MAKING A 4-VALVE PORTABLE

Practical Wireless

9D EVERY MONTH

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PRINCIPAL CONTENTS

Practical Wireless
14th YEAR OF ISSUE
and PRACTICAL TELEVISION
EVERY MONTH
VOL. XXII. No. 483, SEPTEMBER, 1946.
Editor F. J. CAMM

COMMENTS OF THE MONTH. BY THE EDITOR

Radio-Luxemburg

THE debate in the House of Commons on the renewal of the B.B.C. Charter was a disappointing affair, in that apparently the Government's mind was made up long before the debate started and it would appear to the non-political observer that the Government was going merely through the motions of democratic government in permitting the matter to be discussed at all. Spokesmen who were in favour of a debate on the matter and alterations in the terms of the B.B.C. Charter during the period of the Coalition Government made a complete *volte face* and thought that the time was not ripe for any alteration. One speaker pointedly said that the matter should be left in abeyance for five years!

The newspapers of the country have, of course, severely criticised the B.B.C., and whilst the Government flatly refused any suggestion of altering the terms of the B.B.C. Charter, Mr. Morrison adroitly suggested that he was in favour of an examination of the state of health of the Press. Presumably there would be no opposition to that. It would not be a matter which the Government would similarly defer for five years.

However, during the Parliamentary debate the question of Radio-Luxemburg cropped up and it emerged that Britain and France are trying to get the use of Luxemburg radio station, which is normally used for commercial purposes, to broadcast to Germany and Austria. Mr. Morrison said that he did not think it a good thing that commercial broadcasting should be directed at us from overseas transmitters, such as Moscow, U.S.A., and other less important countries, but repudiated the suggestion that he had any such brutal operation as jamming in mind. He stated the obvious when he said that if people wanted to listen to Radio Luxemburg they were at liberty to do so and there was no question of penalising such people. The Government would do its best not to have commercial broadcasting directed at this country, but he omitted to realise that the best answer to a blast is a counter-blast and the best medium for such counter-blast is our own B.B.C. The motto of this vast Government sponsored organisation is "let nation speak peace unto nation," but as no other nation seems to be imbued by similar altruistic motives it would seem sensible for the B.B.C. to adopt defensive tactics if only to answer the scurrilous attacks made upon us by countries who would have been under the heel of Hitler but for the stand which England took.

Mr. Morrison does not like commercial broadcasting. "This particular type of sheer and naked commercial exploitation is one we don't like and we feel that we can discourage it if we should."

Apart from the ungrammatical construction of this sentence, if he has been correctly reported, having stated that he is against it he then indulges in a little piece of political gymnastics by apparently being in favour of it, for he then went on to say that discussions were taking place on the possibility of getting the full-time use of the Luxemburg transmitter for British and French broadcasts except when the Luxemburg Government wanted it, and that the Luxemburg Government had now invited British and French representatives to discuss the matter further. He also said that the British Government did not intend to do anything about commercial broadcasting from Eire. A large amount of anti-British propaganda emanates from this source.

It is beyond all question that before the war the majority of listeners tuned in to Radio Luxemburg on Sunday because of the dullness of the B.B.C. programme. At that time Lord Reith was Director-General of the B.B.C. and he had decided that the British public should have dirges, fugues, sermons, Bible readings, and many of the other things which people could get in church. As the churches were not too well-attended on Sundays, it may be that pressure was brought to bear on the B.B.C. to give them this spiritual pabulum in another form.

Since that time and under different management the B.B.C. has seen the error of its ways and the Sunday programmes have been made much more palatable to those who live in these changing times. The fact that there is still room for improvement does not mean that those improvements will not be made.

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Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

ROUND THE WORLD OF WIRELESS

405-line Television Stays

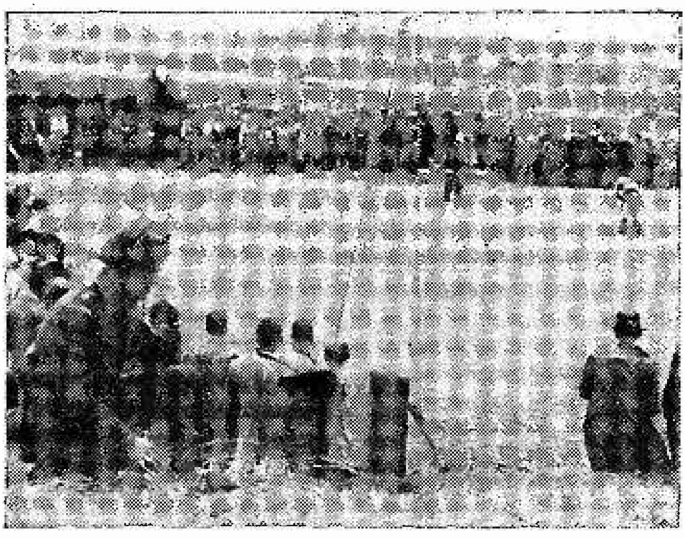
ALTHOUGH giving no undertaking that the present 405-line standard of definition would not be eventually superseded, the P.M.G. in a recent reply in the House of Lords said that adequate notice would be given when it was contemplated that the present system was to be dropped. He further stated that efforts were being made to develop a higher definition system, but that the public need have no hesitation in acquiring receivers designed for the present system.

Austrian Set Production

IT is stated that 100,000 radio receivers will be produced in Austria, but as the Austrians are too poor to afford such luxuries themselves the Government has decided that practically all of the sets will be exported to get foreign exchange to buy food and essential raw materials.

Radio in Every Room

GROSVENOR House Hotel in London has a radio service laid on in every bedroom—first important new amenity to be provided by the hotel since the war. The hotel thus becomes the first in this country to provide fitted radio in every room for the convenience of its guests.



Wireless was recently employed for the purpose of controlling the crowds at a golf tournament.

Big Expansion of Philips, Blackburn

THE Philips Works at Blackburn, in Lancashire, is undergoing considerable extension. The work is well in hand and will be completed in about 12 months. Between 800 and 1,000 more people will be employed than at present in the manufacture of Mullard radio receiving valves, lamp parts, tungsten and molybdenum products and magnet alloys; labour supply permitting.

All sections of the works will be increased in size, each taking a share of this expansion which will be in the region of 100,000 square feet of floor space.

Large orders for underground cable, transformers and switchgear have been placed with suppliers to cope with the greatly increased load that will be imposed on the electric power supply in the district. The expansion of the works, when completed, will enable a valuable contribution to be made to the country's export drive as well as to the home market.

Wireless Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended May 31st, 1946:

Region	Number
London Postal	2,023,000
Home Counties	1,345,000
Midland	1,534,000
North Eastern	1,636,000
North Western	1,416,000
South Western	887,000
Welsh and Border	616,000
Total England and Wales	9,457,000
Scotland	1,030,000
Northern Ireland	154,000
Grand Total	10,641,000

Royal Train to Have Radio 'Phone

SPECIAL railway coaches which are being built at Birmingham for the royal visit to South Africa next year will be equipped with the latest form of radio telephone. This will also be installed in a pilot train which will travel about 10 miles ahead of the royal train.

The two trains will be in constant communication with each other, the pilot train reporting back any difficulties encountered en route to ensure the safety of the royal party throughout the tour.

The apparatus which is being used is the new frequency modulated V.H.F. equipment developed by The General Electric Co., Ltd.

This type of equipment has been widely adopted in this country for police patrol cars and National Fire Services, and was used during the Victory celebrations by the Metropolitan Police and London Fire Service for traffic and river control as well as being fitted on the royal barge.

It will be the first time that it has been put to practical use in a British train, although experiments are being carried out in conjunction with the L.N.E.R. for the main line railway companies.

The royal train will consist of eight new coaches and four already in South Africa. The 100-watt transmitter and receiver will be housed in a compartment in the middle of the train. It will be operated by a Government official of the South African Railways and Harbours.

One of the problems which had to be solved by G.E.C. radio experts was how to fix an aerial so that it would operate efficiently and yet not be damaged or destroyed when the train enters a tunnel. This difficulty has now been overcome. A radio technician will travel to

South Africa when the train is delivered to ensure that the set is in perfect working order on arrival. He will also assist the South African railway authorities to instal the pilot train equipment.

Cheaper Condensers?

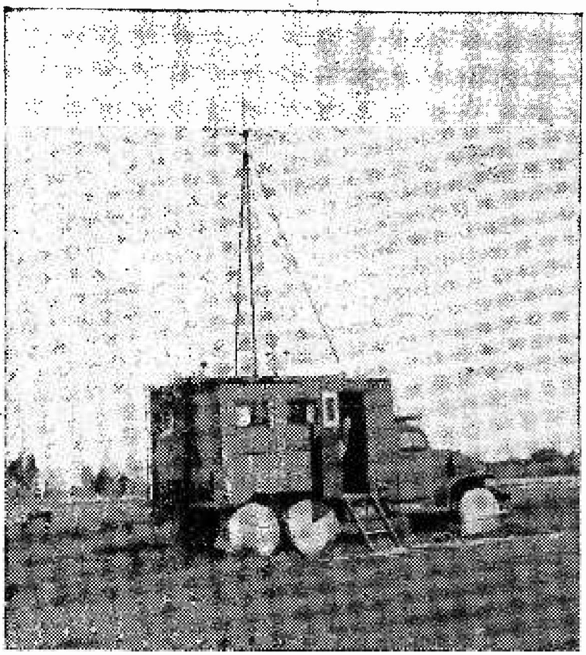
THE American Department of Commerce announces that a German machine, developed by the Robert Bosch concern, will revolutionise the manufacture of condensers. It produces paper condensers without the use of foil, the sides of the paper being coated with a thin layer of vaporised zinc. The machine has been taken to the U.S.A. for study.

Philco Appointments

MR. D. C. ("DON") SPINK took up his duties recently as sales manager of Philco. Don has his headquarters at the Philco London office, Donington House, Norfolk Street, Strand, W.C.2.

Don Spink, who is well known in the trade, succeeded Jimmy Noble as sales manager of Philco. Prior to joining Philco, he had a long association with the General Electric Company, whom he joined in 1922 at the Company's Coventry works. Two years later he came to the London sales office, and in 1935 he was appointed assistant manager of the G.E.C. radio department.

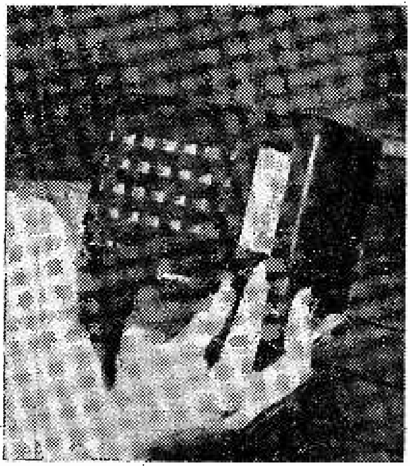
After six years in the Navy, Lieut. Harold F. Ford has returned to Philco as sales representative in the southern zone.



A modern V.H.F. D/F station of the mobile type. Note the aerial array which closely resembles the standard television arrangement.

British Wireless Equipment for Uruguay

MESSRS. MARCONI'S WIRELESS TELEGRAPH CO., LTD., Marconi House, Chelmsford, inform us that they have been awarded the contract for a new broadcasting station by Radio Rural, Montevideo, Uruguay. The equipment, comprising a 5kW. medium-wave transmitter, is being constructed at the firm's works at Chelmsford. It will be capable of operation directly from the local power mains and, when completed, will work on the wavelength of 492 metres.



One of America's latest midget receivers. This is a five-valver using new type valves.

CBC Short-wave Stations

THE following official Schedule is given in response to many requests:

CKNC, 17.82 mc/s per second or 16.84 m. daily from 12.00-20.15 G.M.T.

CKCX, 15.19 mc/s per second or 19.75 m. daily from 12.00-23.05 G.M.T.

CHOL, 11.72 mc/s per second or 25.60 m. daily from 20.30-23.05 G.M.T.

CKLX, 15.09 mc/s per second or 19.88 m. replaces Station CKCX after April 28th.

Hours of Broadcast:

Sundays, 12.15-23.00 G.M.T.

Weekdays, 12.15-14.00 G.M.T. and 17.00-23.00 G.M.T.

Canadian News in English:

Sundays, 12.45-13.00 G.M.T. and 22.15-22.30 G.M.T.

Weekdays, 12.45-13.00 G.M.T., 17.15-17.30 G.M.T. and 22.15-22.30 G.M.T.

Uranium a Protector

DEADLY radiations from the uranium-made atomic bomb may be stopped short by shielding with glass containing the same mineral, Professor Alexander Silverman, of the University of Pittsburgh, revealed recently.

"Strange as it may seem," he said, "uranium, which is used indirectly in atomic bomb manufacture, produces a glass which is probably the best protection we have against powerful X-rays and other harmful radiations. In post-bombing rescue work, uranium or lead spun glass garments and helmets lined with these glasses in plate form will permit safe entry into the bombed area. Oxygen respirators will be equipped with glass-insulated high-frequency precipitators to keep radio-active dust out of the lungs of the rescue squads."

All-wave Switching Considerations

Details of Circuit Design and Receiver Construction for Multi-band Working.

By "SERVICEMAN"

WHEN designing a receiver in which three or more ranges are to be available by switch selection there are a number of circuits possible. Some offer various advantages in the way of increased efficiency or simplified wiring so that if a receiver is being built the methods which may be used should be carefully examined so that unnecessary complication and losses may be avoided. There are also other considerations which should be kept in mind when constructing an all-wave receiver, and these are given here as well. In consequence the constructor should avoid the pitfalls and be assured of good results over all the frequencies tuned.

Detector Circuits

A detector, followed by one or two stages of L.F. amplification, can provide quite satisfactory results. The circuit in Fig. 1 is very good for this purpose. Separate coils are used, the aerial coupling, grid and reaction windings of each being switched in as necessary. If a switch with more contacts is used additional ranges can easily be added, four or five being frequent when long and medium bands are tuned as well as short-wave frequencies.

Plug-in coils in holders may be used, but if it is specially desired to obtain best results below 10 metres the smaller short-wave coil, or any U.S.W. coil, should be permanently wired in circuit to avoid the losses and longer wires associated with the plug-in holder. If this is done, satisfactory results can be obtained from 5 metres upwards.

Frequently better results are obtained with an individual pre-set aerial condenser, and these may be added at the points marked X, each pre-set being adjusted for its own coil.

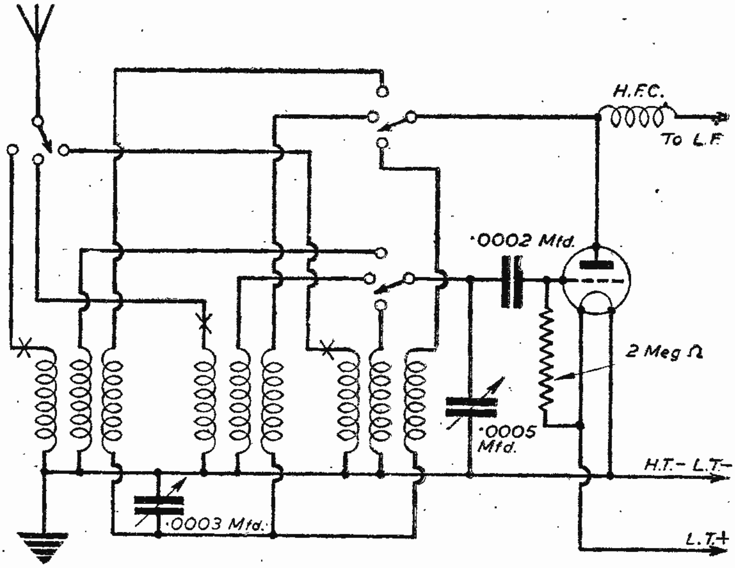


Fig. 1.—All-wave switching in a detector stage.

For reception from 10 to 2,000 metres a .0002 mfd. grid condenser and 2 megohm leak are suitable. If higher frequencies are to be tuned, or S.W. reception is of most importance, the leak may be increased to 3-5 megohms, and the condenser reduced to .0001 mfd.

The tuning and reaction condenser values are usual for all-wave reception. With a good tuning drive tuning is not too difficult, but for a set with, for example, one U.S.W. range and two S.W. ranges, a .0001 mfd. or .00015 mfd. tuning condenser, with .0002 mfd. for reaction, would be better.

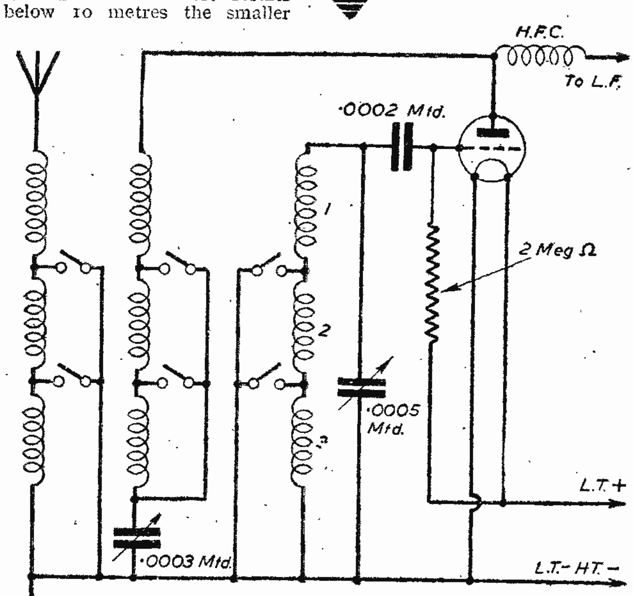


Fig. 2.—In this arrangement, successive portions of the coils are short-circuited.

Short-circuit Switching

This is sometimes employed, after the circuit shown in Fig. 2. Its main advantages are that the switch elements may be earthed, and that there is no switching in the grid circuit of the detector. As a result, reception with the S.W. coil (marked 1 in the diagram) will be good. Unfortunately, on M.W. (obtained by coil 2 being brought into circuit) and L.W. (obtained with coil 3), reception is not so good as with the circuit in Fig. 1.

Sometimes the reaction condenser is placed between the anode of the detector and the reaction coil. In this case all the sections of the switch are connected to earth, and a reduction of losses results. (The reaction condenser should be on an insulated extension spindle to avoid hand-capacity if connected in the anode lead.)

Coils 2 and 3 may be a standard dual-range coil, in which case neither the reaction nor aerial windings will require switching. This gives considerable simplification, as shown in Fig. 3, where by using a coil with no aerial-coupling winding switching has been reduced to a minimum. A double-pole double-throw switch, with central " off " position, is all that is required.

This circuit is particularly suitable where a very short aerial is used, and a small pre-set (about .0001 mfd maximum capacity) is also added to prevent the tuned circuit being damped unduly. Followed by a pentode L.F. stage a simple and efficient all-wave receiver will result.

The S.W. coil may be a plug-in one, entirely separate from the long- and medium-wave coil. If the leads to the switch are short so that the earth-return of the S.W. coil is direct, S.W. results will be entirely satisfactory.

T.R.F. Receivers

In Fig. 4 change-over switching is employed. Although H.F. transformer coupling may be used, the coupling shown, or tuned-anode coupling, dispenses with one section of switching which would otherwise be necessary. This reduces the possibility of instability and losses.

In this circuit V.M. bias is applied through a leak. This bias may be applied through the coils, but on the S.W. bands this may cause difficulties in ganging because the grid windings will not be returned directly to earth, as with the detector coils.

The .0001 mfd. condenser C1 used for H.F. coupling may be of the pre-set type with advantage as its capacitance gives some control of selectivity and the ease with which reaction can be obtained on high frequencies.

The H.F. coupling high-frequency choke should be a high-quality component, suitable for use on the wavelengths tuned, and for preference screened. If there is any doubt about this component tuned-anode coupling may be used instead, or a S.W. choke added between it and the anode of the H.F. valve.

Trimmers are best provided across each individual coil, as if the circuit is trimmed on one range it may not be on the other ranges, due to stray capacities. None of these trimmers should be screwed down more than necessary and sometimes it is best to dispense with those in the H.F. stage and instead use a panel trimmer of about .00005 mfd.

Untuned R.F. Stage

To avoid ganging difficulties—which may cause a grave loss of sensitivity on S.W.—the first circuit may be untuned, as in Fig. 5, on the S.W. range. With V.M. bias applied by a leak R1 will not be required, but if the bias is applied through the coils a resistor (about .25 megohm), or S.W. choke, must be used to provide a path for direct current to the grid of the valve. If the aerial is at all long a small condenser (about .00005 mfd.) should be added at X to prevent break-through of medium- and long-wave stations on the S.W. band.

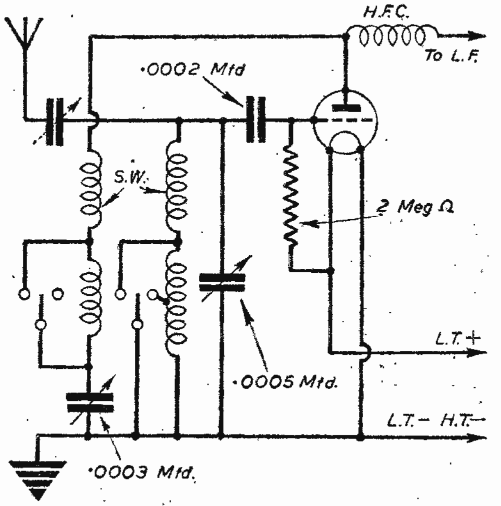


Fig. 3.—Switching is reduced to a minimum in this circuit.

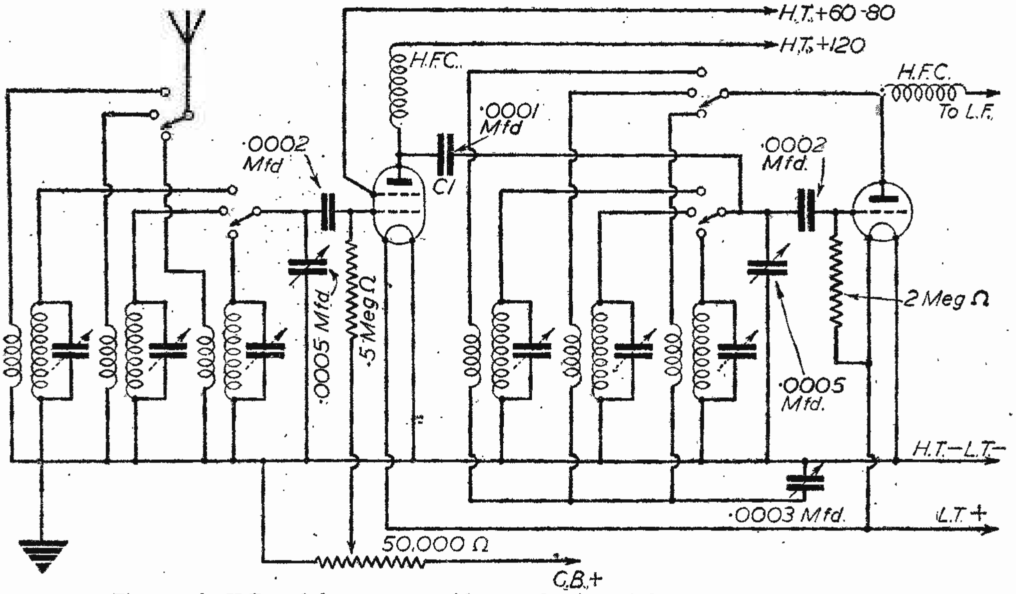


Fig. 4.—An H.F. and detector stage with comprehensive switching—suitable for ganging.

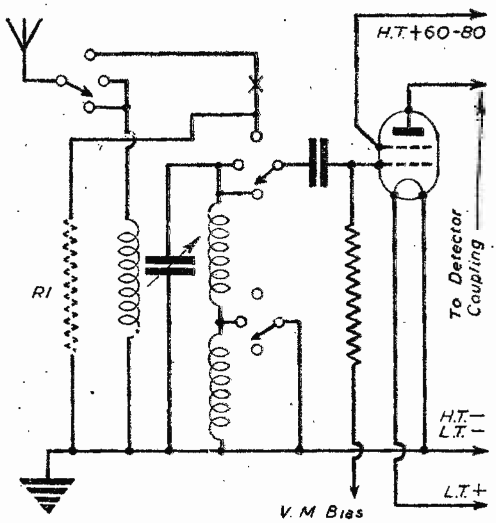


Fig. 5.—A simple two-range switching arrangement.

Fig. 5 also shows a modification of coil arrangement sometimes used, where medium- and long-wave reception is obtained by means of a dual-range coil. In this case the coil is connected at two positions of the grid switch, but the L.W. section is shorted at one position for M.W. reception. This has certain advantages, as when two screened dual-range coils are used for medium- and long-wave reception, and one unscreened (possibly plug-in) short-wave coil for S.W. reception, the H.F. stage being untuned on S.W.

An untuned H.F. stage naturally gives no increase in selectivity, and not so much amplification, but it simplifies design, removes the possibility of bad results from incorrect ganging, and by isolating the aerial from the tuned circuit prevents dead-spots on the S.W. range or ranges.

It should be noted that the tuning condenser is connected so that it is not in circuit on the S.W. range. Failure to attend to this will by-pass most of the signal from the H.F. valve grid.

Superhet Switching

Figure 6 shows a superhet circuit and no more switching is required than with the T.R.F. circuit. As most of the amplification will take place at the I.F., the superhet is particularly suitable for all-wave reception.

Because the use of A.V.C. on short waves may be unsatisfactory, due to high-speed fading, etc., the S.W. coil is returned directly to the earth line, with the L.W. and M.W. coils returned to the A.V.C. line. In consequence the A.V.C. is inoperative on S.W.

Trimming in the oscillator section of the circuit, by means of T1, T2 and T3, adjusted for their individual coils, is usually sufficient. Sometimes a panel-trimmer for the aerial coils is an advantage, however, where best possible results are desired. In addition any padders necessary with the oscillator coils in use (P1, P2 and P3), should be connected to their individual coils as shown. In this case the oscillator section is trimmed and padded on each range separately, the pre-sets not influencing other ranges, as with the circuit in Fig. 4.

General Considerations

For best results all wiring in the switch and tuning-coil circuits must be quite short. With a set with R.F. amplification a switch with two individual sections, on a common spindle, permits of shorter wiring and the R.F. and detector leads being kept apart. The switch should be of the rotary type made for this purpose and the S.W. coil leads, in particular, must be as direct as possible. Screening of S.W. coil leads should be avoided, as causing loss of volume.

The tuning condenser should be of good quality to avoid noises when operating, and should have a low minimum capacity or difficulty will arise in reaching high S.W. frequencies. If it has trimmers they should be removed or fully unscrewed to avoid stray capacity.

Valve holders in the H.F. and detector stages should be of low-loss material, and the detector H.F. choke capable of efficient service over the wave-ranges tuned. An air-dielectric reaction condenser, possibly with small reduction drive, is also best for smooth operation on short-wave ranges.

If these points are kept in mind an all-wave receiver can give very good results over all the frequencies tuned, combined with ease of operation and a sensitivity adequate for all normal purposes. Long leads, stray capacities in wiring and components, and losses by unsuitable switches and components, must be avoided.

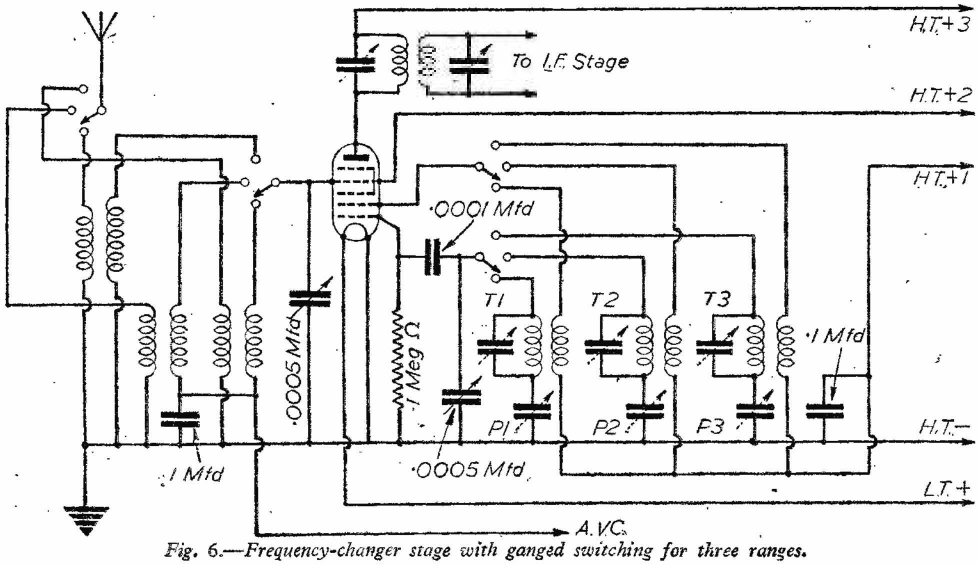


Fig. 6.—Frequency-changer stage with ganged switching for three ranges.

Frequency Modulation—1

Its Development, Present Position and Fundamental Principles

By C. A. QUARRINGTON

FREQUENCY modulation is not new; in fact, it was as long ago as 1924 that Major E. H. Armstrong commenced serious work on this system which has remained in the laboratory for some 20 years, but at last shows signs of coming into general use.

Various reasons have been put forward for the peculiar lack of vitality which the system seems to possess; admittedly some organised use has been made of it, the Armed Forces employed frequency modulation in their most modern equipment (but in most cases for functions other than the transmission of high-fidelity speech or music) and a frequency modulation network is being used on the American continent, although, unfortunately, it seems to be jeopardised, not by some technical limitation but by a squabble over artists' royalties and fees. The apparent indifference of this country towards frequency modulation is due to two factors, the implications of which are so wide that they probably exert an over-riding influence.

Any system of broadcast transmission must, to find favour in this country, have advantages for either broadcasting within the British Isles or as a link between the Mother country and our Empire. While frequency modulation is perfectly suitable for use as a system within the British Isles *one* of its greatest advantages, that is its great increase of signal to noise ratio, would not really be utilised for ordinary broadcasting, as atmospheric and electrical interference do not, generally speaking, warrant a change from the present established system of amplitude modulation; this limitation, however, is not true when applied to television as the present band is particularly prone to interference from motor-car ignition.

The advantages of frequency modulation in more tropical climates can scarcely be over-emphasised as the system gives a high measure of immunity from atmospheric disturbance. Unfortunately, however, this advantage does not justify its use as a system for broadcasting between this country and our Empire overseas, due to a fundamental drawback of frequency modulation, namely, the behaviour of the system when subjected to selective fading. The effects of this phenomenon on the quality of music or intelligibility of speech are far more distressing with frequency modulation than with amplitude modulation.

The present position of frequency modulation having been briefly outlined in the foregoing paragraphs, attention can now be given to purely technical considerations of the system. It will, however, be useful to recall, as briefly as possible, the main principles of amplitude modulation.

Amplitude Modulation

To make possible the transmission of speech or music, it is necessary that two qualities be imposed on the carrier wave, (a) pitch and (b) volume. Obviously, these qualities will vary continuously and independently. In amplitude modulation these two qualities are superimposed on the carrier amplitude, causing the pitch to appear as sidebands above and below the carrier frequency, volume being expressed by the extent or depth of the superimposed pitch characteristics, or modulation as it is normally called. It is worth while to make and emphasise two observations:

(i) The higher the pitch modulated on the carrier frequency, the further will be the sideband from the fundamental carrier frequency. It follows, therefore, that the total bandwidth used is controlled by the highest pitch sound it is desired to transmit.

(ii) Virtually all noise, e.g., man-made static and atmospherics, is an amplitude variation. It is apparent, therefore, that if the nature of sound to be broadcast is arranged to be an amplitude variation and noise is also an amplitude variation, the problem of selecting the one and rejecting the other is extremely difficult, if not impossible.

The precise advantages and disadvantages of frequency modulation are dealt with in a detailed manner in due course, but one advantage is fundamental to the original conception of the system—its inherent freedom from atmospheric and electrical interference—which, as will be seen, requires a carrier wave of constant amplitude in order that the receiver may be so designed that it is unaffected by amplitude modulation (it has already been stated that electrical and atmospheric interference are amplitude variations).

A Comparison

In frequency modulation the carrier amplitude remains constant irrespective of the modulation imposed upon it. In fact, it remains constant irrespective of whether it is modulated or unmodulated; the two qualities, pitch and volume, are imposed on the carrier by swinging its frequency above and below its fundamental or unmodulated frequency in a precisely controlled manner so that the *rate* of swing, or deviation, is proportional to pitch, and the *extent* of the swing or deviation is proportional to volume. For perfect quality this modulation must be precisely related to the volume and pitch of the sound to be transmitted, or in other words, modulation must be linear. To achieve this linearity it is necessary to arrange that the rate of deviation is directly proportional to pitch and the extent of deviation is directly proportional to volume.

In view of the necessity of obtaining a clear mental

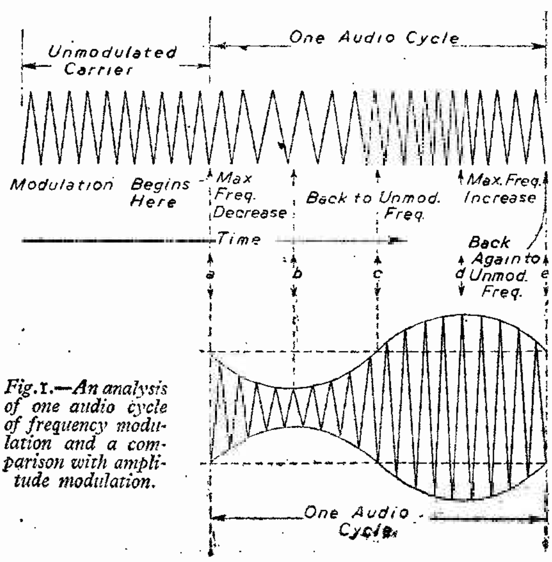


Fig. 1.—An analysis of one audio cycle of frequency modulation and a comparison with amplitude modulation.

picture of frequency modulation, no excuse is offered for recapitulation in simplified if less precise terms. Frequency modulation depends on a change from the fundamental frequency for the expression of both pitch and volume. The higher the pitch, the faster will be the change of carrier frequency—the louder the volume, the greater will be the change.

In forming a mental picture of frequency modulation it is important to remember that changes or deviations from the fundamental or unmodulated frequency are rhythmic in character, and deviation takes place in the upward and downward frequency direction in a symmetrical manner. One modulation cycle is illustrated diagrammatically at Fig. 1. It will be observed that it consists of an excursion first to a frequency lower than the fundamental; back to the fundamental, then to a frequency correspondingly higher than the fundamental and back again to the fundamental. It should be noted that in the interest of clarity, considerable liberties have been taken in drawing Figs. 1 and 2 including the use of straight lines instead of sinusoidal curves to represent the carrier; for similar reasons the number of carrier frequency cycles illustrated has been greatly reduced; a more reasonable representation would be say 1,000 carrier frequency cycles instead of the few shown. Clearly, however, such representation would be impossible on the scale of this page. Further reference to Fig. 1 will show that an attempt has been made to compare one cycle of amplitude modulation with one cycle of frequency modulation. Commencing at (a), it will be seen that the upper diagram shows the carrier at the fundamental or unmodulated frequency and the lower diagram shows the amplitude depth at the mean or unmodulated level. Proceeding from left to right from (a) to (b) modulation in the upper diagram progresses to maximum frequency decrease, completing one quarter of an audio cycle. During the same time interval the lower diagram also completes one quarter of an audio cycle and at the end of a further quarter cycle both diagrams have returned to zero modulation, that is to say, the upper diagram has returned to the fundamental or unmodulated frequency and the lower diagram to the level of mean depth of modulation. The other half of the cycle can be followed in the same way, modulation being expressed by an increase of carrier frequency in the upper diagram and by a corresponding change of amplitude modulation in the lower diagram. It will be noted that the time taken to complete one cycle of events is the same in both the upper and lower diagrams; it follows, therefore, that the audio frequency must be the same in each case although the method of imposing it on the carrier wave is radically different. Both the sequence of events from (a) to (e) of frequency modulation and its comparison with amplitude modulation are worthy of careful and detailed study and should greatly assist the reader to get a mental "moving picture" of frequency modulation which is so necessary if the function of frequency modulation is to be fully understood.

Volume and Audio Frequency

Fig. 2 is a further attempt to help the reader to form a complete mental picture of frequency modulation and is directed towards clear differentiation between the expression of volume and audio frequency. Each of the waveforms shown is one quarter of a cycle, the selected portion being equivalent to (c), (d) of Fig. 1. Waveform (a) represents, diagrammatically, audio modulation of 250 cycles per second (since the duration of the quarter audio cycle is one millisecond, it follows that the complete cycle would take four milliseconds, which is, of course, equal to 250 repetitions or cycles per second). Waveform (b) is also a quarter cycle and occupies the same *time duration* as waveform (a), it must therefore be of the same audio frequency. Although the total time is equal in each case the *extent* of the deviation from the fundamental frequency is much greater in the case of (b) than (a)—note the closer spacing at end of (b). Therefore, it follows that waveform (b) expresses greater loudness than (a). Waveform (c) is also a quarter cycle, which is completed in half the time of (a) or (b), i.e. half a millisecond. Obviously, then, it represents double the audio frequency or 500 cycles per second, or in other words the quicker the swing the higher the pitch, and the greater the swing the louder the volume.

At the time of its inception, frequency modulation was envisaged as working on a bandwidth comparable with that of amplitude modulation and further work was discouraged by Dr. J. R. Carson showing, by mathematical analysis, that the use of the system on normal bandwidths would result in very bad distortion; comparatively recently, however, Major E. H. Armstrong showed that remarkable quality of reproduction could readily be achieved if bandwidths of the order of 100 kc/s. were employed and furthermore that the use of such bandwidths gave even greater freedom from noise.

If wide-band frequency modulation is to be employed it is apparent that its place is on the short or ultra-short wavebands, as such bandwidths can scarcely be tolerated on the longer wavebands; it is, however, necessary to take note of the fact that the wide bandwidth used is not so wasteful as would appear at first sight, as the requirement governing the separation of adjacent frequency transmitters differs in the case of frequency-modulated transmitters from the requirement obtaining for those working on the amplitude modulation system.

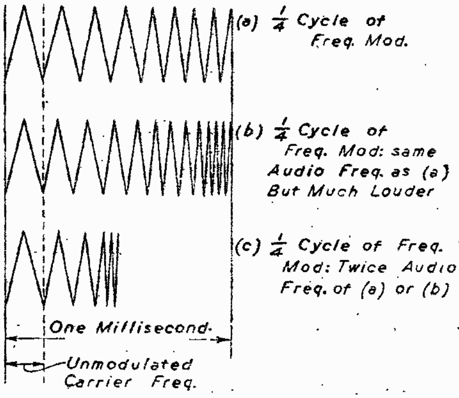


Fig. 2.—Frequency modulation waveform comparisons.

Before attempting to explore the bandwidth aspect of frequency modulation, it will be necessary to introduce a term that will be new to some readers, viz., "Deviation ratio." The frequency variation of a frequency-modulated signal is controlled by both the pitch and volume of the audio frequency; it follows, therefore, that the maximum permitted deviation from the carrier frequency must be greater than the highest audio frequency to be imposed. In other words, some of the permissible deviation will be used in the expression of pitch and some in the expression of volume. Deviation ratio is the method of representing the allocation of the two functions and the term can be defined as follows: Deviation ratio is the ratio of the total carrier deviation to the highest audio modulation frequency. An example will establish this definition more precisely. Presume that the maximum carrier frequency deviation is 75 kc/s. and the maximum audio frequency to be modulated is 15 kc/s (15,000 c.p.s.), then $75 \div 15 = 5$; the deviation ratio is therefore 5 : 1.

Sidebands

Previous paragraphs have established the point that the instantaneous frequency of the carrier at any given time will be dependent on two factors (audio frequency and volume) which will be continuously and independently variable; it requires little stretch of the imagination, therefore, to visualise that under working modulation conditions the carrier frequency will be accompanied by an infinite number of sidebands of various amplitude.

(To be continued.)

Analysis of the Television Receiver—2

In This, the Second of the Series, the Author Deals with the R.F. and I.F. Stages; Gain, Mixing, etc.

To handle the necessary bandwidth of 3 to 4 mc/s, the stage gain must be low, and although a gain of at least ten times should be aimed at, a gain of anything greater than fifteen times should not be expected. At frequencies of the order of 45 mc/s the low input resistance of the valve, due partly to the finite transit-time of the electrons and partly to the impedance of the internal cathode lead rules out, in any case, the possibility of a high amplification from the stage.

The typical R.F. stage of Fig. 1 (see last month's issue) is slightly simplified and brought forward here as the single unit of Fig. 6, together with the simple equivalent circuit, so that it may be more clearly seen and discussed.

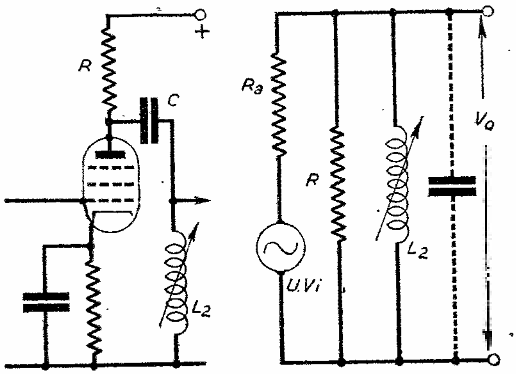


Fig. 6 (left).—A typical R.F. stage in theoretical form and its equivalent circuit, with Fig. 7 (right) a practical constructional layout for an I.F. stage.

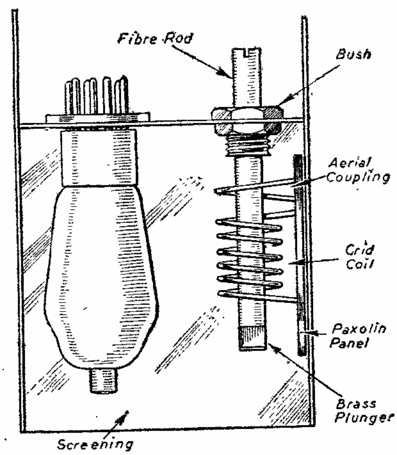
The purpose of this article is not to give cut-and-dried constructional details of any particular part of the circuit, but simply to outline experimental systems together with circuit theory. The grid coil may consist of some six turns of heavy gauge wire, spaced one turn, wound on a ⅜in. paxolin former, with a single turn aerial coupling coil loosely coupled to the dead, or earthy, end. The coil is tuned by a small brass plunger, which is screwed along the axis of the former by an insulated material threaded rod. The writer's circuit, which functioned very well in practice, was constructed on the lines of those shown in Fig. 7. Here the complete R.F. stage was enclosed in a small three-sided screening compartment, made of copper sheet, with the grid coil consisting of six turns of 18 gauge enamelled copper, self supporting, tuned by a brass plunger (a thick brass washer, to be exact) moving down from the threaded bush on the small horizontal valve chassis. The sketch makes the construction quite clear. There are no hard and fast rules, of course, of the way in which the tuning arrangements should be carried out, except the obvious ones kept in mind by the fact that the frequency of operation is 45 megacycles per second. The coil may be condenser tuned, of course, but the plunger method has certain advantages in practice.

The output of the stage, turning now to theory, is developed across L_2, the tuned grid circuit of the mixer stage. This coil is tuned similarly to L_1, though an extra turn is added to the winding. The equivalent circuit of the stage is shown in Fig. 6, where the coupling condenser C, usually .001 to .002 μF in capacity, is omitted, as also is the series R.F. resistance of the coil.

At resonance the impedance of the load circuit is equal to R, and so long as R is small compared with the A.C. resistance of the valve (R_a); the stage gain is given by

$$\frac{V_o}{V_i}=R.g_m,$$

where g_m is the mutual conductance of the valve in amps. per volt, and R is in ohms. R cannot be high since it forms the effective damping of L_2 necessary to secure the 4 mc/s bandwidth, so the stage gain is of necessity limited. The bandwidth which the stage will handle is a function of the circuit capacity and resistance, for, referring to Fig. 8, if the bandwidth $\lambda=f_2-f_1$, and the ratio of the responses at f_2 or f_1 to



that of the resonant frequency f_r (where $f_r=\sqrt{f_1.f_2}$) is N, then it can be shown that

$$R=\frac{\sqrt{1/N^2-1}}{2\pi\lambda C}$$

But

$$\frac{V_o}{V_i}=R.g_m$$

and so,

$$\frac{V_o}{V_i}=g_m.\frac{\sqrt{1/N^2-1}}{2\pi\lambda C}$$

where **C** is the circuit capacity in farads and λ is in cycles per second. Thus, for a given value of N, the stage gain is inversely proportional to the bandwidth and to the circuit capacity C, and is directly proportional to g_m, the mutual conductance of the valve.

In order to obtain a reasonable gain from the stage it is necessary, therefore, to use a valve with a high mutual conductance, keeping the circuit capacity as low as possible. Any of the special television pentodes mentioned previously are quite suitable, keeping the total anode resistance in the order of 10,000 Ω. Referring to Fig. 1, using an Osram Z62 valve, suitable experimental component values are: $R_1=5{,}000$ Ω. $R_2=10{,}000$ Ω, C=0.002 μF, with L_1 having 6 turns, ⅜in. diameter, and L_2, 7 turns, ⅜in. diameter, both plunger tuned.

I.F. Amplification

Before mentioning the mixer stage, we proceed with a brief discussion of the intermediate-frequency amplifier stages. As mentioned previously, three stages are usual in the average vision receiver, all being identical with each other and employing valves of the television pentode variety. The differences between the R.F. stage of the receiver and the I.F. stage, are only those brought about by the lower operating frequency of the latter, the intervalve couplings being carried out in an exactly similar way. Only the important differences will therefore be mentioned in this section.

The advantage that the superheterodyne enjoys over the straight receiver is apparent when one considers

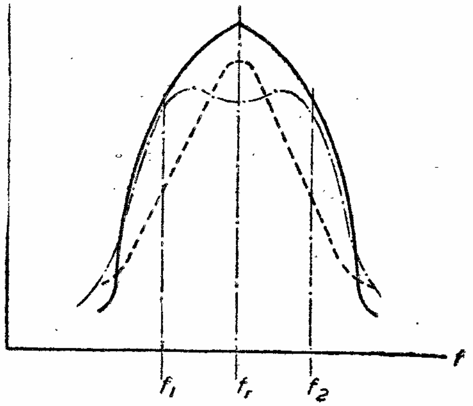


Fig. 8.—The response curves of a good I.F. stage showing the "double-humping" effect.

that it is much easier to design three intermediate-frequency stages handling a signal of, say, 10 mc/s, than three equivalent radio-frequency stages handling the signal frequency of 45 mc/s. Greater gain is automatically obtained from the I.F. stages, for at the lower frequency of operation the input resistance of the valves has very little effect on the performance of the stages, and instability is not so likely to be experienced. The choice of the intermediate frequency itself is determined at the lower limit by the receiver's bandwidth and cannot be usefully less than 5 mc/s, and at the upper limit by practical convenience. The signal frequency is 45 mc/s, and an intermediate frequency of the same order as this will not be chosen for the obvious reason that if it is, there is no longer any reason for employing a superheterodyne, for the difficulties of R.F. amplification will be present in the I.F. amplifier and a straight receiver might just as well be used. An intermediate frequency of 9 to 13 mc/s is generally chosen.

The necessary bandwidth calls for at least three stages, each of low amplification, and the stages V_3, V_4 and V_5 of Fig. 1 are good typical examples. In the writer's receiver, the I.F. "transformers" were single layer solenoids wound from 28 gauge enamelled copper wire on a ½in. paxolin former, tuned, like the R.F. stage, with a brass plunger on a fibre rod. The whole assembly was housed in a screening can of generous dimensions. Valve and circuit parallel capacities must be taken into account when such coils are being designed, as also must the fact that the brass plunger *reduces* the inductance as it is threaded into the former. An iron dust plunger, also practicable, *increases* the inductance of a coil.

The actual I.F. chosen need not be critically tuned. Anything round about 13 mc/s, if this frequency is chosen, will do. The oscillator tuning can be set to produce the right I.F. from the mixer, and the I.F. stages can be accurately tuned afterwards to this frequency.

If the amplifier is built in such a manner that all the couplings are tuned to the same frequency, the overall response curve will be the product of the response curves of the individual circuits. It is usual, however, to "stagger" the tuning so that the necessary bandwidth is obtained from the amplifier. If two circuits initially tuned to the same frequency are slowly mistuned by equal amounts in opposite directions, the response curve broadens and tends to a flat top. As the mistuning is increased the centre begins to sink and the curve becomes "double-humped," as shown by the chain-dotted line of Fig. 8. By tuning two of the I.F.s in this manner with the third tuned to the actual I.F., as shown by the dotted line of the figure, a good square response curve is obtained (full line) and the necessary bandwidth, f_1 to f_2, is secured over the three stages.

This process of stagger-tuning gives a greater amplification from the stages because the individual circuits do not need such heavy damping when they are mistuned as when they are all tuned to the same frequency.

R.F. and I.F. Gain

It is usual to provide some form of gain control on the R.F. stage of the television receiver, this control constituting the "Brilliancy" of the picture on the tube. A suitable system is seen in Fig. 9.

A certain amount of difficulty arises in the choice of a gain control circuit, for the special television pentodes used in the R.F. and I.F. stages of the vision receiver are not of the variable-mu variety and so a large range of control is not possible. Again, and further, increasing the bias on these valves results in a sharp rise in the input resistance of the stage concerned, together with a fall in mutual conductance and input capacitance.

It might seem at first that the rise in the input resistance and the fall in input capacitance are desirable states of affair, but actually they are most undesirable. The fall in mutual conductance is, of course, in order, but once a particular stage has been assembled and set up to deal with the desired bandwidth at maximum gain, the fall in the input capacitance and the rise in the input resistance as the bias is increased to reduce the gain will lead respectively to a mistuning of the grid circuit, already depending on the stability of the stray capacities for its accuracy, and to a reduced grid circuit damping factor, so necessary if the bandwidth response is to be maintained.

Both R.F. and I.F. controlled stages are affected similarly by these changes, though the resistance change is not so important in an I.F. stage as in an R.F. stage. As for the capacity change, since both R.F. and I.F. stages depend upon stray capacity (usually about 20 to 25 $\mu\mu$F) for

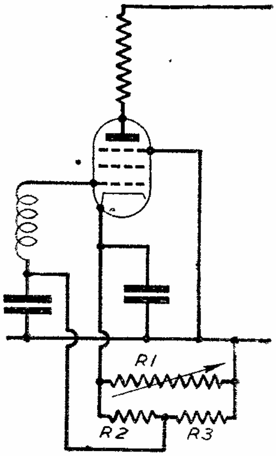


Fig. 9.—Gain control arrangement for an R.F. stage.

their accuracy of tuning, the usual valve change of some 4 to 6 $\mu\mu$F is of considerable importance, forming as it does some 25 per cent. of the total circuit capacity. The effect of such tuning changes, together with the reduced damping factor, leads at once to a serious deterioration in picture quality.

Turning back to Fig. 9, it will be seen that the gain control system operates upon the valve suppressor grid as well as upon the usual control grid, the suppressor bias being made approximately twelve times as great as the control-grid bias by having $R_2 : R_3$ in the ratio 1 : 11.

The total bias developed across the bias resistance (R_1 in parallel with R_2 and R_3 in series) is applied to the suppressor, but only a fraction, R_2/R_2+R_3 = approximately 1/12th of the total, is applied to the control grid. This method of bias, which can be applied to I.F. as well as R.F. stages, overcomes the undesirable effects

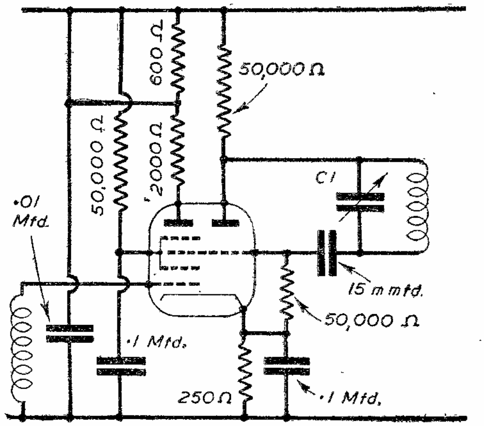


Fig. 10.—*Typical frequency changing stage for the television receiver.*

of input resistance and capacitance changes apparent when only the control grid is so biassed.

Such an arrangement of gain control is used in the receiver of Fig. 1, where the first I.F. stage is biassed in this manner as well as the single R.F. valve. Biassing both valves gives an increased amount of control and reduces the amount of noise generated by the first I.F. valve. Using Z.62 television pentodes, su table experimental values for the components of Fig. 1 are: R_4 = 5,000Ω, R_5 = 70,000Ω, R_6 = 20,000Ω. The cathode series resistances of the valves can each be 120Ω, while suitable values for the series resistances from the bottoms of L_1 and L_4 to the junction of R_4 and R_5 are each 5,000Ω. These values will prove suitable for almost any of the well-known makes of television-type pentode valves. The anode resistances of the I.F. stage may be R_7 = 5,000Ω, R_8 = 1,000Ω, and similarly for stages V_4 and V_5, with all anode decoupling condensers of capacity 0.01 μF throughout, and coupling condensers such as C_3 of 0.002 μF.

The Frequency Changer

There is nothing particularly outstanding in the design of the mixer stage of a vision receiver, and a triode-hexode valve, such as the AC/TH.1, 4.THA or ECH 33, is probably the simplest to set up. A typical mixer stage of this variety is shown in Fig. 10, where the component values are for an AC/TH.1 valve; this circuit is brought forward from Fig. 1, where its inclusion in a complete circuit is clearly seen.

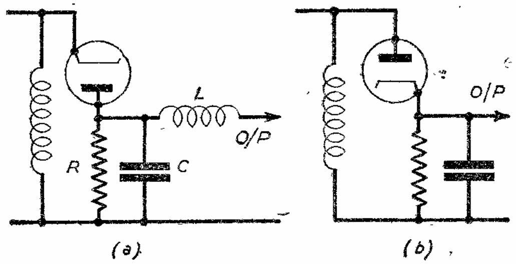


Fig. 12.—*Circuits of the diode detector stage.*

The oscillator coil (provided the R.F. and mixer grid coils are wound as described previously) may be wound seven turns on a ⅝in. diameter former from 20-gauge enamelled wire, the turns being spaced by a little more than a diameter of the wire. The tuning condenser C_1 must be connected *directly* across the coil if parasitic oscillation is to be avoided, and should have a maximum capacity of about 20 $\mu\mu$F. Other circuit component values are not particularly critical, except perhaps the oscillator grid condenser which should not be greater than 15 $\mu\mu$F consistent with the correct amplitude of oscillation. The smaller this condenser is in capacity, the more stable will the oscillator stage be. According to the manufacturers, the correct amplitude of oscillation is obtained when the triode grid and hexode-grid current is 0.15 mA., measured through the 50,000Ω oscillator grid resistance.

The gain obtained from the mixer of Fig. 10, and indeed from almost any vision receiver frequency changing stage, is practically non-existent. It may be calculated in the same way as for an R.F. or I.F. stage, but by considering the conversion conductance of the valve instead of the mutual conductance. This is of the order of 0.65 mA. per volt for most valves. A gain of anything over 1.5 times is phenomenal.

A greater gain can be secured by using an R.F. pentode with a separate oscillator valve as shown in Fig. 11. The conversion conductance of a set-up of this nature, using a television pentode, is some 3 mA.

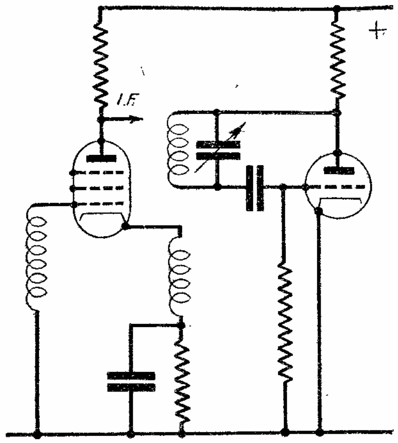


Fig. 11.—*In this circuit a separate oscillator is employed.*

per volt, and a gain of from two to three times can be obtained. Other difficulties, however, such as getting the correct amplitude of oscillation applied to the pentode, rather offset the advantage of increased gain, and for the home constructor the triode hexode is much to be preferred. To tell the truth, the writer, working with a friend, has never experienced the slightest difficulty in getting a triode-hexode mixer stage to "go," but has spent many fruitless hours trying to make sense of the separate valve circuit. In any case, great gain is not required at the mixer stage, and as long as the valve does not introduce attenuation, there is nothing to cause alarm.

"Pulling" between the signal and oscillator circuits is seldom experienced on account of the large intermediate frequency involved, and good common sense in layout and screening is the surest passport to success.

The choice of the oscillator frequency is not unimportant. For intermediate frequency of 23 m/cs, the oscillator frequency may be 45 ± 13 m/cs, that is, 58 mc/s or 32 mc/s. From the point of view of a slightly easier design of the oscillator circuit the lower frequency recommends itself, but second-channel interference is more likely to manifest itself on this range. This danger necessitates the use of a very selective R.F. stage or stages before the mixer and so undoes the advantage gained in a simpler oscillator design. In practice, the higher frequency (signal +I.F.) is almost invariably chosen.

Detection

A diode valve is almost universally employed as second detector in a vision receiver, and V_6 of Fig. 1 shows a conventional design. The diode is one of the special low-impedance type (such as the Mazda Acorn D1) which works into a load resistance of some 3,000Ω and a parallel capacity of about 10 $\mu\mu$F in order to retain the high frequency response. Even then, normal detection efficiency is not secured, and anything above 60 per cent. efficiency is exceptional.

The exact manner in which the diode detector is connected into circuit depends upon the number of video-frequency (V.F.) stages following it. If only one V.F. stage is adopted, the circuit of Fig. 12a should be employed; this is similar to the detector stage of Fig. 1. If two V.F. stages are employed, the detector must be reversed, as shown in Fig. 12b. Unless this distinction is made, the result on the screen of the cathode-ray tube will be a "negative" image, i.e., white for black and black for white. Synchronisation is also likely to suffer. The detector of Fig. 1 (or 12a) gives an output in negative phase, that is, the output increases as a negative potential for increasing depth of input modulation. After passing through the vidio-amplifier, V_7 of Fig. 1, the rectified signal is of positive phase and therefore suitable to apply to the tube grid. We shall refer to this fully later on.

A detector of Fig. 12a shows a simple choke filter output circuit consisting of an inductance L in series with the grid input lead of the following valve. Such a filter is necessary, for the rectified output of the diode appearing across C and R contains a great deal of R.F. and I.F. component, and it is necessary to prevent this getting through the video-frequency stage. Should it do so, and should the receiver screening be inadequate, harmonics of the intermediate frequency generated in the detector will be fed back to the earlier stages and a faint series of diagonal lines will appear upon the picture. (Other faults may produce similar effects to this, of course, but these will be dealt with much later on.) The filter must, therefore, be capable of suppressing all frequencies above about 3 mc/s. Taking the input capacitance of the following stage to be 15 $\mu\mu$F, then for C=15 $\mu\mu$F and R=3,000Ω, L should be about 320 μH in inductance. With such a coil the effect of self capacity rather spoils the theoretical pass-band characteristic, and in practice it is better to employ a system such as is shown in Fig. 13a. Here reasonable filtering characteristics will be obtained if L_1 consists of 35 turns of 30 gauge enamelled wire close wound on a ⅜in. diameter former, and L_2 of eight turns similarly wound, with $C=C_1=10$ $\mu\mu$F, and $R=3{,}000\Omega$.

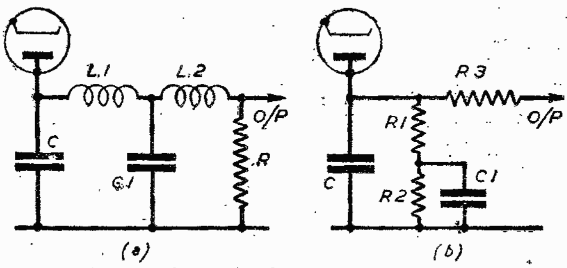


Fig. 13.—Alternative detector stage arrangements.

It is possible to obtain a similar result by adopting the circuit of Fig. 13b. Here the load resistance is divided into two parts, R_1 and R_2, with a condenser in parallel with R_2. C_1 is of such a value that the impedance of C_1R_2 to R.F. is much less than the impedance of R_1. At the same time C_1R_2 presents an impedance to video-frequencies which is very much greater than R_1. Suitable experimental values are: $R_1=250\Omega$, $R_2=2{,}700\Omega$, $C_1=10$ $\mu\mu$F. A series resistance of 50Ω may be included in the output lead R_3.

Video-frequency Amplification

The video-frequency stage, or stages, of the vision receiver corresponds to the audio-frequency stage, or stages, of the ordinary sound receiver, and so consists of a resistance-coupled valve amplifier capable of dealing with the necessary frequency band. In the sound receiver this band generally covers the range 30 to 10,000 cycles per second, but in the vision receiver it becomes necessary to deal with the band zero to 2.5 megacycles per second. Transformer coupling is immediately out of the question, and several modifications have to be made to the conventional R.-C. stage in order to deal adequately with such a frequency band.

(To be continued)

News from the Clubs

South Shields Amateur Radio Club

THE above club has resumed activities again and a most interesting programme has been mapped out for the forthcoming meeting nights. Interesting demonstrations and lectures have been given by Mr. J. Teasdale (G8VV) and Mr. F. Boad (G8IF).

The meetings are held in the St. Paul's School Rooms every Friday evening, commencing at 7 p.m., the first hour being devoted to morse practice and instruction. All interested are invited to our meetings and a great welcome is assured to any visitors, or write to Sec. W. Dennell, 12, South Frederick St., South Shields.

Bradford Short-wave Club

WE have now recommenced activities with temporary headquarters in the Temperance Rooms, Harewood Street, Bradford. We are holding weekly meetings on Mondays at 7.30 p.m. The morse class commences at 7.0 and we are hoping to arrange a programme of lectures, auctions, etc., until we find permanent headquarters in which to instal our transmitter and continue operations on the air under the call sign G3NN. Sec.: V. W. Sowen, 6, West View, Bingley, Yorks.

Whitefield and District Radio Society

THE above society is now holding regular weekly meetings every Monday evening at 7.30 p.m. at the Stand Grammar School, Higher Lane, Whitefield, and at the recent general meeting the following officers were elected:

Chairman: Mr. R. Lawton; hon. secretary: Mr. E. Fearn; hon. treasurer: Mr. R. Purcell.

All radio amateurs, experimenters, and any person interested in radio theory and practice in the Manchester and district area, and all members of the B.L.D.L.C. are welcomed to the meetings of the above society.

Secretary: Mr. E. Fearn, 4, Partington Street, Newton Heath, Manchester, 10.

Stourbridge and District Radio Society

AT the last meeting of this Society it was agreed to commence a local monitoring service of BRS members, who would report on all local signals on all bands. It is hoped that this service will be of use to the transmitting members, for reports and contacts are not always available at the time of special tests.

Any radio amateurs in the district are welcome, and information may be obtained from the Secretary at "Sandhurst," Vicarage Road, Amblecote, Stourbridge.

ON YOUR WAVELENGTH

By THERMION

Training for Electronic Engineers

I AM glad to note that Electric and Musical Industries, Ltd., who evolved the electronic television system adopted by the B.B.C. in 1936 when the Baird system after one year's trial had been found to possess some ineradicable defects, have formed a new organisation E.M.I. Institutes, Ltd., which is charged with the ambitious duty of providing schemes of training which shall become Empire-wide and, later, world-wide. The rapid developments in electronic science and its new application in the last few years have shown the vast need for technical training, and I congratulate the company on its wisdom in creating an institution which will provide the pool from which these technicians of the future will be drawn. If this country and the Empire are to retain their position in the forefront of this new industry such training will be required on a much wider and deeper scale than can possibly be handled by existing facilities. It must provide an effective combination of basic training and practical experience.

The scheme is designed ultimately to ensure technicians of the correct type. The principal of the new institute is Professor H. F. Trewman, M.A.(Cantab.), M.I.E.E., M.I.Mech.E., who has been connected for many years with technical training. Prior to the war he was responsible for controlling the technical training of officers for the various technical branches of the British Army. The London Radio College has been acquired to form the headquarters, and the immediate aim is to provide technical training of all kinds in the fields of television, radio, radar, and associated techniques. Included in their activities will be the provision of post-graduate training in the various fields of electronics, preparation for radio careers in the Merchant Navy, training for amateur radio-transmitter qualification certificates, training of radio and television repair and maintenance personnel, etc. It may be mentioned that one of the Allied navies has already arranged for some of its personnel to be trained at the new college. E.M.I. is in a unique position to undertake such work, having behind it the electronic research laboratories development organisation and the factories which have done such valuable work in the past. The various courses of training will cover not only the most up-to-date knowledge in basic principles but will include the great advantage that students and staff will be in intimate contact as and where necessary with the most expert and modern practices.

Commercial Broadcasting

A PARADOX will be created if the British Government concludes arrangements with Radio Luxemburg to push over from that station propaganda of a political nature. We already have the B.B.C., and if it is necessary to use the radio at all for this purpose the B.B.C. transmitters should be used, otherwise our world critics (and there is no shortage of them at the moment) will be able to say with truth that what we radiate from Radio Luxemburg we are ashamed to transmit ourselves. Moscow, the U.S.A., Eire, and one or two other countries of a less important nature do not hesitate to use their national transmitters to breathe anti-British propaganda. We have an adequate answer to this scurrility, so why should we be ashamed or afraid to answer it by means of our own B.B.C.? It is true that a lot of the propaganda radiated from abroad is beneath contempt, coming as it does from countries which would have been wiped out but for England and the stand it took.

The Typographical Error

ONE of my rather critical correspondents draws attention to the printer's error which seems inevitable and, in spite of all care, quite unavoidable in technical periodicals. This journal sins less in this respect than most and I would remind my readers of the following lines:

The typographical error is a slippery thing and sly,
You can hunt until you are dizzy, but it somehow will get by,
The boss he stares with horror, then grabs his hair and groans,
The copy reader drops his head upon his hands and moans,
The remainder of the issue may be clean as c'ean can be
But the typographical error is the only thing to see.

Another correspondent refers to my recently made claim to have founded the first amateur radio journal. Well, the files of Patent Office and the British Museum can well establish that claim. However, I do not attach any value to the criticisms contained in this reader's letter, which seems to be a good example of bad-tempered writing.

Television History

APROPOS my recent discussion on television, it is interesting to note that the first demonstration was in 1926—from Motograph House. The results were, of course, far from perfect, but they showed that television was possible. These transmissions through 2LO came to an early end, and Baird applied for and obtained a licence for television, and 2TV commenced independent television broadcasting on a wavelength of 200 metres with a power of 250 watts from Motograph House. A service of 30-line television was started in September, 1929, through the B.B.C., and in January, 1931, there was a demonstration of zone television.

The Derby was first televised in 1931, and the first complete B.B.C. service commenced in 1932. In September, 1933, high-definition television was demonstrated to the British Association, and the first public demonstration of this system took place in March, 1934. The Television Committee issued its report in 1935.

Isn't This the Way of It?

[Press Item.—The Government has decided that there shall be no inquiry into the affairs of the B.B.C. and that its Charter shall be renewed for another five years.]

SILENCE the fool who shouts and raves
That "Britons never shall be slaves."
True, in the days of long ago,
But that's not how we run our Show,
They took it as their rightful boon,
Who paid the piper and called the tune;
But now, Our Voice from Sinai speaks,
Ignoring listeners' futile squeaks.

Come, gather round, redundant staff,
What joyous news to make you laugh!
An end to all your recent fears,
You're safe again, for years and years;
No rude inquiry shall there be
Into affairs of B.B.C.,
In victory, our eyeballs glistening,
We mean to stop all "sponsored listening."

Ours are the programmes you shall like,
Only our choice shall use the mike,
And every rival on the air,
We mean to "scramble" till they're not there.
Thus does it prove, great B.B.C.,
That Britons are no longer free,
But robot slaves, doing as they're told,
With despots growing daily still more bold.

"Torch."

A Multi-range Meter

Details of Another Type of Service Instrument by G. J. LAWRENCE

THIS particular multi-range meter is built in a case 6½in. high, 9in. long and 7in. wide. The ranges covered are 0-1 mA., 0-10 mA., 0-100 mA., 0-500 mA. (D.C. only), 0-10 volts, 0-50 volts, 0-250 volts, 0-1,000 volts (A.C. and D.C.), and 0-150,000 ohms. The nucleus around which the meter is built is the 0-1 mA. meter.

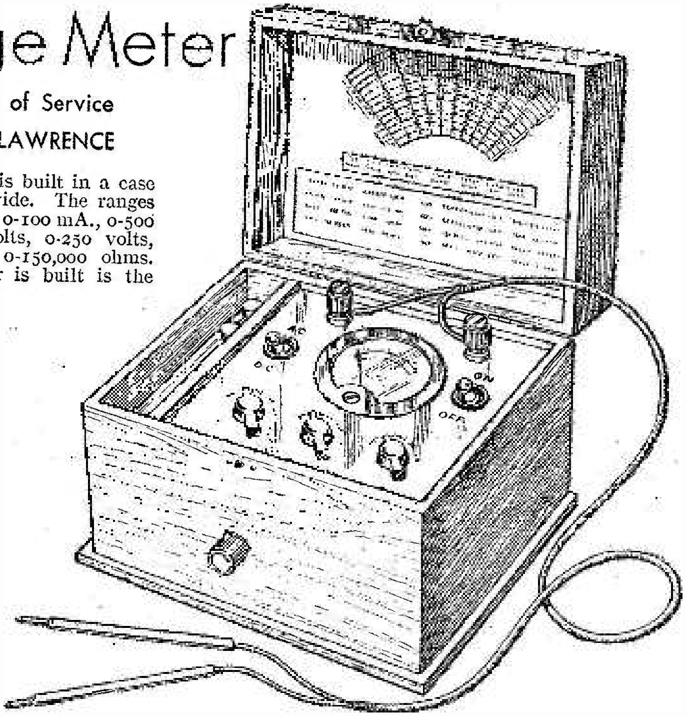


Fig. 1.—The finished meter.

Details of the Circuit

As is well known, to increase the milliamp range a shunt of suitable resistance is placed in parallel with the meter so that if the required range is 0-10 mA., 1/10 of the current passes through the meter and 9/10 through the shunt. A tapped shunt is used to provide the various ranges.

To make the meter measure volts a series resistance is employed. To determine its value Ohms Law is used. If a 10 volt reading is wanted on the full scale deflection of 1 mA., then:

$$I=\frac{E}{R} \therefore R=\frac{E}{I}$$

as we know the current will be 1 mA. (or 1/1000 amp) and E is to be 10 volts, we have:

$$R=\frac{10}{\frac{1}{1,000}}\ \Omega=10,000\ \Omega.$$

The resistance needed is 10,000 ohms. The internal resistance of the meter must be taken into consideration, however, if accuracy is desired, so a series resistance of 9,900 ohms is used. The odd 100 ohms need not be worried about on the higher ranges, as it only makes a difference of 1/10 of a volt. 50,000: 250,000, and 1 meg. ohms resistances are necessary for the other ranges. The range wanted is selected with a single pole four-way rotary switch.

For A.C. volts a rectifier is used of the 1 mA. type. Care should be taken in the handling and use of this rectifier for it is delicate. There is, of course, a voltage drop across it and this can be compensated for by the use of suitably low series resistances, or by separate scale calibration. The latter course was chosen, among other reasons, to keep down the cost. The rectifier is placed between the series resistance and the meter, and is switched in and out by a double-pole double-throw toggle switch. The scale can be calibrated by the application of known voltages. A rough graph will help and, as a guide, the drop on most ranges is about 5 per cent.

Measuring Resistances

To measure resistance an internal source of supply is necessary. This is supplied by a grid bias battery. Only 3 volts are required and the plugs can be moved up as the cells are exhausted. It is obvious that if the reading of zero is required at 1 mA., a resistance of 3,000 ohms must be incorporated for the meter to read 1 mA. at 3 volts. This resistance is made up of a fixed resistance of 2,500 ohms and a potentiometer of 1,000 ohms. This is used to set the meter to read exactly 1 mA. on a dead short. To avoid the inconvenience of having to hold the test prods together to do this, the main switch can be set at ohms and the current switch at 500 mA. This will bring a resistance of negligible value across the terminals and the zero set can then be adjusted.

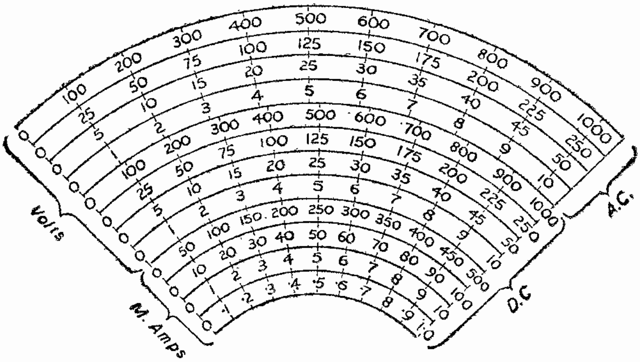


Fig. 2.—How the scale is marked out to cover all ranges.

The Cabinet

This can be made out of practically any wood and covered with American cloth or french polished. The wood is ⅜in. thick, it is 9in. long, 7in. wide and 6½in. tall. The lid should be made 2in. deep. Inside the cabinet put a partition 1in. from the left hand end. This space is to house the grid bias battery and the test prods. A small ledge is screwed around the large compartment ¼in. from the top, on which to fix the panel.

The panel is made of 3-ply wood. A hole is drilled in the centre of the front of the cabinet 2in. from the bottom, to take the potentiometer.

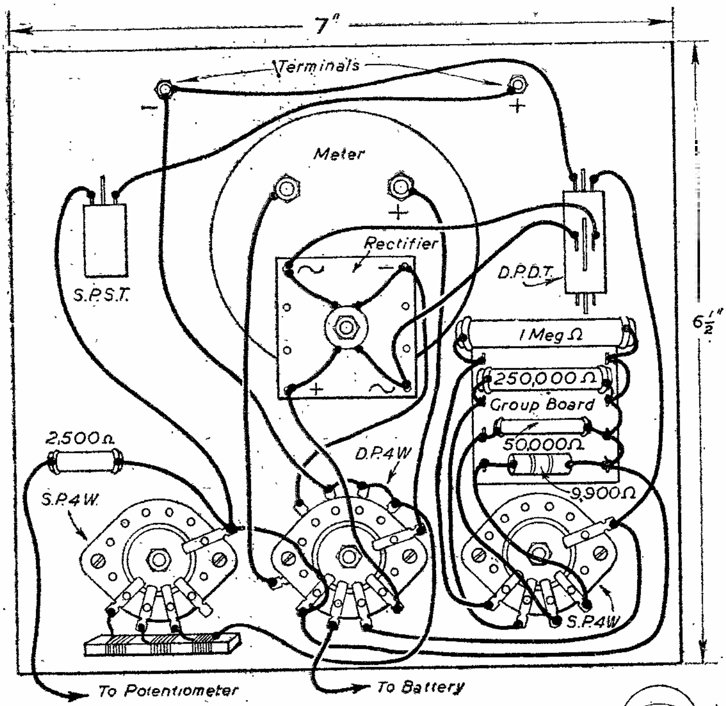


Fig. 5.—Wiring details of the meter.

brought through the partition and not over it. The terminals should be clearly marked + and −, for if too strong a current is accidentally passed through of incorrect polarity, the needle will be bent (as I know from bitter experience).

A scale must be drawn and fixed in the lid. An example of the scale is illustrated. The bottom section reads 0-1 mA., so the meter reading should be compared and then followed up to the desired scale. For the resistance range it is best to make out a graph as the slope is uneven. Two are needed: 1 between 0 and 15,000 ohms, and one between 10,000 and 150,000 ohms. It is a simple matter to read any resistance off these graphs and they can be kept in a pocket in the lid below the scale.

When making out the resistance graphs Ohms Law should be used. On the one reading 0-10,000 ohms this is done every 1/10 of a milliamp, and on the other every 1/50. Do not forget to subtract the 3,000 ohms of the internal resistance, for example at .3 mA.

$I = E/R \qquad 3/10{,}000 = 3/R$
$30{,}000 = 3R \qquad 10{,}000 = R$
$10{,}000 - 3{,}000 = 7{,}000.$

Construction

Cut a hole in the panel to take the meter, and then drill the other holes to take the switches and terminals. It is best to mount the resistances on a group board as this will stop them moving about and will keep the wiring neat. The rectifier can also be mounted on a group board to hold it in a rigid position and so protect it from mechanical damage. With regard to its connections, a red mark indicates the positive connection; a ∾ the two A.C. connections, and the other is the negative connection.

The centre switch is the main selector one. It is a two pole 4 way rotary, and selects mA., ohms, volts D.C. and volts A.C., reading from left to right. The rotary switch on the left hand side is to change the voltage range, and that on the right is to change the current. The toggle switch to the right is the on/off switch and to the left to interchange A.C. and D.C.

A fairly heavy gauge of wire is used to connect up and good, strong connections should be made. It is particularly necessary to see that the connections to the D.C. side of the rectifier are sound, for if current is passed with these connections broken, the rectifier will be damaged.

When connecting up the resistance section it is best to make the wires to the battery and potentiometer fairly long so that easy access can be had to the interior of the cabinet without disconnecting these wires. The leads to the battery are

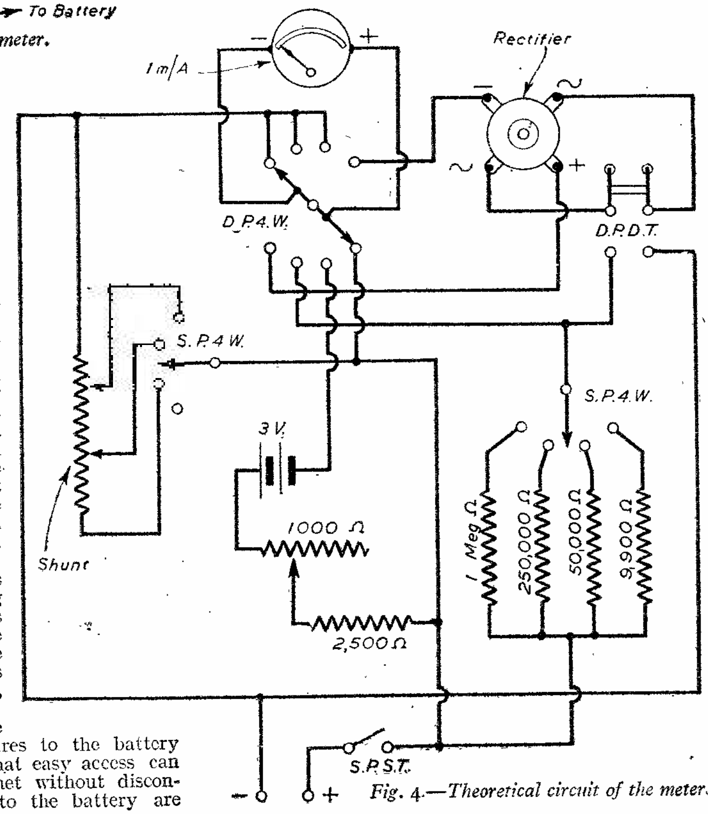


Fig. 4.—Theoretical circuit of the meter.

Therefore, the resistance being measured is 7,000 ohms.

The test prods are kept above the battery and should be connected to the meter with good flex or earphone leads. The latter are preferable as they are designed to stand a good deal of movement and twisting. All components used in this meter are easily obtainable at any reputable wireless store.

LIST OF COMPONENTS

- One 0-1 mA. meter.
- One Westinghouse meter rectifier (1 mA. type).
- Two 1 pole 4-way rotary switches (Yaxley type).
- One 2 pole 4-way rotary switch (Yaxley type).
- One shunt (to read 10 mA., 100 mA. and 500 mA.).
- One S.P.D.T. toggle switch.
- One D.P.D.T. toggle switch.
- One 1,000 ohms potentiometer.
- One 9,900 ohms resistance (±1 per cent. type).
- One 50,000 ohms resistance (±1 per cent. type).
- One 250,000 ohms resistance (±1 per cent. type).
- One megohm resistance (±1 per cent. type).
- One 2,500 ohms resistance (½ watt type).
- Two large terminals.
- Two test prods.
- One 9 volt grid bias battery.
- Wire, solder, screws, etc.

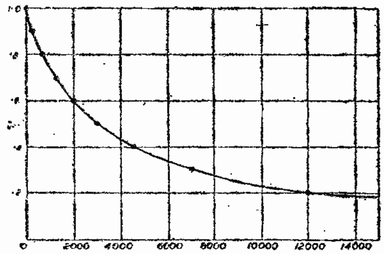


Fig. 3.—Graph showing resistance range readings.

Making Dials and Scales

Hints for Obtaining an Engraving Effect by Simple Means

By D. A. LEADBEATER

SOME time ago I conceived the idea for a meter dial of painting the numbers in reverse on a piece of celluloid and then flooding the back with a contrasting colour of paint, so that the view from the front would be of a calibrated scale on a shiny flat background. Later on I extended the idea to name-plates because of the neat appearance and great durability—the paint all being behind the celluloid. Any yellowness which will occur with time must be only on the outer face and is readily removed with metal polish.

Now while the whole idea sounds simple enough, a number of snags soon made themselves apparent if anything approaching professional standards was to be obtained. The first essential was found to be to wash the celluloid in carbon tet. on the side to be painted, and *not* to touch it with the fingers afterwards. The next difficulty came in writing the figures, and for this I've found by far the best answer is a mapping pen, and *thin* paint diluted in petrol as you go., i.e., mix the paint and the petrol with the pen at each letter or two. Any errors can be easily removed with a piece of cotton wool on a stick, and with care quite professional results may be obtained. When the background is ready to be put in, and when the figures are dried hard, this should be done by pouring a pool of *thin* paint towards one side and persuading it over the whole area by tilting only. Then leave it dead flat to dry.

Larger Areas

When dealing with surfaces over about 8 sq. in., i.e., tuning dials, calibration charts and the like, the flooding operation tends to be a little more complicated if a perfectly uniform background is required, and here a very soft brush is to be recommended to "push" the paint along until it covers the whole area, and then the celluloid must be steeply tilted in alternate directions several times to ensure perfectly even and comparatively thin distribution. The paint which runs on to fingers and top side of the celluloid is easily removed later, but under *no* circumstances *brush* the paint on, for brush marks will never completely disappear.

A quite pleasant mottled effect can be got by using four or five smaller pools of rather thicker paint and running one into the other, the paint thickness and pool size being found by experiment.

Calibrating the Dial

My first method of calibrating the celluloid was to place it in position and mark it appropriately in ink. Then just turn over and paint in reverse. But as the ink wouldn't come completely off, and that even if and when it did it still left a scratched outline, I can hardly recommend such a method. A far more satisfactory practice is to make a paper template, calibrate, and then hold it against the window to draw in its reverse. Then place template, reverse side uppermost, on a table and put the celluloid on top and paint in the calibrations.

Etching in of markings is definitely deprecated unless full tools and skill of trade are to hand, although dots put in with the tip of a drill are very effective, but ensure on a piece of scrap that the tip is at the right angle for the job before operating on the main piece. First impressions can be very confusing here.

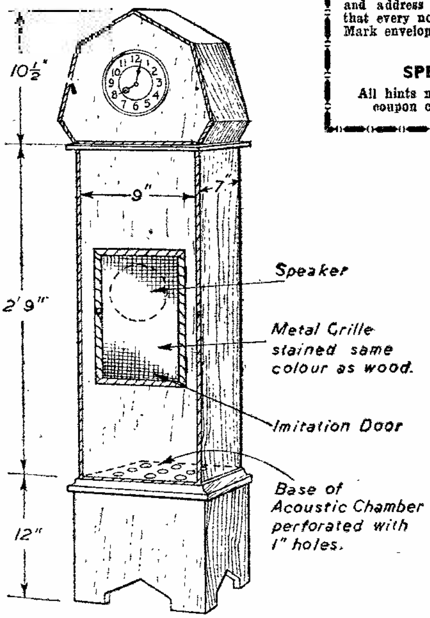
A further point to remember is that in cutting celluloid a deep score on either side with a scriber for straight lines, or a pair of dividers for circles, is quite sufficient to permit a fracture or tear along that line.

Practical Hints

Novel Cabinet

HAVING in the past gained some valuable tips from your Practical Hints page, I wondered if the following would interest other readers:

Having an old marble clock, I decided to use the works to make a grandmother clock. When I realised



A novel radio cabinet.

what a waste of valuable room there was, I decided to fit a speaker inside.

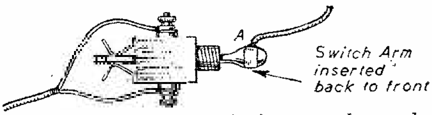
As it is totally enclosed, it is most important to cut some 1in. holes in the base of acoustic chamber, otherwise it would sound "boxy."

It is most realistic when Big Ben is chiming, and I seem to follow the programme better.

The idea could be extended, of course, where sufficient room is available to house the cabinet, by making the clock case a properly-designed acoustic chamber or sound labyrinth. This would convert the clock to grandfather proportions, and the speaker could then be mounted at the upper portion of the cabinet (immediately below the clock) and the "bass" opening could then be suitably included in the cabinet design at the lower end.—A. E. Amond (Hingham).

Plug and Jack

FOR a home-made plug and jack, take the knob off a push-pull switch and extract the arm. Contact a wire between the two terminals and lead a wire from this connection. Solder a length of insulated wire at A



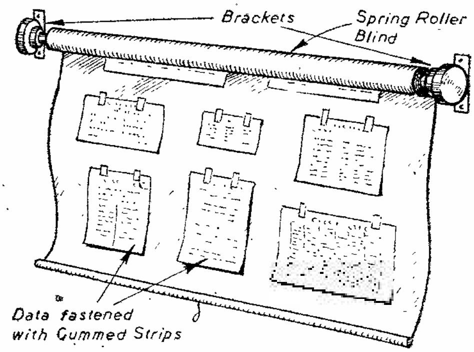
Converting a simple switch into a plug and jack arrangement.

and insulate this connection. Press the springs close enough to hold the arm where the knob has been. Put the arm back into the body of the switch back to front. When you are putting the switch back on the panel put it on in the usual way. If it is necessary to break a circuit quickly and efficiently just pull out the arm.—D. Dowling (Haslingden).

Data File

HERE is a neat and accessible method of filing radio information, keeping it clean and fresh.

An old spring roller blind and fittings is mounted between brackets fixed to the wall or to the underside of a shelf. Data sheets, cuttings from periodicals, etc., are fixed to the blind with gummed strips, so that when not required they are rolled up inside the blind.



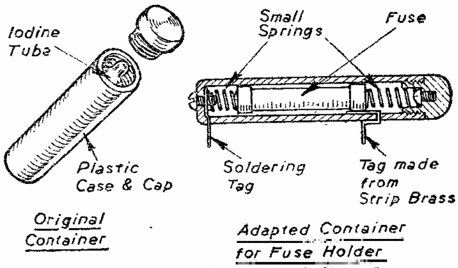
A good idea for keeping valuable data tidy.

The more often required information, such as valve data, resistance colour code, etc., should be mounted on the lower part of the blind.—John H. Marr (Glasgow, N.).

Novel Fuseholder

I REQUIRED a neat fuseholder for a small hook-up that I'd put together, and devised the following means. I took an old bakelite container that formerly had been a cover for a tube of iodine, and adapted it as illustrated.

A clip of the type used to hold electrolytic condensers in place was used to fasten the holder to the panel.



A fuseholder made from an iodine tube.

I was doubtful at first as to how the holder would react to a "blow out," but I found out it stood up to the shock more than "good enough" when the fuse did go.—R. V. Anderson (India).

Servicing the Vibrator Power Pack

Hints for the Overhaul of Modern Car Radio and Similar Power Units

THE design of vibrator power packs has advanced considerably during the past few years. This, I think, can be attributed to the great demand by the military forces for such units.

However, although the power pack designs have been greatly improved, the basic principle is the same, the fundamentals of which have already been described in a previous issue of this journal.* Readers are therefore referred to this issue for the basic theory.

The servicing of any vibrator power pack is greatly simplified if one masters the fundamentals of vibrator technique.

A vibrator power unit usually comprises a vibrator, specially designed transformer, smoothing choke and condensers, as well as the necessary R.F. chokes, buffer condenser and resistors.

The vibrator, transformer and filter unit are screened so as to prevent the radiation of R.F. energy, and it is essential that under no circumstances should this screening be entirely removed.

As for servicing these power packs, examine first Figs. 1 and 2. These schematic diagrams represent the basic synchronous and non-synchronous vibrator power packs. The former incorporates a full-wave indirectly-heated valve rectifier and filter unit, whereas the latter is self-rectifying but includes the filter unit.

First Steps

The procedure adopted for servicing these units differs according to one's experience and method of fault tracing. However, the following is the most efficient way to locate any fault that may be prevalent in vibrator power packs.

Connect an ammeter in series with the positive battery feed, making sure the meter is large enough to handle a current drain caused by the power pack. This done, connect a D.C. voltmeter across the positive and negative battery feeds (this meter should be capable of reading the full battery voltage).

It is advisable that these meters be connected on the "dead" side of the switch, as this ensures that the meters are not reading continuously when the switch is open.

The fault tracing can now begin by switching on the vibrator pack, plus load, and reading the battery voltage on the voltmeter; this figure should be compared with the battery rating. It is essential that for the correct operation of the vibrator unit, the battery voltage should not vary more than 10 per cent. of its rated value.

So much for the voltage supply. Next, take a reading on the ammeter, and if this exceeds the figure laid down by the vibrator pack manufacturer, it is a sure indication that something is wrong in the power unit.

Switch off the power supply, substitute a good equivalent type vibrator and take fresh readings. If these readings are identical with the first set of readings, it more or less proves that the vibrator is in order and that some other component in the pack is at fault.

*March, 1946.

The next step is to locate the faulty component, adopting the scheme whereby each individual component is subjected to conventional tests.

The buffer condensers should be carefully checked for open or short circuits, because open and short circuited buffer condensers will speed up and encourage the destruction of the vibrator itself. This is easily understood if one realises that the purpose of this condenser is to control the arcing at the vibrator contacts.

If it is found that this condenser is at fault, it must be replaced with one of the correct value and rating, and not just replaced with any condenser that is to hand. The correct capacitive value can be obtained direct from the unit manufacturer, so long as he is informed of the type of unit at fault.

To-day, many packs incorporate a resistor in series with the buffer condenser, the presence of which helps to limit the flow of secondary current and also excessive sparking at the contacts.

It is, therefore, essential that this resistor be checked for continuity, because, if found to be "open circuited," no control is offered over the arcing at the contacts.

One must not forget, however, that should the buffer condenser be at fault and withdrawn from the unit, it is advisable not to switch on the unit until a replacement has been made.

Vibrators sometimes develop a fault whereby the contacts "chatter." This can sometimes be remedied by mounting the unit upon sponge or rubber cushions. The latest models have, however, adopted this procedure to overcome any fault that is likely to arise in this direction.

Another fault that was extremely common prior to

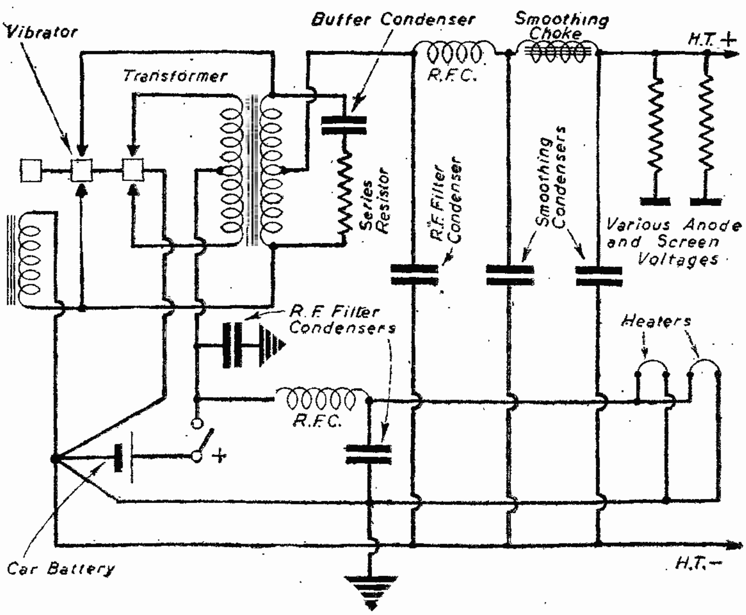


Fig. 1.—A synchronous type of vibrator circuit for a power pack.

the war, was the sticking of vibrator contacts; this caused the vibrator to operate on only one pair of contacts. This fault can be the result of over-running the vibrator, so causing the reed to lose its springy characteristic. The only cure for a vibrator having these faults is a new replacement.

Contact arcing can occur if the commutator in the car system becomes defective in any way. A defective commutator prevents an even flow of D.C., which will cause a surging effect, with the result that the contacts either burn up or that the reed loses its temper.

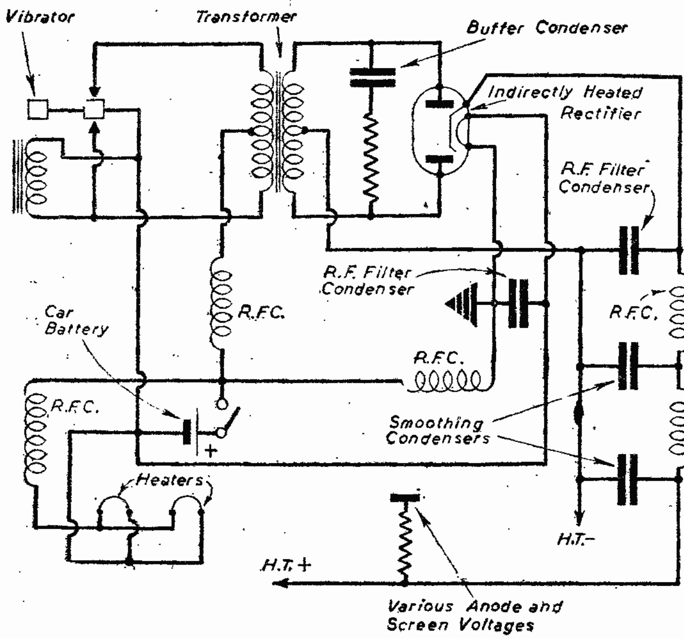


Fig. 2.—A non-synchronous vibrator power pack.

If one discovers that the vibrator contacts are worn, the efficiency of the unit can be improved by substituting a slightly larger buffer condenser. This enables the vibrator to be used whilst the present shortage of radio components is prevalent. One must not forget, however, that when replacing the worn vibrator, the buffer condenser must be replaced with one of the correct value.

Check the Fuses

Most vibrator power packs incorporate fuses in the battery supply leads. These fuses will blow if the unit develops a fault whereby it draws more current than the rated value. It is therefore advisable to include fuses in the circuit if they have been omitted, and it is also essential to make sure that the correct value fuses are used.

The R.F. chokes and resistors found in the unit must be checked for continuity, whereas the remaining condensers should be checked for open or short circuits. The checking of these components is conventional and is well covered in our "Wireless Servicing Manual."

As already mentioned in the March, 1946 issue of this journal, it is essential that R.F. chokes and condensers be included in the circuit, the presence of which help to suppress R.F. radiation and interference. This fault cannot be ignored, as it may be necessary to include more chokes and condensers in the unit. To clarify this interference suppression, refer to Fig. 1.

The power pack should be efficiently screened and the screened battery feeds to the pack kept as short as possible. If the necessary precautions have been taken and R.F. is still prevalent, try to eliminate this fault by twisting the battery leads together. Failing this, it is a sure indication that additional filtering is required; this can be carried out in many ways. For instance, suppose the receiver has developed a kind of ripple which becomes amplified as it passes through the various stages of the receiver, it is possible to suppress this by by-passing the anode resistor of the stage at fault with a condenser to earth.

Other ways of suppression can be tried, such as by-passing the H.T. positive and negative feeds to earth by means of a suitable condenser, or by connecting a condenser across the battery output feeds.

One must not forget, however, that the chassis on the vibrator unit is at earth potential, and should not be used as a negative return for the high tension. It is advisable, therefore, to check to see if the power pack is insulated from the chassis upon which the unit is mounted. If the pack is in electrical contact with the chassis, it is more or less a certainty that ground currents will flow, these being the result of R.F. radiation. It is advisable, therefore, to earth the vibrator pack by by-passing condensers at one point only.

Receiver Interference

Receiver interference, such as hum and ripple noises, are more or less caused by inadequate filtering in the power unit. The only sure cure is for an additional filter to be added; this should first be tried across the battery supply feeds, and secondly, across the H.T. output feeds.

Another point that is worth mentioning because it does help to overcome the ripple effect, is to separate the heater supply lines for the valves in the receiver from those of the rectifier valve.

As in receiver servicing practice, it is essential that the valve rectifier be checked for its operating characteristics, as well as for internal shorts and softness. Any fault with the rectifier will no doubt cause the power unit to draw more than the rated current from the battery. This can be verified by checking the current reading as already explained earlier in this article.

If the rectifier is at fault, never replace with a new valve until the smoothing condensers in the filter unit have been checked for short or open circuits.

So much for the checking of the components and power unit; it is now necessary to mention a few important factors which are so many times overlooked or ignored.

Never overload the power unit by forgetting to check the current the load is taking, and always check the D.C. output voltage. These factors play an important part in car radio; the former can damage the pack if in excess, whereas the latter, if too low, will cause the receiver to be inefficient, because of the wrong potentials that are being applied to the valve electrodes.

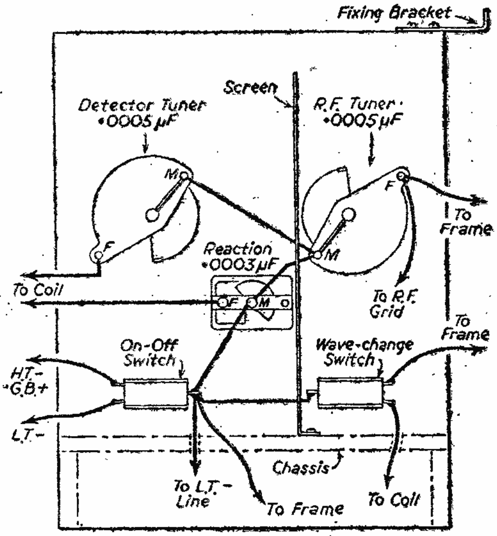


Fig. 1.—*Wiring of the sub-panel.*

A 4-valve

Constructional Details of a Receiver

IN the summer a portable is particularly useful and a fairly large model has advantages. Some of the midget receivers are very efficient, but they require special batteries and sometimes do not work so well as a larger receiver with a frame aerial and speaker of ample proportions. This portable is not a midget, but is quite compact and ordinary batteries can be accommodated. It gives ample loudspeaker reproduction for all normal listening.

Circuit Chosen

This is shown in Fig. 4. It is a four-valve straight arrangement which does not occupy a great deal of space. The use of an R.F. stage before the detector simplifies the construction of the frame aerial as no reaction winding is required on it; it also increases the selectivity and sensitivity considerably and by amplifying the signal before the detector makes reaction less critical. The R.F. stage is coupled by a choke to the detector to give both good gain and stability; transformer coupling would also give satisfactory results.

The detector is followed by two amplifying stages and the use of a pentode in the last ensures ample volume for domestic purposes. If the constructor requires a slightly less powerful set the output pentode may be replaced by a small power valve. With the pentode used as shown very good loudspeaker reproduction is obtained even if the triode L.F. stage is omitted entirely.

The circuit is well decoupled to ensure stability even when the H.T. battery is running down and to remove the necessity for extra H.T. plugs in the battery. Separate tuning condensers are used for R.F. and detector tuning to avoid loss of efficiency through the circuits not ganging and because this is more compact than a two-gang condenser and trimmer.

LIST OF COMPONENTS

Resistors: 5,000 ohm; 25,000 ohm; 20,000 ohm; 40,000 ohm; two 30,000 ohm; .5 megohm; 2 megohm.

Condensers: Three 1 mfd.; .1 mfd.; .05 mfd.; .01 mfd.; .0002 mfd. Two .0005 mfd. solid dielectric tuning condensers; .0003 mfd. reaction condenser; .0002 mfd. pre-set.

Reaction type high-frequency choke H.F. type for R.F. coupling.

Parafeed transformer.

Three 4-pin and one 5-pin valve-holders.

Tuning coil.

Two 3-point toggle or push-pull switches.

Moving-coil speaker with transformer for pentode and .002 mfd. condenser.

Wire for frame (22-28 d.c.c. and 28-32 enamelled or s.s.c.). Wood for cabinet and chassis, etc.

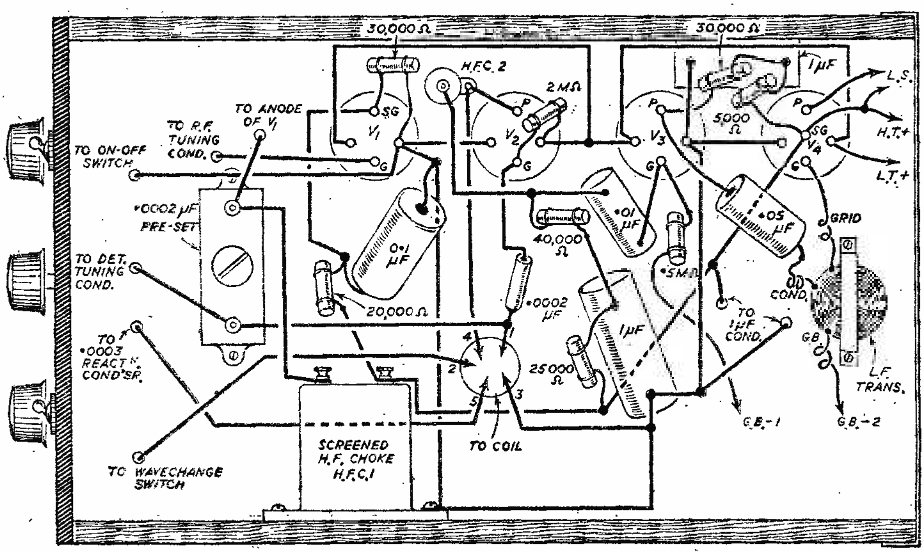


Fig. 2.—*Main wiring under the chassis.*

The Receiver Chassis

This is removable so that the set can be wired up and tested before being inserted in the cabinet. It can easily be made from plywood to the dimensions shown in Fig. 5 and covered with foil. It should be about 1½in. deep. The panel is 5½in. by 7in. high, and is also covered with foil to prevent hand capacity when

Portable

Outdoor Use, by F. G. RAYER

operating. Five holes should be drilled in it in the approximate positions shown in Fig. 6. The two top holes are for the .0005 mfd. solid dielectric condensers used for tuning and the central hole for the .0003 mfd. reaction condenser. Toggle switches are fixed in the lower holes and care should be taken to make sure there is room for the actual components used.

The completed panel is screwed to one end of the chassis as shown in Fig. 5. A piece of ½in. thick wood, 7in. by 5½in., is then screwed to the panel. This piece has a large hole cut in it as in Fig. 6 which faces a corresponding hole cut in the cabinet side when the set is in position. This serves to recess the controls. The chassis is finished by lapping a piece of metal across the remaining end.

To prevent interaction between the R.F. tuning condenser and reaction condenser a screen is placed between them as shown in Figs. 1 and 5. This may be made from zinc, aluminium or foil fixed to a sheet of thick card. It must be earthed to the chassis.

The valve-holders and other parts on top of the chassis are arranged as in Fig. 5. The valve-holders must not be quite together or there will not be sufficient space for the valves to be inserted.

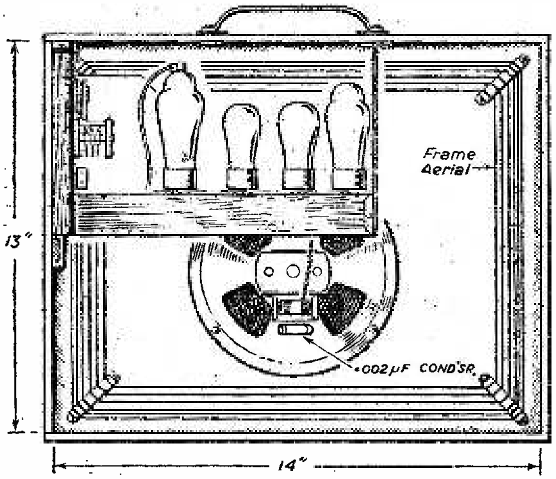


Fig. 3.—Details of the frame cabinet, and mounting for chassis.

Sub-chassis Wiring

Fig. 2 shows the majority of the wiring. It will be necessary to keep the components and wiring approximately as shown to facilitate connecting and avoid instability. Connections should not straggle about and components should be mounted as directly in the run of wiring as possible. All grid and anode leads must in particular be short and direct.

The connections to the coil are numbered to agree with the numbers shown in Fig. 4 and can be taken up through one hole about ⅜in. in diameter. If a coil with terminals is used instead these should be connected in the normal way by taking the leads through the chassis as convenient.

Of the two high frequency chokes, the small one connected to the detector anode is not critical, and may

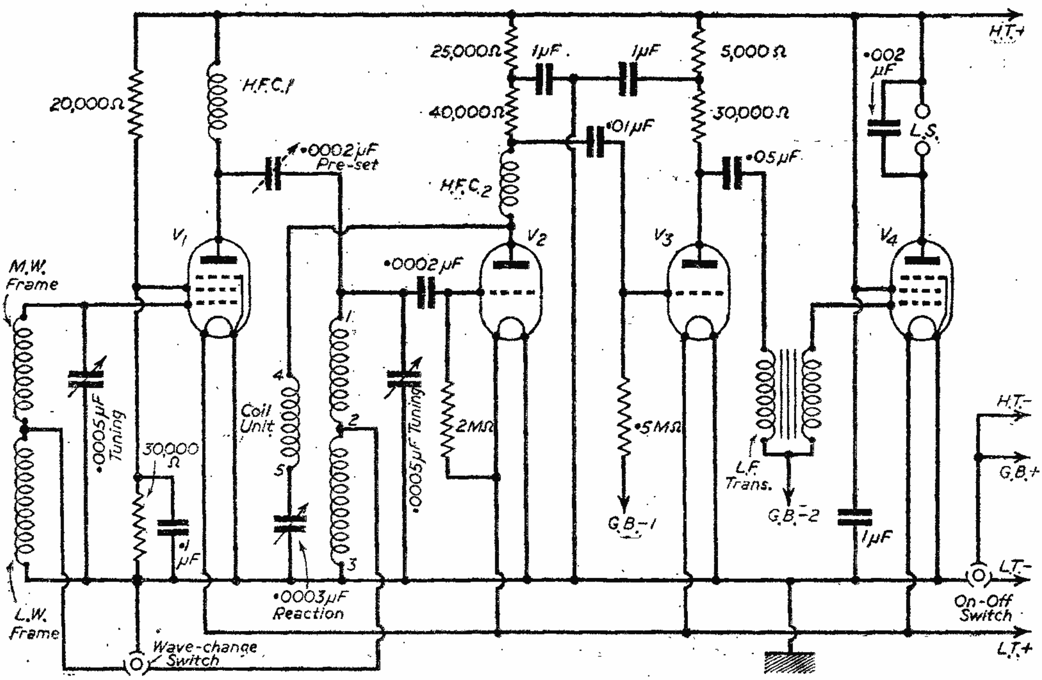


Fig. 4.—Theoretical circuit of the portable.

be omitted or replaced by a 5,000 ohm resistor with some makes of tuning coil. The R.F. coupling choke must, however, be a component especially intended for this circuit position as a reaction choke will not have sufficient impedance. It should be screened and the metal case is connected to the L.T. minus line of the receiver.

Soldering will be necessary and insulated sleeving must be added where wires may touch each other or the foil on the chassis. Battery leads are made from flex, fitted with marked connectors.

Wiring between the panel and chassis will become clear upon consulting Figs. 1 and 2. Three lengths of flex about 6in. long should be soldered on for connections to the frame aerial, when this is made. One of these leads runs from the fixed plates of the R.F. tuning condenser and the second from the wave-change switch. The third lead is taken from the L.T. minus line of the receiver.

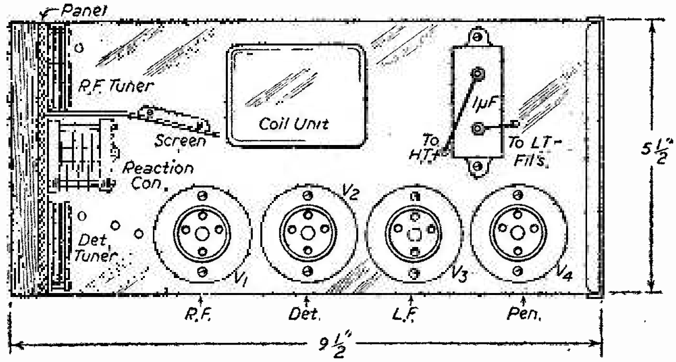


Fig. 5.—Details of the chassis and sub-panel.

A short length of twin flex is taken from the plate and screen grid sockets of the output valve-holder for connection to the speaker (leads marked L.S. and H.T. plus in Fig. 2). The screen grid socket is also connected to H.T. plus.

At this stage the receiver may be tested by connecting a spare tuning coil to the leads which will eventually go to the frame aerial. Both circuits should tune smoothly without any interaction and reaction should build up gently. No screening of leads was needed, but the grid lead of the R.F. valve is taken across the top of the chassis to prevent coupling with the detector circuit. Should there be any instability the anode lead of the R.F. valve may be screened in the usual way.

The Cabinet

This was cut down from one obtained from a junk shop; it may be made from five-ply to the size shown in Fig. 3. It is 14ins by 13in. by 6¼in. *inside.* The finish naturally depends upon the craftsmanship and materials. If a polished, jointed cabinet is not going to be made, American or leatherette cloth may be glued over the whole of the outside with quite a professional result. The front need not be fretted as in the illustration, this being left from the original junk cabinet together with the centre piece which was intended to carry a moving-iron speaker. A suitcase-type handle bolted to the top and a door with catch hinged to the back completed the cabinet.

The Frame Aerial

A piece of three-ply, 14in. by 13in., carries the frame. Four pieces, 2in. long and ½in. square, are screwed diagonally to the corners, as shown in Fig. 3. In these pieces six saw cuts, about ¼in. deep, are made with a fairly wide saw (oak or other hard wood must be used to avoid splitting).

When the pieces are in position a 75ft. length of 26 d.c.c. wire is taken and wound in three of the slots, giving approximately six turns in each slot. The wire is then cut off at a position which will bring the end near the chassis when the latter is in position and 200ft. of 30 s.s.c. joined on. This is then wound in the remaining three slots, giving approximately 18 turns to a slot. Both windings must be in the same direction. The beginning of the shorter winding is connected to the fixed plates of the R.F. tuning condenser; the junction of the windings goes to the wave-change switch; and the end of the longer winding is taken to one of the filament minus sockets.

These connections are made with the short lengths of flex mentioned when the chassis is finally in position.

Fixing Speaker and Chassis

The position of the chassis is shown in Fig. 3. It rests on a strip screwed to the side of the cabinet, and in addition a bracket is screwed to the front of the cabinet (see Fig. 1). A bolt run through panel and cabinet side completes the fixture that end.

A metal piece, 7in. long, with two flanges, holds the other end as shown in Fig. 3. To prevent the chassis slipping from the lower flange a bolt holds the chassis and supporting metal piece together.

The speaker is bolted to a hole so that it occupies the position shown. These bolts do not project through the front of the cabinet and the baffle (with frame wound as described round its edges) is fixed to the front of the cabinet by short wood screws.

A H.T. battery of the long type goes below the chassis, and a jelly or dry accumulator stands besides the chassis.

Operating

It should be remembered the frame does not pick up signals originating from a point in line with its axis so the receiver may sometimes require to be turned about when listening.

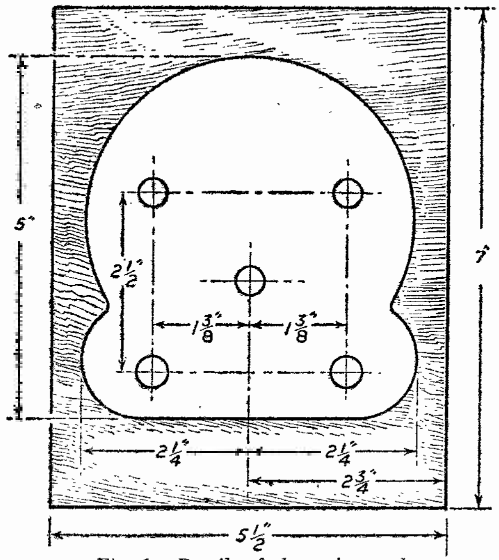


Fig. 6.—Details of the main panel.

If it is desired the two tuned circuits should gang closely together the frame aerial may be adjusted to suit the particular coil used. Adding turns will increase the wavelength tunable, and vice versa. The .0002 mfd. pre-set may be adjusted from below the chassis to control the selectivity and sensitivity as desired.

Receiving Television Sound

How to Build a Battery—or Mains-operated—Converter for Use with Existing Receivers.

By W. J. DELANEY (G2FMY)

NOW that television transmissions are taking place regularly, many listeners are anxious to hear just what is being broadcast before investing in a vision receiver. Others are not at present interested in the vision, but would like to hear the sound part of the programmes, as there are occasions when certain items are televised which are not heard on the normal B.B.C. programmes. It must be pointed out here, however, that the use of a converter such as is to be described will not enable the high quality of the television sound programmes to be obtained. A properly designed receiver is necessary to derive the full benefit of the wide band width which is used on the television frequencies. However, a special S.W. converter can be built which will enable the sound programmes to be tuned in just as easily as the normal Home or Light programmes, and is well worth while.

As the frequency used by the existing television section is in the ultra-short-wave range, some care is required in selecting a circuit which will be more or less foolproof. Experience has shown that a triode-hexode type of valve is the most reliable, and these are now available in either mains or battery-operated types so that all can share in the choice of valve. The hexode section is, of course, used as an H.F. amplifier cum detector, with the triode section as oscillator, the mixing taking place inside the actual valve. This gives reliability right down below the 7 metres round which we are at present interested.

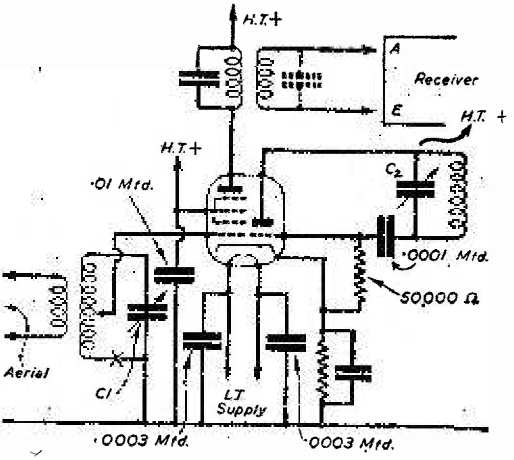
The Circuit

For the oscillator stage certain valve makers have their own preferences, but a Hartley or Colpitts oscillator circuit will give very good results, and of the two, preference goes to the Hartley. The only snag is that the tuning condenser for this part of the circuit cannot be mounted on a metal panel, or, in other words, the spindle or moving vanes cannot be connected to " earth." If an insulating bush is placed on a metal supporting screen a standard condenser can be used, but the capacity to earth may affect results. It is best, therefore, to use separately operated condensers for C1 and C2, mount them on an ordinary insulated type of panel, and fit extension rods to the spindles to avoid hand-capacity effects. The full circuit is given here with all essential values marked. No difficulty should be found in building up a neat little unit round this circuit, but the values of one or two components will depend upon the valve in use, and the instructions of the makers should be followed so far as these are concerned. The small condensers from filament or heater to earth should be included with all types of valves. In the case of a battery valve the lead from the secondary of the aerial coil to earth should be broken at the point marked " X " and a lead taken from the coil to a G.B. tapping to suit the valve. The cathode connections are then ignored, and the grid resistance in the oscillator stage then taken direct to earth.

Coils

Tuning will be found easiest with a 15 mmfd. condenser and these are readily obtainable to-day. The coils to cover the required wavelength will then consist of 6 to 8 turns of wire with a diameter of just over 1in. Obtain some good tinned copper wire if possible (although plain copper will do), with a gauge of 14 or so. Alternatively, if you can obtain them, some of the original silver-plated Bulgin coils will be found ideal. Wind the required number of turns round a piece of material having an outside diameter of just under an inch. Wind the wire on tightly with each turn up close against its neighbour, and when the required number has been wound, and the end of the wire released, it will spring open and leave the turns space-wound just a little over an inch in diameter. A tapping has to be taken to the grid coil, and in the majority of cases the most effective position will be at the centre point of the coil. With some aerial systems, however, it may be found that more stable oscillation is obtained when the tapping is moved towards the " earthy " end of the coil. When a suitable position has been found, however, the lead should be soldered to the coil at that position.

The aerial coupling coil will consist in most cases of 4 or 5 turns of wire wound on a similar former to the previous coils, but placed about ¼in. away from the " earthy " end of the grid coil. Some grounds for experiment may be found here, according to the type of aerial which is used. Best results will be obtained with a proper dipole built on the lines described in last month's issue. But an ordinary aerial can be used, in which case it should be joined to the end of the aerial coil remote from the grid coil, and the other end of the aerial coil then joined to earth. If oscillation is not easy to obtain (due to a very large aerial, or inefficient earth connection) a small condenser should be joined between the aerial and the aerial coil.



Basic circuit of the converter for television sound.

Coupling to the Receiver

To couple the converter to an existing receiver, an ordinary I.F. transformer may be joined to the hexode anode circuit. If a standard unscreened component is used, the pre-set condenser across the secondary should be removed, allowing the secondary then to be tuned by the condenser in the receiver. If the latter utilises a coil having a very small primary winding, it may be found that tuning will be difficult, in which case the two points shown in Fig. 1 as being joined to aerial and earth terminals on the existing receiver should be joined to earth and the grid of the input valve. The aerial is then coupled to the input to the converter in which condition the entire combination becomes a superhet. The receiver should be tuned to some point at the bottom of the medium waveband where no interference is experienced, and then the two condensers on the converter unit should be "swung" through their entire range slowly until the vision or sound signals are heard. If the vision signals are picked up first it will be a simple matter to find the sound broadcast as it is only slightly lower in the scale. When once the programme has been received, experiment with the setting of the main tuning in the receiver, the adjustment of the pre-set across the primary of the I.F. transformer, the exact position of the aerial coupling coil, and the tapping point on the grid coil. Most of these adjustments will be affected by the strength of the received signal and the type of aerial. For instance, if a long way from the Alexandra Palace and near to a busy road, it will be found that car interference will be very bad and perhaps prevent the programme from being heard at all. In such a case a good high dipole properly matched, with correct type of feeder, will do much to reduce the interference, whilst a reflector may even cut out all interference and enable the programme to be heard perfectly. Similarly, tuning to the other end of the medium waveband on the receiver may prove more effective in some locations than in others. Of course, in the case of a mains receiver, the H.T. feeds for the three points in the unit may be obtained from the receiver H.T. line by means of the usual decoupling resistances, whilst the L.T. supply may be obtained from the receiver through the medium of an adaptor placed beneath one of the valves.

A New 1,000 Watt Amplifier

PHILIPS Lamps, Ltd., announce that they will shortly have available a new 1,000 watt amplifier designed for very large public address installations or for wire broadcast systems serving networks of 6,000 subscribers.

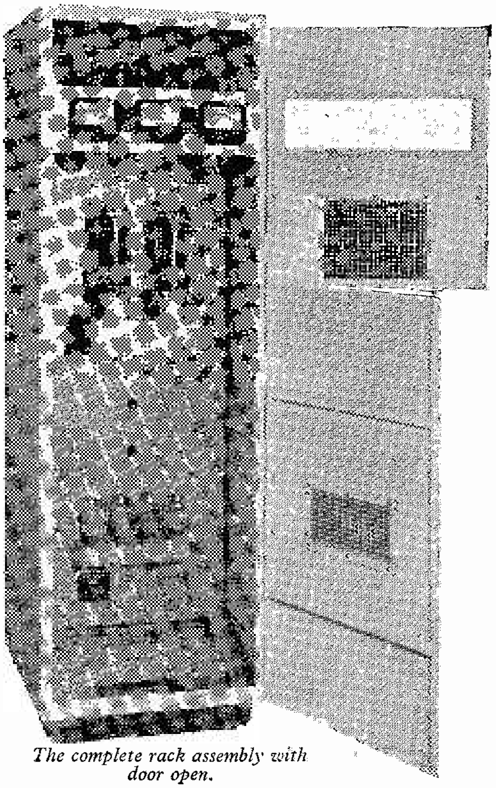
The "Philowatt," as it is to be called, is a high-quality amplifier with the remarkably low distortion level of 1 per cent. It incorporates many novel features including "S.A.M." (Scott Automatic Monitor), which fulfils a function closely parallel to that of "George" the automatic pilot in aircraft.

S.A.M. consists of a unit built into the amplifier which provides electronically-delayed main H.T. switching and automatic monitoring of the amplifier output. This facility is provided to allow the unattended operation of the amplifier, and functions in the following manner:

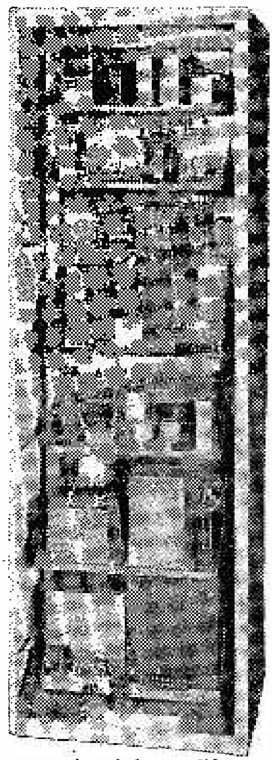
In the event of no audio signals being present in the amplifier output for a period exceeding three minutes a relay is released which may be arranged to inject a small 50-cycle input to the amplifier. If the amplifier is working satisfactorily, the 50-cycle signal will be detected in the output and will automatically re-set the circuit for a further three minutes. The 50-cycle signal is not noticeable on the speakers connected to the amplifier as the duration of the signal is only a fraction of a second, the time required for the resetting of the monitoring relay. If the amplifier develops a fault the relay will not reset and an "earth" is put on a circuit which may be employed to operate an alarm signal and/or switch over to a stand-by amplifier.

A feature of the amplifier is the meter panel. This contains the three meters mentioned below and with the lower grille gives a very well-balanced appearance to the amplifier, which is designed to appeal as much to the eye as to the ear. The meters themselves are of the "easy-to-read" type, the operational segment of their scales being distinctively coloured to permit of satisfactory inspection by the non-technical user.

The body and "works" of the amplifier, being built on a standard 19in. rack, can be obtained without the cabinet if required. The necessary fixing arrangements for the output valve anode-current meters are then available on the front panel after the removal of two cover plates.



The complete rack assembly with door open.



Interior of the amplifier, showing rack assembly.

This model incorporates the electronic-delayed switching unit, but does not include the automatic monitoring facility as standard. It may, however, be fitted at a small additional cost.

Circuit

The amplifier incorporates a special low-distortion direct-coupled driver stage, which provides a low-impedance signal source and also negative bias stabilisation for the class AB2 push-pull triode output stage. The pre-amplifier stages are also push-pull throughout and employ negative feed-back which results in an extremely low harmonic content, even at full drive. The negative feed-back circuit has also enabled a good output regulation to be obtained, a very desirable feature in wire broadcast systems where the load is liable to considerable fluctuation.

The audio coupling and output transformers have received much attention in their design and, as a result, the amplifier is able to provide full output at frequencies as low as 40 cycle per second with a total distortion of less than 3 per cent.

Three 3½in. rectangular meters are provided, two for indicating the plate currents of the output valves, the third being a multi-purpose instrument, which by adjustment of a rotary switch enables it to be used as an output meter with a dB scale, or for checking the cathode currents of each of the pre-amplifier and driver valves.

The output valves are protected, in the event of a failure of the fixed bias supply, by a relay which automatically reverts to auto-bias working. In the event of such a failure, the green bias indicator lamp is extinguished. A similar red lamp indicates that the main H.T. supply is on.

Mechanical Construction

The streamlined cabinet design presents an exceptionally well-balanced and pleasing appearance. Particular care has been paid to the ventilation, and also to the accessibility of components. The front of the cabinet is hinged in two sections which permits adjustment of the pre-set controls and for revalving (see photograph).

The amplifier is built on a standard 19in. rack, and comprises four panels, the voltage amplifier, the output valve stage, the bias supply unit and the main H.T. supply unit.

Two quickly detachable panels give free access to the rear of the apparatus, electrical components and external connections.

Notes and News

Booklet on Solders and Fluxes

MULTICORE Solders, Limited, are releasing for distribution, upon request, to manufacturers, service engineers and all who are interested in soldering, an attractively printed booklet "Modern Soldering, 1946 Supplement." This eight-page booklet contains a number of illustrations showing practical uses of solder. Full technical information is supplied of Ersin Multicore Solder, which contains three cores of non-corrosive Ersin flux, with tables of colour codes, melting points of different alloys and recommendations of which alloy to use for specific purposes. Another interesting table gives details of gauges in inches and millimetres in which Ersin Multicore Solder is supplied as standard, together with approximate number of feet per pound of five different alloys in nine different gauges.

A general article explains simply the composition and uses of solders and fluxes and makes it clear why an activated resin flux such as Ersin, which is incorporated in the three cores of Multicore Solder, is advocated for soldering of radio and electrical components.

Samples of two representative alloys are incorporated in the booklet. Copies of the booklet are obtainable upon application, free of charge, from Multicore Solders, Limited, Mellier House, Albemarle Street, London, W.1.

Technical Notes on the New Pye Television Receivers

BOTH the 1946-47 Pye Television receivers are of entirely new post-war design, and developments resulting from Pye's experience in the production of radar and other military equipment have led to much improved performance. The black and white picture, measuring approximately 8in. x 6in., is brighter, with finer definition. Interference is automatically suppressed in both sound and vision channels. Two exterior controls operate the on/off switch and vary brightness and volume. Four auxiliary controls are concealed beneath a shutter on the front of the cabinet; these are: contrast, focus, frame hold, and line hold. Seven pre-set controls are located at the back of the chassis: line linearity, line amplitude, vision sensitivity, sound sensitivity, frame linearity, frame amplitude and frame synch. They do not normally require adjustment after the set has been installed. The sound channel has been designed to reproduce faithfully the high-quality television sound transmissions. Each model is a T.R.F. receiver designed to operate on 50 cycles 180/250 v. mains. A special Y-matched television aerial has been developed for use with these receivers. Its design provides high signal/noise ratio; maximum sensitivity for sound and vision; reduction in weight and wind resistance. The complete installation provides maximum performance from the receivers in all localities within the service area of the Alexandra Palace transmitter.

Prices: Table Model (B16T) £35 plus £7 17s. 3d. purchase tax.

Console Model (D16T) £45 plus £10 2s. 2d. purchase tax.

Aerial (including tubular metal pole, and down lead; excluding chimney or wall fitments), £3 17s. 6d.,

C.B.C. International Broadcasts

THE Canadian Broadcasting Corporation have issued a brochure designed to give a brief explanation of the C.B.C.'s International Short-Wave Service. The C.B.C.'s International Service broadcasts 36 hours a week in English to the United Kingdom alone.

Its transmitter at Sackville, New Brunswick, which was designed by C.B.C. engineers, has one of the clearest short-wave signals heard in Europe from North America. A year ago, when the short-wave service was commencing operations, the Director General of Programmes of the C.B.C. heard the Sackville Station on a portable set in the Savoy Hotel, London, as clearly as the B.B.C. Home Service.

The C.B.C. broadcasts in English on short-wave every type of programme—variety, music, drama, actualities, news, news-features and political comment. Some of the programmes are designed for Canadian Servicemen still serving in the United Kingdom or Europe, but the majority are for general listening.

The C.B.C. hopes to be able to supply a monthly schedule of its International Short-wave Service. If you should be interested in receiving this, write to: Andrew Cowan, European Representative, C.B.C. International Service, c/o B.B.C., 200 Oxford Street, W.1.

Our Cover Subject

IT is interesting to compare American television practice with that used in this country. The recently published illustrations of B.B.C. television studio arrangements may be compared with that on this month's cover, which shows an American television studio during a broadcast. Note the huge battery of lights and the three Iconoscope cameras which are being used simultaneously. This enables "fades" and close-ups to be brought into effect very much as in the normal cinema film.

Programme Pointers

This Month MAURICE REEVE Discusses the Question of a New Venue for Concert-goers

THE Promenade Concerts commenced another season at the Royal Albert Hall on July 27th. As was the case last year, the conductorship is shared by Sir Adrian Boult and Basil Cameron, and they run for eight weeks. Everything, in fact, is the same, and according to the traditions built up in over half a century of "promenading."

The public, that is to say, the promenading part of the concert-going musical world, would not tolerate it otherwise, any more than the devoted patron of cricket, football or the theatre would tolerate any but minor changes in the presentation of those amusements. And those only with a growl.

The promenader not only must have his promenade, but he insists on attending the concerts in such vast numbers that, even if he wanted to, promenading would be even more impossible than it is on Brighton promenade on a fine August bank holiday. So jammed is the floor of the Albert Hall on most nights that the removal of the fainting, of whom there are always one or two, is a highly skilled and technical operation if the music is not to be indecently interfered with. The title "Promenade Concert" has long since become a misnomer.

Possibly one, and the only, change made of any note is the abolition of the Monday all-Wagner programme, a tradition going back to almost the founding of the series. At Queen's Hall it used to draw the largest audience of the week, not even excepting Beethoven on Fridays It is bound to return when life regains its equilibrium and stability, and when values are seen through less rose-tinted spectacles. Only then will the present "Tschaikovsky-soaked population" realise what it is missing.

Memorial Hall

The concert-goer amongst my readers has doubtless been wondering what is happening to the projected "Henry Wood Memorial Hall"! Or to some house of music to replace the ever-to-be lamented Queen's Hall. I know nothing other than rumour, gossip and hearsay. But the problem is very serious. What an artistic tragedy it was that destroyed the Queen's and not the Albert Hall!

Rumour has it that the plans for a new Queen's Hall have been shelved owing to the raising of the ground rent from £650 to £8,500 per annum. Also that Bruno Walter is going to lay the foundation stone of it when he is over here conducting in the autumn. Meanwhile we are still being asked to buy bricks for the Henry Wood edifice.

I have often wondered whether the purchase of a West End theatre would not be a good financial proposition. Say, the bombed-out Lyric or Shaftesbury, which could be completely re-conditioned as a concert hall, with the seating accommodation brought up to two thousand or just over. The old Shaftesbury probably used to hold about that number; it was one of the larger West End theatres.

Something must be done about it, and quickly. "The Shaftesbury Music Theatre"! It seems to sound grand in my ears! Theatres have proved extremely successful in recent years for holding concerts in, and the Sunday series at the Cambridge Theatre have been profitable and popular. The atmosphere has been admirable, the seating extremely comfortable, and the whole thing as much a pleasure to performers as to listeners. If given over entirely to music, the stage of any theatre would obviously be reconstructed, just as it would in a concert hall taken over by a theatrical company. This should present few difficulties at the Lyric, and none at all at the Shaftesbury, which was entirely consumed and now presents merely a vacant site.

Worth Considering

I have no idea whether either of these propositions is in any way possible; most likely not. But I do suggest, knowing that theatres frequently change hands, that this should not be an unpractical line of approach to the very important problem of providing London with its new concert hall, if the Queen's Hall project falls through. As a new advertising approach to the concert-going public it should be incomparable. All the theatres' patrons passing up and down Shaftesbury Avenue would have music's leading names before it, just as it now has its own attractions. Instead of a few sandwich men tucked up away at the top of Langham Place where nobody can see them except those actually attending Queen's Hall, there would be a constant stream of countless thousands, all day and every day, passing the very doors and actually seeking entertainment.

On the supposition that this idea of bringing music-land into theatre is possible, I would suggest that it be very carefully and exhaustively studied.

Footnote.—I was at the Albert Hall a short while ago. The place was full. I had been sitting about two-thirds of the way back in the stalls. Enormous applause was accorded both the orchestra for its playing of a symphony and a pianist for a concerto. But after the fourth "recall" to the platform, I looked round me and was astonished to notice that scarcely a single person of the hundreds round me was clapping or acknowledging the artists in any way. In fact, the whole of the auditorium could have disappeared into thin air, or need never have appeared at all, for all the difference they made to the volume of sound.

There are probably many reasons, chief of which might be that stall-holders are more blasé and sophisticated. I was *not* among the applauders.

New Zealand Amateur Frequencies

ADDITIONAL frequencies were made available for use by licensed New Zealand radio amateurs with effect from June 30th, inclusive.

Holders of high-frequency permits are now permitted to operate on a world-wide basis within the bands shown hereunder.

High Frequencies

40-metre band: 7,000 to 7,300 kc/s A1 waves (morse) only.

20-metre band: 14,000 to 14,400 kc/s A1 waves (morse) only.

10-metre band: 29,000 to 30,000 kc/s A1 waves (morse) and A3 waves (telephony).

Very High Frequencies

166 to 170 mc/s, 420 to 450 mc/s, 1,345 to 1,425 mc/s } A1 waves (morse), and A3 waves (telephony).

Transmissions in the 80-metre band (3,500 to 3,960 kc/s) previously restricted to New Zealand contacts only, may be made on a world-wide basis.

The use of the frequencies 58.5 to 60 mc/s in the 5-metre band has been discontinued, but in lieu thereof all licensed amateurs are permitted to operate on a world-wide basis in the 50 to 54 mc/s portion of the 6-metre band, using both A1 and A3 waves (morse and telephony).

It is not possible to restore the pre-war 160-metre amateur band.

Underneath the Dipole

Television Pick-ups and Reflections. By "THE SCANNER"

POST-WAR television has started off with a swing. Programmes of the same style and type as the 1939 vintage have served to get the organisation into working order, and highly entertaining they have been. The national Press have, on the whole, given the service a good send off, though one or two writers have expressed surprise that the quality and detail of the picture show no obvious improvement on pre-war television. One writer took particular note of "snow-storms and flashes," blaming the transmission. The description of the blemishes, however, seemed to indicate that he suffered from local electrical interference on his receiver, probably from automobile ignition circuits or from diathermy.

Diathermy

There is, of course, a considerable increase in man-made static compared with pre-war days, and most of this has had its most serious effect on the very short waves. Thanks to the commercialisation of television in Britain before the war, this country had a big lead over all other countries in the development of ultra-short-wave radio in its multitude of applications, including communication, radar, radio controlled weapons and diathermy. This was largely due to the number of commercial firms and technicians who had been engaged on television design and constructional work, quite apart from the host of short-wave "hams" who had made their own television or short-wave receivers. One of the fields in which very rapid progress was made was in ultra-short-wave applications to medical, surgical and curative treatments. "Bloodless surgery," is not a new term; it was used many years ago by the highly entertaining wizards of the music hall, such as "Dr. Walford Bodie" and "Radiana," who made use of the more spectacular school-room experiments with Wimshurst machines and static electricity to produce startling effects on the stage. Such is the power of mind over matter that the colossal (and harmless) sparks and flashes that were their stock-in-trade, together with spell-binding "patter," had the required effect and many sufferers of an astonishing variety of complaints were "cured." Naturally, these showmen had confederates in their audiences. But genuine invalids frequently used to go up on the stage for "treatment" of rheumatism, lumbago or toothache—and come away satisfied! This, however, is far removed from exact and specialised science which is now practised in many hospital and private clinics.

The Short-wave Cure

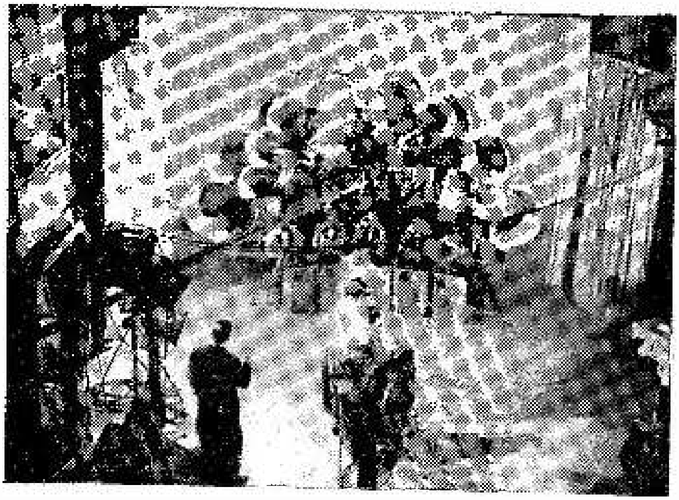
The writer of these notes had personal experience during the war of the curative effects of short-wave radiations. Like many others he was afflicted, through exposure to extreme cold, to a crippling form of sciatica. Practically unable to walk, and experiencing spasms of excruciating pain, life took on a sombre aspect. Then came a transfer to a hospital with a special electrical clinic, presided over by a most progressive surgeon. This writer, however, had seen "Dr. Bodie" and his electrical gadgets in pre-war days, and was not particularly impressed with the gleaming white panels, meters and buzzing noises which seemed to inspire other patients with hope. But the short waves won. The tangled sciatic nerves were straightened out by the amazing "warming up" effect of a six-metre transmission across the spine, which seems to heat up one's very bones while leaving the surface of the body cold. This treatment, together with a few injections, did the trick. In a few weeks a "case" which would otherwise have taken a year to cure (if it could have been cured at all) was walking about with ease. And, I assure you, he regards that clinic with respect, together with the carefully bonded wire-netting screen which covers it and prevents its short-wave radiations from interfering with the radio receivers in the locality.

The Interference Bogy

There are, however, many doctors, specialists, consultants and hairdressers who possess apparatus for electrical treatment who are not so thoughtful about their radio neighbours. It is up to these radio neighbours to remind them that they must take steps to avoid cluttering up the ether with their buzzes and bangs, either by the fitting of efficient screening to the room wherein treatment is given, or by restricting the use of the apparatus to hours when television transmissions, at any rate, are not in progress.

Development of Transmission Technique

While the initial television programmes may not have revealed any startling new devices or technique, you may take it as certain that these will be introduced shortly. The first, I think, will be the regular use of the "cut" type of changeover from camera to camera in the studio. The present standard arrangement is to "mix" over from the long shot to the close-up cameras, using a device somewhat similar to the well-known Dramatic Control Panel. The new "cut" method will give the television producers the opportunity of getting a slicker and more polished technique on the lines of a well-edited film production. The device will require much greater accuracy in judging the correct moment for making a "cut" changeover from camera to camera. But I think that the considerable amount of



A band setting for a television broadcast by Geraldo, which is reminiscent of modern film settings.

research and experiment involved in producing this device will have been justified. The "fade," the "cut" and the "dissolve" of scene to scene are the punctuations of the craft of film making, enabling the tempo of situations to be controlled, tension to be developed, and emphasis to be made. We are now about to witness the exciting and interesting evolution of similar devices in television! Once again, I think, Britain will take the lead.

Back Projection

Another important line of development is the use of "back-projection" for superimposing the figures of actors (in the studio) upon natural exterior scenes which have previously been filmed. The film, for instance, might be the view of the passing countryside, as seen from a train; and the studio scene to be superimposed might be a representation of a railway compartment, with an actor sitting near a window. The natural backgrounds available are unlimited, as long as they are filmable, and such moving subjects as scenic railways, Brooklands track (alas!), London streets (as seen from a moving 'bus), readily come to mind. Stationary backgrounds, such as exteriors of houses, dockyards, etc., are rather more difficult to manage, owing to mechanical problems connected with steadiness. Back projection is a device which has been in constant use for years in the film studios, and has been particularly well developed in England. A fine example was seen in Ealing Studio's magnificent war film "San Demetrio," in which back projection scenes were used in conjunction with scale model shots in telling the glorious story of that famous ship. But there are snags about using it for television. In the film studios, the film background is projected upon a transparent screen, the projector being about sixty feet or more behind it. In front of it is built a portion of "set" in which the actors stand, playing their scene before the camera.

All this layout of apparatus takes up a lot of space, and the lighting of the actors has to be most carefully carried out in order to avoid rays from the lamps falling directly upon the projection screen and spoiling the definition and brilliance of the background picture.

A more advanced method, which the Alexandra Palace back-room boys are now toying with, is to have the actors stand before a white background or, alternatively, a black velvet, and to use the outlines of the figures, as scanned by a television camera, as a matte for suppressing vision signals on a third channel in an area represented by the silhouettes of the artistes. The two visions—the artistes' figures and the pictorial background from film (with a lump cut out to the shape of the artistes' silhouettes)—are then combined electrically to give exactly the same result as in back projection. A pretty device, which will save space and be a remarkable step forward when it is perfected! This will be a leap ahead of the film people!

Single Valve Service Oscillator

THIS oscillator was constructed by way of an experiment to meet the needs of ordinary service work. It was built quite cheaply. As can be seen the circuit is quite straightforward, oscillation being maintained by feed-back through L_2 in the anode circuit. Modulation of the R.F. output is accomplished by means of the A.F. transformer connected between oscillator grid and anode—the .005 mfd. condenser across the primary of the transformer providing a suitably pitched note.

The Circuit

The output providing an R.F. modulated signal is taken from the secondary of T_1 by means of a screened lead, whilst a pure A.F. signal is taken from the oscillator anode through a 0.1 mfd. blocking condenser. An interesting point about the reaction circuit is that V.C.2 actually serves as an attenuator.

The coils L_1 and L_2 are four-pin plug-in type, and were wound to cover the long waves, medium waves, and 16-50 metres in the short-wave band. The coils are mounted unscreened and thus, as a result, direct pick-up is possible when the instrument is placed underneath the test bench. However, for dynamic testing the injection prods are employed.

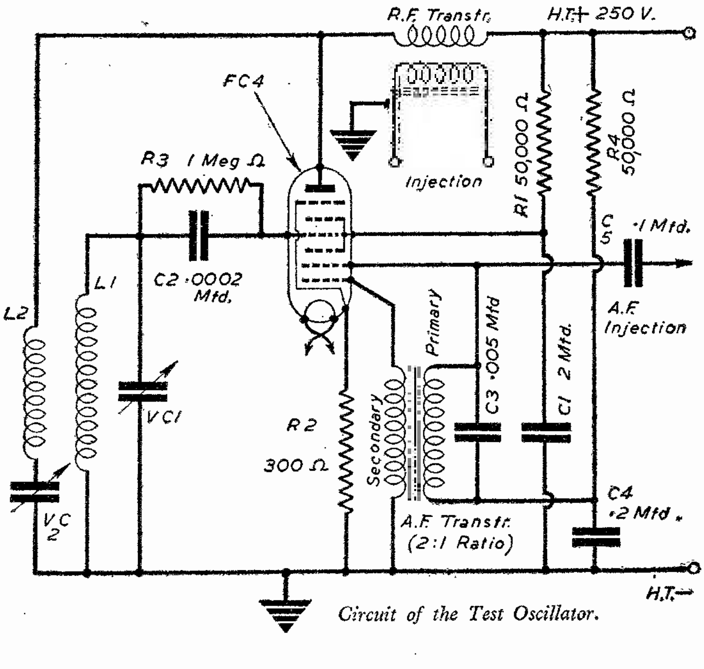
This oscillator can hardly claim to be an accurate precision instrument, but its uses are many in ordinary service work. The writer has used it constantly in localising trouble in sets, and a very rough method of trimming can be performed with it. The A.F. injection proves very useful in checking the A.F. stages of sets, and is particularly convenient for tracing faults in P.A. equipment.

Chassis and Case Construction

The case is constructed of timber, having two metal strips bolted on, one strip to carry the tuning and reaction condensers, the other metal strip forming the main chassis. Two 0-180 deg. dials were obtained from an old set and mounted on the front panel for calibration purposes. A four-pin valve base is mounted on the chassis for H.T. and heater supplies, the respective supplies from the eliminator being fitted to an old four-pin valve.

Calibration

The oscillator is calibrated against a set known to be accurately aligned, the three frequency ranges, i.e., long, medium and short, being marked on the dials in different colours.



Circuit of the Test Oscillator.

Technical Notes

Inverted Amplifiers. Output Impedance and Phase-shift are Among the Subjects Dealt With Here

By "DYNATRON"

"INVERTED" amplifier stages present some peculiar problems.

For instance, cathode loading does not necessarily mean a cathode follower, as will be pretty obvious if one grasps the difference between the two circuits shown in Fig. 1 (a) and (b).

The circuit in (a) is an ordinary amplifier with the load resistance R placed on the cathode side. But it is not a cathode follower. The voltage amplification will be exactly the same as if the load was on the anode side, with the difference, however, that there will be no phase-reversal of the output voltage.

During a positive half-cycle of Eg, the anode current will be increasing, giving a rise in the potential-difference across R. The valve voltage will be falling in the ordinary way, but the cathode end of R will become more positive in relation to −HT, i.e., we have a potential sign at this point, the same as Eg.

If, however, the grid return was joined to −HT, instead of the cathode, Fig. 1(b), the stage would be converted into a cathode follower having 100 per cent. negative feedback, and therefore a voltage gain less than unity.

The −HT end has an alternating potential that *is* phase-reversed with respect to Eg. Hence the whole of the output voltage is negatively fed back. The resultant E.M.F. on the grid will be small, being the difference of two nearly equal voltages, which explains why the overall gain must be less than unity.

Fig. 1(c) shows an ordinary magnetically coupled oscillator, where the basic circuit is the same as Fig. 1(a). Both are ordinary high-impedance stages, but the cathode follower (b) will have an apparent internal impedance of something like 400-500 ohms, given approximately by 1/gm, where gm = the valve mutual conductance expressed in *amperes* per volt. (See notes on "Output Impedance.")

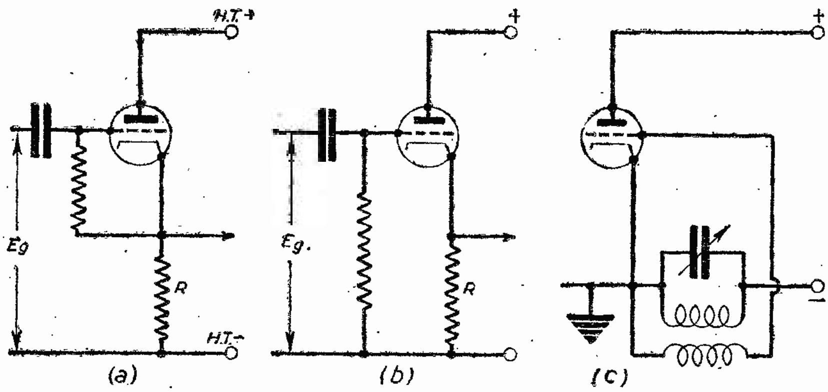


Fig. 1.—Forms of "cathode loading" where (b) is a cathode follower.

Inverted Amplifiers

The inverted amplifier, proper, is shown in Fig. 2(a). It is a more complicated affair than the cathode follower, though embodying somewhat similar ideas. The input is applied across the cathode resistance R2, whilst the output is taken off the anode load resistance R1 in the ordinary way.

The grid appears not to be doing very much, since it is earthed! But the effect of the input signal will be to cause a *relative* change in the grid-cathode (or cathode-grid) potential in the usual way, i.e., it does not matter whether we earth the cathode, and vary the grid potential or vice versa.

This will be clearer if the signal is represented as an alternator giving an E.M.F., Eg, in series with the valve, Fig. 2(b). It then also becomes apparent that this alternator is virtually *acting in series with the valve to supply part of the output*—an important characteristic of inverted amplifiers.

Although the output load resistance is in the anode circuit, the output voltage will *not be phase-reversed*—a feature similar to the cathode follower.

The reason should be evident by considering Fig. 2(b). For what we may decide to define as a "positive half-cycle" of the input E.M.F., the grid actually becomes negative in relation to cathode, and vice versa, giving a potential-change across the valve of the same sign as the input half-cycle.

The circuit is not of a great deal of interest for ordinary purposes. Unlike a cathode follower, the voltage gain is somewhat *greater* than that of a straightforward amplifier, but the input impedance is very low, i.e., the stage loads the input circuit.

There are, however, numerous advantages which render the circuit particularly useful where power triodes have to be used for H.F. amplification. At medium and higher frequencies it is well known that the anode-grid interelectrode capacity of a triode causes instability and self-oscillation—which was the original reason for introducing the screened-grid.

In Fig. 2(b), it will be seen that the grid is at earth potential, and acts as an effective "screen" between the anode and cathode—the latter being the "live" electrode. Some neutralising is required at very high frequencies, but the stage is much more stable than an ordinary triode circuit.

The inverted-triode has also had some limited applications in television technique.

"Output Impedance"

This term is often used in connection with the cathode follower and negative feedback circuits in general, and it is not very clear what it refers to. A loose use is to talk of the "output impedance" of a power valve being, say, 4,000 ohms—meaning, the optimum load impedance.

It is much more satisfactory to use *internal impedance*, or simply *internal resistance*. But, even so, the meaning is not so apparent.

If a valve of internal A.C. resistance, *ra* = 2,000 ohms, be employed in a straightforward power stage, the "internal resistance" is 2,000 ohms. If converted into a cathode follower, the *apparent* internal resistance becomes of the order of 500 ohms.

But, even in the cathode follower, the optimum load must be matched to the 2,000 ohms in the usual way!

Then, why should the 500 ohms be a figure given, approximately, by the reciprocal of the valve *mutual conductance*, gm ?

We shall not go into the mathematics which show the physical meaning of this last fact, but a very simple illustration will help to show how an "apparent resistance" can be made to look much less than its actual physical value, even though power considerations demand that the actual value shall be reckoned with.

Suppose we have a battery of internal resistance r—actual resistance.

The effect of this resistance will be to drop some voltage, internally, when current is taken from the battery. If the terminal load is subject to change, the internal "drop" will vary accordingly, which means an "output voltage" fluctuating appreciably with load.

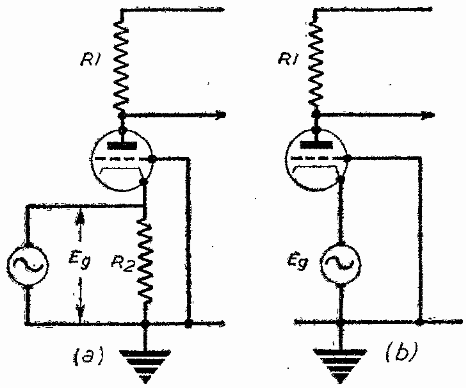


Fig. 2.—Skeleton diagrams of inverted amplifier stage.

Exactly the same thing occurs in a high-impedance amplifying stage, if the load impedance varies, say, with frequency. The output voltage will be subject to wide variations.

But suppose we had some means of making-up this drop, by automatically increasing the internal E.M.F. of the battery—or the E.M.F. of the equivalent alternator used to represent valve amplification. If the compensation is good, the output voltage will be held nearly constant at all values of load impedance.

The actual internal resistance is still *r* ohms, but the apparent resistance looks much less as regards its effect in dropping volts.

In reality, of course, the actual voltage drop and power dissipated in *r*, at a given current, are exactly the same as before. But the voltage-change does not reveal itself at the output terminals because it is largely made-up by extra volts generated.

In all amplifiers embodying voltage feedback, including the cathode follower, the automatic adjustment of the internal E.M.F. is provided by the feedback. The amount of feedback is proportional to the load impedance. Then, the resultant signal (E.M.F.) on the grid of the first valve is the difference between the input signal and the oppositely phased fed-back voltage.

So, "low output impedance" merely signifies a constant output voltage, which is largely independent of load-impedance changes. But, again, the physical internal resistance is still the quantity to be considered when *power* output is the relevant quantity, i.e., the load has to be matched to the actual valve *ra* in the usual way.

Feedback and "Gain"

While on the subject of feedback, an arithmetical problem occurs to me, which seems to give students a lot of trouble.

If the voltage-gain of an amplifier is 100 when, say, 0.5 per cent. of the output voltage is negatively fed-back, what will be the gain without feedback ?

Textbooks and articles are full of various formulae which will enable you to do this problem, but let us try a little straightforward reasoning.

Suppose we apply a 1-volt signal to the input. Since the gain is 100, this becomes 100 v. at the output, and 0.5 per cent.=0.005 of this is fed back. Thus in opposition to the 1-volt input, we have, 0.005 of 100 v.= 0.5 v., or −0.5 v.

Therefore, the resultant signal applied to the valve grid, is, 1.0 v.−0.5 v.=0.5 v., which gives 100 v. output.

Now, the important thing to realise is that negative feedback does not alter the *inherent gain* of an amplifier. All it does do, is to reduce the effective voltage on the grid of the first valve, as shown. Once we have allowed for this, the actual gain (without feedback) is equal to the number of times the *effective grid-signal* is amplified.

The latter is 0.5 v., and so is amplified, 100/0.5=200 times ; the voltage-gain without feedback is 200. But now for another little conundrum.

Suppose you tried the same problem, but using 1 per cent. feedback. One per cent. of 100 v. is 1.0 v., and so the resultant signal on the grid of the first valve is, 1 v.−1 v.=0, or *nil* ; the feed-back voltage is exactly equal and opposite to the input signal !

The fallacy is not difficult to find. No matter how many valves we had in an amplifier, it would be impossible to get 100 v. output, with 1 v. input, i.e., the gain cannot possibly be as much as 100, at 1 per cent. feedback.

A cathode follower provides the best illustration. This is a single stage where we get 100 per cent. feedback, Fig. 1 (b). In consequence, Eo must be *less than* Eg to get a resultant signal on the grid, i.e., the overall gain must be a figure less than 1.0.

A multistage amplifier would similarly show an overall gain less than unity if the whole of the output voltage were negatively fed-back ; it would act as a sort of multistage cathode follower, as regards voltage gain at least. The overall gain would automatically fall to correspond with 100 per cent. feedback.

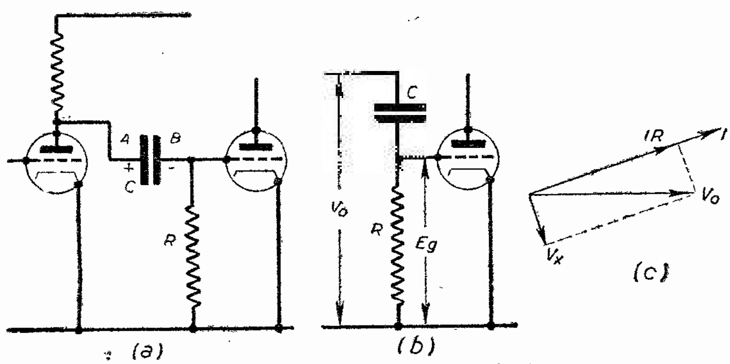


Fig. 3.—Phase-shift in a coupling circuit.

Similarly, if 1 per cent. of Eo is fed-back, the gain will readjust itself to the appropriate figure, which could not, however, be as large as 100. If you are good at mathematics, perhaps you can demonstrate this more rigorously ! With 1 v. input, let X be the output

(*Continued on page* 431)

(*Continued from page* 428).

voltage (and, therefore, the gain), and X/100 = the fed-back voltage. Find X!

If you assume a gain, without feedback, of 1,000, the value of X will still work out a little under 100, actually 90.9 in this case.

A "Phase-shift" Question

I have come across the erroneous idea that there is a 90 deg. or 180 deg. "phase-shift" in the coupling circuit of two valves, Fig. 3 (a), because of the condenser C.

On the one hand, this is a misunderstanding of A.C. principles; on the other, it shows inadequate knowledge of electrostatics.

From an A.C. standpoint, the coupling circuit reduces to that shown in Fig. 3 (b), where Vo is the output voltage of the first valve, I = the alternating-current flowing in C and R in series, and Eg = the voltage applied to the grid of the next valve, which is the same as IR = the alternating p.d. across R.

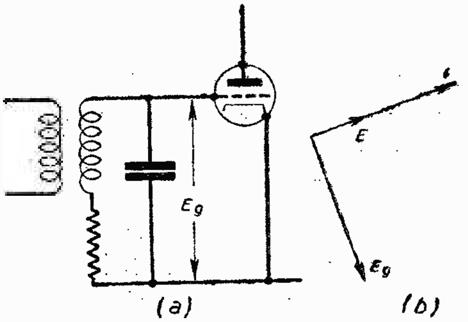


Fig. 4.—Phase-change in a tuned grid circuit.

Now, the A.C. reactance of C will be small compared with the resistance of the grid-leak R. Hence, Vo and I are nearly in-phase, and IR = Eg is also in phase with I, i.e., Vo and Eg are nearly in phase.

The vector diagram, Fig. 3 (c), makes this clear. The p.d. IR is in phase with I, whilst there is a very small reactive drop across the condenser, Vx, lagging 90 deg. on the current. The vector resultant of these voltages is Vo, and the current does lead on this by a very minute phase-angle, as shown. But for all practical purposes, Vo and Eg are in the same phase—there is no phase-shift.

Electrostatically, it is said: When the plate A of the condenser becomes positive, say, the plate B, and the grid, become negative. Therefore, Eg and Vo must be 180 deg. out of phase! But plate B becomes negative by leaving the grid with a *deficit* of electrons, or, in other words, giving the grid a "charge" of + sign — the same as plate A.

Of course, this sort of reasoning is not very sound for showing whether or not there is *any* phase-shift. If C were of too small a value, having a reactance comparable with R, we might have a phase-change of 45 deg. or 60 deg. or more, in Eg relative to Vo, which a vector diagram quickly shows.

In *tuned* grid circuits, however, Fig. 4 (a), there will be a phase-shift of nearly 90 deg. between any e.m.f. *induced into the turns of L*, and the grid signal Eg. The closed-circuit then acts as a series acceptor. The current and injected E.M.F. will be in-phase, but Eg will have the phase of the back E.M.F. in the inductance —which is also the "applied voltage" across the condenser—lagging 90 deg. on the current and injected E.M.F., Fig. 4 (b).

Experiments with Wavetraps

Much instructive information can be gleaned about the properties of tuned-circuits by rigging-up a wavetrap, and using it to "tune-out" some strong station.

It is all very well reading about acceptors and rejectors. Here, we have a very tangible demonstration of how one acts as a short-circuit to the resonant frequency, Fig. 5 (a), whilst the other type offers an extremely high impedance, Fig. 5 (b).

The main desideratum in (a) is a low H.F. resistance, i.e., a good coil. If various coils are tried out, it will probably be found that some are more effective in reducing the signal to an absolute minimum, thus providing a rough and ready indication of their loss resistances.

But the *resonant* impedance of (b) depends also on the ratio L/C. A rejector has a dynamic resistance expressed by L/Cr, where r is the H.F. resistance of the coil, and the best wavetrap will be one where the inductance is as large as possible in relation to the capacity—consistent, of course, with a low *r*, as well.

This bit of textbook theory may be verified easily by making-up a rejector type wavetrap that will tune to the frequency it is desired to eliminate, but using a low inductance and large capacity. The rejecting

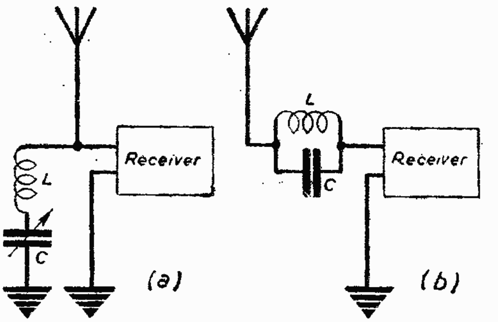


Fig. 5.—"Acceptor" and "rejector" types of wavetrap.

property will be much poorer than in a circuit of large L/C ratio.

Normal L/C values used in tuning circuits are quite suitable. Thus, taking a M.W. coil of about 150 μH, and C = 0.0002 μF, L/C = $150/2 \times 10^4$ = 750,000. If *r* = 5 ohms, say, the rejector impedance at resonance is, L/Cr = 750,000/5 = 150,000 ohms.

If, for the same frequency, C can be reduced to 0.0001 μF, L = 300 μH, the L/C ratio becomes 3×10^6 (3 millions), and the resonant impedance, apparently, 600,000 ohms—4 times the previous figure! But dynamic resistances of this order are almost impossible to realise, using ordinary coils, because, for one thing, the H.F. resistance would be greater than 5 ohms.

In the acceptor type of wavetrap, (a), the L/C ratio has no effect upon conditions *at resonance*. Nevertheless, it is desirable to make the ratio as large as possible, for the by-pass circuit to offer enough impedance to signals it is desired to receive, i.e., at adjacent frequencies in the neighbourhood of the one that is to be cut out.

In (b), conditions at resonance, and off resonance, are affected by the L/C ratio. As in (a), the circuit impedance to frequencies off resonance will increase with the L/C ratio, but as these are the "wanted frequencies" whilst the rejector is *in series* with the aerial—not in shunt—signal strengths will be cut-down, i.e., reception of wanted signals will be better, the *less* we make the L/C ratio.

With the aid of a very simple type of valve voltmeter —or even a receiver and measuring instrument—some interesting comparative measurements may be carried out.

A Question of "Flux"

A querist wonders why the core of a mains transformer should get hot by using a primary coil having considerably less than the required number of turns.

I should think the coil itself should be getting quite hot unless pretty large gauge wire is used. It is not so easy to grasp the idea that, if *less* turns are used on a primary, the magnetic flux in the core *increases*.

In other words, to accommodate a smaller primary we must employ a thicker core, or altogether larger transformer, in order to keep down the number of "lines per sq. cm." The eddy current and hysteresis losses increase rapidly with the flux density, which accounts for core heating.

But the coil has also to carry a larger *magnetising current* which, although lagging 90 deg. on the voltage, nevertheless loads the primary: the wire used must be thick enough to carry the current without overheating. Let us look at the matter another way.

Suppose we had normal primary turns, but took the coil off the core and connected it across the A.C. supply. It would probably get hot enough in a short time to result in a burn-out, or at least serious injury to the insulation.

The reason should be pretty obvious. Without the core, the *inductance* is very small, or, to state it another way, a large current will be necessary to generate a back E.M.F. equal to (or nearly equal) the supply voltage. An enormous number of turns would be necessary on an air-core coil to generate the back E.M.F. at a current within the carrying capacity of the wire used.

Alternatively, by using a sufficiently thick core, the total flux will be increased enormously, together with the inductance. Enough back E.M.F. will be induced to keep the magnetising current within limits by using something like six to 10 turns per volt on the primary.

All this explains, too, why a speedy burn-out will generally result if we make the error of using a "short primary," i.e., connecting the mains across taps—if a fuse does not take care of things.

An Oscillation Problem

An experiment in making a low-frequency oscillator by using an L.F. transformer T, Fig. 6, to couple the anode back to grid, sometimes gives a negative result—or, rather, it seems impossible to get the *positive* feedback which will result in self-oscillation.

Such a device is useful as a "tone source" with which to modulate an H.F. signal generator, and is also used quite a lot for Morse practice.

As a technical problem, the failure to oscillate, whichever way the windings are connected, seems to contradict the basic principles of a magnetically-coupled generator!

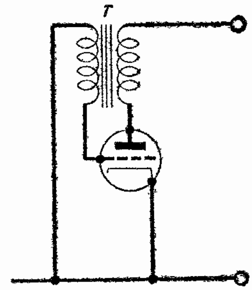


Fig. 6.—An L.F. oscillator?

At high-frequencies, such an arrangement will generate oscillations quite readily.

It is not altogether an easy matter to explain. The E.M.F. induced in the secondary of a transformer is certainly phase-shifted by 180 deg. on the applied voltage across the primary, and, therefore, it should be a simple matter to feed-back an E.M.F. to the grid in the correct phase to maintain an oscillation.

The circuit will work in most cases, and it is feasible for an oscillation to take place outside the audible range. An L.F. transformer is not quite as straightforward as "air-coupling" between two coils. For one thing, the coupling between primary and secondary is very tight, whilst the leakage reactances, self-capacitances, etc., determine the frequencies at which an oscillation can build-up.

As suspected, it is probably a question of whether phase-shifts due to these various reactances are correct for the frequency at which the circuit as a whole is capable of oscillating.

C.-R. Tube Focusing

A POINT which needs careful watching in the design of a cathode-ray tube is the maintenance of constant spot size when the modulation varies. In many cathode-ray tubes the size of the spot tends to increase when the beam current increases, so that black parts of the image become defocused, giving a blurred effect.

One method which has been adopted to overcome this trouble, when the beam is focused magnetically, is to cause the focusing field to vary in accordance with the level of the signals received, in such a way as to keep the spot size constant. This may involve disadvantages, however, on account of the comparatively large amount of iron usually associated with such a magnetic field, which introduces a time lag before the correction can operate. An improved method is, therefore, to use an auxiliary focusing system, with its circuit connected up in the same sense as above, so as to oppose the variation of spot size. This auxiliary system may be either electrostatic or electromagnetic. In the former case it takes the form of an additional electrode disposed, for example, between first and second anodes, or before the first anode, and supplied with potentials taken from the modulating potential. In the latter case the auxiliary system is a coil supplied with current from the modulating circuit, and having a core of the comminuted compressed iron type. The correction with such an auxiliary system will operate instantaneously.

Electrostatic Focusing

Where the focusing is entirely electrostatic, it is also possible to perform the necessary correction by "swinging" the voltage on the cathode in rhythm with the modulation, the swing being correctly adjusted as regards amplitude and phase so as to maintain the spot diameter constant. In operating this method it must be taken into account that the effective absolute voltage of the second anode of the cathode ray tube will be altered as the cathode potential varies, so that the potential applied to the cathode must be sufficient to cause alternation in the focusing ratio, which varies with the modulation potentials. Moreover, the amplitude of the signal applied to the control electrode must be suitably increased to take account of the change of cathode potential. In some cases it is desirable to swing the potential on the accelerator electrode in the same rhythm.

Practical Method

A practical way of applying the above idea is to supply the driving voltage for the tube across a tapped load resistance; the top of this resistance is connected, through a suitable source of bias, to the grid of the tube, and the tapping point is connected to the cathode, the point being chosen so as to obtain the desired relation of voltage swing between cathode and grid. Another alternative would be to have the load resistance in the form of a potentiometer, with the grid and cathode connected respectively to two sliders ganged together. The modulation, or contrast, is then controlled by adjusting the distance between the two sliders, while the best focus may be found by sliding the two in gang, thus adjusting the potential of the cathode with respect to the first anode. (Pat. Applics. 18,508 & 1,9651/38).

Interference Suppression in D.C. Receivers

Notes on the Elimination of Noises in Some Types of Mains Apparatus

By E. G. BULLEY

INTRODUCTION of noise into any mains receivers originates chiefly from the mains supply. It is established that in some areas, especially industrial ones, interference, in the form of oscillation, humming and crackling, is the result of R.F. energy being introduced into the mains supply.

This type of interference will occur if there is excessive sparking at electric motor commutators, or car ignition systems in the neighbourhood of the receiver. Also, industrial equipment such as R.F. induction heaters, dielectric heaters or any similar equipment can radiate R.F. energy if not properly screened.

The latter is less likely to be the cause of the trouble, however, as defined precautions have to be taken by the user—also to the satisfaction of the G.P.O.—to prevent any such cause of interference.

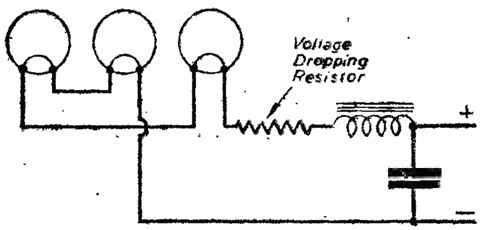


Fig. 1.—How to fit a filter in the filament (heater) supply.

Electric motors and such-like equipment can cause audio-frequency interference. This, too, originates from the commutators in the form of a ripple. Some areas will suffer worse than others.

These notes are penned in the hope that they will assist any radio amateur who has the misfortune to come in contact with these faults.

The indirectly-heated cathode does reduce, to some extent, the noise that could be introduced into the D.C. mains receiver by means of valves. This, however, does not overcome the many mains supply noises, so that it is necessary for additional smoothing to be added to the receiver.

Noises resulting from radio frequency being introduced into the receiver can be reduced if a condenser of fairly large capacitative value is connected direct across the mains supply. The presence of this condenser will help to smooth out any ripple that may have got into the supply by radiation or induction.

The capacitative value that exists between the heater wiring and the actual tuning circuit should be kept as low as possible, otherwise some R.F. interference will remain. It must be remembered, however, that the minimum capacitative value of the tuning circuits should be kept as large as possible.

Electrostatic Induction

Electrostatic induction will cause an appreciable amount of noise to be present in a D.C. receiver, but this again depends upon the area in which the set is being operated.

Audio frequency generated by commutators or resulting from atmospherics can be induced into the mains supply which, in turn, is fed into the valve grid circuit. In this case, a filter is recommended, the filter comprising a suitable condenser direct across the mains, with a L.F. choke incorporated in the live side of the mains supply. See Figure 1.

Audio-frequency interference can be suppressed to some extent by additional smoothing throughout the receiver. For instance, the bias supply of any screened grid valve should be suitably decoupled.

Instability is an extremely common fault in D.C. receivers; this can be minimised by ensuring that the anode of the output valve is fed from a separate line to the anode feeds of the other valves in circuit.

Reference to Fig. 2 shows how the feeds and filter chokes are independent.

L.F. Instability

Low-frequency instability can also be reduced greatly or suppressed if a fairly large condenser is incorporated in the screen supply of the pentode or output valve. The capacitative value should be in the order of 2 or 4 mfds. (See Fig. 3.)

Selection of the filter chokes used in D.C. circuits should be carried out with care, making sure that those selected are capable of handling the currents in the circuit. Failure to consider all the possible current that may flow through the choke will result in disaster.

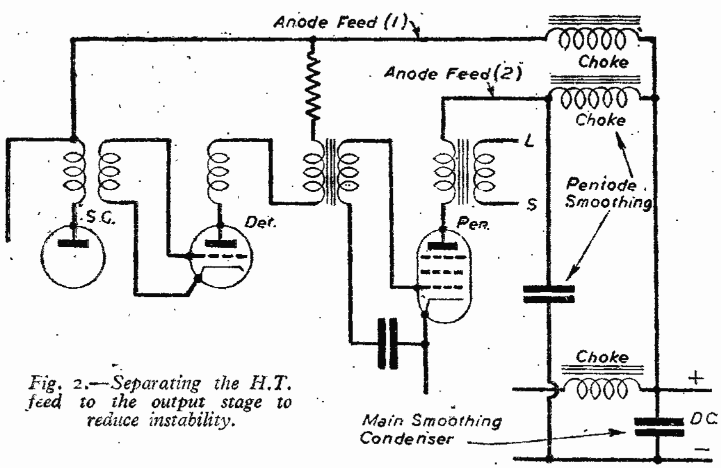


Fig. 2.—Separating the H.T. feed to the output stage to reduce instability.

Assuming the choke is incorporated in the negative return feed, it must be remembered that not only the heater current flows back through the choke, but also there is a possibility of the space current of each valve also flowing back. The space current is the resultant of the electron streams produced by the positive field of the anode.

However, it is common practice to put the choke or chokes in the positive feed, where such not only acts as a filter, but as a preventive for capacitative currents flowing to earth through the grid circuits.

A.C./D.C. Equipment.

To-day, D.C. receivers are becoming obsolete, their place being taken by the universal receiver, but one must not forget that, as in universal receivers, the heaters are all wired in series with, if required, a suitable voltage dropping resistor. The value of the latter depends upon the mains voltage and the valves in circuit, and by selecting the type of valve used in each stage carefully, and arranging the heaters in a definite order—depending on the circuit employed — still further reductions in interference are possible. Generally, the detector should be last in the chain, i.e. at the "earthy" end of the circuit.

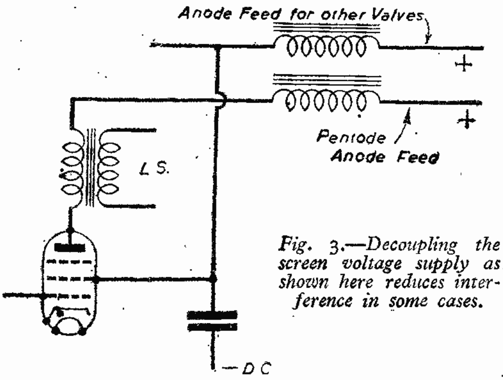


Fig. 3.—Decoupling the screen voltage supply as shown here reduces interference in some cases.

Around the Trade

Honours for the Trade

MANY well-known members of the Industry were honoured in the recently-published Awards, and amongst them may be mentioned A. F. Bulgin, of the well-known components firm of that name. He receives the M.B.E. (Military Division). He is District Inspecting Officer of the Essex II Group of the A.T.C., and has been interested in the movement for more than five and a half years.

From E. K. Cole comes the news that their Chief Engineer, A. W. Martin, and an employee, David Robb, have received recognition for their war work. Mr. Martin gets the M.B.E. and Mr. Robb the B.E.M.

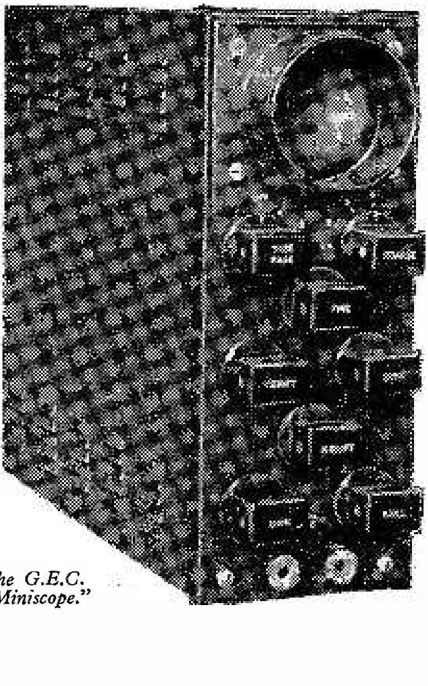
Car Radio Interference

CAR radio sets are becoming increasingly popular, but some motorists have been disappointed because of the "interference" set up by the engine ignition system.

The usual and most convenient method of suppressing this interference is by putting resistors or "suppressors" in the high-tension lead from the coil to the distributor and in each sparking-plug lead. But the curious thing is that what works on one car does not always do so on another of the same make and type.

There may be several reasons for this, one of the most usual being the condition of the high-tension leads. Oily or cracked insulation, which may have no obvious ill-effect on the running of the engine, will cause heavy interference, which even the resistors cannot cure. The remedy is to fit new H.T. leads and to ensure that all electrical connections are clean and tight.

Concerning the resistors themselves, the Lodge plugs company point out that they should be fitted as near as possible to the actual points where sparking occurs, i.e., at the distributor end of the lead from the coil to distributor, and at the sparking-plug end of the plug leads. The resistors should have a value of from 5,000 to 15,000 ohms, but when they are fitted in both distributor and plug leads the total value of the distributor resistor and any one plug resistor should be kept below about 20,000 ohms. If they are of a much higher resistance than this, the actual power of the spark may be reduced, with resultant oiling of the plugs, but resistors of the correct type should have no adverse effect on easy starting or general engine performance.



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The G.E.C. "Miniscope"

THE G.E.C. "Miniscope," M.860B, is an instrument designed to fulfil the long-standing demand for a portable miniature cathode-ray oscilloscope. It weighs only 9lb. and is entirely self-contained; furthermore, it is suitable for either A.C. mains or battery supply. It is easily operated, and its low price brings it within the reach of every radio service engineer.

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Typical radio service applications of the "Miniscope" are the examination of amplifier characteristics and distortion, the alignment of radio receivers, and the monitoring of sound systems. By means of a range of accessories the uses of the instrument can be extended still further. For example, if connected to suitable equipment, the frequency and amplitude of vibration of machinery can be determined, pressure variations in I.C. engine cylinders indicated, sources of alternating current synchronised and faults in electrical machinery located. The list may be extended to cover almost every department of engineering activity, and many other applications of this convenient and portable instrument will readily suggest themselves.

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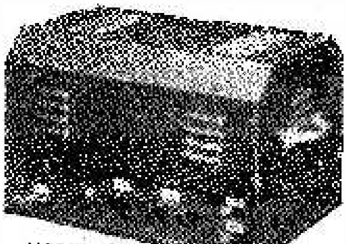

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Impressions on the Wax

Review of the Latest Gramophone Records

RACHMANINOFF was himself a pianist of outstanding ability, and his compositions for his own instrument show an intimate understanding of its powers. This month his "Concerto No. 3 in D Minor for Piano and Orchestra" has been brilliantly recorded by Cyril Smith (piano) accompanied by the City of Birmingham Orchestra, conducted by George Weldon. The recording has been made on five 12in. records, *Columbia XD*1251—5, and supplies nearly an hour of enjoyable music.

Joseph Szigeti, the famous violinist, now making his first appearance in the country since he delighted pre-war audiences here with his superb playing, has recorded "Brahms—Concert in D for Violin and Orchestra (Op. 77)" on five records—*Columbia L*2265—9. He is giving concerts in London, Birmingham, Cambridge and Brighton, as well as a broadcast performance. His wonderful renderings of the classic violin concertos are obtainable on Columbia records, for which he records exclusively.

Johann Strauss was as adept at the writing of polkas as he was with waltzes, and the two energetic examples on *H.M.V. B*9478 show him in his most clever vein. "Tik Tak" comes from "Die Fledermaus," which was given recently in the West End under the title of "Gay Rosalinda." "Sans Souci Polka" on the other side is as carefree and light-hearted as the name suggests. These Strauss pieces are light music of the very best kind, and Arthur Fiedler with the Boston Promenade Orchestra are practised masters at the effective presentation of things of the sort. This is a record that will give many hours of enjoyment.

Two more attractive records have been made by the Philharmonia Orchestra, conducted by Alceo Galliers—"The Three-Cornered Hat," on *Columbia DX*1258—9.

Ravel's suite entitled "Le Tombeau de Couperin," is a collection of pieces written in homage to the great French clavecin composer of the early eighteenth century, François Couperin le Grand. Ravel, like his countryman Debussy, was a great inventor of new procedures in keyboard music as well as possessing great command of orchestration. The two composers are often compared, and although Ravel's music is entirely distinctive, it may be said that the literary idols of them both were the same, and a similar cultural band links them. This new record, *H.M.V.* C3487, from Moiseiwitsch, throws an interesting light on the differences and similarities of Debussy and Ravel in their treatment of the Toccata. As may be expected, Moiseiwitsch plays both pieces with unerring accuracy and insight.

Two records which should make an appeal to all collectors of really fine orchestral performances are *H.M.V. DB*3956-7, which contain a four-part recording of Tchaikovsky's "Caprice Italien," played by the B.B.C. Symphony Orchestra, conducted by Sir Adrian Boult. During the year 1880 Tchaikovsky was enjoying a stay in Italy, and his contact with the musical surroundings of that country inspired the "Caprice Italien." Italian dance rhythms and melodies are freely made use of in the work, and one prominent figure is said to have been borrowed from a bugle call heard at a military post in Rome. There are violent changes of mood and colour, the music passing from sadness to exuberance and from andante to presto in truly capricious manner. The tarantella, characteristic of Southern Italy, is ingeniously used as a rushing wind-up to the piece, punctuated by powerful sforzando chords in the full orchestra.

I conclude the selection of classical records with two sets of three records. The first is a recording by Gladys Ripley, the famous contralto, on three 12in. records —*H.M.V.* C3498-500 of "Sea Pictures, Op. 37" by C. A. and Edward Elgar. She is accompanied by the Philharmonia Orchestra under the able baton of George Weldon. Finally Handel's "The Great Elopement," arranged by Sir Thomas Beecham, has been recorded by the London Philharmonic Orchestra, conducted by Sir Thomas Beecham, on *H.M.V. DB*6295-7.

Light Music

"THE Way to the Stars" is certainly an outstanding production of the war years, a period when, despite difficulties and disturbances of many kinds, the British film industry reached a new level in its output. In the recent British Film Festival various stars re-enacted their roles from notable wartime productions, and an excerpt from this picture was included. The music was written by Nicholas Brodszky, and its quality reminds one of the increasing number of pictures with scores specially commissioned from composers of standing and reputation. *Columbia DB*2180, which is a recording of themes from the film "The Way to the Stars," is played by the Two Cities Symphony Orchestra, the actual orchestra that played in the film.

Many well-known names appear in the vocal recordings for this month, and I start off with a record by Nelson Eddy, the famous baritone who supplies the voice for the singing whale in Disney's latest screen success, "Make Mine Music." The songs he has chosen for *Columbia DB*2222 are "Strange Music," based on "Nocturne" and "Wedding at Troldhaugen," by Edward Grieg, and "I Love You" ("Ich liebe dich"), which is by the same composer.

The other recordings are "Your Hand in Mine" and "Just Been Wond'ring," sung by Robert Wilson, tenor, on *H.M.V. BD*1135; "A Year Ago To-day" and "Resting," by Richard Tauber, on *Parlophone RO*20547; "Sing Gipsy" and "Two Hearts in Harmony," by Irene Ambrus, soprano, on *Columbia DB*2221; and "Elegie" and "None But the Weary Heart," by Joan Hammond, accompanied by Gerald Moore at the piano, on *H.M.V. B*9486.

Variety

MOST of the popular tunes of the moment have been recorded this month and below I give a fair selection.

Victor Silvester and his Ballroom Orchestra have recorded in strict dance tempo "To-morrow Is Forever" and "If I Had a Wishing Ring" on *Columbia FB*3218; "Sweet Dreams To You" and "I'd Like To Get You Alone" is played by Lou Preager and his Orchestra on *Columbia FB*3216; "Knees Up, Mother Brown" and "The Lambeth Walk" have been revised by Harry Roy and his Band on *Parlophone F*2149; and Geraldo and his Orchestra play "Coax Me a Little Bit" and "Amado Mio" on *Parlophone F*2151.

That popular combination, Billy Thorburn's, "The Organ, the Dance Band and Me," have recorded "Let Bygones Be Bygones" and "The Bells of St. Mary's" on *Columbia F*2148; "Into Each Life Some Rain Must Fall" and "Seems Like Old Times" is played by Joe Loss and his Orchestra on *H.M.V. BD*5931; "Mary Lou" and "Money is the Root of All Evil" is played by Paul Fenoulhet, with the Skyrockets Dance Orchestra, and finally we have a recording by Artie Shaw and his Orchestra of "Yolanda," from the film "Yolanda and the Thief," coupled with "Dancing in the Dark," on *H.M.V. B*9476.

Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

The S.W. Three

SIR,—Having built the S.W.3 published in the February issue, I have received over 200 identified signals. I think my success with this receiver was due to experimenting with the detector stage, and when this was functioning properly adding the L.F. and output stages to boost up the volume.

JEYK and GFA/2 remain mysteries to me on C.W.—J. S. DYER (Ilford).

A D.C. Receiver Wanted

SIR,—It is some considerable time since I have written to PRACTICAL WIRELESS, and I feel bound to do so in order to congratulate you on the high standard of articles, etc., which you managed to maintain all through the war. In addition I would like to thank you for once again putting a brief survey of the articles on the outside cover, as I find this a great help and a time-saver.

We have from time to time some very excellent circuits offered, but what I would like to see is an A.C./D.C. (it's D.C. here) tuning unit of the superhet type, with an R.F. stage preceding the F.C., to couple to an amplifier, as I do feel that the results obtained (always provided due care and attention is paid to detail) are far superior to the ordinary type of receiver.

My present receiver is one published by you, and is a Universal 4-valve T.R.F. job, described in January, 1943, and although it is not of course a station-getter, it certainly gives quality with my speaker which is mounted on a baffle about 3ft. square.—E. FENN (London, E.12).

Station Separation

SIR,—In the April PRACTICAL WIRELESS, which has just reached me out here, I read with delight the letter from Mr. C. J. Borwell, in which he recommended 10 kc/s. spacing of transmitters.

This is a subject in which I am deeply interested, having been of the same opinion as Mr. Borwell for some years. In this matter Europe is deplorably backward, since the other countries of the world which count where radio is concerned, i.e., the Americas, Canada, Australia, and New Zealand, have used 10 kc/s. spacing for the past two decades. Due to this, listening in these countries is pleasant and orderly by comparison with the chaotic conditions which exist in Europe at the present time. The squeals and howls which Europeans have come to accept as inevitable are rarely heard.

An additional advantage is that frequencies are easier to remember when they are reckoned in terms of tens of kc/s., or, better still, in numbered channels.

I was also pleased to see the articles on Pulse Communication, a very interesting subject which may have great significance in the future of radio—P. D. THOMAS (S.E.A.C.).

Recorded Television

SIR,—In your June issue "Thermion" states there is no known means of recording a television programme, and that "repeats" must therefore be live. He could also say that no means exist for truly recording a scene in motion, and that "repeats" must also be live.

So far, the best that can be done is to take a series of photographs in rapid succession of the scene, these being projected at the same frequency to form a picture giving the illusion of motion. Add a sound-track to the edge of the film and your "talkie" is complete.

The picture on a television screen is also composed of a series of separate "frames." These can be photographed, plus sound track, and re-transmitted by the same means as ordinary cinema film.—C. H. WHITE (Woolacombe).

A.C.-D.C. Amplifier

SIR,—Reading the letter by N. Richardson in last month's (July) issue of PRACTICAL WIRELESS prompted me to write about my experiments with this amplifier. After constructing it according to the specified circuit, I decided to see how much gain I could really obtain from these two valves. Removing the input capacitors increased the output quite a bit, and after experimenting with load-resistor values, etc., I at last decided to transformer-couple the stages. The output increased a great deal.

I found that the .02 tone condenser did not provide sufficient tone variation, so a .05 component was substituted, which was a lot better but by-passed more signal, so a switch was fitted to provide a "maximum treble" setting giving a higher output, while with the switch in the "on" position the tone is variable from a middle register to bass, but also reducing the output.

The amplifier now gives sufficient gain fully to load two 10in. speakers and the quality is very good. Hum is very low, smoothing being 30H and two 16's. A pilot lamp and a metal cover were fitted, making quite a professional appearance to the complete job.—D. R. BATE (Bristol, 9).

Foreign Call-signs

SIR,—*Re* the Ham stations PR1AA and XP1 ("Open to Discussion," July issue), none of my lists gives PR1 as an amateur call-sign, but PR is in the allocation of call-signs to Brazil. So this may be a post-war allocation. Q.S.L. cards for Brazil can be forwarded through :

L.A.B.R.E.,
Caixa Postale 2353, Rio de Janeiro.

XP1 is not a full call-sign and I suggest it is the call of an unlicensed station or one licensed only for other bands. It is probably a derivation of ex-perimental. What might also be of interest is that amateurs licensed in B.A.O.R. use the call D2 and two letters, U.S. troops in European theatre D4 and two letters, and in Japan J6. Italian stations can be Q.S.L.'d through A.R.I, Viale Bianca Maria, 24, Milan, and Swiss stations through U.S.K.A., Postbox 196, Berne-Transit.

Hoping this may help one or two Ham-band S.W.L.s.—JOHN COLLINGE (B.A.O.R.), B.S.W.L., 1887.

GNF and GYKU

SIR,—The following information may be of interest to reader D.E. Smith (B.S.W.L. 1991) and any others who listen on the medium waves.

GYKU is the call-sign of the s.s. *Duke of York*, a British freighter of 1,437 tons, registered at Lancaster, and is controlled by the L.M.S. Railway, Euston Station, London.

She is equipped with D./F. apparatus, a C.W. and I.C.W. transmitter and R./T. equipment. Her working frequencies are as follow :

C.W. and I.C.W., 375 kc/s. (800 m.), 425 kc/s. (706 m.), and 500 kc/s (600 m.).

Radiotelephony : 1,650 kc/s. (181.8 m.), 2,012 kc/s. (149.1 m.), 2,135 kc/s. (140.5 m.), and 2,225 kc/s. (134.8 m.).

GYKU is open to Public Correspondence during her sea voyages, which are always less than eight hours.

It is interesting to note that the power of the main transmitter is 100 watts.

GNF, not GMF, is as reader Smith heard, North Foreland Radio, situated at 1 deg. 24 minutes 50 seconds E. and 51 deg. 21 minutes 35 seconds N., which puts her between Margate and Broadstairs. The position quoted is that of her D./F. aerials and not necessarily that of the radio shack; however, that won't be very far away.

GNF operates 24 hours daily, and uses I.C.W. and R./T. on the following working waves: I.C.W., 484 kc/s. (620 m.), 500 kc/s. (600 m.), 1,612 kc/s. (186.1 m.).

Radiotelephony: 1,650 kc/s. (181.8 m.), 1,837 kc/s. (163.3 m.), and 2,500 kc/s. (120 m.).

Both stations it will be noted use 500 kc/s. (600 m.) for wireless telegraphy and 1,650 kc/s. (181.8 m.) for R./T., 600 m. being the international distress wave for W./T. and 181.8 m. for R./T. For anyone who is interested in some medium-wave listening on these bands I append the names and call-signs of the 11 principal British coast stations which use them, for they are sure to be heard sooner or later :—

GKR, Wick, N. of Scotland; GPK, Portpatrick, S.W. Scotland; GLU, Seaforth, Mersey; PRL, Burnham-on-Sea, Bristol Channel; GLD, Land's End, Penzance; GNI, Niton, I.O.W.; GNF, North Foreland, Thames Estuary; GKZ, Humber, River Humber; GCC, Cullercoats, Tyne Area; GCK, Valentia, S.W. Eire; GMH, Malin Head, N. Ireland.

As a reader of your paper for seven years I must take this opportunity of saying how much I like it. I am indebted to it for a great deal and hope that it will not be long before I can see it more often. I would like to add that I am very pleased to see Mr. Reeves' name at the top of a page again—and thank you, Mr. Reeves.

With my best wishes for your continued success. JOHN M. BYRNE (Glasgow, C.5.).

A.C. versus A.C.-D.C. Receivers

SIR,—May I be permitted, through the medium of your columns, to endorse the remarks of your correspondent, Mr. R. G. Harrison, in the May issue, respecting the relative efficiency of A.C. versus A.C.-D.C. receivers?

Also in reply to Mr. G. House, whose letter appeared in the July issue, no doubt Mr. Harrison, as well as myself, would welcome details of a voltage doubler circuit to work on D.C.

Could it be that Mr. House is confusing the voltage doubler circuit with a vibratory converter?

With regard to the remarks of Mr. House *re* the hum filtering on his A.C.-D.C. amplifier—it would seem that he is extremely fortunate in his D.C. supply, in that it is well filtered. (Electricity Supply Co., please note.)

As a service engineer employed in a town whose supply mains are largely D.C. and poorly fitted at that, I can assure him that he would soon express a preference for A.C. mains and A.C. receivers, which latter are definitely superior respecting ease of servicing, hum level, efficiency and running costs.

Regarding those "beautiful little midgets" with their "lovely cabinets," the least said about these "midget monstrosities" the better, with their line-cords which are for ever giving trouble, to say nothing of condenser block failures and types of valve still in short supply.

I look forward to the time, not too far distant, I hope, when A.C. Mains will be general and we can say good-bye to noisy D.C. supplies and radiated noise from the brushes of Universal apparatus of all kinds.—EXPERIMENTER (Chailey).

SIR,—I have been following the correspondence about the merits of A.C. and A.C.-D.C. sets. I have constructed several A.C.-D.C. sets, straight and super, with resistance smoothing only. The only iron core was the speaker transformer.

Half-wave rectifiers can stand about twice the filter condenser capacity without damage. The smoothing I used was a 32 mfd. from cathode of rectifier. The output pentode anode was fed direct from this. Then followed a 2,000 ohms resistor and another 32 mfd. for pentode screen and triode anode of D.D.T., followed by 3,000 ohms and 8 mfd. for earlier valves. The .05 from rectifier anode took care of any H.F. in the mains. Hum was hardly existent, even with speakers with a real bass response, and if a pick-up was used liberties could be taken with these sets that were impossible with a mains transformer set.

Thus they could be placed close to the gramophone motor without developing hum or howl.—R. SIMPSON, JUNR. (Paisley).

SIR,—I see that in the July issue of PRACTICAL WIRELESS Mr. G. House, of Bradford, has replied to a letter of mine which appeared in your May issue, and which was, in fact, a reply to a correspondent in Sutton, Surrey, who wondered why mains transformers were still fitted in radio sets. My reply set out the advantages, in my opinion, of a straight A.C. set against a Universal type.

Mr. House, rather unfairly, quotes as an example to support his opinion that quality on a Universal set is not inferior to an A.C. type, a home-constructed 4-6 watt amplifier. I did not intend that this type of instrument should be compared with the ordinary radio manufactured for the home listener, but while on the subject of amplifiers, one of the best I have ever heard (still sticking to standard models) is a Pam, manufactured by Pye and driving their standard speaker and also a Voigt corner model. Going back to Mr. House's letter, he has said nothing to induce me to change my opinion that set for set (amplifiers barred) the A.C. type wins every time on the score of safety, quality, hum level, lower running costs and easier servicing, and that the Universal set is fundamentally inferior on all the above items.

One has only to hear the two new models, A.C. and Universal, in exactly the same cabinets by a famous maker (G.E.C.) to be able to pick out the A.C. model every time.

I rather liked Mr. House's dig at me about voltage doublers, I had overlooked that type of circuit, for, after all, very few manufacturers seem to use it, or, at least, I have come across very few up to date; and as to spares, it is well known that certain parts in short supply in one town are readily obtained in one 50 miles away. (Bradford will be about 100 miles from here.) It is rather a coincidence that a letter in the same issue as Mr. House's, under the heading of "Commercial Set Design," from Mr. Palmer (Wilts), stresses my remarks about hum level and other points, although he is replying to another correspondent.—R. G. HARRISON (Newcastle).

An Amateur's Views

SIR,—I must take exception to your correspondent G. C. Bagley. He has abandoned commercial DX-ing for the amateur bands. I don't blame him at all. I myself spent most of my time on "20" and "40". His letter, however, implies rather that there is no S.W. DX outside the "ham" bands. This is a totally wrong idea. There are a good few low power commercials.

Consider two stations, firstly WVL, at Quarry Heights, Canal Zone on 2,390 kc/s, with a few hundred watts. Then take LU6AJ on "20" with a kilowatt and rotary beam—or, for that matter, a kW. "W" on "80". Which is the better DX?

Mr. Bagley should still be able to get some real DX without any "ham" listening.

In reply to reader Kemp, WNR1 is an N.B.C.-R.C.A. station in New York. It operates 10.45 a.m.-11 p.m. G.M.T. and has a power of at least 50 kW. Frequency is 13,050.

While finding PRACTICAL WIRELESS very interesting, and helpful, I should like to see more attention paid to the DX side, in all its phases—MW, commercial and ham SW.

I wonder if any of your readers could put me in touch with X4KN and RN1SX?—MARTIN HARRISON, (Darlington).

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