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EDITORIAL COMMENT

Interference Suppression

France Sets an Example

IT is a curious paradox that although of all European countries France has been one of the slowest to develop an efficient broadcasting service, yet France is leading the way in the matter of control of interference affecting reception.

It would almost seem as if France has taken the view that the French public ought not to be expected to contribute to broadcasting in the form of paying a licence until proper steps have been taken to clear the ether of interference as far as possible.

Defining Interference

Whilst in this country and elsewhere experts are still arguing as to what constitutes interference, France has made a decision. In the new law just published in the official journal it is laid down that interference comes within the law when it reaches a value equivalent to a field strength of 1 millivolt per metre or more, and further that the interference must be of a duration not less than three seconds and recurring at intervals of greater frequency than 10 minutes.

Another interesting decision of the French Government in promulgating this law is that from October 1st, 1934, all electrical apparatus sold to the public must carry a label indicating whether or not the equipment has been rendered interference-free, in order that the purchaser may be well aware of the risk he runs of causing illegal interference if he uses apparatus which radiates.

Elsewhere in this issue we print a statement from the Institution of Electrical Engineers concerning the work of the Radio Interference Committee. It is pointed out that the Committee has found that it will be essential "to agree some standard of interference which on the one hand will represent substantial immunity for a well-designed radio set, and on the other hand is demonstrated as being of practical application to electrical appliances which emit interference, and to radio sets which are subject to such interference."

From reading the I.E.E. statement in detail it would seem to us that the Committee is influenced too much by the representatives of the electrical industry and that the radio public is not receiving adequate consideration. It cannot be right that legislation should be introduced which would require that hundreds of listeners in a given area should be obliged to fit additional apparatus to their receivers to remove interference which could be far more effectively suppressed at the source at a fraction of the cost which would devolve upon the public to remove such interference individually at their receiving sets.

I.E.E. Committee and the Public

Too much attention seems to be directed towards putting the onus upon the individual listeners, when suppression of the interference at the source is the proper and obvious remedy.

If the Institution Committee will only insist upon putting the public interest first, we feel sure that they will in the long run be acting in the best interests of Institution members. This Committee has been set up on a suggestion from *The Wireless World* to consider a matter of public concern and it would indeed be deplorable if its ultimate findings indicated that it had been serving "party" interests instead.

High Quality Amplification

Designing Distortionless Apparatus

IN the reproduction of music and speech for entertainment purposes the attainment of a high standard of fidelity is of paramount importance, and with suitable equipment it is possible for this to be so high that it is easy to mistake the reproduction for the original. For this desirable effect to be achieved in practice it is necessary for distortion to be considerably lower than the level usually tolerated, and special precautions have to be taken throughout the apparatus. In this article the chief sources of distortion are discussed together with those arrangements which are inherently the most free from undesirable effects, and which are consequently the most suitable for high quality reproduction.

By W. T. COCKING

BROADCASTING and gramophone records are used chiefly for entertainment purposes, the aim being to reproduce in the listener's own home exactly what he would hear if he were in the studio. Unless the sound output from the loud speaker is identical with that in the studio, the reproduction cannot be said to be distortionless. In many aspects of wireless, of course, distortion is not thought of great importance, and most commercial services are considered satisfactory as long as speech is intelligible. Mere intelligibility is far below the requirements of broadcasting, however, and a very high degree of freedom from distortion is necessary if the reproduced version of an orchestra is to bear any great resemblance to the original.

In the link between the studio and the listener's room a very large amount of apparatus is involved, and in the last resort there is none of it which can be truly said to introduce no distortion at all. Properly designed and operated equipment, however, need cause only a minute amount of distortion, and for most practical purposes can be called distortionless.

We need not here concern ourselves with the transmitting side in the case of broadcasting, or the recording difficulties in the case of gramophone records. It is of more practical moment to deal with the apparatus under our immediate control, namely, the reproducing equipment, and of this only a part can be considered at the moment. This part is the low-frequency amplifier, and includes all the apparatus between the detector, or the gramophone pick-up, and the loud speaker.

Frequency Response

There are three types of distortion which such apparatus may introduce—amplitude, frequency, and phase distortion. Amplitude distortion occurs when the amplification is a function of the input voltage. Actually, its effect is to introduce alien frequencies which are multiples of the input frequency. It always occurs if the input is greater than that for which the apparatus is designed, and it is responsible for much of the harsh and rasping reproduction that is heard. Frequency distortion means merely that the amplification is a function of frequency, so that all notes are not amplified equally.

The ear is very accommodating with respect to this type of distortion, and large departures from the ideal condition are possible without any noticeable effect.

For perfect reproduction all frequencies between 25 and 20,000 cycles must be amplified equally. No broadcasting station, however, transmits frequencies above some 10,000 cycles, and few gramophone records contain frequencies above 6,000 cycles. Moreover, experiments have indicated that the range of 25 to 10,000 cycles gives reproduction so natural that it is very difficult to detect the absence of higher frequencies, and their absence is probably noticeable only on certain noises as distinct from musical sounds. We may say, therefore, that practical perfection is reached with a uniform response between 25 and 10,000 cycles.

The response, however, need not be entirely uniform, for the ear cannot detect small changes in volume. With a rapid comparison of a single note the ear cannot detect a change of less than about 1 db. Where the comparison is between notes of different frequency the ear is much less sensitive, for the sensitivity of the ear itself varies greatly with frequency. It is not too much to say that a variation in amplification of 5 db. at the extremes of the frequency scale would not be detectable on either speech or music. For practical perfection, therefore, the overall response of the apparatus should not vary more than 5 db. over the whole range of 25 to 10,000 cycles. Ordinary equipment, of course, gives a much greater variation, and there is often a loss of over 40 db. at the highest frequency.

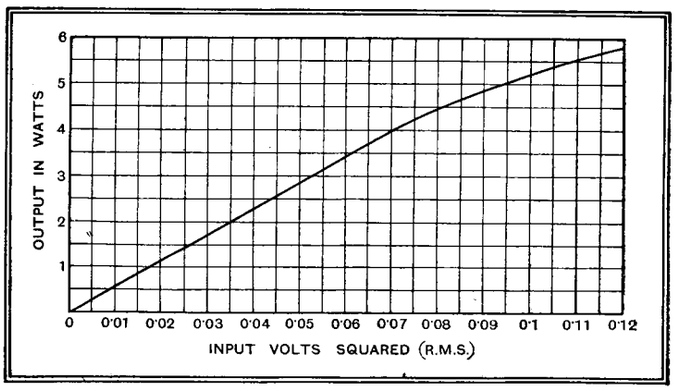


Fig. 1.—This curve shows the relationship between the square of the input voltage to the amplifier and the power output. It is a straight line for outputs up to 4 watts, indicating distortionless amplification. The distortion at 6 watts, however, is quite small.

Amplitude Distortion

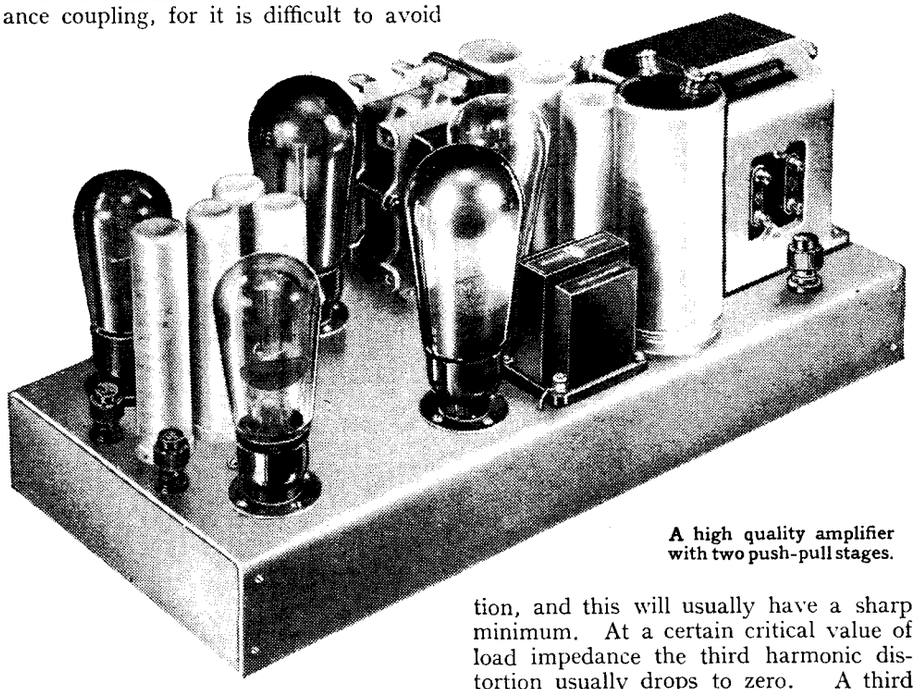
Amplitude distortion is more difficult to specify in figures but it is usually taken that 5 per cent. harmonic content is permissible, and the output of a valve is rated on this basis. Assuming for the moment that this figure is correct, although the writer is inclined to think it too high for the best quality, it must not be forgotten that if we choose every valve in the receiver on this basis the total distortion will be much greater. If we require only 5 per cent. total distortion we can choose the output valve on a basis of 5 per cent. distortion only if the distortion in all the other equipment is zero. This will never be the case, so that where first-class reproduction is needed it is necessary to design every stage for minimum distortion.

Amplitude distortion occurs chiefly in valves, and when the valve is acting as an amplifier the distortion is smallest for a small input. It is, however, never quite zero, although it may be negligibly small. This form of distortion may also be introduced by transformers and iron-cored chokes, for, like valves, the characteristics of iron are non-linear. The distortion may be reduced to a very small quantity by the correct design of the components, but the simplest course is to eliminate it wherever possible by using components which do not involve iron cores. Resistance coupling, therefore, is the most inherently free from amplitude distortion.

The question of frequency distortion is not difficult, and it is not unduly troublesome to obtain an even response with either transformer or resistance coupling, but greater freedom in design is possible

High Quality Amplification—

with the latter. Although phase distortion is usually considered to be unimportant in sound reproduction, it is doubtful if this has been definitely proved, and in any case it plays an important part in television. While not so important as other forms of distortion, therefore, it is desirable that it be kept at a minimum. As a result there is no real alternative to resistance coupling, for it is difficult to avoid



A high quality amplifier with two push-pull stages.

severe phase distortion with transformers. It will be seen, therefore, that resistance coupling is the most suitable for a high-quality amplifier.

Pentodes v. Triodes

Returning to the question of amplitude distortion, we can use triodes or pentodes alone, in parallel, in push-pull, or in parallel-push-pull, in the output stage. Since connecting two valves in parallel is the same as using one of half the resistance, our effective choice is between triodes and pentodes alone or in push-pull. In a triode the distortion is chiefly due to the introduction of a second harmonic, and higher harmonics are negligible in comparison. If we plot a curve showing the relationship between the percentage distortion and the power output, this will gradually rise from small outputs until the rated power for five per cent. distortion is reached. For higher outputs, the curve will usually rise more rapidly. A very similar curve will be found for the total distortion in a pentode, but the distortion may be either second or third harmonic or a combination of both.

Suppose now that for a certain output we plot a curve showing how the distortion varies with the load impedance on a triode valve. There will be a certain value of load impedance for which the distortion is a minimum, and although this optimum load impedance is well defined, it is not very critical, and quite large changes make only a small difference to the distortion. It must be remembered that the distortion is almost entirely due to the introduction of a second harmonic.

Now let us consider the pentode. The curve showing the relationship between second harmonic distortion and load impedance will be similar to that for a triode. Another curve can be drawn, however, showing third harmonic distortion, and this will usually have a sharp minimum. At a certain critical value of load impedance the third harmonic distortion usually drops to zero. A third curve showing total distortion gives another optimum load impedance. With a pentode, therefore, there are three different load impedances which we might use, according to circumstances. There is one load giving minimum second harmonic distortion, another giving zero third harmonic, and still another giving minimum total distortion. In general, each of these impedances is more critical than in the case of a triode.

Before deciding between a triode and a pentode, let us consider the relative advantages of a single large valve and two smaller ones in push-pull, for even harmonics are largely balanced out by the push-pull connection. With two triodes in push-pull, therefore, second harmonic distortion is negligible and the overload point is determined by the appearance of third harmonics when the output is such that the second harmonic *per valve* is much greater than five per cent. Two triodes in push-pull, therefore, will give more than twice the output of a single similar valve for the same total distortion. Of even greater importance, however, is the fact that up to the normal output per valve the distortion is negligible in a reasonably well-balanced stage, whereas it is not with a single valve.

Now let us consider the question of using pentodes in push-pull, and as third harmonic distortion cannot be balanced out it is obvious that we should choose the load impedance giving zero third harmonic distortion. Since the push-pull connection will eliminate the second harmonic distortion, this load impedance should become the optimum for a push-pull stage, and freedom from both second and third harmonic distortion should be obtained.

The Load Impedance

On the data at present available we have no grounds for a choice, for one important factor has been omitted. In practice the load impedance on the output stage is not constant, for it varies greatly with frequency. It is, therefore, impossible to work with the optimum load impedance at all frequencies unless compensating devices are used. Ignoring these for the moment, it will be remembered that the pentode is much more critical in the matter of load impedance than the triode, consequently the distortion introduced by the lack of constancy in the impedance of the loud speaker will be the greater with the pentode. It is true that compensating circuits can be devised to maintain the load on the output stage more nearly constant, but these are usually tricky in their adjustment and often give a loss of power.

Another aspect of the matter is worthy of mention. No loud speaker is completely free from resonances, and it is possible to reduce these by damping the speaker electrically. This is effected by the transferred valve resistance being effectively in parallel with the speech coil,

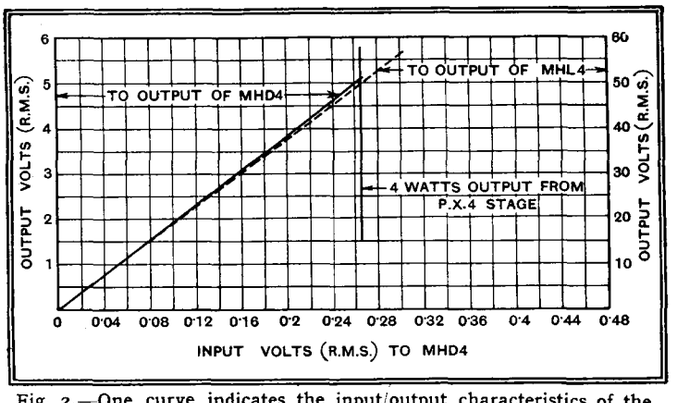


Fig. 2.—One curve indicates the input/output characteristics of the first amplifier stage, while the other gives the same information for the first two stages together. Both curves are straight lines for inputs below 0.265 volt R.M.S.

and this is much lower in the case of a triode than with a pentode. An example may make the matter clear. Assume that we have a speech coil of 8,000 ohms impedance and we use it with a 1-1 ratio output circuit. Correct matching with a triode will be secured when the valve has a resistance of some 3,000 ohms, so that the damping on the speaker is due to a shunt resistance of 3,000 ohms. Now

High Quality Amplification—

with the average pentode the 8,000 ohms impedance of the speech coil gives correct matching, but the A.C. resistance of the valve is some 30,000/60,000 ohms, so that the speaker is damped much less heavily. Resonances, therefore, will be more prominent with the pentode than with the triode.

It will be clear, therefore, that the ideal output stage for present types of loud speaker is a pair of triodes connected in push-pull. It is not sufficient, however, to reduce the distortion in the output stage to a minimum, and just as much care must be given to the design of the earlier stages. Since resistance-capacity intervalve coupling is to be used, it is hardly possible to use a single valve to feed the output stage, for the distortion in this penultimate stage would exceed that of the output valves. Push-pull must be used here, therefore, but as this stage requires only a moderate input it may be fed without distortion from a single valve if care be taken to choose the operating conditions correctly.

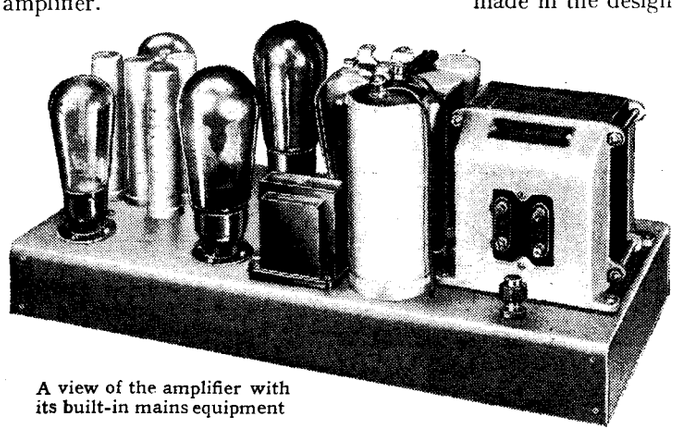
The degree of linearity obtainable by following the procedure laid down in this article is well brought out by the curves of Figs. 1 and 2. Fig. 1 shows the relationship between the square of the input voltage and the power output of an amplifier, full details of which will be given next week. It is a straight line up to the maximum output of 4 watts, but after this the overload point is reached. Fig. 2 shows the linearity of the individual stages, one curve showing the relationship between input and output volts for the first triode, which has a load impedance of 100,000 ohms, and the other the relationship between the input to the amplifier and the input to the output stage. Both curves are straight for inputs exceeding that for 4 watts output, showing that the non-linearity of the whole amplifier at outputs over 4 watts is due entirely to the output stage, as it should be.

In Next Week's Issue :—

PUSH-PULL QUALITY AMPLIFIER

Quality Apparatus for Sound Reproduction and Television

THE highest standard of reproduction demands a flat overall characteristic up to about 10,000 cycles with a very low limit of amplitude distortion, while for television purposes a minimum of phase distortion is also important. These requirements are best met by a resistance-capacity coupled push-pull amplifier.



A view of the amplifier with its built-in mains equipment

In the amplifier to be described in next week's issue of *The Wireless World* two push-pull connected PX4 valves are used in the output stage, and deliver about 4 watts to the loud speaker with negligible harmonic content. If the usual degree of distortion be permitted, however, an output of some 4-6 watts can be obtained.

The output stage is fed by a pair of MHL4 valves, also connected in push-pull, and the necessary phase reversal for their operation is obtained from the single valve used in the feeder unit. In order to obtain the full 4 watts output an input to the first valve of no more than 0.265 volt R.M.S. is needed.

Hum is inaudible and provision is made for energising a speaker field. Although the equipment described is primarily intended for gramophone work, provision is made in the design for using it with radio receivers, and the mains equipment is capable of providing 260 volts at 40 mA. for its operation, together with 4v. A.C. at 5-6 amperes.

Measurements have shown complete linearity up to an output of 4 watts, and that the frequency response is flat within 1.2 db. over the range of 20 to 10.000 cycles.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances

AMPLIFIER

1 Mains transformer, primary, 200 to 250 volts, 50 cycles; secondaries, 425-0-425 volts, 120 mA.; 4 volts 2.5 amps. centre-tapped; 4 volts 1 amp. centre-tapped; 4 volts 1 amp. centre-tapped; 4 volts 7/8 amp. centre-tapped **Sound Sales Type PP/QA**
(B.S.R., British Radio Gramophone Co., Bryce, Challis, Heayberd, Claude Lyons, Parmeko, R.I., Rich and Bundy, Varley, Vortexion, Wearite.)
1 Smoothing choke, 7/30 henrys at 120 mA, 215 ohms **Ferranti B2**
1 Smoothing Choke, 20 henrys at 50 mA., 400 ohms **R.I. "Hypercore"**
(Alternatives same as mains transformer above)
3 Electrolytic condensers, 8 mfds., 500v. peak **Dubilier 0281**
1 Fixed condenser, 4 mfds., 450v. working, cylindrical container **Dubilier LEG/9204**
2 Electrolytic condensers, 4 mfds., 500v. peak **Dubilier 0283**
(Ferranti, Peak, T.C.C.)
2 Electrolytic condensers, 50 mfds., 50v. peak **Dubilier 3003**
2 Electrolytic condensers, 200 mfds., 10v. peak **Dubilier 0283**
(T.C.C.)
2 Fixed condensers, mica, 0.1 mfd. **Dubilier B775**
(T.C.C.)
2 Tubular paper condensers, non-inductive, 0.05 mfd. **Dubilier 4403**
(Graham-Farish, Peak, T.C.C., T.M.C.Hydra)
2 Resistances, 1,000 ohms, 2 watts **Claude Lyons**
2 Resistances, 160 ohms 1 watt **Claude Lyons**
2 Resistances, 1,000 ohms 1 watt **Claude Lyons**
2 Resistances, 5,000 ohms 1 watt **Claude Lyons**
2 Resistances, 10,000 ohms 1 watt **Claude Lyons**
2 Resistances, 25,000 ohms 1 watt **Claude Lyons**
2 Resistances, 250,000 ohms 1 watt **Claude Lyons**
2 Resistances, 500,000 ohms 1 watt **Claude Lyons**
(Dubilier, Erie, Ferranti, Graham-Farish, Seradex, Watmel)
7 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
1 5-pin plug **Bulgin**
(British Radio Gramophone Co.)
3 Ebonite shrouded terminals, Input (2), Earth (1) **Belling-Lee Type "B"**
1 Metal Chassis **C.A.C.**
Valves:—2 Marconi or Osram MHL4; 2 Marconi or Osram PX4; 1 Marconi or Osram MU14

FEEDER UNIT

1 Electrolytic condenser, 8 mfds., 500 volts peak **Dubilier 0281**
(Ferranti, Peak, T.C.C.)
1 Electrolytic condenser, 50 mfds., 6 volts peak **Dubilier 3001**
(T.C.C.)
1 Resistance, 7,500 ohms 10 watts **Dubilier "Spirohm"**
(Bulgin)
1 Resistance, 2,000 ohms 1 watt **Claude Lyons**
3 Resistances, 50,000 ohms 1 watt **Claude Lyons**
(Dubilier, Erie, Ferranti, Graham-Farish, Seradex, Watmel)
1 Tapered volume control potentiometer, 250,000 ohms, with knob **Ferranti Type "P"**
(Claude Lyons, Magnum, Rothermel)
1 Valve holder, 5-pin **Clix Chassis Mounting Standard Type**
1 5-pin plug **Bulgin**
(British Radio Gramophone Co.)
1 5-way cable with twin 70/36 leads **Harbros**
(Goltone)
4 Ebonite shrouded terminals, Output (2), Input (2) **Belling-Lee Type "B"**
1 Metal chassis **C.A.C.**
Valves:—1 Marconi or Osram MH4

Interference With Radio Reception

THE Institution of Electrical Engineers' Committee on Radio Interference has issued the following statement:—

The Committee find it desirable to establish, in the first place, practical methods and instruments for appraising the interference and the apparatus causing it. With this end in view it has been found essential to agree some standard of interference which, on the one hand, will represent substantial immunity for a well-designed radio set, and, on the other hand, is demonstrated as being of practical application to electrical appliances which emit interference, and to radio sets which are subject to such interference.

The attention of the Committee is further being actively directed along two channels:

(1) A study of methods and devices, and their effectiveness, which are within the power of the radio listener to apply, for ameliorating the effects of interference.

(2) A study of methods and devices for suppressing the emission of interference from electrical apparatus.

The interests represented on the Committee are co-operating actively to resolve all these questions as a necessary preliminary to making recommendations.

The Committee note with satisfaction various constructive efforts to help forward a better understanding of the problem, and practical steps for ameliorating the trouble. They think it well, however, to call attention to the fact that there are phases of the problem yet to be solved.

Single-Span Dissected

Simplified Diagrams Explaining the New Tuning System Step by Step

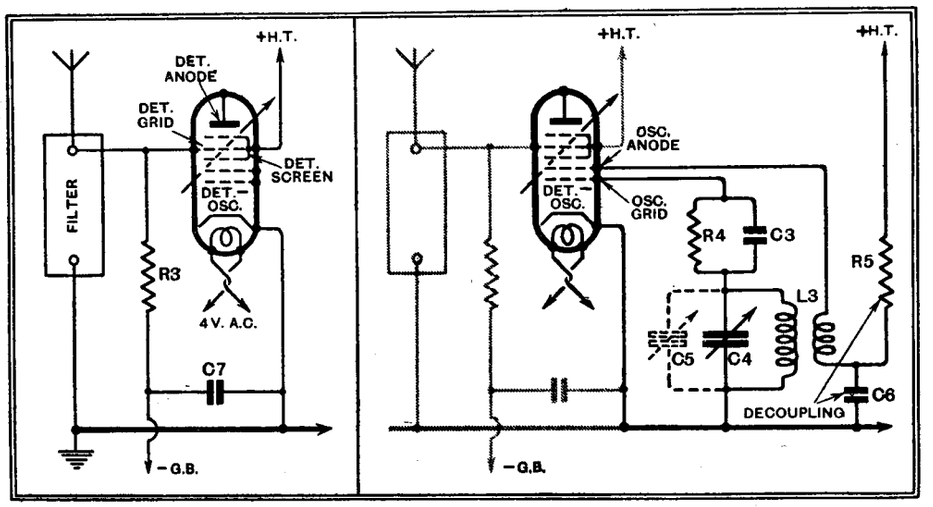
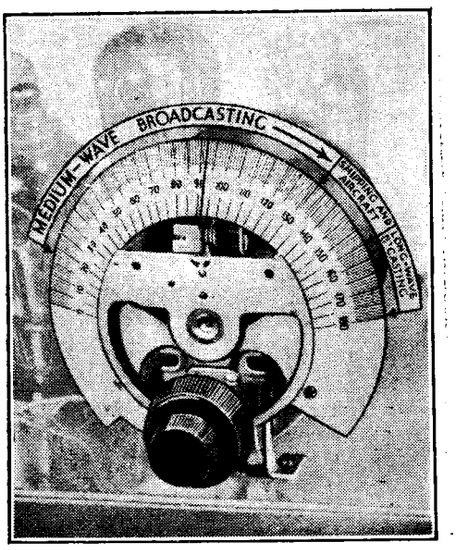


Fig. 1.—The input filter circuit.

Fig. 2.—Oscillator circuits of the frequency-changer valve.



A typical "Single-Span" tuning scale. Although the long-wave section may appear to be crowded, these stations actually have their full share of space.

ALTHOUGH the Single-Span receiver recently described in these pages is simpler than a conventional A.C. superheterodyne, the circuit diagram appears to be complicated unless considered in stages. A study of this series of dissected diagrams will explain the functioning of the new system from an essentially practical point of view.

Fig. 1.—Signals at all broadcasting wavelengths are applied to the detector grid of the frequency-changer valve through a special input filter; all lower wavelengths which might cause second-channel interference are cut off. Negative bias for anode-bend detection is applied through R3.

Fig. 2.—A tuned circuit covering wavelengths between about 100 and 170 metres (1,750-3,100 kc/s) is connected across the oscillator grid circuit of the valve, negative bias being produced by the action of R4 and C3. The oscillator anode circuit is completed through a reaction coil. Locally generated oscillations and those of the chosen wavelength from the aerial combine in the valve to produce a "beat" at nearly 190 metres wavelength (1,600 kc/s).

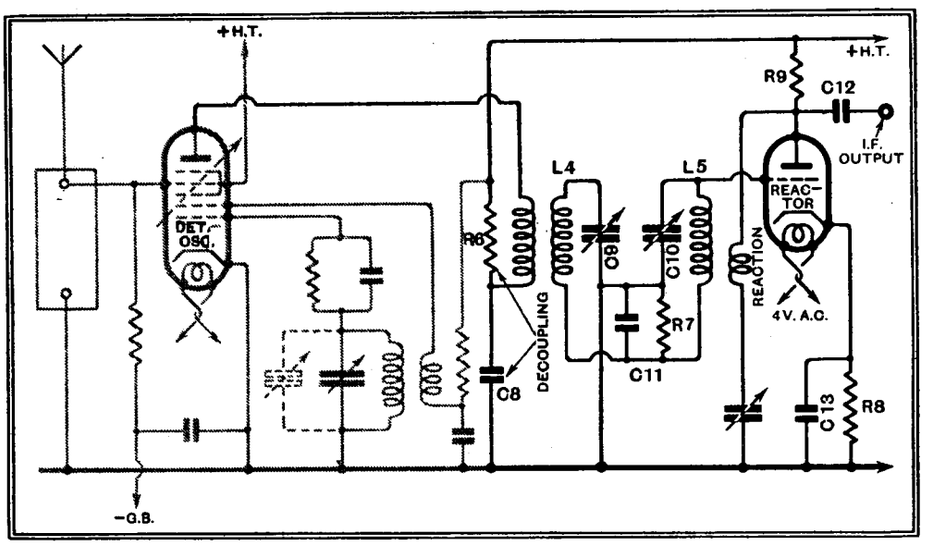


Fig. 3.—Intermediate-frequency impulses are applied to the reactor valve.

Fig. 3.—Signals of this new frequency are applied through the I.F. filter network to the grid of the reactor or buffer valve. Selectivity, and to a lesser extent sensitivity, are determined by the amount of reaction applied between grid and anode circuits of this valve.

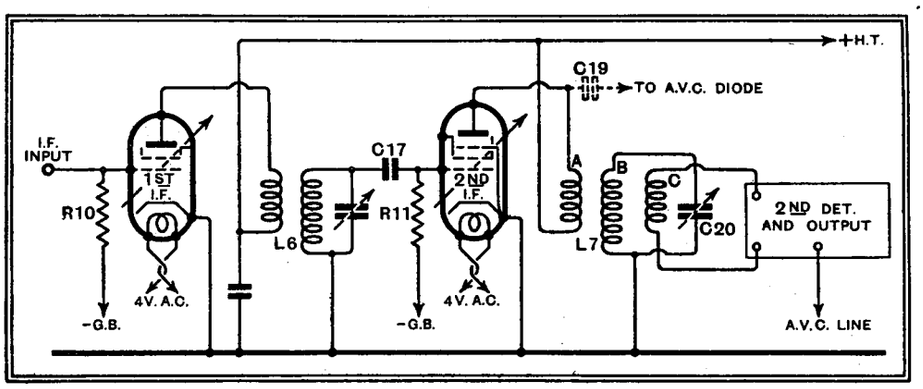


Fig. 4.—Intermediate-frequency amplifier and second detector-output connections.

Fig. 4.—The intermediate frequency output from the reactor valve is passed to a straightforward two-stage I.F. amplifier by resistance coupling, and after amplification, to a second detector and output stage of conventional design. Arrangements are made to feed back A.V.C. voltages to the grids of the detector-oscillator and the first I.F. amplifier.

UNBIASED

By FREE GRID

Confined his lethal activities to wasps.

Summer-y Justice

ONE of the hardiest of annuals in the realms of invention is undoubtedly the death ray. It seems to recur with almost monotonous regularity, and I see by my morning paper that it is being served up to us once again. In this instance, however, the claims of the inventor are singularly modest as, so far, he has confined his lethal activities to wasps, flies and mice.

Still, even if it can only eradicate these pests, his invention should be a boon and a blessing to man, and I am glad to see that this point is appreciated by a well known preserve-making firm who have approached the inventor with a view to securing summary execution of the wasps which keep buzzing round their strawberry jam. Unfortunately, the range and scope of the apparatus seems limited, as it is necessary to place the wasps carefully between two copper plates.

I cannot help thinking that the time taken by the executioner in catching each wasp and placing it carefully between the two plates might be more profitably occupied by swatting it in the conventional manner. In fact, I am reminded of how I was duped years ago by an astute merchant who advertised a patent wasp killer, guaranteed to get its man every time. I sent up my guinea in high hopes and by return of post received two largish blocks of wood marked A and B. "After catching the wasp," ran the accompanying instructions, "place it carefully on Block A and press Block B firmly on top of it."

Why Not Llanfairpwllingogwgoch ?

FROM what I hear, the booklet containing "recommendations" concerning the pronunciation of Welsh place names has been productive of a great deal of unrest among the B.B.C. announcers, racial feeling having been aroused over the matter.

On the one hand, those who, like myself, have a certain percentage of Welsh blood in their veins, are righteously incensed at the outrage committed upon their natural patriotic feelings by a committee whose knowledge of Welsh names seems to have been derived from association with coloured seamen in Cardiff docks. On the other hand, the non-Celtic members of the announcing staff not unnaturally feel that they would endanger their dentures if they attempted to follow the advice of the committee.

Speaking as one who has some knowledge of the language, I must, however, point out that the danger would be no less even if the names were properly pronounced, and in any case the risk of laryngeal dislocation is no greater when pronouncing the Polish name of Szczebrzeszyn (which announcers frequently do) than in tackling our old friend Llanfairpwllingogwgoch, which, by the way, the committee obviously funked, as I can find no trace of it in their precious booklet.

I feel sure that as soon as these recommendations are put into practice ill-feeling will spread to the Welsh-speaking and the more civilised inhabitants of these islands. The former will naturally be displeased at the hideous mangling of their euphonious tongue, and the latter incensed at the apparent ineffectiveness of the devices which they have been inveigled into buying for the suppression of electrical interference.

As usual, the rôle of peacemaker and general problem-solver falls to me, and after much thought I have evolved a scheme which will not only prevent trouble but stimulate trade.

Briefly, my proposal is that Welsh and other foreign names of an unpronounceable type should be televised. By this process much heart-burning would be averted and public interest in television would be stimulated. This, in its turn would

Risk of laryngeal dislocation.

save many of our manufacturers from threatened bankruptcy and find a new use for the B.B.C.'s now scarcely-used 30-line transmitting apparatus.

Philomel

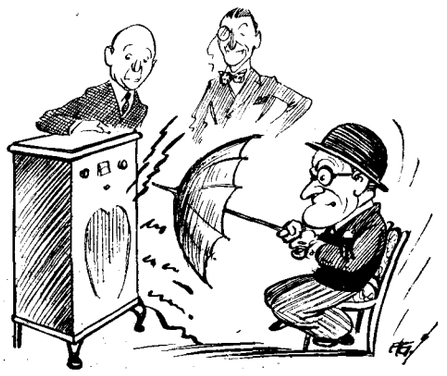
I AM heartily in agreement with the suggestion made by Mr. C. Tompsett in last week's issue to the effect that the B.B.C.'s new interval signal should consist of a recording of the nightingale.

There is, at any rate, no reason why the idea should not be given a trial. It would entail no expense to the B.B.C., as of course, they already possess an ample supply of nightingale records in the control room.

When a Noise Annoys

"WHAT noise annoys a noisy oyster most?" used to be a favourite wisecrack in the days of my youth, and apparently a somewhat similar question is troubling the minds of the committee set up some time ago by the I.E.E. to enquire into the causes and cure of various forms of electrical interference.

Everything has apparently gone smoothly with the enquiry, except that the committee cannot make up its mind as to what constitutes "an annoying noise." The reply to the original wisecrack used, I recollect, to be to the effect that a "*noisy* noise annoys a noisy



A truly appalling row.

oyster most," and I should have thought that this definition would have been good enough for this committee, but far from it. It is apparently quite unable to agree as to when a noise is noisy and annoying and when it is not, or in other words, what ratio to adopt between signal strength and interference.

I was quite unaware of these profound facts until a few evenings ago when I met a member of the committee at the house of a mutual friend. The wireless programme to which we were listening was almost blotted out at intervals by a truly appalling row, which was, our host told us, due to the efforts of a wretched woman next door who had invested in one of those diabolical contraptions known as an electric sewing machine.

My host and I naturally turned immediately to the committee man and asked what he and his colleagues were going to do about this sort of thing. To our surprise, however, he demurred, saying that in his opinion the offending noise was not nearly loud enough to be labelled as undesirable interference. Further questioned, he frankly confessed that the committee was undecided upon the question. In my opinion this disgraceful state of affairs can only be compared to the shilly-shallying of dentists, no two of whom are agreed as to what constitutes pain.

New System of Automatic Volume Control

Improving A.V.C. by I.F. Amplification

THE methods of obtaining automatic volume control are almost numberless and no system can in itself claim any great superiority over the others, for a choice depends largely upon the design of the receiver proper. Simple A.V.C. is now hardly ever used on account of the drop in initial sensitivity which it causes, and delayed systems are practically universal. In this article, a method is described whereby improved control is obtainable in a simple manner

ONE of the simplest automatic volume control systems is that known as delayed diode A.V.C.,[1] for two diodes can provide both signal rectification and automatic volume control, the components required are few in number, there is very little to go wrong, and there is a wide latitude in the choice of diodes. Two ordinary triodes can be used, a duo-diode, a duo-diode-triode, or a pair of Westectors.

The system, however, suffers from the disadvantage that for a wide range of control the delay voltage must be large, and this in turn means that the detector must be operated at a large input. When receiving a strong local station, in fact, the detector input will often be so large that the valve preceding the detector is overloaded, even if it be of the H.F. pentode type. A local-distance switch, therefore, is an essential feature of ordinary receivers incorporating this system of automatic volume control.

In order to overcome these difficulties a system involving the use of an additional valve operating as an anode bend detector[2] has been evolved and has been very widely used, particularly in America. This method of control is extremely satisfactory, and due to the gain obtained through the use of anode bend rectification as compared with diode detection, the A.V.C. bias voltage in the output is greater than the signal input. This, of course, is due to the rectifier acting to some degree as an amplifier also. Owing to the moderate input which it requires to produce a large bias, there is little risk of the last H.F. or I.F. amplifier valve being overloaded, even on a local station. Properly designed, an arrangement of this type can give very nearly perfect A.V.C., and it was employed in the A.V.C. Monodial Super.[3]

It is not without its disadvantages, however, the chief of which is the necessity for a source of potential negative with respect to the earth line of the receiver. This means, of course, that if the mains equipment is built on a separate chassis from the receiver there is a difference of potential of perhaps 100 volts between the two chassis, and if the apparatus be assembled in one unit difficulties arise in the mounting of electrolytic condensers. The provision of this voltage may in some cases prove difficult, for 100 volts is usually necessary for good operation and the avoidance of overloading in the A.V.C. valve itself. A further difficulty arises through the variations in the characteristics of different valves of the same type, which occur at their greatest in the region of anode current cut-off. The bias must normally be adjusted to be slightly higher than the figure which just cuts off the anode current, and it is found in practice that the bias voltage often requires readjustment when the A.V.C. valve is changed. Furthermore, the internal valve resistance is infinite with no applied signal, which means that the time constant of the circuit is high. As soon as a signal is tuned in of sufficient strength to operate A.V.C., of course, the time constant falls. The curious effect is obtained, however, of rapidly falling sensitivity on tuning in a station, but slowly rising sensitivity when tuning away from it.

These demerits of the system, however, are relatively unimportant when compared with the undoubted advantages which it has to offer, and the chief disadvantage is the necessity for a voltage supply negative with respect to the earth line. This point is usually sufficient to prohibit its use in a battery receiver.

The next system to appear for consideration is amplified A.V.C.[4] which would now be better termed D.C. amplified A.V.C. A duo-diode-triode valve is employed in which one diode acts as a detector, the triode provides amplification of the D.C. potentials, and the other diode provides the requisite delay. In addition to its functions in providing A.V.C., signal rectification and first stage L.F. amplification can also be obtained from the same valve. In the D.C. amplification, a stage gain of twenty times can readily be obtained, so that the detector input need only be one-twentieth of that necessary in a delayed diode system, and overloading of the preceding valve need hardly be considered. Practically perfect A.V.C. may be obtained with this arrangement, but if the valve is used also as an L.F. amplifier, considerable care in design is necessary to avoid distortion on a strong signal.

The arrangement is by no means as

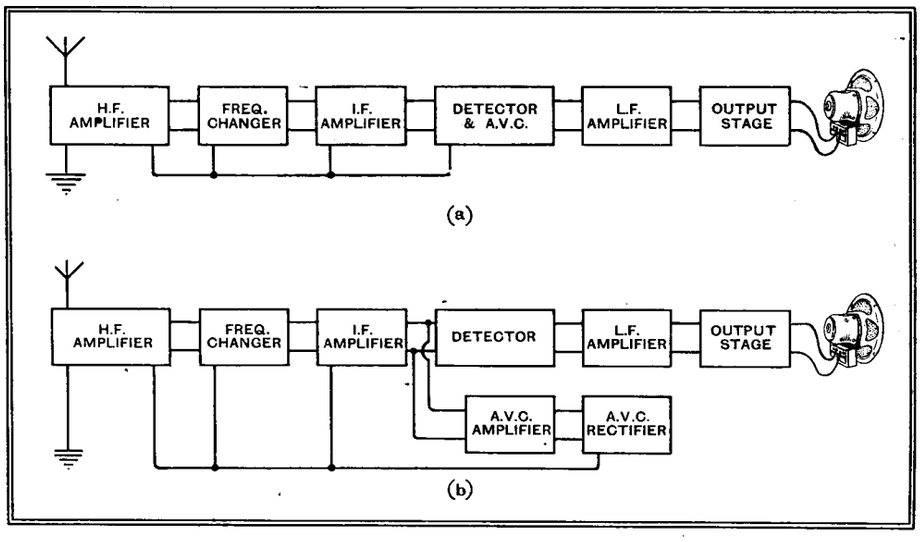


Fig. 1.—The schematic diagram of a superheterodyne fitted with delayed diode A.V.C. is shown (a) and the arrangement for I.F. amplified A.V.C. at (b).

[1] *The Wireless World*, p. 208, Sept. 8th, 1933.
[2] *The Wireless World*, Jan. 6th and 13th, 1933.
[3] *The Wireless World*, March 17th and 24th, 1933.
[4] *The Wireless World*, p. 244, September 22nd, 1933.

New System of Automatic Volume Control—

simple as that using a separate control valve, and it still necessitates a difference of potential between the earth line of the receiver and negative H.T., so that it offers no advantage in this respect, and its use in a battery receiver is usually impracticable. Although the arrangement is in many respects ideal, it has been found in practice to suffer from one serious disadvantage—its liability to cause an effect similar to motor-boating. The reasons for this trouble are not yet all known, but it can be cured by using a large by-pass capacity across the A.V.C. output. Unfortunately, however, this increases the time constant to such a degree that the operation is not always pleasant, for the sensitivity of the set does not decrease quickly enough on tuning-in a strong signal, and rises only slowly as the set is tuned away from it, so that adjacent weak stations may be missed.

I.F. Valve Output

Now, it will be obvious that the only method of control which meets all requirements as regards simplicity, a low time constant, and the absence of any voltage negative with respect to the earth line, is the delayed diode system, and that the only disadvantage of the arrangement is that on a strong signal it requires such a large input that the last H.F. or I.F. valve is overloaded. Such overloading, of course, leads to serious distortion. The amplification of the diode output by a D.C. amplifier is not wholly satisfactory, is often inconvenient, and usually impracticable in a battery-operated receiver. Obviously, however, some form of amplification is needed. The solution would seem to lie in the provision of an extra stage of amplification preceding the diode A.V.C. system—a stage of amplification used only for feeding the diode, and not for feeding the detector.

It might be thought that this would confer no benefit and that overloading in the stage feeding the diode would still be prevalent. This is not necessarily the case, however, for this amplifier would not be controlled for A.V.C. purposes. A comparison of Figs. 1a and 1b will make this clear. The former shows the usual arrangement for delayed diode A.V.C., and it will be seen that the A.V.C. diode is fed from the last I.F. valve, and that the bias is applied to this valve as well as to the early stages. In the case of Fig. 1b, however, an extra I.F. valve is used only for feeding the A.C.V. diode and this is not controlled, for the bias is applied only to the same valves as before.

Now, in the case of variable-mu valves the output obtainable depends very largely upon the bias voltage applied, and it falls rapidly when the bias exceeds a certain figure. Thus, an output of 100 volts R.M.S. may be obtainable when the bias is -2 volts, but the limit may be reached at 5 volts with a bias of -32 volts. Such a bias may easily be needed for local reception, so some idea of the limitations of the arrangement will be apparent.

This will perhaps be clearer if a rough example of the actual voltages involved is given. Suppose that we are working with a delay of 10 volts. A signal of strength just sufficient to give a detector input of 10 volts peak will produce no A.V.C. bias. A band-pass filter is used as a coupling from the I.F. stage in most superheterodynes, but the carrier output of the I.F. valve will not be more

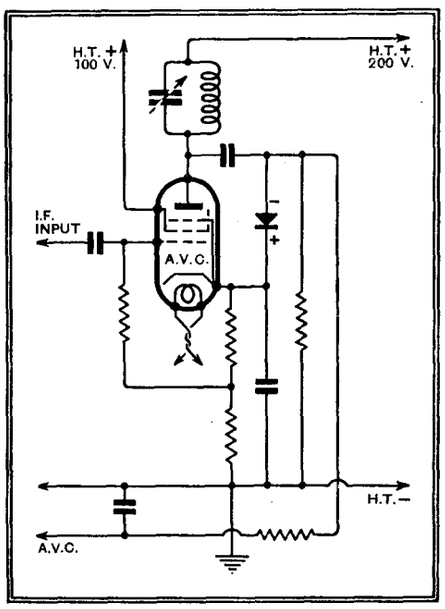


Fig. 2.—The connections for I.F. amplified A.V.C. using a screened H F. pentode and a Westector.

than ten volts peak; on eighty per cent. modulation this will rise to eighteen volts peak. It will be seen, therefore, that even on a weak signal the I.F. valve must give quite a large output. Now let us take the case of a stronger signal such that the detector input has risen to twenty volts peak (an increase of six db) so that the A.V.C. bias is roughly ten volts. The I.F. valve output on deep modulation must now be thirty-six volts peak, but the maximum undistorted output of even an H.F. pentode is unlikely to exceed about thirty volts peak at a bias of ten volts.

The difficulty could be largely got over, of course, by controlling only the early valves from the A.V.C. system. This is by no means a wholly satisfactory remedy, however. In the first place, the efficiency of A.V.C. is reduced, so that a larger bias is required on the stronger signals, which in turn means a larger detector input and a greater I.F. valve output. Secondly, the first valve of the receiver may have to handle a large input when the set is tuned to a local station, and the different operating conditions may not suit this stage so well.

Now, there is a big gain if we use a separate uncontrolled I.F. stage for feeding the A.V.C. diode, for since the output of this valve does not feed the detector proper any distortion which may occur in this stage is relatively unimportant, and does not affect the output of the receiver. It is permissible, therefore, to permit some degree of overloading in this amplifier. An H.F. pentode at about -2 volts bias will give an output of over 100 volts R.M.S. without distortion, or, say, 150 volts peak. It would be possible, therefore, to work with a delay voltage of seventy-five volts in the diode system, and to obtain up to seventy-five volts A.V.C. bias before overloading occurred on a carrier. Even allowing for 100 per cent. modulation, 37.5 volts bias could be obtained before distortion set in, and this would be ample to hold down the strongest local station with the usual three controlled stages.

There are many ways in which the system could be arranged, and one obvious method is to use an H.F. pentode to feed a separate diode, which might be a Westector, as in Fig. 2. Such a system would provide practically perfect A.V.C. and would have the great advantage, particularly for a battery receiver, of not increasing the total H.T. voltage required. The various elements could, of course, be combined in a single valve, and an H.F. pentode-diode would permit the abolition of the separate diode. No suitable valve is at present available in this country, however, for it would be necessary to use a valve with the control grid brought out to the top of the bulb, and the present diode-pentodes have the anode in this position.

A little thought, however, will show that an arrangement such as this is unnecessarily good. An A.V.C. bias of more than some thirty volts is rarely required, which means that the amplifier output need not exceed some sixty volts. A stage gain of 200 times would easily be obtainable with a good mains-type H.F. pentode, so that the input would be only 0.3 volts peak for the strongest signal. It is not usual to work the detector at such a low input on account of the distortion which might occur. We can, therefore, considerably reduce the amplification without adversely affecting A.V.C.

(To be concluded.)

THE RADIO INDUSTRY

THE Automatic Coil Winder and Electrical Equipment Co., Ltd., of Winder House, Douglas Street, London, S.W.1, announce an interesting competition, with valuable prizes, for users of the Avo Minor testing instrument. Among other things, competitors are asked to enumerate tests that may be carried out with the instrument, and some useful hints on this important subject should materialise.

An important announcement from Standard Telephones and Cables, Ltd., refers to the introduction of a complete range of universal A.C.-D.C. valves, comprising a variable-mu H.F. pentode, heptode frequency changer, double diode triode, output pentode, and full-wave rectifier. All valves consume 0.2 amp. at either 13 or 40 volts.

The address of Fluxite, Ltd. (makers of the well-known soldering flux) has been changed to Dragon Works, Bermondsey Street, London, S.E.1. Telephone: Hop. 2632.

An organisation to be known as T.M.C.-Harwell Sales, Ltd., is to be formed, and will take over the selling business of Harwell, Ltd., and the Telephone Manufacturing Co., Ltd. (T.M.C.), including the distribution of T.M.C.-Hydra condensers.

BROADCAST BREVITIES

By Our Special Correspondent

"Secret" Tests Not Secret

WITH the start of aeroplane tests around Daventry the B.B.C. engineers have now employed practically every means of locomotion except the submarine.

The present tests are concerned with measuring the relative strength in different directions of the indirect ray from the Empire transmitters. Taking off from Heston, the 'plane cruises within a radius of twenty miles of Daventry, while the engineer aloft notes the relative strengths on a specially prepared map.

Mast Scrapping at Daventry

Soon the same measurements will be carried out on the transmissions from the new 300-foot masts now being erected in the Daventry field to supplement the existing aerial arrays. Ultimately, the shorter masts may be scrapped.

P.O.'s Missed Opportunity

I am surprised that the Post Office has not nourished the rumour that the Daventry 'plane is searching for wireless pirates.

Are Announcers Nervous?

A CUCUMBER is supposed to have nothing over an announcer in the matter of coolness, so it came as a surprise when Stuart Hibberd and Freddie Grisewood confessed to me last week that they both have bouts of nervousness in the studio.

"There are nights," said Mr. Grisewood, "when one is ready to tackle anything; at other times, one feels that the news bulletin is waiting to trip one up."

Pronunciation Nightmares

A Chinese war spells misery to the announcers. If there is time, an announcer will sometimes 'phone through to the Chinese Gonsulate for the correct pronunciation of a tongue-twisting name; otherwise, he must be guided by certain specially formulated rules.

"Mike Fright" Among the Great

Apparently there is just as much "mike fright" to-day as ever there was.

"Very often," said Mr. Hibberd, "the more eminent a speaker the more nervous he is. Some grow out of it, but others are just as uncomfortable after broadcasting a dozen times."

Secret of Success

The fatal error in addressing the microphone is to visualise the listening millions.

"Forget them," said Grisewood. "Imagine you are talking across the table to a friend."

Henry Hall's Surprise

EVEN Henry Hall gasped last week when, bounding out of the lift, he found himself in the midst of a drove of journalists.

I managed to get in a word edgeways.

Tunes from All Quarters

The big bother at the moment is the spate of unsolicited manuscripts showered on Henry by budding musicians.

Some of these "composers" send merely the top line, the so-called melody, in the joyful belief that Henry Hall will be only too pleased to orchestrate it. Others, who have, perhaps, less faith in the persuasiveness of the melody, specify all kinds of comic instruments, hoping, no doubt, that what is lacking in originality will be made up in noise.

These are the amateurs.

Professionals, Too

There is also the crafty professional who submits a tune which is about to be published. If the printed music sheet can bear the glorious words: "As broadcast by Henry Hall and the B.B.C. Dance Band," the thing will sell.

American publishers, too, send advance copies of their numbers in the hope that a broadcast will help the sales.

Believe me, Henry Hall's life is not all "sweet music."

Opening of Droitwich Transmitter

WHO will open Droitwich? The B.B.C.'s ambitions stop at nothing, and I believe that an announcement of the first importance will shortly be made.

"ULTRA-SHORTS" FOR RADIO REPORTERS. An official of the American National Broadcasting Company visits the circus at Madison Square Garden, New York, with his ultra-short wave equipment strapped to his back.

The inaugural ceremony will take place early in August.

B.B.C. and the Television Committee

THE forthcoming investigation into the television question by the Technical Committee set up by the Postmaster-General should relieve the B.B.C. of a responsibility which has grown more irksome from day to day.

I understand that Mr. Ashbridge, the Chief Engineer, will represent the Corporation on the Committee, other members of which will be drawn from the Post Office, the Fighting Services, the Government, the film industry, and the Radio Manufacturers' Association.

Doomed

Sorry though I am to say it, 30-line television seems to be officially doomed. Be prepared for an early statement.

24-hour Time: The Angry B.B.C.

ONLY a dozen letters reached the B.B.C. anent the 24-hour clock. They were all complaints.

There is a feeling of resentment at Broadcasting House over the attitude of the Post Office in the matter. The Corporation has been made a scapegoat in the furtherment of a Government project. People at Portland Place are asking why the Post Office was afraid to make the experiment. 24-hour time might have been marked on pillar boxes—a much gentler, though more insidious, way of accustoming the public to the 24-hour system.

Scientists in Radio Thriller

"A FANTASTIC crime committed in the Fourth Dimension" is dealt with in Lance Sieveking's new radio play, "Wings of the Morning," which is to be heard in the Regional programme on May 24th and in the National programme on May 25th. I hear there is a scientific touch about the play, which includes members of the Royal Society as well as "minions of the law."

Leonard Henry in Shakespeare

THE Sunday Shakespeare play for the month of May is "The Merchant of Venice," to be broadcast on May 13th. Shylock will be played by Abraham Sofaer, and Jessica, his daughter, by Gwendolin Evans. Tubal will be Hector Abbas, and Launcelot Gobbo, servant to Shylock, will be Leonard Henry. Celia Johnson will play Portia.

For Your Diary

NO weaver of mysteries has supplied bigger posers than those to be discussed by Vice-Admiral Sir Charles Carpendale in his talk on June 25th next. His subject will be "Europe's Wavelength Problems."

A Visitor from Australia

THE only woman member of Australia's Broadcasting Commission, Mrs. Claude Couchman, is arriving in England within the next day or two. Mrs. Couchman will tell English enquirers that Australian listeners seem to like the existing arrangement in the Commonwealth, whereby they have the choice between commercial programmes and those broadcast from the dozen stations of the Australian Broadcasting Commission.

The whole of the technical side of the Commission's system is conducted by the Post Office department. Thus, if anything goes wrong, listeners know where to lay the blame.

"Please Don't Listen"

TO ask listeners not to listen, one imagines, is the best way of ensuring their attention. But the psychology of the business does not worry WOR, Newark, New Jersey, which, in self-protection, from time to time makes this announcement:—

"Those listening in from dry States may now tune out this station, for the next programme is not intended to offer alcoholic beverages for sale or delivery in any State or community wherein their advertisement, sale or delivery is unlawful."

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Single-Span Queries

SEVERAL readers have asked questions as to the possibility of employing double frequency changing in a receiver embodying the Single-Span tuning principle. It is proposed that incoming signals should first be changed to a frequency of 1,600 kc/s (as in the set recently described), or even to a higher frequency. A second frequency changer, with a fixed oscillator to convert the output to, say, a standard frequency of 110 kc/s, would follow immediately; at this frequency high amplification and good adjacent-channel selectivity would be obtainable without difficulty.

A scheme of this sort has so many obvious attractions that it has not been overlooked. However, several difficulties, including interaction between the two oscillators, remain to be overcome before double frequency changing can be regarded as practicable.

The "Directional Aerial" Fallacy

A READER suggests that second-channel interference from a powerful local station might be reduced by employing a directional "L" aerial, so orientated that its receptive powers with regard to the near-by transmitter would be at minimum. It is asked how an aerial of the type in question should be arranged in order to take advantage of its directional properties.

Although the proposed scheme is theoretically attractive we fear that it will be impossible to obtain any practical benefit from it. The directional properties of an ordinary open aerial are generally greatly over-estimated, and, indeed, it is doubtful whether they exist at all, except, perhaps, if the horizontal length can be made many times greater than the vertical height. The direction of maximum reception is indicated in

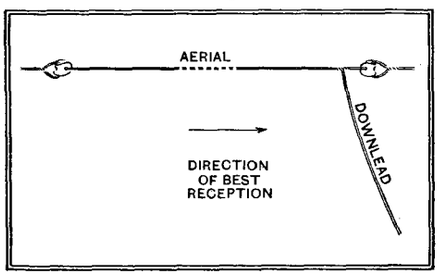


Fig. 1.—Illustrating the direction of best reception with an "L" aerial.

the accompanying Fig. 1; minimum signal strength will correspond to the diametrically opposite direction.

Litz Wire

THE user of a receiver fitted with Litz wire coils has noticed that one of the strands of the H.F. coupling coil is broken. So far as can be judged, neither sensitivity nor selectivity has suffered, but we are asked to say whether any appreciable falling off in performance is likely to result from the breakage.

The harmful effect of broken or disconnected strands in Litz cable has been rather exaggerated. No doubt the position of the break (end or middle of the coil, etc.) has some effect, but as a general rule it may be assumed that discontinuity in only one or two of the total number of strands has little measurable effect on sensitivity or selectivity.

Reducing Aerial Damping

A QUERIST has recently modified a somewhat out-of-date receiver by fitting a band-pass input tuner in place of the original single-tuned aerial system. On wavelengths above 300 metres results are excellent, but at the lower end of the medium band the set oscillates uncontrollably.

It seems to us that the receiver was originally stabilised, to some extent at any rate, by the effect of aerial loading. This loading has no doubt been greatly reduced by interposing a band-pass filter.

It is, of course, possible that the new band-pass coils or their wiring are so disposed that they interact to a greater extent than formerly with the H.F. coupling circuit. We suggest, therefore, that an experimental re-arrangement and the addition of extra screening should be tried. If this fails it will probably be necessary to reduce the amount of H.F. amplification.

Non-inductive Heater Leads

A READER has noticed that the heater circuits of A.C. valves are almost always wired with twisted leads. He considers that straight wires would make for greater neatness, and asks whether it would be permissible to wire the L.T. circuits in this way.

The point about twisted twin leads is that they are more or less non-inductive, and so the risk of hum being introduced through induction into grid circuits, etc., is greatly reduced. But there is no particular virtue in twisting the wires; provided that the "go" and "return" leads for each circuit are run side by side and close together they are unlikely to affect other circuits. Accordingly, flat-laid twin wire might be used equally well, and as our correspondent is apparently a stickler for tidiness we commend this alternative method of wiring to his attention.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

Valve Adaptors

WHEN it is impossible, or at any rate inconvenient, to modify a receiver for use with a pick-up in the usual manner, the simplest solution of the problem is afforded by the use of a "split-grid" adaptor. Judging by recent correspondence there is a good deal of uncertainty regarding the function of this useful device.

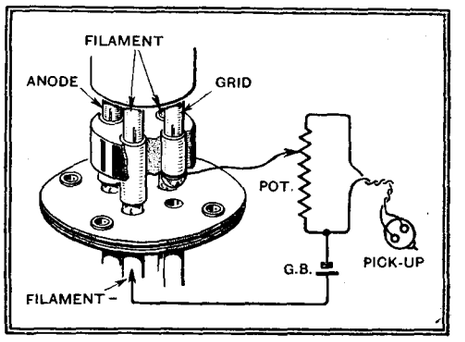
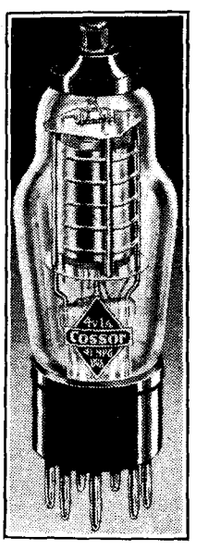


Fig. 2.—By using a "split-grid" adaptor, the grid pin of a valve is isolated from its internal connections.

There is really nothing complicated or abstruse about the matter. The adaptor is merely interposed between the valve and its holder, and has the effect of interrupting the grid connection while leaving the other existing connections to anode, filament, heater, etc., intact. The grid thus becomes accessible, so any such device as a pick-up or microphone may be connected to it. The "return" connection of the circuit is made—usually through a bias battery—to the negative filament (or cathode), as in Fig. 2.

NEW COSSOR VALVES

TWO new valves are being included in the Cossor range of indirectly heated A.C. mains types; these are a Pentagrid frequency-changer and an output pentode. The former has a heater rated for 4 volts at 1 ampere, while the heater of the latter consumes 2 amperes at the same voltage. The 41MPG Pentagrid is rated for 250 volts on the tetrode anode, 100 volts on the screen, and 100 volts on the oscillator anode, and the makers give the high conversion conductance of 1.2 mA/V. The characteristics are stated to be such that harmonic generation is reduced to a minimum, with a consequent reduction in the possibility of whistle production. The valve is fitted to the standard 7-pin base, and it is priced at 20s.



The 41MPG Pentagrid.

The 42MP/Pen is an output pentode with the high mutual conductance of 7 mA/V., and the makers state that the full output is obtained for a signal input of only 40 per cent. of that necessary with older pentodes. The valve is rated for screen and anode potentials of 250 volts, and its price is 18s. 6d.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

WAVEBAND switching has long been universal in broadcast sets, but for short-wave reception we often have to put up with the inconvenience of interchangeable plug-in coils. Although satisfactory switching systems for short-wave work have been evolved, it is not always easy to put them into practice, and, moreover, suitable switches for connection in circuits dealing with extremely high frequencies are few and far between.

Waveband Changing

It may not have occurred to many short-wave enthusiasts that there is a convenient half-way house between the extreme handiness—but possible inefficiency—of switching and the awkward but effective method of coil changing. The alternative in question is provided by the use of a plug-and-socket system on the lines suggested in the skeleton circuit diagram given in Fig. 1; this represents the tuning system of an H.F.-det.-L.F. short-wave receiver which has proved very satisfactory in practice. The inconvenience of changing coils inside the receiver is overcome by mounting a series of sockets in an accessible position on the front panel, these sockets being connected to the appropriate points on each of a series of tuning-reaction coil assemblies.

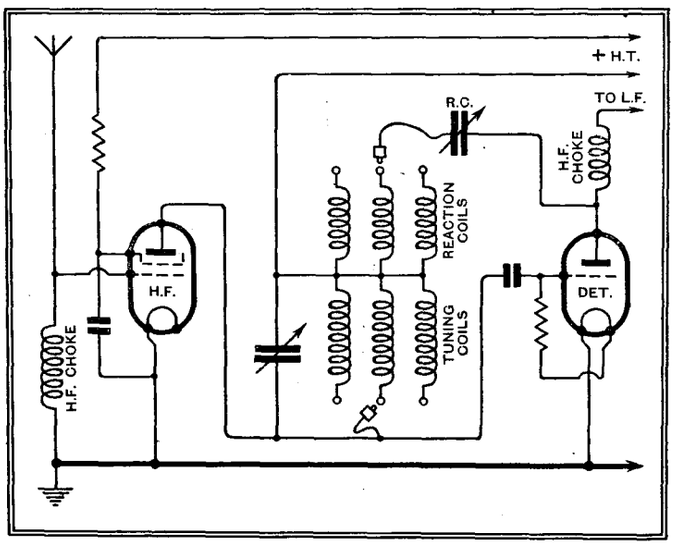


Fig. 1.—Plug-and-socket wave-change system for a short-wave receiver.

Short flexible leads, terminating in suitable plugs, are led out in convenient positions; any number of bands may be covered.

Some care must be taken in mounting the coils in order to prevent undesirable inductive effects between the windings in use at the moment and those that are open-circuited. Possible difficulties of this nature are usually overcome by suitable positioning of the windings, but the use of a small amount of screening might be desirable in some instances.

The plug-and-socket change-over system illustrated represents what is probably the simplest arrangement, but has the disadvantage that both sides of the reaction condenser are at high oscillating potential, and so hand-capacity effects may become evident. These can be avoided most easily by using a reaction condenser with an insulated extension spindle; this plan will generally be preferred to the alternative of a more complicated plug-and-socket system.

LONG waves have many advantages, such as carrying power, small absorption, and freedom from fading, but from the point of view of quality, the advantage lies with the medium-band stations. All other things being equal, it is to be expected that a medium-wave station will provide better quality than one operating on the long waves.

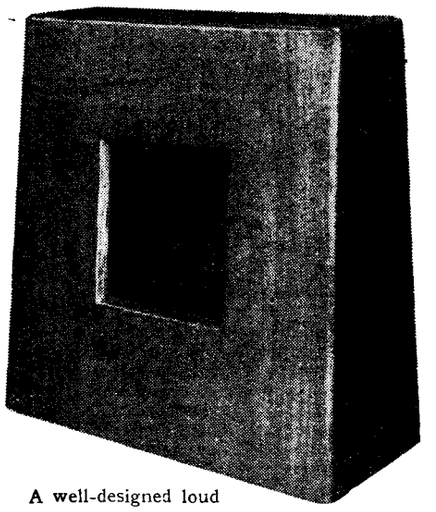
Medium and Long Waves

Even the least technically minded of wireless users will find it worth while to consider one or two points in relation to this state of affairs. Inferior quality may be ascribed both to receiver and transmitter; the former, although it may appear to tune more flatly on the long-wave band, actually is much more selective, and as a result is inclined to "cut" side-bands much more seriously. Even in the heyday of the band-pass filter, no one seriously advocated a long-wave filter with the fashionable 8-kilocycle peaks.

On the transmitting side, it is much more difficult to radiate the upper side-bands at full proportional strength, and so it is not surprising that, as many readers have doubtless noticed, a simultaneous broadcast from both long- and medium-wave stations always appears to be more "brilliant" when received from the latter.

ALTHOUGH the number of sets with external loud speakers grows fewer and fewer, there will probably always remain a fair percentage of listeners who, for some reason or another, find that a completely self-contained set does not entirely meet their needs. Therefore, even if we ignore the question of extra extension loud speakers, a number of readers will probably be interested in the design of cabinets to house a separate instrument.

Loud-speaker Cabinets



A well-designed loud speaker cabinet of good proportions.

It may be taken as an axiom that a loud-speaker cabinet is never large enough for full bass reproduction. Unfortunately, the obvious limitations as to size must be faced in practice, but the guiding rule must be to make the container as large as possible. As to its shape, it seems difficult to better the general proportions shown in the accompanying photograph; a comparatively broad and high cabinet, with a shallow back-to-front dimension, is certainly safer than a deep one. The back may be open, or, perhaps better, covered with loosely woven fabric to keep out dust. The back of the cabinet should always be reasonably well spaced from the wall, etc.

Just as a loud-speaker cabinet cannot be too large, it also cannot be too solidly constructed. Where thin wood must be used, it is sometimes possible to reduce or to obviate "box resonance" by internal cross-battens, screwed rigidly to the woodwork.

The upward-sloping front, as illustrated, is likely to prove of benefit when the loud speaker must be mounted below the normal ear level of the listeners, but is otherwise of no advantage.

NEWS of the WEEK

Current Events in Brief Review

Jobs by Radio

DURING 1933 the Hungarian broadcasting stations, by means of their "Situations Vacant" announcements, found work for 7,000 people.

The Most Northerly

THURSDAY, May 17th, is to see the inauguration of Europe's most northerly broadcasting station, that at Vadsö in the province of Finmarken. The opening programme is to be relayed to other European countries.

Wireless Exchanges

THE question of radio relays was mentioned in the House of Commons last week when Sir Kingsley Wood, the Postmaster-General, replied to a question on the subject. The earliest date on which the licences for broadcasting relay exchanges were terminable, said the Postmaster-General, was December 31st, 1936, and it was, in his opinion, too premature at the present time to consider the appointment of the Committee to enquire into the development of the system.

Marconi Day

IN future April 25th, the birthday of Marchese Marconi, is to be known as "Marconi Day" in the marine wireless service throughout the world. This is in accordance with a decision unanimously agreed to by the representatives of over fifty countries at a meeting of the Comite International Radio Maritime held in Rome.

April 25th is additionally interesting because it was this date, in 1900, that saw the formation of the Marconi International Marine Communication Co., Ltd., the first marine wireless company.

Wireless on the "Endeavour"

THE all-steel racing yacht, the "Endeavour," with which Mr. T. O. M. Sopwith, the famous yachtsman and air pioneer, is challenging the New York Yachting Club in the race for the America's Cup, is to be equipped with a Marconi wireless telephone installation for her voyage across the Atlantic some time in July. The race will take place in American waters in September.

A wireless telephone set will also be installed on Mr. Sopwith's motor yacht "Vita," which is to accompany the "Endeavour" on the long voyage.

Illicit Transmissions in France

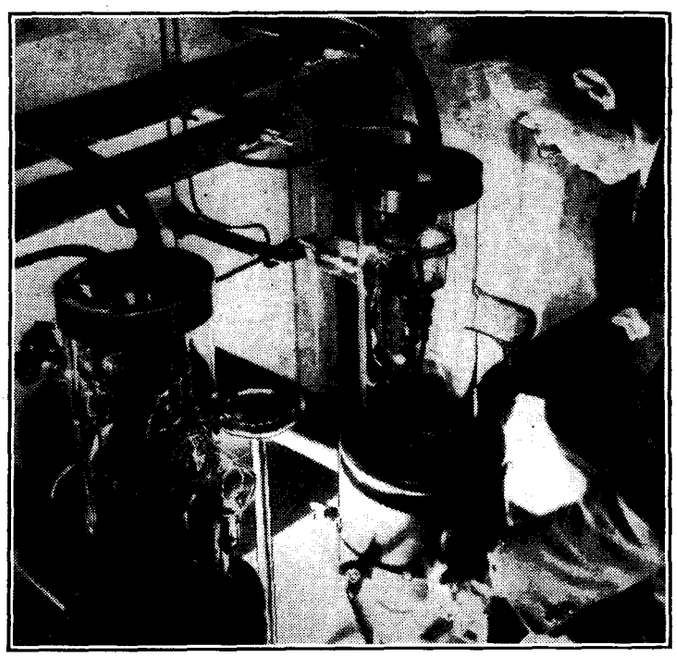
THE wave of illicit transmission which recently passed over Great Britain appears to have reached France. Our contemporary, the *Journal des* 8, launches an appeal to amateurs to maintain the prestige of their craft by vigorously tracking and suppressing all who defy authority.

Another New One

TEST transmissions have just started with the new 20-kilowatt station at Trondheim on 476.9 metres. This transmitter will ultimately replace the existing 1.2-kilowatt plant.

All-round Power Increase in U.S.?

AMERICA'S most powerful broadcasting station, WLW, Cincinnati, operating on 500 kilowatts, has been granted a further permit by the Federal Radio Commission for full power transmissions until August 1st next. The station, which cost nearly half a million dollars to build, has been criticised on the grounds that it will blanket the reception of other stations. It is felt that if the success of the experiment justifies the retention of the 500-kilowatts rating, an all-round power increase of American stations will follow.



HIGHER POWER FROM AMERICA. The chief technical supervisor at WLW, Cincinnati, placing into position one of the 100 kW. water-cooled valves. WLW has a 500-kW. transmission permit until August 1st next. Other American stations may soon secure the same facilities if the tests are successful.

Summer Lectures and Conferences

INTERNATIONALLY famous figures in the broadcasting sphere, including Captain P. P. Eckersley, M. Raymond Braillard (Belgium), M. le Corbeiller (France), and Mr. Van der Pol (Holland), are to lecture in the Nobel Institute and at Oslo University during the week ending June 9th. The audience will consist of delegates to the International Conference of Telephone Communications meeting in Stockholm. Many of the members will be proceeding to London for the Conference of the International Broadcasting Union from June 12th to the 20th.

A Shorter Name

"CABLE and Wireless, Ltd.," is the new name for the former Imperial and International Communications, Ltd.

Solving an Acoustic Problem

A PECULIAR acoustical difficulty at the Brompton Oratory has just been overcome by means of the Marconiphone public address apparatus. For fifty years the musical services have suffered owing to the time lag of eight seconds between the organ and choir. A chord struck by the organist took four seconds to reach the ears of the choir, their response taking another four seconds to reach the organist, so that eight seconds elapsed before the gentleman at the keyboard knew that the choir had commenced singing! Now, thanks to microphones and loud speakers, the whole of the congregation can hear the music simultaneously. In addition, by means of a microphone on the High Altar, the organist can hear the choir without any time lag whatever.

Volts in the Aerial

DWELLERS in Norwegian apartment houses recently had a shock in more ways than one when they discovered that certain American types of receiver in use were allowing the 250-volts mains supply to find its way into the aerial. The electricity supply authorities have now ordered certain modifications to these receivers.

New Battery Valves

NEW Marconi and Osram battery valves are shortly to be available, and will include a variable-mu tetrode, a triode and an output pentode. The characteristics will be similar to those of existing types of valve, but the physical dimensions will be greatly reduced, for a similar form of construction to the Catkin will be adopted. Unlike the Catkin, however, a glass envelope will be retained.

A Worthy Lead

THE French Post Office is setting a worthy example in the matter of interference with radio reception. Up till recently listeners residing within a radius of 300 yards of the Dunkirk Post Office had been much disturbed by the ticking of the telegraphic apparatus. Since the anti-static Bill became law, however, a single request from an aggrieved listener stopped the nuisance.

Radio Records in Morocco

IN one year the number of wireless sets in Morocco has increased from 5,973 to 11,218. On April 1st last, according to the same official figures, the number had increased to 14,000. This percentage increase must be a record in radio history.

The reigning station is Radio-Maroc (Rabat) which, incidentally, receives many letters from France and even the United States. The power is 6.5 kilowatts.

Licences: A Locality Scale

BOWING to a storm of protests, the Norwegian broadcasting authorities have abandoned their intention of raising the licence fee from 5 to 20 kroner for all classes of listeners. Broadcasters, writes a correspondent, have been brought to realise that listeners who live within the effective service area should pay more than those in the more distant parts of the country. Until the projected Regional scheme is completed, therefore, listeners outside service areas will pay only 5 kroners.

All Ears on Hilversum

SELDOM has a foreign station been so popular in one particular district as on Wednesday, April 18th, when Hilversum broadcast a commentary in Dutch on a football match played in floodlight in the evening between Stoke City and the famous Dutch team, The Swallows. The result was announced in English. Practically every receiver in the North Staffordshire district was tuned in to Hilversum. As Stoke City won by 2 goals to 1, Hilversum is a most popular station with Stoke listeners!

Page 313 follows after the Programme Supplement

True Voltage Measurements

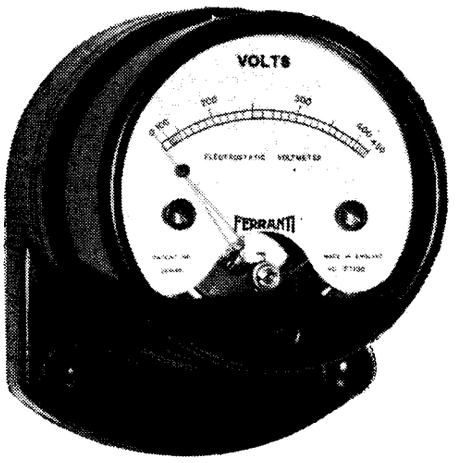
Properties of the Electrostatic Voltmeter

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

BY ordinary means it is impossible to make an accurate measurement of anode voltages, particularly in a mains set. Even keen amateurs, who especially require precise information on this subject, are apt to overlook the fact that an electrostatic voltmeter will give true readings in all ordinary circumstances

THE electrostatic voltmeter is now little used in the laboratory. This is due partly to the fact that for the majority of power frequency measurements modern moving-iron instruments have replaced them, and to the fact that they are relatively expensive. For measurements where a moving-iron or a moving-coil voltmeter will serve there is no advantage in using a more expensive instrument, but for ranges of a few thousand volts the electrostatic voltmeter is actually cheaper, as it has no expensive high resistance, which is necessary for both the above types. The main application in the radio laboratory is undoubtedly to cases where the voltmeter must absorb no power from the circuit.

Small instruments on the market at present are obtainable in ranges from about 150 volts to about 3,500 volts for full scale; with the exception of the lowest ranges, which are more difficult to manufacture, the price is usually constant at about £3.



The scale of a modern electrostatic voltmeter is almost linear—and thus easy to read—over the main working range.

Consider an instrument of, say, 300 volts range; this will serve for D.C. and A.C. mains; transformer voltages, giving the true reading, and not one lowered by the consumption of a current-consuming instrument; true open-circuit voltage of eliminators and the actual volt drop across a valve having a reactance in series with it. No other type will do all these measurements; none at all will do the last three.

The electrostatic voltmeter consists of a variable condenser in which the moving vanes are pivoted and constrained to the minimum position—zero on the scale—by a spring. As the torque developed is proportional to the square of the applied voltage, with a constant capacitance, the scale tends to have a square law, but as the capacitance increases with the deflection and the vanes are shaped so as to obtain a more uniform scale, the resulting scale shape is modified so as to be nearly even over the majority of the scale and contracted at the beginning and the end. The first 20-30 per cent. is generally useless and uncalibrated.

As there is no conducting circuit there is no current consumption on D.C. On A.C. there is a small current, but as it is a nearly perfect condenser there is no power component and so no power consumption.

A.C. and H.F. Measurements

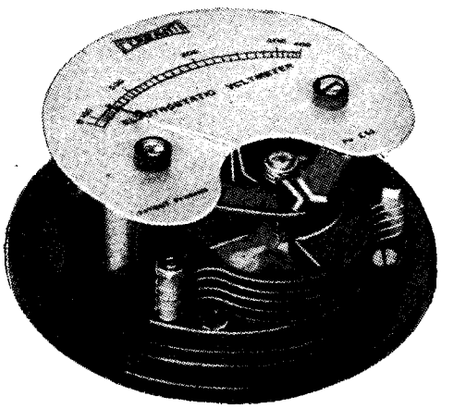
At a given voltage the current is directly proportional to frequency, as $I = V \times 2\pi fC$. This means that at a radio frequency of 50 million the current would be a million times that at 50 cycles per second. Generally this is far more than the circuit will allow, so that the use of an electrostatic voltmeter at high frequencies requires care, although the instrument itself is inherently free from frequency and wave-form errors.

As an example, a 150-volt instrument may have a capacitance at full scale of about 100$\mu\mu$F or 0.0001μF. The table below gives the reactance in ohms and the current at 100 volts at different frequencies.

Frequency in c/s.	Reactance.	Current.
50	31.8 megohms.	3.15 microamps.
1,000	1.59 ,,	63 ,,
1,000,000	1,590 ohms.	63 milliamps.

On the other hand, a range of 2,500 volts would have a full-scale capacitance of about 10$\mu\mu$F so that the reactances given above would be ten times at each frequency.

For radio laboratory use either a 150-volt or a 300-volt instrument has many applications. The former has a minimum reading of about 20 volts, and so can also be used directly for grid-bias measurements where the voltage is not less than this value. By the artifice of connecting a suitable battery in series it is possible to read lower D.C. voltages. Fig. 1 shows this circuit and the means of checking the battery voltage. The added voltage should be such as to bring the two readings on to the open part of the scale. In use, readings are made with the switch in each



Internally, an electrostatic voltmeter is reminiscent of a variable condenser.

position. The voltage of the external source is then equal to the difference between these two readings.

Numerous other measurements will be found for the electrostatic voltmeter. The range may be increased easily, and on A.C. the characteristic of no power consumption still holds. If two equal condensers are connected in series on A.C., and the voltmeter shunted across one of them, the voltmeter will read half the line voltage, provided that the capacitance of each of the condensers is not less than about ten times that of the voltmeter. For other arrangements of condensers the factor may be anything required, four equal condensers giving a factor of four, etc.

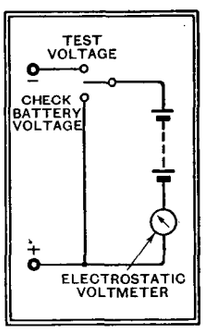


Fig. 1.—With the aid of a supplementary battery, voltages below the normal scope of the instrument may be measured.

On D.C. a resistance potential divider is required, and although its resistance may be very high there is a small current consumption from the circuit. Even so, it is still possible to make the necessary current far less than that taken by a high-resistance moving-coil voltmeter.

Small instruments of the 2½in. type are available for panel mounting, or for bench use, and larger instruments for permanent installation.

Three New Superheterodynes

THIS week has seen the simultaneous release of a group of new models by the H.M.V., Columbia and Marconiphone Companies. The examples tested are representative of the range covered and indicate that the new sets cater for the requirements of the majority of listeners.

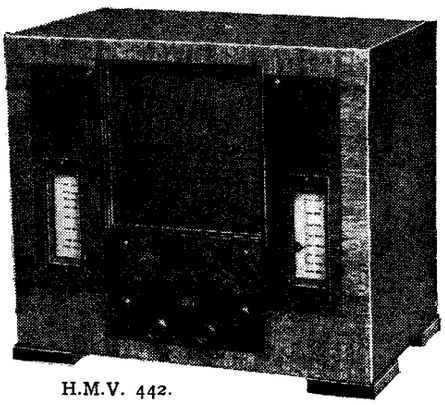
H.M.V. MODEL 442

***Type.**—Table model superheterodyne for A.C. mains. **Circuit.**—Heptode frequency changer—var.-mu I.F. amplifier—duo-diode-triode second det.—power triode output valve. Full-wave rectifier. **Controls.**—(1) Tuning, with "fluid light" indicator. (2) Volume control, with "noise suppressor" switch. (3) Waverange and on-off switch. (4) Tone control. **Price.**—15 gns. **Makers.**—The Gramophone Co., Ltd., 98/108, Clerkenwell Road, London, E.C.*

CLOSELY resembling the Model 438 "Superhet. Selective Five," both in cabinet design and chassis layout, this latest product of the Hayes factory has undergone so drastic a revision in the circuit design that it qualifies for rank as a new set.

In place of the screen-grid detector oscillator the latest type of heptode frequency changer has been adopted. Apart from the simplification of the external associated circuit, this type of valve lends itself admirably to really adequate automatic volume control, and is also less liable to give rise to certain types of whistle interference. Further, re-radiation from the aerial is negligible, as the input grid is very effectively screened.

A duo-diode-triode in the second detector stage supplies the A.V.C. bias, one diode being used for this purpose, and the other for signal rectification. With automatic volume control accurate tuning is essential, and to assist in this direction a "fluid light tuning" feature has been included. This consists of a vertical slit resembling a thermometer in which a column of green light rises with the signal input. It is controlled by a shutter actuated by a milliammeter movement in the anode circuit of the I.F. stage.



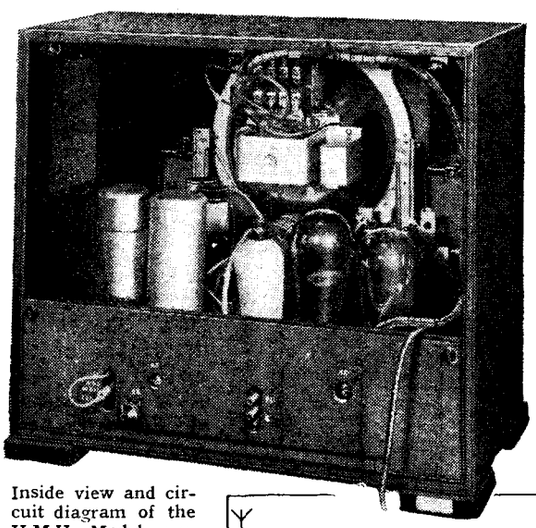
H.M.V. 442.

The overall sensitivity of the set with the new valves is of a very high order, and, as the A.V.C. control gives full amplification between stations, the background noise might in certain circumstances be troublesome. To overcome this objection a "static suppressor" control has been fitted at the back of the set. The function of this control is to limit the sensitivity to any predetermined value, and it is brought into action by pulling out the main volume control on the front panel. With this knob pushed in, the full range of the set is at once available.

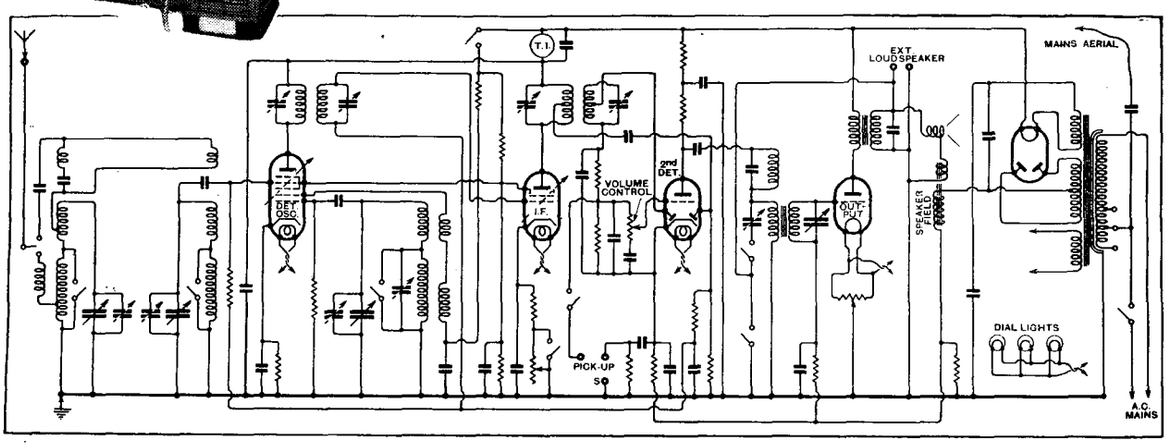
The loud speaker has been redesigned, and there is a noticeable improvement in the extreme bass, while the top register has been strengthened by tone correction circuits, associated with the amplifying portion of the second detector stage.

With the aerial trimmer properly adjusted, second-channel whistles are negligible, while the selectivity is more than adequate for modern receiving conditions. In Central London only one channel is lost on either side of the National and Regional stations at Brookmans Park.

In every respect the performance reaches a surprisingly high standard and the very reasonable price should not deceive intending purchasers into assuming it to be just another mass-produced superhet.



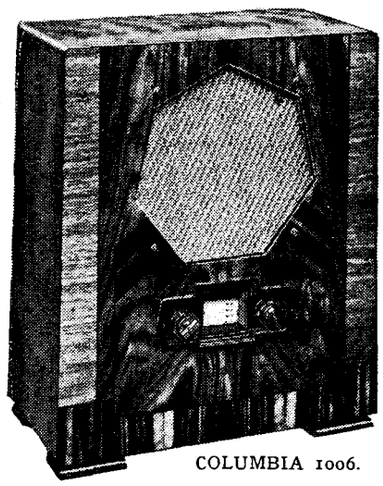
Inside view and circuit diagram of the H.M.V. Model 442. Full A.V.C. is provided by a duo-diode-triode detector and heptode frequency changer.



COLUMBIA MODEL 1006

***Type.**—Table model battery superheterodyne with A.V.C. **Circuit.**—Var.-mu H.F. amplifier—screen grid first det.—var.-mu I.F. amplifier—duo-diode-triode second det.—push-pull pentode output valve. **Controls.**—(1) Tuning control and local-distance switch. (2) Volume control and waverange switch. **Price.**—15 guineas. **Makers.**—Columbia Graphophone Co., Ltd., 98/108, Clerkenwell Road, London, E.C.*

A SET of the calibre of this new five-valve superheterodyne completely removes any cause for complaint which battery users may make on the score that their interests have been neglected by manufacturers in favour of listeners with power supplies available. Here is a set which can hold its own with any mains receiver of equivalent circuit. Indeed, on the score of sensitivity and range, it is definitely above



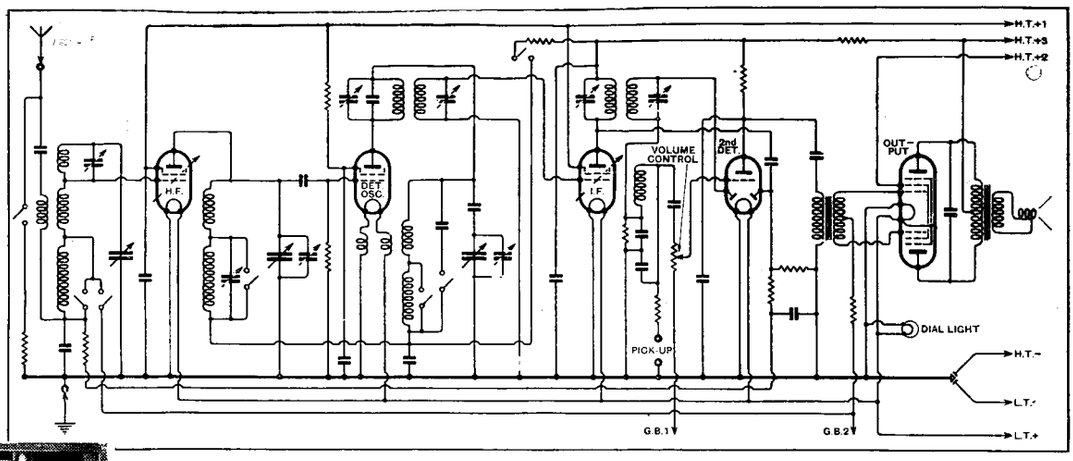
COLUMBIA 1006.

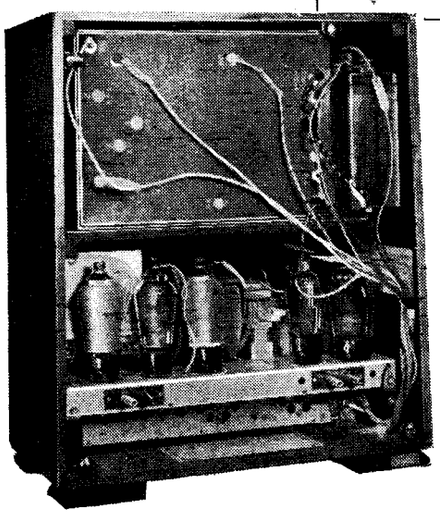
the average in performance, and the clear-cut manner in which stations stand out makes it an extraordinarily fascinating set to handle.

Automatic volume control is included as the result of the adoption of one of the new

Three New Superheterodynes—

battery duo-diode-triodes in the second detector stage. A careful search failed to reveal any trace of second-channel interference, and this is attributable to the use of a section of the aerial input transformer as a wave-trap. In parallel with the aerial circuit is a fixed resistance which can be brought into use by a switch on the front panel to reduce sensitivity when listening to the local station. The high sensitivity is partly accounted for by the use of a variable-mu valve as a first





Circuit diagram of the Columbia Model 1006 and (left) back view of set showing compact stowage of H.T. and L.T. batteries.

amplifier at signal frequency. Following this is the screen-grid detector oscillator in which coupling coils are included in both filament leads. The I.F. amplifier is also of variable-mu type, and is controlled, together with the H.F. stage, by the bias derived from one of the diodes. The other is used for signal rectification, and the volume control preceding the triode portion of the valve operates both on radio and gramophone.

The output stage is one of the new Q.P.21 valves consisting of push-pull pentodes in a single envelope. This valve is capable of 1.25 watts undistorted output, and, in conjunction with the sensitive moving-coil loud speaker, this gives ample volume with very clean-cut quality.

The selectivity is sufficient to give freedom from interference reception 18 kc/s on either side of the Brookmans Park transmitters in Central London, and on long waves Königswusterhausen can be tuned in clear of Daventry. Incidentally, the range on long waves maintains the high standard of performance found on the medium waveband.

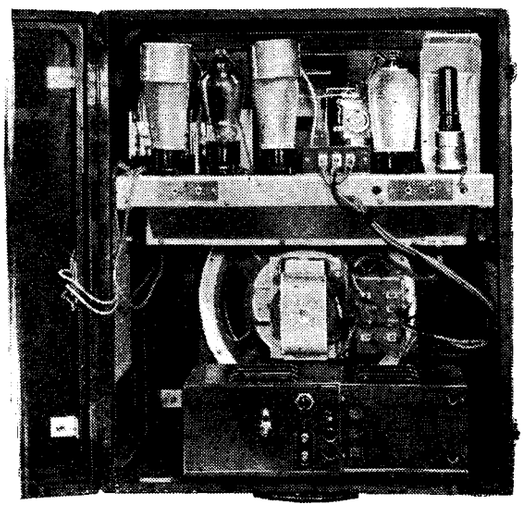
The total L.T. consumption, including pilot lamp, is 0.96 amps., while the standing H.T. current is 12 mA. At full volume on the local station the current taken is 14 mA., but tests with the copper voltameter indicate that the average current on local and distant stations over a long period is of the order of 7.5 mA.

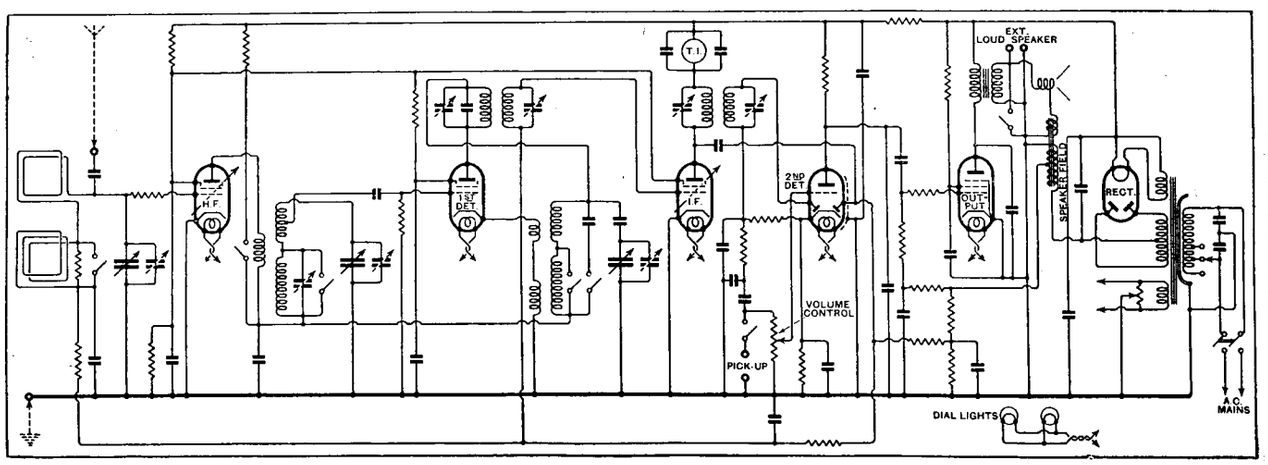
The range is at least equal to that of a first-class three-stage "straight" receiver working on an efficient outdoor aerial. Unlike the majority of frame aerial receivers, the Model "279" is really effective on long waves, and the relative performances on the long and medium wavebands are about the same as those found in open aerial receivers. In a set of this type it is difficult to define the selectivity, as the directional properties of the frame and the action of the automatic volume control both influence the apparent selectivity. However, as a guide to the potentialities of the set in this direction, it was found that the Brookmans Park stations

MARCONIPHONE MODEL 279

Type.—*A.C. mains transportable superheterodyne with self-contained frame aerials.* ***Circuit.*** — *Var.-mu H.F. amplifier — screen-grid frequency changer—var.-mu I.F. amplifier—duo-diode-triode second det. with A.V.C.—power pentode output valve. Full-wave valve rectifier.* ***Controls.***—*(1) Combined tuning control and trimmer. (2) Volume control and waverange switch. (3) Mains on-off switch.* ***Price.***—*16 gns.* ***Makers***—*The Marconiphone Co., Ltd., 210/212, Tottenham Court Road, London, W.1.*

BASED on the Model 255 battery superheterodyne portable this new A.C. mains version will be welcomed by flat dwellers and others who have supply mains available, but cannot conveniently erect an outside aerial.



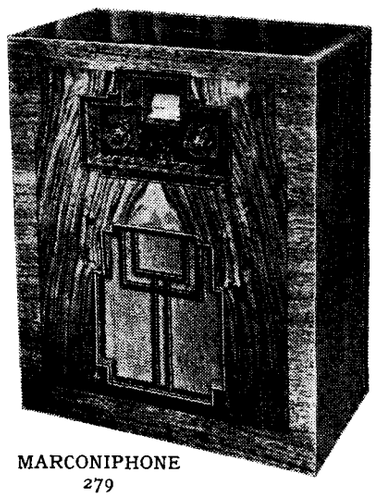


Circuit diagram and interior view of the Marconiphone Model 279 mains transportable. A special safety device cuts off the supply when the back of the set is opened.

Three New Superheterodynes—

could be cut out in Central London when the set was mistuned 20 kc/s on either side of the normal setting.

A power pentode valve in the output stage rated at 2 watts gives ample volume from the energised moving-coil loud speaker, and the quality is notable for the richness of the bass response in so small a cabinet. This is not due to box resonance, as the whole of the back is covered with gauze to give adequate cooling of the indirectly heated valves.



MARCONIPHONE 279

A metal cowl is fitted over the Catkin output valve to deflect the heat out through the back of the cabinet. The power supply unit is separately screened and is mounted in the base of the cabinet. It is impossible to work the set with the back open, as this automatically withdraws the mains plug.

The tuning of the set is greatly facilitated by the visual tuning indicators. The translucent drum dial is illuminated internally, and the image of the arrow pointers lengthens as the signal strength increases. Accurate adjustment of the fine tuning control is a much simpler matter than in the earlier battery model, which had no volume indicator.

The set can be used with a gramophone pick-up, which may be left permanently connected, and no external volume control is necessary, as the radio volume control performs both functions.

FOREIGN BROADCAST GUIDE

BRUSSELS (No. 2) (Belgium.)

Geographical position: 50° 50′ 16″ N; 40° 21′ 12″ E.

Approximate airline from London: 218 miles.

Wavelength: 321.9 m. Frequency: 932 kilocycles. Power: 15 kw.

Standard Time: G.M.T (Belgium adopts British Summer Time).

Standard Daily Transmissions:

B.S.T. Transmits continuously from 12.00; 11.00 (Sun.) con.; 12.00 (Sun.) dance music; 17.00 and 18.30 con.; 19.30 news; 20.00 main evening programme; 22.00 news; followed at 22.10 by con.; (Mon. Tues. and Fri., dance music). Sun. relays dance music until midnight.

Opening Signal: Chimes. Call: *Hier Bruessel N.I.R.*

Announcer: Man. Flemish language only.

Interval Signal: Chimes. First bars of old Flemish song: *Dan zal de beiaard Spelen* (Peter Benoit).

Closes down at 23.00 with words: *Goede Nacht, Dames en Heeren,* followed by "*De Vlaamsche Leeuw*" (Flemish patriotic hymn).

The Diary of an Ordinary Listener

"The isle is full of noises,
Sounds and sweet airs that give delight and hurt not.
Sometimes a thousand twangling instruments
Will hum about mine ears, and sometimes voices."

THESE lines, spoken by my uncouth namesake in one of his poetic moods, came to my memory when resuming touch with the tuning dials after a move from a town flat to a country house ideally situated for wireless reception.

I was agreeably surprised at the comparative absence of interference I encountered when listening on the long waves.

Radio Paris on 1,649 metres seems to take up rather a lot of elbow-room, but reception is always easy and good, and, as a rule, its programmes are very entertaining. Those interested in conversational French will find the announcer's clear diction easy to follow.

The medium waveband, especially on its lower wavelengths, I find somewhat congested with common waves, though there are few stations of interest that cannot be kept clear of whistles.

The past fortnight has been mainly notable for operatic broadcasts which were well worth hearing. On Saturday, April 21st, a fine performance of Verdi's "La Traviata" was given at the Scala, Milan, and from Turin, Warsaw, Vienna, Brussels No. 1, Sottens, Munich, Langenberg, Heilsberg, and the B.B.C. Regional stations. It is always interesting to compare different stations when broadcasting the same programme. The transmission certainly came through well from all that I heard, and I thoroughly enjoyed the performance.

On the same night, Strasbourg, Lyons P.T.T., and Bordeaux-Lafayette broadcast the ever-popular "Madame Butterfly," so between the two I felt little inclined to search around for other stations.

Smash-and-grab raids can be defeated if shops instal a new photo-cell device recently demonstrated by the G.E.C. The intrusion of a hand, or even broken fragments of glass, interrupts a zigzag beam of light on a photo-cell and a steel shutter slides across the valuables, which at the same time are dropped to safety below the window level.

An excellent rendering of Beethoven's "Fifth Symphony" was recently given by the Stockholm Radio Orchestra conducted by Unger. The station kept remarkably steady, with very little fading, and every note came through clearly. Kalundborg was transmitting Verdi's "Rigoletto," but suffered, on that night, from fading, at which times Leningrad could be heard pegging away in the background. Later in the evening I tuned in to Huizen (or, rather, to Kootwijk), always a friendly stand-by at the end of a tiring day, as the station is easy to get, comes in steadily with very little trouble from fading, and the programmes are always worth hearing. On this occasion the K.R.O. orchestra were giving a concert of light music. I heard one of Sousa's marches, followed by dance music, and I was greatly struck by the vocalist, who was not afraid to impart life and humour into his part. As a general rule, the wailings of "crooners" prompt me to switch over to some other programme, but I thoroughly enjoyed the singing of the K.R.O. vocalist, who seemed equally at home in English and Dutch.

Two Schools of Thought

On April 23rd I had intended to listen to the contemporary Russian and Polish music from Funkstunde and other German stations, but was decoyed away by Warsaw, where I found the concert of Rathaus' music, conducted by the composer, well worth hearing; there was also some excellent chamber music from Radio Paris.

On the following day I determined to hear the general German transmission of contemporary East Prussian music, though I confess I tuned in with trepidation, my musical taste not having yet reached the stage of being able to enjoy atonality, and the complete absence of key when each instrument seems striving to "do its damnedest" regardless of the others; however, I was agreeably surprised. The East Prussian music I heard was straightforward and robust, not perhaps very complex, but decidedly enlivening. Brussels No. 2 devoted its evening programme to Shakespearian music, partly performed by the excellent Symphony Orchestra conducted by Meulemans, and partly on gramophone records.

There seem to be two schools of thought among serious listeners. Some map out beforehand the programmes they wish to hear, and firmly refuse to be beguiled by other transmissions; others try around the dials to find which station comes in best at any particular time. I have tried both ways and each has its advantages and disadvantages. The first is certainly the more systematic and, theoretically, the better, but it is often disappointing to find that the particular stations one had determined to listen to were not at their best and suffering from attacks of fading. I must candidly admit a preference for the second, less systematic, school of thought. However, I endeavour to pick out the best, and to sink, as far as possible, my personal tastes and dislikes, so that I trust my readers will echo the words of Stephano: "Lead, monster; we'll follow."

CALIBAN.

Letters to the Editor

Transients and H.F. Circuits

Fuses in Receivers : Unlicensed Transmitters : Broadcast Frequency Scale

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

Transients

YOUR correspondent, Mr. Sadgrove, asks for some remarks about transients and H.F. circuits, and so I venture to put forward my views on the subject, at the risk of reopening the well-worn "transientia controversy."

To begin with, a transient is simply described as an instantaneous change of the values of voltage and current in an electrical circuit, and in acoustics it is an instantaneous change in pressure.

Since all circuits have inductance and capacity, and all air has mass, a transient does not exist in reality. What does occur is a state of affairs that tends to the above, i.e., a *very* sharp rise in voltage or a very steep wave front in acoustics.

Now, according to Mr. Fourier (and I have no reason to doubt him), any wave form may be reduced to an infinite number of simple sine-wave components differing in frequency and amplitude.

The greater the number of components we take, the closer will be their sum to the original wave form.

So it would appear that, in order to secure a "perfect" transient response, all we require is a receiver with a straight line overall audio response from 0 to 30,000 (being about the highest audible frequency).

This is nearly correct. The snag is that Mr. Fourier also stated that all the components must be in the right phase relationship.

Now, as soon as a wave form passes through a "system" which has a circuit that tunes to one of the audio components, that component gets badly shifted in phase. Such systems are in most transformers all-tuned tone-control circuits and land lines.

The transformer is tuned by the shunt capacity with the leakage inductance, and in a very good transformer this can be made very high, e.g., 10,000 ~, so that it is not very important.

At this point the human ear saves us from throwing away expensive components. The ear takes no measurable account of phase relationship. For those who don't believe me (I know there are lots) I would ask them to imagine the B.B.C. orchestra arranged around the mike so that their distance from it does not vary by more than half an inch (assuming 10,000 ~ is wanted).

For those who get good transient response without "iron," I would invite them to count the number of A.F. transformers in Broadcasting House, and then walk along the land line to Brookmans Park.

To sum up and answer Mr. Sadgrove, it would appear that the only place where H.F. circuits have an effect on transients is in their degree of selectivity or side-band cutting, i.e., the extent to which they spoil the audio-frequency response.

HAROLD K. ROBIN.

Streatham, S.W.16.

Correspondence, which should be as brief as possible, should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Fuses in Receivers

AT one time the provision of fuses was very usual. Now, the omission of them is more common than their use. Most commercial receivers do not carry them, nor do your own designs. It is the lack of fuses in the H.T. rectifier circuit of your "Single-Span Receiver" which has moved us to write this letter. Can it be the great trust placed on the reliability of valves in these days which leads to designers leaving the fuses out? If it is so, that reliance seems to be misplaced, as the following may show :—

During the last three months we have had no less than five cases of damage to mains transformers to deal with, the cause of which in each case was a defect arising in the rectifier valve. In three instances new transformers or re-winds were necessary. In two cases chokes were also damaged. Small fuses of the flash lamp or tubular kind at a cost of a few coppers would have saved considerable damage and service work. We tabulate the faults.

Experiences coming in such a bunch make one plead for patronage for the useful little fuse by all designers.

HILL-SMITH (Warrington), Ltd.,
R. W. Taylor, A.M.I.W.T., Director.

Unlicensed Transmitters

I WOULD like you to know that the council of the R.S.G.B. are very appreciative of your editorial on the above subject which appeared in a recent issue of *The Wireless World*.

It will interest you to know that, as a result of enquiries, we have obtained a statement from the G.P.O. to the effect that the information contained in the recent Press paragraphs (inferring that new restrictions are to be imposed on amateur transmitters) is incorrect, and was published as a result of misquoted interviews.

The G.P.O. have been at pains to assure us that they have no intention of placing further restrictions upon transmitting amateurs.

The council and members of the R.S.G.B. deplore the fact that operators of pirate transmitting stations have been lauded in the national Press, and hope that stern measures will be adopted by the G.P.O. whenever proof is obtained that such transmissions have taken place, whether in the broadcast or the amateur bands.

JOHN CLARRICOATS,
Secretary, Radio Society of Great Britain.

A Broadcast Frequency Scale

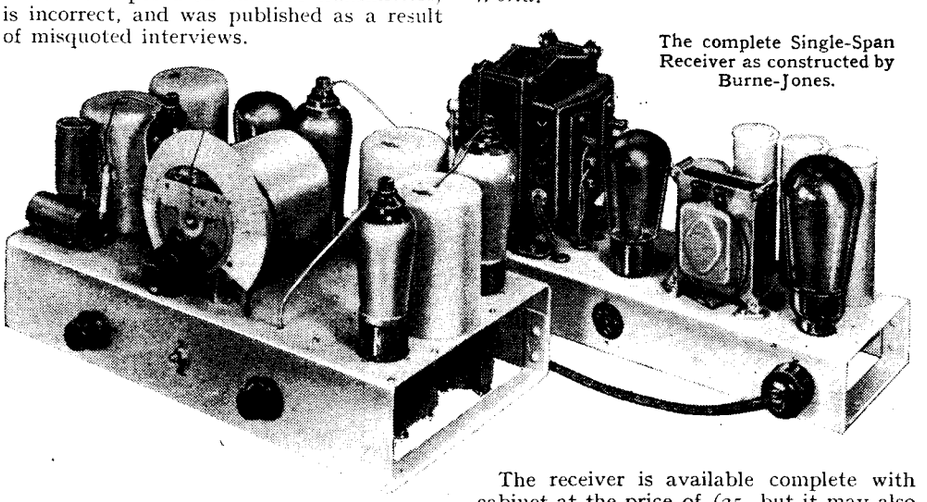
MAY I commend the suggestion in "Broadcast Brevities" that the B.B.C. might radiate a "frequency scale" so that listeners could check the frequency response of their sets? I would suggest that you ask your readers to write to you in order to provide some idea as to the extent to which the proposal appeals to them.

J. F. MARSHALL.

Fallowfield, Manchester.

SINGLE-SPAN RECEIVER

A COMMERCIALLY built model of *The Wireless World* Single-Span Receiver has been received for inspection. The set is assembled on a braced metal chassis finished in grey cellulose, and a similar construction is adopted in the case of the power unit. *The Wireless World* specification has been closely adhered to, and a test of the receiver showed it capable of a very satisfying performance. The quality of reproduction was of a very high order, A.V.C. functioned admirably, there was complete freedom from hum and second channel whistles, and both sensitivity and selectivity were entirely adequate—in fact, the performance of the set was in every way the equal of that of the original model, constructional details of which appeared recently in *The Wireless World*.



The complete Single-Span Receiver as constructed by Burne-Jones.

The receiver is available complete with cabinet at the price of £25, but it may also be obtained without a cabinet at £23. The makers are Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1, who are also making complete coil and oscillator assemblies, coils, coil parts, and other accessories for the Single-Span Receiver.

NEW APPARATUS REVIEWED

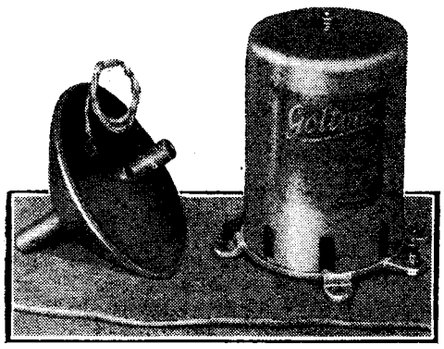
Latest Products of the Manufacturers

GOLTONE SCREENED AERIAL SYSTEM

WARD AND GOLDSTONE, LTD., Frederick Road (Pendleton), Salford 6, Manchester, has introduced a screened down-lead system for combating local interference, using impedance matching transformers and a thin metal braid-covered down-lead. The transformers are described as Statoformers, one unit being joined to the top of the down-lead and the other to the lower end adjacent to the receiver.

As these units are of necessity aperiodic their effectiveness is limited to the medium waveband, although reception is possible on the long waves with the transformers in circuit provided the full sensitivity of the set is not needed, as might often be the case when receiving the National programme. By a simple alteration in the connections on the receiver Statoformer a reversion to normal sensitivity is achieved, but the arrangement then no longer serves for the suppression of interference.

On the medium waveband there is a slight loss of sensitivity at the extreme ends of the scale, but as there are three tappings on the receiver Statoformer for the down-lead connection it is possible to partially restore the sensitivity by changing over to the one that gives the best results at these parts of the scale, while over the major portion of the range the optimum tapping would be employed.



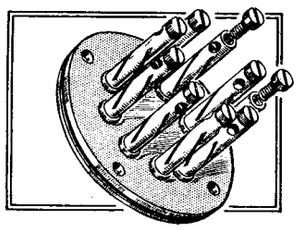
Goltone aerial and receiver Statoformers with a portion of screened down-lead in the foreground.

The aerial Statoformer is housed in a waterproof copper container, while the receiver unit is assembled in a standard type of Goltone screened coil can. The former costs 4s. 6d. and the latter 5s.; shielded metal screened down-lead for use with these transformers costs 4s. 3d. for 50ft., and 8s. for 100ft.

CLIX NINE-PIN VALVE-HOLDER

A FURTHER model has now been added to the Clix range of chassis mounting valve-holders, the latest pattern being for the new nine-pin valves. With so many sockets it is of particular importance that the spacing should be exactly in agreement with the pins on the valve, and this point has received due attention in the new Clix model.

The sockets are riveted to a disc of bakelised material just under 2in. in diameter, the heads being protected by a further disc held in position by a single rivet in its centre. This prevents contact with the sockets until the pins are in correct alignment. These sockets are of the resilient pattern extensively used in Clix valve-holders, and they are fitted with small ter-



Clix nine-pin valve holder for chassis mounting fitted with small terminals and resilient sockets.

minals. A perfectly satisfactory contact is made between each pin and its respective socket, yet the valve can be inserted without undue pressure.

The price is 1s. 3d., and the makers are Lectro Linx, Ltd., 79a, Rochester Row, London, S.W.1.

QUIKON WIRE

AN insulated connecting wire for use in wiring-up receivers, and known as Quikon wire, is obtainable from the British Radio Gramophone Co., Ltd., Pilot House, Church Street, Stoke Newington, London, N.16. It consists of a 22 S.W.G. tinned copper wire covered first with a single layer of cotton, then a rubber covering and, finally, over-wound with an impregnated cotton braid.

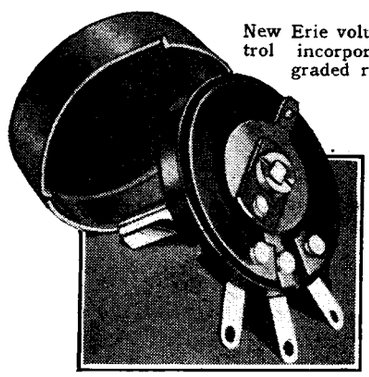
When cut to the required length the insulation can be pushed back quite easily for making a loop or for soldering, and it leaves the wire perfectly clean and bright.

Quikon is sold in coils containing about 10ft. of wire, and the price is 3d. per coil.

ERIE VOLUME CONTROL

THE new Erie volume control, which is fitted with a composition type resistance element, is now available in five standard sizes, ranging from 25,000 ohms to 500,000 ohms in value. A thin bakelite disc 1½in. in diameter forms the body of the component, and to this is attached the three soldering tags, a single-hole fixing bush, and the metal protecting cover.

The moving contact is insulated from the spindle and fixing bush, and consists of a



New Erie volume control incorporating a graded resistance element.

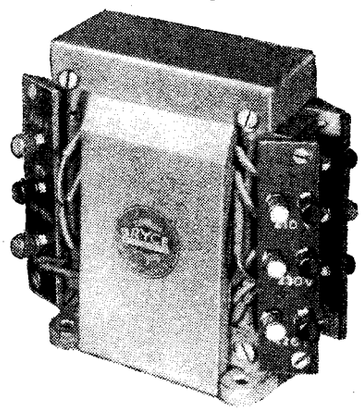
light spring terminating in a small graphite stud. The movement is quite smooth, yet a sure contact is made throughout, the pressure being just sufficient to ensure this but not so heavy that it imposes undue wear on the element.

The resistance is graded to give a smooth and even control, which on test was found to be entirely satisfactory. It is quite silent in operation.

The component is well made and at 3s. 6d. represents good value for money, and supplies are obtainable from the Radio Resister, Co., Ltd., 1, Golden Square, London, W.1.

BRYCE-WILBURN ASTATIC MAINS TRANSFORMERS

A NEW type of mains transformer in which the windings are arranged astatically has been placed on the market by W. Andrew Bryce and Co., Woodfield Works, Bury, Lancashire. The idea being that with astatic windings the external field



Bryce-Wilburn mains transformer with astatic windings to restrict external field.

should be so restricted that other iron-cored components may be mounted close to the transformer without encountering trouble from induced mains hum.

While this ideal state is not yet attainable the new Bryce model is an undoubted improvement, and while it may still be necessary to exercise a little care in the mounting of L.F. transformers and chokes it is much less difficult with these astatic models to find the position of minimum induction than with many other types.

The specimen tested is listed as the B.W.4. It is for use with a valve rectifier of the B. class, and gives 350+350 volts at 80 mA. for the H.T. supply, 4 volts 2.5 amps. for the rectifier filament, and a further L.T. winding rated at 3 to 4 amps. for the A.C. valves. Both the 4-volt windings are centre-tapped.

Using a UU.120/350 rectifier the smoothed D.C. output was 476 volts at 10 mA., 409 volts at 40 mA., and 341 volts at 80 mA., and 310 at 100 mA. The smoothing choke had a resistance of 300 ohms, and the condensers used were 4 mfds. each.

The L.T. windings have been carefully adjusted, for with the full rated load in each case and with 80 mA. flowing in the H.T. circuit the rectifier filament received 4.03 volts, and the four A.C. valves 3.93 volts.

The price of the model B.W.4 is 41s.

BENJAMIN NINE-PIN VALVE-HOLDER

WITH reference to this Benjamin product reviewed in our issue dated April 20th last, we understand that the price is now 10d. for the chassis mounting nine-pin type.

The Wireless World

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EDITORIAL COMMENT

Chattering

Is Broadcasting the Cause?

SIR THOMAS BEECHAM, by his protest over conversation in the audience during the first night of Covent Garden Opera, has drawn attention to what is a comparatively commonplace occurrence to-day but which a few years ago would have been regarded as little short of scandalous.

What is the reason that otherwise well-behaved members of the community so frequently persist in conversation at concerts, the cinema and even at the theatre?

Is not this indulgence in bad manners directly attributable to the habit which has grown up in so many homes of treating broadcasting as a background to other occupations and allowing conversation to proceed, even with raised voices, with wireless still "playing"? It is easy to see how, if once this practice becomes a habit, it can spread to the concert hall and the theatre, the audience overlooking that whereas in the one case the wireless set may be regarded as an impersonal instrument, in the concert hall and theatre the audience is in the presence of the artists themselves who merit different treatment.

Many appeals have been made to listeners to plan their listening intelligently and to give their attention to broadcasting occasionally rather than leave it switched on at all times as a merely disturbing influence to conversation and other occupations.

It is often argued that there is too much broadcasting and that it should not be on tap continually all hours of the day. If we had only, say, four hours' broadcasting a day, it is contended, it would be appreciated more.

There would be serious objections to cutting down the hours of broadcast transmissions, the principal one being that the same hours would not be convenient to all listeners. But on the other hand, there is no reason why listeners themselves should not restrict their listening hours and choose just those items in the programmes which appeal most, and let the remaining hours be filled with their conversation or other occupations.

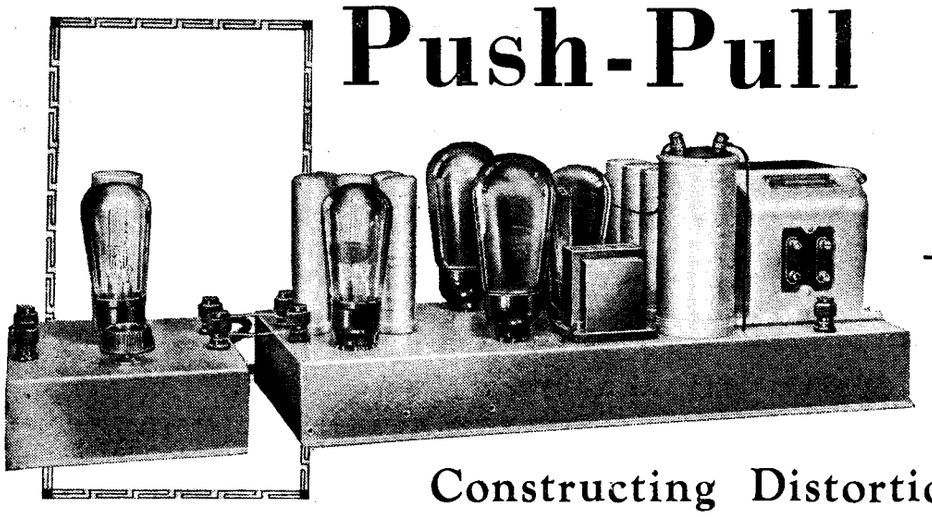
Broadcasting would unquestionably command more respect and be more highly valued by the listener if listening hours were restricted. Some form of time switch might be made compulsory which would turn off the set "until to-morrow" whenever it had completed a total of, say, three "playing hours" per day. But such a scheme can scarcely become practicable so long as the public is free-willed and the hours of broadcasting so generous!

Amplifiers for Theatres

A Case for More General Use

A CONTRIBUTOR to the Correspondence columns in this week's issue recommends that greater use should be made of sound amplifying systems in theatres. Microphones and amplifiers have come into very general use in churches and other public meeting places, but there still seems to be some prejudice against the adoption of such methods for amplifying sound in our theatres. A few theatres have, we believe, already adopted it, but there is every reason why all theatres should make use of this aid, which would greatly enhance the enjoyment of the audience in the less-fortunately positioned seats.

Many of our theatre managers must, we think, be unaware of the difficulty which the public experiences in most theatres of following the words throughout the performance.



Push-Pull Quality Amplifier

By W. T. COCKING

Constructing Distortionless Equipment

THE attainment of high quality reproduction demands the closest attention to detail in design both in the choice of circuit and in the selection of the values of components. The amplifier described in this article is exceptionally free from all forms of distortion and is suitable not only for the high quality reproduction of broadcasting and gramophone records, but also for many television purposes. For gramophone work, a special feeder unit is also described, and the use of the apparatus on radio will be dealt with next week.

SOME of the chief requirements of an L.F. amplifier suitable for the highest quality sound reproduction were discussed in last week's issue of *The Wireless World*, and it will be remembered that push-pull amplification offers very decided advantages over other systems, for it permits amplitude distortion to be greatly reduced. Resistance-capacity inter-valve coupling is also desirable, partly because there is little limit to the economical response at low frequencies, partly because the coupling itself is inherently linear and cannot introduce amplitude distortion, and partly because this coupling gives a minimum of phase distortion—an important point in television work.

The question of the power output required for the highest quality is a matter of some importance, and experience indicates that about 4 watts are needed for domestic purposes. As this figure will appear excessive to many, some explanation may be advisable. In the concert hall the volume of sound from a large orchestra may vary over a range of some

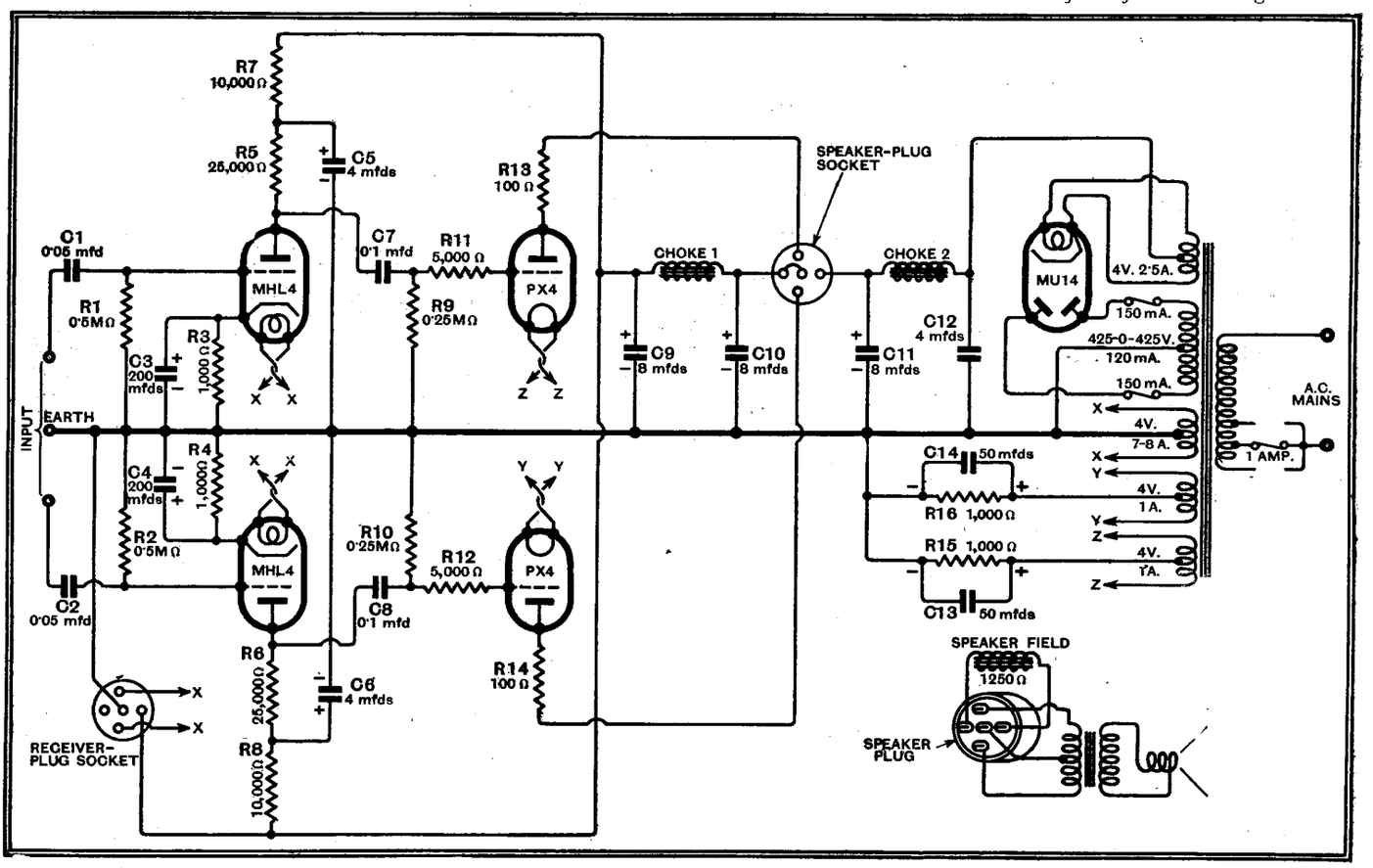


Fig. 1.—The complete circuit diagram of the amplifier shows that two stages of resistance-coupled push-pull amplification are employed. The undistorted output is 4 watts, but an output of up to 6 watts is available before the distortion exceeds the value found in normal apparatus.

Push-Pull Quality Amplifier—

60 db. from the weakest passage of music to the loudest. In broadcasting such a wide range cannot be permitted, for either the loud passages would cause over-modulation or the weak would be below the inevitable slight background noises. It is usual, therefore, for the range of modulation in the transmitter to be kept within 30 db.

Now 80 per cent. modulation is the highest normally used in this country, and 30 db. represents a voltage ratio of about 31.6-1. If the maximum modulation is 80 per cent., therefore, the minimum is 80/31.6 = 2.52 per cent. It is difficult to arrive at a figure for the average modulation depth on a normal musical item, but for our present purposes it will be sufficient if we assume that the weakest sounds are as much below the average as the loudest are above it. This means that the average modulation depth is 15 db. higher than 2.5 per cent., or 14.2 per cent.

If we employ an output stage capable of delivering 4 watts to the loud speaker and we adjust the circuits correctly so that this output is obtained on the loudest passages of music, equivalent to 80 per cent. modulation in broadcasting, we shall have an output of only 0.004 watt, or 4 milliwatts, on the weakest passages. On the average level the output is 126.5 milliwatts. An output of this order is easily obtainable from a small battery valve, and such a valve will give good results on the average level of music. It will be hopelessly overloaded on loud passages, however. An output stage rated for 4 watts, therefore, is necessary for the highest quality reproduction, not because the average volume must be set at a high level, but purely to avoid overloading and distortion on loud passages. If for any reason the volume is required to be unusually great, then the output must be higher than 4 watts if quality is to be maintained unimpaired.

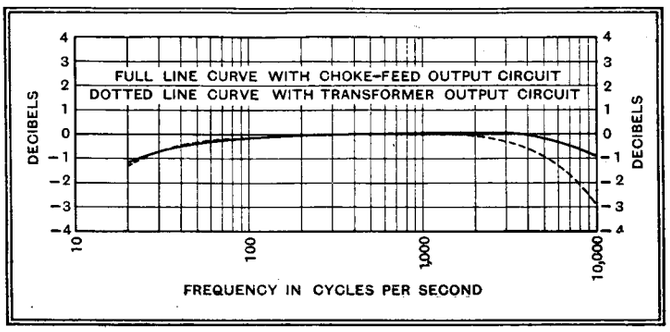
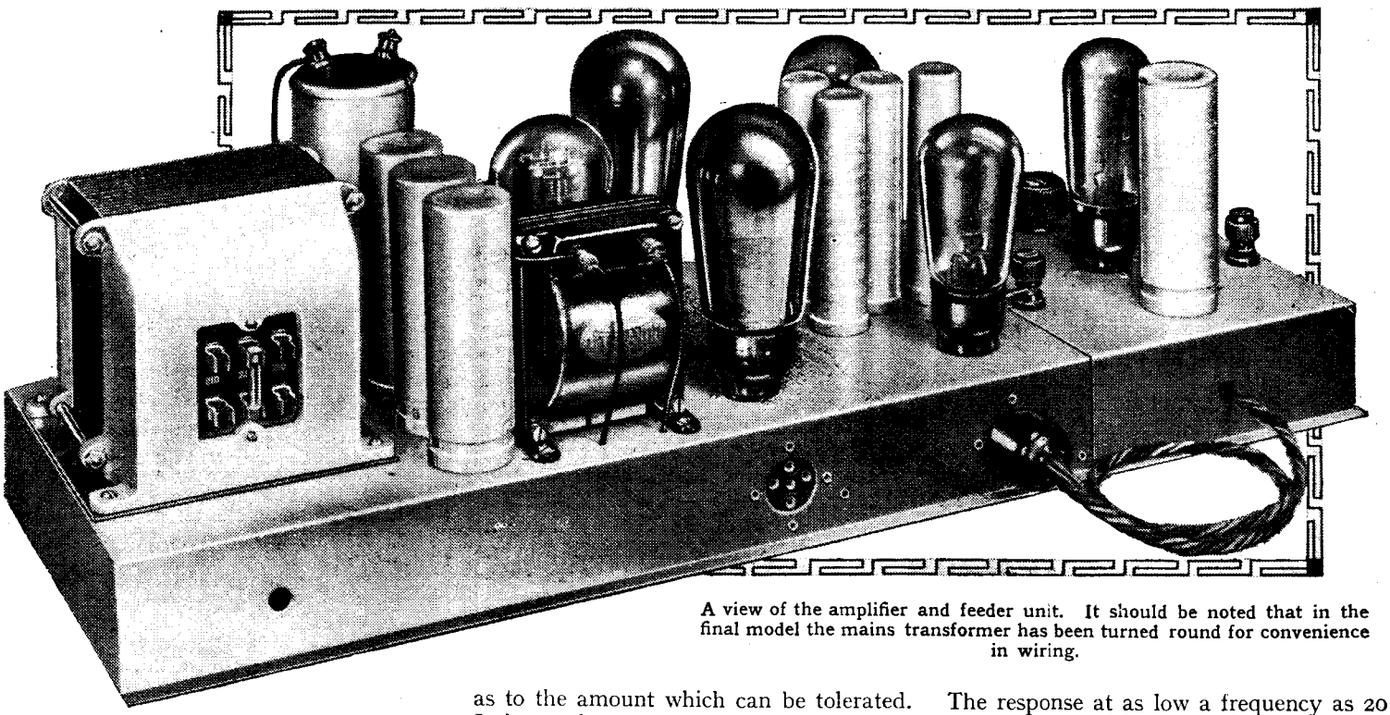


Fig. 2.—The overall frequency response of the amplifier and feeder unit is shown by the solid line curve. At 20 cycles the response falls by only 1.2 db. and at 10,000 cycles by only 1 db. The response with an output transformer included is shown by the dotted curve, and at 10,000 cycles the drop is under 3 db.—a deviation so small that it is inaudible.

No amplifier is completely free from amplitude distortion, and opinions differ as to the amount which can be tolerated. It is usual to rate the output of a triode valve for a figure of 5 per cent. second harmonic distortion, and this appears satisfactory for ordinary practice. For the highest quality, however, the distortion should be lower, and as every stage introduces some distortion, that introduced by the output stage cannot be allowed to approach 5 per cent. Under these circumstances push-pull operation is the most satisfactory and economical arrangement, and curves illustrating the performance of this amplifier were given in last week's issue of *The Wireless World*.

The Frequency Response

As regards frequency distortion, conditions are much simpler, and it will suffice if the overall response curve is flat within about 5 db. over the range of 30 to 10,000 cycles, for the ear cannot readily detect small changes of volume at different frequencies. The requirements for television, however, are more stringent, and the 30-line transmissions theoretically require an amplifier flat from 12.5 cycles to 13,000 cycles. In practice, however, an upper limit for even response of 10,000 cycles is very satisfactory, particularly if the cut-off beyond this frequency is gradual and not sudden. Phase distortion, although of little moment in sound reproduction, is important in television. Fortunately, we need not give it special consideration in this case, for with an uncorrected resistance-coupled amplifier it is at a minimum when frequency distortion also is at a minimum. The small degree of frequency distortion found in the complete apparatus is well brought out by the curves of Fig. 2. The full line curve shows the response of the amplifier with a feeder unit containing a duo-diode-triode valve, and the dotted line shows the effect of including the output transformer.



A view of the amplifier and feeder unit. It should be noted that in the final model the mains transformer has been turned round for convenience in wiring.

The response at as low a frequency as 20 cycles in only 1.2 db. below normal output, and at 10,000 cycles the loss in the amplifier is under 1 db.; even including the output transformer the loss at 10,000 cycles is below 3 db.

The Push-Pull Quality Amplifier fulfils the requirements of the most exacting, and it is suitable for high quality sound repro-

Push-Pull Quality Amplifier—

duction of both broadcasting and gramophone records, and it may also be used in the reception of 30-line television whether a neon tube, Kerr cell, or cathode-ray system be employed. The circuit diagram of the amplifier proper appears in Fig. 1, and it should be understood that the feeder and output circuits adopted will vary according to the use to which the amplifier is to be put. This will be dealt with in detail later, however.

The amplifier is essentially two resistance - capacity coupled amplifiers to which the inputs are applied in opposite phase, and the outputs also joined with a phase reversal thus giving push-pull operation, and a balancing out of second harmonic distortion. The output stage consists of two PX4 valves in push-pull, and to prevent parasitic oscillation the usual grid and anode stopping resistances are included. Each valve is independently biased by the voltage drop along the 1,000 ohms resistances R15 and R16 in the cathode circuits. The valves are operated under slightly different conditions from the maker's rating, which calls for an anode supply of 250 volts and grid bias of 33 volts, giving an anode current of 48 mA. for each valve. Actually an anode potential of about 250 volts is used, but the grid bias is increased to 35 volts, at which the anode current for each valve is 35 mA. It should be understood that these figures are nominal and may vary somewhat with different valves.

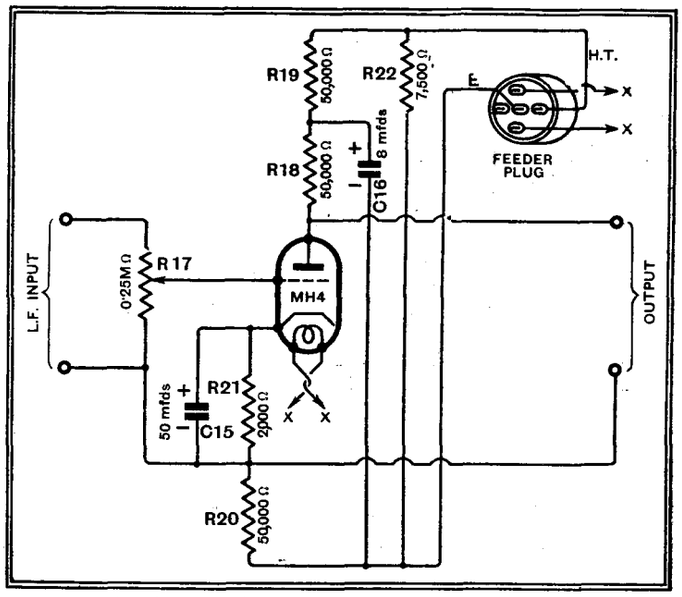


Fig. 3.—The circuit of the feeder unit which is needed only for gramophone work. The input is applied to the valve in the usual way, but the output is split across R18 and R20 for feeding the amplifier in the correct phase.

Valve Handling Capacity

A push-pull output stage under these conditions is quite linear up to about 4 watts output when operated with a total load impedance of 10,000 ohms. This load is higher than the maker's figure, and is the change brought about by the different value of grid bias used. The total anode dissipation of the two valves is 17.5 watts, and for the true undistorted output of 4 watts the efficiency is 22.9 per cent., which is unusually high for the very low degree of amplitude distortion which is introduced. A single P.X.4 under the rated operating conditions gives an output of 2.5 watts for a dissipation of 12 watts—an efficiency of 20.8 per cent.—and this is for 5 per cent. distortion, which is greater than in the push-pull case.

The output stage can accept an input of 35 volts peak per valve, or 70 volts total, so the previous stage must be capable of an output of this order without distortion. No single valve is suitable with resistance coupling, so that a pair of MHL4 valves in push-pull is used. With the values of components selected the stage gain is 9.86 times, so that the total input to these valves is 70/9.86=7.1 volts peak; the input to each valve, therefore, is 3.55 volts peak. In the case of output valves it is unwise to use a high value of grid leak, and 250,000 ohms is considered about the safe maximum. For the proper reproduction of the lower frequencies, therefore, a fairly large coupling condenser has been chosen, and a value of 0.1 mfd. is used. Very high insulation resistance is important in such condensers, otherwise the grid of the following valve may take up a positive potential, with disastrous results to valve life in the case of an output valve. Although they are fairly expensive, therefore, mica dielectric condensers have been chosen for use in the couplings to the output valves, for they give a higher factor of safety than paper types. For the couplings to the MHL4 valves, however, paper condensers are used, since the results of a leakage would not be so serious at this point. Any leakage would still result in a positive bias being applied to the valve, of course, and would upset its operation. It is not so likely to have a harmful effect on the valve, however, since the high resistances in the anode circuit severely limit the possible anode current.

Before proceeding to a discussion of the various input and output arrangements, it may be as well to deal with the mains equipment. The mains transformer is rated to deliver 425-0-425 volts at 120 mA. to the MU14 indirectly heated rectifier, which gives an unsmoothed output of 450 volts at 120 mA. A winding of 4 volts 2.5 amperes is provided for the rectifier heater, two of 4 volts 1 ampere for the two output valves, and one of 4 volts at 7/8 amperes for the two MHL4 valves and up to five other valves in early stages which may or may not be used, according to circumstances.

The Smoothing Circuits

The reservoir condenser C12 has the usual value of 4 mfd., and preliminary smoothing is effected by an 8-H. choke with a resistance of 215 ohms, followed by an 8-mfd. electrolytic condenser C11. The current then passes through a further choke or a speaker field having a resistance of 1,250 ohms and an inductance of some 25 henrys or more, the smoothing being effected by the combination of this with the 8-mfd. condenser C10. The drop across this is 150 volts, or a total drop with Ch2 of 175 volts, leaving 275.5 volts for the output stage. There is a small drop in the output transformer primary, but this may

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

AMPLIFIER

1 Mains transformer, primary, 200 to 250 volts, 50 cycles; secondaries, 425-0-425 volts, 120 mA.; 4 volts 2.5 amps. centre-tapped; 4 volts 1 amp. centre-tapped; 4 volts 1 amp. centre-tapped; 4 volts 7/8 amp. centre-tapped **Sound Sales Type PP/QA**
(B.S.R., British Radio Gramophone Co., Bryce, Challis, Heayberd, Claude Lyons, Parmeko, R.I., Rich and Bundy, Varley, Vortexion, Wearite.)
1 Smoothing Choke, 7/30 henrys at 120 mA, 215 ohms, **Ch2** **Ferranti B2**
1 Smoothing Choke, 20 henrys at 50 mA, 400 ohms, **Ch1** **R.I. "Hypercore"**
(Alternatives same as mains transformer above)
3 Electrolytic condensers, 8 mfds., 500v. peak, **C9, C10, C11** **Dubilier 0281**
1 Fixed condenser, 4 mfds., 450v. working, cylindrical container **C12** **Dubilier LEG/9204**
2 Electrolytic condensers, 4 mfds., 500v. peak, **C5, C6** **Dubilier 0283**
(Ferranti, Peak, T.C.C.)
2 Electrolytic condensers, 50 mfds., 50v. peak, **C13, C14** **Dubilier 3003**
2 Electrolytic condensers, 200 mfds., 10v. peak, **C3, C4** **Dubilier 0283**
(T.C.C.)
2 Fixed condensers, mica, 0.1 mfd., **C7, C8** **Dubilier B775**
(T.C.C.)
2 Tubular paper condensers, non-inductive, 0.05 mfd., **C1, C2** **Dubilier 4403**
(Graham-Farish, Peak, T.C.C., T.M.C.Hydra)
2 Resistances, 1,000 ohms, 2 watts, **R15, R16** **Claude Lyons**
2 Resistances, 100 ohms, 1 watt, **R13, R14** **Claude Lyons**
2 Resistances, 1,000 ohms 1 watt, **R3, R4** **Claude Lyons**
2 Resistances, 5,000 ohms 1 watt, **R11, R12** **Claude Lyons**
2 Resistances, 10,000 ohms 1 watt **R7, R8** **Claude Lyons**
2 Resistances, 25,000 ohms 1 watt, **R5, R6** **Claude Lyons**
2 Resistances, 250,000 ohms 1 watt, **R9, R10** **Claude Lyons**
2 Resistances, 500,000 ohms 1 watt, **R1, R2** **Claude Lyons**
(Dubilier, Erie, Ferranti, Graham-Farish, Seradex, Watmel)
7 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
1 5-pin plug **Bulgin**
(British Radio Gramophone Co.)
3 Ebonite shrouded terminals, Input (2), Earth (1) **Belling-Lee Type "B"**
1 Metal Chassis **C.A.C.**
Valves:—2 Marconi or Osram MHL4; 2 Marconi or Osram PX4; 1 Marconi or Osram MU14

FEEDER UNIT

1 Electrolytic condenser, 8 mfds., 500 volts peak, **C16** **Dubilier 0281**
(Ferranti, Peak, T.C.C.)
1 Electrolytic condenser, 50 mfds., 6 volts peak, **C15** **Dubilier 3001**
(T.C.C.)
1 Resistance, 7,500 ohms 10 watts **R22** **Dubilier "Spirohm"**
(Bulgin)
1 Resistance, 2,000 ohms 1 watt, **R21** **Claude Lyons**
3 Resistances, 50,000 ohms 1 watt, **R18, R19, R20** **Claude Lyons**
(Dubilier, Erie, Ferranti, Graham-Farish, Seradex, Watmel)
1 Tapered volume control potentiometer, 250,000 ohms, with knob, **R17** **Ferranti Type "P"**
(Claude Lyons, Magnum, Rothermel)
1 Valve holder, 5-pin **Clix Chassis Mounting Standard Type**
1 5-pin plug **Bulgin**
(British Radio Gramophone Co.)
1 5-way cable with twin 70/36 leads **Harbros**
(Goltone)
4 Ebonite shrouded terminals, Output (2), Input (2) **Belling-Lee Type "B"**
1 Metal chassis **C.A.C.**
Valves:—1 Marconi or Osram MH4

Push-Pull Quality Amplifier—

be ignored, so that the 275 volts is split for the anode and bias supplies for the output stage.

At this point the current for the output stage is tapped off and the remaining current of 50 mA. passes through the 20-henry choke Ch1, where further smoothing takes place in conjunction with C9. This choke has a resistance of 400 ohms, so that there is a drop of 20 volts across it, and a supply of 255 volts is available. The MHL4 valves are fed from this point and take about 4.3 mA. apiece, so that some 41 mA. is available for operating a radio receiver.

Turning now to methods which may be used for feeding the amplier, several alternatives present themselves according to the use to which the amplifier is to be put. For gramophone operation an additional stage of amplification is needed, and if the amplifier is to be used only for such work, the feeder unit described in this article should be built. This consists of a single MH4 valve, and the circuit appears in Fig. 2. Owing to the necessity for obtaining a phase reversal in one-half of the output, the arrangement is unusual. It will be seen that two coupling resistances R18 and R20, each of 50,000 ohms, are used, and that while one of these is in the anode circuit the other is in the cathode. Since the resistances are of equal value, the anode and cathode of the valve are always at equal and opposite A.C. potentials, and the required phase reversal for push-pull operation of the succeeding stages is obtained.

Unlike the ordinary push-pull system, an amplifier of this type is not balanced as regards disturbances in the H.T. supply; thorough decoupling of the anode circuit of the first stage is necessary, therefore, and is provided by the 50,000 ohms resistance R19 and the 8-mfd. condenser C16. Grid bias is obtained by the voltage drop across the 2,000 ohms resistance R21, and as the anode current is about 1.2 mA., a bias of 2.4 volts is obtained. A 250,000 ohms tapered potentiometer in the grid circuit of the valve provides volume control. It is important to note that neither of the input terminals to which a pick-up is connected is earthed, this being an inevitable consequence of the particular method adopted for feeding the push-pull stage. Care must be taken, therefore, to see that the pick-up leads do not become accidentally earthed, for they are about 60 volts above earth potential.

The full output is obtained with an input of only 0.265 volt R.M.S., so that it is possible to obtain adequate volume from the more insensitive types of pick-up. The range of control afforded by the volume control is adequate, however, even when a component giving a large output is used. On radio, or when both radio and gramophone are required, alternative methods of feeding the amplifier are available, and these will be dealt with next week.

News *of the* Week

Current Events in Brief Review

Radio at Paris Fair

THE Foire de Paris, which opened on Wednesday last, May 9th, includes a radio show in the Electricity Hall and in the Pavilion of Music.

The P.O. Will Help

ELECTRICAL interference which cannot be traced should always be referred to the Post Office. With an "electrical interference questionnaire," obtainable from any Post Office, the listener can explain the situation in a way that enables the engineers to trace the trouble with the minimum amount of delay. The Post Office makes no charge for the investigation.

More American Wavelengths

A DOWNWARD extension of the broadcast wavelength band has been authorised by the American Federal Radio Commission. Within the next few months four new stations will operate on wavelengths between 180 and 200 metres. Hitherto, broadcasting in North America has been confined to ninety-six wavelengths, spaced 10 kc/s apart, between 550 and 1,500 kc/s. Three of the four new stations are concerned with television.

A Veteran on 30-line Television

HIGH praise for 30-line television as broadcast by the B.B.C. comes from Dr. Lee De-Forest in a letter to the President of the National Radio Institutes and quoted in the *New York Sun*. Says Dr. De Forest:—

"I found the British Baird Company making fine progress in commercial television. Four nights each week they broadcast one hour of genuine artistic entertainment. . . . Baird is limited by British regulations to 9,000 k/c side bands. Imagine getting a good picture out of that! Yet Baird does it—by use of 30-line picture and 12½ pictures a second. Considering the handicaps, the results are amazing. Vertical scanning is the answer—incomparably superior to horizontal scanning when less than 120 lines are employed."

Encouraging

TO encourage the local tramway company to fit antistatic devices the Berne Posts and Telegraphs Department has provided a subsidy of 60,000 francs.

Physics and Science Museums

ON Tuesday next, May 15th, at 5.15 p.m., the President of the Institute of Physics, Sir Henry G. Lyons, D.Sc., Sc.D., F.Inst.P., F.R.S., will deliver the Presidential Address on "Physics and Science Museums" in the Royal Institution, 21, Albemarle Street, London, W.1. Tickets of admission may be obtained from the Secretary of the Institute, 1, Lowther Gardens, Exhibition Road, London, S.W.7.

Recording on Film

PHOTOGRAPHIC aspects of sound recording will be discussed by Dr. C. E. Kenneth Mees, F.C.S., of the Eastman-Kodak Company, in a lecture before the Royal Society of Arts, London, W.C.2, on Wednesday next, May 16th, at 8.30 p.m. The lecture will be illustrated by lantern slides and cinematograph films, including sound records.

Wave "Squatting" in Mexico

THE prospect of a radio "bombardment" from Mexico is now facing the U.S. Federal Radio Commission, following the announcement that Mexico has ordered a sweeping re-allocation of the wavelengths of its sixty stations. Mexico has no broadcasting channels regularly assigned to it, having been unable to reach an agreement with the U.S. and Canada. The result is that for several years the Mexican stations have been "squatting" on wavelengths allocated to more than a hundred stations in the U.S.

Listen to Warsaw

MR. THAD ORDON, who broadcasts frequently in English from Warsaw, has begun a "radio mail box" for British listeners. Letters received will be answered once a month at the Warsaw microphone. The time-table of the "Warsaw Radio Mail Box" will appear in *The Wireless World*.

New Radio Menace

MARSEILLES, home of tall stories, is the origin of a fine radio yarn. It appears that when gangsters recently attacked an elderly man in his flat, the neighbours, on hearing the shrieks, imagined it to be the wireless functioning in its normal manner.

In justice to the particular make of set, it should be stated that Marseilles is noted for its man-made static.

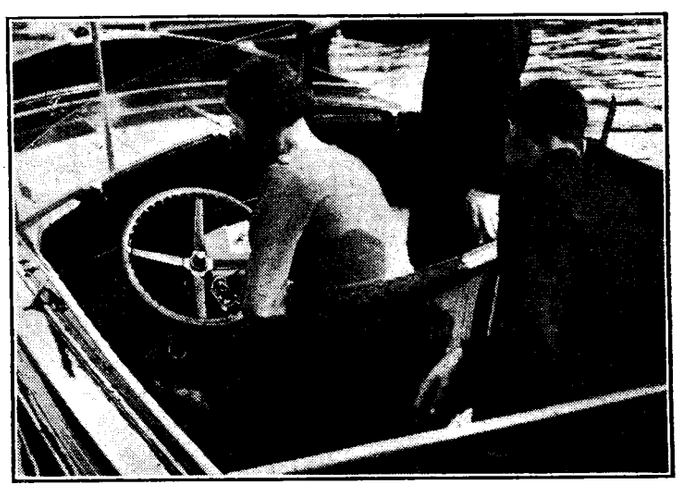
More Money for French Radio

AN idea of France's broadcasting ambitions is furnished by the Post Office demand to Parliament for new credits. The 65,000,000 francs voted by Parliament in 1931 have been allocated to the purchase of Radio Paris and the construction of seven transmitters, namely: Villejust, Paris, 120 kW.; Tramoyes, Lyons, 100 kW.; Antibes, Côte d'Azur, 60 kW.; Realtor, Marseilles, 100 kW.; Muret, Toulouse, 120 kW.; Thouries, Rennes, 120 kW.; and Camphin, Lille, 60 kW.

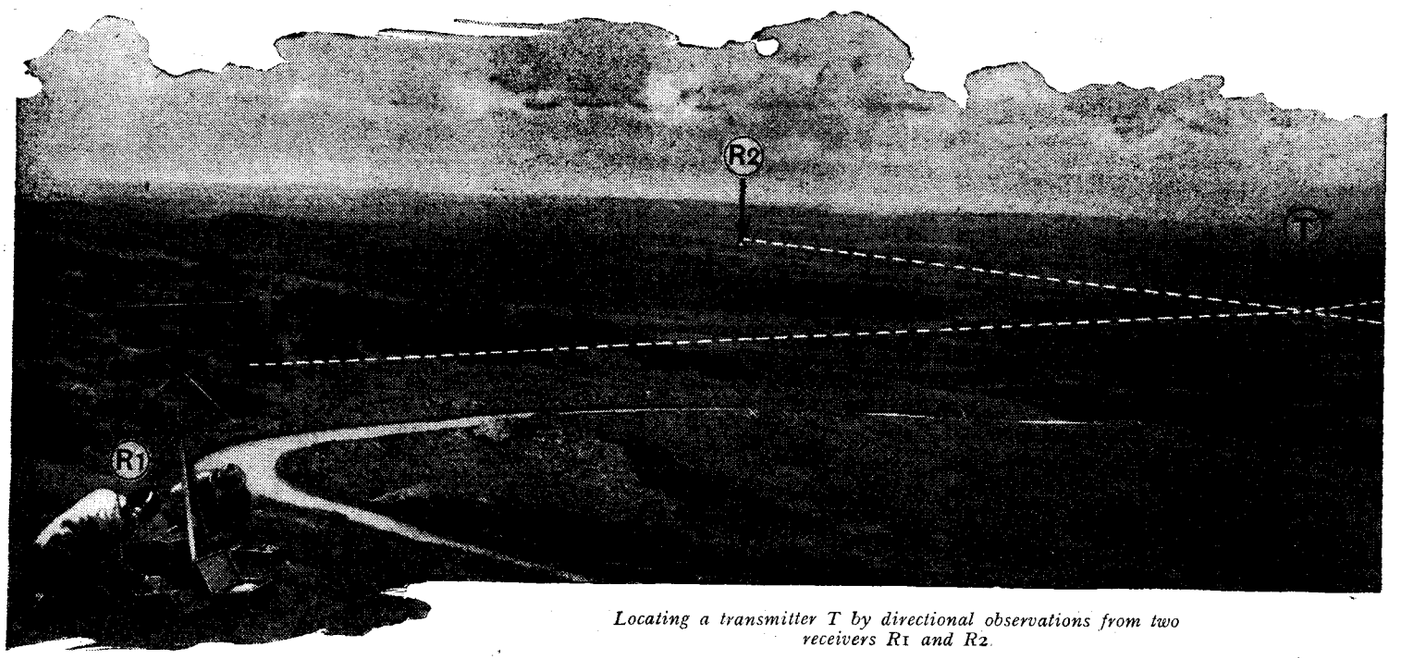
The "second instalment" is required for the Paris "Radic House," studios in the provinces, and many power increases.

Whitsun "Smalls"

WITH the approach of the Whitsun holidays slight alterations are necessary in our printing arrangements. Miscellaneous advertisements intended for *The Wireless World* of May 25th should reach the offices of the Publishers not later than first post on Friday, May 18th.



SPEED BOAT RADIO. Dashboard-operated wireless sets will be included in the equipment of many speed boats this summer. This photograph, taken on a Yorkshire cruising ground, shows how the radio can be manipulated from the steering wheel. The loud speaker is on the left.



Locating a transmitter T by directional observations from two receivers R1 and R2.

Direction-finding by Wireless

How It is Done : Some Practical Points and Applications

DIRECTION wireless as a means of discovering position was developed during the Great War, but it is more recently that some of its peculiar problems have been solved, and highly sensitive receivers have extended its possibilities. This article discusses the general theory and gives practical information for those who may wish to experiment

ALTHOUGH direction-finding is not a subject of direct utility in connection with broadcast reception it is of the greatest importance in many other practical uses of wireless. Its practical application in marine work is one of the oldest, and still remains of the highest importance in navigation, with its attendant increase of safety of life. The navigational value of direction-finding to aircraft, military and civil, is a more modern application of great service. Cross-Channel aircraft regularly use directional observations for location of their position in conditions of difficulty.

Even in broadcast reception it is common knowledge that the directional properties of a frame aerial can, at times, be used to eliminate interference, especially if the interfering station lies in a different direction from that of the station that it is desired to receive. Another practical application is, of course, that of locating sources of interference, such as pirate transmitters or other types of interfering radiation. The Post Office use it regularly for location of pirate transmitters.

The first elementary principle of direction-finding is quite familiar to all listeners who have portable sets or receivers with any type of frame aerial. Briefly, it can be stated in the form that the reception from a given station is at its strongest when the *plane* of the frame aerial is in line with the transmitting station, and is zero (or at least a minimum) when the plane of the frame aerial lies at right-angles to the line connecting transmitter and receiver. These conditions are shown in Fig. 1, which illustrates a frame aerial in several positions with respect to the direction of an arriving signal—the three upper diagrams in elevation and the lower in plan. The direction of the arriving signal is shown by the arrow, while the frame aerial is pivoted about a vertical axis as shown. In (*a*) the plane of the frame aerial is in the line of propagation, and the signal is of maximum strength. At (*c*) the frame is at right-angles to the line of propagation, and the signal should effectively be zero. In (*b*) conditions are intermediate, and the signal strength is proportional to the cosine of the angle which the plane of the frame makes with the line of propagation.

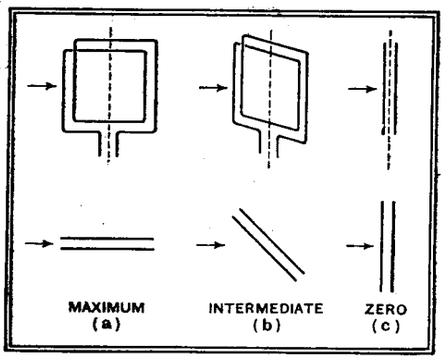


Fig. 1.—Variation of signal strength with rotation of frame aerial. The arrow indicates the direction of arriving signal. The diagrams show the frame in elevation (top) and in plan (bottom).

In actual use as a direction-finder it is usual to employ the zero, or minimum, position for the determination of the direction from which the signal is coming. This is because the change of signal-density is not at all sharp as the coil is swung round the maximum position, and it is very difficult to determine the maximum. On the other hand, as the coil is swung about the minimum position, the change of signal strength is very abrupt, and, with care in the set-up of the apparatus, the "zero" at 90 degrees from the maximum direction can be made very sharp indeed, so that this position can be read with great accuracy. It is usual to fit a circular protractor or similar scale to read the angle which the frame makes at its minimum position. It is also usual to arrange this protractor scale with reference to some definite line. For example, in the case of fixed land stations, the scale is normally set so that it reads 0 degree when the frame is North-South, and all bearings are therefore expressed in angles from North (with an ambiguity of 180 degrees, to which re-

ference is made later). In the case of ships the reference line is the fore-and-aft line of the ship.

Blurred Zeros and the Cure

It has been stated above that when the frame is at right angles to the direction of the arriving wave the signal strength should be zero. In practice, there are two factors that militate against getting good zeros. The first is the fact that the frame-aerial system as a whole has capacity to earth, regarding it as a mass of metal. To look at it in another way, the mass of the frame acts as an ordinary vertical aerial to earth, just as any of the "cage" types of capacity aerial do. Currents are thus set up in it as a vertical aerial, and these currents may have any casual phase relation with respect to the currents in it as a tuned closed loop. This "vertical aerial" current, therefore, need not be, and generally is not, reduced to zero by revolving the frame to the minimum position, so that the "zero" position on rotating the frame is blurred. The other effect is that of direct pick-up in the leads, amplifier, etc. In the maximum direction, of course, this will not be detectable, but in the minimum position it may readily blur the zero that would otherwise be obtained.

In practice, the direct pick-up is very easily overcome by using screened leads and by screening the receiving gear. Such shielding of the amplifier—or at least of those parts likely to pick-up H.F. signals—has long been the practice in all direction-finding work of any practical precision.

The first-named effect, generally known as "vertical" or "antenna" effect, is also corrigible in several ways, illustrated in Fig. 2. In (*a*) the frame is "screened" by surrounding its windings with some form of conductor such as a metal tube, with a gap, as shown, in order to prevent the screen forming a closed loop in the plane of the aerial itself. Such a screen drains off the vertical aerial currents to earth and keeps them out of the frame circuit. The other systems shown all depend on methods of making the frame circuit symmetrical with respect to earth. Thus, in (*b*) the frame is tuned by a split condenser whose mid-point is earthed, while the symmetry can be preserved by the use of push-pull H.F. amplification. In (*c*) the frame itself is centre-tapped, and can be used with push-pull amplification, or can be used, as actually shown, with an ordinary input circuit and a balancing condenser of small capacity to balance the grid filament capacity of the valve. (A similar arrangement could, of course, be used in (*b*).) In (*d*) the frame circuit is joined to the amplfier *via* a high-frequency transformer, whose primary is centre-tapped to earth, thus draining off the "vertical" current differentially. The windings of the transformer should further be shielded from each other by an earthed screen, as shown. The screen for this purpose is preferably in the form of a "comb" whose teeth are insulated from each other along their length, all joined together at one end and insulated from each other at the other end.

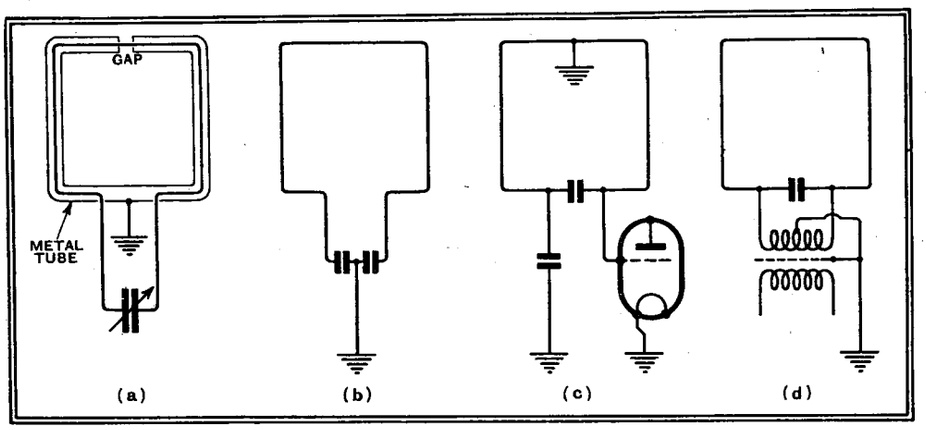


Fig. 2.—Methods of reducing vertical or antenna effect.

Bad Sites for D.F. Work

The blurring of minima discussed above can be described as instrumental, but there exist still other factors of considerable practical importance, to which the D.F. experimenter must pay attention.

For example, the immediate vicinity of the direction-finder may have a grave effect upon its behaviour. Any form of metal-work, overhead wires, even trees, all have the effect of causing local distortion of the received electro-magnetic field. Since the coil determines the minimum of the field which is *acting upon it*, such local distortion may cause this minimum to be considerably different from that of the pure undistorted field. Further, such errors may vary with wavelength, according to casual resonances in the distorting agents. Even underground metal work may give rise to errors, and should be avoided. In the choice of an experimental D.F. site, for example, for portable field work, considerable care must therefore be taken. Generally speaking, the site should be as open as possible, free from telegraph or power lines, trees, and large masses of metal or metal-framed buildings. Moist ground of good conductivity is desirable.

On shipboard things are much worse. The inevitable congestion and abundant metal-work all tend to vitiate an already bad site, and it is the invariable practice to calibrate a ship's D.F. set experimentally on a transmitter whose bearing can be checked visually. By this means it is possible to obtain a curve from which corrections can be read and applied to bearings taken in working conditions.

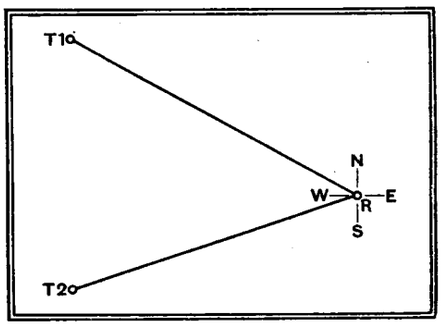


Fig. 3.—Locating the position of a receiver R by directional observations on two transmitters T1 and T2.

Night Error

By far the most serious source of D.F. error, however, is that associated with "night effect." This is particularly serious because it cannot be calibrated nor its amount pre-determined.

This effect has long been known, ever since direction-finding came into real use. Briefly, it can be described as follows. In circumstances where accurate bearings are given in daylight, strange things occur after dark sets in. Sometimes minima become blurred and signals are heard at practically equal strength all round the rotation of the frame. Sometimes minima remain sharp enough, but the directions given are hopelessly in error and vary rapidly. At other times the effects all interchange rapidly, and conditions generally swing about quite beyond the observer's control. Fortunately it has been proved that the average of a sufficiently large number of bearings comes out fairly near the truth, but single instantaneous observations are quite unreliable.

Night effect is now known definitely to be due to the condition of waves returned from the ionised regions of the upper atmosphere (see Fading and its Vagaries, April 20th, 1934). Apparently the waves are frequently, indeed mostly, returned from the layer with their electro-magnetic fields twisted and having any casual relation with the field of the direct ray. As before, the direction-finder still tries to give the minimum of the resultant field, but this is no longer such as to give correct bearings. Further conditions may be affected abruptly by changes in the layer just as are the changes of fading; indeed, this type of error is a symptom of the same conditions as those giving rise to fading.

Night effect varies with wavelength in a manner which is at present not very clearly specified, but certainly increases on the shorter wavelengths, since the ground ray signal is then much more attenuated in its travel. It is also ex-

Direction-finding by Wireless—

tremely difficult to say at what respective distances the effect becomes serious with different wavelengths. On the wavelengths used by ships (600 or 1,000 metres) for D.F. working, day-time bearings are reliable up to 100 miles; in the 250-500 metres broadcast band, 50 miles is probably a reliable day-time value, but on waves below 100 metres it appears likely that the so-called "night effect" is liable to be encountered even in day-time at distances of ten or twenty miles.

The problem of night error is one of the greatest difficulties of practical direction-finding. The main type of solution so far available lies in the use of an aerial which is either uninfluenced or less strongly influenced by the downcoming signal. Several aerial systems of this kind have been devised, but unfortunately they hardly come within the scope of the amateur experimenter.

Practical Scope for the Amateur

At the same time there is considerable amateur interest to be obtained from direction-finding work. In particular, clubs and societies who organise field days will find D.F. exercises both stimulating and instructive. A typical exercise of this kind is that of using direction-finders to locate an unknown transmitter—an "enemy," if one prefers to think of it in warlike terms. Position locating is, indeed, the chief application of wireless D.F., and perhaps the greatest single use of direction-finding which is still made is the marine one, in which ships employ it for finding their own positions.

This application is illustrated in Fig 3. The receiver R is on a moving ship fitted with D.F. apparatus. T1 and T2 are shore-station transmitters whose position the ship knows. Bearings on each of the transmitters are taken aboard ship as rapidly as possible after each other. The bearings are then plotted on a chart and their intersection gives the position of the ship. The Post Office maintains a series of coast transmitting "beacon" stations on 1,000 metres, sending out characteristic signals for the use in this manner of ships off our coast. These beacon stations are literally our radio lighthouses and serve the same purpose to navigation, with the advantage that they are unaffected by fog and other conditions that rule visual guides out of court.

The use of direction-finding in this way is not, of course, confined to purely beacon stations, but can be used on any transmitter of known position coming within the tuning range of the receiver.

Another method of practical application arises when the moving craft (for example, an aeroplane) carries transmitting apparatus and an ordinary receiver but no direction-finding receiving apparatus. This is illustrated in Fig. 4. Two fixed direction-finding receivers R1 and R2 co-operate in taking simultaneous bearings on the transmitter T. One receiver, say, R1, is the control station, and R2 immediately communicates to R1 the bearing which it has observed. R1 plots the two bearings which give the position of T, and then transmits the position back to the moving craft T.

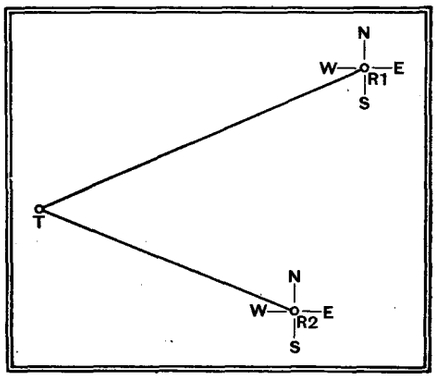
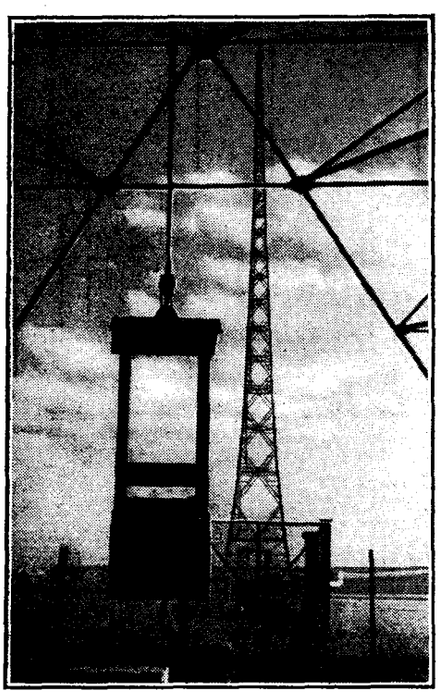


Fig. 4.—Locating a transmitter T by directional observations from two receivers R1 and R2.

This is the method which is used for the navigational assistance of aircraft on the Channel and North Sea routes. The Air Ministry D.F. stations at Croydon, Lympne and Pulham are the receivers. For example, a machine on the Le-Bourget-Croydon route calls Croydon and Lympne on its ordinary telephony transmitter. These stations simultaneously take the bearing of the machine, Lympne communicates its observation to Croydon, who plots the two bearings and finds their intersection, which is the instantaneous position of the machine. This is then transmitted to the machine.

Speedy as this operation is, however, it is nothing to what is, perhaps, the most spectacular example of two-station direction-finding used for the location of a point position. This is the method used for locating the place of origin of individual atmospherics. In this case the bearings of the individual atmospherics are observed at the Radio Research Station at Slough, and at a sub-station in Scotland and the results on single atmospherics are plotted in this manner to indicate the place from which each impulse has come. The direction-finders used for this purpose are not of the ordinary type of rotating coil, but of a special pattern using a cathode ray tube, which explains why they can be used for such rapid work. The principle of two-station observation for position finding is, however, exactly similar to that used in ordinary working.



A weighty problem at Prague. The aerial of this popular high power station is kept taut between the 492-ft. masts by heavy weights.

Locating the "Enemy" Transmitter

The applications of this method of two station observation also form an interesting and instructive field exercise for amateur clubs on their field outings. Reverting to Fig. 4, T might be a "secret" or "enemy" transmitter whose position it is desired to locate. If two receivers are available the method already described can be used. If radio communication is available between R1 and R2 (even a one-way channel) the routine is exactly that described. If not, and if the field operations are not on too big a scale, a motor-cycle despatch-rider will make a good substitute—and some volunteer will enjoy the job.

If operations are not on too big a scale, one portable direction-finder can be used, set up first at R1 and then moved on quickly to R2. (This assumes, of course, that the "enemy" transmitter is friendly enough to continue transmitting so long and does not also move on.)

The possibility of doing this will, of course, depend on the scale of operations, and this will also affect the accuracy of fixing the location. For good accuracy of plotting it is desirable that T R1 R2 should form something like an equilateral triangle. If the distances T-R1 and T-R2 are very long compared with R1-R2 the accuracy of plotting is much impaired. Any inaccuracy in the setting-up of the direction-finder or in the taking of bearings also becomes more serious in the plotting of intersections for position-finding with such an elongated triangle.

For this reason it will be clear that the greatest accuracy possible is necessary in setting up the direction-finder. In the case of a portable set—for example, for field use at different places—we have no fixed reference. It is, therefore, usual in setting up the direction-finder to adjust its protractor or angular scale so that when the frame is North-to-South the scale reads 0 deg. All bearings are then read with reference to North as 0 deg., i.e., N.E. is 45 deg., E. is 90 deg., S.E. is 135 deg., etc. This is convenient for plotting on a map. In setting up on a new site a compass can be used to line the frame to the North-South line, but it must be remembered that the magnetic compass does not read true geographical North but lies along a line which is 11¾ degrees West of true North at the present time.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

IN spite of the generally decreasing margin of difference between normal mains voltage and the voltage required by a chain of series-connected D.C. valves, there generally remains a considerable wattage to be absorbed in a limiting resistance. This energy will be dissipated in the form of heat, and it is the purpose of this note to stress the importance of mounting the main voltage-reducing resistance in a position where air can circulate freely round it. The best practice is to provide an outlet for hot air immediately above the resistance, and an intake for cold air below it.

Heat Dissipation in D.C. Sets

Again, it is wise to mount the resistance as far away as possible from any components likely to be damaged by heat. Cases have been known where the wax filling of paper condensers has been melted through failure to observe this precaution.

THERE is a tendency to use high voltages in the output stage to a much greater extent than formerly. Many amateurs, however, are probably deterred from making alterations to existing sets by the fact that special rectifying equipment is normally required. In such cases the possibilities of voltage-doubling should not be forgotten.

Voltage-doubling Rectifier

A convenient way of doing this with the kind of apparatus that many readers will doubtless have accumulated is shown in

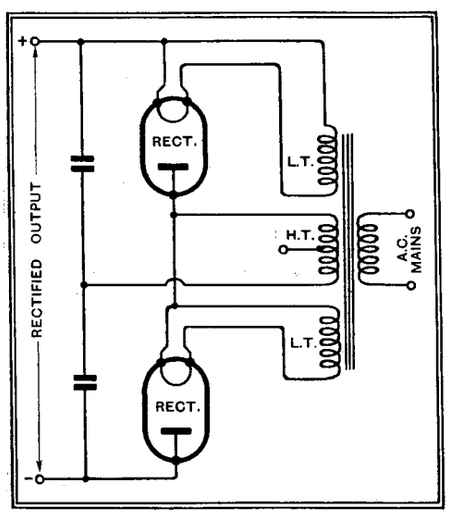


Fig. 1.—An arrangement of rectifying valves giving a D.C. output of about twice the A.C. voltage input.

Fig. 1. The rectified output of this arrangement, on a fair load, is equal to about twice the R.M.S. voltage across the H.T. secondary of the transformer. Of course, there are limitations as to the amount of current that can be taken.

There is no reason why the rectifying valve filaments should not be fed from separate transformers—or one of them may be supplied from an L.T. winding of an existing power transformer and the other from an external transformer.

A voltage-doubling circuit such as that under discussion is suitable for supplying current for many purposes, and the feed to the rectifying valves may be obtained directly from the mains without the intermediary of a transformer. But it should be made clear that to connect a receiver in this way is contrary to the I.E.E. recommendations.

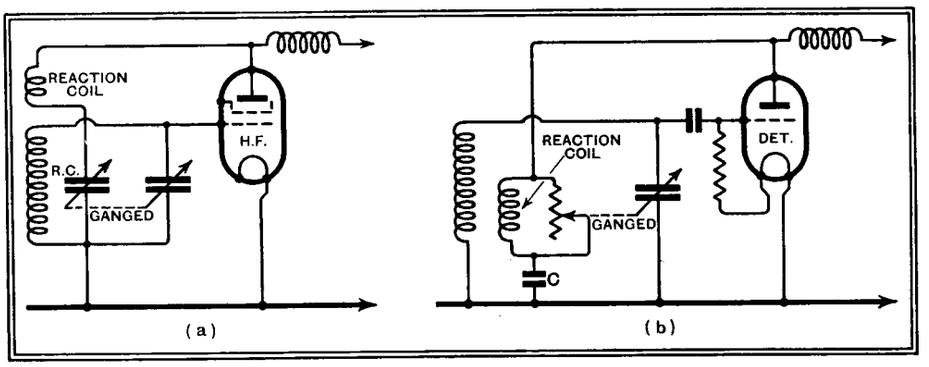


Fig. 2.—Automatic reaction ; the condenser C prevents an H.T. short-circuit.

ALMOST everyone has accepted unreservedly the principle of controlling a series of tuned circuits by means of a ganged condenser. Even the most skilful and "hard-boiled" of amateurs, who used to maintain that single-knob tuning was out of place in an enthusiast's set, have agreed that the small losses consequent on ganging are more than compensated for by the ease of operation of a "one-knob" set.

Inter-linked Controls

In spite of this it would seem that the possibilities of mechanically linking other subsidiary controls have not been fully explored, at any rate in amateur circles. Recent patent specifications show that research engineers are alive to the advantages of this principle : to take the question of "constant reaction," the two arrangements shown in simplified form in Fig. 2 (*a*) and (*b*) have recently been evolved. The fact that these gang control systems were originally intended for specialised circuits does not mean that they have no application to the simpler type of broadcast receiver.

The working of the simpler arrangement shown in diagram (*a*) is fairly obvious. Everyone knows that, in the ordinary receiver, reaction effects—incidental and otherwise—become less marked as wavelength is increased ; it is the purpose of this arrangement to maintain more or less constant reaction by linking the reaction condenser R.C. to the tuning condenser in such a way that the feed-back capacity is made greater with increase of wavelength.

In circuit (*b*) a similar object is achieved by the use of a shunt resistance across the reaction coil. Matters are so arranged that the value of resistance is progressively increased as the tuning condenser is rotated from the bottom to the top of the wavelength scale.

Of course, the rate of increase of the reaction-controlling device is important, and usually it will be found to follow a somewhat complicated law—in fact, so complicated that the nature of the law can only be determined by trial. The same applies, indeed, to all similar types of mechanically linked controls, such, for example, as constant aerial coupling, which was mentioned some time ago in these pages. To those who are gifted with patience, however, the task of working out the details of these controlling systems is an interesting one ; it is usually best, when carrying out experiments, to separate the subsidiary control device from the tuning condenser when determining the best value of capacity, resistance, etc., to correspond to different angular settings.

IT is natural that the attractions of Single-Span tuning for reception on short wavelengths have not been overlooked, although no conclusion has yet been reached as to the best way of using its possibilities in this direction to the best advantage.

Single-Span on Short Waves

For the benefit of those who are interested in the subject it may be pointed out that the Single-Span circuit already described in this journal may be very simply adapted for short-wave work by replacing the special aerial filter by a short-wave choke and by suitably reducing the inductance of the oscillator coil. Unfortunately, this scheme affords no protection against second-channel interference, but nevertheless is sufficiently practical to enable one to make a start in exploring the potentialities of the system.

New System of Automatic Volume Control

(Concluded from page 308 of last issue)

A Fresh Application of the Duo-Diode-Triode

THE defects of certain A.V.C. systems were explained in last week's issue, and this article deals with an improved method using a duo-diode-triode valve. A very large range of control is obtainable, and the arrangement finds its chief application in superheterodynes operating with a low intermediate frequency.

IT is possible to use a duo-diode-triode on the lines described last week. The triode would have to function as an I.F. amplifier, but as the control grid is brought out at the top of the valve, the grid-anode capacity is comparatively low, being about 4.1 mmfds. A tuned coupling between its anode circuit and the diode would obviously lead to difficulties through instability, but the possibility of an aperiodic coupling is worth investigating.

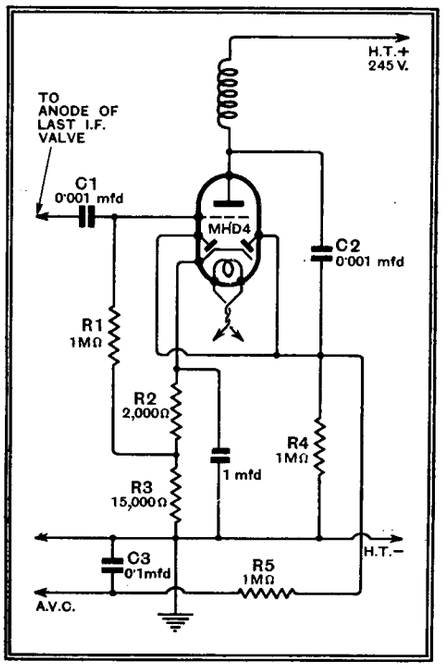
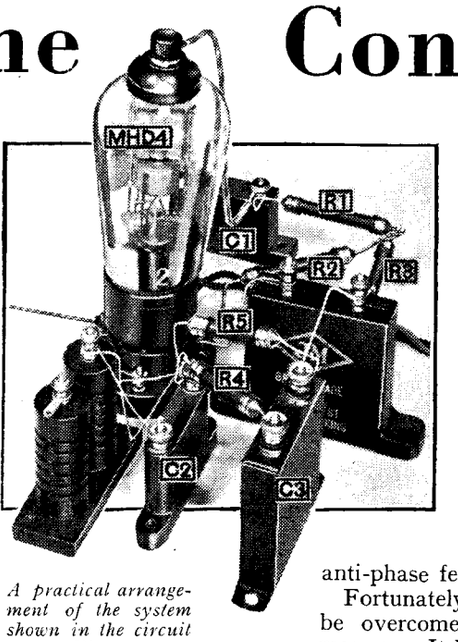


Fig. 3.—I.F. amplified A.V.C. may be obtained from a single duo-diode-triode; suitable values of components are marked on the diagram.

The circuit diagram is shown in Fig. 3, and the operation should be readily apparent. The I.F. input is applied through the condenser C1 to the triode grid, which is negatively biased by the voltage drop along R2 applied through the grid leak R1. An H.F. choke is used in the anode circuit for the coupling, and the potentials developed across it are applied to the diodes through the condenser C2. The resistance R4 acts as the diode load impedance, and is returned to the earth line, and the A.V.C. bias is taken off through the usual filter circuit R5C3. The control grid is biased by the voltage drop along R2, but the diodes are biased by the sum of the drops along R2 and R3. With the MHD4 valve and the values marked on the diagram the diode bias is about 35 volts, and this represents the delay obtainable.



A practical arrangement of the system shown in the circuit Fig. 3.

The triode control grid is biased by 4.1 volts, and as grid current in this valve flows up to −0.7 volt, the peak input should not exceed 3.4 volts. If the stage gain is thirty times, the output would be 102 volts, and roughly 67 volts bias would be obtainable before the A.V.C. system commenced to overload. A.V.C. would just commence to operate with an input of 1.165 volts peak. For the complete avoidance of grid current during very deep modulation, the above figure for maximum output should be halved, but the value of 33.5 volts so obtained is still ample for most purposes.

The Range of Control

The characteristics of the system have been measured, and the curve connecting the A.V.C. volts with the I.F. input is shown in Fig. 4. It will be seen that A.V.C. commences to operate with an input of 0.7 volt R.M.S., or 0.98 volt peak, and that when it has risen to double this figure or by 6 db the bias voltage available is 21.6 volts. This represents a very satisfactory performance.

In view of the capacitative load on the triode amplifier there is very little risk of instability occurring, and the only precaution normally required would be to select an H.F. choke for the coupling such that its resonance frequency with the various stray capacities is somewhat lower than the intermediate frequency employed. On account of the capacitative load, however, and the appreciable grid-anode capacity of the valve, the input impedance will be low and the I.F. tuned circuit to which it is connected will be damped heavily by anti-phase feed-back.

Fortunately, however, this may be overcome in a very simple manner. It has been shown that A.V.C. commences to operate when the input is 0.98 volt peak. This is a very small input for a modern detector, and it is customary to work a diode at an input of at least 5 volts peak in order to avoid distortion. This means 5 volts peak across the transformer primary, and we only need 0.98 volt for the A.V.C. system. We can afford to feed the A.V.C. valve, therefore, from a potentiometer connected across the transformer primary. The input impedance of the A.V.C. valve will then appear across only the lower limb of the potentiometer, and, if suitable values are given to the resistances forming it, the damping on the tuned circuit can be kept at a very small value indeed. This arrangement is shown in Fig. 5.

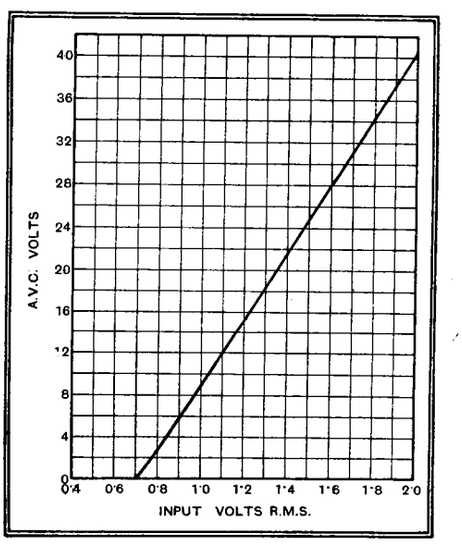


Fig 4.—This curve shows the bias voltage developed for various input voltages with the connections of Fig. 3.

New System of Automatic Volume Control—

It will be seen, therefore, that this arrangement forms a very satisfactory system of automatic volume control, combining the convenience of the delayed diode system with the avoidance of I.F. overloading of the D.C. Amplified A.V.C. circuit. Its sole disadvantage is that to realise its full merits an additional valve is needed. It should be noted, however, that it is possible to use the triode portion as a detector and L.F. amplifier also, and this arrangement is shown in Fig. 6. The triode then really acts primarily as a power grid detector, and the I.F. currents which always appear in the anode circuit of such a valve are fed to the diodes for A.V.C. purposes. An alternative arrangement using an ordinary triode is shown in Fig. 7, and here a Westector is used to provide the A.V.C. bias. This arrangement is quite commonly employed, and forms the basis of many of the A.V.C. units commercially available.

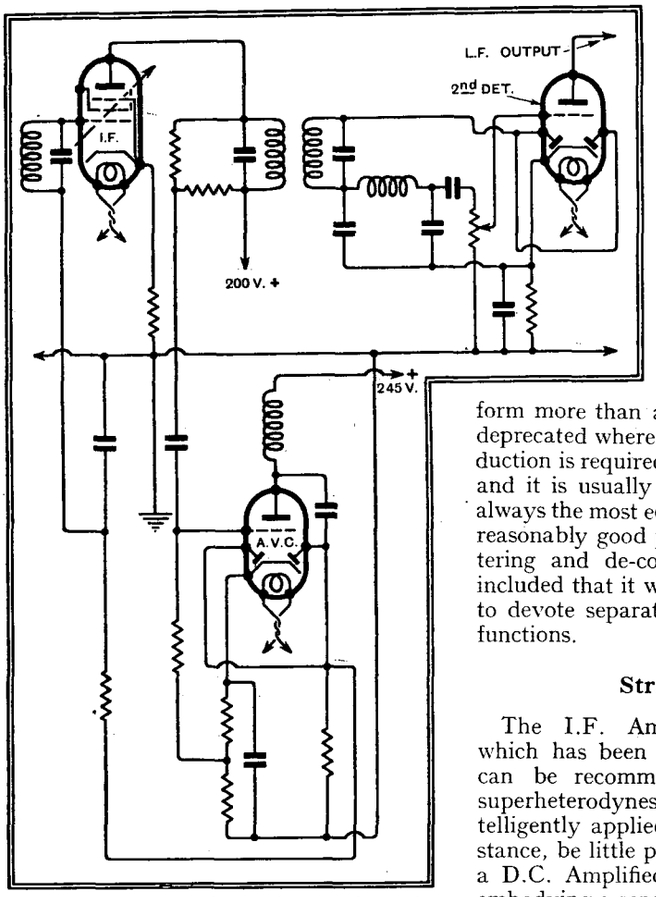


Fig. 5.—When a large detector input is needed, the A.V.C. amplifier is best fed from a potentiometer connected across the I.F. transformer.

Combining Detector and A.V.C.

Although these systems save a valve, they must not be expected to give a performance comparable with that obtainable from the recommended arrangement of Fig. 3, using an entirely separate valve for A.V.C. When the valve has to act as a detector and L.F. amplifier, as well as an I.F. amplifier, its output is greatly restricted, and very careful design is necessary if distortion is to be avoided. In general, the detector must be worked at a moderate input, with the result that the bias available before overloading sets in is limited. Such systems, therefore, will not cope with the large input obtainable from a local station, and do not relieve one from the necessity of fitting a Local-Distance switch, although they may prove entirely satisfactory for smoothing out the volume variations of fading in distant reception.

The practice of making a valve perform more than a single function is to be deprecated where the best quality of reproduction is required. Something must suffer, and it is usually quality. It is not even always the most economical, for to obtain a reasonably good performance so much filtering and de-coupling may have to be included that it would be actually cheaper to devote separate valves to the different functions.

Straight Sets

The I.F. Amplified A.V.C. system which has been described in this article can be recommended for use in most superheterodynes provided that it is intelligently applied. There would, for instance, be little point in using it to replace a D.C. Amplified A.V.C. system or one embodying a separate anode bend rectifier if the present arrangement is functioning correctly. It proves a very useful alternative to the other systems, however, and it will probably find its chief application in the better class of receiver, and, in particular, in battery sets. It should be noted, however, that it is not very suitable for use in a straight set, for the efficiency of the aperiodic coupling to the diode would fall off very greatly at low wavelengths, and it is not improbable that at 200 metres, where A.V.C. is most necessary to counteract fading, the bias available would be no greater than with an ordinary delayed diode system.

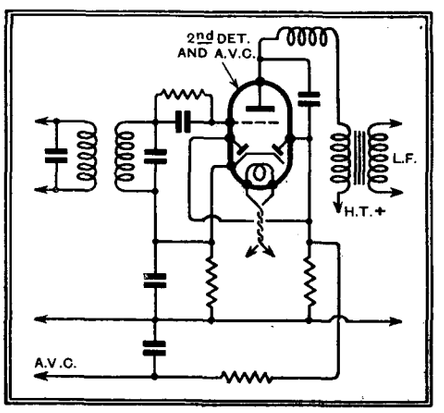


Fig. 6.—A single duo-diode-triode valve can be used as a grid detector as well as for A.V.C.

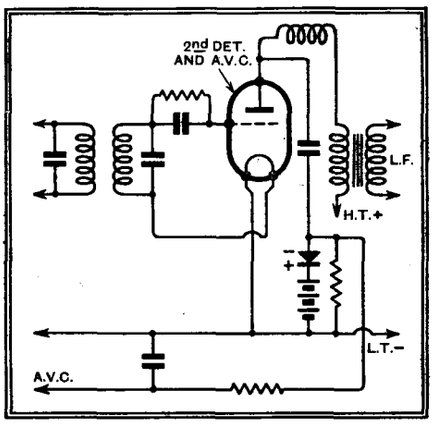


Fig. 7.—The popular A.V.C. system embodying a Westector with a grid detector is really a form of I.F. amplified A.V.C.

THE RADIO INDUSTRY

R. A. ROTHERMEL, LTD., of Rothermel House, Canterbury Road, High Road, Kilburn, London, N.W.6, have put into operation a remagnetising service to deal with loud speakers of any type, and particularly with P.M. moving-coil instruments. The firm's new address should be noted.

◇ ◇ ◇ ◇

Accessories and components bearing the Formo trade mark will soon be available again through a new company, Formo Products, Ltd., of Bromley, Kent, of which Mr. Graham Farish is Managing Director.

◇ ◇ ◇ ◇

Magnum Midget Canned coils, with a diameter of 2in. only, are described in a leaflet received from Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1.

◇ ◇ ◇ ◇

An ambitious public address installation, including a 600-watt amplifier and fourteen loud speakers, has been installed by Philips at the Empire Stadium, Wembley.

◇ ◇ ◇ ◇

It is understood that a new manufacturing company is shortly to be formed under the directorship of Mr. Charlton Higgs. The production of a wide range of receivers and radiogramophones is contemplated, and research is also to be carried out on other appliances.

◇ ◇ ◇ ◇

Lissen, Ltd., are prepared to supply bakelised paper formers for winding the coils of the Single-Span receiver.

◇ ◇ ◇ ◇

A very convincing demonstration of the new Philco car set, costing only 16 guineas, was recently given to *The Wireless World*. The set embodies a superheterodyne circuit with five valves and a rectifier, and is particularly easy to instal in most cars.

◇ ◇ ◇ ◇

Siemens have introduced special Full-o-Power batteries suitable for the Kolster-Brandes Kobra receiver. The price of the special battery for the Marconiphone Model 255 has been reduced from 14s. to 12s.

◇ ◇ ◇ ◇

Ferranti's have produced a new catalogue describing their 2½in. instruments for A.C. and D.C. measurements.

◇ ◇ ◇ ◇

The latest Ekco battery superheterodyne, with four valves (five stages), to be sold at ten guineas.

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The well-known Ferranti book, *The True Road to Radio*, of which some 20,000 copies have been distributed, is now out of print.

Broadcast Brevities

By Our Special Correspondent

That Television Commission

HOW long will the Television Committee sit? Committees and Commissions always frighten me. My mind turns to that Royal Commission, set up in 1851, which is still sitting, with offices in Lowther Gardens. It is not unconnected with the Crystal Palace, where television tests are now in progress.

A Wise Decision

BRICKBATS were flying this time last year when it became known that the B.B.C. intended to abolish early evening alternative programmes during the summer. With pride and joy I announce the decision of Colonel Dawnay, Controller of Output, that alternative programmes are to hold sway throughout the summer.

Not Likely

TENACITY of purpose has always been one of the B.B.C.'s strong cards, and those people are gravely mistaken who imagine that, because the Corporation objects to being a Post Office scapegoat in the matter of 24-hour time, it will shortly abandon the system.

No Relaxation of Effort

By every means in its power the B.B.C. will try to make you and me 24-hour-conscious before summer time ends. Within a day or two from now the announcers will drop translating 24-hour times into clock-face times.

In correspondence, in printed programmes, and even in official conversation, the B.B.C. will ignore the traditional timing which has held sway in these Islands ever since Alfred the Great cut twelve notches on a slow-burning candle.

Pitfalls

One or two little pitfalls have been disclosed. To prevent mistakes, 2400 hours will always be referred to as midnight. In conversation the figure "O" is always to be pronounced "oh," as on the telephone. One minute past twelve in the early morning will be described not as "oh oh oh one" but as "one after midnight."

A certain latitude is to be extended to playwrights, poets and others who use the expression "at the eleventh hour." Similarly, the film critics may still refer to "Dinner at Eight."

Trooping the Colour

FEW items sound more realistic on the loud speaker than military reviews. The blare of trumpets, the crash of drums, and the shouting of orders in the open air are faithfully reproduced, and this is why the Trooping of the Colour, to be relayed from the Horse Guards, Whitehall, on June 4th, will certainly make an ideal broadcast.

The ceremony opens with the arrival of the Royal Procession and the Royal Salute. A drum beats the Call, and the Escort marches up to the Colour, the band and drums playing "The British Grenadiers." Slow march, counter march, halt and quick march—all these will be distinguished by listeners, among whom, one imagines, will be many in remote parts of the Empire, for the programme is to be relayed by Daventry short-wave.

World Message on Medium Wave

WHETHER or not one is interested in the peace message from the Children of Wales to the Children of the World, which will be broadcast in West Regional on May 18th, it is interesting to note that this annual event is the only occasion on which a B.B.C. station, apart from the Empire transmitters, makes an avowed attempt to be heard beyond the shores of Britain.

In the past twelve years replies to the message have been received from seventy countries. This year's programme will deal with wireless and aeronautics.

Thrills at Shelsley Walsh

THE International Open Hill Climb for racing and sports cars, which takes place on June 9th, under the auspices of the Midland Automobile Club, will be described for Regional listeners by F. J. Findon and Major Vernon Brook in a relay from Shelsley Walsh, via Midland Regional.

As previous commentaries have shown, no better commentators could have been chosen to tell listeners how the speed kings of Europe are struggling to cover a 1,000-yard course with a one in eight gradient in something like forty-two seconds.

Cricket Fever

THE cricket germ has infected many of the staff at Broadcasting House, who lose no opportunity to practise at the nets at Motspur Park sports ground in preparation for a number of matches this summer.

The leading spirit is B. Walton O'Donnell, conductor of the Wireless Military Band. Another zealot is Cecil Graves, head of the Empire and Foreign Branch.

A unique photograph which includes both Big Ben (in the far background) and Big Tom, whose chimes are "understudying" those of Big Ben in the B.B.C. transmissions.

News from the Courts

Eric Maschwitz, during those fleeting moments when he is not writing plays and novels or directing variety rehearsals, plays tennis. He and Freddie Grisewood, the announcer, make a good pair on the courts. Listeners would enjoy a running commentary on one of their matches, with "Eric" supplying the comments and "Freddie" announcing the score, copyright reserved.

The Diary of an Ordinary Listener

THE number of good programmes during the past fortnight has made it rather difficult to fix on any one of outstanding merit; in fact, there were so many attractions that a settled daily schedule was almost out of the question.

Among the German stations the musical event which pleased me most was the performance of Richard Strauss' "Alpine Symphony," played by the Gewandhaus Orchestra, at Leipzig, and conducted by the composer himself. With this fine orchestra under the baton of so talented and experienced a conductor, the rendering of this descriptive music was all that could be desired.

After the close of the Symphony I heard the end of the Sacred Concert from Huizen, including Handel's Organ Concerto in B♭ and his Utrecht Jubilate.

Much to my regret, the other evening I missed the first part of a truly excellent performance, broadcast from Kootwijk by the Amsterdam Choir and Concertgebouw Orchestra, of Handel's "Messiah," conducted by Cuypers. I am not ashamed to admit an old-fashioned and sincere admiration of Handel's music in general and his "Messiah" in particular, so that nothing would have tempted me to try for any other station, until the oratorio came to a premature end with the "Hallelujah Chorus." Cuts were, in fact, too many, but were, I suppose, necessary to keep the performance within the limited time allotted. I was especially struck with the singing of the contralto in "He shall lead His flock" and "He was despised"—of course, in the Dutch translation of the original words.

I am beginning to regard Huizen (or Kootwijk) as a most dependable station to which one can always turn if other stations seem "off colour." Being near the top of the long waveband, it suffers very little from interference; even on the most freakish nights it comes in as clear as a bell, and its programmes are always worth listening to.

The performance transmitted by Radio Paris on Saturday of the music of Justin Clérice proved very interesting. He is a composer with whose work I am unfamiliar, but I thoroughly enjoyed his music, which is in the light operatic style. Incidentally, in the interval I heard the result of the Cup Final given out in the French sports news!

On Tuesday of last week Radio Toulouse gave a short concert version of Messager's operetta "Veronique," which came through very well.

Brussels No. 2 transmitted a gala concert by the Station Orchestra, conducted by Kumps, of which I heard the latter part, and was much pleased with the singing of two arias from "Les Huguenots" and "Le Noces de Jeannette" respectively.

The week's listening may perhaps be described as "a mixed bag," but nevertheless it has been good. CALIBAN.

Letters to the Editor:—

The Listener's Birthright

Single-Span: Long-wave Records: Vibratory H.T. Units

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

The Listener's Birthright

I FEEL that I cannot let your correspondent, C. Carpenter, get away with his tale of woe. I commend the B.B.C. for trying to get better results with its short-wave stations; it is not a question of what the domestic listener is losing by these short-wave broadcasts, the main thing to look at being if England does not broadcast to the Colonies, then the Colonies will have to turn around instead to some foreign country. I would like to know how much, indirectly, the short-wave broadcasting has kept the British nation in the eye of the listening public of other countries.

If England can put over good programmes and get people to continue listening to them, naturally the listener is going to be British-minded, and the British trade is going to benefit to a great extent. Mind you, I am not advocating sponsored programmes interspersed with advertising.

Mr. Carpenter has mentioned that the number of Colonial listeners has meant an expenditure of £5 per head. Why take that attitude? What was the cost per head of the English listener? I think it would be only a few pence, and a few pence well spent.

I very much appreciate your special correspondent of "Broadcast Brevities," January 19th. He seems to me a man of very wide knowledge and understanding. I think the Colonial takes broadcasting a little more seriously than his English cousin. In England there are many great towns a few miles apart where the Englishmen can get direct entertainment; whereas in Australia such sources are hundreds of miles apart, and some of the farmers and station people rely solely for their amusement upon the wireless; hence more seriously.

The last Test cricket and tennis matches in England kept many of the listeners awake until 3 a.m. At Christmas time we heard the bells from the church in Jerusalem at 5 a.m. and the round of Christmas greetings at 1 a.m., which were very much appreciated by the people so many miles from England. Of course, these were through the Beam, relayed throughout our National Network of the Australian Broadcasting Commission, covering 3,000 miles of telegraph line.

The Australian has the B.B.C. held up as an ideal (not meaning that our A.B.C. is a rotten show, far from it); let them carry on the good work, and all the best of luck. There is no greater thrill than to hear the chimes of Big Ben; it brings back old memories.

H. C. GIBBS.

Adelaide, S. Australia.

IT is some weeks since I read C. Carpenter's letter on the listener's rights, for I boiled when I read it (I have not cooled down yet) and for once did not read *The Wireless World* from cover to cover: since I nearly always read the Correspondence columns first as being one of the most interesting items, in this case I hid my paper.

Because Mr. Carpenter takes out a licence a year has he any more "rights" than I have? I, like many Colonial listeners, have no theatre to go to, no cinema, no concerts, no entertainment of such kind. The result is I spend a lot of money on wireless goods, all English. I have averaged at least £50 a year for some years. Does that represent to the Government as much as Mr. Carpenter subscribes? I always buy British goods when possible, as all "Colonial listeners" do.

That brings me to another boiling point in your correspondent's letter. Does he realise the very great effect British broadcasting has in the Colonies? Can he not realise that every tie to the home country is beyond price?

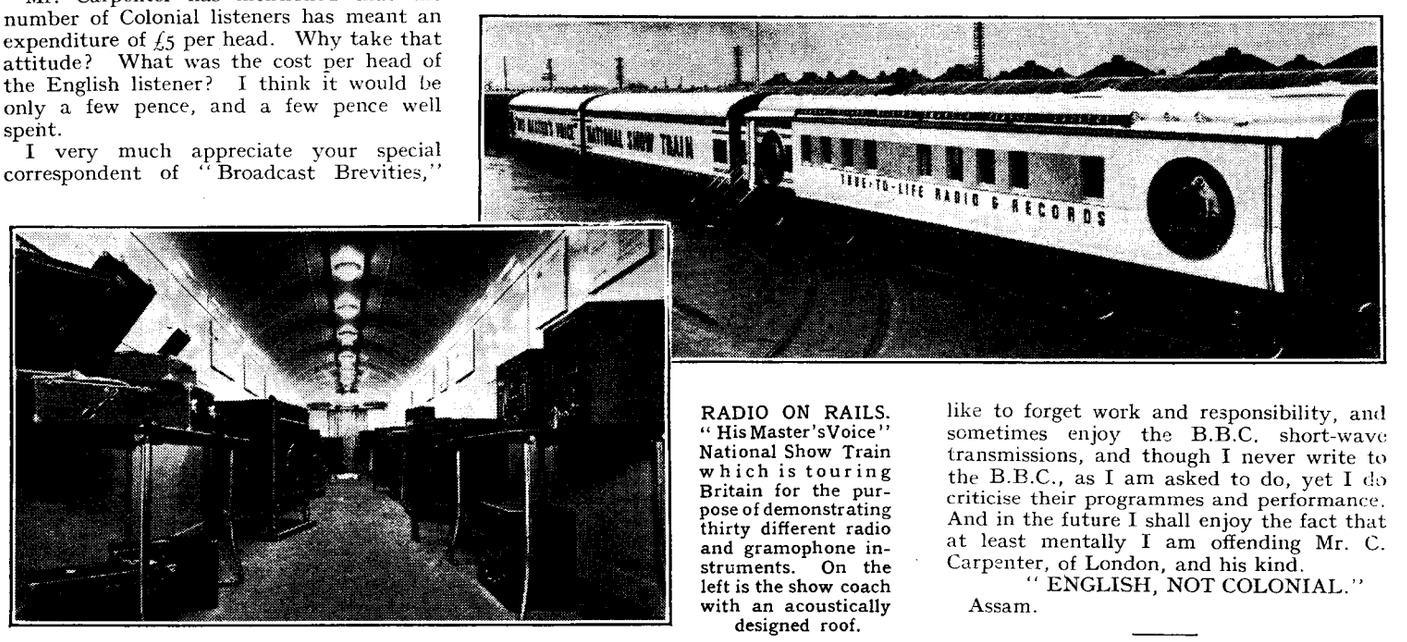
Are there only 20,000 Colonial listeners? Ridiculous. Multiply that figure by 100 and perhaps one would be approaching the correct estimate.

The poor are paying for Colonial listeners' enjoyment? Again, utterly ridiculous. If a rich man or a poor man goes to a cinema show, and each pays sixpence, they both get the same value for their money. Wherein, then, does the wireless licence differ?

So the Colonial listeners' standard of living is higher than that prevailing in England? Admittedly. May I inform Mr. Carpenter that the average Colonial earns it. I would not be very far wrong if I said that the average Colonial works from sunrise to sunset. I know my own period of work extends quite often to seventy hours per week. And still my responsibility does not end with those seventy hours. Each evening I like to forget work and responsibility, and sometimes enjoy the B.B.C. short-wave transmissions, and though I never write to the B.B.C., as I am asked to do, yet I do criticise their programmes and performance. And in the future I shall enjoy the fact that at least mentally I am offending Mr. C. Carpenter, of London, and his kind.

"ENGLISH, NOT COLONIAL."

Assam.



RADIO ON RAILS. "His Master's Voice" National Show Train which is touring Britain for the purpose of demonstrating thirty different radio and gramophone instruments. On the left is the show coach with an acoustically designed roof.

Single-Span

YOUR correspondent Mr. W. H. Chapman, in your issue of April 13th, suggests the use of a bank of semi-fixed condensers and switches for tuning the oscillator coil in the Single-Span receiver. May I point out that this practice would introduce a number of "wave-change" switches, the avoidance of which is one of the great advantages of the new system. Non-technical users would be better served by a visual tuning indicator in conjunction with the variable condenser.

There is in the system, however, a real opening for the development of practical remote control in that a single small condenser may be mounted apart from the receiver and the oscillator coil so wound that a very low minimum capacity was not necessary, to allow for capacity in the extension wires and screening. The added complica-

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Correspondence which should be as brief as possible, should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address

tion would, I think, be well within the bounds of commercial economics, an advantage enjoyed by no other system that has yet come to my notice.

THOMAS CAMPBELL GRAY.

Channel Islands.

[The idea of controlling a Single-Span receiver by means of a remote tuning condenser is quite practicable. With ordinary low-capacity screened cable as a connection for the remote condenser, a distance of three or four yards is possible; by special design this can be extended considerably.—ED.]

Long-wave Records

FURTHER to the "Long-wave Records" discussion in your columns, your readers may be interested to hear that as long ago as December, 1925, Daventry 5XX was audible at very good L.S. strength nearly 6,000 miles away, off the coast of Sumatra. My receiver was a straight 2-v-1 connected to an aerial about 150 feet long, stretched between the foremast and the funnel of the ship upon which I was serving at the time. The valves (I still possess them, by the way) were Cossor 4-volt bright emitters working on 100 volts H.T., and the vessel was making a passage from Mombassa to Singapore. Signals were maintained all the way across until we had passed round to the eastward side of Sumatra, when they disappeared entirely, due presumably to the screening effect of the island. I have a log of these receptions including weather and "atmospheric" conditions at the time.

P. A. CRONIN.

Highbury, London, N.5.

Vibrators

WITH reference to your correspondent's letter under the heading "H.T. from the L.T. battery," my own experience with vibrator units has been that the contact points will not stand up to the wear.

In order to give an output of three watts from a unit (incidentally this is only 20 mA. at 150v.) it will be necessary to use an input of about 3 amps. at 2 volts. In a recent lecture at the I.E.E. by Dr. E. A. Watson on Coil Ignition Systems, 2 amps. was suggested as a maximum for ordinary vibrating contacts. This probably accounts for the short life of these units.

In practice, only recently, two car radio sets of Yankee origin have had so much trouble from the vibrator units that it has been necessary to modify them for use with the M-L convertor. Whether this trouble was fundamental or due to the Yankee origin I should like your readers to discuss.

W. M. DALTON.

London, N.W.2.

Amplifiers for Theatres

IT has occurred to me that as Radio is now out of season, the publication of the following might create interest.

Many of my acquaintances ask me why West End theatres in which it is impossible to hear the actors in the gallery have not been equipped with stage amplifiers.

It is, of course, essential that the loud speakers should either be placed so as to throw the amplified sound over the heads of the people in the stalls or in the gallery. An intelligent use of a simple mixer would compensate for the varying distances of the actors from the microphones.

Larger audiences would make the installation of the necessary equipment a good investment.

W. PENSTONE.

Leyton, E.10.

"Standard" Radio Test Unit

An Inexpensive Modulated Signal Generator

THIS unit is a development of the service man's portable test set reviewed in our issue of August 11th, 1933. It is designed for large service stations, and may be used for taking overall characteristics in addition to routine fault testing and circuit alignment.

The R.F. oscillator is of the dynatron type and covers frequencies from 110 to 280 kc/s and 550 to 1,400 kc/s. Low-frequency circuits are associated with this stage to give internal modulation at 400 cycles if desired, but no means are provided for measuring the degree of modulation in these circumstances.

The output from the oscillator is passed through a tuned R.F. amplifier panel to the modulator unit to which L.F. may be applied from an external source. An input of 20 volts R.M.S. across 600 ohms is required. Incorporated in the same panel is an untuned amplifier stage through which the modulated H.F. passes before being applied to the attenuator.

A modulation meter consisting of a diode rectifier and a leaky grid triode in cascade occupies a separate panel. The meter is connected by means of a switch in the diode circuit for measuring the H.F. component and in the triode for the L.F. component. Normally the meter is accurate from 70 to 6,000 cycles, but a calibrated compensating potentiometer is included to correct for the ends of the frequency range. The calibration is carried out at the works by means of a cathode ray oscillograph.

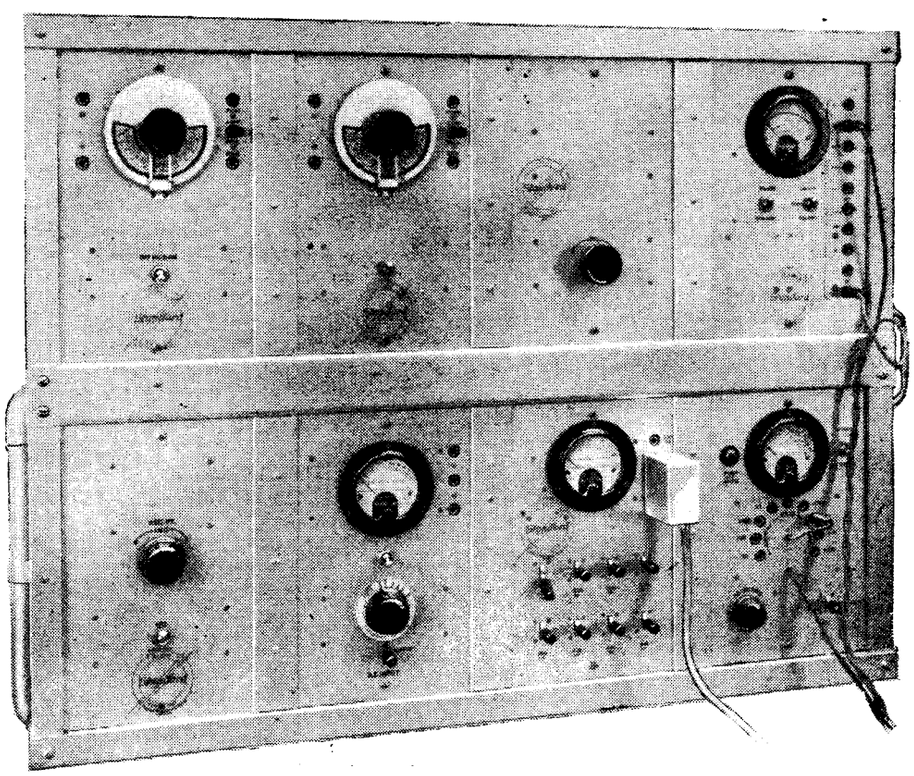
The R.F. attenuator panel includes a valve voltmeter calibrated in decibels referred to 1 volt, and a "T" type network giving a total loss of 120 db. in 2 db. steps. The output from the attenuator is taken to the set through screened leads and may be connected directly or through an artificial antenna built inside the unit.

The output meter for connection to the set under test is of the oxide rectifier type, and is calibrated in db. referred to 50 mW. Two tapped matching transformers give nine load resistances from 1.5 to 20,000 ohms.

A continuity testing panel and universal meter occupies a separate panel, and the remaining unit is devoted to the power supply.

The instrument is easily adaptable to special requirements and may be obtained for operation from batteries or A.C. mains, the price being from £50 upwards, depending on the specification.

The particular instrument tested was fitted with standard dials which did not give quite fine enough adjustment for sets with the selectivity of modern superheterodynes, but we understand that a special slow-motion control giving, in conjunction with a S.L.F. condenser, equal deviations of a few kilocycles for the same setting at all parts of the tuning range is being developed. Difficulty was also experienced in obtaining satisfactory modulation below 100 cycles, but we understand that a larger choke can be supplied to overcome this difficulty if required. In the ordinary way the low-frequency range covered is ample for the majority of commercial receivers, and there can be no doubt that Standard Telephones and Cables, Ltd., have done a useful service in providing a testing instrument of such wide utility at a very reasonable price.



Standard Telephones Type 77/L.E.3 Radio Test Unit. From left to right the panels are as follows: (Top row) R.F. oscillator; Tuned R.F. amplifier; Modulator and modulated amplifier; Output meter. (Bottom row) Supply unit; Modulation meter; R.F. attenuator; Continuity box.

McMichael A.C. Superhet.

A Handsome Set Giving Fine Tonal Quality

FEATURES

Type. *— Table-model superheterodyne with A.V.C. for A.C mains.* ***Circuit.*** *—Triode-pentode frequency changer — var.-mu I.F. amplifier — duo-diode-triode second det.— pentode output valve. Metal oxide rectifier.* ***Controls.*** *— (1) Tuning (2) Volume control and on-off switch. (3) Wave-range switch. (4) Tone control.* ***Price.*** *—14 gns.* ***Makers.*** *— McMichael Radio Ltd., Slough, Bucks.*

IN the competition to supply the public demand for range and selectivity at a low figure too many manufacturers have allowed quality of reproduction to take second place. It is gratifying, therefore, to find a reasonably priced receiver in which tonal quality has been achieved with but little sacrifice of performance in other directions. In the matter of quality of reproduction the performance on long waves is exceptional; there are few sets at any price which have given less evidence of sideband cutting on the many stations of good programme value to be found on this waveband. It is true that the selectivity is slightly below the average on long waves, but not sufficiently so to outweigh the gain in quality. Those stations which are lost on this account are already marred by side-band "splash" even in "super-selective" sets.

On the medium-wave range, in Central London, the two Brookmans Park stations each covered a band of 35 kc/s, which means for practical purposes that two channels would be lost on either side of the local stations.

The range, both on medium and long waves, compares favourably with that of any superheterodyne having an equivalent number of stages, and is sufficient to give five or six foreign stations during daylight on medium waves and all the worth-while Continental programmes after dark.

The latest type of triode-pentode is used in the frequency-changer stage. It consists essentially of a triode oscillator and variable-mu pentode detector designed for automatic volume control. The advantages of this arrangement were fully discussed in an article in the March 23rd issue of this journal, and, judging from the results, the claims of high efficiency and freedom from whistles and repeat points would appear to be justified. Only one whistle just below and clear of London Regional was detected.

While there is only a single tuned circuit preceding the first detector, there are four circuits associated with the I.F. amplifier. This valve is of the variable-mu type and, in addition to the pentode portion of the frequency-changer, is controlled by the bias derived from one of the diodes in the duo-diode-triode second detector.

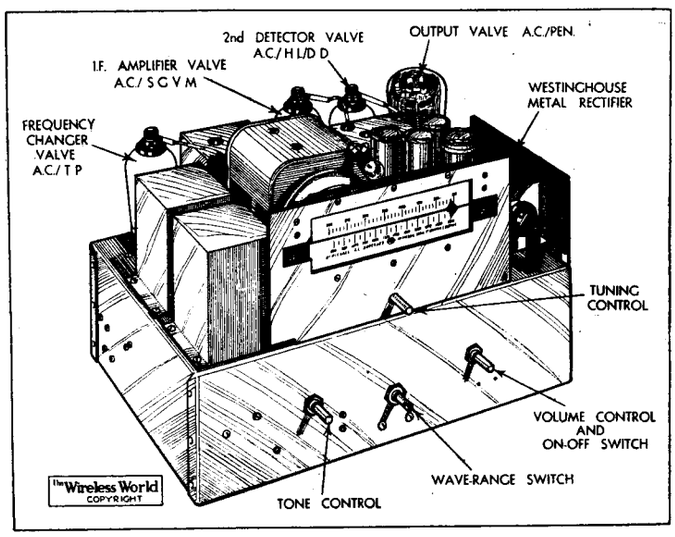
The volume control potentiometer in the grid circuit of the triode portion of this valve operates both on radio and gramophone. On radio it is shunted by a tone-control condenser and resistance, the values being more than usually well chosen. It is usual to find the useful range of control concentrated near the "high" end, but in the McMichael set it is very evenly distributed and at the "low" end the bass is not grotesquely exaggerated.

Resistance coupling is employed between the first L.F. and output stages, the valve in the latter stage being a power pentode. The "Grampian" energised loud speaker is fitted with a hum-bucking coil and its field is used for smoothing. A metal oxide rectifier supplies the H.T. current, and the primary of the mains transformer is by-passed by centre-tapped condensers to reduce mains pick-up. The mains voltage adjustment is made by plug and socket connections on the underside of the chassis, to which access is given by a large-diameter hole in the base of the cabinet.

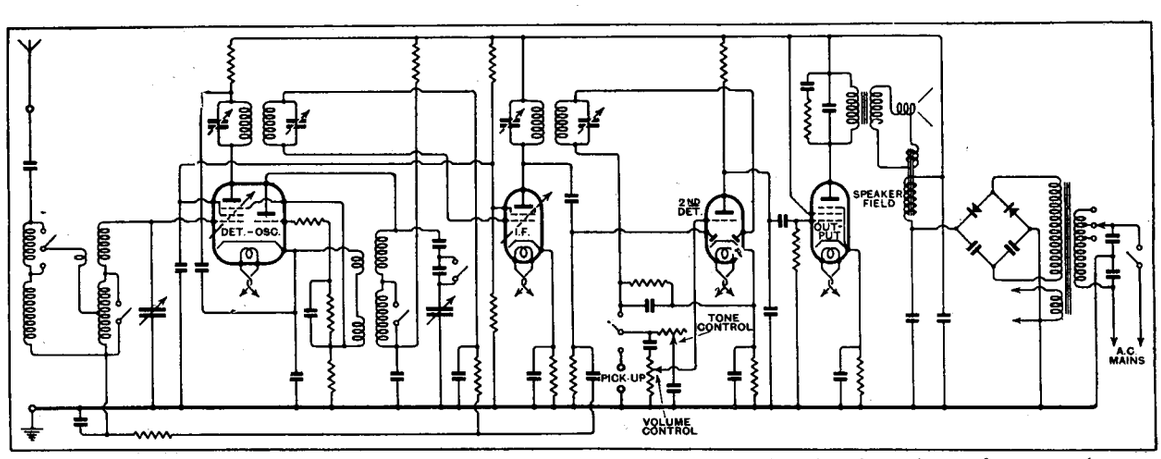
The cabinet work and everything associated with the chassis construction bears the stamp of McMichael quality. Special thought has been given to the switching arrangements, and a new type of rotary wave-range switch having very low capacity and long wiping contacts has been introduced. A separate switch actuated by link couplings and mounted apart from the wave-range switch is used for the gramophone circuit.

All the controls handle smoothly and we were particularly impressed by the accuracy of the horizontal wavelength scale.

Those who put good quality of reproduction first will find their requirements amply satisfied in this set, and on the score of range and selectivity they can rest assured that it will compare favourably with other sets with an equivalent number of stages.



The chassis is notable for high-grade workmanship and finish and the ingenious design of the switch gear.



Circuit diagram of the latest McMichael receiver. One of the new triode-pentode valves is used as a frequency-changer.

Next Week's Set Review:

CLIMAX S5 SUPERHET.

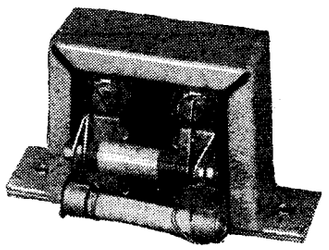
New Apparatus Reviewed

Latest Products of the Manufacturers

BENJAMIN AUTOCONTROLA

THE Autocontrola is a small unit which can be fitted to any battery set embodying a triode or a pentode output valve, and its function is to effect a saving in the H.T. current taken by the power valve by regulating its grid bias according to the volume of sound emitted by the loud speaker.

It consists of a Westector and an arrangement of resistances and a condenser; the resistance that governs the controlling grid bias potential is carried in a pair of clips on the outside of the unit, for in the Benjamin model this resistance is chosen to suit the type of valve in use. For the small



Benjamin Autocontrola, for conserving H.T. current in battery sets, shown fitted with Westector and resistance.

power triodes a resistance of 50,000 ohms is recommended, while for the larger kind one of about 20,000 ohms will suffice. A pentode requires a resistance of 100,000 ohms. Two clips are provided for the Westector which should be the W.6 model.

With the unit connected the output valve can be given in the first case about double its normal grid bias, but various values from about one and a half to twice the usual amount should be tried until that which gives the best quality of reproduction under all conditions is found.

With a medium power triode taking 15 mA. with normal grid bias and using a 30,000-ohm resistor we found that the quiescent anode current could be reduced to a shade less than 2 mA. without any noticeable effect on the quality or on the maximum power output. The resistance is not critical, but the average drain on the battery will be lower with high values of resistance. Here, again, quality of reproduction must be the governing factor.

The clips will accommodate a resistor measuring 1¼in. long, such as the Dubilier one-watt size.

The Autocontrola is made by Benjamin Electric, Ltd., Brantwood Works, Tariff Road, Tottenham, London, N.17, and the price is 7s. 6d.

PIEZO-ELECTRIC CRYSTAL PICK-UP

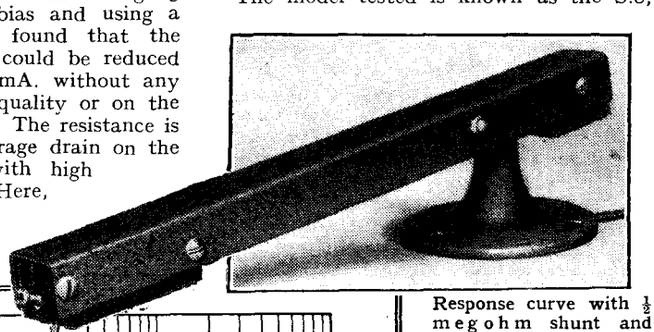
THE properties of Rochelle salt and its application to loud speaker construction have already been described in this journal. Since the effect is reversible, it should lend itself admirably to the design of microphones and pick-ups, and in the model tested these expectations are fully realised.

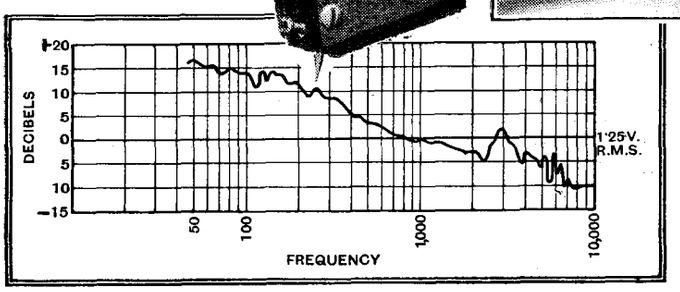
The sensitivity is remarkably high, and just over 1 volt R.M.S. is the average output on orchestral and dance band records. Electrically, the unit behaves as a condenser, and must, therefore, be shunted by a volume resistance if it is connected directly between grid and filament of the first amplifying valve. A value of ½ megohm is recommended.

The needle movement is very free, and the pick-up, in spite of its light weight, follows the wide amplitude frequency records of low pitch without the least tendency to leave the groove. Direct emission of sound from the pick-up head is also small, and record wear must be entirely negligible.

There is an output of 0.25 volt at 8,000 cycles, and, in the absence of the usual cut-off at about 4,500 cycles, some may prefer to use a scratch filter. The general rise throughout the curve as the frequency falls, however, ensures an ample response in the middle register and bass.

The model tested is known as the S.8,



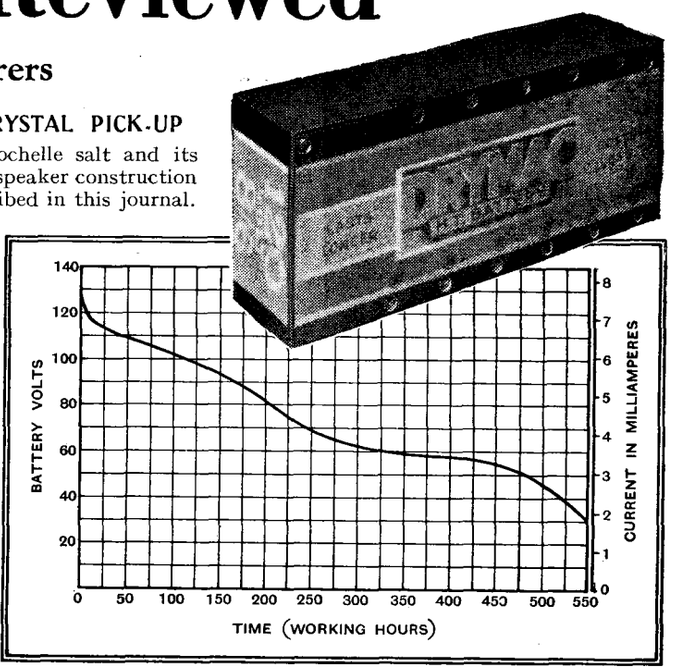


Response curve with ½ megohm shunt and Columbia "Talkie" needle of the Rothermel type S.8 piezo-electric pick-up. In the production model the head will be inclined at an angle to give correct alignment.

and is priced at two guineas. Supplies are obtainable from R. A. Rothermel, Ltd., Canterbury Road, Kilburn, London, N.W.6.

QUIKON WIRE

WITH reference to our review of Quikon connecting wire published last week, we now learn that the correct price is 6d. per coil, and not 3d. as stated.



Drymac 120-volt H.T. battery and average discharge curve.

DRYMAC H.T. BATTERY

DRYMAC H.T. batteries are made in 60-, 100- and 120-volt units of standard capacity, and the most economical discharge rate is between 6 and 7 mA. But this type is quite suitable for use with Class "B" and Q.P.P. output systems, as the average drain on the battery can be kept within an economical value by restricting the power output to just under one watt, although momentary peak currents will exceed this figure considerably.

The specimen tested was a 120-volt unit, which was discharged through a fixed resistance for periods of four hours and with similar intervals for recuperation. The curve shows the average voltage during the working periods only, as for convenience the rest periods have been omitted.

The useful life of the battery has been assumed to be up to the point where the voltage per cell drops to 0.75, and this gives 325 working hours, which at four hours per day represents a life of about three months. Yet this might well be exceeded in practice since the rest periods will be of much longer duration, and the battery will not be worked quite so hard as during our tests which for obvious reasons must be accelerated.

The capacity for an intermittent discharge is 161 watt hours, or 2 watt-hours per cell if the discharge is carried to the full extent described here, as there are 80 cells in this battery.

On this basis it compares very favourably indeed with other batteries of the same capacity and voltage, yet the price is only 8s. 6d. for the 120-volt unit. It can be confidently recommended, and supplies are obtainable from the Metal Agencies Co., Ltd., Queen Square, Bristol 1.

A 60-volt unit in this series costs 3s. 11d. and the 100 volts 6s. 9d.

Catalogue Received

Major Transformer and Coil Company, 99, Waterloo Street, Glasgow, C.2.—Power transformers and chokes.

The Wireless World

THE PRACTICAL RADIO JOURNAL

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CONTENTS

EDITORIAL COMMENT

Television

No Commercial Monopoly

IT has been a wise move on the part of the Postmaster-General to arrange for the appointment of a Committee to advise in regard to the future development of television as a public service. The problem of coming to a decision is beset with difficulties, both technical and commercial, whilst the existence of various systems introduces the question of jealousy amongst rivals.

If television programmes are to be put out through the organisation of the B.B.C., with all the facilities which such an arrangement offers to those whose system or systems may happen to be used, it is extremely desirable that we should start off on a fair basis. Our view on this aspect of television development was expressed just over a year ago, and nothing has occurred in the interval to influence us to change our attitude, so that we may well be excused for quoting at some length from a Leader on this subject which appeared in our issue of April 14th last year. On that occasion we said:—

"In the early days before broadcasting in this country began, the Postmaster-General made a public statement that he would not be prepared to grant facilities for regular broadcast transmissions until he was satisfied that there would be nothing in the nature of a monopoly for the supply of wireless receiving sets, but that equal facilities would be available to manufacturers. There is no doubt that at that time the Postmaster-General envisaged the possibility of a patent situation which might give to one company exclusive rights to supply sets for broadcast reception. We have always believed that it was because of this attitude adopted by the Postmaster-General that the Marconi Company, then owning most of the patents of importance, granted licences subject to the payment of royalties under their patents, without discrimination, to any *bona fide* manufacturer."

Whatever system of television may be adopted, we hope that the Postmaster-General will accept this guiding principle established by a predecessor in office. If the system adopted is covered on the receiving side by patents, then licences should be granted on reasonable terms to any *bona fide* manufacturer in the industry who may wish to produce receivers for television reception.

Amplifiers and the Theatre

Public Interest Aroused

IT has come as somewhat of a surprise to us to find how very general is the support for the suggestion, put forward by a reader in last week's issue and commented upon editorially, that theatres should be equipped with microphones and amplifying apparatus so as to enable the words to be heard throughout the theatre.

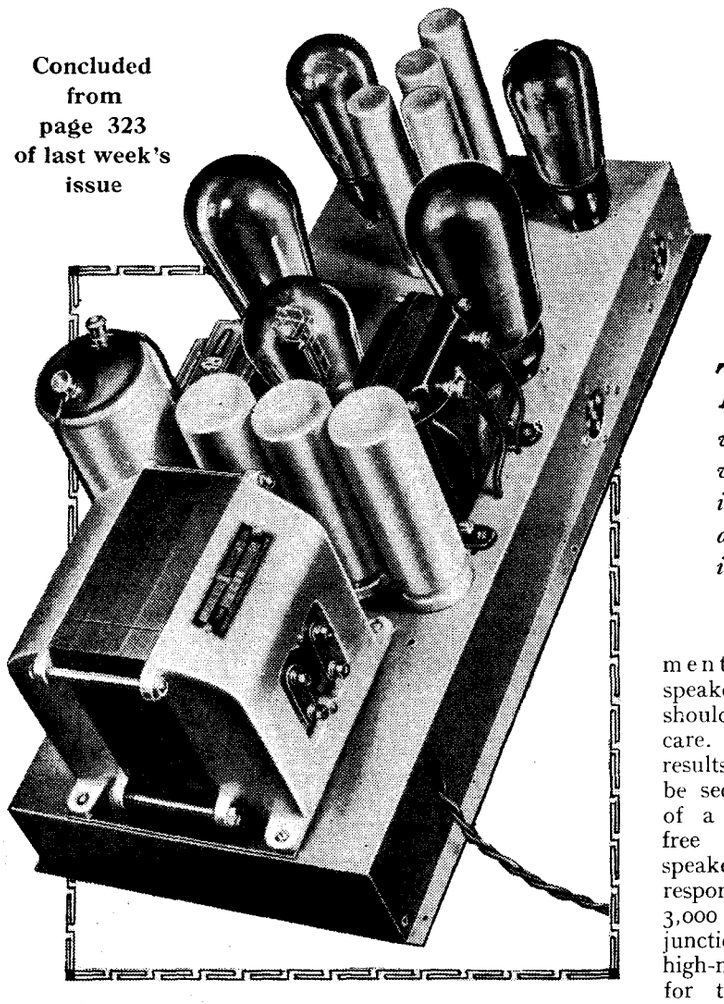
We now learn that quite recently the *Manchester Evening News* has published a number of letters on this question and that several theatres are considering the advisability of installing apparatus.

There is no doubt that the popularity of the theatre would be enhanced by such an innovation, and it might then become possible to follow a play even in the remotest seats with the same ease as a broadcast performance.

Push-Pull Quality Amplifier

Associated Equipment and Feeder Circuits

Concluded from page 323 of last week's issue



By W. T. COCKING

THE considerations underlying the design of the Push-Pull Quality Amplifier have already been dealt with, and in this article will be found details of the various methods which can be adopted for providing its input, both for radio reception and gramophone reproduction. The choice of suitable associated equipment, including both loud speaker and pick-up, is also considered.

THE construction of the Push-Pull Quality Amplifier is so straightforward that it calls for little in the way of explanatory comment; it may be mentioned, however, that all the terminals, except the earthing terminal, must be insulated from the chassis by the bushes provided. The connections to the negative terminals of most electrolytic condensers are made by the contact of the condenser cans with the metal chassis. As the chassis is cellulose finished, care should be taken to scrape off sufficient paint beneath the condensers for good contact to be obtained.

The mains transformer is fitted with fuses in the H.T. secondary, rated at 150 mA., and the adjustment for mains voltage is made on the primary by inserting the 1 amp. fuse into the appropriate clips. When the amplifier and feeder units are used alone for gramophone purposes, an earth should be connected to the terminal provided, otherwise hum may be found. If the amplifier be used with a radio set, however, this will not be necessary for an earth will be used on the receiver itself.

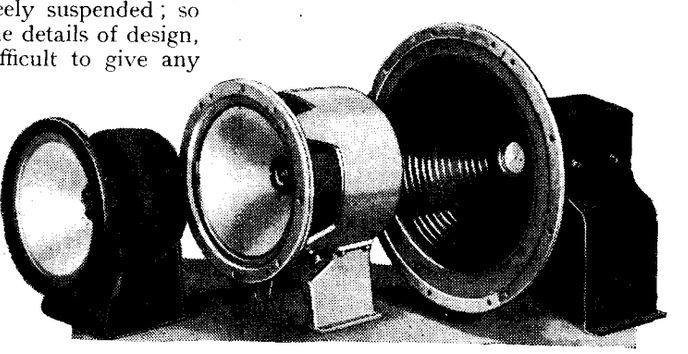
Since the amplifier is so inherently free from distortion some care should be exercised in the choice of the associated equipment. The loud speaker, in particular, should receive especial care. Although the best results would probably be secured by the use of a large resonance-free moving-coil speaker, giving an even response up to some 3,000 cycles, in conjunction with a special high-note "tweeter" for the range above 3,000 cycles, this is hardly a matter of practical politics at the present time. Few small horn speakers for high-note reproduction are available, and the cost of present types is greater than that of large moving-coil models, so this specialised dual combination is of restricted appeal.

Loud Speakers

The best results at reasonable cost, therefore, are probably to be obtained with a single speaker of the larger class. In general, the cone should be of fairly large diameter and freely suspended; so much depends upon the details of design, however, that it is difficult to give any definite ruling. A number of speakers has been tested with the Push-Pull Quality Amplifier, and among the energised type the B.T.H. R.K. Senior has been found very satisfactory. This speaker is normally available with a field resistance of 5,000 ohms, but it is understood that the makers can supply it to order with a field resistance of 1,250 ohms. The speech-coil impedance is 15 ohms, so that the output transformer should have a ratio of 25.8-1.

Although of considerably smaller dimensions, the Ferranti M.1. speaker is capable of an exceptionally good performance, and will handle a large input without distress. It is a permanent-magnet model and has a speech-coil impedance of 20 ohms, so that the output transformer should have a ratio of 22.4-1. The Parmeko speaker is also a permanent-magnet type with a speech-coil impedance of 16 ohms, and calls for a transformer ratio of 25-1.

If an energised model is to be used, it should have a field resistance of 1,250 ohms and require a current of 120 mA. Other resistances may be used, however, provided that they are connected correctly, and details of the commonest arrangements are given in Fig. 1. If a permanent-magnet or separately energised speaker be used, it will be necessary to employ a 1,250 ohms speaker field replacement type choke to obtain correct



A group of high-quality loud speakers; from left to right they are the Ferranti M.1, the Parmeko, and the B.T.H. R.K. Senior.

Push-Pull Quality Amplifier—

smoothing and voltages; a suitable component is obtainable from Sound Sales.

The question of loud speakers leads naturally to the transformer which must be used for coupling the speaker to the output stage. For a negligible loss of bass, the transformer primary reactance at the lowest frequency required should not be less than the load impedance of the output stage. If it be made equal, however, the load impedance will be below optimum, even although the frequency response may be unaffected. In order to avoid amplitude distortion at low frequencies, therefore, it is desirable for the primary reactance to be not less than twice the load impedance. If the lowest frequency required be taken as 50 cycles the inductance should be about 63H. for a 10,000 ohms load impedance. If 20 cycles were required, the inductance should be 160H.!

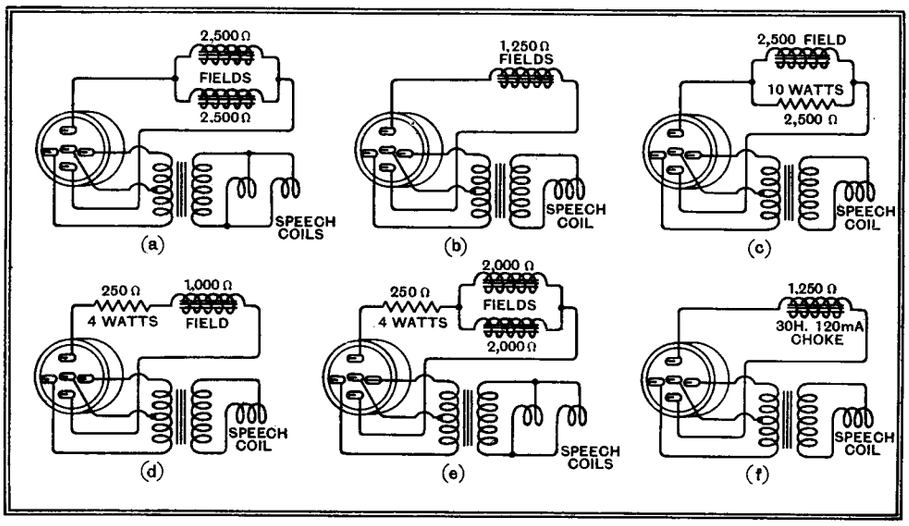


Fig. 1.—The various speaker connections for different cases are illustrated, at (a) for dual speakers with 2,500-ohms fields, at (b) for a single 1,250-ohms speaker, at (c) for a single 2,500-ohms field, at (d) for a single 1,000-ohms field, at (e) for dual 2,000-ohms speakers, and at (f) for a non-energised speaker.

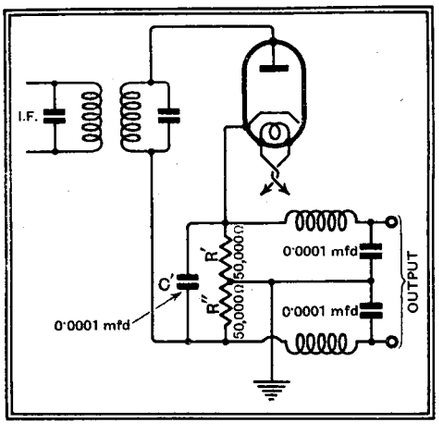


Fig. 2.—The amplifier may be fed directly from the diode second detector of a superheterodyne by adopting the connections shown in this diagram.

For the maintenance of the high-frequency response, however, low leakage inductance is required, and it is difficult to obtain this with a high primary inductance. Some compromise is necessary, therefore, and as frequencies below 50 cycles occur very rarely in music and speech, it is safe to base the design on this frequency. It is recommended, therefore, that the component, constructional details of which appeared in *The Wireless World* for September 8th, 1933, be used. This has a primary inductance of 69H., so that the theoretical conditions are fully met down to 46 cycles, and an even response is maintained to below 23 cycles.

In spite of its high primary inductance the leakage inductance has been kept at a low figure with the result that there is a loss of only 2db. at 10,000 cycles. The transformer, in fact, is specially designed for use with a push-pull PX4 output stage, and it was used when taking the frequency response curves given last week and also when measuring the input-output characteristics.

The only other point which should be mentioned in connection with the equipment relates to the gramophone pick-up. Any good quality component may be used but the writer was particularly pleased with the performance of the B.T.H. needle-armature pick-up. Although its output is below the average, it is ample for the Push-Pull Quality Amplifier.

Feeding the Amplifier

Turning now to the question of feeding the amplifier, the feeder unit is necessary only when radio is not required. When it is, other methods must be adopted. When radio only is needed the simplest arrangement is that shown in Fig. 2. It will be seen that a diode detector is used, and the load resistance is split into two equal parts, R′ and R″, the centre-point being earthed. The L.F. potentials developed across the resistance as a whole are then equal and opposite in phase across the two halves. Two H.F. chokes and by-pass condensers are needed in the output if H.F. potentials are to be kept out of the L.F. circuits. The valve used

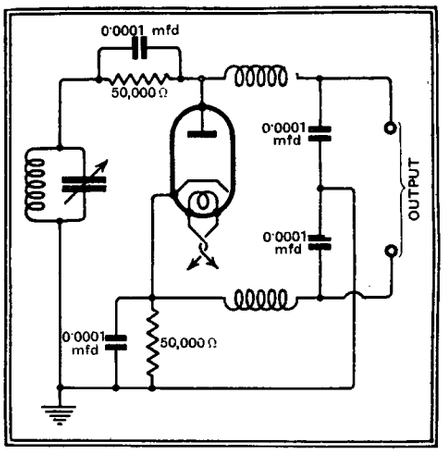
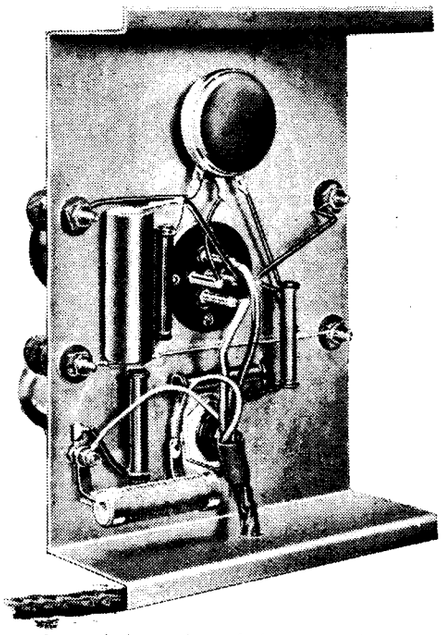


Fig. 3.—An alternative method of feeding the amplifier from a diode detector is available in the case of a straight set.

may be any indirectly heated triode with the grid and anode strapped together. The scheme shown in this illustration is suitable for a superheterodyne where the tuned circuit need not be earthed; for a straight set, however, the alternative arrangement of Fig. 3 is more convenient.

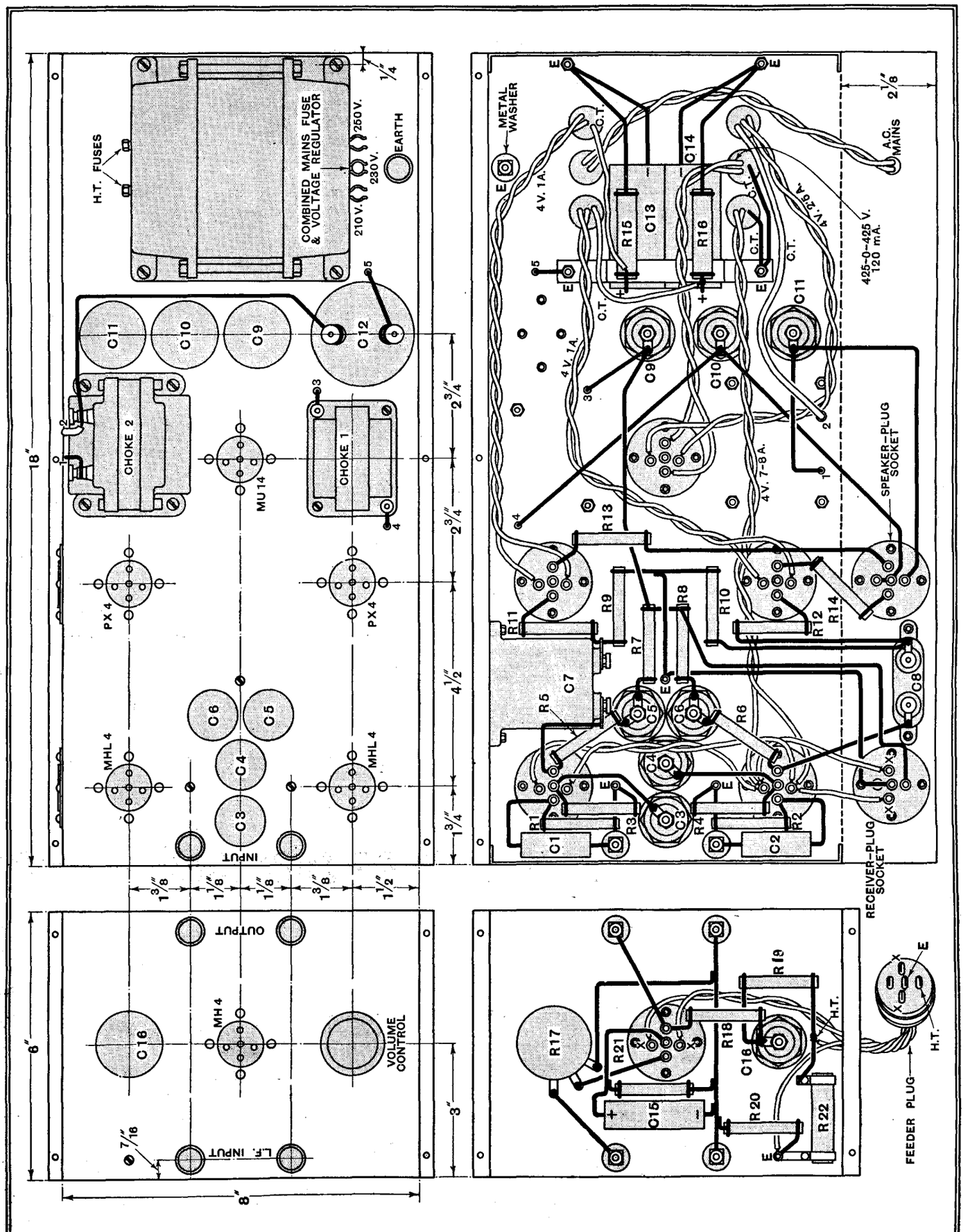
The amplifier requires an input of 7.1 volts peak, so that if it is to be fully loaded on an 80 per cent. modulated signal the diode input must be about 8.5 volts R.M.S. This is a large input, but only just large enough for distortionless rectification. It means, however, that an H.F. stage will be needed even for local reception. If it be desired to use this method of feeding the amplifier on radio and still retain gramophone reproduction, a duo-diode-triode can be used with switching for changing from radio to gramophone.



An underbase view of the gramophone feeder unit.

It should be noted that with the direct feed from the detector, L.F. volume control is very difficult to arrange, and in general a pre-detector control must be

PRACTICAL WIRING DIAGRAM



These drawings show the construction and wiring of both the amplifier and the feeder unit. Care should be taken to ensure a good contact between the chassis and the cans of the electrolytic condensers.

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A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d. post free.

used. It would seem worth while, therefore, to employ an extra stage of L.F. amplification on radio, for this will always be needed on gramophone. The circuits of Figs. 2 and 3 seem only justified in cases where gramophone reproduction is not required.

If the extra stage (as in the feeder unit) is employed it is necessary to use a duo-diode-triode with the connections of Fig. 4. It is important to note that the tuned circuit must not be earthed, and that A.V.C. cannot usually be obtained from this valve. It is probable that this will be the arrangement usually employed and it is for this reason that the performance curves of the amplifier were taken with a duo-diode-triode instead of the MH4 type.

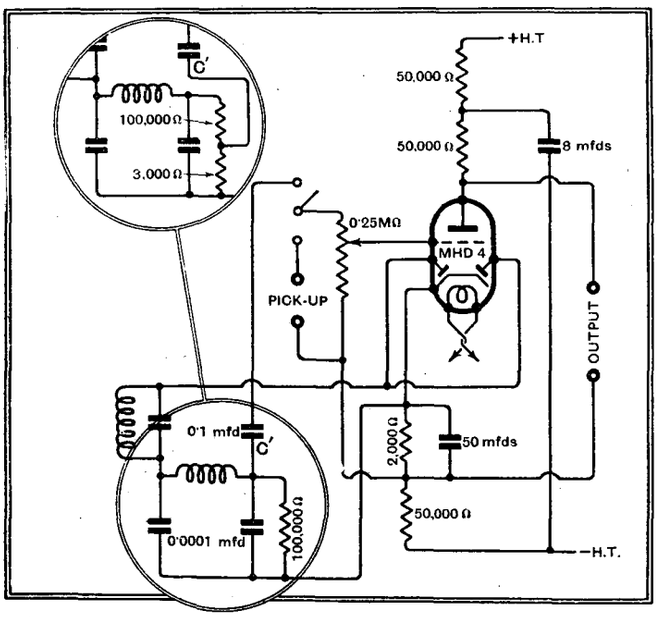


Fig. 4.—Where both radio and gramophone are required the arrangement shown here is one of the most satisfactory. If a large degree of H.F. amplification be used the connections shown inset are often advisable.

One point worthy of mention arises in connection with this arrangement on radio. The detector requires an input of about 10 volts R.M.S. for truly distortionless rectification with modulation depths up to 80 per cent. As a result, the maximum L.F. output will be about 9.6 volts peak. The triode, however, only requires an input of 0.265 volt, so that most of the detector output must be thrown away in the volume control, and it will be easy to overload the amplifier.

If the H.F. amplification is insufficient to provide a detector input of 10 volts, and an H.F. stage will be necessary even for local reception, there is no alternative to operating the detector at a smaller input. Any distortion which this may introduce does not become serious until the detector input is quite small. Where the full input is available, however, it is best to change the connections of C' of Fig. 4, as shown inset, so that with the volume control at maximum the full output of 4 watts is obtained on an 80 per cent. modulated signal with a detector input of 10 volts. This is the ideal, but not the most economic case, and the extra resistance should have a value of 3,000 ohms.

The precise connections adopted for radio use will naturally vary in different cases, depending upon the design of the receiver. The foregoing notes, therefore, are intended chiefly as a guide for those who wish to use the amplifier with an existing set; it should not be forgotten, of course, that such a receiver must introduce very little distortion if any great improvement in quality is to be found. For television work, of course, the input requirements are the same as those for sound broadcasting. It may be pointed out that it is hoped to describe at a later date the modifications necessary to the Single-Span Receiver for using it with this amplifier, for this receiver is particularly well adapted for high-quality reproduction.

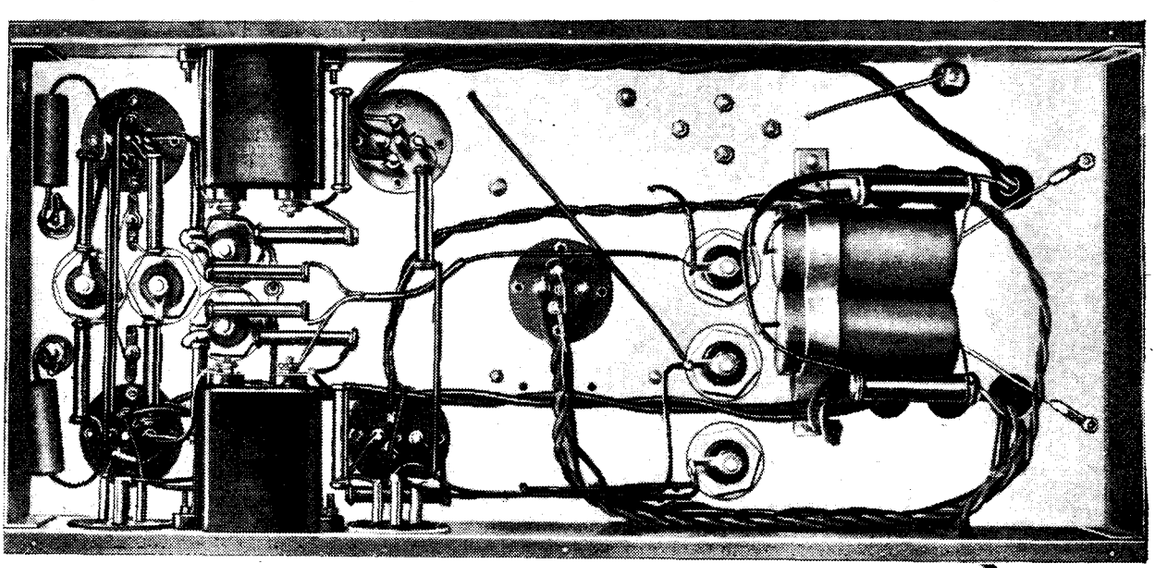
During the tests on the amplifier various speakers were employed, and the quality of reproduction was instantly noticeable as reaching an unusually fine standard. The presence of the highest audible frequencies in the amplifier output was marked by a great increase in the naturalness of the reproduction, and not necessarily by an increase of brilliance. The so-called brilliant reproduction is often due to an accentuation of frequencies around the 4,000-5,000 cycles mark, and is often found with a lack of the extreme upper register. The increase in response to 10,000 cycles gives quite a small change in the quality, but it greatly adds to the naturalness of speech and music.

The freedom from amplitude distortion was most marked during the tests, and the increased purity showed that the distortion introduced by ordinary equipment, although it may not be great, has a decided adverse effect. In conclusion, it may be remarked that the performance of this Push-Pull Quality Amplifier reaches so high a standard that it is unlikely to be surpassed in the future. The frequency response is practically perfect from 20 to 10,000 cycles, and it is unlikely that an appreciably greater range will ever be needed for sound reproduction. The amplitude distortion is negligibly small up to the rated output of 4 watts.

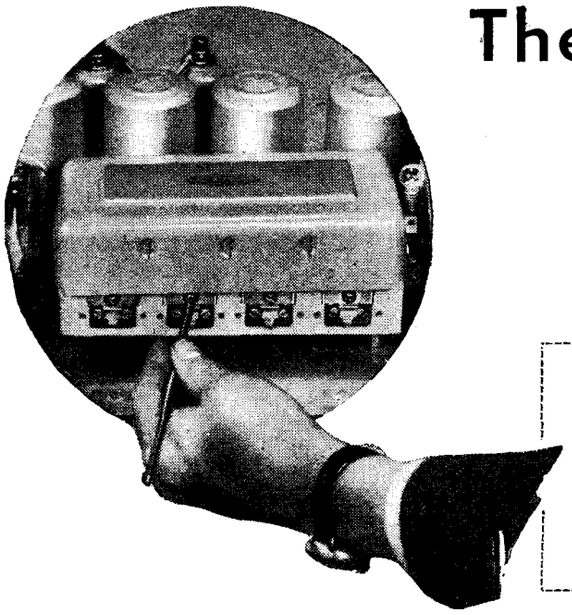
VOLTAGES AND CURRENTS.

Valve.	Anode Volts.	Grid Bias.	Anode Current mA.
Output 1, PX4	270	34.9	35.8
Output 2, PX4	270	35	35
L.F.1, MHL4 .	112* (121)	3.1* (4.4)	4.4
L.F.2, MHL4 .	116* (128)	3.1* (4.2)	4.2

Volts across C12 = 450 v., C11 = 425 v., C10 = 275 v., C9 = 255 v.
* Measured values, true voltages in brackets.



An underbase view of the amplifier showing the wiring. The two electrolytic bias-resistance by-pass condensers for the output stage can be seen on the right supported by a strap.



The Art of Ganging

Straight Sets

IN spite of its apparent simplicity, the attainment of accurate ganging leads to many difficulties. Although the recent development of single-span tuning has made ganging unnecessary, there are many thousands of receivers in use in which some form of ganged tuning control is embodied. These receivers all require adjustment at some period in their lives, and the series of articles of which this is the first will deal with both the underlying principles and practical adjustments of ganging.

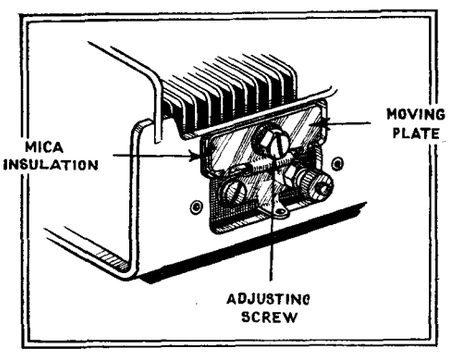
IN the early days of radio each tuned circuit of a receiver had a separate variable condenser, controlled by a separate tuning knob. Since few receivers had more than two tuned circuits this was little disadvantage. As time went on, however, and broadcasting stations increased in number the need for greater selectivity became important, and this could be conveniently obtained only by an increase in the number of the tuned circuits. With each circuit operated by a separate control it is obvious that the difficulties of handling a selective receiver soon became prohibitively great, particularly in the case of non-technical listeners.

The difficulties of tuning were not so much of a kind as to prevent satisfactory reception as to make the operation extremely tedious and to call for a large amount of patience when a distant station was required. It will be apparent that the difficulties lay chiefly in the necessity for retuning every circuit for every fresh station. Few found any difficulty in tuning to the stronger stations, for they were usually audible before all circuits came into exact resonance with one another, but all objected to the necessity for continually repeating the process, and many found it impossible of achievement in the case of the weaker stations. In those days the performance of a receiver depended very largely upon the skill of the operator.

It seems obvious that if identical coils and condensers were used in every circuit, and the condensers were all linked together mechanically, all tuning could be carried out by means of a single control. As everyone knows, this has now been accomplished, but the difficulties were great, and have only recently been overcome to a degree which can be called in any measure successful. The difficulties have lain chiefly in obtaining circuits in which the effective inductances were equal to one another, and in which the capacities of the different circuits were of identical values at different dial settings. They have been, and still are, largely mechanical.

The resonance frequency of a tuned circuit depends on the product of the inductance and capacity forming that circuit, and varying either alters the frequency. It is almost invariably the practice to change the capacity of the circuit for tuning purposes, and only to vary the inductance in large steps by means of switches. The condenser employed is really an assembly of a number of variable condensers, there being as many such sections as there are tuned circuits. In general, such condensers have a capacity of about 20 mmfds. to 30 mmfds. at their minimum setting, and a capacity of some 500 mmfds. when the vanes are fully enmeshed. These condensers are nominally of 500 mmfds., or 0.0005 mfd., maximum capacity, and it is now rare to find a sample intended for use on the normal broadcasting bands with a capacity lower than this.

The mechanical construction of a gang condenser varies according to its maker's ideas, but the chief important characteristics are that the assembly should be very



The usual form of trimmer construction is shown here. The frame of the gang condenser forms one plate of the trimmer.

rigid, and that at any degree of rotation the capacities of the different sections should be all exactly alike, while the trimmers, about which more later, should be of sufficient maximum capacity and of good mechanical construction. In practice the capacities of the different sections are never exactly the same, and the "goodness" of a condenser is judged by the extent of the errors. The difference in capacity between two sections expressed as a percentage of the condenser capacity at the dial setting under consideration is taken as the figure of merit, and, naturally, the lower the figure the better the condenser.

At the time of writing a first-class gang condenser will have its sections matched to within plus or minus 0.5 per cent. for capacities above 100 mmfds. and to within 0.5 mmfd. plus or minus 0.5 per cent. for capacities below that figure. This represents a high degree of accuracy, but not by any means an unnecessarily high degree.

Stray Capacities

The tuning coils obviously present a simpler problem, for no question of variable inductance is involved, and it is naturally easier to produce a set of matched coils of one definite value than a set which must be variable over a considerable range and yet maintain a high degree of accuracy. Modern coils are usually matched to within about 0.5 per cent., but in some cases greater accuracy is claimed.

Having obtained a set of matched coils and an accurate gang condenser it might be thought that there would be no further difficulty, and that it would only be necessary to connect them in circuit to obtain a satisfactory performance. This is by no means the case, however, for the very fact of connecting components to the tuned circuits, and such components are essential if any use is to be made of them, means that the circuit constants are changed by a small amount. Inductance is usually thought of as being only the property of a coil, and capacity as the characteristic of a condenser, and it is often forgotten that every conductor possesses some inductance and forms one plate of a condenser, however minute the inductance or capacity may actually be. The ultra-short-wave enthusiast does not readily forget this, but

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one is all too apt to overlook it when dealing with reception on the normal broadcast wavebands.

It is safe to say that the inductance of connecting leads in a receiver working on wavelengths above 200 metres is quite negligible, unless the leads are unusually long, but the same cannot be said of their capacity to one another and to earth. Apart from such wiring capacities, however, which in a typical circuit may amount to 5 mmfds., there are the valve capacities and the stray capacities of the coils themselves.

The self-capacity of an air-core coil for the medium waveband rarely exceeds 10 mmfds. and may be as low as 5 mmfds. An iron-core coil of the latest type, however, will have a higher capacity, and a normal figure would be from 12 mmfds. to 20 mmfds., although samples have been found with self-capacities of over 30 mmfds. The internal valve capacity from grid to cathode may be about 7 mmfds. and the holder may add another 3 mmfds., but the anode-cathode capacity of a screen-grid valve may easily reach 15 mmfds.

It will be seen, therefore, that the stray capacities of the various circuits are by no means negligible, and, moreover, that they are unlikely to be the same in the various tuned circuits. An example will best illustrate this, and a good illustration is afforded by the popular three-valve type of receiver, the circuit of the H.F. and detector stages of which appears in Fig. 1. The capacity across the band-pass filter secondary can be estimated as follows for a typical case:—

	mmfds.
Self-capacity of coil	12
Minimum capacity of condenser	25
Grid-cathode capacity of H.F. valve	7
Capacity of valve-holder	3
Wiring capacity	4
Total capacity	51

In the case of the intervalve circuit we have:—

	mmfds.
Self-capacity of coil	12
Minimum capacity of condenser	25
Grid-cathode capacity of det. valve	8
Capacity of valve-holder	3
Anode-cathode capacity of H.F. valve	15
Wiring capacity	7
Total	70

The Aerial Circuit

The aerial circuit is much more complicated if an accurate analysis be required. To begin with, the aerial possesses both inductance and capacity in appreciable measure, and it is usually connected to the tuned circuit by the medium of a coupling coil. Because of this both the capacity and the inductance of the tuned circuit are affected. Strictly speaking, therefore, accurate ganging of the aerial circuit is an impossibility by ordinary means. In practice, however, quite good results are obtainable by treating the aerial as possessing only capacity, and assuming that this capacity is transferred to the tuned circuit as if the tuning coil and coupling coil together acted as a transformer.

The aerial capacity is usually taken as about 200 mmfds., and it is common to use a ratio of about 1:3 in the coupling; the effective capacity is then roughly 20 mmfds., and the stray capacities of the first tuned circuit become:—

	mmfds.
Self-capacity of coil	12
Minimum capacity of condenser	25
Wiring capacity	3
Transferred aerial capacity	20
Total	60

It will thus be apparent that if we assign identical values to the coils, and the gang condenser is set at minimum, the three circuits will all be tuned to different frequencies, for the capacity values are 60 mmfds., 51 mmfds., and 70 mmfds. for the aerial, band-pass secondary, and intervalve circuits respectively. Since each section of the gang condenser has the same capacity it is obvious that at no dial setting will accurate ganging be obtained, for increasing the dial setting merely adds the same value of capacity to each circuit. It should be noted, however, that the greater the added capacity the smaller would be the errors, for the discrepancies would form a smaller proportion of the total capacity.

The early attempts at ganging failed largely because of these variations in the stray capacities of the circuits, or because compensation was attempted by varying the inductances of the coils. For accurate ganging it is essential that the stray capacities of all the circuits be identical. With a properly designed receiver using matched coils and a good gang condenser accurate ganging is then secured.

Various problems in design are encountered in order that these conditions may be fulfilled. It will be sufficient here, however, to point out those factors which may be responsible for poor ganging, for it is intended to deal chiefly with the actual adjustments necessary for ganging. The stray circuit capacities are inevitably of different values, so the practical adjustment of ganging consists simply of equalising the capacities. This is done with the aid of trimming condensers, which are now fitted to all gang condensers. They are really very small variable condensers, one of which is connected in parallel with each section of the gang condenser, having mica dielectrics, and usually adjustable either by means of a screwdriver or a small starwheel. The maximum capacity of these trimmers is usually from 30 mmfds. to 60 mmfds., since these figures represent the largest difference in stray capacities encountered in most practical cases. In the particular case which we have taken for purposes of illustration a maximum

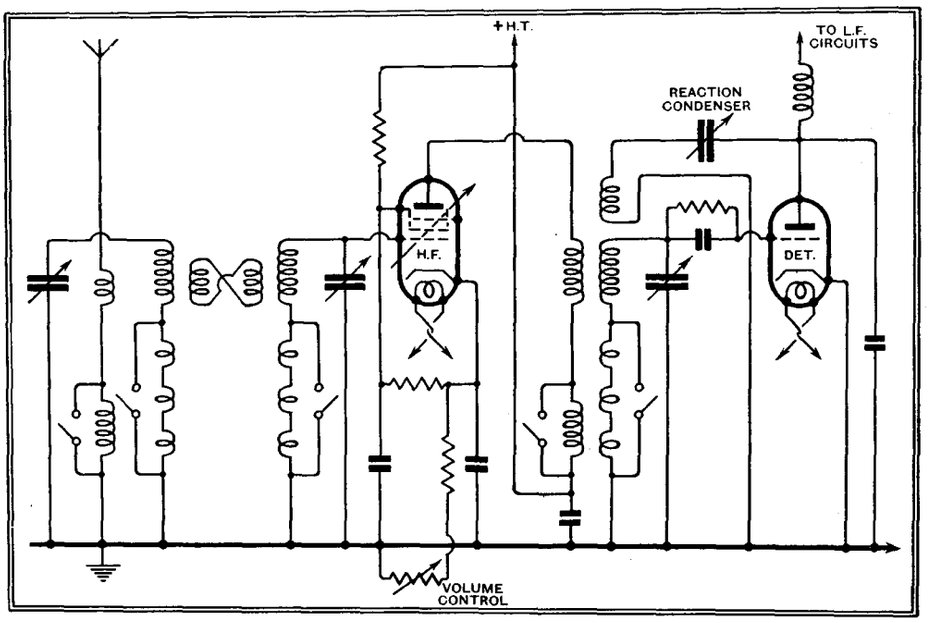
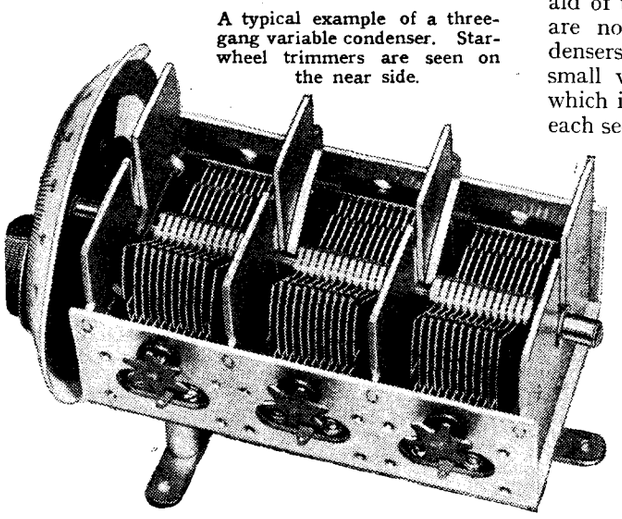


Fig. 1.—The H.F. circuits of a common form of straight set. It is explained in the article that there are usually wide variations in the stray capacities of the different tuned circuits.



A typical example of a three-gang variable condenser. Star-wheel trimmers are seen on the near side.

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trimmer capacity of 70 – 51 = 19 mmfds. would suffice, since it is only necessary to bring up the lowest stray capacity to the value of the highest, and, strictly speaking, the last circuit needs no trimmer. For convenience in ganging, however, it is the standard practice to add capacity to all circuits.

The process of ganging is extremely simple, and consists merely in adjusting each trimmer for maximum signal strength. The trimmers should be regarded during the process of ganging as the separate tuning controls of an unganged receiver. Ganging should always be carried out at as high a frequency (low wavelength) as possible, for although it can theoretically be performed at any frequency the trimmers represent the largest proportion of the tuning capacity at the highest frequency, and the greatest accuracy is obtainable. A station on a high frequency should be tuned in, therefore, using the main tuning dial driving the gang condenser, and this will usually be possible even with the receiver in an unganged condition. Having obtained a station each trimmer should be adjusted for maximum response, as determined by the loudest signals in the loud speaker.

Ganging Adjustments

It will often be found that this leads to a condition in which one trimmer is screwed fully home or fully unscrewed, whereas definite optimum settings are obtainable for the others. The condition to be aimed at, of course, is one in which each trimmer has a definite optimum setting, for one can only be sure that ganging is correct when the state has been reached in which any increase or decrease of trimmer capacity leads to a reduction of signal strength. If it be found that one trimmer has to be fully screwed home it must be taken as a sign that ganging is being attempted with too much trimmer capacity. All trimmers should be unscrewed slightly, therefore, and the station retuned at a slightly higher dial reading—this process being repeated until an optimum setting can be found for each trimmer. The process should be reversed, of course, if a trimmer must initially be fully unscrewed, and it is then necessary to screw up the trimmers a little and retune the station at a slightly lower dial setting.

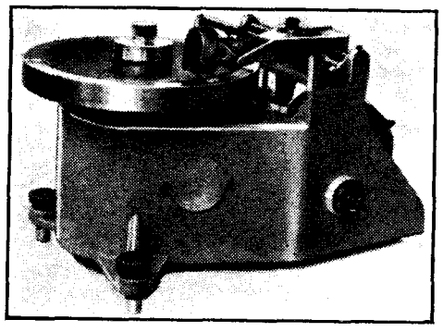
When once definite optimum settings have been obtained in this way no further adjustments are usually required, and if the receiver is properly constructed with good components the ganging will be found to hold accurately over the whole of both wavebands. No additional adjustment is normally needed for the long waveband, for the stray capacities of the added long-wave coils should all be equal, since their inductances are the same. In cases where the components are connected to the coils by means of tapping points or coupling coils, as in the case of the aerial, the stray circuit capacity depends upon the degree of coupling adopted, as already pointed out. In coil design, therefore, it is a matter of some importance to arrange the couplings for the two wavebands in such a way that the stray capacities remain constant. This usually involves the switching of the tapping points or coupling coils, and where a coil includes such switching it may be assumed in most cases that the designer has taken this point into consideration.

Scanning and Synchronisation in Television

Manfred von Ardenne's New Method

THE necessity of "scanning"—viewing the subject bit by bit, all in the fraction of a second, transmitting the corresponding electrical impulses by line or by radio, and finally piecing together the "bits" in the receiver to reform a momentary image of the subject—is the primal curse of television. "Scanning," says G. W. Walton, the inventor of the "Scophony" system of television, "is not essential to television, and has introduced all the greatest difficulties," and it is to avoid these difficulties that he has devised his interesting method of converting, by means of a special optical system, the two- or even three-dimensional subject into a "line" image of only one dimension. Most people, however, are content to regard scanning as a necessary evil, and continue to "view" their subject line after line, each line being shifted so as to be clear of its predecessor, so that a number of them—180, or thereabouts in "high definition" systems—cover the whole field. It is true that a system has been invented in which the scanning takes place spirally, instead of line-by-line; that is to say, it begins at the centre of the picture and moves round in an ever-increasing spiral till it reaches the edge; but, apart from this, everyone retains the line-by-line method, performing it either by some modern form of the old-fashioned "Nipkow disc," or a substitute such as the mirror drum, or (in systems using cathode-ray tubes at both ends) by deflecting the beam of electrons by means of suitably varying potentials applied to two pairs of deflecting plates, one pair giving the line-traversing motion and the other the line-shifting motion.

PARMEKO RECORDER



The new recording turntable designed by Partridge and Mee, Ltd., Aylestone Park, Leicester, in its production form. Adjustments are provided for depth of cut, weight and angle of recording needle, and provision is made for cutting run-off grooves. The apparatus has been designed for film studios and other commercial purposes and the price is £45.

Whatever scanning system is used, two painful facts remain; the whole field has to be covered something like twenty-five times in a second, and the scanning motion has to be reproduced at the receiving end in exact synchronism with the transmitting end, otherwise it would be impossible for the receiver to give a true reproduction of the subject viewed at the transmitter. Now that the introduction of cathode-ray methods has led to "high-definition" systems with 180 or more lines per picture, instead of the usual thirty lines, this exact synchronisation becomes more and more important, and methods of accomplishing it efficiently and simply are badly needed.

Usual Synchronising Method

The usual method is to include in the equipment associated with the receiver special kinds of oscillating circuits which generate the correctly varying potentials for the deflecting plates, and which are "tuned" so that of their own accord they keep as closely as possible in time with the processes at the transmitter; they have to be brought exactly into time by means of synchronising signals sent out by the transmitter, which hustle or pull them back if they are a little out of step. This may be compared to the use of a clockwork device at the receiver, with its balance wheel so timed that it swings as nearly as possible in time with a balance wheel at the transmitter, but is kept *exactly* in time by very small braking or hastening signals from the transmitter; the spring of the clockwork provides whatever energy is needed, and all the transmitter has to do is to see that the timing is correct.

Now this, as may be imagined, means rather complicated circuits, rather difficult adjustments, and quite a good chance of the receiver "balance wheel" getting out of time with the transmitter. Since, within reason, it does not matter how complicated things are at the transmitting end (where there are expert engineers, and cost is not a serious matter) while at the receiving end the greatest possible economy and simplicity are essential, various workers have developed the notion of getting rid of these oscillating, potential-generating circuits at the receiver and transmitting the required potentials, for the two pairs of deflecting plates, direct from the transmitter. This, theoretically, seems the ideal solution, for it would simplify the receiver enormously, and would, no doubt, lead to greatly improved synchronisation, since there would be far less chance of things going wrong or being maladjusted. Unluckily, there are great objections to the plan; one is that either a second wave-

Scanning and Synchronisation in Television—

length must be used for transmitting the potentials; or if, by ingenious methods, the same wavelength is made to convey both the picture modulation and the scanning potentials, too great a proportion of the total signal power is taken up by the latter. For here, to return to the analogy of the "clockwork device," there is no clockwork spring waiting at the receiver to provide the necessary energy for the scanning movements; the signals themselves have to do the work. Perhaps in time the difficulties will be overcome and the almost ideal simplicity of the method will be made available. One can imagine, for instance, that one day there will be, all over the world, an international system of "scanning" signals providing the necessary deflecting plate potentials to every receiver which cares to tune up to the one wavelength reserved for these signals.

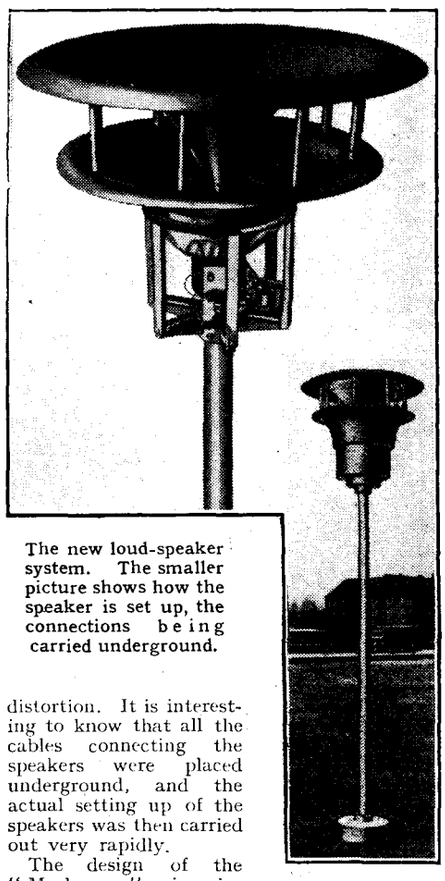
But in the meantime we have to make the best of things as they are, and as neither of the systems described above is really satisfactory, Manfred von Ardenne, from whose laboratory so many interesting developments have come, has devised and is using a method which is a happy combination of the two. He provides at the receiving end the "clockwork spring" ready to supply the energy, but he simplifies things by cutting out all the "balance wheel" gadgets, so that the circuits at the receiver have no idea of timing at all. Thus, although he has potential-generating circuits at the receiver, the timing is done entirely by signals from the transmitter, which merely release the energy of these scanning circuits at exactly the right instants. In this way very little signal energy is used up, the receiver timing is of necessity exactly in synchronism with the transmitter, and the receiver is considerably simplified. Once again the old maxim would seem to be confirmed: when there are two conflicting lines to take, "in medio tutissimus ibis"; of which probably the best translation is that of Smith Minor, which reads: "In the middle is the safest Ibis." H. D.

LOUD SPEAKER FOR OPEN-AIR WORK

SINCE the political changes in Germany the demand for public address equipment for use in the open air has increased to an extraordinary extent. This year's First of May Celebrations, which again took place on the Tempelhofer Field, called for special equipment, for last year's system of a vast number of horn loud speakers distributed all over the field failed to give complete satisfaction owing to the formation of echoes. This was largely due to the fact that the range of the sound waves could not be limited, so that they were reflected partly by the tall houses bordering on one side of the field and partly by the high grandstands erected on the field itself.

Since last year, however, the Telefunken Company has developed a type of loud speaker whose fundamental principle is not new but whose application to open-air use is a novelty. This loud speaker is also suitable for indoor use, and should eliminate many of the troubles which arise from the employment of the directly radiating type of speaker. If it is arranged that the sound arrives at the listeners' ears without also reaching the walls, these troubles can be avoided. Another application is to open-air cafés, gardens, and similar places where the common use of the ordinary loud speaker leads to annoyance to everyone in the neighbourhood.

The new Telefunken apparatus has been named the "Mushroom" loud speaker. It is obvious that with the horn-type speaker a number of units must be combined, directed in different directions, if a large area is to be covered; this plan is not only uneconomical, but—as was found on the Tempelhofer Field—is liable to lead to echo trouble, since it is difficult to limit the range of the beams. The "Mushroom," on the other hand, when mounted (as shown in the photograph) on top of a 12-foot post, "sprays" its sound all round itself and covers a circle of about 100 feet radius. Outside this circle the sound is not perceptible. On the Tempelhofer Field, which is some half-million square metres in area, 122 of these speakers were installed in such a way that the individual circles did not intersect. In a small zone, mid-way between four of the "Mushrooms" and about six feet in diameter, one would hear nothing; on moving just out of this zone only one of the four speakers would become audible, so that there was no reception from two speakers simultaneously, which would have given rise to distortion. It is interesting to know that all the cables connecting the speakers were placed underground, and the actual setting up of the speakers was then carried out very rapidly.



The new loud-speaker system. The smaller picture shows how the speaker is set up, the connections being carried underground.

The design of the "Mushroom" is interesting. The loud speaker is of the moving-coil type, and directs its sound vertically upwards. This upward transmission is assisted by a bowl-shaped horn, but the waves are directed out sideways and down towards earth. The upper bowl is nearly 4 feet in diameter, and, like the lower one, is made of copper sheet. The space between the two bowls is of exponential shape, so that no distortion occurs. In the larger photo the copper cap protecting the loud speaker movement has been removed. F. N.

Short-Wave World

IMMEDIATELY prior to the time of writing this, short-wave conditions seemed to undergo a sudden change that indicates the long overdue improvement. With the longer days and the adoption of B.S.T. the 20-metre band has become useful at both ends of the scale, as it were. One can now rise at 06.30 G.M.T. without any particular hardship, and hear quite an interesting assortment of amateur transmissions on the 20-metre band.

In the evenings the 20-metre amateur band and the 19-metre broadcast band are both useful until midnight. By the time this appears in print it will probably be the general rule for activity on "20" to continue until 01.00 or even later.

As the longest day approaches there will even be a period when the fade-out on 20 and 19 metres is only of about three hours' duration—usually between 02.30 and 05.30.

There has been no startling changes in short-wave broadcast during the past few weeks. The 19 and 16-metre stations are surprisingly consistent; the rapidly growing group of American broadcasters on 49 metres continues to provide most of the interest after 23.00 or midnight; and the spice of life, so to speak, is derived in between whiles from the 25- and 31-metre bands.

Sydney, VK2ME, on his 31-metre wave, has been logged by one reader for twenty-nine consecutive Sundays, always at about 07.30. This is not surprising for 20 kW., but is nevertheless creditable to both transmitter and receiver, bearing in mind the variable conditions that have prevailed.

New Station Heard

In connection with recent remarks concerning the scarcity of Asiatic stations, a reader in Singapore has forwarded a cutting from a local newspaper. This gives in detail the programme of station ZHI, Singapore, owned by the Radio Service Co. of Malaya, Ltd., and operating on 49.9 metres. Here is an obvious station to search for!

In passing, it is a little odd to look through the "Empire Programme" in the columns of this paper and to see "Whither Britain—6.20 a.m." at one end of the scale and "The News—12.35 a.m." at the other!

It is refreshing, too, to see that a determined attack is being made in Singapore on the disturbances caused by "unsilenced" electrical devices. Would that this particular nuisance showed some sign of abating in the Home Country.

Among the new stations reported by readers are the following:—

HIX, San Domingo, Dominican Republic, on 50.4 metres.

COC, Havana, Cuba, on 49.96 metres.

VE9DN, Drummondville, Canada, also on 49.96 metres.

HJ5ABD, Cali, Colombia, on 46.30 metres.

Two readers report the frequent reception of an unidentified station on about 16.7 metres. The only clue received is the repetition of a musical interval signal with the notes F-A-C-F.

Another case of an unidentified station has occurred in the 19-metre band, where an American may frequently be heard working between W2XE on 19.64 metres and W2XAD on 19.56 metres. Reports are to hand that W3XAL, already well known on 49.18 and 16.87 metres, has started a third transmission, which may possibly account for the newcomer. MEGACYCLE.

Programmes from Sunny Spain

Higher Power and a New Long-Wave Transmitter

By CECIL W. LUSTY

SPAIN, like France, is suddenly awakening to the importance of an efficient broadcasting service, and the result, as our correspondent discloses, is a plan for the speedy erection of a chain of high-power stations. Easy reception of the colourful Spanish programmes will be warmly welcomed by listeners in Great Britain

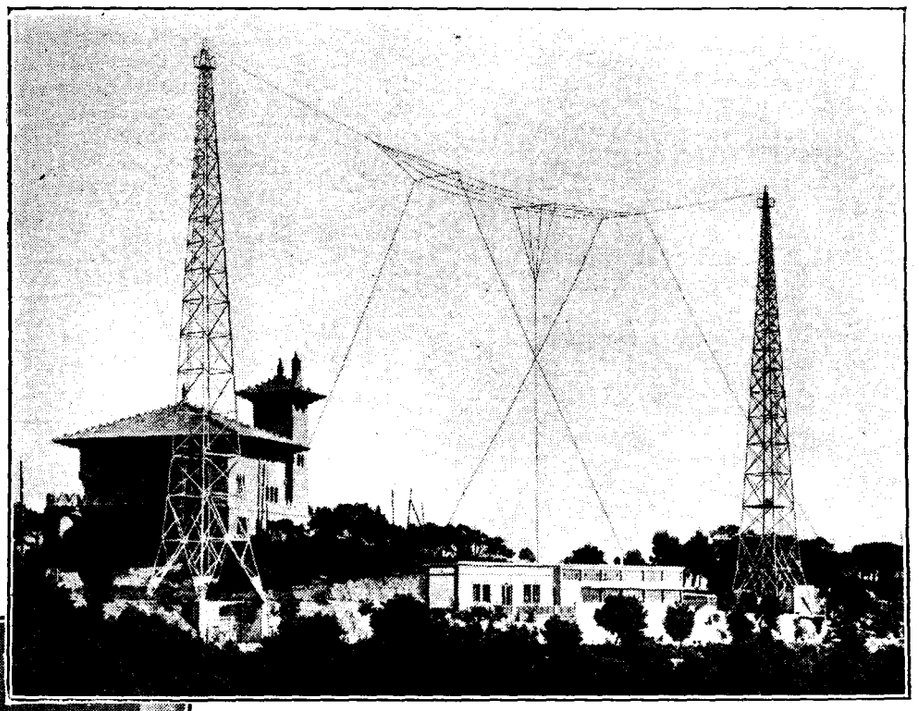
THE Spanish programmes have never loomed large in the reception repertoire of the average British listener. A recent tour of the Peninsula, however, has convinced me that Spain will very soon take a much more prominent part in European broadcasting. Reorganisation plans are in busy preparation, and these include higher power as well as better programmes.

Most *Wireless World* readers have heard the fine opera broadcasts from Radio Barcelona, the oldest broadcasting station in all Spain. I found the Union Radio studios, which have been modernised and compare favourably with the general run of Continental studios, in the Calle de Caspe, near the picturesque Plaza de Cataluña. Soon I was exchanging "Buenas Dias" with the director, Señor Cordoves, and the announcers, Señor Miret and Señor Toresky, the latter probably the only ventriloquist announcer in the world. Señor Cordoves showed me letters from English listeners appreciative of the Grand Opera and Comic Opera broadcasts. Rather ironically, in Barcelona itself, where the spirit of the place seems to be incarnated in the laughing faces of the flower girls behind their great masses of blooms in the Ramblas, many listeners to the programmes complain bitterly. Apparently, the broadcast listener, under the skin, is the same the world over!

From the studios I proceeded to the transmitting station on the wooded slopes of Mount Tibidabo, the traditional resting place of the Holy Grail.

Leaving Barcelona, I followed the Costa del Sol to Valencia, whose little 0.7 kilowatt station appears to give quite good radio fare, and I then proceeded over the Sierra Nevadas to romantic Seville. Here, as I entered the studio, I was just in time to hear the "cante jondo," the Andalusian folk-song, sung with guitar accompaniment. This, I learnt, was a typical programme item in the city of oranges.

From here I paid a lightning visit to neighbouring Portugal, in which Lisbon, the city of seven hills, will shortly possess its first State-organised station. In the meantime I visited the little amateur stations CTIG, Radio Parede, and CTIAA, Radio Coloniale, which have been keeping the flag flying pending the advent of the official service. I found the owner of CTIAA, Senhor Dos Santos, junr., in the studio in the palm-fringed Avenida da Liberdade. The station has been "on the air" since 1924. Talks are given in English, French, and



Radio Barcelona, on the wooded slopes of Mount Tibidabo.

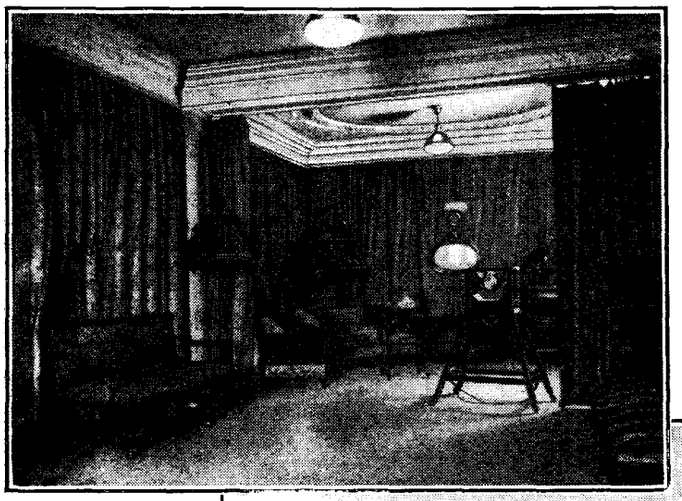
(Left) The Madrid Sextet, a popular musical combination at Union Radio.

(Below) The station trio at Valencia.

Programmes from Sunny Spain—

Spanish, and several of the Lisbon theatres are connected by relay lines.

I turned back from Badajoz, the gateway to Spain, through ancient Toledo to Madrid, the modernistic capital of the Republic. I approached Union Radio from the Puerto del Sol, from the clock tower of which the chimes are broadcast, and came to the "Paris-Madrid" building in the Gran Via, where the station EAJ7 is situated. The Castillian director, Señor Urgoiti, conducted me around the studios and introduced me to the announcers — Señor Gomez, who reads the news bulletins, Señor Medina, Señorita Lola Agullo, and Señor Poro. I learnt that the Castillian listener, like his Catalan cousin, enjoys opera broadcasts more than anything else in the programmes.

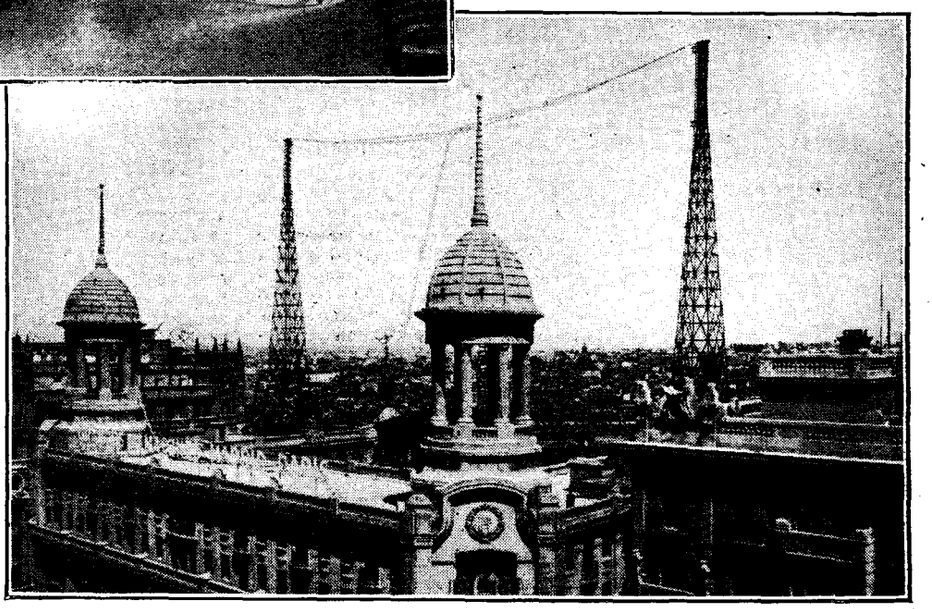


The transmitter of EAJ7 is situated on the roof of the building.

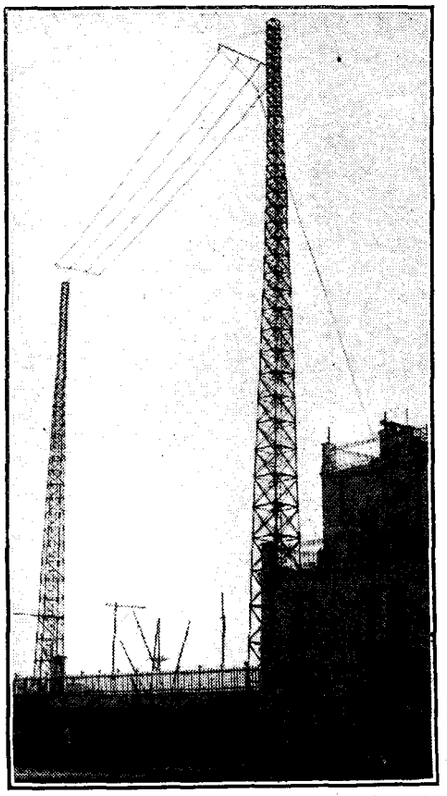
Hitherto, broadcasting in Spain has been carried on by the famous Union Radio chain and by one or two other privately owned stations. There is a licence fee of 5 pesetas a year (about 2s. 6d.), but payment of this has been more honoured in the breach than in the observance. Now, however, the long-debated broadcasting decrees have been approved by the Spanish Cabinet. Salient features in the plans are a State-controlled broadcasting system, directed by the Communications Ministry in collaboration with the Ministries of Education and Fine Arts; within three years, a chain of stations to the number and power permitted by the Lucerne Plan; and a national long-wave transmitter, probably near Madrid, which will be constructed before the others. A minimum of two new stations will be erected annually until the plan is complete. A grant of some £50,000 is made in the current Budget towards the cost of the service.

This new National transmitter, in addition to the more powerful of the new regional stations, will provide British listeners with a choice of reliable Spanish transmissions, and Spain will undoubtedly figure much more in the interchange of Continental broadcasts. This will bring a new note into European broadcasting, to be welcomed not only because it will increase the choice of concerts, but because it will introduce variety.

I concluded my radio tour with a call at the popular San Sebastian station, which, although limited in power to 0.6 kilowatt, is frequently heard in Great Britain. I learnt from the announcer, Señor Alcaraz, that Basque music is the principal feature of the programmes. Like Barcelona, the San Sebastian station has many devoted listeners in the South of France.



Union Radio, Madrid, the best known of Spanish broadcasting stations. Above is a view of the main studio.



Valencia, a typical small Spanish station soon to be replaced by a modern high-power transmitter.

Señorita Lola Agullo, an announcer at Madrid.

The Radio Industry

REFERENCE has already been made to the interesting competition for users of the Avo Minor testing instrument. We are asked to point out that in the leaflet setting forth the conditions of this competition there is a misprint; on page 3, the line reading "o-3 megohms" should read "0-3 megohms."

◇ ◇ ◇ ◇

A new firm of battery manufacturers, known as The Northern Batteries, Ltd., has just acquired a large factory at Birtley and are laying down up-to-date plant for the production of dry batteries of all types, to be manufactured under the trade name of "Northern Lights."

◇ ◇ ◇ ◇

There is a natural reluctance to use ordinary varnish for impregnating the windings of H.F. coils, particularly those for short-wave work. It is interesting to learn that a special high-frequency varnish has lately been developed for this purpose by Mr. Paul D. Tyers; it is being manufactured by Grampian Reproducers, Ltd., and we understand is already used in the making of Wearite short-wave coils.

◇ ◇ ◇ ◇

Mr. Ernest J. Long, for many years General Manager of the British Ebonite Co., Ltd., has now been appointed Managing Director.

News of the Week

Current Events in Brief Review

Scottish Programme From Paris

RADIO PARIS is to relay a Scottish National transmission from the Edinburgh studio on June 19th next.

Langenberg on Low Power

FOR the next fortnight Langenberg is transmitting on a modest 15 kilowatts, the 60-kilowatt transmitter undergoing alterations for a power increase to 100 kilowatts.

Car Radio Week in U.S.

"LISTEN as you ride" is to be the slogan of American radio manufacturers this summer, according to our Washington correspondent. The industry estimates that the sale of auto-sets this year may be anything between one and two million.

June 10th to the 16th is to be Car Radio week.

A High-power Freak

DESPITE its twin vertical aerials, the Vienna-Bisamberg station appears to give less satisfaction in the immediate vicinity than in more distant countries. An Hungarian radio journal states that its readers get very much better results on the 7-kilowatt relay station at Graz, although Bisamberg employs nearly twenty times the power. Yet Bisamberg is exceptionally well heard in Great Britain.

Strangely enough, Austrian listeners complain that the British stations are difficult to get, while those of similar power in Scandinavia are clearly heard.

A Word in the Ear

A SPEAKING poster has just made an appearance on the Boulevards and in the Champs-Elysées, Paris. Operated by a photo-electric cell, the device whispers its sales message to the passer-by.

It is suggested that the next development should be speaking traffic signals.

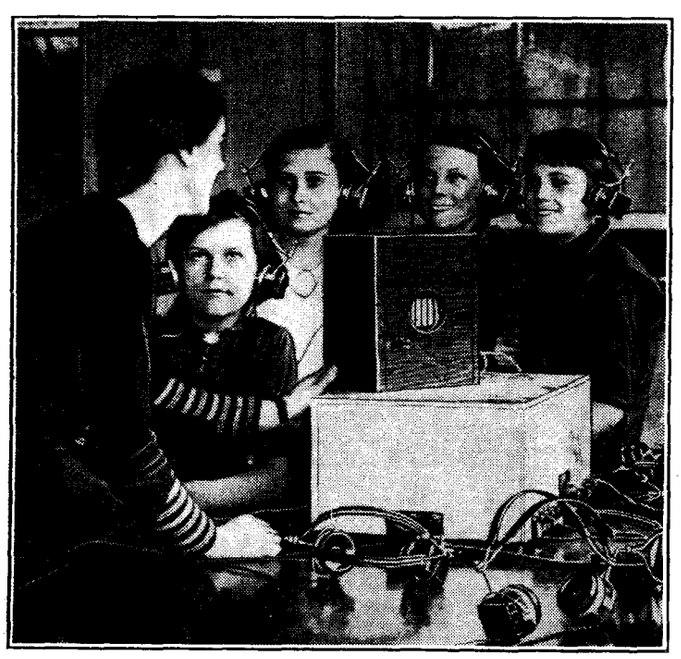
A Helpful Punch

THE Soviet stations have their regular Children's Hours. The most popular programme at present is the Punch and Judy entertainment radiated from several of the larger transmitters. Punch, besides his dramatic appearances, takes the rôle of general adviser, answering at the microphone questions which reach him by post from all over Russia.

5-Metre Opportunities

AMATEUR 5-metre working promises to be well to the fore during the coming summer. Listeners with ultra-short-wave sets in South-east England have a good opportunity on most Sundays of hearing tests by the Research and Experimental Section of the R.S.G.B. on Blackdown, Hants. Well-known transmitters, such as G2NH, G6NF and G5MA, are usually in action, and these work any other stations desirous of effecting communication.

On most Monday evenings between 10.30 and midnight there is considerable 5-metre activity in the London area and various transmitters ask for reports.



AMPLIFIERS IN A DEAF SCHOOL. Pupils at the Royal School for Deaf and Dumb Children, Old Trafford, Manchester, undergoing a headphone test. Each pair of 'phones is adjusted to give a tonal response suited to the user's requirements.

New Hungarian Station

HUNGARY'S new 20-kilowatt transmitter at Csepel will begin testing within the next week or two.

New Television Society

A TELEVISION Society has been formed for Cheshire and South-west Lancashire. Readers interested should communicate with Mr. R. O. Base, 223, Seaview Road, Wallasey.

America's "Lookers In"

TWENTY-NINE experimental television stations were licensed in U.S. on May 1st. Most of these are operating intermittently on two short-wave bands and two ultra-short-wave bands specially reserved for television. It is estimated that there are about 10,000 "lookers in."

Broadcasting House for Belgium

WORK has begun on the construction of the Brussels "Radio House," which will probably be opened in about eighteen months time. Occupying a commanding site in the Place Saint-Croix, Radio House will have a frontage of 210 feet on the Place and 180 feet on the Rue de Belvedere. The five-storey building will contain twelve studios of the most modern design, with sound-proof walls and special acoustic novelties.

Radio Cops: New Version

THE Brussels and Tatsfield wave checking stations may soon appear obsolete in the light of America's latest experiments, organised by the Federal Radio Commission. The Commission has decided to check the "wave wobble" of stations by means of mobile monitoring stations which will patrol the country at all hours without the knowledge of the station engineers. The Commission has purchased six of the new monitoring cars, and the instruments will cost 25,000 dollars.

Teaching by Television

TELEVISION, even in its present embryonic stage of development, is being used for classroom instruction at the University of Iowa, writes our Washington correspondent. So far the visual broadcasts have been restricted to simple subjects such as illustrating the correct method of brushing the teeth; diagrams; shorthand symbols; statistical charts; charcoal sketchings; French pronunciation in which the speaker demonstrates lip and tongue movements, and elementary art.

The University authorities contend that poor television is better than none at all, on the principle that 83 per cent. of human knowledge comes through the sense of sight, as compared with only 13 per cent. through hearing.

MIDGET VALVES FOR PORTABLES. The Marconiphone H.L.2 valve in the new "K" series. Its size can be gauged by comparison with the Yale key.

The Radio Dentist

TOOTHACHE can be cured by wireless waves, according to Dr. Oartel, of Wilkinsburg, New York. In an address before the Pennsylvania Dental Society, Dr. Oartel said that the germs in diseased teeth can be killed by placing the molar between sending and receiving plates of a simple short-wave set.

English Talks from Warsaw

A TALK in English on "Anglo-Polish Business Relations" will be broadcast by Mr. Thad Ordon from Warsaw on Wednesday next, May 23rd, at 10.40 p.m.

Sound and Noise

PROFESSOR A. M. LOW will lecture on "Sound and Noise" before the British Radio Institution at King's College, Strand, W.C.2, on Thursday, May 24th, at 7 p.m.

Admission is free, and a special invitation is extended to readers of *The Wireless World*.

Television Courses

A COURSE of four lectures on television will be given at the Polytechnic, Regent Street, London, W.1, on Wednesdays, commencing May 30th next, from 6.30 to 8 p.m., by Mr. H. J. Barton Chapple, Wh. Sch., B.Sc.

The lectures will be illustrated by experiments, lantern slides, and demonstrations of television receivers, including the mirror drum with large screen and cathode ray tube. Full particulars can be obtained on application to the Electrical Engineering Department, Polytechnic.

BROADCAST BREVITIES

By Our Special Correspondent

A Broadcasting Anomaly

FOR some inscrutable reason the new North Scottish Regional must work on the low wavelength of 267.4 metres, which is about as bad as could have been chosen for a transmitter in the most mountainous part of Great Britain.

The B.B.C. engineers have been dogged at every turn by the thought of this handicap, and it is no betrayal of confidence to say that a few weeks ago they nearly threw in the sponge.

Is North Scottish Site Ideal?

Then they took another look along the pleasant Morayshire coast, ambling past Lossiemouth till they came to Burghead, ten miles from the Prime Minister's birthplace, and chose a site there. Morayshire, though, can be a snare to the unwary. As a frequent visitor I know the sense of calm and security which settles upon one in that quiet agricultural district, apparently so far from the rugged and inhospitable Grampians.

The district is, in fact, cut off from the rest of the country, and it is just this fact that makes one wonder whether it is an ideal situation for a station intended to serve a large proportion of the population in the North of Scotland.

A Doubtful Document

Reading between the lines of the official announcement, one detects a perturbing hint that the radiation from the new site may not be all that could be wished for.

"The efficiency of propagation of wireless waves is not the only consideration," runs the notice. "It is necessary, for instance, to take into account the provision of suitable high-quality telephone lines for conveying the programme to the transmitter, as well as the general suitability of the site for building purposes."

The Main Consideration

I submit that the efficiency of propagation of wireless waves *is* the only consideration of any importance. What in the name of Hertz is the use of high-quality telephone lines and beautiful building sites if the waves don't go out!

If I appear to take a jaundiced view perhaps readers will be good enough to write and tell me.

The Patient West

And now let us take a jump from Scotland to the West of England.

If any people have exercised patience in the last twelve years it is these West Country folk, small in numbers, and not given to blowing their own trumpet or parading their "rights." For years they have relied upon a puny little transmitter at Plymouth, and even now they are not within the reliable service area of West Regional. What they do get is mostly Welsh.

The "D.-G." Scores Again

They sent a deputation to Broadcasting House last week. It was greeted by Mr. R. S. Norman, the Vice-Chairman, Sir John Reith, Admiral Sir Charles Carpendale, and Mr. Wellington, of the programme division. When the Mayor of Plymouth had stated his case Sir John Reith, with that electrical persuasiveness which never seems to fail, satisfied the whole party that Droitwich—the wonderful 120-kW. Droitwich—would meet all needs. But the Director-General was careful to add that the programmes of West Regional would soon have a more West of England flavour.

Look out for early news of a Welsh deputation!

Recording Talks "to Order"

I WONDER whether our friends in the wireless trade are missing a golden opportunity. A few days ago an enquirer asked me whether he could obtain a sound record of a talk broadcast some ten days previously, and I had regretfully to tell him that no such thing was available to the public. He had no desire to install a home recording apparatus since a record of that one talk would have satisfied his immediate needs, and he asked me if anyone in London would be prepared to record talks to order.

THE "STAR" TURN. The Zoo Man (Mr. David Seth Smith) broadcasting from an aviary at Regent's Park. With him is Uncle Mac (Mr. Derek McCulloch). The Zoo Man's talks secured top place in the recent Children's Request Week.

Copyright and Other Questions

I understand that the B.B.C. claims the copyright for twenty-eight days, but no doubt a broadcast talker might have something to say on the question. He might object to having his address pigeon-holed in this fashion to be used in evidence against him at a later date.

An enterprising trader, however, might overcome these objections and arrange a regular recording service.

Non-stop in Northern Ireland

PROGRESS goes on in connection with Ulster's new high-power broadcasting station. Having inserted the survey pegs on the Lisburn site the B.B.C. has now decided that the Station Director is to be known as "Director, Northern Ireland Regional." More news to follow!

The B.B.C. Writes the "Unemployed" Talks

I HAVE learnt the secret of how talks by the unemployed are prepared for the microphone. What happens is that the prospective talker has a heart to heart chat with a B.B.C. official in one of the small studios. A few days later the postman brings him his "talk," typed out and ready for delivery at the microphone.

Stenographers Are Busy

How is it done? Does the B.B.C. official take notes during the interview? No, for the sight of pencil and notebook would spoil the spontaneity of the interview.

Unbeknown to the visitor, the harmless-looking microphone is "alive," and the whole interview is taken down in shorthand by stenographers in another room.

Other Talks Would Benefit

Why is this method used only in the case of the unemployed? One wishes the B.B.C. would do the same with some of those eminent professors whose talks lack sparkle because of poor presentation. A good talks editor could turn any over-heard conversation into a pithy address for the microphone.

A Hitch

The method I have described violates one of the original rules of the B.B.C. whereby no microphone may be switched into circuit without an indicating light. Despite this rule hitches do occur. There is no automatic connection between the microphone and light, so that very often the microphone is in circuit for two or three seconds before the light appears. The other night, for instance, just before a piano interlude, the whole world heard a popular B.B.C. artiste say, "I've got a rotten cold."

Film Tracks via Ether

FILM recordings will be fed through to the Regional transmitters on May 29th, when, in "Picture People," we shall hear a variety programme made up of recent talkie successes. The stars will include Eddie Cantor, Gracie Fields, Richard Tauber, Florrie Forde, and Jessie Matthews, as well as the B.B.C. Symphony Orchestra conducted by Adrian Boult and the Women's Symphony Orchestra conducted by Grace Burrows. The programme has been devised and will be introduced by Clayton Hutton.

Leading film manufacturers are co-operating.

Thomas Carlyle at the Microphone

"THE Carlyles of Cheyne Row" is the title of a promising broadcast on June 10th, in which the sage of Chelsea and his wife will figure. The programme will actually be relayed from the old house in Cheyne Row in which the great *littérateur* lived for nearly fifty years.

The part of Thomas Carlyle will be taken by Alaistair Sim.

There are other literary haunts which the microphone should visit. One immediately thinks of Dr. Johnson's house in Gough Square, Fleet Street, Charles Dickens' home in Doughty Street, Bloomsbury. There must be a host of others.

UNBIASED

By FREE GRID

This 'Ere Progress

"THERE is a tendency," says the writer of the wireless notes in a West Country journal, "to fit a switch in modern sets to change over from the medium to the long waveband instead of using plug-in coils as hitherto."

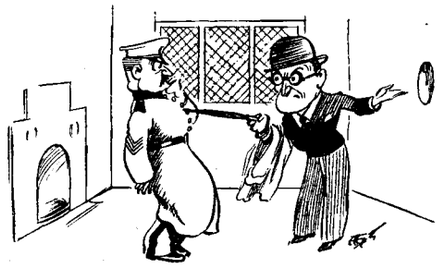
It must, I think, be a charming sight to see the arrival of the Editor every morning in his stately coach and four, and to watch throughout the day couriers galloping into the town on hard-pressed horses to deliver the latest news to the Editorial sanctum.

Seriously, however, is this not carrying the cult of modernism a little too far? Before we have all discarded our slider inductances in favour of plug-in coils this writer wants us to make a further change. In the words of the famous advertisement, "That's an invention, that was."

Those New Houses

DURING the run of a recent exhibition in which, among other things, desirable villa residences were a feature, I was tempted to inspect them by an announcement that some of these modern eyesores were fully equipped with built-in radio sets and electric clocks.

I have to confess, however, that I was bitterly disappointed with what I saw. With regard to the clocks, I perceived at once that they were there all right, being built into the wall of every room, with no wires showing, as per prospectus. The radio installation, however, revealed appalling ignorance on the part of the builders.



Bitterly disappointed

The wireless set was "built-in," and so was a loud speaker—very much so indeed. The builder had scooped out a recess in the wall just big enough to accommodate the loud speaker, so that it fitted like the proverbial glove. What the good man thought the sound waves at the back of the cone were going to do with themselves I don't know.

But perhaps a builder may be forgiven for lack of technical knowledge; what cannot be overlooked, however, was the total lack of provision for loud speaker reception in any room other than that in which the set was housed. I suppose I could hardly expect the house designers to have thought of providing a remote tuning control panel in every room after the manner of car radio, or even a remote volume control and on-and-off switch, but I at least anticipated the provision of a loud speaker socket in every room, more especially as the architect had had sufficient foresight to install electric clocks.

Yet another criticism which I have to make is that although an elaborate nursery was provided in at least one house I saw no effort whatever to make provision of a baby alarm of the type which has so often been advocated in this journal.

Still Waiting

I WAS interested in a recent letter in *The Wireless World* on the respective merits of films and discs for gramophone reproduction. The writer gives many weighty reasons against the employment of films, among which he mentions "the difficulties connected with rewinding and storing."

Surely he has forgotten that this trouble was completely overcome nearly four years ago when a gramophone was produced in which the record consisted of a standard 35-milliametre film in the form of a continuous band with the sound track in the form of a spiral. The film accommodated as many as twenty sound tracks, giving a long playing time. The "sound head" of the machine was similar to that employed on a standard talkie machine.

I recollect the details well, because, when I examined the machine at the Manchester Show of 1930, I ordered one there and then. True, the machine has not been delivered yet, but I am not one of those selfish fellows who order a thing at an exhibition and then expect it to be delivered in time for Christmas, or some such absurdity. In any case, the salesman told me at the time that I gave my order that the output of the factory was booked up for five years ahead, and naturally my time has not come round yet.

The Mating Call

FINDING myself on a longish train journey, which I had to undertake at very short notice the other day, I cast about for some means of passing the weary hours away, as, unfortunately, owing to my haste, I had come away without my vest-pocket portable.

In the end I started a conversation with a fellow traveller, only to find, to my chagrin, that he didn't know the difference between a grid leak and a milliwatt, his soul being so dead that he took not the slightest interest in wireless. He was, I found, one of those strange people who take pleasure in journeying from one place to another at high speed on a motor bike,

Fraught with meaning to females of an understanding heart.

accompanied by a maximum amount of noise, and he insisted upon pressing on me the current issue of the journal devoted to this strange cult.

Reading its pulsating pages, I was interested to learn that the noises which many youthful motor cyclists cause their machines to emit are deliberately intended to attract the fair sex. Apparently, the way to a woman's heart is *via* her ears, and the louder and more appalling the noise the better.

Far into the Night

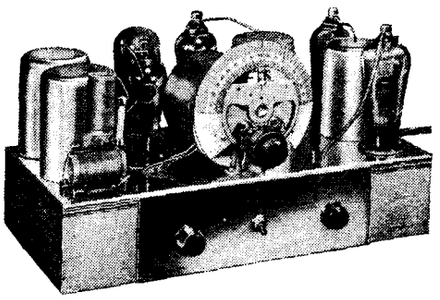
This piece of information at once solved a problem which has long been puzzling me, namely, why it is that so many owners of wireless, particularly youthful members of the male sex, keep the volume control hard over, so that the loud speaker gives vent to a deafening roar, and also why, in so many cases, this sort of thing continues all day and far into the night. I realise now that the operators are emulating the example of tom-cats and youthful motor cyclists, or, in other words, are giving voice to the "mating call," as one of our lady novelists calls it.

According to eminent naturalists, who understand these things, the various cries uttered by birds during the mating season each have different meanings which are readily understood by experts, even though they all sound alike to the ordinary citizen. Similarly, I suppose the different kinds of noises produced by overloading the output valve, excessive reaction, or a saturated L.F. transformer and suchlike things are all fraught with meaning to females of an understanding heart.

Filled with a new interest in wireless, I intend to devote considerable study to this aspect of the service with a view to bringing out a comprehensive list of interpretations which I propose to record on a disc for reproduction on the gramophone. Those of you whose imaginations are stirred by the new revelation will assist me by sending along any interpretations you may discover. Do not hesitate to write to me, no matter how strange or bizarre your interpretations may appear to be, as all letters will be treated in strict confidence.

The Signal Through "Single-Span"

The Frequency-changing Process Explained



VERY naturally, those who are accustomed to the elaborate and bulky tuning systems of ordinary sets are puzzled by the extreme simplicity of the corresponding section of the "Single-Span" receiver. In the new set both broadcasting bands—to say nothing of a band of extra wavelengths as makeweight—are covered by a single sweep of a tiny 0.00016 mfd. variable condenser, working in conjunction with an oscillator tuning coil assembly of almost "short-wave" proportions. The accompanying diagrams will help to show what actually happens to the signal at each stage between aerial and loud speaker.

We all know that the superhet differs from straight sets in that the wavelength of the signal is changed to suit the amplifier instead of tuning the amplifier to resonate with the signal. This applies equally to the Single-Span system, but, instead of employing an I.F. amplifier of lower frequency (higher wavelength), we use an intermediate amplifier working at a higher frequency (lower wavelength) than that of any incoming signal with which the set is designed to deal

The superheterodyne principle depends on tuning the local oscillator to a frequency differing from that of the incoming signal by the frequency of the I.F. amplifier. By choosing a high intermediate frequency it becomes possible to cover the requisite

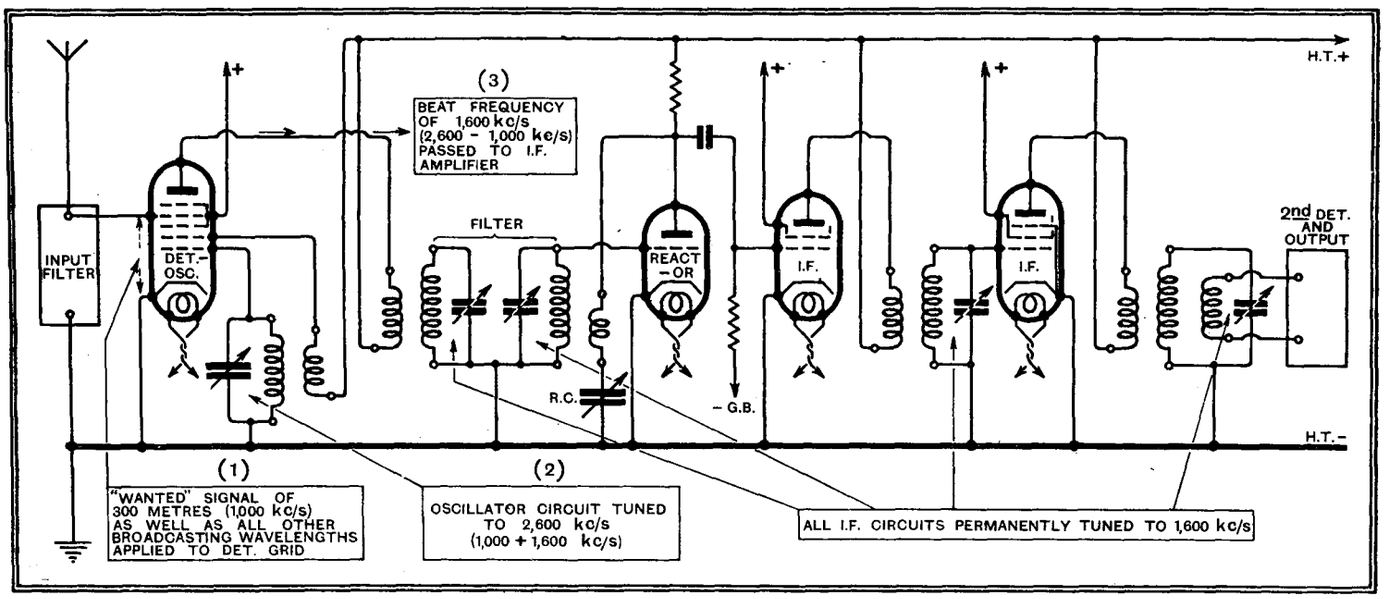


Fig. 1.—How the "Single-Span" set deals with a medium-wave signal having a wavelength of 300 metres.

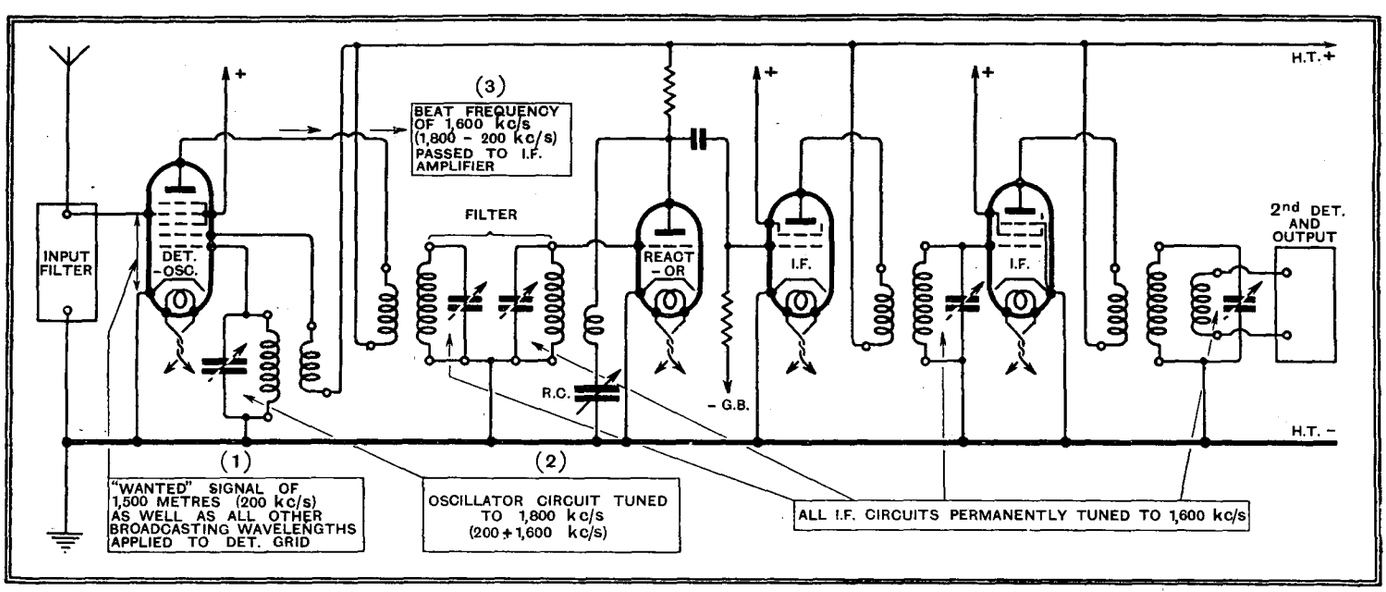


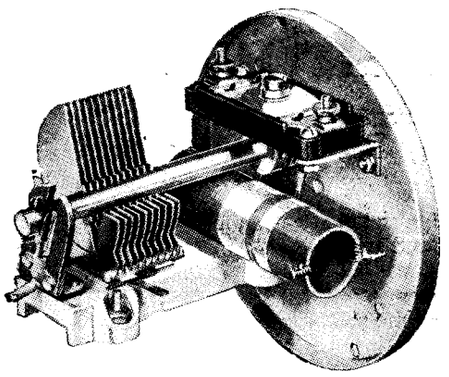
Fig. 2.—For reception of a long-wave 1,500-metre signal oscillator tuning is changed from 2,600 to 1,800 kc/s.

The Signal Through "Single-Span"—

band with a local oscillator condenser having a capacity change in the ratio of 3.14-1. The oscillator actually covers a frequency band of about 1,750 to 3,100 kc/s; it will be seen that frequencies within this range, when combined with any broadcasting signal between 150 and 1,500 kc/s, will produce a "beat" at 1,600 kc/s, which is the frequency chosen for the I.F. amplifier.

In the accompanying diagrams the passage through the receiver of a medium-wave and long-wave signal are shown; the interested reader will be able to work out for himself the appropriate oscillator setting for any other wavelength within the range of the receiver.

The special input filter has been devised to "cut off" those frequencies between 3,350 and 4,700 kc/s which would otherwise cause second-channel interference.



Screened oscillator unit—the "works" of a Single-Span set.

Readers' Problems

Extending Wavelength Range

WE are asked to suggest an easy method of extending the wave-range of a receiver in an upward direction (on the medium waveband) in order that 600-metre signals may be receivable. A straightforward H.F.-det.-L.F. circuit with band-pass input is employed, and the wavelengths at present covered are from approximately 200 metres to 540 metres.

Without making radical alterations to the receiver, it is difficult to extend wave range in a manner that is not open to criticism. Strictly speaking, the correct plan would be to substitute three-range coils, but we realise that this is impracticable. It is therefore suggested that, in spite of its inefficiency, the method illustrated in Fig. 1 (a) should be adopted. This comprises the addition of a semi-variable condenser of about 0.0002 mfd., in series with a switch, across the main tuning condenser; each of the three circuits will require this addition, and, of course, the switches should preferably be ganged and operated from a single control knob.

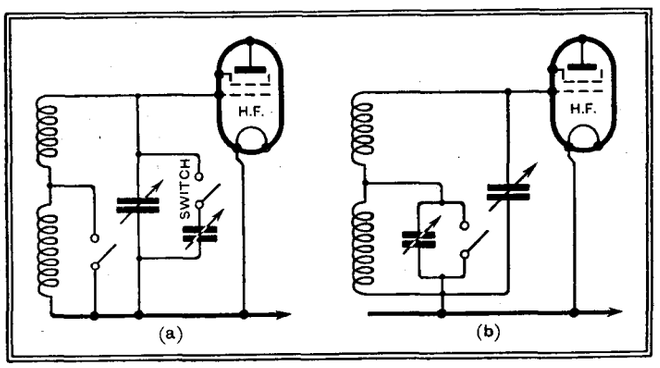


Fig. 1.—Two practical methods of increasing the upper limit of wavelength range.

Although this method is not highly efficient, it will probably be found quite effective enough for our correspondent's purpose. Having once adjusted the extra condensers on a wavelength of, say, 600 metres, it will not be necessary to make subsequent alterations to their capacity.

While on the subject, it would perhaps be as well to point out that wavelength coverage on the long waveband will also be extended when the extra condensers are thrown into circuit. In cases where it is desired to receive higher wavelengths than is normally possible on the long waveband only, the simpler arrangement shown in Fig. 1 (b) may be tried. This is even more open to criticism on the ground of inefficiency, but has the advantage that no extra switching is needed. Unfortunately, however, the addition of the extra condenser shown as being connected across the built-in switch contacts will seriously restrict wave-range at the lower end of the long-wave scale.

Aperiodic H.F. Amplification

AS selectivity is such a pressing need nowadays we hear little about aperiodic H.F. amplification, which, in theory at any rate, gives equal magnification of signals of any wavelength, and so contributes nothing to the selectivity of the receiver.

In spite of this shortcoming there are conceivably a few cases where amplification, unaccompanied by selectivity, would be desirable. A correspondent, commenting on this matter, suggests that with the help of modern valves of high efficiency it should be possible to obtain a worth-while measure of amplification from an untuned H.F. stage, and asks us to say how much could be expected on the medium waveband.

So far as we know, very little work has been done on this subject of late, and so precise data is not available. However, taking into account the measured amplification of an aperiodic stage when valves were much less efficient, we think it would not be far wrong to say that an average gain of five or six times would be easy enough to obtain on the medium broadcast waveband. A screen-grid valve would, of course, be used. Higher gains might be expected from a semi-aperiodic coupling designed to resonate at one end of the waveband; such an arrangement has been used to compensate for the inherently inconstant amplification of the ordinary receiver.

On the long waveband much greater amplification would be obtainable.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

CLUB NEWS

Loud Speaker Contrasts

Twelve obsolete loud speakers, dating from 1922 onwards, were demonstrated with amusing results in the course of a recent lecture by Lt.-Col. H. Ashley-Scarlett, D.S.O., before the Golders Green and Hendon Radio Scientific Society. In striking contrast to the pioneer types, the lecturer demonstrated a quality combination consisting of one of the new Piezo-Electric speakers for high frequency reproduction with a special 14in. moving coil speaker for the low frequencies, the L.F. amplifier being modelled on a *Wireless World* instrument. Hon. Secretary: Mr. J. Hillier, 8, Denehurst Gardens, Hendon.

Keenness in Kettering

Mr. E. T. Cottingham, F.R.A.S., has been elected president of the Kettering Radio and Physical Society. At the annual general meeting it was reported that the membership exceeded eighty, the closing session having been highly satisfactory. The new Hon. Secretary is Mr. T. H. Hall, 59, Tresham Street, Kettering.

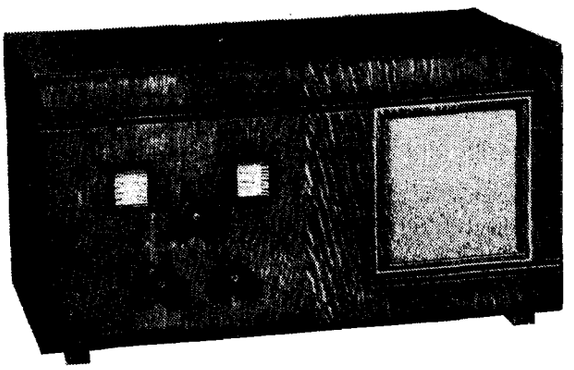
Television: For and Against

"Is Television Worth While?" was the question debated recently by Slade Radio (Birmingham). A surprising number of members raised objections, though several contended that their strictures were confined to experiments with the present apparatus. The voting of the majority answered the question in the affirmative. Hon. Secretary: 110, Hillaries Road, Gravelly Hill, Birmingham.

Institute of Wireless Technology

Mr. W. B. Medlam dealt very comprehensively with "Selectivity" in his presidential address at the annual general meeting of the Institute of Wireless Technology on April 27th.

A review of the year revealed much good work and great enthusiasm on the part of the various sections. The Assistant Hon. Secretary is Mr. B. Hogben, and the Institute's headquarters are at 4, Vernon Place, Southampton Row, London, W.C.1.



Climax S5 Superhet.

A Sensitive Set with a New Type of Frequency-changer

FEATURES :— *Type.*— *Table-model superheterodyne for A.C. mains.* ***Circuit.*—** *Octode frequency-changer—var.-mu I.F. amplifier—triode second detector—power pentode output valve. Full-wave valve rectifier.* ***Controls.*—** *(1) Tuning. (2) Volume control and on-off switch. (3) Waverange switch.* ***Price.*—** *£10 10s.* ***Makers.*—** *Climax Radio Electric Ltd., Haverstock Works, Park Hill Road, Hampstead, N.W.3.*

THE outstanding impression after testing this set is its exceptional efficiency, having regard to the fact that only four stages are employed. The high overall magnification and the unusual crispness and clarity of the reproduction combine to give one the impression that one is handling a "sports" model among receivers. The selectivity, too, is very good, and there are few sets of its type which can give such a good performance in this respect on long waves.

A new form of octode frequency-changer has been adopted. This is essentially a combination of a triode oscillator and a variable-mu H.F. pentode rectifier. An inductively-coupled aerial band-pass filter precedes this stage, and there are four tuned circuits associated with the I.F. amplifier. The latter is of the variable-mu type, and volume is controlled in this and the frequency-changer stage by a variable cathode bias resistance which is common to both valves. A grid detector follows the I.F. stage, and bias is automatically applied to convert this valve to an amplifier when the pick-up is in use. Resistance-coupling is employed between the detector and the output valve, which is a pentode capable of handling three watts undistorted.

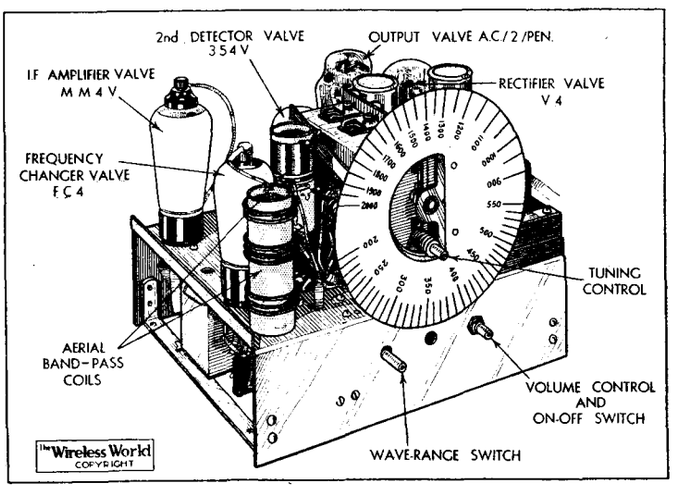
The loud speaker is a Magnavox energised unit, and plugs and sockets have been arranged at the back of the set to cut out either the internal or the external loud speaker as desired. The external loud speaker terminals are shunted by a resistance to avoid breaking the load on the pentode should the plug be removed when the external loud speaker is disconnected.

A full-wave valve rectifier supplies the H.T. current, and the primary of the mains transformer is screened. A mains aerial pick-up is provided through the capacity to the power cable.

The set is available either in a horizontal or vertical cabinet, and an interesting feature is the provision of an easily removable panel in the base giving access to the underside of the chassis. The tuning scale is calibrated in metres, and the markings are easily read from a distance. The dial lights are connected with the wave range switch, a green light being used for the medium waves and red for the long.

The volume control has an ample range, but in Central London the control is confined to about a quarter of the total rotation provided. When situated nearer to a main B.B.C. station, however, the lower portion of the control will probably be needed, and it is unlikely that a need for a local distance switch will be felt.

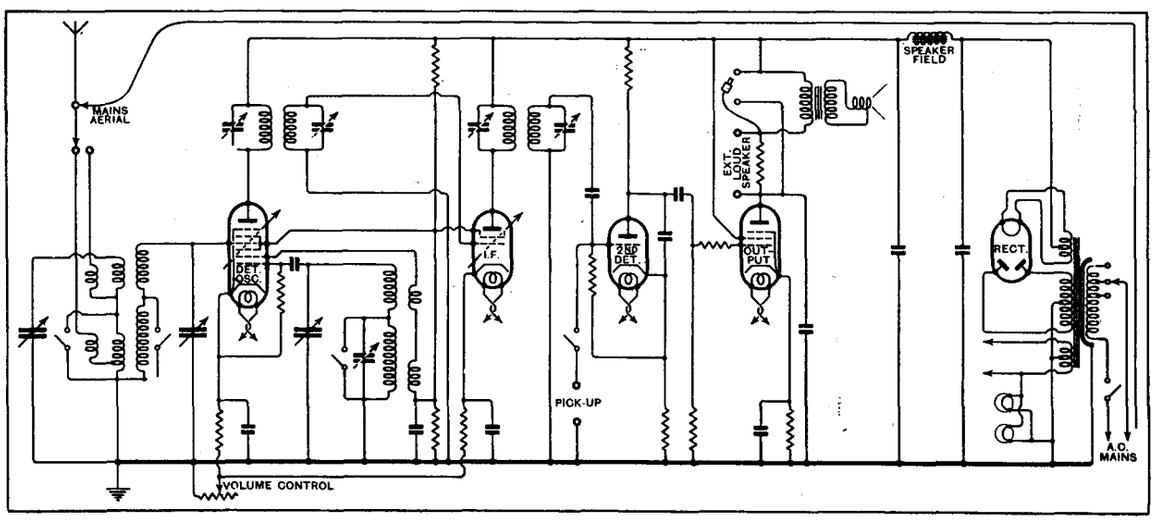
The two Brookmans Park transmitters occupied bands of approximately 25 kc/s, or a little over one channel on either side of their normal settings. On long waves Königswusterhausen was quite free from direct interference from Daventry and Radio Paris, and interference due to side-band splash was almost entirely absent. This, combined with the high sensitivity, made the German station really well worth while receiving. On medium waves, too, the sensitivity was of the order usually associated with superheterodynes with a signal frequency H.F. stage.



A notable feature of the chassis is the legible tuning scale.

The reproduction is quite free from hollowness, and is notable for its incisive quality. The set is particularly good when receiving dance music and other arrangements involving brass and percussion instruments. This type of quality is often accompanied by harshness, but in the Climax set the softer tones have no unnatural "edges."

The makers have simplified the design and construction of the cabinet and chassis in order that a larger proportion of the manufacturing costs may be devoted to giving what is undoubtedly a high performance.



Complete circuit diagram. An octode valve is used in the frequency-changer stage.

Next Week's Set Review:

KOLSTER BRANDES K.B.444

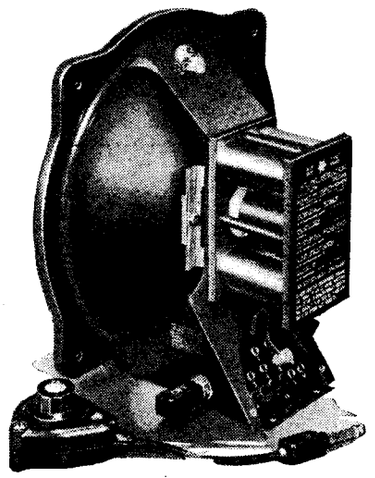
NEW APPARATUS REVIEWED

Latest Products of the Manufacturers

BLUE SPOT "STAR" LOUD SPEAKER

A NEW type of magnetic alloy is used in this loud speaker. The active material is enclosed in four chromium-plated tubes which are connected magnetically by rectangular end plates and a central cylindrical pole piece. The diaphragm is housed in a die-cast chassis and a new design of exterior suspension is employed. The inside apex of the cone is closed by a conical sub-diaphragm which assists in strengthening the high-note response and prevents dust reaching the air gap. In addition, the back of the air gap is sealed, and a flexible dust shield is fitted between the moving coil and the top of the magnet plate.

A versatile input transformer with a tapped secondary gives a wide range of effective impedances from 1.5 to 20,000 ohms. In addition, there are two jacks, one of which enables the unit to be used as an extension loud speaker and the other provides a connection for a remote volume control. A special plug is also supplied which, when inserted in this socket, provides an on-off switch.



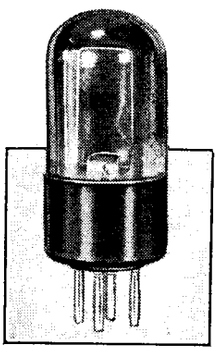
The Blue Spot "Star" permanent magnet loud speaker in which a new type of magnetic material is employed.

The diaphragm suspension is free and the sensitivity and efficiency compare very favourably with units of similar dimensions using a cobalt or chrome steel magnet. The output between 150 and 2,500 cycles is remarkably uniform and the fundamental resonance at 90 cycles is rounded and not sufficiently pronounced to mar the natural reproduction of the bass. In the upper register the response is good up to 5,000 cycles, but between 5,000 and 6,000 cycles there is a decided drop, after which the output is maintained at the new level up to approximately 12,000 cycles. There is a decided increase of output in the region of 2,800 cycles, but judging from the results given in actual use, this is not sufficient to upset the balance of tone. The makers are to be congratulated on the unusually complete specification of this model, which is definitely above the average of its class, both in mechanical design and performance. The price is 70s., and a remote volume control is also available at 10s. 6d.

The makers are British Blue Spot Co., Ltd., 94-96, Rosoman Street, London, E.C.1.

OXFORD PHOTO-ELECTRIC CELL

A NEW type of photo-electric cell possessing a high order of sensitivity has been developed by the Oxford Instrument Co., Ltd., 7, Keeble Road, Oxford. Known as the Type X cell, it is available either as a vacuum cell or as a gas-filled cell, the latter giving a considerably larger current output for the same illumination.



Oxford photo-electric cell fitted with a standard four-pin valve base.

It is claimed for this new cell that the emission from the cathode is between 40 and 70 micro-amps. per lumen when using a half-watt lamp, and that it is possible with the gas-filled type to obtain over one milli-amp. per lumen.

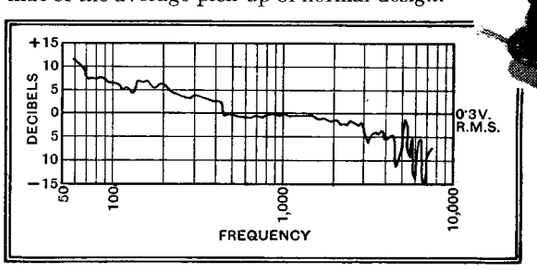
Under normal conditions the standard type cell requires a potential of about 90 volts, which may be increased to 110 volts if the illumination is low, but this potential should not be exceeded. Special cells can be supplied to order for operating at potentials of from 35 volts upwards, or for research and general scientific work. Normally a resistance of not less than 20,000 ohms is connected in series with the cell.

The standard vacuum Type X photo-cell costs £4, and the gas-filled style £4 4s. It is cylindrical in shape and measures approximately 1⅜ in. in diameter and 3½in. high overall.

B.T.H. NEEDLE ARMATURE PICK-UP

IN designing a pick-up it is essential to keep the inertia of the moving parts as low as possible, and the limit is reached when the needle itself is made to carry out the function of the armature. The difficulty has been to obtain a sufficiently high output for the requirements of existing amplifiers and sets, but this has been overcome in the model under review.

The average output with an H.M.V. "Loud Tungstyle" needle is of the order of 0.3 volt, and it is noteworthy that this has been attained with an air gap wider than that of the average pick-up of normal design.



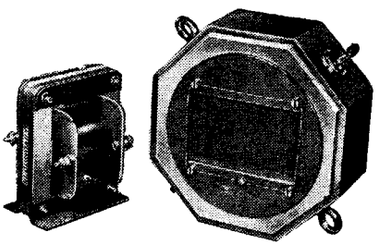
Waveform distortion should, therefore, be at a minimum.

With the exception of the extreme top above 4,500 cycles a very smooth output is obtained, and the rise in the bass is just adequate to correct modern records.

A 100,000-ohm potentiometer is supplied with the pick-up, and also a rest for the hinged head. The price of the complete equipment is 40s., and supplies are obtainable from The Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London.

SHAFTESBURY SUPPLIES MICROPHONE

A NEW transverse current carbon microphone for public address use has been introduced by the Shaftesbury Supplies, 224, Shaftesbury Avenue, London, W.C.2, at the exceptionally low price of 55s. Yet it is in every way a first-grade instrument, electrically as well as mechanically, for it has a very good frequency response, and the workmanship is of the very best.



Shaftesbury Supplies new transverse current microphone and skeleton-type transformer.

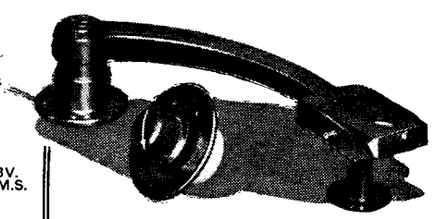
The microphone is housed in a strong octagonal polished aluminium case measuring 5in. in diameter and 2in. deep, and suspension hooks are fitted for mounting.

During our tests no apparent resonances were noticed, and the response, judged orally, seems to be fairly uniform throughout. It is an instrument that undoubtedly justifies the use of a first-class amplifier. One outstanding feature of the microphone is its low noise level even when followed by a high gain amplifier. A two-stage unit giving an overall gain of from 750 to 1,000 will answer for the everyday requirements of public address work.

The input transformer should have a step-up of about 1 to 30, while the microphone requires between 6 and 9 volts, and with the latter passes about 12 mA.

While this microphone is of the type usually classified as public address equipment, in view of its very low price it brings a first-grade instrument within the reach of amateur transmitters and those interested in home recording. It is exceptionally good value for money.

Special microphone transformers cost 7s. 6d. in skeleton form, or 10s. shielded, while a table stand for the microphone is available at 15s., and an adjustable floor type at 25s.



B.T.H. needle armature pick-up and volume control. The characteristic with H.M.V. "Loud Tungstyle" needle and 100,000-ohm. shunt.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Star Items of Broadcasting

Advance Advertising

IT may be that broadcasting has recently produced some unusually attractive items, or it may be just coincidence, but during the past few days we have come across a number of people who have expressed regret at having missed some particular broadcast because they were unaware of the item until after the event. Discussing the matter with them, we met with the same general complaint that something ought to be done to bring to the notice of the public special broadcast items with more emphasis than at present.

It is all very well to say that the programmes are in the *Radio Times*, or in every daily newspaper, but not everyone has the time to search systematically through the Press for the items which make the most appeal, nor is there sufficient distinction made in these printed sources of information between the items of unusual interest or infrequent occurrence to make them stand out amongst the many hours of what may be described as "ordinary matter."

Comparison with the Theatre

Those who are interested in the theatre have but to look down the list of theatre performances in any paper to select what interests them, and, having chosen their play, they still have the choice of many days, weeks or months to see it. But in the case of broadcasting if an item is missed it is usually gone beyond recall, unless by chance the same performance may be repeated from some other station at a later date.

Is it really necessary that the broadcasting programme should, in so far as its principle items are concerned, be changed daily?

Readers may have some ideas to offer for overcoming this inconvenience. The B.B.C. might, for example, advertise special programmes some time in advance, or they might arrange for a daily space in the newspaper classification of theatre and other entertainments. Far too often the daily Press devotes space to discussing a broadcast which has already taken place, instead of drawing attention to some item of special interest in a forthcoming programme. There is nothing more exasperating than to read that some particularly interesting item was broadcast the previous day and to contemplate that, having missed it, it is very likely that the same piece may never be on the air again.

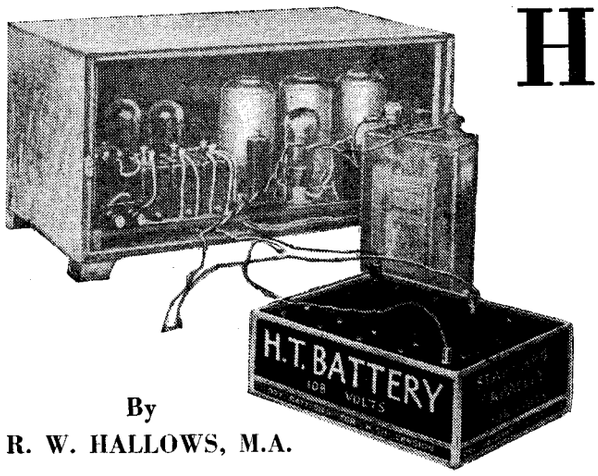
Single-Span

A Battery Model Announced

THERE seems to be no abatement of interest in the principle of Single-Span reception, and in response to a very large number of requests a battery version has been designed and is announced in this issue for description next week.

The set has been retained in the same form as for the A.C. mains version except for the omission of the mains equipment. The coils and other constructional details already given for the mains set remain unchanged.

The performance of the battery model is very satisfying and, in fact, there is little to choose between it and the mains equipment, except, perhaps, in the matter of power output; even here, the natural limitations of battery sets have been largely overcome by a particularly satisfactory Q.P.P. system. All the inherent advantages of "Single-Span" have been retained.



H.T. Battery Questions

The Economics of Anode Current Supply

By
R. W. HALLOWS, M.A.

THE author stresses the harmful effects of badly maintained H.T. voltage, especially with modern "quiescent" output systems, and urges the advantages of using good batteries of adequate capacity, both for economy and for the sake of good and consistent performance.

IT is a curious fact that to many there is only one kind of high-tension battery. I am referring not to makes but to capacities: to a surprisingly large number of people the term high-tension battery means a battery, with an E.M.F. of from 60 to 120 volts or more, made up of cells of the same size as those used in pocket flashlamp refills. Whether or not it is realised that batteries of larger capacity exist, that of standard capacity is frequently asked to do more than it economically can by being made to supply the plate current required for sets containing anything from three to seven valves and drawing 10, 12, or even 15 milliamperes of high-tension current.

For this state of affairs set manufacturers are to no small extent to blame. In some instances careful design and ingenious internal arrangements have kept the high-tension current consumption so low that even the multi-valve set is almost within the powers of the standard-capacity battery. But these examples are rare; numbers of sets with surprisingly high plate current consumption are fitted with small batteries for no better reasons than that these make for lightness and compactness.

Limit for Standard Batteries

Having made in the past five years laboratory tests upon hundreds of standard-capacity batteries of all makes and qualities, I am convinced that the maximum load which can be imposed upon them economically, even if they are of the very best grade, is not more than 5 milliamperes. To subject these batteries to a heavier load entails three interesting but undesirable consequences. The first of these is that the set costs far more to run than it should owing to the frequent battery renewals that are necessary. Secondly, the performance of the set is continually and rapidly falling off as day follows day. Thirdly, reception cannot be so good at the end of a given evening as it was when the set was first switched on.

Fig. 1 shows a service life curve of a kind that I believe not to have been previously published. In place of a single thin line, the graph takes the form of a "ribbon" showing the starting voltage under load and the ending voltage also under load for each test period.

The battery whose record appears in Fig. 1, and the others upon whose performances this article is based, were run under laboratory conditions for four hours a day through a fixed resistance, the load being initially 10 milliamperes. By "laboratory" conditions I mean that regular hours were kept, that the temperature was subject to only small variations, and that each battery was safeguarded from accidents of the kind that may come the way of the H.T. battery in actual use.

Myself, I should regard most dry, high-tension batteries as of little further use when the voltage had fallen to 1 per cell —that is, 80 volts for a 120-volt battery. It is, however, conventional to run batteries under test until the E.M.F. reaches 0.9 volt per cell—that is, 72 volts for the 120-volt battery, which is built up of 80 cells.

The battery whose service life is recorded in Fig. 1 cost five shillings. It will

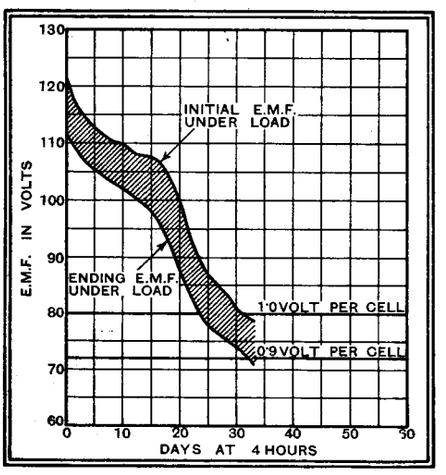


Fig. 1.—Service life of cheap standard-capacity battery. Nominal 10-milliamp. load; 4 hours per day.

be seen that the 80-volt mark was reached in twenty-three days, and the 72-volt in thirty-two. But note particularly the kind of service that it gave under a 10-milliampere load. On the first day the voltage drop was nearly 10; on the fifteenth it was 9.7; on the sixteenth 10; on the eighteenth 14; and on the twentieth 11.8.

Compare these figures with those shown in Fig. 2, which represents the record of a standard-capacity battery of good quality tried out under the same conditions. Here the service life is forty-eight days if we take 80 volts as the cut-off, and fifty-two if the limit is lowered to 72 volts. But there is one very big difference which is of vital importance. The good battery shows much smaller falls in voltage between the beginning and the end of each four-hour run. Its curve is far less steep, and the ribbon is much narrower.

Recuperative Power

Even so, the performance of the high-quality standard-capacity battery falls far short of the ideal, for the very good reason that, like the cheap battery, it is being overworked. It stands up better to the overload owing to the superior action of its depolariser.

Though everyone knows that the function of the depolariser is to prevent the clogging of the cell by the formation of hydrogen bubbles round its central carbon electrode, comparatively few realise that its efficiency in a battery designed for plate current purposes is not proved by its ability to enable a big "pick-up" in voltage to occur during rest periods. I have seen advertisements which made a great point of the fact that such-and-such a battery (the world's best, of course!) recovered from 100 to 110 volts after standing on open circuit for twenty hours.

In that case it must have fallen during its previous period of work from, say, 112 volts to 110 volts, and the truth is that, had the battery been up to its work and the depolariser sufficiently rapid in its action, such a voltage fall would never have occurred. In a word, the ideal battery is not the one with great powers of recovery during rest periods; it is the battery which shows the smallest possible fall during a three- or four-hour period of work.

This can be appreciated by a study of the family of valve curves shown in Fig. 3. These are for a typical small-power valve, such as might be used in the output

H.T. Battery Questions—

of a battery set intended to supply moderate volume in a small living-room.

It may be taken that the grid bias remains unaltered between the beginning and the end of an evening's reception, except where automatic bias is fitted. But if the plate voltage is falling comparatively rapidly, the grid-volts-anode-current curve of the output valve cannot be stable. It

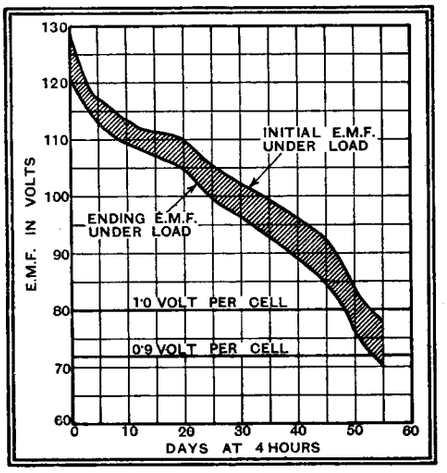


Fig. 2.—A good standard battery tested under the same conditions as in Fig. 1.

is, in fact, a succession of curves, each rather worse than its predecessor from the point of view of efficiency.

Since the grid bias is fixed, the working point of the output valve moves vertically downwards, as indicated in Fig. 3. In the interests of economy it is customary to apply to output valves in battery sets the maximum negative grid biasing voltage that is consistent with reasonable freedom from distortion. For the particular valve whose curves are shown in Fig. 3 the grid bias recommended by the makers is 9 volts with 120 volts on the plate. With 110 volts on the plate, the recommended grid bias is $7\frac{1}{2}$ volts, and with 100 volts, 6.

An examination of the curve shows that if the plate voltage falls in the course of an evening's run from 120 to 110, pronounced distortion must set in within the last hour or so, since the working point is taken right down to the top of the lower bend.

The Daily Voltage Drop

A fall in E.M.F. of 10 volts, then, is sufficient to produce what is known as "end-of-the-evening" distortion; such a fall is also definite proof that the battery is being overworked. It may be taken as an axiom that no high-tension battery is being run economically if the fall during a four hours' period of work exceeds about 5 per cent.

Compare next the curves of Fig. 1 and Fig. 2 with that of Fig. 4. This is for a good quality battery made up of larger cells. Only ninety days of its history are recorded, since this battery is still under test. Comparing its record up to the present with those of the many other good-quality batteries of high capacity that have passed through my laboratory, one can say that all the indications point to a service life of between five and six months.

Notice particularly how this battery behaves. Once it has worked off its original exuberance it settles down from about the tenth day onwards to a remarkably steady E.M.F. The average fall during a four hours' run is under 5 volts, and between the twenty-ninth and sixty-fifth day there was practically no difference in starting and ending voltages. It invariably began at about 108 volts under load, and ended at 103, or very little less. Since then the decline in both starting and ending voltages has been gradual and slight. Not until the eighty-fifth day did the voltage under load at the end of the day's run fall to the 100-mark.

With such a battery the good set can do itself justice. The fall during the day's run is not sufficient to produce noticeable distortion, and the general decline is so gradual that only occasional alterations of the grid biasing voltage of the low-frequency valves are required. Further, the rise in internal resistance is comparatively slight, and there would be no tendency for a set operated from such a battery to indulge in motor-boating.

If small-capacity batteries, and particularly cheap ones, are bad in multi-valve sets using single power valve output, they are infinitely worse in sets which employ Q.P.P. or Class B output. Consider for a moment what happens in such sets. The standing current when no station is tuned in may be quite small, say, 7 milliamperes or less. The moment a transmission is tuned in the plate current of the output valve rises, and it ceases to be steady.

Connect a milliammeter into the plate circuit, and you will see that the current is continually peaking to 15, 20, or even 40 milliamperes if the volume is large. Now project yourself in imagination into the inside of one cell in the high-tension battery. The depolariser, if the battery is of standard-capacity size, has all that it can do to clear away the accumulation of hydrogen for which the normal current is responsible. Whenever there is a peak in the current, a rush of millions upon millions of hydrogen molecules takes place to the carbon electrode. The depolariser is for the moment snowed under, and the internal resistance of the cell rises. If another current peak occurs almost immediately, there is a further rush of hydrogen molecules to add to the congestion round the carbon electrode.

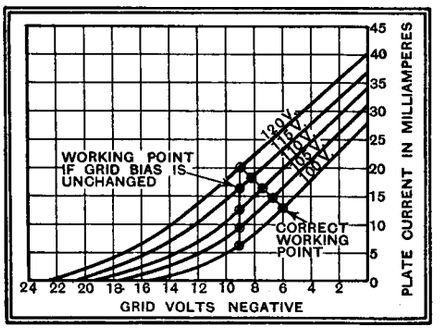


Fig. 3.—A family of valve curves, showing how badly maintained anode voltage gives rise to distortion unless bias is altered.

Modern Battery-economy Circuits

Owing to the big temporary internal resistance, this second peak cannot develop properly, and distortion arises, for the reason that the battery cannot supply extra current when called upon to do so.

For Q.P.P. and Class B the action of the depolariser must be so good that it is practically instantaneous. This cannot possibly be obtained in cells of standard-capacity size when the momentary loads amount to from 20 to 40 milliamperes.

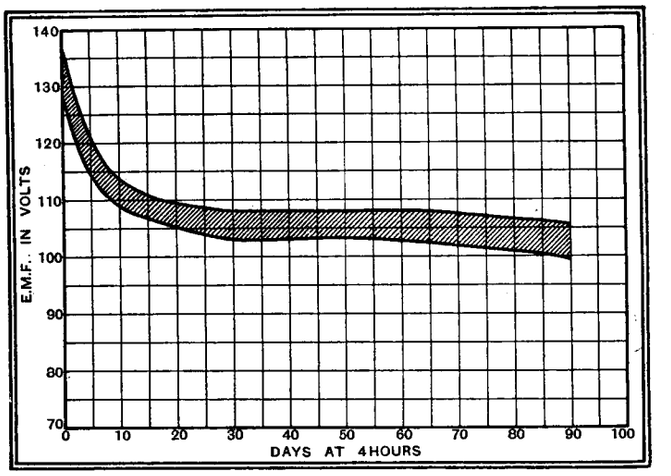
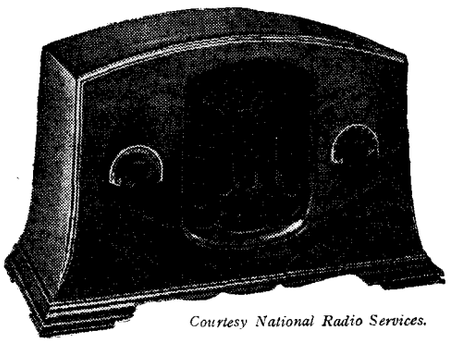


Fig. 4.—Record of the first 90 days of service of a good triple-capacity battery tested under the same conditions as the smaller ones.

From the points of view, then, of quality and performance, the triple-capacity battery wins hands down. How does it compare as regards running expenses? The cheap standard capacity battery of Fig. 1 gave a maximum of thirty-two days' service—and very bad service at that. Its cost was approximately twopence per day. The good-quality battery of Fig. 2 works out at about the same cost per day, though the set will perform infinitely better when operated from it. We may take it that the average life of a battery such as that of which the record appears in Fig. 4 is about five months, or, say, 150 days. Its cost was actually 15s. 6d., so that running expenses work out at approximately $1\frac{1}{4}$d. a day.

From every point of view, then, the large-capacity battery scores, and there is no question that it is by far the best investment for the battery-operated set containing three or more valves. Small cells are suitable only for very simple sets, or for portables, where considerations of weight outweigh everything else.



Courtesy National Radio Services.

The Midget Superheterodyne—a typical example.

The Midget Superheterodyne

America's Most Popular Set Described

By J. H. OWEN HARRIES

THE author of this article, who has just returned from the U.S.A., has had ample opportunity to study present tendencies in receiver design. Except for shortcomings in its tonal quality, the small and cheap American set was found to be surprisingly effective.

SUPERHETERODYNES have virtually replaced straight sets in America, and "midgets" have become so popular and so cheap that hardly any other type of set is sold. The marvels of cost reduction obtained by the engineers and designers are almost incredible to British eyes. Wireless is cheaper and more popular in the U.S. than anywhere else in the world, but at the cost of a ruined industry.

There are two types of midget superheterodyne on the market. One type is that made by "bootleg" firms, and attains its low cost because of the use of inferior materials and designs. These sets are no different from any other thoroughly bad sets, and will not be described in this article. The following is a description of the second type of superheterodyne midget, which is produced, with excellent materials and workmanship, for a very low cost. The profit is of the order of a few halfpence per receiver.

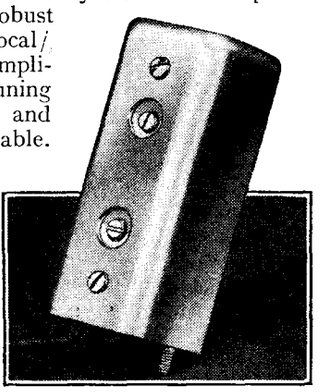
To understand the design it is necessary to realise that the removal of one or two resistances from a receiver may make the difference between the manufacturer operating at a loss or just making a profit.

Illustrating the compactness of American components. From left to right: aerial coil; oscillator coil; single-tuned I.F. transformer.

With the cost of a by-pass condenser representing the margin of profit, the designer in America has nevertheless to fulfil stringent requirements, which seem to have become standard, if he is to compete successfully.

Effective automatic volume control is universal and must be fitted. The receiver must not be larger than about 6 × 12 × 8 inches overall—no larger than three Brownie cameras put side by side.

It must be absolutely robust and foolproof. Even a local/distance switch is too complicated. Only a single tuning control, a volume control and an on/off switch are allowable. This is tantamount to specifying an extremely efficient automatic volume control, capable of avoiding overloads when the receiver is tuned in to a powerful transmitter a few hundred yards away.



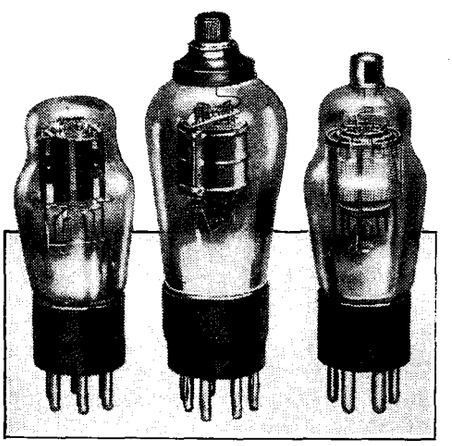
A band-pass I.F. transformer.

Sensitivity must be ample to obtain good signal strength when the receiver is demonstrated in a city building with a very inadequate aerial. It is not particularly necessary for the receiver to pick up very many distant stations, but it must give at least two watts output on a number of "local" stations under almost any conditions. Dealers have found from experience that although most users never operate a set at more than a "comfortable" level they will not buy it unless, in the shop, it can be made unpleasantly loud. In fact, it is necessary, for this reason, that the output valve, whatever its power, should actually be overloaded during the sales demonstration. Unless the prospective buyer has to turn the volume control down, on several stations, because the output is unpleasantly loud and distorted, he does not consider that he is being offered a "powerful set."

Tonal fidelity is unimportant so long as the general effect is pleasant. Resonances are of little consequence, provided that speech is intelligible. The loud speaker is built into the case of the tiny receiver; therefore real bass is unobtainable, as there is insufficient baffle area.

The set is so small that even the dissipation of heat from the valves is a problem for the designer. A series resistance to drop the mains voltage frequently consists of a flexible resistance lead for the mains connection. This avoids the generation of too much heat in the receiver itself.

The receiver should theoretically operate off both A.C. and D.C. mains. In practice, however, no special attempt is made to obtain the best results off the standard American 110-volt D.C. lines. So-called A.C.-D.C. midgets have actually been sold with no means to change from A.C.



Two American valves compared with a typical British specimen, seen in the centre.

The Midget Superheterodyne—

to D.C. Except in New York City, D.C. mains are comparatively rare.

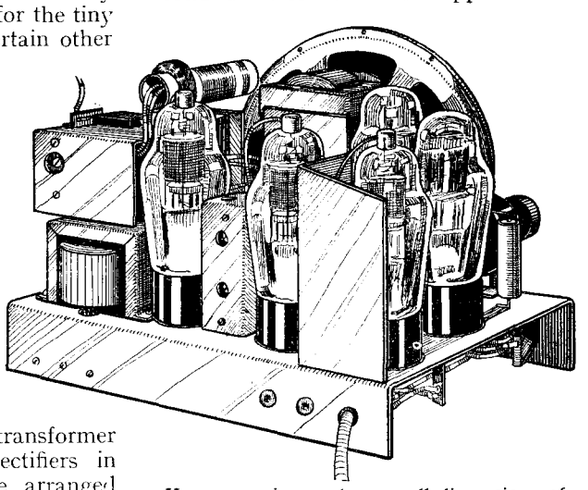
Too high a sensitivity is actually undesirable, because of the noise produced with A.V.C. when tuning between stations. Quiescent A.V.C. is too expensive for midgets.

These requirements are met entirely satisfactorily, and, were it not for the tiny loud speaker employed and certain other minor details where cost reduction has been too stringent a requirement, the American midget superheterodyne, as produced by firms of high standing, is a better engineering job than correspondingly priced receivers in this country.

Fig. 1 shows the circuit of a typical midget superheterodyne. The valves all take the same heater current of 0.3 ampere, and their filaments are arranged in series, no mains input transformer being used. Instead, two rectifiers in one bulb are used; they are arranged to charge alternatively two series-connected electrolytic condensers, C1, C2. These two condensers tend to have a total potential across them of twice the original A.C. mains voltage of 110. This scheme is undoubtedly the cheapest possible way of feeding a set with H.T. current from 110-volt A.C. mains. After allowing for the drop in voltage through the loud speaker field, which acts as a smoothing choke, the H.T. voltage is of the order of 150 volts. A D.P.D.T. switch is arranged to change from A.C. to D.C. mains. In the D.C. position the anode current flows through one of the rectifiers.

Two-circuit aerial tuning is used only in order to get rid of second-channel interference.

A 6A7 Pentagrid is employed as a single-valve frequency changer, and a screened pentode serves as an I.F. valve. To obtain adequate A.V.C. action, both the converter valve and the I.F. valve must be fully controlled by the A.V.C. voltage from maximum down to virtually zero magnification. These two valves deliver about four volts peak to the diode on fairly strong stations with the indoor aerial, consisting of a few yards of wire, which is permanently fitted to the set. The grid of the triode portion of the second detector valve is supplied with L.F. voltages from a tapping on the diode load resistance R. Volume control is obtained by varying the position of this tapping. The D.C. potential across the diode resistance is employed for A.V.C. The triode gives sufficient L.F. magnification to load the output pentode, even on very weak signals, when the peak I.F. volts to the diode are much less than four.



How space is saved; overall dimensions of the chassis are about 9in. × 6½in. × 4½in.

The loud speaker has a cone of only about three inches diameter, and is often fitted with a "hum-bucking" coil. The values of various typical components are marked on the circuit diagram. A careful examination will show that there is not a single component or connection in the receiver which could possibly be eliminated. As an instance, it might be thought that cost would be saved by employing a tapping on the aerial coil, instead of a separate aerial winding. A tapping is not used because the H.T. eliminator circuit connects the whole receiver directly to the mains. Accordingly, the aerial is electrically isolated from the receiver by means of the condenser C3 and a separate aerial winding, in order to avoid danger to the user.

For operation of the set there are only two knobs, one actuating the three-gang tuning condenser and the other the volume-control potentiometer. The latter knob also acts as an on-off switch when it is turned to zero.

The number of valves in the receiver is at the irreducible minimum. The frequency converter obviously cannot be eliminated, while the I.F. valve is required not only for its magnification but for the selectivity it confers by means of its tuned output transformer. Diode detection is essential both for A.V.C. and to avoid detector overloading on strong signals.

With a highly sensitive British output pentode one might perhaps eliminate the triode portion of the detector valve without losing too much sensitivity, and feed the audio-frequency volts from the diode load resistance direct to the output valves. But such high-efficiency output valves are unknown in the U.S.A.; they are probably far too expensive to be made successfully for that market, even if the American valve makers overcame the technical difficulty of obtaining a sufficiently high mutual conductance.

The magnification factors and mutual conductance of the valves in a typical receiver are shown in the table, and it will be seen how unfavourably these figures compare with those of British valves. The anodes of all the valves receive the same voltage of about 135, and the screening grids are fed from the same source of voltage through a resistance. They are nominally operated at about 100 volts, but pressure varies with the application of the controlling A.V.C. volts. This variation is less than might be expected, however, because the screen current of the pentagrid valve increases as its grid bias is made more negative by the A.V.C.,

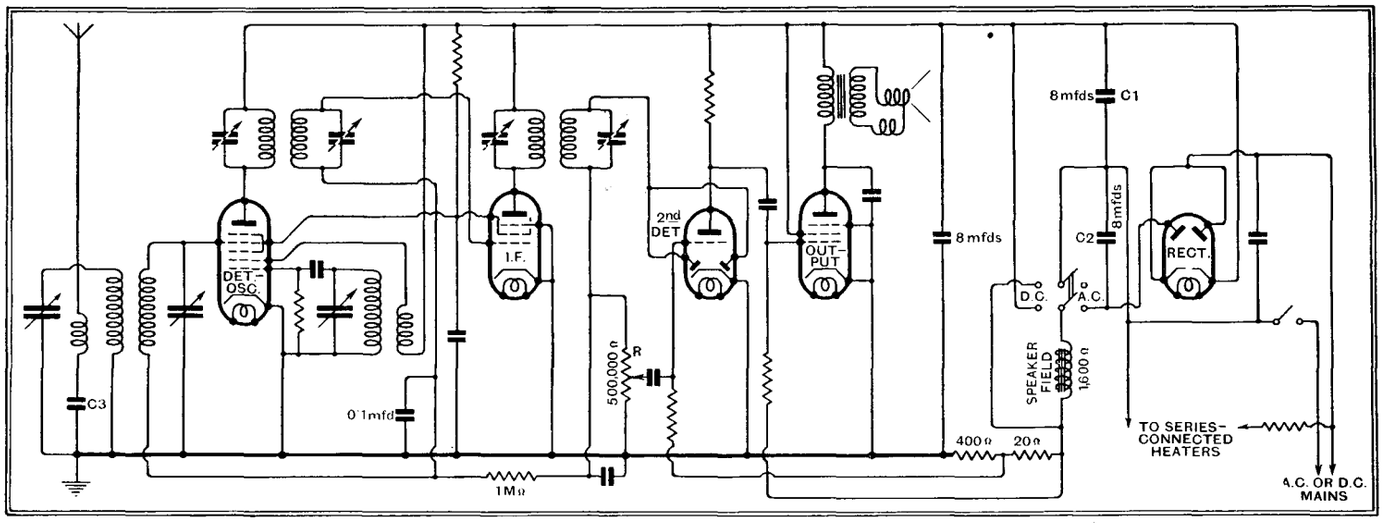


Fig. 1.—The circuit arrangement of a typical midget superheterodyne.

The Midget Superheterodyne—

while at the same time the screen current of the I.F. pentode is reduced. Therefore the total screen current of the two valves, and therefore the screen voltages, tend to remain very roughly the same for all values of A.V.C. voltage.

Further economies are made, and a great deal of ingenuity is shown in the actual layout adopted. Even the cost of an extra coil shield is a matter of serious moment to an American designer. The aerial and band-pass coils are wound on an unshielded former, and positioned above a metal base-board. They are just sufficiently screened from one another by a metal shield to give the desired looseness of coupling without the expense of shielding cans and extra coupling devices.

The oscillator coil and first I.F. coil are found not to produce whistles even if they are close together and are unshielded. But both must be shielded from the aerial input circuits. To avoid putting them in separate cans they are therefore fastened *below* the metal panel, which serves to screen them from the aerial coils, which are above it. The second I.F. transformer must, however, be shielded from all the other coils, and is therefore placed in a separate can.

The loud speaker is sandwiched in as shown, and the valves arranged compactly. It is found that only the I.F. valve need be shielded. The I.F. transformers consist of two tiny coils barely an inch in diameter, but, nevertheless, having the quite good dynamic resistance of 175,000 ohms at the standard intermediate frequency of 175 kc/s.

The set described covers the broadcast band only. Other midgets include switching for shorter wavelengths, such as those employed by the police. The never-ending warfare between police and underworld is apparently a source of entertainment to a large percentage of American listeners.

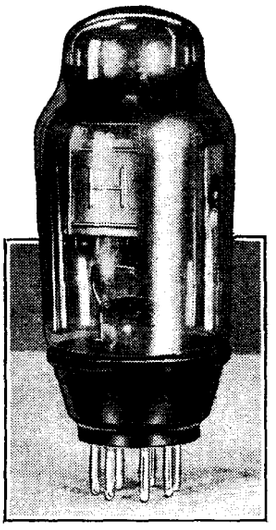
VALVE TYPES AND THEIR CHARACTERISTICS

Stage.	Type.	Mutual Conductance.	Magnification in Receiver.	Fil. Volts.	Fil. Amps.
Det.-Osc. ..	Pentagrid	0.65 mA./v.	50	6	0.3
I.F. Amplifier.	Screened pentode.	1.6 mA./v.	150	6	0.3
Detector and A.V.C.	Double diode triode	1.1 mA./v.	6 to 10 L.F.	6	0.3
Output ..	Pentode	2.3 mA./v.	Drive of 20 v. peak to give 2,000 mW.	25	0.3
Mains Rectifier	Double diode	—	—	25	0.3

HIVAC QP.240 VALVE

A Double Pentode Assembly in One Bulb for Economical Battery Operation

THE High Vacuum Valve Co., Ltd., 113-117, Farringdon Road, London, E.C.1, have now added to their range of battery valves a new type for Q.P.P. operation. Known as the QP.240, it consists of a double pentode assembly in one bulb and is rated to give a power output of the order of 1.4 watts with 150 volts H.T. Owing to the high efficiency of the two elements in the valve—their mutual conductance is given as 2.3 mA. per volt—this output is obtained with a grid swing per system of 14 volts R.M.S., so that about 19½ volts grid bias is needed to avoid swinging the grids into the region of positive grid bias.



New Hivac QP.240 double pentode output valve for Q.P.P. operation.

With the specimen tested the measured total anode current in the quiescent state, with 150 volts H.T. and −19½ volts grid bias, was 6.9 mA., while 1.2 mA. flowed in the auxiliary grids circuit.

An output adequate to meet most requirements with battery operation can be obtained, however, with a considerably lower H.T. voltage, for if operated with only 125 volts on the anodes just over one watt may be expected. Under these conditions the total quiescent H.T. current amounts to 5.8 mA., of which 4.9 mA. is passed by the anodes and 0.9 mA. by the auxiliary grids. These figures were obtained with a grid bias of −16½ volts.

With output systems of this type, and more especially if the valves are of high efficiency, any tendency towards self-oscillation must be watched and, if suspected, counteracted, as not only will it spoil the quality, but also give rise to an excessive H.T. consumption.

Instability of this nature gave actual warning during our tests by a high-pitched whistle, but should the oscillations be outside the audible range their presence might conceivably be overlooked. But poor quality and an unduly high anode current reading will, in most cases, be an almost certain indication of their presence.

A 250,000-ohm resistor connected between the centre tap on the input transformer secondary and the grid bias battery was found efficacious in suppressing such oscillations. The makers recommend joining a resistance of between 5,000 and 10,000 ohms in series with the auxiliary grids supply, and this might be adopted as a further precaution.

With the maximum H.T. voltage the valve requires to work into a load of 14,500 ohms, while with 125 volts on the anodes and on the auxiliary grids the optimum load is 16,500 ohms. The filament consumption is 0.4 amp. at two volts, and the valve is fitted with a seven-pin base of standard pattern and the connections are as in other Q.P.P. valves of the same type.

An output filter consisting of a 10,000-ohm resistance and a condenser of between 0.005 and 0.01 mfd. joined across the two anodes could be used as a frequency corrector, though we found this unneccessary, as the quality was particularly good with a correctly adjusted transformer ratio to suit the loud speaker in use. There is ample power for normal needs, and as an economical power stage for battery operation the QP.240 can be confidently recommended. Its price is 19s. 6d.

BOOK REVIEW

Loud Speakers; Theory, Performance, Testing and Design. By N. W. McLachlan, D.Sc., M.I.E.E. Pp. 399+xii. 165 diagrams. Published by Oxford University Press, Warwick Square, London, E.C.4. Price 40s.

Much of the author's work, particularly upon the moving-coil speaker, is well known to readers of *The Wireless World*. In this volume the problems of the reproduction of sound are comprehensively treated from both the theoretical and practical points of view. Approximately the first half of the book is devoted to the fundamental acoustic and mechanical principles involved. The treatment is good. The necessary analysis is set out with the practical object always in view, with the result that, even when the mathematics concerned goes beyond the powers of the more elementary reader, there is little difficulty in gathering the argument between the lines. Typical problems treated are the propagation of sound in free air, the mechanical and electrical relationships existing between the parts of the reproducing system, the theory of the electrostatic speaker, propagation of sound down a horn. The principles deduced are applied to the practical problems of design.

The second half of the book is essentially practical, dealing in detail with the action and design of the various types of speaker. Their faults, virtues, and particular applicability are treated at length. Tables of experimental data necessary in design work are given, and practical designs for speakers for both domestic and public address purposes are worked out. It is difficult to imagine a question of practical importance in sound reproduction which has escaped the author's consideration.

A very complete list of references completes the volume. This is the first comprehensive treatise on loud speakers which has been published, and it fills a gap in our technical literature with distinction. The printers and publishers have ably contributed their share to a worthy production.

A. G. W.

Catalogues Received.

W. Andrew Bryce and Co., Woodfield Works, Bury, Lancashire.—Peak condensers and connector blocks.

Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2.—Needle armature pick-up and tone arm.

Grosvenor Electric Batteries, Ltd., 2-3, White Street, Moorgate, London, E.C.2.—H.T. and L.T. accumulators.

The Art of Ganging

II.—Common Difficulties

ALTHOUGH the adjustments necessary for the attainment of accurate ganging in a straight set are by no means difficult, there is a number of faults which may easily occur unless care be taken in both the design and the construction of the receiver. Such faults are dealt with in this article, and it is pointed out that the use of unsuitable materials may greatly affect the performance of a set.

THE previous article in this series dealt with the theoretical considerations underlying the design of a ganged receiver and indicated the process necessary for the adjustment of the ganging. It was pointed out that good results are an impossibility with a single set of trimmers unless the tapping points of coils, or the transformer ratios, are so adjusted that the stray capacities remain constant on both wavebands. If the stray capacities are relatively different on one waveband from those on the other, it is essential to provide additional trimmers—one set for each waveband. It is, therefore, the usual practice to employ carefully tapped coils, even although this course may involve extra switching.

Where for any reason such switching cannot be used, a separate set of trimming condensers should be provided, and this course is actually adopted in a few commercial receivers. Ganging then involves the adjustment of the usual trimmers on the medium waveband in the manner already described, and afterwards the adjustment of the additional long wave trimmers. This is carried out exactly as for the medium waveband, but on a station at the lower end of the long waveband. Any re-adjustment to the medium waveband trimmers will usually necessitate re-ganging the long wave circuits, but much depends upon the precise arrangement of the circuit.

With very few exceptions, however, only one set of trimmers is included, for only one set is necessary with the normal arrangement of the circuit; and it will be apparent that once the correct ganging has been achieved on the medium waveband, no further adjustments are required. This is true insofar as ganging itself is concerned, but it may happen that considerations of the wavelength range necessitate alterations. As already pointed out, the frequency or wavelength to which a circuit is tuned depends upon the product of the inductance and capacity comprising that circuit. Tuning is carried out by varying the capacity of the variable condenser, but as we have already seen, this does not represent the total circuit capacity, for the stray capacities have to be taken into account. At any dial setting the total capacity is the sum of the stray capacity and the condenser capacity at that dial setting. The total ratio of minimum to maximum capacity of the variable condenser is fixed by its design, but the effective ratio when in circuit depends upon the stray capacity, and it will be obvious that the larger this capacity the smaller will be the ratio of effective minimum to maximum capacity. Since the ratio of minimum to maximum wavelength depends upon this capacity ratio, a decrease in the one will reduce the other, and we find that a high stray capacity restricts the tuning range of a receiver.

In the early stages of a superheterodyne screened anode leads may be used to prevent direct pick-up of signals as well as to avoid instability

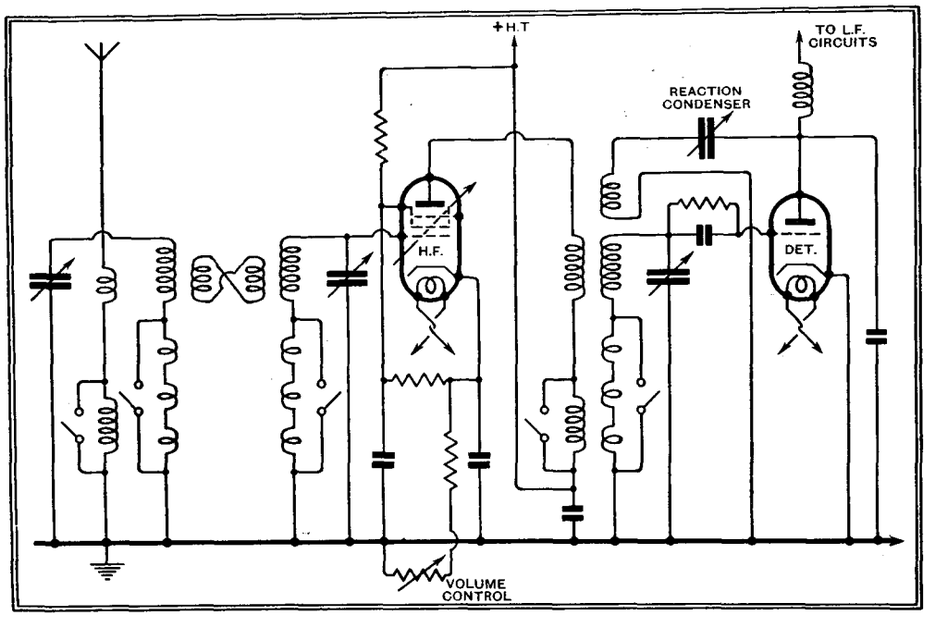


Fig. 1.—This typical circuit of the H.F. and detector stages of a straight set is repeated from last week's issue for convenience of reference.

It will usually happen that with present day tuning coils and condensers, and with normal values of stray capacities, correct ganging can be obtained with a tuning range of 200-550 metres (1,500-550 kc/s) for the medium waveband. Although many would like a wider tuning range, this leads to a surprising number of difficulties. The use of a larger capacity tuning condenser proves inefficient, so that a wider range can only be secured by increasing the coil inductance, and reducing the stray capacities. There are very definite limits to what may be done in this respect, and it is all too common to fail to secure the 200-550 metres coverage without thinking of an attempt at a wider range.

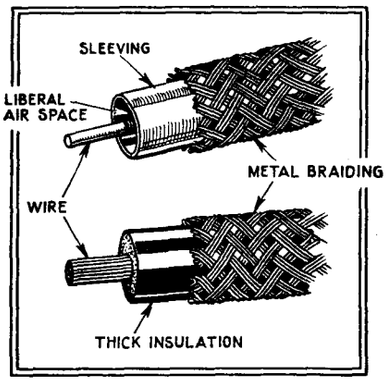
Stray Capacities

Since the trimmers employed for ganging merely add capacity to the tuned circuits, it is easy to see that their improper use will restrict the tuning range and make it impossible to receive stations below, perhaps, 220 metres. If this effect be found in a properly designed and built receiver it is a sign that it has been ganged with too much capacity in all the trimmers. The capacity of each trimmer should be reduced by the same amount,

The Art of Ganging—

therefore, until the receiver will tune down to 200 metres. This does not necessarily mean, however, that each trimmer must be unscrewed by the same amount, for the rate of change of capacity of condensers of this type varies according to their exact settings. The best procedure, therefore, is to unscrew each trimmer slightly, and to re-gang in the usual way. This process should be carried out until one trimmer is very nearly, but not quite, at its minimum capacity, and it should then be found that the correct tuning range has been secured.

The process of ganging a straight set has now been fully described, and there is little more which can be added dealing with ganging proper. Before concluding this section, however, some notes on troubles which experience has shown to occur at times may prove helpful. Probably the most usual defect is the failure to obtain the full tuning range, even with the trimmers correctly adjusted so that one of them is practically at minimum. The lowest wavelength to which the set will tune may be 220 metres instead of



The upper drawing shows the construction of a good type of screened sleeving, while the lower illustrates the construction of a high-capacity type which is unsuitable for H.F. circuits.

the correct 200 metres. Provided that the coils have the correct inductance values, which will usually be the case, this condition is brought about by an excessive stray capacity in one or more of the circuits, the capacity of that circuit which requires the least trimmer capacity being the highest.

It is not always realised how easily it is possible for the stray capacities to be too high if care is not exercised in the construction of a receiver. An example may bring this home most forcibly. Referring to Fig. 1, the intervalve tuning coil will have an inductance of 157 mH., and the stray capacities estimated on the basis of careful design reach the figure of 70 mmfds. Now the capacity required to tune a coil of this inductance to resonance at 200 metres or 1,500 kc/s is 71.94 mmfds.; this is only 1.94 mmfds. more than the stray capacity, and represents the amount of capacity which must be introduced by the trimmer in this circuit. A capacity of this order, however, is extremely small and might easily be exceeded by a wire running for a short distance close to a metal chassis. The use of a screened anode lead to the H.F. valve would certainly introduce excessive capacity, as would also the addition of a radio-gramophone switch in the detector grid circuit.

In connection with this, it should be remembered that when circuits are connected to the coil by tapping points the effective stray capacity is reduced by the square of the turns ratio, so that the situation is greatly relieved. It is increasingly becoming the practice to use such tapping points for the connection to the anode of the H.F. valve, and often for the detector also, in order to minimise damping and obtain the maximum selectivity. It then becomes permissible to use screened anode leads for valves and to fit a radio-gramophone switch without running into any difficulties through excessive values of stray capacity. It should be pointed out, however, that if the materials employed are of the incorrect type, the stray capacities may reach enormous values, even when the coils are tapped.

The correct type of screened wire for practically all radio purposes consists of a length of large diameter sleeving covered with metal braiding. The internal wire must be much smaller in diameter than the sleeving so that the spacing from the braiding is large, and, moreover, chiefly by air. In general, the internal wire should be as thin as possible consistent with mechanical strength. By adopting these precautions the capacity introduced by the screening can be kept as low as 5 mmfds. per foot length. Many other types of screened lead are available, however, which may lead to serious difficulty with ganging. It is safe to say that any material which is fitted by its makers with an internal lead is unsuitable, unless the internal wire is largely air spaced from the insulating material. *Rubber-covered metal-braided leads or motor-car type armoured cable must never be used.* The true distinction between the different types of material is probably best expressed by saying that screened sleeving is satisfactory while complete screened cable is not.

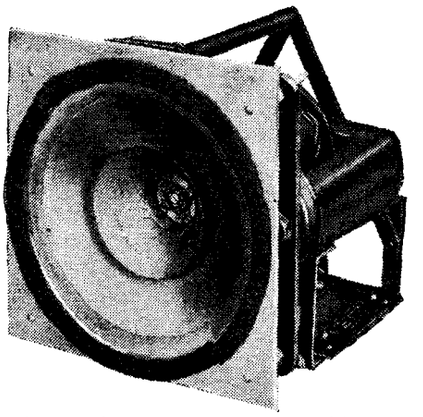
Voigt Twin Diaphragm Speaker

A FULL description of the standard Voigt moving-coil unit and "Tractrix" horn baffle appeared in our issue of September 29th, 1933. Since that date a new type of diaphragm has been developed which may be fitted as an alternative at an extra cost of 10s. It consists of two cones cemented at the apex to the moving coil, the object of the smaller cone being to strengthen the upper register above 4,000 cycles.

On a frequency test the output from the new unit, judged aurally, showed no sign of falling off until 8,500 was reached, while a really useful response was obtained up to 12,000 cycles. The earlier unit gave excellent results, but the new diaphragm gives an improvement in the realism of reproduction which is readily appreciated provided the microphones used in the transmission are of sufficiently high quality.

The twin diaphragm unit maintains the high electro-acoustic efficiency of the previous model.

Although with a 4-foot mouth horn there is attenuation of frequencies below about 70



Voigt moving-coil loud speaker with new twin diaphragm. The unit is designed for use with a horn baffle.

cycles, this is not noticeable in the general effect, and at least as far as transient response is concerned the results have not been surpassed in any reproducer we have so far tested.

The makers are Voigt Patents, Ltd., The Courts, Silverdale, London, S.E.26.

The Radio Industry

SEVERAL new valves have been added to the Ostar-Ganz high-voltage series, including a pentagrid converter, H.F. pentodes (both plain and variable-mu), a high-power output pentode, a double diode, and a double rectifier with two heaters, two cathodes, and two anodes in one envelope. This latter valve is, of course, suitable for voltage-doubling circuits, and is especially valuable for this purpose when used on low-voltage supplies.

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Claude Lyons, Ltd., send us a leaflet describing an interesting new type of direct-reading impedance bridge. The instrument measures capacity, resistance and inductance values up to 100 mfds., 1 megohm, and 100 henrys respectively.

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The new Marconi and Osram HD.21 is a battery-fed double-diode-triode, in which two separate filaments are used, one being purely for the diode section of the valve. It is to be expected that this construction will give higher efficiency than usual in the triode section.

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The Radcar A.C. battery charger, designed to deal with 2-, 6-, and 12-volt batteries (radio or car), is described in a leaflet received from Cranley Radio, Ltd., 32, Craven Park Road, Harlesden, London, N.W.10.

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Since the Mazda AC/HL.DDD valve was described in this journal, it has been fitted with a 9-pin base, the connections being as follows:—

Pin	No. 1	Diode No. 2
,,	No. 2	Diode No. 3
,,	No. 3	——
,,	No. 4 and 5	Heaters
,,	No. 6	Cathode
,,	No. 7	Anode
,,	No. 8	Diode No. 1
,,	No. 9.	Metal Coating
Top Cap		Control Grid

◈ ◈ ◈ ◈

The Franchi Endura Company, Ltd., manufacturers of radio cabinets, etc., of Endura Works, Abbey Road, Park Royal, London, N.W.10, will in future be known as the Freestone Endura Company, Ltd.

Practical Hints and Tips

Aids to Better Reception

IT is rather annoying to find that, even if one has a good voltmeter, accurate measurement of grid bias voltage is usually impossible. Of course, with a battery receiver one can easily obtain an indirect, but sufficiently convincing, indication of the actual voltage applied to the grid by taking a measurement across the battery tappings employed, and then assuring oneself that continuity exists between the negative terminal and the grid. But when dealing with a mains set, or even with a battery set fitted with automatic bias, the readings of the meter cannot be depended upon.

Grid Bias Measurements

For the sake of illustration, let us take the typical circuit shown in Fig. 1 (*a*). Note that the voltmeter should be joined between the grid and cathode of the valve; one is sometimes inclined to connect the test leads between grid and earth line, but consideration of the circuit will show that no voltage should exist between these points. With the meter connected as shown it will (subject to the usual error) measure the voltage developed across the bias resistance, but unfortunately the resistance of the transformer secondary will be in series with it. This resistance, which may amount to as much as several thousand ohms, is unfortunately by no means negligible in many cases; when using a low-resistance meter the voltage shown may be appreciably less than that actually existing.

The same applies to the resistance-coupled circuit shown in diagram (*c*), when the meter is connected in position X. Here the instrument is in series with the grid leak, of which the resistance is likely to be considerably greater than the meter resistance. In such cases it is better to connect the meter in position Y, and then by a continuity test to assure oneself that the bias voltage developed across these points is actually reaching the grid.

AS a very small clearance is generally given between the moving coil of a loud speaker and the walls of the magnet gap in which it works, there is a risk that the coil may ultimately become so much out of centre that it will touch the metal.

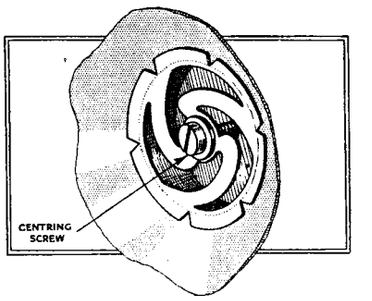
Centring the Moving Coil

This may happen as a result of warping of the cone or of the coil former, perhaps through changes in atmospheric conditions.

The slightest amount of rubbing will produce serious distortion, which fortunately is quite easy to recognise. As a general rule the best plan is to return an instrument suffering from this trouble to its manufacturers for repair; the operation of recentring is quite a delicate one, which requires a good deal of experience.

But when the owner cannot avail himself of the manufacturer's services it is unlikely that he will at any rate make things much worse if he tries to do the job himself. In almost every case the centring of the coil-cone assembly is carried out in a very simple way by means of a flexible "spider" of thick paper, as shown in the accompanying sketch. The centre of the spider, in which a slightly over-sized hole is cut, is fixed to the magnet pin by means of a screw. To recentre the coil, this screw must be slacked off, when the coil may be moved in the necessary direction to centre it in the gap.

The operation is best carried out when listening to signals, and preferably to a steady note at constant pitch. The suggestion has already been made in these columns that an artificial signal obtained by applying some 10 volts or so of alternating current to the transformer primary is the best to use when adjusting a loud speaker.



The normal method of centring a moving coil.

IF great care be taken, it is possible to match a set of screened coils before actually mounting them in their "cans." But it is rather risky to do so; matching will only hold good in the screened condition if all the windings are of equal size physically, all screening cases of the same dimensions, and all coils symmetrically and uniformly mounted inside their screens.

Coil Screens and Matching

In practice it is usually found that more or less serious discrepancies are liable to creep in when this procedure is followed. It is therefore better, before tackling the operation of matching (or of testing the matching of ready-made coils), to mount all the windings rigidly in the screening cases in which they will ultimately be housed.

THE effect of operating the type of volume control which functions by varying grid bias is to reduce the total anode current of the receiver, and thus, in the case of a mains set, to increase H.T. voltage. Accordingly, when checking anode voltages the volume control should always be in the same position—preferably at "maximum."

H.T. Voltage Measurements

The same principle should be applied to sets with automatic volume control, although here the manual control may have no effect on current consumption. It is a fact, however, that an incoming signal may have a considerable effect, and accordingly the measurement should be made either when no carrier wave is being received, or, to be on the safe side, with the aerial disconnected.

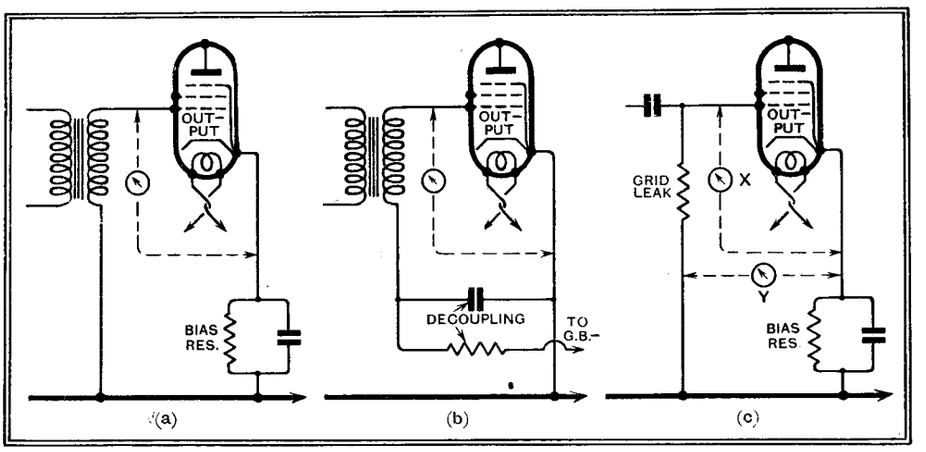


Fig. 1.—Illustrating the possibilities of error when making direct measurements of automatic bias voltage.

News of the Week

Current Events in Brief Review

Bordeaux to New Zealand

MR. A. E. SHORTT, of the New Zealand DX Club, has reported reception of the Bordeaux Sud-Ouest station, which he heard on March 23rd on 201.1 metres.

Another "People's Set"

DENMARK is to introduce a "People's Receiver" on the lines of the well-known "Volksempfanger" of Germany, a mass-produced foolproof receiver guaranteeing reception of the local programmes.

Short Waves from the Atlantic

EIGHTEEN young Americans are about to start on a seven-months' cruise of the South Atlantic on their yacht "Buccaneer," taking with them a short-wave transmitter. The call sign is WCFZ. The transmissions are to be made nightly on 8,300 kc/s.

Hidden Transmitter Hunt

A HUNT for a hidden transmitter will take place in Hertfordshire on Sunday next, May 27th, when the Golders Green and Hendon Radio Scientific Society will be conducting the annual direction-finding competition in the neighbourhood of St. Albans, Rickmansworth and Kings Langley. The transmitter will operate on 150 metres, and six prizes are offered to groups successful in tracking the station.

International Congress on Radio-Biology

MARCHESE MARCONI will preside jointly with Count Giuseppe Volpi di Misurato over the first International Congress on Electro-Radio-Biology, to be held from September 10th to the 15th next in the Doges Palace, Venice.

Research workers from all over the world are to take part in the discussions on the biological uses of high-frequency radiations.

The General Secretary of the Congress is Dr. Giocondo Protti, S. Gregorio 173, Venice.

"Broadcasting House" of the Air

BROADCAST reception and talkie shows are to be available to the 120 passengers on Russia's new airship, the "Maxim Gorki," said to be the greatest airship in the world. There will be two radio transmitters, one for short waves and one covering the medium waveband. In the transmitting cabin there will be a high-power amplifier with loud speakers audible over a radius of twelve miles. A broadcasting studio will also be included, and there will be all necessary provision, we learn, for the efficient installation of television.

The first trials of the "Maxim Gorki" are to take place in a few days.

A Necessity

YUGO-SLAVIA shares the German view that a wireless set is a necessity, not a luxury, for Belgrade High Court has pronounced judgment affirming that a bankrupt's broadcast receiver may not be seized in payment of debts.

A Faked Broadcast

A FAKED broadcast was conducted by members of the Bradford Experimental Radio Society at their last meeting, microphones, amplifiers, and loud speakers providing an excellent illusion. Various members supplied musical items, while "Tuner," of the *Yorkshire Observer*, gave impressions of local amateurs when "on the air."

Microphone in Grave

MR. O. H. CALDWELL, former member of the U.S. Federal Radio Commission, recently reported a case of an American citizen who, fearing premature burial, has made arrangements with his undertaker that his coffin shall be equipped with a microphone connected with loud speakers in the dwelling of the cemetery caretaker. The microphone is to be kept in circuit for a year, and periodically checked by the sounding of a small bell in the coffin.

New Interval Signals

NEW interval signals have been chosen for all the Czechoslovakian broadcasting stations. The new Prague interval signal will be the harp theme from the symphonic poem "Vysehard" by Smetana. Bratislava will use a chime version of the song "Hejslovaci"; Kosice a wind instrument rendering of "Hej-Hore-Haij," and Moravská-Ostrava the song "Pilek" by Janacek.

Listener-Controlled Broadcasting

OF Denmark's half million radio licence listeners, nearly 207,000 belong to various listening organisations, who are thus able to exercise control in the choice of programmes.

Radio Palace for Moscow

A TWENTY-TWO-STOREY Radio House is under erection in Moscow, according to the *Manchester Guardian*. It will be equipped with a theatre, seating 2,000 persons, and twenty-nine studios designed for all types of broadcast programme.

British "O.B." from Denmark

A DANISH broadcast of special interest to British listeners will take place on Thursday next, May 31st, between 4.45 and 5.30 p.m., when a commentator will give a microphone description of a visit to the new rail and road bridge between Sealand and Lolland. The constructors are the British firm of Dorman Long and Co., and it is expected that an English engineer will broadcast some remarks during the afternoon.

OLD AND NEW. "Snapped" in the Tungsram valve factory, Budapest. The young girl, who is dressed in the traditional Hungarian peasant garb, is testing double diode-triode valves.

Praise for Pocket Wireless

"RECEPTION is very good," said Captain W. J. Hutchinson, Chief Constable of Brighton, at a Conference of Police Superintendents last week, in describing the pocket wireless system used by the local police. "Every man on the twenty-two beats is equipped with a set, and we have, in addition, four in police vehicles and four in the detective department. Home Office officials have reported that the reception is better than any they have heard in apparatus installed in cars."

Radio Feats at R.A.F. Display

EXPERT use of wireless will be required in an entirely new event—synchronised acrobatics by flights—at the R.A.F. Display at Hendon on Saturday, June 30th. The event is to be provided by No. 43 Squadron, and many complicated manœuvres will be carried out simultaneously with perfect precision and timing by the six machines engaged.

An elaborate public address system will be installed.

Equality on the Ether

FREE speech on the ether is a jealously guarded privilege in Spain, where the Under-Secretary for Home Affairs has fined the Radio-Espana Broadcasting Company 5,000 pesetas for omitting to broadcast a report of the speeches at a Monarchist banquet on Saturday, May 5th. The Company has been warned that if it again violates the Government rule that all parties must have a fair hearing, it will forfeit the right to transmit.

"Watts Up"

THIS is the title of a fascinating film included in a Gaumont-British Magazine now showing at cinemas up and down the country. The subject, which is the construction of electric lamps, is handled in an imaginative manner, allegorical personages representing Power and Light figuring in a dramatic episode which leads up to the actual manufacture of the lamps in the Ediswan factory. The film should interest both the technicians and the general public.

The Television Committee

IN the House of Commons last week Sir Kingsley Wood, the Postmaster-General, announced the *personnel* and terms of reference of the Television Committee.

The members are as follows:—

Lord Selsdon (chairman).
Sir John Cadman (vice-chairman).
Colonel A. S. Angwin, Assistant Engineer-in-Chief, G.P.O.
Mr. Noel Ashbridge, Chief Engineer, B.B.C.
Mr. O. F. Brown, Department of Scientific and Industrial Research.
Vice-Admiral Sir Charles Carpendale, Controller, B.B.C.
Mr. F. W. Phillips, Assistant Secretary, G.P.O.
Secretary, Mr. J. Varley Roberts, Telegraph and Telephone Department, G.P.O., E.C.1.

The terms of reference to the Committee are:—

To consider the development of television, and to advise the Postmaster-General on the relative merits of the several systems and on the conditions under which any public service of television should be provided.

Page 363 follows after the Programme Supplement

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Wavelength

(Stations with an aerial power of 50 kW. and above in heavy type)

Station.	kW.	kc/s.	Tuning Positions.	Metres.
Kaunas (Lithuania)	7	155		1935
Brasov (Roumania)	20	160		1875
Huizen (Holland). (*Kootwijk, 50 kW. after 3.40 p.m.*) (*V.A.R.A. and A.V.R.O. Programmes.*)	7	160		1875
Lahti (Finland)	40	166		1807
Moscow, No. 1 (U.S.S.R.)	500	174		1724
Radio Paris (France)	75	182		1648
Istanbul (Turkey)	5	185		1621
Königswusterhausen (Deutschlandsender) (Germany).	60	191		1571
Daventry National	30	200		1500
Ankara (Turkey)	7	200		1500
Minsk (U.S.S.R.)	100	208		1442
Reykjavik (Iceland)	16	208		1442
Eiffel Tower (Paris)	13	215		1395
Motala (Sweden). (*Relays Stockholm*)	30	216		1389
Warsaw, No. 1 (Poland)	120	223		1345
Luxembourg	150	230		1304
Kalundborg (Denmark). (*Relays Copenhagen*)	75	238		1261
Leningrad (U.S.S.R.)	100	245		1224
Oslo (Norway)	60	254		1181
Madona (Latvia)	20	265		1132
Moscow, No. 2 (U.S.S.R.)	100	271		1107
Budapest, No. 2 (Hungary)	0.8	360		833.4
Boden (Sweden)	0.6	387		775.2
Ostersund (Sweden)	0.6	392		765
Geneva (Switzerland). (*Relays Sottens*)	1.3	401		748
Moscow, No. 3 (U.S.S.R.)	100	401		748
Oulu (Finland)	2	431		696
Hamar (Norway)	0.7	519		578
Innsbruck (Austria). (*Relays Vienna*)	0.5	519		578
Ljubljana (Yugoslavia)	5	527		569.3
Viipuri (Finland)	13	527		569.3
Bolzano (Italy)	1	536		559.7
Wilno (Poland)	16	536		559.7
Budapest, No. 1 (Hungary)	120	546		549.5
Beromunster (Switzerland) (Schweizerischer Landessender).	60	556		539.6
Athlone (Irish Free State)	60	565		531
Palermo (Italy)	4	565		531
Mühlacker (Stuttgart) (Germany)	100	574		522.6
Riga (Latvia)	15	583		514.6
Agen (France)	0.6	583.6		514
Vienna (Bisamberg) (Austria)	120	592		506.8
Radio Maroc (Morocco). (*S.-w. Stn., 48 m.*)	6.5	601		499.2
Sundsvall (Sweden). (*Relays Stockholm*)	10	601		499.2
Florence (Italy). (*Relays Turin*)	20	610		491.8
Brussels, No. 1 (Belgium). (*French Programme.*)	15	620		483.9
Lisbon (Portugal)	20	629		476.9
Trondheim (Norway)	1.2	629		476.9
Prague, No. 1 (Czechoslovakia)	120	638		470.2
Lyons, PTT (France)	15	648		463
Langenberg (Germany)	60	658		455.9
North Regional (Slaithwaite)	50	668		449.1
Sottens (Switzerland) (Radio Suisse Romande)	25	677		443.1
Belgrade (Yugoslavia)	2.5	686		437.3
Paris, PTT (France)	7	695		431.7
Stockholm (Sweden)	55	704		426.1
Rome, No. 1. (*Short-wave station, 25.4 metres*)	50	713		420.8
Kiev (U.S.S.R.)	100	722		415.5
Tallinn (Estonia)	20	731		410.4
Seville (Spain)	1.5	731		410.4
Munich (Germany)	100	740		405.4
Marseilles, PTT (France)	5	749		400.5
Katowice (Poland)	12	758		395.8
Midland Regional (Daventry)	25	767		391.1
Toulouse, PTT (France)	2	776		386.6
Leipzig (Germany)	120	785		382.2
Barcelona, EAJ1 (Spain)	5	792		378.8
Lwow (Poland). (*Relays Warsaw*)	16	795		377.4
Scottish Regional (Falkirk)	50	804		373.1
Milan (Italy). (*Relays Turin*)	50	814		368.6
Bucharest (Roumania)	12	823		364.5
Radio, LL (Paris)	2	827		362.8
Moscow, No. 4 (U.S.S.R.)	100	832		360.6
Berlin Funkstunde. (*Short-wave Stations,*) 16.89, 19.73, 25.5, 31.38 *and* 49.83 *metres.*)	100	841		356.7
Bergen (Norway)	1	850		352.9
Valencia (Spain)	1.5	850		352.9
Strasbourg (France)	15	859		349.2
Poznan (Poland)	16	868		345.6
London Regional (Brookmans Park)	50	877		342.1
Graz (Austria). (*Relays Vienna*)	7	886		338.6
Helsinki (Finland)	10	895		335.2
Limoges, PTT (France)	0.5	895		335.2
Hamburg (Germany)	100	904		331.9
Radio Toulouse (France)	10	913		328.6
Brno (Czechoslovakia)	32	922		325.4
Brussels, No. 2. (*Flemish Programme*)	15	932		321.9
Algiers (Algeria)	12	941		318.8
Göteborg (Sweden). (*Relays Stockholm*)	10	941		318.8
Breslau (Germany)	60	950		315.8
Poste Parisien (France)	100	959		312.8
Grenoble (France)	20	968		309.9
West Regional (Washford Cross)	50	977		307.1
Cracow (Poland)	2	986		304.3
Genoa (Italy). (*Relays Turin*)	10	986		304.3
Hilversum (Holland). (*KRO and NCRV*) (*7 kW. till 5.40 p.m.*).	20	995		301.5
Bratislava (Czechoslovakia)	13.5	1004		298.8
North National (Slaithwaite)	50	1013		296.2
Parede (Portugal)	5	1031		291
Heilsberg (Germany)	60	1031		291
Rennes, PTT (France)	2.5	1040		288.5
Scottish National (Falkirk)	50	1050		285.7
Bari (Italy)	20	1059		283.3
Bordeaux-Lafayette	12	1077		278.6
Zagreb (Yugoslavia)	0.7	1082		277.2
Falun (Sweden)	2	1086		276.2
Madrid, No. 2 (EAJ7)	7	1095		274
Naples (Italy). (*Relays Rome*)	1.5	1104		271.7
Kosice (Czechoslovakia). (*Relays Prague*)	2.6	1113		269.5
Radio Vitus (Paris)	0.7	1113		269.5
Belfast	1	1122		267.4
Nyiregyhaza (Hungary)	6.2	1122		267.4
Hörby (Sweden). (*Relays Stockholm*)	10	1131		265.3
Turin, No. 1 (Italy)	7	1140		263.2
London National (Brookmans Park)	50	1149		261.1
West National (Washford Cross)	50	1149		261.1
Moravska-Ostrava (Czechoslovakia)	11.2	1158		259.1
Monte Ceneri (Switzerland)	15	1167		257.1
Copenhagen (Denmark). (*S.-w. Stn., 31.51 m.*)	10	1176		255.1
Frankfurt (Germany)	17	1195		251
Trier, Cassel, Freiburg-im-Breisgau and Kaiserslautern.	—	1195		251
Prague, No. 2 (Czechoslovakia)	5	1204		249.2
Lille, PTT (France)	5	1213		247.3
Trieste (Italy). (*Relays Turin*)	10	1222		245.5
Gleiwitz (Germany). (*Relays Breslau*)	5	1231		243.7
Cork (Irish Free State)	1	1240		241.9
Juan-les-Pins (France)	2	1249		240.2
Rome, No. 3 (Italy)	1	1258		238.5
San Sebastian (Spain)	3	1258		238.5
Nürnberg and Augsburg (Germany)	2	1267		236.8
Bodö, Stavanger and Kristiansand (Norway)	0.5	1276		235.1
Dresden (Germany)	1.5	1280		234.3
Aberdeen	1	1285		233.5
Linz, Klagenfurt and Salzburg (Austria)	0.5	1294		231.8
Danzig. (*Relays Heilsberg*)	0.5	1303		230.2
Swedish Relay Stations	0.25	1312		228.7
Magyarovar (Hungary)	1.25	1318.5		227.6
Hanover, Bremen, Flensburg, Stettin and Magdeburg.	1.5	1330		225.6
Lodz (Poland)	1.7	1338		224.2
Montpellier, PTT (France)	5	1339		224
Dublin	1	1348		222.6
Milan, No. 2 (Italy)	4	1348		222.6
Königsberg (Germany)	0.5	1348		222.6
Turin, No. 2	0.2	1357		221.1
Warsaw, No. 2 (Poland)	2	1384		216.8
Lyons (Radio Lyon) (France)	5	1393		215.4
Tampere (Finland)	1.2	1420		211.3
Newcastle	1	1429		209.9
Béziers (France)	2	1432.5		209.4
Miskolc (Hungary)	1.25	1438		208.6
Fécamp (Radio Normandie)	10	1456		206
Pecs (Hungary)	1.25	1465.8		204.7
Bournemouth	1	1474		203.5
Plymouth	0.3	1474		203.5
Bordeaux Sud-Ouest (France)	1	1492		201.1
Nimes (France)	0.2	1492		201.1

The Diary of an Ordinary Listener

FOR me the last fortnight began badly, as horrible sounds, resembling the stentorian cracklings of celestial machine-gun firing, made distant stations painful to listen to. Finding that my neighbour had not experienced similar trouble, I eventually traced the cause to a faulty lamp socket.

Soon afterwards, in searching around the stations, I struck an ultra-modern pianoforte solo from a station I was unable to identify. It brought back vivid memories of the days of my boyhood when I was soundly smacked for thumping and kicking the piano on being set down to practise scales and exercises. My parents did not recognise the noise as the outpourings of budding genius.

Operatic Impressions

A good performance of "Lohengrin" was relayed from the Royal Opera House at Stockholm. I tuned in to hear the connubial wranglings of Elsa and Lohengrin in Act II when she complains that he has married her under an assumed name, and he further enflames her natural curiosity anent his mysterious past by vehement outpourings of high-falutin' priggishness—always, to me, an irritating scene. The singing, however, left little to be desired as the Lohengrin did not force his top notes in the way so common with Wagnerian tenors, a fault mainly attributable to the merciless demands of the composer.

Speaking in an operatic sense, Thursday, May 10th, might be described as a diabolical evening as we had an excellent performance from Toulouse of Berlioz' "Damnation of Faust," while Boito's "Mefistofele" was given at the Scala, Milan, and relayed from Rome and Turin. I was particularly interested in the former as I had not heard it in its entirety since the bygone days when it was done by an amateur philharmonic society, of which I was an unworthy member. I sought in vain for my dilapidated copy of the vocal score so that I might follow the music better, but that, unfortunately, had apparently been sacrificed during one of those Saturnalian orgies known as "spring-cleaning." If I can trust my memory cuts were somewhat too frequent.

On Sunday, May 13th, the Berlin Station Orchestra, conducted by Steiner, gave a pleasing orchestral concert, including Haydn's "Children's Symphony" and an air from Humperdinck's "Hansel and Gretel," while Rome transmitted an excellent programme by the orchestra of the Teatro Eleanora Duse at Bologna, which included Beethoven's "Egmont" overture, Debussy's "L'Après-midi d'un Faune," the ever-popular "Forest Murmurs" from Siegfried, and the "Ride of the Valkyries." Juan les Pins gave us lighter fare in an entertaining programme of vaudeville. The French seem to have the art of imparting an unusual amount of light-hearted gaiety into their low comedy performances; it may be "tripe," but it is certainly well-cooked and most palatable "tripe."

Milan, Turin and Rome transmitted a pianoforte recital on Monday evening by Rosenthal, which included Chopin's Concerto in E minor, played, of course, with the orchestra, music by Schumann and Schubert and the soloist's own composition "Butterflies." After this I tuned in to Radio Paris and was greatly entertained with Boieldieu's Operetta "La Dame Blanche." This began, I thought, rather uninterestingly, but warmed up as it progressed, until at the close it became musically quite thrilling, especially when the whole company of singers joined forces in developing a spirited chorus on the theme of "Robin Adair," in which some of the voices sang a most effective descant to the groundwork of the well-known air.

On Tuesday Verdi's "Rigoletto" was transmitted from Rome and Milan, but I found that Rome was unusually affected by fading and turned instead to the programme of light music from Fecamp. CALIBAN.

Manchester Amateur Club's Interesting Programme

Visits to Barton Airport and the B.B.C.'s North Regional transmitter at Moorside Edge, and also a field-day in July and August, figure on the programme of the Manchester Chapter of the International Short Wave Club. At the last meeting Mr. G. V. Colle, of Messrs. Ward and Goldstone, Ltd., dealt interestingly with short wave problems and the use of various forms of A.V.C. The next meeting will be held on Tuesday, June 5th, at 8 p.m., at the "Clarion Café," 50a, Market Street, Manchester.

Wireless World readers are invited to apply for full information to the Hon. Secretary, Mr. R. Lawton, 10, Dalton Avenue, Thatch Leach Lane, Whitefield, nr. Manchester.

BROADCAST BREVITIES

By Our Special Correspondent

Trouble Over a Relay

A STORM is still raging at Broadcasting House on the question of balance and control during the Command Performance of the B.B.C. Dance Orchestra at the Palladium, and it would not surprise me if drastic disciplinary action were taken. Henry Hall is keenly aware of the undoubted failure to give listeners a fair impression of what was, to the audience at the Palladium, an excellent performance.

A Wrong Impression

People may ask why so much fuss is made over a programme broadcast three weeks ago, but the affair is serious because of the possible mishandling of future relays.

Apart from Radiolympia, this was the first public appearance of the band, and the opinions I have heard from listeners are unanimous in suggesting that the B.B.C. Dance Orchestra is still "in the raw" and always likely to be overcome with stage fright on an important occasion.

A Change of Staff ?

I do not agree with this view, for it was generally admitted that the relay of Henry Hall and his Orchestra from Radiolympia last year revealed a splendid musical combination. Consequently, one is led to assume that the officials responsible for balance and control on that occasion were not the same as those in charge at the Palladium on May 1st.

Readers would be interested to hear a repetition of the Command programme in the studio, followed by the electrical recording that was made at the time. I could guarantee that their attitude would be one of amazement.

Electrical Recordings : An Infallible Check

Not only dance band leaders but orchestral conductors should make more use of the electrical recordings. I believe it would be an illuminating experience for Dr. Boult and other eminent wielders of the *bâton* if they were to listen to the electrical recording on the morning after the night before.

So far as I know there is at present no such check. Broadcast musicians' faith in the Balance and Control section is one of the most beautiful things at Portland Place.

This Regional Scheme

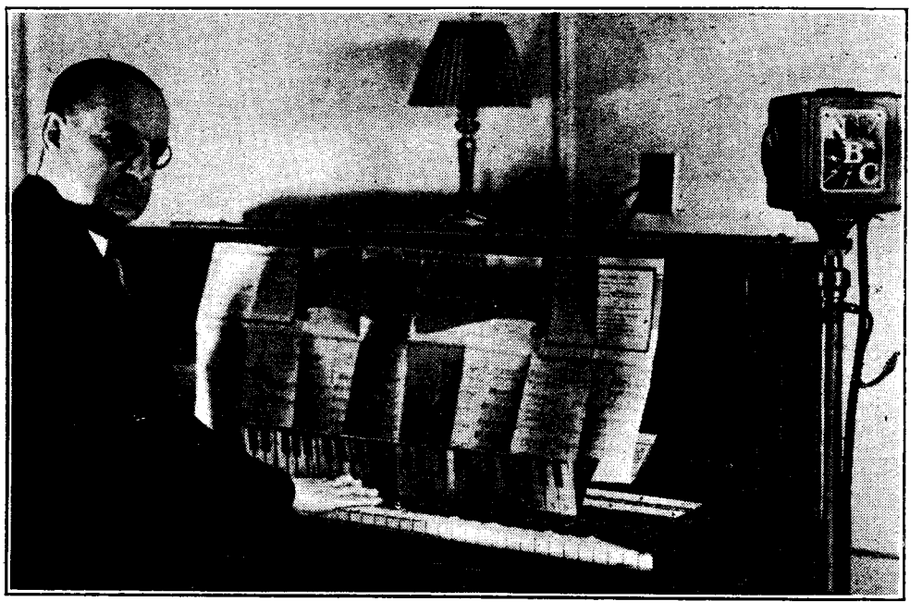
AFTER Droitwich, North Scottish Regional. Construction of the latter will take eighteen months. Then a start will be made on Belfast, which may be completed a year afterwards; then the Newcastle Regional will be begun.

At this rate there is no prospect of the Regional scheme being completed before July, 1938!

If you mention the possible non-renewal of the B.B.C. Charter in 1937 the B.B.C. engineers are not amused.

It May Be For Ever . . .

It looks as if the construction of B.B.C. stations will go on for ever, like the painting of the Forth Bridge. A vast station rebuilding scheme is even now being considered, and may start five years hence in order to bring the transmitters up to date for the demands of television, which should then have become a practical proposition.



PIANOFORTE TEACHING BY WIRELESS. This is how the American National Broadcasting Company furthers the art of pianoforte playing. The listener attaches the "Keys to Happiness" chart to his pianoforte ; the professor at the microphone does the rest.

Still Experimenting

The completion of the Regional scheme will have filled the "First Ten Years," and the rebuilding scheme should keep the B.B.C. engineers busy for the second decade of the Corporation's Charter. One supposes that the first ten years must be regarded as the experimental period and the second ten years as the consolidation period.

Empire Views on the B.B.C.

After that—but the mind reels at the thought. Shall we have a broadcast dictatorship with Sir John Reith at the helm? (People actually *do* think along these lines at Broadcasting House!) Whatever happens, a lot will depend upon the attitude of the Empire broadcasting organisations. At present their attitude to the B.B.C. is anything but complimentary, the feeling being that nothing that Daventry short-wave has yet offered has justified a cessation of the local programmes in favour of those from the Mother Country. Sir John Reith may dream of a British Empire Broadcasting Corporation, but I do not think it will materialise.

A Band of Veterans

THE Wireless Military Band, who spend practically every Sunday in the studio, besides appearing in the programmes on most week-days, will attain their tenth anniversary in July. Few changes have taken place in the constitution of the band; but the B.B.C. did draw upon them when the B.B.C. Symphony Orchestra was formed, and transferred some of the players to the latter body. The Wireless Military Band is now the oldest music combination in the service of the B.B.C., being known originally as the 2LO Military Band. They have had as conductor, since early in 1927, Bertram Walton O'Donnell, who spent ten years at the Royal Academy of Music as 'cellist, pianist and composer, and afterwards became conductor of the Royal Marines Band at Deal. Mr. O'Donnell is Professor of Military Music at the R.A.M.

A Clue to the Mystery

ASTUTE listeners may spot the solution to J. C. Cannell's mystery play, "At the Sign of the Rainbow," to be broadcast from Midland Regional on June 8th. The play concerns stolen goods and a woman crime reporter's efforts to find them. A clue to their whereabouts is conveyed in a curious way, and listeners who can think quickly may anticipate the conclusion of this thriller. The scenes are a newspaper office, a night club and a prison.

A New Air Service

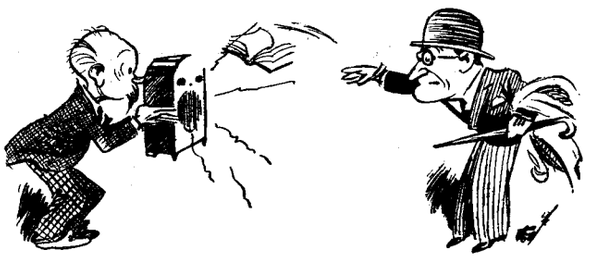
A RUNNING commentary on the arrival of the aeroplane inaugurating the service between Holland and the North of England will be relayed in the North Regional programme from Hedon Airport, Hull, on May 31st. The 'plane—a Dutch Fokker monoplane with a cruising speed of well over a hundred miles an hour—is expected to arrive at Hull about two hours after its departure from Amsterdam.

Cricket Commentaries for India

HOWARD MARSHALL, who is to give eye-witness accounts of the Test Matches, is arranging to give special ball-by-ball commentaries for Indian listeners, *via* the Daventry No. 3 transmitter. These chats, which will not be heard by listeners in this country, will go out at 1 p.m. daily.

Rhythm

ONE of the queerest auditions at Broadcasting House was given last week to a gentleman who arrived with a big drum decked with such domestic utensils as tea pots, kettles, and saucepans. His aim, he explained, was not melody but rhythm, and, with a pianoforte accompaniment, he proceeded to turn theory into practice. Visually he produced quite an effect, but the officials feared that listeners would miss most of the fun. However, the artiste has been promised another audition if he can make his pots and pans produce a melody.



"Surely it was Summer Time 1914?"

UNBIASED

By

FREE GRID

Scrap the Scrapbook

THERE has always been great controversy whether the primary purpose of the B.B.C. is to instruct or to amuse us, but I must confess that until the broadcasting of "A Scrapbook of 1914" a week or two ago I had never given much thought to the matter.

At the end of this entertainment I was completely bewildered. Most of it turned out to be an elaborate burlesque, and while, of course, it was amusing, as all burlesques are, it was, I think, highly dangerous because no indication was given whereby the modern schoolboy could distinguish fact from fiction, and he might, therefore, suffer in his historical studies through no fault of his own.

After all, the essence of successful historical studies is accuracy, and it seems a pity, therefore, to inform listeners that our ultimatum to Germany expired at midnight on August 4, 1914. True, if we regard things from the Teutonic point of view and make use of Central European time, then midnight it was. That there can have been no such thought in the mind of the compiler of this scrapbook is, however, amply proved by the solemn striking of twelve by Big Ben to usher in the war. Even the ill-informed plea that "surely it was Summer Time in August, 1914," uttered by a member of my family, who is an ardent Bebeseophile, cannot be allowed to stand.

But this was not all. We were given a personal memoir by one who was an eye-witness of the scene in the House of Commons on that memorable night when the members were gathered together to hear a statement concerning the Irish question, and heard instead something far more momentous. This night, we were told, was that of Friday, July 30. Even I would scarcely doubt the word of an eye-witness, but, alas, my old diary tells me that in 1914 such a day and date did not coincide.

To make quite sure that I had heard aright, I listened carefully two nights later, when the programme was repeated, and heard the same inaccuracies perpetuated.

Surely, if the B.B.C. can censor the talks they can do likewise with the efforts of people who would broadcast historical inaccuracies.

Sound or Unsound?

A WELL-KNOWN radio engineer has drawn my attention to a report published on page 312 of the May 4 issue of *The Wireless World* to the effect that for the past half-century the musical services in the Brompton Oratory have suffered owing to the fact that a chord struck by the organist takes four seconds to reach the choir.

As he rightly remarks, all respectable text-books give the speed of sound as approximately "1,100 feet per second, and at this rate the Brompton Oratory must be nearly a mile long." At his suggestion I immediately investigated this state of affairs, and, as a result, am happy to absolve *The Wireless World* from any stigma of inaccuracy.

The whole affair is, according to what I have been told by an eminent engineer, due to echoes which act in the same manner in air as old man Heaviside does in etheric realms. Just as phase-fading results from the direct ray and indirect ray —or two or more indirect rays—arriving at our aerials sometimes properly in phase with each other, sometimes partially out of step, and sometimes in complete opposition to each other, so also is this sound lag brought about by similar interaction with the direct sound and the various echoes.

According to my informant, an echo may penetrate the subsoil of a choirboy's ear simultaneously with the direct sound, and completely cancel it out owing to its being completely out of phase. Finally, some echo which has spent several seconds bouncing about the auditorium may triumphantly reach its objective long after the organist has given up hoping.

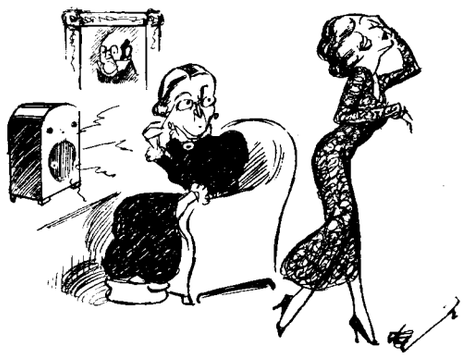
After the organist has given up hoping.

At first I was rather impressed by the earnestness of my informant, but my suspicions were aroused by his evident desire to gloss lightly over my further enquiries, and impress upon me the enormous importance of the fact that over two miles of special cable were used in the wiring up. It must, indeed, have been very special.

A Pernicious Influence

DURING the past twenty or thirty years most of us have got used to the delinquencies of small boys being put down to the pernicious example of "the pictures."

Everything from murder to petty gluttony has been blamed on to the long-suffering cinema, but I little thought that I should ever live to see the day when the same things would be attributed to the wireless.

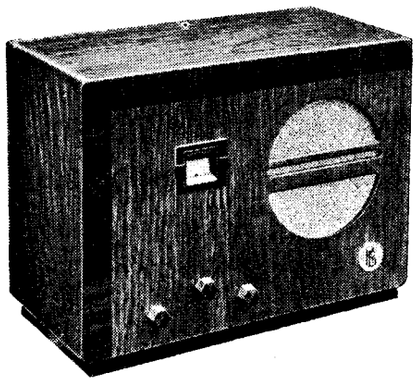


Why girls leave home.

Only recently a case of this kind was brought to me for treatment by a good mother under the mistaken idea that, since I occasionally prescribe for the maladies of friends' sets, I could do likewise for *Mordax cimicis lectularii radionis*, which, according to her own diagnosis, had affected her son.

It appeared that, apart from minor shortcomings, the lad had developed the unfortunate habit of leaving his school without any apparent reason. As the result of cross-examination, it had been decided that "the wireless" was to blame, and I was to see what could be done about it. I can well understand that the proper answer to the old question "Why do girls leave home?" may be "Because of the B.B.C. programmes," but frankly I cannot understand the modern boy being troubled by even the most persistent of chamber concerts since, even with a humble one-valve set, he has the whole Continent at his feet. It seems, however, that it was not the programmes so much as the persistent desire for pursuing his hobby of home construction which led to this particular boy's outbreaks.

I have now been definitely saddled with the case, and unless my readers can assist, I stand in grave danger of losing my hard-won reputation for resourcefulness.



Kolster-Brandes Superhet

MODEL K.B.444

A Three-valve Circuit with Combined Volume and Tone Control

FEATURES

Type. *—Table-model superheterodyne for A.C. mains.* ***Circuit.*** *—H.F. pentode frequency changer—tuned I.F. transformer with reaction—H.F. pentode first detector—power pentode output valve. Full-wave valve rectifier.* ***Main Controls.*** *—(1) Tuning. (2) Volume control and on-off switch. (3) Waverange switch.* ***Subsidiary Controls.*** *—(1) Reaction. (2) Local distance switch.* ***Price.*** *—11 guineas.* ***Makers.*** *—Kolster-Brandes, Ltd., Cray Works, Sidcup, Kent.*

AN interesting feature of this receiver is the small number of valves employed having regard to the fact that the circuit operates on the superheterodyne principle. The reason for this is that the I.F. amplifying valve has been omitted, reaction being relied upon for magnification and selectivity in the I.F. circuits.

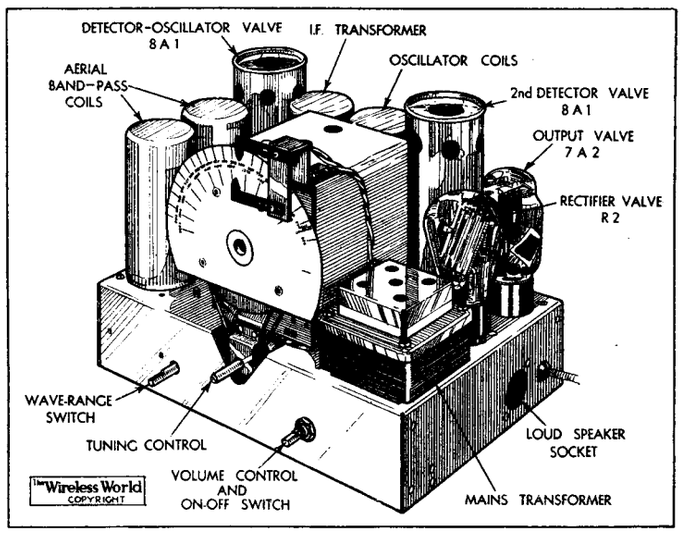
A band-pass filter with capacity coupling precedes the first valve, the aerial coupling coils being connected in parallel on medium waves. For the purpose of reducing sensitivity on powerful local stations a series aerial condenser of a few micro-mfds. may be brought into circuit by the local distance switch situated at the back of the chassis.

The frequency changer is of the H.F. pentode type, and a switch is included in the screen grid lead to suppress radio signals when using the pick-up terminals. The beat frequency passes to a single I.F. transformer in which both primary and secondary are tuned. Reaction is applied to this transformer through the usual coupling coil and condenser, the latter being preset with a control at the back of the chassis. The method of controlling volume at this point is particularly interesting, and although the method is simple, the values assigned to the various components have resulted in a smooth graduation of the control. A potentiometer resistance is employed, and one section is connected across the aerial input circuit while the other is included in series with the secondary of the I.F. transformer. The latter section of the resistance, therefore, controls both reaction and the sharpness of tuning of the I.F. transformer, and the values have been chosen so that the effect of reaction is almost entirely removed before the resistance is high enough to appreciably increase the resistance of the tuned circuit. Thus, side-band cutting is least when the volume control is at a minimum on a strong local station. Incidentally, the volume control functions also when the set is used for gramophone reproduction.

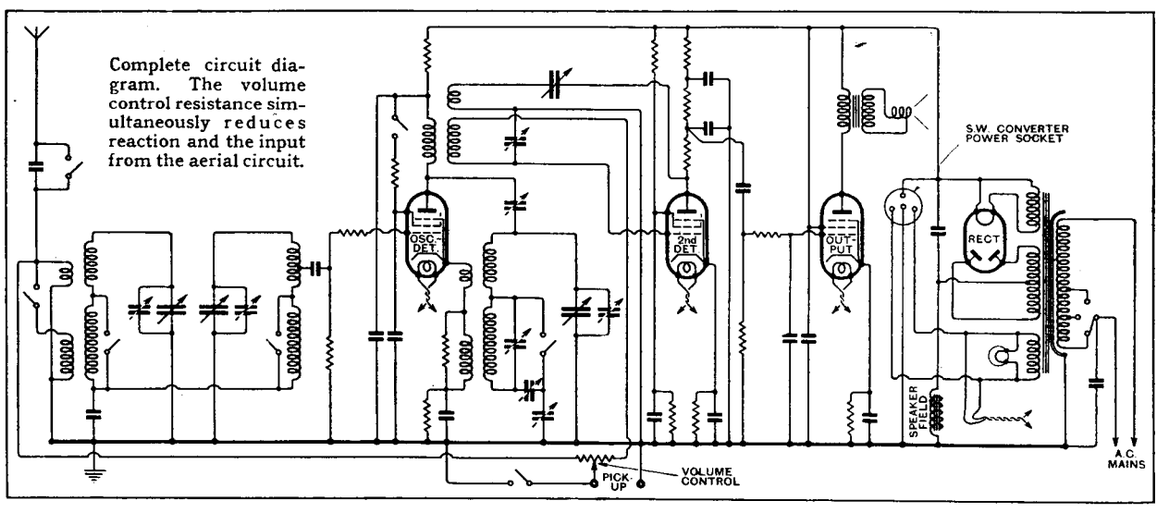
The second detector is also of the H.F. pentode type and is resistance-coupled to the output valve, which is a steep slope power pentode capable of an undistorted output of 3 watts. The power supply is provided by a full-wave rectifier, and the output available is sufficient to work a short-wave converter which has been designed for use in conjunction with this receiver. Sockets for this purpose are fitted at the back of the chassis.

With the preset reaction control carefully adjusted to be just below the oscillation point with the volume control at maximum, the receiver gave a performance from the point of view of range which was quite equal to, if not better than, that of the average four-stage superheterodyne. Nine foreign stations were, in fact, logged on medium waves in daylight, and all the more important long-wave stations came in at exceptionally good strength. Although there are only two tuned circuits in the I.F. stage the set gave a very creditable account of itself from the point of view of selectivity. On long waves Königswusterhausen could not be quite freed of interference from Daventry and Radio Paris, but on the medium waveband only two channels were lost on either side of the London Regional and National transmitters when working the set in Central London. Two or three second channel whistles were noted, but they were not of sufficient strength to incur adverse comment. One point with which we were particularly impressed was the comparative absence of background hiss.

The loud speaker is of good design and has a very flexible surround. As a result the fundamental resonance falls much lower than usual and does not give noticeable colouration of the bass. There is no trace of confusion in the reproduction of complex sounds and the transient response is particularly clear and crisp. The design throughout, including the cabinet, is workmanlike and the finish is good.



A local distance switch and a preset reaction control are fitted at the back of the chassis.



Complete circuit diagram. The volume control resistance simultaneously reduces reaction and the input from the aerial circuit.

Letters to the Editor:—

Gramophone Motor Hum

Fuses and Receivers : Vibratory H.T. Generators : The Listener's Birthright

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

Gramophone Motor Hum

A FEW notes in connection with electric gramophone motors may be of interest to other users. I have, from time to time, tried out on an A.C. supply several types of motor, viz., universal (commutator), synchronous, and induction. In every instance hum has occurred to a varying degree, having arisen by induction from this source into the pick-up circuit; it has been most in evidence when the pick-up approached the turntable centre. The usual precautions, i.e., earthing the carrier-arm and motor frame, and running pick-up leads in earthed screened cable, were taken, with, however, at most, only partial success. The synchronous motor was the worst offender, offering apparently no hope of cure, and had to be definitely abandoned—with regret, for this type, in my experience, maintains a constancy of speed unequalled by any other. An induction motor by a maker of the highest reputation was recently fitted, and, strange to say, exhibited the defect under discussion to a marked extent. No doubt the trouble was aggravated by the use of a pick-up of somewhat low output, followed by a high-gain amplifier.

I am indebted to Messrs. E.M.G. Hand-Made Gramophones, Ltd., for a suggestion which has proved effective in removing the hum. A disc of sheet-iron approximately 10in. in diameter was screwed to the underside of the turntable. In my own case a thickness of about one-twelfth inch was required in order to provide sufficient screening against the motor field. The turntable itself, it was noted, prior to the adoption of this device, exerted a definite but quite insufficient effect in this direction.

In conclusion I may remark that no motor which has come to my notice is (1) to a really satisfactory degree free from the defect mentioned and silent mechanically, and (2) capable, in the case of motors of other than the synchronous type, of governing the unvarying accuracy of the latter (which possesses undesirable features in other directions, scarcely calling for discussion here). It should not, in my opinion, fall to the user of a motor to have to make fitments to overcome weaknesses in design. The cost of incorporating during manufacture some such device as that described would surely be negligible.

GILBERT PACKMAN.

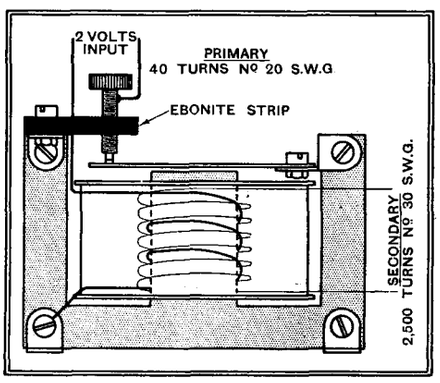
London, N.W.11.

[Columbia has recently produced a pick-up incorporating a "hum bucking" coil, the object of which is to remove the hum referred to by our correspondent.—ED.]

Vibratory H.T. Generators.

YOUR correspondent, Mr. A. B. Everard, may be interested to hear that I have obtained quite good results from an ordinary H.T. eliminator of the 150 volts 30 mA. 4 volts 4-amp. type by feeding L.T. to the 4-volt winding through an interrupter consisting of a buzzer with magnet coils of 20 S.W.G. wire and negligible resistance.

The output was somewhat short of that rated, however, so I constructed an experimental power buzzer, as shown in sketch, from old transformer stampings of "E" shape. This was more efficient, as the losses in the buzzer were eliminated. The rectified output was about 12 mA. at 120 volts, and I think one of larger capacity could easily be constructed (my stampings were rather small).



An experimental power buzzer.

The rough wave form of the "chopped" primary current necessitates more smoothing than would be sufficient for a sinusoidal input as from the mains.

Pembrokeshire. H. G. MARTIN.

Fuses and Receivers

I NOTE with interest a letter from Messrs. Hill-Smith, Ltd., concerning damage that may ensue in a receiver which has no fuses. In spite of my experience being only that of an experimenter, I have been thankful on several occasions that I have formed the habit of never building any receiver without a fuse inserted in each anode lead of the rectifier valve.

At one time I was in the habit of relying upon flash lamp bulbs as fuses, but a complete breakdown of the rectifier supplying a hospital set, which I supervise, taught me that such a type of fuse is no use, because arcing takes place across the very narrow gap which such a fuse allows and the short circuit continues.

This occurred on two occasions, resulting in the complete destruction of two expensive mains transformers. After that I always used fuses of about one inch in length and 500 mA. loading, and on several occasions since valves have broken down with complete short circuit between either one or both anodes and the filament, and in each case the fuse mentioned above has avoided any further damage.

A fuse in each anode lead is by far the most effective position, and which, in my experience, is the only one which can be relied upon to prevent damage to the transformer or other components.

Torquay. GRAHAM HUNT.

A Broadcast Frequency Scale.

I WAS pleased to see Mr. Marshall's letter on this subject in your issue of May 4th. Your readers will probably remember that in the winter of 1932-33 a frequency scale was twice broadcast in connection with a series of talks. In February, 1933, I wrote the B.B.C. asking whether they could not repeat these frequency scales at intervals, pointing out that the time occupied would not exceed five or ten minutes. I have their reply beside me, in which they said that the matter had been considered, but that they could not do so at present, pointing out that "in these days of high-selectivity sets the low frequency output depends upon the particular adjustment of selectivity." They went on to say, "So far as manufacturers are concerned, there is, of course, little need for such transmissions, as they are fully capable in their own laboratories of making such a test themselves. Serious experimenters could, of course, also arrange to test their receivers by means of a local oscillator or tone source."

No doubt this is the case, but I think there is probably quite a large body of "serious" constructors who at intervals endeavour to improve the quality of their reproduction, but would have some difficulty in arranging such a test. I believe they would welcome an occasional broadcast frequency scale to enable them to judge how far they have succeeded. I certainly should.

Forfar, Scotland. JOHN OGILVY.

The Listener's Birthright

IF it be not too late, may I comment on Mr. Carpenter's letter in your issue of January 26th? The remark in this letter which strikes one as delightfully sardonic humour is that the overseas listener "pays nothing for his programme." In India we pay a ten-rupee—fifteen-shilling—licence fee and we pay a forty per cent. tax on British and fifty per cent. foreign wireless material. As Mr. Carpenter remarks, the standard of our living is high. This is due to the fact that in the absence of such amenities as shops, cinemas, theatres, concerts, roads, and the inability of one's better-half to show off new frocks or buy more than goat or mutton for dinner, we save money. My high standard of living has enabled me to buy the last word in S.W. superheterodyne sets. With this instrument it is, if conditions are good, occasionally possible to receive a programme to which one's non-technical friends will listen for twenty minutes without their becoming markedly restive.

I have been a wireless fanatic of the most intense and objectionable variety for the last six years, and I have spent about £150 on my various sets, kits and material. During this period the real solid musical or other entertainment has most definitely not been of 600 hours' duration—taking as a standard, say, the entertainment value of a mechanical gramophone. My wife, I am sure, would say that this figure was too high.

Letters to the Editor—

However, on this basis my entertainment works out at about five shillings an hour. If Mr. Carpenter doubts this, I advise him to confine his listening for one month solely to American S.W. stations plus a medium-wave station 1,800 miles away, and at the end of that period, if he has not decided that most S.W. listeners are insane, I think he will agree that what we pay is sufficient. Not an iota of criticism of the B.B.C., Eindhoven, or any other S.W. transmission is intended.

I see the matter thus. Scattered over the world are hundreds of thousands of people in lonely little stations. The men's lives are monotonous; the monotony of the women's lives is worse. No one who has not lived for some years in these places can really appreciate how deadly the tedium can be. If wireless is a blessing, as it is, to people in England, it will be an hundredfold blessing to the lonely stations. And if a few stout-hearted lads like the B.B.C. and Paris Colonial don't start transmitting and a few enthusiastic maniacs receiving, we shan't get much forrarder. We have made progress, considerable progress, in the last five years, but we have yet some way to travel before the housewife in the wilds can twiddle a knob and hear a tune on a receiver which isn't too fearfully expensive or complicated. When we've reached that stage, the licence fees will roll in, and doubtless the various home and overseas Departments will be able to arrange for us to contribute directly to the Empire station; it really isn't our fault that they can't agree about this now.

But it does seem hard to be told that we don't pay for our programmes.

"PUNJABI."

In Next Week's Issue:—

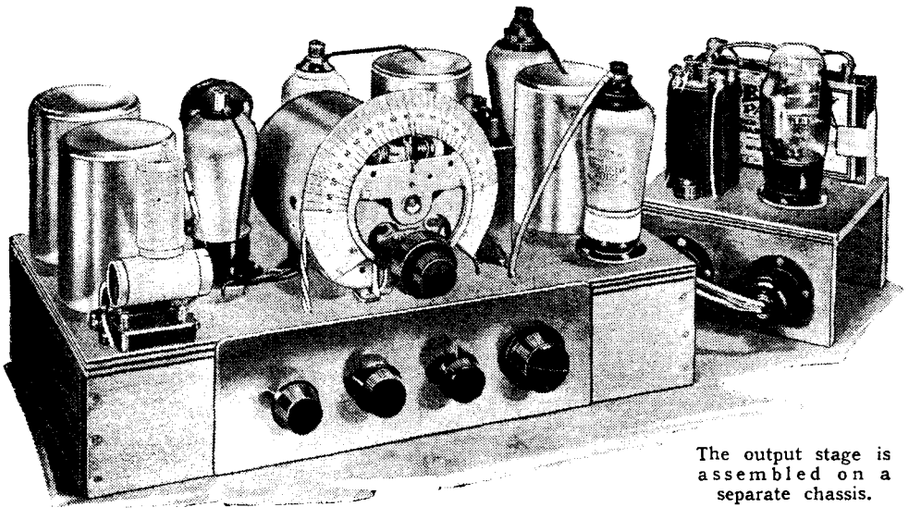
The Wireless World

Battery Single-Span Receiver

A Single Control Set Tuning from 200 to 2,000 Metres Without Ganging or Waveband Switching

THE new receiver embodies the recently developed system of single-span tuning which permits reception to be obtained on all wavelengths between 200 and 2,000 metres without coil changing or switching, and which gives single control tuning without any ganging. This method of tuning has been fully described in recent issues of *The Wireless World*, and it will be remembered that all tuning is carried out by means of a small variable condenser in the oscillator circuit—the signal-frequency circuits being aperiodic over the desired receiving range.

A high intermediate frequency is used, and the combination of reaction with A.V.C. permits variable selectivity to be obtained, and so leads to improved quality of reproduction. The first valve in the set is a heptode frequency-changer, and this is followed by a triode buffer valve. Two I.F. stages are then employed, the second of which embodies an H.F. pentode, and a duo-diode-triode provides detection, delayed A.V.C., and first-stage L.F. amplification. The output stage is of the Q.P.P. type.



The output stage is assembled on a separate chassis.

The sensitivity of the set reaches a high order, and is adequate for distant reception under all normal conditions, while the selectivity is ample for receiving all musically worth-while Continental transmissions. The quality of reproduction reaches an unusually high standard, and the output is adequate for most domestic purposes when a sensitive speaker is used. Complete freedom from second channel interference and other forms of whistle production is obtained through the use of the single-span principle.

Full constructional details, not only of the receiver, but also of the coils for use in it, will be given in the next two issues of *The Wireless World*.

LIST OF PARTS.

RECEIVER.

1 Variable condenser, 0.0016 mfd. **Polar Type "E"**
1 Dial, slow motion type **Polar Micro-drive semi-circular**
2 Bulbs, 2 volts 0.06 amp. **Bulgin Type "H"**
1 Slow motion reaction condenser, 0.0002 mfd. (Polar) **Eddystone 957**
1 Tapered volume control, 250,000 ohms and knob **Rothermel Type 72-121** (Ferranti, Claude Lyons, Magnum)
1 Rotary Q.M.B. D.P.D.T. switch **Claude Lyons 2163**
1 Rotary Q.M.B. D.P.S.T. switch **Claude Lyons 2161**
3 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
2 Valve holders, 7-pin **Clix Chassis Mounting Type**
1 Compression condenser, 100 mmfds. **Colvern**
4 Microdensers, 100 mmfds. **Eddystone 900**
1 Fixed condenser, 0.0001 mfd. **Graham-Farish Bakelite Case Type**
1 Fixed condenser, 0.0002 mfd. **Graham-Farish Bakelite Case Type**
2 Fixed condensers, 0.1 mfd. **Graham-Farish Tubular Type**
2 Fixed condensers, 0.01 mfd. **Graham-Farish Tubular Type**
2 Fixed condensers, 0.001 mfd. **Graham-Farish Tubular Type**
1 Fixed condenser, 0.0005 mfd. **Graham-Farish Tubular Type**
4 Fixed condensers, 0.0001 mfd. **Graham-Farish Tubular Type** (Dubilier, Peak, T.C.C., Telsen)
2 Resistances, 250 ohms ½ watt **Ferranti Type G.5**
1 Resistance, 2,000 ohms ½ watt **Ferranti Type G.5**
1 Resistance, 10,000 ohms ½ watt **Ferranti Type G.5**
1 Resistance, 20,000 ohms ½ watt **Ferranti Type G.5**
2 Resistances, 50,000 ohms ½ watt **Ferranti Type G.5**
3 Resistances, 100,000 ohms ½ watt **Ferranti Type G.5**
1 Resistance, 1 megohm ½ watt **Ferranti Type G1**
2 Resistances, 2 megohms ½ watt **Ferranti Type G1** (Dubilier, Erie, Graham-Farish, Claude Lyons, Seradex, Watmel)
1 Screened H F. choke **Wearite Type HFP** (Bulgin, Kinva)
1 10-way connector **Bryce**
1 5-pin plug **Bulgin P.3** (British Radio Gramophone Co.)
1 4-way battery cable **Bulgin B.C.2**
1 5-way battery cable **Bulgin B.C.3** (Belling-Lee, Goltone, Harbros)
6 Knobs **Bulgin K.6**
4 Ebonite shrouded terminals A. E. Pick-up (2) **Belling-Lee Type "B"**
4 Coil screens, 3¾ x 2½in. diam. **Mains Power Radio, Ltd. Broadway Works, Eastern Road, Romford, Essex.**
1 Coil screen, 4 x 3⅝in. diam. **Colvern**
Materials for coils:
12in. Paxolin tube, 1in. diam. **Wright & Weaire**
2½in. Paxolin tube, ⅜in. diam **Wright & Weaire**
Quantity No. 32, 36 and 38 D.S.C. wire.
or **1 set of coils**
2 Lengths of screened sleeving **Harbros**
1 G.B. battery, 4½ volts
1 G.B. battery clip **Bulgin No. 2**
6 Wander plugs **Clix No. 12B**
2 Spade ends **Clix No. 3**
2oz. No. 20 tinned copper wire, 6 lengths Systoflex, wood, etc.
Plymax baseboard, 15 x 8 x ⅜in. **Peto-Scott**
Screws:
24 ⅛in. No. 4 R/hd.; 6 ¼in. No. 4 R/hd.
All with nuts and washers.
2 ⅜in. No. 6BA with metal threads and nuts and washers.
Valves:
1 Ferranti VHT2, 1 Cossor 220PA, 1 Cossor 220VS, 1 Mullard VP2, 1 Mullard TDD2.

OUTPUT UNIT.

1 Q.P.P. transformer, 1:8 **R.I.** (Varley)
2 Fixed condensers, 0.005 mfd. **Graham-Farish Tubular Type** (Dubilier, Peak, T.C.C., Telsen)
1 Resistance 150,000 ohms ½ watt **Ferranti G.5** (Dubilier, Erie, Graham-Farish, Claude Lyons, Seradex, Watmel)
2 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
1 Valve holder, 7-pin **Clix Chassis Mounting Type**
1 5-pin plug **Bulgin P.3** (British Radio Gramophone Co.)
1 G.B. battery, 9 volts
1 pr. G.B. battery clips **Bulgin No. 1**
2 Wander plugs **Clix No. 12B**
1 Loud speaker, permanent-magnet moving coil **Blue Spot "Star"**
Quantity No. 22 tinned copper wire, 2 lengths Systoflex, wood, etc.
Plymax baseboard, 5 x 5½in. x ⅜in. **Peto-Scott**
Screws:
14 ⅛in. No. 4 R/hd.; 2 ⅜in. No. 4 R/hd.
All with nuts and washers.
1 ⅜in. No. 6BA with metal thread and nut and washer.
Valves:
1 Marconi or Osram QP.21.

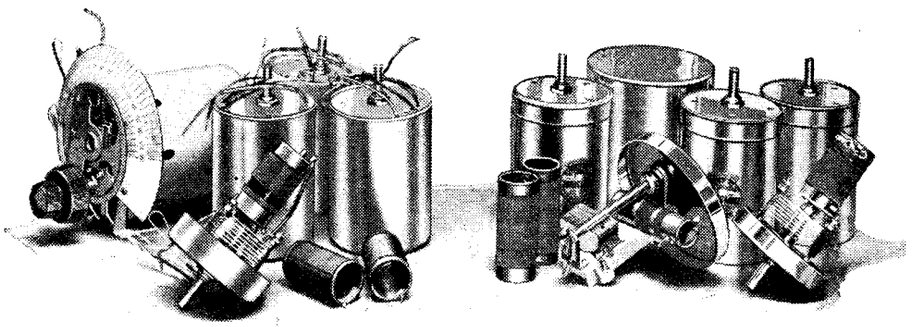
Components for Single-Span Receiver

A Review of Mains and Tuning Equipment

UNLIKE ordinary sets, the Single-Span Receiver does not require accurately matched coils. Constructional details of the coils, therefore, were given in the articles describing the set. There are many builders, however, who do not wish to go to the extra trouble of making their own coils, and a number of firms have consequently placed coils for this receiver on the market made to *The Wireless World* specification

The Wearite coils are solidly constructed, and are clearly marked, both for identifying the coils themselves and for their connections. The I.F. coils are fitted with brackets for mounting on the trimming condensers, and the oscillator coil is supplied with fixing screws. The complete set of seven coils is priced at 12s. 6d. The makers are Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N. 17.

A similar set of coils is also available by Graham-Farish, Ltd., Mason's Hill, Bromley, Kent. They are made exactly to specification, and all coils are wrapped in cellophane for protection. The I.F. coils are fitted with mounting brackets, and the set of seven coils is priced at 12s. 6d.



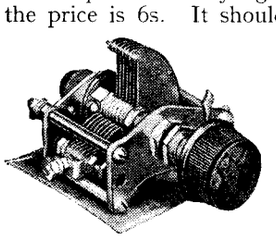
I.F. transformers, oscillator units, and aerial coils for the Single-Span Receiver; the Cranley Radio components can be seen on the left, and the Eddystone on the right.

Complete Transformers

Completely assembled I.F. transformers are available from Stratton and Co., Ltd., Eddystone Works, Bromsgrove Street, Birmingham. Each transformer consists of one I.F. coil and one air-dielectric trimming condenser, mounted in a polished aluminium screening can. The set of four transformers for the Single-Span Receiver costs 35s. The same firm is also making an oscillator unit, comprising the oscillator coil and the specified Polar tuning condenser, mounted in a large polished screen at the price of 10s., while the pair of aerial filter coils is available at 2s.

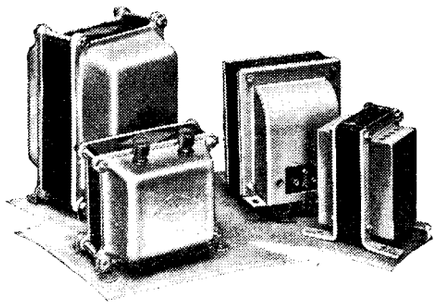
Cranley Radio, Ltd., of 32, Craven Park Road, London, N.W. 10, are also making complete I.F. transformers, and here again each transformer consists of the appropriate coil, and the trimming condenser mounted in an aluminium screen. The oscillator unit comprises the Polar tuning condenser, the oscillator coil, the padding condenser, and the oscillator grid condenser and leak, all mounted in the screening can and wired up. The complete set of four I.F. coils, oscillator unit with Polar dial, and the two aerial coils, is priced at 52s. 6d. The set of seven coils alone is listed at 12s. 6d.

Wingrove and Rogers, Ltd., 188/9, Strand, London, W.C. 2, are marketing a special reaction condenser for this receiver. This is the type Q.J with a capacity of 0.0002 mfd., and it is fitted with a slow-motion drive. Brass vanes are used, and the component is very rigidly constructed; the price is 6s. It should be noted that the physical dimensions are slightly larger than those of the specified condenser, so that its use necessitates an increase in the size of the opening in the front supporting batten of the chassis. Mains equipment is also now available from W. Andrew Bryce and Co., Woodfield Works, Bury, Lancashire. The mains transformer is of the chassis-mounting type, and is fitted with leading-out wires.



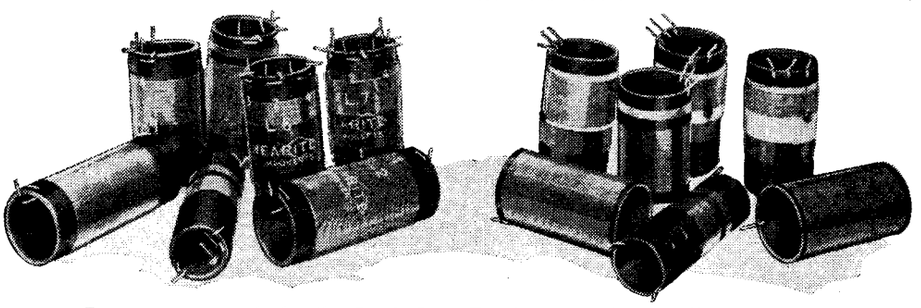
The Polar reaction condenser.

An adjustment for different mains voltages appears on the side of the component, which is priced at 32s. 6d. A smoothing choke by the same firm is available at 12s. 6d., and this is also fitted with leading-out wires.



The Vortexion mains transformer and smoothing choke are shown on the left, and on the right are similar components by Bryce.

The mains transformer submitted by Vortexion, Ltd., 150, Broadway, Wimbledon, S.W.19, is built with cast-aluminium end plates, and the leading-out wires are clearly marked. The component has a substantial core, and is priced at 25s. A smoothing choke of massive proportions can also be obtained, and this is fitted with terminals for the connections. The dimensions of the component are slightly greater than those of the one specified, so that when it is used a slight change in the layout may be necessary. This, however, is unimportant. The choke costs 12s. 6d.



Two groups of coils for the Single-Span Receiver; on the left Wearite, on the right Graham-Farish.