TELEVISION AT HOME AND ABROAD

Wireless Magazine

MAY

AND MODERN TELEVISION

Edited by PERCY W. HARRIS M.I.R.E.

GEORGE NEWNES LTD. LONDON

An Enthusiast's Power Amplifier

How the Valve Works

Practical Resistance Amplifier Design

More About the Stenode

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If you take a serious interest in Wireless development, make certain of this important new work. The information it contains is reliable, it is up-to-date and it can easily be understood by any reader of "Wireless Magazine and Modern Television."

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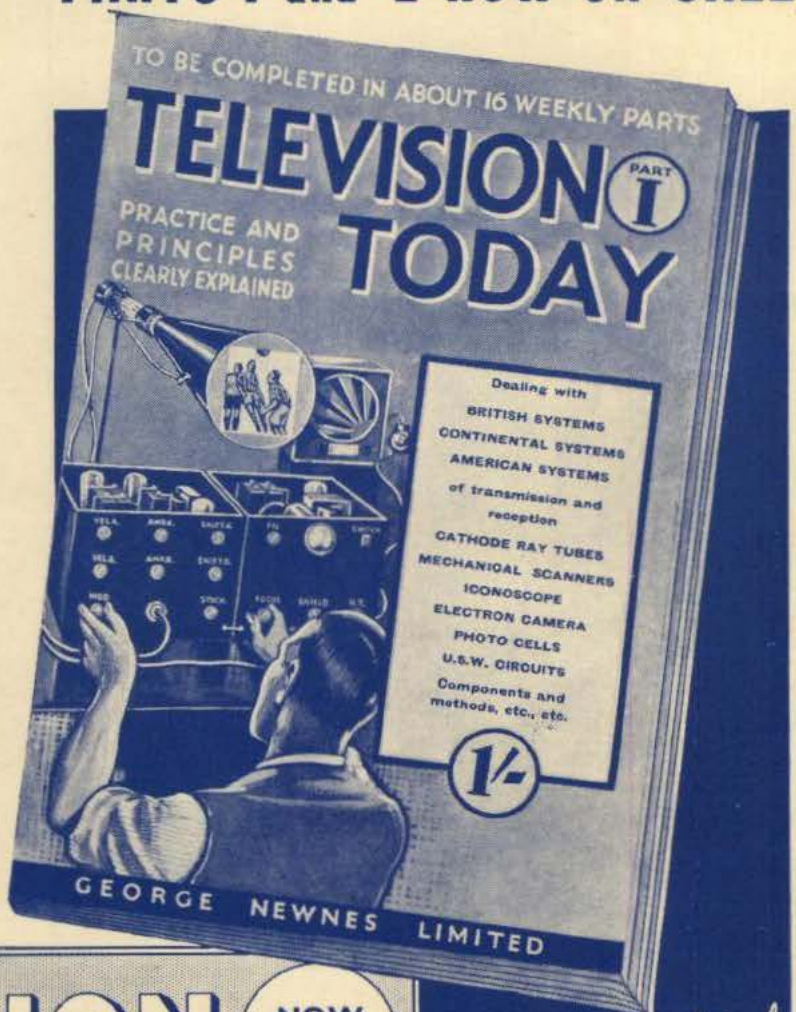

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Wireless Magazine
AND MODERN TELEVISION

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GREAT JUBILEE GALA OF THE ETHER!

Marconiphone and "New Set" Boom

OVERWHELMING DEMAND FOR SPECIAL "EASY PURCHASE" SUPER SETS

Radio House, London.

THE JUBILEE AND ITS ATTENDANT CELEBRATIONS — TOGETHER ONE OF THE OUTSTANDING EVENTS OF OUR LIFETIME—IS ALMOST UPON US. THE VITALLY IMPORTANT PART WHICH RADIO WILL PLAY IN BRINGING IT RIGHT INTO OUR OWN HOMES HAS BEEN STRESSED TIME AND TIME AGAIN. YET EVEN NOW MANY PEOPLE HAVE STILL NOT FULLY APPRECIATED THE REALLY INESTIMABLE IMPORTANCE OF THESE JUBILEE PROGRAMMES — THE PATRIOTIC APPEAL WHICH THEY HOLD FOR EVERY ONE OF US — AND THE MARVELLOUS ENTERTAINMENT WHICH MONTHS OF PLANNING AND ORGANISATION HAVE PREPARED. In one week alone we are to hear H.M. The King and H.R.H. The Prince of Wales, a Thanksgiving Service, attended by Their Majesties The King and Queen, speeches by Rudyard Kipling and many other celebrities, Shakespeare's "King Henry V" with an all-star cast, Variety programmes featuring the world's most famous entertainers, community singing from Hyde Park, in short — a veritable Empire Gala of the Ether!

Only up-to-date superhet radio can do full justice to these wonders— can render them in all their original pageantry and brilliance. Many thousands of families are unfortunately still tolerating old, thoroughly out-of-date sets which provide only a thin imitation of the real thing. It is the ambition of Marconiphone to send every one of these sets to the scrap-heap well before the Jubilee programmes. Three Special Marconi Jubilee Year Superhets have been designed to commemorate this special occasion and to replace all these old models. They are respectively a Radiogramophone at 22 Gns., a Console at 17 Gns. and a Table Grand at 12½ Gns.; each has already met with an overwhelming and absolutely unprecedented reception from the British public.

Specially accommodating terms of only 5/- per week place these exceptional instruments within the reach of everyone.

From the technical point of view these models are particularly impressive. **The descriptive leaflets mention twenty-five of the many interesting up-to-date technical features in which the chassis abounds.** Their electron-coupled circuits are designed largely round two very wonderful new Marconi super valves. One is the Marconi MHD4, a triple purpose double-diode-triode and the other the Marconi MX40, a non-radiating high performance detector-oscillator. **These two gems of Modern Science hold the secret of the Marconi Jubilee Year chassis.** It takes the advanced technician to appreciate fully many of the ingenious refinements of this new masterpiece such as the high-efficiency static suppression and the time delayed A.V.C. over 1500 to 1 signal ratio, 5-speaker power, Tone Compensated volume control, 'Quiet' tuning and adjustable sensitivity, energised moving coil speaker with wide response diaphragm, etc., etc.

Beautiful Cabinet-Work

The great thing from the average man's outlook, however, is that while the Jubilee Year Table Grand is well within his purse, it is nevertheless a really first-class piece of Radio engineering and at the same time a most exquisite piece of figured walnut furniture that will grace any home.

Designed For The Future

Any future changes in wavelengths or other technical developments will not worry the Marconi Jubilee Year models in the least. **They have, in fact, already ended the period of radio troubles and difficulty that has existed in many homes for years.**

Consult Your Local Marconi-men

Next time you are round the shops look for your local Marconi-men. **You can identify them by the Marconi-man symbol which you will find outside their premises or in their window.** Send a postcard with your name and address to the Marconiphone Company Limited, Radio House, Tottenham Court Road, London, W.1. They will send a descriptive leaflet and arrange for you to hear the Marconi Jubilee Year models without delay; you are advised to secure your model while there is yet time—all available supplies are being rapidly absorbed by both trade and public.

Wireless Magazine
and Modern Television

The Editor's Page

May, 1935.

What the Amateur Appreciates

THE 1935 Stenode which Mr. Paul D. Tyers described last month and of which further particulars are given in the present issue, has had an enthusiastic reception. Not only the performance, but the excellent appearance both " above and below deck " has earned the highest praise and justified our belief that sound design is really appreciated by the amateur.

Bearing in mind that " Wireless Magazine " readers are interested in the practical as much as in the theoretical aspects of new apparatus and inventions, we publish this month a design for a high-quality radiogram incorporating both the piezo-electric pick-up and the piezo-electric loudspeaker, both of which have been described in recent issues by Mr. P. Wilson.

Working backwards from these high-quality components, the rest of the receiver has been designed to make the best of them, with the result that in a complete radio gramophone we have a receiver capable of doing full justice to the programmes and records now available. It is worth noting that although the receiver has been shown in what may be termed a " de-luxe " cabinet complete with record cupboard and loudspeakers, the set is so made that it will go into any cabinet capable of taking a 12 in. by 18 in. baseboard, with or without a gramophone turntable.

As Mr. P. Wilson has written a number of highly interesting articles on quality in recent issues of " W.M.," we feel that readers will be interested in the apparatus he uses himself. We have therefore asked him to describe his own super-power amplifier, at the same time giving full constructional particulars in case readers wish to build a similar instrument for themselves. Mr. Wilson as a leading expert in gramophone reproduction (he is technical editor of *The Gramophone*) is never satisfied with anything less than the best, and those who have heard his demonstrations on sound reproduction will be interested to know that this is the actual amplifier used.

Our television section this month contains much of interest including a description of what is being done in Germany at the present time. Mr. Merdler's articles on television circuits will be welcomed by the true experimenter, and in this he will see some of the problems that have to be faced in the peculiar conditions which television imposes.

The experimenter should realise at once that television work divides itself under the three headings, the radio-frequency circuit, which has to deal with the ultra-short-waves, the post-detector circuit which has to deal with frequencies from practically zero to over 1,000,000, and the cathode-ray tube circuits with their associated scanning arrangements.

The radio-frequency circuits do not present any very great difficulty, but when we come to the amplifiers covering such an enormous frequency range a special technique has to be evolved. For this reason it is sheer nonsense, if not worse, for some radio firms to announce that their present 30-line television receivers can be converted at a later date for high-definition television for a few pounds.

A 240-line cathode-ray television receiver can be adjusted at practically no expense to receive 30-line television, if anybody should want it, for such a receiver can adequately handle all the frequencies required for 240-line television.

It is quite another matter to suggest that a receiver, designed to work on the ordinary broadcast band, with an amplifier capable of handling frequencies up to only 10,000 or so, can be changed into an ultra-short-wave receiver with an amplifier handling frequencies up to 1,000,000, with an entirely different scanning circuit, for five pounds or so. This indicates a complete lack of understanding on the part of those who make the statement.

Our experts are at the present time engaged upon the problem of designing a first-class "straight" three-valve receiver of a simple and inexpensive type for those who want first-class modern results at a price within the reach of all. First particulars will be published in the June number.

May we again thank readers for their very kind letters which continue to pour in expressing appreciation of " W.M." in its present form. Many of the letters contain valuable suggestions for the improvement of the magazine, and these are being acted on as opportunity arises.

Percy W. Harris.

The Editor's Jubilee Radiogram for Discriminating Users—page 246

BY APPOINTMENT

★ PROOF!

LETTER TO MR. W. J. FOX, "HIS MASTER'S VOICE" DEALER OF HIGH STREET, NEWBRIDGE, MONMOUTHSHIRE, FROM A CUSTOMER WHO PURCHASED A "HIS MASTER'S VOICE" FLUID-LIGHT FIVE. MODEL 442.

We do not claim that this popular radio receiver will regularly receive American stations, but this letter just shows how enthusiastic owners of "His Master's Voice" instruments are about the capabilities of radio receivers and radiogramophones which bear this famous trade mark. Model 442, with its fluid-light tuning, is one of the most popular of the Silver Jubilee Year "His Master's Voice" receivers. Write to "His Master's Voice" for technical details and full specification of this instrument and of the complete range of "His Master's Voice" "Silver Jubilee" Year Radio. Or call in at your local "His Master's Voice" dealer's, to-day.

(C O P Y)

Dear Sir,

We purchased Model 442 AC "His Master's Voice" Superhet Fluid-Light Five from you 2½ months ago, and I feel I would like to write and tell you how pleased we all are with the set. The volume is all that can be desired and the tone is really beautiful. That is the only way I can put it, the speaker or band actually sound as if they are in the room with us.

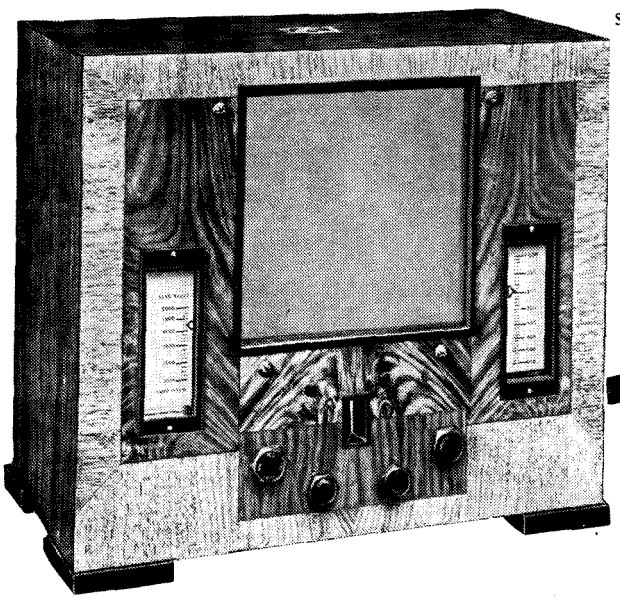
On both wave-bands there is no interference between stations, a fault in many sets. Moscow on the long waves can be got free of either Huizen or Radio Paris. The majority of sets I have heard are not capable of that.

I may say that my programmes are not confined to Europe, as practically every night, after 11 p.m., America has been coming in at quite good loudspeaker strength, and I have a log of 26 U.S.A. stations, 1 Canadian, 2 Mexican and 4 South American stations. On the 14th November at 1 a.m. I picked up K M O X, St. Louis, at full loudspeaker strength and heard a relay from Hollywood with such stars as El Brendel, Dick Powell, Ruby Keeler and Clark Gable broadcasting. St. Louis is 4,500 miles away. Eddie Cantor was on the air last night from W C A U, Philadelphia.

I am,

Yours faithfully,

(Signed) D. E. EVANS.



MODEL 442

SUPERHET
ALL-ELECTRIC
FLUID-LIGHT FIVE (AC)

13½ GNS.
(or by hire purchase)
(Price does not apply in I.F.S.)

● *Mr. Evans sent Mr. W. J. Fox a few weeks later a complete list of 35 U.S.A., Canadian, Mexican and South American stations he had received.*

"HIS MASTER'S VOICE"

SILVER JUBILEE YEAR RADIO

THE GRAMOPHONE COMPANY LIMITED, 98-108 CLERKENWELL ROAD, LONDON, E.C.1.

Advertisers like to know you "saw it in the 'Wireless Magazine'"

His Majesty the King

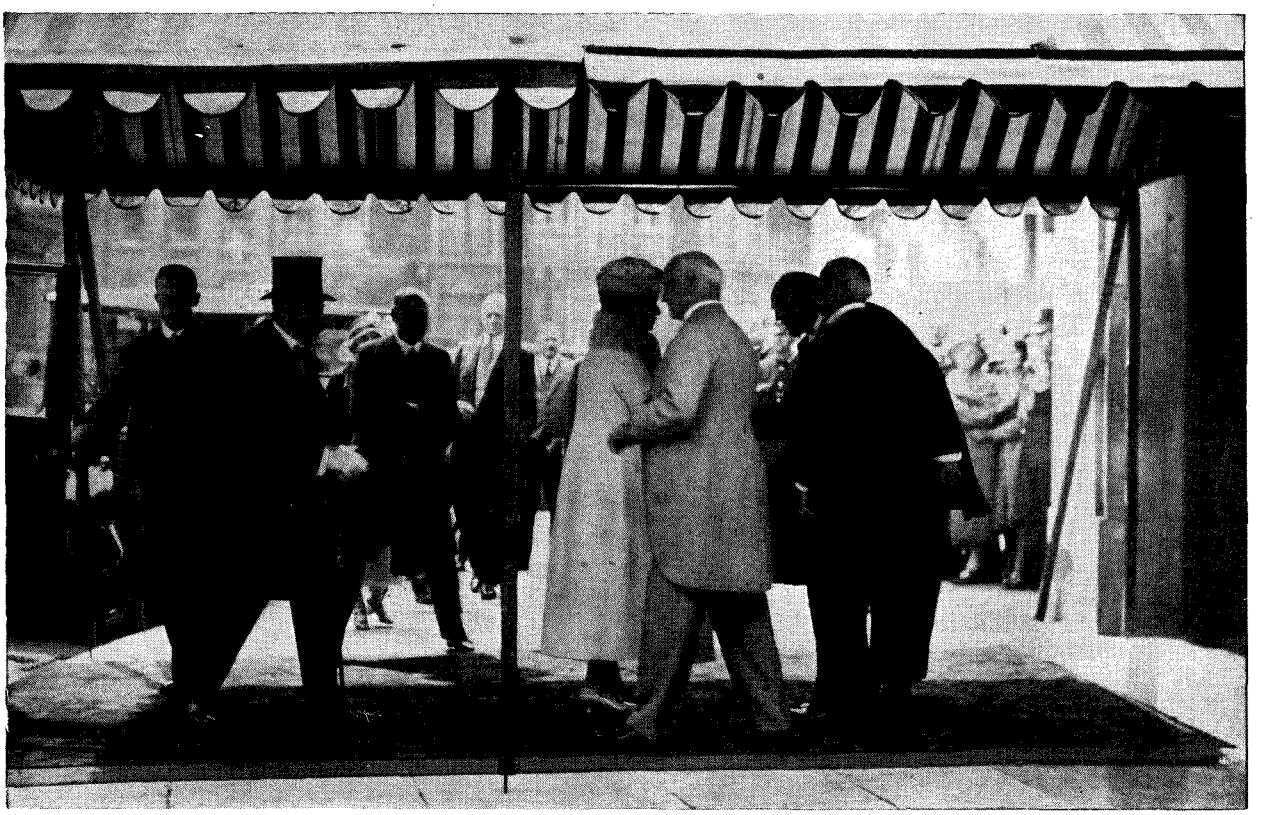
Times photo

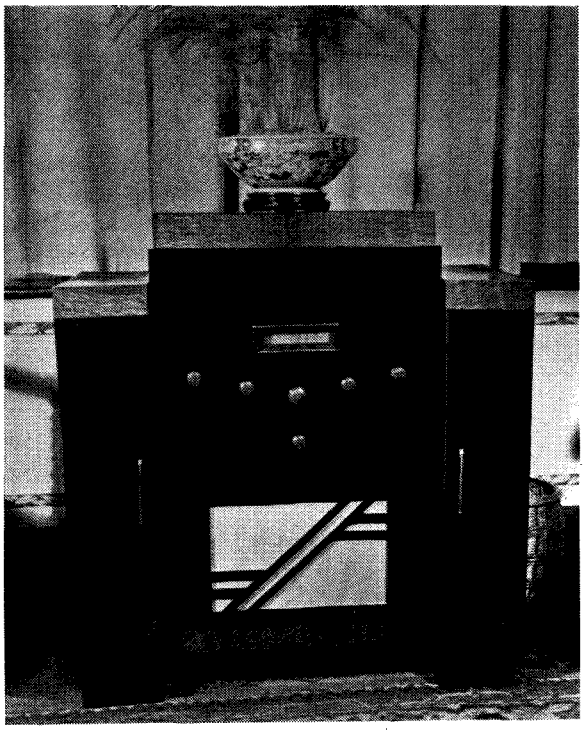
It is now the custom for the King to broadcast a message to the country and the Empire in the afternoon of Christmas Day. His Majesty speaks from a small room at his own home, Sandringham.

In 1932 with Her Majesty the Queen, the King paid a visit to Broadcasting House where he inspected the studios and control rooms in the building.

His Majesty the King has always taken a keen interest in the development of radio—a science that has grown so tremendously during his auspicious reign—and from the earliest days His Majesty has been a keen listener. Recently, when with Her Majesty the Queen he stayed at Compton Place, Eastbourne, the King's private wireless set was installed there to provide for his well-earned recreation.

His Majesty's Christmas Day messages have strengthened the bonds between the Mother Country and her Dominions and Colonies abroad. We join with all His Majesty's faithful subjects in an expression of our loyal devotion at this time of national rejoicing.





A modern cabinet for a modern set. Notice the rectangular effect of dial window and speaker grille

My 1935 Radiogram

Designed by Percy W. Harris, M.I.R.E.

A WELL-DESIGNED radio receiver, properly made in the first place, lasts a long time. If, at the time of building, it incorporates the latest ideas in quality and efficiency its life will be considerable, and so, for this and other reasons, I do not often build a receiver for my own family use.

For some little time past, however, I have been turning over in my mind the idea of building a new home set that would give a performance of outstanding quality with adequate range on the radio side while doing full justice to the superb electrical recording which characterises the products of the leading gramophone companies today.

I have now finished my new set and, quite frankly, I am so delighted with its performance that I do not hesitate to publish at this, the earliest possible moment, a full description of how to build it. The enthusiasm with which it has been greeted by all who have heard it has proved to me that my liking for it is not just based on a kind of parental blindness to faults.

At the beginning, let me endeavour to indicate its leading points. First, one notices an extremely high quality of reproduction, ranging from the deep bass to the high harmonics of speech, musical instruments, and characteristic noises. The bass is a genuine bass and not dependent upon cabinet resonance; there are no irritating peaks to give "edginess" to speech and music from certain instruments, while the full rendering of the higher frequencies brings out unexpected beauties in orchestral music.

To hear my 1935 Radiogram reproduce dance-band music from the B.B.C. is a revelation of what most radio receivers miss, for the sharpness of the brass, the clash of the cymbals, and all those peculiar sounds which come from the use of wire brushes, the rattle of dried peas, etc., are changed entirely in their character.

On the average set one hears these noises after a fashion, but they have little resemblance to the "real thing." In the 1935 Radiogram they sound as if one were in the hotel or dance hall oneself. You may not like this kind of music (I do not, myself!) but it is an excellent test of quality of reproduction in higher frequencies.

Quality With Range

But quality without range is not sufficient. A receiver of this type should bring in a good selection of foreign stations with such a reserve of strength that it is not necessary to run the receiver on the verge of oscillation and thereby sacrifice the good qualities to which I have just referred. And range without selectivity

WHAT THIS SET WILL DO !

Brilliant undistorted volume on local stations with freedom from interference.

Exceptional long-wave performance and efficiency.

Excellent range of alternative foreign stations.

Valuable marginal reserve of sensitivity for skilled handling.

Dance-hall volume if required on gramophone and radio.

Full justice to modern electrical recording.

A Jubilee Radiogram

again is insufficient, so we must have a good measure of selectivity without sacrifice of strength or quality. Fortunately this Radiogram shines in this direction also.

Nothing Mysterious or Revolutionary

There is, of course, nothing "revolutionary" nor mysterious about the set when it is analysed. It is a much better receiver than most just because sound radio-engineering principles have been applied in a logical fashion, and the expert will be able to see from the circuit diagram and other particulars given just why it is good.

The design started from a consideration of the requirements of high-quality reproduction both on the radio and the gramophone side and the fact that certain components were now available to fit in with these ideas. As the human ear is the final judge of such matters the set was, so to speak, worked out backwards from this point, the first consideration being the loudspeaker.

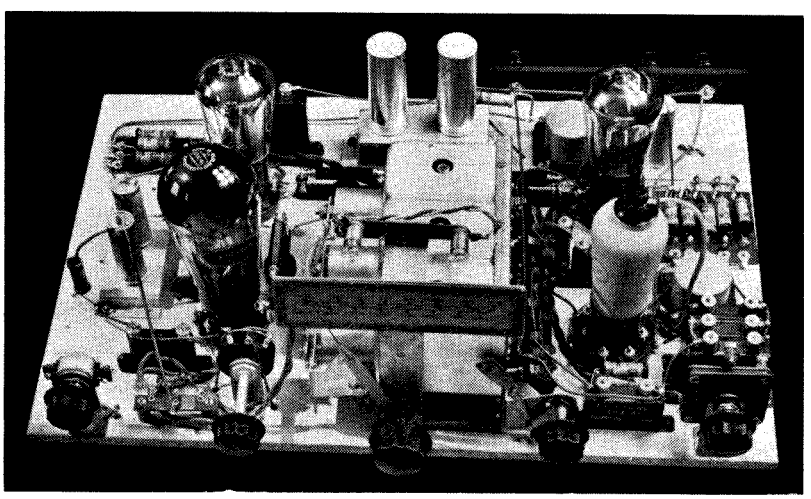
Two Loudspeakers to Get Good Quality

Here experiments with the new Piezo-electric Tweeter, so fully described recently in these pages by Mr. P. Wilson, M.A., showed that provided it was used with a suitable moving-coil loudspeaker to reproduce the bass and middle register adequately, here was just what was wanted from the quality point of view. Two loudspeakers are therefore used, one the Tweeter and the other a 9-in. Rola with an energised field, the two being mounted on a baffle together with a special control which enables the output to be progressively varied from the point where both moving-coil loudspeaker and Tweeter are in circuit, gradually back to the point where the Tweeter is no longer in circuit and the whole of the reproduction comes from the moving-coil loudspeaker. At the same time a high-note cut-off is introduced.

This control enables one to use the highest possible quality on local station reproduction or upon any programme which is reasonably free from interference, and on the other hand when required—for example, when the station is badly interfered with and when there are heterodyne whistles—to cut down high-note reproduction and so remove a great deal of the interference.

Next, having decided on the loudspeaker combination and control, we must consider how justice can be done to this combination. I could have used a pentode or a super-power valve immediately after the detector with good transformer coupling and obtained a very high measure of quality, but after careful consideration I decided to use *two* valves, resistance coupled, with the audio coupling so designed as to give the best possible reproduction and adequate gain.

A piezo-electric pick-up is used. This, with the two speakers, gives admirable quality on gramophone-record reproduction

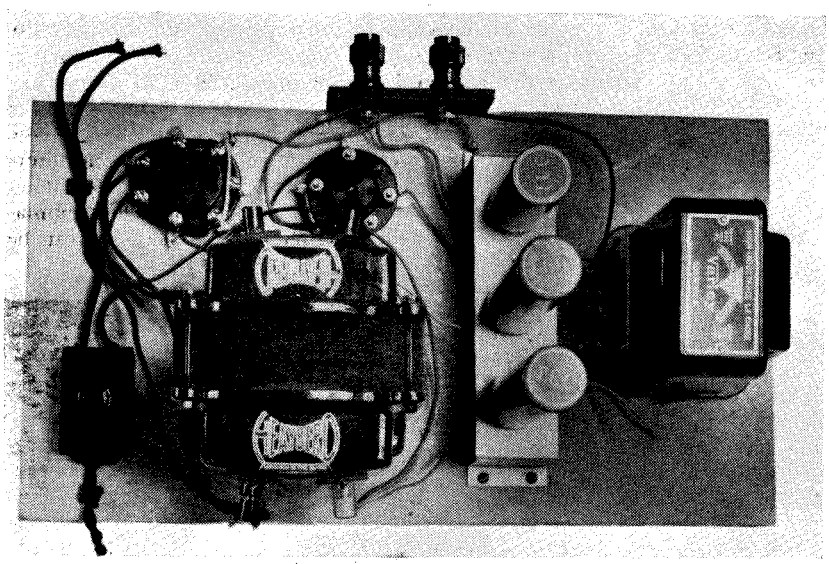


Here is the complete assembly of the receiver. The power-pack has its own baseboard, to which the set is connected by means of a cable and plug

Stabilising

High quality being at least as much a matter of stability as of design in the audio coupling, the most careful measures were taken in stabilising, with results that fully justified the trouble.

In the matter of the detector there were several interesting points to be considered. Regular readers will know that I am the last to be carried away by



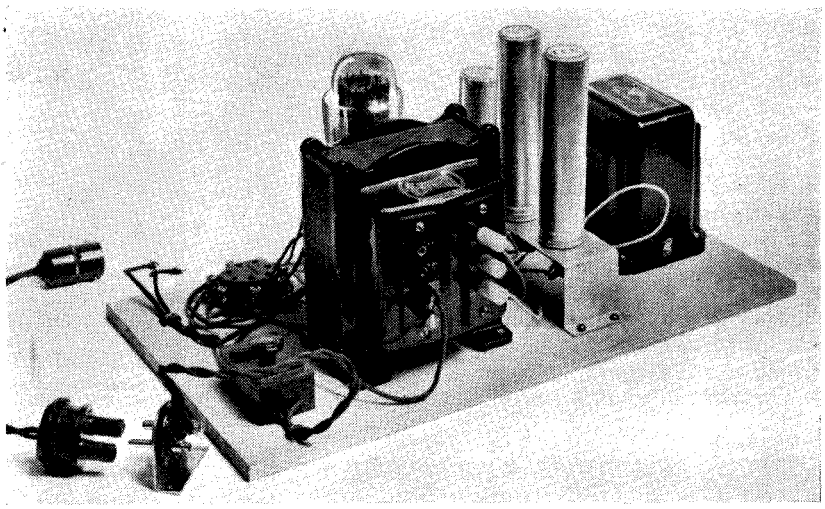
The power pack. Incidentally this pack is useful for many other sets as it provides for speaker energising and has two H.T. tappings

temporary theoretical fashions or, in fact, by any theories which are not adequately backed up by practical proofs. So far as detectors are concerned, I have watched both changes of fashion in detector circuits and the claims made for them with no little interest and amusement.

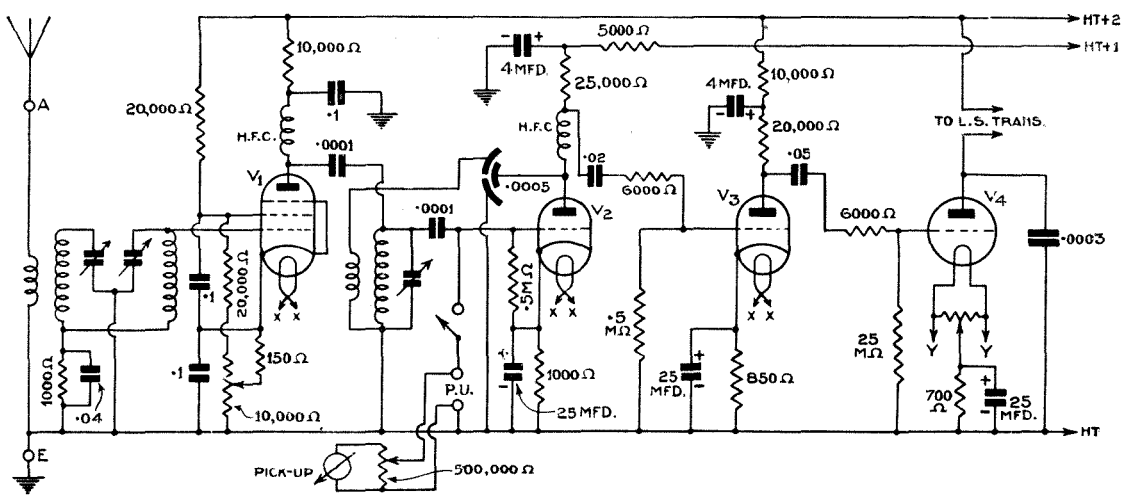
A number of years back when grid leak and condenser rectification was the rule, the anode bend method suddenly became fashionable, and its protagonists were anxious to point out that no good quality could come with grid leak and condenser rectification.

Following this we had power-grid rectification, which was a reversion to the old grid leak and condenser rectification with, however, a better understanding of the values concerned and the use of adequate voltages. Nothing could equal the scorn of the power-grid protagonists for those poor creatures who used anode bend.

Then we had diode rectification, the advocates of which were equally vociferous in pointing out that no good quality could come with the power-grid method. Commercial considerations in the saving of space, cost of components, current consumption and the like, have led to the introduction of a number of special valves utilising the diode principle and suitably used these valves give excellent results, but in any case I soon found in my experiments with my 1935 Radiogram that grid leak and condenser rectification adequately decoupled and with a good high voltage and the right values gave results as satis-



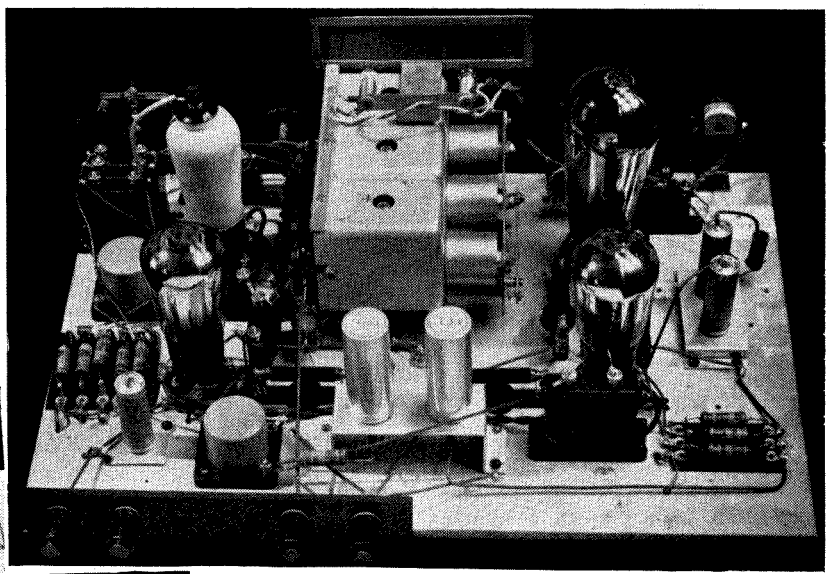
Another view of the power pack. This was wired up with rubber-insulated single flex. This assures adequate insulation of the leads

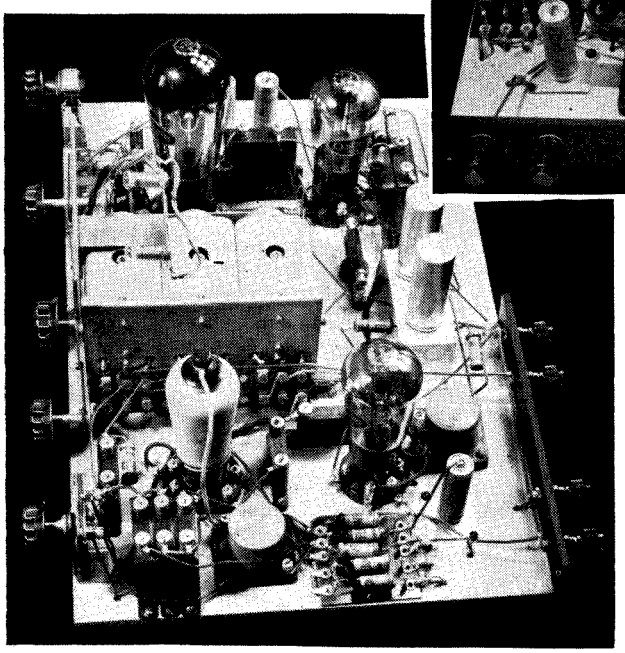


The theoretical diagram. For simplicity the wave-change switching has been omitted. Although variable condensers are used, these are variable only for trimming, the actual tuning being done by varying the inductance. Observe the very full decoupling everywhere, complete stability being a noteworthy feature of this set. Without this the excellent quality would not be obtained

fying as any other I have heard with other detector circuits.

I decided upon one well-designed high-frequency stage using a new variable-mu high-frequency pentode valve and a bandpass input circuit. Reaction was provided for in the detector circuit, for there are times when the additional gain which reaction gives is very valuable. I decided upon fully ganged tuning, for the set is designed for family use as well as my own and the employment of the high-frequency pentode with its very high gain enables this to be done satisfactorily.



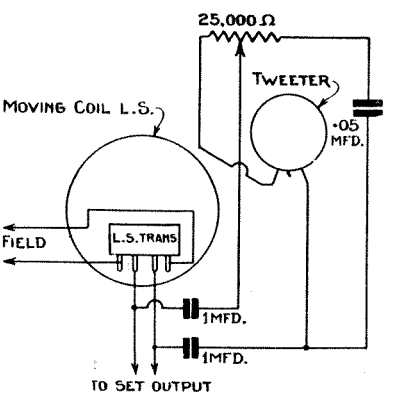


Above, a rear view of the receiver and, on the left, the H.F. and detector ends. All vital leads are kept as short as possible

For the general tuning arrangements I chose the Varley Permeability tuner, which tunes by inductance and not by capacity. In this unit very high efficiency is obtained with an admirable uniformity over the whole of the tuning range both on the medium and the long waveband. This unit has proved very satisfactory indeed, both in accuracy of tuning and in high efficiency.

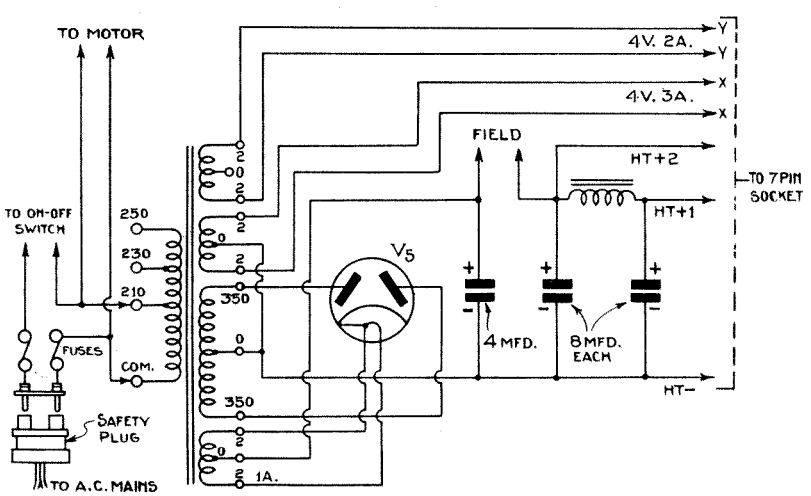
Volume control on the variable-mu valve is manually controlled, and no provision has been made for automatic volume control, as such an arrangement requires a very strong signal with very high gain (such as is obtained in a super-heterodyne) for satisfactory operation.

On the gramophone side the pick-up is obviously a vital factor, and after experimenting I chose the new Piezo-electric pick-up which again has been fully described by Mr. Percy Wilson. A separate volume control is provided for the pick-up, and a special switch is attached to the tuning unit by means of which, when the tuning knob is turned to the point on the dial marked "Gramophone", the pick-up is switched into circuit.

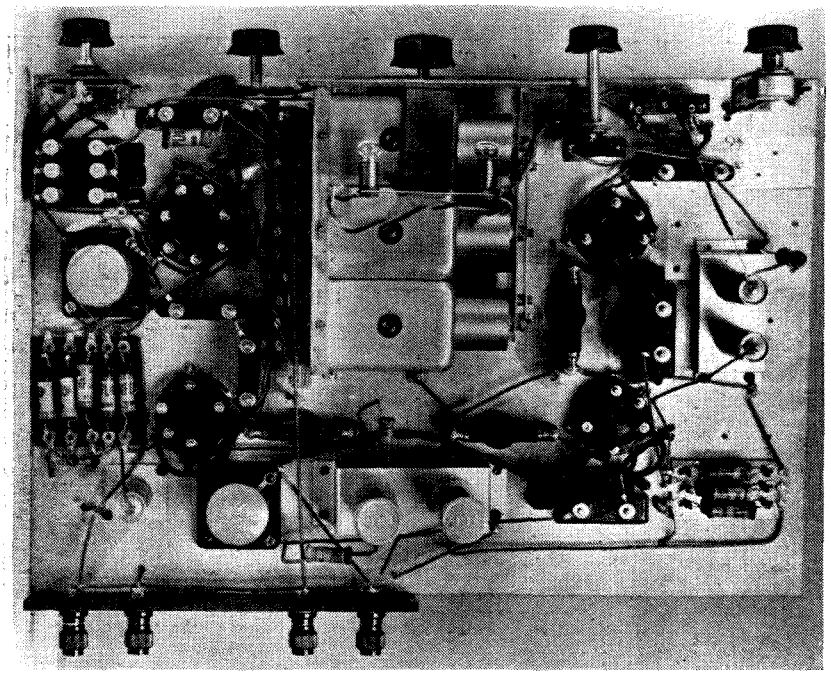


How the two loudspeakers are wired up with the tone control potentiometer

This being a mains set, we have to consider the power unit, and here I have departed from conventional practice to a slight extent. Frequently nowadays the power unit is



The circuit of the power pack. Fuses and a safety plug are provided. Note that the centre tap on the 4-volt winding at the top is not used



Top view of the receiver. The three trimmer screws for the three sections are clearly shown. The controls (reading from the left) are reaction, wave-change switch, tuning, volume, and on-off switch. This last is not incorporated with the volume control as is often done on commercial sets, so that the receiver can be left tuned to a station and the volume arranged for comfort with immediate control by the on-off switch

also made to include the output valve or valves either in parallel or push-pull. In my case, and bearing in mind the requirements of " Wireless Magazine " readers, I decided to make the mains power unit of such a kind that it is not only suitable for this receiver but to a number of others which may exist or may be designed in the future.

Output Valve

The output valve of the set is in its logical position, namely, on the set itself, and if you do not require to build a set at the present time you may find the design for the power unit (which gives two different high tensions, one for the main part of the set and the other for the detector, carefully and separately filtered) of use to you.

While I have chosen rather a large cabinet, including record compartments, for my own receiver and can recommend this to anybody who wishes to build the set into a handsome piece of furniture worthy of it, the design of the set and the power unit is such that it will fit into almost any cabinet, small or large.

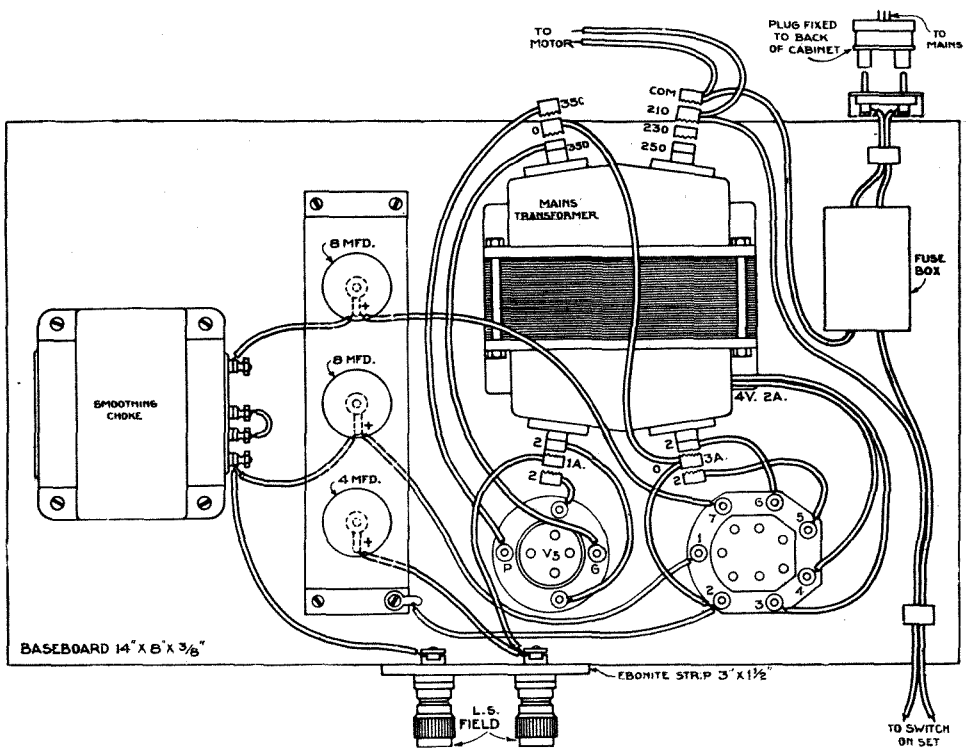
If you already have a radiogram cabinet you should have no difficulty in finding room in it for this set as the baseboard of the set itself measures only 18 in. by 12 in., while the power unit measures only 14 in. by 8 in.

Simple Construction

Constructional work is particularly simple. I have used a metallised baseboard for both set and power unit, and this, with the layout arranged, works just as well as a metal chassis. The particular arrangement of the terminals on the permeability tuner calls for a somewhat unconventional layout of the set, and you will notice that instead of starting on the left we start on the right.

In spite of its very high standard of performance and efficiency this set is by no means expensive to build. There is no special work to be done on the cabinet if you choose the one illustrated.

Although this is truly a one-knob tuning instrument, the tuning control is not the only one we require on a good set. The central knob immediately beneath the dial window is for

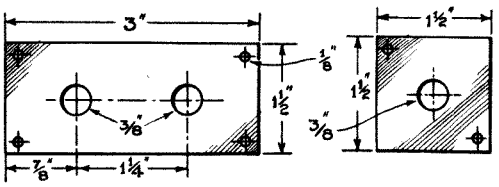


The power pack layout. The numbers shown on the 7-pin socket are actually moulded on the component and are not arbitrarily chosen. They should not be confused with the lead number on the plug. The mains transformer is suitable for all A.C. supplies from 200 to 250 volts

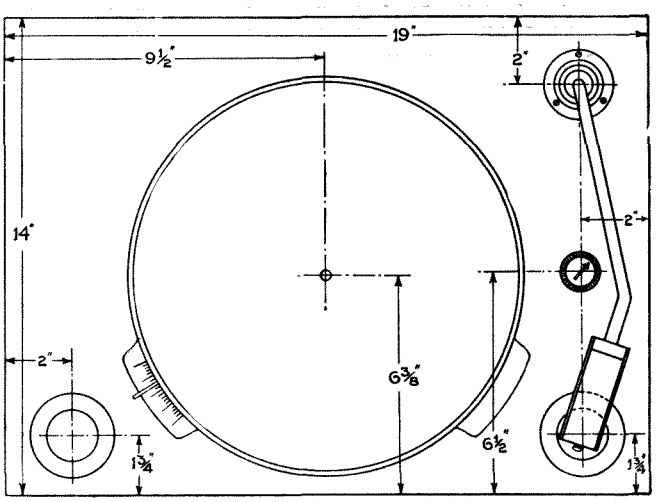
tuning, while the two knobs on the left are (counting from the tuning knob) respectively volume control and on-and-off switch.

On the right of the tuning knob we have first of all the wavechange switch, and secondly the reaction control, while the knob immediately beneath the tuning control operates the potentiometer controlling the loudspeaker combination.

When the knob is fully to the right both moving-coil speaker and Tweeter are in circuit,

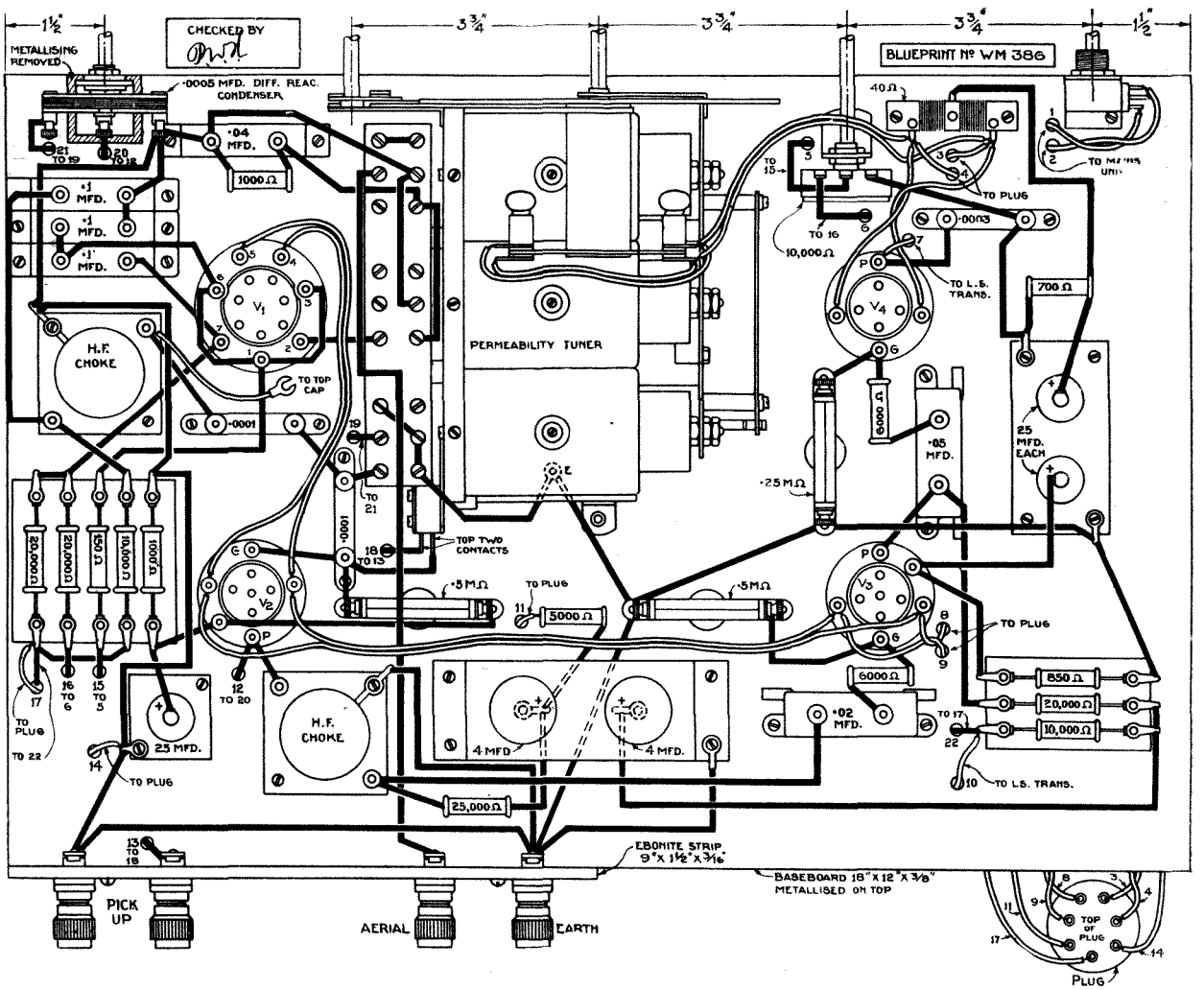


Dimensions of the metal plates which can be used for mounting the 25-microfarad condensers. Beneath each large hole a recess should be drilled in the baseboard for the centre shank of the condenser. If desired, a purchased bracket can be used

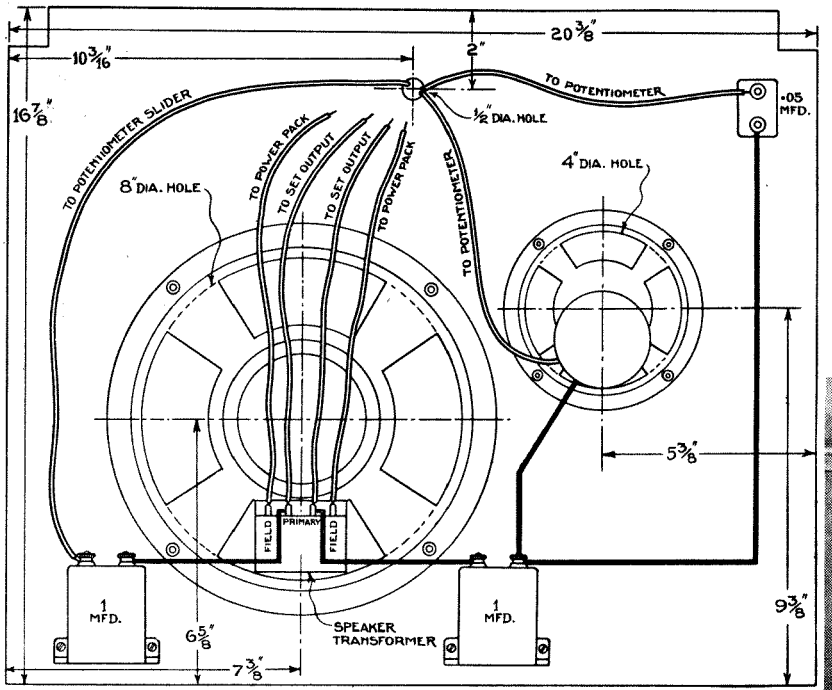


Motor-board layout. The exact position of the pick-up arm should be determined by means of the template provided by the makers

Scale Reproduction of the Blueprint



A full-size blueprint of this wiring diagram is available, price 1s. 6d., or if application is made before May 31 it can be obtained at the special price of 9d., post paid, if the coupon to be found on the last page is used



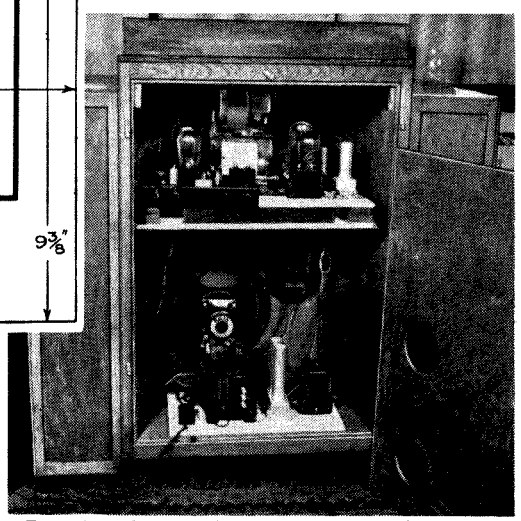
*If you cut your own baffle, this will help you. The exact positions are **not** critical. The potentiometer is mounted on the cabinet itself*

and as we turn the knob in an anti-clockwise direction the Tweeter is gradually cut out of circuit till at the full left position only the moving-coil loudspeaker itself is operating with a condenser across it to remove further high frequencies. (Normally this control is used fully to the right.)

Full particulars of how to build this set are provided this month with drawings and a list of components, and I can assure you that if you build this set it will do full justice to the admirable Jubilee programmes which the B.B.C. are putting out, while the tonal beauties contained in the good modern orchestral gramophone records will come as a revelation to you.

The Set for You!

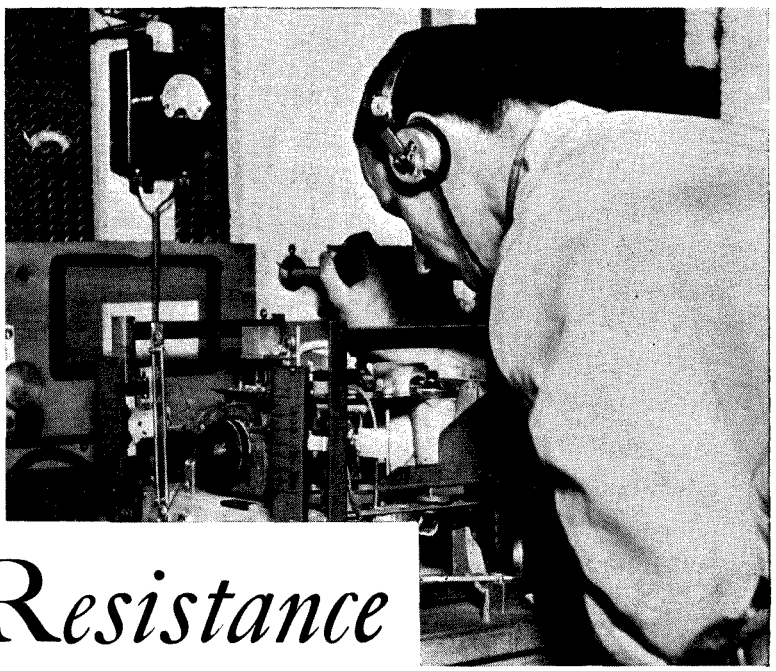
More constructional and working hints will be given next month, but meanwhile I do hope that you will decide that this is the set for *you!*



Everything fits into place with ample room to spare. The back of the cabinet is provided with sound outlets to prevent box resonance effects

COMPONENTS NEEDED FOR THE HARRIS JUBILEE RADIOGRAM

	£ s. d.
BASEBOARDS	
1—18 x 12 Metaplex, say ...	4 0
1—14 x 8 ditto, say	3 0
CABINET	
1—Peto-Scott de-Luxe 1935 Adaptagram model	6 10 0
CHOKES, HIGH-FREQUENCY	
2—Graham-Farish screened (single) type	5 0
CHOKE, LOW-FREQUENCY	
1—Varley, type DP16	17 6
CONDENSER, VARIABLE	
1—Graham-Farish .0005 microfarad differential reaction ...	2 0
CONDENSERS, FIXED	
2—T.C.C. .0001 microfarad, type 34	2 6
1—T.C.C. .0003 microfarad, type 34	1 3
1—T.C.C. .02 microfarad, type 25A	3 6
1—T.C.C. .04 microfarad, type T.C.C. 40	1 9
1—T.C.C. .05 microfarad, type T.C.C. 40 (mounted on baffle board)	1 9
1—T.C.C. .05 microfarad, type 25A	5 6
3—T.C.C. .1 microfarad, type T.C.C. 50	5 6
2—T.C.C. 1 microfarad, type T.C.C. 50	5 0
3—T.C.C. 4 microfarad, type 502	12 0
2—T.C.C. 8 microfarad, type 502	10 0
3—T.C.C. 25 microfarad, type C	7 6
GRAMOPHONE MOTOR	
1—Garrard gramophone motor, type 202A	2 10 0
HOLDERS, VALVE	
1—**Benjamin**, seven-pin	2 0
4—**Benjamin**, five-pin. (Note: One four-pin could be used for the output position, but the five-pin is suggested in case it should ever be desired to use a valve of the indirectly-heated type here.)	3 4
1—Bulgin, seven-pin (mounted on power unit for use with special connector between set and unit), type VH15	1 6
HOLDERS, RESISTANCE	
1—Bulgin 10-way group board, type C32. (Note: This is cut up in the manner to be described, to form one 5-way unit and one three-way.) ...	1 9
3—Graham-Farish Ohmite holders horizontal type	1 6
LOUDSPEAKERS	
1—Rothermel "Tweeter" loudspeaker, type 155	1 1 0
1—Rola excited-field speaker, Model F7-1250-00 with 1250-ohm field winding	2 7 6
PICK-UP	
1—Rothermel-Brush piezo-electric pick-up, de Luxe model ...	4 4 0
RESISTANCES, FIXED	
1—Amplion 150 ohms	1 0
1—Amplion 700 ohms	1 0
1—Amplion 850 ohms	1 0
2—Amplion 1,000 ohms	2 0
2—Amplion 6,000 ohms	2 0
1—Amplion 5,000 ohms	1 0
2—Amplion 10,000 ohms ...	2 0
3—Amplion 20,000 ohms ...	3 0
1—Amplion 25,000 ohms ...	1 0
1—Graham-Farish ¼ megohm, Ohmite	1 6
2—Graham-Farish ½ megohm ...	3 0
1—Varley 40 ohm, centre-tapped, type CP75	1 6
RESISTANCES, VARIABLE	
1—Rothermel-Centralab 10,000 ohm volume control	3 9
1—Rothermel-Centralab 25,000 ohm. (Note: This is mounted on the cabinet front.) ...	3 9
1—Rothermel-Centralab ½ megohm ditto (mounted on the motor-board). (This one should be obtained with a knob: the previous two are to be fitted with the spare knobs supplied with Varley tuner.)	3 9
SUNDRIES	
2—Peto-Scott needle cups, projecting type, say	1 6
2—Dial-light bulbs, 5- or 6-volt type	
2—Peto-Scott brackets for mounting reaction condenser and on-off switch. (Volume control is mounted on spare bracket supplied with Varley tuner.)	
1—Peto-Scott 3-way electrolytic condenser mounting bracket, standard type	
1—Peto-Scott 2-way ditto, special type	
1—Peto-Scott single-way ...	
6—Belling and Lee terminals, type R, markings as per diagrams	3 0
1—Bulgin mains plug and socket, type P12	2 6
1—Bulgin seven-pin cable plug, type P37	2 0
1—Bulgin safety fuse holder and fuses, type F19	2 6
1—Terminal strip, 9 x 1½ in. ...	
1—ditto, 3 x 1½ in.	
Supply of wire, screws, sleeving, etc.	
SWITCH	
1—Bulgin, type S91, rotary on-off	1 9
TRANSFORMER, POWER	
1—Heayberd special model (quote name of set when ordering) ...	1 13 0
TUNER	
1—Varley Permeability Tuner, type BP100, with radio-gram switch, and three spare matching knobs (i.e. two in addition to the one spare knob normally supplied)	3 10 6
VALVES	
2—Osram MHL4	1 7 0
1—Osram VMP4, 7-pin base ...	17 6
1—Osram PX4	16 6
1—Osram MU12	15 0



The design of a straightforward resistance amplifier for faithful reproduction is no longer a matter of advanced laboratory practice. Simple empirical rules can be made a perfectly safe guide

Practical Resistance Amplifier Design

By G. P. KENDALL, B.Sc.

ONE of the few radio circuits that can be worked out completely in theory and will then function pretty exactly according to plan is the resistance amplifier. In consequence, the highbrows have indulged their love of mathematics to the full and have really made the plain practical man feel that the whole subject is one of great complexity, and that to design a resistance amplifier for the best quality is a task which demands a knowledge of the differential calculus at the very least !

Yet in actual fact there is no such difficulty about the matter. The mathematics of resistance couplings have been worked out over and over again; there is no earthly reason why we should go on repeating the process every time we want to make an amplifier to give good quality.

It is now possible to do the whole thing on a purely empirical basis with the aid of some quite simple rules anyone can master. The important thing is to understand the reasons for the use of these rules and then it becomes easy to apply them to almost any actual case. Here I would remark that such an understanding of the underlying fundamental principles does *not* necessarily follow from the ability to treat the subject mathematically !

Maximum Amplification

The first point to be settled is obviously that of the value of the anode resistance, marked R for reference in Fig. 1. Observe that this is in series with our source of voltage, which is the valve. It is quite easy to see that when we have two impedances in series like this the one across which we want to develop the largest possible voltage should be high in relation to the other one.

In other words, to obtain the maximum signal voltage across R for handing on to the next valve we require to make the resistance high in proportion to the impedance of the valve preceding it. That would be simple enough were it not for the fact that there are two opposing factors : first, we must remember that there will be a drop of high-tension voltage across the resistance which will become excessive if the figure is too high; secondly, we must allow for the fact that there are certain capacity effects which act in parallel with the resistance.

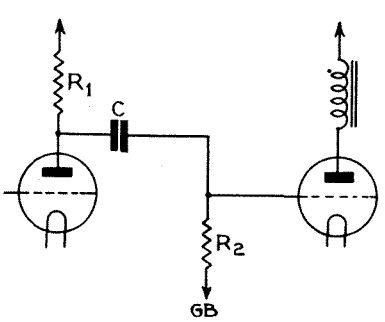


Fig. 1.—Fidelity from a normal resistance-coupled stage is primarily a matter of choosing correct values for R1, C, and R2

Of these two limiting considerations the second happens to come into operation before the other, so the question of high-tension voltage drop can usually be neglected when deciding upon the value of the anode resistance. The point we must consider is this : if the resistance is too high there is a loss of the upper frequencies which impart life and colour to speech and music.

Permissible Stage Gain

On the other hand if the resistance is too low we sacrifice amplification unnecessarily. It is evidently a matter for compromise; we must choose as high a value as we can without running the risk of loss of the upper frequencies.

In practice this means that we must not aim to get a stage gain of more than about half to two-thirds of the amplification factor of the valve. I am assuming, of course, that we are aiming at really super-excellent quality.

Now, it is no doubt very comforting to those with mathematical tastes to set to work and calculate all this out from first principles on every occasion, but since in practice

the main deciding factor is the impedance of the associated valve I really fail to see the necessity. It is quite possible to fix a general rule which will serve as a perfectly satisfactory guide for all normal cases.

Here it is : for really high quality

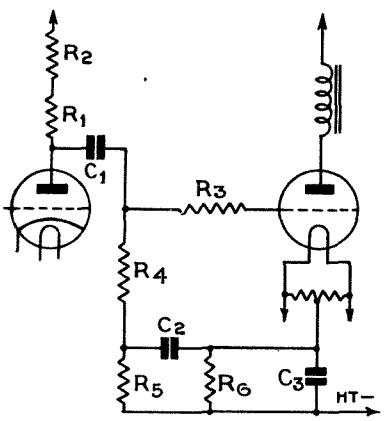


Fig. 2.—In designing the more elaborate type of resistance stage the total resistance of the grid circuit is obtained by taking account of the grid stopper R3, grid leak R4, and bias decoupler R.5

the anode resistance should have a value equal to three times the impedance of the valve to which it is connected. A lower value gives no perceptible improvement in upper frequency response under normal conditions, but merely lowers the amplification and tends to introduce other undesirable effects.

Safe Ratio

A higher value, on the other hand, gives only slightly more stage gain, but may begin to cut off those important higher frequencies. If the associated valve is of very low impedance below, say 10,000 ohms, then it may be permissible to go up to a figure of four times the valve " resistance," but in general it is safest to keep to the three-to-one ratio.

Then we come to the grid condenser and leak which complete the coupling to the succeeding valve. These components have in normal practice no effect on the amplification given by the stage or upon its upper frequency response. The point to consider here is the effect upon bass reproduction, which is governed by the value of the condenser in relation to the leak.

Every resistance stage of the ordinary leak and condenser type cuts off somewhere in the bass and the aim must be to see that this effect takes place below the range of frequencies which experience shows to be important for good reproduction. Here again empirical rules can be used with complete confidence.

The general principle is that the condenser must not be less than a certain value in relation to the resistance of the leak. A reasonable factor of safety can be provided by going slightly higher, but any substantial increase is not to be advised, simply because it may lead to " grid choking " troubles if the amplifier should overload slightly.

The rule can be expressed most simply by fixing a minimum value for the figure obtained by multiplying together the grid condenser capacity in microfarads and the leak resistance in megohms. Adequate bass response will be obtained from a single stage if this product is not less than a figure of .006 Thus, the condition will be satisfied by a leak value of 1 megohm and a capacity of .006 microfarad, a leak of .5 megohm and a condenser of .012 microfarad, and so on.

To provide that little bit extra which makes certain, of course, one would probably use condensers of perhaps .01 and .015 microfarad in these cases, but to go much higher would be neither helpful or desirable.

Two-stage Value

In the case of a two-stage amplifier the product value should be doubled, making it the figure .012. As before, this would lead to the choice of a condenser of about .02 microfarad with a leak of .5 megohm, or about .04 to .05 microfarad with one of .25 megohm.

So far we have merely determined relative values. Next we have to decide upon the actual figures. To obtain the full amplification from the stage the resistance of the grid leak must not be less than four times the value of the preceding anode resistance.

This, however, is only part of the story. In a first stage there is little point in keeping to so low a value and it is usually advantageous from the point of view of cost to make the leak equal to some ten times the anode resistance figure. In special cases it is possible to go even higher, but it is wise to make it a rule not to exceed .5 megohm here. By using these fairly high resistances when possible the capacity of the condenser, and likewise its cost, can be kept down.

Resistance Limits

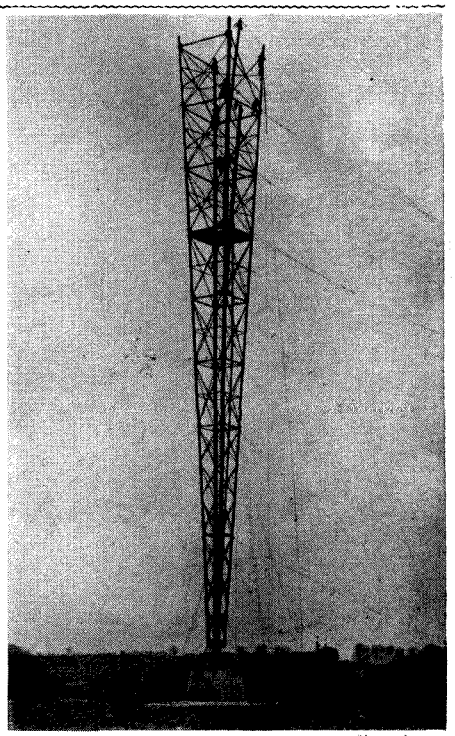
In the second stage there enters another factor. The larger output valves are usually specified to work with a total grid circuit resistance not exceeding a certain figure. In these cases it is best to take the stipulated value and work out the appropriate condenser capacity to go with it. If the resistance proves to be less than four times the preceding anode resistance value, you must sacrifice a little amplification for safety's sake.

Florence Desmond listening to her H.M.V. portable in her dressing-room during an interval in C. B. Cochran's " Streamline." We shall soon be thinking of a portable, for the outdoor days are nearly upon us

What the B.B.C. Is Doing

By T. F. HENN

In the past this feature has dealt primarily with broadcast happenings of a programme nature. From this month it will be extended to cover items of general interest relating to how we hear as well as what we hear. This month particular attention is paid to the reputed poor reception of B.B.C. programmes in outlying parts of the country. We are anxious to receive readers' reports on their reception conditions so that the actual gravity of the situation can be studied



Fox photo

A real step forward in solving bad reception is likely to result from the anti-fading aerial being erected at the new Northern Ireland Regional

THERE are several reasons why this feature has been extended to cover more than programme news. The chief is that, on the whole, programmes themselves have become so stereotyped—the same artists and programmes of little distinctive value—that we can turn our attention to topics that affect how we hear rather than what we hear.

Let me hasten to assure the many overseas readers who have written expressing their appreciation of advance programme details that we shall devote some space to notable forthcoming events. It is my intention, primarily, to make this feature more of a listener's gossip, and I shall be pleased to have readers' own views on the matter.

First of all, the Jubilee celebrations. Even at the time of writing final arrangements have not been made. On the Sunday before Jubilee Day there will be a sort of warming-up programme. For instance, on the Regional wavelength the Grenadier Guards Band will be playing in the afternoon followed by an orchestral concert with the exciting title, Music of the British Isles—bagpipes and whatnot!

In the evening Sir Henry Wood is conducting a concert of selected works by British composers whose works have been given a first performance during the last twenty-five years at Promenade concerts. Harriet Cohen, the pianist, will be the soloist.

The main Jubilee programmes on the Monday will be as I outlined last month. Two additions have been made since then. One is a relay of a super variety programme from Brighton at 8.10 p.m., and the other is that Jack Payne and his Band are providing the late dance music from 11.30 till 1 a.m.

Other "super" programmes for the week include two performances of Romberg's *Desert Song*—first a Drury Lane success, then a film, a relay from Westminster Hall of the loyal addresses by the Lords and Commons on May 9 at 11.20 a.m., and on May 12 there will be a relay of the Thanksgiving Service from St. George's Chapel at Windsor Castle at 10.45 a.m.

A curious thought struck me as I was thinking over the B.B.C.'s outside-broadcast arrangements for the Jubilee ceremonies. They have as good as announced that a commentary on the Naval Review at Spithead during July will be broadcast. Anyone with a slight knowledge of the Spithead locality must realise that the mike will have to go afloat if a reasonably interesting commentary is to be given. A naval review is not like the Boat Race. The stern dignity of the British Navy would not permit a B.B.C. launch complete with transmitter and mike to wander round the fleet during the review.

The solution to this problem puzzles me greatly. All I know is that it will be done, and that the British Navy will not suffer any indignity.

Talking of outside broadcasts brings me to a new development that is the talk of the O.B. department. The department in question has acquired a mobile

recording van so that it can send round to various localities recording noises for inclusion in radio plays, or record notable outdoor functions on the spot.

I ran across Mr. Fletcher, who is in charge of recorded programmes, and he enlightened me quite a lot on the new van, of which he seemed extremely proud. The gear includes a complete recording outfit and four microphones together with miles and miles of wire, so that the mikes can be placed in the " line of fire " of the scene of activity without the van being anywhere near.

Mantovani (above) and his Tipica Orchestra have been responsible for many fine broadcasts during the past month or two. (Right) Michael Carr, the well-known song writer, responsible for " Old Faithful " and many other successes

On the other hand the van can lie in wait round the corner at Broadcasting House ready to connect up to interesting material coming to Broadcasting House via the telephone lines.

For instance, Mr. Fletcher told me that during a recent International football match he connected up his van to the incoming lines at B.H. and made a complete recording of the game—it took twenty-seven sides of 12-inch records.

From this suitable excerpts were chosen and re-recorded on to one record with connecting commentary, the result being broadcast as a " stunt " in the Second News at night.

I believe that this van will do a deal in the way of preserving broadcasts of note. You may remember the production *Gale Warning* broadcast recently. The noises of the gale were recorded by the van at Ramsgate Harbour and, I am told, the London Fire Brigade staged a real fire for the B.B.C.'s especial benefit. Such is fame!

By the way, like the B.B.C.'s transmitters, the van is not dependent on power from the place where it works—all the power is derived from generators operated by the van's engine.

◆ ◆ ◆

Saturday night Music Hall shows are to finish on the last Saturday in April. They will be given on Thursday nights instead. It is part of Eric Maschwitz's policy to take off a popular feature before listeners get tired. I disagree entirely; there are so few really good features that the listener cannot afford to get tired.

Anyway, Thursday night is the night now, and on Saturday we are to be given a light entertainment instead. The first on May 4 is an hour's programme by Jack Hylton's band—this is an hour's variety in itself, so why worry!

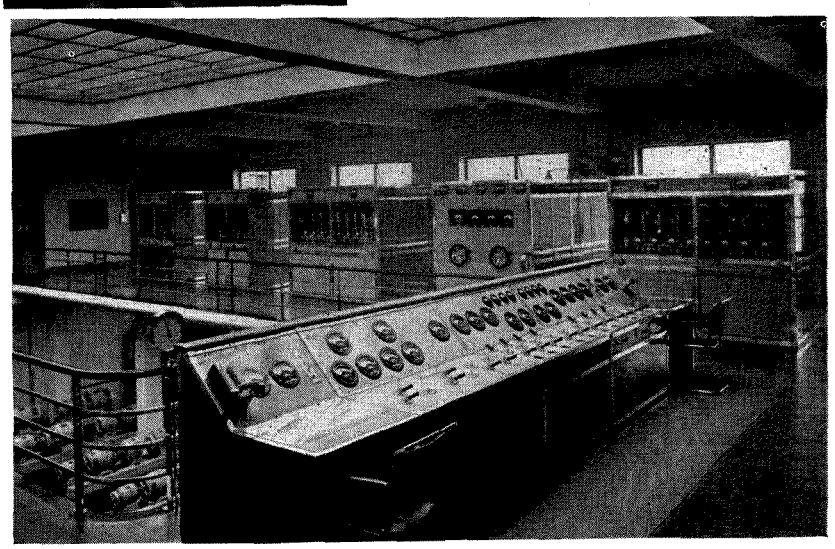
◆ ◆ ◆

There is a problem that is causing me rather a deal of worry. You may have read in a newspaper that the B.B.C. had reduced the power of London, West and North Nationals to 20 kilowatts instead of the advertised 50. I tackled an official at Broadcasting House on the subject, because some readers in the outer suburbs had complained that London National was little more than useless now that the three transmitters (London, North and West Nationals) were synchronised on one wavelength.

The B.B.C. emphatically denies that any reduction in power has taken place, but it admits that modulation has been reduced. There isn't space here to explain what this actually means, but it amounts to a reduction of signal strength in the long run.

The problem of providing a reliable service area to the whole of Britain, Scotland, Wales and Ireland is by no means solved. A listener in Cornwall writes saying that after dark Radio Paris is an exceptionally strong and reliable signal, while Droitwich is still as useless as ever, signals fading after dark making listening a trial.

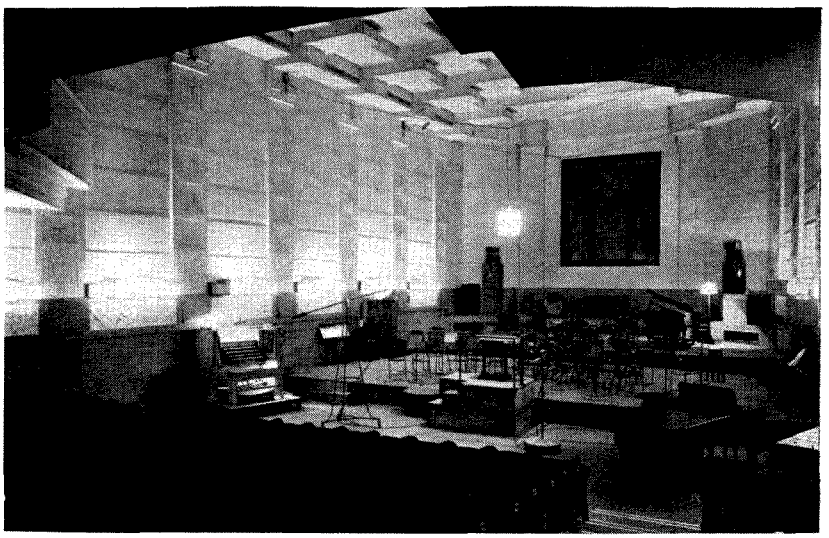
As the West twin transmitters are known to give a poor service in Cornwall, it is high time that steps were taken to do something. Droitwich



The huge gallery at Droitwich now houses the new 50-kilowatt Midland Regional seen on the far side behind the control desk, besides the national transmitter

opened nine months ago. Fading was experienced, and it was put down to phenomena called "night effect." It was said at the time that this effect was only seasonable and would vanish after a while. It is still vanishing!

And I believe this fading will still go on unless a special anti-fading aerial replaces the present T aerial at Droitwich. I am anxious to get reports from outlying districts on the reception of B.B.C. stations. If you are a victim perhaps you would be good enough to drop me a line. I cannot promise any help, mind you, but it would be valuable for us to know exactly the ruling conditions of reception in various parts of the country.



The imposing Concert Hall at Broadcasting House from which the Jubilee Preparation Service will be relayed on May 5. (Left) Walsh and Barker, two popular American duettists often heard over the air

It is a sign of the times that at Lisburn, N. Ireland, where a Regional station is being built, an anti-fading aerial—the first to be erected by the B.B.C.—is to be tried out. The illustration on the first page of this article shows that mast in the course of construction.

Lattice-shaped, the actual mast itself is the aerial. The mast is insulated from the ground by a huge porcelain insulator; all the stays are treated in the same way. Northern Ireland Regional will makes its bow to the ether in the early autumn of this year.

The anti-fading aerial which is being used at Lisburn and is now in use at many high-power Continental stations, is a definite help towards the prevention of fading, though by no means a way of avoiding the trouble.

Midland Regional has firmly settled down on its new wavelength and with increased power. Unfortunately, it is almost impossible to receive it in Southern England. Unfortunate because that transmitter is *still* used in the low-definition television transmissions put out by the B.B.C.

Down here we cannot get the sound to the vision put out by the London National transmitter. Strange that such happenings should occur now that everyone is on tip-toes about television developments. Sound should be transferred to a station that we in the South can log. Even Scottish Regional would be better!

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I have seen advance details for the May programmes. Let me draw your attention to just one item. On May 18 I note that the late dance music will be provided by "Ambrose and Nightingale." No doubt Gertie the Girl with a Gong will feel put out!

The nightingale is due to appear during late dance music from May 1 to 18 inclusive. Another job for the recording van!

Rumour has it that the B.B.C.'s nightingale interludes are provided by gramophone records. Ask the O.B. engineers—you will learn something of the birds' habits!

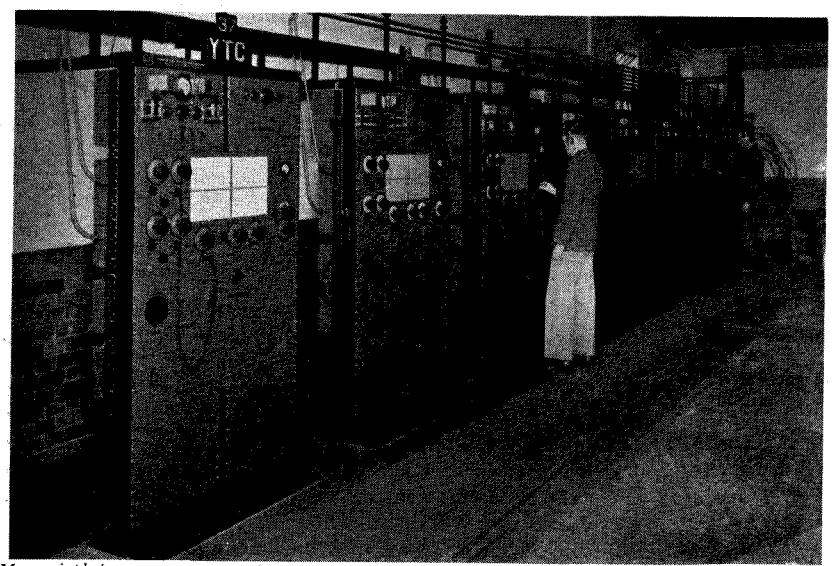
Jack Hylton with his merry men in the H.M.V. recording studio. Jack is giving the first of the light entertainment hours, which replace Saturday-night music hall shows, on May 4

Short-wave Prophecies

Notes on Current Conditions and Stations to be Heard

THE chief charm of short-wave work is its unlimited variety. Not only do conditions change with the seasons (and in just as noticeable a fashion), but they change with every hour of the day and with every day of the month!

When one has had three or four years' experience in short-wave reception, however, one is able to make quite reliable prophecies about the stations that are likely to be good at certain times of the year, and I propose to set myself up occasionally in this role.



Marconi photo.

How the experts rig up gear for short-wave reception is seen by this bank of RC47 receivers recently installed at the Brentwood receiving station of Cable and Wireless, Ltd. In addition to really super sets, "diversity" aerials to reduce fading are used

This is a fortunate time to do so, for May is usually the best month of the year. The stations that you have been receiving throughout March and April should increase in strength as we go into May, and should remain at their best until the end of June.

Varying Conditions

A general statement like this is intended to take no account of the fact that they will doubtless vary from one day to another. The *average* should be distinctly good.

The 19-metre broadcast band—always one of the most interesting, though rather sparsely populated at present—has been at its best this year. The star station is undoubtedly Pittsburgh (W8XK) on 19.72 metres, with Schenectady (W2XAD) a close second.

The only other distant stations heard by the average listener on this band are Wayne (W2XE) and sometimes Taschkent (RIM), handling commercial telephony.

The 19-metre band's closest neighbour, the 20-metre amateur band, exhibits very similar properties, but is, of course, packed with stations in all parts of the world. During the first three months of the year the timetable has been roughly as follows: Midnight to 7 a.m., blank; 7-9 a.m., Australasia and an occasional South American; 9-11 a.m., New Zealand and Europe.

11 a.m. to 4 p.m., East Coast U.S.A. and Asia, particularly India. 4 p.m. till 6 p.m., Central and West Coast U.S.A., and South Africa. At the beginning of the year the "fade-out" occurred by 6 p.m., but now it is as late as midnight. The East Coast Americans come over well till 11 p.m., after which the South Americans are heard.

An interesting feature has been the reception of Japanese signals in the early mornings. By the time this appears in print a few Hawaiian amateurs should be coming over at 8 a.m., and later, in May, the West Coast Americans should be there.

This progressive shortening of the "skip distance" in a westerly direction has always been a fascinating feature of short-wave reception in the spring. Amateur telephony enthusiasts should make a point of listening at 6.30 or 7 a.m. during May as they will be rewarded by strong reception from the sixth and seventh districts of U.S.A.—California, Washington, Oregon, etc.

25-metre Band

The 25-metre broadcast band is one of the least interesting, and I need not say much except that Pittsburgh (W8XK) should come over strongly right up till midnight during the next month.

The 31-metre band holds more thrills for the DX man, and Sydney (VK2ME) has been extraordinarily consistent this year. Every Sunday he may be heard in the early morning and again during the afternoon. I know of listeners who have not missed him for twenty-five or twenty-six consecutive Sundays.

Bombay (VUB) is another good station, working just above VK2ME's wavelength. Sunday afternoons will not always reveal this station, chiefly because he does not always transmit on Sundays. Saturday afternoons are more reliable.

"Thicker Population"

The 40-metre amateur band probably has a thicker population per kilocycle than any other part of the spectrum. Its chief disadvantage is the preponderance of very bad telephony from European countries, mostly radiated on very rough and unstable carrier-waves, but after dark most of this fades out and leaves the ether clear for DX.

The Americans come in throughout the night, with West Coast stations and Australasians at their best between 6 and 8 a.m. South Americans are rarely heard on this band, although one sometimes en-

By
G. HOWARD BARRY

counters a freak night when the whole dial seems full of them.

British amateur telephony reigns supreme on Sunday mornings—the one time when no B.B.C. programme is being radiated. Many British stations are using quite high power and are putting out 'phone that would not disgrace the B.B.C. Conditions on this band should improve steadily as the summer progresses, 20-metre DX falling off during June.

Wise Amateurs

Many wise amateurs who do not wish to use gear and aerials suitable for both wavelengths keep to 20 metres during the winter and change over to 40 at the end of the spring.

The 49-metre broadcast band is, of course, one of the most exciting of them all. Extending practically from 42 to 50 metres, it forms an excellent playground for the owner of a band-spread receiver, and as many as thirty broadcast stations have been heard within a few minutes in this band.

Logging Americans

North Americans may be heard from 11 p.m. until 5 a.m. or thereabouts, with the South Americans coming in a little later—midnight onwards. Nairobi (VQ7LO) and Johannesburg (ZTJ) may often be heard quite early in the evening, and the Europeans are strong all day.

Outstanding DX that may be heard on this band includes the following stations: Kuala Lumpur, F.M.S. (ZGE) on 48.92 metres; Penang (ZHJ) on 49.34 metres; Singapore (ZHI) on 49.92 metres; and Vancouver (VE9CS) on 49.4 metres. The last-named uses extremely low power, and has not yet been heard over here.

I haven't done much in the way of prophecy as yet, so here goes. I imagine that the large number of Central and South American broadcast stations that we hear at present will be greatly diminished by the time you are reading this. I shouldn't be surprised, in fact, if they fade out almost completely this summer.

Everything indicates that the so-called "optimum wavelength" is moving downwards again, and that 40-50 metres will be the best all-round wavelength during the coming year.

The 80-metre amateur band has had a very good spell and is now beginning to fall off again, so "40" will probably become even more overcrowded. The DX enthusiast is strongly recommended to leave this band alone and to concentrate on the 20-metre amaeur band and the broadcast stations.

Before concluding I should like to mention the fact that there is considerabe amateur activity now both on 10 and 5 metres, and that readers who hope to construct their own television receivers later on would be well advised to get an insight into the handling of ultra-high frequencies by making receivers for these bands.

In London and North Kent there are about a dozen stations regularly on 5 metres in the evenings, and Surrey also has a fair number. Conditions in the Midlands are problematical at the moment—we shouldn't hear them in London except in exceptional circumstances.

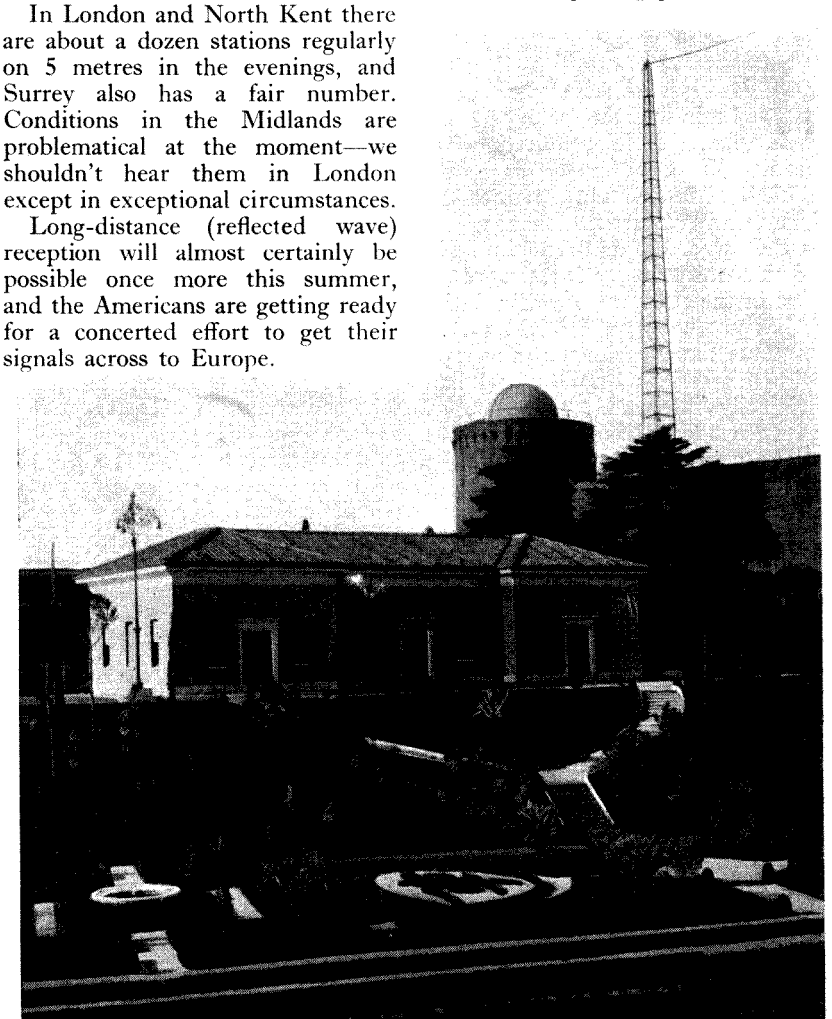
Long-distance (reflected wave) reception will almost certainly be possible once more this summer, and the Americans are getting ready for a concerted effort to get their signals across to Europe.

OTHER SHORT-WAVE ENTHUSIASTS ....

will be glad to know of the stations you hear and how you heard them. You are invited to write to G. Howard Barry so that your reports can be incorporated in this monthly short-wave gossip

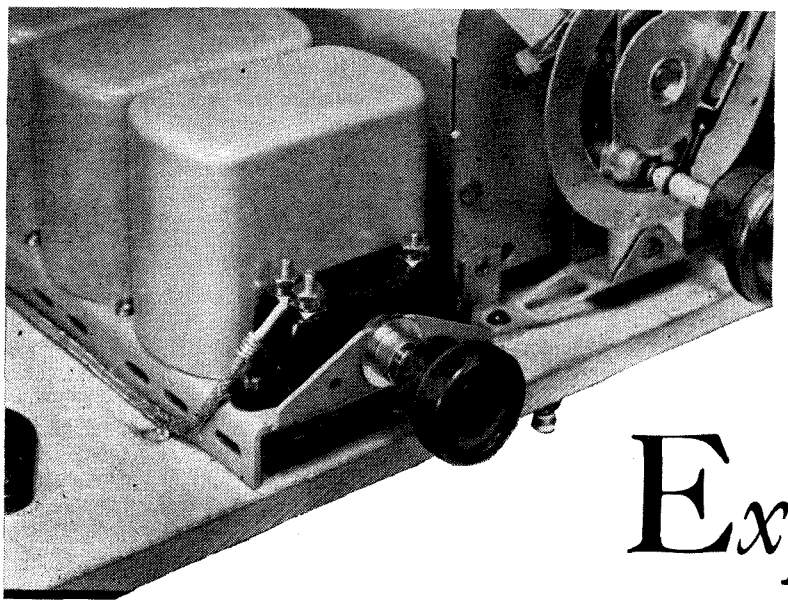
The Belgian station ON4AU has already been heard in Canada, this being the first authentic case of transatlantic transmission on 10 metres since 1929-30. Rumour has it, too, that Australians have been heard in this country.

The compleat short-wave enthusiast must have a receiver that will enable him to keep watch on the amateur bands—5, 10, 20, 40, 80 and 160 metres—and the broadcast bands round about 14, 16, 19, 25, 31, and 49 metres. If any of those bands are missing from your spectrum at the moment, please get down to it and fill up the gap!



Lusty photo.

The "greenest" short-wave ham will have no difficulty in picking up short-wave signals from Vatican City, which operates on 19.84 and 50.26 metres. Here you see a fine view of the station surroundings



Many of us use band-pass tuning and take much for granted. In this article Mr. Harris not merely explains the principles involved, but outlines many interesting experiments that can be performed on the special test board already described

Experiments with Band-pass Tuning

By PERCY W. HARRIS, M.I.R.E.

THIS article should properly begin with an apology for the fact that its publication has been held over for two months. With the March number, as readers know, there occurred a change both in the ownership and the editorship of this magazine, with the result that in the pressure of other duties it has not been possible for me to continue the experiments concerned with this series as rapidly as I had originally intended. However, so many readers have written, and even telephoned, asking why the article has not appeared, that I must apologise again for inconveniencing them.

Apparatus Needed

This hunting for facts with an experimental board is a very illuminating business. You will need, for this month's work, the high-frequency amplifying unit, the low-frequency unit, two screened tuning coils (as near identical as possible), and a twin-gang condenser. It will also be useful if you have two separate tuning condensers, but for a proper understanding of the effects to be obtained a twin-gang is necessary.

Furthermore, you will want a few fixed condensers and a resistance or two. I do not propose to give a list here, because as you read through the article you will find that you have some of the various parts on hand. Others you can perhaps improvise, while still others may have to be bought.

The object of fitting band-pass tuning to a receiver is to obtain a resonance curve which when you are tuned to a given station, will include the sidebands necessary for good reception while excluding, as far as possible, all signals outside this frequency range. The trouble with an ordinary sharply-tuned circuit is that if it is tuned sharply enough to reject unwanted signals it will also attenuate many of the wanted sidebands.

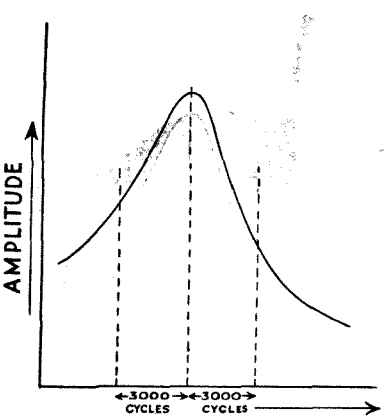


Fig. 1.—With a single-peaked sharp resonance curve there is a tendency to cut off the higher modulation frequencies

You must have found this in any receiver fitted with good smooth reaction, for when you have sharpened up the tuning by reaction to the point just prior to oscillation, all the low notes will be unduly accentuated, while the high frequencies will be severely reduced so giving an overall effect generally described as boomy or woofy.

Approximate Shape

You will see why if you examine Fig. 1, which shows the approximate shape of a sharply-tuned resonance curve with the sideband frequencies marked on each side of the central carrier. Frequencies are marked along the bottom line and signal strength on the vertical line.

If you take frequencies of, say, 3,000 (round about this figure we get the frequencies which give the "s" sounds and many of the characteristic qualities of speech and music) you will find their strength to be only a fraction of that of the carrier.

Resultant Curve

In a previous article we have described coupling experiments. Now, if you take two low-resistance circuits very loosely coupled to one another, either inductively or capacitatively, the resultant curve in the second circuit will be somewhat similar to that shown in Fig. 2, and there will be, naturally, still further

attentuation of the speech and music frequencies.

If now we tightly couple them we shall get a double-humped curve due to interaction between the two circuits. If you examine the curve of Fig. 3 you will see that there are two maxima fairly widely separated with a considerable reduction of strength in the middle. If next we loosen the coupling slightly we get the result in Fig. 4, which is really the double-humped effect so reduced that there is not much dip between the two humps.

Band-pass Effects

In this way we get what is called a band-pass effect, the tuner passing a band of frequencies from the carrier up to, say, 5,000 cycles on each side, at approximately uniform strength. The outer side of the two curves which have been merged are fairly sharp and this gives us the necessary sharp cut-off to exclude any unwanted frequencies beyond the figure named.

A band-pass circuit, then, is one in which two tuned circuits are so coupled together that this "square-top" curve is obtained. There is a number of ways, and a number of troubles associated with the idea. The first trouble is that practically all the coupling effects that can be used for the purpose are very closely dependent upon the frequencies with which they are used. Thus in the simplest form of inductive coupling if we get a degree of coupling to give the effect we want on, say, 300 metres, this amount of coupling will be insufficient on 400 and still more so on 500.

On the other hand, if we make it right at 500 metres it will be much too tight at 300 and we shall get the effect shown in Fig. 3. Of course, theoretically and practically, we could arrange a coupling so that as we change the setting of the tuning condenser so we vary the spacing between the two coupling coils, attaining constancy in that way, but it is not easy to arrange, is expensive in commercial sets and undesirable for other reasons.

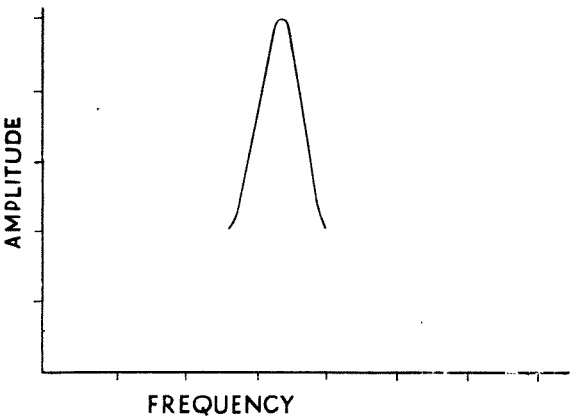


Fig. 2.—An increase in the number of tuned circuits produces a still more sharply peaked resonance curve

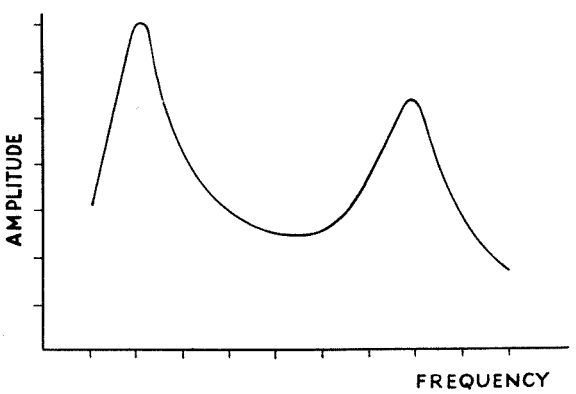


Fig. 3.—This is the resonance curve which results when two tuned circuits are arranged with tight coupling between them

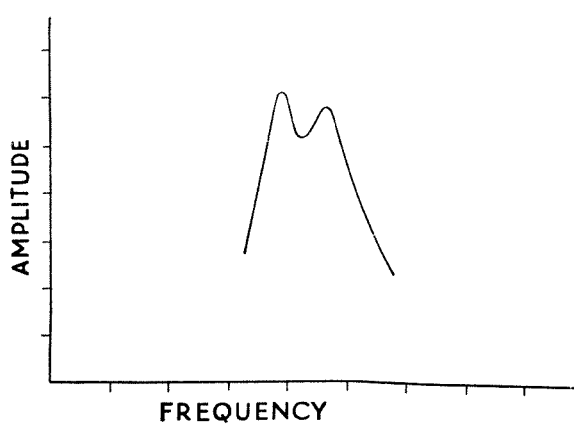


Fig. 4.—The effect of weakening the coupling between a pair of tuned circuits is a resonance curve with "humps" closely grouped in this fashion

As we are only concerned with pairs of circuits coupled to one another we can show a number of simplified diagrams which will help us to get the correct picture. In Fig. 5*a* I have shown a pair of circuits coupled to one another inductively, and in this, as I have said, for a given separation the coupling is tighter the shorter the wavelength. Furthermore, as in all practical circuits one side is earthed, I have shown the two variable condensers joined together and earthed.

Let us now consider capacitative coupling as in Fig. 5*b*. Here the dotted lines are meant to suggest that the coils and condensers are screened from one another so that there shall be no stray coupling from either coils or condensers. You will notice that the lower ends of the variable condensers are earthed as before and that I have placed between the upper ends a small condenser marked C_1. A very small condenser indeed is sufficiently large to give all the coupling effect we want at this point; actually a small neutralising condenser or one of the smallest of the compression type in a practically "unscrewed" condition will do.

"Wire Coupling"

It is best to start experimenting with this by taking two pieces of insulated wire, one connected to each of the condensers, and to twist these two pieces together for an inch or two, the capacity thus obtained being quite sufficient.

Connect up the right-hand coil to the high-frequency unit, and the left through a loose coupling (a .0001 microfarad condenser) to the aerial, and let the two condensers be the twin-ganged one referred to above. Then try experiments with the twisted wire form of coupling. Tune first of all to the local station, adjust your trimmer to get the circuits balanced, and then experiment with the coupling. You will find a very small capacity quite enough.

Now make the capacity larger and you will notice that first of all the local station will seem to tune rather broadly and later when the coupling is still tighter you will get a " double-humped " effect in your tuning, indicating that the coupling is too tight.

Experiment with other stations. Become thoroughly acquainted with this effect, for a similar one will be found in other band-pass couplings, and a realisation of just what happens when the coupling is too tight is important.

Loss of Quality

When the coupling is too loose the set will tune very sharply and you will lose quality. Notice, too, that this form of capacity coupling suffers from the same defect as the inductive coupling, that is, the shorter the wavelength the tighter the coupling.

I now want you to try another method of capacity coupling, which works in the opposite direction. In Fig. 5*c* notice that the lower ends of the two condensers are earthed as before, but that the coils are connected together at the lower end and *not* directly to earth.

Between the lower ends of the two condensers and the coils I have placed a condenser C_2 which is now the coupling. Notice that the left-hand oscillatory circuit consists of the coil, the fixed condenser and the variable condenser on the left, while the tuned circuit on the right consists of the coil, the same fixed condenser C_2 and the variable condenser on the right. This condenser then is common to both circuits and any voltages set up across it in the first circuit are bound to be communicated to the second.

The value of this condenser should be varied, but to start with you can make it .01-microfarad, which is quite large compared with the capacity C_1 in Fig. 5*b*. The reason for this is that the total voltage across the tuned circuit is divided between the variable condenser C_1 and the fixed condenser C_2. If both were of the same size then the voltage would be divided in the ratio of half each. The larger we make C_2 the smaller the proportion of voltage across it.

Furthermore, the higher the frequency the easier it is for radio-frequency currents to pass through a condenser, and therefore the lower the voltage set up across it. Incidentally, the opposition offered by the condenser to the flow of high-frequency current can be expressed in ohms as if it were a resistance, and, as we know, with a resistance the higher the current through it the higher the voltage across its terminals.

It is, in this particular case, the voltage set up across the coupling condenser C_2 by the high-frequency currents in the circuit consisting of C_1 and C_2 and the first coil which affords the necessary coupling.

The higher the frequency the weaker the coupling becomes, because there is less voltage set up across C_2. This is exactly the opposite effect to that obtained in Fig. 5*b*, where it will be remembered with the coupling condenser C_1 the shorter the wavelength the tighter the coupling. Try a number of different condensers in the postion C_2, starting with .0003 microfarad, and going up to about .05, or even more if you can, and you will find that the larger the value the looser the coupling.

In Fig. 5*d* we see a combined band-pass coupling using a condenser C_2 at the lower end and a very small condenser C_4 at the upper. By suitably proportioning these values a uniform coupling over the whole wavelength band is possible, but the values have to be just right, and C_4 has to be exceedingly small. This is an arrangement well worth experimenting with. Remember that C_2 will have to be larger and C_4 smaller than would be the case if either were used alone.

A Warning !

A final note of warning. If you introduce reaction into either of the circuits you will get all kinds of strange effects. The experiments I have described are all made on the assumption that no reaction is introduced into either circuit.

Incidentally, most band-pass arrangements in commercial receivers are compromises, and it is rare to find sets—at least in the inexpensive varieties—where good band-passing is obtained everywhere on both wavelength ranges.

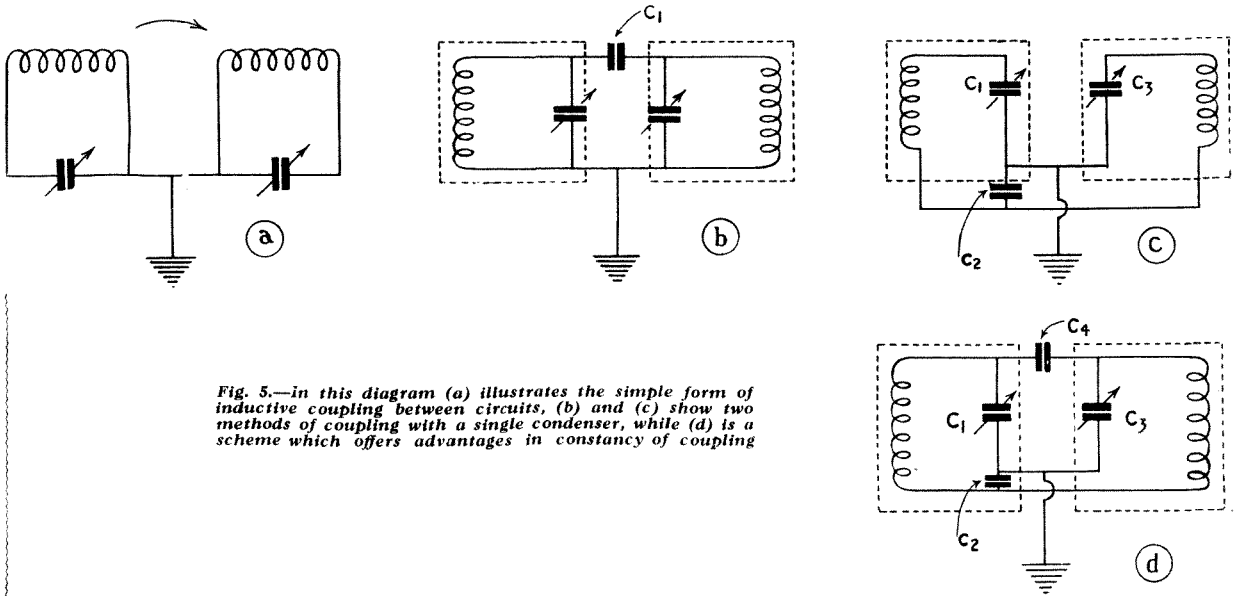


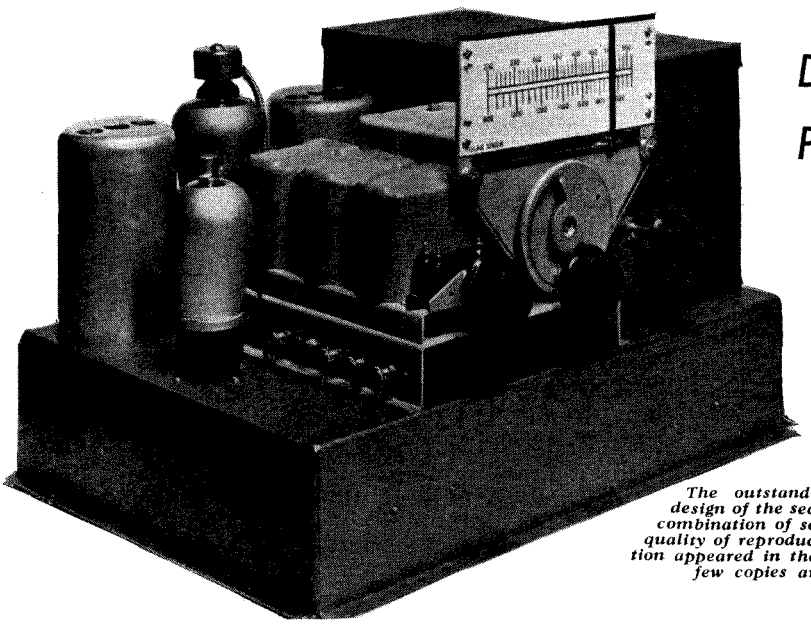
Fig. 5.—in this diagram (a) illustrates the simple form of inductive coupling between circuits, (b) and (c) show two methods of coupling with a single condenser, while (d) is a scheme which offers advantages in constancy of coupling

More About the 1935 Stenode

A Stenode with Provision for a Pick-up

Super Selectivity

Designed by PAUL D. TYERS



The outstanding long-range receiver design of the season, giving a remarkable combination of sensitivity, selectivity, and quality of reproduction. A general description appeared in the April issue, of which a few copies are still available

LAST month I described somewhat briefly the main constructional features of the 1935 Stenode. The description, however, was confined essentially to the building of the chassis, together with some preliminary notes regarding adjustments.

The power pack is built as a separate unit, and the speaker is not in any way connected with the chassis. This therefore affords considerable flexibility in the arrangement of the receiver in the cabinet.

I have designed a modern type of cabinet which is in keeping with the general nature of the receiver. The lines are bold and clean and the arrangement is logical. (*Editorial note:* photographs will be given next month showing a specimen cabinet built to this design by the City Accumulator Co.) The controls are at convenient hand height, and the shape of the speaker grille harmonises with the tuning scale.

Choosing a Cabinet

Possibly some readers may care for a more decorative type of cabinet to one which has bold, clean, simple and, to my mind, restful lines. If they do, they are not likely to run into any trouble in designing one of different proportions and dimensions.

There are one or two points, however, which should be carefully observed. The receiver has a high audio-frequency gain, and accordingly is susceptible to stray low-frequency fields. The design which I have adopted is such that there will be no appreciable hum due to stray field of the transformer if it is mounted directly below the chassis.

It will be noted that if the set is switched on and the power pack is moved to various positions with respect to the chassis several points will be found at which the hum rises to a very high level. It is essential, therefore, that if the set is used in a different type of cabinet the position of the transformer must be very carefully checked before the design is commenced.

A word must be said with reference to the leads which connect the power pack and speaker to the chassis. The base plate of the chassis is provided with three outlets. The first is for the wires which feed the heaters. These leads should preferably be twisted together and they should be of either very heavy flex, to prevent volt drop, or two or three strands of thick tinned copper wire. The next outlet is for the earth line, and the positive and negative high-tension supply.

The final wire comes from the anode of the output valve, and this emerges from a hole directly below the anode socket. It is most important that this wire is taken directly through this hole and on no account must it be allowed to lie loosely inside the chassis. If it does it will cause instability in the amplifier and it will be impossible to use full gain without self-oscillation occurring.

Fixing the Loudspeaker

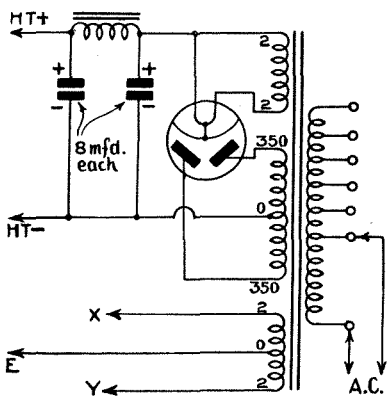
The speaker is screwed to the cabinet through the medium of a small sub-baffle square, and the power pack is simply screwed down to the small wooden baseboard. This in turn is screwed to the bottom of the cabinet. The back of the cabinet has a number of acoustic outlets backed by gauze to exclude dust. It is important not to use a cabinet which has a completely enclosed back as this tends to accentuate box resonance.

Correct Adjustment Essential

However good may be the design, and however excellent the performance, no set can give the best possible results unless it is correctly adjusted. It is desirable, therefore, to repeat in some detail the precise ganging instructions which I described in connection with the original Stenode produced last year.

I believe that few home constructors possess really useful testing instruments, and accordingly much work has to be carried out more or

less on empirical lines. Considering that quite useful universal test instruments can now be purchased at a reasonable figure it is a great pity that more constructors do not realise the value of a fairly accurate meter. This, in conjunction with a valve voltmeter and a calibrated oscillator, both of which can be made very simply and cheaply, enable the most complicated receiver to be checked, and it is even possible to carry out reasonably accurate measurements of sensitivity and selectivity.



The power unit employs a simple and straightforward circuit which provides the set with a smoothed supply of high tension ready for de-coupling and voltage-dropping

I will assume, however, that the adjustment of the Stenode will be carried out without any aids other than perhaps a simple voltmeter and a continuity tester. It really is essential, particularly in a home-built receiver, to check through the various circuits before the valves are inserted and the mains supply switched on.

Apart from making sure that the heater circuits are complete, it is very important to determine that no high tension supply is in any way connected with the grids of the valves through an error in wiring. If this is the case the valves will probably be immediately ruined when the set is switched on. It is very necessary, therefore, to connect a high-tension battery to the main high-tension lead and carefully check round all the grid sockets with a voltmeter.

At the same time the high-tension voltage should be noted as being present on all the screen and anode circuits. Assuming that everything is correct it is permissible to insert the valves and then switch on.

The set should work immediately. If it does not work it indicates a faulty component, a faulty valve, or some form of error or defect in the wiring. As only high-class components have been recommended, if these have been used the possibility of defect in this category should be very remote. The same may be said of the valves. If the wiring has been checked as correct it is then conceivable that there is an obscure fault such as a stray wire tail or blob of solder causing a short-circuit, or a wrong connection somewhere in the receiver. It will be assumed, however, that the set actually functions.

It is imperative that the Stenode intermediate couplers should be left exactly as they are and no attempt whatever should initially be made to touch the trimmers. The coupling may be set between half-way and maximum, which will make the set somewhat unselective and everything will be far from critical. Under these conditions the intermediate amplifier should definitely be most responsive at substantially 110 kilocycles. This then enables the ganging of the input and oscillator circuits to be adjusted.

Ganging

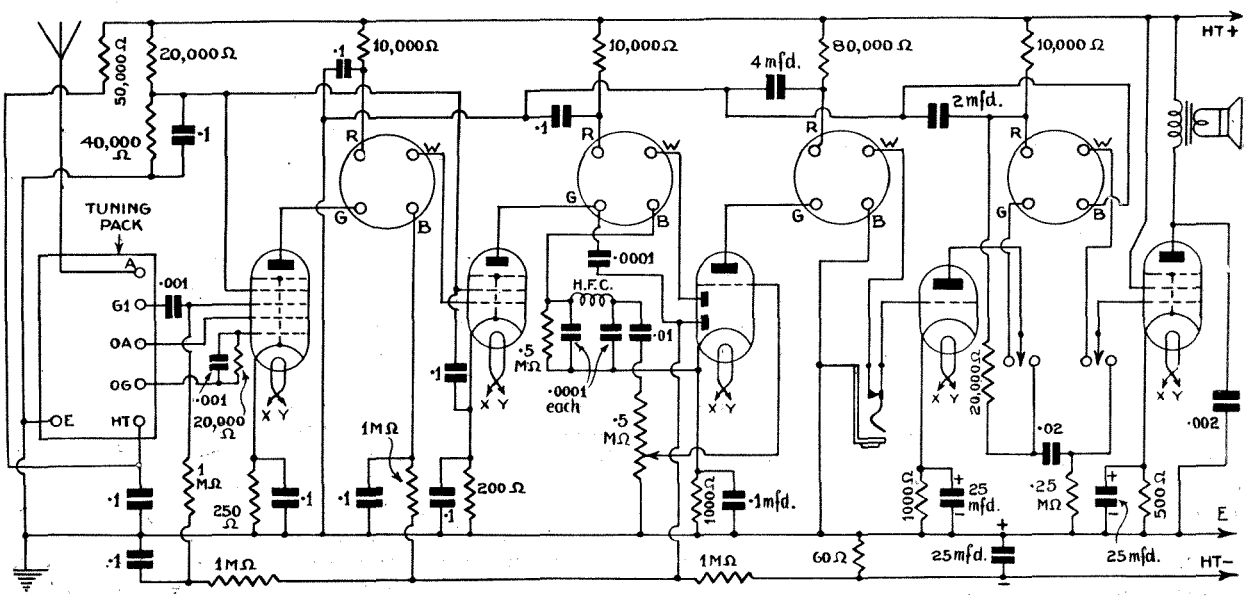
First of all the position of one or two local stations of known wavelength should be carefully checked. For example, London National and Regional should tune in almost exactly at their correct wavelengths. The same may be said of some of the more powerful stations, such as Stuttgart at one end of the scale and Fécamp at the other.

Oscillator Ganging

The correct way of ganging the oscillator is to turn the main tuning control until a local station is received. It may be found that the station is tuning in a few metres high according to the dial indication. If the main tuning control is then rotated until the correct setting is obtained, it is obvious that this will have had the effect of increasing the frequency of the local oscillator.

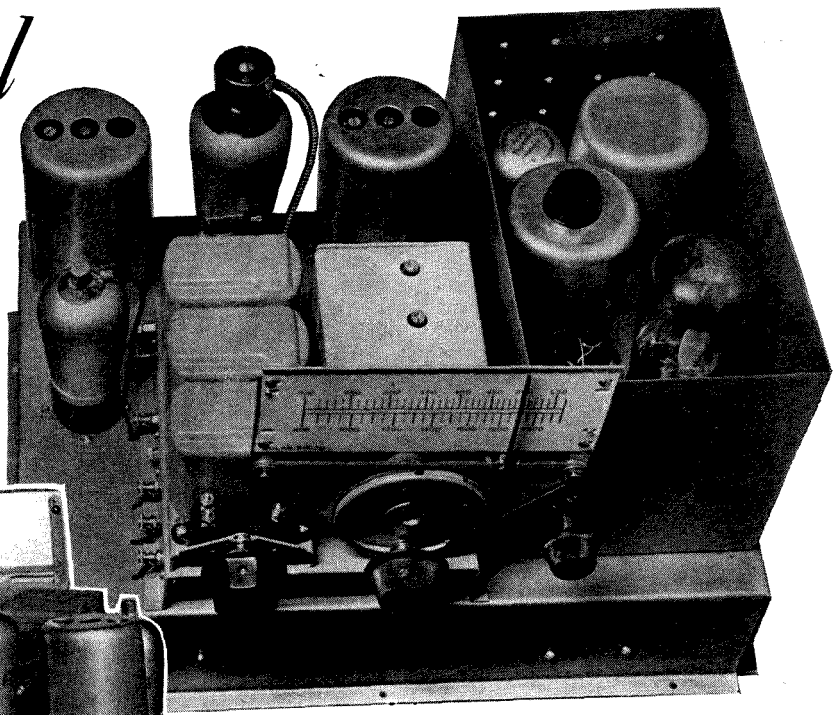
In order to bring this back to the correct setting it is therefore necessary to increase the capacity of the oscillator section trimmer, that is the one

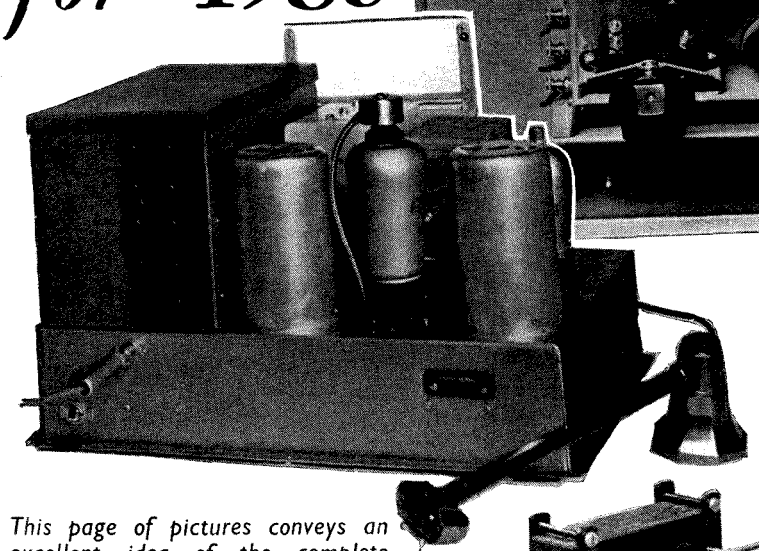
Continued on Page 266.



The carefully-engineered circuit, with every detail worked out on the lines of the best modern practice. Note particularly the extreme thoroughness of the de-coupling at every vital point

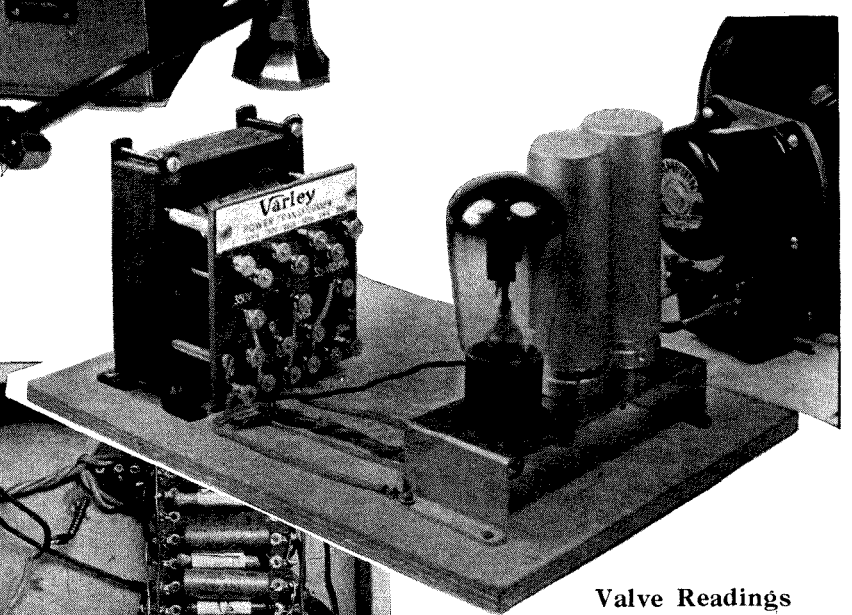
The Real Station-getter for 1935

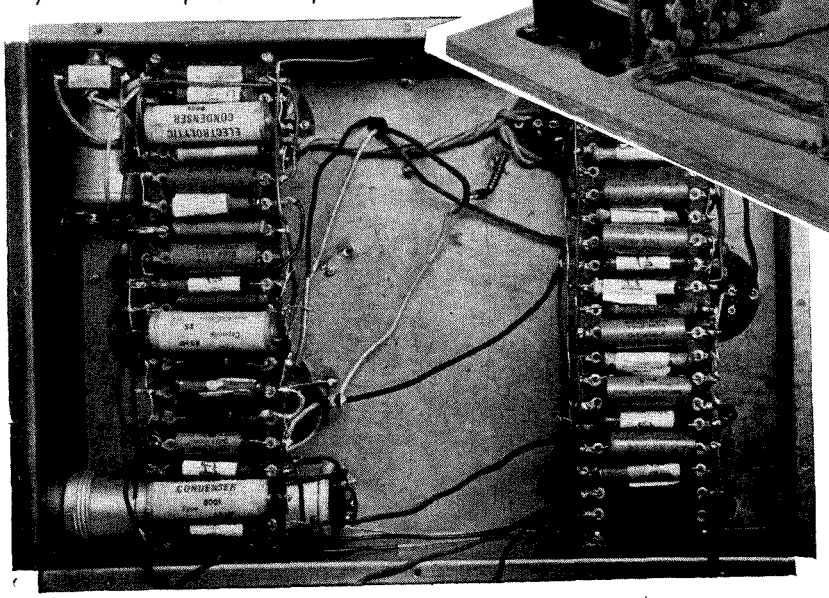




Designed for "W.M." by
PAUL D. TYERS

This page of pictures conveys an excellent idea of the complete installation, and clearly demonstrates the fact that although its construction is well within the capabilities of the amateur, yet the finished instrument need not fear comparison upon any basis with a professional product





Valve Readings

Valve	*Electrode*	*Voltage Reading*
FC 4	Anode	240
	Screen	88
	Oscillator Anode	80
VP 4	Anode	230
	Screen	88
TDD 4	Anode	80
354	Anode	158
PEN 4VA	Anode and Screen	Max

nearest to the tuning dial. This adjustment should be carried out gradually. The station should be tuned out practically to the edge of the side bands so that the dial setting is nearly correct, and the oscillator trimmer should then be screwed up until it is brought back to the dead tune point. The dial should then be adjusted again until the correct setting is obtained, followed by the final adjustment of the oscillator trimmer.

Checking Settings

It is then rather important to check the setting of a station such as Fécamp at the beginning of the medium waveband, and also that of a station near the top of the medium waveband. It may be found that both these stations are a few metres out. In such a case I would advise making a compromise setting so that practically anywhere over the whole scale no station is more than one or two metres off the correct setting point.

It should be noted that the Polar dial is provided with a slight adjustment by means of which the whole dial can be moved slight to either side. Movement of this again helps in obtaining the most accurate adjustment over the entire waveband.

Tuning Pack Ganging

The next adjustment is that of the aerial and band-pass trimmers. These should simply be turned until the station is brought to a maximum. It is convenient to make this adjustment somewhere near the lower end of the medium waveband, as stray capacities are of more consequence. It is only after this stage has been reached that the Stenode couplers should be adjusted. The coupling should gradually be reduced, particularly in the first one, until extreme selectivity is obtained.

Selectivity of the highest order together with correct tone compensation is only given when the four tuned circuits are accurately ganged. Only a fraction of a turn is required on the trimmers. This adjustment should be carried out when listening to quite a weak station, and it is also helpful to reduce the volume with the aid of the volume control. Under these conditions the exact tune point will be extremely sharp.

Having adjusted the trimmers accurately with a weak coupling, it is then only necessary to vary the tone correction by adjusting the knob on the first low-frequency Stenode coupler. This, of course, is located inside the screening box. This adjustment must be carried out with the set mounted in the cabinet because the baffling effect obtained from the cabinet affects the amount of low-note radiation.

It is not a difficult matter to decide upon the best setting of this control, as it immediately affects the balance of musical reproduction. An incorrect setting will always give a noticeable colouration to speech.

The tighter the coupling in the Stenode high-frequency couplers, the more will be the side-band response and the less Stenodic will become the action of the receiver. As a result the selectivity will be increased and less tone correction will be required. Accordingly it is necessary to determine the optimum setting of the coupling of the tuned circuits in the radio-frequency couplers for any given locality and aerial conditions with which the set is used.

Selectivity

The selectivity of the set is such that it can be used with quite a long outside aerial even fairly near to a local transmitter. Under these conditions almost more than adequate gain will be obtained from all the important Continental transmissions, and many of the weaker ones should easily be obtained.

When a shorter aerial is used if the reader is not situated very close to a local transmitter less side-band cutting and less tone correction are necessary, and in practically every locality and under any conditions it should be possible to separate all the adjacent channels, providing, of course, that the transmissions concerned are reasonably powerful. It was revealed during the test of the receiver that many of the low-power Continental transmissions could be received and completely separated.

Table of Voltages

As a further indication that the set is correctly adjusted a table is published showing the various anode and screen voltages which should exist in the circuits. Slight variation in the constants of the actual valves and resistances used will make a slight difference to the measured values, but they should certainly be quite close to those given in the table.

COMPONENTS NEEDED FOR THE 1935 A.C. STENODE

CHASSIS	£	s.	d.
1—Peto-Scott to specification, steel, with screening box, power pack platform, and piece of wood 12 in. by 9½ in., by ¾ in., also extension spindle for volume control		19	6
CHOKE, HIGH-FREQUENCY			
1—Belling-Lee screened superhet high-frequency choke		6	6
CONDENSERS, FIXED			
3—Dubilier .0001-microfarad, type 665		1	6
2—Dubilier .001-microfarad, type 4501		2	0
1—Dubilier .002-microfarad, type 4501		1	0
1—Dubilier .01-microfarad, type 4501		1	0
1—Dubilier .02-microfarad, type 4503		1	4
10—Dubilier .1-microfarad, type 4503		13	4
1—Dubilier 2-microfarad, type 9200		3	6
1—Dubilier 4-microfarad, type 9200		7	0
2—Dubilier 8-microfarad, type 0281, 8/500 v.		11	0
3—Dubilier 25-microfarad, type 3001		6	0

HOLDERS, FUSE	£	s.	d.
1—Bulgin fuse holder and mains connector, type F15		3	0
HOLDERS, VALVE			
3—Clix Air-sprung 7-pin valve-holders with soldering ends		4	0
2—Clix Air-sprung 5-pin valve-holders with soldering ends		2	6
1—Clix Air-sprung 4-pin valve-holder with soldering ends		1	2
RESISTANCES, FIXED			
21—Erie 1-watt resistors, values: 60, 200, 250, 500, 1,000(2), 10,000(3), 20,000(3), 40,000, 50,000, 80,000 ohms, .25-megohm, .5-megohm, and 1-megohm(4)	1	1	0
RESISTANCES, VARIABLE			
1—Erie .5-megohm volume control with insulated spindle, without switch		3	6
STENODE COUPLING UNITS			
1 set of Belling-Lee Stenode couplers	3	5	0

SUNDRIES	£	s.	d.
1—Belling-Lee terminal strip with plugs and sockets			9
1—Belling-Lee low-loss screened lead and cap		1	6
1—Polar dial, type 110, 2B		6	6
1—B.T.S. stenode type jack and plug		3	0
2—Stenode sub-assembly panels		4	9
Suitable wire and sleeving, say		2	0
SWITCH			
1—Bulgin switch, type S98		2	3
1—Bulgin switch, type S80		1	6
TRANSFORMER, MAINS			
1—Varley EP33	1	17	6
TUNING UNIT			
1—Colvern superhet tuning pack, type H superhet Pentagrid, 110 kilocycles	2	17	6
VALVES			
1—Mullard FC4	1	0	0
1—Mullard VP4		17	6
1—Mullard TDD4		15	6
1—Mullard 354v.		13	6
1—Pen 4VA		18	6
1—Mullard 1W3		15	0
LOUDSPEAKER			
1—Grampian Type E1/Stenode loudspeaker	1	19	6

Scanning Simply Explained

The main technical difficulties of high-quality television have now been overcome. In the intermediate period while commercial developments are being worked out the amateur would be wise to get acquainted with the basic principles so that he may fully appreciate new inventions as they are described. Here is an explanation by our Technical Editor of scanning—one of the fundamentals of television—presented with clarity and simplicity.

TELEVISION, it must be confessed, is not a very easy subject to understand, simply because it does *not* work the way one would naturally expect it to do. The student is apt to start off with a wrong impression, as a result of the natural tendency to assume that the process must be one in which the whole picture is transmitted instantaneously to a distant point. Until we rid our minds of this conception we shall not be able to grasp the basic principles of television.

Not an Instantaneous Operation

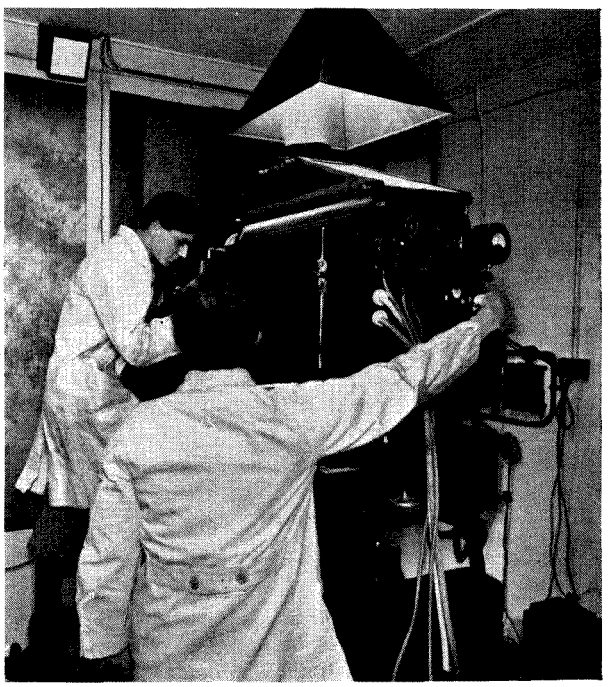
The fact of the matter is that no system of television by radio has yet been devised capable of transmitting the whole picture in a single instantaneous operation. It is indeed just this that creates all the practical difficulties responsible for sending high-definition television down on to the ultra-short waves.

All the known systems function on the same basic principle; they split the picture up into a multitude of tiny separate pieces, and transmit those fragments one by one in an orderly manner. At the receiving end the pieces are projected upon a screen one by one in their proper relative positions, and then our old acquaintance, "persistence of vision," comes into play and gives us the illusion of seeing the whole picture at once.

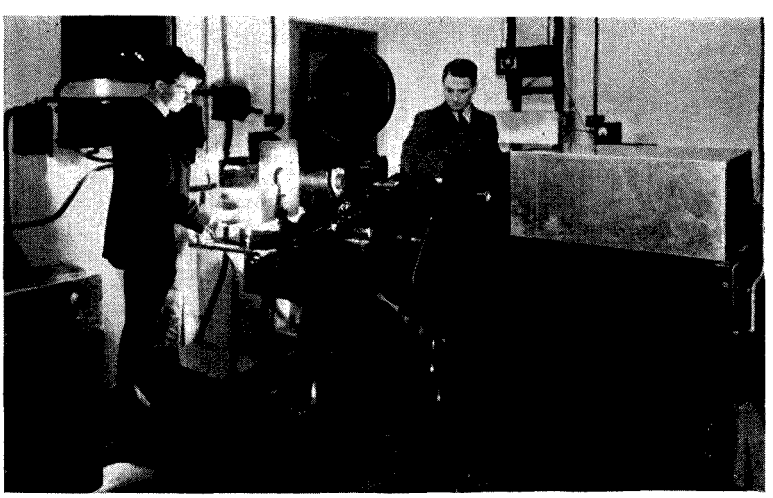
Vital Business of Scanning

There it all is in the proverbial nutshell, but merely to describe the process in a couple of brief sentences is not going to help the reader to understand the actual working of the operation.

It is my aim to provide such an explanation of the vital business of scanning as will make it quite clear to those many readers who have just started to take an interest in television. Before I can really make a start, however, I must pause long enough to clear up some points about that process of "transmitting" a picture or a piece thereof.



In one of the studio methods of scanning a moving spot of very intense light is used. The apparatus illustrated here is a high-power arc used for the purpose at the Crystal Palace



For film transmission it is necessary to scan a very small area with extreme accuracy; such precision apparatus as that shown here becomes essential. It is obvious that apparatus at the transmitting end is going to cost quite a lot of money!

I will assume that the reader can visualise the processes whereby *sound* can be transmitted in the form of a modulation of a radio wave, and that he is familiar with the function of the microphone.

Microphone for Light

What we have now to do is to see how an equivalent process can be devised to do something similar for the light and shade which make up the character of the little pieces of picture with which we have to deal in television. We want something which will translate them into corresponding variations of electric current; something, in fact, which will do for light exactly what the microphone does for sound.

In modern television systems this function is carried out by some form of the photo-electric cell. This is a device having the property of passing an electric

current which varies in exact proportion to the brightness of the light falling upon it, and is indeed the closest analogy to the microphone that one could expect to find in a different medium.

To analyse our picture, then, we have only to pick up the light reflected from each of the separate elements into which we are going to break up the scene, and allow that light to fall upon a photo-electric cell. The output from the cell will then vary in accordance with the brightness of the light, so providing us with a current with which a radio transmitter can be modulated.

Instructive Explanation

At the receiving end the modulation can be caused to vary the brightness of the corresponding little bit of the screen, and so give it the correct degree of illumination to match the detail of the particular bit of the picture which is being reproduced at that instant.

For the moment let us forget about trying to fathom the actual process of scanning, and instead devote ourselves to getting a really clear mental picture of that "piece-by-piece" business. Imagine that we could set up a battery of telescopes—thousands of them—each one trained to cover just one little spot on the scene to be televised. Further, the fields of view of the telescopes are to be arranged so that each covers its own bit of the picture without overlapping on the pieces viewed by any of the others.

Given a sufficiently large number of telescopes the whole picture could be covered in this way. We will make the still further assumption that the field of view of each instrument is cut down to a mere dot. Now suppose that we placed a photo-electric cell behind the eyepiece of every telescope; obviously, the current output of each cell would be proportional to the brightness of the piece of the picture being viewed by that particular telescope.

Receiving End

Imagine that we next set up a great screen covered all over its surface with a sort of mosaic of tiny electric light bulbs, set as close together as we could squeeze them. Let each bulb be fed with the amplified output from just one of the photo-electric cells at the transmitting point, and then we should see something interesting begin to happen.

Each tiny bulb would glow with a brightness which was proportional to the light falling on the photo-electric cell feeding it; in other words, it would copy the brightness or otherwise of the particular bit of the picture concerned.

Provided that each bulb was set in such a position on the screen that it corresponded exactly to that of the piece of the picture covered by the telescope associated with that particular photo-electric cell, then we should have a reproduction of the original picture on our screen. It might be coarse in grain and lacking in detail, but the broad outline of the scene would be there.

To get a clear and finely detailed picture we should have to use a multitude of telescopes, cells, and bulbs. It would be necessary to place the lamps on a screen very large in relation to the size of each individual bulb and perhaps to stand well back to view it, but granted all this there is no theoretical reason why a nearly perfect picture should not be "televised" in this way.

Practically, of course, the scheme is useless for radio purposes; we have to devise a method which can be carried into effect with only a single channel of communication, instead of the multitude of separate connections involved by the individual cells and bulbs we have just been discussing.

In radio we can only transmit the impulse from a single cell at a time, and that would mean, under the conditions we were considering, that we should have to transmit just one little bit of the picture at a time. Imagine that we connected up the photo-electric cells to some sort of rotating switch arranged to join them up to a radio transmitter one by one in rapid succession so that we sent out one after the other impulses corresponding to the output of each cell.

Piece by Piece

Then at the receiving end we should need a similar rotating switch to connect the output of the radio receiver through to the appropriate bulb at the right moment. The result would be that each bulb would light up for an instant with a degree of brightness corresponding to the light or shade of the bit of the picture picked up by the equivalent cell in the transmitting system.

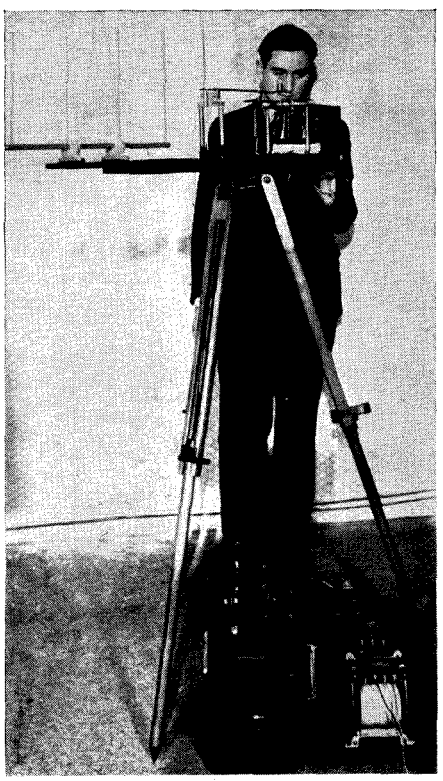
Now, if this arrangement were made to function comparatively slowly the result would be a meaningless series of flickers, and if it were not for a certain defect of the eye nothing more would ever be possible. That defect, known as persistence of vision, comes to our aid and makes possible not merely television, but the cinematograph as well.

Persistence Effect

What it does is to make any visual impression linger in the eye for a certain time, and as a result if we make our "blinking" operation go on fast enough, the separate impressions persist and blend into one continuous picture. In other words, although only a single dot of the scene is really present at any one instant the eye "remembers" all the others, and so sees, or thinks it sees, the complete scene.

Evidently, then, the "one at a time" system will suffice for our purpose and now we can begin to see how our transmitting arrangements can be simplified and made practical.

Continued on page 271



One of the most difficult problems in television concerns the direct scanning of outdoor scenes. In one of the methods developed by the Baird Company the operation is performed on the spot, communication with the main transmitter being established by the micro-wave transmitter seen here. It has a range of ten miles

Whilst we in this country are looking forward to an orgaanised television service, Germany has left the initial stages and introduced its first public television transmissions. The Berlin service started on March 22 with news reels and entertainment films. In this special contribution A. A. Gulliland reviews the position of television in Germany and forecasts future developments

The Berlin television reporter's car. Special long-focus lenses are fitted in the camera—seen on the roof. The system employed is called the intermediate-film process, which permits the filming of any given scene and televising it after a delay of only thirty seconds or so

Berlin's Public Television Service

By A. A. GULLILAND, our Special German Correspondent

ON March 22, 1935, the German Broadcasting Company officially opened a regular experimental service of sight and sound high-definition television to the Berlin public. The programmes which are broadcast three times a week from 8.30 p.m. to 10 p.m., consist of films. For the first few weeks of operation excerpts from news reels, followed by a full entertainment film, were broadcast.

News Reporting

At the time of writing a news-reel operator has already been appointed to the staff of the R.R.G., and in a few days' time a lightweight news-reel van and a truck containing suitable lighting equipment will be delivered to the R.R.G. who intend making their own topical news reels. These films will be broadcast under the title, *Mirror of the Day*.

It will be remembered that at the German radio exhibition last August the R.R.G. demonstrated a television reporter's van (supplied by the Fernseh A.-G.) which, by means of the intermediate film system, can televise any given event within thirty seconds of its happening. This van will be used for important events where immediate television is required. The intermediate film used will then be dried, and thus it will be possible to repeat the programme in the evening or at some later date as required.

In Germany television is organised as follows: The German Post Office will exercise its monopoly of wireless transmission and will operate the television transmitters just as it already operates the broadcasting transmitters. The television programmes will be supplied by the German Broadcasting Company.

The broadcasting of high-definition television from high-power ultra-short-wave stations has been going on in Berlin ever since 1933. At first 90-line pictures were transmitted, but early in 1934 the definition was increased to 180 lines and a second transmitter was added to provide for the accompanying sound.

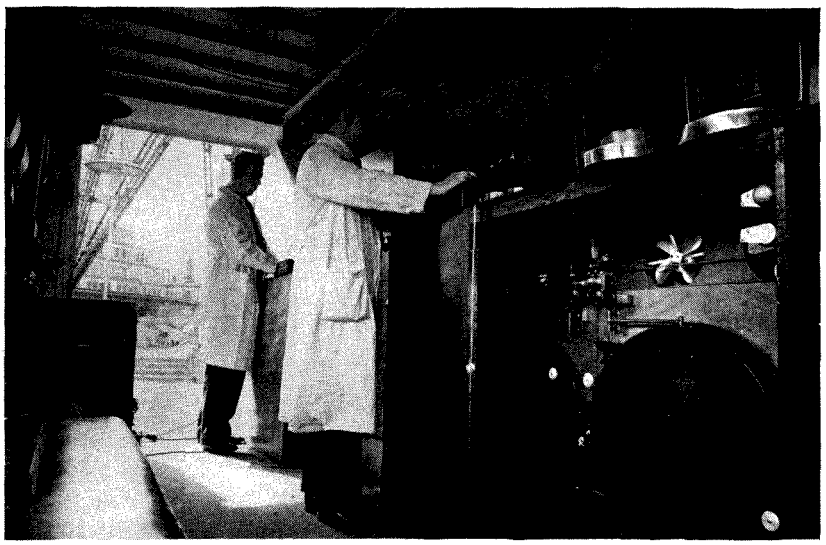
Germany has never had a *public* television service of 30-line pictures. Some years ago the Post Office laboratories arranged for test transmissions from the old medium-wave Berlin station at Witzleben, and until quite recently the long-wave German station also broadcast experimental 30-line 12.5 frame-per-second pictures.

Early Beginnings

Reception was limited to a number of enthusiastic amateurs as programmes in the ordinary sense of the word were not provided. Germany was one of the first countries to realise that 30-line broadcasting had no future as an entertainment medium for a public used to high-quality films and illustrated papers. For that reason first 60-line, then 90-line, and ultimately 180-line definition was aimed at and achieved.

Purely Experimental

Here, as with the 30-line broadcasts, the Post Office transmitted short loops of film, no regular programme being provided. The tests were intended for manufacturers and scientists.

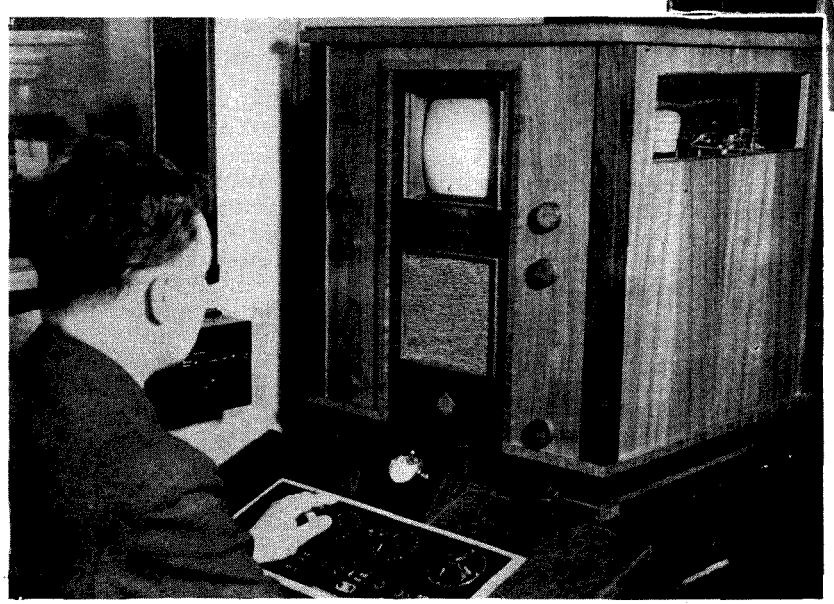


Inside the German outside-television car. The illustration shows the film scanner and some of the film drying apparatus. Note the modern building in the distance

Early this year the authorities decided that a standard had been reached when the general public could be invited to look-in. Therefore programmes are being provided.

Preliminary Reception Tests

It is only natural that for the first two or three months of the service the number of lookers will be limited to those persons who will obtain the loan of receiving sets from the German Broadcasting Company and the Post Office. These two bodies have decided to distribute about a hundred receivers among suitable persons who will be asked to report regularly on their experiences. By this means it is hoped to gather sufficient practical programme experience under regular working conditions so that the authorities can launch out more fully in the autumn when it is hoped that the service will be well under way.



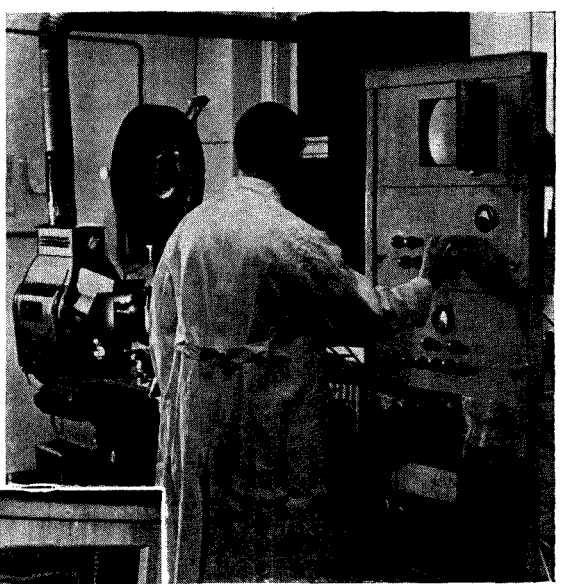
Whilst sound and vision are being transmitted an engineer sits in front of a check receiver making sure that all adjustments are right. Note the curved end of the cathode-ray tube

Private individuals wishing to buy sets will be able to do so. At the present moment, however, it seems as if only one firm, Radio-Loewe, are in a position to, and willing to supply apparatus to the public. Radio-Loewe has a cathode-ray tube receiver working from the mains for both sight and sound on the ultra-short-waves, and this set will be sold at 600 marks.

Careful Advance

The German authorities intend proceeding very gradually so as not to risk a sudden setback.

Last year the German Post Office equipped a van with television receivers and carefully went over the ground covered by the ultra-short-wave station, Witzleben. *It was found that an ordinary local range of thirty miles could be guaranteed.*



Inside Berlin's television transmitter showing the film-scanning apparatus with a cathode-ray check tube. An arc light consuming 250 amperes is used for the 180-line scanning

On the other hand, reception was still possible at a distance of about sixty miles by placing the receiving aerial on the top of a church tower.

The van then continued further afield and discovered that the ultra-short-waves *had a far greater range than was assumed at first.* Reception was good at a distance of 124.5 miles, on the summit of the Brocken mountain in the Harz at an altitude of 3,649 ft. This position is twenty-five miles further than the horizon of the Witzleben ultra-short-wave stations and 3,280 ft. below it. *These facts prove that the ultra-short-waves are not limited to so-called optical range.*

It has been decided to make use of transportable high-power ultra-short-wave transmitting apparatus to continue tests. These transmitters were ordered some months ago, and will be delivered shortly. They will first be placed on the Brocken, where they will be modulated by wireless link from the Berlin television transmitters. They will later be taken to other likely sites. These direct experiments will greatly help in finding suitable places for the proposed twenty-five permanent television transmitters.

Definition Possibilities

Meanwhile work is progressing in various laboratories to produce suitable electrical scanning apparatus for pictures of 360 lines or more; mechanical scanning is possible only up to 240 lines.

Well-known German television experts, however, are of the opinion that the added quality in definition derived from the use of 360 lines over 240 lines will not be equivalent to the extra cost and elaboration involved.

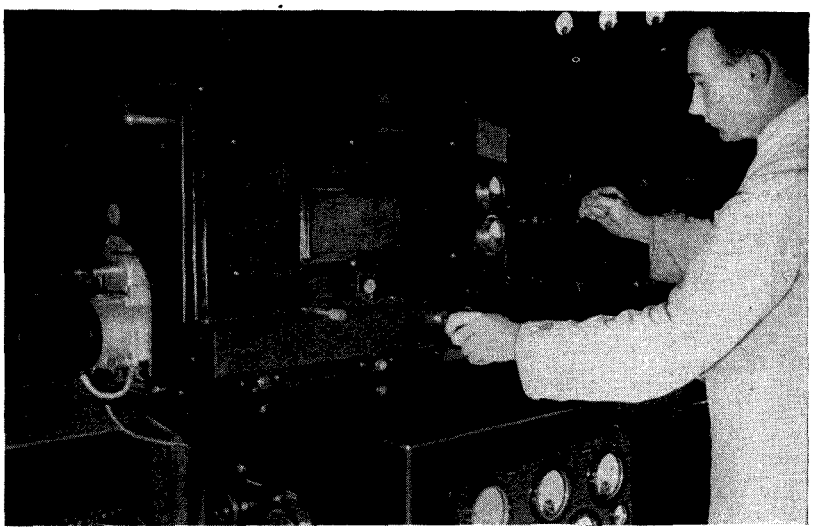
Flicker Problem

Pictures of 180 lines with 25 frames per second still have a certain amount of flicker, and the greater the illumination of the screen of the cathode-ray tube the more noticeable does this flicker become. One of the most promising systems to suppress this without requiring a larger band of frequency is the so-called "interlock" method of scanning.

Radio Loewe has just perfected apparatus working on this system, and its receivers can easily be adapted to it the moment it is decided to make use of the system.

In this article reference has been made to Radio Loewe's receivers. This does not mean that these are the only ones in Germany. Telefunken, which has supplied the ultra-short-wave transmitters and also the film scanning apparatus for the German Broadcasting Company's programmes, has excellent receivers, but the price is at present in the neighbourhood of 3,000 marks—few lookers would decide to buy this set when they have the Loewe at 600 marks.

TeKaDe of Nurnberg, well known for their pioneer work in connection with mirror screws, are the only firm in Germany which still stick to mechanical means of reception. This firm has produced a mirror screw for 180 lines, but there is no news of the possibility of raising the definition to 240 lines.



Showing the apparatus used for televising close-ups of performers. The new television service in Berlin uses a definition of 180 lines at 25 frames per second

SCANNING SIMPLY EXPLAINED

Continued from page 268

First of all, if we are going to transmit the impulse from only a single cell at a time, it should surely be possible to make just one cell do the whole work and so eliminate the complication of the multiplicity of cells and the rotating switch idea.

That is just what is done in practice, and we can get a preliminary notion of the way it is managed like this: suppose that we set up just a single telescope and cell, and mount them on a mechanical contrivance so arranged that the field of view of the telescope can be made to sweep in regular fashion across the scene in a series of adjacent lines.

Suppose that the telescope starts off pointing at the top left-hand corner of the scene and then sweeps across to the top right-hand one. That done, it jerks instantaneously back to the left, then sweeps across to the right again on a track just below the first line and continues to do this until it arrives at the bottom of the picture area. It then jumps back to the top left-hand corner once more and starts the process all over again.

The photo-electric cell would meanwhile be giving out currents proportional to the brightness of the particular bit of the scene at which the telescope was pointing at any given instant. Now if these currents were applied to the appropriate bulb in our receiving screen at the right moment we should obviously get a picture built up just as before.

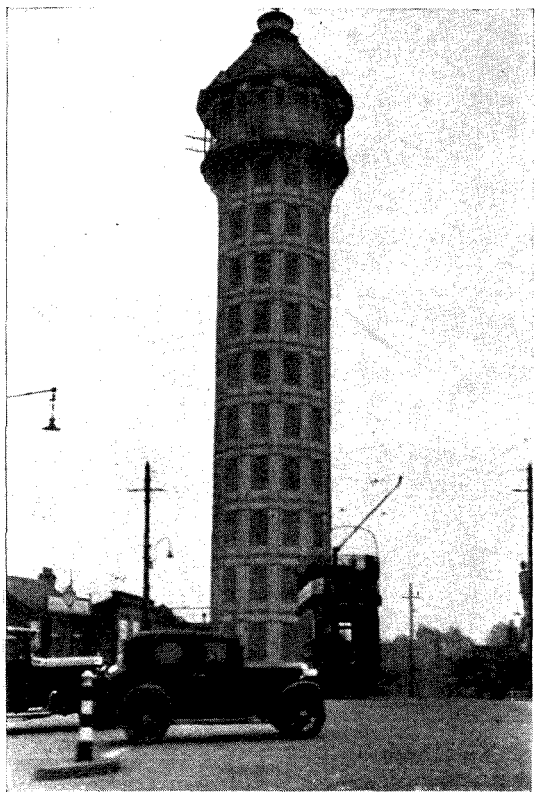
Next Month

There you have in outline the fundamental principle of scanning as used in television today. Next month I shall be treating the subject in somewhat greater detail and shall endeavour to show how the process is carried out in actual practice, how the receiving arrangements are simplified and made practical, and so on.

I hope, too, to begin the consideration of some of the actual apparatus which is used.

Television Notes and News

Collected by P. WOODWARD



This photograph taken on the top of "Sydenham Hill" shows one of the huge towers at the Crystal Palace used by Baird Television for its experimental transmissions

New Cathode-ray Tubes

IT is interesting to note that already the makers of cathode-ray tubes are beginning to release details of new types specially intended for high-definition television. Some of these tubes are of great interest to the experimenter, for they promise him a bigger picture of a more pleasing colour, without requiring a higher operating voltage.

There is, for example, the Ediswan type A.H. tube, which is very similar electrically to the type B.H. described in the April issue (page 187), but is of considerably larger size. The screen diameter, for instance, is no less than 20 centimetres, as near as no matter, 8 in. Obviously, there is room for quite a good picture on a screen as big as that!

A special feature of this new model is the colour of the fluorescence—that is, the tint of the picture which it reproduces. The older types of cathode tubes gave a bright green glow which, it must be confessed, tended to make the picture displeasing to a critical eye. Much research is being done nowadays with a view to obtaining a true black and white effect.

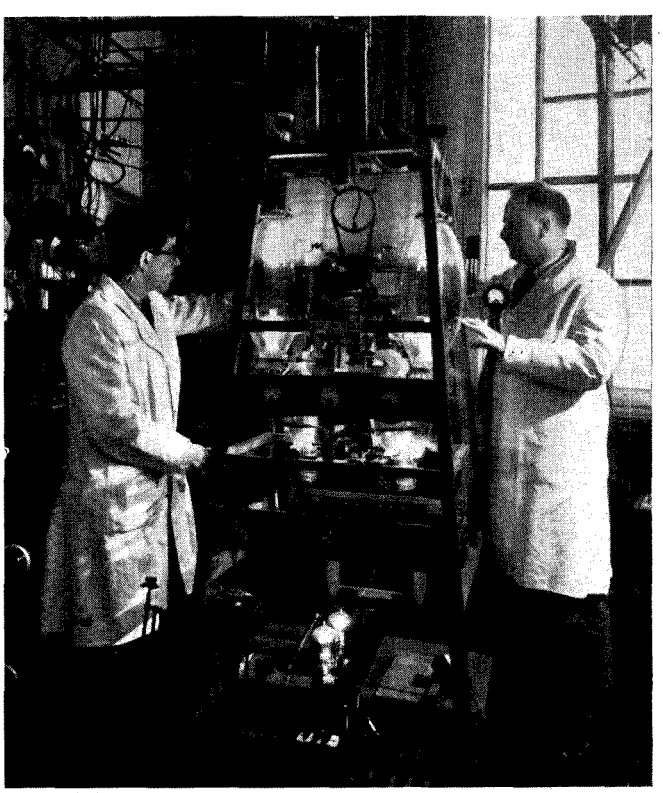
Considerable success has already been achieved, and a colour resembling the familiar sepia tint used in photographic work is readily obtainable. The Ediswan tubes, for example, are available with screens to give either the original green or a tint very nearly pure white. One has merely to specify the colour required when ordering in either of the types mentioned.

Berlin High-definition Television Service

The Germans seem to have lost no time starting their high-definition service; although the official date was March 22, it now appears that the service actually began on the first of the month without being announced as such, the idea being, apparently, to try out the service on a programme basis without inviting the public to watch until all was going smoothly.

Transmission is now taking place from the Witzleben station, which, of course, is intended to cover Berlin. The normal schedule allows for five to six hours of actual television on most days of the week with several extra hours of sound only. Makes one envious when compared with the beggarly two hours a day for which we in London expect to have to wait some months!

Here are some technical details of the transmission: the power rating of the transmitter, in terms of anode dissipation of the stage feeding the aerial, is 16 kilowatts. Vision



One of the Baird ultra-short-wave sound transmitters installed at the Crystal Palace. Actually there is suitable gear, studios and staff at the Crystal Palace, to start an experimental service immediately

signals are transmitted on 6.7 metres, while the sound goes out on 6.985 metres.

The picture frequency is 25 per second, and the scanning is done in 180 lines. That all suggests quite a good picture, but not, obviously, so fully detailed as the one we hope for when the recommendations of our Television Report are put into execution.

The times of the principal items in the service appear below. Note that they are given in local (*Central European*) time, so that the reader can appreciate their programme value. (There would not be much point in converting them into G.M.T., since the chances of receiving such waves over here are just as near to non-existent as anything can be in radio.)

9 a.m. to 11 a.m.: Post Office television tests; Mondays, Tuesdays, Wednesdays, Thursdays, Saturdays.

11 a.m. to 12.30 p.m.: Broadcasts of music on sound wave; no vision; Mondays, Tuesdays, Wednesdays, Thursdays, Saturdays.

3 p.m. to 4.30 p.m.: Post Office television tests; Mondays, Wednesdays.

5 p.m. to 8.30 p.m.: Broadcasts of music on sound wave; no vision; daily.

8.30 p.m. to 10 p.m.: *Television programmes by German Broadcasting Company*; Mondays, Wednesdays, Saturdays.

8.30 to 10 p.m.: Post Office television tests; Tuesdays, Thursdays.

10 p.m. to midnight: Broadcasts of music on sound wave; no vision; daily.

◆ ◆ ◆

Choosing London's Television Tower

At the time of writing there is still no definite news of a site for the London transmitter, although the odds appear to be shortening in favour of the Alexandra Palace. Really, it is all very provoking when you reflect that there is already in existence a complete transmitter and set of studios that could begin a real entertainment service tomorrow !

There is now no doubt whatever that the Baird station at the Crystal Palace *could* cover the area with considerable efficiency. For months it has been ready for a start at a moment's notice.

Why, then, must another site be found ? Probably there is quite a good reason, but it is difficult to see why the Crystal Palace transmitter should not be allowed to put out a stop-gap service in the interim. Let us have something upon which to make a real start on the problem of designing suitable receivers for home construction!

Probably it will be suggested that it would be showing unfair favour to one of the television companies. Quite apart from the possibility that the favour in question might be no more than the natural result of the enterprise displayed by this company, surely there is a complete precedent for such an arrangement ?

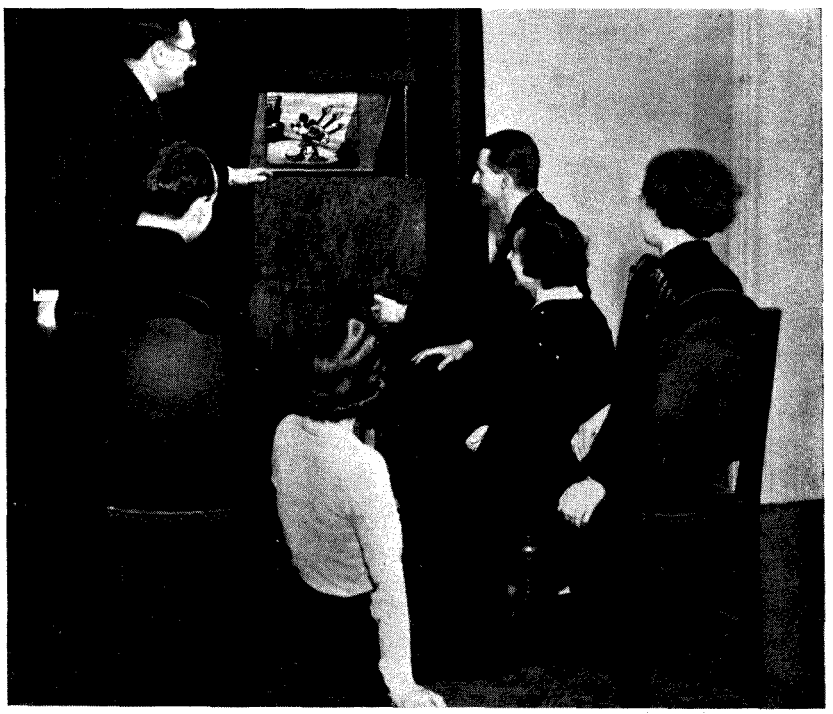
Did not sound broadcasting start with transmissions from a station owned and built by the Marconi Company ?

Television and the Home Constructor

Television receivers for home assembly are likely to present the designer with some acute problems: the question is definitely separate and distinct from the task of producing a design for commercial manufacture, which is in many ways an easier one.

The home constructor has not the means of making certain types of preliminary adjustments with the accuracy called for in high-definition work, and special arrangements will be necessary to meet his needs.

One direction in which something is already being done to help him is in the matter of supply circuits for the cathode tube. The construction and initial adjustment of time base and power-supply circuits is certainly one of the more difficult problems of high definition, and so it is encouraging to be able to report that there is a good prospect of such apparatus being made available in ready assembled and adjusted form.



A Baird home television receiver giving a black and white picture 12 in. by 9 in. and which is suitable for entertaining an audience of thirty or forty people

Assuming that it will be possible to purchase one's cathode tube complete with the needful auxiliary circuits in ready calibrated form, the question then becomes much simpler; the constructor will then have only to build and adjust the radio receiver. That should quite definitely be within his powers!

An article appears elsewhere in this issue which should do much to dispel the mistaken idea that a television receiver for the ultra-shorts is something too complicated for the amateur to tackle.

When it is remembered that amateurs are already making receivers for *five* metres, it is obvious that the problem of an instrument for a wave of the order of seven metres cannot be so terribly difficult!

The width of band which has to be covered in the intermediate-frequency amplifier certainly sounds alarming, but the simple expedient of the use of a very high intermediate-frequency seems an adequate remedy.

Receivers for Short-wave Television

By L. R. MERDLER
of Baird Television, Ltd.

ALTHOUGH there have been sound and vision transmissions below 10 metres for the past year or two, few amateurs have taken sufficient interest in this band to take part in some of the most interesting experiments that have led to the present stage of television development.

This has been due probably to thoughts of intricate apparatus and valves of special design to cope with radio frequencies of the order of 50 megacycles.

Such ideas are definitely unfounded on fact, and there are few experimenters who could not almost immediately construct receivers to pick up the experimental television stations now working.

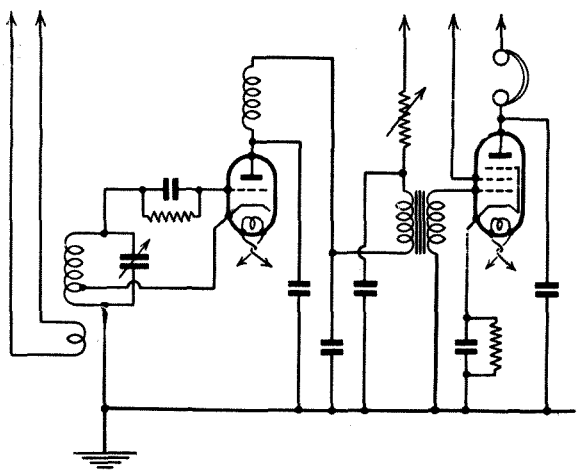


Fig. 2.—The circuit of a simple regenerative receiver suitable for the reception of short-wave sound broadcasts

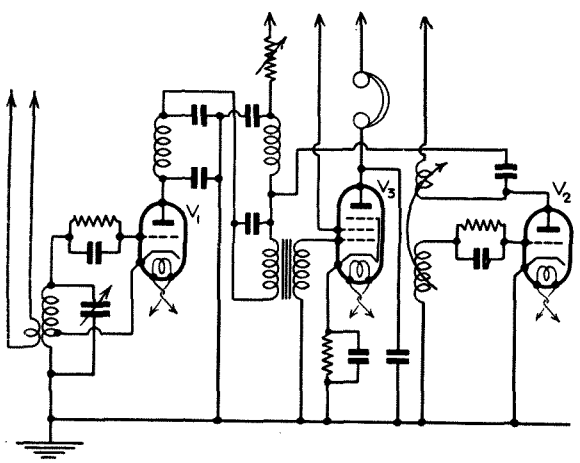


Fig. 3.—A typical super-regenerative circuit in which V1 is the detector and V2 the quench valve

Even if actual pictures are not received, there is a wealth of interest and entertainment to be gained by research into this region. It must be remembered that transmissions are still of an experimental nature. The major part of the experimental transmissions are carried out during daytime, and the chances of picking up transmission in the evening are correspondingly lessened. There is no reason, however, for the less fortunately placed amateur not to make a start now in preparation for regular transmission hours.

How to Start Experimenting

A knowledge of how to make a start probably presents the most serious obstacle in the way of the keen experimenter. Ultra-low loss components, superheterodyne and super-regenerative circuits tend to confuse the issue, but none of these are strictly necessary for reception purposes. Broadcasting and short-wave principles may be confidently employed provided that certain simple precautions are taken in view of the ultra-high frequencies involved. High-frequency amplification, reaction, and the various known forms of detection may still play their part with standard valves at frequencies well above those under discussion.

Straightforward receivers of the detector, low-frequency transformer-coupled type used with a pair of headphones will enable those entering the 7-metre band to get a sound idea of the conditions to be met. Such a receiver will enable the listener to discover the best type of aerial and its exact position and height for maximum possible signals.

It will also enable him to find out the type of interference he is likely to run up against and to experiment with his aerial and lead-in to keep such interference as low as possible.

Receivers for 240-line Reception

For the reception of high-definition pictures of 240 lines at 25 pictures per second simple receivers are of little value, and a superheterodyne becomes almost essential as the band width required is over 1 megacycle. The use of the superheterodyne for this purpose must not be confused with broadcast practice where the aim is to obtain selectivity and high gain.

It is found, even at 7 metres, that such band widths as a megacycle are not obtained without considerable circuit damping, and it can thus be seen that low-loss plays a comparatively unimportant part in picture reception. In view of this circuit damping it becomes necessary to use three or more stages of intermediate-frequency amplification to obtain the necessary gain with the required band width.

The number of stages used will depend largely on the distance the receiver is located from the transmitter and the height of the receiving aerial.

A typical circuit is given in Fig. 1 in which V_1 is the first detector, V_2 oscillator, V_3, V_4, V_5 the intermediate-frequency stages, V_6 second detector, and V_7 the output valve.

Phase distortion is of major importance in television reception, and it is important that phase reversals should not be introduced in the vision-frequency amplifier. Thus with the present television system in use an anode-bend detector must be followed by a further stage of valve amplification, while grid detection gives the correct phase on the output anode condenser.

Further amplification is obtained by adding units of two stages, although it is advisable to keep such stages down to a minimum. When dealing with pre-detector amplification, phase reversals do not worry us, and a single stage may be added without causing any trouble in this respect.

Receiving Short-wave Sound Broadcasts

For the reception of short-wave sound broadcasts a simple regenerative receiver of the type shown in Fig. 2 may be used. Tuning, however, will be found to be sharp although in view of the large ratio of the sound modulating frequencies to the carrier frequency, quality will not be impaired.

It will be noted that cathode coupling is employed for reaction with control by means of high-tension volts. This method has the advantage of avoiding blind spots over the tuning range of the condenser.

It is in these higher frequencies, of course, that super-regeneration really comes into its own, which accounts for its almost universal use by DX workers in the region below 10 metres. Super-regeneration gives a much higher gain than a straight regeneration receiver, and with care can be made to give good quality.

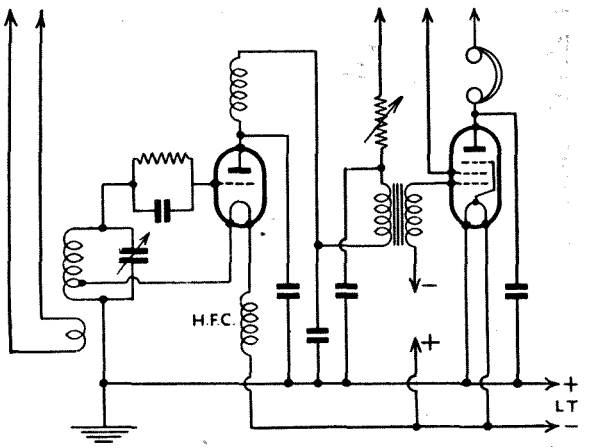


Fig. 4.—A simple reaction circuit employing battery valves. Notice the inclusion of a high-frequency choke in one of the filament leads

The system first devised by Armstrong in 1916 consists, briefly, of a detector in a critically regenerative condition which is periodically quenched at a lower frequency. Fig. 3 gives a typical super-regeneration circuit in which V_1 is the detector and V_2 is the quench valve, which may be operating at a frequency of 100 kilocycles.

The tuning will be found to be substantially flat, and this is sometimes an additional advantage at these frequencies.

It is generally preferable to use mains type valves for the circuits outlined above because of their higher efficiency. Battery valves may be used with suitable circuit modifications. Where cathode coupling is used for regeneration a low D.C. resistance high-frequency choke will be required in one of the filament leads (Fig. 4).

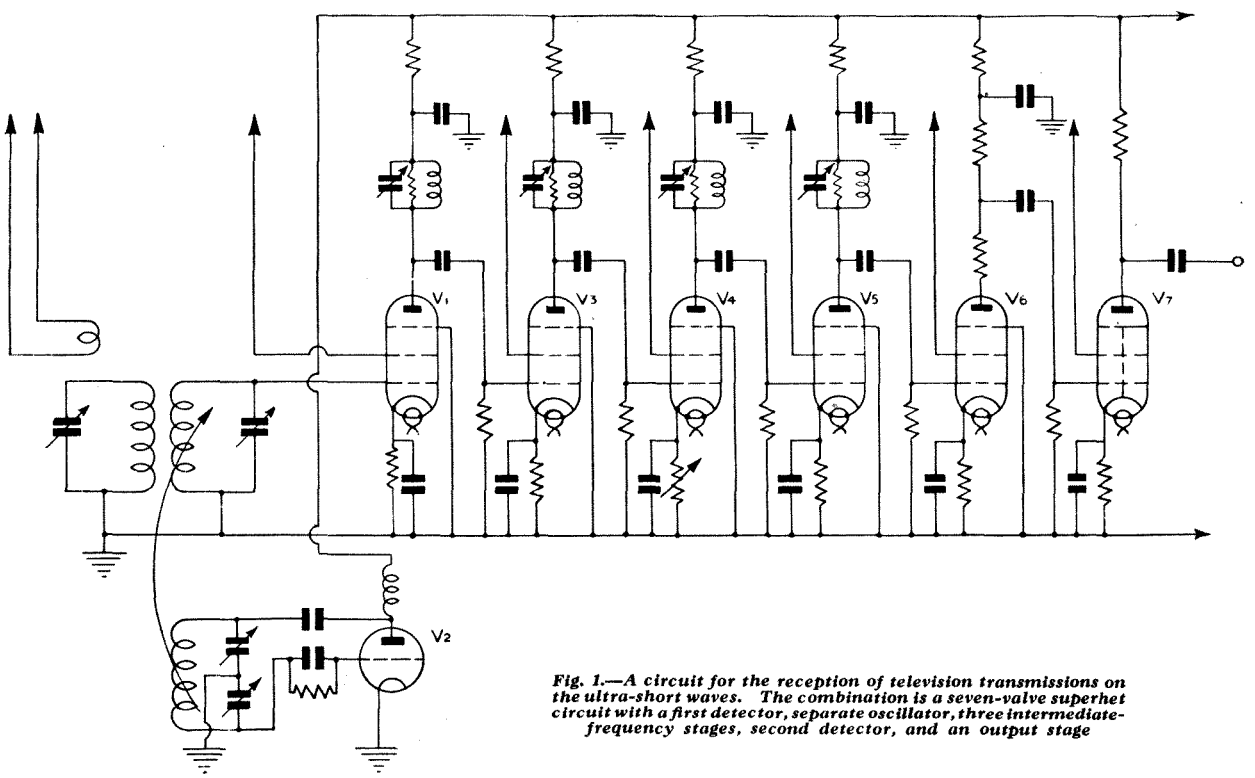
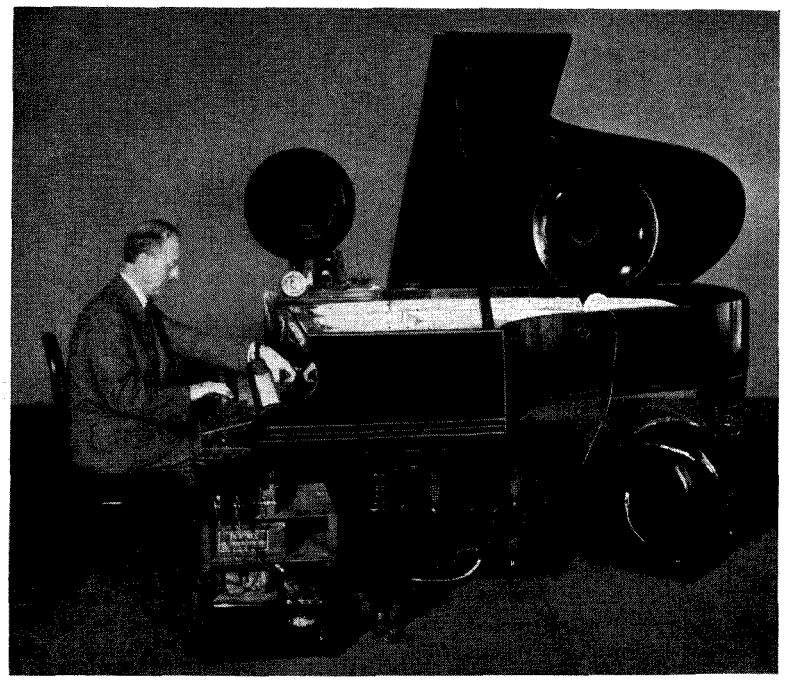


Fig. 1.—A circuit for the reception of television transmissions on the ultra-short waves. The combination is a seven-valve superhet circuit with a first detector, separate oscillator, three intermediate-frequency stages, second detector, and an output stage



We cannot imagine such a conglomeration of apparatus heaped around the piano in the modern home. This photograph shows the Hellertion, a single-voiced instrument, the manual of which is seen in front of the piano keyboard

New Developments

Our Continental Correspondent Explains

WHEN we speak of electrical music and electrical musical instruments, the term refers not to self-playing pianos or other musical automata, with their perforated paper rolls, the sound of which strikes terror into the breasts of real music lovers, but to instruments in which the range of tone consists of electrical oscillations made audible by a loudspeaker.

The electrical oscillations—nothing else than alternating currents—can be produced in a variety of ways. Electical musical instruments so far developed differ in the main by the method of producing these alternating currents, and in the devices serving to vary the pitch and loudness of the notes.

The recent enormous advance in electro-acoustic technique owes everything to the invention of the thermionic valve, which has also opened up new ways for the production of electrical music.

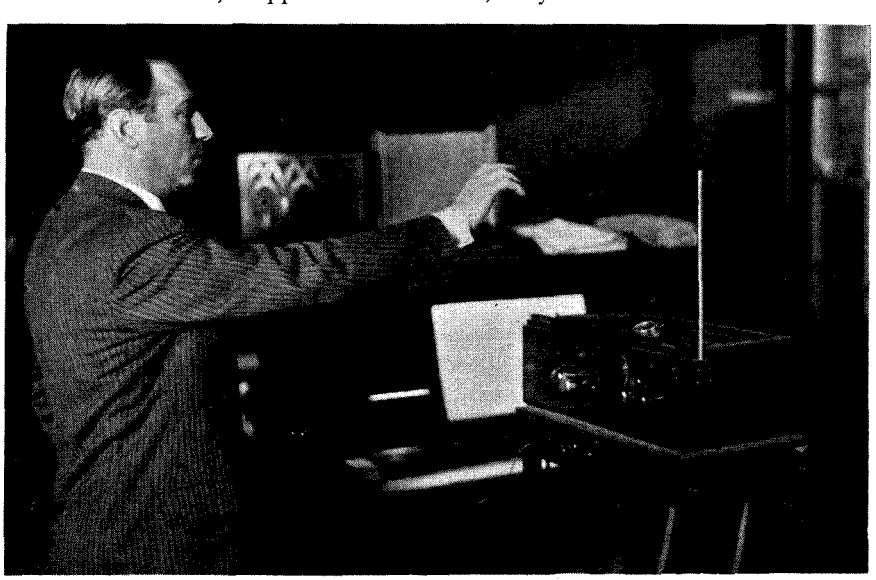
The use of a thermionic valve in conjunction with inductances and condensers in a back-coupling or reaction circuit enables an alternating current to be generated, while if the values of inductance and capacity in circuit are made variable, the frequency of the alternating current can be changed at will.

If this alternating current is now applied, after suitable amplification, to a loudspeaker, the diaphragm of the loudspeaker will vibrate at the frequency of the alternating current being generated.

The human ear can appreciate variations of pitch corresponding to a range of frequencies extending from about 16 to perhaps 16,000 cycles per second, but wave motions of higher frequencies are inaudible. We are therefore obliged, if we wish to produce a note electrically, to produce in the oscillating circuit an alternating current of audible frequency, which is obtained by suitably adjusting the values of the switching or controlling elements.

We can, however, attain the same object by producing simultaneously in two independent oscillating circuits alternating currents of different but very high frequencies, both lying above audibility.

If two such high-frequency alternating currents are applied to a rectifier, only the difference between the



Showing Professor Theremin's ether-wave piano. It is controlled by the backward and forward movement of a hand (in thin air) in front of a small rod protruding above the instrument. The instrument has been demonstrated many times in this country; many will remember a broadcast given by a leading exponent

frequencies is passed. This proceeding is called "heterodyning" (from Greek "beating together") of two high-frequency oscillations. In order to vary the pitch of the different tones when playing a tune it is only necessary to alter the frequency of one of the two oscillating circuits.

One of the first scientists to use a low-frequency valve oscillator for the production of electrical notes was the German, Jorg Mager. He constructed an instrument on which not only semi- and whole tones but also smaller intervals (quarter-tones and below) could be produced.

On his instrument the adjustment of pitch was effected by a variable condenser, the knob of which was turned above a pitch-calibrated scale. Even when very quickly passing from one tone to another, all the tones lying between are audible if the loudspeaker is not disconnected and again connected after each tone.

In a later design of his Sphaerophone, Mager therefore divided the entire tonal sphere after the style of keyboard instruments into a large number of *fixed* intervals. The Sphaerophone is "single voiced," i.e. unlike the piano it can only give one note at a time. Polyphony can be obtained only by combining many instruments with separate keyboards with, however, an amplifier and loudspeaker common to all instruments.

Played in conjunction with other instruments, the Trautonium offers many opportunities in unusual tone colour and on it practically any musical instrument can be imitated

in Electric Music

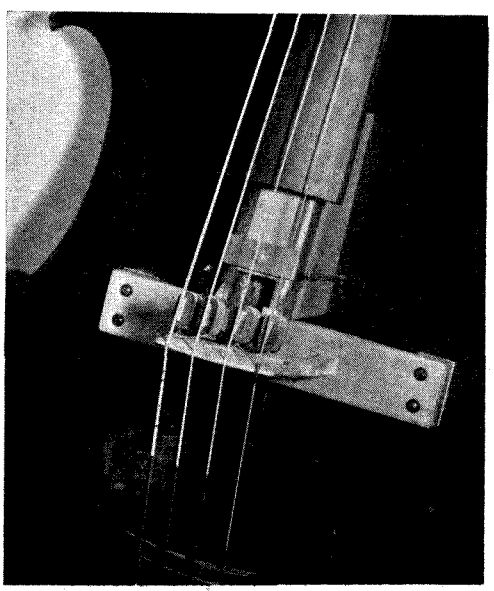
By FELIX HARBENNE

How the Valve Produces Electric Music

With the object of freeing the artist of all distractions by mechanical manipulations, Professor Theremin constructed his Ether-wave Piano (Aetherophon). His keyboard is really suspended in the air. For the adjustment of the pitch he uses hand capacity.

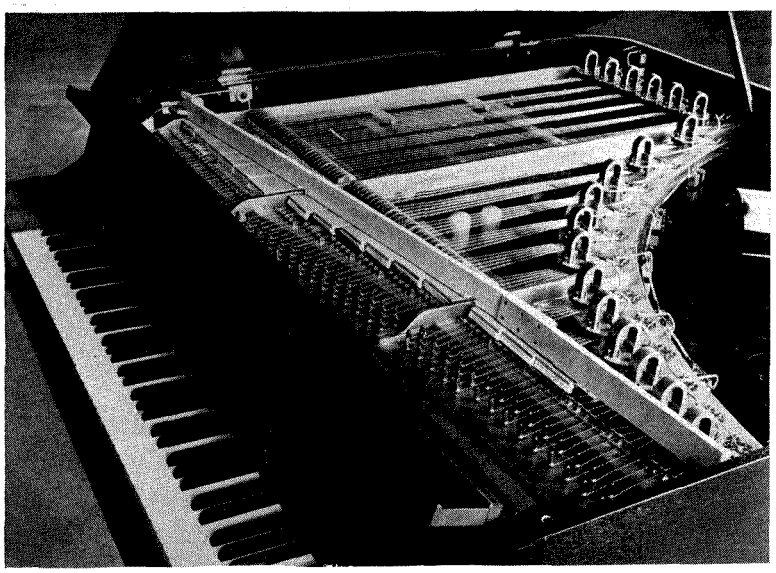
The right hand of the artist becomes, by capacity, part of the apparatus, and by its movement alters the frequency of one of the high-frequency oscillators.

A drawback is perhaps that the player will have no guide as to the hitting of the pitch, consequently he must

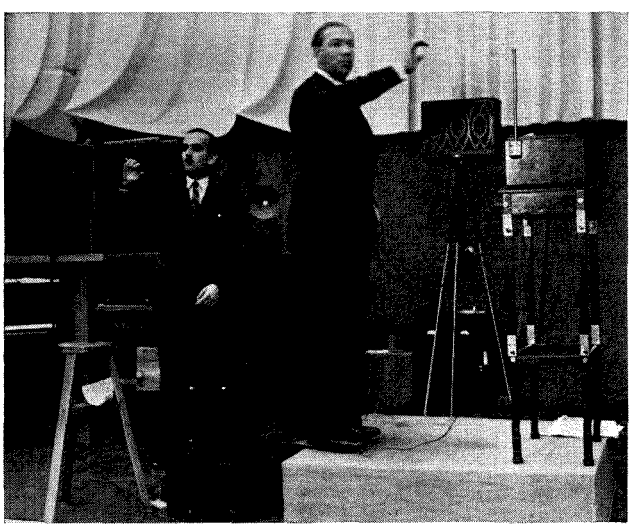


On the same principle as the Neo-Bechstein piano, electrical pick-up of the sound of the 'cello and violin is accomplished by electro-magnets fixed under the strings

A close-up view of the Hellertion. Five keyboards (shown absolutely plain without any markings) are seen below a strip of wood coloured to resemble the keys of an ordinary piano. This dummy keyboard acts purely as a guide for the beginner at the instrument



(Above) Showing how the electro-magnets are arranged on the frame of the Neo-Bechstein piano. The small boxes seen on the sides of the frame are condensers for filtering out unwanted higher frequencies



(Right) Two accomplished artists giving a duet recital with Theremin's Ether-wave electrical instruments

play entirely by ear, which presupposes a high degree of musical accomplishment and training. The unavoidable impurities in the tones may easily be covered by a light vibrato.

Another method of regulating pitch and volume, invented by B. Helberger and P. Lertes and used in an instrument called the Hellertion, is also interesting. The manual is arranged in such a way that the position of the fingers will determine the pitch and the pressure exerted by the fingers the volume.

The oscillator used is similar to that first described, that is, one producing low-frequency tones audible in the loudspeaker. By running one's fingers over the manual, the grid tuning of the tube is altered and the tone can be altered within a range of five octaves.

The Hellertion is also single voiced. But here also, as with the Mager Sphaerophon, up to four instruments can be combined, and in this way polyphony is obtained. The controls are arranged side by side in such a manner that they can be operated by one hand.

Doctor Trautwein went one step farther than the inventors mentioned above with his Trautonium, which permits of variation not only in pitch and volume but also in tone colour, and thus, as it were, of "three-dimensional playing." The tones of the piccolo-flute produced by this instrument are reminiscent of those hitherto available only with large organ pipes, while the beating of drums can also be simulated quite realistically.

It is possible to render, quite easily and surely notes of instruments not at the disposal of every orchestra. Tones soft or harsh, dreamy or grotesque, and even shades of tone colour never heard before, give the player power of expression only limited by his ability.

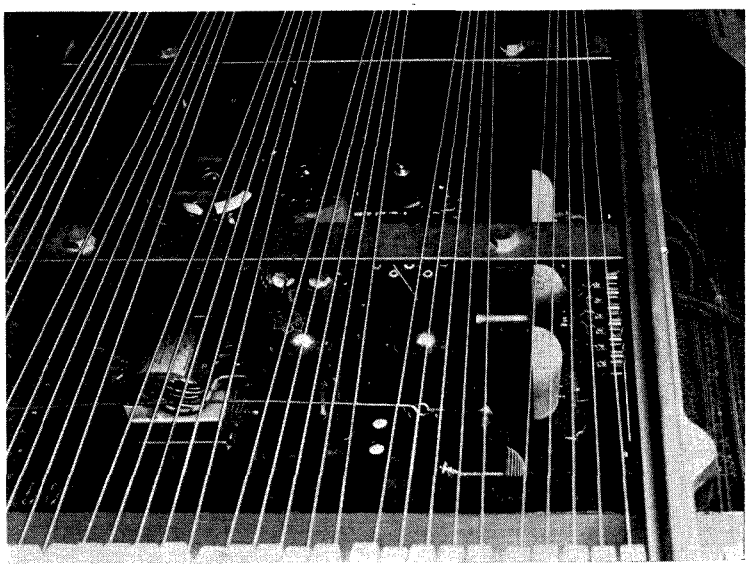
How, then, does the Trautonium work? As is well known, every tone consists of vibrations of different frequencies. The slowest or deepest vibration forms the main tone and defines the pitch, while the quicker vibrations, the so-called overtones, form the characteristic sound of the particular instrument.

In the Trautonium the fundamental oscillation is produced by a valve generator. From this fundamental oscillation circuit so-called "formant" circuits are hit and in these the overtone oscillations are created. The oscillations so obtained are then amplified in the usual manner by means of the necessary number of valves and finally rendered in a loudspeaker.

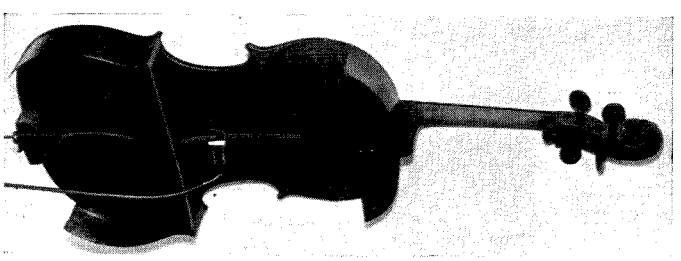
The loudspeaker on the Neo-Bechstein piano can be disconnected and a pair of headphones substituted. A boon to the household when the children are at practice!

The manual consists of a metal rail, over which a metal string is stretched. By pressing down this string sounds are produced. Markings above the string keyboard show the position of octaves and fifths, and other intervals; it is then easy for the player to find the tones.

For changing the tone, studs and keys are arranged on the right side of the instrument. These are manipulated in the same manner as is the register of a harmonium. Anyone with an ear for music can learn to play the Trautonium, which is a single-voiced instrument.



An absolutely new epoch in the traditional making of instruments and perhaps also a revolution in musical history itself is marked by a group of instruments which, in contra-distinction to the fully electrical musical instruments, may best be described as semi-electrical. Here mechanical vibrations (string vibrations) are first set up and then transferred into electrical oscillations which are made audible in a loudspeaker.



(Above) The amplifying gear of the Neo-Bechstein piano is built into the body of the instrument underneath the strings. Notice that there is only one string for each note in this piano—the middle and upper registers of the ordinary piano have three strings per note

(Left) Showing the back of an electrical 'cello. The resonance board is absent and its place is taken by an electrical device which is connected to the amplifying gear

The sounds are reproductions of the well-known instruments—piano, violin, 'cello, and others—only the tonal qualities recognised as good being retained. The player performs as formerly on the normal instrument.

And now comes the vast difference: with all these instruments, whether piano, violin, or 'cello, the sounding-board, that important part which alone decides the amplification of the notes and the tone quality, is missing. Centuries of development and experience have been necessary to obtain the full sound perfection of these instruments by traditional methods, but by the use of electrical methods, free from all shackles of matter, the same result has been attained within a very short time.

The mechanical string vibrations, which without sounding-boards are practically inaudible, excite weak alternating currents in the spools of the electro-magnets incorporated above the strings. After amplification, the electric oscillations are again transformed by means of the loudspeaker into acoustic disturbances.

On this principle, the well-known physicist, Professor W. Nernst, has developed an electric piano to such an extent that for more than a year it has been awaiting manufacture as a commercial proposition.

To eliminate the disturbing sound of the hammer blows when the strings are struck, Nernst built in a special micro-hammer, which hits the string with only

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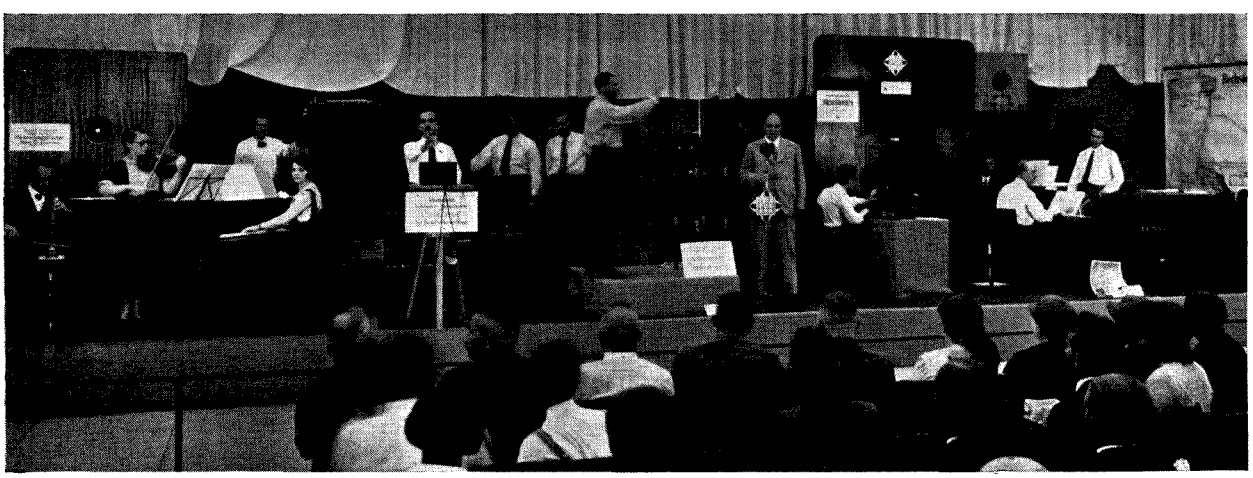


An all-electric orchestra gave a public performance at the German radio exhibition as far back as 1932. The complete orchestra is seen here; from left to right are the electric 'cello, violin and piano, two Theremins, the ordinary microphone, the Trautonium, the Hellertion, and another electric piano

Lusty photo

One of the easiest of short-wave stations to log is Zeesen. Here you see the forest of aerials outside the transmitting house. Remember that a different aerial is used for every wavelength used

WHAT YOU SHOULD KNOW ABOUT SHORT-WAVE DESIGN—6

This is the sixth of a series of articles in which the special problems of short-wave working are being discussed and the recommended methods explained. In this article HOWARD BARRY deals with receivers for use on the amateur wavebands. He describes them as "special products"

Receivers for Amateur Wavebands

By G. HOWARD BARRY

BEFORE passing on to the superhet and other receivers of a more complicated nature, I think it would be advisable to cover the whole question of receivers for the amateur bands. They are, in every way, specialised products and there seems to be a good deal of misapprehension about their essential feature.

First of all, let us examine these in detail, assuming that we are thinking of building a receiver which will have, as its main object efficiency and easy handling on the amateur wavebands only, and capable of receiving both telephony and C.W. telegraphy.

Amateur Wavebands

The wavebands allotted to amateurs are in the regions of 160, 80, 40, 20, 10, and 5 metres. The last two, which come in the category of ultra-shorts, will be dealt with at some later date. We have, therefore, to cover the 160, 80, 40 and 20-metre bands. Expressed in terms of frequencies, these are as follow: 1,720-1,995 kilocycles, 3,505-3,730 kilocycles, 7,005-7,295 kilocycles, and 14,005-14,395 kilocycles.

The 14,000-kilocycle (20-metre) band is therefore the broadest of them all, and occupies slightly less than 400 kilocycles. The average short-wave receiver, using a .0001-microfarad tuning condenser, probably covers that waveband in 10-degree markings of the dial. Within these ten divisions we might have upwards of 200 amateur stations all working at once.

Band-spreading therefore becomes an essential. Personally, I like my amateur-band receiver to be adaptable for use over the rest of the short-wave spectrum. I therefore use the same band-spreading scheme which I included in the Standard Four-Valve Short-waver described in the March issue.

The main (.0001) tuning condenser is seldom used except for arriving approximately at the band to be covered, whether it be one of the short-wave broadcast bands or an amateur band. After that, all tuning is carried out on the small condenser. In practice, the 20-metre band covers nearly 80 degrees on the latter, and tuning is therefore reasonably simple.

A *real* amateur-band receiver would employ coils cut to such a size that a very small tuning condenser would cover just the necessary band and nothing else. Such a receiver is rather difficult to design, and cramps one's style somewhat if one suddenly wants to receive a transmission on, say, 30 metres.

Furthermore, the use of a large coil and a very small condenser does not make for either selectivity or stability, and it is usually necessary to use a fixed padding condenser in parallel with the tuning. Why not come back to the original scheme and make the padding condenser variable? The receiver is more flexible and efficiency has not suffered.

Point of Efficiency

The next point we have to consider is that the set must be equally efficient for the reception of telephony or C.W. This implies that the reaction control must be as nearly perfect as we can make it. But the most important implication is that the set *must* be reasonably quiet, even in the oscillating condition.

A big short-wave broadcast re-

ceiver will give marvellous results on a 20-kilowatt telephony station, but it doesn't follow that it will be the slightest use to us on a 7½-watt amateur signal from the Fiji Islands. The background-level will probably be far greater than the noise made by the few micro-micro-watts that reach us from Fiji !

Only Efficient Sets

In practice, it turns out that the only really efficient receivers for amateur-band DX work are small straightforward designs or specially-designed superhets with such refinements as crystal-gates or quartz-filters.

Fig. 1 shows the circuit I use myself, complete in every detail. Note the band-spread arrangement, the selectivity-control in the aerial circuit (which does *not* noticeably upset the tuning, because the aerial circuit is already very loosely coupled) and the volume control across the 'phones. (A 50,000-ohm resistance in parallel with the headphones is quite the most effective volume control that I have struck, particularly for C.W. reception.)

No Buffer Stage

I do not use a screen-grid buffer stage for this type of work, although I am a firm believer in its merits for short-wave broadcast reception. Loose coupling of the aerial is almost as beneficial as the use of a buffer, and does much to abolish the risk of hand-capacity troubles.

The whole set is in an *iron* box, and both the tuning condensers are equipped with really good slow-motion dials and mounted on the front panel. The reaction control is on the left-hand side and the volume control on the right. The selectivity control, not very often used, is at the back, just above the aerial terminal.

Now we have another problem to consider. A receiver working in the most efficient state for C.W. reception must be just on the oscillation point. This, unfortunately, is just about the most unstable condition in which any receiver can be, and sudden arrival of a very strong local signal, or even of an atmospheric, tends to produce an objectionable "spill-over" effect.

Some folks find that this can be improved considerably by the use of a separate reactor circuit. In other words, your detector is not made to detect the incoming signal *and* provide reaction. Another valve is used, its grid being in parallel with the detector grid; but whereas the anode of the detector passes straight to high-tension, via either the 'phones or the low-frequency coupling unit, the anode of the second valve has the reaction coil wired in series with it.

An uncannily silent background can be obtained with this circuit when it is carefully adjusted. The only reason why I am not using it in my own receiver is that I have succeeded, after some years, in taming the latter to such an extent that it is just as quiet as the separate reactor circuit.

Another Method

Yet another method is to use a reacting detector just *below* the oscillation point, supplying the necessary beat-note for C.W. reception by means of a separate valve.

A heterodyne wavemeter may be made to combine this function with its normal duty, but this, of course, increases the number of controls that one has to operate—and one of the chief requirements of amateur-band work is quick searching.

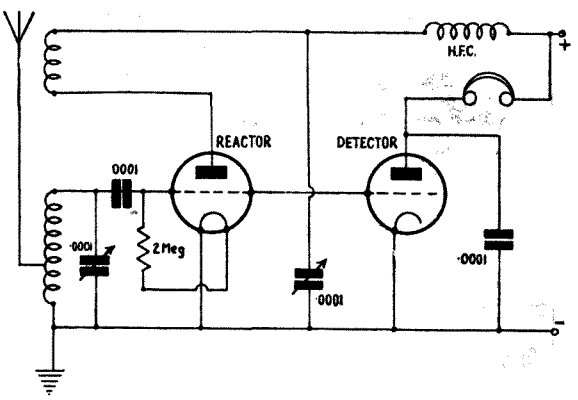


Fig. 2.—A twin detector valve arrangement which some enthusiasts believe to give a particularly quiet background

The well-known screen-grid detector circuit in which reaction is applied in series with the screen, instead of the anode, is also interesting, and certainly makes for quiet operation. It is, however, a little tricky when one gets below 20 metres, and it does not seem to work particularly well with high-frequency pentodes.

Single-valve Receiver

Excellent results may be obtained with a detector only, particularly if one of the very efficient indirectly-heated valves is used for the job. For some years I kept a single-valve short-wave receiver of this type, and it certainly received everything that could be identified on a larger receiver.

One resistance-coupled stage of low-frequency, however, with a good volume control, is a great convenience, and it is satisfying to have a little amplification in reserve. One sometimes wants it on one of those beautiful quiet nights when *really* weak signals can be heard.

Next month I intend to start talking about superhet design.

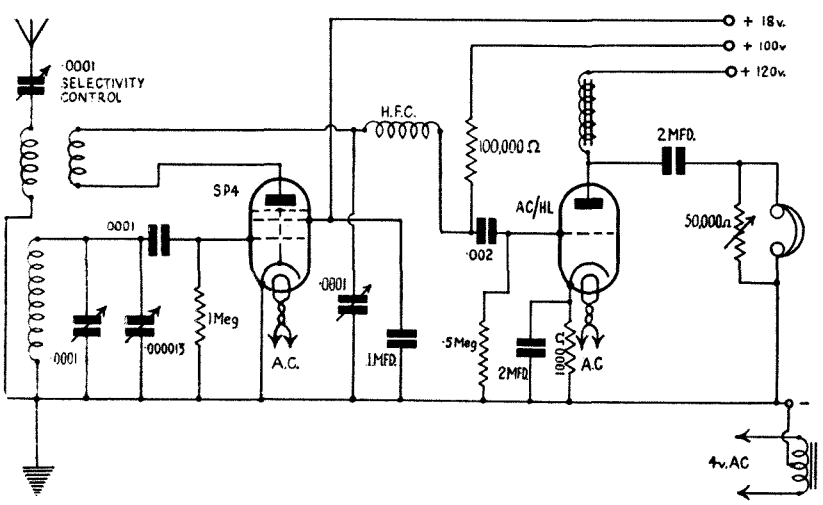


Fig. 1.—The circuit used by Howard Barry for reception on the amateur wavebands. Notice that band-spread tuning is incorporated. This form of tuning was included in the specification in the Standard Four-valve Short-waver described in the March, issue of "Wireless Magazine"

Mr. Wilson, like most true experimenters, draws upon his stock of parts when making up new apparatus. It so happens that some of the components used in this amplifier are no longer on the market; where this is so we have specified suitable modern alternatives, all approved by Mr. Wilson. Readers can therefore build up the amplifier with modern parts if they so wish without any hesitation.

Designed by
P. WILSON
M.A.

The amplifier built by P. Wilson is arranged in three distinct parts in one metal box. The power pack is constructed as a separate unit

An Enthusiast's Power Amplifier

PLENTY OF POWER — GOOD QUALITY

IN an article on automatic bias last September I gave some particulars of a low-frequency amplifier which I had then had in operation for over three years. This description apparently excited a good deal of interest and requests for further information continue to arrive.

The Editor has therefore asked me to describe in some detail, my present version, which differs slightly from the original.

Stock Components

Although I actually have two complete examples of this amplifier working at present, I am at some disadvantage in my description, in so far as neither of them was originally constructed with a view to publication in this way. In both cases I used components I had had on hand for some time and, moreover, the general layouts were determined by the particular purposes I had in view.

The fact, however, that notwithstanding differences in components and in layout between the two examples, they give almost identical performances, and are both completely stable and free from hum. This indicates that the design is one which constructors should be able to follow without difficulty and with every expectation of complete satisfaction, even though in some cases they use different components from those I have used myself.

In case anyone should wish to modify or to adopt a different layout, it would be well perhaps if I were to indicate what I find to be the two or three major principles of design of a low-frequency amplifier. They are these :—

(1) Keep all grid leads as short and direct as possible. If, for example, as in the case of a pick-up connection with volume control on a separate motor-board, it is necessary to use a long grid lead, screen it, and any components at a distance from the valve as thoroughly as possible and earth the screen.

(2) Never let the amplifier turn back on itself. Before finally deciding on the layout, play a game of chess with the components on the baseboard for an hour or two to determine in which way the shortest routes can be obtained with continuous progression from component to component.

"Intense Dislike"

(3) Never overlook the fact that inter-valve and output transformers dislike mains transformers and mains smoothing chokes intensely. The best screen between them is distance, but in any case try to vary the direction of the magnetic fields and interpose smoothing and decoupling condensers with their cases earthed.

(4) In a three-stage amplifier it is often an advantage to keep the value

of the decoupling condenser in the intermediate stage lower than that in the first stage. If there is any hum passed on by the first stage it will then tend to be cancelled out by hum of opposite phase in the second stage.

For Demonstration

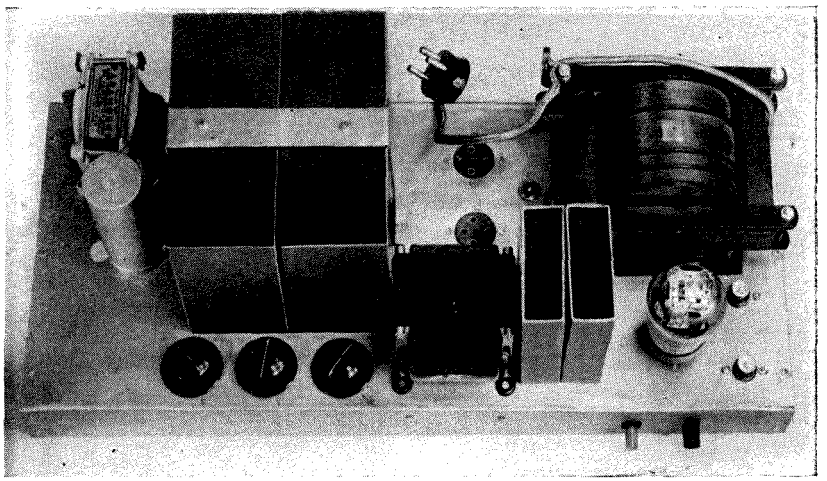
The description which follows relates to the amplifier I use for demonstration purposes outside my own home. The amplifier proper was made up in an aluminium box I happened to have by me, and the mains unit is in chassis form as to be interchangeable with the chassis in my home receiver.

Connection between the two is made by a 5-pin plug and a 4-pin plug, old valve bases being used for the purpose. The two chassis are also directly connected and earthed. The mains unit chassis, by the way, is made of tinned iron.

In this version, which I use for gramophone records only, the volume control is mounted on the playing desk for convenience. I use two playing desks at different times. One has a single turntable and a single volume control; the other has two turntables and a mixing control of the type shown in Fig. 4.

No volume control is therefore shown in the amplifier box. The knob seen in the middle of the panel is the frequency response control of the high-note booster which I usually set once and for all to suit the acoustic properties of the room in which the demonstration is being given.

The other two components mounted on the panel are the input and output jacks. I used this form of connection for convenience in quick assembly: there is usually



Showing the upper side of the power-supply unit. The three knobs along the front are the controls for the grid-bias voltages

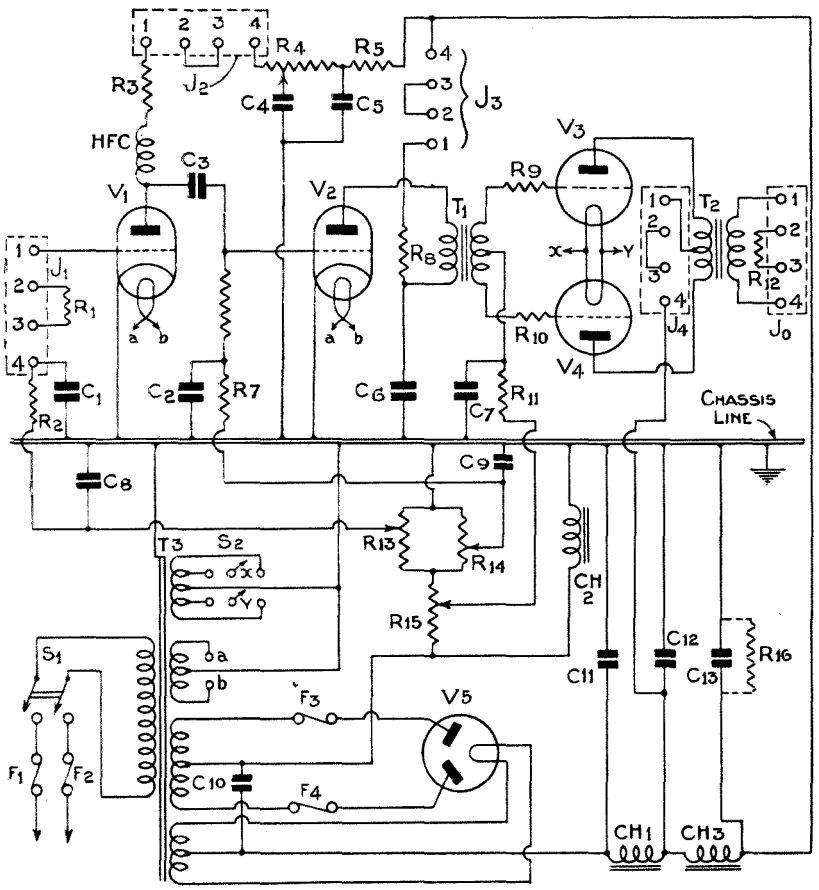


Fig. 1. Theoretical circuit of P. Wilson's power amplifier. In brief, it consists of one stage resistance-capacity coupled to a second stage which is in turn transformer-coupled to two valves in push-pull. A valve rectifier is used for supplying high tension

not much time to spare before a demonstration begins. But this meant that I had to put resistances across the jacks in case the plugs should be accidentally withdrawn while the amplifier was switched on.

The resistance across the input jack may be of any convenient value; its purpose is to safeguard the bias on the first valve and if more than a few thousand ohms are used the amplifier is dead silent.

Resistance Across Output Jack

The resistance across the output jack should be equal to the impedance of the loudspeaker circuit so as to maintain the proper load on the output stage and it should be of a rating sufficient to carry the full A.C. output normally taken by the loudspeaker, that is 10-15 watts in this case.

Naturally the value will vary according to the loudspeaker and output transformer used. Thus, suppose two PP 5/400 valves are used in the output stage and the output transformer in the amplifier has a step-down ratio to match a 15-ohm loud-speaker—the optimum load for the two valves in push pull is 2 × 2,700 ohms, or 5,400 ohms.

The transformer ratio required is obtained by taking the square

root of 5,400/15 or 360, and this works out to nearly 19. A 20 : 1 ratio will therefore be satisfactory and the resistance to be connected across the jack will be 15 ohms.

Resistance Value

On the other hand, if a 1 : 1 output transformer or choke-condenser filter is used with the two PP 5/400 valves a resistance value

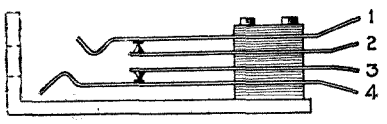


Fig. 2.—Diagram of a double-circuit jack, showing key to numbering in Fig. 1

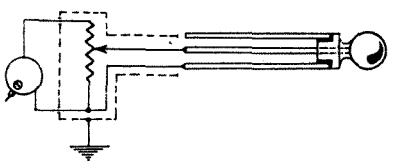


Fig. 3.—The leads from the pick-up and the volume control on the motor board should be effectively screened

of 5,400 ohms is strictly required; 5,000 ohms will, of course, be satisfactory. This is the arrangement I use, my pet loudspeaker being a home-made one with high-resistance speech coil shunted by a piezo-electric tweeter.

I have already commented on some of the features of the amplifier in the previous article, but it will no doubt be convenient if I repeat the more important remarks and add some further details.

A discussion of the mains unit circuits I shall have to reserve for next month, so for the present we must pass straight on to the amplifying circuits.

Across the loud-speaker field, CH_2 is the potentiometer arrangement to provide bias for the valves. Originally I had V_1 and V_2 both supplied with the same bias voltage from one potentiometer. It added to the flexibility of the unit, however, to have separate biasing potentiometers and this is accordingly shown.

One day I may change over to separate bias for each of the output valves also, but so far I have not done so. The arrangement would be quite simple as indicated in Fig. 5. It can only be used, of course, when the intervalve transformer T_1 has separate secondaries, but such transformers are now available (for example, Varley DP6, as specified).

This arrangement would have the advantage of enabling the bias on each of the output valves to be adjusted separately so as to secure a better matching in the operating conditions of the valves. For this purpose the bias would be adjusted so that each valve showed the same anode current.

It should be noted, too, that by this arrangement the separate biasing of the output valves is secured without the necessity for independent filament windings on the mains transformer as is required with the usual biasing methods.

If this arrangement were used it would be necessary to provide one more connecting link between the two chassis. In place of the 5-pin valve holder and plug, therefore, 7 pins would be used; and the extra pin would come in handy to connect the two chassis together so that only one of them need be earthed.

Insignificant but Essential

Returning now to the main circuit diagram, the condensers C_8 and C_9 should be noticed. They are insignificant looking things, but they are absolutely essential. I suspect that it is because they have hitherto been omitted that this method of biasing has not been more extensively used, without them a parasitic hum may be encountered which is most objectionable.

The function of the resistance R_{16} is simply to make sure of discharging all the condensers when the amplifier is switched off. If C_{13} is an electrolytic condenser its leakage current will serve the same purpose, so that R_{16} is not absolutely essential.

Amplifier Circuit

Coming to the amplifier proper, the first point to notice is that so far as high-tension current is concerned the cathodes of the valves and the heaters are all at earth potential.

This is an advantage not only so far as the life of the valves is con-

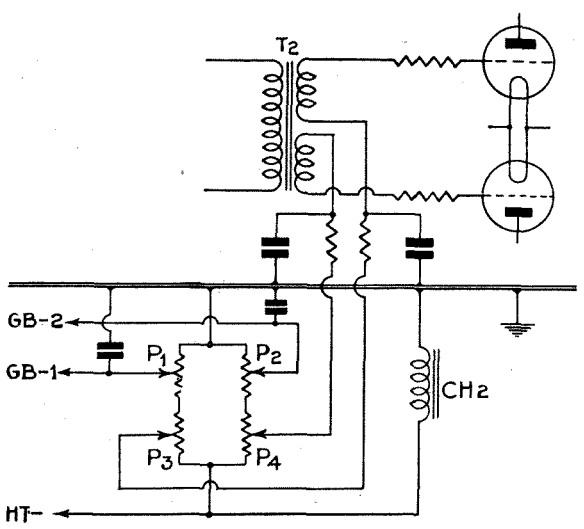
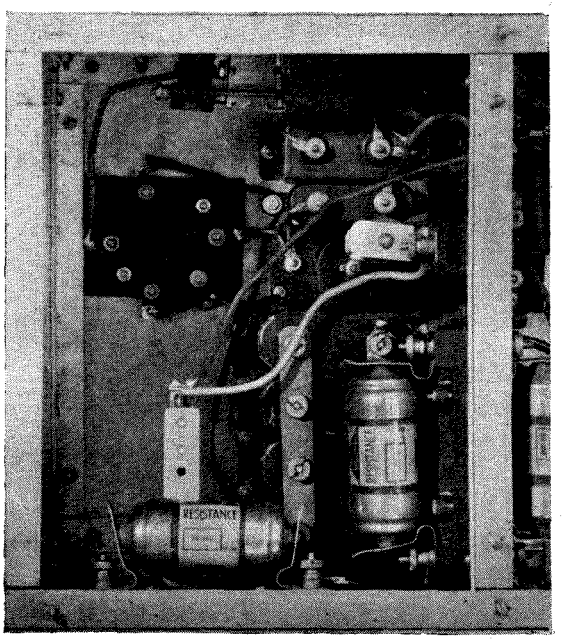


Fig. 5.—Circuit showing alternative biasing arrangements with independent control of bias for each of the output valves. The bias potentiometer values can be P1, P2 ; 50,000 ohms : P3, P4 ; 250,000 ohms. This circuit is only possible if the inter-valve transformer T2 has two (independent) secondaries



A close-up view of the first compartment in the metal cabinet, showing the layout of the components used in the first amplifying stage

cerned, but also because it tends to avoid another source of hum—cathode hum.

The grids, too, are effectively decoupled by the resistance capacity filters R_2, C_1; R_7, C_2; and R_{11}, C_7.

Double-circuit Jacks

Double-circuit jacks are connected in each of the high-tension leads to the valves so that a milliammeter can be plugged in whenever desired either to adjust bias or to judge the condition of the valve. Only one jack is shown for the output stage, but if the alternative arrangement for separate biasing discussed above is used it would be well to

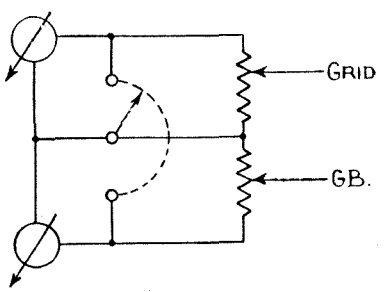


Fig. 4.—Mixing control for two pick-ups with three-position switch to ensure complete silence from either pick-up when desired

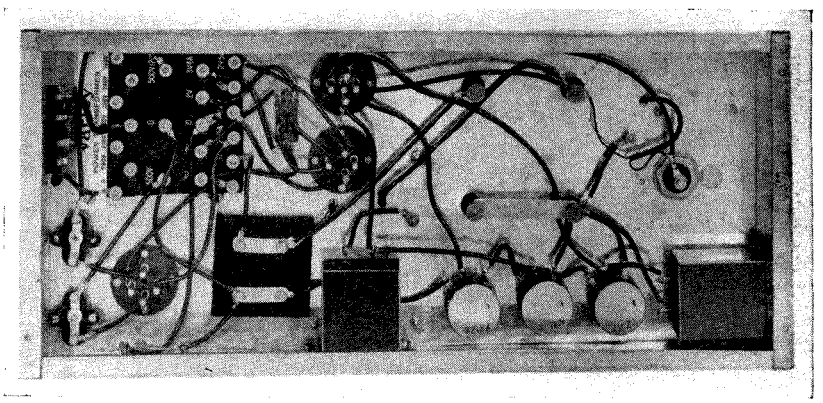
have two jacks, one in each lead from T_2 to the valve anodes, as shown in Fig. 6.

This type of jack is specified because the frame of the jack will not be live with high-tension when the plug is withdrawn. It may, however, be alive when the plug is inserted, so that the frame of the jack should be completely insulated by suitable washers from the metal box.

The high-frequency choke HFC acts in conjunction with the potentiometer R_4 as a high-note control, and the connection of the slider of R_4 to the condenser C_4 has been so arranged that the adjustment does not affect the high-tension voltage on the valve V_1.

As the slider is moved, so part of the resistance R_4 is transferred from the anode circuit of the valve to the decoupling circuit or vice versa.

It should be noted that this high-note control acts as a high-note booster and not as a high-note attenuator as is the case with the usual form of tone control. And the high-note increase is obtained without any resonant frequency in the audible scale.

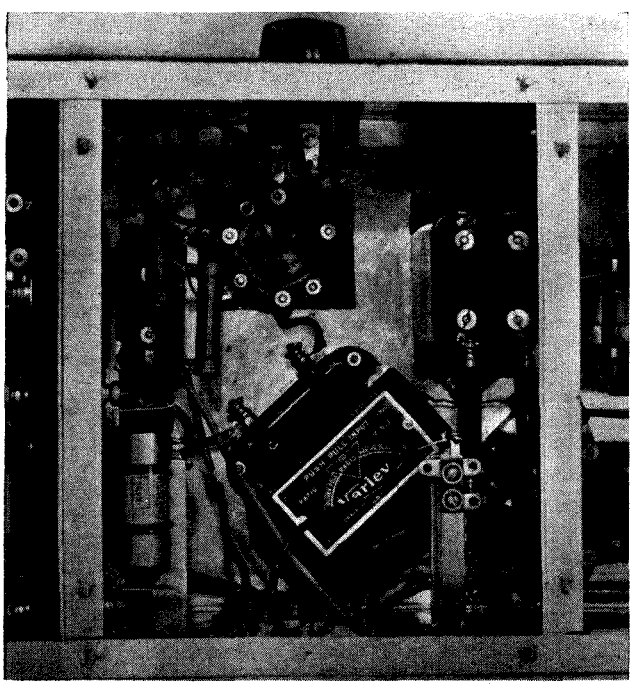


A view of the components underneath the mains-unit chassis. Note particularly the handy method of wiring from the distribution panel of the mains transformer

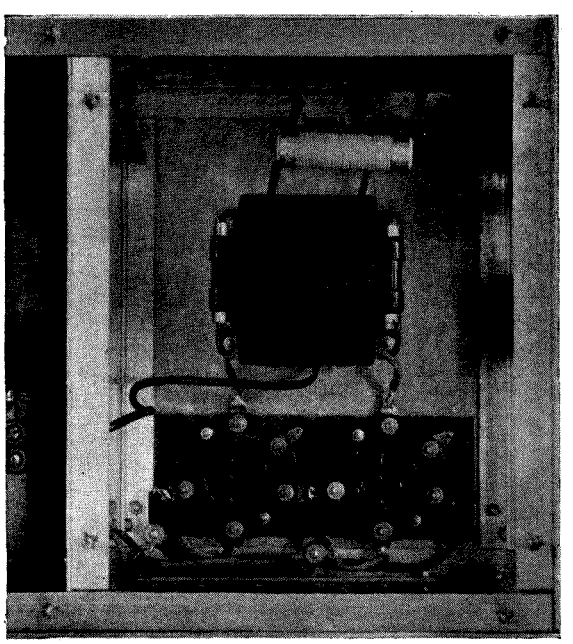
Rare Specimens

I try to avoid resonances of this kind wherever possible; my ear does not like them. If I could get hold of inter-valve and output transformers in which the high-note peaks are well above 10,000 cycles, I should use them. But such transformers are not obtainable as standard products in this country, though I understand that they are now being produced in the United States.

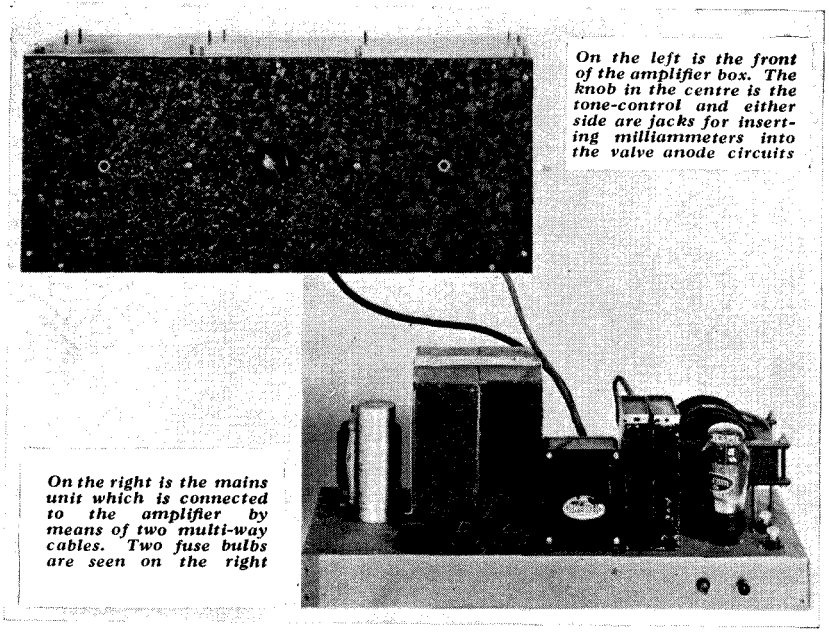
However, the transformers I



The centre compartment in the metal cabinet showing the components for the second amplifying stage. The input push-pull transformer is included in this section



The third section is the simplest of them all, the only components being two valve holders, the output transformer, a resistance, and a jack



On the left is the front of the amplifier box. The knob in the centre is the tone-control and either side are jacks for inserting milliammeters into the valve anode circuits

On the right is the mains unit which is connected to the amplifier by means of two multi-way cables. Two fuse bulbs are seen on the right

specify are not unsatisfactory in this respect and I have not yet been persuaded that it is worth while in a sound-amplifier to endure all the complications and troubles (and they are by no means negligible) of resistance-capacity push-pull circuits in order to avoid the use of an inter-valve transformer. But that is another story. . . .

Balancing Circuits

If it is desired to have the possibility of high-note attenuation as well as that of high-note boost, two arrangements will be found convenient. I use the balancing circuit for my crystal loud-speaker for this purpose as described last month.

The other method is to connect a Rothermel Octave tone control directly across the secondary of the transformer T_2 (or, in the case of the alternative circuit, between the grid terminals of the two secondaries).

This control is in the form of a tapped condenser, the maximum capacity being .006 microfarad and the minimum so small as to be negligible in this circuit.

As usual, the grid resistances R_9 and R_{10} are to prevent parasitic oscillation in the output stage. I have found them adequate for this purpose, but if anyone should have any trouble in this respect they should, in addition, insert small resistances, say of 100 ohms, between the valve anodes and the transformer T_2, and as close as possible to the anodes, rather than increase the values of the grid resistances.

We will leave the amplifier at this stage for now. Next month we shall have something to say about the mains unit and about the operation.

Wiring Diagrams will Appear NEXT MONTH

It will take you quite a time to get your parts together, layout satisfactorily arranged, and the spade work done. Next month, actual wiring diagrams will be given. I have, however, given full circuit diagrams, which will enable you to study the methods I have adopted.

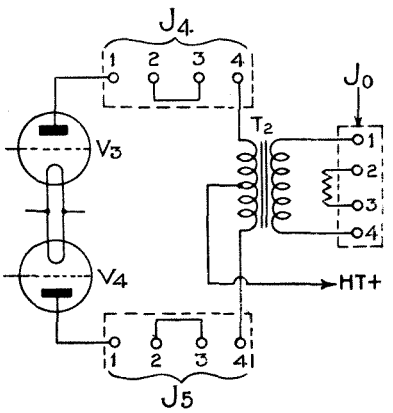


Fig. 6.—Alternative circuit for output stage showing double-circuit jack in each anode lead for the purpose of checking the anode current of each valve, adjusting bias, etc.

LIST OF COMPONENTS FOR THE P. WILSON AMPLIFIER

CABINET AND CHASSIS
1—Peto-Scott screening box with three compartments, to specification. (Aluminium.)
1—Peto-Scott chassis for power unit to specification.

CHOKES, LOW-FREQUENCY
1—Ferranti B5.
1—Ferranti B1.

CHOKE, HIGH-FREQUENCY
1—Bulgin "Standard" Model or other type of 250,000-microhenries.

CONDENSERS, FIXED
6—2-microfarad.
3—4-microfarad.
2—6-microfarad.
1—8-microfarad.
1—.1-microfarad.
(*Note.*—The original amplifier contains a mixture of Dubilier and T.C.C. Any standard types can be used, subject to the obvious limitations of working voltages, which can be ascertained from the circuit diagram.)

CONNECTING DEVICES
1—4-way battery cable.
1—5-way ditto.
2—Bulgin P.9 4-pin cable plugs.
2—Bulgin P.3 5-pin cable plugs.

FUSES
2—Bulgin type F5.

JACKS
5—Peto-Scott double-circuit jacks.

LOUDSPEAKER
1—Field-excited type, resistance 1,000-ohm.

MAINS TRANSFORMER
1—Special Varley model.
(*Note.*—The transformer in the original amplifier was a Varley EP24 which is no longer listed, but another model is available giving the correct outputs.)

RESISTANCES, FIXED
2—1,000-ohm.
2—5,000-ohm.
1—40,000-ohm.
2—50,000-ohm.
2—100,000-ohm.
1—250,000-ohm.
1—500,000-ohm.
(*Note.*—The resistances in the original amplifier were of Ferranti, Varley and Graham-Farish make. Any standard types can be used, subject to the obvious requirements of current-carrying capacity. Reference to the circuit diagram will provide this information where necessary.)
1—resistance equal to T2 secondary impedance. (See text.) 10-watt size.

RESISTANCES, VARIABLE
2—50,000-ohm Rothermel-Centralab potentiometers.
1—100,000-ohm Rothermel-Centralab potentiometer.
1—10,000-ohm Rothermel-Centralab potentiometer.

SWITCH
1—Bulgin type S98 (double-pole change-over).

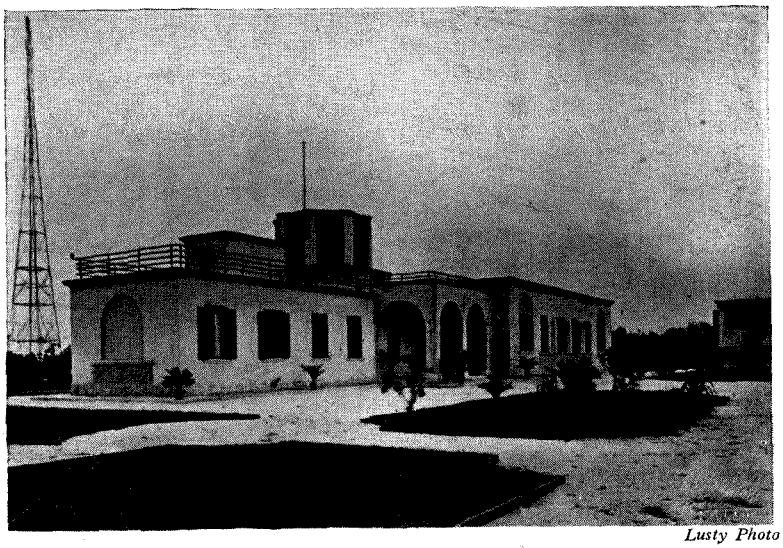
VALVES
2—Marconi or Osram MHL4 or Mullard 164V
2—Mazda PP5/400, Mullard DO26 or Marconi or Osram PX25 or 25A (LS6A can also be used if available. Suitable arrangements must be made about filament supply.)
1—Mazda UU120/500, or Marconi or Osram MU14.

VALVE HOLDERS
4—Baseboard mounting valve holders for amplifier.
1—4-pin chassis-mounting for amplifier (inter-connection device with power unit).
1—5-pin ditto. (Same purpose as above.)
1—4-pin chassis-mounting valve holder for power unit. (Rectifier.)
1—Ditto (inter-connection device with amplifier).
1—5-pin ditto. (Same purpose.)

TRANSFORMERS, LOW-FREQUENCY
1—Varley DP6 inter-valve push-pull.
1—Ferranti push-pull output transformer to suit loudspeaker.

Radio News from Abroad

By JAY COOTE



Lusty Photo

Bari, an Italian 20-kilowatt station, which is well heard in this country, is housed in a delightfully modern building of rather unusual style. A vivid contrast to our own B.B.C. station buildings!

FRANCE

UNDOUBTEDLY, optimism is rife in the French provinces. The Rennes-Thourie high-power transmitter, although well under way, is not expected to be ready for another eighteen months, yet a café situated in a neighbouring village already bears the sign: *A l'Hôtel de la T.S.F.*, which must be the French counterpart of The Listeners' In(n)!

◆ ◆ ◆

GERMANY

Now that Germany has resumed possession of the Saar, the *Reichsfunk* has decided to build a relay station at Saarbruecken to operate on a channel common to either Stuttgart or Frankfurt-am-Main. In the meantime, a provisional studio has been opened to permit the employment of local talent.

◆ ◆ ◆

GREAT BRITAIN

For weather reports and forecasts, we are not always compelled to listen to the B.B.C. broadcasts. If, during the day at other times these are required, we may turn to Heston Airport on 1,202 *metres* (249.5 *kilocycles*) *through which Air Ministry bulletins are given out primarily for the benefit of aircraft.*

The times of transmission are: G.M.T. 08.45; 09.30, then hourly *to* 12.30 (*inclusive*) *and again at* 14.30; 15.30 *and* 16.30. *The information covers most districts of the British Isles.*

◆ ◆ ◆

HOLLAND

Although the Dutch already possess a 50-kilowatt station at Kootwijk, they have never been satisfied with the power of the Huizen station. Tests are now being carried out with a new plant (120 kilowatts) which may adopt one or other of the channels used, namely, 1,875 metres or 301.5 metres.

On the higher channel it would prove a severe competitor of the Brasov-Bod (Roumania) station which may have been brought into operation by the time these lines are in print.

◆ ◆ ◆

ICELAND

The 16-kilowatt station at present broadcasting the Reykjavik programmes is to make place this summer for a 100-kilowatt transmitter now being built at Marconi's Chelmsford works. It will work on the long-wave channel now in use.

It is also stated that a 7-kilowatt short-wave station is to be installed at Reykjavik for a public telephony service with Copenhagen, *via* Lyngby. It will also act as the relay of Icelandic radio entertainments.

◆ ◆ ◆

IRAN

The Iranian (late Persian) government has voted a large sum of money for the establishment of a broadcast network. As a start, it is reported that stations will be installed at Teheran, Tchask, and also at some other important centre—possibly Schiraz. The organisation to be established will be closely modelled on that adopted by Turkey.

◆ ◆ ◆

JAPAN

As an antidote to the propaganda which is being broadcast by Siberian stations of the U.S.S.R. the Japanese Government is planning to equip Tokio with a 150-kilowatt transmitter. Its programmes could be relayed by the new Hsinking station in the Kingdom of Manchuquo.

◆ ◆ ◆

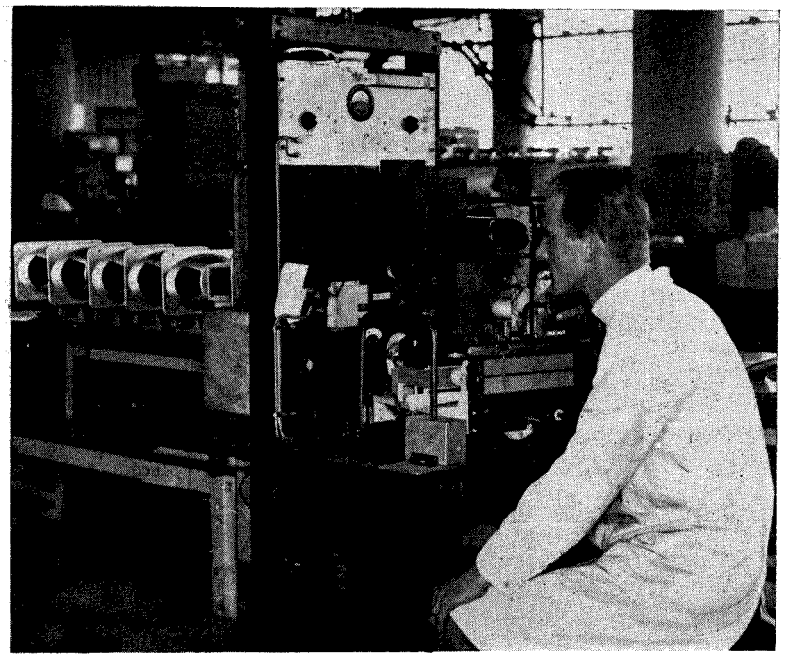
POLAND

The area covered by the new 20-kilowatt Torun station is such that the Polish authorities have decided to reorganise a portion of their network. The Katowice and Cracow transmitters may possibly be closed down and the two replaced by a high-power transmitter installed on a site between these cities.

◆ ◆ ◆

ROUMANIA

In addition to the Bucarest 12-kilowatt station, Roumania will shortly bring into operation the new 150-kilowatter at Brasov. The temporary station now working there on 1,875 metres gives out its call as *Radio Roumania*. A third transmitter, Radio Moldova (20 kilowatts) is still experimenting; its broadcasts are made on 2.126 metres (1,411 kilocycles).



Home constructors get over their little problems with fairly simple apparatus. Here is an intricate H.M.V. testing bench installed at the Hayes factories for checking the characteristics of radio components before they are fixed to the chassis

Mr. Everyman's Wireless Jobs

By R. W. HALLOWS, M.A.

THIS month I am going to make some suggestions about the wiring up of receiving sets and other pieces of apparatus that readers may build for themselves. There are many different kinds of wire to choose from and heaps of different ways of using wire for making connections.

What we want to find is both a material and a method that will enable us to do sound, neat work as quickly as possible and with a minimum of trouble.

Best Size of Wire

First of all what is the best gauge of wire to use? This must depend to some extent on the job in hand, but generally speaking what we require is wire thick enough to offer small resistance and to stay put, yet not so thick that it cannot be shaped readily, or its ends formed into neat loops.

For most ordinary wiring jobs I give my vote unreservedly for No. 20 or No. 22 gauge. Personally I prefer No. 22 to No. 20 for a good many reasons. You get many more yards of the finer wire on a half-pound reel; it has sufficient stiffness to enable leads to keep their shape; with a pair of bottle-nosed pliers you can make loops—if you like the loop - and - screw - down - terminal method of connection—in the twinkling of an eye; if on the other hand you are one of the wise who solder, No. 22 gauge is ideal for joints neatly and quickly made with a small iron.

Perhaps the best method is to have a reel of each of these gauges by you, using the thinner wire—No. 22—for all short leads and the stouter for the longer ones, which have to be shaped in certain ways and must keep their shape.

Hard or Soft Wire?

Whatever insulating covering you decide upon using the wire within should be tinned and should be of soft, electrolytic copper. Tinned wire keeps bright and clean and saves a great deal of trouble when soldered connections are made.

Soft, electrolytic wire may cost a little more than the hard variety, but the minute extra expense is very well worth while since leads made with it are so much less likely to break, no matter how much they may be bent in the process of shaping.

Insulation Question

The next point to consider is concerned with the insulating covering of the wire. There are three kinds in general use by those who build sets at home. The first has an inner covering of plain cotton and an outer winding of the same material impregnated with varnish. This is very good stuff and not the least of its advantages is that there is no trouble about taking off the ends.

All that you have to do is to peel off the outer glazed covering for the necessary distance and snip it off short with scissors. The inner plain cotton covering is then treated in the same way. As the outer covering has no tendency to unwind itself nothing more need be done.

A further advantage of this kind of wire is that it can be obtained in a large variety of colours and it is sometimes a good plan to use, say, yellow leads for low-tension positives, black leads for both high- and low-

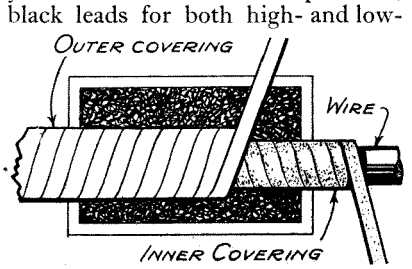


Fig. 1.—The two coverings of double-cotton-covered wire are laid in opposite directions

tension negatives, red leads for high-tension positives and so on.

Very much cheaper is the wire known as double-cotton-covered or "D.C.C.," the make-up of which is illustrated in Fig. 1. The two plain cotton coverings are laid on in opposite directions and this renders it easy to make a neat job of the ends of your leads in double quick time. Figs. 2 and 3 illustrate the quickest method that I know, and certainly one of the most effective.

Unwind the outer covering for an inch or a little more, then knot the end round the standing part of the lead as shown in Fig. 2. Next unwind the inner covering right down to your first knot, loop it over and tie knot No. 2 on top of No. 1.

Making Certain

Pull the ends tight and snip off with scissors. You can make assurance doubly sure if you like by applying a blob of shellac varnish to

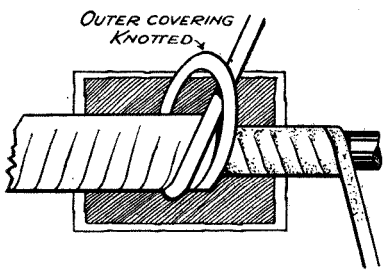


Fig. 2.—In making off the end of a lead the outer covering is first knotted (back on itself) as shown here

the knots, but even if you don't the ends of the cotton coverings will not come adrift and fray out.

Rubber-covered Wire

Another very handy kind of wire for set making is that which has an inner covering of cotton and an outer covering of rubber. This is largely used by electricians. You can buy it at most shops which deal in electrical goods.

Using Rubber-covered Wire

Good as this kind of wire is there are one or two snags for which you must be on the look out. The first is that the sulphur which rubber contains is apt to cause the tinning of the wire within to become discoloured and dirty looking.

When, therefore, you are using any kind of rubber-covered wire, it is always as well to brighten up the ends by drawing them through a folded piece of emery cloth or glasspaper, and this is particularly important if you are going to solder your joints.

Stripping the Ends

The next point to watch is that you don't injure the wire when stripping off the coverings to bare the ends. Fig. 4 shows the professional electrician's method. He takes a pair of end-nippers and just nicks the rubber covering with them. Then he gives a smart pull and off comes the insulation, leaving the end bare.

This seems a simple enough job, but it needs both practice and care, for it is so easy to nick not only the insulation, but also the wire beneath —and if you do, a breakage of the lead just at the nick is more than likely to occur in time.

A safer method, I think, is to use an old pair of rather blunt scissors. Use them gently and you will find that the danger of nicking the wire is very much reduced; in fact, provided that you go carefully, there is no risk at all. Once the nick has been made the insulation is easily drawn off with your fingers.

Straightening Wire

By far the best way of straightening any kind of copper wire is to stretch it. If you have a longish piece that is full of bends here is the way to set about straightening it. Select a biggish terminal from your junk box and clamp this into the jaws of the vice. Make a loop in one end of your wire and fix this tightly to the terminal. Wrap the other end twice round one of the jaws of a pair of pliers, grip tightly and then pull hard. You will find that the wire straightens itself instantly. Cut off the two waste ends and there is a perfectly good length for making one or more leads.

But here a word of warning. Be

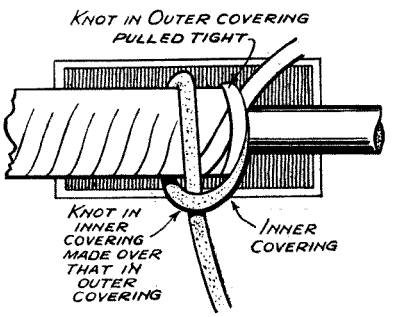


Fig. 3.—The knot in the outer covering having been pushed tight, the end of the inner covering is knotted over it

very careful to see before you pull that there are no kinks in the wire. Soft copper wire will stand a great deal of straightforward bending, but once it is kinked and subjected to any tension it will break readily. Therefore, smooth out the kinks with your fingers before you apply the stretching process.

What Tools are Needed?

For wiring-up jobs the first essential tool is an old knife (one of the table variety so long as its blade is

Some hundreds of practical ideas have been incorporated in the making of this batch of H.M.V. "Silver Jubilee" set chassis

not of stainless steel is admirable), which is just the thing for scraping the ends of wire, tags, terminal surfaces and so on. Next comes the old pair of scissors referred to in a previous paragraph.

These should be 5 or 6 in. in length over all, and besides being of service in nicking rubber insulation, they can also be used for the actual cutting of thinnish wire. Last, but not by any means least important, come pliers.

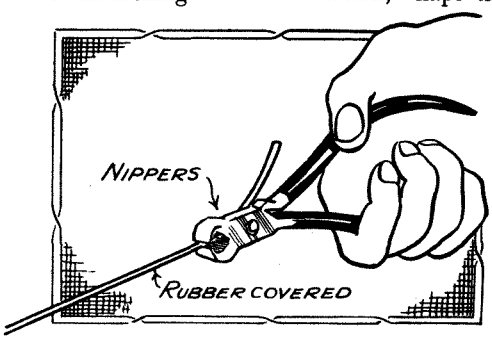


Fig. 4.—The professional electrician nicks the rubber covering with end-nippers, gives a smart pull, and off comes the covering, leaving the bare end of the wire

I detest nearly all tools designed to do a large variety of jobs. Many of them, like the proverbial jack-of-all-trades, do everything by turns, but nothing particularly well. For this reason I don't recommend the combination pliers containing all kinds of gadgets.

You can purchase pliers whose noses are partly round and partly flat, and which contain also both side cutters and those horrible little cutters composed of notches. If you insist upon buying this kind of plier the best pattern is that known as milliners'—but you must buy good quality milliners' pliers if they are to be of any real use.

Three Pairs of Pliers

You will, though, find it much better in the long run to provide yourself with three separate pairs of pliers, each intended to do one special kind of work and to do it well. A pair of end-nippers comes first. You see them illustrated in Fig. 4, but the job that you will put them to is that of cutting wire and not of nicking rubber insulation. No other tool enables you to snip wire so neatly and cleanly as this.

Next, flat-nosed pliers. These, like end-nippers, and the bottle-nosed pliers I am going to speak about in a moment, can conveniently be from 4 to 4½ in. long overall. Flat-nosed pliers cannot be beaten for bending wire, and they are very useful for straightening leads when you cannot apply the stretching method.

Bottle-nosed pliers are unequalled for making loops in the bared ends of wire. Despite the advantages of soldering, many constructors—perhaps the majority—will continue to make their connections by looping the ends of their leads and screwing them down under the nuts of terminals. You cannot make a neat loop, fitting closely round the threaded part of a terminal, without bottle-nosed pliers.

Screw-down Terminals

There is a right way and a wrong way of connecting leads to screw-down terminals. Look at Fig. 6: A is the right way of fixing the looped end of a lead to a terminal; B is the wrong way. Without reading further can you see why?

When you tighten the milled (or better still hexagon) nut which forms the top of the terminal you turn it down in a clockwise direction. If the loop in the lead is formed as seen at A it is pulled in and made tighter as the terminal top is screwed down, for the loop is formed clockwise. But when you have a counter-clockwise loop as shown in Fig. 6 B the screwing down of the terminal nut tends to make it open and spread.

This may seem a small point, but it is one of real importance with screwdown connections, particularly if several leads are taken to the same terminal.

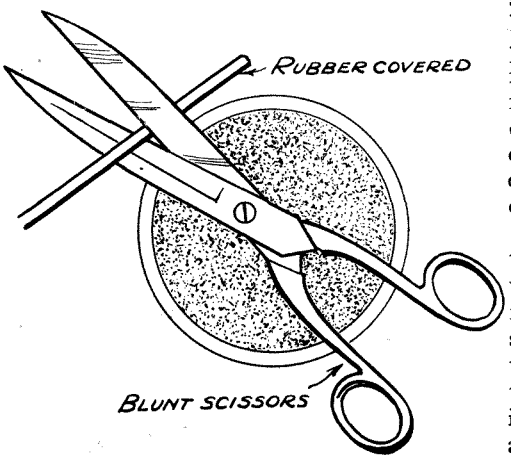


Fig. 5.—The author thinks it is safer to nick the rubber covering off the end of a length of wire with an old blunt pair of scissors

If you solder the ends of your leads to tags it is always as well to use the kind of tag having a small hole pierced near its tip. Pass your wire through this and with the flat-nosed pliers bend the end round and pinch it up tight. You then have a joint which is doubly secure and once you have applied a blob of solder nothing is going to shake it loose.

If the components you are using are not provided with pierced tags, you can obtain such tags from most wireless shops for a few pence a gross. Believe me, those pence are very well spent; a gross of tags lasts a very long time.

Planning the Wiring

In many sets designed nowadays for the home-constructor the sequence of the connections is sometimes given. Follow this, beginning with No. 1, and putting each lead in position in proper order and you will find no difficulties. The designer of the set has carefully worked out the order so that each connection can be made easily.

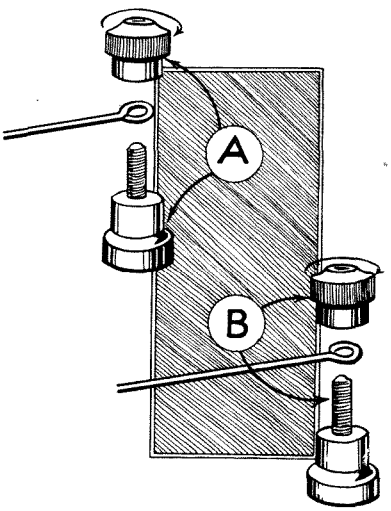


Fig. 6.—There's a right and a wrong way of connecting a lead to a terminal. A is right and B is wrong. You see why!

But often no such instructions are given: you have to work from a blueprint showing what may at first sight seem to be a rather bewildering mass of leads. In that case spend a little time in studying both the wiring and the layout diagrams, then decide the proper order of wiring yourself.

WIRELESS FOR THE BUSY MAN—No. 3.

How the Valve Works

By PERCY W. HARRIS, M.I.R.E.

In the past it has been assumed, quite erroneously, that radio listeners are divided into two classes—those who build their own sets and are interested in technicalities, and those who buy sets ready made and have little interest in how they work. "W.M." believes that of the hundreds of thousands who buy sets, many are anxious to learn the principles of wireless without delving too deeply into technical matters. This is the third of a special series of articles designed to remedy the omission. Last month selectivity and tuning were explained, and here we learn what happens to the signal after it leaves the aerial and tuning circuit

Gulliland photo

At Tungsram's big valve factory in Budapest a number of the workers still wear the picturesque working garb of the Hungarian peasant. Our photo shows valves in the process of being capped

ONE of the first questions that may be asked when considering what happens to the wireless signal after it reaches the aerial is this: "Why have we so much elaboration, and why cannot the loud-speaker be connected straight to the tuner? We saw last month how the tuning apparatus with its coil and variable condenser picks out the signal we want; why not cut out all this valve business and join up the loud-speaker direct?"

Two Distinct Reasons

There are two reasons, and each calls for separate consideration. The first is that even when we are quite close to a powerful station the electric currents set up in our tuner are far too weak to give us room strength when feeding direct into a loud-speaker and, secondly, the currents are the wrong kind to operate a loud-speaker even if they are magnified.

This second reason will call for a separate article, so this month we will concentrate on the first reason, which incidentally is the more interesting!

To compress anything like a satisfactory explanation of valve magnification into one article will call for a certain economy.

First of all, let us see what we have to do, for a clear understanding of a problem takes us at least halfway to a solution. We have in our tuning circuit minute electric currents rushing in and out—or oscillating, as we call it—of our condenser at a very high rate of speed, which incidentally is constant for a given dial setting.

Let us imagine we have a circuit tuned to 300 metres. The frequency of this wavelength corresponds with a rushing in and out of a million times per second. While the speed of oscillation is constant the intensity is not, for the "overall" strength rises and falls according to the variations of speech and music—this variation is termed "modulation."

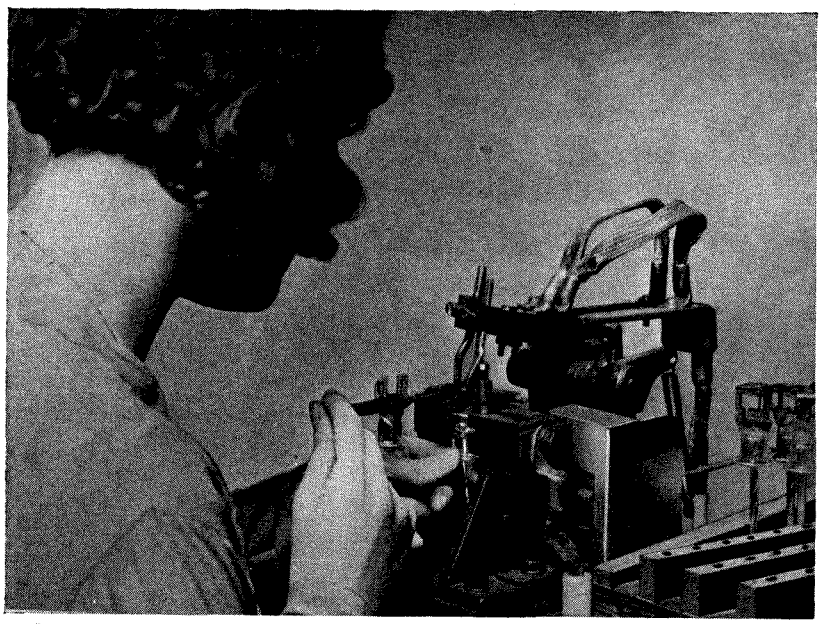
What we want to do is to produce in another circuit a faithful copy of these currents with exactly the same frequency and the same variations of strength. No mechanical form of relay could possibly operate at such a frequency, so we have recourse to the modern electrical maid-of-all-work, the electron stream.

The modern wireless valve (wretched name, valve, for it misleads the beginner, but let that pass !) is a convenient and relatively inexpensive electron relay without mechanically moving parts and with it, if we join it up in a proper fashion, we can do wonderful things. Just how, we shall see a little later, but meanwhile let us examine one in detail.

Inside a Valve

If it is a battery valve it will be found to consist of a glass bulb, the interior of which can seldom be seen for generally there is either a metal coating over the glass or else a kind of silvery or darkened inner surface that makes it almost opaque.

The base of the valve has a black cap with four pins sticking out of it. Turn the valve upside down and you will find these pins are irregularly spaced, according to a definite pattern, which prevents these four pins being inserted in the wrong four sockets when pressed into the valve holder. The pins are



Both accurate and intricate machinery is used in the manufacture of radio valves; in fact accuracy is the most important factor of successful valve manufacture. Here you see a girl in the Mullard factory mounting grids and anodes by electric spot welding

merely to make electrical contact with the various parts of the circuit and to enable valves to be interchanged with ease.

Let us now remove—a rather ticklish job—the outer glass bulb and examine the inside. It appears, at first, rather a complicated mass of metal supports with a box-like container, some fine wire in the form of flattened coils, and a thin zigzagged wire held taut by a kind of spring arrangement on a support.

Rigid Fixing

The various parts are held as rigid as possible, and there seems little to account for the valve's marvellous functioning. It is not, however, quite so difficult to understand if we tackle it properly. Let us start with that zig-zagged wire called the filament, just because it *is* in this particular case, a filament. The filament is about the only part of a valve having a sensible name, as we shall see later.

Heating the Filament

Now when the valve is plugged into its socket in a battery set, the two pins which are connected to the two ends of this filament are joined to a 2-volt accumulator and the current flowing through the wire will heat the filament. In early valves the filament was heated so brightly that one could almost read by the light given off, but modern valves have low temperature filaments which glow at only a dull red.

The filament is actually a special form of wire coated with certain mineral substances the exact composition of which we need not worry about. When all of this internal structure of the valve is encased in a glass bulb and all the air removed, this heated wire—or rather the surface of it—emits a kind of spray of minute particles of electricity called "electrons." They, so to speak, boil out to the surface but do not go very far and fall back into it again. If you could see this effect it might appear something like the surface of a freshly-drawn glass of soda water with the electrons as the effervescence.

Now look at that box kind of arrangement open at the ends, made of shiny metal, which encases the filament. Don't worry about that network of fine wire between the box and the filament for we have not yet to consider it. Look at the metal box (which is called the plate, although it is not a bit like one) and you will see that it has its own separate lead through the base—actually it is joined to the pin farthest away from the other three. It is electrically insulated, as we say, from the filament.

If, when the valve is sealed up in its glass bulb, we take a high-tension battery (that rectangular box marked 120-volts which you have occasionally to buy from your wireless dealer) in such a way that the negative (the end marked —) is connected to one of the filament pins and the positive (marked +120) is connected to the box-like affair or plate, then a most astonishing thing will happen.

Although there is no visible connection between the plate and the filament, and although it is carefully insulated from it, it will be found (if we insert a suitable measuring instrument) that an electric current is flowing from the battery to the plate, across the evacuated space to the filament, and back to the battery.

Current flows from . . . .

Here I must pause a moment and refer to the peculiarity of wireless circuits which are confusing to the beginner who remembers his school-day electrical knowledge. At school we were all told that current flows from the positive of a battery through the circuit to the negative. According to modern theories, electric current is a flow of electrons going from negative to positive.

If you say that the electrons flow in one direction and the current flows in the other, you will get confused, although the electron flow *is* the current. The first, or school, method of expressing the flow of current was merely a convention adopted so that we should all know which way something was happening, but in future in these articles we shall treat the *current as flowing from negative to positive* because we are talking about electron streams. And now to get back to our subject.

The Plate Current

The reason why the current is flowing across this evacuated space is that immediately we make the box-like structure more positive than the filament (which we have done by the way we have connected up the battery) then the electrons, instead of just boiling off the surface of the filament and dropping back into it again, speed across the evacuated space, enter the plate, and continue their path all through the wire down to the battery, through that, back to the filament, up to its boiling surface again, and so on.

So long as the filament is hot and so long as the battery voltage is applied, so long will an electron current flow.

This electronic current across the evacuated space inside the valve must not be confused with the radiating waves of energy between stations. These latter are not an electron flow, whereas in the valve we are actually dealing with the passage of electrons across the space.

The strength of the current or electron flow will depend on several things. One of the factors will be the voltage applied by the battery, and another the richness of the emission from the filament surface. Modern valves are far more efficient than the older ones, and an electron flow is easily obtainable with just a few volts.

Maximum Voltage ?

Up to a certain point the higher we raise the voltage of the battery the stronger will be the current flow, but when this special point is reached there will be no increase of current because the plate is catching all the electrons given off by the filament; we can say that for a particular set of conditions we have reached "saturation."

If we reverse the battery voltage, making the filament positive and the plate negative, no matter how high we raise the voltage or how hot we make the filament *no* electron stream will flow. The valve is thus a one-way device and it is for this reason that it got its original name.

But merely being a one-way device will not help us in magnifying currents, although this "rectifying" property is used in some parts of a wireless set. Forget it, however, for a moment because we want to consider purely the question of magnification.

The Grid

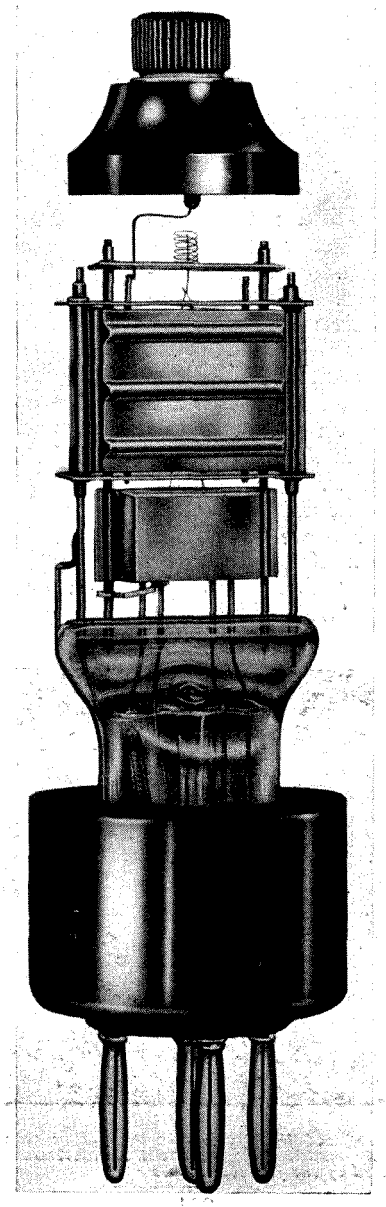
And this is where we come to a consideration of those fine wires which form a kind of mesh or network interposed between the filament and the box-like structure. This meshwork of wires is known as the grid (you would not think of that name for yourself because it is not a bit like a grid any more than the plate is like a plate !) This grid is connected to the remaining pin of our four, so that you see two are joined to the filament, one to the plate, and one to the grid. This grid can be made to exercise a very considerable *control* upon the electron stream, and if we make the grid positive as well as the plate, then it, too, will attract electrons, some of which will flow into the grid wires and down to the battery. But many will shoot past the grid, through the open spaces therein, and will join the plate, thereby increasing the plate current. We can thus have a grid current, as we call it, and a plate current.

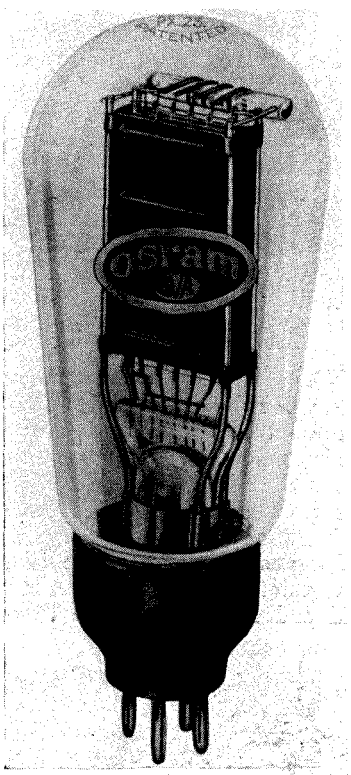
Let us now join the grid pin straight to the filament so that there is no voltage applied to it, or "electrical difference of potential" as we say. The stream of electrons now shoots through the grid wires and reaches the plate in the manner we explained above. The flow, however, will be smaller than before, as the accelerating action of the positive grid is now absent.

Let us now take another little battery, called a "grid-bias battery," and make the grid more negative than the filament by connecting the positive end of the grid-bias battery to the filament and the negative end to the grid. The grid will now repel the electrons and force a lot of them back into the filament, thereby considerably restricting the flow of electrons from the filament to the plate.

Grid Current

The more negative we make the grid the more we shall repel the electrons which are trying to get to the plate, and we can easily reach a point when none of them will go through the grid and the plate current will cease entirely. Similarly we can make the grid positive and accelerate the flow, so that by





(Above) This photograph of an Osram PX25—a big triode output valve—shows clearly the rectangular plate. Above this one can see the beginning of the grid, and the filament which is suspended vertically. This is typical of modern three-electrode valve practice

(Left) This drawing of the Mullard battery double-diode-triode—that is, a three-in-one valve—gives a clear conception of the care that must be taken in accurate assembly of the various parts

varying the electrical pressure or voltage on the grid we can take our electron current from nothing up to maximum just as we please.

Let us return for a moment to last month's talk, when we saw how our tuned circuit, with its condenser and coil, had built up in it electrical oscillations or variations of pressure.

1,000,000 a Second

The terminals of the condenser on our tuned circuit become, as we know, alternately positive and negative at the rate of a million times a second if we are tuned to 300 metres. If, now, we connect one side of this condenser to the filament and the other side to the grid, the grid will become alternately positive and negative with the condenser.

If you think for a moment, you will now realise that the strength of the electron flow across the valve will rise and fall at exactly the same rate, namely, one million times a second, and if we connect between the plate of this valve and its high-tension battery another tuned circuit, also adjusted to a million, then we shall get an exact and perfect repetition of the oscillations or electrical vibrations in our second circuit.

An Interesting Point

Notice at this juncture one very interesting point. While there is a faithful copy of the currents in the second tuned circuit the *energy* comes not from the incoming signal, but from the high-tension battery which is now supplying the power.

So great is the influence of the changes of electrical pressure on the grid and filament that the current in the second tuned circuit is very much stronger than in the first, so we have obtained just what we wanted to get, and that is faithful magnification.

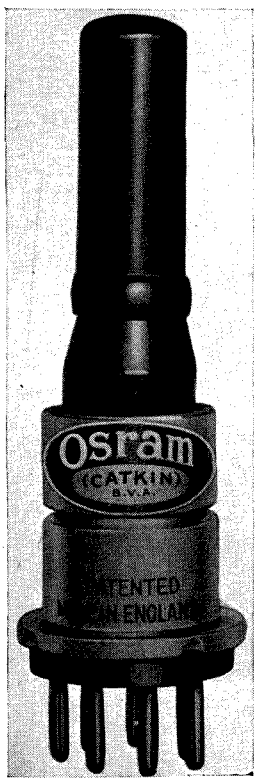
This is what we call "one stage of magnification." With modern valves and circuits, and everything properly arranged, it is quite easy to get a magnification of twenty or thirty times with one stage, although it may be convenient to have less.

If, now, this second tuned circuit is connected to the grid and filament of a further valve the same process can take place all over again. If the next stage *also* magnifies twenty times the gain is 20 times 20, or 400 times!

Last month we saw that the more tuned circuits we had the greater the selectivity or sharpness of tuning, so that in the arrangement I have just described not only do we get *magnification*, but also further *selectivity*. In a modern wireless receiver there are several valves and several tuned circuits so that we get a great deal of gain and a greatly enhanced sharpness of tuning.

The magnification to which we have just been referring is known as "high-frequency" or "radio-frequency" magnification to distinguish it from another kind about which we shall talk in a further article.

In practice the simple three-electrode valve consisting of a filament, grid and plate of the kind we have just described suffers from certain electrical disadvantages which make a set unstable. In recent years another type of valve has come into general use known as the screened-grid valve.



An unusual valve, the Osram Catkin has an anode which also takes the place of the glass bulb of the ordinary valve. This form of construction ensures exceptional rigidity and robustness

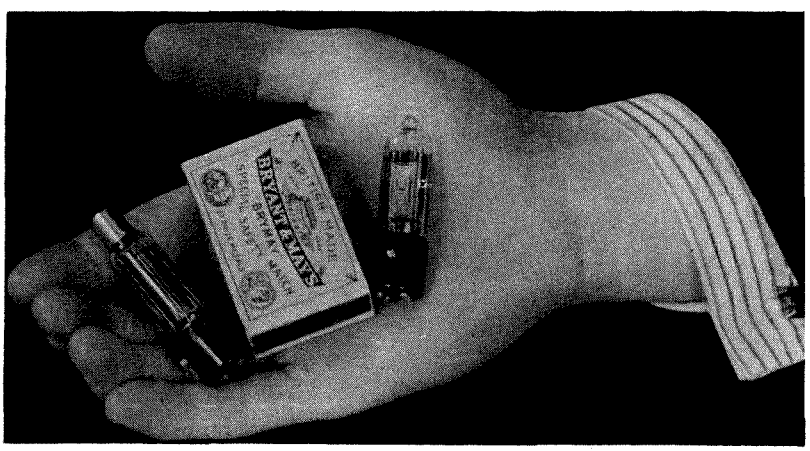
Screened-grid Valve

This valve really operates on exactly the same principles as the three-electrode type we have described, but there is another grid inside for a special purpose connected with stability. It does not vary its pressure during operation, and it is not the controlling grid to which we have referred. It is always made positive and is also connected to the high-tension battery.

Due to the interposition of this further grid there has been an alteration of the pin connections, so that we now have not merely four pins on the base, but also a cap at the top. In the screened-grid valve the cap at the top is connected to the plate and the pin at the bottom (which is connected to the plate of the ordinary valve) now goes to the second grid.

A still further valve used for magnification in this part of the circuit is known as the "high-frequency pentode" and has one more grid inside, but this again is not used for controlling the electron stream by the signal, so that the filament, control grid and plate, even in this kind of valve, still perform exactly the same functions as those I have described above. This makes one more connection and one more pin, which is now placed centrally.

Valves designed to work off alternating current mains are generally of a type called "indirectly heated." In these valves the electrons are not emitted directly from the surface of the heated filament,



Just how small the new midget valves introduced by Hivac really are can be seen from this photograph. Although physically small, their electrical characteristics approximate to the standard of the full-size valves

but from the surface of a kind of tube surrounding the actual heater. This heater is connected to an alternating-current supply of low voltage and serves only to give the necessary temperature to the insulated tube, on the outside of which is coated the electron-emitting material.

Indirectly-heated Valves

For certain reasons, which we need not describe here, it is undesirable for the heater to be connected to the electron-emitting surface and so we have five pins on the base, two for the heater wires, another one connected to the electron emitting surface, one to the grid and one to the plate.

Sometimes, too, we have special valves in which virtually two valves or two complete sets of electrodes are included in the same bulb, but we need not worry about those here.

In Magnifying Valves

In magnifying valves used for the purpose we have described it is found inadvisable to allow the grid ever to become positive, so instead of allowing the grid to become alternately positive and negative in controlling the electron flow we place a steady negative voltage on it which is only partly counteracted by the rising positive voltage, with the overall effect that the grid becomes *more or less negative* as the voltage on the condenser rises and falls, rather than negative and positive.

Variable-mu Valves

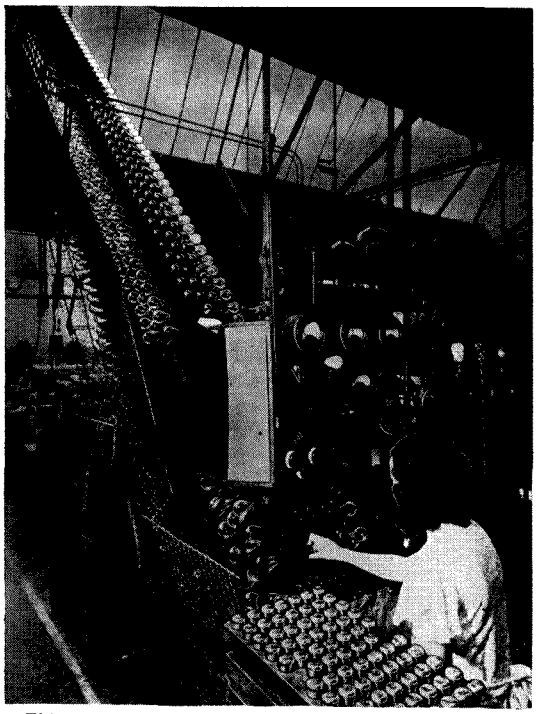
A very useful magnifying valve is what is known as the "variable-mu screened-grid valve." This magnifies in the way I have described above and has the special stability grid inside. The control grid is also made in such a way that the more negative we make it the less the valve magnifies.

In this way, by connecting the grid to a special battery and joining it up to a control by means of which we can make the grid more and more negative as we turn the knob, we are provided with an excellent distortionless volume control. When we want to cut down the strength of the signal in our loud-speaker all we need to do is to turn the knob to make the grid more negative, whereupon magnification goes down and the signal strength with it.

A still further improvement in modern sets enables this valve to be used for automatic volume control. In this case the strength of the signal, when it reaches a later part of the set, is made to control the strength of the negative voltage on the grid of our variable-mu valve. Thus the stronger the signal the more negative does the valve become and the less it magnifies.

In this way, and by a suitable adjustment of values, a substantially equal strength can be obtained for distant or near stations, and also compensation for the natural fading of signals which sometimes occurs on long-distance transmissions. It also prevents us suddenly hearing a tremendously strong signal when we are turning the tuning control.

Sketchy as this article has had to be in the endeavour to compress into so small a space what really should extend over a book, I hope it has given you at least an insight into the working of the modern valve. Next month we will discuss some of the ways of making these high-frequency electric currents operate our loudspeaker.



This big conveyor belt in the Cossor valve factory at Highbury takes the valves from a test bench to the section where they are packed before delivery

New Midget Valves

THOSE whose radio memories go back as far as the old "Weco" peanut valves cannot fail to be interested in the modern trend of design which is leading valve makers to produce up-to-date types of similar minute dimensions.

The resemblance, of course, is in physical dimensions alone; the electrical characteristics of the latest midgets approach the normal standards of to-day. Their technical interest, by the way, lies not so much in their tiny size, though that may have its value, as in the fact that it is being found possible in some cases to obtain quite usable characteristics from filaments which require only the veriest trickle of heating current.

There is, for example, a new range of Hivac midgets rated for a filament current of only .06 ampere at 2 volts, which should make them of importance in the design of receivers for special purposes involving use in places where battery current is hard to come by.

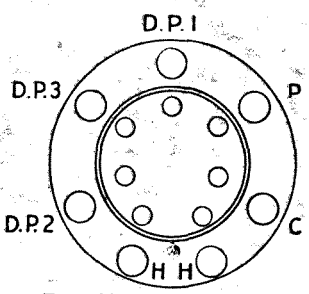
The new Hivac range consists of three types. Of these, type XD is intended for detection, the valve having an impedance of 27,000 ohms and amplification factor of 16.

Type XL is designed for low-frequency work, the impedance being 14,000 ohms and magnification factor of 12; while type XG is a screened-grid valve of 600,000 ohms impedance and an amplification factor of 360.

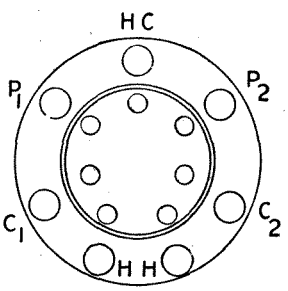
The minute size of these valves can be gauged from the photographs reproduced on facing page. Actually, the overall length of the new type, including pins, is a bare $2\frac{1}{4}$ in.

A Helpful Feature for the Constructor—No. 3.

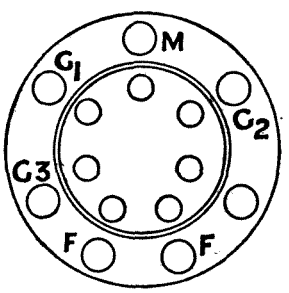
Standard Valve-holder Connections



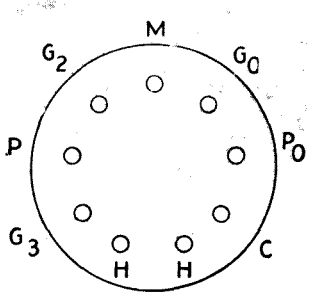
7-PIN TRIPLE-DIODE-TRIODE (INDIRECTLY HEATED)



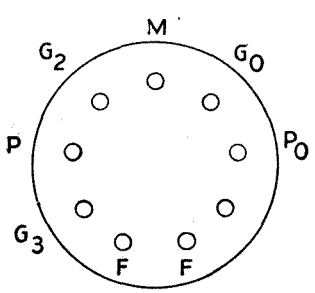
7-PIN VOLTAGE-DOUBLING RECTIFIER (INDIRECTLY HEATED)



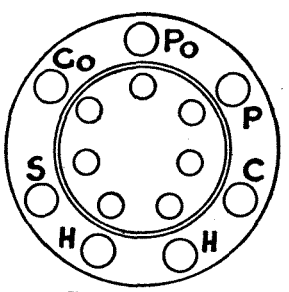
7-PIN H.F. PENTODE (DIRECTLY HEATED)



9-PIN TRIODE-PENTODE (INDIRECTLY HEATED)



9-PIN TRIODE-PENTRODE (INDIRECTLY HEATED)



7-PIN HEPTODE (INDIRECTLY HEATED)

There are now so many kinds of multi-pin valves that few constructors can memorise the connections of all the types with which they have to deal. We are, therefore, preparing a series of handy reference diagrams showing the connections of the more important types, the third selection appearing above. It is important to note that these diagrams show the connections of the valve holder, that is, the actual wiring. The following abbreviations are employed: G for grid, F for filament, P for plate, S for screening grid, H for heater, C for cathode, P.G. for priming grid, D.P. for diode plate, and M for metallising

The "Key-record" System

A LONG-FELT want has been satisfied in a recent innovation by the Gramophone Co., Ltd., of the H.M.V. "Key" record system.

We have all at one time or another heard an item of music, or a song, at a restaurant or concert, and desired to have a permanent record of it, but not knowing its title have been unable to purchase it.

Again, when one wishes to extend one's gramophone library with some standard works, the same difficulty is often present.

Now almost all H.M.V. dealers are equipped with eight albums, containing altogether sixty-six "key" records. Recorded on these discs are extracts from about eight hundred of the best non-ephemeral records from the H.M.V. general catalogue.

They are divided into (*a*) heavy orchestral, (*b*) light orchestral, (*c*) songs and ballads, (*d*) instrumental (solos and concerti), (*e*) brass band and military band, (*f*) operatic, (*g*) musical comedy and light opera, and (*h*) sacred music.

A few typical excerpts of the item are played, and after each one particulars of the record are announced.

These discs provide an example of the "dubbing" process, and are technically interesting in themselves.

But their object and use to the public is to remove the difficulty already outlined.

One has only to know whether the piece required is, say, light orchestral or an operatic aria, and the dealer will play over the records from the suitable album for you to identify it and make a note of the number.

In this manner many standard music recordings will be discovered that have been hidden for years in a maze of supplements and catalogues.

Thus another amenity is available for those with a modern radio gramophone. *D. W. A.*

"The GRAMOPHONE RECORD" BY H. COURTNEY BRYSON

WE have received a copy of a book on gramophone records which has been written by H. Courtney Bryson, who, it will be remembered, has contributed to "W.M." The book deals with the record from the rudiments of sound recording, the material of which the record is made, and how it is made.

The book makes interesting reading, and is to be recommended. It is published by Ernest Benn, Ltd. (£1 1s.).

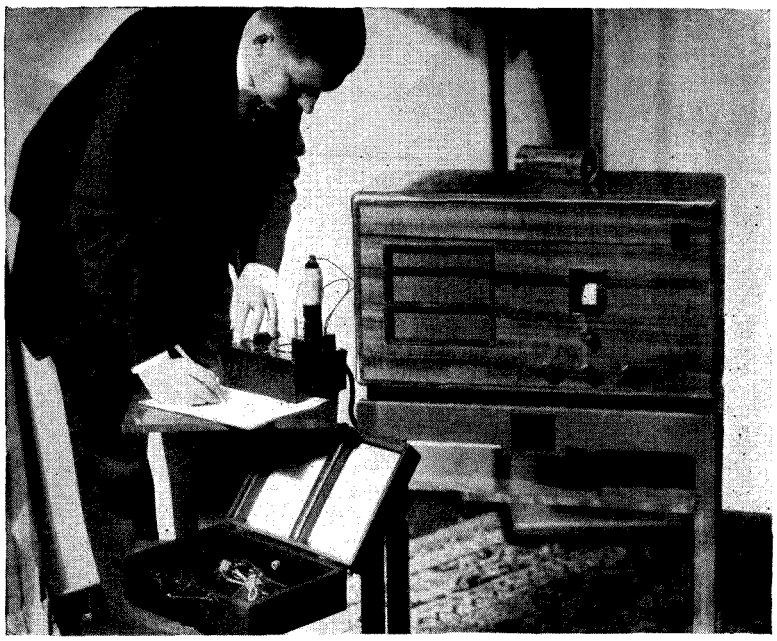
Hints for the Service Engineer

This new feature is primarily intended to assist the service engineer. However, so many interesting subjects are dealt with that every radio enthusiast who makes his own "running repairs" will find something here to interest him. The feature is conducted by G. P. KENDALL, B.Sc., who is known to you as a practical man. He will be pleased to discuss suggestions sent by readers

Some of the most vicious of all man-made interference is that which comes from certain types of electro-medical apparatus and it is, moreover, one of the most difficult kinds to stop. The only redeeming feature of the situation is that apparatus of this sort is usually in the hands of people possessed of some degree of scientific knowledge who readily understand the need for remedial measures.

Real Difficulty

The real difficulty of the problem arises from the fact that apparatus such as this does not merely generate high-frequency impulses as a by-product of its main activity, but actually carries out its intended functions with the aid of what may be quite a generous supply of high-frequency energy.



Much time and trouble in set servicing can be saved if suitable and good test apparatus is used. Here you see a service engineer with the Weston Analyzer in use

Thus, the high-frequency apparatus which the barbers call a violet-ray machine generates high-frequency currents in sufficient quantity to enable it to act as a transmitter capable of covering considerable distances under suitable conditions. Diathermy apparatus is even more troublesome, for here the amount of high-frequency energy is really large.

Direct Radiation

Direct radiation is not as a rule the most troublesome in these cases, for its range is limited, and it is quite easily suppressed by simple screening methods. (Not quite so simple in the case of diathermy, by the way, because here it is necessary to enclose machine, patient and operator in some sort of screened cubicle.)

The really acute problem is concerned with the fact that when high-frequency currents of such strength are being used there is an excellent chance that an appreciable amount of the energy will be induced back into the mains and distributed thence over quite a wide area. The simpler suppression devices using merely a couple of condensers may not always effect a cure in these cases and something more drastic must be provided.

Chokes as well as condensers will then be required, and here the situation is complicated by the fact that, in some instances, the apparatus draws quite a considerable current from the mains; the chokes must then be of generous design. One should be inserted in each mains lead and the customary pair of condensers connected across thei ends with the centre point earthe(as usual.

The chokes should, of course, be of the air-core type and their inductance as high as circumstances permit; in the case of the smaller kind of apparatus, taking only a few watts, it is usually permissible to use chokes of quite high inductance, say 20,000 microhenries. Such chokes can be obtained at quite moderate prices with resistances as low as 30 to 50 ohms, so that the voltage drop produced will be very small.

Apparatus taking larger currents is naturally more difficult to deal with since a fair inductance is still needed but the D.C. resistance must be lower. Here it is generally necessary to have special chokes made, and they will inevitably be both large and expensive.

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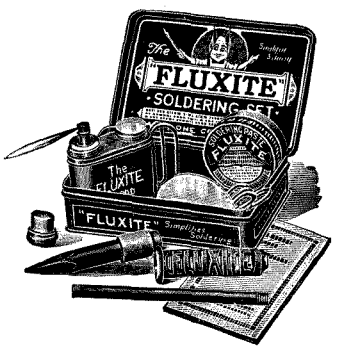
Using an Audio Oscillator

Most people carrying out servicing work on a small scale are apt to regard the audio oscillator as a luxury that can be afforded only by the fortunate few. No doubt that is quite true so far as the precision laboratory type of oscillator is concerned, but it is not generally realised that much can be done with quite a crude and simple type of apparatus.

Given merely an oscillator which will produce some sort of a note over the main audible range, even if it is nothing like a pure sine wave, some very valuable and strictly practical test work can be done. Take, for example, the question of loudspeaker faults. Very often it happens that the trouble takes the form of an unpleasant noise of some



A complete soldering outfit is sold by the manufacturers of the well-known Fluxite soldering paste. The outfit costs only a few shillings

sort produced only by certain particular musical notes or speech sounds.

Laborious Process

Testing and correction then becomes in most cases a laborious process of waiting for those critical sounds in a broadcast transmission, or a search for a gramophone record containing them. How different is the picture when some sort of oscillator is available: the operator has merely to turn the dial until he strikes the note which provokes misbehaviour in the loudspeaker and then proceed to investigate.

The removal or mitigation of boom effects in cabinets is another excellent example of the usefulness of the method. Really deep bass notes are comparatively rare in either broadcast or record reproduction, and the work is apt to be very tedious if one has to depend on these sources. With the oscillator, on the other hand, a suitable pitch can be found in a few seconds and the work can go on without waiting for elusive notes from the double bass or organ.

Expensive Oscillators

Commercially-made oscillators, it must be admitted, are expensive, probably prohibitively so for the independent service man, but it is by no means difficult for one to make up something quite good enough for these purposes. I hope to give a suitable design in an early issue.

Portable Soldering Outfits

EVERY service man who covers a district of any size soon discovers that he must have a good soldering outfit which is not dependent upon electric mains or gas. Knowing that a clean and smokeless flame is essential one's thoughts are apt to turn at first to some sort of spirit lamp.

It is clean and convenient, and the fuel is cheap, but it suffers from sundry drawbacks: the flame is not very hot, so that there is often a tiresome delay, and it will not stand draughts.

A much more effective source of heat is to be found in a small plumber's blow-torch. The heat is really intense, and must be applied to the iron some little distance from the tip, and, of course, the flame will stand any amount of wind.

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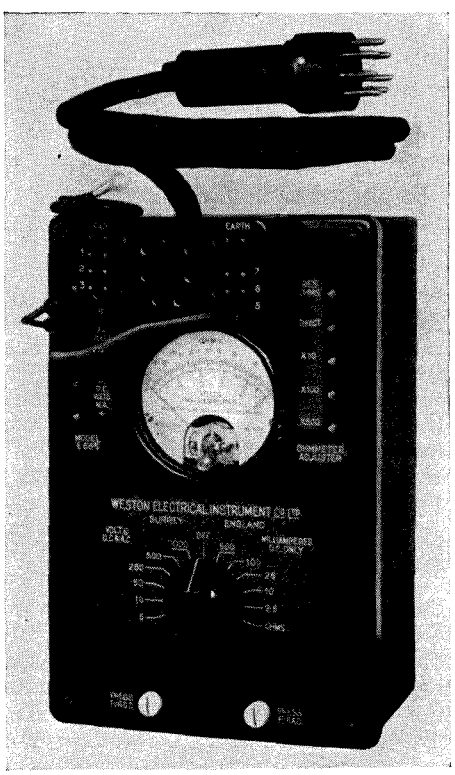
A Profitable Sideline

If one may judge by experience in America, the enterprising serviceman can supplement his more usual work to a worthwhile extent by acquiring a good public-address outfit and offering it for hire at such functions as gymkhanas, fêtes and other outdoor events.



The Weston Analyzer is a combination test instrument of great value in service work. It covers a great variety of voltage, resistance and current measurements

Such an outfit does not involve a very heavy outlay if the construction is done in spare time, but it is important to design it on really generous lines. It must be remembered that the quality given by the apparatus will be a good or bad advertisement according to the impression it makes on the listener, and nothing sounds worse than acute overloading.

Always, therefore, make a point of finding out in advance what area has to be covered, and if it seems likely that the apparatus available cannot do the job really creditably, *ask to be excused!*

It is never good policy to take on work of this kind unless quite certain of being able to do it well.

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Weston Analyzer

I propose in these colums to refer occasionally to such pieces of test equipment as it seems to me should be known to service engineers, and to give opinions on their merits based on actual tests in some cases.

This month I have selected an instrument which does *not* call for any praise or blame of mine to establish its place in the world; the Weston " Analyzer " is regarded as more or less standard equipment by many service people, and there can be no doubt that it is capable of earning its keep in any busy establishment.

An idea of its usefulness can be obtained from the following list of the ranges of measurement of which it is capable: volts, 0-5, 10, 25, 50, 250, 500, and 1,000 (A.C. and D.C.); milliamperes, 0-2.5, 25, 100, 250, 500 (D.C.); ohms, 0-1,000, 10,000, 100,000, and 500,000; microfarads, .0002-10.

The great feature of the Analyzer, however, is not so much the multiplicity of its ranges, as the ingenious way its system of connections has been worked out to enable test measurements to be made with great ease and in the shortest possible time. Space will not permit me to describe this in detail, but I should certainly advise anyone seriously concerned with service work to obtain a copy of the Weston leaflet for this instrument.

Tests of the New Sets

By the "W.M." SET SELECTION BUREAU

IT is necessary at this time of the year to say a few words about the daylight reception capabilities of the modern set. Thousands and thousands of four-valve superhets have been installed in British homes since last October or November.

And it is quite truthful to say that they have given excellent results during the dark evenings of the past winter—the ordinary non-technical listener has easily managed to log thirty or forty foreigners on any evening without much trouble.

But now the light evenings are beginning it is well to warn these people that they must *not* expect too much from their sets until it is nearly dark. Certainly they will not record foreign-station logs of thirty or more stations unless conditions are extraordinarily favourable.

While these small superhets shine favourably in the light of local-station reception and overall selectivity, daylight range on the medium waveband is one of their weak spots. Again it is almost certain that on this band the amount of noise and atmospherics would be of such strength as to spoil real entertainment value.

We believe that the best foreign-station reception during the coming summer months will be obtained by those listeners using six- and seven-valve, perhaps five-, superhets, and by those with straight sets employing two high-frequency stages. These remarks apply to the medium waveband only. The customary reception of the best six long-wave signals should continue satisfactorily.

A useful tip is this: if you are using an indoor or a moderately small outdoor aerial, try and fix up, say, a 60-ft. outdoor wire, as high as possible and clear of the house, trees, and the like.

If any reader feels that his reception is suffering unduly, he is invited to write to the Set Selection Bureau, enclosing a stamped and addressed envelope for reply.

The Marconiphone twenty-two guinea Jubilee radiogram in pleasant surroundings! Three receivers comprise this firm's Jubilee range—a radiogram, a floor console, and a table model

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Set designers are now racking their brains with semi-finished designs of sets to be released during the coming autumn. May we remind them that we would like to see the set's main volume control operative on both radio and gramophone. There are not many offenders in this respect, but this is a specification we should like to see standardised.

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This month we review an H.M.V. radiogram and a Marconi table set, which have been released to coincide with the Jubilee celebrations. Aerodyne Radio, Ltd., has also released three new Jubilee sets with very "Spring-like" names—the Silverwing, the Thrush, and the Nightingale. The Silverwing is a six-stage A.C. superhet—using four valves and a rectifier—housed in a well-designed figured-walnut cabinet (£10 19s. 6d.).

The Thrush, which costs £6 17s. 6d., is a straight battery three-valver of the best kind using a variable-mu high-frequency pentode, a triode detector, and a pentode output feeding into a permanent-magnet moving-coil loudspeaker, the complete chassis being housed in an exceptionally modern walnut horizontal cabinet. Incidentally a set of this type should provide a "fairly decent" daylight range. One cannot define daylight range unless a test has been made.

FREE ADVICE TO PROSPECTIVE SET BUYERS

To make the most of this free advice service, we ask you to answer the following questions:—

(1) The maximum price you wish to pay, and whether you are prepared to exceed this if there is no suitable set at your desired price.

(2) The locality in which the set will be installed.

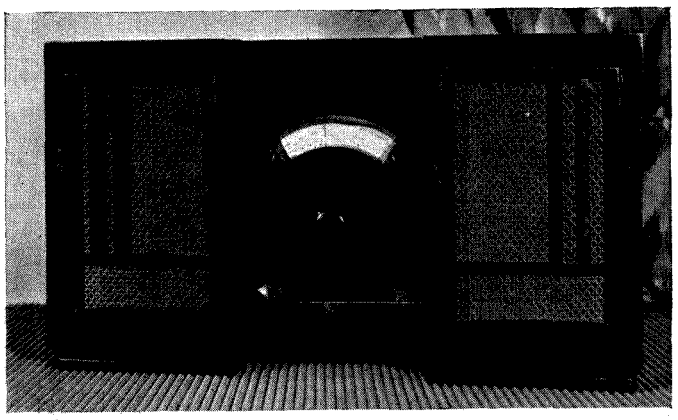
(3) The stations required, that is, locals only or a selection of foreigners.

(4) Whether you want an entirely self-contained set or one with external aerial and earth.

(5) Whether battery or mains driven. If the latter, whether A.C. or D.C.

A stamped-addressed envelope for our reply is your only expense. Address your inquiry to Set Selection Bureau, "Wireless Magazine." 8-11 Southampton Street, Strand, W.C.2. Tell your friends about this useful service, exclusive to "W.M."

C.A.C. Austin Superhet



"The set's cabinet is one of the finest we have come across this season . . . walnut. . . and it is by no means small"

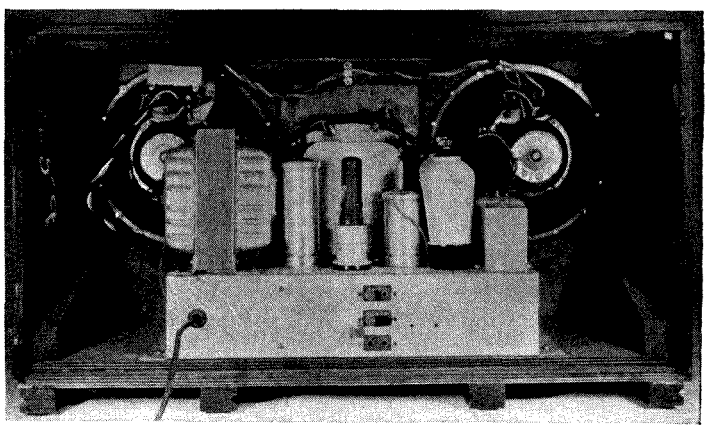
IT is an old slogan that if you want the best you have to pay for it! This C.A.C. four-valve superhet under review costs a little more than the usual run of sets of its class, but this extra cost is definitely warranted.

From the general point of view the most interesting of the set's many features are the two loudspeaker frets, one on each side of the recessed centre panel. Behind these are two moving-coil loudspeakers carefully matched to reproduce faithfully the output from the 3-watt power pentode.

The use of two loudspeakers in the set does not bar a third being used, should the user so wish. The external speaker should have an impedence—to get correct matching—of about 7,500 ohms.

We have no hesitation in saying outright that the set's cabinet is one of the finest we have come across this season. It is of walnut. And it is by no means small—23 in. wide, 11 in. deep, and 13 in. high.

As you can see from the specification there is nothing unusual in way of the valve combination. But we were strongly of the opinion that every valve was pulling its weight. Results were definitely above the average; quality, particularly, was good, but more about these results later on.



"The set chassis . . . materials and workmanship of the best . . . clean, robust piece of engineering"

BRIEF SPECIFICATION

BRAND NAME: C.A.C. Austin.
MODEL: Twin-speaker A.C. superhet.
PRICE: £18 18s.
SPECIFICATION: Five valves including rectifier are used. The first is a combined detector-oscillator (Osram MX40) followed by a single intermediate-frequency amplifier (Osram VMP4), a double-diode-triode provides second detection, feedback voltage for A.V.C. and the first low-frequency amplifier. The fourth valve is the output pentode (Osram Catkin-type) while the rectifier is of the full-wave type.
POWER SUPPLY: A.C. mains 200-250 volts, 40-100 cycles.
MAKERS: City Accumulator Co., Ltd., Normans Buildings, Central Street, London, E.C.1.

The control layout is easily understood. The main tuner, on its own in the centre, operates a full-vision scale—illuminated when the set is on—marked in wavelengths and also in the general division style from 0 to 100. The other three knobs from left to right are wave-change and gramo-radio switch, tone control and, finally, on-off switch combined with the volume control.

We spent an enjoyable ten minutes examining the set chassis. Obviously, time and money had been spent in making sure that the materials and workmanship were of the best. A clean robust piece of engineering, this!

We took many weeks—on and off—in putting this receiver through its paces. First of all its daylight range. This is a question to which we have referred elsewhere, and is one that we want firmly understood. Daylight results on the long waveband were as good as at night—in fact, decidedly better. The long waveband is apt to be noisy at times—no fault of the set, mark you—and you will always find that results are "cleaner" during daylight hours.

During the summer months there is no earthly reason why the usual six or seven programme providers on this waveband should not give entertainment comparable with the medium-wave locals.

Daylight medium-wave results were, if anything, slightly better than we expected. Nothing like evening results, but under normal working conditions in South London with a 60-ft. outdoor aerial we were able to tune in about seven or eight alternatives to the local at fair entertainment value.

At night there was literally not an empty space on the tuning dial. At a guess we should take the selectivity to be roughly 8 kilocycles, that is to say that, provided every station working under the Lucerne agreement was on its allotted wavelength, there would be no mutual interference. Actually stations wander, but a moderate estimate would be that we obtained fifty "listenable" signals between 200 and 550 metres at night.

In spite of all this talk about station-getting we feel that the real virtue of this set lies in the combination of this sensitivity and quality. Quality is, in our opinion, the high light of this receiver.

One can adjust the variable tone control to suit the balance of tone. A set that sets a high standard!

H.M.V. Jubilee 541 Radiogram

IT has given us more than ordinary pleasure to test this H.M.V. Jubilee radiogram. The reason for this is that we can visualise the ordinary man paying less than an average price for a musical instrument worth infinitely more than what it costs !

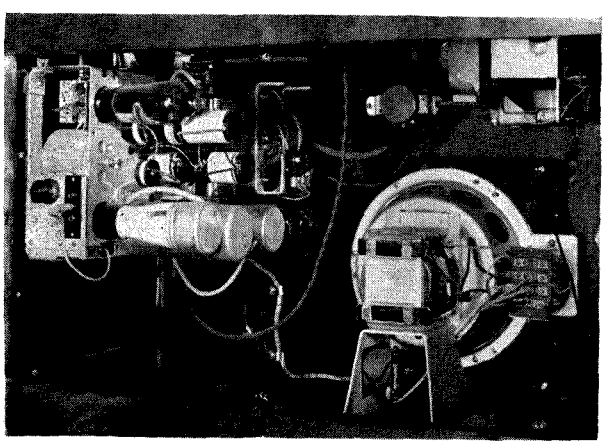
H.M.V. has long been associated with the best, and at the best price. By entering the moderately-priced radiogram market this well-known firm has made good radio possible for all. That is praise where it is justly due.

This twenty-two guinea all-electric radiogram is, we can say without hesitation, a satisfactory job. You have only to look at the two illustrations on this page to realise that from the appearance point of view. *You can take our word that it is technically sound.*

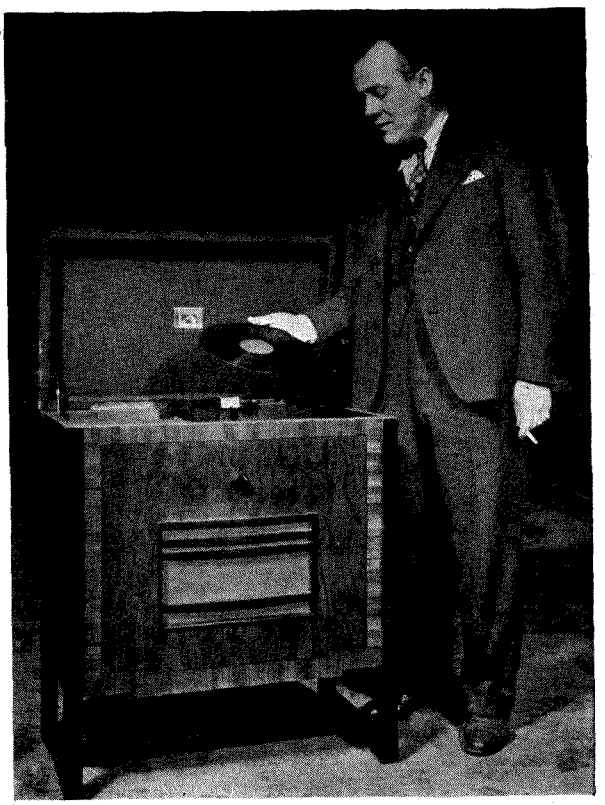
The radio set itself is a five-valve (four plus rectifier) superhet using the latest types of multi-grid valves. First of all comes a heptode frequency-changer; then there is one intermediate-frequency amplifier in the form of a variable-mu high-frequency pentode; a double-diode-triode comes next, and this functions as second detector, provides a feed-back voltage for A.V.C. and also acts as the first low-frequency amplifier. This three-in-one valve is followed by a power pentode output. High tension for these valves is provided by a valve rectifier.

The set chassis is fixed on its side at one end of the cabinet while a fair-sized loud-speaker—a product of the H.M.V. research department—occupies the central position.

THE four main controls are grouped round a large tuning scale—marked in wavelengths and forty-eight of the best-heard stations —on the motor board. We won't weary you with their functions for all are clearly engraved. We found all the controls smooth in operation.



How the set and loudspeaker are arranged inside the cabinet



Jack Hylton, who is again recording for H.M.V., about to try his latest record on the Jubilee Radiogram

BRIEF SPECIFICATION

BRAND NAME: H.M.V.
MODEL: 541 Jubilee.
TECHNICAL SPECIFICATION: Five-valve (including rectifier) superhet radiogram. The first valve is a heptode (Marconi MX40) which is coupled through a band-pass intermediate-frequency transformer to the intermediate-frequency amplifier (Marconi VMS4). The second detector and low-frequency circuit comprises a double-diode-triode (Marconi MHD4) and output pentode (Marconi MPT4). The indirectly-heated rectifier is a Marconi MU12.
POWER SUPPLY: A.C. mains 200-250 volts, 50 cycles.
PRICE: £23 2s.
MAKERS: The Gramophone Co., Ltd., 98-108 Clerkenwell Road, London, E.C.1.

The gramophone motor and pick-up, together with needle cups and racks, are at the other end. By the way, a useful feature here is that an automatic stop is provided for switching off the motor at the end of the record. This is indeed handy !

There is only one knob on the front, and that is the volume control—operative on both gramophone and radio—which is smooth in action and varies the volume from almost zero to full strength.

One point of interest is that besides full-delayed A.V.C. there is a switch for silent tuning fitted on the motor board. When this switch is pulled out, only stations of high entertainment value are heard—mush being completely obviated.

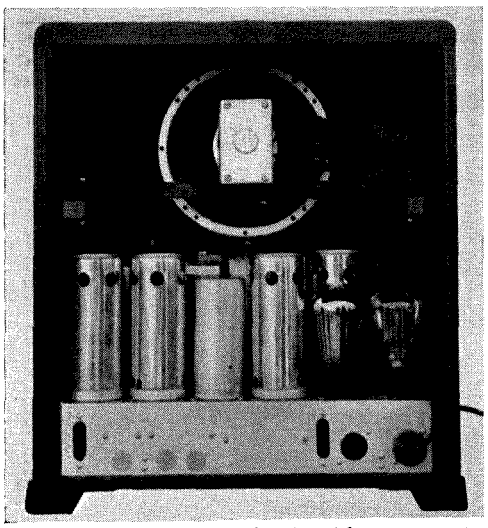
Under normal conditions with an outdoor aerial at our South London laboratories, we could, any evening, log upwards of fifty stations, all worth hearing—that is with the noise-suppression device out of circuit.

With the noise-suppression device *in* circuit we heard about fifteen stations on the medium band, all of which provided enjoyable—in the best sense—entertainment.

Daylight reception came up to our expectations. Some seven or eight medium wavers, in addition to the usual six long-wave stations—Kootwijk, Radio Paris, Droitwich, Motala, Luxembourg and Oslo—provided enough alternative programmes for even the most difficult-to-please listener.

Quality. Just H.M.V. Enough top-notes and well-proportioned bass. There is a tone control to get this elusive property suited to your own whims.

Kolster-Brandes A.C. Superhet 935



"Inside . . . a big set chassis with every part screened, except the output pentode and the rectifier"

ONE of the most interesting sets we have tested for some while is this K.B.935. The specification is chock-full of new ideas—ideas that actually mean improved results in practice.

By way of introduction: the basic arrangement of the 935 is a five-valve superhet chassis employing three high-frequency pentodes, a double-diode-triode, power output pentode, and a rectifier which is termed the sixth valve.

On top of all this we have refinements in the nature of automatic tone compensation, visual tuning indicator, tone control, automatic volume control, and a stage of high-frequency amplification before the first detector.

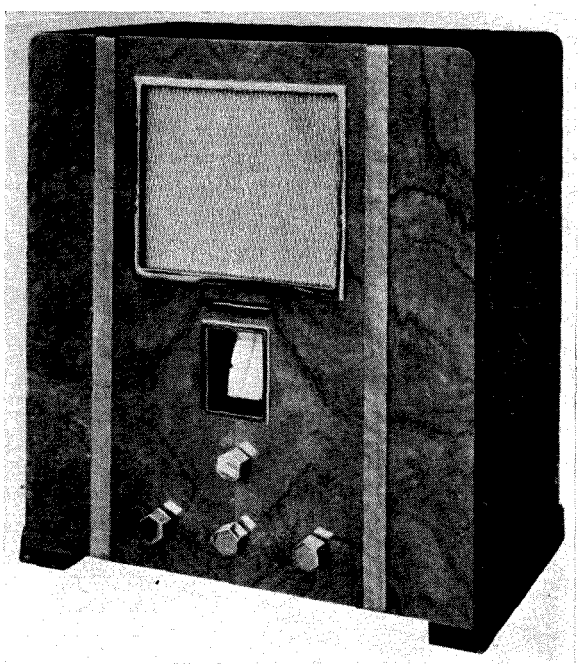
This extra-high-frequency stage ensures among other things a fair chance of good daylight reception. We found its advantages during our tests. In daylight one could count on a round dozen alternatives to the local on the medium band, that is with the set hitched on to a 60 ft. outdoor wire—the test being carried out a few miles south of London.

BRIEF SPECIFICATION

BRAND NAME: K.B.
MODEL: 935.
TECHNICAL SPECIFICATION: Six-valve (including rectifier) A.C. superhet in table cabinet. The valve combination consists of a high-frequency amplifier (Cossor MVS/Pen), frequency changer (Mullard SP4), intermediate-frequency amplifier (Cossor MVS/Pen), combined second detector, A.V.C., and first low-frequency amplifier (Mullard TDD4), pentode output (Cossor MP/Pen) and full-wave rectifier (Micromesh R2).
POWER SUPPLY: A.C. mains 200-250 volts, 40-60 cycles.
MAKERS: Kolster-Brandes, Ltd., Cray Works, Sidcup, Kent.

Next in order of merit comes the neon tuning indicator. All one does when tuning to a station is to turn the main tuner carefully until the glow from the tube spreads the greatest amount. It is surprising how many listeners with a modern set sit for hours with bad quality simply because the set is just off-tune. And it is so easy to be on-tune! K.B.'s neon tuning is so easy that there is no excuse for bad tuning.

Two other points: the set has been designed for use with the K.B. Rejectostat system by means of which electrical interference can be minimised—if not cured. The other is that the 935 is suitable for use with the K.B. short-wave converter, so enabling the user to get down to short waves between 15 and 80 metres, in addition, of course, to the usual medium and long wavebands.



"Nothing flashy about the 935's walnut cabinet; a straightforward neat design with chromium-plated knobs and edgings"

There is nothing flashy about the 935's walnut cabinet; a straightforward, neat design with chromium-plated knobs and edgings—the loudspeaker fret silk harmonises with the general design, being of blue and silver.

Inside one finds a big set chassis with every part screened except the output pentode and rectifier. Just behind the rectifier is the mains adjustment device: the simplest we have yet found—a plug and socket arrangement fixed on to the top of the chassis.

On the back of the chassis are the aerial and earth and gramophone sockets, sockets for additional loudspeaker; and then there is a four-way connection between the loudspeaker and a socket strip on the chassis.

So much for the set; we would, however, point out that the tuning scale is marked in stations and wavelengths, and that, should further station shuffles take place, a new dial will be supplied at a nominal cost.

Our first tests were carried out at night. On the medium waveband, just like a good set should, there was a signal on nearly every point of the scale. Selectivity was ample: Hamburg and Berlin were easily clear of London Regional, in fact, a station between Berlin and London gave splendid entertainment.

Long-wave selectivity was especially good. Even powerful Droitwich fizzed out, leaving Königswusterhausen quite free. Very unusual, this! Luxembourg—another good programme signal—was notable for absence of whistles.

Wireless Magazine. May 1935

Marconiphone 264 Jubilee Superhet

Professor A. M. Low at the controls of the Marconiphone Jubilee 264. A fine up-to-date set noted for its good quality

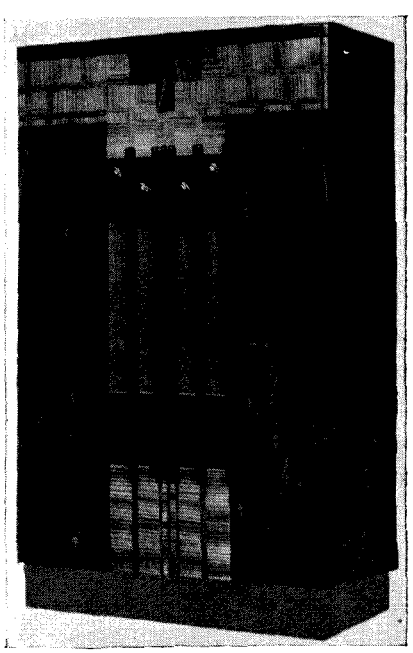
THIS new Marconi 264 is ideal for what we term the popular market. At least 70 per cent. of A.C. receivers sold to-day are superhets, and this is the favourite type with most listeners.

We have given this Marconiphone receiver more than our ordinary routine tests. In addition to a test at about 30 miles from the local regional station, we made further observations at a distance of only five miles.

First let us tell you exactly what the set is. It is a four-valve (five including rectifier) superhet for operation on A.C. mains; a table receiver following conventional form, with a moving-coil loudspeaker at the top and the set chassis underneath. And, considering its fine specification—we have examined the circuit in detail—it is a very good proposition at its price of twelve and a half guineas.

The cabinet—of a very striking modern design, you will agree—is of walnut, and highly polished. Four controls are grouped under a full-vision scale at the bottom. These controls from left to right are: volume control combined with the silent tuning switch, tone, tuner, and a combined on-off, wave-change and gramo-radio switch.

The tuning scale is marked in two wave-ranges, from 200 to 550 metres, and from 1,000 to 2,000 metres—so covering the entire wavebands where the best entertainments are to be found.



If listeners so desire, the Marconi Jubilee superhet can be obtained in a very modern floor cabinet. In this form the set costs £17 17s.

In common with the other receivers in the Jubilee range, this model 264 has a variable noise suppressor control on the back so that—in effect—the sensitivity can be increased in proportion to noise level, or vice versa; that is, the sensitivity can be reduced so that stations of good programme value are heard *without a trace of background.*

Now about our tests. Actually, we have come to the conclusion that the receiver is a dual-purpose one. It is ideal for the family that wants perhaps two local programmes and half a dozen of the best foreigners at good strength and equally good quality; on the other hand, it is ideal for the ardent knob-twister who listens to everything but his local station.

Our first tests, made thirty miles from the local station, proved without a doubt that the Marconiphone engineers have managed to make the set one of the *most sensitive of its type.* On the medium wave-band alone we logged fifty-seven stations on a normal outdoor wire (the noise-suppressor being cut out of circuit by means of a push-pull switch embodied in the volume-control knob).

With a 40-ft. aerial, close to the Regional station, selectivity was as good as at a much greater distance. We found it quite easy to get Berlin (two channels away from London Regional) perfectly free of all interference, while no ill effects of being closer were noted in the reception of stations adjacent to London National. We think that this test would be applicable to districts within the same distance of other B.B.C. Regional centres.

Long-wave selectivity was noticeably good. Luxembourg, which in ninety-nine cases out of a hundred has a high-pitched whistle caused by a neighbouring station, was almost free.

At our laboratories we made a test in broad daylight. Results, taking every condition into account, were very satisfactory.

A really strong point about this receiver is its fine quality. *It would be hard to find better from a table set.* Altogether we have come to the conclusion that this model 264—inexpensive as it is—is an ideal receiver for general use and, what is more important, it will not go out of date for a long time to come.

BRIEF SPECIFICATION

BRAND NAME: Marconiphone.
MODEL: Jubilee 264.
TECHNICAL SPECIFICATION: Five-valve (including rectifier) superhet in table cabinet. Valves comprise heptode frequency-changer (Marconi MX40), intermediate-frequency amplifier (Marconi VMS4), Double-diode-triode for second detector, A.V.C. and first low-frequency amplifier (Marconi MHD4) and output pentode (Marconi MPT4). The indirectly-heated rectifier is a Marconi MU12.
POWER SUPPLY: A.C. mains 200-250 volts, 50-100 cycles.
PRICE: £13 2s. 6d.
MAKERS: The Marconiphone Co., Ltd., Radio House, Tottenham Court Road, London, W.1.

"W.M." Short Wave Identification Panels

Compiled by JAY COOTE

MADRID-ARANJUEZ (EAQ)

Spain

Metres: 30.43 Power: 10 kw. Kilocycles: 9,860

Standard Time: Greenwich Mean Time.

Languages Used: Spanish, French, and English.

Announcer: Man.

Call: "Aqui Estacion EAQ Radiodifusion Ibero-Americana." In English: "Good evening, everybody. This is station EAQ, Madrid, Spain."

Times of Transmission (G.M.T.): 22.15-00.30, daily; 18.00-20.00, Saturday.

Transmits programmes for European listeners and occasionally relays Madrid EAJ7.

English sponsored concerts are given on Sunday, Tuesday, Thursday, and Saturday from 24.00-00.30 G.M.T.

Closes down with good-night greetings in Spanish, French, and English, followed by Spanish Republican National Anthem, *Himo de Riego.*

ZEESEN

Germany

Call:	***DJB***	***DJD***	***DJA***	***DJN***	***DJM***	***DJC***
Metres:	***19.74***	***25.49***	***31.37***	***31.45***	***49.35***	***49.83***
	(5 kw.)	***(5 kw.)***	***(5 kw.)***	***(50kw.)***	***(50kw)***	***(5 kw.)***
K/cs.:	***15,200***	***11,770***	***9,560,***	***9,540***	***6,079***	***6,020***

Standard Time: Central European (coincides with British Summer Time, i.e., G.M.T. plus 1 hour).

Announcers: Man and woman.

Call: "Achtung! Hier Deutscher Kurzwellensender.

Times of Transmission: G.M.T. 08.45-12.30 (DJB and DJN) for India and Southern Asia. (German and English announcements.) 13.00-16.30 (DJA and DJN) for Far East. (German and English announcements.) 17.00-21.30 (DJD and DJC) for Africa. (German and English announcements.) 22.15-02.15 (DJA only), South America. (German and Portuguese announcements.) 22.30-03.30 or 04.00 DJC, also DJM test) for North America. (German and English). News bulletins are given out in English at G.M.T. 12.00 (DJB, DJN); 16.15 (DJA); 21.00 (DJD, DJC); 01.15 (DJC and DJM).

Metres:
31.27 (20 kw.)
38.48 (20 kw.)

PRANGINS

Switzerland

Call: HBL; HBP
Kilocycles: 9,595, 7,797

Standard Time: Central European (coincides with British Summer Time).

Languages: French, Spanish, and English.

Announcer: Man.

Call: "This is the wireless station of the Information Department of the Secretariat of the League of Nations at Geneva, Switzerland." (Also given in French and Spanish.)

Times of Transmission (G.M.T.): 22.30-23.15 (Saturdays), simultaneous broadcasts on both wavelengths. Broadcasts relating to the activities of the League of Nations.

The following wavelengths are also used for special purposes:—

HBQ	...	44.94 metres	...	6,675 kilocycles	...	20	kilowatts
*HBO	...	24.94 ,,	...	12,030 ,,	...	20	,,
HBJ	...	20.64 ,,	...	14,535 ,,	...	20	,,
*HBH	...	16.23 ,,	...	18.480 ,,	...	20	,,
HBF	...	15.83 ,,	...	18,950 ,,	...	20	,,

Test broadcasts from G.M.T. 08.15-08.30 every Monday.

***Metres: 49.5**
Power: 500 w.

SKAMLEBAEK (OXY)

Denmark

Kilocycles: 6,060

Geographical position: 11° 25′ 26″ E; 55° 50′ 20° N.

Standard Time: Central European (G.M.T. plus 1 hour).

Opening Signal: One stroke on a gong.

Announcer: Man.

Call: "Kalundborg-Kobenhavn og Danmarks Kortbolgesender (also Denmark's short-wave transmitter).

Language: Danish, but German, French and English also used when broadcasts of international interest are made.

Interval Signal: As Copenhagen.

Times of Transmission: G.M.T. 18.00-24.00 every week-day; on Sundays from 16.00.

Closes down with the words: "Hermed slutter udsendelserne for i aften, Godnat, Godnat," followed by the Danish National Anthem, *Derer et Yndigt Land.*

*Also occasionally on 31.6 metres (9,493 kilocycles).

NEW DEVELOPMENTS IN ELECTRICAL MUSIC

Continued from page 279

one-twentieth part of the force of a normal piano hammer-head. The string is therefore set vibrating only lightly, thus contributing to the enhancement of the tone, especially in the depths and in the descant.

A further advantage of this construction is the reduced tension of the strings, which now need not vibrate a heavy sounding board. This results in a reduction of the load on the notches, boxes and iron plates, which therefore can now be constructed very lightly, and has the advantage that the die-away time is increased three- to five-fold. To reduce this to the usual time for normal playing, a special damper-rail has been fitted in addition to the ordinary damper device.

When this damper-rail is raised the bass tones take longer than a minute dying away. If now the audibility regulator connected with the left pedal is also used, harmonium-like sounds can be obtained on the instrument. It may be mentioned, in passing, that with this instrument there is combined a gramophone pick-up system. By this means it is possible to accompany on the grand piano a violin or 'cello solo reproduced from a gramophone record.

The effect is very pleasing, the more so as both the violin and the piano accompaniment from the loud-speaker sound as if they come from the same source. It may be of interest that an Englishman, J. Compton, applied in 1929 for a British patent for an electric piano constructed on similar lines.

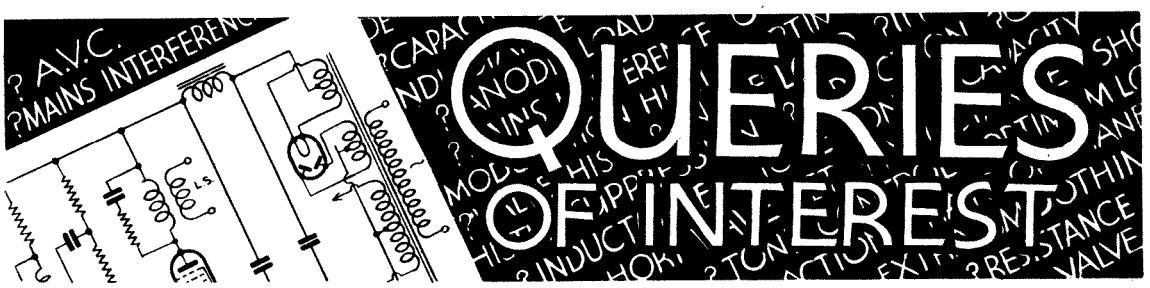
Last year two German scientists, B. Bizos and O. Vierling, constructed string instruments in which, also, the mechanical vibrations caused through the passing of the bow over the strings are transformed into electrical oscillations and rendered by a loudspeaker.

Especially noteworthy in their work was the demonstration that with loose stretching of the strings basso could be played on a violin, for the size of the body of the instrument is of no consequence, the deepest vibrations being rendered by the loudspeaker to their fullest strength.

By intermediate connection of electrical means, the inventors have also been able to change the tone colour in such a way that notes of quite different timbre were rendered by the loudspeaker.

It may perhaps be mentioned here, for the sake of completeness, that the characteristic of the photo-electrical cell of altering its electrical resistance in accordance with the strength of the light thrown on it has also been utilised by many inventors for the production of electrical music. Space does not, however, permit us in this article to go into details regarding instruments developed on this basis.

As yet the development in this latent sphere of electro-acoustic technique is not complete. It seems, however, certain after what has been said above that electrical music has brought, and will still bring, to composers and artists the realisation of their desire for greater powers of expression.



The selection of questions and answers appearing below is the result of a search through our post bag in quest of matter which we consider of general interest and having a direct bearing upon everyday practical problems. The readers who actually asked these questions have, of course, received a reply through the post

"I HAVE a four-valve (mains) receiver with two high-frequency stages to which I have recently added automatic volume control of the amplified delay-action type with unfortunate results. While it certainly does something to reduce fading and completely eliminates blasting effects on the more powerful stations, it seems to prevent me from getting full volume on *any* station. At first I thought that something had gone wrong with the set and caused it to lose power, but on disconnecting the A.V.C. circuit all the old pep came back, so I conclude that the trouble lies in the arrangement of the control device. Can you put me on the track of it?"

It would appear that the measure of control which is being applied is too severe; it comes into action before the volume has had a chance to rise to its normal level. The remedy is to be found in a slight readjustment of the "delay" device. Our correspondent does not tell us very much about the exact circuit in use, so we must put our advice in quite general terms. The object should be to increase the delay action, so that control shall take effect only after the volume has risen to a higher level than at present. This will presumably mean that the opposing delay voltage must be increased, and if it is obtained in the usual manner, from the voltage drop across a resistance, the value of this must be modified suitably.

◆ ◆ ◆

"I AM considering the construction of the 1935 Super Five described in the January number, but am not altogether pleased with the gramophone pick-up arrangements. I observe that the pick-up must be disconnected when not in use, and this strikes me as inconvenient. Could I not fit a simple switch instead?"

Usually a dangerous proceeding, but comparatively safe here because the valve whose grid circuit is concerned happens to be a low-frequency amplifier. Insert a single-pole on-off switch in series in Wire No. 69 and all should be well.

◆ ◆ ◆

"I AM somewhat puzzled to account for the proposal to use such ultra-short waves as 5 and 6 metres for television work, when we have all been told that such waves have a range limited to the distance at which the transmitter can be seen. Would you explain?"

The "optical range" theory was simply one of those premature pronouncements of the pundits which are soon exploded by the practical experimenters.

◆ ◆ ◆

"UNTIL recently I used a two-stage resistance-coupled amplifier for both radio and gramophone work and got excellent quality but not quite enough power. About a month ago I rebuilt the instrument with three stages, with rather unsatisfactory results. There is now ample power and and the circuit appears quite stable, but there is a noticeable loss of bass. Can you suggest anything?"

This trouble is probably a matter of circuit values, since our correspondent states in his letter (which we have summarised above) that the amplifier is completely stable. It would appear that he simply duplicated the first stage of the old amplifier when adding his third valve, and it seems that the grid circuit components were in the first place of such values as to cause a slight, but scarcely perceptible, loss of bass. It has to be realised in such cases that the effect increases progressively with the number of stages. We note that the actual values of grid condenser and leak in this instance were .005 microfarad and 1 megohm., which combination is barely adequate for a single stage and definitely undesirable for two. We have advised our correspondent to substitute condensers of .01 microfarad, and have already heard from him that this has effected a cure.

◆ ◆ ◆

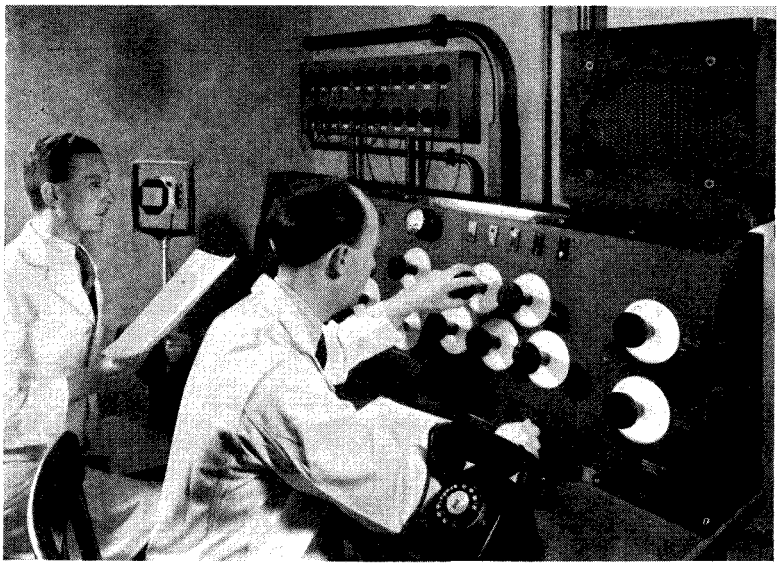
"I HAVE added A.V.C. to a receiver with a single high-frequency stage, although I knew that it could not be expected to give very much control. I had hoped that it would at least serve to prevent blasting when a powerful station rose suddenly to maximum after a period of fading, but this it fails to do. It has *some* effect, though, because I can no longer get such heavy overloading from the local as I used to previously. Can I do anything to improve matters?"

It is, of course, difficult to get any real measure of control with a single stage, but we think that our correspondent should be able to improve on his reported results. Fortunately, he gives very complete details of his circuit, and we can therefore advise him with some confidence that his first step should be to try a considerable reduction in his "delay" voltage.

The object should be to lower this voltage until it is found that the volume of the more powerful distant stations begins to be cut down, with reaction just a little below maximum, whereupon the voltage can be raised again just a trifle to a value which will be correct for all general purposes.

Records

A Review of



A new control board has been built at the Columbia and H.M.V. recording studios. It enables sounds from various studios to be mixed, the result being passed on to the recording apparatus. We can expect some rather unusual effects in future records

JUBILEE records must be the chief topic this month. It is usual to begin with a march: *Silver Jubilee*, written by R. Letts and played by the Wireless Military Band (Col. DB1518, 2s. 6d.) is very well recorded, but I cannot honestly say that I was stirred to enthusiasm, though I expected to be.

I did enjoy the two 12-inch records of Geraldo's *Twenty-five Years of Musical Comedy* (Col. DX679 and 680, 4s.). The four sides cover from the *Quaker Girl* of 1910 to *Streamline* and *Jill Darling* of today. I am not an ancient, but, believe me, I was much impressed with such "historical" tunes as those from *Maid of the Mountains*, *Kissing Time*, *Last Waltz*, *Lilac Time*, and *No No Nanette*, just to mention a few. There is eight shillings worth of real music here.

Denis Gonet, a thirteen-year-old schoolboy, has recorded two operatic airs for Regal-Zonophone this month. He has a fully developed tenor voice. A real novelty record, this! (MR1633)

Debroy Somers produces an *Empire Pageant*, introducing all the usual patriotic airs . . . but I wonder whether I like such tunes played by a dance-band combination. But there you are: this modern school! (Columbia DX681, 4s.).

H.M.V. has done a 12-inch *Jubilee Dance Memories*, played by the New Mayfair Orchestra. Now this is excellent. Do you remember "The Sheik of Araby," "My Sweetie Went Away," "Horsey, Keep Your Tail Up"? Dance tunes die quickly, I admit, but it is really fine to hear some of the old ones all over again. (H.M.V. C2732, 4s.).

Ambrose records Decca's *Jubilee Cavalcade*. I will pick out just four tunes: "Just a wee Doch and Doris," "If You Were the Only Girl," "Round the Marble Arch," and "Dinah." There's a contrasted quartet! Another really splendid medley (Decca K750, 3s.).

So much for Jubilee discs. Whilst talking about twelve-inchers, there's *Musical Moments*, a medley of melodious tunes, with such favourites as "Merry Widow," "One Night of Love," and "The Lights Are Low," introduced by Robert Tredinnick and played by Anton and the Paramount Astoria Orchestra with vocalists. You've heard Anton's band over the air. It is a fine record (Columbia DX678, 4s.).

If you have a good radiogram, take my advice and get *A Garland of Roses* played by Quentin Maclean on the organ of the Trocadero Cinema. Marvellous recording and marvellous playing. The tunes have all roses mixed up in their titles—a crude way of putting it, I admit—"Roses of Picardy," "Moonlight and Roses," "Wedding of the Rose," "Only a Rose," and so on (Columbia DX675, 4s.).

Now if you want something really nice—as the salesman would say—my recommendation for the month is Mozart's *Symphony in G Minor*, played by the London Philharmonic Orchestra, under Serge Koussevitsky—conductor of the Boston Symphony Orchestra—on three H.M.V. red label twelve-inchers (DB2343-5, 6s. each). Recording as perfect as the science permits, performance as good as we shall ever get!

At the other end of the stick I find Gracie Fields singing *Born to be a Clown* and *You Haven't Altered a Bit* (H.M.V. B8298, 2s. 6d.). All Gracie's *inimitable* tomfoolery is in the second; a good laugh for all.

I'm always thrilled by Billy Mayerl. *Nimble Fingered Gentleman* is the apt title of his Columbia record this month. That man's nimble playing is amazing. Incidentally a good test record for fans (Columbia DB1524, 2s. 6d.).

Talking of wonders: a mere schoolboy sings *Plume in the Summer Wind*, by Verdi, and *On With the Motley*, Leoncavallo, both in Italian, on Regal-Zonophone MR1633. This schoolboy, Denis Gonet, thirteen years of age, has a fully-developed man's tenor voice.

If you want a novelty, here is an outstanding one.

for Your Radiogram

the Latest Record Releases by T. F. HENN

One criticism, though: the novelty accompaniment spoils the real effect. Try it! By the way, all Regal records cost 1s.; last month I priced them as 1s. 6d. A mistake, and I'm sorry.

I'm very fond of really old ballad songs, and one I would strongly recommend you to get is Ernest Butcher singing *I Sing as I Limp Along* and *Nowt About Owt* on Columbia DB1520 (2s. 6d.). You have probably heard these songs over the air; if not, make a point of hearing them. They are really good! John Hendrik sings *A Beggar Who's in Love Can be a King* and *Too Beautiful for Words*, on Parlophone R2052 (2s. 6d.). Not very old, I admit, but these two tunes have also caught my fancy. (2s. 6d.)

Piccaver on Decca M459 (2s. 6d.) records *Out of the Twilight* and *Dreams*, two fine old songs that really—and I do like the modern ones—do make one think that the old ones are best after all.

As a decided contrast we have Bob Crosby—the great Bing's brother—trying his hand at crooning, on Decca M460. He sings two songs, *Clouds* and *Blue Moon*. I am inclined to think, from an impartial point of view, that Bob is as good as Bing, though, mind you, he has not got that " appeal " that has made his brother.

I am going to give a trio of the best of these light vocal records in the order of merit which I, personally would put them: (1) Pat Hyde, accompanied by Edgar Jackson and his Orchestra, singing *Dinah* and *Poor Butterfly*, beautifully done, this; unusual orchestral accompaniment is the chief attraction (Parlophone R2050, 2s. 6d.): (2) Elsie Carlisle singing *I've Got an Invitation to a Dance* and *I'm Afraid to Open Your Letter*, on Decca F5456 (1s. 6d.)—one of the finest lady crooners, and the most versatile, we have in this country: and, thirdly, I liked *Pop Goes Your Heart* and *Rain*, sung by Brian Lawrence, on Panachord 25696 (1s.). *Pop Goes Your Heart* is one of today's best tunes.

As a motorist I have great pleasure in bringing to your notice *Gertie, the Girl with the Gong*, with Elsie Carlisle as Gertie, assisted by Sam Browne and Ambrose's Embassy Club Orchestra (Decca F5486, 1s. 6d.), one of the most entertaining skits on the speed limit I have heard.

Before I talk about dance tunes there are two neat light-music records which will appeal to those listeners with " quiet " tastes. The Orchestre Raymonde plays *Chanson d'Amour* and Eric Coates' *Sleepy Lagoon* on Columbia DB1519 (2s. 6d.). *A Bouquet from Jerome Kern* on Regal MR1637 is another.

And now for dance music. Take your choice from the following, the best of the month.

Harry Roy: *Two Trumpet Toot* and *Let's Have a Jubilee* (Parlophone F129).

Eddie Carroll and His Music: *A Little White Gardenia* and *I Knew You When* (Parlophone F134).

Teddy Joyce and His Orchestra: *Corcovada* (rumba) and *I'm Afraid to Open Your Letter* (H.M.V. BD138).

McKinney's Cotton Pickers: *Wherever There's a Will There's a Way*, and Jimmie Lunceford and his Orchestra: *Breakfast Ball* (H.M.V. BD135).

Lew Stone and His Band: *Song of the Trees* and *Old Timer* (Regal MR1626).

Sidney Kyte and his Piccadilly Hotel Band: *Old Missouri Moon* (waltz) and *Old Bohemian Town* (Panachord 25706, 1s.).

And, finally, a medley of dance tunes played by the Bugle Call Raggers on Decca F5483. All dance tunes mentioned above are fox-trots and cost 1s. 6d.

Harry Roy is turning out really brilliant hits for Parlophone

" Gertie the Girl with a Gong " is Ambrose's big hit on Decca this month

Sidney Kyte, whose Piccadilly Hotel Band has recorded for Panachord

News from the Radio Societies

Conducted by G6QB

Under this heading we propose to publish reports every month of the activities of short-wave and transmitting societies. We shall be pleased to give publicity to any announcements of forthcoming events, etc., and secretaries of short-wave societies, whether national or local, are asked to make the fullest use of this space

Radio Society of Great Britain

REGULATIONS for the R.S.G.B.'s next important event, National Field Day, have now been published. This contest, which runs from 5 p.m. on Saturday, June 1, till 8 p.m. on Sunday, June 2, is a regular annual event and does much to keep up the popularity of work with portable receivers and transmitters.

Each district of the R.S.G.B. is permitted to erect two portable stations, one transmitting and receiving on the 160-metre and 80-metre bands, the other on the 40- and 20-metre bands.

Limited Powers

Power is limited to 10 watts on 160 metres, and to 25 watts on the other wavebands. Power-supply must *not* be derived from mains, and the stations may *not* be operated from a "normally occupied dwelling house." This, naturally, means tents, large car batteries, motor-generators, etc.!

Points are scored for all contacts with stations outside the particular district in which the portable station is situated, and a special bonus is granted for contacts with *other* portable stations.

Aerial Restrictions

Aerials are restricted in height to 45 ft. above ground level, and no apparatus may be erected on the site before 11 a.m. on the Saturday.

From all this one can see that "N.F.D." is a real test of the efficiency of portable equipment and that the winning district can really claim to have achieved something in that line.

A great amount of 5-metre activity is taking place amongst London members of R.S.G.B., and Monday and Thursday nights at 10.30 p.m. have been chosen for regular tests. The following stations, all in South London and district, are known to be working regularly at these times: G2AW (Bromley), G2GB (Shortlands), G5LB (Beckenham), G5OJ (Keston), G5IS (Dulwich), G6NF (West Norwood), G6QB (Thornton Heath), G2NH and G2DZ (New Malden), and G2MR (Kingston).

Anyone hearing these stations on 5 metres is asked to report at once, preferably to R.S.G.B. Headquarters, 53 Victoria Street, S.W.1.

The International 10-metre Contest, which has been running for six months and continues for another six, is being fairly well supported, but transmitters in this country seem to have little chance of amassing points.

The Australians have no difficulty in communicating with New Zealand on that wavelength, but the only stations available to transmitters in this country are occasional Europeans.

> **AN INVITATION**
>
> *Secretaries of short-wave and transmitting societies are invited to make full use of this new feature in "W.M." Contributions and notices should be addressed to G6QB, c/o the Editor, "Wireless Magazine," George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2*

Readers hearing signals of any kind on the 10-metre band are also asked to report them to R.S.G.B. at once.

◆ ◆ ◆

International Short-wave Club

This club now has "chapters" in this country at London, Leicester and Manchester, all of which hold regular meetings. Readers are invited to attend these meetings and to make themselves known to the secretaries. The London chapter meets at the R.A.C.S. Hall, Wandsworth Road, S.E., on every Friday in each month, except the second, at 8.30 p.m.

The Manchester Chapter meets at the British Legion headquarters, Long Street, on the first and third Tuesdays of the month at 8 p.m. Leicester is also holding regular meetings, but I have not been supplied with the place or times.

The I.S.W.C. caters chiefly for keen short-wave broadcast listeners, and its monthly publication is full of the latest news about new stations, wavelength changes, and other facts of interest to the short-wave "B.C.L."

◆ ◆ ◆

Anglo-American Radio and Television Society

The A.-A.R. & T.S. is now holding occasional surprise meetings, at which members are given the opportunity of handling short-wave receivers designed and constructed by other members. Much useful interchange of knowledge is made at these meetings, and readers of "Wireless Magazine" are invited to apply for particulars to Leslie W. Orton, "Kingsthorpe," Willowbank, Uxbridge, Middlesex.

Most of the activity, at present, is confined to the home counties.

◆ ◆ ◆

The Radio, Physical and Television Society

This society, with headquarters at 72a North End Road, West Kensington, is anxious to obtain new members. Meetings commence at 8 p.m. and are held once a month. The subjects discussed extend from loudspeakers and pick-ups to television and ultra-short waves.

Further details may be obtained from M. E. Arnold, 12 Nassau Road, Barnes, S.W.13.

Continued on page 310

Tonal Balance!

Whatever your taste in music, from the balanced rhythm of a dance band to the sublimity of a classical symphony, the Garrard Radio-Gram ensures faultless reproduction. The new Type B is especially designed for the owner of the small set, fits into a space 14½ in. by 13¼ in., and incorporates the proved Garrard Motor.

PRICES:

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With 202A Induction Motor	**69/-**
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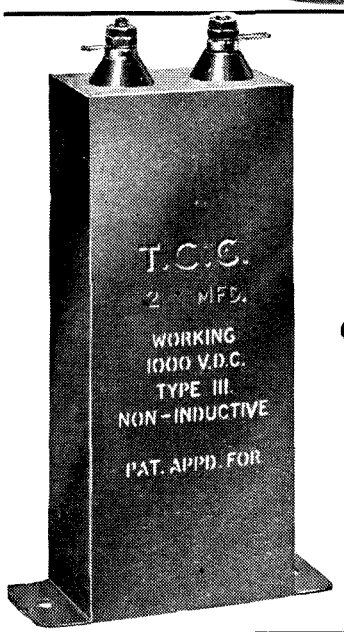

Announcing the NEW PETROLEUM JELLY—IMPREGNATED PAPER CONDENSERS

for HIGH VOLTAGES

These Condensers are designed for the high voltages common in Cathode Ray Television and modern Radio and L.F. Amplifiers. With working voltages up to 2,000 D.C. they are built on entirely new principles. The multiple-wound dielectric is of pure linen rag tissue—impregnated with petroleum jelly.

NO FREE LIQUID. Jelly gives all the advantages of oil filling without risk of leakage or "creeping" since no free liquid is employed.

Wherever high voltages or temperatures are involved—in quality R.C. amplifiers, for reservoir, decoupling or smoothing, or in tropical climates these condensers fill every exacting need.

Capacity	Type 111 1,000 V.D.C. Working	Type 121B 1,500 V.D.C. Working	Type 131 2,000 V.D.C. Working
	s. d.	s. d.	s. d.
0.1	3 6	4 3	5 0
0.25	4 0	6 3	7 6
0.5	4 6	6 9	8 0
1	6 0	8 6	10 0
2	8 3	12 0	15 0
4	14 6	18 6	21 0
5	18 0	24 0	— —
6	21 0	29 6	33 0
8	32 0	39 0	43 0
10	40 0	48 0	54 0

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SAFER AGAINST BREAK-DOWN NO FREE LIQUID

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ALL-BRITISH CONDENSERS

The Telegraph Condenser Co. Ltd.
Wales Farm Road, N. Acton W.3.

CA 6689

NEWS FROM THE RADIO SOCIETIES

Continued from page 308

South London and District Radio Transmitters' Society

The S.L.D.R.T.S. meets on the first Wednesday of each month at the Brotherhood Hall, West Norwood, S.E.27, at 8 p.m., and the first hour and a half is usually occupied by lectures or demonstrations of a technical nature. At 9.30 the meetings are thrown open for informal discussion until about 10.15.

" Junk sales " are held occasionally and facilities are always provided for the exchange of surplus gear between members, by means of a " Wanted and Disposals " sheet that is circulated at meetings.

Further details are obtainable from Mr. H. D. Cullen (G5KH), 144 West Hill, Wandsworth, S.W.15.

◆ ◆ ◆

The Local Societies

Small local societies are far too numerous for me to be able to give details of them all separately. Several secretaries have written to me with full particulars, and any reader who would like to get in touch with his local society (if he doesn't know where its headquarters are situated) is asked to send me a postcard, which will be forwarded to the proper quarter.

Nearly all the small radio societies are now specialising in short waves and television, interest in the ordinary broadcast bands being confined chiefly to the sphere of high-quality reproduction.

◆ ◆ ◆

New Societies

New societies, chiefly with a special interest in television, are being formed in practically every town. Secretaries seem to be rather slack about publicity, which I shall be pleased to give them if they will only make their existence known to me by means of a letter or postcard.

I have been notified that plans are on foot for the founding of a television society in Croydon and district, but that lack of support is holding them up at the moment.

There is also a proposal to start a Home Counties Short-wave and Television Society with a branch on each side of the Thames. Anyone interested is asked to let me know at once.

Next Month !

NEW STRAIGHT THREE-VALVER —a battery set, designed by G. P. Kendall, B.Sc.

Wiring Diagrams of P. Wilson's Power Amplifier.

NEW SHORT-WAVE ADAPTOR.

More About the Harris 1935 Radiogram.

KEEPING H.F. WHERE IT BELONGS—a special contribution by Marcus G. Scroggie, A.M.I.E.E.

The June Issue of " W.M." will be on sale Thursday, May 23.

In Introducing this High Fidelity Instrument

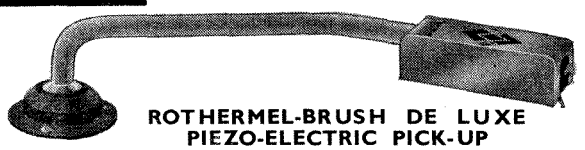
Mr. PERCY W. HARRIS M.I.R.E.

EXCLUSIVELY SPECIFIES

the following

ROTHERMEL

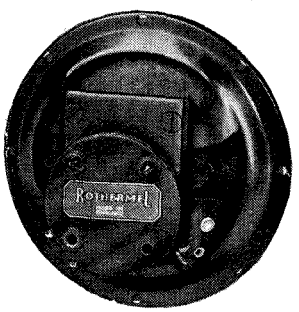
HIGH FIDELITY INSTRUMENTS for "MY RADIOGRAM"



ROTHERMEL-BRUSH DE LUXE PIEZO-ELECTRIC PICK-UP

This new Pick-up provides an average output of 1.8 volts with no pronounced peaks over the entire frequency range up to 10,000 c.p.s. The bronze finished arm has a swivel head, and bearings are damped in order to eliminate resonances. The base has a ball race movement.

PRICE £4.4.0



ROTHERMEL-BRUSH R155 TWEETER

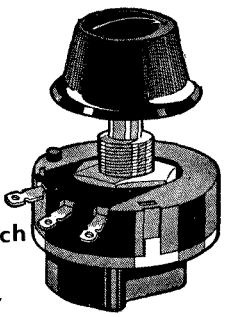
The Rothermel-Brush Piezo-Electric "Tweeter" is a definite necessity in providing high-fidelity reproduction. It can be used with all moving-coil speakers and will provide a frequency response up to 12,000 cycles. Overall diameter, 5 in. Depth, 1¾ in.

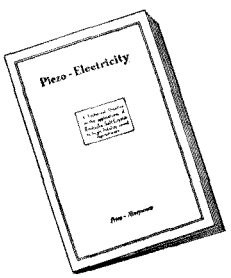
PRICE 21/-

CENTRALAB GRADED RADIOHM VOLUME CONTROLS

Centralab Volume Controls provide a resistance track 3¾ in. long, all of which is brought into use. For years they have been standardised by leading radio set manufacturers all over the world. The specification of "MY RADIOGRAM" includes one 10,000-ohm, one 25,000-ohm and one 250,000-ohm Centralab Volume Control, all without switch.

PRICE 3/9 each





PIEZO-ELECTRICITY

Get to know more about Piezo-Electric pick-ups, tweeters, speakers and microphones by writing to-day for a copy of "Piezo-Electricity"—a technical treatise on the application of Rochelle Salts to high-fidelity reproducers. **Price 9d.**, post free.

POST THIS COUPON TO-DAY

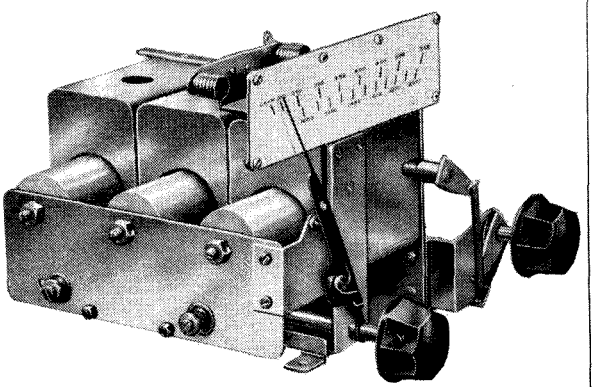
To R. A ROTHERMEL LTD.,
Rothermel House, Canterbury Road,
High Road, Kilburn, N.W.6.
(Phone: Maida Vale 6066)

Please send me a copy of "Piezo-Electricity." I enclose 9d. to cover cost of same.

Name .....

Address .....

PERMEABILITY TUNER SPECIFIED AGAIN!



Once again the Varley Permeability Tuner has been specified—yet another proof of the efficiency of this new method of tuning instituted by Varley. This time Mr. Percy W. Harris has specified the 3-Gang Permeability Tuner for his radiogram, "My Radiogram," described in detail in this number of "Wireless Magazine."

● Write for our Free Illustrated Catalogue, giving information on all Varley components—particularly the following, which have been specified for "Wireless Magazine" sets, described in this issue: Permeability Tuner (BP 100), 67/6; Smoothing Choke (DP 16), 17/6, specified for "My Radiogram"; and the Mains Transformer (EP 33), 37/6, specified for the "1935 A.C. Stenode."

PERMEABILITY TUNER

3-GANG MODEL (BP 100) **67/6**

Varley

(Oliver Pell Control, Ltd.)

Bloomfield Road, Woolwich, S.E.18 *Tel. Woolwich 2345*

Mention of the "Wireless Magazine" will ensure prompt attention

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The story of the lives of our Beloved King and Queen and their Family is graphically told in simple, moving language. Beginning with the death of the Duke of Clarence, it passes through the unforgettable years that followed, right down to the present time. Here is a beautiful Souvenir, to be treasured in your home, to be looked at and read again and again. It is undoubtedly the most magnificent Souvenir published to commemorate the Jubilee and Jubilee Year.

Make certain of yours to-day—the demand will be exceptional!

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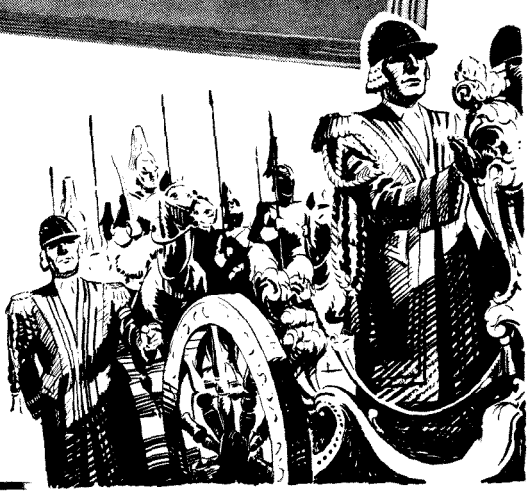

Geo. Newnes Ltd.

World's Broadcast Wavelengths

Stations best received in the British Isles are indicated in bold type. This list is corrected up to the time of going to press

Note : Names in brackets are those of the main stations from which the greater part of the programmes are relayed

Wave-length	Name of Station	Dial Readings	Country
13.93	Pittsburgh W8XK		United States
13.97	**Daventry (Empire) GSH**		Great Britain
14.49	Buenos Aires LSY		Argentine
15.92	Bandoeng PLE		Java
16.36	Lawrenceville (N.J.) WLA		United States
16.38	**Rugby GAS**		Great Britain
16.5	Drummondville (CFA8)		Canada
16.56	Bandoeng PMC		Java
16.56	Buenos Aires LSY3		Argentine
16.81	Bandoeng PLF		Java
16.85	Kootwijk PCV		Holland
16.86	Daventry Empire GSG		Great Britain
16.878	**Boundbrook W3XAL (WJZ)**		United States
16.88	**Eindhoven PHI**		Holland
19.47	Riobamba PRADO		Ecuador
19.52	Szekesfehervar		Hungary
19.56	**Schenectady W2XAD (WGY)**		United States
19.61	La Paz CP4		Bolivia
19.63	**New York W2XE (WABC)**		United States
19.66	**Daventry (Empire) GSI**		Great Britain
19.67	Coytesville N.J. WIXAL (WEEI)		United States
19.67	Tashkent (Rim)		U.S.S.R.
19.68	**Radio Coloniale FYA**		France
19.72	**Saxonburg W8XK (KDKA)**		United States
19.74	**Zeesen DJB**		Germany
19.82	Daventry (Empire) GSF		Great Britain
19.84	Rome (Vatican) HVJ		Italy
19.88	Moscow (RKI)		U.S.S.R.
19.93	W8XK, Saxonburg (KDKA)		United States
20.27	Rocky Point WQV		United States
20.31	Rocky Point N.Y. (WEB)		United States
21.43	Cairo SUV		Egypt
21.53	Rocky Point WIK		United States
21.58	Rocky Point WQP		United States
21.605	Rocky Point WQT		United States
21.83	Drummondville CJA8		Canada
22.26	Rocky Point WAJ		United States
22.48	Santa Rita YVQ		Venezuela
22.684	**Zeesen (DHB)**		Germany
23.39	Radio Maroc (Rabat) CNR		Morocco
24.41	Rugby GBU		Great Britain
24.9	Kootwijk PDV		Holland
25	Moscow RNE		U.S.S.R.
25.25	Radio Colonial, Paris (FYA)		France
25.27	**Saxonburg (Pa.) W8XK (KDKA)**		United States
25.28	**Daventry (Empire) GSE**		Great Britain
25.34	Wayne W2XE (WABC)		United States
25.4	**Rome 2RO**		Italy
25.45	Boston WIXAL (WEEI)		United States
25.49	**Zeesen DJD**		Germany
25.532	**Daventry (Empire) GSD**		Great Britain
25.63	Radio Coloniale FYA		France
26.83	Funchal CT3AQ		Madeira
27.65	Nauen DFL		Germany
27.86	Rugby GBP		Great Britain
27.88	Marapicu PSG		Brazil
28.28	Rocky Point (N.J.) WEA		United States
28.5	Sydney VLK		N.S. Wales
28.98	Buenos Aires LSX		Argentine
29.03	Bermuda ZFD		West Indies
29.04	Ruysselede (ORK)		Belgium
29.35	Marapicu PSH		Brazil
29.59	Leopoldville OPM		Belgian Congo
29.64	Marapicu PSI		Brazil
29.84	Abu Zabel, Cairo SUV		Egypt
30	Radio Excelsior LR5		Argentine
30.1	Rome IRS		Italy
30.4	Lawrenceville WON		United States
30.4	Tokio JIAA		Japan
30.00	Madrid EAQ		Spain
30.77	Lawrenceville WOF		United States
30.9	**Rugby GCA**		Great Britain
31.23	Mexico City XETE		Mexico
31.25	**Lisbon CTIAA**		Portugal
31.26	Radio Nations HBL		Switzerland
31.28	**Philadelphia W3XAU (WCAU)**		United States
31.28	**Sydney VK2ME**		N.S. Wales
31.32	**Daventry (Empire) GSC**		Great Britain
31.35	**Millis W1XAZ (WBZ)**		United States
31.38	**Zeesen DJA**		Germany
31.41	Jelöy LCL		Norway
31.45	**Zeesen (DJN)**		Germany
31.48	**Schenectady W2XAF (WGY)**		United States
31.55	**Daventry (Empire) GSB**		Great Britain
31.55	Melbourne VK3ME		Victoria
31.55	Caracas YV3BC		Venezuela
31.58	Rio de Janeiro PSA		Brazil
31.6	**Skamlebaek**		Denmark
31.71	New Brunswick WKJ		United States
31.9	Bandoeng PLV		Java
32.71	**Lawrenceville WNA**		United States
32.79	Maracay YVQ		Venezuela
32.88	Szekesfehervar HA I4		Hungary
33.26	Rugby GCS		Great Britain
33.59	Rocky Point (N.J.) WEC		United States
34.68	London VE9BY		Canada
36.65	Rio de Janeiro PSK (PRA3)		Brazil
37.04	Quito HCJB		Ecuador
37.33	Rabat (CNR)		Morocco
37.41	Suva VPD		Fiji Isles
38.07	Tokio JIAA		Japan
38.47	**Radio Nations HBP**		Switzerland
38.65	Kootwijk PDM		Holland
39.34	Tashkent RIM		U.S.S.R.
39.76	Moscow RKI		U.S.S.R.
39.82	Riobamba PRADO		Ecuador
40.3	Radio Nations HBQ		Switzerland
40.5	Bogota HJ3ABB		Colombia
40.54	Rocky Point WEN		U.S.A.
41.55	Bogota HKE		Colombia
41.6	Las Palmas EA8AB		Canary Isles
41.67	Singapore VS1AB		Sts. Settl'mts.
41.84	Grenada YN6RD		Nicaragua
41.9	Manizales HJ4ABB		Colombia
43	Madrid EA4AQ		Spain
43.86	Budapest HAT2		Hungary
44.61	Rocky Point WQO		United States
44.96	Maracay YVQ		Venezuela
45	Constantine FM8KR		Tunis
45	Guatemala City		S. America
45.02	Guayaquil HC2RL		Ecuador
45.38	Moscow RW72		U.S.S.R.
46.53	Barranquilla (HJ1ABB)		Colombia
46.69	Boundbrook W3XL (WJZ)		United States
46.7	Boston WIXAL		United States
47	Cali HJ5ABB		Colombia
47.5	S. Domingo HIZ		Dominican R.
47.8	Domingo HIAA		Dominican R.
48.75	Winnipeg CJRO		Canada
48.78	Caracas YV3BC		Venezuela
48.86	**Saxonburg (Pa.) W8XK (KDKA)** / Moscow (RKK)		United States / U.S.S.R.
49.02	Bandoeng (YDA)		Dutch E.Indies
49.02	Wayne W2XE (WABC)		United States
49.08	**Caracas YVIBC**		Venezuela
49.1	**Daventry (Empire) GSL**		Great Britain
49.18	**Boundbrook W3XAL (WJZ)** / Chicago W9XF (WENR)		United States / United States
49.22	Bowmanville VE9GW (CRCT)		Canada
49.26	St. John VE9BJ (CFBL)		N. Brunswick
49.3	La Paz CP5		Bolivia
49.34	Chicago W9XAA (WCFL)		United States
49.35	**Zeesen (D9M)**		Germany
49.39	Maracaibo V5BMO		Venezuela
49.4	Vienna OER2		Austria
49.43	Vancouver VE9CS (CKFC)		Brit. Columbia
49.47	Nairobi VQ7LO		Kenya Colony
49.5	**Skamlebaek**		Denmark
49.5	**Philadelphia W4XAU (WCAU)**		United States
49.5	Cincinnati W8XAL (WLW)		United States
49.586	**Daventry (Empire) GSA**		Great Britain
49.6	Bogota HJ3ABI		Colombia
49.67	Boston WIXAL (WEED)		United States
49.69	Priok (YDA)		Dutch E.Indies
49.83	**Zeesen DJC**		Germany
49.92	Havana COC		Cuba
49.96	**Drummondville VE9DN (CFCF)**		Canada
50	**Moscow RNE**		U.S.S.R.
50.8	Barcelona EA3AB		Spain

Continued overleaf

WORLD'S BROADCAST WAVELENGTHS

Continued from page 313

Note Specially the Re-arrangement of British Wavelengths

Wave-length	Name of Station	Dial Readings	Country
50.26	**Rome (Vatican) HVJ**		Italy
50.42	Domingo HIX		Dominican R.
50.6	Medellin HJ4ABE		Colombia
55.56	**Szehesfehevar**		Hungary
56.9	Königswusterhausen (DTG)		Germany
57.03	**Rocky Point WQN**		United States
58.0	Bandoeng PMY		Java
58.31	**Prague**		Czechoslovakia
60.3	Rugby GBC		Great Britain
62.5	**Long Island (N.J.) W2X**		United States
62.5	London		Ontario
65.93	Rocky Point WAD		United States
67.11	Soerabaja (YDA)		Dutch E. Indies
68.18	Moscow (RFCK)		U.S.S.R.
69.44	Rugby GDB		Great Britain
70.2	Khabarovsk RV15		U.S.S.R.
73	Quito (HCJB)		Ecuador
76	Maracay (YV11AM)		Venezuela
80	Lisbon CTICT		Portugal
84.5	Berlin D4AGE		Germany
85.9	Boston WIXAL		United States
98.68	Priok (YDB)		Dutch E. Indies
203.5	Plymouth		Great Britain
	Bournemouth		Great Britain
204.8	Pecs		Hungary
206	**Fécamp**		France
208.6	Miskolcz		Hungary
209.9	Beziers		France
	Alexandria		Egypt
211.3	Tampere		Finland
215.4	Radio Lyons		France
216.8	Warsaw No. 2		Poland
218.2	Basle, Berne		Switzerland
221.1	**Turin (2)**		Italy
222.5	**Milan (2)**		Italy
222.6	**Dublin**		Irish F. State
	Bordeaux S.O.		France
	Königsberg		Germany
224	Montpellier		France
	Lodz		Poland
225.6	Hanover		Germany
	Bremen		Germany
	Flensburg		Germany
	Stettin		Germany
	Magdeburg		Germany
230.2	Danzig		Germany
231.8	Linz		Austria
	Dornbirn		Austria
233.5	**Aberdeen**		Great Britain
	Dresden		Germany
235.1	Stavanger		Norway
236.8	**Nurnberg**		Germany
238.5	San Sebastian		Spain
	Rome (3)		Italy
240.2	Juan-les-Pins		France
242	**Cork**		Irish F. State
243.7	**Gleiwitz**		Germany
245.5	**Trieste**		Italy
247.5	**Lille PTT**		France
249.2	Prague Strasnice (2)		Czechoslovakia
51	Frankfurt-am-Main		Germany
	Trier		Germany
	Freiburg-im-Breisgau		Germany
	Cassel		Germany
	Kaiserslautern		Germany
253.2	Kharkov (2)		U.S.S.R.
255.1	**Copenhagen**		Denmark
257.1	**Monte Ceneri**		Switzerland
257.1	Kosice		Czechoslovakia
261.1	**London National**		Great Britain
	North National		Great Britain
	West National		Great Britain
263.2	**Turin (1)**		Italy
265.3	Horby		Sweden
267.4	**Newcastle**		Great Britain
	Nyiregyhaza		Hungary
270	**Moravska-Ostrava**		Czechoslovakia
271.7	Madona		Latvia
274	Madrid EAJ7		Spain
276.2	Falun		Sweden
	Zagreb		Yugoslavia
278.6	Bordeaux PTT		France
280.9	Tiraspol		U.S.S.R.
283.3	**Bari**		Italy
285.7	**Scottish National**		Great Britain
288.5	Leningrad (2)		U.S.S.R.
	Rennes PTT		France
291	**Königsberg**		Germany
	Parede		Portugal
293.5	Barcelona (EAJ15)		Spain
296.2	**Midland Regional**		Great Britain

Wave-length	Name of Station	Dial Readings	Country
298.8	**Bratislava**		Czechoslovakia
301.5	Hilversum		Holland
304.3	**Genoa**		Italy
307.1	**Belfast**		N. Ireland
309.9	Odessa		U.S.S.R.
312.8	**Poste Parisien, Paris**		France
315.8	**Breslau**		Germany
318.8	Goteborg		Sweden
	Algiers		North Africa
321.9	**Brussels (2)**		Belgium
325.4	Brno		Czechoslovakia
328.6	Radio Toulouse		France
331.9	**Hamburg**		Germany
335.2	Helsinki		Finland
338.6	Graz		Austria
342.1	**London Regional**		Great Britain
345.6	Poznan		Poland
349.2	**Strasbourg**		France
352.9	Bergen		Norway
	Valencia		Spain
356.7	**Berlin**		Germany
360.6	Moscow (4)		U.S.S.R.
364.5	**Bucharest**		Roumania
368.6	**Milan**		Italy
373.1	**West Regional**		Great Britain
	Salonika		Greece
377.4	**Lvov**		Poland
	Barcelona (EAJ1)		Spain
382.2	**Leipzig**		Germany
386.6	**Toulouse PTT**		France
391.1	**Scottish Regional**		Great Britain
395.8	**Katowice**		Poland
400.5	Marseilles PTT		France
405.4	**Munich**		Germany
410.4	Seville		Spain
	Tallinn		Estonia
	Madrid (Espana)		Spain
415.5	Kiev		U.S.S.R.
420.8	**Rome**		Italy
426.1	**Stockholm**		Sweden
431.7	**Paris PTT**		France
437.3	**Belgrade**		Yugoslavia
443.1	**Sottens**		Switzerland
449.1	**North Regional**		Great Britain
455.9	**Cologne**		Germany
463	**Lyons PTT**		France
470.2	**Prague (1)**		Czechoslovakia
476.9	Trondheim		Norway
483.9	**Brussels (1)**		Belgium
492	**Florence**		Italy
499.2	**Sundsvall**		Sweden
	Rabat		Morocco
506.8	**Vienna**		Austria
514.6	Agen		France
	Riga		Latvia
522.6	**Stuttgart**		Germany
531	**Athlone**		Irish F. State
539.6	**Beromünster**		Switzerland
549.5	**Budapest**		Hungary
559.7	Wilno		Poland
	Bolzano		Italy
569.3	Viipuri		Finland
	Ljubljana		Yugoslavia
578	Innsbruck		Austria
	Hamar		Norway
696	Oulu		Finland
748	Moscow		U.S.S.R.
	Geneva		Switzerland
765	Boden		Sweden
834	Budapest No. 2		Hungary
845	Finnmark		Norway
1,107	Moscow (2)		U.S.S.R.
1,154	**Oslo**		Norway
1,224	Leningrad		U.S.S.R.
1,261	**Kalundborg**		Denmark
1,304	**Luxembourg**		Luxembourg
	Ankara		Turkey
1,339	Warsaw		Poland
1,389	**Motala**		Sweden
1,395	**Eiffel Tower**		France
1,442	Minsk		U.S.S.R.
1,500	**Droitwich National**		Great Britain
1,571	**Deutschlandsender**		Germany
1,600	Istanbul		Turkey
1,648	**Radio Paris**		France
1,724	**Moscow No. 1**		U.S.S.R.
1,807	Lahti		Finland
	Kootwijk		Holland
1,875	Huizen		Holland
	Brasov		Roumania
1,935	Kaunas		Lithuania

Notes and Jottings

FROM A. C. Cossor, Ltd., comes an interesting note giving details of the new " Thermometer tuning " device developed for use on the new model 364 superhet. This receiver is fitted with two " Thermometers "—one for medium waves and one for the upper band.

The devices are lighted from within, and they function thus : as the tuning knob is turned the column in the transparent thermometer tube rises and shows the name of the station received upon a scale, which is made interchangeable as a safeguard against future wavelength shuffles.

◆ ◆ ◆

A new Portuguese station is announced for erection on a site at Barcarena (near Lisbon) for providing a service to the Portuguese colonies. It will, of course, work on the short waveband and will be housed in the same building with the existing Lisbon medium-wave transmitter.

The power is expected to be in the neighbourhood of 20 kilowatts, and the aerial system will be designed to give maximum radiation in the direction of the countries for which the service is intended. No information as to wavelength is yet available, but so large a power should certainly give the station a good chance of being well heard here, in spite of the directive aerial.

◆ ◆ ◆

An interesting pamphlet has come from Ward and Goldstone giving collected data regarding the interference-suppression devices supplied by that firm. It seems a very useful little publication, furnishing electrical data, information as to uses, principal dimensions, and so on for 14 different models.

◆ ◆ ◆

A very elaborate system of " approach beaconing " has just been installed by Marconi's Wireless Telegraph Co. at Speke Aerodrome, Liverpool. The apparatus will enable the approaching pilot to pick up a guiding signal when he is still a considerable distance away, and there is a double " marker " system which tells him when he has arrived at a position three miles from the aerodrome, and also when he actually passes over the edge of the 'drome.

Continued on page 320

A Sound Knowledge of Television

TELEVISION promises to be a subject that will give endless pleasure and entertainment to the keen experimenter who bases his work on a really sound knowledge of fundamental principles. A new part-publication now appearing under the title of "Television Today" will make an instant appeal to all those who intend to take an active part in the fascinating new field of high-definition.

To quote the publishers' announcement: "This work is intended for people who are not content with just a superficial knowledge, but who wish to obtain complete and reliable information on the wonderful developments which have been made recently in the art and practice of television."

This suggests a wide scope, but it is fully justified by the list of contents, which we summarise thus:

TRANSMISSION SYSTEMS
Spotlight Scanning.
Floodlight Scanning.
Film and Intermediate Film Transmission.
Electronic Scanning.

RECEPTION SYSTEMS
Nipkow Disc.
Mirror Drum.
Multiple Mirror Drum.
Stationary Mirror Drum.
Mirror Screw.
Echelon Prism Lens.
Cathode-ray Tube.
Large Screen Television Reception.

THE OPTICS OF TELEVISION
ELECTRON OPTICS
PHOTO-ELECTRIC CELLS
STUDIO ARRANGEMENTS
TELEVISING OUTDOOR SCENES
SPECIAL APPARATUS
The Zworykin Iconoscope.
The Farnsworth Electron Camera.
The Electron Multiplier.

SOUND FILM TECHNIQUE APPLIED TO TELEVISION

ULTRA SHORT-WAVE WORK
General Considerations.
Short-wave and Adapter Circuits.
Components.
Ultra Short-wave Receiving Circuits.
Aerial Systems for Ultra-Short Waves.
Noise-reducing Aerials.
Amplifiers for Ultra-short-wave Working.
The Generation of High-frequency Oscillations.

CATHODE-RAY TUBES IN PRACTICE
Power Units.
Time Bases.
Thermal Relay Switches.
Rectifiers.
Synchronising Methods.
Operating Notes.
Faults and Remedies.

LIGHT SOURCES
Arc Lamps.
Neon Lamps.
Mercury Lamps.

THE KERR CELL

THE ZINC SULPHIDE LIGHT VALVE

GLOSSARY OF TERMS

Continued on page 319

Tests of New Apparatus

AMPLION FIXED CONDENSERS

Description

A RANGE of non-inductive 700-volt working fixed condensers have been released by Amplion (1932) Ltd. These condensers are mounted in bakelite cases having integrally moulded flanges for fixing purposes. Connections are made by means of small terminals mounted adjacent to the fixing holes instead of on the top of the case, which has been the more usual practice in the past.

The indications are moulded into the top of the container, and show the capacity and the test voltage.

Observations

The appearance of the condensers is quite pleasing, and a satisfactory grade of bakelite appears to be used for the containers. The sealing appears to be properly carried out. It will be noted that the constants are satisfactory, although the tolerances on some of the examples examined are rather large.

Measurements

These are given in the table at the foot of the page.

The condensers are made by Amplion (1932) Ltd., of 82-84 Rosoman Street, Roseberry Avenue, London, E.C.1. Prices are 2s. 6d. for the 1-mfd. type, 3s. 6d. for 2 mfds., while the 4-mfd. type costs 5s. 6d.

◆ ◆ ◆

GRAHAM-FARISH "MUM"

Description

UNDER the title of "Mum," Graham Farish is producing a disturbance suppressor. This consists of two centre-point connected condensers combined with fuses in a small bakelite moulded case. Connections are made by means of a terminal for the earth lead and two short lengths of flex connected to the free sides of the condensers. The unit is sealed with black plastic compound. For fixing purposes the case has two flanges having ordinary screw holes.

Observations

It will be noted that the condensers fitted are quite small, being of the order of .1 microfarad. It is conceivable, therefore, that so small a condenser may not be sufficient to reduce some type of disturbance. In the event of a breakdown the incorporated fuse will blow, but as there is no means of replacing this it is apparently necessary to replace the complete unit.

The fusing current seems to be exceptionally high, and as the object of the fuse is merely to protect the condenser one of a much smaller rating would appear to afford a greater factor of safety.

Tests showed that the unit was successful in limiting certain types of disturbance, but the performance of any disturbance suppressor depends entirely upon the specific conditions of the interference concerned.

Measurements of the Graham Farish "Mum"

Condenser capacities	.14 mfd.	.132 mfd.
Fusing current	30 amperes.	
Power factor	.0047	.00537

The unit is made by Graham Farish, Ltd., of Mason's Hill, Bromley, Kent, and costs 2s.

Measurements Taken with Amplion Condensers

Nominal capacity	2 mfd.	2 mfd.	1 mfd.
Actual tolerance	−20%	−18%	−6%
Power factor	.0071	.0063	.0094
Insulation resistance	1,000 megohms/mfd.	666 megohms/mfd.	960 megohms/mfd.
Nominal capacity	1 mfd.	4 mfd.	4 mfd.
Actual tolerance	+6%	−10%	−15%
Power factor	.0071	.0086	.0075
Insulation resistance	500 megohms/mfd.	2,774 megohms/mfd.	2,000 megohms/mfd.

In Tune with the Trade

EXAMINERS' Review of the Latest Catalogues

SEND TO US FOR THESE CATALOGUES!

Here we review the newest booklets and folders issued by six manufacturers. If you want copies of any or all of them, just cut out this coupon and send it to us. We will see that you get all the literature you desire.

Please indicate the numbers (seen at the end of each paragraph) of the catalogues you want below:—

My name and address are :—

Send this coupon in an unsealed envelope, bearing ½d. stamp, to "Catalogue Service," WIRELESS MAGAZINE, 8-11 Southampton St., W.C.2.
Valid till May 31.

COLVERN COILS

THERE is always a deal of pleasure to be obtained in nosing one's way through a coil catalogue. I picked hold of a Colvern one recently with the result that an hour was soon spent refreshing my knowledge of Ferrocart principles. Colvern make Ferrocart coils for all sorts of sets, and I speak from experience when I say that the extra pep obtained from them is really worth the trouble.

Colvern also publish in this book a number of typical circuits using their coils, from a one high-frequency battery receiver to a rather complicated A.C. operated mains superhet with A.V.C.

I do suggest that every serious experimenter should write for a copy of the Colvern booklet—and it costs nothing! **455**

◆ ◆ ◆

TRUE-BASS BOFFLE

BOFFLE is the word all right—not a misprint! This queer word is the name of a loudspeaker container described in a leaflet come to hand from Hartley-Turner Radio, Ltd. This firm has definite views on baffles for moving-coil loudspeakers: they say that a board six ft. square is none too large. As that is an impossibility for most civilized households, this "boffle" is the suggested solution to the problem. The boffle is not expensive, and it is well worth while getting the "dope." **456**

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TUNGSRAM VALVES

I CANNOT remember seeing so much information compressed into so small a space as in this new Tungsram valve data sheet. Every type of Tungsram valve is listed; there are key drawings to all the various types of valve bases, some with four and others with seven pins; there are full details for converting existing receivers to operation from A.C. or D.C. mains at will, and so on.

Tungsram, I believe, supply nearly all of their valves in the new dome-shaped bulb. This system, which makes use of a mica structure at the apex of the electrode system, is claimed to give exceptional rigidity and to be an almost certain prevention against microphony. **457**

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PIFCO ROTAMETERS

PIFCO has sent along a broadsheet detailing the range of Rotameters and Radiometers for which this firm is well known. These instruments, which are priced from as little as 12s. 6d., give readings of volts, milliamperes, resistance, besides a plug-in test for valves in the better ones, that is, the models costing £1 9s. 6d. and two guineas.

The wireless experimenter can make all sorts of tests with one of these meters. He can test the continuity of wiring; he can make insulation tests of such components as fixed condensers, valves, transformers, loudspeaker windings, and so on; again, he can check the working conditions of detector and output circuits, and make certain that ganging is correctly carried out. In fact, there are dozens of useful measurements to be made. **458**

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A LIST FROM W.B.

W. B. ARE known to most of us for their range of Stentorian loudspeakers in and out of cabinets. My object here is to draw your attention to a catalogue which, besides loudspeakers, contains details of some of W.B.'s other lines.

For instance, this firm makes all types of valve holders, from the ordinary baseboard-mounting types to skeleton five- and seven-pin types for chassis sets. Again, there is a range of push-pull switches if you are interested, or a class-B unit for converting an ordinary battery set.

This catalogue is yours for the asking; just cut out the coupon on this page and mark the number in the space provided. **459**

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FROM ROTHERMEL

WE have heard a lot about crystal loud-speakers and pick-ups from P. Wilson, M.A., during the past few issues of "W.M." Now comes a list from Rothermel describing a piezo-astatic crystal microphone. A remarkably uniform frequency response is claimed for this microphone, which costs £5 17s. 6d.

In the same batch of catalogues are details of other crystal products. If you are really interested in high-quality reproduction, I suggest that you ask for this catalogue. **460**

A SOUND KNOWLEDGE OF TELEVISION

Continued from page 316

SPECIAL SYSTEMS

Bell Telephone Company's System.
Cossor Velocity Modulation.
Fernseh System.
German Post Office System.
H.H.I. System.
Loewe System.
Marconi-E.M.I. System.
Mihaly System.
Scophony System.
Tekade System.
Telekino System.
Telefunken System.
Von Ardenne System.

The list of contributors includes the names of many of the foremost television authorities of the day and gives a clear indication of the very sound and reliable nature of the information provided.

G. Baldwin Banks, B.Sc.
L. H. Bedford.
F. J. Camm.
H. J. Barton Chapple, B.Sc., A.M.I.E.E.
R. W. Corkling, M.I.R.E.
J. J. Denton, A.M.I.E.E.
Philo Farnsworth.
Dr. Alfred Gradenwitz.
Percy W. Harris, M.I.R.E.
F. H. Haynes.
T. D. Humphreys.
E. W. Hobbs, A.I.N.A.
E. Bolton King.
R. J. Kemp, M.I.E.E.
T. M. C. Lance, A.M.I.R.E.
N. Levin.
N. W. Maybank.
L. M. Myers, B.Sc.
W. J. Nobbs.
G. Parr, A.M.I.E.E.
O. S. Puckle.
C. Quarrington.
A. T. Sinclair.
E. H. Traub.
H. W. W. Walden.
R. C. Walker, B. Sc., A.M.I.E.E., A.M.I. Mech.E.
Capt. A. G. D. West, M.I.E.E.
J. H. A. Whitehouse.
W. D. Wright, D.Sc., A.R.C.S., D.I.C.
V. K. Zworykin.

"Television To-day" will be completed in about 16 weekly parts obtainable from all newsagents and booksellers at 1s. each, or direct from the publishers, George Newnes, Ltd., 8-11, Southampton Street, Strand, London, W.C.2., for 1s. 3d. post free.

BLUEPRINT COUPON

Valid only until May 31, 1935 (or until June 29, 1935, for overseas readers)

FOR ONE BLUEPRINT ONLY

If you want a full-size blueprint of the set constructionally described in this issue for half price, cut out the above coupon and send it, together with a postal order, to Blueprint Department, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

This coupon is valid for one blueprint only at the price indicated:—

MY 1935 RADIOGRAM (page 246), No. WM 386, price 9d., post paid.

INFORMATION COUPON

Valid only until May 31, 1935 (or until June 29, 1935, for overseas readers)

If you want to ask any questions, cut out the above coupon and send it, together with a postal order for 1s. and stamped, addressed envelope, to the Information Bureau, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

Note that not more than two questions may be asked at a time and that queries should be written on one side of the paper only.

Under no circumstances can questions be answered personally or by telephone. All inquiries must be made by letter so that every reader gets exactly the same treatment.

Alterations to blueprints or special designs cannot be undertaken: nor can readers' sets or components be tested.

If you want advice on buying a set, a stamped, addressed envelope only (without coupon or fee) should be sent to the Set Selection Bureau, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

NOTES AND JOTTINGS

(Continued from page 315)

Critics sometimes argue that car radio has its dangers, a point on which we disagree with them, but there cannot be any doubt that the long-distance motor coach offers an ideal field for radio equipment.

It is therefore interesting to learn from Philco that some half dozen of the leading coach body-builders are now offering a built-in equipment as a regular line. At least one transport company (the East Kent) is known to be fitting up a complete fleet of buses in this way.

◆ ◆ ◆

Kolster-Brandes announces the release of a very neatly-designed car radio equipment of the separate unit type. The receiver employs five valves in a superhet circuit; is well provided with noise-suppression devices; draws only 3.5 amperes from the car battery and is priced at 20 guineas.

◆ ◆ ◆

Literature we have received announcing the new H.M.V. "High-fidelity" gramophone needles contains some striking facts and figures.

For example, in playing one record the needle point covers a track *two hundred yards long*, and with an average pick-up the pressure on the point amounts to nearly five tons per square inch! The new H.M.V. needle, which has a chromium plated tip, is claimed to be capable of playing from 30 to 60 record sides without serious deterioration after the journey of about five miles involved thereby.

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Printed in Great Britain by THE SUN ENGRAVING CO., LTD., London and Watford, for the Proprietors, GEO. NEWNES, LTD., 8-11 Southampton Street, Strand, London, W.C.2. Sole Agents for Australia and New Zealand: Gordon & Gotch, Ltd. Sole Agents for South Africa: Central News Agency, Ltd. May, 1935.

"Wireless Magazine" Blueprint Service

These blueprints are full-size. Copies of appropriate issues of "Practical Wireless," "Amateur Wireless," and of "Wireless Magazine" containing descriptions of most of these sets can be obtained at 4d. and 1s. 3d. each, respectively, post paid. Index letters "P.W." refer to "Practical Wireless" sets, "A.W." refer to "Amateur Wireless" sets, and "W.M." to "Wireless Magazine" sets. Send, preferably, a postal order (stamps over sixpence unacceptable) to "Wireless Magazine" Blueprint Dept., Geo. Newnes, Ltd., 8-11 Southampton Street, Strand, W.C.2.

CRYSTAL SETS

Blueprints, 6d. each.

Four-station Crystal Set ... 31.3.34		AW427

STRAIGHT SETS (Battery Operated)

Two-valvers: Blueprints, 1s. each.

Iron-core Two (D, QPP) ... 12.8.33		AW396

Three-valvers: Blueprints, 1s. each.

Transportable Three (SG, D, Pen)	Feb. '32	WM271
Multi-mag Three (D, 2 Trans)...	June '32	WM288
Fercy Harris Radiogram (HF, D, Trans)	Aug. '32	WM294
£6 6s. Radiogram (D, RC, Trans)	Apr. '33	WM318
Simple-tune Three (SG, D, Pen)	June '33	WM327
Tyers Iron-core Three (SG, D, Pen)	July '33	WM330
Economy-pentode Three (SG, D, Pen)	Oct. '33	WM337
All-wave Three (D, 2LF) ...	Jan. '34	WM348
"W.M." 1934 Standard Three (SG, D, Pen)	Feb. '34	WM351
£33s. Three (SG, D, Trans) ...	Mar. '34	WM354
Iron-core Band-pass Three (SG D, QP21)	June '34	WM362
1535 £6 6s. Battery Three (SG, D, Pen)	Oct. '34	WM371
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New Britain's Favourite Three (D, Trans, Class B)	15.7.33	AW394
Home-built Coil Three (SG, D, Trans)	14.10.33	AW404
Fan and Family Three (D, Trans, Class B)	25.11.33	AW410
£5 5s. S.G.3 (SG, D, Trans) ...	2.12.33	AW412
1934 Ether Searcher: Baseboard Model (SG, D, Pen)	20.1.34	AW417
1934 Ether Searcher: Chassis Model (SG, D, Pen)	3.2.34	AW419
F.W.H. Mascot with Lucerne Coils (Det, R.C., Trans) ...	17.3.34	AW337A
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Pentaquester (HF, Pen, D, Pen)	14.4.34	AW431
£5 5s. Three: De-luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	9.6.34	AW437
"Wireless League" Three (HF Pen, D, Pen)	3.11.34	AW451
Graduating to a Low-frequency Stage (D, 2LF)	Jan. '35	WM378

Four-valvers: Blueprints, 1s. 6d. each.

Quadradyne (2 SG, D, Pen) ...	Feb. '32	WM273
Calibrator (SG, D, RC, Trans)	Oct. '32	WM300
Table Quad (SG, D, RC, Trans)	Nov. '32	WM303
Calibrator de Luxe (SG, D, RC, Trans)	Apr. '33	WM316
Self-contained Four (SG, D, LF, Class-B)	Aug. '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	Feb. '34	WM350
£5 5s. Battery Four (HF, D, 2LF)	Feb. '35	WM381
The "HK" Four (2HF, D, LF)	Mar. '35	WM384
"A.W." Ideal Four (2 SG, D, Pen)	16.9.33	AW402
Crusaders' A.V.C. 4 (2 HF, D, QP21)	18.8.34	AW445
(Pentode and Class-B outputs for above; blueprints 6d. each)	25.8.34	AW445A

Five-valvers: Blueprints, 1s. 6d. each.

Super-quality Five (2 HF, D, RC, Trans)	May '33	WM320
New Class-B Five (SG, D, LF, Class B)	Nov. '33	WM340
Class-B Quadradyne (2 SG, D, LF, Class B)	Dec. '33	WM344
1935 Super Five (Battery Super-het)	Jan. '35	WM379

Mains Operated

Two-valvers: Blueprints, 1s. each.

Economy A.C. Two (D, Trans) A.C.	June '32	WM286
Consolectric Two (D, Pen) A.C.	23.9.33	AW403

★ **SPECIAL HALF-PRICE OFFER**

A Blueprint of the following "Wireless Magazine" set described in this issue is obtainable at the special price, given below, if the coupon on facing page is used before May 31st.

My 1935 Radiogram (S.G., D., 2 L.F.) WM386 ... ... 9d.

Three-valvers: Blueprints, 1s. each.

D.C. Calibrator (SG, D, Push-pull Pen) D.C.	July '33	WM328
Simplicity A.C. Radiogram (SG, D, Pen) A.C.	Oct. '33	WM338
Six-guinea AC/DC Three (HF Pen, D, Trans) A.C./D.C. ...	July '34	WM364
Mantovani A.C. Three (HF Pen, D, Pen) A.C.	Nov. '34	WM374
Home-lovers' New All-electric Three (SG, D, Trans) A.C. ...	25.3.33	AW383
S.G. Three (SG, D, Pen) A.C....	3.6.33	AW390
A.C. Triodyne (SG, D, Pen) A.C.	19.8.33	AW399
A.C. Pentaquester (HF Pen, D, Pen) A.C.	26.6.34	AW439

Four-valvers: Blueprints, 1s. 6d. each.

A.C. Quadradyne (2 SG, D, Trans) A.C.	Apr. '32	WM279
All Metal Four (2 SG, D, Pen) A.C.	July '33	WM329
AC/DC Straight A.V.C. 4 (2 HF, D, Pen) A.C./D.C. ...	8.9.34	AW446
"W.M." A.C./D.C. Super Four	Feb. '35	WM382

SUPER-HETS

Battery Sets: Blueprints, 1s. 6d. each.

Super Senior	Oct. '31	WM256
1932 Super 60	Jan. '32	WM269
Q.P.P. Super 60...	Apr. '33	WM319
"W.M." Stenode	Oct. '34	WM373
Modern Super Senior	Nov. '34	WM375
1934 Century Super	9.12.33	AW413

Mains Sets: Blueprints, 1s. 6d. each.

1932 A.C. Super 60, A.C. ...	Feb. '32	WM272
Seventy-seven Super, A.C. ...	Dec. '32	WM305
"W.M." D.C. Super, D.C. ...	May, '33	WM321
Merrymaker Super, A.C. ...	Dec. '33	WM345
Heptode Super Three, A.C. ...	May '34	WM359
"W.M." Radiogram Super, A.C.	July '34	WM366
"W.M." Stenode A.C. ...	Sep. '34	WM370
1935 A.C. Stenode (A.C. Super-het)	Apl. '35	WM385
1934 A.C. Century Super, A.C.	10.3.34	AW425

SHORT-WAVERS (Battery Operated)

One-valvers: Blueprints, 1s. each.

Roma Short-waver	10.11.34	AW452

Two-valvers: Blueprints, 1s. each.

Home-made Coil Two (D, Pen)	14.7.34	AW440

Three-valvers: Blueprints, 1s. each

Experimenter's 5-metre Set (D, Trans. Super-regea)	30.6.34	AW438
Experimenter's Short-waver ...	19.1.35	AW463

Four-valvers: Blueprints, 1s. 6d. each.

"A.W." Short-wave World Beater (HF Pen, D, RC, Trans)	2.6.34	AW436
Empire Short-waver (SG, D, RC, Trans)	Mar. '33	WM318
Standard Four-valve Short-waver (SG, D, 2LF)	Mar. '35	WM383

Super-hets: Blueprints, 1s. 6d. each.

Quartz-crystal Super	Oct. '34	WM372

Mains Operated

Two-valvers: Blueprints, 1s. each.

Two-valve Mains Short-waver (D, Pen) A.C.	10.10.34	AW453
"W.M." Band-spread Short-waver (D, Pen) A.C./D.C. ...	Aug. '34	WM363

Three-valvers: Blueprints, 1s. each.

Emigrator (SG, D, Pen), A.C. ...	Feb. '34	WM352

Four-valvers: Blueprints, 1s. 6d. each.

Gold Coaster (SG, D, RC, Trans), A.C.	Aug. '32	WM292
Trickle Charger	Jan. 5,'35	AW462

"PRACTICAL WIRELESS"

A.C.-D.C. Two	7.10.33	PW31
All-wave Unipen	14.10.33	PW31A
F.J.C. 3-valve A.V.C. (Transfer Print)	4.11.33	PW32
Luxus A.C. Superhet	14.10.33	PW33
A.C. Quadpak	2.12.33	PW34
Sixty-shilling Three	2.12.33	PW34A
Nucleon Class-B Four	6.1.34	PW34B
Fury Four Super	27.1.34	PW34C
A.C. Fury Four Super	10.2.34	PW34D
Leader Three	10.3.34	PW35
D.C. Premier	31.3.34	PW35B
A.C. Leader	7.4.34	PW35C
Master Midget Two	12.5.34	PW35E
Atom Lightweight Portable ...	2.6.34	PW36
Ubique	28.7.34	PW36A
Four-range Super-mag. Two ...	11.8.34	PW36B
Summit Three	18.8.34	PW37
Armada Mains Three	18.8.34	PW38
Midget Short-wave Two ...	15.9.34	PW38A
All-pentode Three	22.9.34	PW39
£5 Superhet Three	27.10.34	PW40
A.C. £5 Superhet Three ...	24.11.34	PW43
D.C. £5 Superhet Three ...	1.12.34	PW42
Hall-mark Three	8.12.34	PW41
Universal £5 Superhet ...	15.12.34	PW44
A.C. Hall-mark	26.1.35	PW45
Battery Hall-Mark 4	2.2.35	PW46
Universal Hall Mark	9.2.35	PW47

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