.	Amps.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./volt).				
Cossor	210 HL	2.0	0.1	22,000	24	1.1	150	3.0	1.6	8/6
	41 MH*	4.0	1.0	18,000	72	4.0	200	1.5	3.2	15/-
	41 MHL*	4.0	1.0	11,500	52	4.5	200	3.0	4.0	15/-
Marconi and Osram.	HL 2	2.0	0.1	18,000	27	1.5	150	3.0	1.75	8/6
Marconi ..	L2/B	2.0	0.1	10,000	15.5	1.55	150	4.5	4.0	8/6
Mazda ..	DC/HL**	6.0	0.5	13,000	35	2.7	200	3.0	5.6	15/-
Mullard ..	PM 1 HL	2.0	0.1	18,500	28	1.5	150	3.0	1.4	8/6
	PM 3 D†	4.0	0.1	8,000	24	3.0	150	4.0	3.25	8/6
	904 V*	4.0	1.0	17,000	85	5.0	200	1.5	4.5	15/-

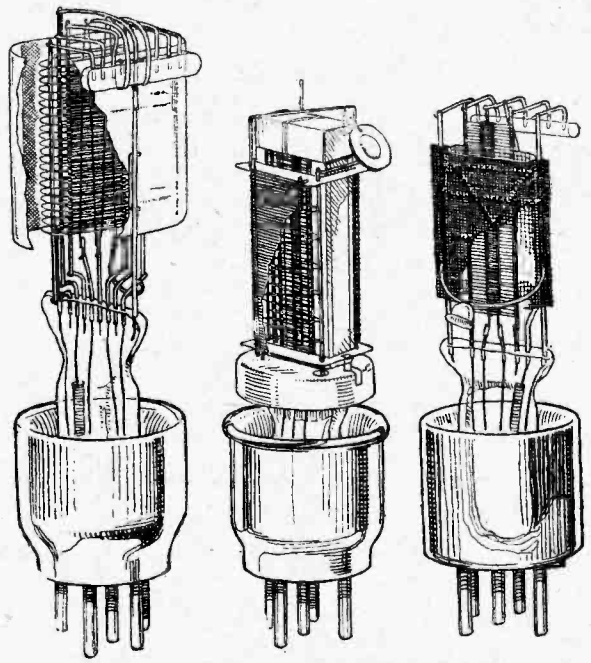
* With indirectly heated cathodes for A.C. mains. ** With indirectly heated cathode for D.C. mains. † Specially suitable for series filament connection in D.C. mains sets.

rapidly, as witness the addition of three indirectly heated models and the same number of the directly heated type—all of high sensitivity.

Although the Mazda indirectly heated D.C. mains valves have been reviewed in detail in the pages of this journal and readers will be familiar with their functions, their characteristics are published again as certain modifications and improvements have been effected. It is understood that the Marconi and Osram companies will soon be releasing a series of D.C. mains valves with independently heated cathodes and with heaters consuming but 0.25 amps. at 16 volts; thus the consumption of a D.C. set need not exceed 60 watts, or no more than a single electric lamp bulb.

A welcome standardisation in mains rectifying valves is understood to be contemplated. In the place of a heterogeneous mixture of full-wave and half-wave rectifiers demanding all manner of different heater and plate windings on the mains transformer we are eventually to have three main types which are shown in the accompanying table as A, B and C. The constants given in heavy type will remain unaltered, but individual makers may vary slightly the figures in light types. By a happy coincidence, the D.C. volts developed (across a 4-mfd. condenser, which must always be shunted across the output of a rectifying valve) for full load are about the same as the max. R.M.S. volts which may be applied to one anode. For example, type B will give 350 volts D.C. at full load when the R.M.S. voltage is 350-0-350. This reduction in the number of valve types should considerably assist transformer makers.

Not only have electrical characteristics generally undergone a tremendous improvement, chiefly by dint of closer spacing of electrodes, but also in mechanical detail big strides have been made. With the help of mica locking and multi-point suspension, microphonic howling is a thing of the past; furthermore, greater rigidity of construction makes for fewer breakages in transit. Attention has also been paid to the dielectric properties of valve bases, and tests in our laboratories show that a modern H.F. or detector valve will shunt a preceding tuned circuit with the equivalent of 5 megohms, whereas two years ago 0.5 to 1 megohm was the loss to be expected. Practically all the screen-grid valves and detectors can now be obtained externally sprayed with an earthed metal coating without extra charge. These "metallised" valves, as they are called, avoid the necessity for separate metal screening cans and reduce the anode-grid capacity in the case of S.G. valves.



The electrode assembly of three highly specialised new valves. On the left is the Marconi and Osram PT4 valve—a high-voltage directly heated pentode for A.C. mains. In the centre is the first commercial screened H.F. pentode—the Cossor MS-PEN-A with which cross-modulation is considerably reduced. On the right is a special power grid detector with an amplification factor of 85 and an A.C. resistance of 17,000—the Mullard 904V.

The set designer can indeed congratulate himself on having a wider choice of valves than ever before, and the British valve manufacturer must receive the highest praise for his products, which are now well ahead of those of any other country in the world.

New Valves. –

It will be as well to take some of the new valves individually and discuss their advantages. In the screen-grid list there are two Cossor mains valves, styled MSG-HA and MSG-LA. The former, having a comparatively high impedance, is designed especially for tuned anode coupling or untapped tuned grid circuits. For tuned step-up transformer or tapped tuned grid coupling the second valve is recommended, as its impedance is *very low* and cross-modulation and modulation distortion will be minimised. The constants for both valves are published under 1.5 volts negative bias conditions—200,000 ohms is therefore advisedly called very low as such an impedance measured and quoted at zero grid might become 500,000 ohms at normal bias.

reduced to a very low figure. It will be seen that a screen potential twice the normal value can be applied; this is possible owing to the absence of a negative resistance kink in the curve and has the effect of producing a low-impedance screened valve capable of handling, without rectification, comparatively large signal voltages. Preliminary tests show that cross-modulation and modulation distortion are reduced a number of times as compared with the best screen-grid valve on the market.

The price to be paid for these advantages is a large anode current—the maximum being 10 mA., while the screen passes 8 mA.—not a serious figure in a mains receiver. The large screen current suggests a series resistance—rather than a potentiometer-feed. With the

OUTPUT VALVES.

(A.C. resistances less than 7,000 ohms.)

Type.		Filament.		At Zero Grid Volts and 100 Volts H.T.			*A*	*B*	*C*	*D*	*G*	Price.
		Volts.	Amps.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./Volt).	Max. Anode Volts.	Grid Bias (*for A*).	Average Anode Current (*for A and B*) (mA.).	Max. Undistorted Output (*for A, B and C*) (Milliwatts).	Optimum Load (*for D*) (Ohms).	
Cossor	220 PA	2.0	0.2	4,000	16	4.0	150	4.5	10	160	7,000	10/6
	41 MP*	4.0	1.0	2,500	18.7	7.5	200	7.5	24	1,250	3,000	17/6
	41 MXP*	4.0	1.0	1,500	11.2	7.5	200	12.5	40	1,650	2,000	22/6
Marconi and Osram.	LP 2	2.0	0.2	3,900	15	3.85	150	4.5	11.5	150	7,100	10/6
	P 2	2.0	0.2	2,150	7.5	3.5	150	10.5	17	300	4,500	13/6
Marconi	P 2/B	2.0	0.2	1,850	6.5	3.5	150	13.5	16	350	5,000	13/6
Mazda	DC/P**	8.0	0.5	2,220	10	4.5	200	13.5	17	650	4,500	17/6
	PP 5/400***	4.0	2.0	1,500	9	6.0	400	32	63	5,000	2,750	30/–
Mullard	PM 202	2.0	0.2	2,000	7	3.5	150	13	14	350	4,000	13/6
	DO 75***	10.0	2.0	2,000	12	6.0	1,000	55	75	18,000	8,000	£8

* Indirectly heated A.C. valves. ** Indirectly heated D.C. valve. ***Directly heated valves. The max. undistorted output, which is for 5% second harmonic, and the optimum load (i.e., loud speaker impedance) figures have been calculated by *The Wireless World*.

PENTODE VALVES.

Type.		Filament.		Mutual Conductance (mA./Volt).	*A*	*E*	*B*	*C*	*F*	*D*	*G*	Price.
		Volts.	Amps.		Max. Anode Voltage.	Max. Screen Voltage.	Grid Bias (*for A and E*).	Average Anode Current (*for A, B and E*) (mA.).	Average Screen Current (*for A, B and E*) (mA.).	Max. Undistorted Output (*for A, B and E*) (Milliwatts).	Optimum Load (*for D*) (Ohms).	
Cossor	MP/PEN*	4.0	1.0	4.0	250	200	12	30	7	1,900	6,500	27/6
Marconi and Osram.	PT 4***	4.0	1.0	2.2	200	200	18	30	8	1,800	6,000	27/6
	M.PT 4*	4.0	1.0	3.0	250	200	11	32	5	2,000	5,000	27/6
Mazda	DC/PEN**	8.0	0.5	2.5	250	200	10	30	5	1,900	8,000	27/6
Mullard	PM 24 C***	4.0	1.0	3.0	400	200	28	30	5	3,500	8,000	30/–
	PM 24 D***	4.0	2.0	4.0	500	200	35	50	6	8,000	8,000	35/–

* With indirectly heated cathodes for A.C. mains. ** With indirectly heated cathode for D.C. mains. *** Directly heated A.C. valves.

The MS-PEN-A is an extremely interesting newcomer. It follows closely the design outlined in *The Wireless World*[2] a short time ago. It is a pentode in that there is a third grid between the auxiliary or screening grid and anode, but the latter is brought out at the top of the bulb so that the inter-electrode capacity by virtue of this and the special construction of the electrodes is

rapidly increasing congestion of the ether, cross-modulation will become more and more evident with the ordinary S.G. valve, and the MS-PEN-A is to be welcomed as the first British commercial valve specially designed to combat this evil. Owing to the large signal-handling capacity, low impedance and negligible anode-to-grid capacity, the valve can be used as a power grid detector, having quite a small input damping—in fact, less than an anode-bend detector. To couple such a valve to the output stage, the best circuit is a

[2] See "Interesting Valve Development," by W. I. G. Page, December 17th, 1930.

New Valves.—

choke-condenser-fed L.F. transformer with a variable 50,000-ohm resistance across the primary, which not only improves the frequency response, but also gives a measure of tone control.

Valve manufacturers, appreciating this, have added a number of new A.C. valves with suitable impedances between 10,000 and 20,000 ohms with remarkably high mutual conductances of 4 and 5 mA. per volt. Reference is made to the Cossor 41MH and 41MHL and the

STANDARDISED RECTIFYING VALVE TYPES.

Type.	Filament.		Type of Rectification.	Max. Anode Volts. R.M.S.	Max. D.C. Output* (Unsmoothed).		Price.
	Volts.	Amps.			Volts.	mA.	
A	4.0	1.0	Full-wave	250—0—250	250	60	15/-
B	4.0	2.0	Full-wave	350—0—350	350	120	17/6
C	4.0	2.5	Full-wave	500—0—500	500	120	22/6

* Across a 4-mfd. condenser. The figures in heavy type are to be standardised, while those in light type will be maintained approximately.

The new Marconi and Osram screen-grid valves—the S21 and S22—for battery-driven sets have conveniently low impedances which suggest reasonably linear characteristics. The selectivity of an H.F. stage embodying one of these valves should be adequate if a step-up ratio coupling be used. Of the remaining valve—the Mazda DC/SG—little need be mentioned beyond the change of heater voltage from 4 to 6 volts. With the high mutual conductance of 2.8 and the low inter-electrode capacity of 0.003 $\mu\mu$f, the first indirectly heated D.C. mains valve introduced in this country for H.F. amplification should give high stage gain with stability.

In the list of miscellaneous valves will be found power grid and leaky grid detectors and intermediate L.F. valves. Anode-bend detection is omitted from the discussion as this method of rectification compares unfavourably with either of the two types of grid rectification. It can be shown[3] that the grid volts-grid current curve of a modern valve—especially the indirectly heated type—provides extremely linear rectification so long as the input is kept reasonably large and that a limit is set only by the curvature of the anode characteristic.

[3] See article elsewhere in this issue entitled "A New Development in Power Grid Detection," by F. M. Colebrook.

Mullard 904V. These valves should prove to be sensitive power grid detectors when used at zero grid, with a voltage actually applied to the anode of, say, 130 to 140, and with a grid leak and condenser of 0.25 megohms and 0.0001 mfd. respectively. Before dismissing this series, tribute should be paid to the makers of the 904V, which has an amplification factor of no less than 85 for an impedance of 17,000 ohms.

All the new output valves represent an advanced standard of performance, as can be seen by examining columns B and D, which give the undistorted output for a given input. The listener who, through force of circumstances, must use a small accumulator for filament heating will find a good range of 2-volt power valves from which quite large outputs can be obtained with the modest L.T. consumption of 0.2 amperes. Such valves are the Cossor 220PA, the Marconi and Osram LP2 and P2, the Marconi P2/B and the Mullard PM202. There are three new indirectly heated valves; two for A.C. mains and one for D.C. mains. The latter—the Mazda DC/P—provides a three-electrode alternative to the DC/PEN when pentode output is not desired. The Cossor 41MP and 41MXP and the Mazda PP5/400 must represent the high water of valve efficiency to-day. Slopes of even half the figure attained by these valves were scarcely approached a year ago.

W. I. G. P.

Tracing a Moving Transmitter.

A mysterious transmitter was the attraction at the opening outdoor meeting of the North Middlesex Radio Society on Sunday, May 17th, when, in the course of operations near Broxbourne, direction-finding groups were required to trace the movements of a car carrying transmitting equipment. Each transmission from the car included the true bearing of a prearranged fixed point, actually Cuffley Station. By combining this with the bearing obtained by a directional receiver, each party should have been able to identify the position of the car at the moment.

A comparison of notes during tea showed that the majority of readings gave a very high order of accuracy, the error in several instances amounting to no more than 200 yards. At a range of 5 to 6 miles this was considered extremely satisfactory. The signals from the transmitter were heard at distances up to 8½ miles, the power dissipation being 2½ watts.

A similar field day will be held on Sunday next, June 14th, and other radio societies are invited to participate.

Hon. Secretary, Mr. M. P. Young, 40, Park View, Wynchgate, N.21.

CLUB NEWS.

FORTHCOMING EVENTS.

THURSDAY, JUNE 11th.

Slade Radio (Birmingham). At 8 p.m. At the Parochial Hall, Broomfield Road, Erdington. Questions and Answers.

MONDAY, JUNE 15th.

Hackney Radio and Physical Society. At the Electricity Showrooms, 18-24, Lower Clapton Road, E.5. A Dual-range Band Pass Filter.

THURSDAY, JUNE 18th.

Ilford and District Radio Society. At the Wesleyan Institute, Cleveland Road. Tests with members' portables.

Loud Speaker Mystery.

Excitement was created by music coming from behind a screen at the last meeting of Slade Radio (Birmingham). The occasion—the test of fourteen loud speakers, mostly of the moving-coil type—gave members an opportunity of registering an impartial vote in favour of the instrument that pleased them most. The four "winners" were the products of well-known manufacturers.

The Society hopes to stage an interesting summer programme, and particulars can be obtained from the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

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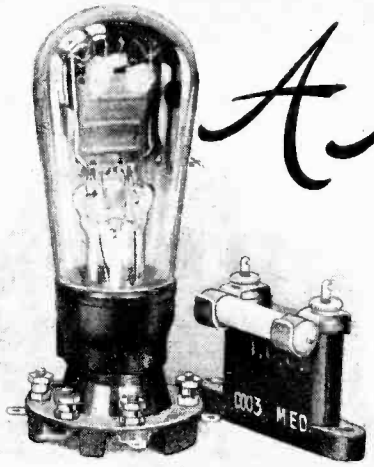
Transmitters on Tour.

A motor tour of the home counties was carried out by the South London and District Radio Transmitters' Society on Sunday, May 17th, when six amateur stations were visited.

The Society plans to hold meetings on the first Thursday of each month, commencing at 7.45 p.m. Over 30 members and friends were present at a recent meeting, and participated in a discussion regarding conditions on the 1.7, 3.5, 7 and 14 megacycle bands.

Full particulars can be obtained from the Hon. Secretary, 25, The Gardens, London, S.E.22



A New Development in Power Grid Detection

Dividing the Functions of Rectification and Amplification.

By F. M. COLEBROOK, B.Sc., D.I.C., A.C.G.I.

THE advantages of suitably designed grid rectification as compared with anode bend rectification are now becoming generally realised. The articles on what has been described as "power grid" rectification, published in *The Wireless World*, for May 7th, 1930, and December 3rd, 1930, showed that under the right conditions a practically linear type of rectification could be produced in the grid circuit, with consequent freedom from amplitude distortion and its associated introduction of spurious harmonic frequencies into the modulation.

ALTHOUGH as far as the grid circuit is concerned, very large signal voltages can be rectified without distortion by the grid detector, there are limitations due to curvature in the anode characteristic. It is found, therefore, that the single valve power grid detector requires a high anode voltage before linear results are possible, and to avoid this, as well as to provide certain additional advantages, the author suggests the simple expedient of dividing the functions of rectification and amplification and allocating each to a separate valve.

The distinctive and very desirable feature of large amplitude grid circuit rectification can be stated and illustrated quite simply. Referring to Fig. 1, it is well known that the input carrier wave voltage (represented by E in Fig. 1) causes a lowering of mean grid potential (V_g in Fig. 1). The change of mean grid voltage V_g depends on the carrier wave voltage E in the manner shown by the curve in Fig. 2, which can conveniently be referred to as the "rectification characteristic." It is a line very similar in shape to the actual grid current—grid voltage characteristic, but the distinction between the two must be clearly borne in mind. The important feature of the rectification characteristic is that it becomes more and more nearly a straight line the larger E becomes. This feature is important because it is the uniformity of the slope of the rectification characteristic which matters in the reproduction of modulation. For suppose the modulation causes E to vary between the limits A and B in Fig. 2, then the consequent variation of mean grid potential will be between the limits C and D in synchronism with the modulation frequency changes in E, so that if the relevant part P_1 P_2 of the rectification characteristic be a straight line, or nearly so, the changes of mean grid potential are a faithful copy of the modulation. (This is strictly correct only if it be assumed that the impedance of the grid leak and condenser combination does not change appreciably with modulation frequency, but this fact does not greatly affect the matter at present under consideration in this article.

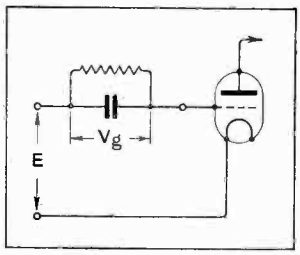


Fig. 1.—Skeleton circuit of a grid rectifier. The input carrier wave voltage E causes a lowering of mean grid potential V_g.

The ideal rectification characteristic is obviously a straight line passing through the origin, as shown by the dotted line in Fig. 2. Such a characteristic would give perfect reproduction even of 100 per cent. modulation. With the actual characteristic, on the other hand, there will be a certain amount of distortion if the modulation variation of E goes outside the limits A′ B′ in Fig. 2. (Cocking attributes such distortion to the curvature at the foot of the grid current curve, but that is only partly true. It is the rectification characteristic we are concerned with all the time.) Now, as Cocking quite rightly points out, the higher we go up the rectification characteristic, the less important is the curvature at the foot, so the larger we make the carrier wave voltage, the more nearly perfect will be the reproduction of the modulation, even with high modulation percentages.

As far as the grid circuit alone is concerned there is apparently no upper limit, practically speaking, to the permissible input carrier wave voltage. In his article in *The Wireless World* for May 7th, Cocking gives

A New Development in Power Grid Detection.—

curves extending up to a peak voltage of 7, and even more striking curves were published by S. E. A. Landale in the Proceedings of the Cambridge Philosophical Society in October, 1929. Fig. 3 is based on one of Landale's curves. It actually shows the change of grid current in microamperes, but since the grid leak used was one megohm, the left-hand scale can be read as the change of mean grid potential in volts. It will

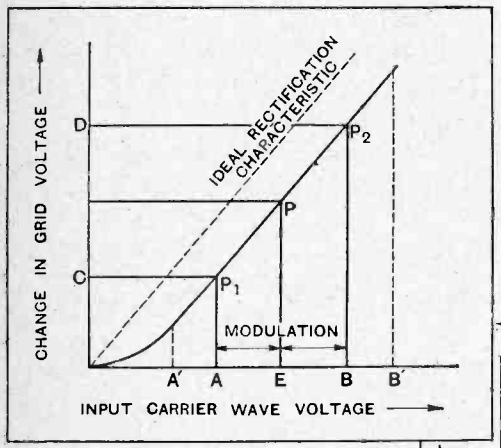


Fig. 2.—(Left) Rectification characteristic. The larger the input carrier wave voltage the more linear is the rectification.

be seen that the input voltage is taken up to nearly 50 volts, and the resulting rectification characteristic appears to be a straight line through the origin. The curvature at the foot is still there of course, but it is dwarfed by the increased scale of the total changes.

Unfortunately, however, the anode current characteristic has also to be taken into account, and it is here that the limitations are found. It is clearly necessary that the anode current characteristic shall be able to accommodate within its straight region the relatively large changes of anode current corresponding to the large input radio-frequency grid voltages. Furthermore, it must satisfy this condition for the mean grid voltage which results from the rectification of the carrier wave. If the grid swing carries the anode current changes outside these straight line limits of the anode current characteristic, anode bend rectification will take place in opposition to the grid rectification, so that the line showing the change of anode current as a function of the input carrier wave voltage will begin to bend over at the top. The rectification characteristic in terms of anode-potential change shown in Fig. 4 is an example of this. It was published in *The Wireless World* for July 30th, 1930, and refers to the rectifier used in the new Science Museum receiver. A saturation effect is setting in even with as low an input as 3 volts. This cannot be due to any saturation in the grid circuit, and must therefore be due to curvature of the anode current characteristic, the resistance load in the anode circuit tending to increase this effect.

This anode current requirement is, in practice, rather a troublesome one. In order to satisfy it, the steady potential on the anode of the valve has to be made much larger than is usual in grid-circuit rectification, and the mean anode current is correspondingly large—larger, in fact, than is desirable for the primary winding of an inter-valve low-frequency transformer. The difficulty can be met to some extent by using a resistance-transformer coupling, but then the anode battery voltage has to be further increased to allow for the drop of voltage in the resistance. The decoupling resistance presents a similar difficulty. Even with the modified couplings proposed by Cocking in his article in *The Wireless World* for December 3rd, 1930, high-tension voltages of two to three hundred are called for, and a limited range of valves is specified as suitable.

Advantages of Dual-Valve Rectification.

These are not, of course, very serious objections, but they are drawbacks nevertheless, and some element of compromise is involved in the design of the circuits.

It is the purpose of this article to show that all these difficulties can be avoided and certain additional advantages obtained by the simple expedient of dividing the functions of rectification and amplification, normally performed

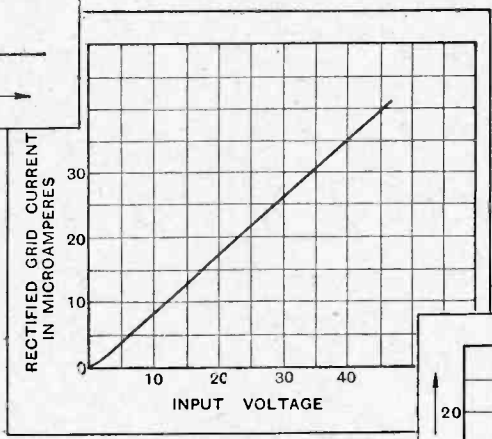


Fig. 3.—As far as the grid circuit is concerned, large inputs up to 40 or 50 volts can be accepted by a grid detector.

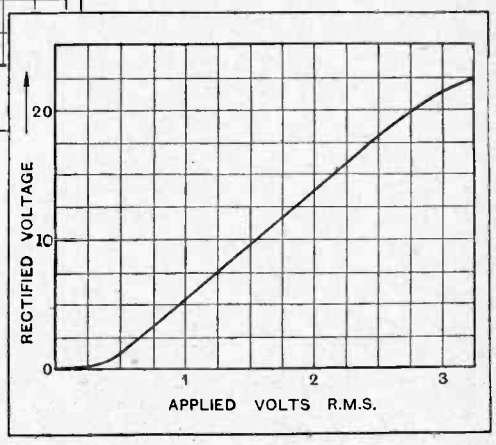


Fig. 4.—(Right) Although the grid circuit will handle a very large voltage, a saturation effect due to anode rectification is evident.

by the single rectifier stage, and allocating each to a separate valve. It means an additional valve, but it is worth it, for the conditions in each valve can be adapted to its own particular function.

In its simplest form the arrangement is that illustrated in Fig. 5. The grid of the rectifier valve is coupled by resistance and capacity to the grid of the amplifier or output valve, as the case may be.

Even in this skeleton form certain advantages are apparent. In the first place, the second valve can be chosen entirely without reference to its rectifying properties, and the grid bias used with it can likewise

A New Development in Power Grid Detection.—be that best suited to this function instead of the plus two or so required for grid rectification. In the second place, the mean grid voltage of the second valve will not be affected by the change in the steady or d.c. grid voltage of the rectifier valve, so that the fall of grid voltage due to the rectification of the carrier wave has not to be catered for in any way.

A simple addition to the circuit will afford another important advantage. The grid of the rectifier valve must of necessity be subjected to radio-frequency changes of potential, since its function is the rectification of such changes, but there is no need for any such radio-frequency changes on the grid of the second valve, and there is a very good reason for avoiding them. They can, therefore, be choked off, so to speak. In other words, a radio-frequency choke can be inserted in the coupling system, as shown in Fig. 6. Under these conditions there will be no tendency to anode rectification in the amplifier valve, since the radio-frequency currents are no longer there to be rectified, and, as far as the amplifier valve is concerned, it has only to satisfy the condition that it shall be able to accommodate within its straight-line region the modulation-frequency potential changes which occur at the grid of the rectifier. Further, this arrangement prevents the passage of unwanted and possibly harmful radio-frequency currents and potentials into the audio-frequency and output stages of the set —a very desirable feature.

The anode of the rectifier valve is as yet unemployed. We can dispose of it in two ways. If retroaction is not desired or required it should be connected direct to the grid of the valve as shown in Fig. 7*a*. Under these conditions the valve will actually be slightly more efficient as a rectifier than with any ordinary anode-circuit load, since the whole of the filament emission is available for the grid circuit. With this arrangement it will probably be desirable to reduce to somewhere near the optimum value the load of the rectifier on the input tuned circuit. This means that the grid of the rectifier should be connected somewhere below the free end of the circuit—probably about a half or two-thirds of the way up.

If, on the other hand, retroaction is required, the anode circuit of the rectifier valve is conveniently available for this purpose. Plain coil retroaction, with some form of resistance control, or the more popular shunt system with capacity control, illustrated in Fig. 7*b*, can be used. In the latter case a resistance could be used in the anode circuit in place of the radio-frequency choke, but the choke is much to be preferred as it will give a smaller modulation-frequency input capacity to the rectifier valve, a point of some importance in relation to uniformity of modulation-frequency output.

It is hardly necessary to discuss suitable types of

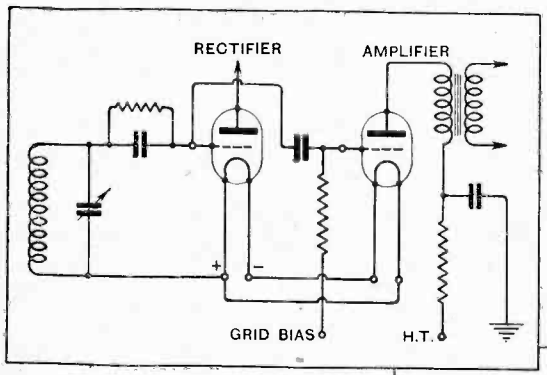
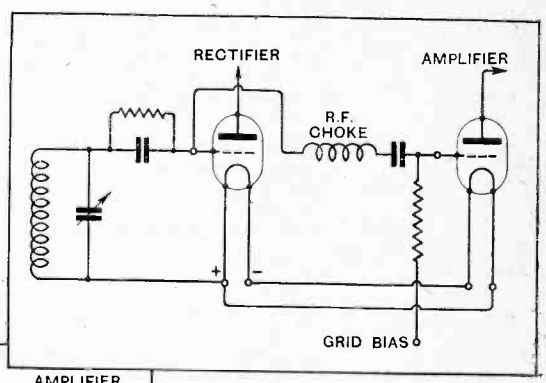
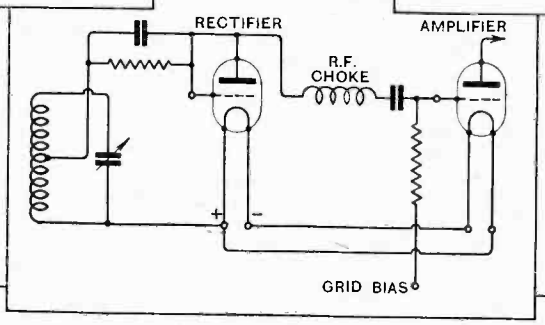


Fig. 5.—(Left) Simplified circuit showing how the processes of detection can be divided into two functions—rectification and amplification. Two valves are employed. Fig 6.—(Right) By interposing an H.F. choke between the two valves, there will be no tendency for anode rectification to take place and the passage of H.F. into the L.F. amplifier will be prevented.





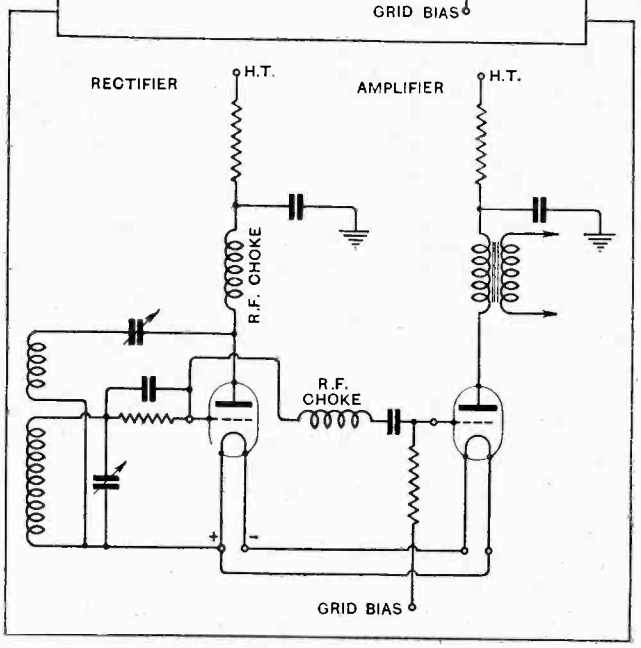


Fig. 7a.—(Above) Method of connecting the anode of the rectifying valve when reaction is not required.
Fig. 7b.—(Below) Complete circuit of dual valve detector with provision for reaction.

A New Development in Power Grid Detection.—

valve for the two purposes in any great detail, since any good rectifier will do for the first, and the requirements to be satisfied by the second are quite normal. Similarly, the coupling capacity and resistance for passing on the modulation-frequency potentials to the grid of the second valve are such as would normally be used for this purpose in a resistance-coupled amplifier. The condenser need not exceed 0.05 mfd., but should be of mica dielectric, if possible, for the sake of the insulation. The resistance should be kept fairly low—say 0.5 megohm—to reduce shunt-capacity effect on the higher modulation frequencies. The rectifier grid-leak should be kept low for the same reason, preferably not greater than 0.25 megohm.

Apart from the introduction of the additional valve no other requirements are imposed on the remainder of the set, which can be of quite conventional design. Moreover, normal decoupling resistances can be used in the rectifier stage, since the anode-voltage conditions are much less stringent than in the original power-grid rectification circuit.

CURRENT TOPICS

Events of the Week in Brief Review.

"AVENUE BRANLY."

The French custom of naming streets after celebrated persons has already given the amateurs of Cannes the opportunity of honouring the chief of French military radio. Avenue du Général Ferrié is a well-known thoroughfare, and in a few weeks' time a new avenue will be christened "Branly."

oooo

RADIO BRAIN WAVES.

Short-wave wireless has attracted an unusual number of inventors during the past year, according to the annual report of the Comptroller-General of the Patent Office. Attention has been concentrated on directional systems employing aerials of the beam type. As usual, the problem of fading has also proved a draw.

And now who will tackle atmospherics?

oooo

SIGNALS FROM NORTH POLE SUBMARINE.

Wireless messages from Sir Hubert Wilkins' submarine Nautilus on its voyage to the North Pole should provide fresh thrills for short-wave listeners during the coming months. The range of the transmitter can be gauged from the fact that signals from the Nautilus in New York harbour have been picked up by Amalgamated Wireless of Australia at Sydney. The transmitter, which has a power of 200 watts, will work on no fewer than twelve different wavelengths, viz. :— 800, 750, 731, 600, 54.3, 54, 45.3, 35.5, 33.6, 27, 22.6, and 18 metres. The call sign is WSEA.

oooo

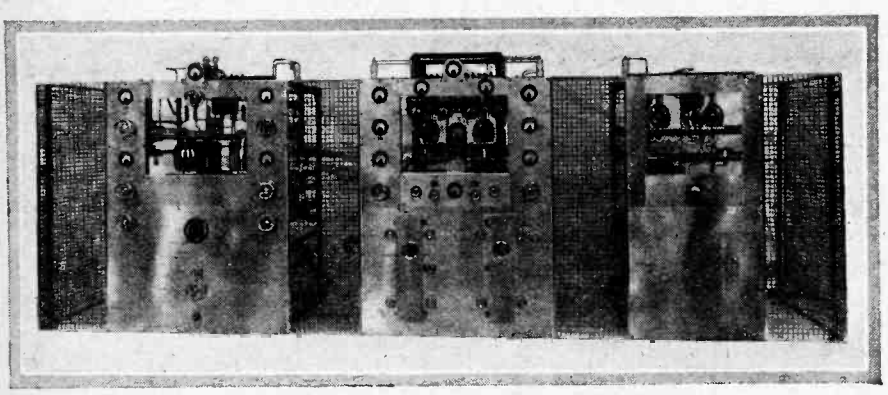
DERBY RESULTS ON "FLYING SCOTSMAN."

For the fourth year in succession Messrs. L. McMichael, Ltd., were able to supply the B.B.C. running commentary on the Derby to passengers on the up and down "Flying Scotsman" expresses. Both trains were equipped with Super Range Portable Four sets.

oooo

B.E.S.A. SETS NEW EBONITE STANDARD.

In the new revised British Standard Specification—No. 234 : Ebonite for Electrical Purposes—the British Engineering Standards Association now includes two grades of ebonite, an additional specification being included for ebonite having superior electrical and mechanical properties, this grade being intended for use where the highest quality material is required. Copies of this specification can be obtained from the B.E.S.A. Publications Department, 28, Victoria Street, London, S.W.1, price 2s. 2d. post free.



AN EMPIRE PRODUCT. Our Australian cousins have always adopted a go-ahead policy in wireless matters, both in commercial working and broadcasting. Our photograph shows one of the latest products of Amalgamated Wireless (Australasia), Ltd. —a 3 kW. (1 kW. aerial) short-wave transmitter supplied to the New Zealand Posts and Telegraphs Department for service between that country and Australia.

WIRELESS KEEPS FOOD FRESH.

Bad eggs will soon be things of the past in a new sense if Mr. Robert Pape, of Soest, Holland, can substantiate his claim of being able to arrest decomposition in organic products through the agency of ultra-short-wave radiations from a special transmitter.

According to a correspondent the invention consists of a generator of waves in the region of 25 centimetres to one metre. The waves thus generated form, after about ten days and within a radius of 20 metres from the machine, an electro-magnetic field in which no organic product can decompose.

In the inventor's house food has been seen, odourless and undecayed, which had been there for months. There were eggs, broken on a plate several months ago, a little dried, but with not a sign of decay. Eggs in the shell stored in the house on May 23rd, 1930, were opened and the yolk was beautifully yellow and without odour.

Reports of experiments by outsiders have been published, among them one of Dr. A. van Raalte, chief of the Amsterdam Meat Inspection Service, on behalf of the Dutch Patent Council.

From these reports it appeared that shrimps, mixed with only 4 per cent. of salt, showed no ammonia development after a fortnight's exposure.

oooo

DE FOREST VALVE VICTORY.

A severe blow is claimed to have been struck at America's "radio trust" by the judgment of the U.S. Supreme Court on May 25th deciding in favour of the de Forest Radio Company in its action against the General Electric Company concerning the validity of the Langmuir vacuum valve patent.

The Langmuir patent, held to be the most important in the radio patent pool, claimed originality for the production of a high vacuum in the three-electrode valve, thereby increasing its efficiency. After the case had been thrashed out in various courts, the Third Circuit Court of Appeals sustained the plea of the General Electric Company, representing the radio trust, but the Supreme Court, from which there can be no further

appeal, has overruled this judgment, and the matter appears to be definitely settled.

After a review of the scientific aspects of the patent the Supreme Court stated :

"Once known that gas ionisation in the tube caused a regularity of current which did not occur in a high vacuum, it did not need the genius of the inventor to recognise and act upon the truth that a better tube for amplifying could be made by taking out the gas."

Commenting on their victory, the de Forest Radio Company says :—

"Both within the radio industry proper and in the industrial applications of the vacuum tube, this decision definitely circumscribes the licensing field of the General Electric-RCA group, since, if held valid, the high vacuum patent would have covered every radio tube in use to-day, and would have created a virtual monopoly of all the industries which depend for their operation on vacuum tubes. This is so because the vacuum tube has become the heart and soul of the electrical arts."

oooo

MOTOR MAGNETOS CHOOSE 7-METRE WAVELENGTH.

Recent tests in Copenhagen on a wavelength of 7 metres were seriously interfered with by motor traffic, but, according to our correspondent, the trouble disappeared when the wavelength was raised to between 9 and 10 metres.

oooo

THE BIG TEST.

Listeners within the service area of the new Moorside Edge broadcasting station have an opportunity this week of testing their sets under the conditions which will prevail when the twin transmitters are in normal operation. The following schedule is being observed :—

WEEKDAYS (afternoons from approximately 5.15 to 6.0 p.m.).

Transmitter.	*Wavelength.*	*Programme.*
North Regional	479.2 m. (626 kc/s)	North Regional Children's Hour each evening.
North National	301.5 m. (995 kc/s)	Relaying a programme consisting mainly of dance music.

WEEKDAYS (nights from approximately 10.45 p.m. to midnight).

North Regional	479.2 m. (626 kc/s)	A programme of light music by a quintet.
North National	301.5 m. (995 kc/s)	The National programme dance music.*

*Late National programme dance music will eventually be radiated by the North Regional transmitter, as it is by the London Regional transmitter.

SUNDAY AFTERNOONS.

North Regional	479.2 m. (626 kc/s)	A composite Regional programme from 3.0 to 5.30 p.m.
North National	301.5 m. (995 kc/s)	The National programme from 3.0 to 6.15 p.m.

The times stated above are necessarily approximate as they are dependent upon the timing of the regular daily programmes. It is probable that this schedule will be continued for about a fortnight.

oooo

RADIO AND LIBRARY BOOKS.

Radio's "remarkable development" evidently has tended to whet the public's appetite for books rather than diminish the demand, according to the results of a library survey undertaken by the U.S. Office of Education. During the past six years, in which broadcasting steadily has mounted in public favour, libraries throughout America have shown meteoric expansion, with an increase of 33,500,000 books recorded.

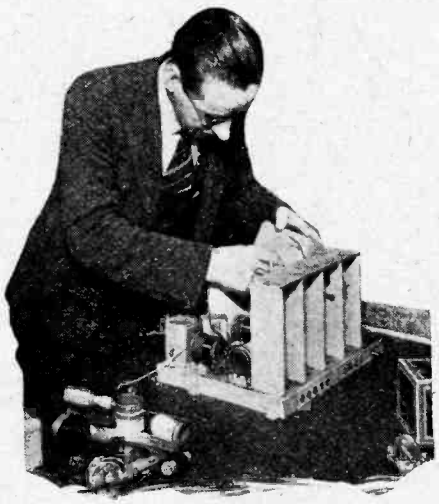
oooo

SOLVING THE SERVICE PROBLEM.

It must be reassuring to the prospective purchaser of an H.M.V. radio-gramophone to know that a new scheme for imparting technical instruction to their dealers has just been inaugurated by the Gramophone Company.

In general, the courses are planned on the same lines as those so successfully conducted last summer by the Marconiphone Company, and which were described at length in this Journal.

Subjects dealt with include elementary electricity and magnetism, principles of



TRAINING THE DEALER. A student at the Gramophone Company's school at Dagenham engaged in overhauling a Model 521 radio-gramophone chassis.

radio communication, and wireless circuits, but the greater part of the time available is devoted to such essentially practical matters as fault-finding, testing and repairing. The courses last a fortnight, and are held at the Dagenham Works in Essex.

A representative of *The Wireless World* technical staff, who was recently given an opportunity of watching the students at work, was very favourably impressed by the efficacy of the instructional methods adopted, and still more by the obvious keenness of those undergoing training. The reproach that so many dealers are unable to rectify trivial faults, thereby involving their customers in quite unnecessary expense and trouble in sending their sets back to the works, will soon be without justification if more training schemes of a similar nature come into being.

In matters of "service," the Gramophone and Marconiphone Companies work in close collaboration, and naturally the dealer training scheme of the latter concern is also in operation again for the present summer.

HARROW CALLING.

Every Harrow schoolboy, apparently, is a potential announcer. On Monday next, June 15th, Crompton elocution prizes will be awarded for clear speaking into the microphone. A public address system has been installed for the test.

oooo

ROYAL RADIO ENTHUSIAST.

The King of Siam is one of many royal personages who probe the nocturnal ether. Recently His Majesty purchased an Eddystone All-Wave Four with Mullard valves from a Bangkok firm, and the set occupies the place of honour in the royal drawing room.

oooo

THE HOME NECESSITY.

In the new Earl Haig Memorial Homes, a block of 183 houses and flats at Morden, Surrey, each house is provided with a wireless "point" connected to a central receiving set. The homes are reserved for disabled ex-Service men and for war widows.

oooo

WHERE AMATEURS ARE FREE.

"We, if we had the same freedom, could also startle the world," is the thought that many British amateurs have when they contemplate the exploits of their Yankee cousins. The latest triumph of the American Radio Relay League has been the wide co-operation with the U.S. Air Corps in the aerial manœuvres from May 23rd to May 25th. During this period American amateurs handled more than one hundred official messages all along the line of flight from Mitchell Field, New York, to the Hartford and Springfield aviation fields.

The amount of traffic handled was very large; the operating staff of each amateur station in a big network was kept continuously busy from 6 a.m. to late evening for four days, either receiving or transmitting messages which varied in importance from personal greetings from one officer to another to detailed instructions affecting the operation and safety of dozens of flyers and planes.

oooo

RE-BROADCASTING IN AMERICAN HOTELS.

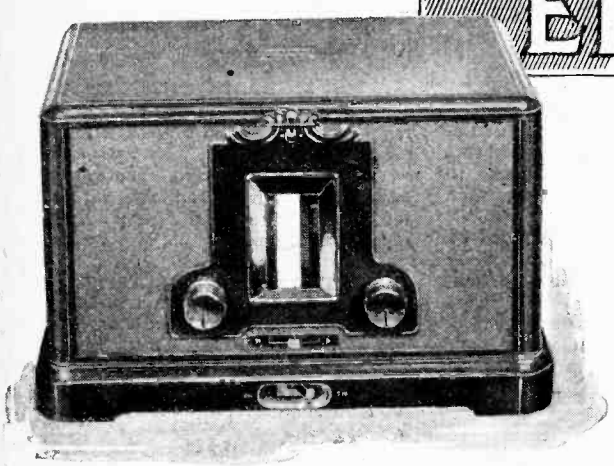
That much harassed body, the U.S. Federal Radio Commission, has a new problem to solve, viz., whether the proposed adoption of wired-wireless for distributing radio programmes through the larger hotels will mean the establishment of miniature short-wave broadcasting systems which require licences.

The problem, according to our Washington correspondent, was presented to the Commission in a letter from Montague Lyon, Jr., of St. Louis, a patent attorney. An unnamed client, he stated, has invented the system, patents for which are pending.

Mr. Lyon explains that programmes would be picked up on a standard receiving set and rebroadcast on a low-powered transmitter, of perhaps 10 watts power, which would be worked into a "dummy aerial system" composed of the electric light wiring on a ground. He said this would prevent radiation to receivers other than those in the hotel or building, and that therefore the system actually was not radio but wire.

EKCO A.C. Model 312

A Popular Two-valve Set Tested.



THOSE listeners whose requirement is only that of local station reception are completely served by the two-valve set. To use more valves is to induce interference, bring heterodyning into evidence and appreciably add to the cost. The popular set of to-day is the two-valve local station receiver which, if mains operated, affords the most reliable outfit for delivering the broadcast programme whenever required. It is true to say that the fewer the valves the less the chances of distortion, while the simplicity of the set almost entirely removes the chances of maintenance costs and breakdown. The following technical description deals with one of the best-known receivers in the two-valve class—the Ekco set.

Adequate Station Separation.

In brief, it is an all-mains operated set working from A.C. supply giving essentially the alternative local programmes and delivering ample power to the loud speaker for ordinary home conditions with a quality of reproduction which few could criticise. Looking over the circuit we find no unusual features, the arrangement following well-tried practice. The first valve is a leaky-grid detector with capacity reaction, coupled by a transformer to an output pentode valve with a filter feed to the loud speaker. An indirectly heated valve used in the detector stage, the Mullard P.M.354V, renders the set particularly sensitive while its generous signal handling properties reduce overload distortion to a minimum.

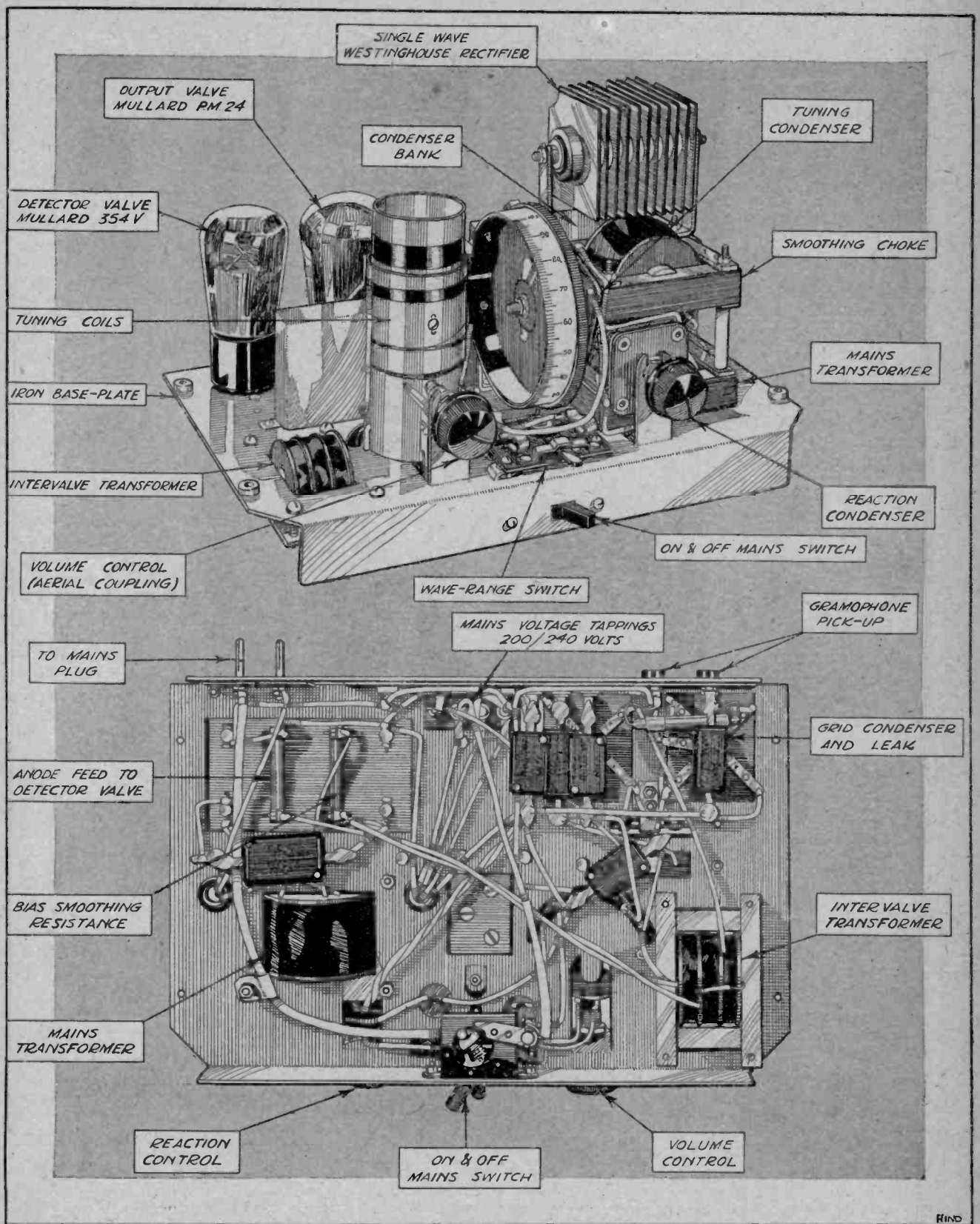
The principal problem in the design of the two-valve set is that of providing adequate station separation as a high degree of selectivity cannot be obtained. For local station reception however, this, perhaps, is not a requirement and all one expects is the avoidance of interference between the two transmissions of a dual programme station. In the Ekco set every reasonable step has been taken, within the limits of simple apparatus, to give the required selectivity, three aerial terminals being fitted so that when near to the transmitter signal strength can be sacrificed for selectivity, and when distance from a station removes the interference difficulty and the signal strength has declined, the selectivity may be reduced and the sensitivity increased. Of the three aerial terminals provided, two can act through alternative values of aerial coupling condenser to a swingabout coil set up in the centre of the tuned grid circuit of the detector. By rotating this coil a balance may be obtained between signal strength and the extinction of an interfering transmission. This adjustment is, in effect, the volume control giving a smooth variation of output from maximum volume to extinction. Reception on both medium and long waves is arranged by a change-over switch which short circuits either the medium or long-wave portion of the tuned circuit about its centre point. Tracing out the circuit it was to be noticed that a short circuit is applied to part of the medium-wave coil at the same time as the long-wave coils are short circuited out of action, a minor detail no doubt introduced to provide smooth reaction in consequence of the particular disposition adopted for the windings.

Other circuit details show the use of a metal rectifier connected merely in series with one of the transformer secondary leads and feeding a charge to a 4 mfd. condenser. A single choke is used for smoothing, a tapping point being taken off at some distance along the winding to supply a negative biasing potential to the output pentode. A voltage-dropping resistance feeds the detector circuit which, in conjunction with a bridging condenser, provides both decoupling and supplementary smoothing. Both the heater of the detector and filament of the pentode, a Mullard P.M.24, are fed from a common winding on the transformer, and the precaution has been taken of fitting an adjustable potentiometer across this winding with the object of preventing mains hum.

Construction has been arranged to render assembly easy and inexpensive, making no sacrifice in values or dimensions, yet avoiding the folly which lies in the way of the easiest course of construction, of that of being over generous. A pressed-out iron frame forms a chassis on which the components

SPECIFICATION.

Two-valve set with two range tuning and reaction. Indirectly heated detector (Mullard PM.354V) and pentode output (Mullard PM.24). Westinghouse metal rectifier. Capacity reaction. Volume controlled by loose coupled aerial. Transformer intervalve coupling. Filter fed output to loud speaker of 500 milliwatts. Durable bakelite case. Price complete with valves, £14 10s.

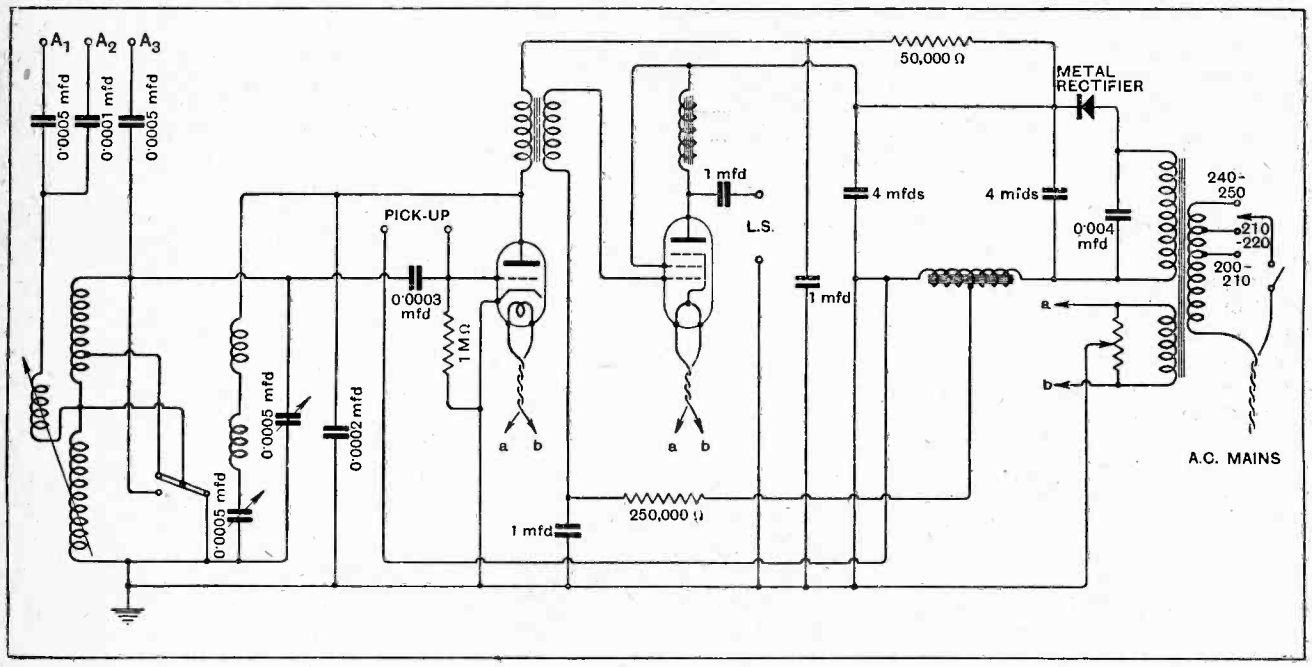


Constructional features of the Ekco A.C. set. Model 312.

Ekco A.C. Model 312.—

are assembled, carrying the transformers, chokes, smoothing condensers and rectifier on its upper side and the wiring with the smaller condensers and resistances in the recess underneath. Some of the components are secured by rivets, a most reliable method, and others with screws and spring washers. Tuning and reaction condensers are of the compact solid dielectric type, and by the way of removing any prejudice which may be held against these small condensers, it is pointed out that the performance of the set would be precisely the same were the customary large-type air-spaced condensers substituted.

The first impression on test is that the set is just what one would recommend when asked for an easy-to-operate set, even if the enquirer made good quality his first essential. In spite of the precaution taken by the manufacturers to fit a hum-reducing potentiometer, not the slightest hum will be experienced when using a reed-driven cone, the type of loud speaker which is intended for the set. To test the station-separating properties the set was tried out at a distance of five miles from the Brookmans Park transmitters. Using the most selective aerial tapping with the volume control turned down from maximum the transmissions were readily separated, while the output valve was delivering nearly its full rating of 500 milliwatts, it having first been ascertained that this valve was receiving its rated H.T. potential and grid bias, the measured values being 150 and 14 volts respectively. Two or three other stations were heard as well as numerous carriers, but it was necessary to wait until the closing down of the local transmitters before intelligible reception could be obtained from foreign transmitters. On the long waves Daventry 5XX came in well, but on the lower part of the tuning scale both local transmissions were heard quite strongly. This is a common property of simple two-valve sets and is of little consequence, for the long-wave station will not be required when the same transmission can be obtained from a nearby Regional.



Circuit details include selectivity adjustment, two range switching, pentode with choke filter output and single unit Westinghouse rectifier.

Next Week's Set Review:—EDISWAN POWER PENTODE 2.

Catalogues Received.

Ferranti, Ltd., Hollinwood, Lancashire.—Descriptive booklet dealing with the three-valve A.C. receiver, models 31 and 32. Also technical details of the A.F.8 L.F. transformer and construction broadsheet of the 1931 model Screen-grid Four Receiver.

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Standard Battery Co., 184-188, Shaftesbury Avenue, London, W.C.2.—Illustrated folder describing the Wates Rotary Converter for operating A.C. receivers from the D.C. supply mains.

Bakelite, Ltd., 68, Victoria Street, London, S.W.1.—Illustrated brochure dealing with the production and various uses of bakelite varnish.

o o o o

Darwins, Ltd., Fitzwilliam Works, Sheffield.—Illustrated catalogue describing the Cobalt Steel permanent magnets for incorporating in the construction of moving-coil loud speakers.

Le Carbone, Ltd., Coventry House, South Place, London, E.C.2.—Illustrated catalogue dealing with the "A.D." electric cell for low-voltage power work. In remote country districts it should afford a trouble-free source of L.T. current for a wireless receiver.

o o o o

F. C. Hill and Co., 154, Compton Road, Wolverhampton.—Illustrated leaflets dealing with "Hexa" mains transformers, L.F. chokes, and moving-coil loud speakers.

Unbiased.

By FREE GRID.

Ohm's Law Again.

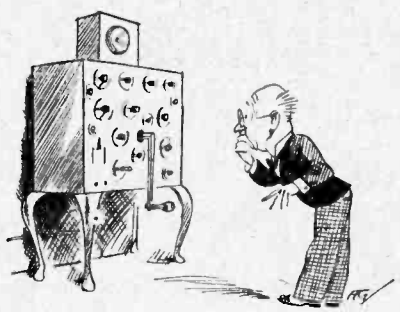
I MAKE it an invariable practice to read all British and American radio journals, and those of Continental origin which are written in languages with which I have some acquaintance, and I was considerably astonished the other day, when skimming through the pages of a well-known British radio journal (not "W.W."), to see a prominent contributor committing himself to the foolish allegation that Ohm's law was not invariably accurate. According to him, ordinary metallic conductors at ordinary temperatures obey Ohm's law *fairly* well, but if the temperature of the conductor is raised, then Ohm's law no longer applies.

I thought that *The Wireless World* had definitely killed this hoary old chimera long ago, and things are coming to a pretty pass if statements of this nature are allowed to appear in a responsible technical journal. I would emphasise strongly that Ohm's law is one of those delightful laws of nature to which there is no exception under any circumstances whatsoever. If anybody thinks that he has discovered an occasion upon which it fails, it would be advisable for the good of his soul that he seek enlightenment either from me or from *The Wireless World*.

A "Knobby" Idea.

I notice that, in spite of the continued great progress in receiver design, manufacturers are still persisting in their pig-headed obstinacy in the matter of refusing to put gramophone pick-up controls on their receivers, even though the latter be fitted with pick-up terminals and with special switches designed to do away with the irritation of having to disconnect the pick-up every time it is desired to revert to radio. I have lately had the privilege of examining quite a number of advance models of sets which will not be "released" for several weeks to come, and in no case did I find that any attempt had been made to remedy this deficiency.

I found it quite entertaining to observe the feeble excuses and "wriggles" made in response to my queries. Indeed, some of them—the excuses and wriggles I mean—would have been beneath the contempt of even the most inexperienced of politicians. In the majority of cases I found that the first excuse offered to me was that these devices were unnecessary on the set as they were usually included in the pick-up. Upon my pointing out that this statement was a calculated untruth, or, alternatively, showed a lack of observation, my victims usually fell back upon the old excuse that they had omitted it because it would mean an extra knob on the panel, merely serving to confuse the non-technical user.



". . . it would mean an extra knob . . ."

At first sight this might seem a perfectly reasonable argument; but it is, of course, only calculated to throw dust in the eyes of the ordinary person, for there is no need whatever for an extra knob. It is quite a simple matter for the gramophone volume control to be mounted on the same shaft as the radio volume control, both being operated by the same knob, as is, indeed, done in the case of one well-known make of radio-gramophone.

I greatly fear, however, that my well-meant efforts will only mean that eventually manufacturers will adopt my idea, spend another two shillings on a volume control, and charge the public an extra two guineas for it.

Dropping the Pick-up.

A well-known radio designer who ought to know better had the effrontery to tell me the other day that the interest of the public in reproducing gramophone records through the amplifier portions of their receivers was waning, and that in future he did not intend to incorporate any arrangement into his set designs for quickly connecting up a pick-up. He furthermore prophesied to me that at the next Olympia Exhibition—which opens on September 18th, by the way—it would be found that the pick-up connection with which we are so familiar will largely have disappeared from commercial sets, and the public, if they are interested in gramophones as well as radio, will have to buy complete radio-gramophones.

I must say that he rather backed up his arguments by producing a high-class four-valve commercial receiver which has recently made its appearance, in which no provision whatever is made for a pick-up. I pointed out to him, however, that the set in question was intended for taking all its power from D.C. mains, and the pick-up connection had probably been omitted because, if connected in the grid circuit of a valve in the ordinary manner, it would actually be directly connected to one of the mains via the automatic grid-bias connection, and, therefore, there was grave risk of shock to the user. He retaliated by saying that if this were the only consideration the makers of the set would have built into the set a simple 1:1 coupling transformer which would have completely isolated the pick-up from D.C. mains. I seriously do not think that there is anything in this, however, because I am reluctantly compelled to admit that the idea of putting in a coupling transformer is a thing not likely to occur readily to the average manufacturer who always lags sadly behind the amateur in the matter of bright ideas.

Apart from this consideration, however, the prices asked for radio-gramophones are far too fancy for the average man.

Broadcast Brevities

Announcers, engineers and U.S. Army fliers in the monoplane from which a running commentary was given on New York's "air raid" on May 22nd.

By Our Special Correspondent.

Colonies and Empire Broadcasting.—Sir John Reith at the White House.—Watchet.—New Football Ban.

New Empire Broadcasting Mystery.

A new complexion is given to the Empire broadcasting project if it be true that the B.B.C. are patiently waiting for replies to questions addressed to the Colonies six months ago.

This is the substance of information coming to me from a reliable source.

oooo

Letters to the Colonies.

When the Colonial Conference broke up last year, the B.B.C. took it upon themselves to circularise the Colonies and minor Dependencies, indicating the nature of the service that could be provided and enquiring to what extent each Colony would be prepared to co-operate.

After careful preparation and discussion, the letters were sent out towards the end of last year.

oooo

No Answer.

The Colonies and Dependencies to receive attention included Rhodesia, East Africa, Ceylon, British Honduras, and many others. Since then, not one reply has been received.

oooo

Officials to Blame?

Before accusing Colonial listeners of indifference, it would be fair to ask whether their respective Governments are not to blame for shirking the issue. One thing is certain: if the Colonies, through their officials, show a lack of enthusiasm for broadcasting from the Mother Country, overseas listeners must not grumble if the first fine frenzy in this country begins to evaporate.

oooo

Like Father, Like Son.

Probably the best advice that could be offered to overseas listeners is that they should tackle the local bureaucracies without delay. We have all come in contact with the Ministries of Circumlocution in Whitehall, and, without doubt, their offspring in different parts of the globe exhibit hereditary tendencies.

oooo

G.K.C. and Others.

G. K. Chesterton's novel, "The Napoleon of Notting Hill," in a radio version by John Watt, will be broadcast to National listeners on July 9.

Some other plays to be heard that month are adaptations of Sapper's "Jim Maitland," R. L. Stevenson's "The Wrecker," and Housman's "The House Fairy."

A Chat with the American President.

Sir John Reith, when he recently had the honour of an hour's private conversation at the White House with the American President, probably found that Mr. Hoover and he shared several interesting opinions.

FUTURE FEATURES.

National (261 and 1,554 metres).

JUNE 14TH.—Service from St. Martin-in-the-Fields.

JUNE 16TH.—"Turandot," Act 3, from Covent Garden.

JUNE 17TH.—"Across the Moon," a play by Holt Marvell.

JUNE 20TH.—"Portland Cement," a revue by Charles Brewer.

London Regional.

JUNE 17TH.—"Francesca da Rimini" (Zandonai), Act 3, from Covent Garden.

JUNE 18TH.—"Portland Cement."

JUNE 20TH.—A. J. Alan: "My Adventure in Norfolk."

Midland Regional.

JUNE 17TH.—"Youth," orchestral programme.

North Regional.

JUNE 16TH.—Orchestral concert from the Royal Princes Parade, Bridlington.

JUNE 20TH.—Julian Wylie's Gay Dogs of 1931, relayed from the Coliseum, Isle of Man.

West Regional (Cardiff).

JUNE 15TH.—"Finnish" orchestral programme from National Museum of Wales.

JUNE 18TH.—A West Country Programme, including "Thic Thare Dawg," a West Somerset dialect play by Phœbe M. Rees.

Glasgow.

JUNE 16TH.—"The Darkness," a play by Joe Corrie.

Belfast.

JUNE 15TH.—A Shakespearean programme, including scenes from "A Midsummer Night's Dream."

What Mr. Hoover Thought.

It was Mr. Hoover who once said: "I think it will be agreed at the outset that it is inconceivable that we should allow so great a possibility for service, for news, for entertainment, for education, and for vital commercial purposes to be drowned in advertising chatter or to be used for commercial purposes that can be quite well served by our other means of communication."

oooo

Then and Now.

But Mr. Hoover voiced this powerful sentiment over nine years ago: to be precise, on February 27th, 1922, when, as Secretary of State for Commerce, he took part in a conference on broadcasting.

Much water has ebbed and flowed past the Statue of Liberty since then, and Mr. Hoover has since seen inconceivable things flourishing like a green bay tree.

oooo

The Radio President.

It is improbable, however, that the U.S. President has seen fit to alter his opinions, so those of us who are opposed to sponsored programmes in this country will rejoice that Sir John Reith had the opportunity of hearing the views of America's "Radio President." Mr. Hoover, since he came to the White House, has faced the microphone at least fifty times.

oooo

The D.G.'s Holiday.

The "D.G." completed the official business of his visit within a few days of his arrival, and is now, with Lady Reith, spending the rest of his vacation in a tour of the States and in renewing old associations.

oooo

Setting an Example.

In choosing June for his holiday Sir John is setting an example to the Savoy Hill staff, who have been asked to take their holidays as early as possible this year in preparation for the big move to Broadcasting House in the autumn.

oooo

More About Watchet.

The Watchet site for Western Regional is regarded as more or less a "cert." at headquarters. I hear that the Air Ministry and the Post Office have both expressed the opinion that the site is ideal, but the negotiations for pur-

chase are proceeding with a slow legal dignity. The spot is on high ground just behind the little seaside town, and there is plenty of fresh water in the locality.

oooo

Chosen by the Air Ministry.

Another recommendation is that the site has already served as a wireless base for the Air Ministry, and it is worth noting that the Air Ministry has a nose for good wireless positions. (By the way, I haven't heard why it gave up Watchet!)

oooo

Behind Time.

That the Regional Scheme will be a long way behind schedule there can be scarcely any doubt. The end of 1932 was originally set as the uttermost time limit, but it seems unlikely that the Scottish transmitter will be operating a full service before another year has passed. Western Regional may require a year after that!

oooo

Newcastle Wins Through.

Congratulations to Newcastle listeners for having shown so much determination in their fight for an alternative programme that the B.B.C. are about to give them a concession which has no precedent in this country.

Novocastrians at present take their programmes (mostly the National) on the common relay wavelength of 288.5 metres. Their only alternative is Daventry, 5XX, also transmitting the National fare.

oooo

A Tricky Test.

But early in August the B.B.C. intend to try the experiment of synchronising Newcastle with Northern Regional on 479.2 metres. This may be a ticklish business, Moorside Edge being powerful and little more than 100 miles away, but modern crystal control has reached a point of efficiency which should make the scheme quite feasible.

If it becomes permanent, Newcastle will be able to tune in both "Nat." and "Reg."

oooo

Sufficient Unto the Day . . .

With summer upon us and football almost as far from our minds as plum pudding, we may perhaps overlook the importance of the decision of the Football League not to permit the B.B.C. to broadcast any more football matches. The B.B.C. are rightly concerned over the matter, knowing too well that a full-blooded public outcry is to be expected in September next when the force of the edict really makes itself felt.

oooo

The Balloon Idea.

All kinds of canny schemes are in the wind for providing listeners with running commentaries. It is possible that, as a last resort, the B.B.C. may be forced to adopt the methods employed at the Cup Final in 1929, when breathless eye-witnesses came bounding out of the Wembley Stadium at intervals and poured their tale into a microphone in a neighbouring house.

And, of course, Professor Piccard's exploit has suggested the use of a captive balloon suitably armoured to withstand pea-shooter assaults by officials of the Football League.

oooo

Another Method.

It seems to me that the B.B.C.'s most effective move would be to ban all reference to professional football at the microphone. The football authorities are very human, and the thought that they were to be robbed of the publicity attaching to the broadcast announcement of results might exert a compelling influence.

oooo

Broadcasting the "T.T."

The final hour of the Senior T.T. motor cycle race in the Isle of Man will again be broadcast by the B.B.C. in the National programme this year, on June 19th. The broadcast is timed to take place from 12.45 to 1.45 p.m.

"Broadcasting House" in a Revue.

"Portland Cement, a Concrete Case for Broadcasting," is the title of a Charles Brewer revue which listeners to the Regional and National transmitters are to hear respectively on June 18th and 20th.

The background of "Portland Cement" is the nearly completed headquarters of the B.B.C. in Portland Place. Clapham and Dwyer will take part in the broadcast, also Leslie French, the well-known actor who was the model for the figure of "Ariel" in Mr. Eric Gill's sculpture group which is to be placed over the front entrance of Broadcasting House.

oooo

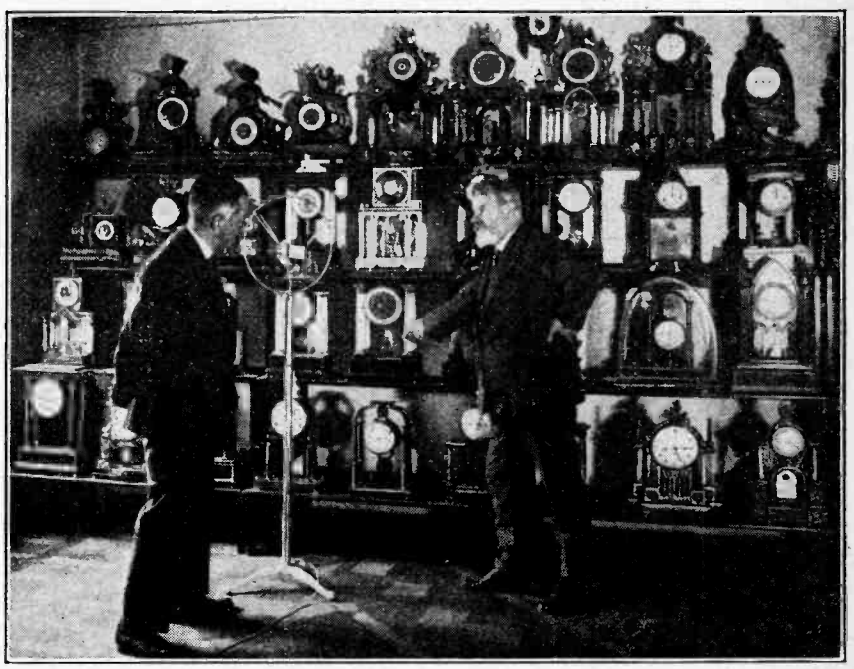
G.B.S. and the Time Limit.

Mr. Bernard Shaw is always provocative. On Saturday, May 30th, he provoked me into devising a system whereby broadcast talkers who exceed their time might be firmly but artistically made aware of the fact. No speaker, however interesting—and Mr. Shaw was very interesting—has a right to upset the evening time-table by ten minutes. To boast about it afterwards is to add insult to injury.

oooo

Getting Hotter.

My device would be ridiculously simple. Of its existence and functioning the listener would be completely unaware. It would consist of an electric heater. As, minute by minute, the allotted time was exceeded, the temperature of the talks studio would mount by imperceptible gradations until at ten minutes (Mr. Shaw's little excess) the heat of the place would test the fortitude of St. Joan herself.



"TIME SIGNALS." Vienna listeners recently enjoyed a "talking tour" round the celebrated Clock and Watch Museum. The ticks and chimes of the various timepieces were clearly heard, while the announcer interviewed the curator, who is seen on the right.

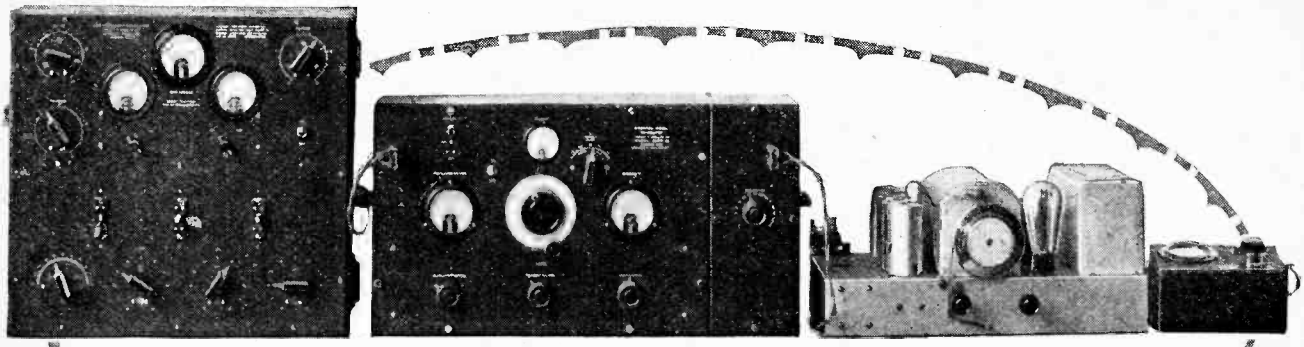
A Famous Hairpin.

The running commentary in 1930 was so successful that the B.B.C. have decided to elaborate their arrangements this year. Last year the race was described by commentators stationed at two points on the course—the grandstand at Douglas, and Craig-ny-Baa. This year a third point will be used—the famous hairpin bend at Ramsey.

oooo

A Central Switching Point.

"Ixion," of our sister journal, *The Motor Cycle*, Major Vernon Brook, and Mr. Victor Smythe (a Manchester official of the B.B.C.) will be the three commentators. Their microphones will be linked by telephone wires to a central switching point at Douglas, where the switching over from one commentator to another will be performed.



TESTING WIRELESS RECEIVERS

Standardised Measurement of Overall Performance.

By R. L. SMITH-ROSE, D.Sc., Ph.D., A.M.I.E.E.

THERE is a well-known general principle in science which states that before a subject of study can be thoroughly understood it is necessary to be able to make measurements of the various items involved so that their behaviour can be expressed in a quantitative manner. This fundamental principle is just as true of wireless reception as of any other science or technique. To judge the merits of a set by its ability to receive a number of stations constitutes a mere *qualitative* test dependent upon the skill of the operator and of his hearing abilities, while it is well known that when one has passed beyond a range of fifty miles or so from a transmitting station, the field intensity from the station becomes a very uncertain quantity and may vary with atmospheric conditions by amounts of the order of hundreds per cent. Furthermore, in the early stages of development the increase in sensitivity of receivers due to modifications and improvements is comparatively large, whereas in course of time it is necessary to concentrate on the improvement of performance of details of the components, and it is not always easy to ascertain the results of the improvement without recourse to some kind of *quantitative* test.

DURING the early stages of development of broadcast receivers it was sufficient to compare the performance of different sets by stating their capabilities in terms of the range of reception. Such information does not disclose the principal properties of a set, and data is wanted revealing in numerical terms the sensitivity of the receiver, its selectivity and the fidelity of its output. Details are here given of the steps which are now being taken to develop a standardised form of test by which a ready comparison can be made as to the behaviour of various sets.

These considerations indicate the desirability of establishing some reliable means of measuring receiver performance for the use of those responsible for the development of receiving apparatus. It is further conceivable that at the present stage of receiver design the prospective purchaser and user of the apparatus should have supplied to him some quantitative data as to its performance, this data having preferably been supplied by an independent testing authority with an established reputation.

Equipment for Measuring the Overall Performance of Receivers.

Several descriptions have been published of equipments which have been specially developed for measuring the salient features required to give an adequate knowledge of the performance of a broadcasting receiver under typical working conditions. Many of these have emanated from America, where the work of one or two large co-operative research laboratories has had a notable effect upon the design and production of broadcasting receivers. Furthermore, at least one firm is now marketing in America and in this country suitable apparatus for making a limited series of tests on receivers, and this apparatus is being found of great utility to the manufacturers of receivers.

A description of the installation which has been set up at the National Physical Laboratory for carrying out a comprehensive series of tests on wireless receivers of all types was given by H. A. Thomas in the "Journal of the Institution of Electrical Engineers," 1930, Vol. 68, p. 475. This equipment has been used for conducting tests and measurements required in connection with the development of various types of receivers operating over a wide range of wavelengths, but it has recently been modified and improved with particular reference to its application to the testing of broadcasting receivers.

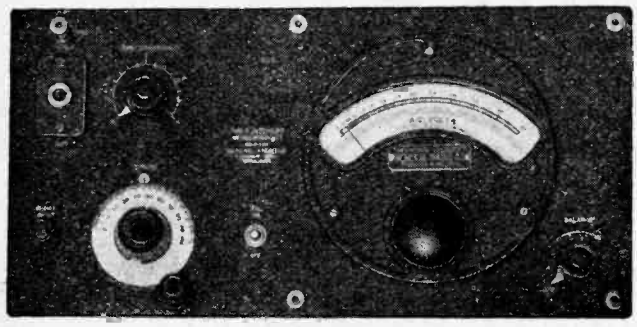
A schematic diagram of the arrangement is given in

Testing Wireless Receivers.—

Fig. 1. Oscillations at the necessary carrier frequency are obtained from a suitable valve generator (1) and these are modulated at the required audio-frequency by another valve generator (2). These two generators, together with their supply batteries and all necessary instruments for measuring the frequencies and the amount of modulation, are enclosed in a screened cabin (3) constructed of tinned sheet iron on a wooden framework. All joints between the iron sheet are carefully soldered and a mercury sealed trap-door is provided. This screened cabin is entirely self-contained, and no leads are brought outside the screen.

The General Circuit Arrangement.

Provision for ventilation has been made by a rotary blower drawing air into the cabin through long metallic tubes provided at intervals with fine gauze diaphragms. Modulated radio-frequency oscillations pass from the screened cabin down leads enclosed in the screened trunk (4) to a non-inductive resistance attenuator (5). This comprises a series of tapped or interchangeable resistances of suitable values for the measurements involved. These resistances are connected in series with a non-contact thermo-junction by means of which the current passing through them can be observed upon the direct current meter (6). Thus, from a knowledge of the current and resistance a known potential difference at the modulated radio-frequency can be applied through the dummy aerial (7) to the aerial and earth terminals of the receiver (8) under test. The constants of the dummy aerial have been selected to be representative of a typical 100ft. aerial with which the receiver is intended to be used. In the case of portable or other receivers employing a closed-loop or frame coil, the necessary input voltage is applied by inserting a small portion of the attenuator resistance in series with the frame coil itself. A knowledge of the effective radio-frequency resistance of the frame is required in order to obtain from the measured current the voltage applied to the input circuit of the receiver. Upon passing through the receiver which is tuned to the carrier frequency, the applied voltage becomes amplified in the radio-frequency stages, rectified at the detector stage, and the resulting voltage at the audio modulating frequency is further amplified in the audio-frequency stages.



In testing the sensitivity of a receiver information is required as to the field strength of the stations to be received. This illustration shows the portable field strength equipment of the General Radio Company (Claude Lyons, Ltd.), while the apparatus shown in the title illustration represents the overall set testing gear by the same Company, including the variable low-frequency oscillator, the standard signal generator, dummy aerial, receiver on test and output meter.

The final output voltage is then applied to an external resistance which is representative of the impedance of the appropriate loud speaker or transformer for which the output valve is suited. The current in this resistance is then measured either directly with a thermal instrument or by means of a valve voltmeter (10) shunted across the fraction of the total resistance. The receiver with the dummy aerial, output load, and the input and output meters, is suitably enclosed in a room screened with small mesh iron wire netting. This screening is required not only as an additional precaution against pick-up on the receiver of stray fields from the oscillation generators, but also to protect the receiver against the effects of fields from outside transmitting stations, electric power mains, etc.

Nature of Tests on Receivers.

The principal tests carried out on a receiver to enable a decision to be made as to its performance for the reception of broadcasting are conveniently divisible into three classes: Sensitivity, Selectivity and Fidelity.

In the sensitivity test the relationship is found between the input voltage applied to the receiver and the output given by it under conditions at which freedom from distortion is obtained. It is desirable to specify the output power in milliwatts which the receiver is required to give, and the test thus becomes a measurement of the input voltage required to give this output. Further, since a dummy aerial of known electrical constants is employed, this input voltage can be transformed into a value of field strength, which, in turn, can be converted into range from a broadcasting transmitter of known ratio or surface area covered. This sensitivity test is made for several values of the carrier frequency over the full tuning range of the receiver, while the depth of modulation and its frequency are maintained constant.

The next test is concerned with a measurement of the overall selectivity of the receiver, and is carried out either by varying the carrier frequency of the input supply while the receiver tuning is maintained constant, or by keeping the supply frequency constant and detuning the receiver by known amounts. In either case the modulation is kept constant throughout the test. Under practical conditions interfering signals would usually give a much weaker response than those from the wanted station to which the receiver is tuned. It is more convenient in the tests, however, to increase the input during the detuning process so as to keep the output up to the standard value mentioned above. In

Testing Wireless Receivers.—

this way a kind of inverted resonance curve is obtained from which the selectivity of the receiver may be judged. This selectivity test may be carried out at one or more points in each wavelength range of the receiver.

range, and also the proportionality of input to output at one or more audio-frequencies, and thus the amount of amplitude distortion being actually produced in the receiver.

During these tests care must naturally be taken that

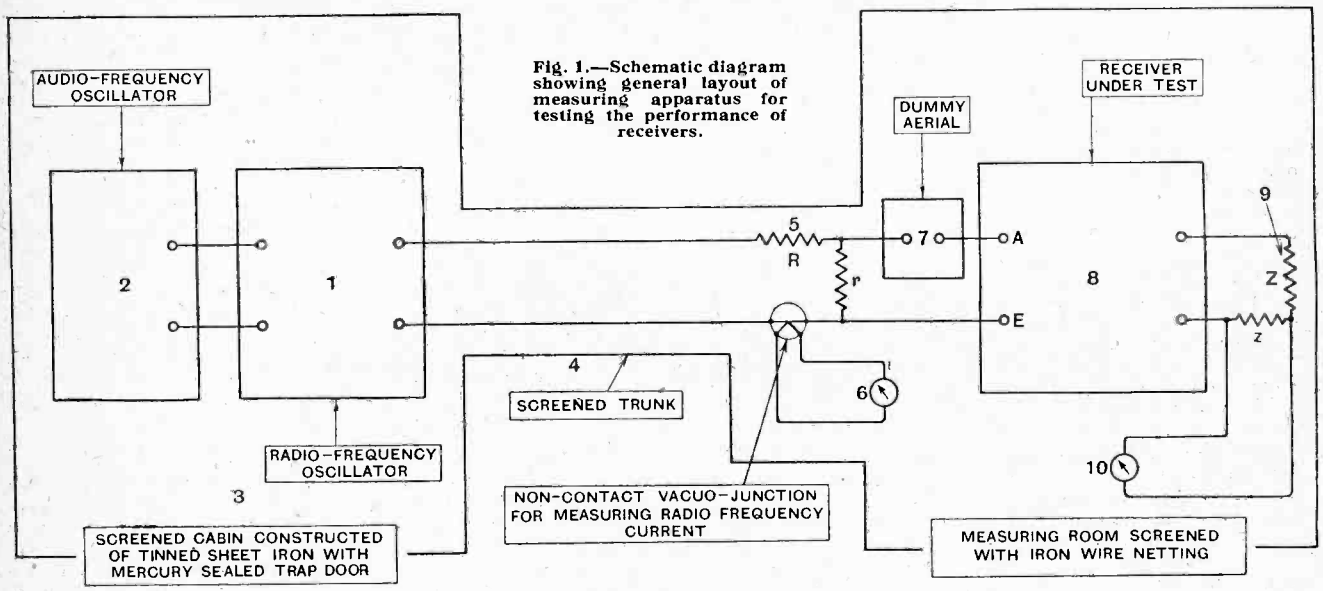


Fig. 1.—Schematic diagram showing general layout of measuring apparatus for testing the performance of receivers.

The fidelity test is concerned with the capability of the audio-frequency portions of the receiver of accurately reproducing the modulation over the full range of audio-frequencies required. This test is, therefore, made at a constant radio-frequency by varying first the frequency and then the amount of the modulation. In this way the measurements show the degree of constancy of the output for constant input over the audio-frequency

the output stages are not overloaded, and again the test is made by varying the input conditions to obtain a constant power output in the specified load. An additional test in connection with the fidelity of the receiver is concerned with the amount of harmonic content which is present in the output when a pure sinusoidal source is employed for the modulation.

(*To be concluded.*)

CORRESPONDENCE.

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

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

AMATEURS AND BROADCASTING.

Sir,—I have read Mr. F. G. Kay's letter in your issue of May 27th, and it is evident he is not at all conversant with actual facts; I feel, therefore, his letter calls for some reply from me. As one of the oldest amateurs in the country, I would like to say that all amateurs realise they have to take a back seat and give way to broadcasting, which now plays such an important part in every homestead.

With regard to Mr. Kay's final remarks, I can only say that it was due to the efforts of the Radio Society of Great Britain that broadcasting was originally started in this country; furthermore, wavelengths of below 200 metres were given to amateurs, the authorities stating they would be of no use for commercial purposes, and it was the said amateur who was the pioneer on these frequencies, while many members of the above-mentioned Society hold records which can never be broken, namely, first two-way communication with the greater part of the world. Finally, it will be found that some of these early amateurs were recruited for the development of this new branch of science.

GERALD MARCUSE,
Past-President, R.S.G.B.,
Sonning-on-Thames. First Vice-President, I.A.R.U.

Sir,—The recent revival of the old argument, Broadcast Listener *versus* Experimenter, prompts me to beg the hospitality of your columns, so that I, too, may offer a thought or so on the subject.

It seems that in Mr. Hum and in Mr. Kay we have two extremists, each intolerant of the other's point of view.

The broadcast listener wants the B.B.C. to transmit all hours of the day and night, so that when he chooses to switch on there is something to hear. I'm a broadcast listener, so I know! The experimenter wants to transmit whenever he has any work to do, and is a little disgruntled to find that the local B.B.C. transmitter is still working, even though it is 7 p.m. on a Sunday, when by all known laws there should be a gap.

He, therefore, courteously defers his operations until late at night, and spends hollow-eyed days in consequence. As a keen experimenter and the owner of Station 6-LR, I know that, too!

There is, however, some reason in Mr. Kay's remarks, as certain owners of transmitters seem to think that experimental work is merely using an oscillator of primitive design, coupled to an equally primitive aerial, with the object of obtaining contact over the greatest possible distance, the ultimate aim being to add to a collection of "Q.S.L. cards."

What he overlooks, however, is the fact that a large proportion of amateur transmitters are actually with the undertakings he mentions, and are extremely sound engineers. Furthermore, it is true to say that amateurs, as amateurs, were instrumental in hastening the development of the broadcast service, and also the development of short-wave communication, so that Mr.

Hum's statement, if a little wild, is not so astonishing as Mr. Kay would have us believe.

Can we not all take a broad view of the situation and "live and let live"?

Incidentally, why is it necessary to apply the term "ham" indiscriminately to amateur radio research workers?

Worcester Park. L. A. C. LAWLER.

Sir,—Your correspondent Mr. Kay gives me the impression that he has particular hatred for the amateur transmitters, and is evidently not interested in the experimental side of wireless, but only for the purpose of his own selfish entertainment.

His knowledge of the activities of amateurs during the early days of radio must be scarce, otherwise he would not make that daring statement: "The broadcasting companies, the Government, and the big commercial firms are the only people who have made radio what it is to-day." Allow me to inform him that one of the first broadcast telephony stations in England was run almost entirely by persons who had originally been amateur experimenters.

Finally, as an amateur transmitter since the early days, I must say that I should be sorry to see the whole of Sunday occupied for broadcasting, and to reserve the few hours now available during the week for experimental work is not asking a great deal. M. SKINNER (G5SN).

Westcliff-on-Sea.

Sir,—Your correspondent, Mr. F. G. Kay, has obviously not yet cultivated the art of discriminate listening, otherwise he would not have so foolishly rushed into print against the amateur transmitter. I have experience of some listeners; five or six hours' solid listening, irrespective of programme quality, fails to quench their insatiable appetite for one long uninterrupted noise. Then, horror of horrors, a transmitter, after six days' compulsory inactivity, switches on! He immediately becomes the object of antagonism for spoiling the sport of the selfish majority—and only perhaps during an hour or two all the week! I think, Mr. Kay, you must learn to give and take, even if you do take most.

As for saying that 'hams" have done nothing to further the progress of radio science is too ridiculous for words. Mr. Kay is talking out of the proverbial hat, and would be well advised to look a few more inches beyond his nose before venturing on another unwarranted attack.

London, E.4. J. ERIC JOHNSON (G2ZN).

Sir,—Referring to Mr. Kay's letter under "Sunday Broadcasts" in your issue of May 27th last, I feel it is my duty to have a word regarding the statement that the present-day high technique of radio was not brought about by amateurs.

This gentleman is obviously not aware of the fact that a large percentage of the B.B.C. Technical Staff have been recruited from amateur transmitters. Had it not been for the activities of these enthusiasts, broadcasting would possibly not have been started when it was.

Was it not through amateurs that the Post Office authorities consented to broadcasting on a small scale at the old Marconi Station at Writtle, known as 2 M.T., and was it not a fact that these transmissions, together with amateur radio co-operation, enthused the minds of the public, and led up to the start of the first regular transmissions by the British Broadcasting Co.?

The B.B.C. have always recognised the help which was given them by amateur transmitters, and they were continually appealed to for guiding reports during early transmissions from the company's stations.

Further, I might add that perhaps Mr. Kay is not aware of the fact that amateurs were the first in the field to make successful two-way short-wave communications with all parts of the world.

I myself have always been interested in radio development, and have been a keen experimenter since 1906, and when I see statements made in the Press such as that contained in the letter above referred to, I think it is time that I should voice my opinion.

I prefer, as a rule, to remain silent, and do not like publicity. However, I trust you will find sufficient space to voice my opinion in the interests of our pioneers.

Perhaps Mr. Kay will be astonished still more when he learns the truth. J. E. NICKLESS.

Rayleigh, Essex.

DEAF AIDS.

Sir,—Your correspondent, Mr. Balbi, will have caused interest among your readers, especially those who are deaf, by his suggestion that the electrical deaf aids should be mass-produced and supplied by wireless retailers. Although essentially the apparatus is very simple, consisting of a sensitive microphone, receiver and a dry battery, there is a diversity of design required to suit varying types of deafness which requires years of experience to produce, and to know which type of instrument for the particular type of deafness.

We know this is much the same in the case of the optician and those with defective vision, but, with this exception, the optician has the co-operation of the school clinic, the hospital and private practitioner. On the other hand, the manufacturer of deaf aids seems to be regarded by both the medical profession and the people who require hearing appliances as merely people who are out to make money by exploiting the disability of others. The demand for free trial by customers verifies this statement. If this were demanded in the case of spectacles, there would be a surprisingly large number of glasses returned as unsuitable, as is the case with deaf aids, not owing to any fault of glasses or the deaf aids, but simply to the lack of confidence on the part of the customer.

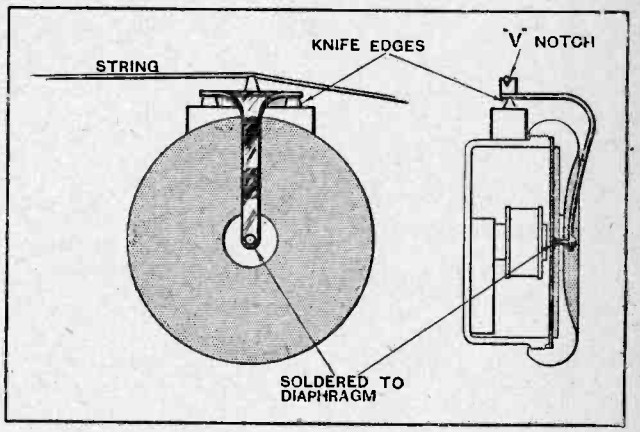
If Mr. Balbi can suggest a scheme whereby the confidence of the medical profession and of the deaf public can be enlisted, it will not be a spark to a new industry, but a help to an industry of many years' standing. With this confidence there would be much larger sales, and consequently the cost of production would fall, but hardly to the level of £1, as suggested, owing to the difficulty of selling such a commodity which could never, under any circumstances, be handed over the counter like a high-tension battery. J. W. GREENWOOD.

Halifax.

"ELECTRICAL CELLO."

Sir,—I read with interest the article by Mr. Raven-Hart, in your issue of May 27th.

Some years ago I constructed an instrument on similar lines, using a 2,000-ohm earphone. I overcame the difficulty of the pressure of the strings on the diaphragm by transmitting the motion through a right-angled lever, pivoted on two knife-edges on a block screwed to the casing, as in the sketch. (The idea I borrowed from H.M.V., to whom my belated acknowledgments.)



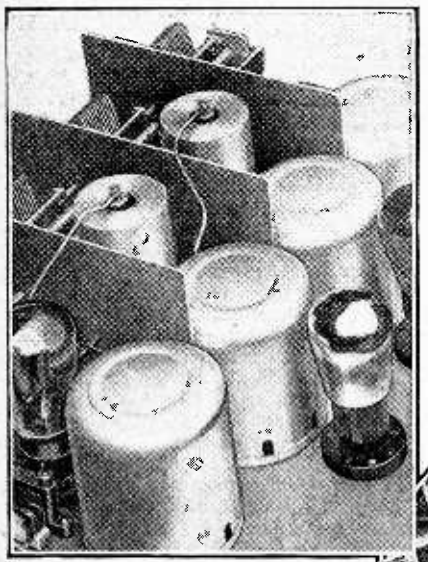
Anticipating some trouble in keeping the lever on dead-centre, I put the notch, V, a little to one side, putting the lever slightly in tension.

The great snag, however, that ultimately caused me to abandon the idea was the number of resonances I found in the several diaphragms I tried, but I hope, when time and funds permit, to try again, using a modern pick-up as a driven unit.

All good wishes to *The Wireless World*. "BEN."

Brondesbury, N.W.6.

PRACTICAL HINTS AND TIPS.

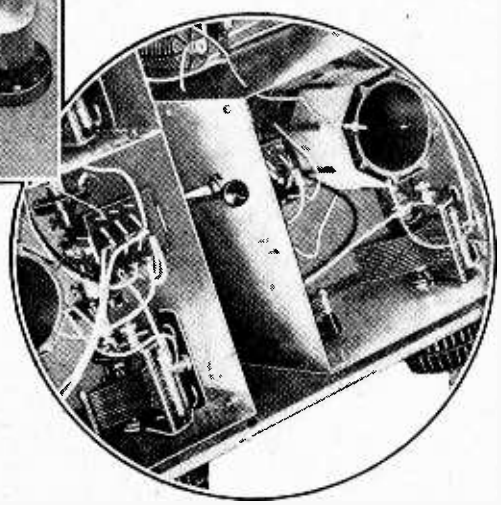


PERHAPS some day a scheme of receiver construction may be evolved that will be free from all objections and applicable to every sort of set. The need for screening, which is now present in almost every circuit arrangement with any pretensions to selectivity and range, is responsible for most of the minor constructional troubles which beset the builder of wireless apparatus; nowadays, even a two-valve detector - L.F. set will, as often as not, include a band-pass filter, which generally calls for quite as complete isolation of its component circuits as that required for an H.F. stage. In consequence, layout of components and constructional work generally is largely influenced by screening, and so the all-metal chassis, which clearly helps towards the attainment of the necessary conditions, is widely used, at any rate, for factory-built sets.

"POTTED" COILS.

Until the designer of a revolutionary and perfect system receives the necessary inspiration, most of us will content ourselves with the best method of H.F. screening that is now available—"potted" coils in individual metal containers and tuning condensers separated by simple electrostatic screens. Completely enclosed condensers may be desirable for self-contained frame-aerial sets. This scheme is singularly free from any serious shortcomings, and, now that the effects of "potting" on the efficiency of tuning coils is being investigated intensively, still further improvements are likely to materialise in the near future.

Methods of receiver construction compared.



A glance at the accompanying illustration will serve to show the general convenience and neatness of this system as compared with the alternative plan of enclosing the components associated with each grid and plate circuit in a separate metal box. It would be misleading to suggest that the latter is completely obsolete; it still has its advantages, but is definitely less suitable for a home-made set with "ganged" tuning. This is because it is a matter of real difficulty, even if all coils are properly matched when they are wound, to mount them in such a way that their inductance values are affected to an equal effect by the screens and other metal-work in close proximity to them.

As already pointed out in these notes, coils under individual "pots" present no such difficulty, and it is merely necessary to observe the elementary precaution of mounting them symmetrically with relation to their containers.

Accessibility is a strong point in favour of this system; if matters are reasonably well arranged all terminal points will be get-at-able when the covers are removed.

°°°°

MINIMISING INDUCTION INTERFERENCE.

When a pick-up is connected to a radio receiver by means of a long extension lead, a step-up transformer is sometimes interposed in circuit. In cases where this plan is adopted there seems to be some uncertainty as to where the transformer should be mounted, and it is sometimes fitted in or on the record turntable support. If induction interference from the household electrical circuits is to be avoided this is wrong; the transformer should be as close to the receiver as is practicable, or, if possible, it should be mounted in it.

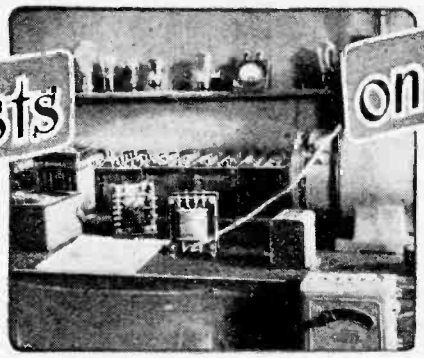
°°°°

DETECTOR CONVERSION.

When the question arises of converting a set with an anode bend detector to the more modern "power grid" principle, it is usually recommended that reaction should be added, in order that the relatively heavy damping imposed on the preceding tuned circuit by this system of rectification may be offset.

Such advice is unquestionably sound, but it is not always easy to put it into practice. Those who wish to convert an existing receiver may be reminded that provision for reaction is not essential, and that an alternative method of reducing loading exists. Instead of joining the detector grid condenser to the high-potential end of the associated tuned coil it may be connected to a tapping point, so situated that roughly two-thirds of the total number of turns are shunted by the detector valve.

Wireless World Laboratory Tests on New Apparatus



Components Reviewed.

We can say confidently that this model is a sound electrical job, and mechanically it is no less deserving of praise. All the terminals are clearly marked and very accessible, and the price is 47s. 6d. only.

The makers are Radio Instruments, Ltd., Madrigal Works, Purley Way, Croydon.

o o o o

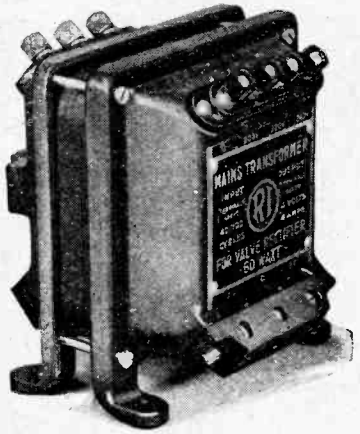
R.I. MAINS TRANSFORMER. Type EY24.

Recent additions to the extensive range of mains transformers made by Radio Instruments, Ltd., include some twenty different types covering nearly every possible application of the valve and the metal rectifiers. These range from small 15-watt models to 100-watt power transformers, and the prices are from 15s. upwards.

The model tested is rated as a 60-watt transformer and gives the following output voltages :—

250+250 volts.
4 volts (centre tapped) at 2 amps.
4 volts (centre tapped) at 4 amps.
6 volts (centre tapped) at 2 amps.

The primary is tapped to accommodate mains voltages of 200, 220 and 240 at 40 to 100 cycles per second. The H.T. secondary is designed to deliver 60 mA. of D.C. after smoothing at approximately 250 volts, maximum.



R.I. 60-watt mains transformer, type EY24

Our test consisted of loading all windings of the transformer to their maximum rated capacity, and then measuring the voltages at every point. A U10 type full-wave rectifying valve was employed in conjunction with a 4 mfd. reservoir condenser. The A.C. input was 235 volts at 50 cycles, so that we decided to employ the 240-volt tapping.

Dealing with the H.T. side first, the rectified D.C. was 60 mA. at 220 volts, and the rectifier filament winding gave 4.2 volts at 1 amp. The 6-volt L.T. winding gave 2 amps. at 5.8 volts, and the 4-volt L.T. winding 4 amps. at 3.9 volts, the total output amounting to 45 watts approximately.

Measurements were then made of the primary current. This was found to be 0.25 amp. at 235 volts A.C., which amounts to 58 watts.

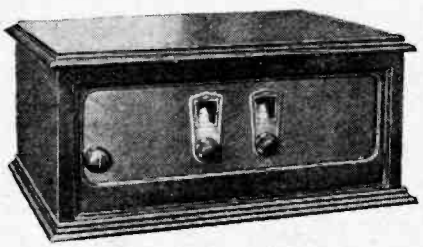
CABINET FOR "SUPER SELECTIVE SIX."

A well-made cabinet designed to accommodate this set when it is used as a table-type receiver is now obtainable from F. Digby, 9, The Oval, Hackney Road, London, E.2. The top is hinged to give access to the valves, while the chassis is fitted by sliding it in from the back. A loose vignette is supplied to fit between the panel and the front aperture, the purpose of which is to conceal the various screw heads on the panel. It serves the further purpose of enhancing the appearance of the set and giving it a professional finish.

The overall size is 24in. ×17in. ×10¾in. high, and the price in polished mahogany is £2. An oak model, equally well made and polished, costs 35s. In both cases a baseboard is included in the equipment.

This firm supply also radio-gramophone cabinets for housing the chassis of the "Super Selective Six," and the additional equipment necessary to convert the set into a complete radio-gramophone.

The prices range from £9 9s. to £12, according to the nature of the wood and the finish.

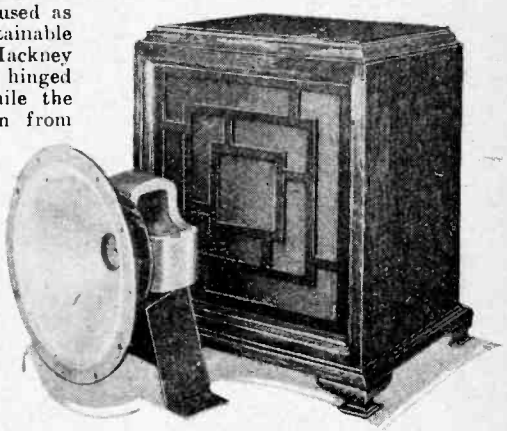


Digby cabinet for the "Super Selective Six," showing the set in position.

GAMBRELL MOVING-COIL LOUD SPEAKER.

This model is known as the "Vario-Chromatic" loud speaker for the reason that it incorporates a tone control operated by a knob at the back of the cabinet. The loud speaker is of the moving-coil type, and is energised by a massive cobalt-steel permanent magnet. A parchment cone diaphragm 8in. in diameter is driven by a high-resistance moving coil and centred by a paxolin spider behind the apex of the parchment cone.

The loud speaker was first tested in chassis form without the tone control. It showed a remarkably good response in the upper register between 4,000 and 6,000 cycles, and the output from 4,000 down to 1,000 was free from resonances, but at a somewhat lower level. A dip occurred between 300 and 400 cycles, and there was a distinct bass resonance between 100 and 150 cycles. At 50 cycles the amplitude developed was comparatively low, and it is possible that a little less stiffness in the paxolin centring device would improve the response at this frequency.



Gambrell "Vario Chromatic" permanent magnet moving-coil loud speaker incorporating tone control.

The overall sensitivity is high and not inferior to the average mains-excited moving-coil loud speaker. Measurements of impedance gave an average figure at 400 cycles of 2,250 ohms.

The tone control takes the form of a fixed condenser and variable high resistance connected in parallel with the moving coil. As might be expected, tests at 100 cycles showed that the bass is unaffected, and adjustments of the control have the effect of curtailing the upper frequencies only. Thus the listener is able to effect a compromise between high note loss and extraneous mush or needle scratch in accordance with his own special conditions.

The makers are Messrs. Gambrell Radio, Ltd., Buckingham House, Buckingham Street, Strand, London, W.C.2, and the price complete is £8 15s. The chassis alone costs £5 10s., and the tone control is available as a separate unit at 12s. 6d.

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B. & J. NICKEL-IRON L.F. TRANSFORMER.

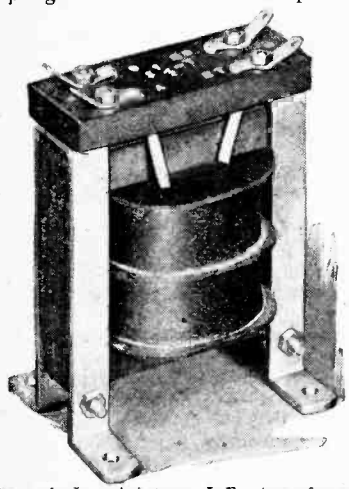
The two outstanding features of this transformer are its diminutive size and the exceedingly high primary inductance obtained when small values of D.C. are passed through the winding. The overall dimensions are 2in. × 1⅜in. × 2¾in. high, and it weighs but a few ounces.

The employment of a nickel-iron alloy for the core has made it possible to produce a component having these qualities, but it imposes a definite limitation on the amount of D.C. that may be passed through the primary winding. The makers give the maximum value as 5 mA., but our tests show that the core reaches saturation with about 4 mA. of D.C. flowing.

The measured inductance of the primary winding with various amounts of D.C. flowing was found to be :—

D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.	D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.
0	0.142	101	3	3.43	33
0.5	0.153	93	3.5	0.535	26
1.0	0.18	78	4.0	0.63	22.5
1.5	0.217	65	4.5	0.68	20.8
2.0	0.27	53	5.0	0.7	20.5
2.5	0.335	42	—	—	—

The primary has a resistance of 1,500 ohms, and the ratio is 1 to 3½. To take full advantage of the very high primary inductance it will be necessary to adopt the resistance - capacity method of coupling the transformer to the preceding valve, as this deflects the steady anode current and allows only the A.C. component to pass through the windings. Under these conditions it would be permissible to employ valves whose A.C. resistance is of the order of 20,000 ohms., and maintain a good balance between the amplification of the high and the low musical frequencies.



B. and J. miniature L.F. transformer with nickel iron core; the ratio is 1 : 3½.

If the component is connected in the anode circuit of the valve and the steady current limited to 3 mA., the valve employed should have an A.C. resistance not exceeding 8,000 ohms.

The makers are B. and J. Wireless, Ltd., Athelstane Mews, London, N.4, and the price is 12s. 6d.

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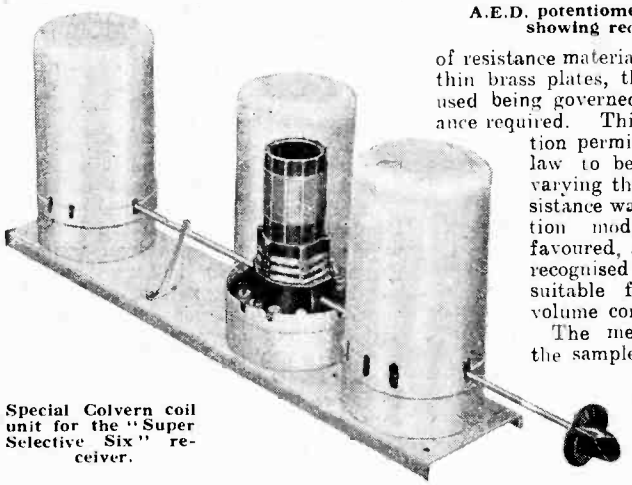
COILS FOR THE "SUPER SELECTIVE SIX."

The coil unit illustrated here has been produced especially for the "Super Selective Six" receiver by Colvern, Ltd., Mawneys Road, Romford, Essex. It consists of a metal base carrying the three screened coils, correctly spaced, and with the switches incorporated in the base of each coil former. These switches have gold-silver contacts, and are fitted with floating cams, so that exact alignment is not essential to assure smooth operation.



Special Colvern coil unit for the "Super Selective Six" receiver.

The formers have been especially moulded; the upper portion has twelve narrow ribs, which support the medium-wave coil—this has a mean diameter of 1¼in.—while below is a series of slots for the long-wave portion and the other windings associated with the various coils. Enamelled covered wire is employed throughout.

The terminals are placed in an accessible position, and are arranged to connect direct to their respective points with the shortest possible external leads. The complete unit, as illustrated, with ganged switches and ready to fit into position, is available at 28s. 6d.

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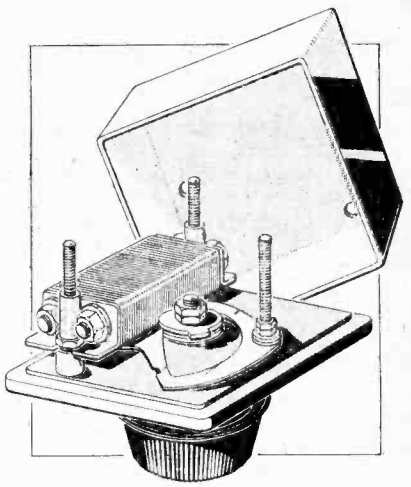
LOTUS DIFFERENTIAL CONDENSER.

Since receiving a sample of this new condenser, a review of which we published last week, Lotus Radio, Ltd., Lotus Works, Mill Lane, Liverpool, have modified the design slightly. The floating vanes are retained, but a lower minimum capacity is now claimed and a larger bearing has been fitted to counteract end play.

A.E.D. LOG LAW VOLUME CONTROL.

The resistance element in this volume control consists of a number of thin wafers of resistance material sandwiched between thin brass plates, the number of couples used being governed by the total resistance required. This method of construction permits any predetermined law to be followed by simply varying the thickness of the resistance wafers. In the production models a log law is favoured, since this is generally recognised as being the most suitable for the purposes of volume control.



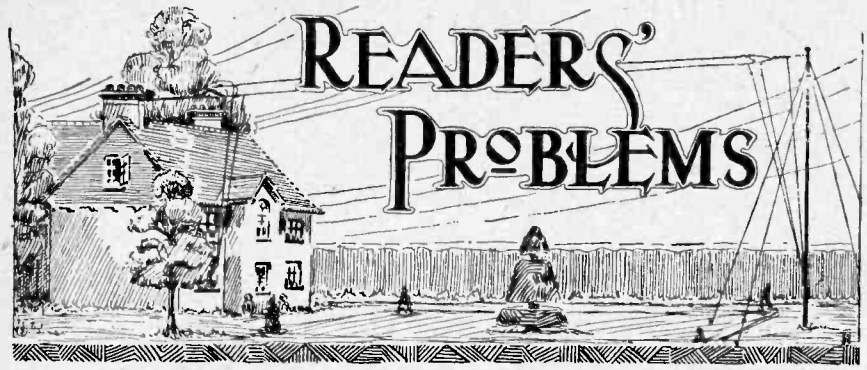
A.E.D. potentiometer volume control, showing reduction drive.

The measured resistance of the sample sent in for test was approximately 800,000 ohms when passing a few micro-amps of D.C. Its value is influenced by the magnitude of the current passing, and with 0.5 mAs. the measured value was approximately 400,000 ohms.

The comparatively large amount of metal in the resistance might lead one to believe that it is not suitable for use in H.F. circuits, but investigation shows that the effective shunt capacity introduced is considerably smaller than expected, being of the order of 17 micro-mfds. only. This is due to the fact that each resistance couple is in series with its neighbours, thus we have a large number of small condensers connected in series and the resultant capacity is, of course, considerably smaller than any of the single capacities taken alone.

The volume controls are available in two types—one, a plain potentiometer, as illustrated, and the other a combined radio and gramophone volume control, in which the resistance is centre tapped. The plain potentiometer costs 8s. 6d., and the centre-tapped model 10s. 6d., which can be employed as a dual fader in a radio-gramophone.

The makers are the Auto Electric Devices, Ltd., Diamond Works, Brighton, Sussex.



Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Wattage and Current.

It has often been stated that an ordinary electric lamp can be used satisfactorily as a voltage-reducing resistance in a D.C. mains receiver. Will you please tell me how to calculate the current passed by a lamp when its rated voltage and wattage are known?

The current (in amperes) consumed by a lamp working under its normal conditions is ascertained by dividing its rated wattage by its rated voltage.

It is of some importance that a lamp used as a resister in a D.C. set should always be operated under such conditions that it will be glowing at a normal brilliancy; this is because the resistance of a cold—or even of a cool—lamp filament is considerably below that given as a result of calculation on the above basis.

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Switch Contact Resistance.

As signals from my receiver are relatively much better on the long-wave side than on the medium band, I have come to the conclusion that at least one of the wave-changing switches may be making a poor contact, although no fault can be seen.

Among other measuring instruments I have an ammeter reading 0-3 amps. Would it be possible to use this instrument to obtain an idea as to whether the switch contacts are really defective?

Your ammeter, in conjunction with an L.T. accumulator battery and a rheostat, can certainly be used for this purpose. The rheostat may have a maximum resistance of 5 ohms, but if a single accumulator cell be used one or two ohms would be ample.

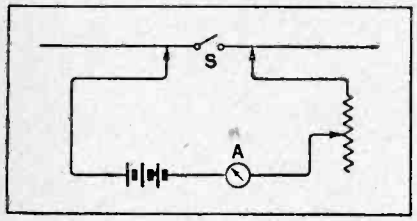

Fig. 1.—Method of testing the resistance of a switch contact.

We show how to connect the ammeter, rheostat, and battery in Fig. 1. These are joined in series, and then, with the testing leads (indicated by arrows) connected together, the rheostat is adjusted so that a fairly heavy current—1 or 2 amperes—is flowing. The test leads are then disconnected and are applied across the contacts of the switch to be tested; if this component has a negligible resistance the reading of the milliammeter will remain sensibly unchanged when the contacts are in the "closed" position.

A contact resistance of considerably less than half an ohm can easily be detected by this method. Of course, the wiring of the switch should be temporarily disconnected before making a test if there is a parallel current path.

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Mat Resistances.

In recent articles mention has been made of asbestos-wire woven resistances, particularly in connection with D.C. mains receivers. Can you give me the address of a maker of these components?

Woven resistances of this type are made by the Cresswell Manufacturing Co., Eclipse Works, 31, Tower Street, Birmingham.

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Valve Emission.

Although I realise that a complete treatment of the subject would be a lengthy matter, I should be obliged if you would explain briefly how, with the help of a milliammeter, to make a rough test as to whether a valve has lost its emission.

With a milliammeter inserted in series with the valve anode, and with known filament, H.T., and grid bias voltages applied, the current reading should be noted. If it corresponds fairly closely with the normal consumption shown in the manufacturer's published curves or tabulated data, it can generally be assumed that emission is satisfactory. As a further check, another comparison may be made with a different grid voltage, but with other operating conditions unchanged. By doing this a much more searching test of the condition of the valve is made.

Remote Voltage Control.

In order that the volume of my H.F.-det.-L.F. set may be controlled from any part of the room in which the receiver is installed, I have recently fitted a flexible three-wire extension lead for the 50,000-ohm potentiometer which regulates the screening grid voltage supply to the H.F. valve. Unfortunately, this alteration has introduced a certain amount of H.F. instability, although when receiving signals at the upper end of the tuning scale the scheme works very satisfactorily.

A circuit diagram of my receiver is enclosed. Can you suggest any addition that can be made so that the remote control system may operate satisfactorily?

It is clear that by fitting extension leads the effectiveness of your decoupling devices has been impaired, and that excessive stray coupling is present.

Normally, the fixed and variable sections of the controlling potentiometer shown in your diagram will prevent this, but, as the potentiometer is now connected by long leads, we advise you to insert an extra decoupling resistance of about 1,000 ohms, as shown in Fig. 2. This resistance should be mounted as near as is practicable to the H.F. valve socket.

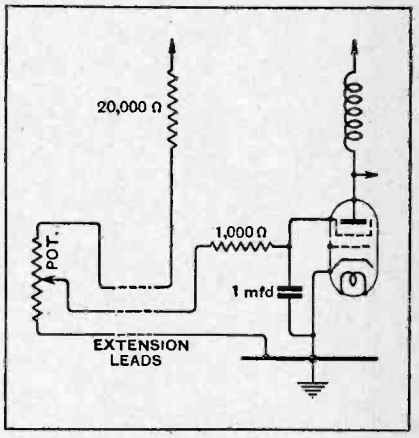

Fig. 2.—An extra decoupling resistance is generally necessary when the screening-grid potentiometer is remote from the receiver.

The receiver should now be as stable as before the extension was fitted.

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A.C. and Battery Valves Compared.

Broadly speaking, it seems that A.C. valves are always better than their battery-heated equivalents; if I change over to these valves shall I obtain better selectivity than at present?

Yes and no. Without going into the finer points of this question it may be said that when better valves are substituted it becomes possible to obtain a given strength of signal when working with looser aerial and inter-valve couplings than before. This means that, for equal sensitivity, the overall apparent selectivity of the receiver will be higher, but true selectivity will not be affected to any noticeable extent.

Effect of Aerial Capacity.

It is noticed that several of the commercial receivers described in your journal have a directly coupled aerial which is joined to the high-potential end of the grid coil through a small fixed condenser. In cases where this method is applied to a receiver with ganged tuning control is it not a fact that the use of an aerial of non-standard dimensions will adversely affect the adjustments of the single-control tuning system?

When this system of aerial coupling is adopted in a ganged receiver it will almost invariably be found that the coupling capacity is extremely small—in the order of 30 micro-microfarads. Provided that any aerial that may be used has a capacity several times greater than this value, its disturbing effect on the input circuit tuning will be practically negligible.

o o o o

Battery Charging Polarity.

It is proposed to charge my H.T. accumulator battery from 240-volt D.C. mains, inserting a suitable resistance to limit the current flowing. Would it be correct to join the cells directly to the negative or positive main, and what should be the polarity of the connections?

Strictly speaking, the battery should be joined to the earthed main, which may be either positive or negative. This main

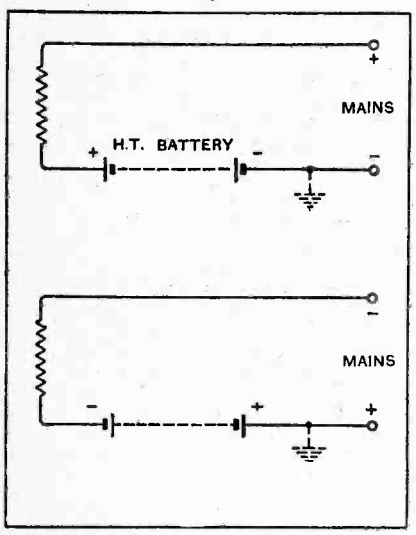

Fig. 3.—Charging an H.T. accumulator from either positively or negatively earthed D.C. mains.

lead is connected to the battery terminal of the same polarity; suitable connections are indicated in Fig. 3.

o o o o

Short-range D.C. Set.

From the point of view of quality, would it be desirable to use an input band-pass filter for the single-valve D.C. receiver discussed in the "Hints and Tips" section of your issue of May 13th? In my own case there is no need for high selectivity.

A filter is almost always to be advocated nowadays, but in the circumstances you describe its omission could be tolerated. High-note loss in a single tuned aerial circuit will hardly be too great to be compensated for by the natural tendency (if unchecked) of a pentode to over-accentuate high audio-frequencies.

If you fit a tone control circuit across the output choke, as was recommended, it will be correct to embody a rather smaller condenser—or, alternatively, a rather larger resistance—than is usually specified when a filter is employed.

o o o o

High-ratio L.F. Transformer.

It seems that L.F. transformers with an extra high step-up ratio, of, say, 1 : 7, are never used to couple the detector to the pentode: the application of these transformers seems to be confined to triode output valves. I am engaged in planning a set from which rather more L.F. magnification than usual is desired. Is there any basic reason why a 1 : 7 transformer would not be satisfactory as a coupling between a power grid detector and an indirectly-heated pentode?

The difficulty is that, due to the high overall magnification afforded by the combination you describe, it possesses a greater tendency than usual to oscillate uncontrollably. However, these difficulties can be overcome, and the arrangement is used in at least one commercial receiver which gives reproduction of extremely high quality.

o o o o

A One-way Circuit.

I am engaged in some experiments with a short-wave super-regenerative receiver, in which quenching oscillations are generated by a separate valve, and are fed to the detector grid circuit through a variable capacity. My trouble is that the signal-frequency circuit tuning is affected by any adjustments made to the quenching valve. Is there any way, without going to the length of adding a tuned filter circuit, of preventing this interaction?

It should be possible to avoid this trouble by inserting an efficient H.F. choke of the value normally used for short-wave work in series with the lead through which quenching oscillations are fed to the detector valve. No difficulty should be experienced in finding a component that will offer a sufficiently high impedance to the short-wave oscillations, and which at the same time will pass quenching oscillations of the normal periodicity practically without loss.

o o o o

Single-voltage H.T. Supply.

I am making a portable set, and find that it would be convenient to use a single pair of connecting leads for the H.T. battery; of course, those anode circuits requiring less than the maximum pressure available would be fed through voltage-dropping resistances. The point about which I am not quite clear is whether this scheme is economical. Would the H.T. battery last longer if tapped connections were made to it in the usual way?

As energy is dissipated in the voltage-absorbing resistances, it will be obvious that a certain amount of loss will result from the adoption of this scheme. But this loss is more apparent than real; with the usual system of connections the full anode current required by the set is consumed from all the cells at the negative-end of the battery, and when these are exhausted it is usually necessary to replace it with a new one. In actual practice, then, the extra cost of maintaining an H.T. battery connected in the way you describe will be almost negligible.

o o o o

A Matter of Modulation.

I have been trying the effect of connecting a milliammeter in series with the detector valve of my set, and am puzzled by the fact that in many cases a signal which brings about quite a small downward deflection of the meter needle gives audibly louder reproduction than another which causes an appreciably greater reduction of detector anode current.

I was under the impression that the detector valve, with the meter in series with its anode, acts more or less as a valve voltmeter, and that equal H.F. voltages applied to its grid circuit would be responsible for equal deflections of the needle; apparently this is not so. Will you please explain?

You have overlooked the effect of modulation. Transmissions which give the same change of anode current will be responsible for the same volume from the loud speaker, but only when they are modulated to the same extent.

You are correct, however, in supposing that your detector valve, in conjunction with an anode milliammeter, functions as an uncalibrated valve voltmeter, showing relative amplitudes of applied H.F. voltages due to various trasmissions.

FOREIGN BROADCAST GUIDE.

LIMOGES (PTT)

(France).

Geographical position: 45° 50′ N., 1° 16′ E.

Approximate air line from London: 402 miles.

Wavelength: 293 m. Frequency: 1,022 kc. Power: 0.08 kW.

Standard Time: Greenwich Mean Time (France adopts B.S.T.).

Standard Daily Transmissions.

12.30 B.S.T., concert or gramophone recital; 20.30, news and concert.

Time signal before closing down.

On Sundays Limoges relays Ecole Supérieure (Paris PTT) throughout day.

Man announcer. Call: *Ici PTT* (phon: *Pay-tay-tay*) *Limoges.*

Closes down with usual French formula followed by *La Marseillaise.*

Relays Ecole Supérieure, Paris and occasionally Bordeaux-Lafayette, Marseille and Lyon (PTT).

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Rekindle the Amateur Spirit.

LAST week in these notes we took up the cudgels on behalf of the amateur and quoted an opinion of Dr. Eccles as far back as 1923, when he expressed the view that the amateur had contributed largely to wireless development. There is no doubt that evidence goes to show that in many directions in the early days the amateur was responsible for achievements which contributed in no small measure to progress in the development of the science and to our general knowledge on the subject of the propagation of short waves.

Thinking over the comments of Dr. Eccles which we quoted in our last week's issue, we cannot help being driven to ask ourselves whether Dr. Eccles, as representing an independent view, would be prepared to speak as warmly to-day of the recent achievements of the amateur as he was able to do in 1923. Has the amateur begun to lose heart and to lack enthusiasm for pioneering efforts? Looking round for evidence of amateur achievement during the past few years, one must confess that the situation seems to be distinctly disappointing as compared with earlier periods in the development of wireless, both for general communication and for broadcasting purposes.

Present-day Opportunities.

There should be to-day at least as much opportunity for the amateur to assert himself and give evidence of his inventive ability as there ever has been in the past. Having established a name for themselves in connection with short-wave communications, it would almost seem that since then amateurs have been satisfied to rest on their laurels and allow the commercial companies and those who have taken up wireless as a profession to earn the credit for practically all the inventions and improvements of recent date. Frankly, we should be pleased to know that we are wrong in this supposition and would welcome opinions from any amateurs who can cite any outstanding contributions by the amateur during, say, the past five years.

Complexity of the Science no Excuse.

Perhaps the explanation for the lack of activity on the part of the amateur may be found in the fact that the science is becoming more complex as time goes on; but that ought not, in our opinion, to debar him from making useful contributions, provided that individual amateurs will be content to specialise in particular directions and not expect that in their spare time they will be able to keep pace with development in all its branches. It would be a pity if the line of demarcation between the amateur and the professional worker became so pronounced that the amateur came to be regarded as a slavish follower of blue prints and wiring diagrams and took no interest in the theory of how his apparatus worked.

It is time that the amateur rekindled enthusiasm for individual achievement, and we feel confident that the material of which inventions are made is to-day just as plentiful amongst the amateur as ever it was.

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Remote Tuning Control Systems

New American Synchronous Motor Devices.

By A. DINSDALE.

WHILE little progress has been made in the development of remote control devices in this country, America is now evincing considerable interest in what may be termed the armchair method of operating a broadcast receiver. The trend of design appears to lie in the direction of synchronous motor control of volume and tuning. Readers will be interested in the accompanying description of the first commercial remote control attachments which are now being manufactured by Westinghouse, R.C.A., and the National companies.

FOR many years past ingenious experimenters have devised ways and means for controlling their wireless sets from a distance. Probably the commonest arrangement is one which permits the listener to switch off his set last thing at night without the necessity for getting out of bed.

From time to time sporadic attempts have been made by various manufacturers to commercialise some form of remote control, but with little success. The probable explanation of these failures is that the devices so far offered have presented so many disadvantages of one sort or another that the average set owner just could not be bothered with them; also, the few advantages presented did not warrant the additional expense.

In America to-day, however, there are signs that remote control will ultimately become a standard feature of high-quality sets. The devices which will be described in this article are at present being offered to the public on an optional basis, for attachment to the manufacturers' standard sets, and their simple and successful operation seems to augur well for their future popularity.

The Radio Corporation of America and the Westinghouse Electric and Manufacturing Co. both offer two identical systems, one of the push-button type which can be attached to either company's higher quality superheterodyne sets, and the other, a very much more elaborate dialing system, which is only fitted to special "custom built" installations (i.e., specially built non-standard contract jobs) built into large mansions.

Dealing with the push-button system first, the R.C.A., in introducing it, states that "it is well known from a study of listening habits that few set owners listen to the programmes of more than three or four stations, in ordinary circumstances. The R.A.C. equipment provides six 'pre-selected' programmes and, by a simple adjustment, any other stations desired. A duplicate set of buttons on the radio panel permits automatic tuning at the receiver itself. With a 25ft. length of a new cable tape, it is a simple matter to extend complete and effortless operating control of the radio set to any desired location. This connecting tape, which is only ⅛in. thick and 1in. wide, is superior to the ordinary cable, because it may be laid unobtrusively under the carpet or run along the skirting board. As many remote control units as desired may be connected to one receiver; thus a small tablet containing the push-buttons may be conveniently placed near a favourite easy chair, a bridge table, in the dining-room, bedroom, or even in the kitchen."

The remote control unit consists of a small bronze finished box, on top of which is a set of six buttons, for as many stations, with small spaces alongside wherein are set the station call letters. Two more buttons turn the receiver on or off, and a slight pressure on two other push-buttons increases or diminishes the volume. A tiny jewelled pilot lamp lights when the set is in operation and indicates by its varying brilliancy whether a station is tuned in to its most sensitive point on the dial. To tune in distant stations or other stations not pre-selected, pressure is released on the buttons at the moment the desired station is heard clearly. Operation of the tone control or local-distant switch must be done at the receiver.

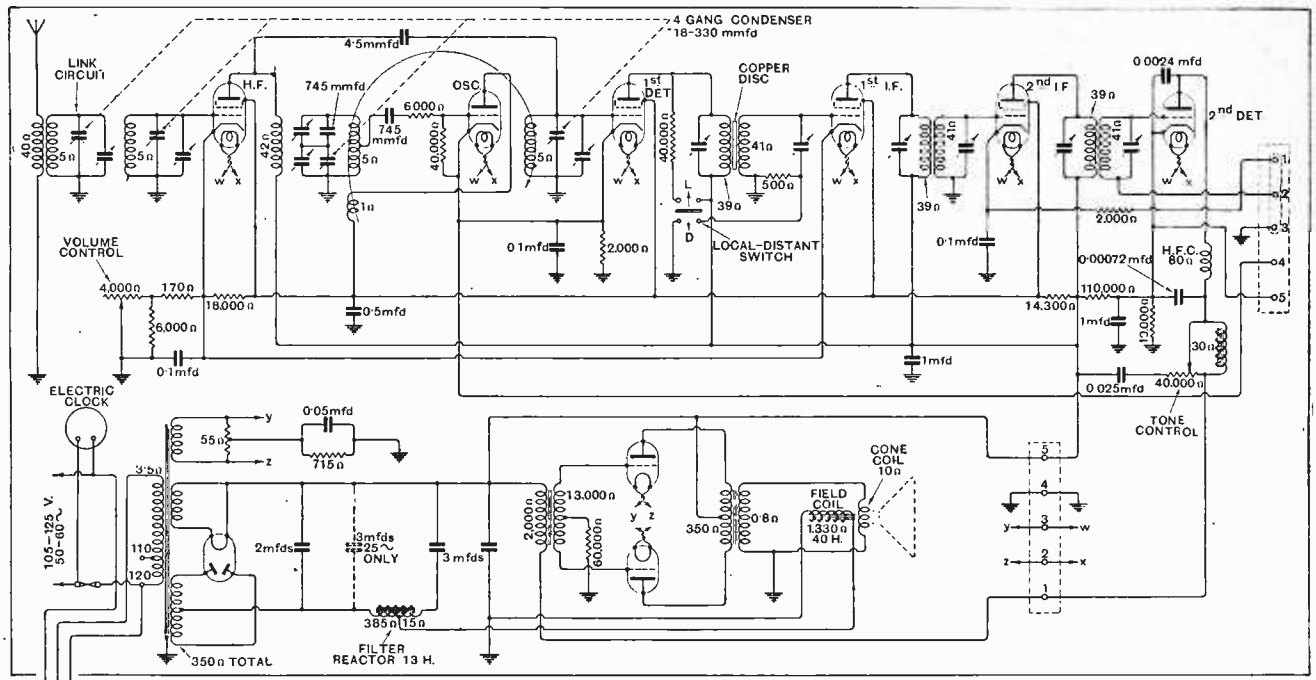


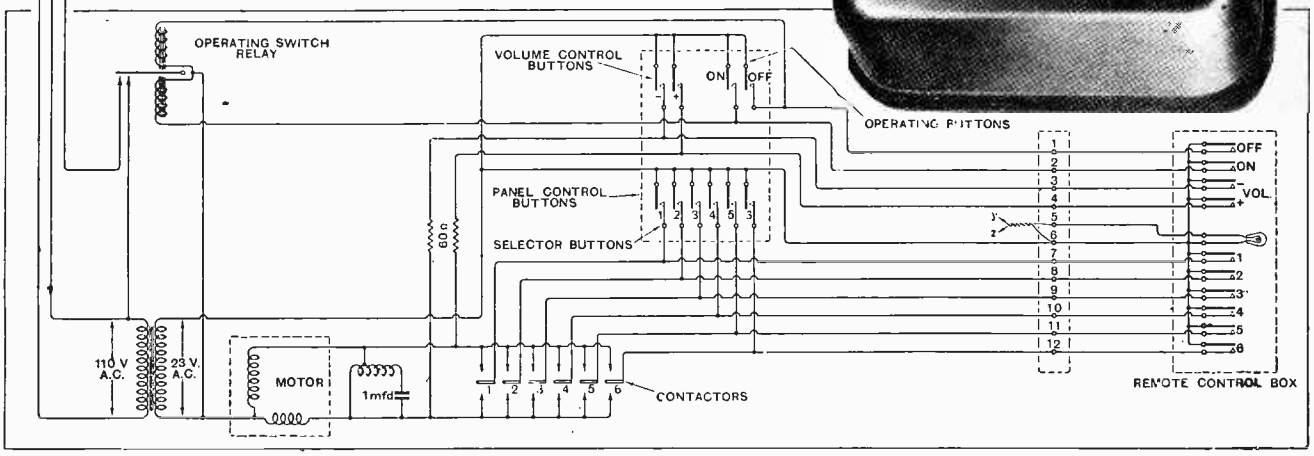
Fig. 1 (a).—Complete circuit details of the Westinghouse "Columaire" receiver, also the Radiola receivers Nos. 82 and 86.

The mechanism of the remote control consists of an electric motor, apparently of the synchronous induction type, which is coupled to the shaft of the gang tuning condenser through a series of gears, a series of drums and contactors (commutators) by means of which the motor is started in the right direction for a given station and stopped at the right point, a special volume control geared to the motor, a relay to switch the receiver on or off, and the remote control box by means of which these operations are controlled.

The motor is provided with a tapped reactance and condenser for changing the phase angle of the applied current so that operation in either direction may be secured. The motor operates at 23 volts for the station selector (tuner) and 18 volts for the volume control. The complete circuit arrangements are shown in Figs. 1 (*a*) and 1 (*b*), which also gives the complete circuit diagram of the Westinghouse "Columaire"[1] and Radiola 82 and 86 receivers.

[1] See description in *The Wireless World* for April 8th, 1931.

Fig. 1 (b).—Remote control unit and circuit arrangement for the device which can be attached to the Westinghouse and Radiola receivers.



Remote Tuning Control Systems.—

Fig. 2 (*a*) shows the normal position of the motor armature. It will be noted that a spring holds the armature so that the gear at one end is meshed with the volume control gears. At 18 volts, the potential used for volume control operation, the gears remain in this position and operation of the volume control is secured. When the speed of the motor is increased by operating it at 23 volts, this voltage being used when the station selector buttons are pressed, the end thrust of the armature causes it to move laterally, thereby disengaging the gear at the volume control end and engaging the gear at the station selector end, as shown in Fig. 2 (*b*). The spring at the end of the armature

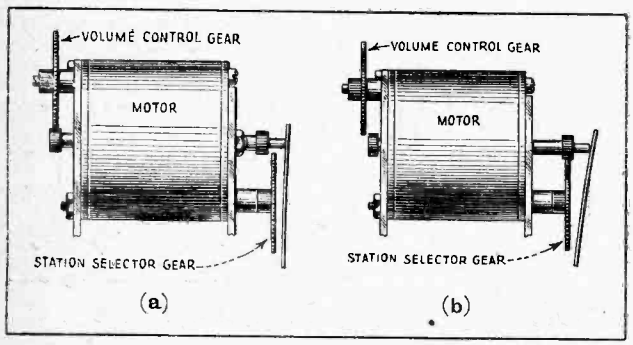


Fig. 2.—(a) The motor with armature in volume control position and (b) in station selector position.

always causes it to return to the volume control position when the current is "off" at the motor. As this action takes place with the motor operating in either direction, controlling the voltage at which the motor is operated determines its function. A 60-ohm resistance (see Fig. 1) is placed in each motor circuit controlling the volume to reduce the voltage from 23 to 18.

Pre-setting the Receiver Dial.

The proper direction of operation and stopping of the motor for the selection of a desired station is controlled by a commutator-like arrangement of drums and contactors. The drums hold the contactors in the proper position so that when a particular selector button is depressed the motor will turn in the correct direction. When the contactor is at the point on the drum where it is halfway between each contact, the motor stops. This point is 180 deg. from the hole that is used to set the drum for a particular station.

The setting of the six drums is made by means of a set of six pins and a duplicate set of six push-buttons mounted on the chassis of the receiver. To set, a push-button is pressed and the drum is moved by the motor until the corresponding contactor is midway between the contacts. The pin will now fall into the hole in the drum if pushed in by the finger (see Fig. 3). Holding the pin firmly in the hole, the desired station is then accurately tuned in by means of the manual station selector (tuning) knob. After tuning, the pin is released. As the point on the opposite side of the drum is where the diameter of the drum changes, the contactor is halfway between the contacts. Pressing that particular selector button will therefore cause no movement of the motor, for that particular station is already accurately tuned in. If another button is pressed and the drum moved, pressing the original button will always bring the drum back to the position for which it is set.

Referring to Fig. 1, it will be seen that a common lead is used for the pilot lamp and the selector buttons in the remote control box. By doing this, when a selector button on the box is pressed, the current through the common lead is increased, likewise the voltage drop in the lead is increased. The result is that while the motor is running the pilot lamp becomes very dim. As soon as the motor stops, the lamp resumes full brilliancy, thus indicating that the motor has stopped and the station is tuned in. If the station is not then heard, it is only necessary to press the + volume control button a little at a time until the desired output level is obtained.

Dialing Selection of Radio and Gramophone Items.

In the dialing system of remote control, also the product of the R.C.A. Victor Company, dials and associated switching mechanism similar to those employed in the dial telephone system are employed (Fig. 4). A simple dial control, mounted on a small ornamental box with a pilot light, is installed at desirable points throughout the house, and connected to a master radio-gramophone set situated in the attic or basement. Complete operating control of both the wireless set and the automatic gramophone is provided by each dial station.

Up to 18 different stations are pre-tuned and adjusted to the master dial unit to respond to easy code number combinations. The automatic gramophone is similarly adjusted for each of its functions. To bring in a radio programme to one of the rooms the dial is twirled to the code number of the desired station from any one of the dial controls. In the same way, a code number is dialed to raise or lower the volume, start or stop the radio music, and to play records or reject them, at will. The volume of each loud speaker outlet may be separately regulated by any of the dial controls.

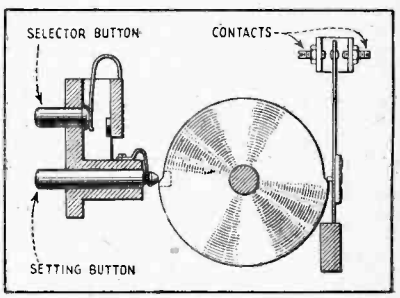


Fig. 3.—End view of one drum and its associated contactor.

The code numbers are conveniently listed in the lid of each control box. For gramophone record programmes the code number of the record changing device is dialed and the machine plays a continuous programme of twelve records, stopping at the end automatically.

The features of the dial system are many, among them being a minimum of wires to be installed in the home. Three wires are run to each dial box location, and usually terminate in a triple-pole receptacle in the skirting boards of the various rooms. This permits the

Remote Tuning Control Systems.—

dial, through an extension cord, to be plugged into a baseboard when it is desirable to economise in the number of boxes. Any number of dials may be used with one master switching mechanism. Each dial box carries its own pilot light, which serves as an indicator to tell whether the set at the basic equipment is turned on or off. When one dial has been actuated the pilot lamps all over the house automatically light.

Since motor driven volume controls are used across each set of loud speakers, it is possible, from any one dial box, to control any of the various speakers throughout the house. A motor attached to the tone control is also controlled from the dial. With this system, increasing or decreasing the volume of loud speakers in one room does not cause any change in volume of speakers in other parts of the house.

The actual operating mechanism of this system is simply an elaboration of the push-button system. Whereas in the latter system the contactors which operate the driving motor are operated by hand, in the dialing system the contactors operating the several motors are actuated by switches and relays controlled by the dials.

Another remote control system which resembles in some respects that of the R.C.A. has been perfected by the National Company, Inc., of Malden, Mass., and is called by them the National Kinematic Remote Control. Two outstanding differences in the National system are: (1) Continuous tuning throughout the entire range is secured, instead of giving a limited choice of pre-selected stations; (2) two driving motors are used, one for tuning and one for volume control.

The actual control unit consists of a small box on top of which is mounted a tuning knob, which is turned just as if one were operating the dial on the set itself, and which operates in conjunction with a tuning scale let into the top of the box, so that one can see the dial reading to which the receiver is tuned. Also mounted on the control box are a conventional-looking volume control knob and a reset button. The control boxes are made of attractively moulded bakelite and measure $3\frac{3}{4}$in. × $5\frac{7}{8}$in. × $2\frac{1}{2}$in. Any number of them may be used with the one installation.

Extension Leads carrying Three-Phase Currents.

The two knobs on the control box actuate two commutators within the box, which in turn control the operation of the two "step by step" motors which drive the tuning condensers and volume control. These motors are equipped with stators somewhat similar to the usual three-phase stator, and unwound rotors energised by induction. Each motor is wired to the control by three phase wires and one common wire, making seven wires for the complete installation. Rotation of either commutator in the control box successively energises the windings of its respective motor and causes the armature to rotate in exact synchronism with the commutator. Thus, the device is essentially a synchronous one; the motors will not function without the commutator and there is neither over-running nor under-running. The reset button sets the motor and commutator in synchronism before tuning.

The two motors are connected to the radio set by means of an initial reduction gearing and a cable drive. Due to the fine pitch of the gears used, backlash is negligible. The cable is securely anchored to the drums, preventing slip, and an idler pulley, bearing on the cable under spring tension, prevents backlash in the drive due to cable stretch.

Due to an ingenious switching mechanism the motor power circuits are automatically open when the control box knobs are not being turned, so that there is no switch to forget to turn off. The maximum potential on the seven-wire cable connecting the control box with the set is only 25 volts A.C., so that the cable may be run under rugs, etc., without violating wiring regulations as would be the case were a higher voltage employed.

Fig. 4.—The Victor dialing system of remote tuning and volume control.

The complete installation costs about £7 10s., and it may be easily fitted to any of the standard types of commercial sets, as well as home-made receivers. A diagram of the connections is given in Fig. 5.

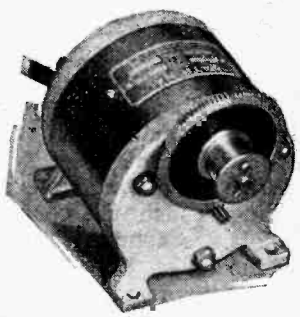
The Wireless World readers will perhaps recall the Lyric 24-hour tuner which was exhibited at last year's New York radio show, and described in these pages on October 29th, 1930. A somewhat similar, but more elaborate and all-electric device has just been perfected by Edwin K. Cohan, technical director of the Columbia Broadcasting System, and Emile Brugger, an expert on timing devices. The writer has just seen the first console model of a receiver incorporating this device in Mr. Cohan's office. The instrument is not yet on the market, but, as it may be expected in the near future, a brief description, based on the sparse information at present available, may not be out of place in this article.

The front of the console is provided with 38 five- and six-way toggle switches, by means of which the

Remote Tuning Control Systems.—

operator may pre-select his entire radio entertainment on five different broadcasting stations for the ensuing eighteen hours (the entire period of the broadcasting day in America). Once adjusted, the receiver need not be touched for the entire period. If no change of stations is desired from the arrangement originally selected, the set need not be touched for weeks on end!

An electric clock is included in the installation, and by means of a set of relays, timing devices and station selectors operating through synchronous motors, the set automatically tunes from station to station, as pre-arranged, remaining tuned to each station for half- or one-hour periods, as desired. Referring to the title photograph, each switch may be thrown to any one of five positions, thus selecting a different station. The left-hand switches in each double row represent the hours, and the right-hand switches the half-hours. The left-hand double row represents the morning hours and half-hours, and the right-hand double row the afternoon hours and half-hours from 1 p.m. to midnight. Thus, if the operator desires to listen to, say, WJZ from 1 p.m. to 4 p.m., he sets the top three pairs of switches under Mr. Cohan's left hand in the title photograph, to WJZ, and that station will continue to "perform" until 4 p.m. When making this setting, if it is desired to switch off the set from 4 to 6 p.m., the fourth and fifth pairs of switches are set to the off position. The set may be caused to switch on again automatically at any later time by pre-setting the appropriate time switches to the desired stations. If the user sets the switches so that the receiver is in operation up to midnight, but he falls asleep in the meantime, the set will automatically switch itself off at midnight, and automatically start up again in the morning to waken him at whatever time and with whatever station he pre-selects before going to bed.



The small motor with geared cable drive used in the National equipment.

This is "radio made easy" with a vengeance, and will provide a striking contrast in the minds of older wireless men who remember the days when——, but why bring that up!

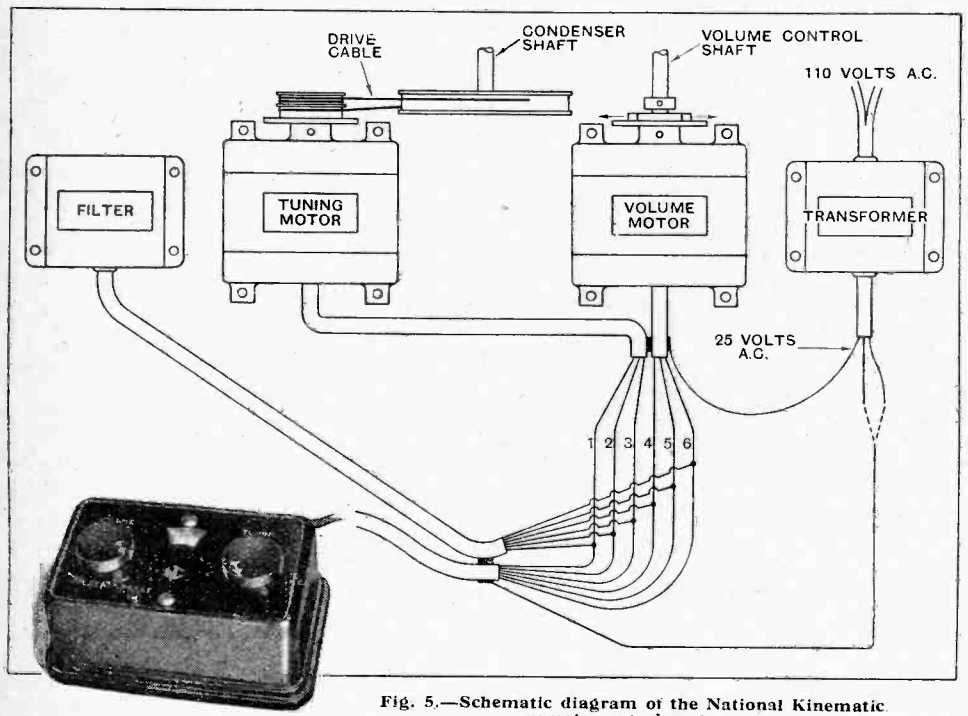


Fig. 5.—Schematic diagram of the National Kinematic remote control system.

PRECAUTIONS AGAINST HIGH NOTE LOSS.

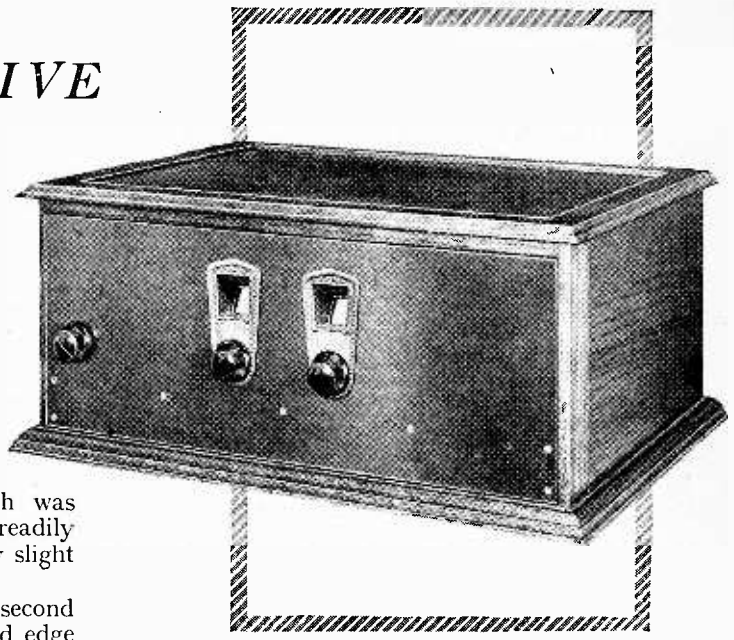
IF the condenser connecting plate and filament of an anode bend detector is increased in size the negative reaction effect exerted on the grid circuit of the valve will be lessened. If, therefore, this capacity is gradually augmented signal strength will be correspondingly increased, the effect being akin to the releasing of a brake. Unfortunately, it is not possible to increase the condenser to such a value that the brake is entirely released, as before this desirable state of affairs occurs severe distortion due to high note loss sets in. The value of this condenser must always, therefore, be something in the nature of a compromise. It is customary to make it as large as quality considerations will permit. In a well-designed set used in conjunction with a really good moving-coil loud speaker, where high note loss is easily discernible, the permissible value will—all other things being equal—be far less than in the case of a set employing a moving iron type of reproducer. The actual value of condenser is dependent on the A.C. resistance of the detector valve and upon the value of anode resistance used, and so no hard-and-fast rule can be laid down. The lower the value of the valve resistance and of the external resistance, the greater will be the permissible maximum value of the condenser, and in cases where a transformer follows the detector quite a large value can be employed.

Notes on the

SUPER-SELECTIVE SIX.

Different Methods of Connecting a Gramophone Pick-up.

By W. T. COCKING.



THE gramophone pick-up is now so popular among music lovers that it is felt that the description of a receiver designed for high-quality reproduction is incomplete without some mention of the most suitable methods of connection. The Super-Selective Six, which was described in the last two issues of this journal, is readily adaptable to the use of a pick-up, and only very slight modifications are necessary.

The layout chosen for the set is such that the second detector valve is placed at the extreme right-hand edge of the baseboard, and so it becomes possible to place the pick-up terminals within an inch or so of the valveholder. The risk of instability brought about by long leads within the set is thus avoided, and the efficiency of the radio portion of the apparatus is maintained at its maximum.

Three different ways of connecting a pick-up are indicated in the illustration, and one of the most satisfactory methods is that shown at (a). Two terminals, which are connected to the grid of the detector and to negative H.T. respectively, are mounted on the edge of the baseboard and as close to the valveholder as possible. The volume control is connected across the pick-up leads in the usual manner, and is mounted external to the set, the slider of the control being connected to the grid of the valve, and the junction of the potentiometer and the pick-up being connected to negative H.T. Grid bias must be used with a pick-up, and this is most readily obtained by connecting a 600-ohms resistance, shunted by a 2-mfd. condenser, in the cathode lead of the detector. Negative grid bias, however, is not required when the valve acts as a rectifier for radio reception, and it is necessary, therefore, to connect the low-potential end of the second intermediate frequency transformer directly to the detector cathode, instead of to negative H.T.

In order to avoid disconnecting the grid connection to the pick-up for broadcast reception, a simple make-and-break switch is included in the grid lead. It will be noticed that when the receiver is used for gramophone reproduction the grid leak and condenser are connected in parallel with the pick-up; as explained later, this is no disadvantage, but, in any case, where it is considered undesirable, the method shown at (b) should be adopted. It will be seen that a single-pole change-over switch, which should be of the low-capacity type, is fitted in the grid lead close to the detector valveholder.

The third method, shown at (c), is the simplest of all, and necessitates no alteration whatever to the receiver. A 1.5-volt battery is used to provide grid bias, and it is only necessary to provide two terminals for the convenient connection of the leads. It should be remembered that the positive terminal of the bias battery must be joined to the negative H.T. lead. Again, it will be noticed that the grid condenser and leak are in parallel with the pick-up.

Tone Control.

Now when these modifications have been carried out it will be found that, while the reproduction on "radio" is normal, the reproduction on "gramophone" is high pitched and lacking in bass. A pentode normally accentuates the upper audible frequencies, and some method of reducing these is essential in order to obtain the correct balance of tone. It was explained in last week's article that an unusual method of compensating has been used; the usual resistance-condenser combination in the pentode anode circuit has been omitted, and instead the intermediate frequency circuits have been so designed that sidebands are cut to the degree necessary to prevent excessively high-pitched reproduction.

While this method of compensating a pentode has important advantages on "radio," it is inoperative when a pick-up is used, and it becomes necessary, therefore, to add some form of compensating circuit for use on "gramophone" only. This may take the form of the usual resistance-condenser combination shunted across the loud speaker, but it will then be necessary to remove it when receiving broadcasting, and it is usually more convenient, therefore, to fit the tone control across the pick-up itself.

It is often sufficient to connect a condenser directly across the terminals of the pick-up, and the best value for this condenser must be found experimentally for the particular pick-up and loud speaker used. With a high-impedance unit and a speaker which does not greatly accentuate the upper frequencies a capacity of as little as 0.0002 mfd. may suffice, but with a low-resistance

Notes on the Super-Selective Six.—

pick-up and a speaker which gives strong high-note reproduction as much as 0.002 mfd. may be necessary. It should not be forgotten, of course, that the connection of the grid leak and condenser across the pick-up, as in circuits (a) and (c), will help in reducing the high-note response.

A somewhat better method of tone control, however, in that it gives a more gradual high-frequency cut-off, is obtained by placing across the pick-up a condenser and a resistance in series. A rather larger capacity condenser must now be used, while the resistance should be variable with a maximum value of some 50,000 ohms, assuming that the volume-control potentiometer has a resistance of about 500,000 ohms. By varying the amount of resistance in circuit, a continuously variable control of the tone can thus be readily obtained.

Once the tone has been adjusted satisfactorily in this manner it will need no further attention, and the components, therefore, can be included in a unit with the volume control to serve as a connecting link between the pick-up and the receiver. Alternatively, they may be built into the gramophone itself, whichever may be found the more convenient in individual circumstances. When using the gramophone it is, of course, necessary to turn the receiver volume control to minimum, otherwise a certain amount of interference from broadcasting may be experienced.

The amplification afforded by the AC/HL detector and the AC/Pen. with the 4-1 intervalve transformer is very great, and with most pick-ups it is necessary to make drastic use of the volume control in order to avoid overloading the pentode. The pick-up should be earthed and the leads to it should be kept as short as possible, while they should be widely separated from the loud speaker leads, in order to avoid any risk of L.F. instability. If these precautions be taken, no trouble at all should be experienced, and it should readily be possible to obtain first-class quality of reproduction both on "radio" and on "gramophone," while the amplification is sufficient to allow of full volume being secured from even an insensitive pick-up.

In the radio portion of the receiver it is well to adhere to the specification, for there are few changes which can be made without a detrimental effect upon the performance. The valves are particularly important, and no alternatives can be recommended, except in the case of the oscillator and second detector, where Mullard 354V. type can be used without affecting the results. It is not recommended that any change be made in the screen grid valves, since this would necessitate alterations to the anode feed resistances, screen grid potentiometers, and bias resistances. Similarly, a change in the output valve might necessitate the complete redesign of the voltage regulating resistances.

WHAT WILL IT DO?

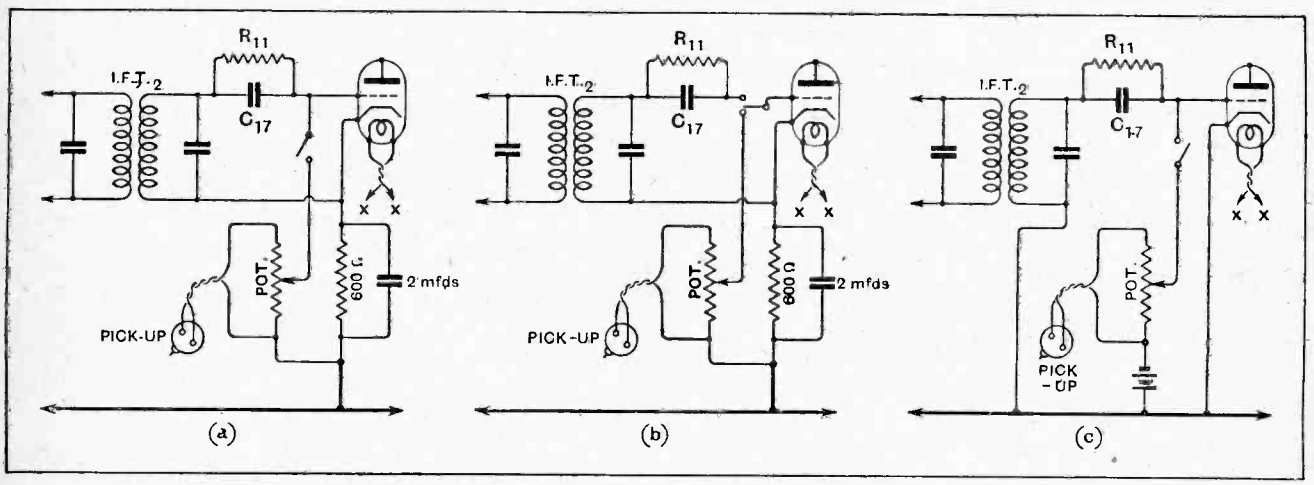
THIS question will be answered in next week's issue, in an independent test report compiled by an experienced listener who will give his impressions on the working of the Super Selective Six.

The most important valve in the set is undoubtedly the first detector, and it is advisable to try the effect of interchanging the I.F. and first detector valves, for it has been found that two valves which are of apparently equal efficiency as amplifiers may perform differently as detectors.

It should be realised that if the oscillator does not function, nothing at all will be receivable. This is unlikely to occur, but in the event of a failure the cause will be found among the following:—

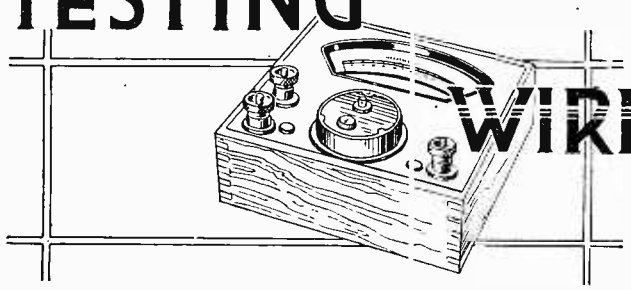
Faulty valve; oscillator coil connected incorrectly (particularly reaction coil leads reversed); no H.T. on the valve; too high a value bias resistance; faulty or badly connected bias resistance condenser; bad contact of the valve in its holder (in particular, the connection between the cathode pin and its socket).

It should be emphasised that trouble is no more likely to occur in a superheterodyne receiver than in a tuned H.F. set, and no trouble at all should be met with if care be taken in its construction. Indeed, it will be found somewhat simpler to put into operation, since there is not the slightest risk of instability and the ganging adjustments are reduced to the setting of two trimmers on the input filter.



Gramophone pick-up connections. (a) An easy method in which the grid condenser and leak remain as a shunt circuit. (b) Complete isolation of the pick-up. (c) Simple arrangement using a grid cell for bias.

TESTING WIRELESS RECEIVERS



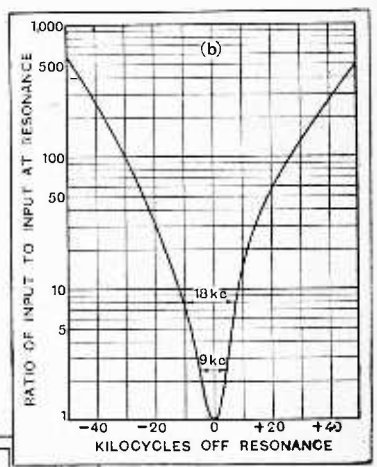
By R. L. SMITH-ROSE, D.Sc., Ph.D., A.M.I.E.E.

(*Concluded from page 638 of previous issue.*)

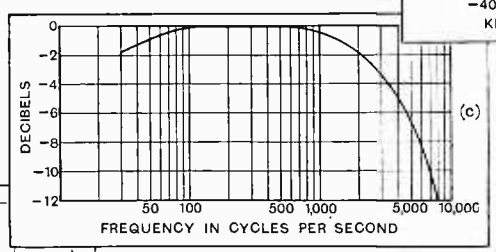
Sensitivity, Selectivity and Overall Fidelity Curves of some Typical Receivers.

SO far no standardised conditions have been set up in this country for testing receiver performance, but the Committee on Standardisation of the Institute of Radio Engineers in U.S.A. has published details of "Proposed Standard Tests of Broadcast Radio Receivers" in the Proceedings of the Institute for August, 1930. The conditions outlined in this publication are already being adopted by manufacturers and others in America, and there is an indication that they may form the basis of specifications in this country. It will be interesting, therefore, to give here briefly the quantities proposed in relation to these standard tests which are to be carried out on the lines described above.

The standard artificial antenna proposed is a series circuit comprising a capacity of 200 micro-microfarads, and has an inductance of 20 microhenrys and a resistance of 25 ohms. For the sensitivity and selectivity tests the fixed modulation frequency is 400 cycles per second, and the normal amount of modulation is 30 per cent. The standard audio-frequency output proposed is 50 milliwatts in a non-inductive resistor arranged to carry alternating current only, and connected across the output terminals of the radio receiver. This resistance is adjusted to the value recommended by the valve manufacturer to give maximum undistorted output for the type of output valve employed. If the receiver is not arranged to filter out direct current, then an external filter circuit is to be employed at a negligible D.C. resistance, and comprising an inductance of not less than 100 henrys when carrying 50 milliamperes direct current, and a condenser of not less than 8 microfarads, these components being connected in the usual manner for the A.C. output circuit.



An indication of the performance to be expected from modern receivers may be obtained from a brief discussion of the results of three receivers, as published by the manufacturers. The first is a well-known British-made receiver, the performance curves of which were published in *Experimental Wireless* for November, 1930. The remaining results refer to two American receivers.



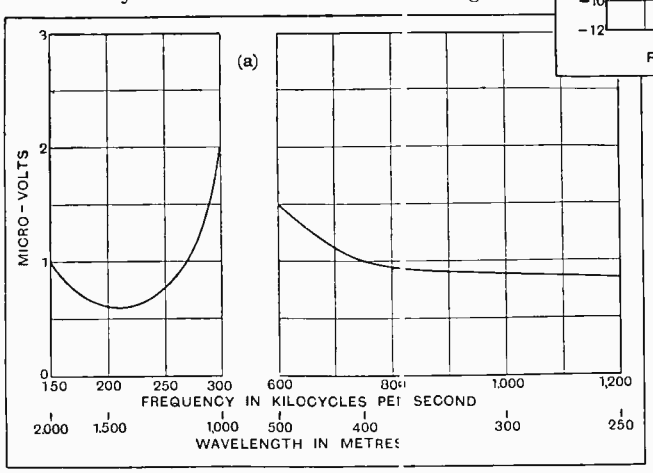


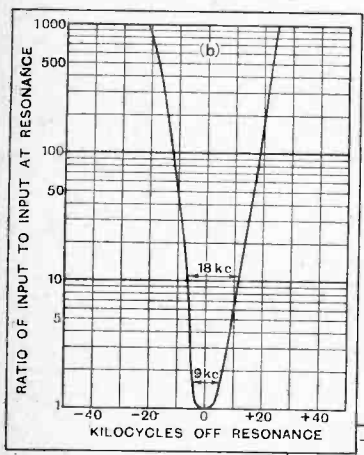
Fig. 4 (a).—Sensitivity curves of a four-valve British receiver taken over two wavebands. (b) Selectivity performance showing the response up to 50 k.c. off tune. (c) The fidelity characteristic.

The British receiver is of the four-valve type, containing two screen-grid radio-frequency amplifying stages, a detector, and one power output audio-frequency stage. Fig. 4*a* shows the results of a sensitivity test carried out on this receiver over both the medium and long broadcasting bands of wavelength. The curves show that over the majority of the useful range of the set an input of about 1 microvolt, or less, is required to produce the standard output of 50 milliwatts in an external circuit which, in this case, consists of a 4,000-ohm non-inductive resistor. The selectivity performance of this receiver is illustrated by the curve shown in Fig. 4*b*. In this and the later selectivity

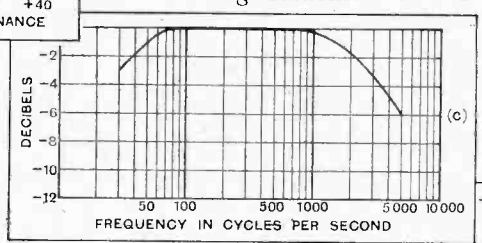
Testing Wireless Receivers.—

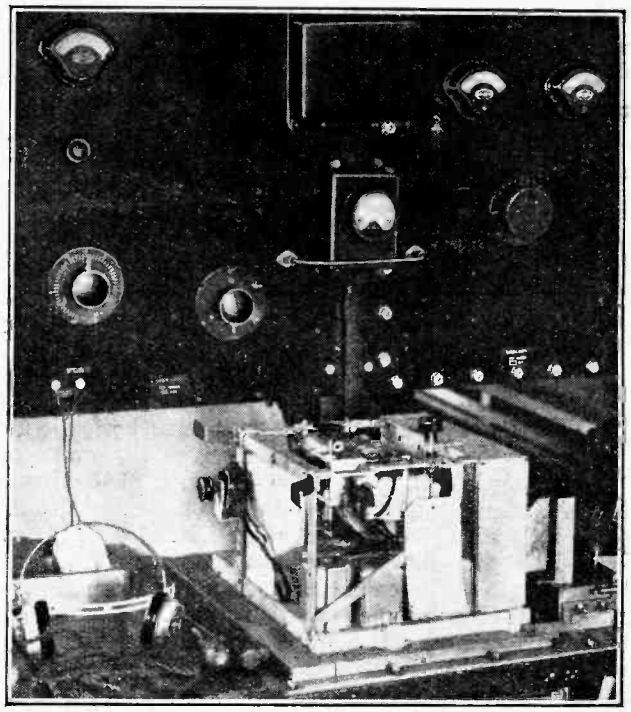
curves the positions of the 9- and 18-kilocycle band widths are indicated, the latter being a point relating to the separation of European broadcasting stations. It is seen that in this case, for a signal 9 kilocycles per second out of tune with the receiver, about eight times the input is required to produce the same output as that obtained from a signal on the wavelength to which the receiver is tuned. While this selectivity is not excessive, it is probably adequate for most ordinary situations of the receiver. At 30 kilocycles per second the sensitivity of the set has decreased one-hundredth of that at the resonance point. The audio-frequency characteristic of the receiver is shown in Fig. 4*c*, from which it is seen that the reproducing quality is very good from 30 to 1,000 cycles per second, and that even up to 5,000 cycles per second the output has decreased only 7 decibels (about 0.45) from its value at the standard frequency of 400 cycles per second.

The first of the American receivers, for which data are available, is of unit construction, comprising a three-circuit band-pass tuner, a three-stage tuned radio-frequency amplifier with screen-grid valves, a detector and two stages of audio-frequency amplification. In common with most American receivers, the tuning range is restricted to the 200-600 wavelength band, since provision is not required for long-wave broadcasting stations.



From Fig. 5*a* it is seen that this receiver is somewhat less than half as sensitive as the set just considered, and that it requires an input of from 2.4 to 5 microvolts to produce the standard output. This sensitivity is, however, adequate for most broadcast reception purposes, since in this country the standard service area of a broadcasting station is considered to be that over which the field intensity is above 2.5 millivolts per metre. The standard antenna used for test purposes is considered to have an effective height of 4 metres, so that in a field strength of 1 microvolt per metre the receiver would have an input of 4 microvolts applied to it, which will be adequate to produce the standard output under the conditions specified. At a frequency of 1,000 kilocycles per second, i.e., approximately in the middle of the tuning range of the receiver, the selectivity curve obtained is shown in Fig. 5*b*. This curve is interesting in showing the performance of the band-pass selector circuits which





Stage-gain testing apparatus used by the Gramophone Co. in measuring the overall performance of "His Master's Voice" receivers.

are incorporated in this receiver. For example, over a frequency band of 9 kilocycles per second around the resonant point the sensitivity only varies in the ratio 1.6 : 1, which would be expected to give good-quality reception without undue cutting of side-bands. On the other hand, at a band width of 18 kilocycles per second on the curve the sensitivity of the receiver is less than $\frac{1}{10}$th of that at the point to which it is tuned. There is, therefore, little interference from unwanted signals at a frequency of 9 kilocycles per second on either side of that of the wanted station. The overall fidelity characteristic of the receiver is shown in

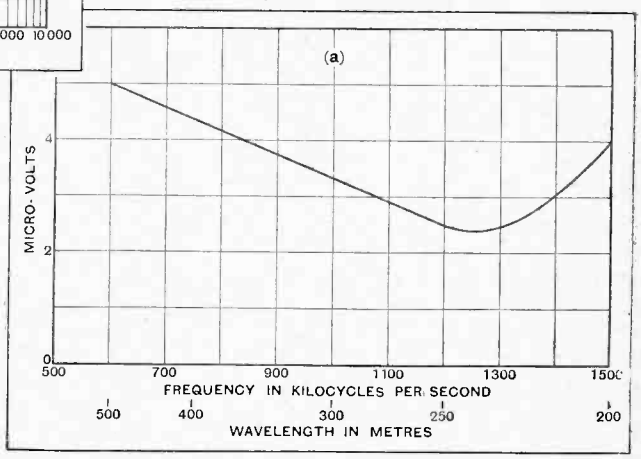
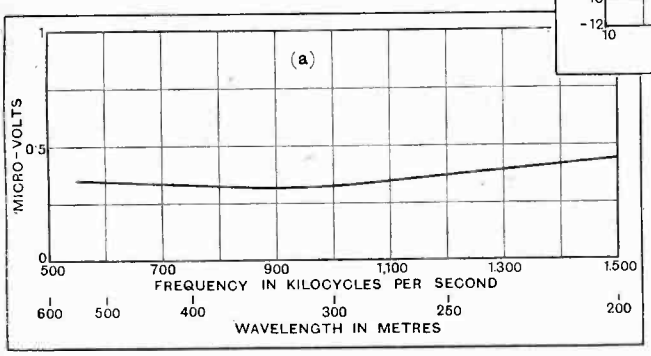


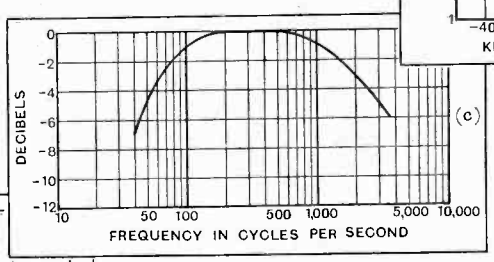
Fig. 5 (a).—Sensitivity curve of a typical six-valve American set with a straight circuit. (b) Response curve showing the effect of a triple pre-selector tuning device. (c) The overall fidelity curve which is comparable with that of Fig. 4 (c).

Testing Wireless Receivers.—

Fig. 5*c*, which is comparable with that of the previous receiver in Fig. 4*c*.

The second of the American receivers, for which performance characteristics are reproduced, consists of a six-valve supersonic heterodyne tuner and radio-frequency amplifier for use with a standard type of two- or three-valve audio-frequency amplifier. The receiver comprises one screen-grid radio-frequency stage, a screen-grid first detector, an oscillator, and two screen-grid intermediate-frequency stages, followed by a second or power detector. Four tuned circuits are employed at the incoming frequency, and these, combined with the three tuned stages operating at the intermediate frequency of 175 kilocycles per second, give the receiver a very high sensitivity and selectivity performance, as shown by the curves in Figs. 6*a* and 6*b*. The first graph shows that the set requires an input of only 0.3 to 0.5 microvolt to give the standard output of 50 milliwatts, which is thus attained for a field strength of less than 0.1 microvolt per metre. Such a high sensitivity is required only for reception at very long distances, and, indeed, the receiver is claimed to be capable of reproducing any signal which is above the normal atmospheric noise level. The selectivity, as illustrated by the graph in Fig. 6*b*, is very high and results in the sensitivity falling to about 1/50th at a band width of about 9 kilocycles to about 1/2,000th at a band width of 18 kilocycles. Such selectivity, while admirable for the separation of signals from different stations, is a trifle excessive for good-quality reception from broadcasting stations. The audio-frequency characteristic of the receiver is shown in Fig. 6*c* and indicates a performance that is moderately good, although there is undoubtedly a marked tendency for the output to be reduced at frequencies below 100 and above 2,000 cycles per second.





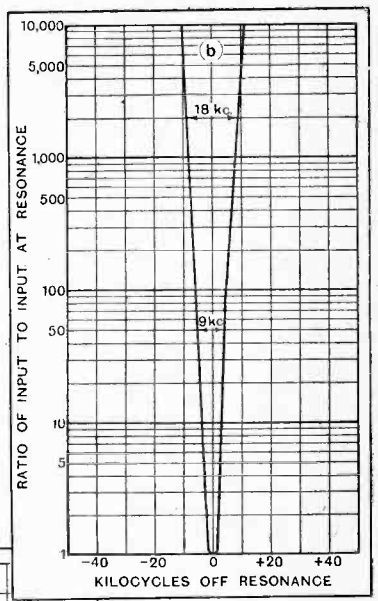


Fig. 6 (a).—Sensitivity of a highly specialised American superheterodyne. (b) This curve shows the remarkable selectivity that can be obtained from a superheterodyne receiver. (c) The audio-frequency characteristic showing a marked cut-off below 100 and above 2,000 cycles.

The above graphs are merely intended as a selection taken at random to illustrate the type of performance curve that is obtained under the conditions of measurement which were described in the early portion of this article. When the habit of taking quantitative measurements on receivers and the subsequent publication of results become more widespread the user and purchaser of the receiver will be in a position to appreciate the exact capabilities of any particular set and the direction in which advance is being made in receiver design and construction.

BOOKS RECEIVED.

The New Zealand Radio Guide and Call Book, 1931.—Compiled by the *N.Z Radio Record*, and including chapters on Broadcasting in New Zealand, Explanatory and Constructional articles, List of Broadcasting Stations, N.Z. Amateur Transmitters, Useful Data, etc. Pp. 180, with numerous illustrations and diagrams. Published by Radio Publishing Co., of N.Z., Ltd., Wellington, N.Z., price 2s. 6d.

British Standard Specification for Apparatus for Workshop Testing of Permanent Magnets, issued by the British Engineering Standards Association (Specification No. 406-1931), including introduction, definitions of quantities, method of mounting specimens for test, and the method of using moving-coil and rotating disc fluxmeters. Pp. 33, with 4 diagrams and 7 plates. Published by Crosby Lockwood and Son, London, price 2s. net, 2s. 2d. post free.

We have received the first (January) number of the *Journal of the Television Society*, containing papers read before the Society of Developments in Television, Recording and Reproducing, Talking Pictures, Television in Natural Colours, and their ensuing discussions. The acting editor of the journal is Mr. W. G. W. Mitchell, who is well known to readers of *The Wireless World* as the writer of many articles which have appeared in our columns. Published by the Television Society, 4, Duke Street, Adelphi, W.C.2, price 5s. net.

Radio Tube Data. Compiled by J. D. Reid and containing useful data concerning typical American valves, with very complete characteristic curves. Pp. 32 Published by Lefax Inc., Philadelphia, Pa., U.S.A., price $1.

The Design of Capacitator Motors for Best Starting Performance, by Prof. B. F. Bailey. Pp. 25, with 12 diagrams. Published by the Department of Engineering Research, University of Michigan, U.S.A., price 50 cents.

Televisie, Wat Het Is—Hoe Het Werkt (Television, What it is, How it Works), by C. G. Philp. Translated into Dutch by D. C. van Reyendam. Pp. 78, with eight illustrations and diagrams. Published by J. Schuyt, Jr., Alkmaar, Holland.

CURRENT TOPICS

Events of the Week in Brief Review.

OVERCOMING SKIP DISTANCE EFFECT.

Mr. R. M. Wilmotte, formerly of the Wireless Department of the British Post Office, has developed a new transmitting aerial system which, it is claimed, eliminates the skip distance effect. The aerial is to be tried out at station KSTP, St. Paul, Minnesota.

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NO MORE ATMOSPHERICS?

The radio world may soon resound with the name of Signor Riccardo Bruni, of Genoa; if it be true that he has indeed invented a device which "completely suppresses" atmospherics.

All technical details are withheld, but we understand from a correspondent that Signor Bruni has been conducting anti-parasite researches for several years, and has gained the sympathetic interest of the Italian Government.

But we shall await the confirmation of the report before offering congratulations on a discovery which would come next in importance to the invention of tuning.

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THE NIGHTINGALE IN FRANCE.

"Nightingale fever" is spreading over the European ether, according to a Paris correspondent who reports that the B.B.C. have set an example that is being followed in Holland and France, and will soon be emulated farther east. The French radio journals are trading upon the word "rossignol" (nightingale) which is a well-known slang term meaning an unsaleable article. French listeners, it is stated, are familiar with this sort of "rossignol"!

MUSIC EN ROUTE. The Hungarian railway system provides passengers in all classes with an efficient service of broadcast reception. The headphones are plugged into "points" in the luggage rack. A simple twin-wire aerial is used.

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CALL IT A DAY.

Two American amateurs, Carl Miller and Kenneth Smith, recently kept a 24-hour watch at their station, W5 AUC, Brooks Field, Texas, with the object of determining how much useful work could be accomplished by a typical transmitter from sunrise to sunrise. According to the American Radio Relay League, they secured contact with every State in the Union, and also communicated with China, Cuba, Canada, New Zealand, Nicaragua, Hawaii, Mexico, Haiti, Tahiti, and Porto Rico.

OCH HONE!

The Irish Free State is still without a site for its projected high-power broadcasting station. Athlone is the district chosen, but, according to a reply in the Dail by the Minister of Posts and Telegraphs, considerable difficulty is being experienced in carrying through the negotiations for purchasing the desired land.

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WANTED: A NEW RADIO BEACON.

Captains of ocean liners are strongly urging the installation of a radio beacon at Eddystone or Penlee Point. This portion of the English Channel is notorious for its fogs. Ships which have kept to schedule time on long voyages sometimes have to stand by for hours almost within sight of Plymouth.

EXPENSIVE STATIC.

The French police distinguish between cases of unintentional electrical disturbance and those in which the offender has wilfully endeavoured to interrupt the pleasures of broadcast listeners. From Dijon comes a report that a resident has been fined nearly £6 for maliciously upsetting his neighbour's reception by means of an electric machine.

STILL TESTING ON 400 KW.

KDKA, East Pittsburg, the world's oldest and most powerful broadcasting station, has been licensed by the Federal Radio Commission to continue its early morning tests on 400 kW. A corps of engineers is taking field strength measurements at points distributed all over the United States.

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RADIO AT R.A.F. DISPLAY.

Wireless will play an important part at the Royal Air Force display at Hendon on Saturday, June 27th. One of the most spectacular events will be the refuelling of flying boats in the air, and a demonstration of the method employed will be given by two Vickers Virginia bombers. Radio telephony will be used for communicating between the two aircraft before the dropping of the pipeline and also during the demonstration.

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£17,000 BUYS 100-WATT STATION.

One can still make a fortune in America by selling a broadcasting station. According to our Washington correspondent, the supply of available stations is so far behind the demand that churches and schools are disposing of their broadcast transmitters at fabulous prices. Our correspondent mentions, among other examples, a 100-watt station in New York, which is now on the market for the modest sum of £17,000. This station's equipment originally cost £180; to-day it is one of those "hay-wire" or third-rate broadcasters with an obvious illusion about the size of its audience and the value of the one-fourth time it is licensed to remain on the air.

There is another in the same vicinity, a 500-watter, which is now being "offered" for £32,000. A year ago its owners were tearfully begging for £10,000. The management of still another New York station, a 1,000-watter, is known to have placed a "conservative value" of £50,000 on it.

Station WOR, Newark, with 5,000 watts, is understood to have turned down a cool £600,000 for plant and good will, presumably offered by a well-known newspaper magnate.

VALVES TESTED

The ETA Series

Test Report on Six Representative Valves. A New Range.

THE full range of ETA valves available at the time of compiling this report includes sixteen different types for receiving purposes and a full-wave rectifying valve. Of these eight are for battery use, being fitted with a two-volt filament, while the remainder are intended for A.C. operation. The latter class is subdivided into two sections: indirectly heated valves and directly heated valves. The directly heated section contains three valves, all of which are power valves, the smallest rated to give some 330 milliwatts output, while the largest will deliver 1,600 milliwatts of undistorted A.C. power. The range does not include a pentode valve, but there are three screen-grid valves: one in the two-volt class and two in the indirectly heated section.

Since it is obviously impossible to deal individually with each of the sixteen specimens sent in, a few of the more interesting types have been selected for test in the present review. From the two-volt range the BY6 screen-grid valve, the BY2010, a detector, and the BW602, a power output valve, were selected for mention. The rated characteristics of the BY6 are given as:—

A.C. resistance, 300,000 ohms.
Amplification factor, 300.
Mutual conductance, 1 mA. per volt.
Maximum anode voltage (E_a), 150 volts.
Optimum screen voltage (E_{s_0}), 80 volts.

These measurements have been made with the maximum voltages mentioned applied to the anode and to the screen grid, while the working grid is given a bias of −1 volt. On checking the characteristics of a specimen BY6, the mutual conductance, A.C. resistance, and am-

SCREEN GRID VALVES.

	Type.	Filament. Volts.	Filament. Amps.	Max. Anode Voltage.	Optimum Screen Voltage.	Average Anode Current (mA.).	Amplification Factor.	A.C. Resistance. (Ohms).	Anode-Grid Capacity ($\mu\mu$F.).	Price.
ETA	BY 6	2	0.15	150	80	2.5	300	300,000	0.002	17/6
	DW 2*	4	1.0	150	80	2.5	240	200,000	0.002	19/6
	DW 6*	4	1.0	200	100	1.0	1,000	800,000	0.002	19/6

* Indirectly heated A.C. valves.

MISCELLANEOUS VALVES.

	Type.	Filament. Volts.	Filament. Amps.	At Zero Grid Bias and 100 Volts H.T. A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./volt).	*A* Max. Anode Volts.	*B* Grid Bias (*for A*).	Average Anode Current (*for A and B*). (mA.)	Price.
ETA	BY 2023	2	0.12	23,000	20	0.85	150	3.0	1.5	7/-
	BY 1814	2	0.12	14,000	18	1.3	150	2.5	3.0	7/-
	BY 2010	2	0.12	10,000	20	2.0	150	2.5	4.0	7/-
	DW 4023*	4	1.0	23,000	40	1.75	150	2.0	2.5	11/6
	DW 1508*	4	1.0	7,500	15	2.0	150	6.0	5.0	11/6

* Indirectly heated A.C. valves.

The above tables have been compiled on the lines of the Valve Data Sheet published as a supplement to *The Wireless World*, dated November 26th, 1930.

Valves Tested—The ETA Series.—

plification factor agreed with the maker's figures. Increasing the grid bias to −1.5 volts resulted in a fall in mutual conductance to 0.85 mA/volt. With −0.5 volt on the grid, the figure obtained was 1.18, and with zero grid bias 1.22 mA/volt.

Further investigation brought to light the fact that grid current starts to flow with −0.2 volt on the grid. After these preliminary measurements a full set of curves connecting anode current with anode volts, for various selected values of grid bias, was then prepared. These are given in Fig. 1. To enable the curves to be shown on a larger scale, only those portions relating to anode voltages higher than the screen potential are given. Assuming the maximum anode voltage and the rated screen potential, several load lines have been drawn through the operating point on the −1 grid bias curve to represent tuned circuits of various dynamic resistance values, assuming the load to be a pure resistance at resonance.

The grid swing that the valve will handle, without introducing serious distortion and giving rise to cross modulation troubles, is the order of 0.3 of a volt, assuming a tuned circuit of some 150,000 ohms dynamic resistance. As a consequence, there is nothing to be gained by increasing the grid bias; the input will have the same limitations, but the general characteristics of the valve will be impaired.

With various coils actual measurements of stage-gain were then made at 400 metres, using the tuned grid circuit, as shown in Fig. 2.

2in. coil of solid wire without long-wave section: inductance: 208 μH.	86 times
Dual-wave coil wound on ribbed bakelite former, 2¼in. dia.; inductance: 216 μH.	75 ,,
60-turn plug-in coil (multi-layer); inductance: 212 μH.	56 ,,

The average anode current using the operating voltages mentioned is 2.75 mA, and the screen-grid current approximately 0.25 mA.

The BY2010 valve is described officially as a detector, its rated characteristics being:—

* A.C. resistance, 10,000 ohms.
* Amplification factor, 20.
* Mutual conductance, 2 mA/volt.

Maximum anode voltage (E_a), 150 volts.

* At $E_a = 100$; $E_g = 0$.

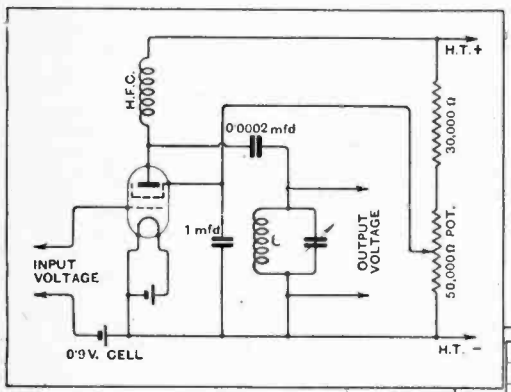


Fig. 2.—The tuned grid circuit used in the measurement of stage-gain.

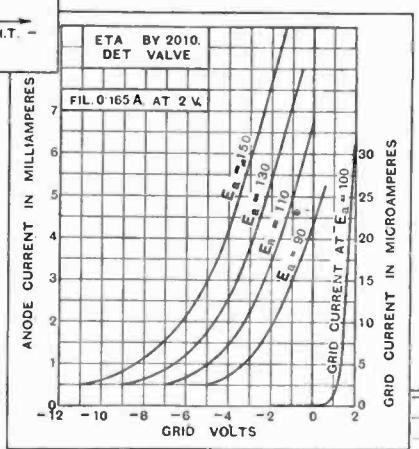


Fig. 3.—Grid volts-anode current characteristics of the special detector valve—the ETA BY2010.

We were not able to obtain figures quite so good from the specimen tested when measured under the same conditions as given above. The mutual conductance did not exceed 1.9 mA/volt; the A.C. resistance was 7,850 ohms; and the amplification factor 14.8. These values did not improve to any extent when the maximum voltage was applied to the anode and the grid biased to −3 volts. However, this condition is not one that holds any particular interest, since as a detector the actual voltage on the anode will not exceed 100 volts; in all probability it will be lower in most cases. Even when the valve is employed as a power grid detector it would not be advisable to permit more than 100 volts to reach the anode, as with the grid returned to the position L.T., or given a slight positive bias by the aid of a potentiometer, the anode current will amount to between 7 and 9 mAs. It would be better to limit the anode potential to about 90 volts in the case of a power-grid detector, and to about 60 volts for leaky grid detection.

The Power Valve.

The largest power valve in the two-volt class, regarded from the point of view of undistorted power output, is the BW602. The maximum anode dissipation that the valve will stand is 2 watts, and its rated undistorted A.C. output 330 milliwatts. The other characteristics of the valve are:—

* A.C. resistance, 1,900 ohms.
* Amplification factor, 6.5.
* Mutual conductance, 3.4 mA/volt.

Maximum anode voltage (E_a), 150 volts.

* At $E_a = 100$; $E_g = 0$.

Our first concern was to prepare a set of curves connecting anode voltage with anode current, as shown in Fig. 4, and draw in the 2-watt anode dissipation line AB.

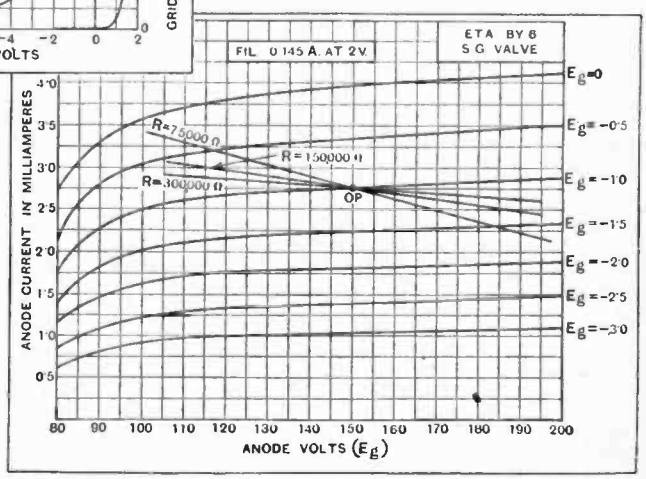


Fig. 1.—Anode current-anode volts curves together with load lines representing various tuned circuits at resonance. With a load of 150,000 ohms it can be seen that rectification and cross-modulation will occur with the BY6 valve unless the input is limited to a small fraction of a volt.

Valves Tested—The ETA Series.—

This is the limiting factor, as the anode current must not be permitted to rise above this line under working conditions. By suitably proportioning the output load or the speaker impedance, it is possible to comply with these conditions.

With 150 volts on the anode and −13 volts grid bias, the optimum load line, XZ, was found to be 7,000 ohms, and the maximum undistorted A.C. power output 300 milliwatts, allowing 5 per cent. second harmonic. This amount of power will operate the majority of reed-driven, cone-type loud speakers at sufficient volume for all ordinary purposes, but it will not enable the moving-coil variety to give of their best, although fairly good results may be expected

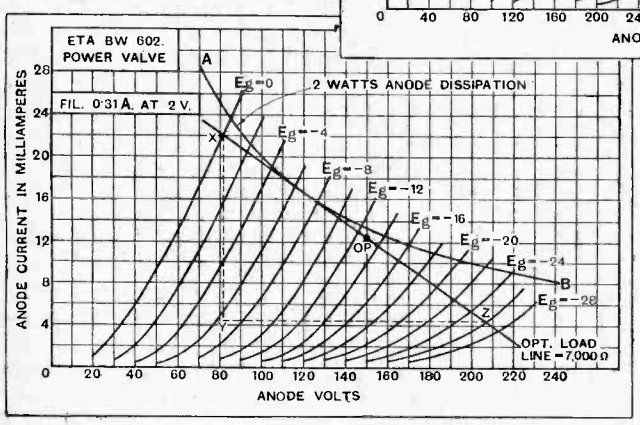


Fig. 4.—A load line limited by the watts dissipation curve shows that about 300 milliwatts A.C. output can be expected from the BW 602 output valve.

from those showing an unusually high order of sensitivity.

The average anode current under the working conditions mentioned above is 12.5 mA's, a value which permits the use of dry batteries for the H.T. supply. What is officially known as the triple-capacity type or the "super" class should be favoured, as these will prove more economical in the long run than those of small capacity.

The Type DW302 is a super-power output three-electrode valve fitted with a 4-volt filament requiring 1.05 amp. of current. It is intended that the filament current should be taken from the A.C. supply mains, using a transformer to obtain the required voltage. The maximum anode dissipation the valve will stand is given as 7.5 watts, and the rated maximum undistorted A.C. power output is 1,600 milliwatts.

The characteristics of the valve

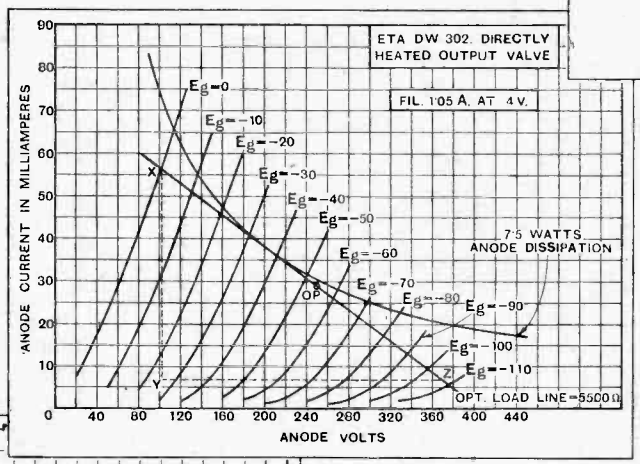


Fig. 5.—Characteristics of the DW 302 valve having a heavy filament suitable for direct A.C. heating. The measured A.C. output is about 1,610 milliwatts.

are given as:—

* A.C. resistance, 1,800 ohms.
* Amplification factor, 3.5.
* Mutual conductance 1.95 mA/volt.

Maximum anode voltage (E_a), 250 volts.

* At $E_a = 100$; $E_g = 0$.

The specimen tested showed slightly better characteristics when measured with 100 volts on the anode and zero grid bias, but under normal working conditions, with the maximum anode voltage, the values obtained were A.C. resistance 1,870 ohms, amplification factor 3.5, and mutual conductance 1.9 mA/volt. From the anode voltage-anode current curves shown in Fig. 5, the optimum loud speaker impedance was found to be 5,500 ohms, and the maximum A.C. power output, allowing 5 per cent. second harmonic, 1,610 milliwatts.

All measurements were made with the filament heated by A.C. and with the grid circuit returned to a

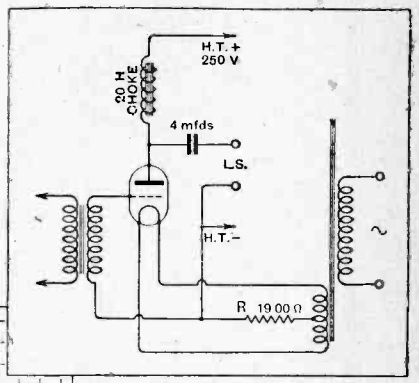


Fig. 6.—Suitable output circuit with self-bias arrangement for the valve, the curves of which are shown in Fig. 5.

centre tapping on the filament transformer. Under these conditions grid current started to flow when the grid was biased to −2 volts. This fact was taken into consideration when computing the power output. The optimum grid bias required, with 250 volts on the anode, is −55 volts, and the average anode current is then 28.5 mAs.

Indirectly Heated S.G. Valves.

Since the valve is to be used normally on A.C. supplies owing to the special nature of its filament, the anode voltage, and the grid bias, will be derived from the same source, using, of course, a rectifier and a simple smoothing circuit. This might well be arranged on the lines of Fig. 6, which shows the filament circuit, the grid bias resistance, and the output circuit. The rectifier is omitted, as it does not call for special mention, any of the recognised arrangements being admissible.

In the indirectly heated class are two screen-grid valves, designated the DW2 and the DW6 respectively. The first mentioned has a nominal amplification factor of 240, while that of its companion is given as 1,000. Preliminary tests made on the DW6 unfortunately showed our sample to be below standard, and as the measured characteristics of the DW2 compared quite favourably with the maker's figures, it was decided to proceed with the preparation of a set of curves for this valve only. These are given in Fig. 7, and connect anode current

Valves Tested—The ETA Series.—

with anode volts for some selected values of grid bias. The region of the curves for anode voltages lower than the screen potential have been omitted since they are of little interest. Furthermore, this enabled the useful portions to be shown on a large scale.

and −1.5 volts grid bias. The mutual conductance was found to be 1.1 mA/volts, and the amplification factor 370; the measured A.C. resistance being 336,000 ohms.

The stage gain afforded by the valve, using the tuned-grid method of H.F. coupling and the same coils as employed in the case of the BY6 valve, came out as follows:—

2in. coil; 208 μH. 115 times
Dual-range coil; 216 μH. ... 98 ,,
No. 60 plug-in coil; 212 μH. 74 ,,

Grid current commenced at −0.5 volt grid bias, but in view of the small input that the grid will accept without introducing serious distortion, the fact that it starts to flow at a small negative value is of little concern.

The official detector valve in the A.C. class is designated the DW1508. Its rated characteristics are:—

* A.C. resistance, 7,500 ohms.
* Amplification factor, 15.
* Mutual conductance, 2 mA/volt.
Maximum anode voltage (E_a), 150 volts.
* Measured at E_a=100; E_g=0.

The sample tested gave sensibly the same mutual conductance figure with 100 volts on the anode and zero grid bias: the amplification factor obtained was 20, and the A.C. resistance 9,530 ohms. These values did not change to any extent with the maximum anode voltage, and the grid biased to −5 volts. This condition would obtain if the valve was employed for amplifying purposes; indeed, it would fill this rôle admirably, provided it was not required to accept a large grid swing. The average anode current is 5.2 mA; a value which enables an L.F. transformer to be employed as the coupling between it and the following valve, provided that the primary inductance remained adequate.

OUTPUT VALVES.

Type.		Filament.		At Zero Grid Bias and 100 Volts H.T.			*A*	*B*	*C*	*D*		Price.
		Volts.	Amps.	A.C. Resistance (Ohms).	Amplification Factor.	Mutual Conductance (mA./Volt).	Max. Anode Volts.	Grid Bias (*for A*).	Average Anode Current (*for A and B*) (mA.).	Max. Undistorted Output (*for A, B and C*) (Milliwatts).	Optimum Load (*for D*) (Ohms).	
ETA	BW 1304	2	0.2	4,000	13.0	3.2	150	6.0	6.0	130	8,000	8/-
	BW 303	2	0.32	2,700	3.0	1.1	150	25.0	11.0	253	6,000	8/-
	BW 602	2	0.32	1,900	6.5	3.4	150	12.0	12.0	330	5,500	8/-
	DX 502†	4	0.15	2,100	5.0	2.4	150	17.0	12.0	330	5,000	11/6
	DW 702†	4	0.23	2,250	7.0	3.2	200	20.0	18.0	600	5,000	11/6
	DW 302†	4	1.05	1,800	3.5	1.95	250	50.0	33.0	1,600	4,000	11/6
	DW 704*	4	1.0	4,500	7.0	1.5	150	14.0	10.0	180	7,000	11/6
	DW 1003* ..	4	1.0	3,300	10.0	3.3	200	12.5	12.5	380	7,000	11/6

† Directly heated A.C. valves. * Indirectly heated A.C. valves.

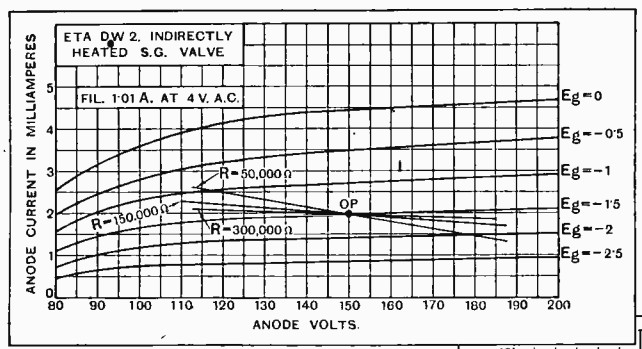


Fig. 7.—The indirectly heated screen-grid valve—the DW 2. Characteristics are shown for loads of 50,000, 150,000 and 300,000 ohms.

The rated characteristics of the valve are:—

A.C. resistance, 200,000 ohms.
Amplification factor, 240.
Mutual conductance, 1.2 mA/volt.
Optimum screen voltage (E_s), 80 volts.
Maximum anode voltage (E_a), 150 volts.

It appears that these values were obtained with 200 volts on the anode, 75 volts on the screen, and −1.5 volts grid bias. This is rather at variance with the statement that the maximum anode voltage should not exceed 150 volts. All measurements made by us under working conditions were with 150 volts on the anode, 80 volts on the screen,

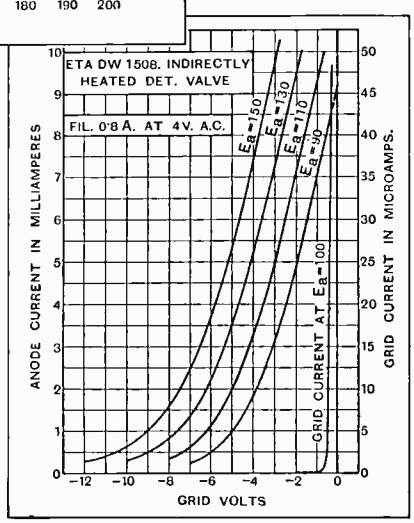


Fig. 8.—Special detector valve (the DW 1508) with indirectly heated cathode. Note that grid current starts to flow at a small negative grid potential.

Next Week's Set Review:—

DUBILIER A.C. THREE

CORRESPONDENCE

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

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

DEAF AIDS.

Sir,—I have read Mr. Balbi's letter in your issue of April 29th and the subsequent published replies. Having been for the last thirty years fitting and selling aids for the deaf, I think I can claim a very wide experience, probably greater than anyone else in the British Isles.

To select the correct aid for deafness a salesman should first be able to judge the form and degree of deafness the enquirer suffers from. From this knowledge an aid can be made up by selecting a certain type of microphone and receiver. True, this first selection may have to be altered until the deaf party secures the maximum benefit he or she can obtain—there are also cases where an electrical aid is absolutely useless.

The question of cost introduced by Mr. Balbi is quite inaccurate—the manufacturing cost alone goes into a considerable sum for a scientifically constructed aid, and to this has to be added very heavy overheads when one is dealing with an article that requires expert knowledge, highly rented receiving rooms, and an unlimited service.

Further, making known to the public that such aids exist means heavy advertising expenses, and until the time arrives when the public look upon aids for the deaf as they do glasses for defective sight, this expense has to go on to the retail price of the aid.

Unfortunately, there has been a crop of so-called cheap aids introduced that apparently are similar in appearance and purport to achieve similar results—these have been bought by the deaf public, and the experiences gained from such aids frequently break public confidence, and one cannot wonder at it.

The talk of mass production aids for the deaf is absurd—one might as well have mass production of lenses for everyone with defective sight.

In conclusion, I think the time has arrived when everyone selling aids for deafness should have to qualify for a certificate from a board of examiners. PHILIP V. SUMMER.

London, W.1.

AMATEURS AND BROADCASTING.

Sir,—Although I definitely shall not enter into a discussion with all and sundry over the question of amateur transmitters and Sunday broadcasts, I must certainly correct some of the rash statements made by your correspondent, Mr. F. G. Kay, in *The Wireless World* for May 27th.

My first letter was quite straightforward, and I intended no one to "read between the lines." My ideal is not "no transmissions at all on Sunday." If it were, I should, to be consistent, demand no transmissions on any other day either. Even I am not so selfish as that.

The present B.B.C. Sunday programmes are quite adequate, and in my original letter I protested against any possible extension of hours. Mr. Kay misses this point, I fear.

I am fully aware that broadcast listeners outnumber "hams." The latter, however, are far more numerous than Mr. Kay evidently thinks; they constitute, furthermore, a highly trained body of operators whose services in times of national emergency would be of the utmost value to the country. This cannot be said of the vast majority of BCLs, whose stations would doubtless be promptly closed down if war broke out—to cite the most extreme case of national emergency. Therefore, amateur transmitters should be encouraged; fortunately, they are receiving increasing recognition, despite the outcries of the Mr. Kay.

Your correspondent says that Sunday is the day of recreation. Unfortunately this is rapidly becoming the case, especially in suburban districts such as Hampstead! The B.B.C., however, are respecting the wish of the majority of English people by not pandering to those who want a Continental Sunday; this majority, I might say, is to be found in the provinces, and not in wicked London. The B.B.C. can hardly be expected to close down during the week for the benefit of "hams," so the latter are compelled to conduct the bulk of their experiments during the Corporation's quiet hours on Sundays, whether they want to or not.

Mr. Kay includes cinemas in his list of public services. Well——!

Regarding "my astonishing statement" that the research of "hams" had brought about the present-day high technique of radio, I regret that your correspondent here reveals an abysmal ignorance of the amateur movement generally by his belief that this is untrue. As Mr. Kay is a "keen broadcast *listener*" (his italics), he cannot be expected to know that "hams" are to be found in the highest positions on the B.B.C.'s technical staff. Nor will he know that the B.B.C. have used—and, as far as I know, are still using—for their gramophone broadcasts a pick-up designed by one of Britain's foremost "hams." Most of the receiving circuits in everyday use—Schnell, Reinartz, and so on—owe their origin to amateur transmitters, while the Goyder-lock system of transmission, developed by the famous Mill Hill School operator, is universally known. However, these names probably convey nothing to Mr. Kay, if he is only a BCL.

The initial efforts of the Radio Society of Great Britain led to the foundation of British broadcasting. The "broadcasting companies, the Government, and the big commercial firms" only followed when the amateurs had paved the way. Incidentally, I would point out that much of the success of many of the "big commercial firms" is due to the developments by the "hams" on the technical or sales staffs. Though radio is their profession, as it is mine, they are "hams" none the less.

The present short-wave transmissions of B.B.C. programmes from Chelmsford were only started following the successful Empire broadcasts from G2NM, the amateur station of Mr. Marcuse.

Mr. Kay should become a "ham" himself, and join the greatest international brotherhood existing. I will willingly attempt to convert him. J. H. HUM.

London, N.10.

DEMODULATION OF A WEAK SIGNAL BY A STRONG ONE.

Sir,—We have been particularly interested in Mr. Colebrooke's simplified account of the theoretical work of Beatty and Butterworth on the demodulation of a weak signal by a strong one. (*The Wireless World*, May 27th, 1931, p. 560.) Some months ago, struck by the profound difference between the results obtained by Beatty and Butterworth, we undertook a fresh examination of the whole problem, at the same time seeking to check our results experimentally. Our work, which is in course of publication, was carried out both with the "straight-line" triode rectifier advocated by Mr. H. L. Kirke and with the ordinary cumulative grid detector, and, in cases where the theories given by Beatty and Butterworth diverged, the experimental results are found to decide very definitely in favour of Butterworth's analysis.

One very simple and useful result can be stated. If strong and weak signals of carrier-wave intensities, S and W respectively, are simultaneously received with a linear detector, the modulation of the weak signal is reduced to a fraction $\frac{1}{2}\frac{W}{S}$ of its original value. At the same time, the strong signal is reduced slightly to $\left[1-\frac{1}{4}\left(\frac{W}{S}\right)^2\right]$ of its original value.

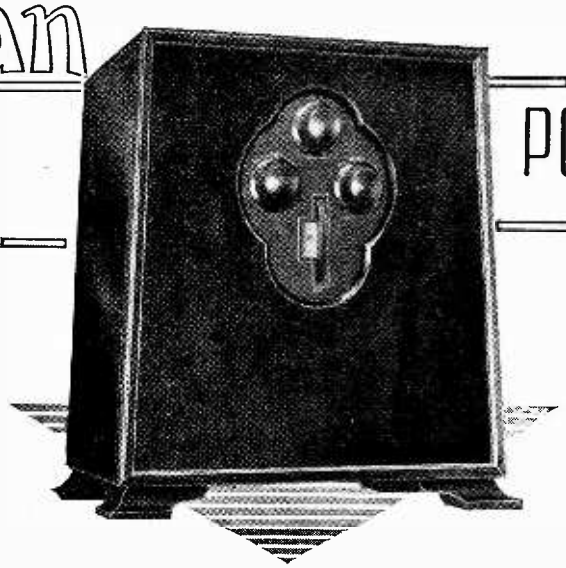
We believe that this demodulation effect, together with another effect not usually appreciated, plays a very important part in the remarkable behaviour of such highly selective receivers as the Stenode Radiostat invented by Dr. J. Robinson.

Wheatstone Laboratory, King's College, W.C.2. E. V. APPLETON, D. BOOHARIWALLA.

Ediswan

High-quality Local Station Reception.

POWER-PENTODE 2



SPECIFICATION.

CIRCUIT: Two-valve, all A.C. operation. Leaky grid detector with reaction coupled by L.F. transformer to indirectly heated pentode.
CONTROLS: One dial ganged tuning; capacity controlled reaction: trimming condenser on panel: waveband switch: gramophone pick-up switch.
GENERAL: Ganged two-circuit tuner with variable coupling. Compensated pentode output. Hum-neutralising device in last stage. Decoupling in anode and grid circuits.
VALVES: AC/HL; AC/PEN; UU.60/250 (rectifier).
PRICE: £12/10/-.
MAKERS: Edison Swan Electric Co., Ltd., Radio Division, 155, Charing Cross Road, London, W.C.2.

WITHOUT disputing the fact that long-distance listening has a real fascination for many wireless amateurs, it can safely be said that a majority of the British public is now sufficiently critical to demand first of all good-quality reception from two or three local transmitters. The Power-Pentode Two caters for the needs of these, and gives an excellent account of itself on near-by stations, whilst half a dozen foreign programmes can be relied upon after dark.

The lack of selectivity which too often mars reception with detector-L.F. sets is not evident with this receiver; on the contrary, considerable attention has been paid to the tuning device which comprises a ganged band-pass filter coupled by mutual inductance.

The circuit contains a number of interesting features. The aerial can either be connected through a small series condenser to the primary of the filter or, where the conditions are less exacting, to the secondary to which reaction is applied. To ensure that resonance is obtained satisfactorily at all points on both wavebands a small solid-dielectric condenser acting as a trimmer is mounted on the panel. This component was found very helpful in getting the most out of distant transmissions.

Input Filter with Variable Coupling.

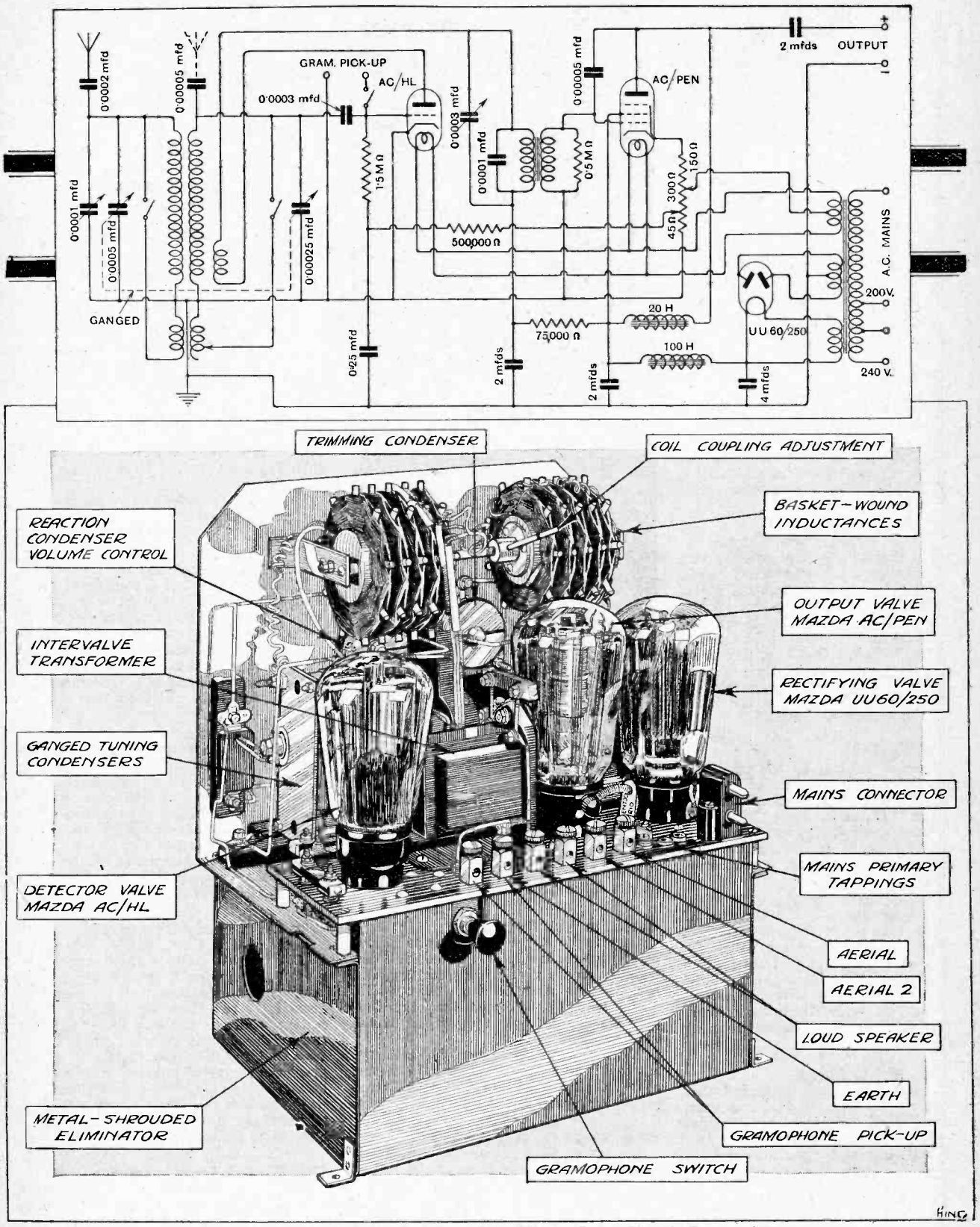
The degree of coupling between the coils is adjustable, but the locking device which alters the distance between them is not intended as a general control, and should be considered as a semi-permanent setting to be arranged to suit local conditions when the set is first installed. When the tuning inductances—which take the form of basket coils—are separated to the maximum extent, the selectivity was found to be adequate for all circumstances, and two foreign stations were tuned in between the London National and Regional Stations. On the other hand, when the receiver is being used at a considerable distance from any powerful station, the filter can be more tightly coupled, with the advantage that signal strength is improved.

As with all filters having adjustable coupling, it is possible to obtain double humped tuning in which there are two marked resonances for one transmission; care must be taken to avoid bringing the two coils too close together. For the long wave band single coils are used, and for the medium waves two coils of small inductance are switched in parallel with these.

Although grid current flows at zero grid volts in the AC/HL valve used in this set as the detector, additional positive bias is applied to it from the cathode resistance of the AC/Pen valve. This ensures that hum is reduced to a minimum. For reproduction from a gramophone pick-up a small switch at the back of the set is closed, bringing the input connections directly to grid and cathode of the first valve.

Decoupling has been carried out with care, and no signs whatever of instability were apparent. Owing to the high amplification of a pentode stage, it is often found that the last traces of hum are difficult to eliminate, especially when transformer coupling is used. Admittedly, the indirectly heated AC/Pen offends least in this respect, but there is always a chance of residual mains noises in this type of circuit. It was interesting to find that the background was particularly silent—an asset which must be ascribed to the special hum-neutralising scheme to be found in the cathode circuit of the output valve. The centre tap of the heater winding, instead of being joined to the end of the cathode bias resistance, is carried to a central point so as to apply an out-of-phase voltage to the input of the pentode.

The reproduction was well balanced, and no objectionable resonances were noticed. Speech was natural, and transients particularly well rendered, while over-accentuation of the higher audio frequencies is prevented by the shunting of a condenser across anode and grid of the output valve. Reaction is applied by a solid dielectric condenser, which gives a smooth and progressive control. The value of the filter was very evident on the long waves, where there could be found no trace of medium-wave signals at the lower settings.



Circuit diagram and chassis details of the Ediswan Power-Pentode Two receiver.

B 23

Broadcast Brevities

A glimpse of the movable studio floor at Hamburg which can be raised or lowered to vary the acoustic effect.

By Our Special Correspondent.

The King's Speech : A Double Broadcast?

It is quite probable, I learn, that the speech which the King will deliver at the opening of the new Ilford Hospital on July 18th will be broadcast twice.

In the afternoon, listeners will hear His Majesty direct, and then, if the present suggestion is adopted, a Blattnerphone record of the speech will be broadcast in the course of the evening.

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The Blattnerphone in Action.

A few days ago I was privileged to see and hear the Blattnerphone in operation in the special recording room which has been set apart at Savoy Hill. The magnetised steel tape, which is less than a quarter of an inch wide, is slowly transferred from one drum to another, passing through a pick-up device which responds to the varying degrees of magnetisation, and re-converts them into current pulses in the amplifier system.

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Themselves as Others Heard Them.

Reproduction on the loud speaker was up to the best gramophone standard, with, of course, the advantage that there was no scratch. Each drum carries enough tape for a twenty minutes' performance.

The whole of "The Crisis in Spain," which was broadcast last Thursday evening, had been recorded on three drums, and the artistes engaged were enabled to hear themselves in rehearsal a few hours before their actual broadcast.

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Is This a Record?

This canned version, by the way, provided an interesting example of how far one can go with the mechanisation of music, for "Crisis in Spain" incorporated several gramophone records made at the H.M.V. studio in Barcelona.

Thus we listened to a record of records.

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The B.B.C. is 'Quake-proof.

It says something for the stability of the B.B.C. that the earthquake left them unscathed. Apparently not a valve was broken or a meter deflected from its correct reading. On the other hand, lots of listeners wrote to Savoy Hill with woeful tales about the havoc which the tremors had wrought in their delicate receiving apparatus.

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Earthquake Not to Blame.

Many London listeners contended that the sensitivity of their sets had been enormously increased, for the reason that, on the Sunday evening after the earthquake, they heard Glasgow for the first time in their lives.

The explanation was simple. What they imagined to be a church service in Glasgow was actually a service from Swansea which was relayed from Daventry National. The item had not been printed in the B.B.C.'s official organ, but had been announced on the previous Saturday night. Those who wrote had apparently missed the announcement.

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Gandhi to Visit Savoy Hill?

Despite the rather portentous tales now going the rounds to the effect that Mr. Gandhi, on his visit to this country, will broadcast to America from Savoy Hill, I am officially informed that the Corporation has not been approached on the matter.

If the Indian visitor were to broadcast, it would probably be at the invitation of either the American National Broadcasting Company or the Columbia System.

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What Would the P.M.G. Say?

The B.B.C. have not hitherto attempted to impose any censorship on the American broadcasts for which they lend a studio on Sunday evenings, but I gather that if Mr. Gandhi's appearance in the series were at all likely, the Corporation would probably seek the sanction of the P.M.G., who, as a representative of the Government, has the last word on what should or should not be broadcast from this country.

In the meantime, Mr. Gandhi is still in India.

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H. G. Wells to Broadcast.

Mr. H. G. Wells comes to the microphone again on July 13th, when he will contribute his views to the series of talks which is being broadcast on "Russia in the Melting Pot."

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Programmes Re-hashed.

"This twice-cooked stuff" is the apt but vulgar description I have heard applied to those programmes which the B.B.C. are so fond of handing out twice in one week.

I am told that the motive in duplicating programmes in this fashion is twofold.

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On Grounds of Economy?

In the first place, it is considered sound economics to kill two birds with one stone—i.e., to fill two separate programme periods at different stations with the same programme, the assumption being that transaction does not rob the listener of an alternative choice. A moment's thought, however, will show that it does.

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"Dress Rehearsals."

Secondly, it is considered that the play or other item chosen for rebroadcasting gains a good deal on its second performance; in fact, the first broadcast performance is now regarded more and more as being in the nature of a dress rehearsal.

When we remember that, as often as not, the first performance is broadcast on the National wavelength, we can see the kink in the existing plan.

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Why Not a Third Programme?

Now is the time, surely, when the B.B.C. might show a little more programme enterprise by introducing a third programme, relegating all "dress rehearsals" to Daventry 5XX. This station, which is the only truly National transmitter in the country, might serve very well for the dissemination of a programme of general interest, which would be available to all. The twin transmitters in the various regions would then be free to broadcast programmes of a genuinely alternative character.

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Why We Get Aural Indigestion.

Each Regional station would distribute its programme of local talent while its twin brother tapped the local output of other stations.

If a plan of this kind were developed —and the growth of the Regional scheme makes this quite possible—every British listener would be assured of at least two *new* programmes each night, with the frequent possibility of a third original programme from the National transmitter.

Twice-cooked food, the physicians tell us, is bad for the digestion. The present B.B.C. programmes provide a close parallel.

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Hope in Hull.

Perhaps the most optimistic people on earth are the owners of crystal sets in Hull. Every night they pick up the headphones with the expectation that the local relay station has been reopened.

"Hull is admittedly a bad case," says Mr. Noel Ashbridge, "but, having once closed down the relay station, we do not feel inclined to start it again, except for the strongest reasons."

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Better Aerials.

Sufficiently strong reasons may be adduced one day, but for the present the B.B.C. engineers believe that even crystal owners in Hull can obtain good signals from Northern Regional with a little perseverance and the use of good outside aerials.

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A Dangerous Notion.

If the notion got abroad that the relay stations were to be reopened on the slightest provocation, thousands of listeners would be prepared to sit back in their chairs instead of making the small alterations necessary to pick up the Regional transmissions.

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Relays in Reserve.

It is worth noting, however, that the B.B.C. have definitely decided not to dismantle any of the plant at the relay stations for several months.

Considering the slow progress which is being made with the Regional scheme, I think it would be wiser to retain the relay stations for several years.

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Broadcasting the R.A.F. Display.

The commentary by Squadron-Leader Helmore on the Royal Air Force Display at Hendon on June 27th will open with Event No. 7, Inverted Flying and Aerobatics by instructors from the Central Flying School.

The other five events which will be described to listeners are the Fly Past by Flying Boats, Flight Aerobatics, Parachute Descents, Parade and Fly Past of Men and Experimental Types of Aircraft and the Catapult Event, the latter being a demonstration of apparatus which enables heavy aircraft to take off after a run of less than forty yards.

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Queue Entertainers in the Studio.

An unusual programme will be broadcast on June 27th (National). Those taking part are all street artistes, or "buskers"—those people who entertain theatre queues. Listeners will hear Fred Walker's Street Band, Finnelli and Partner, Josh Cairns, George Gorman, and Fred Lester and Cyril.

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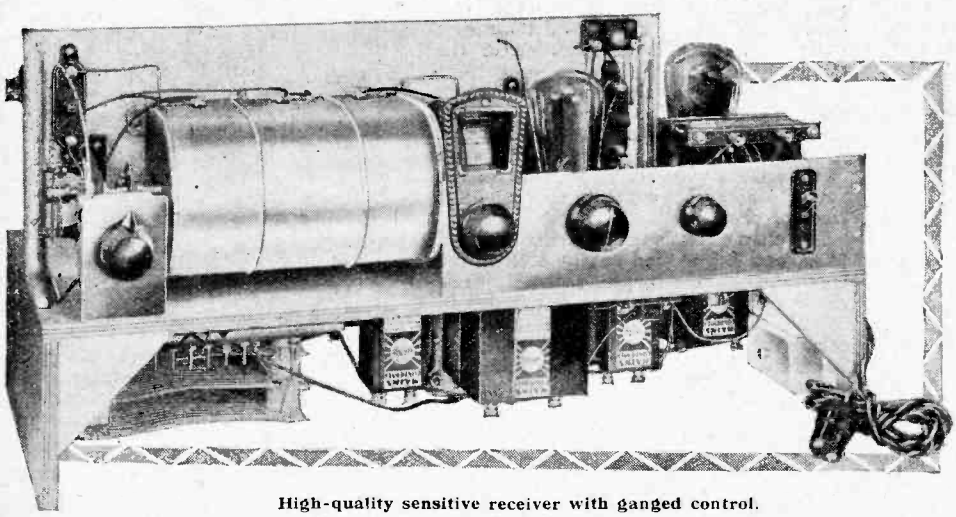
The "D.G." Wins a Medal.

When Sir John Reith returns to Savoy Hill I hope he will be wearing the medal which was presented to him by the Columbia Broadcasting System of America when he broadcast from Chicago on June 9th.

Sir John had the honour of being the first to receive one of these symbolic medals, which have been struck for presentation to distinguished speakers and musicians appearing before the Columbia microphone.

IN NEXT WEEK'S ISSUE: Preliminary Constructional Details of a Three-valve Mains Receiver Embodying the New Indirectly Heated D.C. Valves.



High-quality sensitive receiver with ganged control.

THE

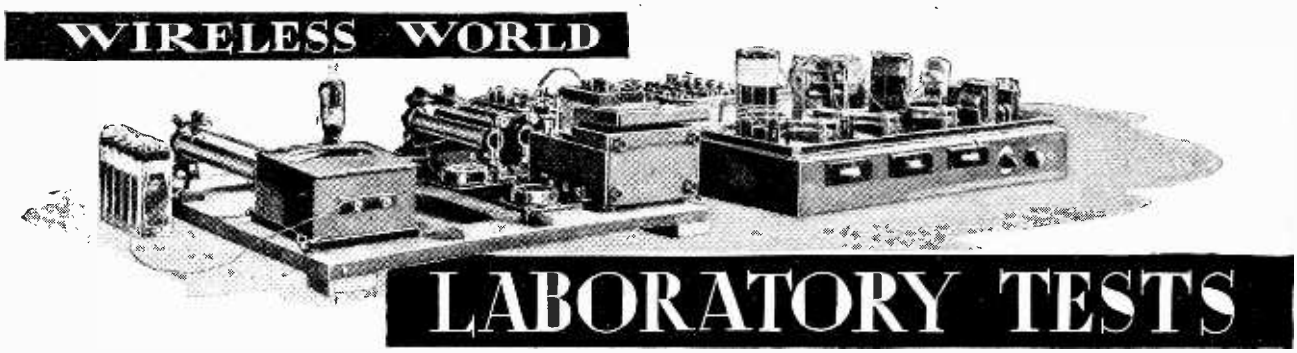
D.C. MAINS THREE.

SPECIFICATION.

Three-valve all mains operated D.C. set.
Indirectly heated D.C. valves.
One-dial tuning control.
Band-pass pre-selector with constant peak separation.
Reaction control.
Ganged waveband switching.
Pre-detector volume controls.
Compensated pentode output.
Maximum undistorted power output 1,900 milliwatts.

LIST OF PARTS REQUIRED.

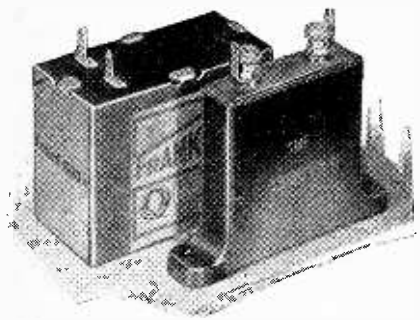
1 Three-gang condenser, with drum drive (Polar "Tub")
1 Pre-set condenser, 0.001 mfd. ..... (Polar)
1 Pre-set condenser, 0.0003 mfd. ..... (Polar)
1 Coupling condenser, 10 m. mfd. ..... (Utility)
1 Differential condenser, 0.0005 mfd. .. (Utility W212)
1 Condenser, 0.0003 mfd. (Burton Bakelite Dielectric)
1 Fixed condenser, 0.0001 mfd. ..(Dubilier, Type 620)
1 Fixed condenser, 0.0002 mfd. ..(Dubilier, Type 620)
1 Fixed condenser, 0.01 mfd. ..(Dubilier, Type 620)
5 Fixed condenser, 2 mfd., 400 v. type ..... (Formo)
6 Fixed condenser, 4 mfd., 400 v. type .... (Formo)
3 Grid leaks, 0.25 megohm ..... (Dubilier)
1 Grid leaks, 100,000 ohms ..... (Ediswan)
4 Grid leak holders ..... (Bulgin Porcelain)
2 Potentiometers, 25,000 ohms ..... (Colvern)
1 Potentiometer, 20 ohms ..... (Igranic Pre-set)
2 Wire-wound resistances, 1,000 ohms ..... (Watmel)
1 Wire-wound resistances, 7,000 ohms. ....(Watmel)
1 Wire-wound resistances, 10,000 ohms. .... (Watmel)
1 Wire-wound resistance, 50,000 ohms. .... (Watmel)
1 Asbestos woven resistance net, 150 ohms. Type ERE. (Cressall Mfg. Co., 31–32, Tower St., Birmingham)
1 Asbestos woven resistance net, 200 ohms. Type ERF ..... (Cressall Mfg. Co.)
1 Asbestos woven resistance net, tapped 8 equal parts. Type SR 31. 120 ohms. (Cressall Mfg. Co.)
40 Unglazed porcelain spacing washers, ⅜in. × ¼in. ..... (Cressall Mfg. Co.)
2 H.F. chokes ..... (Burton Binocular)
1 Constant inductance primary L.F. transformer. Ratio 1 : 2 ..... (Parmeko)
1 Pentode output choke .... (R.I.: "Hypercore")
2 Range-wave switches, 2 pole ..... (Colvern S2)
2 Change-over switches, single pole .... (Colvern S2)
1 Spindle, 18in., long and knob ..... (Colvern)
1 Mains switch, double pole ..... (Bulgin, S56)
1 Valve holder, 5-pin A.C. ..... (W.B.)
2 Valve holders, 5-pin ..... (Burton)
1 Valve screen ..... (Colvern)
3 Special coil screens and bases, 4¾in. dia × 5in. high ..... (H. & B.)
3 Coil formers, 2⅜in. dia., 4in. length, 8 ribs. Type "C" ..... (Redfern)
3 L.F. chokes ..... (Igranic, C30)
2 Cut-outs, 5 amp S.P. ..... (G.E.C., S 845)
2 Terminal mounts ..... (Belling-Lee)
4 Ebonite shrouded terminals ..... (Belling-Lee)
1 Pair panel brackets, 6in. × 3in. ..... (Bulgin)
1 Pair panel brackets, 4in. × 3in. ..... (Bulgin)
1 Flexible condenser coupling link ..... (Cyldon)
1 Safety S.G. anode connector ..... (Clix)
Plug adaptor, flex, sleeving, wire, screws, wood, aluminium, ebonite, etc., etc.



A Review of Manufacturers' Recent Products.

FRANKLIN HIGH-VOLTAGE CONDENSERS.

The Franklin Electric Co., Ltd., 109, Kingsway, London, W.C.2, were among the first to introduce the high-voltage-test type of condenser in small dimensioned cases. The 4 mfd. type is condensed into the satisfactorily small size of 2⅜in. × 1½in. × 2in. high, and it is tested at 1,500 volts D.C. The price is 7s. 6d. in a metal case. A 1 mfd. size, also of the same test voltage but enclosed in a neat bakelite case measuring 2in. × 1⅛in. × 2⅝in. high over terminals, is available at 4s. All standard sizes from 0.1 mfd. to 4 mfd. are made.



Franklin condenser (1,500-volt test). A 4 mfd. size in metal container and a 1 mfd. size in bakelite case.

The advantages arising from the policy of strictly limiting the overall size is that considerable saving of baseboard space is effected, so that without increasing the dimensions of the set or mains unit the factor of safety can be increased considerably and at only a small increase in the cost of the essential components.

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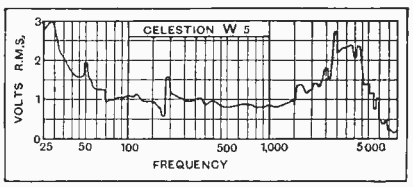
CELESTION TYPE W5 PICK-UP.

This model was introduced at Olympia last autumn and at once attracted favourable attention by the obvious soundness of its design. One or two minor modifications have been made in the present production model, but the principle of operation remains the same.

The permanent magnet and field coils are of unusually large proportions, and a high average output is obtained (1.0 to 1.5 volts R.M.S.) even with a wide air-gap to prevent amplitude distortion. An extremely light armature pressed from sheet iron is employed. The needle is located in a V-shaped channel by means of a strong phosphor-bronze spring and is quickly released by a press button on the outside of the case. The armature is lightly clamped on each side between

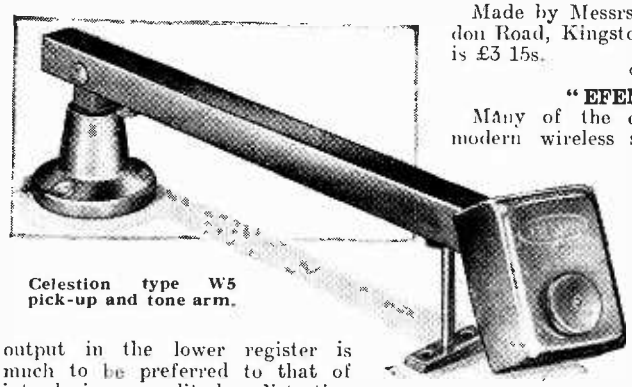


Characteristic of the Celestion type W5 pick-up using H.M.V. loud-tone needle.

rubber pads, and the point of contact between the clamping spring and the needle determines the axis of vibration of the system.

The lightness of the moving parts and the low damping factor employed ensure the absolute minimum of record wear. Actually, the pick-up follows the groove in the special wide amplitude test records down to 25 cycles without the slightest trace of chatter.

The characteristic is of excellent general form, and has a good output both in the bass and in the upper register. The rising response in the bass is not due to amplitude distortion but to a carefully calculated tone-arm resonance at about 25 cycles. This method of increasing the



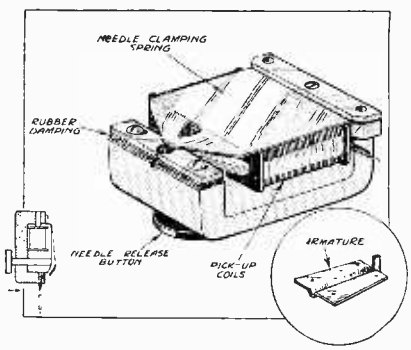
Celestion type W5 pick-up and tone arm.

output in the lower register is much to be preferred to that of introducing amplitude distortion with its consequent cross-modulation between high and low frequencies.

The middle register between 100 and 1,500 cycles is uniform apart from a curious kink at about 180 cycles. Apparently this is peculiar to the particular model tested, and is probably due to a subsidiary mechanical resonance in the armature-needle assembly.

The high-frequency resonance is conveniently placed between 3,000 and 4,000 cycles. It is obtained by electrical resonance in the pick-up coils and is not of mechanical origin. A high-resistance potentiometer should therefore be used as a volume control, the figure recommended being 250,000 ohms.

The pick-up is attractively mounted on a bronze finished square-section tone arm



Details of the Celestion pick-up movement.

designed with the object of giving accurate needle track alignment.

Made by Messrs. Celestion, Ltd., London Road, Kingston-on-Thames, the price is £3 15s.

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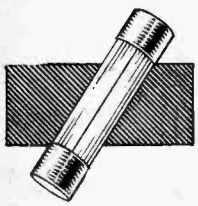
"EFEN" FUSES.

Many of the components used in a modern wireless set can be irreparably damaged by being overtaxed through an excessive rush of current; this applies particularly to some of the components embodied in all-mains sets. Damage due to such causes as breakdowns in condensers, resulting in a short-circuit on the rectifier, can be guarded against by using fuses of suitable value in the various H.T. leads or in the mains supply.

The Friho Manufacturing Co., Ltd.,

233, City Road, London, E.C.1, market a wide range of fuses, especially designed to meet these requirements.



An enlarged sketch of the "Efen" enclosed fuses for use in H.T. circuits and mains leads.

They are of German manufacture, and consist of a fuse of low temperature melting point enclosed in a glass tube approximately $\frac{3}{16}$in. in diameter and $1\frac{3}{8}$in. long. Metal-end caps are fitted. The range of standard types comprises some 25 different grades, the fusing currents ranging from 100 mA.s to 6,300 mA.s.

Tests were made on a few representative samples, the results being tabulated below :—

"Efen" Fuse.	Rated Fusing Current.	Actual Fusing Current.
Specimen 1..	550 mA.	680 mA.
" 2..	550 "	650 "
" 3..	1,000 "	1,100 "
" 4..	1,000 "	1,200 "
" 5..	2,500 "	2,800 "
" 6..	2,500 "	2,650 "

The fuse "blew" within a few seconds of the current reaching the critical value, and so will afford adequate protection to the components in the set in case of accidental short-circuit.

"Efen" fuses can be supplied with various types of end caps : plain, as illustrated here, or with pointed conical caps, or with flat end caps. In the last-mentioned case, the protective container is not tubular, but fashioned to accommodate this style of end cap.

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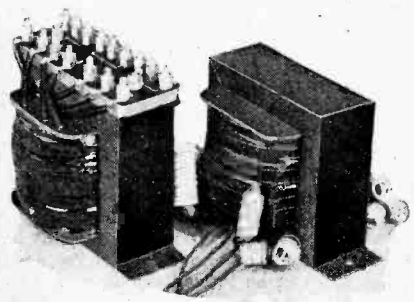
SAVAGE TRANSFORMERS FOR SUPER-SELECTIVE SIX.

Mains transformers designed especially for the Super-Selective Six receiver are now obtainable from W. B. Savage, 292, Bishopsgate, London, E.C.2. Two models giving the specified voltages are available; one, styled Type SS6, is priced at 36s., and is fitted with terminals, and the



Alternative types of Savage mains transformer for the Super-Selective Six.

other—Type SS6M—is without terminals, the ends and tappings of the various windings being of sufficient length to enable the wires to be taken through the baseboard, and thence carried direct to their respective points. This dispenses with a certain amount of wiring above the baseboard, thus giving the set a neater finish. The price of this model is 31s.

With all windings delivering the specified currents, it was found that the L.T. voltages were slightly higher than the rated values. The 4-volt windings showed a voltage of 4.2 each when giving 4 amps. and 1 amp. respectively, while the 5-volt winding for the rectifier showed a measured voltage of 5.2, the valve passing a current of 1.65 amps. In the case of the 4-volt windings this represents an increase of 5 per cent., which is generally regarded as being the maximum latitude permissible.

The output from the high voltage secondary is well regulated, the maximum R.M.S. voltage variation being of the order of 3.8 per cent. between no load and the full load of 50 mA.

Those who desire to use a 4-volt 1-amp. type rectifying valve will be interested to learn that either of the above-mentioned transformers can be supplied with a 4-volt 1-amp. winding in place of the 5-volt 1.6-amp. output by specifying this when placing the order.

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FRAME AERIAL WIRE.

Regarded from the mechanical point of view, there is some advantage in using a semi-flexible wire for a frame aerial. A single-stranded conductor shows a tendency to stretch, and, since it is a copper wire, has no elasticity, of course. The multi-stranded wire shows less tendency to stretch, and furthermore is much easier to handle.

C.V. Radio, 131-132, Bunhill Row, Finsbury, London, E.C.1, market stranded wire especially for this purpose. Each strand is enamel-covered, and the whole is then finished with a double cotton covering. For the medium-wave winding 27-40 wire is employed, while for the long-wave portion they supply 9-40 wire.

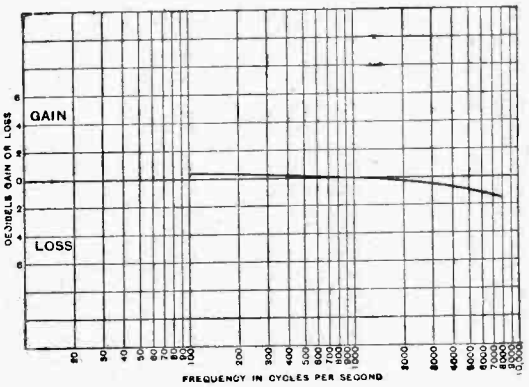
These wires must not be confused with Litz, despite the fact that the number of strands in each case constitute a multiple of three. The strands are merely bunched together and not arranged in the special order adopted for Litz.

Sufficient wire of each size for a dual-wave frame aerial costs 5s. 5d

A NEW PHOTO CELL.

A new gas-filled photo cell, possessing a considerably higher sensitivity and a much better frequency characteristic than those of the cæsium type, has recently been produced by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. The new cell is officially designated the CMG8, and permits the application of higher voltages, and therefore greater emission than hitherto possible, and there is no appreciable limitation of the frequency response. The minimum sensitivity is about 75 micro-amps. per lumen, but in the case of many of these cells this figure is greatly exceeded.

New Osram photo cell, Type CMG8.



(Left) Response curve of Osram new photo cell giving gain or loss, in decibels, taking 1,000 cycles as the datum line.

In the frequency response curve of the new cell reproduced here, the abscissæ indicate sound frequencies, and the ordinates the gain or loss in decibels, taking 1,000 cycles as the datum line. It will be observed that a loss of only 1.5 decibels occurs at 8,000 cycles, a definite improvement over the earlier potassium cells.

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Catalogues Received.

Radio Instruments, Ltd., Madrigal Works, Purley Way, Croydon.—Revised edition of general radio catalogue, including details of new range of mains transformers for valve and metal rectifiers. Also a special leaflet dealing exclusively with these transformers.

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Dubilier Condenser Co. (1925), Ltd., Ducon Works, North Acton, London, W.3.—List No. 930S, a revised catalogue giving particulars of fixed condensers, variable condensers, and other radio components made by this firm.

o o o o

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.—Illustrated leaflet describing the G.E.C. loud speaker coupling unit.

READERS' PROBLEMS

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

Suggestion for A.C. Conversion.

Now that an A.C. supply is available, I wish to convert my 0-v-2 battery set for mains operation. As a two-stage L.F. amplifier seems to be unsuitable for A.C. valves, I suppose you would recommend the adoption of an H.F.-det.-L.F. arrangement, but I should prefer something rather simpler and less expensive. Any suggestions for a circuit that will not involve any great loss of sensitivity would be welcomed.

It is generally held that the best possible way of using three valves is in a 1-v-1 circuit; but as you do not care for this plan, we offer the suggestion that a detector-pentode two-valve combination should meet the case. With modern valves, its sensitivity should be approximately equal to that of your original battery set; volume and quality should be much better.

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Pentode Output Choke.

If the centre tap of a special pentode output choke is ignored, is it permissible to use this component in conjunction with an ordinary triode valve? Is there any disadvantage other than its high D.C. resistance?

As a general rule, these chokes are quite suitable for insertion in the plate circuit of a triode. As some pentodes consume quite a high anode current, it does not altogether follow that chokes designed for use with them have an excessively high D.C. resistance.

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Automatic Bias.

The practice of obtaining automatic bias by the simple expedient of inserting a resistance in each cathode lead of a set employing indirectly heated valves seems to be increasingly popular. Will you tell me what are the advantages of this method as compared with other systems?

When bias is obtained in this way there is practically no risk of introducing undesirable interaction between the various circuits of a receiver. If you study the circuit diagram of a receiver which is biased by inserting resistances in each cathode lead you will see that none of the bias resistances are common to the grid or anode circuits of any other valve, and in consequence the use of decoupling devices becomes unnecessary.

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Lifting an Idea.

It has occurred to me that the volume-control system of the "Super-Selective Six" might well be applied to my own H.F.-det.-L.F. receiver, of which I am sending you a circuit diagram. As interference from Daventry 5XX is sometimes troublesome (my distance from that station is less than 20 miles), I propose to retain the long-wave acceptor, in the hope that it will prove helpful in reducing this form of interference.

If you think that the idea is practicable, will you please give me a circuit diagram showing the necessary alterations to my own receiver.

The usefulness of an aerial input potentiometer, working in conjunction with a screening grid voltage control, is certainly not confined to superheterodyne receivers, and these devices could be applied to your own set. Similarly, the acceptor circuit, if adjusted to the wavelength of the near-by long-wave station, should have the desired effect.

A circuit diagram showing the necessary alterations to your receiver is given in Fig. 1.

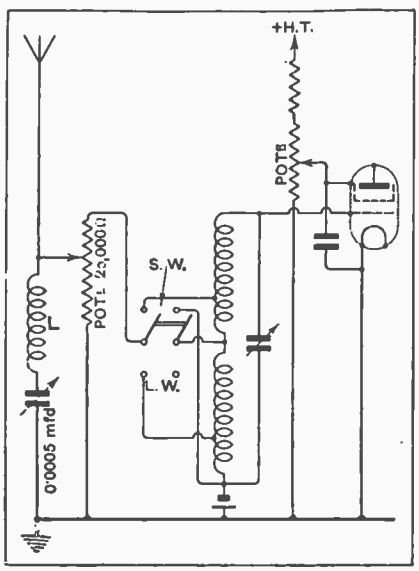

Fig. 1.—Aerial input and screening grid control potentiometers fitted to a conventional receiver with one H.F. stage. The inductance L and a semi-variable condenser form an acceptor circuit for minimising interference from a near-by long-wave station.

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L.F. Transformer Connections.

I have a rather out-of-date L.F. transformer on which the external connections of the terminals are not marked, although the ends of the windings are indicated by lettering—I.P., O.S., etc.

Can you tell me how this transformer should be connected?

There is no definite rule on this subject, as a good deal depends on the method of winding. However, it is usual to join adjacent ends of the two coils to the external circuit in such a way that they are at low potential; if the secondary is wound over the primary, it will be correct to connect the terminals as follows:—

I.P. to plate,
O.P. to H.T.+,
I.S. to G.B.−,
O.S. to grid.

o o o o

Hartley L.F. Oscillator.

I have a large air-cored inductance of known value—actually 1 henry—and wish to use it in a low-frequency oscillator. I believe that the single-coil "Hartley" circuit is practicable, and should like to know whether it is possible to dispense with the usual anode feed choke which is always a part of this arrangement when it is applied to the generation of H.F. oscillations.

In your case it will not be absolutely necessary to use an anode feed choke, and if the coil can be tapped the form of circuit you describe should be practicable. It will be necessary to join the H.T. battery between the valve anode and one end of the tuned circuit; this means that the battery will be at high potential, and, consequently, must be well insulated. Of course, the oscillator valve grid must be isolated by a series condenser.

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The Trend in American Design.

THE annual American trade radio show which opened in Chicago on June 8th has provided an opportunity for getting a general impression of what America is proposing to do for the coming season, and how manufacturers there are endeavouring to create new markets to overcome the influence of the severe depression in American industry generally.

A report which we have just received from our representative who attended the show indicates quite clearly that America has recognised the necessity for appealing not only to those who, up to now, have been content with poor receivers, or even with none at all, but that manufacturers have also gone out to interest regular users of the better types of sets and get their custom by so altering the general design of their receivers as to create a new fashion and make the older sets at least *look* out of date.

This is almost a new angle of "radio merchandising," as it would be termed in the States, but hopes are high that it will be effective in its results. Very small receivers constitute nearly fifty per cent. of the display at the trade show, and whereas a year or so ago sales seemed to be in proportion to the size and impressiveness of the receiver, big sets are to-day giving place to these really small and compact equipments. Everything possible has been done to reduce bulk. Moving-coil speakers have midget diaphragms with, we presume, compensation for poor low-note response taken care of in corrections applied in the amplifier. The pentode valve has leapt into favour as providing a means of reducing the number of valves, and, consequently, the bulk of the set as a whole.

The prices of the new midget sets are to be extraordinarily low as a result of super mass-production arrangements. How far such a policy will succeed it will be interesting to watch, for flexibility in design must suffer with such standardisation. An illustration is to be found in the very late introduction of the pentode in America as compared with its established use in this country.

The midget set has not, however, eliminated the popularity of the larger equipments where an adequate excuse can be found for their bulk. There are still a large number of very up-to-date Console models, which include gramophone units and the luxury of record-changing devices, whilst, in addition, electric clocks form part of the equipment of many of these sets.

Another feature of particular interest is that short-wave reception has grown so much in popularity with the American public that several sets have been designed to cover wavelengths from 15 to 600 metres with a wave-changing switch to avoid the necessity for changing coils.

It is estimated that there are still in the United States 6,000,000 homes without electric supply, and that 4,000,000 of these are still without wireless of any kind. Nine manufacturers at the Chicago show are exhibiting new sets specially designed to cater for those who are dependent upon batteries for their supply.

In This Issue

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DUBILIER A.C. THREE SET REVIEWED.
LABORATORY TESTS ON NEW APPARATUS.
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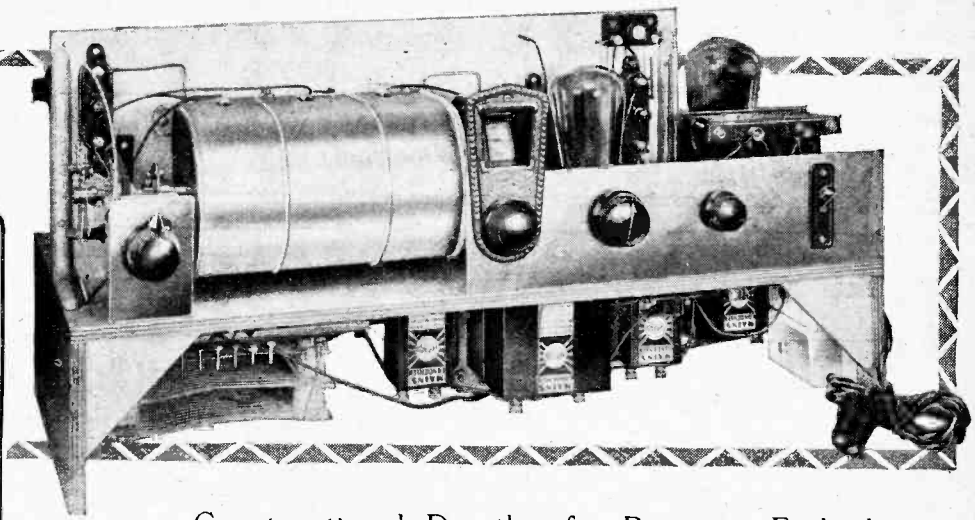
READERS' PROBLEMS.



D.C. Mains Three

Constructional Details of a Receiver Embodying the New Indirectly Heated D.C. Valve.

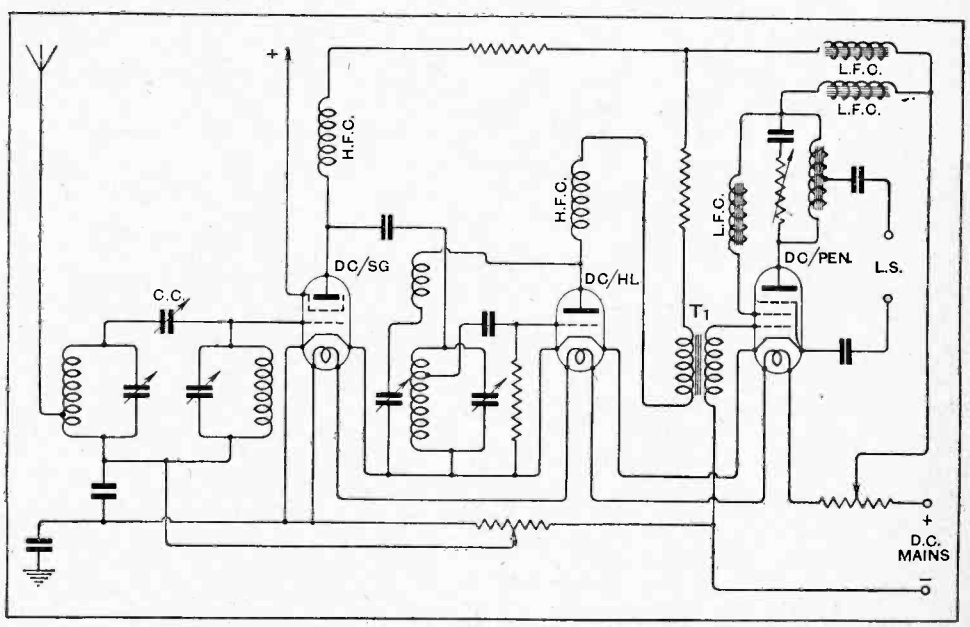
By H. B. DENT.

AT the beginning of this year, when the Mazda valve organisation introduced the first indirectly heated D.C. valves, it was immediately apparent that at long last the all D.C.-operated set was about to assume equal status with its A.C. counterpart. Readers will recall, no doubt, that the early specimens of the DC/SG and the DC/HL were fitted with 4-volt filaments consuming 0.5 amp. of current, while the DC/PEN required 8 volts at 0.5 amp. also.

Recently some minor modifications have been made to the DC/SG and the DC/HL valves, but the DC/PEN remains as hitherto. The first two mentioned now have 6-volt filaments, but require the same current as formerly. At first this may appear to have little bearing on the subject of this article, which is a description of the construction of a D.C. set fitted with these valves. But, since the circuit adopted here differs in many respects from that suggested in the review of these valves, it is felt that an explanation is demanded.

Further acquaintance with these valves has shown that the practice of utilising the voltage dropped across the H.F. and detector filaments to provide grid bias for this output stage is not entirely satisfactory, and it is now advocated that a separate resistance, in the negative supply lead, should be used.

The circuit favoured is not an ambitious one, as it consists of a three-valve arrangement with band-pass aerial tuning, a power grid detector and a pentode output stage. Transformer coupling is employed between the detector and the power stage. This transformer has a step-up ratio of 1 : 2 only as the pentode



Simplified theoretical diagram, omitting waveband switching, decoupling resistances and smoothing condensers.

D.C. Mains Three.—

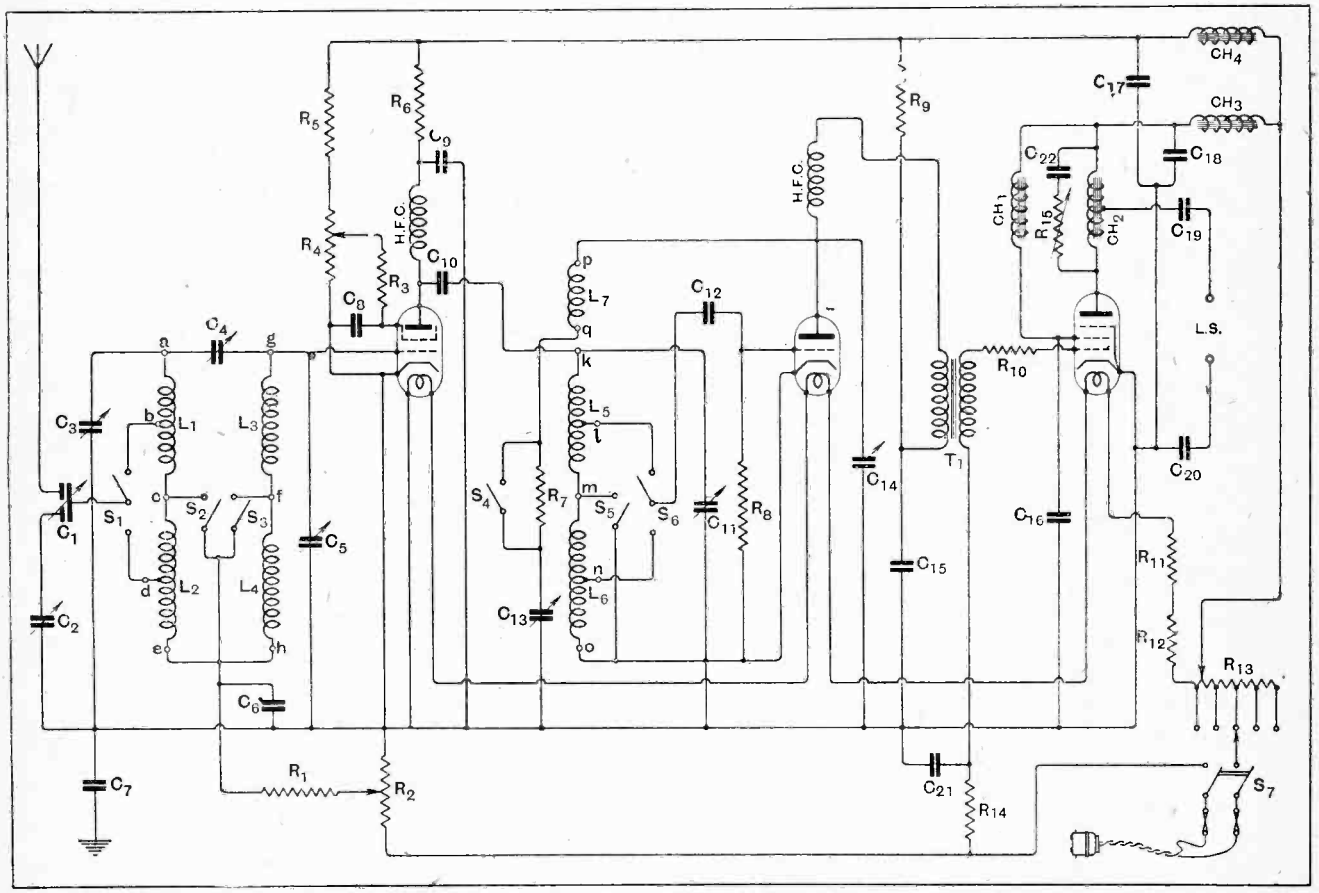
necessarily imposes a limitation to the permissible stage-gain afforded by the penultimate valve. By choosing a transformer capable of carrying the detector anode current it has been found possible to simplify the decoupling arrangement in the anode circuit of this valve.

Some of the features embodied in the receiver under discussion have been borrowed from the "Pre-Selection A.C. Three," notably the method of coupling the band-pass circuits and the differential input volume control. Another means of controlling the volume is available in the present set, as a potentiometer for varying the screen voltage to the H.F. valve has been fitted. Both controls are of the pre-detector type.

The merits of the particular band-pass coupling arrangement adopted will not be discussed here, since they have been dealt with fully elsewhere. It will suffice to say that it offers a comparatively easy means of maintaining a constant peak separation throughout the tuning range of the coils.

The value of the coupling condenser—C_4 in the theoretical diagram—is dependent, to some extent, on the stray capacities associated with the circuits. Thus, to enable the same style of condenser as designed for the "Pre-Selection A.C. Three" to be used in the present case, it was deemed advisable to adopt the same style of layout for the main tuning condenser and the coil screens.

But for the special features mentioned above there is little in common between the two sets, although both embody a 3-valve circuit. In D.C. receivers the heaters of the valves are connected in series, a practice which is virtually essential when dealing with D.C. filament supplies if the current consumed is to be kept within reasonable bounds. Even so, it becomes necessary to dissipate about 120 watts in a resistance to bring down the voltage to the correct value for the valves. The construction of this resistance has been greatly facilitated by the use of the asbestos-woven resistance mats made by the Cressall Manufacturing Co., Ltd., 31, 32, Tower Street, Birmingham. To obtain the required resistance in the space available below the base it was necessary to employ three resistance mats each measuring 6in. square. These are catalogued as types ERE, ERF, and SR31, and their resistances are 150 ohms, 200 ohms, and 120 ohms respectively. The SR31 is tapped at eight points, each section having a resistance



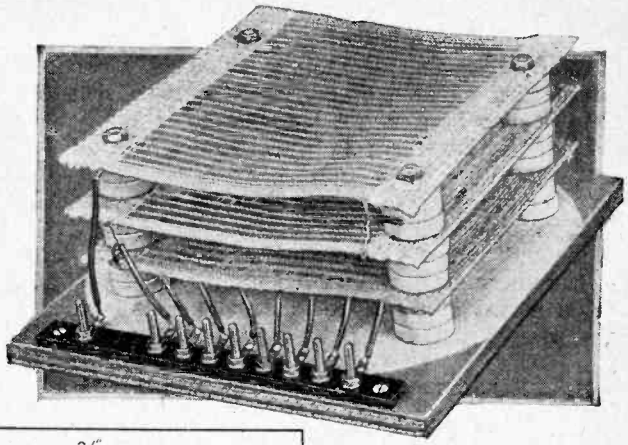
Complete theoretical diagram. C_1, 0.0005 mfd.; C_2, 0.001 mfd. max.; C_3, C_5, C_{11}, "Polar" Tub; C_4, 10 micro-mfds. max.; C_6, C_7, C_8, C_9, C_{21}, 2 mfds.; C_{10}, 0.0002 mfd.; C_{12}, 0.0001 mfd.; C_{13}, 0.0003 mfd.; C_{14}, 0.0003 mfd. max.; C_{15}, C_{16}, C_{17}, C_{18}, C_{19}, C_{20}, 4 mfds.; C_{22}, 0.01 mfd. R_1, R_8, R_{14}, 0.25 mΩ; R_2, 20-ohm pot; R_3, R_7, 1,000 ohms; R_4, R_{15}, 25,000 ohms; R_5, 50,000 ohms; R_6, 10,000 ohms; R_9, 7,000 ohms; R_{10}, 100,000 ohms; R_{11}, 150 ohms; R_{12}, 200 ohms; R_{13}, 120 ohms tapped; Ch_1, Ch_3, Ch_4 30 henrys; Ch_2, 20/30 henrys.

D.C. Mains Three.—

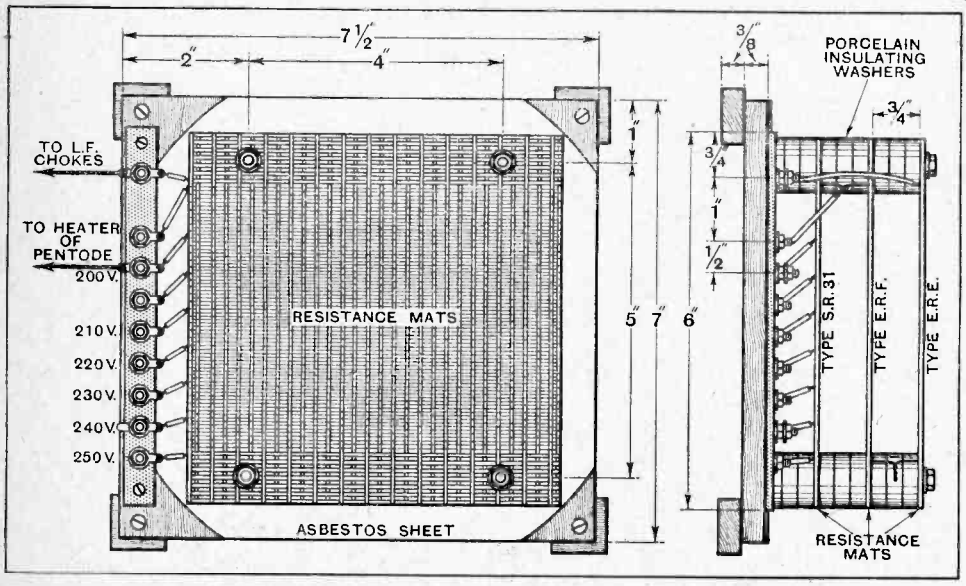
of 17 ohms approximately, which is equivalent to a difference of 8.5 volts between sections.

This resistance is passing 0.5 amp. of current, so that with a supply voltage of 240 there are 120 watts dissipated in the resistance. As a consequence, the amount of heat generated is considerable and provision must be made for air to circulate freely. This is achieved by spacing each mat $\frac{3}{4}$in. from its neighbour, using the small porcelain washers supplied by the makers of the mats for this purpose. They measure $\frac{3}{4}$in. in diameter, are $\frac{1}{4}$in. thick and have a $\frac{7}{16}$in. dia. hole through their centres.

The resistance is built as a separate unit on a small wooden base covered with a thin sheet of asbestos.



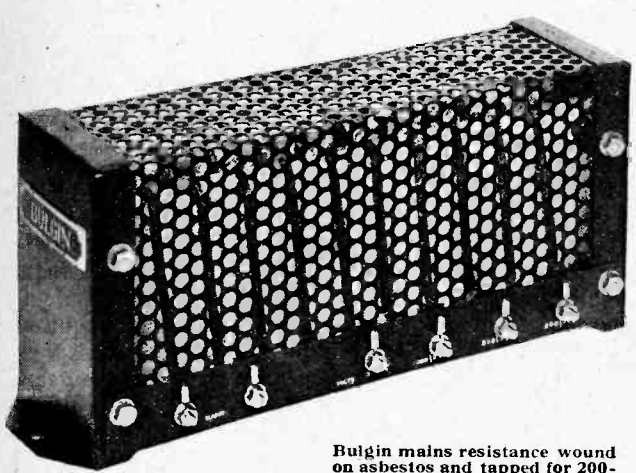
Special resistance built with asbestos-woven resistance mats; total resistance 470 ohms.



Constructional details of the mains resistance to carry 0.5 amp.

Failing other sources of supply, the constructor can purchase for a few pence from most hardware stores a circular asbestos stove mat and, after removing the metal ring, cut this to the approximate size of the base. The essential details of this unit are given in the drawings and the illustration, so that a wordy description seems unnecessary. The resistance unit is spaced $\frac{1}{4}$in. from the underside of the baseboard, a porcelain washer being threaded on to each of the four fixing screws. This precaution was found necessary as, despite the presence of the asbestos sheet, the top of the baseboard became warm before these spacing washers were interposed.

As an alternative to the home-made resistance, the constructor can fit the special resistance unit made by H. F. Bulgin and Co., 9-11, Cursitor Street, London, E.C.4. It is enclosed in a perforated metal case measuring 10in. long by $4\frac{3}{4}$in. by 3in., and tappings are provided for supply mains of from 200 to 250 volts.



Bulgin mains resistance wound on asbestos and tapped for 200- to 250-volt supplies.

The only other component of interest in the filament circuit is the 20-ohm potentiometer (R_2), which provides grid bias for the H.F. valve and the output valve. Originally this was a home-modified version of the Igranic 20-ohm pre-set resistor, but it is more than probable that by the time this article is published readers will be able to obtain the 20-ohm pre-set potentiometer modified in accordance with the requirements of the present set.

The receiving circuits are quite orthodox and, on the whole, do not call for detailed description. It is felt that a few comments might not be out of place regarding the coils and the coil screens, as these are somewhat larger than usual. So many receivers embody two or more H.F. stages to-day that the single-stage set is at a definite disadvantage when compared on the basis of H.F. amplification. Furthermore, any improvements in the coils will be reflected in enhanced selectivity. This applies only to the medium wave-band, where selectivity is of paramount importance.

LIST OF PARTS REQUIRED.

1 Three-gang condenser, with drum drive (Polar "Tub")
1 Pre-set condenser, 0.001 mfd. (Polar)
1 Pre-set condenser, 0.0003 mfd. (Polar)
1 Coupling condenser, 10 m. mfd. (Utility)
1 Differential condenser, 0.0005 mfd. (Utility W212)
1 Condenser, 0.0003 mfd. (Burton Bakelite Dielectric)
1 Fixed condenser, 0.0001 mfd. (Dubilier, Type 620)
1 Fixed condenser, 0.0002 mfd. (Dubilier, Type 620)
1 Fixed condenser, 0.01 mfd. (Dubilier, Type 620)
5 Fixed condensers, 2 mfd., 400 v. type (Formo)
6 Fixed condensers, 4 mfd., 400 v. type (Formo)
3 Grid leaks, 0.25 megohm (Dubilier)
1 Grid leak, 100,000 ohms (Ediswan)
4 Grid leak holders (Bulgin Porcelain)
2 Potentiometers, 25,000 ohms (Colvern)
1 Potentiometer, 20 ohms (Igranic Pre-set)
2 Wire-wound resistances, 1,000 ohms (Watmel)
1 Wire-wound resistance, 7,000 ohms (Watmel)
1 Wire-wound resistance, 10,000 ohms (Watmel)
1 Wire-wound resistance, 50,000 ohms (Watmel)
1 Asbestos-woven resistance net, 150 ohms. Type ERE. (Cressall Mft. Co., 31–32, Tower St., Birmingham)
1 Asbestos-woven resistance net, 200 ohms. Type ERF (Cressall Mfg. Co.)
1 Asbestos-woven resistance net, tapped 8 equal parts. Type SR 31. 120 ohms (Cressall Mfg. Co.)
40 Unglazed porcelain spacing washers, ¾in. × ¼in. (Cressall Mfg. Co.)
2 H.F. chokes (Burton Binocular)
1 Constant inductance primary L.F. transformer. Ratio 1 : 2 (Parmeko)
1 Pentode output choke (R.I.: "Hypercore")
2 Range-wave switches, 2 pole (Colvern S2)
2 Change-over switches, single pole (Colvern S2)
1 Spindle, 18in., long and knob (Colvern)
1 Mains switch, double pole (Bulgin, S56)
1 Valve-holder, 5-pin A.C. (W.B.)
2 Valve-holders, 5-pin (Burton)
1 Valve screen (Colvern)
3 Special coil screens and bases, 4¾in. dia. × 5in. high (H. & B.)
3 Coil formers, 2⅝in. dia., 4in. length, 8 ribs. Type "C" (Redfern)
3 L.F. chokes (Igranic, C30)
2 Cut-outs, 5 amp S.P. (G.E.C., S 845)
2 Terminal mounts (Belling-Lee)
4 Ebonite shrouded terminals (Belling-Lee)
1 Pair panel brackets, 6in × 3in. (Bulgin)
1 Pair panel brackets, 4in. × 3in. (Bulgin)
1 Flexible condenser coupling link (Cyldon)
1 Safety S.G. anode connector (Clix)
Plug adaptor, flex, sleeving, wire, screws, wood, aluminium, ebonite, etc., etc.

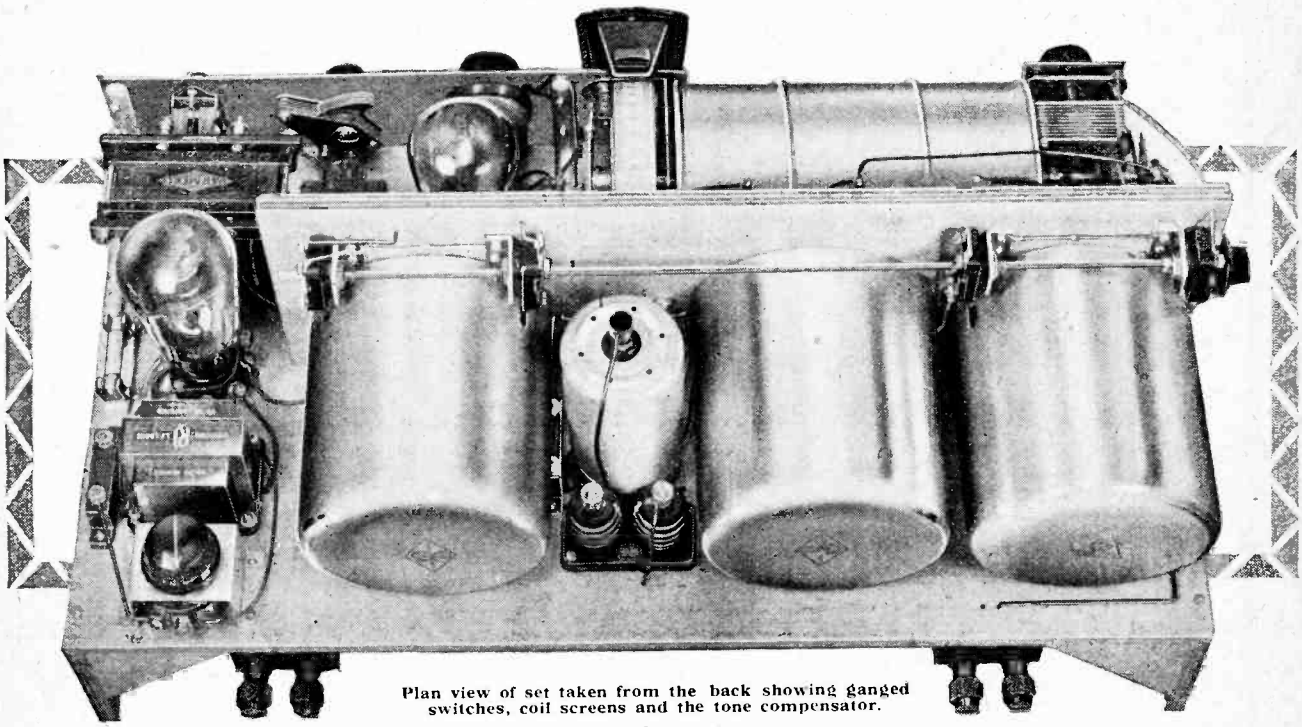
This list gives the actual components used in the construction of the set. There are certain instances where alternatives of other manufacture may be introduced, but readers must take into account the quality and suitability as regards dimensions when adopting a substitute. In addition to the sources of supply mentioned, other manufacturers are specialising in the production of components of similar type which are suitable for use in the building of this receiver.

The coils are wound on ribbed ebonite formers 2⅝in. in diameter and 4¾in. long, and enclosed in screening pots 4¾in. in diameter and 5in. high. Three formers are required, and each carries a medium-wave section, wound as a solenoid and occupying 2in. of the former, and a long-wave coil wound in three sections. The H.F. coil, which immediately precedes the detector stage, has, in addition, a reaction winding wound in a single slot adjacent to the long-wave portion. This coil serves for both medium and long waves. The complete winding details are given in the following table, and it should be noted that all coils are wound in the same direction.

In every case the tapping point is counted from the low-potential end of the coil.

WINDING DATA.

Coil Reference.	Wire.	Turns.	Tapping.
L1	No. 24 D.C.C.	60	20th turn
L2	No. 34 D.S.C.	150	50th turn
L3	No. 24 D.C.C.	60	None
L4	No. 34 D.S.C.	150	None
L5	No. 24 D.C.C.	60	40th turn
L6	No. 34 D.S.C.	150	100th turn
L7	No. 34 D.S.C.	25	None



Plan view of set taken from the back showing ganged switches, coil screens and the tone compensator.

To ensure satisfactory ganging, it is essential that all coils should be accurately matched. This is not a difficult matter, nor does it demand access to complicated and expensive apparatus. The absorption method discussed in the Hints and Tips section in the issue of this journal dated May 13th last is as good as any, and, with the exercise of a little care, gives perfectly satis-

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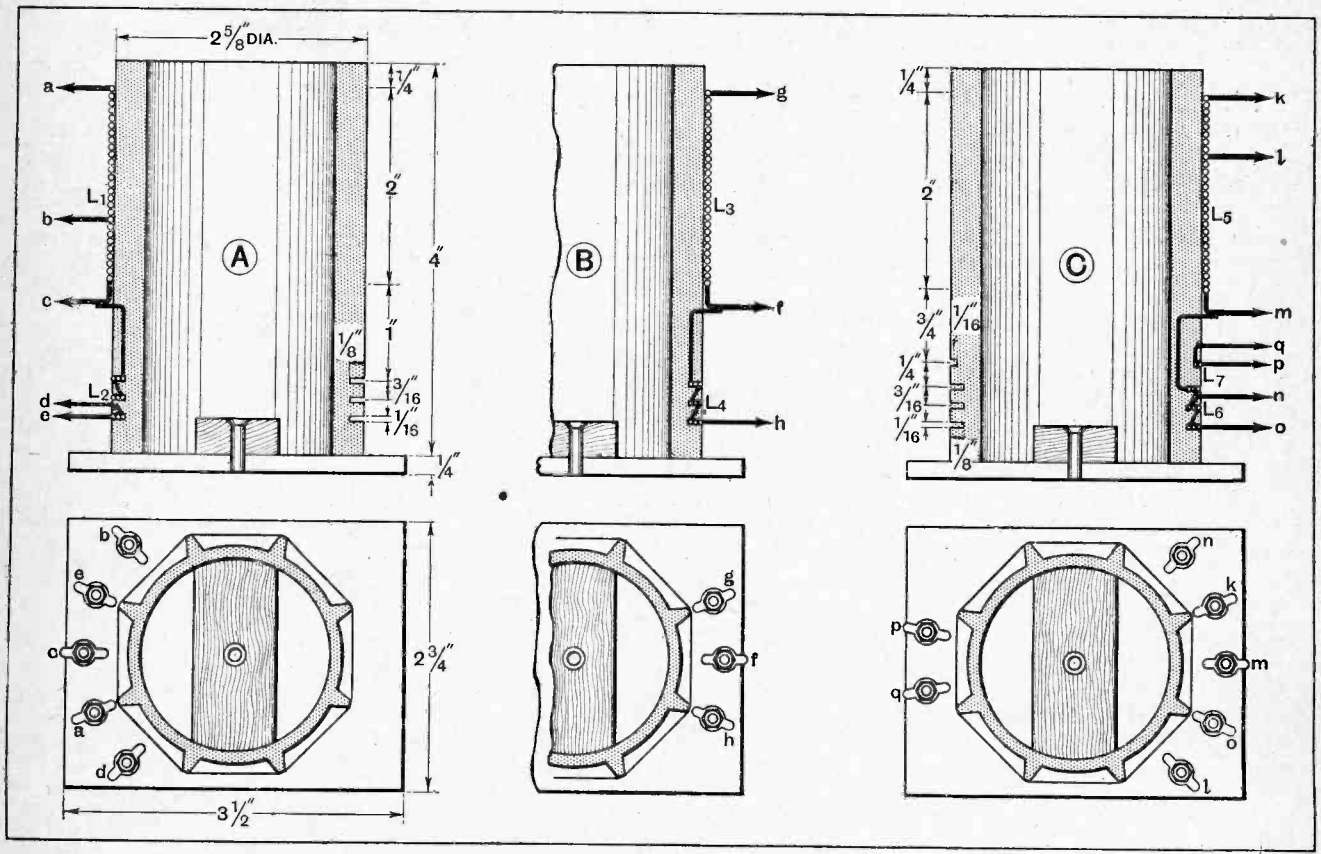
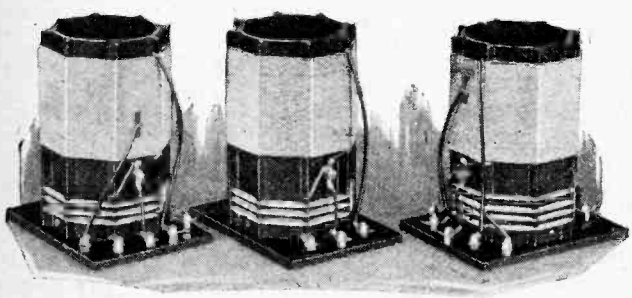
factory results; indeed, this method was adopted in the present case.

and as a consequence the inductance will change; thus the ganging will not hold and the sensitivity and selectivity will suffer. In the dimensional drawings of the



Constructional details of the coils.

The coils should be fixed to their bases before matching, and all connections made to the terminals so that the minimum amount of handling will be required once this operation is finished. To prevent any possibility of the end turn on each medium-wave coil loosening, as it might quite well do in the course of time as the



The three coils, A, B and C, in this order, reading from the left. Note the method of bringing out the tappings.

wire stretches under tension, it would be advisable to apply a little adhesive to fix them to the ribs.

A movement of a fraction of an inch might lead to a slight spacing of a few of the end turns in some cases,

coils, A and B are the filter coils, and C the H.F. tuned-grid coil. The illustration shows these coils in the same order and serves as a guide to the method of construction.

(To be concluded.)

This receiver is available for inspection at the Editorial Offices 116-117, *Fleet St., E.C.4.*

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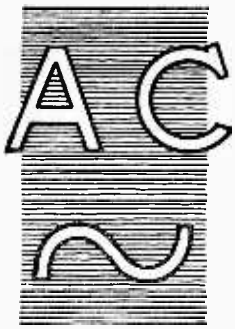
CORRECT ELIMINATOR FEED ARRANGEMENTS.

IT is most important when designing an H.T. battery eliminator of any type to make sure that the proper feed arrangements are made to each valve, or trouble is bound to occur. If the feed current is likely to be in the order of several milliamperes a series resistance should be used for voltage dropping, for if a potential divider is used the passage of a relatively heavy current through its "upper" arm will completely upset its working, so that it will behave as though a series arrangement with much too large a value of resistance were being used. In cases where the current consumption is small, such as in the screening grid circuit of an S.G. valve, or in the anode circuit of a bottom bend detector, a potentiometer is essential in order to keep the voltage steady.



Calculations Simplified

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

The Application of Vectors and Vector Diagrams to Some Representative Circuits.

THE problems of alternating-current calculations having been explained with the aid of the vector, simplified methods for determining the current and voltage in circuits carrying A.C. are here discussed.

With the aid of the examples given, and a little practice on his own account, the reader should find the vector method not only useful in solving A.C. circuits, but also helpful in enabling him to understand better the orthodox theory.

IN a recent article[1] it was explained how alternating currents and voltages can be represented by rotating vectors, and the object of the present one is to illustrate in a simple way how some of the more usual types of A.C. circuits met with in practice can be conveniently solved with the aid of vectors and vector diagrams.

For each type of circuit there is a corresponding vector diagram enabling the relationship between the various currents and voltages to be obtained with a minimum of trouble. Vector diagrams may be drawn to scale, in which case numerical values are found by measurement, or the diagrams may be only roughly drawn and the numerical values found by calculation from the geometry of the figures.

When using vectors for theoretical determinations, it is of great advantage to adopt some system enabling current vectors to be distinguished from voltage vectors at a glance. As it is not usually practicable to employ two colours, the writer suggests that all current vectors could be drawn as heavy lines with triangular arrow heads, whereas voltage vectors might be represented by thinner lines with barbed arrow-heads. Such a system has been adopted in all the vector diagrams accompanying this article.

Simple Rules for Series and Parallel Circuits.

In alternating-current work one must be systematic if proficiency is to be attained, and in this respect too much stress cannot be laid on the following rules in connection with series and parallel circuits. A series circuit is one which has no branches, and so the same current flows successively through each element of the circuit. This means that there is only one current in a series circuit, but a separate potential difference or voltage will exist across each individual element of the circuit. For these reasons, when one comes to solve a series circuit with the aid of vectors, the one and only current vector *is drawn in first*, and then the separate voltage vectors are drawn in their correct positions relative to the current vector, which is in this case called the *reference vector*.

On the other hand, a parallel circuit is one in which each element of the circuit is connected between the same two points so that the same potential difference exists between the ends of each element or branch. Consequently, in a parallel circuit there is *only one voltage*, but a separate current flows through each branch. Hence, when constructing a vector diagram for a parallel circuit the one and only voltage vector (reference vector) should be drawn in first and the various current vectors then drawn in their correct positions relative to it.

It is a good plan, when starting a vector diagram, to draw the reference vector either horizontally or vertically, according to whether it represents a current (as for a series circuit), or a voltage (as for a parallel circuit) respectively. The foregoing rules and conventions are adhered to in the examples which follow.

Series Circuit and Inductance and Resistance.

The calculation which has to be made most frequently in any branch of alternating current work is the determination of the relationship between the applied voltage and current in the case of an ordinary inductive coil. A coil possessing resistance R ohms and inductance L henrys is electrically equivalent to a circuit consisting of a pure or non-inductive resistance R *in series* with a pure or resistance-less inductance L. (See Fig. 1.) This is so because it is one and the same current which simultaneously generates heat in the resistance and establishes the magnetic field representing the inductance.

Suppose then that we have a coil whose resistance is R = 8 ohms, and whose inductance is L = 0.0191 henry, and that it is required to find the voltage between the ends of the coil when the current is 5 amperes at a frequency of 50 cycles per second. (It is assumed here

[1] "The Vector Explained," *The Wireless World*, May 20th and 27th, 1931.

A.C. Calculations Simplified.—

that the formula for the impedance is not known, but that the meaning of resistance and reactance are understood.)

The first step in finding the solution by the vector method is to draw the current or reference vector OI horizontally to the right as in Fig. 2 (*a*). This vector need not be drawn to scale as there are no other current vectors to be compared with it. Now the voltage required to drive 5 amperes through 8 ohms resistance will be $E_1 = IR = 5 \times 8 = 40$ volts by Ohm's law, this being in phase with the current. Consequently, the vector OE_1 is drawn coincident with the current vector OI and its length is made to represent 40 volts to a suitable scale.

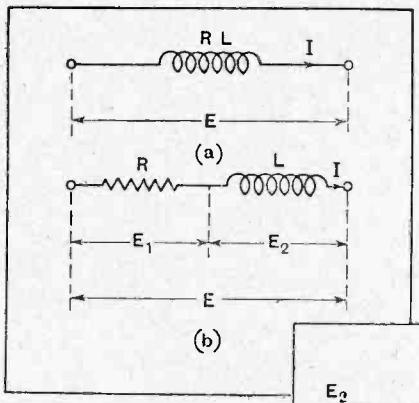


Fig. 1.—A coil (a) with both resistance and inductance is electrically equivalent to a non-inductive resistance in series with a resistanceless inductance (b).

The reactance of the coil at 50 cycles is $X = 2\pi fL = 2\pi \times 50 \times 0.0191 = 6$ ohms, and the voltage required to drive 5 amperes through a reactance of 6 ohms will be $E_2 = IX = 5 \times 6 = 30$ volts. But for a pure inductance the current lags by exactly a quarter of a cycle behind the voltage driving it, and so this voltage *leads* the current by a quarter cycle. Consequently the corresponding vector OE_2 is drawn vertically upwards in Fig. 2 (*a*), since the vectors are assumed to be rotating in the anti-clockwise direction, and its length is made to represent 30 volts to the same scale as OE_1. It is clearly seen that OE_1 and OE_2 are at right angles.

The total voltage required to drive the current against the opposition of both resistance and reactance is equal to the vector sum of the individual voltages represented by OE_1 and OE_2, and is given by the diagonal OE of the completed rectangle OE_1EE_2 in Fig. 2 (*a*). If the diagram is drawn to scale, the length of OE will be found to correspond to 50 volts, or, by calculation: $E = \sqrt{E_1^2 + E_2^2} = \sqrt{30^2 + 40^2} = 50$ volts. Thus 50 volts will be required to drive 5 amperes through the coil, proving, of course, that the impedance of the coil is $Z = \frac{50}{5} = 10$ ohms. It will be seen that the phase difference between the applied voltage and the current is represented by the angle denoted by ϕ in the diagram.

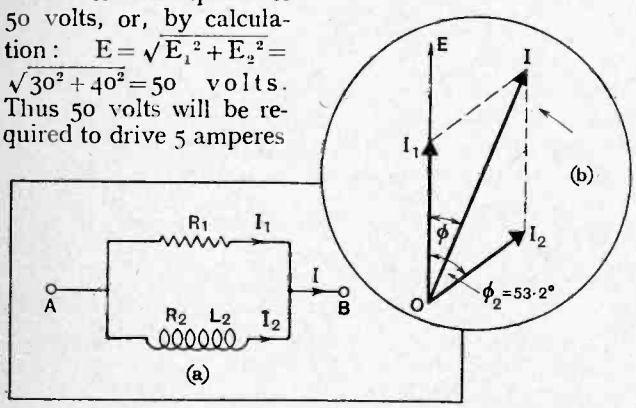


Fig. 3.—(a) A non-inductive resistance in parallel with an inductive coil, and (b) the corresponding vector diagram. When the vectors are not drawn to scale the total current can be calculated from the formula $I = \sqrt{I_1^2 + I_2^2 + 2I_1I_2 \cos\phi_2}$.

Impedance Triangle.

Obviously, the complete diagram of Fig. 2 (*a*) can be simplified to that of (*b*) where $Oa = E_1$ and $ab = E_2$ and $Ob = E$. We thus have a right-angled triangle Oab, whose sides represent the three voltages. The side Oa parallel to the current vector is IR volts, the vertical side is IX volts, and the sloping side is IZ volts, where R, X, and Z are the resistance,

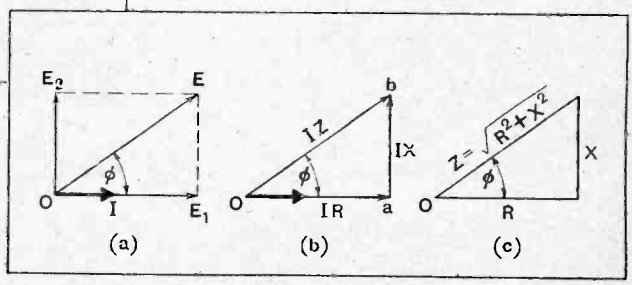


Fig. 2.—Vectors relating to the circuits of Fig. 1. (a) The complete vector diagram, (b) modified diagram, and (c) the impedance triangle, developed from (a) and (b).

reactance, and impedance, respectively, of the coil. If we divide each side of this triangle by the current I, we obtain a new triangle, whose sides are R, X, and Z ohms, as shown at (*c*), this being the *impedance triangle* of the coil. From the impedance triangle we see at once that the impedance is $Z = \sqrt{R^2 + X^2}$ ohms, and so our well-known impedance formula is obtained by the use of vectors.

The cosine of an angle in a right-angled triangle is the ratio of the two sides forming the angle, the shorter side being at the top of the fraction, and the longer side (hypotenuse) at the bottom. From the impedance triangle the angle of lag of the current is given by $\cos\phi = \frac{R}{Z} = \frac{8}{10} = 0.8$. From tables the angle whose cosine is 0.8 is about 36.8°. Cos ϕ is the power factor of the coil.

Resistance in Parallel with a Coil.

Now let us consider the circuit of Fig. 3 (*a*), in which a resistance of R_1 ohms is connected in parallel with an inductive coil, whose resistance is R_2 ohms and whose reactance is X_2 ohms at the working frequency. Suppose that $R_1 = 15$ ohms, $R_2 = 12$ ohms, and $X_2 = 16$ ohms, and that it is required to find the impedance of the circuit between the ends A and B. The simplest way to find the impedance is to determine the total current taken when a particular voltage is applied to the ends, the impedance then being given by dividing the voltage by the current obtained.

A.C. Calculations Simplified.—

Accordingly, let us suppose that 10 volts (R.M.S.) is applied between A and B. Since the circuit is a parallel one, 10 volts will be applied to each branch, and the voltage vector is thus drawn first as the reference vector, preferably in the vertical position, as shown by OE in Fig. 3 (*b*).

The current I_1 in the upper branch of the circuit is calculated from Ohm's law, being $I_1 = \frac{E}{R} = \frac{10}{15} = 0.667$ ampere, and this is exactly in phase with the voltage. The corresponding current vector OI_1 is thus drawn over the top of the voltage vector as shown, and its length could conveniently be made 6.67 inches.

The lower branch has an impedance of $Z_2 = \sqrt{R_2^2 + X_2^2} = \sqrt{12^2 + 16^2} = 20$ ohms, and the current in it is therefore $I_2 = \frac{E}{Z_2} = \frac{10}{20} = 0.5$ amp. But as this is an inductive branch, the current lags to some extent behind the voltage. If ϕ_2 is the angle of lag, $\cos\phi_2 = \frac{R_2}{Z_2} = \frac{12}{20} = 0.6$, and from a table of cosines we find that $\phi_2 = 53.2°$. Thus in the vector diagram of Fig. 3 (*b*) the current vector OI_2 is drawn at an angle of 53.2° to the voltage vector OE, to the right, since the current *lags* by this angle. Using the same scale, its length would be made 5in. The total current is then found by completing the parallelogram and measuring the length of the diagonal OI. This will be found to be about 10.5in., corresponding to a current of 1.05 amperes. Thus with 10 volts applied, the total current taken is 1.05 amperes, and the impedance of the circuit as a whole is

$$Z = \frac{E}{I} = \frac{10}{1.05} = 9.07 \text{ ohms.}$$

The combined current I lags behind the applied voltage by the angle ϕ (Fig. 3 (*b*)), which can be measured with a protractor, its calculation being beyond the present scope. The angle of lag will be found to be 22.9°.

Application to an Intervalve Coupling.

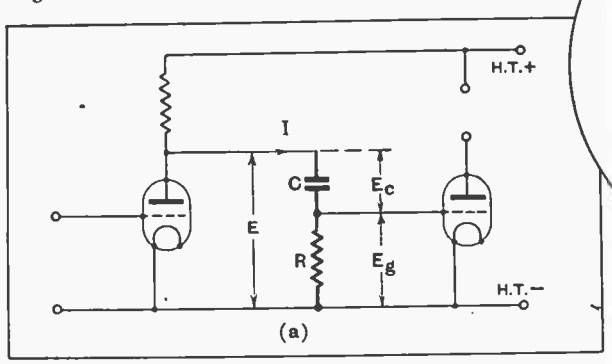
In a low-frequency amplifier where resistance-capacity or choke-capacity coupling is employed between the valves, one has to guard against excessive loss of voltage across the coupling condenser at the lowest frequencies, and the determination of the fraction of the total available voltage passed on to the grid of the second valve is a matter which is easily effected with the aid of vectors, which give also the phase angle of this voltage.

Fig. 4 (*a*) depicts an ordinary resistance-capacity coupling. Assuming that the alternating component of voltage developed across the anode resistance is E volts, this potential difference is set up between the ends of the coupling circuit CR as shown. Suppose that the grid leak R has a resistance of 0.5 megohm, and that the capacity of the coupling condenser is 0.01 microfarad. Assuming that 50 cycles per second represents the lowest frequency to be dealt with, the reactance of the condenser at this frequency is

$$\frac{1}{2\pi fC} = \frac{10^6}{2\pi \times 50 \times 0.01} = 318{,}000 \text{ ohms, or } 0.318 \text{ megohm.}$$

Now, since R and C are in series, there is only one current, and so the current vector of Fig. 4 (*b*) is drawn in position first, this being denoted by OI, of arbitrary length. In the circuit diagram the voltage required to drive the current "through" the condenser is denoted by E_c and through the grid leak by E_g. What we require to find is the ratio of E_g to E. By Ohm's law, $E_g = IR$ volts *in phase with* I. Its numerical value cannot be found yet because I is not known, but the vector OE_g can be drawn parallel to OI and its length made proportional to the resistance R. Since R is 0.5 megohm, OE_g could conveniently be made 5in. long.

The current taken by a condenser leads the voltage across it by a quarter of a cycle, and the voltage E_c will therefore lag behind the current by this amount. Hence the vector OE_c is drawn at right angles to OI, in the position shown in Fig. 4 (*b*),



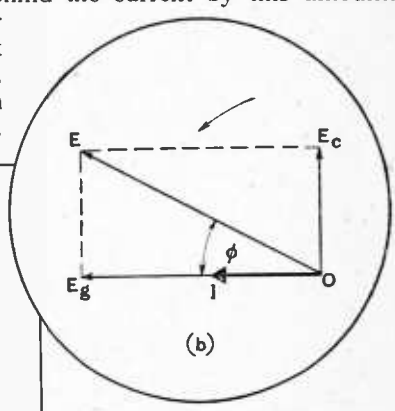


Fig. 4.—(a) Two valves with resistance-capacity coupling. The part of the circuit dealt with is indicated by the heavy-line drawing. (b) Vector diagram for the coupling circuit.

and its length is made proportional to the reactance of the condenser to the same scale as OE_g. Since the condenser reactance at 50 cycles is 0.318 megohm, OE_c will have to be 3.18in., using the same scale as before.

Now the total voltage E across the coupling circuit must be equal to the vector sum of E_c and E_g. If, then, the rectangle OE_cEE_g is completed as shown, OE will represent the total available voltage to the same scale. The length of OE will clearly be $\sqrt{\overline{OE_c}^2 + \overline{OE_g}^2} = \sqrt{5^2 + 3.18^2} = 5.92$in. Thus the ratio of E_g to E is $\frac{5}{5.92} = 0.844$, so that 84.4 per cent. of the available signal voltage is passed on to the succeeding valve at 50 cycles, which represents quite a high efficiency.

Incidentally, the actual value of the voltage E would be $0.592\,I \times 10^{-6}$ volts, so that the impedance of the coupling circuit is 0.592×10^{-6} ohms, or 0.592 megohm. It can be shown that the efficiency of the coupling is equal to its power factor.

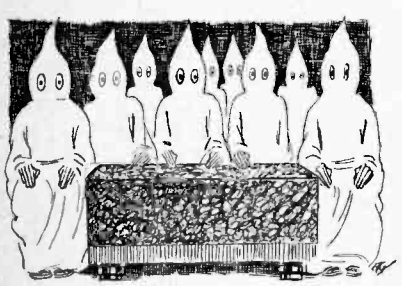
UNBIASED
BY FREE GRID

Trade Secrets.

The other day in the Tube I happened to pick up a periodical which a half-starved-looking individual had left behind him in the hasty exit which he made as he perceived a ticket inspector entering the train at the other end. To my delight I found that it was a wireless trade journal, which to me, and also to you, is taboo, it being available to members of the trade only.

Knowing the great effort made by these journals to prevent copies falling into the hands of the general public, I began to search feverishly for evidence of extortion and other malpractices in which such journals might well be presumed to encourage the wireless shopkeeper, judging from the aforementioned efforts at secrecy. To my surprise I found no such evidence, but, on the contrary, formed the opinion that the average radio retailer (not to be confused with the wholesaler) is a hard-working individual whose "discounts" would certainly not permit him to spend much time on the Riviera.

I must say that I cannot see at all why such efforts at secrecy are maintained—and I know too much



Traders in conference.

about the business for any publisher to call me a liar—as surely the ordinary man in the street is not such a fool as to think the radio dealer buys his wares at the same price as he sells them, and is merely in the business in order to wear his old clothes out. It is as useless to argue that because this state of affairs is customary in all other trades it must necessarily exist in the wireless trade as it would be to argue that the wireless trade ought to be completely on the rocks now because so many other trades are.

This attitude of secrecy only breeds suspicion in the minds of the general public, and makes them think that probably there *is* something to be hidden after all. For aught I know definitely to the contrary there may, of course, be dirty work at the cross-roads which my perusal of the journal did not reveal to me, and, if so, I make my apologies. Who knows what dreadful secrets may be contained in each issue of the *Coffin Makers' Gazette and Mutes' Magazine.*

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A Personal Note.

I frequently receive letters from readers asking whether I contribute articles other than "Unbiased" to the pages of this venerable journal, and if so, what?

To give an answer to this question would mean a breach of my agreement with the Editor, and I should probably be strung up to the tallest of the W.W. laboratory aerial masts; the Editor has, in fact, placed the seal of the confessional on my lips in this matter, and I can only say, therefore, that the appearance of my brain-children is less frequent in *The Wireless World* than it is in *Experimental Wireless.* My technical writings have, however, often been plagiarised in a large number of British and foreign contemporaries, in common with those of other enlightened contributors to *The Wireless World* and *Experimental Wireless.*

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Why Not Be Comfortable?

Some time ago I had a few words to say in these columns concerning the best position for a tuning dial to enable it to be read without difficulty. This let loose upon my devoted head a flood of letters from all sorts and conditions of men, and evidently the editor of this journal suffered similarly, judging from his Correspondence columns.

Having settled to my own satisfaction the question of dial position, I decided the other week to find out the best position for the control knobs from the point of view of comfort. The most suitable position I found was to mount them on the front of the set about three inches from the bottom, as this enabled the wrist to be rested comfortably on the table. Although the knobs are thus rather low, this does not matter, provided that the indicating dials are mounted higher up in a position where they can be easily seen.

I claim no originality for this idea, however, as the manufacturer of a very well-known portable receiver

Why not be comfortable?

adopted a highly practical variation of this system about a year ago, and favourable comments were made upon it in this journal. Further investigations, however, showed me that it was still better to have the knobs mounted on each side of the set, rather than on the front. One well-known British set-maker, whose pet set was reviewed by *The Wireless World* some weeks ago, adopts this scheme, but, in my opinion, he misses the boat, because he puts the knobs high up, where the wrist can have no support. My tip to him, and, indeed, to all other manufacturers, is to put the knobs low down at each end of the set, the tuning scales being at the top. A considerable amount of testing has conclusively proved to me that this arrangement cannot be bettered, although I shall be only too pleased to be contradicted if someone can indicate a more "comfortable" position.

Current Topics

EVENTS of the WEEK in BRIEF REVIEW

TELEPHONE SERVICE TO THE CANARY ISLANDS.

The Postmaster-General announces that telephone communication with the Canary Islands, which has hitherto been restricted to calls to and from London, is now available from all parts of Great Britain and Northern Ireland.

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A NEW USE FOR BROADCASTING.

It is stated that the latest fashion among the smart society of Paris is to have the news of births, marriages, deaths and divorces broadcast instead of publishing the information in the conventional manner in the columns of the daily papers.

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FRENCH BROADCASTING OUTLOOK.

The new French Postmaster-General, M. Guernier, is using his best endeavours to speed up the Public Works Commission and get the Broadcasting Bill on the Statute Book by next autumn at latest. He stresses the fact that there is to be a Radio Congress in Madrid next year and that if France does not appear there with a regularly organised broadcast system she will run the risk of seeing herself deprived of some of the wavelengths allotted under the Prague plan.

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CENSORSHIP DISPUTES IN HOLLAND.

The Dutch Central Commission of Control recently prohibited a wireless play by Mr. H. Wouters, which was to have been transmitted by the Dutch Association, "Vara," on the ground that it attacked a rival radio association and criticised the transmission hours fixed by the Government.

The "Vara" maintained that this prohibition was illegal and *ultra vires*, and The Hague court which heard the case they brought against the Commission decided in favour of the company, declaring that the attitude of the Commission was not justified and condemning them to pay damages and costs. The piece was ultimately played on June 3rd, but the Commission tried to "get even" with the company by forbidding its secretary, M. de Vries, to make any speech. "Vara" therefore retaliated by a thirty minutes' complete silence. Relations, our correspondent says, are still strained.

The next move in the contest is now up to the Commission, and it will be interesting to follow its progress.

THE ELYSÉE KEEPS ITS AERIAL.

The departure of President Doumergue from the Elysée palace was a source of regret to French amateurs, who were proud of the fact that their chief magistrate was a wireless enthusiast. As the new President, M. Doumer, is not a radio amateur, there was considerable fear that the familiar aerial would now be dismantled. The grandsons of the new President, however, are keen enthusiasts, and the new general secretary, M. Georges Huisman, finds time to devote some of his leisure to wireless as well as art and history, in all of which subjects he takes great interest, so that the aerial will be as actively employed as before.

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MAN-MADE STATIC.

Messrs. Siemens-Schuckert, of Berlin, have decided that all electrical apparatus constructed by them will in future be designed in such a manner as not to interfere with neighbouring wireless receivers. We understand that Messrs. Browne, Bouverie and Co. have taken similar steps, and that Continental manufacturers generally are following this good example in their endeavour as far as possible to eliminate all sources of interference.

A CAVALRY PORTABLE. An American cavalry officer with aerial coiled round the staff and receiver hanging from his saddle. In tests near Fort Sam Houston, Texas, the use of this apparatus was found invaluable in cavalry manœuvres.

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WIRELESS AN INVENTION OF THE DEVIL?

The question of broadcasting church services was discussed at the York Diocesan Conference, when one speaker said he was appalled at the suggestion of bringing "that devilish mechanical device of the wireless" into their country churches.

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DUBLIN WIRELESS AND GRAMOPHONE EXHIBITION.

The wireless and gramophone exhibition which is being organised by the Irish Radio Traders' Association, Ltd., will be held in the Mansion House, Dublin, from September 28th to October 3rd.

The organising secretary is Mr. Howard J. Duncan, 29, South Anne Street, Dublin.

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NEW VALVES.

We understand that the Mullard valves 904V (with indirectly heated cathodes for A.C. mains) and PM24D (directly heated A.C.), which were described in our issue of June 10th, are not yet on the market but will be available very shortly.

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IN BLISSFUL IGNORANCE!

A Streatham man summoned for working a wireless set without a licence, pleaded that he did not know the offence was regarded seriously.

He cannot, in any case, have used his set much, as the B.B.C. announcers give frequent warnings to listeners on the subject of licences and statistics of the number of prosecutions undertaken by the Post Office for neglect to obtain these. But, perhaps he was one of those who only listen to dance music.

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MAXWELL AND FARADAY.

The centenary of Prof. James Clerk Maxwell, who was born on June 13th, 1831, will be celebrated at Cambridge on October 1st and 2nd, following the Faraday celebration and the centenary meeting of the British Association in London.

We understand that inscriptions will probably be cut in the floor of Westminster Abbey in memory of both Faraday and Maxwell.

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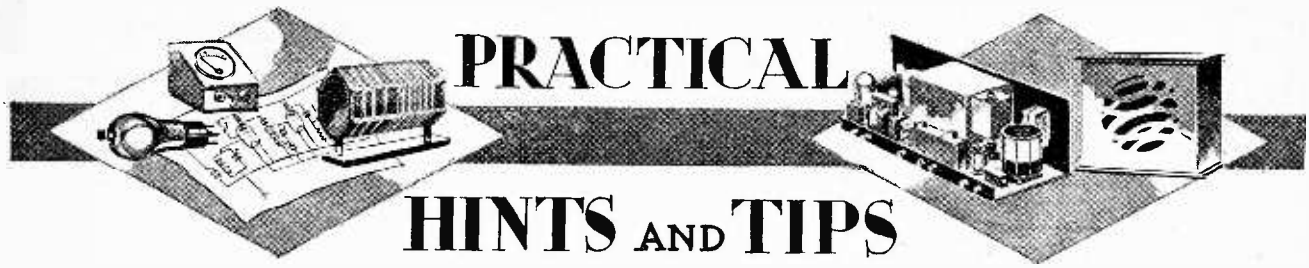
ANOTHER RADIO WAR.

A provisional agreement recently put an end to a dispute between Germany and Poland on the question of alleged radio propaganda, but it seems less likely that an understanding will be reached between Russia and Roumania in regard to the high-power broadcasting station which the Soviet has just erected at Tiraspoli, close to the Roumanian frontier. This station, it is alleged by the Ministry of Communications in Bucharest, sends out propaganda in the Roumanian language, and, owing to its power and hours of working, prevents many listeners in Bessarabia and Moldavia from picking up the programmes of their national stations.

A plea is put forward for an International Convention which would decide how far a country may go in broadcasting material intended for listeners of other nations.



PRACTICAL HINTS AND TIPS

Aids to Better Reception.

DRY CELL L.T. BATTERIES.

LOW-TENSION current supply for a real portable receiver, in which many desirable qualities must be sacrificed in order that it may be light and compact, is generally something of a problem to its designer. If the receiver is to be used regularly and for long periods, there is hardly an alternative to the unspillable accumulator, now so satisfactory and so low in price, but if it is to be operated on comparatively rare occasions, the use of dry cells still has much in its favour. An accumulator must be recharged at regular intervals, even if current is not taken from it; one is apt to forget this, with the result that the cell is ruined.

The type of set with which we are here concerned will generally not embody more than two or three valves, and will probably be intended for headphone reception. An ordinary 4½-volt flashlamp battery, particularly if of a good make, will feed the series-connected filaments of two 2-volt 0.1 amp. valves for a much greater length of time than might be expected—until one remembers that

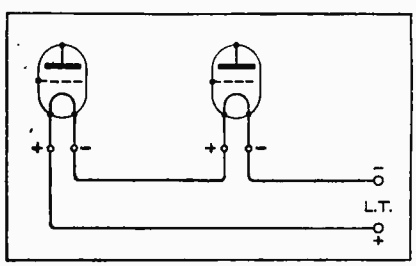


Fig. 1.—Filament polarity of valves connected in series.

many flashlamps consume at least twice as much current. If three valves are used, the best plan is to use types with filaments rated at 4 volts, 0.075 amp., and to provide a separate battery for each valve; voltage on load will quickly drop, and so the excess half-volt will do no harm.

Flashlamp L.T. batteries have obvious limitations, but are quite practical, provided they are not expected to supply a heavy current or to work for long periods. There is the advantage that they are obtainable everywhere, and so the portable set user need not burden himself with a large stock of spares.

As renewals must be made at fairly frequent intervals, it is convenient to provide a spring-clip contact device, similar to that included in the usual flashlamp case, so that when a new battery is inserted electrical connections are made automatically.

Those who have had no experience of series-connected valves are often at a loss to know exactly to which filament terminal the corresponding grid circuit should be "returned"; it will be clear that, when this rather unconventional method is adopted, the familiar negative "earth line," common to all valves, will no longer exist.

The actual polarity of each filament terminal can readily be determined with the help of Fig. 1. No matter what number of valves are included in the chain, the sequence of alternate positive and negative terminals as shown will be maintained.

This question of the connection of grid return circuits arises, of course, in connection with valve operating conditions with regard to grid bias, and it is often possible to utilise the voltage drop across one or more filaments for this purpose. For example, in the case of a simple detector-L.F. set for headphone reception, a bias of 2 volts will be adequate for the output valve; this pressure may be obtained automatically by arranging the grid circuits as in Fig. 2. It is assumed that two-volt valves will be used; bias for the L.F. amplifier is derived from the voltage drop across the detector valve filament.

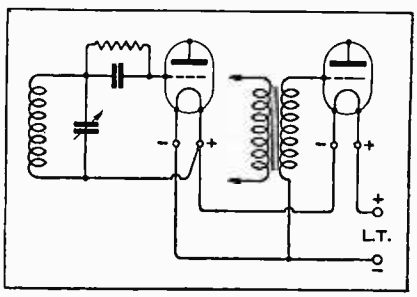


Fig. 2.—Free grid bias for the output valve of a detector-L.F. set with series-connected valves.

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As the power of broadcasting stations becomes greater, it is brought home to us with increasing force that the usual form of pre-detector volume control is, in itself, hardly capable of bringing about a sufficient reduction of intensity for average receiving conditions. Not only is it sometimes impossible to keep signal input from a powerful local station within bounds; at night-time, distant transmissions will quite often be audible at great strength even when the control is set at minimum.

DOUBLE VOLUME CONTROL.

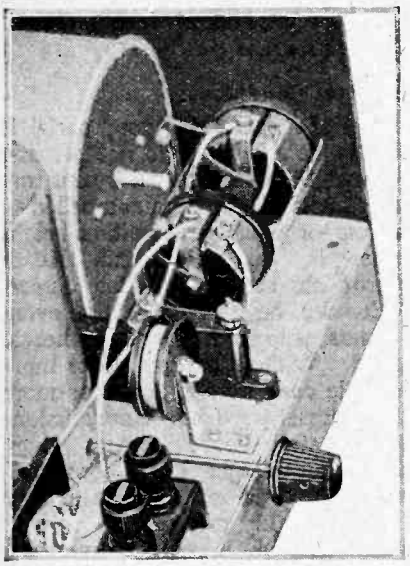
It has already been suggested that the fitting of a "local-distance" switch, by means of which a receiver may be desensitised, is often a highly desirable addition. An elaboration of this idea is to be found in the new *Wireless World* superheterodyne receiver, the "Super-Selective Six," where two separate volume-control potentiometers, acting in different circuits but mounted on a common spindle and controlled by a single knob, are embodied in the design.

The first of these potentiometers

is used to regulate input to the receiver from the aerial, while the second controls the screening grid voltage — and consequently the amplification—of the intermediate-frequency amplifying valve.

Modifications of this very effective scheme are applicable to less ambitious receivers having one or more stages of "straight" H.F. amplification, and the necessary alterations can usually be made without much trouble. Whatever form of pre-detector volume control may be originally included—differential aerial feed condenser, plain series condenser, or H.F. grid potentiometer—a second control, in the form of a regulating device for regulating screening grid voltage, can almost always be added with advantage. Of course, if the existing control is already of this type, the addition must be of the kind which affects signal input to the first H.F. valve.

Single-dial operation of these controls is an undoubted convenience, and, with a little ingenuity, mechanical linkage of the regulating devices can often be arranged in a satisfactory manner. But it must not be



Ganged volume control potentiometers of the "Super-Selective Six."

imagined that "ganging" is absolutely essential to the success of a double pre-detection volume control system; if independent devices are manipulated properly and in the right sequence, results are all that can be desired.

Initial regulation of intensity should always be made by means of the control preceding the H.F. valve; if signals are still too loud when this is set at minimum, a further reduction in volume should then be made by reducing screening grid voltage below the optimum figure. By working in this way, cross-modulation and H.F. valve rectification troubles are largely avoided.

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TUNING IN SILENCE.

Quite a number of amateur-built receivers of the more ambitious type are fitted with a detector anode milliameter. Although the uses of this refinement as an aid to adjusting valve operating conditions and for checking the functioning of band-pass filters, etc., are fairly well known, another of its advantages—and one of considerable practical utility—seems to be generally ignored.

Anyone who has operated a really sensitive receiver knows that searching for any particular transmission, of which the corresponding tuning adjustments are not known with absolute certainty, can be rather a nerve-racking operation nowadays; unless one is particularly quick in manipulating the volume control, unwanted stations on adjacent wavelengths will probably be heard at deafening strength. At best, the process of tuning-in the wanted transmission will generally be accompanied by more or less distressing overloading before final adjustments can be made.

All this may be avoided by using a visual rather than an aural indication of tuning. If a short-circuiting switch be fitted across the loud speaker, adjustments may be made with the detector anode meter reading as a guide, and without any noise whatever. Unless the receiver be accurately calibrated, it may be that the station heard when the loud speaker is switched on may prove not to be the wanted one, but at least its signals will not be too loud.

A milliammeter for this purpose should have a maximum reading but slightly in excess of the highest anode current passed by the detector.

INCREASING ELIMINATOR OUTPUT.

It is not generally known that the output of a Westinghouse metal rectifier, connected in the conventional voltage-doubling circuit, may be increased to a small, but by no means negligible, extent by shunting the rectifying unit with a large condenser.

Connections are as shown in dotted lines in Fig. 3, in which the

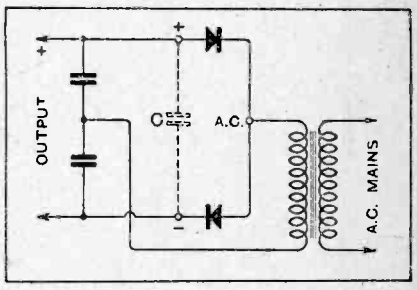

Fig. 3.—An extra by-pass condenser connected across a metal rectifier unit.

rectifying unit terminals are marked. The condenser C may have a capacity of one or two mfds.

Traces of residual hum will often disappear when an extra condenser is added as described.

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EARTH EVERYTHING.

When wiring a receiver, it is almost always wise to "earth" all large metal objects wherever possible. Although complete observance of these precautions may often be neglected with impunity, occasions sometimes arise where H.F. potentials are conveyed from one circuit to another in a most puzzling and obscure manner by "free" masses of metal; the resulting lack of stability is most difficult to trace.

It is unnecessary to emphasise the need for "tying down" such components as coil pots and inter-stage screens, but the reader's attention may be drawn to the fact that several other components may be responsible for trouble. In particular, metal rods used as a link between wave-range switches should always be carefully earthed, not merely at one point, but between each stage.

An Evening with the "Super Selective Six"

What I Think of the New "Wireless World" Superheterodyne.

By J. GODCHAUX ABRAHAMS.

WHEN the Editor of *The Wireless World* informed me that he was sending up to my house his technical staff's latest achievement, the *Super-Selective Six*, for a thorough test of its capabilities, I pointed out to him that he could not have chosen a worse period of the year. Earthquake tremors, storms, atmospheric disturbances, long sultry days and a viciously congested ether are not exactly conducive to facilitate the reception of distant transmissions. The creditable log often achieved by the possessor of an average wireless receiver during the most favourable winter months usually takes on an anæmic appearance with the advent of British summer time. It is at this particular period of the year that the extra valve or two becomes an object of longing, and attempts are made to pep up the old set in the hope that it may provide again the musical entertainments from those stations which, with the coming of brighter days, seem to have disappeared from our horizon.

THIS carefully prepared and unbiased report describes in practical terms the results obtained by an experienced listener after a comparitively short acquaintance with the set. Of considerable help in station identification is the log of dial settings revealing a remarkable degree of selectivity and an outstanding performance in relation to the number of valves employed.

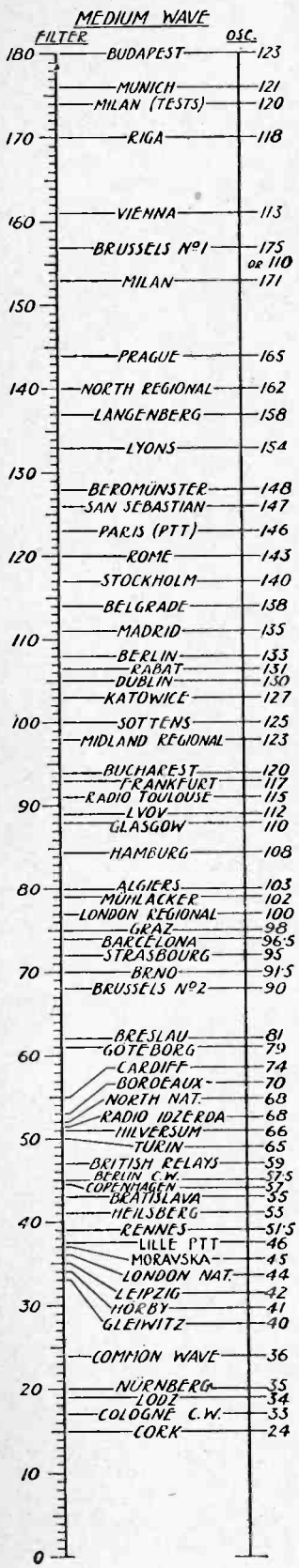
Well, the *Super-Selective Six* has fulfilled its claims; it has proved its title; in fact, it has achieved considerably more than I expected it to do in the present circumstances.

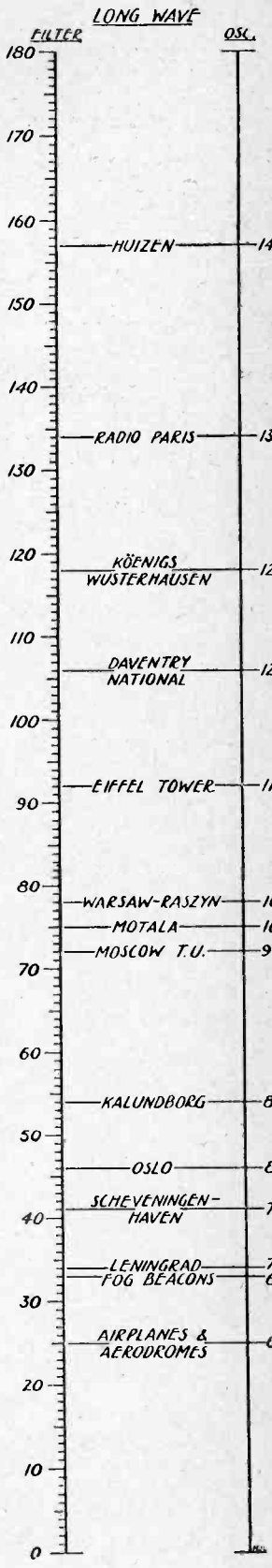
In most instances, when acquaintances have asked me to recommend a suitable receiving instrument for their homes I have fought shy of suggesting a super-het in view of its poor reputation of quality in production. With the fanatical "station-getter," whose sole ambition is to boast of his captures, this type of circuit has enjoyed great popularity owing to its great sensitivity and selectivity, but this special class of receiver has never made a strong appeal to the average household. In the case, however, of the *Super-Selective Six*, I should have no hesitation in advising its adoption as the regular stand-by receiver in the home for, although highly sensitive and selective, it is easy to handle, and possesses the signal advantage of offering an almost perfect reproduction. Providing it is coupled to a good type of moving-coil loud speaker, it will give you a faithful copy of any broadcast item you may pick up, be it music or speech. Notwithstanding the fact that transmissions tuned in can be amplified to an overpowering volume of sound the receiver is endowed with an efficient control, and even if the signal be greatly reduced the quality is not impaired. The use of the volume control does not, as is often the case, imply distortion.

Severe Test Conditions.

For the exhaustive test of a receiver a good aerial is essential, and this for the time being I do not possess, as my pet installation had been dismantled during my absence from London. In its place I was compelled to use a temporary arrangement which gave neither height nor length, yet, with this Heath Robinson-ish contraption the *Super-Selective Six*, on two consecutive evenings, has supplied the log hereto annexed. Without doubt, under more favourable conditions a dozen or more of the lesser-powered transmissions could be well heard; again, given better radio weather I am convinced that the number of stations logged would also have been appreciably greater.

I was particularly struck with the great ease with which it was possible to tune the receiver; every degree of the dial appears to be a "live" one. Although the filter and oscillator condensers do not work in step—it would be a troublesome matter to obtain this extra facility—provided a few readings of well-known transmissions have been registered, it is just as easy to pass from one broadcast to another. The setting of the oscillator condenser, you will find, in most instances, is of a knife-edge sharpness; there is somewhat more latitude in the setting of the ganged filter circuit. But





An Evening with the Super-Selective Six.—the condensers must be carefully handled and turned very slowly; it is easy to lose a transmission. The receiver works silently; you will only hear a faint rushing sound when you strike a wave and not the ear-splitting yip or howl of the ordinary set with more or less violent reaction. Notwithstanding the fact that but little separation exists between Heilsberg and Bratislava, Langenberg and North Regional, Söttens and Midland Regional, you will experience no difficulty in keeping their transmissions clear of each other. In the case, however, of London and Mühlacker, in the London area it is not so easy to achieve. I might qualify this by adding that on one evening I was able to do so but on the next I was not successful. (Algiers, on the other hand, can be tuned in without any vestige of interference.) No doubt readers residing outside the swamp area of Brookmans Park will find this no problem. On the long waves, namely, above 1,000 metres, perfectly pure reception can be obtained of Köenigswusterhausen and Daventry 5XX with a silent background.

Range with Quality.

The *Super-Selective Six* is peculiarly clear of mush, a quality which most super-hets do not possess, and interference of C.W. telegraphy on the long waves has been reduced to a minimum; in fact, only on one or two occasions was a transmission impaired by this trouble. Time did not allow me to readjust the acceptor circuit, and this *contretemps* could have been remedied.

The range of the receiver is, roughly, from 220 to 550 metres on the medium wave-band. In order to bring in such stations as Vienna, Milan (on about 525 m. *not* 296 m.), Munich and Budapest the lower reading of the oscillator condenser must be taken. Brussels, as shown in the log, can be tuned in at 175° or 110°, and it was from this latter reading that a fresh start was made.

Atmospheric conditions, as I have already stressed, during the short period the receiver was under test were particularly bad, and consequently it was not possible to establish the full capabilities of this new set. It is noteworthy, however, that notwithstanding such an unfair trial a very respectable log has been obtained. In every instance I have only noted the readings of transmissions after individual identification, and after having assured myself of the fact that they were obtainable again and again on the same condenser settings they were not tuned in by a mere fluke.

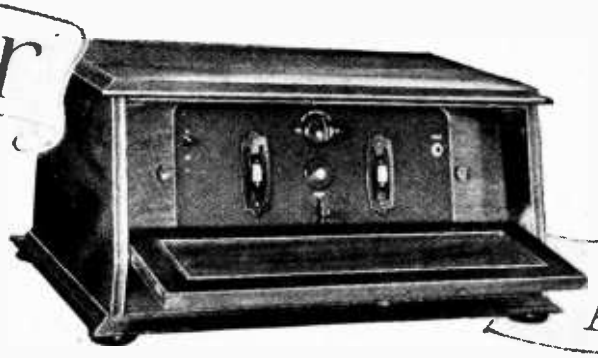
The fact that a radio instrument is capable of bringing to your ears transmissions from over sixty stations is not necessarily a conclusive proof of its merits, but the assurance that on *any* day or evening and under adverse conditions the receiver will provide no fewer than twenty to thirty programmes at full loud speaker strength of a pleasing quality must be taken as a decisive factor in weighing up the merits of a wireless circuit.

The *Super-Selective Six* has come through with flying colours, and may be heartily recommended to anyone who requires a receiver which combines sensitivity, selectivity, ample power, and an almost faultless reproduction.

(The set can be seen at the Editorial Offices, 116, Fleet Street, London, E.C.4.)

Dubilier A.C.3

A General-purpose Receiver with Many Unconventional Features.



AT the present time the three-valve H.F.-detector-L.F. set is still the most popular type, and, in spite of predictions to the contrary, seems likely to retain its hold on the public taste for as long as anyone dare look into the future in wireless matters.

It has been urged—logically enough—that the broadcast listener should first decide clearly what stations he wishes to receive, and then buy or build a highly specialised receiver capable of doing its definite job really well. But even the most strong-minded of us are apt to change our views, and, should a purely local station set be decided upon, a time will almost inevitably come when we feel a pressing need for a rather more extended range, in order that we may listen to something else. Unless a super-sensitive multi-stage receiver is within our means, the obvious compromise is a general-purpose set. Of the various circuit arrangements adopted for receivers in this category, it is hardly necessary even to consider anything except the 1-v-1 combination.

The Dubilier A.C. Three is a good example of this type of set, being admirably suited to fulfil the purpose for which it is obviously designed. An exacting and extended test fails to bring to light any weaknesses or shortcomings, whether with regard to construction, quality of reproduction, selectivity, or sensitivity, to which one might reasonably take exception. Its design is anything but stereotyped; a few of its features are unusual, but, judging by results, their inclusion seems to be amply justified.

Double-wound transformers of the so-called "aperiodic" type are used for aerial input, series fixed condensers being so arranged that three degrees of coupling may be obtained by changing the aerial connecting plug. Further, a fourth socket is provided for use with an inside aerial of exceptionally small dimensions.

Transformers are also used to couple the H.F. amplifier to the detector, which operates on the anode bend principle, and is in its turn linked to the output valve by another transformer. A choke output for the loud speaker is fitted.

Instead of connecting the H.F. transformer windings in series, and effecting wave-range changes by the usual expedient of short-circuiting the loading coils, arrangements are made for changing over the high-potential ends of the windings. Were it not for the fact that exceptionally well-made switches are used, this plan might be criticised on the grounds that its advantages do not outweigh the disadvantages of an increased possibility of contact failure. As it is, such an eventuality would appear to be remote. Incidentally, both wave-range switches, though mounted in separate screening compartments, are operated by a single knob.

Indirectly heated A.C. valves are used throughout, their heater and cathode circuits being conventional. Negative voltage for the H.F. valve grid is developed across a cathode resistance, but the detector is biased in a rather unusual way. Referring to the accompanying circuit diagram, it will be seen that a 600-ohm resistance in the cathode lead of this valve is, in effect, a part of the H.T. potentiometer. Accordingly, the bias voltage applied is due both to the current flow through the potentiometer and that consumed in the valve anode circuit.

The rectifier, also, with an indirectly heated cathode, is of the half-wave type. In conjunction with a smoothing circuit designed on generous lines, this valve supplies H.T. current in an entirely satisfactory way, and there is an altogether negligible amount of hum. High-tension voltage is supplied to the set at about 180 volts, and so the L.F. valve is being run under practically the best conditions.

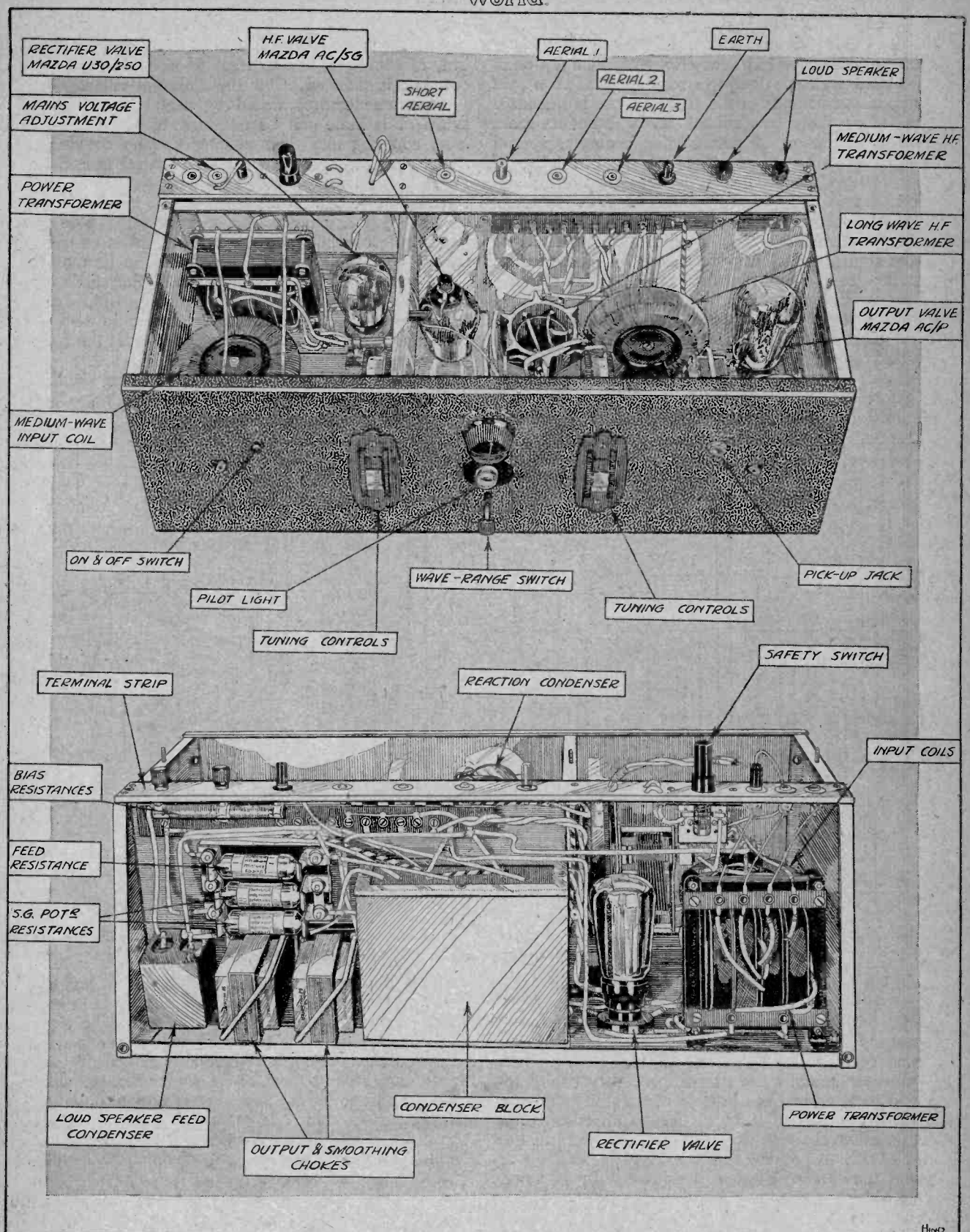
A pilot lamp, fitted in the orthodox way, gives nothing more than an indication that mains voltage is applied to the set, and that the power transformer primary and L.T. secondary are more or less in order. The neon indicating lamp, as included in the Dubilier set, is much more valuable; it does everything that the ordinary lamp can do, and, in addition, shows whether H.T. voltage is being delivered at approximately the right voltage, as it does not light until a pressure of some 150 volts is applied. Further, it shows when the valve heaters have become sufficiently warm to operate. This particular type of lamp consumes no more than 2 milliamps.

SPECIFICATION.

GENERAL: Entirely mains operated on A.C. voltages from 200 to 240. For use with open aerial. Provision for gramophone pick-up.

CIRCUIT: One H.F. stage, anode bend detector, and triode output valve. Transformer coupling throughout. High-tension supply through half-wave valve rectifier.

CONTROLS: Two edgewise tuning dials; reaction; wave-range switch; on-off switch.



Semi-plan and rear views of the Dubilier A.C. Three chassis.

B 23

Dubilier A.C.3.—

Fieldless toroidal coils are used throughout, except for the medium-wave H.F. transformer, which is wound on a ribbed former. Complete screening between grid and anode components of the H.F. circuits is included.

The set is solidly constructed, and one notices more than usual attention to details; for example, special locking washers are fitted to reduce the possibility of loosened connections. The chassis is built up as a metal box, with two compartments, and is easily removed from the case, which is of walnut and designed on simple but attractive lines. A drop front is fitted so that the control panel may be concealed, and there is an automatically operated safety switch which is operated by opening the lid.

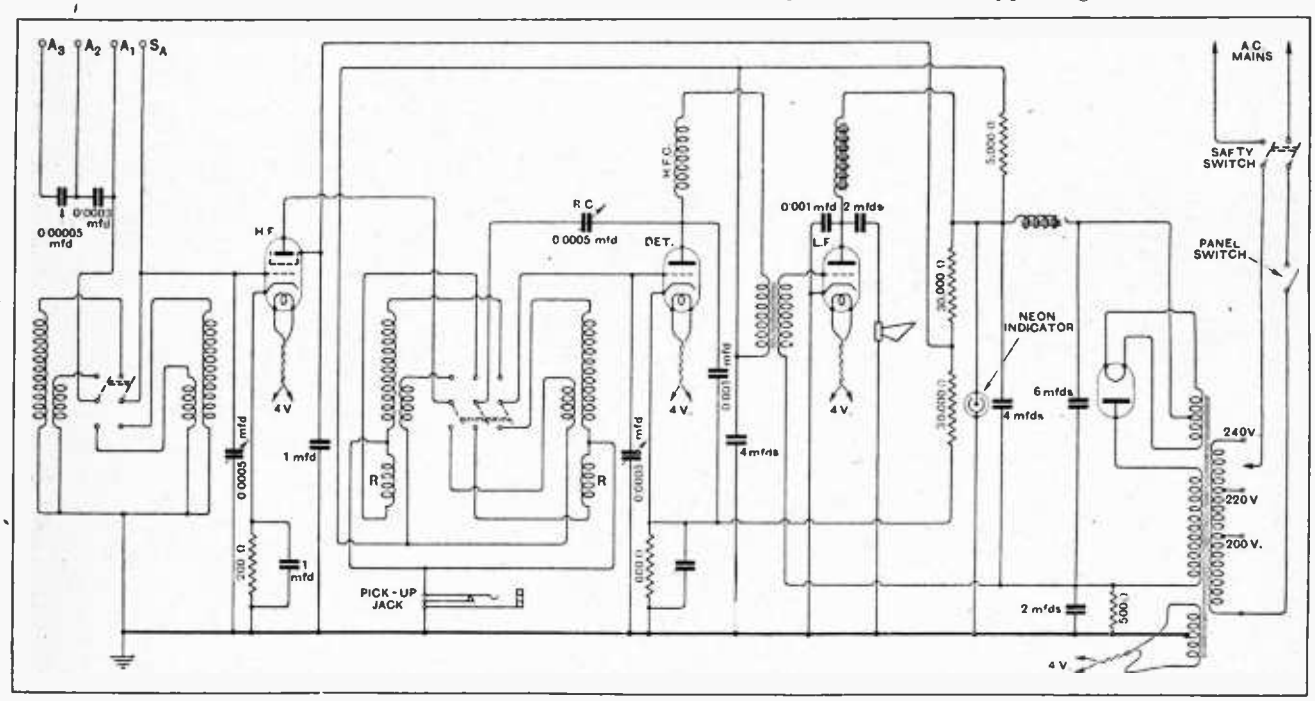
The majority of the components are of Dubilier manufacture, and the few parts of other makes that have been used are of the highest grade. Indeed, there is no evidence anywhere that undesirable economies have been effected.

Edgewise condenser drums with both direct drive and slow-motion discs are fitted. It is a matter of taste whether this form of control is preferable to other methods, but in the present case the dials are very conveniently mounted on the sloping panel, and the operation of tuning could hardly be easier. Although the condenser spindles are not ganged, they run practically in step, and so the process of searching for any particular transmission is by no means difficult.

All the other controls work as they should, and the set is pleasant to handle. Its sensitivity is well up to the usual standard of its class, and selectivity is, for a receiver with only two tuned circuits, appreciably above the average; no doubt the use of anode bend detection contributes a good deal towards this. By making full use of the aerial circuit adjustments that are provided, most forms of interference can be avoided or mitigated, but, of course, at the expense of signal strength when coupling is reduced below the optimum value.

A volume control would be useful, but as a rule sufficient latitude can be obtained by working with a loose coupling and then making up any deficiency in signal strength by reaction. This control is exceptionally good, not only on the medium band but also on the long waves; here we see one of the benefits of using separate coil assemblies for each band. There is no perceptible overlap, and the adjustment is so constant that it is possible to maintain the set in its most sensitive condition by making very small alterations to the reaction condenser setting while passing from one end to the other of the tuning range. One could wish, however, that a definite stop were fitted to limit the rotation of the moving vanes to 180 degrees.

A consideration of the circuit arrangement would lead one to anticipate that quality of reproduction would be marked by a well-defined upper register. This conclusion is borne out in practice; music is bright and crisp, and there is a better balance than usual. It might be expected that low-note reproduction would be slightly deficient, but no such falling-off can be noticed; the bass register, though not obtrusive, is sufficiently strong for ordinary requirements. In short, the set will do justice to almost any loud speaker at present obtainable.



Complete circuit diagram of the Dubilier A.C. Three. Reaction coils are marked R.

The receiver, which is made by the Dubilier Condenser Co., Ltd., Ducon Works, Victoria Road, North Acton, London, W.3, costs £25, complete with valves.

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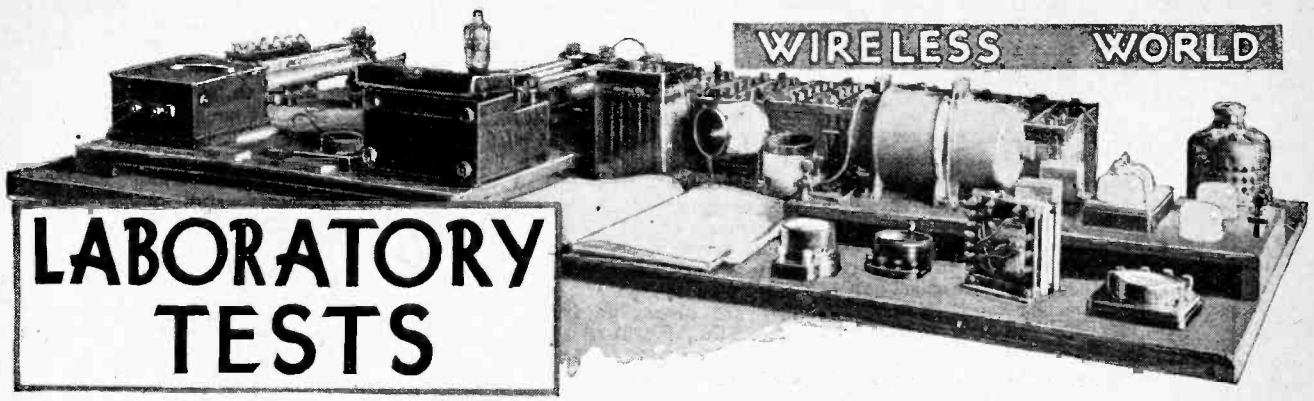
Next Week's Set Review:—

BURNDEPT MERRYMAKER TWO.

B 24

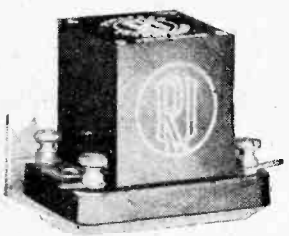


LABORATORY TESTS

A Review of Manufacturers' Recent Products.

R.I. PARAFEED TRANSFORMER.

This transformer is the result of investigation made by the R.I. Research Dept., into the practicability of employing a core of exceedingly high permeability with a consequent reduction in the amount of wire required to give a suitable inductance value; the object being to produce a component smaller in size and considerably lighter than hitherto but



R.I. Parafeed transformer with high permeability core and step-up ratio of 1 : 3.

possessing the electrical qualities generally regarded attainable only with more bulky construction.

That this object has been achieved is evidenced by the excellent characteristics exhibited by the R.I. Parafeed transformer. Although the overall size is but 2in. × 1⅜in. × 1⅝in. high, the primary inductance is over 100 henrys when no D.C. is passed through the winding. Indeed, the special nature of the core precludes passing the steady anode current through the winding, and it is essential to adopt the resistance-capacity method of coupling the component to the preceding valve.

The primary inductance was measured with various values of A.C. current passing through the winding, since the permeability of these special nickel-iron alloys is very susceptible to small changes in the value of the current component of the A.C. flowing. It was found that with 0.1 mA. of A.C. the inductance was 98 henrys, and with 0.2 mA. 123 henrys, while with 0.3 mA. the inductance fell to 103 henrys. With an AC/HL type power-grid detector valve and 1 : 4 ratio connections, a 50,000-ohm anode resistance and a 0.5 mfd. coupling condenser, the voltage amplification between 100 cycles and 8,000 cycles attains a constant value of about 80 times for the stage. At 50 cycles this falls to about 65 times, and at 25 cycles it is a shade below 40 times. If a special high inductance choke is used in place of the anode resistance, an amplification of about 100 times is available and an improvement can be made in the amplification of frequencies below 100 cycles.

Used in the manner specified, the Parafeed transformer will give excellent results, and the price is 8s. 6d. only. The makers are Radio Instruments, Ltd., Purley Way, Croydon.

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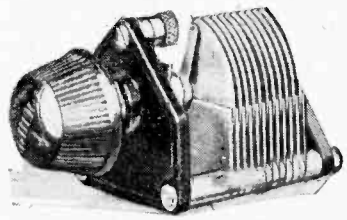
FERRANTI VOLUME CONTROL CONDENSER.

This condenser has been developed specially for use in the aerial circuit of sets where a series aerial condenser is employed as an input volume control. Its special feature is that when the moving vanes are fully meshed with the fixed vanes a cut-out device short-circuits the condenser. Thus, in the position of maximum input, the condenser is virtually removed from the circuit and the aerial lead



Ferranti aerial volume control condenser fitted with automatic cut-out.

connects direct to its tapping on the aerial-grid coil, or direct to the aerial winding as the case may be.

The measured minimum capacity was found to be 8 micro-mfds. only, and the maximum value 0.00026 mfds. This compares favourably with the rated value of 0.00025 mfd.

The makers are Ferranti, Ltd., Hollinwood, Lancashire, and the price is 6s. 3d., including knob.

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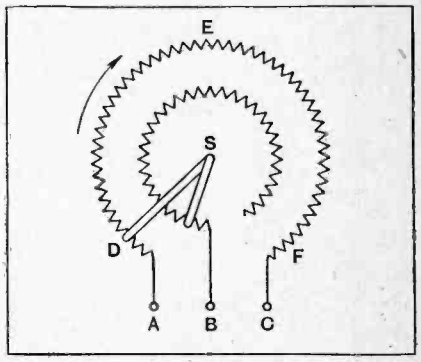
PREFERATO VOLUME CONTROLS.

It is generally accepted that the change in resistance effected by the potentiometer type of volume control should follow a logarithmic law if the acoustic output is to be proportional to the angular movement of the control knob. In some cases this is achieved by utilising a graduated

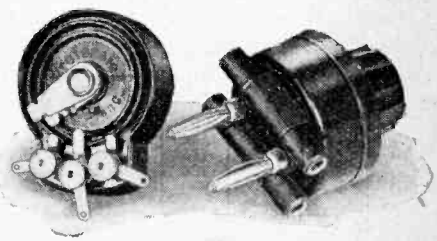


Schematic arrangement of the two resistances in the Preferato volume controls.

resistance track, but in the Preferato devices it is achieved by mounting two evenly wound resistances concentrically and using a double slider.

Referring to the diagram, it will be seen that as the double slider moves from the position D to E the change in resistance is infinitely greater than that afforded by the change from E to F.

These volume controls are available in two styles, viz., No. 2, a plain potentiometer device with exposed resistances, priced at 5s. 9d., and an all-enclosed model, No. 3, fitted with pins and contact sockets. This model costs 7s. 3d.



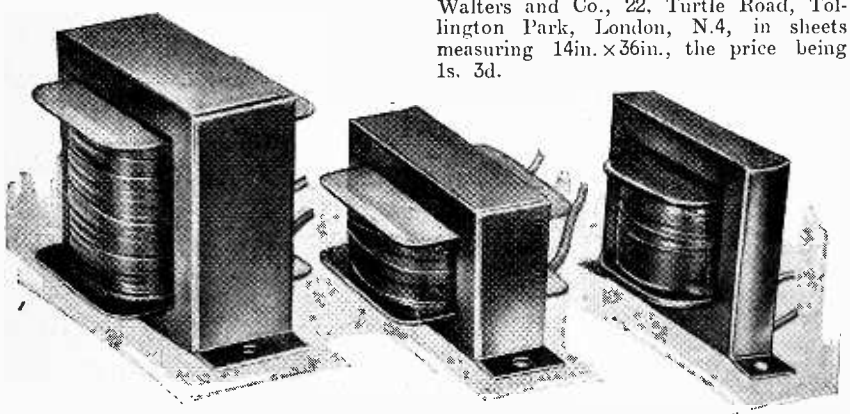
Preferato logarithmic-type volume controls.

They are of German manufacture and are handled in this country by S. W. Lewis and Co., Ltd., 39, Victoria Street, London, S.W.1.

SAVAGE'S L.F. CHOKES.

A new range of smoothing chokes, hitherto reserved for manufacturers' use only, has been placed on the market by W. B. Savage, 292, Bishopsgate, London, E.C.2. This range is somewhat cheaper than the standard pattern, since they are not fitted with terminals, in lieu of which loose leads are provided. These leads are of ample length to connect direct to the appropriate components.

There are seven models in all in the "M" range, as they are described officially; the smaller models carry up to



Savage's Type "M" smoothing chokes.

50 mA. of D.C., while the largest size is rated to pass 150 mA. and give an inductance of 17 henrys. Two samples were chosen for a test, and measurements were made of the inductance with various amounts of D.C. flowing.

SAVAGE MODEL C.C.38 M. CHOKE.

D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.	D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.
5	0.765	62.5	25	1.05	46
10	0.83	57	30	1.13	43
15	0.90	52.8	35	1.65	39
20	0.965	49	40	1.53	32.7

The C.C.38 M. is a useful general-purpose model; it has a D.C. resistance of 1,100 ohms (measured), and the price is 11s. 6d. The other model tested was the C.32 M.—a heavy-duty choke rated to pass 120 mA. of D.C., and listed at 18s.

SAVAGE MODEL C.32 M. CHOKE.

D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.	D.C. in mA.s.	A.C. in mA.s.	Inductance in Henrys.
0	0.76	37	70	1.3	26.4
10	0.01	34	80	1.34	25.6
20	1.09	32	90	1.39	25.0
30	1.13	30.8	100	1.44	24.0
40	1.16	29.5	110	1.49	23.3
50	1.21	28.2	120	1.56	22.5
60	1.25	27.2	—	—	—

The D.C. resistance of this model is 300 ohms. There is a pentode output choke, styled Model L.36 P.M., tapped half-way and three-quarter-way. It passes 60 mA. of D.C., and gives 47 henrys (rated) of inductance. The price is 18s. 6d.

"RAYDON" METALLIC SCREENING PAPER.

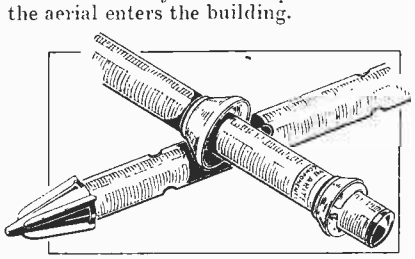
This consists of a thin cartridge paper on one side of which is securely glued a layer of tinfoil. Its principal application seems to be for covering baseboards, the back of wooden panels, and for lining cabinets. Care must be exercised when mounting components not to tear the metallic surface, and, if the usual precautions are taken, it should prove quite as effective as sheet metal, but, of course, it will be easier to handle.

Supplies are obtainable from Brady, Walters and Co., 22, Turtle Road, Tollington Park, London, N.4, in sheets measuring 14in. × 36in., the price being 1s. 3d.

WEARITE EARTH TUBE.

The latest style of Wearite earth tube takes the form of a hollow copper tube, with the lower half perforated, measuring 24in. long and ¾in. in diameter. It is fitted with an iron-shod tip and a special reinforced top, in which is fitted a cap to prevent the metal distorting when the tube is hammered into the ground.

These tubes offer a very satisfactory solution to the earthing problem when access to the ground is available, and, furthermore, enables the earth connection to be made at the most convenient point, thus ensuring a short and direct earth lead immediately below the position where the aerial enters the building.



Wearite new style copper earth tube.

The makers are Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17, and the price is 3s. 6d.

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SULLIVAN CAPACITY TEST SET.

During the course of experimental work, or when testing a receiver, the occasion often arises when it is necessary to test and measure the capacity of certain fixed condensers. With a view to bringing this within the scope of experimenters and service engineers, H. W. Sullivan, Ltd., Leo Street, Peckham, London, S.E.15, have developed an easily operated capacity test set. Condensers from 0.00005 mfd., up to 1 mfd., can be measured with an accuracy of about 2 per cent. over the major part of the range.

The test set consists of a simple four-capacity arm-bridge energised by a buzzer. Two standard mica condensers suffice to cover the full range, and these are brought into use by a simple push-pull switch. With the switch in the "in" position the effective range is from 0.00005 mfd. to 0.005 mfd., direct readings of the capacity being possible. In the "out" position capacities of from 0.005 mfd. to 1 mfd. can be read off direct.

The only additional apparatus necessary is a telephone ear-piece, or for preference a pair of headphones, and the mode of operation is to adjust the pointer until the buzzer note ceases to be audible. The silent point is easily determined so that the possible error due to reading of the scale is reduced to a minimum. Actual tests made with this instrument showed that only at the extreme ends of the two scales did the error in measurement exceed 2 per cent., but it was within the 5 per cent. limit stated by the makers as being the maximum error.

Sullivan simple capacity test set covering a range of 0.00005 mfd. to 1 mfd. with calibrated scale.

This test set should prove invaluable to the serious experimenter and the service engineer as it is very compact—the overall size is 8in. × 7in. × 8in.—and it weighs but 6lb. The price is £5.

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Trade Note.

Diehl Gramophone Motor.—With a view to simplifying the fitting of this motor to a baseboard, Messrs. Claude Lyons, Ltd., 40, Buckingham Gate, London, S.W.1, have prepared a full-size working drawing to supplement the instructions supplied with the motor. In addition to showing the correct relative position of the starting switch, etc., the drawing gives the minimum size of motor board required for representative types of pick-up.

The Diehl motor was reviewed in the December 31st, 1930, issue of this journal.

BROADCAST BREVITIES.

By Our Special Correspondent.

Continental Appreciation.—Fancy Dress for Engineers.—The Subsidy.—A Matter of Taste.

Bouquets for the B.B.C.

I hear from a friend in Paris that the journal *Radio Pratique* recently invited replies to the questions, (1) which station has the best modulation? (2) which transmits the best programme? The result of this questionnaire was distinctly favourable to the B.B.C., as London National headed the list as regards modulation, with Mühlacker second and Radio Paris third, while in the second list London Regional led, followed by Radio Paris and Strasbourg.

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Should O.B. Engineers Dress for the Part?

A discussion has arisen, I understand, among the engineers who take part in outside broadcasts whether they should be camouflaged to conform with their particular surroundings. During the Aldershot Tattoo one of the Marconiphone engineers marched in front of the band disguised as an ancient Briton, and carrying the microphone aloft on a pole, the leads being paid out or wound up as required by a colleague among the spectators. If this idea were to be developed by the B.B.C. it might necessitate a considerable theatrical wardrobe ranging from cassock and surplice for the broadcasting of religious services to lion-skins or ostrich feathers when zoological sounds were to be transmitted.

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Northern Regional Tests Satisfactory.

Though it is only three weeks since tests were begun on the second transmitter of the Northern Regional station these have proved so satisfactory that regular transmissions between 6.40 and 11 p.m. were tried last Monday and are to be repeated this evening. It is probable that within a month the full service will be in operation from both transmitters but, before deciding finally to give a service similar to that from Brookmans Park, Savoy Hill will probably wait until the new Post Office cable between London and Leeds is in full working order. This cable will provide circuits available for broadcasting purposes throughout the twenty-four hours, thus dispensing with the wireless link which, under present conditions, is necessary for relaying the National programme from Moorside Edge.

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The Scottish Regional Station.

A Glasgow correspondent to one of our daily contemporaries has expressed surprise that an oil engine generating set will probably be installed in the new station at Falkirk instead of taking the necessary power from the "grid" which passes within twenty yards of the site. I understand, however, that it is the policy of the B.B.C. to make every station self-contained with duplicate parts so that, as far as is humanly possible, the risk of a breakdown may be avoided.

The Subsidy Agreement.

It was chiefly owing to the pertinacity of Mr. J. H. Whitley, the recently appointed chairman of the Corporation, that the Government has made even the small concession of reducing the Post Office share of our 10s. licence fees from 12½ per cent. to 10 per cent. An amusing story has been going around that Mr. Whitley has lately occupied his time in paying a surprise visit to Moorside Edge and commandeered the engineers for sweeping up some waste paper that littered the floor. This apocryphal story has considerably tickled the chairman, who was, in fact, big game hunting at the Treasury and had no time for the pursuit of "mice and rats and such small deer" in Yorkshire. The result of his efforts is seen in the 3d. concession, which will be divided between the B.B.C. and the Treasury.

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Thankful for Small Mercies.

The concession, about which so much has been written, is nothing to cause a panic among taxpayers. It will probably bring the B.B.C. an extra £35,000 on the present licence figures, but with one Regional station—Brookmans Park—in full operation and another—Moorside Edge—about to be put on full service it will not go very far towards the repayment of the £300,000 already expended on the Regional scheme.

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Sheffield Relay Station.

The fate of the Sheffield station is still uncertain as it has not yet been proved whether Moorside Edge will be heard satisfactorily on crystal sets in the city of steel. If reception by crystal is found unsatisfactory, it is probable that the B.B.C. will resume the relays from their Sheffield station.

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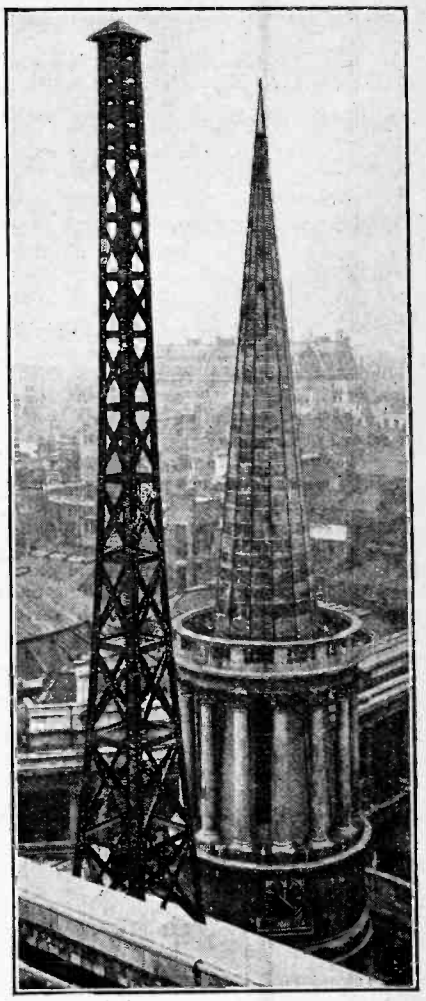
Chacun à son Gout.

"At last! An alternative to Bach!" This, according to a contemporary, will be the joyful welcome to the alternative programme for the early part of Sunday afternoons. But why should Bach be singled out for contempt? There are many who find old John Sebastian's music as exhilarating as a tonic or a day at the seaside; others, again—perhaps more advanced—find their greatest pleasure in the dynamic sounds and zoological discords of a ultra-modern symphony, and there are yet others who delight only in the bleat of the saxophone, the wailing vocalist, and the rhythmical hammering of the banjo—the astute reader may possibly divine in which direction my personal tastes are biased—but surely the programmes are sufficiently long and varied for every listener to find in one or other of them something to suit his fancy, at the worst he can switch over to a foreign station, or even read a book in silence. I think that those who clamour for jazz, jazz, and nothing but jazz, are culpably intolerant. The lovers of classical and even very advanced music realise that their less fortunate brethren cannot yet share their tastes, and are content if only part of the musical programme satisfies their desires; in fact, most of them can quite well appreciate light music and good dance music in moderation, but to be perpetually restricted to only one class of music would be as appalling as the popular conception of a celestial orchestra consisting solely of twanging harps and strident trumpets.



A lofty view of London from the roof of Broadcasting House. The quaint spire of All Souls' Church and the Queen's Hall are clearly seen.

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Another Man-made Static.

Complaints are already reaching Savoy Hill of sundry clicks heard in the neighbourhood of busy centres, and these have been traced to traffic control signals. This interference is obviously not often experienced in residential districts. At the same time there is a danger that as traffic control posts increase in number the interference may become considerable.

READERS' PROBLEMS.

Replies to Readers' Questions of General Interest.

Technical enquiries addressed to our Information Department are used as the basis of the replies which we publish in these pages, a selection being made from amongst those questions which are of general interest.

The D.C. "Regional One."

Will you please tell me what is the right value for the main voltage-absorbing resistance in the single-valve D.C. mains receiver discussed in the "Hints and Tips" section of your issue of May 13th?

It is intended to use one of the new D.C. pentode valves consuming 0.5 *ampere; my mains voltage is* 240.

A resistor of 468 ohms will be required. If you are unable to obtain a component of exactly this resistance, you should purchase the next lowest in value, making up the difference by means of a fixed, variable, or semi-variable resistance of adequate current-carrying capacity.

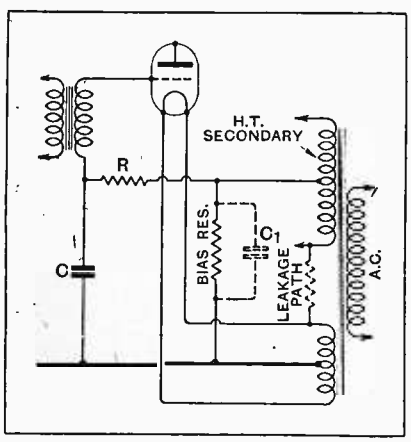

Fig. 1.—Power transformer leakages may cause the development of hum-producing A.C. voltages across an automatic bias resistance. R and C represent the usual decoupling resistance and condenser.

Obscure Cause of Hum.

If I remember aright, it was once stated in "The Wireless World" that "hum" in an A.C. mains receiver is sometimes traceable to inadequate insulation between the filament heating winding and the H.T. secondary of the power transformer.

This matter is not at all clear to me, and I should be obliged if you could explain it briefly. My own set, though fairly free from hum, might be improved in this respect, hence my request.

Leakage between the different sections of a power transformer may cause hum in various ways; even though the following explanation may not apply entirely to your own set, it may suggest a possible means by which traces of unwanted A.C. voltage are getting into one or other of the grid circuits.

Referring to Fig. 1, it will be appreciated that a high A.C. voltage is developed between either end of the H.T. secondary and the centre tap of this winding. Now if there is an appreciable leakage between one of these ends and the L.T. secondary, there will be a path for alternating current through the bias resistance; A.C. voltages developed across this resistance will be applied to the output valve grid, and hum will be produced.

A more or less complete cure can often be effected by shunting the bias resistance with a large condenser (C_1 in Fig. 1).

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"H.M.V." Radio-Gramophone.

With reference to your recent description of the "H.M.V." Radio-Gramophone for D.C. mains supply, I should be obliged if you would elucidate a point in the circuit diagram. It is noticed that the detector grid coil is shunted by two switches in parallel; I cannot see any reason for this duplication.

In this receiver, waveband switching and radio-gramophone change-over is effected by a system of cam-operated switches, and somewhat elaborate precautions are taken to prevent the possibility of radio interference when the set is operated as a gramophone amplifier. The switches operate in such a way that, in the "gramophoue" position, the long-wave loading coils of the first two tuned circuits are open-circuited: in order to ensure that the third circuit may be tuned to a widely different wavelength, a short-circuit is introduced across its loading coil by an extra switch contact.

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Reaction Winding Design.

I have been attempting to wind a dual-range tuning coil, but have not been quite successful in obtaining good reaction control, in spite of having tried various numbers of turns in the reaction winding. My experience is that it is most difficult to arrive at a winding that will give adequate feedback control on the long wave side, and which at the same time will not result in unduly "fierce" reaction when medium-wave transmissions are being received.

Is there any simple formula for calculating the right number of turns?

This is hardly a matter that is susceptible to exact calculation, as so many assumptions have to be made. In practice one must be guided largely by previous experience and the results of trial and error. Apart from the question of the number of turns, the position of the reaction coil with regard to the tuned grid windings is a matter of great importance.

A reaction coil that is common to both medium and long wavebands should as a general rule, be much nearer to the long-wave winding than to the medium-wave section. It would appear that you have ignored this side of the question, and we expect that one or two experimental alterations will enable you to obtain good results.

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Ganged Control Impossible.

My receiver is based on a design which appeared in your journal about two years ago, and, as it is rather out of date, I have been attempting to modernise it by fitting a band-pass input filter with ganged control. So far I have been unable to find an adjustment that will hold good over more than a very limited band of wavelengths.

The original receiver included a two-circuit input tuner, with the aerial circuit fully tuned. Coils for the primary and secondary circuits are of slightly different design; do you think that this fact is responsible for my failure? Any suggestions you can make will be appreciated.

It is impracticable to tune a pair of circuits of the type you describe by means of a ganged condenser even if it were possible to balance out the large amount of aerial capacity that is transferred to the primary coil, a sufficiently wide band of wavelengths could hardly be covered. This is apart from the fact that both your existing coils are not suitable for inclusion in a filter circuit.

We advise you to obtain another filter primary coil of the same type as at present in use in the secondary circuit, and to couple the aerial to it by one of the conventional "aperiodic" methods.

FOREIGN BROADCAST GUIDE.

VIIPURI (VIBORG)

(Finland).

Geographical position: 60° 43′ N., 28° 47′ E.

Approximate air line from London: 1,270 miles.

Wavelength: 291 m. Frequency: 1,031 kc. Power: 15 kW.

Standard Time: Eastern European (one hour in advance of B.S.T.).

Standard Daily Transmissions.

Relays Helsinki (see Lahti).

Man and woman announcers. Call: *Huomio! Huomio! taala Suomen Yleisradio Helsinki-Lahti* (in Swedish: *Giv akt! Giv akt! Har Finlandsrundradio Helsingfors-Lahti*).

Good Night: *God Nat.*

Viipuri broadcasts on a common wavelength with Tampere (Tammerfors) 1 kW.