Practical Wireless

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Rheo Klystron Panel

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Mains Operated.

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Two-valve: Blueprints, 1s.

Superhet (Two SOF, D, Trans)

Two-valve: Blueprints, 1s.
Matched Components

THE question of matching various parts of a radio receiver is not one which normally troubles the home constructor. The manufacturer supplies condensers of the gauged type with sections correctly matched, and coils and other units of a similar nature are also properly matched. This does not mean, however, that they may be used without any modification, as stray circuit wiring may modify the balance of tuned circuits. Trimmers on the condensers, however, enable this to be carried out easily, and thus there is little difficulty. Coils, however, can be wounded by the experimenter, and then some form of correctly matching them is required. Alternatively, commercial coils may be obtained in single units and be required for use in pairs or other sets, and then some arrangement for matching these is needed. In this issue we give a short description of a simple method by means of which the desired matching may easily be carried out. Although this is not obviously a laboratory method of matching, it only utilises apparatus which is in the hands of every listener and thus does not call for any outlay or expensive gear.

Illega l Transmitter

A 18-year-old youth was recently fined £50 for using an unlicensed transmitter. He was traced by official detectors while sending messages to friends using a call sign which had been allotted to the R.A.F. It should again be emphasised that callers should be again addressed: The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southwark Street, Strand, W.C.2. Registered at the G.P.O. for transmission by Canadian Magazine Post. The Editor does not hold himself responsible for any loss or damage to property or manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed to: The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southwark Street, Strand, W.C.2.

Air Conditioners

A not so popular sideline among radio dealers in America is the air conditioning unit. This is a self-contained device made to fit on a window-sill or table and provides dehumidified, fresh-filtered air in summer and fresh filtered air (warm) and ventilation in winter. This device is taking its part with room-to-room communications devices.

Re-allocation of Stations

T is announced that the Federal Communications Commission will re-allocate a number of broadcasting stations in America during the autumn. This is the first general shift since the present scheme was inaugurated in 1928 and has been rendered necessary in order to conform to the provisions of the North American regional broadcast agreement, now ratified by Canada, Cuba and Mexico, as well as by the U.S.A.
The moving-iron, in a good make of meter, has advantages to outweigh any considerations of that nature and the higher price which its precision construction necessitates.

The essential parts of a moving-coil meter are shown here. Note hair-spring connections to coil.

Moving-coil Movement

Meters embodying this form of movement are, undoubtedly, the most popular as they are much more accurate and the pointer follows a linear law, or in other words, the movement is directly proportional to the current or voltage being measured. In actual construction, they are not so robust as the previous type but they offer sufficient advantages to outweigh any considerations of that nature and the higher price which their precision construction necessitates.

Moving Iron

This term is given to one of the cheapest forms of meter construction and, as the name implies, the movement depends on a small piece of iron, so located and pivoted that it actsuates the meter pointer, moving with relation to a separate fixed piece of iron which is situated within the effective magnetic area of a small coil, the coil being connected to the external circuit under examination.
Matching Tuning Coils

Some Simple Methods of Carrying Out Tests with the Minimum of Equipment and Test Gear

O

NE of the greatest difficulties in connection with home-made tuning coils is that of matching two or more of them so that they can be used with a gang condenser. It would appear to be a simple matter to ensure that all are physically the same; this could be carried out by making sure that the corresponding windings on all coils were in the same relative positions, and that they consisted of precisely the same number of turns. Thus it would seem that the question resolves itself into one of mechanical accuracy.

The fact that it does not is clearly shown in the case of many tuners made by reputable manufacturers. Despite the fact that they are wound by means of precision machinery it is often necessary to make slight adjustments after completion, to match them up. Even if the coils themselves are not altered it is often necessary, in order to obtain a matched set, to replace two or more which have been found to have similar characteristics when bridge-tested.

Inductance and Capacity

As most readers are aware, for two coils to be matched they should have similar values of both inductance and self-capacity. Whilst it is possible to measure the values of these properties, the measurement calls for the use of fairly elaborate and expensive test gear; in addition, of course, a certain amount of skill is necessary to use such apparatus correctly, the meters are calibrated in the most simple manner.

One very simple method of matching, which can be used by the amateur not in possession of complete test gear, is to connect one of them in a receiver, note the necessary setting for a given frequency, replace the coil and again note the condenser setting for the same frequency. From this it will be known that if the condenser reading with one coil, that is to say, too many turns or its self-capacity is higher than that of the other coil.

A very simple test of this kind may be of some use if the coil is of the simple type, but if there are both primary and secondary windings false conclusions may be drawn. This would be because any variation in coupling between the two windings would give a similar effect to that produced by variation in the numbers of turns on the secondary or tuned windings.

A Test Circuit

One method which can be adopted very easily, and which is reasonably accurate, is to make a unit with the circuit shown in Fig. 1. It will be seen that there is simply an anode-bend detector valve, and that a variable condenser is wired across the grid circuit; to each end of the condenser is attached a short lead with crocodile clip. The clips are used to make contact with the ends of the coil winding under test. In the anode circuit of the valve there is an H.F. choke (which is not strictly necessary) and a milliammeter, reading up to about one mA, or a pair of 'phones.

In passing, it may be mentioned that it will often be found better to use an H.F. pentode instead of the triode if a valve of this type is available. The screening grid may be taken to an H.T. + tapping and by-

passing means of a 1-mfd. fixed condenser in the usual manner.

Comparing Condenser Readings

Using this simple circuit the grid or tuning winding of one of the coils to be compared should be connected to the tuning condenser, and to an aerial lead, as shown in Fig. 2. After that, the local station can be tuned in and the tuning condenser very carefully set until the highest reading is shown on the milliammeter scale. At that point the tester is tuned exactly to the station being received, and a careful note should be made of the condenser setting. When making this test it is best to include a very small fixed condenser (a .00005-mfd. component is shown) between the aerial lead-in and the top of the tuned winding. It is also desirable to use a short aerial, provided that the signal input is sufficient to cause the needle of the meter to move a few turns and of course it is obvious that the aerial should have no other connections.

It will be seen that there is simply the connection of the maximum point to be noticed, and if variations in voltages have proved unavailing, the meter may be replaced by a pair of 'phones and tuning altered until maximum volume is obtained. It should be remembered, however, that the ear is very deceptive and therefore that accurate readings will be very difficult to obtain, even when the tests are made on speech.

Coil Modifications

Should it be found that the two coils differ to a noticeable extent—represented by more than about 5 degrees variation in condenser readings—it will be necessary to make one of them. The most convenient method will probably be to remove one half-turn, or even a complete turn, from the coil which requires the lower condenser reading. After that has been done, the test will have to be repeated on that coil. Another method which is often fully effective and more easily carried out is to slide about a dozen of the turns at one end of the winding away from the others, as shown in Fig. 3. This should produce an effect similar to that of removing a part of a turn. After matching in this manner it is advisable to give both coils a very thin coat of shellac varnish to hold the windings in position.

Having checked the tuned windings in this manner the coils should, in turn, be connected in the usual way to the grid circuit and to the aerial lead. The tests can then be repeated. Variations now disclosed will be due to differences in coupling between the primary and secondary windings. The coil requiring the maximum condenser capacity should be modified, by moving the windings rather farther apart or by taking a turn off the primary.
A very efficient superhet for operation on all wavelengths down to 15 metres or so can be made by using perfectly standard components, and without going to a great deal of expense, and many of the standard components employed in a single type of "straight" circuit can be utilized without any sacrifice in efficiency.

It is not generally known that standard short-wave coils—either of the single-range or multi-range type—can be used for both the input and oscillator circuits, even when it is desired to make use of a two-gang condenser. The fact is that an ordinary tuned-grid or aerial coil with reaction winding can be used with every satisfaction in the oscillator tuning circuit of a short-wave superhet, due to the fact that the percentage difference between the signal and oscillator frequencies is quite small. Moreover, the characteristics of a plain tuned coil with a reaction winding are similar in nearly every respect to those demanded of a special oscillator coil; after all, the oscillator section of a frequency-changer is only the same as a regenerative detector stage.

Suggested Circuit

The matter will more readily be understood by making reference to Fig. 1, which shows the first two stages of a short-wave superhet employing a pentagrid valve. The aerial and oscillator coils are identical although the reaction winding is not used in the former, and the loose-coupled aerial winding is not used in the latter. The terminal numbers indicated are not those relating to any particular make of component, but are given simply to show the correspondence between the two components. A double .00016 mfd. tuning condenser is shown, and there is a wide variety of components by most of the better-known manufacturers which are suitable for the purpose. Of separate condensers could be used if preferred. In order to enable the full wavelength range to be obtained, a 40 mfd. variable condenser is wired in parallel with that section of the two-gang condenser which is used to tune the aerial circuit. It will be understood that, since the wavelength of the oscillator circuit might be lower than that of the aerial circuit, it would be better to say that the frequency of the former must be higher than that of the latter. The lower part of the scale of the oscillator condenser and the upper portion of the scale of the aerial condenser would not be of any use if this compensation were not provided. This remark really applies only when separate condensers are used—as they may be if desired—for when a single gang condenser is used as suggested it would be impossible to obtain accurate tuning of both circuits at the same time, and thus efficiency would be impaired.

It might even be imagined that it would be impossible to receive any signals when using a gang condenser without the trimmer, but this would not be the case; in fact, the difference in efficiency when using an aperiodic aerial circuit is not particularly great.

Component Values

When operating the set it is possible to control the gang condenser alone until a signal is received, after which final tuning can be accomplished by means of the trimmer. This not only gives an increase in signal strength, but also has the effect of increasing selectivity. Values of the principal components are given in Fig. 1, but it will be noticed that the type of intermediate-frequency coupler is not specified. The reason is that a coil such as the Bulgin I.F. coil may be used with a .0005 mfd. fixed condenser in parallel, a 150 or 465 kc/s I.F. transformer may be employed, or a really good H.F. choke could be substituted. In most instances I.F. transformers will prove more satisfactory, but in that case it is necessary to have a complete superhet, whilst if one of the other components be used the circuit shown can be used as a converter in conjunction with a standard broadcast receiver covering the normal bands of 200 to 500, and 1,000 to 2,000 metres. The equivalent wavelength when using either of the I.F. transformers is outside the range mentioned. Of the two intermediate frequencies referred to, 465 kc/s is to be preferred, and the capacity of the trimming condenser is sufficient to permit of this frequency difference without restricting the wavelength coverage. When using a choke or the Bulgin I.F. coil the latter is preferable, of course, due to the fact that it is definitely tuned. The intermediate-frequency amplifier of the type, in which the lead marked "To I.F. should be joined to the grid of the first H.F. valve.

For Mains Operation

When building a mains S.W. superhet, or superhet converter, it is worth while to use a triode-hexode frequency-changer, when the connections in the oscillator circuit are slightly modified, as shown in Fig. 2, so that the anode circuit of the oscillator is tuned, instead of the grid circuit. Otherwise the arrangement shown in Fig. 2 is in every respect comparable to that indicated in Fig. 1, whilst having the extra advantages conferred by the mains type of specialised valve which is particularly suitable for short-wave use. When using a battery type converter, H.T. and I.F. can be taken from the batteries used for the broadcast set, but the question of power supply is not quite so easy of solution when an A.C. outfit is under consideration. Very often the mains transformer is designed to supply sufficient output for the set alone, and has insufficient "reserve" to permit of its use for the extra valve. In that case, it is a good plan to have a separate 4-volt L.T. transformer for the valve of the converter, as indicated in Fig. 2, the primary winding of this should be wired in parallel with the primary of the other mains transformer. The amount of H.T. required can invariably be obtained from the power supply unit in the set, so there is no difficulty in this respect.

A Dictionary of Metals and Their Alloys

Edited by F. J. Gamm.

This book is a handy and straightforward compilation of salient and useful facts regarding all the known metals, and nearly all the known commercial alloys. Chapters are also included on polishing, metal spraying, rustproofing, metal colouring, case-hardening, and plating metals, as well as numerous instructive tables.

The book costs 8s., or by post 8s. 6d., and is obtainable from all bookdealers or the publishers:

Faith!

I was amused at the story told last week by a cleric. He had asked a boy what his religion was. The boy replied that his mother was a Protestant, his father a Roman Catholic, and whilst he was Wireless! Fortunately, or unfortunately, wireless is not yet a religion. You observe that I play for safety by leaving you to decide that point for yourself. There can be no possible doubt, however, that, even though not in a religious sense, it is a faith to many tens of millions of us. What is its definition occupies nearly a half a column of my dictionary. As a transitive verb it means to believe, give credence to, credit. We can certainly give credence to our broadcasts but very little to those of our enemies. My dictionary, however, goes on to say that faith is a firm belief in what another states, affirms, or testifies, simply on the ground of his truth or veracity. Therefore, we cannot have faith in the broadcasts of our enemies.

However, I like the reference to wireless as a faith, and I hope that it will develop so that our English motto, "Nation Shall Speak Peace Unto Nation," will be under- stood by our adversaries. At present they are merely using it to speak hate to us.

Register of Experimenters?

One of my readers, J. B. Rudkin of Hoylake, refers to the paragraph in which I detailed the adventures of one of my readers who was an enthusiastic experimenter, but was suspected by his neighbours as being a spy merely because he thought of this hobby as going over the garden fence about such subjects as the rate of growth of spring onions, silver leaf, and blight. Mr. Rudkin thinks that the police in all districts should keep a register of experimenters. He thinks that all that would be necessary would be for such experimenters to send a post card to the police station stating that he was an enthusiast.

There is something in his idea, but it would not be sufficient merely to send a postcard, as the very object of the register would be defeated, because such a system would leave the door wide open for the very people against whom the register is designed, namely, the fifth columnist, and the spy. The police, in my view, are not competent bodies to analyse the qualifications of one claiming to be an enthusiast. If such a register is compiled I suggest that the bona fides of the applicants should be investigated by a competent engineer from the Post Office.

The register would also have a further use in that the country would have a list of people with a first-class knowledge of radio. I pass the suggestion along, however, to the Government for their consideration.

Myth Columnists

Unfortunately, there are thousands of people suffering from the "I know something you don't" complex. They have either heard it on the radio when they were listening to Timbuoto, Tokyo, or some other remotely situated station, to give the impression that they have a wonderful set, and are thus am fad with all of the world's news. Such a tribe as the various languages involved does not seem to worry them. Thus, the rumours they spread cause damage. One or two of them have been caught, and then have been compelled to admit that they had invented the story. These are the myth columnists, and they are just as dangerous as the fifth columnists. There are also the columnists without numerical coefficient who write letters to the press telling us how to win the war. There are even those who broadcast simple stuff in a didactic tone as if we were a collection of nitwits. For this reason I do not like some of the broadcasts of Professor John Hilton, who seems to talk and talk on the most elementary subjects without saying anything. I have no doubt, of course, that this is due to my dim intelligence, but I do not like his didactic schoolmaster style. He should probably that his listeners have at least some knowledge of the elementary subjects on which he speaks. A great deal of it, I know, is purely statistical, and is common knowledge.

National Service

It is worthy of record that I have received thousands of letters from readers who are now engaged in some of the branches of the radio service thanking this journal for the fact that they have been able to place their technical knowledge at the service of the country. All of these readers paid grateful tribute to the fact that they have obtained their entire radio knowledge from our wireless book, and from this journal. They were all able easily to pass the tests.

Contrast Contract?

In an article which I published in "The Wireless Amateur" a few weeks ago, I said that there are many readers who are becoming interested in the work of the Wireless School. I have received a number of letters from these readers expressing their admiration of the work of the Wireless School and asking me how they could get a place in it. I am glad to say that I have been able to arrange a contract for a number of readers who have shown a special aptitude for the work of the Wireless School.

Our Roll of Merit

Our Readers on Active Service—Fourth List.

R. Rowland
(Sgt., Royal Welch Fusiliers), Wrexham.

R. W. Walker
(Signalman, R. Signals), Newcastle-on-Tyne, 2.

B. P. Atkinson
(Observer Corps, R.A.E.), Boroughbridge, York.

By Thermion

called a contrast expander. A writer says that he finds that what is really necessary in listening to B.B.C., orchestras is a contrast contractor. He thinks that if a set is turned on that the pianoforte is audible at all, even at close range, the crescendos are unbearable; even the neighbours don't like them. That is bad broadcasting, he thinks, and it probably the cause of so much of the unnecessary blasting that one hears.

"Be Advised—Join a Wireless Club"

Congratulations, Thermion! Your suggestion's really good:

"To prove one's not a Nazi spy
Just join a wireless club."

Then when some local "3 letter-box" calls
On in the regard,
We'll prove to him "you're false," is false,
And show our winder's card.

We realise the need just now
For constant supervision,
And due care and vigilance
For our noble ideal.
But the fact that we are radio fans
Must not, really not imply
That purps we are Fifth Columnists,
Dr. secret Nazi spy.
The war won't last for ever,
And when at last we've won,
Our necessary transmissions,
To our joy, can be begun.

But haste the day when "on the air,"
This message we can send.
"We're free from foul suspicions, for
'They've cooked old Hitler's goose!"

B.B.C. Polish Refugee Service to Cease

Shortly after the occupation of Poland, the B.B.C. introduced in its Overseas programmes daily announcements of the names of Polish refugees. Now, for various reasons, this service has had to be suspended, and the B.B.C. can no longer undertake to broadcast personal messages in Polish or in any other language.

Before the war it was a standing rule that no S.O.S. or personal message of any kind should be transmitted by the Polish refugees. But when the brutal invasion of Poland occurred, the B.B.C. could not disregard the plight of the thousands of Poles who were forced to seek sanctuary from Nazi vengeance in Allied and neutral countries and who were completely cut off from their native land. So at the request of the Polish Embassy, the B.B.C. began a service of broadcast messages—the Poles called it a "letter-box"—by which refugees were able to communicate news of their safety and whereabouts to their friends and relations who had no other means of knowing what had happened to them.

The B.B.C.'s Polish Refugee Service has been the means of banishing grief and anxiety from countless homes. Since it was introduced on October 7th of last year, an average of 131 names has been broadcast daily and the grand total has reached 34,000. It is, of course, impossible to estimate exactly the number of Polish families the B.B.C. has helped to re-link by its "letter-box," because few listeners in German-occupied Poland are able to get in touch with the world outside. But even so hundreds of appreciative letters have reached Broadcasting House.
One of the main difficulties experienced by listeners on the short waves is the critical adjustment which is often called for in the tuning or reaction circuits. In the majority of cases, however, it is found that these troubles are not experienced if a loudspeaker is being used. When, however, headphones are worn the capacity to earth which exists through the body results in a leakage of H.F. currents and these in turn affect the operation of controls, owing to the presence of the body of hand. It is often recommended that screening be employed to overcome this trouble, but many experimenters have tried screening in cases most comprehensive schemes, all with the result. A long extension rod controlling both tuning and reaction condensers, and the interposition of a sheet of metal behind the panel (such metal being soundly earthed) will often afford an improvement, but will not in all cases completely remove the trouble. Let us examine the usual arrangements employed in a standard short-wave circuit and see how we can overcome these troubles.

**'Phone Connections**

In the simplest circuit the headphones will be included in the output stage, direct in the anode circuit. In the detector anode circuit we usually find an H.F. choke, the main purpose of which is to detect the H.F. currents through the reaction circuit. If a simple reaction condenser (as distinct from a differential condenser) is employed, however, the H.F. will not be taken to earth unless the condenser is set to maximum capacity—a position which is not often used. Consequently, it would appear that if the detector anode circuit that we must introduce our H.F. stoppers in an endeavour to remove the capacity effects. A by-pass condenser from anode to earth will prove effective on the higher wavelengths, but when going down below 30 metres it will be found that this condenser will result in some signal loss. If, however, we are dealing with a circuit employing an H.F. stage we may be able to introduce an effective H.F. stopper in the grid circuit of the output valve, the simple series resistance then proving quite effective. It will not, however, remove all of the H.F. and thus we must still try and eliminate it from the 'phones themselves. An effective way of doing this is to use an output filter of orthodox design, namely an L.F. choke feeding the anode direct, with the 'phones connected between the anode and earth through a fixed condenser. This will, in many cases, be found perfectly satisfactory. In the event of trouble still being experienced, however, we must take more elaborate steps and a scheme which has been found very effective is to connect the 'phones in the anode circuit through series H.F. chokes, connecting a fixed condenser in parallel as shown in the full circuit of Fig. 1.

**Fig. 1.—Suggested circuit of a short-wave 3-valve battery set. Components not marked will be of standard values.**

**Fig. 2.—The suggested circuit of Fig. 1, following the detector, may be arranged as shown here to improve stability.**

If we take the full circuit we may consider one or two arrangements which will assist in removing H.F. from the detector or output stages, the most important point being always to remember effective decoupling and sound earth connections throughout. The effectiveness of the lead does not need emphasis in short-wave work as it is already well known that all such connections should be as short and direct as possible.

**Tuned or Untuned?**

Examining the complete circuit in Fig. 1 we can see that the arrangement depicted would answer the要求 set out. Firstly, an untuned H.F. stage is suggested, the use of a choke (or if preferred a resistance) in the aerial circuit will reduce the risk of a large field and thus take away some of the problems of screening. Secondly, the use of an H.F. transformer coupling the first two stages will permit the anode circuit of the H.F. valve to be more or less directly earthed, using a fairly large coupling condenser in association with the small primary winding found on short-wave transformers. As far as this point the wiring should be of heavy gauge wire and connections made from point to point in the most direct and shortest manner. A test would perhaps be advisable if a circuit of this nature is being made up to see whether it is worth while introducing normal anode decoupling in the first stage. Sometimes this is not essential, especially with a simple three-valve circuit where the detector may be efficiently decoupled. In the detector stage more or less normal arrangements are suggested, but the inclusion of a good H.F. choke in the filament lead of this valve may be found worth while. Such chokes should, of course, be of low resistance to avoid voltage drop in the filament circuit, and should be capable of carrying the normal filament current. When using headphones it is possible, if the circuit is properly arranged, to obtain improved results by the use of critical reaction control, and therefore it may be found worth while in the set to include some form of filament potentiometer to which the grid leak is connected. Adjustment of this will control the smoothness of the reaction control and even at times may be adjusted which would otherwise not be heard.

Finally, the point to remember when using 'phones is that should there be any H.F. present in the 'phone circuit this will automatically be fed into the body and therefore unless a good earth return is provided externally it will be bound to try and get back to earth through the easiest circuit, which will invariably be via the tuning controls when these are manipulated. A separate earth lead to the panel of a screen type of valve could be found more effective than the mere connection of the screen to the normal earth circuit in the receiver.
Two-stage H.F. Amplifiers

Details of Variable Bias Volume Control Systems are Discussed in this Article

The advantages of a two H.F. stage receiver are already well known, and it is interesting to consider the design of such a two-stage amplifier. The degree of amplification which can be obtained from such an amplifier is tremendous, and the difficulties which are experienced in its design do not concern the matter of efficiency nearly so much as of stability; the step-up provided by two modern H.F. pentode valves is so great that the least amount of carelessness in design is certain to lead to uncontrollable reaction and unwanted oscillation of all sorts. It is mainly for this reason that it is nearly always best purposely to arrange the valves so that they are operated except by the expert.

“Asymmetrical” Tuning Circuit

Generally speaking, the tuned-anode circuit is the most efficient, and the tuned-grid circuit is the least efficient; from this it would appear that the latter would be most suitable in the case under consideration. In practice, however, it does not work quite like that, and it is nearly always found to be easier to make the two inter-valve circuits “asymmetrical,” because by so doing there is less fear of feed-back between the two stages. Thus, it is found an excellent plan to use tuned-grid coupling between the first and second valves, and tuned anode between the second and third, the general circuit being rather as shown in Fig. 1. Here the circuits are arranged so that a three- gang condenser can be used to give single-knob tuning, it being understood that the characteristics of all three coils are similar.

Selectivity

The one objection to this form of circuit is that the degree of selectivity is so high that there is a danger of introducing distortion due to the sharp response of the three circuits in cascade. Nor would the use of a band-pass filter in the aerial circuit confer any great advantage because this would still be followed by two sharply-tuned stages. This difficulty can most easily be overcome by placing the band-pass filter between the first and second valves as shown in Fig. 2. The advantages of this are that the band-pass circuit is not damped by the aerial, and that the two “sharp-peak” circuits are isolated, and that the arrangement becomes completely asymmetrical since all three tuning circuits are of different form. This is probably the best method of using two H.F. stages when ease of control and high-quality reproduction are required. Where high fidelity is not considered in the battery circuit a separate H.T. tapping supplies the screening grids through decoupling resistances. With a variable-tuned circuit it is important that the S.G. potential should remain constant regardless of the setting of the volume control, and it is this fact which makes it necessary to use an apparently rather complicated resistance system in the case of the A.C. circuit.

When the matter is first considered, it would appear that the required condition could be satisfied simply by connecting a fixed potentiometer between H.T. + and H.T. − , and taking leads from the tapping of this to the S.G. terminals. But it must be remembered that the current passed by the screening grids when the volume control is set to increase the bias on the grids of the valves (to reduce volume) is automatically reduced, and as the current becomes less the voltage increases. The resistance network shown is typical of that required for most valves, but the values of the resistances vary according to the exact characteristics of the valves chosen, and, therefore, with their make. For this reason it is best to refer to the makers’ instruction leaflet with regard to this point.

It will suffice to mention that the combined effect of the resistances is to maintain the S.G. voltage constant. This is because a movement of the slider of the volume control towards the negative end reduces the screening-grid current, and as the current tends to reduce the voltage provided by the potentiometer by increasing the resistance of the lower “arm.” These two effects, combined with those of

(Continued on next page)
applying a variable bias voltage to the first valve only. In this case the second valve should be of the "plain" H.F., pentode type, and it simply receives a fixed bias voltage. This system is not a good one, a certain bias voltage on the grid of the valve when the volume control is full on.

A Dual-function Volume Control

Another method of control which is extremely successful, although not widely used, is that shown in Fig. 5, where a single potentiometer is made to serve the double purpose of varying the bias voltage and also of imposing a variable "load" on the aerial circuit. Theoretically, this system is open to criticism, but in practice it is frequently found to be very valuable. The volume-control resistance has a much higher value than usual, because if it were of only about 2,000 ohms, say, it would tend to flatten the tuning of the first coil to a considerable extent. Being of about 15,000 ohms it does not produce this effect in any objectionable degree. The advantage is that as the amplification factor of the second valve when the volume control is full on, will provide a very well-graded control over volume, but it is desirable that the valves chosen should be of types which take a bias voltage up to 40 or so—in other words, they should be of the "long-base" variety.

Voltage Change

The fixed S.G. potentiometer is connected directly between high-tension positive and negative, so that the voltage which it supplies must vary to a certain extent according to the setting of the volume control and, consequently, according to the current passed by the screening grids. So long as "long-base" valves are employed, however, and provided that these are not normally required to function with less than about one quarter of the maximum bias voltage, the voltage change is so slight that it can generally be ignored. In any case, losses in this direction are adequately compensated for by the other more important advantages which have been enumerated above.

NOTES FROM THE TRADE

Cossor Valves

MESSRS. COSSOR announce the release of some new 6.3 volt A.C. mains valves with octal bases. These valves are of the miniature type, and accordingly are known as the O.M. series. Seven types are available, and they include an octode, a triode hexode, two H.F. pentodes, a double diode, and a double diode triode. Full characteristics of these and the entire range of Cossor valves may be found in the new leaflet No. L370, which may be obtained on application to Messrs. Cossor. This leaflet also gives the base connections of all the Cossor range.

Westalite Rectifier

A new type of rectifier is announced by the Westinghouse Brake and Signal Co., Ltd. This rectifier, the result of six years' research, is of the selenium compound type, and is intended primarily for power rectification. It is not intended to replace the copper-copper oxide rectifiers, but for a number of applications the new rectifier will be substituted. Priority at the moment is being given to Government requirements, and in future the term "Westinghouse Metal Rectifiers" will include both the copper-copper oxide and the new "Westalite" types. The Westinghouse Company also informs us that they have now arranged for their representative, Mr. E. R. Rogers, to be available for any assistance that may be required in Scotland in connection with their metal rectifiers. Priority communications for Mr. Rogers should be addressed to the offices of their Scottish Agents, Messrs. J. E. Robson and Co., 11, Bothwell Street, Glasgow, C.2.
A Handy Valve-rack

I WISHED to make a valve rack for the valves (batteries) which I am continually using. I obtained a box about 3in. high and covered the bottom with a pad of cotton wool about 1in. thick and covered this with a piece of linen. Any sort of pad would do, probably the best being one of sponge rubber. Then I placed at the ends of the box two pieces of wood about 1in. square running the length of the end, and about 1in. down. On to the underside of these pieces of wood I fixed some wire netting so that it covered the box. On the top of the bars of wood I fixed another piece of wire netting so that the holes came directly over the holes in the other piece of netting. Now the rack is complete, and it will be found that a valve rests nicely in the holes of the two layers of wire and on to the pad.—P. HALL (Rose-on-Wye).

Novel Tone Control System

THE accompanying circuit diagram shows a tone control arrangement which does more than merely subtract the unwanted frequencies when “highs” or “lows” are to be stressed. With this system high notes are “boosted,” low notes in another. To prevent tests of current flow of a volt or so pressure. An arrangement on a more ambitious scale is shown on the box, which is self explanatory. From this it will be seen that the spool for the coil is made from sheet brass, and is made in such a form as to also serve as a stand for the finished instrument. The spool is made of such size as to allow of a close fit for the compass, which can be slipped in, as shown, to form the complete galvanometer, and can be removed when normal use of the compass is required. Dimensions of the spool have been purposely omitted, owing to the large range of sizes of these pocket compasses.

The gauge and number of turns for the coil is a matter for experiment, but approximately 150 turns of about 40 gauge enamelled wire will be found to give quite good sensitivity. To facilitate easy connection, the two ends of the winding should be soldered to light flex leads. In use, the complete instrument is turned bodily, until the needle of the compass is parallel with the coil; in other words, the coil will be pointing north and south. When a current is passed through the coil the compass needle will turn at right angles to the coil.

The instrument described will be found to indicate the current flow of a few milliamps, although, of course, no actual check on the number of milliamps passing would be possible. Such actual readings are possible only with one or other of the many excellent commercially made milli-ammeters. However, for rough checking purposes, the home-made instrument described would be found quite useful, and is certainly of interest for the experimenter.

A point worth noting is that certain components in a receiver, such as L.F. transformers and chokes, and speakers will deflect the compass needle, if brought into close proximity, so in rough tests of anode current flow, it is best to fit leads of 3ft. to 4ft. in length, in order to keep the instrument clear of the receiver. Experiments might be tried of using tin plate in place of brass for the spool. This metal being magnetic, would automatically draw the compass needle in parallel with the coil, but would possibly affect the instrument’s sensitivity for small currents.—R. L. GRAPER (Chelmsford).

An I.F. Oscillator

BRING chiefly interested in superhet work, I was badly in need of an oscillator, and the accompanying circuit is one I constructed out of components from a “spare box.” It consists of a 175 kso I.F. transformer, centre tapped, with 50 turns removed from one end; the side with the smaller number of turns was made the plate side. To calibrate connect the output terminals to the A and E of a broadcast receiver tuned to a known frequency, and then tune the oscillator to the same frequency, keeping the signal just audible. Note the reading on the tuning dial. This operation has to be repeated several times and from the results a graph is drawn. From the graph drawn, the dial settings for a required frequency can be determined and by reversing the process of calibration the receiver can be adjusted. The oscillator was housed in a wooden box measuring 10in., 5in., and lined and perforated zinc. It is important that once the oscillator is calibrated, nothing be moved.—Roy C. E. MARTIN (Devonport).

SPECIAL NOTICE

All hints must be accompanied by the coupon cut from page iii of cover.

I have found this installation to be highly satisfactory.—L. BLAGBROUGH (Brighouse, Yorks).

An Easily-made Galvanometer

QUITE a neat and handy testing instrument (actually it is the simplest form of galvanometer) can be quickly made by fitting a winding of wire to an ordinary pocket compass. A few turns of enamelled or silk-covered wire, wound round the compass casing, will be found quite sufficient for rough tests of current flow of a volt or so pressure.

The gauge and number of turns for the coil is a matter for experiment, but approximately 150 turns of about 40 gauge enamelled wire will be found to give quite good sensitivity. To facilitate easy connection, the two ends of the winding should be soldered to light flex leads. In use, the complete instrument is turned bodily, until the needle of the compass is parallel with the coil; in other words, the coil will be pointing north and south. When a current is passed through the coil the compass needle will turn at right angles to the coil.

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Increasing Length of Life

It is well known that when an electron multiplier is built with electrodes of caesium on silver there is a high ratio of secondary emission for every primary electron bombardment. On the other hand, experiments have shown that these surfaces have the disadvantage of relatively high vapour pressures and low melting points. When used in an electron multiplier, therefore, in which the degree of vacuum is made as high as possible, there is a tendency for these surfaces to release a quantity of free ions. Not only do these ions interfere with the normal stream of electrons in its passage from cathode to final collecting anode, but there is the greatest chance to make an impingement on the target electrodes themselves. When this happens it brings about an additional stream of these ions on these surfaces and causes the coating to disintegrate and thereby ruins the useful working life of the complete multiplier. Steps have, therefore, been taken to avoid this defect and the most successful idea at the moment consists in shaping the electrodes to a special design. This shaping is of such a character that the positive ions are deflected away from the normal flow path of the main negative electron stream. They leave the electrode at an angle and are collected by a separate electrode before they have had any chance of doing damage to the target electrode surfaces.

A Screen Problem

There are many important problems associated with the fluorescent screen of a modern high vacuum cathode-ray tube and no matter for what purpose it is used the geometrical image or television picture built up on this surface should be sharp and clear out. Experience has shown, however, that due to the accumulation of casual electric charges on the screen there is a tendency to distortion of the main impacting electron stream and this produces a blurring effect, particularly if the tube is being employed for television picture reproduction. Any scheme which introduces a conducting material to equalise or dissipate these spurious charges is satisfactory, provided the fluorescent powder of the screen is deposited on this material. One very effective method is to use a screen backing covered with a thin but continuous layer of platinum. This is very useful to keep the screen free from charging, but all this difficulty is avoided because of the effective leakage path provided for the stray electric charges.

Reducing Tube Length

One of the fundamental drawbacks of cathode-ray tubes, especially the earlier model, was the very long length of glass container required in order to obtain the screen face of reasonable diameter. This was due in no small measure to the fact that the initial larger faced tubes were based on the design of the laboratory C.R.T. tubes of 5 to 8ins. screen diameter having a narrow angle conical taper and a long cylindrical neck housing the deflector plates, electron emitting cathode and one or more focusing anodes. Due to the demands for compact designs both in monitoring equipment, laboratory oscillographic apparatus and television receivers, designers at once set to work to reduce the overall length without cutting down the fluorescent screen diameter. This introduced many unexpected complications, for in the case of a television picture reproducer a limit is set between the distance separating the final anode, deflecting system and screen due to questions of scanning voltages, line curvature, etc. Some designers resorted to pyramidal glass envelopes instead of the more conventional conical ones, and as an example of the success which could be achieved in this connection reference can be made to the accompanying illustration. Here the tube is at least a foot in diameter, yet its length does not exceed the depth of the receiver chassis and so avoids that annoying rear projection cover which characterised so many of the sets put on the market last year. Another very effective suggestion which has been put forward, however, is to avoid the neck length which normally accommodates the cathode, pinch, and terminal cap. This is done by placing the pinch section in a right-angled projection to the neck a few inches remote from the end. The cathode only is then housed at the end of the shortened neck and from then onwards focusing and deflecting equipment is normal and an effective reduction in overall length is brought about.

Caught in Its Own Mesh

The much lauded American television service which came into being over a year ago and which the authorities claimed would make that country the leading one in the world has, quite frankly, proved a big failure. This seems to be attributable to the fact that the Official R.M.A., the Federal Communications Commission and the leading television manufacturers themselves all had different ideas on how the service should be run and the picture standards that should accompany it. It has been pointed out that in the U.S.A. the broadcast, as in America, is a factor on which no one seems prepared to voice an authoritative opinion.

A Novel Meter

The modern forms of meter can be relied upon for making measurements of most things whether they depend upon electrical or photo-electric phenomena. A new device has been produced, however, which by an ingenious arrangement of two photo-electric elements enables the reflection factor of an illuminated screen to be read off directly from a calibrated scale. In so far as a cinema or television screen is concerned the factor is measured as the power of the screen to reflect the incident light back to a point—say the middle of the screen—where the iridescent spots is measurable distance from the screen. This measurement will naturally be confined to a comparatively narrow beam of light and so differs from the methods of measurement mentioned earlier. The meter itself is therefore arranged with its sensitive elements in such a way that one unit responds to light from a narrow angle (brightness) and the other to light from a wide angle (illumination). The ratio of these two quantities is the reflection factor which is shown clearly on a scale.
Oscillator Tuning

The Merits of the Standard and the Shaped-plate Tuning Condenser are Considered and Compared in This Article

Constructors sometimes desire to build a superhet, but are undecided whether to use a ganged tuning condenser to employ. In other words, shall it be a condenser of standard plate shape, as used in the tuned radio-frequency receiver, or shall it be one which has a special plate-shape section for tuning the oscillator circuit of a superhet?

Most constructors are familiar with the principle of the superhet receiver; how the locally generated oscillations are mixed with the incoming signal, and a new frequency—the intermediate frequency—is produced and passed on to the grid of the second detector. This principle applies in all cases, whether a separate oscillator valve be used or one of the new single-valve frequency changers. It is also common knowledge that the oscillator frequency should differ from the signal frequency by an amount which is equal to the peak frequency of the intermediate-frequency amplifier which is now standardised at 465 kc/s in this country.

A transmitter can be tuned in by adjusting the frequency of the oscillator circuit either by 465 kc/s above or below the signal frequency, provided, of course, we are not employing ganged tuning control for the oscillator circuit.

Now it has to be borne in mind that, although no difficulty is encountered in obtaining this frequency sum or difference, when the circuits are tuned to one wavelength or frequency, this position is vastly different, since when on the medium waveband alone we have to tune in stations on frequencies from 300 to 1,500 kc/s representing 200 to 550 metres.

Frequency Difference

When the signal frequency circuits are tuned to any one station on the medium waveband, the tuned oscillator circuit must be so arranged that the frequency generated by it is either more or less than the signal frequency by 465 kc/s, irrespective of the frequency of the station being tuned in within limits mentioned.

In practice, designers arrange the oscillator circuit to tune to a frequency higher than that of the incoming signal (that is, to a lower wavelength), consequently the inductance of the oscillator coil must be lower than that of the inductances in the signal-frequency circuits. This gives us the required frequency difference at one point, but unfortunately does not permit of a constant frequency difference being maintained over the whole of the tuning scale.

Our object, therefore, is to devise some means whereby this frequency difference is maintained at all positions of the tuning condenser if we are to obtain satisfactory results.

Two methods are actually employed in practice to achieve this result, and these will now be discussed. An appreciation of their advantages and disadvantages will enable us to determine which system is the most suitable for the particular receiver we have in mind.

Matching Frequencies

With the padding condenser method a ganged tuning condenser is employed in which the capacity of each section is equal at all points in the tuning scale, and it has a maximum capacity in each section of 0.0005 mfd.

Now adjust the tuning condenser until a station at the top end of the medium waveband is received at, say, 590 kHz (900 metres). At this point the moving vanes of the tuning condenser will be nearly fully extended and consequently near their maximum capacity. Do not touch the trimming condenser; its capacity is very small in comparison with the maximum capacity of the tuning condenser. At this point we adjust the series condenser C2 in the oscillator circuit; this will alter the maximum capacity of the tuning condenser.

Eventually it will be found that ganging will hold quite satisfactorily over the whole of the tuning scale. When coils are accurately matched, no adjustment is usually necessary on the long waveband. It is, however, necessary to employ an additional padding condenser to maintain accurate ganging on the long waves. This condenser is switched out when receiving medium-wave stations, and Fig. 3 shows the usual arrangement of the oscillator circuit.

Special Condensers

With the special plate-shape ganged condenser system only one padding condenser is required—for the long waveband. Theoretically perfect ganging can be obtained over the whole of the tuning scale. The inductance of the oscillator coil has now been standardised at 325.5 microhenries for the medium waveband when coils in the signal-frequency circuits have an inductance of 157 microhenries.

If you examine a triple gang tuning condenser, which has specially shaped vanes for tuning the oscillator circuit, it will be noticed that the fixed vanes of the oscillator section have been cut away so that it follows a different law and so maintains a constant frequency difference over the whole of the waveband.

Practically the same methods should be adjusted to ensure perfect ganging as described for the standard plate shape system.

Tune in a station on the lower medium waveband, and adjust oscillator trimmer so that about a half of its capacity is used. Then turn to the trimmer in the signal-frequency circuits and adjust for maximum response. Next tune in a station, as before, at the top end of the medium waveband but as we have no series condenser to adjust, in this case we slightly adjust the oscillator trimmer.

In both cases discussed it will be noticed that the oscillator trimmer of the trimmer has been cut away, but here, the other circuits will appear relatively flat in comparison. In carrying out these adjustments it may be necessary to tune the dial at the same time to keep circuits in resonance.

(Continued on next page.)
When results are satisfactory on the medium waveband, switch over to the long waveband. A long-wave padding condenser is necessary, as with the other system, and if this is of the semi-variable type, it may be advisable to make slight adjustment. Tune in a station at the top end of the waveband and adjust padding condenser, at the same time rocking the tuning condenser back and forward very slightly. This completes the ganging, and results should be quite satisfactory. Sometimes, however, it may be necessary to adjust trimmer slightly in the middle of the medium waveband.

Fig. 4 shows the circuit arrangement employed which differs from the previous circuit as no medium-wave series padding condenser is employed.

It is essential to bear in mind that, irrespective of the method employed, unless accurate ganging is achieved, many of the advantages of the superhet circuit will be lost. Second-channel interference and harmonics and whistles may become very troublesome.

We are now in a position to review the relative merits of the two systems; both have advantages and disadvantages. If the constructor possesses a standard ganged tuning condenser, there is no reason why it cannot be employed in a superhet receiver.

The advantage of this method is that the tuning condenser can be used in either a superhet or tuned radio-frequency receiver. An additional padding condenser is, however, necessary, and it is not quite so simple to adjust the circuits for accurate ganging.

The special plate-shaped method is the ideal arrangement. Ganging is fairly simple to carry out and excellent results can be obtained without complications. Only one padding condenser is necessary for the long waveband.

There is only one disadvantage and this does not affect the operation of the superhet concerned; the condenser cannot be used either in a straight receiver or in a superhet employing an intermediate frequency for which it was designed.

Grid-blocking

In order to avoid the distortion known as "grid-blocking" indicated by a straggling effect, it is important that the time-constant shall be short compared with the shortest interval likely to be experienced between two successive oscillations. As modern amplifiers and speakers often show a good response as high as 12,000 cycles, the problem is not an easy one.

In practice it is customary to tolerate a little grid-blocking in order to preserve the lower frequencies; furthermore, this trouble is rarely noticeable unless the signal is loud and the time-constant very high. A good rule is to choose a value of leak and condenser which will give 90 per cent. of the theoretical amplification at 50 cycles. Such a combination will have a time-constant of approximately 0.0066, and any values of leak and condenser may be chosen to give this product, with the reservation as to too high a resistance.
A.V.C. Circuits

Some Interesting A.V.C. Arrangements which the Experimenter Can Try

As most readers now know, there are various ways of obtaining the A.V.C. effect, the most usual being by means of a diode rectifier associated with the normal detector stage. This diode may form part of a double-diode triode valve, or it can be separated as, for example, when a Westector is used for this purpose. The H.F. voltage applied to this diode circuit by the carrier is rectified, and fed through suitable filters as a negative grid bias to the grids of one or more pre-detector amplifying valves. For example, in the circuit shown in Fig. 1 the heptode VI and the variable-mu S.G. valve V2 are controlled by the A.V.C. bias voltage.

V1 and V2 an increase of A.V.C. bias will tend to reduce the amplification, and also the carrier voltage applied to the A.V.C. diode and the signal diode.

Obviously, if the A.V.C. system has a sufficiently wide range of control, a constant peak carrier voltage will be applied to the signal diode D2 which feeds the L.F. amplifier, and this peak carrier voltage will be equal to the D1 diode delay voltage. When the carrier voltage is insufficient to operate the A.V.C. system the receiver operates at full efficiency.

It should be mentioned that the principle of controlling a diode rectifier by applying a bias voltage should be noted as it is of primary importance in the use of diode rectifiers in general. For not only can the action of a diode be delayed, that is to say made inoperative on weak signals, by applying a negative bias, but by the use of positive bias the diode action can be accelerated and made sensitive to very weak signals.

Increasing Sensitivity

A positive bias equal to the filament voltage is applied to the signal diode D2, shown in Fig. 2 by returning the 1-megohm load resistance to L.T.−. This increases the sensitivity of the diode, and of the receiver on a whole to very weak signals. Fig. 2 also shows the method of applying a delay voltage to the A.V.C. diode in a battery receiver. The effect of biasing a diode is the same as that of varying the grid potential of a leaky-grid detector, and can be applied to a Westector as well as a valve-type diode.

It will be clear that the L.F. amplifier of an A.V.C. controlled receiver should be so designed that when the peak input to the L.F. from the detector is equal to the A.V.C. delay voltage, the full output desired is obtained without the L.F. volume control being reduced appreciably. The A.V.C. system will then hold all stations received at the maximum undistorted output, or less. As previously explained, this is the desired effect.

Many receivers incorporating A.V.C. have not fulfilled this requirement, with the result that the A.V.C. action has only been obtained with the L.F. control reduced considerably. As in most cases of this type, only very strong stations are receivable with the L.F. volume control reduced appreciably so that the A.V.C. action has occurred when it is least required.

3-valve Superhet

The combination of a double-diode with a high-eficiency output pentode as output valve makes a three-valve A.V.C. superhet with a very good A.V.C. characteristic possible. A receiver of this type

(Continued on next page)
How Frequency Modulation Works

In our issue dated June 15th last we gave some details of the new transmission system known as Frequency Modulation. In the illustrations accompanying this article, however, two of the curves were transposed. To remove any confusion which may exist the curves are reproduced below, in their correct order. It is hoped that these curves will give them a line to work on, and help them to effect some improvement.

(a) Is a radio carrier wave of constant amplitude; and (b) is a proportional or audio wave for modulating (a).

(c) is the carrier and audio wave combined in Amplitude Modulation, whilst (d) is the same combination in Frequency Modulation.
I have tried to show how music reached a culminating point in Beethoven, and how his towering genius and mighty output were at least partly responsible for the developments which took place after his death. The very exhaustiveness and comprehensiveness of his message, together with the spirit of the age, forced composers into what is now termed the "romantic" school of writing.

I will now offer some brief biographies of the leading figures of the movement, together with short sketches of their work.

**Mendelssohn**

Felix Mendelssohn-Bartholdy, born in 1809 at Hamburg, was the son of a Jewish banker who embraced Christianity. Favored with most things that money can buy, he here shows an exception to the usual run of the great composers. But the amenities of an opulent upbringing, to the usual run of the great composers.

He wrote four symphonies, two of which are noted "Italian" and the "Scotch," which was written on strict sonata form, are imbued with a romantic programme, as their titles would suggest. They are very charming, and have well held their places in the concert repertory.

The Violin Concerto is another masterpiece, and is incomparably superior to the one he wrote for the piano. In fact, all his piano music is poor by comparison with such great contemporaries as Chopin, Schumann, and Liszt, though a few numbers keep their place in the pianist's repertoire.

Some of his organ music are classics for that instrument, and he wrote many beautiful songs, notably the "Ode to Godot" and "Walpurgis Night." The catalogue is completed by some excellent chamber music, chief of which is the famous Octet.

Mendelssohn's fame has suffered the extremes of fortune. At some times nothing derogatory dare be said of him, whilst at others not a good word, would be listened to. To-day he has probably reached his equilibrium. "Elijah," the "Violin Concerto," and the "Midsummer Night's Dream" music, ensure his great favourite here and was much admired by Queen Victoria and the Prince Consort—and Italy, and then settled in Germany. He founded the Berlin Gewandhaus Orchestra and took over the direction of the famous Gewandhaus Concerts there. "Elijah," which is probably only second in popularity to the Messiah among sacred works, was first produced at Birmingham in 1846.

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often allowed such an unbridled licence as to make the very atmosphere itself seem overcharged, Schumann always keeps them under the most beautiful control. It was music of an entirely new order, but obviously showing the greatest respect for its classical forbears.

His piano works seem to be built up of an exquisite patchwork whilst the material used is absolutely original. Closely woven and almost continuously contrapuntal, he eschews the extreme compass of the piano in a much greater degree than his contemporaries. In his shorter works the higher and lower octave are hardly called upon at all.

He frequently built his themes up on a remarkable "cryptographic" method, as in the wondrous "Carnival," where we have the presentation of his famous society of the "Davidshunder," who were genial and artistic spirits banded together to resist the Philistinism of the age. He attaches fancy names to the movements, such as Florestan and Eusebius (which refers to Schumann himself in his dual nature of the gentle and the rough), Chiarina (representing his future wife, Clara), Chopin, Eragon, etc., and the letters ASCH and SCH come sphinxes. They are taken from Schumann's own name and represent the following notes in German:

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These two tiny themes recur in the course of the work almost as frequently as do the opening notes in Beethoven's "Fifth."

Schumann wrote four symphonies, some splendid chamber music, the music to Byron's "Manfred," a poor Violin Concerto which, conscious of its feebleness, neither he nor Clara allowed to be performed in their lifetime, and some marvellous songs which, in deep sentiment and intellectuality, rival Schubert's.

In all this music Schumann left a treasure-house to posterity, and pianists are especially in his debt for some of the greatest masterpieces in their repertory.

### A Simple Mixer

Details of an Add-on Component to Facilitate the Mixing of Two Audio Signals

A FEATURE of most B.B.C. programmes is the novel mixing or fading process, whereby musical items, or music and speech or sound effects are interwoven or introduced. Special "faders" or "mixers" have been placed on the market to enable the amateur to carry out a similar scheme, but it is possible to do this without special components.

The simple method described below enables the amateur to do all the "fading in" and "fading out" stunts in the approved broadcast style, by merely adding an additional potentiometer, either in the receiver itself or externally.

Fig. 1 shows the way in which radio reception may be mixed with gramophone record reproduction, the extra connections, though simple, should be observed carefully.

![Fig. 1](https://example.com/fig1.png)

**Fig. 1.** A simple fading circuit for radio and gramophone.

R1 is the usual volume control for the secondary of a low-frequency transformer, R2 is the pick-up input potentiometer, having a value of ½ megohm; other values may be used, but the reason for this particular value will be pointed out later.

One end of R2 is connected to the moving contact of R1, which in turn goes to the grid of the valve. The other side of R2 goes to earth (it is assumed that A.C. valves are being used), though the same connections apply in the event of a battery set, the only difference being that the grid of the valve is biased through the resistance R1.

Switches Eliminated

It must be appreciated that the normal volume control serves the total input to the grid of the valve of both radio and record reproduction, the amount of radio broadcast coming through being adjusted in the H.F. or detector stages, of course, and the amount of pick-up reproduction controlled by the potentiometer R2.

Apart from the amusement that can be had in changing over from radio to gramophone in this fashion, it is a great convenience over the more conventional way of switching. It might be as well at this stage to mention that the input potentiometer R2 will have no effect on the operation of the set in the usual way, provided the value chosen is not less than ½ megohm and the volume control on the set 50,000 ohms. Any other values can be used, but it must be seen that the resistance R2 has a value approximately four times as great as that of the normal volume control.

For those who use piezo-electric pick-ups this is an ideal way of putting the pick-up in circuit as, due to the fact that this particular type of pick-up has a very high impedance, it is necessary that it should have across it a resistance of not less than ½ megohm. It will, however, be seen that in the circuits under discussion the maximum resistance is only across the pick-up when the control R2 is fully open. hence it follows that there is going to be a change in the frequency response as the record is faded in; this is not by any means a serious disadvantage; as the total volume can be altered by R1.

### Fig. 3

In this arrangement signals may be superimposed on those present at the grid.

![Fig. 3](https://example.com/fig3.png)

**Fig. 3.** In this arrangement signals may be superimposed on those present at the grid.

For Public Address Work

The versatility of this little scheme will now be obvious, and should have particular interest to the amateur P.A. worker, where a microphone is being used either for announcements or band-repeating where it is wished to fade-in an alternative programme of music, either of radio or gramophone reproduction. Fig. 2 shows the necessary connections to the grid input of the first stage of the amplifier.

**Fig. 2.** This mixer arrangement enables music and speech to be mixed.

NOW READY

**RADIO ENGINEER'S POCKET BOOK**

By F. J. CAMM

Vest pocket size

3½, or 3½d by post from George Newnes, Ltd.

(Book Dept.), Tower House, Southampton Street, Strand, London, W.C.2.
Why Use an Aerial?

In this Article the Author Discusses the Utility of the Aerial

SOME time ago much was made in advertisements of commercial receivers which enabled the user to dispense with an aerial. In view of the contrapositions one sees deprecating the sky-line, I heartily agree with the movement to abolish the aerial, but I still maintain that efficient results, with high quality, demand an efficient aerial and earth system. Wherever there is a difference of opinion on the subject it is either being viewed from different angles, or there must be sufficient grounds to substantiate the various opinions.

Let us, for clearness’ sake, look upon our receiving apparatus as a simple machine having work to do. By the most elementary law of mechanics the output of a machine is dependent on the input it receives, while the comparison between the output and input will denote the efficiency.

Efficiency

Supposing the output is greater than that required for our needs, then it is obvious that the input can be decreased, or, better still, a smaller machine used with greater overall efficiency, owing to the possible causes of losses being reduced. This being so, the running costs will likewise be reduced, together with the number of sources of trouble and possible breakdown.

If the comparison holds good, it would seem that the most logical thing to do would be to make our input as great as possible, design efficient receivers employing fewer valves, and pay particular attention to the efficiency and appearance of our aerials.

It is also known that some people, who are not enthusiasts or constructors, only require the local stations, while there are others who have a horror of any outside aerial because of the fear of spoiling the appearance of their garden or residence. These are exceptions, and, if they are content with the results they do obtain, and the apparatus they have to employ, I would not suggest that they make any alterations.

Indoor or Outdoor?

Indoor aerials, of the home-made variety, and many of the commercial types, have their uses, but it can hardly be claimed that their efficiency is comparable to that of a good outside aerial. There are many who will say that an indoor aerial has certain advantages, while others will most emphatically state that an outside aerial is not all that can be desired under the present broadcasting conditions.

To these I would say, make your aerial as efficient as possible, and then pay attention to the design of your receiver. A good commercial indoor aerial is often better than an outdoor aerial, unless the latter is sited high and is of fair length.

An efficient aerial demands low losses, high electrical efficiency, low self-capacity, and low high-frequency resistance. A properly designed outside aerial has all these qualifications, while the average indoor arrangement is notable for the exact opposite features.

In the first form it is an easy matter to obtain ample insulation, and to obtain a good electrical circuit needs very little care, while the correct self-capacity and low H.F. resistance can be secured by no further trouble than a little attention to the location of the wire and its size or formation.

Now, with the second form low losses will become high losses; for various reasons. Greatly reduced pick-up of the signal, losses through heavy damping and high self-capacity, while it is highly probable that the H.F. resistance will be appreciably higher. Here again there are exceptions.

The resultant effects are obvious; the indoor aerial will sometimes call for greater use of reaction or other boosting effects, with consequent losses to the quality of reproduction. Some receivers are likely to become unstable, owing, in certain cases, to the absence of the correct aerial load across the grid circuit. It will be most unsuit for good short-wave reception, while electrical interferences are likely to be pronounced, and, last, but by no means least, more valves will be used than efficient conditions would require.

Let us now examine the alleged drawbacks of an outside aerial. With regard to appearance there is a strong argument in this point, but there is no need for an aerial to be an eyesore. The whole thing only calls for a little care and consideration in the selection and fitting of the necessary gear. It is necessary to pay attention to details, to have everything taut and neat.

The next points are, overloading and selectivity. These can be dealt with in a much more satisfactory manner with an outside aerial than with an inside one, provided the system is properly designed and the receiver is capable of coping with present broadcasting conditions. In these cases, the aerial will help to cover up the inefficiencies in a receiver, but it cannot be expected to give complete compensation.
**Indirectly-heated Rectifier**

"I am building the Experimental 6-watt amplifier described in your issue dated March 9th last. Could you give me the type number of an indirectly-heated rectifier instead of the directly-heated valve mentioned? Is there an extra pin on the existing coil, and about 10 turns will probably be found effective. The top of this new winding is joined to the aerial and the bottom of the winding is joined to earth.

We wish to draw the reader's attention to the fact that the 'Queries' Service is intended only to give the reader of 'Practical Wireless' some help in arriving at the construction of receivers described in our pages, from articles appearing in our pages, on practical matters. We regret that we cannot, for obvious reasons—

(1) Supply circuit diagrams of complete receivers.
(2) Suggest alterations or modifications of receivers described in our periodicals.
(3) Suggest alterations or modifications to aerials.
(4) Answer queries over the telephone.
(5) Grant interviews to journalists.

A stamped addressed envelope must be enclosed for the reply. All sketches and drawings must be enclosed. The coupon must be enclosed for the reply. A stamped addressed envelope must be enclosed for the reply. All sketches and drawings must be enclosed. The coupon must be enclosed for the reply.

The connection you suggest is not suitable, as it may provide all the volume that is needed. If I just release the 60v. lead goes to earth, you will probably find that the secondary of the mike transformer may be joined across the L.F. volume control and this may provide all the volume that is needed. The connection you suggest is not suitable, and even if you included the transformer, the rectification process will probably still be very low and you would probably obtain only the weakest of signals.

**Intermittent Fault**

"I am using a superhet with a peculiar fault. The receiver suddenly goes very quiet, sometimes with a plop, but mostly just goes off. If I just release the 60v. lead for a second the receiver is quite all right for a time, but this goes on a lot. I have had valves tested and passed O.K. I have had a transformer with a double secondary made up, the two passed O.K. Coils have been tested, but still no cure."—W. M. (Mitcham).

There are many intermittent faults that may give the same sort of symptoms, but I am not afraid to think that there is one signal (above audibility) or the oscillator stage has gone out of order. Removal of the H.T. enables the stage to settle down, with the result that signals are restored when the load is replaced. We therefore suggest that you insert a good milliammeter in the anode circuits of the valves in question and watch the anode current. It should be borne in mind that oscillation is indicated by a fall in anode current, and therefore if one stage goes into oscillation the current will fall, and if the oscillator stage ceases to operate the fall is indicated by a rise in the current reading.

**Crystal Set Selectivity**

"I have a crystal set I have built (circuit enclosed), but I find that when one station is received the other station is heard in the background. The stations are the Home and Forces. Being a newcomer I am unable to cut out the unwanted station and would like to know how to do so. Does this make any difference?"—F. B. N. 13.

The use of a single-circuit tuner with a crystal set generally introduces selectivity difficulties, especially in your locality. The most effective way of obtaining the desired station separation, without loss of signal strength, is by means of a wavetrap. This is a coil exactly the same as the one you are now using, with a .0008 tuning condenser across it. The aerial is joined to one of the tapping points on the wavetrap former and dispense with the two-pin plug-in system. It would, of course, be possible to wind separate coils on lengths of former and fit two pin bases if you have these or can obtain them. You can adopt the rule that the number of coil indicates the number of turns on a 3-in. diameter former. For the larger coils you will, of course, have to adopt a pipe-wound formation, either separating the total coil into four or five sections, with cardboard discs or similar method of keeping the sections separate, and enabling the wire to be piled up without occupying too much space on the former. The reference X in the coil indicates that the winding is tapped, the tapping points being made at the centre and at a point one third of the distance from the earthed end of the coil. When using the coils make certain that all windings run in the same direction.

**Microphone Connections**

"I have a commercial communications receiver and wish to use a microphone with the same, but wondered if it could be connected in the usual manner between the grid of the output valve and earth. If so, is the top-cap connection to remove or is the microphone attached regardless of the top-cap connection (the output valve being a type 41). I have gone back through my copies of this issue and cannot find no reference to connecting microphones in multi-valve circuits."—R. S. B. (S.E.13).

In general, a microphone may be regarded as a pick-up. The only difference is that the pick-up may be joined direct, whereas the microphone has to be fed through a transformer, the secondary of which is connected to pick-up terminals and a battery being joined in series with the microphone and the transformer primary. It is generally found, however, that the output from the simpler types of microphone is lower than that from a standard pick-up, and accordingly a greater amplifier is needed. Without details of the circuit of your receiver we cannot give the exact circuit, but you will probably find that the secondary of the mike transformer may be joined across the L.F. volume control and this may provide all the volume that is needed. The connection you suggest is not suitable, and even if you included the transformer, the rectification process will probably still be very low and you would probably obtain only the weakest of signals.

**Replies in Brief**

The following replies to queries are given in abbreviated form, as a save-guard against confusion and repetition. The reply is written in the writer's own words.

E. Y. T. (S.W.19). The Listener's 3-watt Amplifier blueprint WS.398 would be suitable for your purpose, but you must remember that a crystal pick-up needs a parallel resistance or equivalent device to complete the grid circuit.

R. M. (Swindon). We regret that we have no data now available concerning the connections of the coils in question and the makers are no longer producing the components.

E. V. Q. (Bath). It is sometimes possible to combine the transmitting section, but the main difficulty is the greater power of the valves over the antennas, which draw current from the mains. We have no data of the particular converters you mention, and the best plan is to follow the recommendations of the makers of the sets in question.

S. O. (Lr. Weston). The matter is under consideration by the makers. We have no details now available. We think you will find that if a microphone is tapped and the tapping is returned to cathode of the microphone then this will provide the correct method.

G. V. F. (Chichester). Sixty volts for the H.T. and more than 4.5 volts for B.H. should be quite satisfactory.

The coupon on page iii of cover must be attached to every query.
Fleet S.W. Two

Sir—I was particularly interested in the remarks of Mr. J. Gordon, of Chesterfield, in your issue of July 6th, containing the Fleet S.W. Two, as I have also had very satisfactory experiences with this small set. I fully endorse the remarks concerning its efficiency, and had I not been intrigued by the description of the Kestrel 3-A.4 Receiver, is doubt whether I would have made any change.

I do not know whether Mr. Gordon made any alterations to the original circuit of the Fleet, but I did find that a slight improvement could be obtained by reducing the value of the detector anode resistance to 60,000 ohms.

Regarding the Kestrel, I made the three-valve section first, and was frankly amazed at the results obtained, and later, when finances permitted, I added the fourth valve. The results to have been shown me what can be done with a well-designed straight H.F. circuit, and, although I know that a superhet receiver has certain advantages, I think it will be a long time before I forsake my present receiver.

J. Hareleigh (Williton).

For the Beginner

Sir—Might I, as a newcomer to radio, thank you for the articles you write in Practical Wireless from time to time under the heading of “For the Beginner.” While I fully appreciate that the majority of your readers are, no doubt, advanced studies, I would like to suggest that others wishing to utilise the information, would be thankful to have the results of the tests that are not always directly related; thus we again hear “Calling test forty!”—C. Beckford (Hull, Yorks).

While I fully appreciate that the majority of your readers are, no doubt, advanced students, I wish to improve. I purchased this and added it to my receiver. I have also had very satisfactory experience with the Kestrel, and I have also heard “Calling test forty!”—P. J. Howwood (Abbey Wood).

[What do readers think of this suggestion?—Ed.]

Back Number Wanted

A Reader, H. Ward, of Lea Hurst, Watnarrow, Lincs, will be grateful if any reader could oblige him with a copy of Practical Wireless of May 3rd, 1940, concerning the Fleet Short-ware Two, as he would like to try it in the near future.—AREADER, H. Ward, of Lea Hurst, Watnarrow, Lincs.

Correspondent Wanted

A. E. Godier, 6, Woodford House, Woodford Road, Shawcross, E.18, is anxious to get in touch with a local radio enthusiast who makes his own apparatus.

Pure Problems

PROBLEM No. 409.

Barnes had a small resistance-capacity coupled two-valve battery set which he wished to improve. He found a market stall selling old components, all guaranteed, and amongst them was an old L.F. transformer. He purchased this and added it to his receiver in place of one of the R.C.C. units, but could obtain no signals. Where had he gone wrong?

Solution to Problem No. 408.

The photo-cathode pick-up needs a resistance shunted across its terminals. Marshall overlooked this, as the magnetic type of pick-up which generally had its own volume control incorporated and accordingly this was removed with the pick-up. There was only one correct solution to Problem No. 407 and a booth has accordingly been forwarded to G. Martin, “Lynton,” Found Road, Burledon, Southampton.
 Impressions on the Wax

A REVIEW OF THE LATEST GRAMOPHONE RECORDS

THIS month the Decca Company have assembled an all-star cast for the making of two records which literally put history on record. On two 12in. discs, this company have recorded all the events that led to the Munich crisis of 1938 and all the world-shattering happenings of last autumn. In a dramatic documentary style the story brings vivid life to the dignified words of world statesmen in these critical times. In turn you hear Chamberlain, Hitler, Mussolini and Daladier. In fact, all the leaders of those thrilling times are present in their own words and voices. The records thus offer an unparalleled insight into current history not only for people of the present day but for a new generation of all times. The guiding spirit behind the idea is journalist Dick O'Connor, who is editing what Decca hopes to make into a series. The commentator, Mr. Kent Stevenson, has drawn on his association with a crew of West-End actors.—Decca K 926-7.

Ballads

ONE of the most marked tendencies of the war has been towards a revival of interest in old ballads—particularly among record enthusiasts. Decca have contributed a great deal towards this by bringing such great artists as Alfred Picayou, who is known as the "English Troubler," out on their two-shilling label. He sings "Thanks for Your Love" on Decca F 7492. This month they offer the first record by Margaret Eaves, one of the stars of "Gosport Theatre," a soprano who is rapidly becoming radio's most popular singer. She has chosen "I'll Walk Beside You," for her first record and has coupled it with "I Love the Moon" on Decca F 7513. Frank Ryan has two Irish songs on the same label. "Macushla" and "The Lark in the Clear Air"—Decca F 7528.

Remember the Insect Play? Well, Billy Mayerl has now written a little suite of insect music. He calls it "Insect Oddities." First we have "Wedding of a Ant," and "Ladybird Lullaby." Then come "Cricket" and "Bees in the Bottle"—all for 2s. on Decca F 7512.

No character has sprung into the public's fancy so rapidly before as has Jack "Blue Pencil" Warner, and yet it is not his own words and voices. The records thus offer an unparalleled insight into current history not only for people of the present day but for a new generation of all times. The guiding spirit behind the idea is journalist Dick O'Connor, who is editing what Decca hopes to make into a series. The commentator, Mr. Kent Stevenson, has drawn on his association with a crew of West-End actors.—Decca K 926-7.

Brussels

T HIS company have just released two new albums devoted to George Gershwin which contain a happy mixture of old favorites and tunes scarcely known in this country at all. The first record in the first album is by Bing Crosby, who sings "Somebody Loves Me," and "Maybe."—Brunswick O 2986. Then come two keyboard duettists Yray and Braggiotto, who play two tunes from "Of Thee I Sing" and two from "Funny Face"—Brunswick O 2987. "Summer Time" from "Porgy and Bess" is sung by Anne Jamison, who has chosen "Looking for a Boy" as a coupling on Brunswick O 2988. The Merry Maids go to town with "I Got Rhythm" and "Glog Yo' Hands" on Brunswick O 2959, while Shirley Ross has made a recording of "That Certain Feeling" and "Mine," on Brunswick O 2990.

Connie Boswell opens up Album No. 2 with "They Can't Take That Away from Me" and "Soon"—Brunswick O 2990. Next number contains "Lady be Good" and "Bidin' my Time," by the Four Sons. Brunswick O 2993 brings us to Judy Garland and the first hit ever written by Gershwin—"Swanee." The coupling is "Embraceable You." Finally, there are two sides each by Frances Langford and Tony Martin. Frances has made the best yet recording of "The Man I Love" and on the reverse side is "Someone to Watch Over Me" on Brunswick O 2994. Both the Tony Martin sides are from "The Song of the Flame." One side has the same name and the other is "Oaskell Love Song."—Brunswick O 2995.

Yet two more of to-day's popular songs ove their main themes to Tschaikovsky melodies. "When Night is Blue" is one of them, sung by George Melachrino on Decca F 7523. "On the Isle of May," which is the other one, is by Connie Boswell on Brunswick O 3005. This lovely song has been adapted by André Kostelanetz from the famous Andante Cantabile which occurs in the great Russian composer's String Quartet in D Major.
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