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B.V.34, PRACTICE QUESTIONS

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* Prices do not apply to U.S.A.
* Characteristics measured at -5 grid volts.

Prices do not apply to I.F.S.
OPERATING THE £5 SUPERHET FROM A.C. AND D.C.

The £5 Three-valve Superhet—
Good News for Mains Users

Users of D.C. and A.C. mains and owners of eliminators will be delighted to learn that Mr. F. J. Camm's £5 Superhet Three will be produced in special versions to meet their special needs. There will be a D.C. version, an A.C. version, a model employing Universal valves, and, additionally, its operation by means of eliminators will also be dealt with. For identifying purposes only it will be necessary to retain the designation title. It will be appreciated, of course, that these mains versions will give rise to variation in prices of the components. The designer will, of course, produce these mains versions as cheaply as is compatible with efficiency.

Index and Binding Cases for Vol. 4

Now Ready

Those readers who bind their copies of "Practical Wireless" will be pleased to learn that indexes for Volume 4 can be supplied for 2s. 9d. post free, and that binding cases (including index) can be supplied for 2s. 9d. post free, from George Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2.

Our Companion Journals

Readers of "Practical Wireless" should make a point of placing regular orders for our companion journals, the Practical Motorist, 3d. every Wednesday; Practical Television, 6d. monthly; and Practical Mechanics, 6d. monthly. For only 6d. per month you can learn all there is to know about the latest developments in this newest of sciences from Practical Television, whilst Practical Mechanics deals with every field of mechanical and scientific thought. The Practical Motorist is the paper for the owner-driver.

The Television Committee

It has been announced officially that the Television Committee have now made good progress in sifting the evidence presented to it. Before formulating any definite proposals, however, they have deemed it advisable to visit America and Germany in two separate parties in order to become acquainted with the television progress made in these two countries. A return to this country is not expected until towards the end of November, so the report will inevitably be delayed, and it seems unlikely that anything will be heard until 1935.

"The Microphone at Large"

The third of this series will be heard from Tewkesbury Abbey on November 10th. The programme is arranged by Walter Pitchford, who was the narrator in the Midland Cathedral series last year, and Owen Reed; it will include change-ringing by the Diocesan Guild of Ringers, and music from both the organs. The bells are a peal of twelve, completed this year by Taylors, of Loughborough, as a memorial to the Reverend Charles Davies, a native of Tewkesbury, who is regarded as the father of modern change-ringing. The larger organ was originally built for the Inventions Exhibition of 1885, and was given to the Abbey as a Victoria Jubilee Memorial in 1887. Milton, the poet, played the smaller organ at Harris of York when it was at Hampton Court. Tewkesbury Abbey, dedicated in 1123, is famous for its Norman work.

Sibelius Concert

On November 15th, the City of Birmingham Orchestra is giving a Sibelius Concert which includes the Symphony in A minor, and the violin concerto—with Arthur Catterall. Leslie Howard will conduct this concert, which will be relayed from the Birmingham Town Hall. A talk on Finland will occupy the interval.

Brigade of Guards Bands at the Cenotaph

Broadcast of the Armistice Day ceremony at the Cenotaph, London, on November 11th, will start at 10.30 a.m., when the Brigade of Guards will play the following: "Heart of Oak"; "The Minstrel Boy"; "Lament of my Fathers"; "Isle of Beauty"; "David of the White Rock"; "Land of the Leal"; "Skye Boat Song" (pipes); "Oh in the Stilly Night"; "When I am laid in Earth" (Purcell); "Solemn Lament" (Walsh Davies); "Flowers of the Forest" (pipes), and "Funeral March" (Chopin).
The Royal Wedding

The B.B.C. have received permission to broadcast the wedding of His Royal Highness the Duke of Kent and the Princess Marina at Westminster Abbey in the presence of Their Majesties the King and Queen, on November 29. The service will be relayed in its entirety. The scenes outside the Abbey will be described by Howard Marshall before and after the ceremony. The service and the commentaries will be broadcast from all B.B.C. transmitters, including the Empire station at Daventry.

The B.B.C. Orchestra at Manchester

During the coming winter the B.B.C. Symphony Orchestra, with its conductor, Dr. Adrian Boult, is visiting four provincial cities. The first visit will be to Manchester, where it is expected the orchestra will give a concert in the Free Trade Hall on Monday, December 5th, at 7.30 p.m. The orchestra will have the full complement of 115 players, with Arthur Catterall as leader, and the programme has been laid out so as to take the fullest advantage of that large body of players.

Radio in the Kitchen

The owner of this H.M.V. refrigerator has had a loud-speaker finished in cellulose to match the porcelain exterior of the refrigerator.

Solve this!

Problem No. 112.

Jackson had a small two-valve A.C. mains receiver, which he had constructed, and which gave fair results. As volume was not all that could be desired, he decided to add a further valve. This took the form of an L.F. stage between the detector and output valve, but then completed volume was less than with the original two-valve. So part of the original receiver had been altered, except as far as concerned the breaking of the anode circuit of the detector to include the primary of the extra transformer. The heater terminals of the extra valve were wired in parallel with and earth, and therefore on medium waves the bias of this H.M.V. refrigerator has had a loud-speaker finished in cellulose to match the porcelain exterior of the refrigerator.

Interesting and topical paragraphs

The music is by Austen Croom-Johnson. No matter what the difficulties, the composer has had a它的.[...]

Light entertainment from Scottish Regional

An hour’s mirth and melody by members of the Glasgow Press will be broadcast on November 10th. Taking part will be representatives of all the Glasgow daily and evening newspapers. The programme is described as “Glasgow Press Cake.”

“Show Goes Over”

This show, which will be broadcast on the National wavelength, November 29th, and on the Regional wavelength, November 30th, will afford listeners an opportunity...

PRACTICAL WIRELESS

November 10th, 1934

ROUND the WORLD of WIRELESS (Continued)

of a peep behind the microphone during the production of a musical comedy by a broadcasting company which specializes in sponsored programmes. The director of the show meets with many trials and tribulations in handling a theatrical star, who is very temperamental, and a bunch of “yes” men. No matter what the difficulties, the show must go over and the band has to keep the show “The Show Goes Over,” are by Max Kester on a scenario by Laurence Gilliam, the music is by Austin Croom-Johnson and Brian Osibas will produce.

“Invitation to the Waltz”

This new production of the author of “Good Night Vienna,” will be broadcast in the London Regional programme on November 14th, and the National programme on November 15th. The book and lyrics are by Holt Marvell, and the music is by George Posford. This is the first occasion for three years that the latter has composed for the microphone. During that time he has been busy on films and stage work. “Invitation to the Waltz” is a customary explanation why Weber wrote the world-famous piece of the same title. The story takes place in Venice and in Germany during the time of Napoleon. Weber is featured as one of the characters.

The “Red Aces”

On November 12th, a new dance band will broadcast from the Midland Regional. It is a versatile ten-piece combination, directed by Eddie Carney—Tony’s “Red Aces.” The manager of a Birmingham dance hall formed it from bands he has organized in various parts of the country. Most of the players are masters of more than one instrument, and with the help of the boy soprano, Stanley Rawlings, who, at fourteen years of age, can sing in three languages and play twelve instruments.

An interesting School Concert

The concert by the Dean Close School at Cheltenham, the school’s fourth broadcast, will be relayed to Midland Regional listeners on November 17th. Its remarkable musical progress is largely due to the work and enthusiasm of Dr. Nicholas, the composer, who is the Director of Music.

Concert from Midland Regional

On November 17th, an important concert, chiefly of light music, will be given from the Midland Regional. It will be broadcast from the Midland Regional. And the vocalist is Winifred Lawson, of the D'Oyly Carte fame. The programme will include Debussy’s “Clair de Lune,” orchestrated by Moonan, and the song "One Fine Day" from “Madame Butterfly.”
The Simplest Methods of converting a "Straight" Receiver into a Modern Superheterodyne are Described and Illustrated on This Page

The many advantages which are peculiar to the superheterodyne circuit are being more extensively realized than ever before. There is no doubt that the modern superhet, completely solves the years-old problem of selectivity, but it is not yet universally appreciated that a superheterodyne receiver may be as simple and inexpensive to construct as a receiver of the "straight" type. This fact will doubtless be emphasized in the minds of thousands of constructors by the advent of the "C5 Superhet. Three," as simple and inexpensive to make a new one. Although many hundreds of readers are sure to build the new set, there will be others who are not prepared to make a completely new receiver at the present time. One reason for this may be that the owner is loath to dismantle it in order to convert it into a modern superhet.

One can hardly expect difficulties of this kind to be overcome by retaining the set in its present state and adding to it a unit which will convert it into a modern superheterodyne. Provided that the receiver is of sound design and now functions satisfactorily there is no reason why the addition should not produce still more gratifying results. One can hardly expect the conversion to prove so efficient as a completely new design, but it will be useful in demonstrating the remarkable capabilities of a really up-to-date superhet.

Moreover, all the new parts required for the superhet unit can later be used in the construction of a new and self-contained receiver. The simplest methods of changing to a modern superhet are described and illustrated on this page.

Fig. 1.—The circuit of a simple superhet unit intended for working at an intermediate frequency of 150 kilocycles.

Fig. 2.—The general circuit for a superhet unit employing a pentagrid frequency-changer. If desired, the I.F. transformer shown may be replaced by a choke-condenser combination. Inset shows the connections (underside) to the pentagrid 7-pin valve holder.

Most readers are aware that any superheterodyne must incorporate, in some form or other, the following stages: first detector, oscillator, intermediate-frequency amplifier, second detector, and low-frequency amplifier. An ordinary three-valve set with high-frequency amplification (S.G., H.F., pentode, or V.M.) contains the elements of all except the first two stages, so it can be seen that if these are added a superheterodyne circuit can easily be built up. After slight modification the present high-frequency valve will act as I.F. amplifier, whilst the detector and L.F. valve will continue to perform their normal functions.

The Frequency-changing Unit

The only functions to be carried out by the additional superhet unit are those of first detector and oscillator, and it is possible to employ either two separate valves or one multi-electrode valve of the pentagrid, heptode, octode, or triode-pentode type for the purpose. The constructor who has one or two valves on hand will no doubt prefer to employ separate valves, but if there are no spare valves available it will be better to buy one of the modern dual-purpose type. A first-detector oscillator circuit employing two battery valves is given in Fig. 1, from which it can be seen that the arrangement is very simple and straightforward. Note that a band-pass filter, of the inductively-coupled type, is used in the aerial input circuit and feeds into a screened pentode (this might be replaced by a plain S.G. valve). The band-pass circuit is a practical essential with almost any superhet.

Fig. 3.—Showing how two ordinary and similar coils can be used in a band-pass circuit by employing a neutrodyne condenser to provide "top-capacity" coupling.

For the avoidance of second-channel and other forms of interference. A good high-inductance H.F. choke is connected in the anode circuit of the first detector, and anode-circuit mixing of the oscillator frequencies is employed. The oscillator valve is an ordinary triode—type L or H.L. and is connected to a standard oscillator coil. Only the first detector and the H.F. valve in the receiver, so that the set must be tuned.
to the wavelength corresponding to the intermediate frequency provided by the superhet. unit. It is customary to use oscillator coils and condensers which give an I.F. of 110 kilocycles. This, however, is equivalent to a wavelength of about 230 metres, which is higher than the average receiver is designed to tune. For this reason it is better to choose oscillator coils and condensers which give an I.F. of not less than 160 kilocycles (2,000 metres) so that the receiver can be tuned to the correct wavelength. Once the receiver has been tuned to the intermediate frequency it need not be altered again; for this reason it is quite permissible to remove the normal tuning condenser which might then be used in the superhet. unit and replace it by the appropriate number of 0.001-mfd. paper condensers.

When the receiver is not fitted with a band-pass input circuit it is much better to substitute a H.F. transformer coupling for the circuit-grid circuit previously mentioned. In that case the anode circuit of the first detector becomes as shown by broken lines in Fig. 1, the transformer supplying a special 150-kilocycle I.F. unit. This replaces both the H.F. choke and the coil and condenser used to tune the grid circuit of the H.F. valve in the receiver.

For Mains Operation

The circuit given in Fig. 1 can readily be modified for use with a mains set, provided that the power unit of the set is capable of supplying the additional current (both H.T. and L.T.) required by the unit. High tension will rarely present any difficulty. This means that there will be no "spare" L.T. current available, in which case it will be necessary to employ a separate 4-volt, 2-amp. transformer for feeding the heaters of the valves in the unit. The primary winding of this is simply connected in parallel with that of the existing mains transformer.

Using a Pentagrid

A circuit arrangement including a battery pentagrid valve is given in Fig. 2; apart from the valve itself this is almost identical with Fig. 1. Provision is made for varying A.V.C. or variable grid bias, however, but whether these are of those required is the legal position of the second band-pass coil may be connected straight to the earth line. Should the present receiver be provided with A.V.C. or variable grid bias, the lead marked G.B. should be joined to the supply lead, as shown in Fig. 2, to prevent the mains from flowing through the pentagrid valve's grid. This precaution is necessary to prevent the grid from being driven to near the cathode by the high-frequency voltage.

A mains-frequency-changing valve could be used in the circuit with the proviso that it is connected in series with a transformer. The triode-pentode frequency-changer may be used, but in the latter case the arrangement would be more complicated and would not differ very widely from those in Figs. 1 and 2. In fact, the triode-pentode can be considered to be almost identical with two separate valves.

The practical constructional details will be almost the same, regardless of which of the three types of circuits is employed. If a suitable pair of band-pass coils is already in the set, this can be used in the input circuit of the superhet unit and the same two-gang tuning condenser can be employed. A new oscillator coil will, of course, be required, and this can be best tuned by means of a separate .0005-mfd. variable condenser, provided that two tuning controls are not objected to. When band-pass coils are not on hand the coil at present used in the aerial circuit of the set can be employed in conjunction with the triode-pentode and a "top-capacity" coupling condenser connected as shown in Fig. 3, the coupling condenser requires to have a very small capacity, and a neutralising condenser having a maximum of about 30 micro-microfarads will prove most convenient.

Single-knob Tuning

When single-knob tuning is desired it will generally be best to obtain a complete three-coil assembly, as well as a three-gang superhet condenser on two types of such assemblies available which are designed to give an intermediate frequency of over 200 kilocycles. In order to be in a position to provide the coils and condensers for various circuits suggested, but as the connections are very few in number these should not be required. In order to avoid possibility of confusion, however, the connections to the multi-electrode valves mentioned are given as insets to the circuit diagrams.

A Romance in "Ekcos"

THERE are two men who call for my particular admiration in the radio world, for they have not been spoiled by their success. They are Mr. E. K. Cole and Mr. W. S. Verrells, of E. K. Cole and Co., Ltd., the makers of the famous Ekco receivers. When first I came in contact with them they knew very little about the technical side of radio, but they realized the great bugbear to wireless was the troublesome high-tension battery. They sought to devise some means of utilizing the electric mains as a source of supply. They were so successful in this direction that the foundation was laid for the huge factory which is now one of the largest and most modern in the world. For the past few years their business has grown from a shanty to an enormous factory covering nearly 200,000 sq. ft. This progress could only be made by giving a customer a square deal and a receiver for excellence.-C. D. K.

Concert by Bristol Artists

WEST REGIONAL listeners will hear a concert by Bristol artists on November 12th. Margaret Harris and Edgar Glasspool will give two groups of duets on two pianos, and Eveline Willcox (soprano) will sing a group of songs. Eveline Willcox was a soloist with the Bath Choir in Toronto last year; she has also sung at recitals and musicales in Paris. Edgar Glasspool, who has been living in the province since he was six, found himself very much at home in the town and now plays the piano. When he found that Margaret Harris was always his rival in competitive festivals he asked her to join forces instead, and now they play duets.
A Use for Systoflex
Now that metal-covered valves are being extensively used, I devised the simple method (shown in the accompanying sketch) for preventing the metal covering coming into contact with any metal screen or base-boards on which the valve may have to pass through.

A piece of sleeving is split and put round the edge of the hole, thus effectively insulating the valve.—Hugh Hughes (Liverpool).

A Mercury Wave-change Switch
One of the most troublesome parts in a receiver is the wave-change switch, which is often noisy and unreliable. I solved the problem by making for my own use the simple mercury switch shown in the accompanying sketch. A piece of chabote rod is bored to a depth of 3 in. to form a cup, and through the sides two holes are bored and tapped to take two screws. The cup is then half filled with mercury and the opening closed with a screwed cap, or some Chabote's compound. A hole is drilled through the other end of the ebonite so that it can be slipped on a spindle. Connection to the two screws is made with short pieces of flex. On half-turning the spindle the ends of the two screws are submerged in mercury and so form a perfect contact. Any number of these switches could, of course, be fixed on the same spindle.—D. Stuart (Bankhead).

A Novel Coil-winding Arrangement
The handy coil-winding device shown in the accompanying sketch can be made as follows. First, cut a piece of wood about 4 in. square, screw a clamp on one end, and drill a hole in the wood to take the stem of a ratchet screwdriver. Push the screwdriver through the hole and clamp to the side of a gramophone cabinet. Next fit a rubber washer on the turn table spindle, and fix the coil to be rewound. This is done by pushing two pins through the hole in the coil, and into the rubber washer. When this is done, put an old transformer coil, or bobbin of wire, on the blade of the screwdriver as shown in the sketch, and wind the motor. To wind the coil simply start the motor.—W. Kennedy (London, S.E.).

A Razor-blade Condenser
Here is a novel use for used razor blades. Procure a piece of wood roughly 3 in. by 1 in., and screw a long terminal in each end 1 in. apart. Cut a number of pieces of mica, or similar insulating material, to a size slightly larger than the blades. Slip a blade over one terminal by the end hole, then a piece of mica, and repeat the operation on the opposite terminal so that the blades are interleaved with sheets of mica between.
FACING THE VALVE REPLACEMENT PROBLEM

The Use of Modern Type Valves in Lieu of Those which Have Done Yeoman Service in the Past is a Problem which All Readers Have to Face. This Article Explains How Best to Meet the Situation.

SOONER or later every listener realizes that the time has come when he must replace his valves, and the choice of new ones is not always a simple one. If the receiver is of fairly modern design it is, as a rule, just a matter of purchasing new types of valves identical with or equivalent to the original kit. There are many cases, however, where the selection of suitable replacements presents something of a problem.

The Best Plan
In the case of a very old set, for example, such as the once popular detector and two L.F. to combination, the nearest modern equivalent of the original types may be quite unsuitable because they are not nearly as efficient for use in the grid circuit. As a result, oscillation, howling and all sorts of similar troubles will be experienced. The new detector is quite likely to give trouble in this respect due to the much greater sensitivity of the modern valve. Of course, the best plan with such an old receiver is to scrap it and build a more up-to-date instrument, but if this is not practicable for any particular reason it may be possible to modify the receiver, bringing it sufficiently up to date for use with the nearest modern equivalent of the original valves.

When proceeding with the adaptation of a really old set, a new detector valve will often be made to work in a stable manner by reducing the high-tension voltage to this stage. In the old days it was quite usual to employ dual voltages of 50 to 75, or even more in the detector stage. It is worth while trying the effect of using 40 volts or perhaps a little less, and this often proves the desired result of a restoration to stability.

Reducing the Number of Stages
When using a new and highly efficient output valve, trouble may be experienced with distortion due to overloading in this stage. The explanation is that owing to the greater sensitivity of modern valves they need not be designed to handle such big input signals. As a result, when used in place of an old output valve of low design the newer types are overloaded and considerable distortion ensues. If the valve in question is of the "power" type it will be fairly safe to substitute a super-power valve which is considerably less sensitive than the power type. Another alternative is to reduce two lower frequency stages to one and use a power pentode, this type of valve being able to give its full output when fed direct from the detector valve.

Modern valves of greater sensitivity are more likely than their forerunners to develop low-frequency instability, particularly of the form known as "motor-boating," which is usually the result of a high resistance common to the anode circuits of several valves, such as the resistance caused by a faulty cell or cells in the H.T. battery. The effect can be avoided by adequately decoupling all high-tension circuits except, of course, the anode circuit of the output valve.

Such patching up of a really old set for use with new valves is, however, at best, a temporary measure, and it can be taken that, in general, sets of the old det. and two L.F. type will in a very short time become as rare as the dodo, since they can have neither the range nor the selectivity necessary for satisfactory reception under modern broadcasting conditions. It is best, therefore, if it possibly be managed, to re-design and rebuild the set completely, using modern parts and, of course, modern type valves.

More Modern Sets
The question now arises of choosing replacement valves for a somewhat more modern type of set, say, the popular screened grid detector and pentode combination, which, in one form or another, has been the standard set for the average listener and constructor during the past four or five years. In most cases quite satisfactory results will be obtained if the new valves are of the same types or the nearest modern equivalents of the types used in the original receiver.

There is one direction in which an improvement can be made at once in the certain knowledge that it will be effective. That is the substitution of high-frequency pentodes in place of grid-valve types in the high-frequency stages. The change-over usually calls for no alteration whatsoever in the connections to a high-frequency pentode being identical with those for a screen-grid valve. One point, however, must be kept in mind, namely, that in the case of most makes of battery H.F. pentodes the valves are fitted with a seven-pin base and not the more familiar four-pin or five-pin base. Also, mains valves in the H.F. pentode class are, however, available in either seven-pin or five-pin form.

It will be of service to point out here the contact arrangement of the seven-pin base as applied to H.F. pentodes. Looking at the valveholder and turning it so that the two pins which come closest together are at the bottom, and commencing with the single pin at the opposite side of the holder from the two pins just mentioned, the top pin, which we will call No. 1, is connected to the metallized coating. Working round the holder in an anti-clockwise direction, pin No. 2 on the left of pin No. 1 is connected to the control grid; the next pin, No. 3, is the suppressor-grid connection; the next two pins, 4 and 5, are the filament or heater connections. Pin No. 6 is unconnected in the battery types, but is the cathode connection in indirectly heated mains valves, while pin No. 7, on the right of pin No. 1, is the auxiliary grid connection. The top cap, of course, is the anode connection, as in the case of a screen-grid valve.

The illustration Fig. 1, should make this quite clear.

Another Form of Detector
Another improvement which can be made in a receiver employing a high-frequency stage, whether a screen-grid or screened pentode valve be used, is to modify the circuit so that a variable-mu type valve may be employed. The circuit for this type of valve has been reproduced many times in Practical Wireless, and the alteration will present no difficulty.

In place of an ordinary triode detector a high-frequency pentode can be used, and this is a particularly useful idea for a receiver employing only one high-frequency stage and where, therefore, the added gain of a highly sensitive screened pentode detector will be welcome. Moreover, the larger gain obtainable with this type of valve may make it possible for the listener to dispense with reaction, thus simplifying the operation of the set, eliminating at least one cause of distortion, and making it possible to gang the tuned circuits much more accurately with a very satisfying effect on both selectivity and sensitivity.

It is recommended that the leaky-grid system of detection be employed, and that resistance coupling be used following the H.F. pentode detector.

The theoretical circuit is shown in Fig. 2, the approximate anode and auxiliary grid voltages being 100/150 and 50 respectively.

Better Output
Concerning the low-frequency side of a battery set of the type we have been (Continued on page 305)
IMPROVING A.V.C. ACTION

THE term “Automatic Volume Control” or, to use the well-known abbreviation, A.V.C., is familiar to all interested in radio. The purpose of A.V.C. is to keep the output from the detector stage, and therefore the output volume, also, at a reasonably constant level.

Two considerable advantages are conferred by the provision of A.V.C. One is that when a station is tuned in, the output volume is automatically set to a predetermined level, and the other is that variations due to fading are minimised. Naturally an A.V.C. system does not enable exceptionally weak signals to be received, but simply serves to reduce the receiver’s overall amplification as is necessary.

Various A.V.C. Systems

There are various ways of obtaining the A.V.C. effect, but the most usual is 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 separate as, for example, when a Westector is used for this purpose. The

A Brief Explanation of the Principles of A.V.C., and a Description of Two Suggested Circuits to Give a More Useful Range of Control Than Is Usually Provided

When the peak carrier voltage across the 1-megohm load resistance is less than the D.C. delay voltage across V3 bias resistance, the A.V.C. diode does not rectify, and as no A.V.C. bias voltage is developed, V1 and V2 will operate at full efficiency.

When the peak carrier voltage exceeds the D.C. delay voltage the A.V.C. diode will rectify and develop an A.V.C. bias voltage, this voltage increasing as the carrier strength increases. As the A.V.C. bias voltage controls the amplification given by 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

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.

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 as 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 designed so that when the peak input to the (Continued overleaf)
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. action 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.

**PRACTICAL WIRELESS**

November 10th, 1934

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**HUM-BUCKING and HUM-DINGING**

Undoubtedly the greatest trouble which the builder of an A.C. mains receiver has to contend with is hum. It seems to be almost ineradicable, and there are dozens of places in the circuit where hum is introduced. The correct type of A.C. valve operates quite satisfactorily with raw A.C. as its heater supply, and the only part of this circuit which can cause hum is an inexact centre-tap to the heater supply. If the mains transformer is made by a reliable firm there should be no difficulty here, but the actual receiver might unbalance the centre-tap and thus cause trouble. The use of an artificial tap will remove anxiety from this, and a small potential-meter having a resistance of about 30 ohms is well known for this purpose. In its commercial form it is known as a hum-dinger or nodalizer. Even when this is employed and all inductances, etc., are screened, hum sometimes persists, and although the smoothing may seem adequate, owing to the use of a loud-speaker field winding for a choke it may seem impossible to remove the last trace of hum. The field winding of a mains-energised loud-speaker is difficult to use with supplies from 6 volts up to 250 volts. The smaller variety is intended for excitation current. Unfortunately, although the current in each case is rectified, it will still bear a slight ripple and it is this which gives rise to hum.

**DOUBLE-Diode and Pentode**

The combination of a double-diode with a high-efficiency output pentode as one multi-valve makes a three-valve A.C. superhet with a very good A.V.C. characteristic possible. A receiver of this type is shown in Fig. 1, and the pentode section only requires an input of two or three volts to give some three watts output. Unfortunately, no valve of this type is at present available for the battery user, but a similar circuit could be employed using a steep slope pentode and two Westeckers as the diodes. When Class B output is desired on the grounds of economy the circuit shown in Fig. 3 could be adopted. The first detector and oscillator are not shown, but a heptode could be employed with advantage. The triode section of the double-diode-pentode is used as the Class B driver in this circuit. It is usual to use a small-power valve as driver for a Class B stage, but providing the smaller type of Class B valve is used with the correct ratio driver transformer the circuit shown should give 1 to 12 watts output.

To obtain higher sensitivity than a four-valve superhet of this type would give, a signal-frequency H.F. stage could be employed with advantage. This stage could be controlled by the A.V.C., and this would improve the A.V.C. characteristic, although two controlled valves in a superhet give a sufficient range of control for general use. Both the suggested circuits operate with a high input to the signal diode, which ensures linear rectification, and, consequently, very good quality apart from the improved A.V.C. action.

---

**Some Devices for Overcoming the Introduction of Hum by a Modification in the Construction of the Moving-coil Loud-speaker**

By W. J. Delaney

The exact number of turns, the distance from the speech coil, and the tightness of coupling with the field winding will vary according to the particular design of the loud-speaker, and therefore exact details cannot be given. For test purposes, a small coil having the same number of turns as the speech coil, and wound directly over the field winding, may be used, and to avoid an alteration in the impedance of the speech coil, care will have to be exercised in the choice of the wire gauge.

It should be mentioned that modern speakers of reputes are fitted with this hum-bucking coil, but there are many older types still in use where the addition of this coil will affect an improvement in reception.

---

**Fig. 1.—Hum may be prevented by connecting the earth lead to a potentiometer across the heater winding.**

**Fig. 2.—A large capacity fixed condenser across the low-voltage field winding.**

**Fig. 3.—A hum-bucking coil used with a mains-energised speaker.**

**Fig. 4.—The normal A.C. mains smoothing circuit for use on D.C. or universal receivers.**
November 10th, 1934

CURRENT
0-6 mamps.
0-30
0-120

VOLTAGE
0-6 volts.
0-120
0-300

RESISTANCE
0-10,000 ohms.
0-60,000
0-3 megohms

D.C.

THE

Total Resistance
100,000 ohms.

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UNUSUAL LOUD-SPEAKER ARRANGEMENTS

A Number of Interesting Suggestions in Connection with the Mounting and Disposition of the Speaker are Here Made. By FRANK PRESTON

DESPITE the fact that it has, within the recognised practice to arrange a loud-speaker as a moving-coil unit placed behind a grille or opening covered with silk or similar material, it is by no means certain that this is the best system. Various attempts have been made to render a wireless receiver less like a piece of laboratory equipment and more in keeping with home furnishings, but the same amount of attention has not been paid to the speaker. There does not appear to be any particular reason for this, and it is time some change was made.

An important step in connection with the method of mounting the speaker unit was made in the "All-Pentode Three" recently described in these pages. In the case of that popular receiver the speaker was mounted underneath the lid, as shown in Fig. 1. A circular hole was made in the lower portion of the lid, but this was covered by a second board placed over it and supported on four small pillars. It will be seen that with this arrangement the sound from the speaker cone is directed on to the upper portion of the lid which acts as an efficient baffle, or sound board. The consequence is that the sound is "diffused" and more uniformly distributed over the room. In addition to this, however, the speaker is completely disguised.

The type of speaker which often functions admirably, and can be made from an old moving-iron or reed-type unit.

Fig. 1.—The ingenious speaker arrangement used in the "All-Pentode Three," and which is described in the accompanying text.

There may be many readers who would like to experiment with this arrangement themselves, and they will find the dimensions given in Fig. 1 helpful. There is one point that should be mentioned, which is that it is generally advantageous to fit a small "deflector" cone on the underside of the baffle. This cone may be of the type previously made for use in conjunction with a moving-iron or reed speaker movement, and it is wise to try a few different cones of varying degrees of stiffness. The cone can also be fitted in one of two ways: rigidly attached to the baffle, or mounted with a strip of spongy rubber between its rim and the sounding board.

Those readers who have a speaker movement, or even a telephone earpiece, of the reed design will find that a very interesting speaker can be made, as shown in Fig. 2. It will be seen that the movement is mounted on a wooden batten fixed across the framework of thin-panelled door, whilst the projecting reed is so arranged that it just touches the paneling. An improvised loud-speaker of this type will often be found to produce excellent results, especially when positioning the unit. It is generally known that when the speaker is mounted in a cabinet of the console type it should either be on the same level as the ear (when listening) or should be placed on a sloping baffle, as in Fig. 3. The latter arrangement is often to be preferred, and is particularly valuable when dual speakers are used and one of these must, of necessity, be placed low down. A little refinement that often proves popular in an arrangement of this kind is the provision of a lamp for floodlighting the speaker. Such a light can easily be provided, as shown in Fig. 3, by making a rectangular hole over the speaker opening and fitting a small flash-lamp bulb-holder over it. The hole should be covered with a strip of rubber to prevent fire, Whilst the lamp-holder can be wired in parallel with the normal dial light. When the latter is not fitted the terminals of the holder should simply be connected to the two filament wires, as shown in Fig. 3.

Fig. 2.—A type of speaker which often functions admirably, and can be made from an old moving-iron or reed-type unit.

Fig. 3.—This drawing shows a small refinement which might well be fitted to a speaker mounted on a sloping baffle—it takes the form of a lamp for floodlighting the speaker opening.
SIMPLE AIDS TO GANING

Setting the Trimming Adjustments of a Ganged Tuned Receiver is Considerably Simplified by Suitably Connecting a Milliammeter

CORRECT adjustment of the trimming condensers of any receiver with ganged tuning is essential if the best results are to be obtained. This process should present no difficulty if the designer's instructions are followed.

The trimming adjustments can conveniently be made while receiving any constant transmission of moderate strength, but if a modulated H.F. oscillator is available the procedure is facilitated. This is because slight differences in strength of the constant L.F. tone provided by an oscillator are more easily noted than small changes in intensity of speech or music.

Adjusting the Set

When adjusting a set in conjunction with a modulated H.F. oscillator a visual indicator of resonance will enable very accurate settings to be made. Any of the various output meters now available may be used, but if an instrument of this type is not at hand it is usually possible to arrange a milliammeter in some part of the receiver to serve as an indicator.

For example, if the receiver is provided with automatic volume control some form of tuning indicator is usually fitted. If this should not be so, a milliammeter can be inserted in the H.T. supply lead to any one of the A.V.C. controlled valves. An 0–10 milliammeter is usually suitable for this purpose, and the connections for a typical arrangement are shown in Fig. 1.

The trimmers are adjusted in the correct sequence until the tuning indicator change is as great as possible or, in the case of a milliammeter, until the reading reaches its lowest point.

If the receiver is not equipped with A.V.C. it will usually have a leaky-grid or anode bend detector. With a superhet this reference applies to the second detector. The anode current of either of these types of detector.
detectors changes when a signal is applied, the current decreasing with a leaky-grid detector but increasing with an anode bend rectifier. By adjusting the trimmers until the greatest possible change in current is obtained, accurate results are assured.

With battery-operated receivers a 0–5 milliammeter will serve for a leaky grid detector, and a 0–1 milliammeter is satisfactory for the anode bend type. With mains valves these values will usually be suitable except when the detector is a "power" grid, in which instance a meter reading up to 10 milliamps will be adequate in most cases. As the change of current is relatively small it is desirable that the meter range be such that the detector anode current gives approximately half scale when a signal is tuned in. A meter with several ranges is ideal for this purpose.

Fig. 2 shows the meter suitably inserted in a battery leaky-grid detector stage.

Battery-operated Receivers

With battery receivers having Class B, Q.P.P., or an output valve controlled by an H.T. economiser, the output stage anode current varies in sympathy with the applied signal. A meter can be connected in the H.T. lead to the output stage, and the trimmers set to give the greatest obtainable increase in anode current.

Should it not be convenient to connect a meter in the detector stage of a battery-operated receiver having a normal power or pentode output valve, this may be converted into an anode-bend rectifier by increasing the negative grid bias. A milliammeter connected in the anode circuit of the output valve would then show an increase as the signal input becomes greater. The negative grid bias should be increased between 50 and 100 per cent. while checking in this way.

Whatever arrangement is adopted the meter should always be connected at the low potential end of the anode circuit. That is to say, the meter should not be inserted between the anode terminal and the component normally connected to the anode. This arrangement, in the case of a detector or H.F. valve, usually causes instability and may cause serious errors in ganging. It is preferable to place the meter in series with the lead connecting the particular stage to the H.T. positive wiring. The diagrams show the meter connected as suggested in typical circuits.

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THE HYVOLTSTAR UNIVERSAL SUPER SEVEN

This particular receiver is probably one of the most advanced models on the market to-day, and it would appear from an examination of the circuit incorporated that there is no feature or principle which has been omitted. To briefly go over the circuit we find the following: Seven valves incorporating a nine-stage superheterodyne principle. The first valve functions as a pre-signal H.F. amplifier and is coupled to a pentagrid frequency changer. A double-tuned I.F. transformer couples the output of this stage to a variable-mu pentode acting as an intermediate-frequency amplifier, and this in turn is coupled to the following stage by a second double-tuned I.F. transformer.

For second detection a Westecator is employed, one of the new WX types being used in this position. A second similar component is included in this part of the circuit to provide A.V.C., and this is arranged to operate with a delay voltage as well as an amplifier, thus providing fully delayed and amplified A.V.C. This stage is followed by an I.F. stage and is fed into a push-pull output stage incorporating two pentodes. Finally, a double-rectifier is employed, one half supplying rectified current for the field winding of the energized loud-speaker. In addition to all of the above features, all valves are of the Universal mains-voltage type, thus avoiding the use of a mains transformer, and rendering the receiver suitable for use on A.C. or D.C. supplies without alteration. The specification is still further enhanced by the inclusion of a visual-tuning indicator, and the tuning range covered extends from 13 to 2,000 metres. This is without a doubt a most ambitious circuit.

The Layout

As may be seen from the illustrations on this page, the receiver has six controls, although the operation is not rendered difficult as might at first be supposed. The extreme right-hand control changes from radio to gramophone reproduction, pick-up sockets being provided on the chassis for the permanent inclusion of this component. The next control regulates the wave-range, and has four separate positions. On its lowest setting the wave-range is from 13 to 27 metres, and the scale for this range is printed at the top of the large scale and is in brown print. The next position on the switch is the short-wave range, and the appropriate scale is situated immediately below the previous one, is printed in green, and covers a range of 20 to 53 metres. The next position is the medium wave, extending from 200 to 550 metres, and this is printed immediately beneath the former scale in black, whilst the final setting is for long waves, from 800 to 2,000 metres, and this scale is in red. A 15-watt lamp, operated from the mains supply, illuminates this scale, and this provides a ready method of ascertaining the range which is in use, and as the scale is calibrated in metres and is so perfectly illuminated there is no hesitation in obtaining an accurate setting at any time.

The next control is a combined on-off switch and the tuning control with the volume control set to the silent point. In this condition it is possible to tune through the broadcast band and the indicator remains at its highest setting throughout practically the whole scale length, the indication being, of course, that there is a station at every part of the scale. Naturally, owing to the signal-noise ratio above-mentioned, quite a large number of these cannot be listened to and, therefore, the indicator is adjusted so that it goes completely out in between stations, and then, by setting the volume control to the silent point, it is possible to rotate the tuning control, and when the light rises to a maximum the volume control may be turned up to provide the requisite signal strength. This avoids all the between-station noises, and the limit set by the indicator control ensures that only worthwhile stations will be heard. The output-stage provides 7,000 milliwatts. The chassis, with valves, is obtainable separately for those who wish to build their own receiver or radiogram, and it costs 22 guineas. Complete in the cabinet, as shown on this page, the price is 26 guineas, and it is also obtainable as a complete self-contained radiogramophone for 40 guineas.

The Hyvoltstar Super Seven in its attractive table cabinet.

The chassis of the Super Seven, showing the short-wave condenser ganged to the main condenser.
OUR post-bag gives a very good indication of the interest which is aroused by an article or design published in our pages, and we certainly expected to receive numerous letters when we published details of Mr. Camm’s £5 Superhet Three battery receiver. We had no idea, however, of the tremendous interest which this receiver would arouse, and the enthusiasm which the public is evincing for this particular model far exceeds any previous design which we have published. We have literally been snowed under with requests for demonstrations; suggestions for modifications to meet some individual needs; queries concerning mains models, etc.

Modifying the Design

Many readers prefer a Class B output stage, and wish to know whether the change to this type of output would be likely to introduce instability or mar the performance of the receiver. A specimen was modified for this purpose, and certainly gave high-class results, but it must be appreciated that an extra valve is required for this conversion, and thus the upkeep costs will be greater, as well as calling for some modification of the chassis. We do not propose to give details concerning this change, as we do not consider it worth while. Those who do not object to the extra valve, and who prefer the Class B circuit are quite at liberty to make the change if they so desire. Many readers have the electric supply mains in the home, and wish to dispense with the H.T. battery and, in many cases, also with the L.T. battery. We have carried out a number of experiments with this receiver, using home-made mains units, commercial mains units, and with modifications of the original design to employ special mains valves. All of the experiments have been highly successful.

A.C. Mains Units

An examination of the original circuit diagram will show that the decoupling which is included is very meagre, and, indeed, some criticism has been levelled at the design from this point of view. When originally constructed, the receiver employed every device conceivable in the interests of stability and perfection of performance. Then, when the circuit was in thorough working order and was giving the performance which was desired, the circuit was gradually stripped. First this component was dispensed with, then another. All the time, the aim of the designer was to reduce the receiver to the bare essentials consistent with high-class performance, and no endeavour was spared to bring down the price whilst still maintaining the high standard which was set with the receiver in its original condition. Thus, if a small change in wiring produced a slight fall in volume or selectivity, the wiring was replaced. In this way the circuit was slowly stripped, and a condition was arrived at where any further modification produced inferior results. In that state the £5 Superhet Three was presented to our readers, and thus full confidence is placed in its performance. To ascertain how the receiver would function when connected to the electric supply mains, several
OPERATING THE £5 SUPERHET THREE FROM A.C. AND D.C.
MAIN UNITS AND FURTHER NOTES ON OPERATION

This illustration shows the underside of chassis, from which it will be seen that there is ample room for decoupling components when an inefficient mains unit is employed.

The Decoupling Circuits

For those readers who find that the particular unit which they are employing gives rise to this trouble the following are the modifications which were found to be necessary. Two fixed resistances of 1,000 ohms each and one of 2,000 ohms, together with a fixed condenser of 1 mfd, will be required. The latter is joined between the change-over switch and earth line or earth core and the screening lead of Val. V. The screening lead, remember, is the main earth return in the transformer set and so must be connected to the mains unit which is used for test purposes and which is shown in the diagram. In this case, the condenser will be connected from a 120-volt high tension supply to the receiver for gramophone record reproduction.

The extra stage is automatically added, or omitted, depending on whether the bias is sufficient to load the valve, the makers’ figures should be adhered to when the undistorted output will be in the neighborhood of 750 to 1,000 milliwatts.

Other Requests

It is, of course, impossible to deal in one issue with all the various points which have been raised, many of which are of such slight importance that they are applied only to the individual receiver. The main points, that is to say, which have been raised by a number of readers, are dealt with below, and it will be seen that we are making every endeavour to cope with the needs of every reader. To do this, of course, a very extensive programme has had to be prepared, and Mr. Camm is sparing no effort to ensure that no reader will be dissatisfied, either with the arrangements made especially for him, or with the receiver in the form which he builds it.

The L.S. terminal strip is fitted with pick-up sockets, and several requests have been received concerning the use of this receiver for gramophone record reproduction. Unfortunately, it is not a simple matter to couple the pick-up to the isolators, or that part of the circuit, and so it is necessary to arrange to include this in the grid circuit of the pentode valve. The pick-up is, of course, joined between the grid and the grid bias plug, which means that the wiring may be left in place permanently, or a simple single-pole change-over switch may be used to make the change-over.

Components for the £5 Superhet Three

One 7-pin sub-baseboard subholder, terminal type (Clix).
One 7-pin sub-baseboard subholder, notched type (Clix).
One 5-pin sub-baseboard subholder, terminal type (Clix).
One 5-pin sub-baseboard subholder, notched type (Clix).
One trilux valve (Finnin).
One Dumont 22.5 B.S. transformer (250 kx/s).
One G.B. 161-volt battery (Drydex).
One Metaplex chassis, 11in. by 10in. with 2lin. runners (Peto-Scott).
One G.B. 161-volt battery (Drydex).
One 3-gang superhet Midget variable condenser, type 2124 B.
Two "Practical Wireless" I.F. transformers (110 kc/s) (Varlet').
One set 3-gang superhet coils, type W476 (Telsen).
One 5-pin sub-baseboard valveholder, terminal type (Clix).
One 7-pin sub-baseboard valveholder, terminal type (Clix).
One G.B. 161-volt battery (Drydex).
One Metaplex chassis, 11in. by 10in. with 2lin. runners (Peto-Scott).
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One Metaplex chassis, 11in. by 10in. with 2lin. runners (Peto-Scott).
OPERATING THE £5 SUPERHET THREE FROM A.C. AND D.C.

MAINS UNITS AND FURTHER NOTES ON OPERATION

The illustration shows the underside of chassis, from which it will be seen that there is ample room for deoxidising purposes when an inverted main unit is engaged.

The £5 Superhet Three, showing the seat control layout.

The circuit used by the receiver, as described in the November 10th, 1934, PRACTICAL WIRELESS, is shown in the diagram. The oscillator is a simple Hartley type, with one of the 1,000 ohm resistors, and one of 2,000 ohms, together with an input grid of valve V2.

Among the numerous queries which have been many regarding the design of a three-valve oscillator on these lines, but intended entirely for commercial operation, and for these reasons it was only possible to report to the readers that experiments are being made to perfect the performance of the unit. Among others, three fixed resistances, 150,000, 1,5910, 30,000 (Graham Farish), one potentiometer bracket (Peto-Scott), one .01 mfd. tubular condenser (Graham Farish), and one .002 mfd. Formodenser (Formo). Three valves, 210PG, 210YPT, 220PT (Cossor).

One 7-pin sub-baseboard valveholder, terminal type (Clix). One 5-pin sub-baseboard valveholder, terminal type (Clix). One 50,000 ohm potentiometer (Graham Farish). One .0001 mfd. fixed condensers, type 34 (T.C.C.). One .002 mfd. fixed condenser (W.B.). A number of requests have also been received regarding the H.T. consumption. In the original model, when operated from a 120-volt H.T. battery, the total current consumption was 11 mA. The maximum undistorted output of the pentode valve, when fully loaded and with current voltage applied, is 1,000 milliamperes. These figures are both subject to modification, and the current consumption, for instance, may be considerably modified by varying the value of the applied bias. If reductions in current could be made, it will be seen that the specified bias is given as 9 volts. It was further stated that by increasing the bias to 12 volts the anode current could be further reduced, but naturally, the input will have to be modified. When only 8 volts bias is applied the total anode current may be reduced to 17 or 18 milliamperes. Consequently, when it is desired to obtain the maximum of which the pentode is capable, and when the applied signal is sufficient to load the valve, the maker's figures should be adhered to, and the undistorted output will be in the neighborhood of 250 to 270 milliamperes.

A number of requests have been received for diagrams showing how a receiver may be altered to fit in some other means of coupling, and whether this is applicable. It was stated that experiments are being made to perfect the performance of the unit. Among the numerous queries have been many regarding the design of a three-valve oscillator on these lines, but intended entirely for commercial operation, and for these reasons it was only possible to report to the readers that experiments are being made to perfect the performance of the unit.

One 7-pin sub-baseboard valveholder, terminal type (Clix). One 5-pin sub-baseboard valveholder, terminal type (Clix). One 50,000 ohm potentiometer (Graham Farish). One .0001 mfd. fixed condensers, type 34 (T.C.C.). One .002 mfd. fixed condenser (W.B.). A number of requests have also been received regarding the H.T. consumption. In the original model, when operated from a 120-volt H.T. battery, the total current consumption was 11 mA. The maximum undistorted output of the pentode valve, when fully loaded and with current voltage applied, is 1,000 milliamperes. These figures are both subject to modification, and the current consumption, for instance, may be considerably modified by varying the value of the applied bias. If reductions in current could be made, it will be seen that the specified bias is given as 9 volts. It was further stated that by increasing the bias to 12 volts the anode current could be further reduced, but naturally, the input will have to be modified. When only 8 volts bias is applied the total anode current may be reduced to 17 or 18 milliamperes. Consequently, when it is desired to obtain the maximum of which the pentode is capable, and when the applied signal is sufficient to load the valve, the maker's figures should be adhered to, and the undistorted output will be in the neighborhood of 250 to 270 milliamperes.

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Our Demonstrations

Certain queries have been raised to know whether we are prepared to demonstrate the receiver in remote parts of the country, where it is said that the local mains supply is very imperfect. With this par-
One of Many Testimonials which have been Received by Us:

Clapham, S.W.4.
28th October, 1934

Dear Mr. Camm —

You will recollect my calling to see you to hear a demonstration of your £5 Superhet Three, a favour for which I would express my very sincere thanks. I was pleasantly astonished at its remarkable performance.

You will, I am sure, be very pleased and gratified to hear that I have built the set, and that I am extremely pleased with it. At the moment of writing it is playing in this room, and it is, to my mind, the ideal set of all superhet designs for the battery user (I have no mains).

I have built one superhet set before, viz., a four-valve superhet designed by a well-known firm, but I never got it to work properly: therefore you will appreciate that, after constructing and wiring up, and switching on, I naturally expected, at least, considerable trouble before I got it to go. As a matter of fact, when I switched on, I turned the dial from end to end, and not one station came in. I quite imagined I had failed, in spite of careful checking of the wiring. I discovered I was on long waves, and then immediately tried medium waves. Here again careful searching did not seem to bring in anything until at last the London Regional came through full and clear, without any trimming of any kind. I found the trouble was simply due to the hair-breadth tuning—a most valuable feature—and, after getting used to it, and gauging up—which, by the way, only took about 5 minutes—station after station came through at good round volume and quality, and entirely free from interference. What a difference from my old "professional" superhet! With this one always had whistles and interference.

I tried long waves again, and then I remembered the .002 variable pre-set tracking condenser. Setting the condenser to about 1,500 metres, and just rotating the knob of the pre-set, in came Droitwich at full volume. I may say I have fitted a full-vision scale (with vertical drive) to this set, and this, calibrated in wavelengths, is remarkably exact.

I must offer you my sincere congratulations on the success of your magnificent set. Your patient two years’ research is thus amply rewarded, it being just the very set I have been looking for, and yours is the first set I have seen so ingeniously designed, and I have no doubt it will be built in thousands, as it deserves to be. In any case, I will strongly recommend it.

I have, I may say, never read “Practical Wireless” before the present number. I was introduced to it merely by the fact that I saw it hanging outside a shop, and the advertisement relating to the set was so conspicuously displayed on the cover, and seemed to be so precisely what I required, that I at once bought it, and, after quickly perusing the circuit details, set out to collect the parts. Henceforth I shall be a regular reader, having placed a standing order with my local newsagent, and shall follow your articles and developments of this set with very keen interest. Your paper is truly named “Practical.”

Yours very sincerely,

TRIPLE GANG TUNING CONDENSER

PENTODE OUTPUT VALVE

VOLUME CONTROL

IRON-CORED I.F. TRANSFORMER

H.F. PENTODE I.F. VALVE

THE SET WHICH SOLVES ALL YOUR RADIO PROBLEMS

GOOD NEWS FOR MAINS USERS
In order that every reader may take advantage of this remarkable circuit development, we shall produce it for A.C. and D.C. operation. In addition we shall produce a model employing Universal valves.

ALBERT E. HOLDAWAY.
10th November, 1934

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PILOT AUTHOR KIT EXACT TO SPECIFICATION

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CONTROL COILS

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£26 6 6 - FULL SIZE CONE. Power Company, Input Transformer. Send by 1st class. Balance in monthly payments of £6. Cash or C.O.D. Paid, this Kit must be returned with Kit, 10/- for each B.P., 15/- for each Superhet, or 5/- for each Triode, 7/- for each Valve, 10/- for each Condenser, and 15/- for each Metaplex Chassis, less Valves and Cabinet.

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Send only NB for Cash or C.O.D. Carriage Paid.

Send only NB for Cash or C.O.D. Carriage Paid.
A typical two-valve short-wave circuit using an untuned H.F. stage and band-spread tuning.

**Short Wave Section**

**EASIER SHORT-WAVE WORK**

An Article Explaining Two Methods for Simplifying Tuning. By K. E. BRIAN JAY.

**THE UNTUNED STAGE**

Amateurs are sometimes discouraged from attempting short-wave work by stories of the extreme delicacy required in operating a short-wave receiver manufactured choke may be used, but a satisfactory one can be made at home by winding about sixty to eighty turns of 36 SWG D.S.C. wire on a half-inch diameter bakelite or glass rod or tube. The screen-grid valve is coupled to the detector by means of a second short-wave high-frequency choke Ch2 and the 0.0001 mfd. mica condenser C3. If manufactured chokes are used for Ch1 and Ch2, they should be of different makes or have widely differing characteristics; if this precaution is not taken the amplifier will probably be unstable and oscillate uncontrollably. It is sometimes found that a universal type choke is best at Ch1. The effect of this stage is to isolate the detector from the aerial circuit: this is an advantage because the H.F. valve often gives rise to unstable operation of a reacting detector, by causing signals to swing when it is blown out in a high wind, and by producing "blind spots," that is, places in the tuning range at which the receiver refuses to oscillate owing to the loading effect of the aerial at its natural wavelength or its harmonics. The H.F. valve also produces a little increase in the overall amplification of the receiver, but it will not be at all unimportant compared with the benefit of more stable detector operation, a benefit that is obtained without any complication of the tuning controls.

**Band-spread System**

The band-spread arrangement consists merely of a small variable condenser C2 connected across the main tuning condenser C1 of the detector circuit. In the usual way, when C1 is the only condenser it has a capacity of about 0.0015 mfd., and this is rather large for comfortable tuning on short waves; at the same time the use of a smaller condenser limits the range of wavelengths that can be covered, and makes it necessary to use several coils, which is somewhat inconvenient. The short-wave broadcasting stations are grouped in bands of wavelengths at various points throughout the spectrum, roughly at 51, 23, 19 and 17 metres, in which bands they are fairly close together, and so with a large condenser at C1 we may find that it covers three of these bands on one coil and that the stations in the bands only occupy a couple of degrees on the tuning dial. Now if we connect a smaller condenser C4 of about 0.00035 mfd. or so in parallel with C2 we can tune C1 to the required waveband, and then tune in the individual stations using C3 only, on whose dial they will be much more widely spaced than on C2.

**The Condenser**

C4 now becomes the main tuning control, and is called the band-spread condenser, while C1 is the band-selecting or band-setting condenser. C5 may be the ordinary condenser as specified for the coil concerned, and C2 one of the special midget short-wave variable condensers that are made for the purpose. The method of operation is to set C1 to the middle of its capacity, and adjust C5 so as to bring in a station in the centre of the required band, for example, Zeesen D.J.A. on 31.38 metres in the centre of the 31.34 metre band. Other stations within the band, Daventry G.S.B., Schenectady W2XAF, etc., are then tuned in with no more trouble than on the ordinary medium-wave broadcast band. Not the least advantage of the system is that the usual 1:2 ratio dial gives quite sufficient reduction for the purpose. The receiver is calibrated with the band-spread condenser at the middle of its range by noting the readings of the band-setting condenser C5 for different wavebands; slight mis-adjustment of C5 may upset the calibration by a degree or two, but it will not be at all hard to bring it in practice with a little practice. Of course if a wavemeter is available it may be used for the calibration.

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**PART 3 ON SALE NOV. 9th**

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The Easy Road to Radio.

The Beginner's Element

How the Superhet Works—2.

This week the intermediate frequency is dealt with and the proverbial superhet selectivity explained. Practical details of the "mixer" circuits are also discussed.

So far you will notice the superhet does not differ in any way from the straight set, but from the grid of the first detector stage the worker is one different. With a straight set the oscillations in the aerial coil are boosted up by one or two stages of H.F. amplification before reaching the detector, or else—as in the simpler sets—they are fed directly to the detector valve. They are then rectified, that is, to speech frequencies and separated from the high frequencies, and finally, the speech frequencies are passed through an L.F. amplifier stage or direct to the output stage and the loud-speaker.

With the superhet the current in the aerial circuit is mixed with another alternating current before it is passed through the usual amplifying and rectifying processes. This second current is produced by the oscillator valve and by means of a tuning condenser it is made to alternate at a slightly different speed from the input current. The mixing of these two currents, each vibrating at a different frequency, results in their vibrating in unison at one moment, and the next moment vibrating against one another. It is like two people walking along together, the one taking slightly longer steps than the other. At one moment they may be walking in step, but gradually they get out of step until one is putting his right foot forward while the other is stepping out with the left. As they continue, however, the cycle is repeated and they find themselves once more in step. The periods during which their steps coincide occur at intervals of time equal to the difference in the number of steps they take per minute. In the same way the period when the vibration of the two currents coincide occurs at regular intervals dependent on the difference between their respective frequencies. Naturally, when the two frequencies are "in step" they produce an extra power-ful alternation in the current, and when they are "out of step" they tend to neutralize one another, and so reduce the magnitude of the oscillations.

This regular rise and fall in the value of the current, due to the different speeds at which the two component currents vibrate, is called the intermediate frequency. The practical details of the production of the intermediate frequency, and how it is amplified, etc., will now be fully explained.

We have seen that up to the grid of the first valve the superhet is no different from a straight set. The waves received by the aerial set up electric currents in the aerial-tuning coil in the same way as in any other type of receiver. With the superhet there is, however, a slight difference which may occur between the two settings, due to the different speeds at which the two currents coincide occurs at regular intervals dependent on the difference in the number of steps they take per minute. The periods during which their steps coincide occur at intervals of time equal to the difference in the number of steps they take per minute. In the same way the period when the vibration of the two currents coincide occurs at regular intervals dependent on the difference between their respective frequencies. Naturally, when the two frequencies are "in step" they produce an extra power-ful alternation in the current, and when they are "out of step" they tend to neutralize one another, and so reduce the magnitude of the oscillations.

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station being received. Let us see how this is brought about.

It is all to do with the intermediate frequency. If you see behind it you will find how the superhet is being designed to mix the high-frequency current due to the incoming signals with another high-frequency current generated by the receiver. The frequency of the second current is arranged to be slightly different from that due to the incoming waves and, as already explained, the resulting mixed current will rise and fall accordingly as the two currents pulsate in step or out of step with one another. It is this rising and falling which is known as the intermediate frequency.

Now, it will be readily understood that the amount of the rising and falling depends on the difference between the frequencies of the two currents. Thus, if the two currents pulsate at a speed or frequency only slightly different from each other, then the pulsations will coincide comparatively long intervals, whereas if the frequencies of the two currents differ considerably, because of the rising and falling will occur at short intervals. In the superhet, it is arranged that this rising and falling (the intermediate frequency) will always take place at the same speed. In other words, the intermediate frequency is always the same.

That is why the tuning coils and condensers in the intermediate-frequency part of the circuit have fixed tuning. Whatever the wavelength or frequency of the incoming signal happens to be they are converted into the one fixed intermediate frequency by the time they reach this part of the circuit, and, therefore, the coils only need tuning to this frequency. Once the signals have been converted into the intermediate frequency, they can be passed through any number of fixed tuned circuits and amplified by as many valves as required, thus giving extreme selectivity and the amplification without adding to the number of controls. In practice, however, the use of more than two to six tuned circuits and one or two valves is rarely necessary.

The large number of tuned circuits gives a high degree of selectivity, but there are other advantages to be obtained from the conversion, for it is much easier to design efficient circuits when dealing with low frequencies than when dealing with high frequencies. The intermediate frequency of a superhet is usually the comparatively low one of 100 kilocycles, and at that frequency coils and other components are relatively more efficient. Stray capacities between wires, self-capacity in the tuning coils, copper losses, eddy currents, and insulation leakages, etc., have a less serious effect than at high frequencies. There is a third important reason for the superhet selectivity. It is connected with the fact that the percentage of the reception between one station and another becomes greater at the intermediate frequency than at signal frequencies, but we may leave the discussion of this until later as it is rather difficult to understand at this stage.

How the Mixing is Carried Out

Now let us return to the practical side of the superhet circuit and see how the H.F. current, due to the incoming waves, is mixed with the locally generated current to provide the intermediate frequency. This is the most important part of the whole circuit. In the typical circuit under discussion the mixer is composed of two valves—one known as the oscillator (V2) and one as the first detector (V1). The oscillator valve and its attendant coils act like a one-valve set in which the reaction is turned "full on," thus causing the valve to oscillate continuously.

This, however, does not mean that it is producing howls and whistles which are popularly understood to constitute oscillating. A valve which is oscillating does not produce howls unless the oscillations clash with, or "heterodyne," those from an outside source, such as a broadcasting station. This is clearly demonstrated when you turn the reaction knob of a lively receiver too far. Although it may be oscillating violently, howls and squeaks are only produced when you tune the station to the same, or nearly the same, wavelength as a broadcasting station. You then hear a chirp as you swing the tuning control past the station.

It is the usual practice, however, to tune the oscillator to the higher frequency, and by gantry the oscillator condenser with the tuning condenser C2 it can be made to track round, so that the oscillator circuits tunes 110 kilocycles above the frequency of the aerial circuit. Thus, if the set was tuned to a station operating on 1,100 kilocycles, then the oscillator-condenser would be automatically set to 1,110 kilocycles. When the set is tuned to a station broadcasting on 1,500 kilocycles the oscillator would tune to 1,610 kilocycles, and so on.

One Knob Tuning

Of course, it is not possible to use the ordinary type of ganged condenser— the type in which each section is identical—for this purpose, because the oscillator does not require to be tuned to the same frequency as the aerial coil. It must tune 110 kilocycles above it at all settings of the dial. A special superhet type ganged condenser must therefore be used. In this, the section tuning the oscillator has specially shaped vanes. The capacity of this section is smaller than the aerial tuning section, so that it tunes the oscillator coil 110 kilocycles above the frequency of the aerial coil at any setting. Of course, the lower the setting of a tuning condenser the higher the frequency to which the circuit tunes, hence the reason why the oscillator section has a smaller capacity than the aerial section.
NOTES ON SECONDARY EMISSION

How Distortion is Avoided

A SECONDARY emission effect is a purely static phenomenon, so that it takes place under D.C. conditions. In a screen-grid valve the screen does actually screen the plate to a large extent so that the plate voltage does not very greatly affect the emission. For a fixed-grid voltage $E_g$ and screen voltage $E_s$, we can say that the cathode emission is $I_c$. Assuming the grid to be negative, there is no grid current, therefore $I_g = 0$.

Curves of a typical value are shown in Fig. 1. S.G. voltage 90, control grid at $-1.5$ volts. If the S.G. and anode currents are added they are almost constant. When the anode voltage is below that of the screen grid a large amount of secondary emission takes place, and the anode current becomes negative! This strange effect, negative resistance, is because under some conditions an increase of anode voltage causes a greater-anode current, but the electrons hitting the anode have gained much energy, and each may knock two or three out of the anode, these going to the screen grid.

Although the anode voltage may be but 20, the electrons may have a velocity equivalent to 20 to 60 volts if the screen is at 90. The effect is due to the mechanical inertia of the electrons, which is again a result of their finite mass, which although very small cannot be entirely neglected. If their mass were negligible they would follow the lines of force accurately and secondary emission would not occur.

In a pentode a grid is placed between the anode and the screen grid. This is tied, usually inside the valve, to the cathode. If now the electrons are knocked from the anode and the screen grid is more positive than the anode, there is no anode-to-screen-grid current, for there is no accelerating field, the suppressor grid causing a stopping field. Thus the electrons cannot escape from the anode. If the anode of a pentode becomes disconnected there may be a potential, negative, of course, of hundreds or even thousands of volts on it. This causes many breakdowns from a pentode while it is working. A break at X in the diagram might cause much damage to the valve and other components.

**AGAIN Mr. F. J. Camm specifies a STENTORIAN EXCLUSIVELY WHY?**

"As near perfection as I believe perfection is possible," says Mr. F. J. Camm.

In appearance the W.B. Stentorian is almost conventional; but make no mistake—this new instrument, incorporating three distinct revolutionary improvements on previous practice, brings an illusion of reality which is amazing.

Even if your present speaker cost double the price of a Stentorian, ask your dealer to demonstrate this remarkable new instrument. You will be astounded at the improvement.

Stentorian Senior (PMS1) - 42/6
Stentorian Standard (PMS2) - 32/6
Stentorian Baby (PMS6) - 22/2

Write for the new W.B. Stentorian leaflet.

**STENTORIAN PERMANENT MAGNET MOVING-COIL SPEAKER**

FOR most practical purposes the hole size can be taken as .028in., and this gives a total picture width of .34in. The single turn spiral of 30 holes will have positions marked as in Fig. 4, but punching operations should not start until the second spiral of 30 holes has been marked off.

Suiting Continental Transmissions

For the German transmissions of 30-line pictures the scanning is horizontal, starting at the top left-hand corner and finishing at the bottom right-hand corner. Disc rotation is clockwise, and the spiral linking the holes is therefore in an anti-clockwise direction towards the centre as indicated in Fig. 5. In order to furnish the required synchronising signal and include it in the picture transmission, one hole is marked off at each end of the slightly wedge-shaped picture area. The whole scheme of things is made clear by a reference to Fig. 6.

The length of the picture is taken as the circumferential distance measured on the circle of mean radius r, that is midway between the area AD and BC. But since the picture ratio is given as four horizontal to three vertical we have the first expression \( \frac{4}{3} \), where z is the width and y the height. In order to allow for the hole masked off at each end the true circumferential width is the distance \( \pi r \), plus two hole sizes. Questions of disc size settle the length of the mean radius \( r \), and so the hole size is calculated quite readily.

Marking the Second Spiral

Now in the 20in. disc we are dealing with the inside edge of the last hole is .046in. from the disc centre, so a satisfactory length for the mean radius is 7.4in. Hole size then becomes \( 2\pi r \times 7.5 \) which is .0374in.

Taking the figure to the nearest thousandth as before—i.e., .037in., this gives an actual picture height of 1.11in., and an actual picture width (allowing for masking) of 1.48in. It is worth noting that although the actual mean disc radius for the German picture is much less than that for the B.B.C. standard, the hole size is over 30 per cent. greater, and the resultant picture therefore appears much brighter.

The same radial lines of 12 degrees angular separation can be used for marking off the hole positions, and so as to adequately clear the first spiral markings it is suggested that the first hole be started diametrically opposite the first marked hole position, and the distance of the outside edge of the first hole from the disc centre in 7.5 - (15 x .001), that is .056in. The second hole is stepped in a distance of .037in. towards the centre, working round the spiral in an anti-clockwise direction. The third hole is a further .07in., inwards, and so on round for the 30 holes. The two sets of hole markings will be as shown in Fig. 7, and the next step is actually punching the holes.

Making the Holes

Two square section punches of .028in. and .037in. size must be obtained. These can be made up by the reader if extreme care is taken, using silver-steel rod, and adequately tempering a 1in. length, which can be accommodated in a brass holder as shown in Fig. 8. Using the smaller punch for the outside spiral, place the punch so that the outside edge coincides with the mark on the radius and a second edge lies along this radius. Place a hard wood block underneath, and—with a single hammer blow drive the punch through the thin aluminium disc.

When the first spiral of 30 holes is done, repeat the process for the inner spiral, using the larger punch but locating it for each hole position as in the previous case.

The disc can be used solid, but it is better to lighten it by cutting away sections so that there are eight spokes and a rim as shown in Fig. 9. These spokes can then be used for stroboscopic speed observation as has been shown in previous articles. The rim of the disc which faces the observer must then be sprayed with a dead-black paint, taking great care not to fill up the punched holes.

Finally, add a brass or aluminium boss.

Using the Disc

For driving the disc a universal motor should be used, and as the direction of rotation has to be altered for observing the horizontally scanned images, it is necessary to bring the brush connections out to a double-pole double-throw switch, as indicated in Fig. 10. In the same diagram the switching arrangements are shown for feeding the television signals to one neon lamp or the other. The lamp on the right will show the B.B.C. images, while the lamp at the top gives the Continental images.
UNUSUAL LOUD-SPEAKER ARRANGEMENTS (Continued from page 247)

or heater terminals on one of the valve holders.

A method of mounting a loud-speaker unit which is seldom employed, despite the excellent results which it often gives, is shown diagrammatically in Fig. 4. It will be seen that the unit is in the top of a grandfather clock or other tall piece of furniture, and faces upwards. Where the wireless cabinet is very high the speaker can be mounted in the top of that; other-

Baffle Boards

Fig. 5.—It is frequently worth while to arrange a pair of speakers on baffle boards set at an angle to each other, as shown here. If wise it will be better to fit the unit into a box or rough framework that can be stood on top of any convenient piece of furniture. The framework referred to may take the form of a rectangular piece of five-ply wood with a hole in its centre mounted on two 6in. bearers of 3in. wood, the whole being covered with silk gauze or even muslin to keep out dust. A solid box is not suitable because it is liable to introduce too many resonances. Where it is permissible to cut the top of the cabinet itself it is, naturally, better to fit the speaker on the inside.

Several receiver manufacturers have devised a variety of methods of mounting their (double, in most cases) speakers with a view to getting better "balance" in reproduction, to "focusing" the sound, and to diffuse it. An arrangement which has not, so far as I am aware, been used in any commercial set is one I experimented with several years ago, and which is illustrated in Fig. 5. Here, two speaker units are mounted in the conventional manner on inclined baffles situated at an angle to each other. If one speaker gives emphasis to the higher frequencies, the other to the lower, it is found that excellent "balance" can be secured. It might appear that an undue "focusing" effect would be obtained, so that volume would be much greater at one spot than at all others, but this need not be the case. A certain amount of initial experiment is at first necessary to find the optimum angle for the baffle boards, and this varies according to the speakers chosen.

Although it appears to be quite wrong in theory, I have often found that extremely good reproduction could be secured by mounting the speaker in the back of the receiver cabinet, more particularly when it was of the console type. To obtain best results with this arrangement it is generally necessary that the set should be placed in a corner, so that the walls act as fairly effective sound reflectors.

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This speaker is of latest design with full 3-inch cone of special fabric for reproducing perfectly over a wide frequency range. High grade steel magnet and pressed steel chassis. Output transformer (tapped for Power, Super-Power and Pentode output valves) included. Only a limited number of these speakers available, so send P.O. 10/6 NOW to-

RADIO and ELECTRICAL WHOLESALE SUPPLY LTD., 6, Conduit Street, London, W.1.
November 10th, 1934

The New B.B.C. Studio at Maida Vale

Owing to the prospect of having to relinquish No. 10 Studio, due to the rebuilding of Waterloo Bridge, the B.B.C. found it necessary to find another large studio to replace it, and in February of last year the old Skating Rink in Delaware Road, Maida Vale, was acquired. This has now been transformed into a studio, and is the largest which the Corporation now possesses. It occupies a site nearly twice as large as the British Broadcasting Company's old Maida Vale studio.

The building is mainly of one storey, although it contains a basement. There are two such storeys, one on the top, and the other one below. The studio itself is on the middle floor, and is surrounded by a long, 200-yard block of buildings, which forms a noise-screen. The Maida Vale Skating Rink, which the B.B.C. have now converted into a modern studio, occupies a site nearly twice as large as the site of the old studio.

The studio is equipped with ten microphone points, which are connected to five separate circuits, two being two points in parallel on each circuit. This allows flexibility in the placing of microphones about the studio, while provision is made for any type of microphone to be used. The microphone circuits terminate on a 6-way fade unit in the adjoining listening-room, which is equipped with a gramophone desk for the reproduction of effects and a loud-speaker for checking purposes.

The control room equipment consists of four control positions and one switching position and, in addition, two rows of racks which carry the amplifiers, switching relays, line termination equipment, and power-discharge switching. An additional control position is provided in an acoustically-treated room fitted with a loud-speaker so that the studio can be controlled by a member of the balance and control section. Apart from certain modifications, the detail design of the apparatus installed at Maida Vale is similar to that in Broadcasting House. The illustration on this page shows the new studio as it appears from the outside.

PRACTICAL TELEVISION

The only Television

Monthly,

PRICE SIXPENCE

By JACE

The Maids Vale Skating Rink, which the B.B.C. have now converted into a modern studio.
INDEX & BINDING CASES

For Volume 4 are now ready.

Index and binding cases: binding cases, index and binding cases.

Radio Clubs and Societies

Club reports should not exceed 200 words in length and should be received First Post each Monday morning for publication in the following week's issue.

SLADE RADIO

The thirteenth of the society's "Junk Sales" took place last Saturday. A very large quantity of surplus apparatus was brought in, but the door was locked at 8.30 p.m. and was not opened for entry, and, as usual, some of the lots proved considerable amusement. The quality of material and advanced apparatus will be forthcoming on application. Hon. Sec., 110, Hill-er-road, Gravely, H.I., Enfield.

There was a lecture on "Commercial Photo-electric cell applications," by Mr. W. G. Stockton, of the General Electric Co., Ltd., at the last meeting of this society. After describing the theory very briefly he went on to give details of a large number of the applications. These included timing (horse-racing), counting papers, etc., paper control at printing works, counting tyres, smoke detection, counting steel tubes, automatic lighting traffic lights in Brentford, control of town lighting, tax, cleaning of controls, coal fires, control of teleprinters, and almost anything else. Various uses on underground railways. A number of excellent slides were exhibited during the lecture.

THE CROYDON RADIO SOCIETY

The thirteenth meeting of the above society was held on Tuesday, October 23rd, at 8, Leach Lane, Whitefield, near Manchester. The technical adviser used the amplifying stages of his famous quality receiver, and by switching in two parallel tanks he showed that his B.T.H. receiver was still performing correctly. Many instruments brought by members were described and compared. Among the tanks of the society's receivers Meredyth-Jones's B.T.H. Minor, which was noted as being better than the others in most respects, was given a demonstration at 8.30 p.m., weekly short-wave review, followed by Morse instruction. Arrangements for a programme of lectures and demonstrations for the coming season were discussed, and a lecture and demonstration by Mr. R. C. Noble, 10, Over Lane, S.W.8, and is near Vauxhall Station. A. E. Leach, Sec., 9, Over Lane, S.W.8, and is near Vauxhall Station. The next meeting will be held on November 24th, commencing at 8 p.m. Morse instruction will be given at 7.30 p.m. at all future meetings.

INTERNATIONAL SHORT-WAVE CLUB (MANCHESTER CHAPTER)

The thirteenth meeting of the above chapter was held at the British Legion, Long Street, Middle ton, on October 26th. The meeting was called to order at 8.30 p.m. by Mr. W. G. Stockton, of the General Electric Co., Ltd., at the last meeting of this society. After describing the theory very briefly he went on to give details of a large number of the applications. These included timing (horse-racing), counting papers, etc., paper control at printing works, counting tyres, smoke detection, counting steel tubes, automatic lighting traffic lights in Brentford, control of town lighting, tax, cleaning of controls, coal fires, control of teleprinters, and almost anything else. Various uses on underground railways. A number of excellent slides were exhibited during the lecture.

INTERNATIONAL SHORT-WAVE CLUB (LONDON)

A very interesting demonstration of a National A.C. Short-wave 5 was given at the meeting of the above club held on Friday, October 26th. The receiver comprised screen-grid variable-muf E.H. stator, the tuning being done by one L.P. stage, and final output stage in push-pull. The power sold of the receiver was a separate unit. Many of the regular short-wave stages were based on full strength on the output of the speaker. Everything is done at our orders. The Clip-on unit illustrated is not screwed permanently to the transmitters, you slip it on the side. It is complete with type A packing, screw-arm and volume control. Clip-on unit complete 35/-.

Model A box a telescopic arm, and an adjustable head to ensure minimum tracking error. The head ever for needle-changing. Price such 276.

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KIT A. Complete parta. Cash or C.D. 45/- , or 7/- secure delivery, balance by 11 monthly payments of 3/2.

KIT B. Complete parta, including specified valves. Cash or C.D. 47/9, or 12/- secure delivery and balance by 11 monthly payments of 12/.

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3/6 Blue Spot Star Moving-Coil Speaker. Cash Price £1/10/6, or 9/- with order and 11 monthly payments of 6/.

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H.T. ELIMINATORS


Eko 110/20 H.T. Eliminator, with Triplet Changer. Cash Price £22/12/6, or 5/- with order and 10 monthly pay delivery deals 5 of 6/.

MANUFACTURERS KITS

Graham Farish Raider Kit, with Valve. Cash Price £5/5/6, or 10/- with order and 11 monthly payments delivery of 6/.

5/6 Graham Farish Raider, lesa Valve. Cash Price £4/15/6, or 6/- with order and 11 monthly deliveries of 5/-.

VALVES

Every type of valve replacement supplied on consignment terms. 3 Valve-Collector. Cash Price £10/10/6, or 5/- with order and 10 monthly delivery payments of 5/.

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Ask to see the FLUXITE SMALL-SPACE Soldering Set—compact but substantial—complete with full instructions—7/- Ask also for Leaflet on CASE HARDENING STEEL and TEMPERING TOOLS with Fluxite.
Ferranti Loud-speaker Cabinet

Many constructors already possess an extra loud-speaker for use as an additional listening point, but find that the construction of a suitable cabinet is not such an easy matter. Not only does the design require to be fairly correct, but the finish will have to warrant the inclusion of the speaker in any room, and it is not a simple matter to obtain that high-class finish generally seen on a factory-produced article. Messrs. Ferranti have introduced the cabinet shown below, and it is obtainable in walnut and Macassar ebony, with a square black bakelite grille. Its dimensions are 14in. high by 15in. wide by 7in. deep, and it costs £2s. 6d. No doubt many constructors could accommodate a small receiver in such a cabinet in addition to the speaker, and it will prove a very useful addition. The popular Ferranti speaker, type M5, can be supplied for fitting into this cabinet at 30s.

A speaker cabinet which will be found very useful. A Ferranti product.

Ferranti Condenser Colour Code

Table of Colour and Capacity:

<table>
<thead>
<tr>
<th>Colour</th>
<th>Capacity (μF)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brown</td>
<td>0.002 1500v Test</td>
</tr>
<tr>
<td>Blue</td>
<td>0.004</td>
</tr>
<tr>
<td>Green</td>
<td>0.01</td>
</tr>
<tr>
<td>Yellow</td>
<td>0.02</td>
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<tr>
<td>White</td>
<td>0.05</td>
</tr>
<tr>
<td>Red</td>
<td>0.06</td>
</tr>
<tr>
<td>Red (2 Bands)</td>
<td>0.06 1000v Test</td>
</tr>
<tr>
<td>Black</td>
<td>0.06</td>
</tr>
</tbody>
</table>

The condenser colour code which is used by Messrs. Ferranti.

New Heayberd Lines

Messrs. HEAYBERD inform us that they have recently introduced some interesting new chargers and a special safety hand lamp. The latter consists of the normal protected lamp with carrying handle and suspending hook, but it is fed from a double-wound transformer contained in a neat metal box designed to hang on the wall near to a lighting or power point. The voltage from the mains is thereby reduced to 12 volts, and thus there is little risk of receiving a dangerous shock should a short-circuit develop. It is especially recommended for use in damp places or where machinery is in action. The price is 30s., complete.

The chargers comprise type A and type B. The former includes an impregnated mains transformer, metal rectifier, and ballast resistance. The panel is fitted with mains input plug and socket, and intermediate tappings with shrouded terminals are fitted. The metal case is of perforated sheet metal for adequate cooling, and provided with rubber feet. Type B includes a polarised ammeter and a variable slide-resistance in addition to the parts included in type A. The prices range from £4 10s. to £7 19s. 6d. Two portable models are available at £5 17s. 6d and £6 15s., the former delivering an output of 12 volts at 5 amps, and the latter 60 volts at 2 amps.

Graham Farish Accessories

An item to merit attention is the "Gard" lightning arrestor, priced at 2s., which provides a £300 insurance against damage caused by lightning. The new model is slightly different in design from the previous one, for it has been improved. The arrestor is automatic in its action and need only be connected between the aerial and earth leads to ensure immunity from lightning; actually, it consists of a small spark gap of extremely low capacity built into the bakelite container. The new model is provided with a hood so that it can be fixed outside the house without the contacts being short-circuited by rain water.

Another useful item is the "Slot" solenoid device, which is a special form of variable condenser for connection in series with the aerial lead-in. It can be attached either to the set or at any other convenient point between the lead-in and the aerial terminal, and the sharpness of tuning can readily be varied by movement of a small projecting lever. The "Slot" is priced at 2s.
SIR—In your issue for October 13th a letter from a reader asking for a short-wave receiver. As I have had the same urge I can sympathize with him. If Americans can produce all-wave receivers, import them, pay duty, and undersell the cheapest broadcast receiver sold in this country, I think we ought to do the same. I may not have the funds for such a receiver, but I do have the need, and I hope that the day will come when British brains and British manufacturers will produce an all-wave broadcast receiver. I became a free trader through spending 30 years abroad, and I now buy American receivers, altering them to suit my idea of quality, or constructing from American goods in the market. I have no sympathy with battery users unless they live miles from a good system or supply, and have no patience with either. I have experienced the kind of service that is expected in their homes and 2-volt accumulators will be of no use. I have had a difficulty in finding a good deal of certainty how a signal of any wavelength will be received, and may not receive any broadcast signal at all, and at any given time during the day and at any given season of the year, but the question of wave propagation of 5-metre signals has been left largely to the amateur. As I see it, the question to be discussed is: "What extent do 5-metre signals obey the law of light propagation?" Many text-books refer to these waves as "quasi-optical," but this definition has had to be so modified during the last year or so as to make it meaningless. I do not know what is the greatest distance a 5-metre signal has been received at, but distances up to 200 miles or so have been reported during tests both in this country and in America, so there is ample proof that the waves that were once believed to travel in straight lines do definitely bend to some extent with the earth's curvature. If any of your readers get down to real experimental work on 5 metres I am sure they will get along on 5 W.A. as they do when working on the lower frequency bands.

In conclusion, I should like to say that I shall be very pleased to co-operate with anyone within reasonable distance from my station, by providing test transmissions. The power used at present is only about 2 watts, but this will be increased shortly to 10 watts, so a comparatively large area should be covered.Off. Mls (Radio G2NK), Bromley, Kent.

FACING THE VALVE REPLACEMENT PROBLEM

Problem (Continued from page 241)

discussing, valve replacement at the expense of a little more trouble is a good opportunity to change over to Class "B" output or to quiescent push-pull, in the latter case using one of the new double pentodes specially designed for this purpose. Considerably enhanced output, while keeping the high-tension consumption within very modest bounds, will be the result of this modification.

In the case of a mains receiver little alteration will be possible in the low-tension portion of the set, but the choice lying between triode or pentode output using valve types which have not substantially changed for some time.

The question of re-valving a superheterodyne receiver needs special care. The detailed design of the frequency changer portion of such a receiver is intimately bound up with the characteristics of the valves employed, and no departure from the original arrangement is usually possible, at any rate in the case of a commercially-manufactured set. A time-built superhet therefore has a rather different proposition, and one built over a year ago might with advantage be modernized to use one of the latest types of frequency changer. Those, of course, fall into two main classes—the triode-pentode comprising triode oscillator and pentode mixer with exterior coupling, and the other class, represented by the hexode and the octode, in which the coupling between oscillator and mixer is electronic. Recent articles in Practical Wireless have given full details of these valves, and of the circuit arrangements required for their practical application.
SPECIAL NOTE

We wish to draw the reader's attention to the fact that the queries and problems are intended for the solution of practical difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons, give the name and address of the sender.

Advantages of the Superhet

I have a 2 H.F. det.-pen. receiver working from a mains eliminator with accumulators for L.T. I have three separate tuning condensers as the coils are not matched. Will you please tell me the advantages of the superhet? I am quite pleased with my receiver, but I feel that I should like one a little more powerful. How will volume compare with my present set? Also, would it be possible to tune with three different tuning condensers? I do not mind how difficult tuning is.-R. H. (Aylesbury).

A superhet would be more powerful than your receiver if it was properly designed, but you cannot get louder signals than your present output valve gives when fully loaded, and, therefore, the local would still be the same volume. It is to be presumed, however, that the superhet would have a greater range. The various features of this circuit will be explained in the series commenced in last week's issue under the Beginner's Supplement. Separate condensers could certainly be used, and, in fact, are essential unless matched coils and condensers are used.

Values of Decoupling Resistance

"Could you please tell me what value of decoupling resistance is required to drop 80 volts when the current passing through it is 10 milliamperes?"-F. T. H. (Thornton Heath).

The value of a resistance is ascertained by dividing the required voltage by the current expressed in amps. Thus 10 milliamperes is .01 amps., and the value of the resistance in question would be 800,000 ohms. Another method of ascertaining the value is to divide the voltage by the milliamps and multiply the answer by 1,000, thus: 80 × 1,000 = 80,000 ohms.

Overheating

"I have an H.T. eliminator which has been in use for two years. I have had satisfactory service from it all the time, but yesterday I detected a strong smell of burning coming from it, and I found that the mains transformer had got very hot. None of the other components of the eliminator or set was more than warm, and I still get excellent reception. The transformer gets hot in about five minutes. Can you tell me the cause of this trouble and the remedy?"- W. A. T. (Swansea).

The heating is almost certainly due to an overload, but there are many different causes which might be found for this. The insulation of the transformer windings may have broken down; a component in the receiver or eliminator may have broken, or a short-circuit may have developed. This may be traced by measuring the total current of the receiver, by including a milliammeter in the common negative lead and checking up with the valves in use, together with any potential dividers across the supply. It would probably be advisable to send the mains transformer to the manufacturers in order that they may ascertain whether or not it has been damaged.

Crystal Set Wanted

"I am desirous of building a crystal set, and should be pleased if you would supply me with some instructions. Probably you have a book giving full instructions, and I should be glad to know if this is so."-D. J. W. (Chichester).

You will find a circuit of a wireless receiver in "50 Tested Wireless Circuits," obtainable from this office for 2/10 by post.

A-Field Winding Problem

"I have been using a 3-valve home-made set with a field-energised loud-speaker, having no field resistance marked on it. I have now bought a new speaker with a field of 2,500 ohms and have joined this in series with a smoothing choke in my mains unit. I am wondering whether I am passing too much current through the field, as I do not understand Ohm's Law, and do not want to damage the speaker."-H. S. (Skegby).

You should have no fear of overloading the winding with your present equipment. The only point to worry about is whether the resistance of the field is so high that it limits the voltage applied to your valves. Unless your field eliminator delivers 300 volts or so, you will find that you are not fully loading your valves as the voltage drop through the 2,500 ohms field will make a considerable difference to the H.T.

Using a Mains Pack

"I have a little point I should like explained. I have a commercial A.C. receiver and should like to use the mains portion for supplying other batteries. Is this possible, please?"-W. H. P. (Degany, N.W.).

We presume you wish to use the mains section, but not the receiver portion. This should be possible, although you will have to be careful regarding the cutting out of various voltage dropping resistances, etc. If you examine the mains section you will find a smoothing choke, and this point is the position lead, and you should take the lead for your other set from the receiver side of this choke. You could break the lead here and fit two terminals to insulated sockets on the chassis and bridge these when using the mains set, but take a lead from the live one for the extra set.

A Resistor Query

"I have two centre-tapped resistors, one is marked .04 and the other .015 on each side of the centre tap. I shall be grateful if you could tell me their values."-N. W. (Forest Hall).

The marking is probably in megohms, and thus .04 is equal to 40,000 ohms and .015 is 15,000 ohms. There is a possibility, however, that the components are double condensers, as it is not usual to mark resistances with a decimal value in the manner stated.

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1/6

Compiled by the Leading Short Wave Specialists

Obtainable from your Radio Dealer, W. J. HITCH, or in case of difficulty, direct from THOMSON & CO. LTD., Dept. 59, Reversion Works, Gainsborough Road, Wakefield. 

W.H. BATTERY CO. (P.O.), 75, Dean St., Oxford St., W.1. New address. Gerrard 0211

(Continued from foot of column above.)

SPECIAL Offer of Wire Wound Resistances, 4 watts, value up to 50,000 ohms. 1/-; 8 watts value up to 10,000 ohms 1/6; 15 watts, any value up to 500 ohms, 2/-; 25 watts, 100 ohms, 4/-.

C. C. ELECTROLYTIC Condensers.

D.C. 100,000 volts working, 10/-.

A.C. 250,000 volts working, 25/-.

C. C. Electrolytic Condensers, 8 ins., 440v. working, 64/6.

Replenish at long intervals—that's all. —R. Wiglield, Furlong Road, Golders Green.
Home Charging!

Do you take your accumulators to a service station? Haywood have a quicker and better way.
Install a Haywood Portable Charger and charge your accumulators at home. Under your own personal supervision you can be sure that they are charged efficiently.

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PRACTICAL WIRELESS

November 10th, 1934

PEARL & PEARL


All the following bargains guaranteed perfect. Cash or C.O.D. Carriage Paid.

**SPECIAL OFFER**

Lancaster 5-valve superhet coil transformer for A.C. or battery sets, £1 15/- nett.

**AMPLON Class B Inverter Transformers,**

1-1, 1-5, 1-8, 1-11.

**Specially large core bargain at 95% of List price.**


Our price 6/6.

**SPEAKER UNITS.-**

**KENT-STEWART** Permanent magnet moving-coil speakers. Special offer; in a transformer double speaker complete, at 5/6 with any receiver, our price 3/6. Our price 6/6.

**SPEAKERS.**

**Cabasse** Coils, 15
dual-range, filtered, in sealed iron cored dual coil sets with circuits, 1/- each.

**CONDENSERS.**

**TOREX** 25-mfd. variable condenser, £2 0/6, 15/-, 10/-, 8/-.

All capacitors guaranteed perfect.

Our price 6/6.

**COLUMBIA 2-valve Battery Receivers with Speaker and Micrometron and tuning drum and cover; can be fitted on board a.m. or f.m. receiver, £2 15/-.

Our price 6/6.


**COLUMBIA 5-valve Battery Receivers with Speaker and Micrometron and tuning drum and cover; can be fitted on board a.m. or f.m. receiver, £3 12/-.

Our price 9/6.

**SPECIAL BARGAIN.**

**CONSTRUCTORS OF COILS, Transformers, and Chokes.**

**SPECIAL OFFER.**

**THERMO-TRON** double pole change-over switches for receivers with points and contacts. Made of best copper for point and contact bushings. $2 0/6, 15/-, 10/-, 8/-.

All capacitors guaranteed perfect.

Our price 6/6.

**COLUMBIA** 5-valve Battery Receivers with Speaker and Micrometron and tuning drum and cover; can be fitted on board a.m. or f.m. receiver, £3 12/-.

Our price 9/6.

**J.E. LUCAS COILS.**

**NEW LUCERNE** dual-range, filtered, in sealed iron cored dual coil sets with circuits, 1/- each.

**CONDENSERS.**

**TRIRAY** 25-mfd. variable condenser, £2 0/6, 15/-, 10/-, 8/-.

All capacitors guaranteed perfect.

Our price 6/6.


**COLUMBIA 5-valve Battery Receivers with Speaker and Micrometron and tuning drum and cover; can be fitted on board a.m. or f.m. receiver, £3 12/-.

Our price 9/6.

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All capacitors guaranteed perfect.

Our price 6/6.
THE "GOLD-MINE" STORES

transformers and such
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possible requirement, at the lowest prices In the
with thousands of radio bargains covering your every
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metres, with reaction, 2/11. British Radiophone Super-
in coils, most sizes, 9d.

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VARIABLE CONDENSERS.

.0003, .0005 mfd.

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dielectric 2-gangs.

issue, also note that this Kit is being demonstrated
See also our page advertisement (p. 231) in October 27th
KIT D. - The finished
KIT B. -As
KIT A. -Comprising

sundries, in sealed carton.

ponents of exact specified
vice your set free of charge so that you do get them,
every "Gold-Mine" kit which leaves our premises.
FULL PURCHASE PRICE REFUNDED IN
suitability for the part of the circuit which it fits.

TO SPECIFIED VALUES

AMAZING BARGAIN OFFER.

"£5" 3-VALVE SUPERHET

Radio Market

amount should be included. TERMS: Cash or C.O.D.
All Goods over 10/- postage free, except batteries, mains

PRACTICAL WIRELESS, 10/11/34.

offers the large working, limited quantities only; all orders for carriage
-Phone: H.M. 2988. The following components are suitable for f. V. Camm's
"£5 Three-Valve Super Hét.

Radio CLEARANCE offers British Radiophone Triple Gang
Condensers, 2x0,0005 and 110 Kc. related with
chokes and variable condensers; Golvern coils, Polar condensers, T.C.C.
condensers, Golvern coils, T.C.C. condensers, 2 mfd., 1000-2500
condensers, 2 mfd., 1000-2500

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Give Your Set a Tonic!

What a Power of Difference a New DETECTOR VALVE will make in Sensitivity, Selectivity and Quality of Reproduction

The majority of broadcast receivers prior to 1933 used a Triode Detector. This valve may be said to be the 'key' stage in the set as upon its proper functioning depends the sensitivity, selectivity, quality of reproduction and general absence of background noise so essential to the correct working of a set.

SENSITIVITY and SELECTIVITY falling off in the range of a set or flattening of the tuning may be due to weakening of the electron emission from the Detector Valve filament, or poor vacuum in the valve. Modern OSRAM Detector Valves are made with greater emission reserve and devices which ensure the highest possible vacuum.

Do not put up with inferior reception when your set can be so much improved by fitting a new OSRAM Detector Valve. There is a type for every class of broadcast receiver.

OSRAM DETECTOR TRIODES

<table>
<thead>
<tr>
<th>Triode</th>
<th>Description</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>HL2</td>
<td>For 2-volt Battery Sets or HL2/K</td>
<td>5/6</td>
</tr>
<tr>
<td>HL210</td>
<td>For old type 5-valve &quot;portable&quot;</td>
<td>5/6</td>
</tr>
<tr>
<td>H210</td>
<td>For OSRAM &quot;MUSIC MAGNET&quot; FOUR and OSRAM &quot;FOUR&quot; Sets</td>
<td>5/6</td>
</tr>
<tr>
<td>MH4</td>
<td>For A.C. Mains Sets or Catkin M H 4</td>
<td>13/6</td>
</tr>
<tr>
<td>DH</td>
<td>For 0.25 amp. D.C. Mains Sets</td>
<td>13/6</td>
</tr>
</tbody>
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