

THE INVERTED AMPLIFIER

# Practical <sup>9<sup>D</sup></sup> EVERY MONTH Wireless

*Editor*  
F. J. CAMM

Vol. 22 No. 482

NEW SERIES

AUGUST, 1946



BUILDING A  
TWO-VALVE  
PORTABLE  
Full Details Inside

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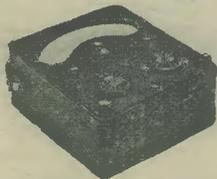
A Level Response Amplifier  
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The Vacuum Condenser  
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Tag Boards and Hum  
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# Practical Wireless

14th YEAR  
OF ISSUE

EVERY MONTH  
VOL. XXII. No. 482, AUGUST, 1946.

and PRACTICAL TELEVISION

Editor F. J. CAMM

COMMENTS OF THE MONTH:

BY THE EDITOR

## Television Restarts

FROM reports we have received from all those within the service area, it is apparent that the renewed television service was a signal success. It did not show any marked improvement on the 1939 transmissions, but at the same time there was no deterioration due to the six years' lapse. It is perhaps unfortunate that the early programmes suffered modification as a result of cancellations due to the action of theatrical managers, who, whilst professing that they had no opposition to television and such, could not allow it to interfere with normal stage programmes. A dance band leader had been engaged by the B.B.C. for one of the television programmes, but after considerable money had been spent the theatrical management concerned decided that they could not permit it to take place because it would upset the balance of the stage programme as the times of the two collided.

We devoutly hope that this is not another way of saying that the stage is opposing television because it is considered that people will not pay money to see live programmes if they can be viewed at home on the end of a cathode-ray tube; for this would be following the same path as was pursued by the newspapers and the gramophone companies in the early days of sound broadcasting. It is common knowledge that the newspapers and the gramophone companies were wrong, and that broadcasting has enhanced the sales of both.

At the same time it must be realised by all concerned that television still has a long way to go. There is no satisfactory means yet of recording it for retransmission, and therefore the expense of each transmission is vastly greater than for a sound programme of similar magnitude. Depth of focus is still a problem, and we feel that the cathode-ray oscilloscope is not the final word. It gives rise to barrel distortion, and by no means can the present transmission compare with the cinematograph. We are, as a fact, still at the same point as we were in 1939. The programmes may be better, but the transmissions themselves from a technical point of view have not greatly improved

The victory celebrations were selected for the opening programmes, and there seems to be general approval of them. The reception, of a clear nature, was reported as far distant as over 100 miles from Alexandra Palace. The Baird Company installed a twenty-eight inch tube receiver at the Savoy Hotel during the victory celebrations on which one could see a directly viewed picture approximately 23in. by 21in.

The manufacture of television receivers is still on the small side, and the erection of provincial television transmitting stations is going to take a few years. We must therefore still regard the Alexandra Palace transmissions as a purely local service of interest to those few thousands who owned a television receiver in 1939. It is unlikely that television receivers in any considerable quantity will be available to the public for at least a year.

### The Passing of John Logie Baird

IT is a tragic circumstance that almost on the eve of the reintroduction of the television service Mr. John Logie Baird, one of the pioneers of television, should pass away.

Although not a scientist himself, he spent his life endeavouring to advance the new science. Although he contributed very little himself to the science of television, he gathered around him a team of scientists who experimented along lines which he laid down. The original Baird disc machine was not, of course, a Baird invention. It was, as a fact, the Nipkow disc which had been produced many years before Baird commenced to experiment with it in this country.

In many respects Baird died a disappointed man. The Television Advisory Committee gave him a year in which to demonstrate the superiority of his system over that evolved by E.M.I. At the end of that year the B.B.C. abolished the Baird system, and from that point he was mainly associated with the production of television receivers.

It was in January, 1926, that the first demonstration of real television took place through B.B.C. channels.

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# ROUND THE WORLD OF WIRELESS

## A New Service for Industry

**H**UNDREDS of manufacturers in Britain will be interested to learn that Electric and Musical Industries, Ltd., the great electrical and general engineering organisation with subsidiaries throughout the world, has launched a new company—Emi Suppliers, Ltd.—to specialise in buying on behalf of any firms who wish to avail themselves of a unique buying service.

The new company, with world-wide connections in many industries, will have its finger on the pulse of the world's principal commodity markets. It offers to all the services of a team of expert buyers, supported by the full resources of one of our greatest industrial groups. Customers of the new company will benefit when buying from experience, resources and prestige which few individual firms command.



"Stand Easy" is now stated to be second in popularity on the B.B.C. regular feature programmes. In the illustration above cheerful Charlie Chester is seen on the left, with the rest of the "Gang."

## Municipal Trading a Menace

**A** DISTINCT menace to all private traders in this country" was the way in which Mr. W. E. Clibbon, of Kensington, described the growth of trading by municipalities, when he spoke at the annual conference of the National Chamber of Trade at Scarborough recently.

Mr. Clibbon, who was elected to the board of management of the Chamber, instanced the case of Fulham, which not only supplied electric light but also ran a radio shop where all kinds of electrical and radio equipment was sold. Traders in Fulham were paying heavy rates to support this rate-aided trading.

Mr. Clibbon was supported by Mr. W. Bird, of Sutton, Surrey, who said that private traders appeared to have no legal remedy against municipal trading. A resolution, proposed by Mr. Clibbon to the effect that the Chamber recorded a vehement protest against the extension of municipal trading and, where necessary, take steps against that extension, was carried unanimously by the Conference.

## New Philco Sales Manager

**PHILCO RADIO AND TELEVISION CORPORATION OF GREAT BRITAIN, LTD.**, announce that Mr. D. C. Spink, formerly assistant manager of the radio department of the G.E.C., has been appointed sales manager to succeed Mr. J. G. G. Noble, who, as already announced, recently resigned to join Regentone as sales director.

Mr. Spink, who is well known in the trade, has been connected with the General Electric Co. since 1922, when he began his career in the company's Coventry works. Three years later he joined the sales office in London, and was their first radio traveller, covering the Eastern counties for two years, and later, for 12 months, the South coast. He was then for four years manager of the Midland area in Birmingham, and in 1932 returned to London in charge of sales for the London area, and assistant sales manager of the radio department. In 1935 he was promoted assistant manager of the radio department. He takes up his new duties at Philco on July 1st.

## Radio "Relay" in the Hermes

**T**HE new Handley Page "Hermes" aircraft, which will shortly be brought into commission, incorporates a number of novel features for the convenience of its passengers. Amongst these is the installation of a microphone in the pilot's cabin and loudspeakers in the main compartment to enable the pilot to point out places of interest as the aircraft passes over them and also to issue any necessary instructions to the passengers.

The equipment has been specially designed for this aircraft by the General Electric Co., Ltd., and it will be the first installation of its kind.

In the pilot's cabin are the microphone control equipment and 14-watt amplifier. It operates from the aircraft 24-volt D.C. supply, a rotary converter providing the H.T. The loudspeaker units, which are also of special design, are situated at strategic points in the main passengers' cabin.

In addition, radio is "relayed" throughout the aircraft so that each passenger will be able to listen-in at will to broadcast transmissions.

## Wireless Receiving Licences

**T**HE following statement shows the approximate numbers issued during the year ended April 30th, 1946.

Region	Number
London Postal .. .. .	1,966,000
Home Counties .. .. .	1,308,000
Midland .. .. .	1,505,000
North Eastern .. .. .	1,606,000
North Western .. .. .	1,398,000
South Western .. .. .	873,000
Welsh and Border .. .. .	606,000
Total England and Wales .. .. .	9,262,000
Scotland .. .. .	1,020,000
Northern Ireland .. .. .	152,000
Grand Total .. .. .	10,434,000

**Broadcast Receiving Licences: Increased Charges**

HERE is a reminder that as from June 1st higher charges were payable for broadcast receiving licences as follows:

£1 per annum for a licence permitting the reception of sound only.

£2 per annum for licences permitting the reception of television and sound for domestic use.

These higher charges are not payable by existing licence-holders until their licences become due for renewal.

A television set may, therefore, be installed in the home without extra charge during the currency of an existing 10s. licence, but when that licence expires the charge for a licence on renewal will be £2.

A statement of the conditions applying to other than domestic use will be made in due course.

**The Bermuda Agreement**

LONDON'S position as the principal centre of world telegraphic traffic may be endangered and the British taxpayer faced with heavy financial burdens as a consequence of the agreement concluded at Bermuda between the Empire and United States Governments. Britain's loss will be largely America's gain.

The financial loss to the British oversea telegraph services is estimated, on the basis of present traffic, to be in the region of £2,500,000 a year.

These are the main conclusions drawn by Cable and Wireless, Ltd., after thorough study of the White Paper in which the British Government has summarised the Bermuda agreement.

**Full House for Ekco Television Pre-view**

THE desire to be in on the "ground floor" of post-war television was evident at a lecture on the Ekco Methods and Design Building, by Mr. F.A. Inskip, A.M.I.R.E., Engineer-in-Charge of Television Development, recently, where his audience was so large that it had to be subdivided into an "overflow" meeting.

Mr. Inskip described in clear detail for the non-technical the principles of television transmission and reception. He gave a demonstration of transmitting a picture with equipment that had been specially designed for this purpose by E. K. Cole, Ltd., and of receiving on a standard Ekco television set.

It is being arranged to repeat the demon-

stration at some future date for the benefit of those who were unable to be included.

**Ministry of C.A. Demonstrations**

THE demonstrations by the Ministry of Civil Aviation of technical radio equipment originally scheduled for May and June, to be followed by a meeting of the Special Radio Technical Division of P.I.C.A.O. in Montreal on July 1st, have been amended as follows:

September 9th-30th.—Demonstrations in the U.K.

Early October.—Demonstrations in the U.S.

Immediately afterwards.—First meeting of the Special Radio Technical Division of P.I.C.A.O. in Montreal.

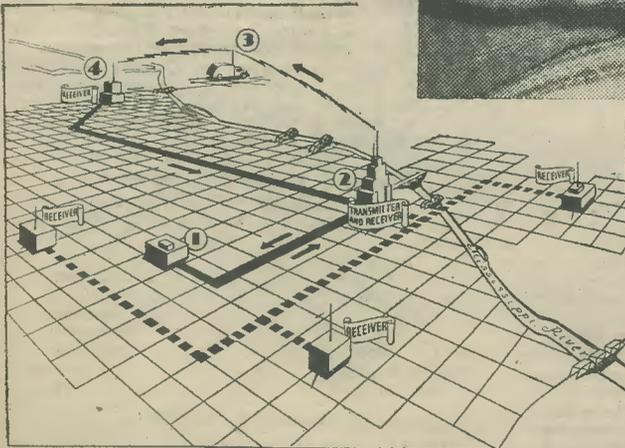
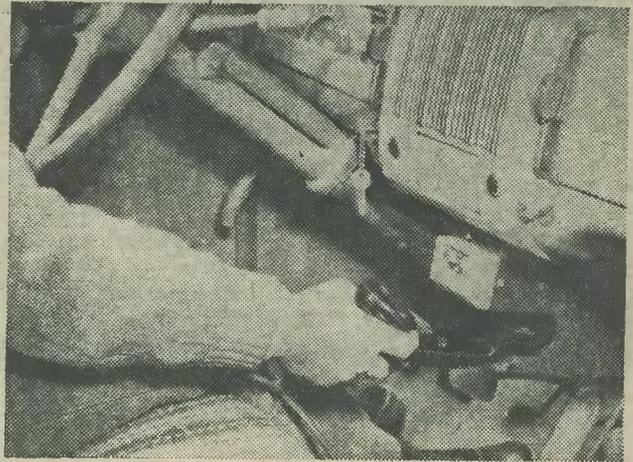
**Radio Control**

THE G.P.O. has now allocated the frequency of 460.5 mc/s for use in the remote control of models by radio. They require notification of the use of apparatus for this purpose (to be submitted to Radio Branch W2/6, Engineering Department, G.P.O., London, E.C.1, quoting Ref. 16311/46).

**Mobile Telephone Service**

ANY motor vehicle driver, either parked, speeding over a highway, or caught in a traffic jam, may now reach for his vehicular radiophone, ask for any one of America's 27,000,000 odd phones by number, and get it in a few seconds.

St. Louis is the first American city to receive such a service. The accompanying illustrations show a view of the handy slide-out type telephone set used in connection with mobile radiotelephone equipment. The set fits



Mobile Radio Telephone Service and diagram of the method of working. The scheme is explained in the accompanying paragraph on the right.

under the dashboard of the motor vehicle, within easy reach of the front seat occupants.

To operate the mobile radiotelephone, the customer (1) dials "Long Distance," and asks to be connected with the mobile service operator, to whom he gives the telephone number of the vehicle he wants to call. The operator sends out a signal from the radio control terminal (2), which causes a lamp to light and a bell to ring in the mobile unit (3). Occupant answers his telephone, his voice travelling by radio to the nearest receiver (4) and thence by telephone wire. To place a call from a vehicle, the occupant merely lifts his telephone and presses a "talk" button. This sends out a radio signal which is picked up by the nearest receiver and transmitted by telephone wire to the operator.

# Tag Boards and Hum

A Review of the Methods of Wiring-up Receivers

**S**UPERFICIAL examination of a modern wireless set alongside another 10 to 15 years old will reveal a number of differences, perhaps the most striking being the change over that has taken place from the old method of hanging small components on their own connecting leads, to the modern workmanlike method of arranging these small components in a symmetrical manner on tag boards. This tag-board technique is illustrated at Fig. 1, which shows a small portion of a straight A.C. mains receiver, namely the R.F. amplifier and detector valveholder and the associated portion of tag board. Fig. 2 is not taken

reduce the hum level of an otherwise very excellent radiogram; the use of the oscilloscope suggested that the cause of hum was fairly evenly distributed over a number of stages, and after attention to smoothing, adjustment of heater centre taps and the usual remedies, it was thought that the trouble might be caused by a general tendency towards long leads. The tag boards were forthwith scrapped and all components wired point-to-point fashion by the shortest possible route without any great regard for appearance. On completion of this change, it was found that the hum level was greatly reduced; an apparent fact that was checked with the oscilloscope. This incident alone cannot do otherwise than provoke serious thought on the desirability of this modern trend of receiver layout.

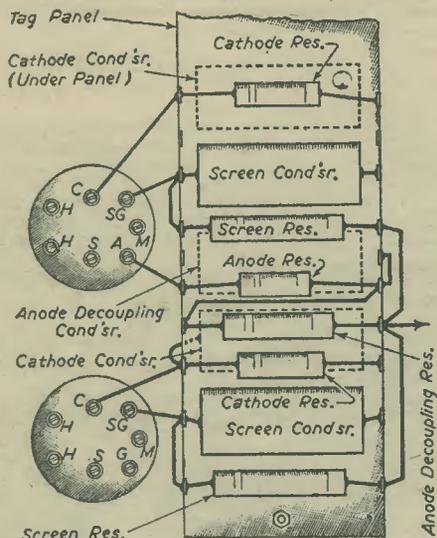


Fig. 1.—Portion of an actual receiver. Only connections to and between tag-board components are shown.

from an actual receiver, but is a suggested rearrangement of the components shown in Fig. 1, using the old method of layout. It will be noted that in the illustrations no detector grid leak and condenser are shown as these are in the anode coil can. Only wires connecting tag-board components are shown.

## Long Leads and Hum

There can be no question that the modern arrangement is the more workmanlike of the two from the appearance point of view, and often more convenient for the service engineer, provided that all components are mounted on top of the tag board or that the latter is mounted edgewise up; some manufacturers mount components under the tag board, which besides rendering them inaccessible, makes it difficult to trace connections unless the tag board is high enough from the chassis to permit the use of an inspection mirror. The mechanical advantages having been duly admitted, the question is open to debate whether tag-board assemblies are electrically superior or inferior to the old method. Comparison between Fig. 1 and Fig. 2 makes a most interesting study, and tends to suggest that tag boards can easily be a retrograde step from the efficiency point of view; however useful they may be from the economic and appearance point of view, the chief objection is the long leads between components and valveholders.

This whole question was provoked by an effort to

## A Comparison

It is interesting to take a complete range of sets of any well-known manufacturer, choosing examples of the 1937-40 vintage, and to see what may be learned about the use of tag-board sub-assemblies from the radio industry. The range examined by the writer offered strong evidence in support of the view that one manufacturer, at least, presumably considered tag boards undesirable in the higher gain receivers. Briefly, in the range examined, battery sets had all appropriate components mounted on a single tag board; straight mains sets had most of the components on tag boards; the simpler mains superhets used several small tag boards, carefully placed, apparently, to cut down leads to a minimum, while the multistage A.C. mains "all-wave" superhet, employing high-gain in both intermediate frequency and audio-frequency stages, used no general tag board, although employing one holding only anode decoupling and cathode-bias resistances and condensers and little else, the idea being to provide a H.T. distribution panel.

However convenient a tag board may be to the manufacturer who finds it economic to use as many mass-produced sub-assemblies as possible, the amateur building a single receiver must find the making of a tag board a somewhat tedious undertaking, and should pause to consider whether the task is worth while.

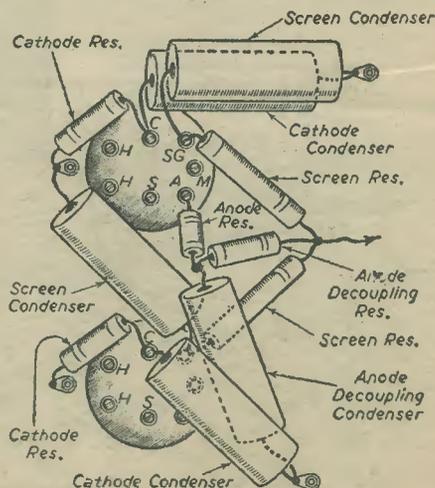


Fig. 2.—The same components of Fig. 1 rearranged in the same space with a view to reducing lengths of leads to a minimum.



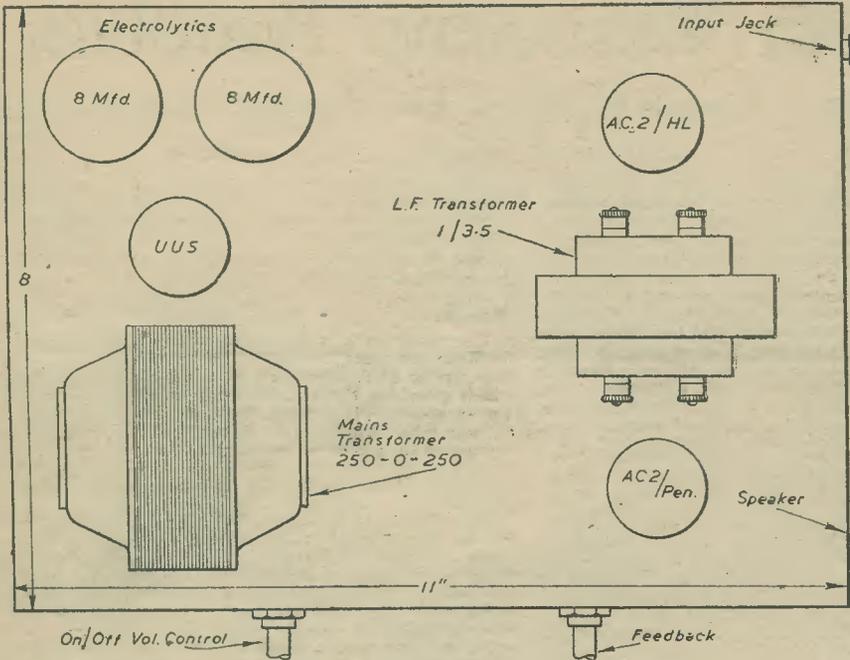


Fig. 2.—Layout of the main components.

**Chassis Layout**

A suggested layout for an 11in. by 8in. chassis is indicated in the photograph and shown separately in Fig. 2. The chassis itself may be conveniently made of plywood, but preferably of sheet-metal. If the mains transformer is not itself screened, as in the photograph, some form of sheet screening between power-pack and amplifier may be necessary. However, trouble due to hum is more likely to be caused by unscreened leads than by unscreened components if this layout is adopted. Screened sleeving should be used on all grid and anode

leads and is essential on the input leads, as shown in Fig. 1.

No wiring diagram is given since the layout will give sufficient indication of the method adopted.

**Output**

The audio output of the amplifier is much greater than might be expected from an examination of the characteristics of the AC2/Pen. This is, of course, due to the fact that negative feedback increases the "efficiency" of the valve by diminishing the distortion due to harmonic content. The matching of the output valve to the speaker, too, is much less critical than would be the case without feedback.

In choosing the volume level for a given record it is a good plan to vary feedback and volume controls tentatively, when it will be discovered that a fine tonal balance can be achieved at good strength. For a level response, work with the volume control as near as possible to its "full" position and the negative feedback fully applied.

"PRACTICAL WIRELESS" INDEX

THE Index for Volume 21 (December, 1944, to November, 1945) is now ready in limited quantities. Copies may be obtained, price 6d., by post, from the publishers, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2.

**LIST OF COMPONENTS**

**Resistors**

- R1—0.5 megohms; volume control.
- R2—10,000 ohms; anode decoupling.
- R3—1,000 ohms; bias.
- R4—15,000 ohms; grid stopper.
- R5—150 ohms; bias.
- R6—50 ohms; anti-parasitic oscillation.
- R7—200,000 ohms.
- R8—50,000 ohms, variable } Negative feedback potential divider.
- R9—30,000 ohms.

**Condensers**

- C1—25  $\mu$ F; bias by-pass.
- C2—8  $\mu$ F; anode decoupling. } Electrolytic.
- C3—50 to 200  $\mu$ F; bias by-pass.
- C4—0.1  $\mu$ F; negative feedback tapping.
- C5—8  $\mu$ F; electrolytic; smoothing.
- C6—8  $\mu$ F; electrolytic; smoothing.

**Mains Transformer**

- Primary: 200-250 volt A.C.
- Secondaries: H.T.: 250-0-250 volt, 60 mA.
- L.T.: 4 volt, C.T. 2.5 amp.
- 4 volt, C.T. 3 amp.

**Valves**

- V1—AC2/HL.
- V2—AC2 Pen.
- V3—Rectifier (UUS, 1881 or other available alternative).

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# Points in Short-wave Receiver Construction

Valuable Hints for the Short-wave Listener.

By F. G. RAYER

**W**HEN building S.W. receivers there are a number of points which must be kept in mind if best results are to be obtained—and among desirable features of any receiver may be mentioned ease of operation, freedom from background noises caused in the set, and stability of frequency or wavelength readings, as well as the more obvious features such as obtaining the maximum selectivity and sensitivity from the circuit used, etc. To show just what difficulties may arise, and what should be done to avoid them, the most important factors are dealt with here.

## Insulation

Good quality insulation is very necessary in the radio-frequency and detector stages of a receiver. Poor insulation will cause poor reception due to absorption and leakage, and the consequent losses will rise with frequency. Modern short-wave components should therefore be used in stages dealing with R.F. currents as these are made from Ceramic Trolitol and other materials suitable for the frequencies handled. In addition they are generally designed with long leakage paths between the metal parts to increase their efficiency.

But in the L.F. sections of a receiver normal components can be used as minute R.F. signals are not present and this makes possible a saving in expense on such items as valve holders.

Tuning condensers should be air-spaced, although solid dielectric condensers are suitable for reaction purposes on wavelengths above 10 metres if they are of good quality and smooth in operation.

Fixed and pre-set condensers should be air-spaced for very high frequencies, or of mica or steatite insulation. Paper condensers should be avoided, especially in grid and R.F. coupling circuits. These components should not be mounted directly on the chassis as this will give a short leakage path to earth, and introduce stray capacities which do not give best results. As a general rule small condensers may best be suspended in the receiver wiring.

Valve and coil holders must be low-loss components—

DL-9, Ceramic, or similar materials. And when trying to obtain very best results on U.S.W. the advantages of the comparatively new types of valves with a top cap for the grid connection should not be overlooked.

Coils should be wound upon low-loss formers, or if for very high frequencies, be self-supporting. Tinned-copper wire is usually used to lower skin resistance.

## Layout

Of equal importance is the disposition of the components and wiring. Long wiring will introduce losses, but a cramped layout will cause interaction between various parts and cause trouble. The parts should be so arranged that the chance of undesired feedback is reduced to a minimum or uncontrollable instability, hand-capacity or generally poor results may arise.

As a field exists around a tuning coil, space should be allowed around it so that screens, valves, etc., may be kept outside the field. If this is not done, loss of efficiency will result and oscillation may cease on some frequencies. Large coils will have larger fields than smaller coils, and as a rule no metal part should be nearer the side of the coil than half a diameter, or nearer the end of the winding (*not* former) than one diameter of the coil. More space can be allowed with advantage if possible.

Unscreened chokes should be similarly treated, if possible, and they should also be kept well clear of the coil or coils and other chokes to avoid undesired inductive coupling.

Mounting tuning and reaction condensers low down upon the panel helps to shorten wiring; alternatively valve and coil holders may be raised upon pillars. When band-spreading is employed, the connections between the band-set and band-spread components should be as short as possible.

In a complicated receiver it is generally best to treat each stage as separate, enclosing them in screening boxes where necessary. This is especially so when unscreened coils are used in a receiver with one or more tuned R.F. stages if stability is to be retained.

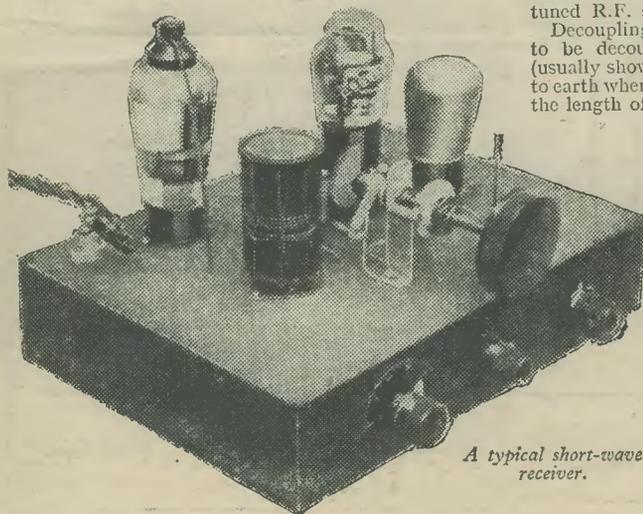
Decoupling components should be close to the points to be decoupled and when marked the outside foil (usually shown by the letters O.F.), should be connected to earth when using tubular condensers. After decoupling, the length of screen grid, V.M. bias and similar leads is not important and they should be run in such a position that they are kept well clear of more important connections.

## Wiring

Tinned-copper wire is best—about 20 s.w.g. for S.W. receivers and 16 s.w.g. for U.S.W. receivers. For convenience a thinner wire (about 22 s.w.g.) may be used in L.F. stages. Insulated covering should not be added to leads carrying R.F. in U.S.W. receivers unless necessary.

Joints should be soldered for preference, or if terminals are used a loop made in the wire so as to secure a good area contact. Good soldered and terminal connections can be made more easily if the wire and parts are quite clean.

Grid and anode leads should always be kept clear of other leads, and especially from each other. If they



A typical short-wave receiver.



The circuit may be made up in a very small space if the two L.F. transformers are compact types, and the triode output valve is very suitable for operating a small moving-iron or balanced-armature speaker unit. A very light receiver results.

With a pentode output valve greater volume will be obtained; a moving-coil speaker becomes almost essential if the full advantage of the pentode is to be obtained. A heavier set will result, and in addition decoupling will have to be added to prevent L.F. instability. Because of this the circuit as it stands is well worth using. If

either choke-capacity or H.F. transformer coupling may be used instead. The coil should be screened, and may be a dual-range type, for use with a dual-range frame, as will be described later.

The reaction choke should also be screened, or replaced by a non-inductive resistor of about 5,000 ohms.

The value of the auto-bias resistor (two 250 ohm components in series) is suitable for average valves, although in some cases this may require slight modification. It should not be found necessary separately to

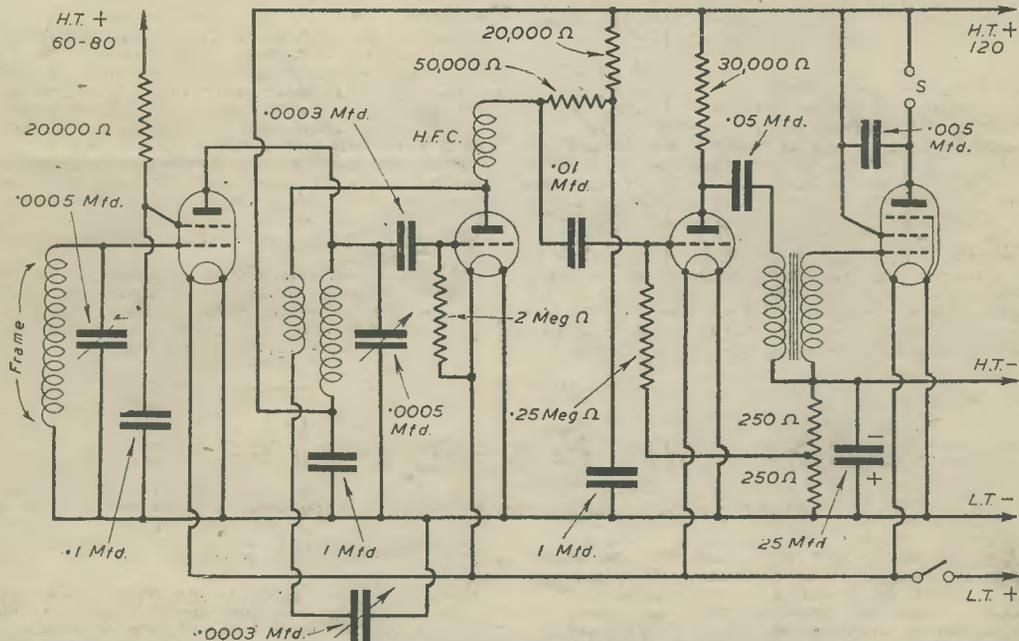


Fig. 2.—A 4-valve circuit which may be relied upon for good reception.

a valve type such as the Osram HL2 is used for both Detector and L.F., with a fairly high amplification small power valve, such as the Mullard PM2, for output, very satisfactory reception from the locals will be obtained. A moving-coil speaker will not be necessary.

Improvements to the circuit may take the form of additions as shown in the L.F. section of the circuit in Fig. 2, e.g., automatic bias, decoupling to increase stability and avoid the extra H.T. connection, and parafecding the first transformer.

**A Second Circuit**

For a more powerful portable the circuit in Fig. 2 is very satisfactory. The H.F. stage, together with a pentode in the output stage, gives sufficient sensitivity and volume for all normal domestic purposes.

This circuit will give really good speaker reception even if the first L.F. stage is omitted, and a constructor looking for a somewhat simpler circuit should remember this.

Besides increasing sensitivity, the use of a high-frequency stage simplifies the frame aerial, as no reaction winding is required on it. But two tuned circuits have to be used, and it is very difficult to gang these with full satisfaction. As a result a two-gang condenser with trimmer, or two separate tuning condensers, become necessary. As the more compact the second alternative is best.

**H.F. Coupling**

Tuned-anode coupling is used as this gives maximum gain, but care must be taken to preserve stability and

by-pass the resistor providing the L.F. bias, the single 25 mfd. electrolytic being sufficient.

**Practical Considerations**

It should be remembered that the presence of the

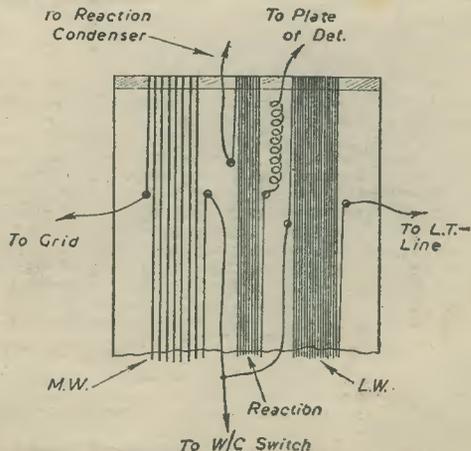


Fig. 3.—Details of winding for a dual-wave frame aerial.

frame aerial tends to induce instability, and because of this care must be taken to prevent feed-back of H.F. currents. Ample decoupling is necessary, and the metal chassis of the speaker should be connected to the L.T. minus line of the set.

The H.F. and detector wiring and components should be kept as far apart as space permits, and screening used where tuning condensers, etc., have to be very close together. As the frame obviously cannot be screened the problem of possible H.F. instability must be approached from the detector stage. The coil, H.F.C., anode lead and reaction leads should be screened.

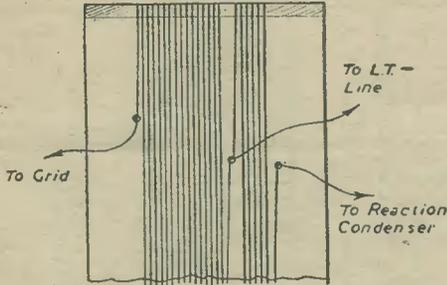


Fig. 4.—A simplified form of frame aerial.

Because of the compactness of the layout care should be taken to keep the various grid and anode leads apart, to avoid instability.

#### The Frame Aerial

Where a dual-wave frame with reaction is required, Fig. 3 shows the way the ends of the windings have to be connected. Note also that each of the windings is in the same direction. It is usually best to finish off

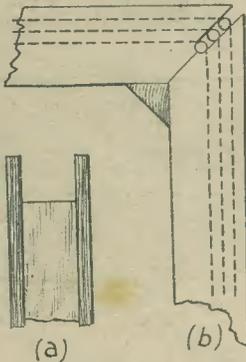


Fig. 6.—Where space is limited the frame aerial can be built up on a former constructed on these lines. The aerial is wound in layers between the projecting side strips.

the windings in such a position that the ends will be near the points to which they have to be connected when the receiver is installed.

For the medium-wave winding the turns are usually spaced when possible. Wire of from 18 s.w.g. to 24 s.w.g. is satisfactory, and it may be either enamel or cotton covered.

Thinner wire (about 32 s.w.g.) is used for reaction and long-wave windings, and the turns are side by side.

When using a circuit such as that in Fig. 1 the frame may with advantage be in one continuous winding, as shown in Fig. 4. In this case there are three connections only.

The number of turns will depend upon the size of the frame, and it is usually satisfactory to use about 75ft. of wire for medium waves and 210ft. for long waves. A very small frame will require rather less wire. If there is any doubt ample turns should be put on, when a turn at a time may be removed when testing until the desired waveband is tuned.

Where space permits thicker wires may be used with

some slight increase in pick-up—say, silk-covered flex for M.W. and 26 d.c.c. for L.W. windings.

Usually about 30ft. is sufficient for reaction, with about  $\frac{1}{2}$ in. between M.W. and reaction winding, and  $\frac{1}{2}$ in. between L.W. and reaction winding, as in Fig. 3.

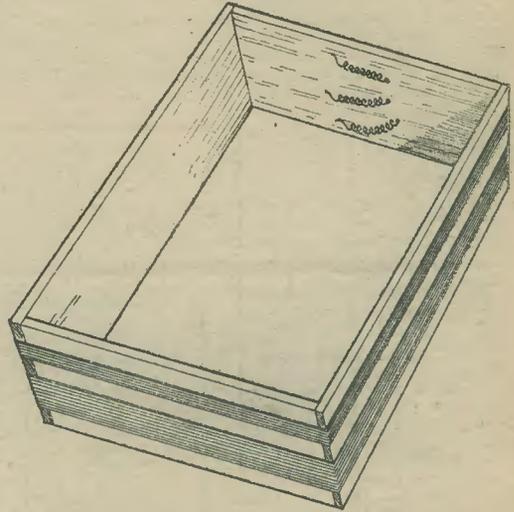


Fig. 5.—Details of the former for a frame aerial.

#### The Frame Former

An oblong frame, such as shown in Fig. 5, is usually more convenient than trying to wind the wire upon strips fixed upon the inside of the cabinet. It is made from thin ply, with the grain lengthwise, and the corners may be braced by small blocks. Before winding on the aerial the outside is varnished to prevent moisture influencing reception.

It is usually convenient to build the receiver, with speaker, inside this box, which may be screwed to the receiver panel. There is then room for the batteries behind. Standing batteries inside the frame, so that they are adjacent to the winding, will give loss of volume.

Where space is limited, the frame shown in Fig. 6 can be used. Four wooden strips  $\frac{1}{2}$ in. by  $\frac{1}{4}$ in. of the required lengths are channelled as shown in A. They are firmly joined together to make the former, small blocks being used as in (b). A slot is now cut in each corner. In winding, about eight turns are put on; a  $\frac{1}{2}$ in. length of  $\frac{1}{4}$ in. dowel is now put in each slot, and a further eight turns wound on. This is continued until sufficient turns are in place, the winding lying in layers as shown by the dotted lines in (b).

#### Ganging

Ganging the frame with the detector coil will be greatly simplified if two separate tuning condensers are used, or can be connected temporarily if a gang-condenser is employed.

The set should be switched on and a station tuned in, peaking each condenser for maximum volume. If the frame aerial tuner is now set at less capacity than the detector tuner then wire must be removed from the frame aerial. A turn should therefore be removed and another trial made, until both the tuning condensers show approximately the same dial readings. Final slight adjustments may be made by slipping the turns on the frame closer together or farther apart as necessary.

Unfortunately the frame and coil will not gang perfectly throughout the whole tuning range. Because of this it is best to gang as described on the most popular station, when slight individual adjustment will be required when listening to other stations.

# A Two-valve Portable

Details of a Small, Efficient, Triode-pentode Receiver for Medium-wave Tuning

By "EXPERIMENTALIST"

**A**LTHOUGH ordinary B.V.A. valves and a 6 $\frac{1}{2}$ in. moving-coil loudspeaker are used in making the portable receiver shown, plus the usual baseboard valve holders, transformer, mica-spaced variable condensers, etc., the case only measures 10 $\frac{1}{2}$ in. high by 8 $\frac{1}{2}$ in. wide by 4in. deep, and is strongly made from  $\frac{1}{2}$ in. thick deal and  $\frac{3}{4}$ in. plywood. The writer has designed the portable receiver for a number of reasons, and for the use of general-purpose triode and pentode valves—such as an Osram HL2 and Cossor 220HPT type—is one of them.

tried different gauges of wire and numbers of turns of the wire, but, while he can recommend a certain gauge of wire and a specified number of turns for each winding, the reader is advised to experiment in the matter rather than be satisfied with the results he may obtain.

Like all portable receivers, the set is directional, i.e., the case has to be turned so that the aerial winding is in line with the transmitting station, thus obtaining the maximum volume.

### Making the Baseboard

The first thing to make is the baseboard, this measuring 6 $\frac{7}{8}$ in. by 3 $\frac{3}{8}$ in. by  $\frac{1}{2}$ in. The front and back strips are cut to size and shape from  $\frac{1}{2}$ in. plywood, as shown at Fig. 1, and secured to the baseboard side edges with  $\frac{1}{2}$ in. by No. 4 flathead iron screws.

Now, the circuit of the portable receiver is the well-known "straight" triode-pentode arrangement, with certain modifications. For instance, instead of a proper H.F. choke, we have a 10,000 ohm resistor, which saves space. No grid-bias battery is needed, and the G.B. terminal on the transformer is earthed, as shown in the top plan at Fig. 3.

Mica-spaced tuning and reaction condensers also save space as much as possible, as do 1 $\frac{1}{2}$ in. diameter bakelite valve holders, a midget transformer, and a Bulgin single-pole type switch. All these components can be conveniently arranged on the baseboard and its side strips, as shown.

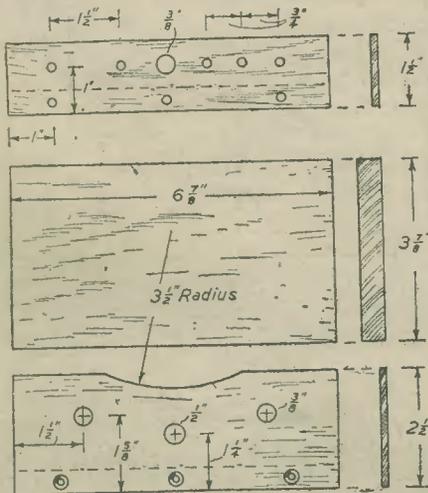


Fig. 1.—Sizes and shape of baseboard, front and back strip.

Another reason is that many amateurs still prefer to make use of baseboard components, rather than chassis components. They can understand such parts better; moreover, there is no soldering to do—a job which the beginner greatly dislikes, for he sometimes makes soldered connection to the wrong points. Some constructors cannot solder successfully at all, and to try to connect four wires to a single pin socket on a chassis valve holder is not only irritating to the amateur, but he also knows in his bones that the connections are far from being satisfactory.

If a proper aerial-earth collector system is available, one may connect the receiver to it, thereby increasing the range and volume. Results on the experimental receiver, with an outdoor aerial and earth wire connected to its terminals, were extremely loud, especially with a local transmitter tuned in sharply and reaction applied. When operating independently, one obtains nice, plain, natural reception of both the Home and Light programmes.

### Aerial and Reaction Windings

A great deal, of course, depends on the aerial and reaction windings which are wound around the case of the receiver. The writer

### The Connections

Bolt the variable condensers in position first, then screw down the valve holders, with the transformer going between them so that terminal P is almost in line with the anode terminal on the four-pin valve holder. Having attached a 20in. long flexible lead and a 6in. length of insulated connection wire to the tags the switch is inserted in its hole and secured by its nut.

If you are attempting to build a two-valve receiver for the first time, ignore the battery leads, fixed condensers and the resistors; these can all be added after the components have been correctly wired up. For the

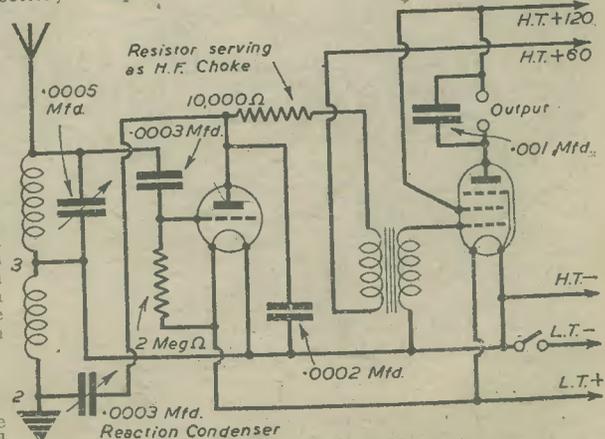


Fig. 2.—Theoretical circuit of the home portable receiver.

back strip, you require five terminals, which can be merely small  $\frac{1}{8}$ in. bolts, with suitable washers and nuts.

Having attached these, number the earth terminal 3 and the aerial terminal 1, the other being numbered 2, as shown in the back view at Fig. 6. All battery leads must be 20in. long. The reason for this is that the receiver can be set on a shelf by itself, with the battery leads running through a hole to a second shelf on which the batteries are kept which, together with other shelves, may be hidden by a curtain.

If the receiver is intended to be set on a small kitchen cabinet, fitted with a door and shelves at, say, one side, a good plan is to bore a rin. hole in the cabinet back, near the top corner, so that the battery leads can be brought to the first shelf which will hold the batteries. This in no way spoils the appearance or value of the cabinet, and, as a result, one gets the impression of a small, neat, self-contained radio receiver.

**Making the Case**

To make the case, prepare two sides 9 $\frac{1}{2}$ in. by 3 $\frac{3}{8}$ in. by  $\frac{1}{2}$ in., a top 8in. by 3 $\frac{3}{8}$ in. by  $\frac{1}{2}$ in. and a bottom 7in. by the same width and thickness. Use deal flooring material. The ends must be neatly trimmed and squared with, if possible, a try-plane and the use of a shooting-board.

Glue and attach the top to the top ends of the sides with rin. oval nails, then add the bottom, this going between the sides, flush at the bottom ends of the sides, as seen at Fig. 6. Sink the nail heads with a punch, then test the work for squareness with a set-square.

Meantime, prepare the case front. If you are not a fretworker, you can cut the front to the size and shape shown at Fig. 4 and a neat cabinet will result, the 5 $\frac{1}{2}$ in. diameter loudspeaker aperture being cut with a fine pad-saw or scroll-saw, then trimmed with a spokeshave or filed. All holes are, of course, bored with suitable bits. As  $\frac{1}{8}$ in. plywood is used, the  $\frac{3}{8}$ in. holes should be bored from both sides, boring half-way at one side and clearing out at the opposite side, this ensuring "clean" holes.

On the other hand, if you are a fretworker, you might prefer the case front design provided at Fig. 5. It is the same size as the plainer front described.

**Winding Strips**

Assuming the front is attached with glue and panel pins and the top corners of the case have been

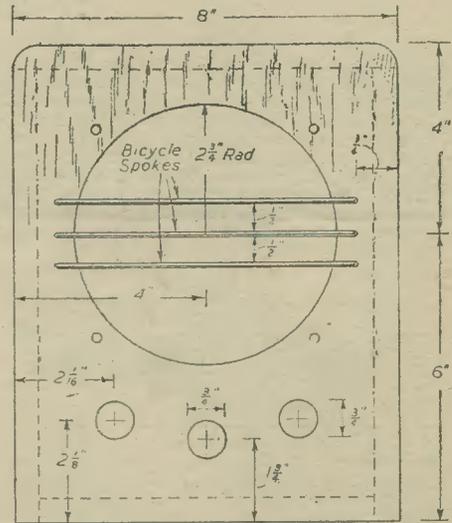


Fig. 4.—Size and shape of the case front.

rounded over to conform with the shape of the front, the wire winding strips can be attached. These strips are  $\frac{1}{8}$ in. wide by  $\frac{1}{8}$ in. thick. You need four pieces 10 $\frac{1}{2}$ in. long, two 8in. long and two 8 $\frac{1}{2}$ in. long.

The strips are kept in  $\frac{1}{8}$ in. from the back and front edges, as seen in the views at Fig. 7. Attach the bottom strips first, add the side strips, then the top strips. The corners of the latter are rounded over suitably and the "gaps" at each corner (see Fig. 6) filled with plastic wood, these gaps being due to rounding the case corners, of course. In appearance, the strips seem to be bent over the case.

**Completing the Case**

A back block  $\frac{1}{2}$ in. by  $\frac{1}{2}$ in. square is glued beneath the top of the case to sit in  $\frac{1}{8}$ in. for the case back which is ultimately screwed to it. The back (Fig. 8) is cut from  $\frac{1}{8}$ in. fretwood or plywood.

If you have merely cut a plain aperture for the speaker, an excellent plan is to introduce three protective horizontal wires across the aperture, as seen at Fig. 4. These are made from nickel-plated bicycle spokes to the shape shown at Fig. 8, the length depending on the distance between the holes bored for the "lugs" in the case front, this being about 6 $\frac{1}{2}$ in.

When fitted, remove the wires and french polish or enamel the case, the back being merely stained. Fit the wires into position again, then glue a 7in. disc of fancy gauze material over the loudspeaker aperture (this has not been done on the experimental model, nor a finish applied, for the

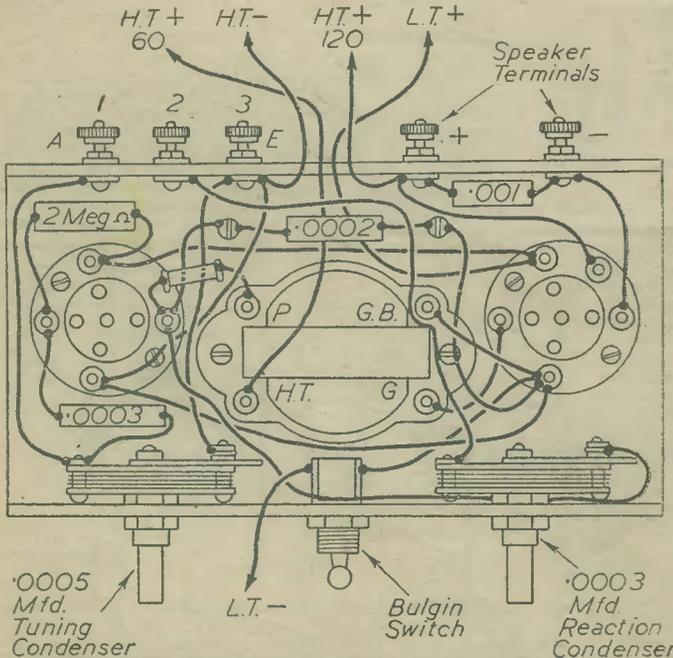


Fig. 3.—Top plan of the baseboard, showing how the various components are arranged, with wiring connections. All the battery leads are brought through the hole in the back strip.

sake of clarity in the photograph), having it stretched free from wrinkles, following which the speaker is affixed in position, the latter being a 6 $\frac{1}{2}$  in. permanent-magnet, moving-coil "Rola" type fitted with a suitable matching transformer.

The best wire for the aerial-coil winding to use is 22 S.W.G. enamelled.

Connect it to terminal 1 via the inside and put on 16 turns, the end being connected to terminal 3. The turns must be tight and parallel, but spaced, as stated.

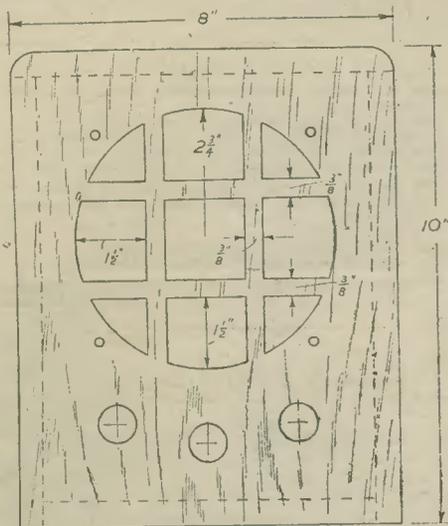


Fig. 5.—Alternative case front design for the fretworker.

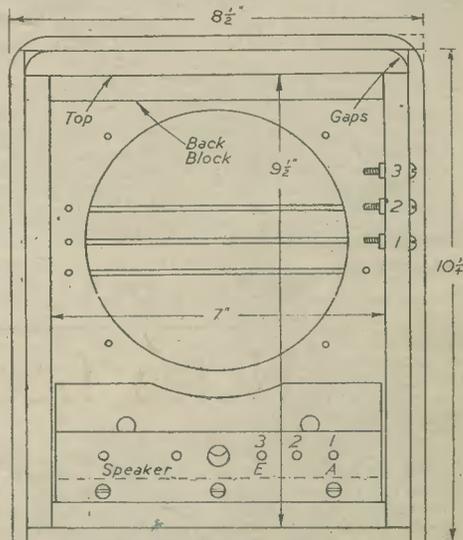


Fig. 6.—A back view, with baseboard in position.

**The Frame Aerial**

The frame-aerial winding also acts as a tuning coil. The whole thing is constructed much like an ordinary coil having grid and reaction windings only, complete with anchoring terminals. However, in order to have as much of the wire as possible for "collecting" purposes,

Bore a second hole beside the one made for the connection to terminal 3 and connect 28 S.W.G. or 30 S.W.G. enamelled wire to the same terminal. Wind on eight turns of this wire, keeping the turns tight and close together, then connect the end to terminal 2. All this is clearly shown in the views at Fig. 7, and it will be observed that the reaction winding is about 1/4 in. from

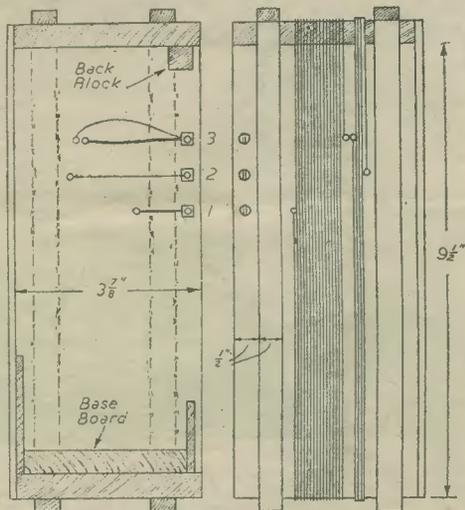


Fig. 7.—A sectional side view, with view of the loop aerial and reaction windings and their connection points.

each turn of the aerial winding must be spaced slightly from its neighbour—approximately equal to the thickness of the wire.

Now attach three rim, by 1/4 in. bolts to the rear side of the case, as seen at Figs. 6 and 7. The windings, as can be seen, are arranged between the flanges of wood.

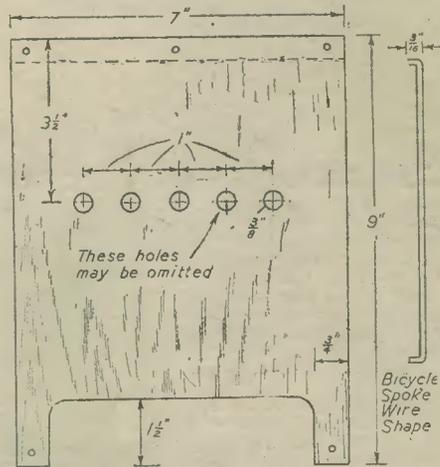


Fig. 8.—Size and shape of the back, with detail of one of the protective wires used across the speaker aperture in the case front.

the aerial-coil winding. Both windings must be in the same direction.

**Testing the Receiver**

The baseboard is held to the case by means of an "On-off" switch face plate (or a washer rim, diameter

with a  $\frac{1}{2}$  in. central hole) and the second switch nut. Having inserted the valves, fix short flexible leads to the frame aerial terminals and connect them to the baseboard terminals in their correct order.

Screw on the back, using roundhead screws, then (assuming the battery leads have been labelled and fitted with plugs and spade ends) connect the leads to their batteries, such as a 120-volt H.T. battery and a 2-volt accumulator. As soon as the set is switched on, some programme should be heard immediately.

Tune in the station properly and gently apply reaction to increase the volume. If reception is still rather weak, the receiver should be turned sidewise slightly for the reasons mentioned in a previous paragraph. If nothing is heard, wait a few minutes. A programme may have just finished. Try tuning in the other station. If nothing is heard again, change the L.T. leads about, as you may have got these reversed. This could also apply to the H.T. leads.

If the set remains silent, check the wiring connections. If no reaction is obtained, this is generally a sign that the wires are connected wrongly to the fixed and moving

plates of the condenser; reverse these connections. When the receiver is working satisfactorily, to complete it, the windings around the case should be covered with a band of leatherette material. You need a strip  $3\frac{1}{2}$  in. long by  $\frac{1}{2}$  in. wide. Make the overlap joint at the underside of the case, of course, where it will not be seen.

#### LIST OF COMPONENTS

- One mica-spaced tuning condenser, .0005 mfd., with knob.
- One reaction type, .0003 mfd., with knob.
- Three fixed condensers, .001, .0002 and .0003 mfd.
- Two resistors, 10,000 ohm and 2 megohm.
- One small L.F. transformer, 3 to 1 or 5 to 1 ratio.
- One single-pole Bulgin switch, with face plate.
- Two baseboard valve holders, 4-pin and 5-pin,  $1\frac{1}{2}$  in. diameter.
- Five small terminals.
- One triode valve, such as an Osram HP2.
- One pentode valve, such as a Cosor 220 HPT.
- Three battery plugs and 2 spade ends.

#### Sparks' Coils

**I**N addition to the popular range of Data Sheets, L. Ormond

Sparks is now able to supply a range of high-efficiency dual-range tuning coils for incorporation in home-constructed receivers. The coils are of the unscreened type, covering the ranges from 200 to 500 metres on the medium band and from 900 to 2,000 on the long waveband. The coils are wound on  $1\frac{1}{2}$  in. diameter formers and are varnished and baked after winding. They are impervious to moisture, are wound with a good gauge of wire, and provided with soldering tags for connections. At present the coils are available in two distinct types, an aerial coil with primary and secondary, and an H.F. transformer with reaction winding. These components are tested and guaranteed and may be relied upon to give excellent results. The aerial coil costs 4s. 6d. and the H.F. transformer 5s. 6d., or a pair neatly boxed for 9s. 6d.

#### Londex Aerial Change-over Relays

**O**NE item of equipment which deserves consideration when planning a radio station is an aerial change-over switch. With the higher frequencies we have been allocated, directional aerial arrays will become more popular, and these arrays should be used with the receiver as well as with the transmitter, if the full benefit of them is to be obtained. Messrs. Londex, Limited, 207, Anerley Road, London, S.E.20, have placed on the market two relays which are eminently suitable for this purpose. The accompanying illustration shows two of the relays. In both types the insulation material carrying the contacts is of pure silver, and the solenoid can be supplied for any normal voltage A.C. or D.C. to suit customer's requirements.

The smaller type A.E.C.O. 4, shown on the right, will handle up to 4 amps, and is especially suitable for small transmitters, amateur stations and experimental purposes. The larger type A.E.C.O. 15 will handle up

## Notes from the Trade

#### Osram Valve Characteristics

**A**LL those who are interested in the technicalities and design of radio receivers, electric amplifiers, television sets, photoelectric devices and, indeed, of almost any kind of electronic equipment should make a note of a new folder just produced by The General Electric Co., Ltd.

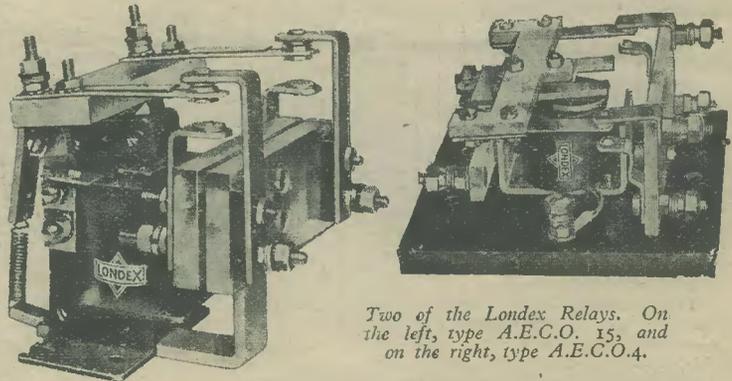
This folder gives in tabular form the characteristics of more than 80 types of valve, tube and photo cell, together with tables and diagrams, which form a useful valve base and valve pin connection chart. Each class of valve is clearly indicated by "streamer" side headings so that easy reference is facilitated.

The folder is available on request from the Publicity Organisation, Magnet House, Kingsway, W.C.2.

#### Lee Kits

**L**EE PRODUCTS, LTD., of Radio House, 48, East Street, Brighton, 1, are now supplying complete kits of parts together with wiring diagrams and instructions for radio receivers.

Kit 3 is a five-valve A.C. D.C. three-waveband receiver; Kit 2 is a four-valve, and Kit 5 is a six-valve job.



Two of the Londex Relays. On the left, type A.E.C.O. 15, and on the right, type A.E.C.O. 4.

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# A Coil Winder

Constructional Details of a Versatile, Easily-made Machine for the Radio Amateur or Serviceman

By W. SUTHERLAND

**I**N amateur or small service workshops a coil winder of some kind is a necessity, but unless much precision transformer winding is undertaken there is no justification for spending a large sum on a complex, power-driven, commercially produced unit. The simple winder described here will do most jobs, is efficient and extremely comfortable in use, and can really be built in a few hours from material found in any junk-box.

on the table. A  $\frac{3}{16}$  in. Meccano pulley wheel gives a gear ratio of about  $4\frac{1}{2}:1$  with the  $\frac{3}{16}$  in. drum, and this is as high as is desirable. The belt (9) may be a strong rubber band of the type used with fruit preserving jars. Any small piece of brass rod serves as an axle for the drum turning in a bush taken from an old reaction or tuning condenser. This particular drum has the extra advantage that its central hole happens to fit the Meccano spindle, so that it may be mounted

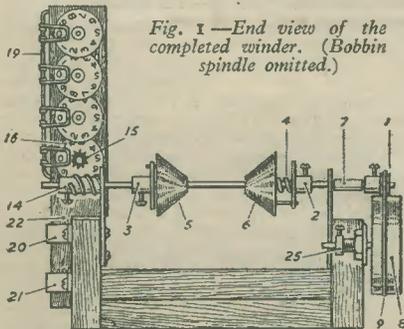
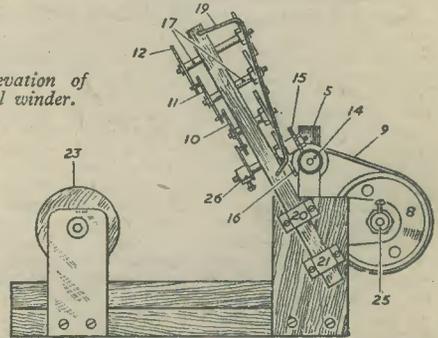


Fig. 1.—End view of the completed winder. (Bobbin spindle omitted.)

Fig. 2.—Side elevation of the complete coil winder.



### Winding Spindle

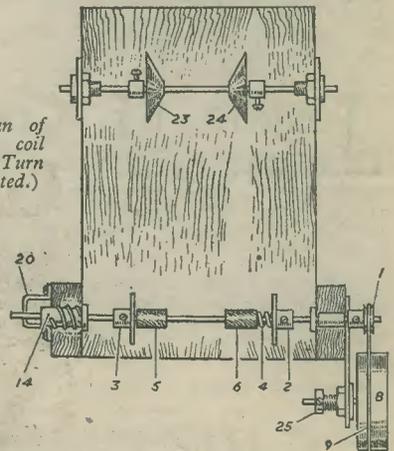
For this a "Meccano" bar (11.5 in. x 0.16 in.) was chosen, chiefly because appropriate pulley-wheels, etc., to fit it were readily available. Any long  $\frac{1}{16}$  in. spindle will serve the purpose, but the pulley (1) and the wheels (2) (3) will then have to be home-made by soldering suitable discs to brass bushes fitted with grub-screws. The parts necessary for this will usually be found in old type slow-motion dials, or in the cam-operated wave-change switches which formed an integral part of most old broadcast coils. In the present case (2) and (3) are  $1\frac{1}{2}$  in. Meccano wheels with eight peripheral holes. A small nail with head removed projects from each chuck and engages in one of these holes to transfer the drive to the chucks. Between one wheel and its chuck is placed a spring washer or small spring (4) which holds the coil former firmly between the two chucks (5) and (6). These are made by ruling a  $2\frac{1}{2}$  in. square with both diagonals on a piece of hard  $\frac{1}{4}$  in. timber. Cut the square across one diagonal and use the other as a guide for drilling the central hole, which should be a loose fit on the spindle used. The instrument described will allow a coil former 6 in. long to be placed on the winder, but it was originally constructed to wind an induction coil. Since most formers are not more than 3 in. long, a shorter spindle may be used. (7) is a small spacer to prevent lateral movement.

### Drive

The "shock-absorbing" properties of a rubber belt drive are a great advantage when winding with fine wire at high speed, since a momentary "check" is not so likely to break the wire. The  $\frac{3}{16}$  in. belt drum (8) was originally the dial of an Osram "Music-magnet" 4-valve battery set, and is ideal for the present purpose, having a heavy brass centre bush with grub-screws and two suitably placed  $\frac{1}{2}$  in. holes near the rim. The drum is rotated by means of a finger-tip inserted in one of these holes. This causes the least possible fatigue, since the rotation is secured with only a slight movement of the wrist, the elbow resting comfortably

directly on the end of the latter in place of the small pulley when a direct-drive is needed for winding such things as M.W. coils or speech-transformer secondaries. If the "Music-magnet" bakelite drum is not obtainable, use a tobacco tin with a brass rod soldered through the centre for an axle. The driving hole in the lid of the tin should be fitted with a larger rubber grummet.

Fig. 3.—Plan of the complete coil winder. (Turn counter omitted.)



### Turn counter

If a commercially made revolution counter is not at hand, quite a useful one can be made from odds and ends, and will read up to 10,000 within a fraction of a single turn. It consists of three tin or brass discs (10), (11), (12), with ten teeth, and each driven by a projection on the preceding disc. The "units" wheel is driven by a 10:1 reduction drive in order to reduce the speed at which the driving projections engage with the teeth of the other wheels, so that there is no danger

of a wheel being knocked past its position and causing the whole counter mechanism to "lock" at high speeds. The worm (14) is made by soldering two or three turns of 16 S.W.G. wire on a hollow brass tube. The small "star" wheel (15) is made by cutting ten sharp teeth in a  $\frac{1}{2}$  in. brass disc, and the turns of the worm can then be spaced to suit these teeth. The "star" wheel is raised about  $\frac{1}{4}$  in. above the "units" indicating disc (16) by a small spacer, the three being held between two nuts on the (4BA) threaded rod which forms the axle. The indicating discs are all paxolin washers about  $\frac{1}{2}$  in. diameter, taken from an old 110 Kes. I.F. transformer, but any cardboard or metal discs will do. The axles of the counter wheels rotate in pieces of brass tubing (17, etc.) hammered tightly through the timber.

### Making the Counters

Suitable tubing and 4 BA threaded rod (as well as a miscellaneous collection of bushes, brass discs, etc.) were obtained by dismantling the large three-gang condenser of the Osram Music-magnet which supplied the driving drum. The tin discs (10, 11, 12) are soldered to the 4 BA rod. The sketch shows clearly how the teeth on these discs are shaped, but note that the central one (shaded for clarity) rotates in the opposite direction to the outside ones, and therefore the teeth must be reversed. The discs are cut from  $\frac{1}{2}$  in. circles of ordinary strong tin, and the driving projections are  $\frac{1}{2}$  in. lengths of 18 S.W.G. wire, soldered just at the base of any one tooth on each disc (except the last). The indicating "windows" through which the numbers are observed are made by soldering pieces of 18 S.W.G. wire to a length of bicycle spoke (19), suitably bent and held in small holes drilled down about  $\frac{1}{16}$  in. into the side of the timber. The spoke, wire and figures are painted white, standing out well against the rest of the counter, which is black enamelled, so that the reading may be seen at a glance. The figures are best marked by trial when the whole counter has been assembled, and note again that the figures run alternately clockwise and anti-clockwise. The counter is held in two brackets (20), and the step (22) is placed so that it compes against the top of the upright when the "star" wheel is nicely engaged with the worm. The counter may be disengaged merely by sliding it slightly upwards. It is easier to read the figures if the counter is sloped as in the illustrations. For normal use, four discs, registering up to 9,999, should suffice.

### Bobbin Spindle

If a second Meccano spindle and wheels are available, they may be used for this, but otherwise any  $\frac{1}{16}$  in. rod turning in condenser or volume-control bushes will do. The two large cones (23), (24), were made from tin,

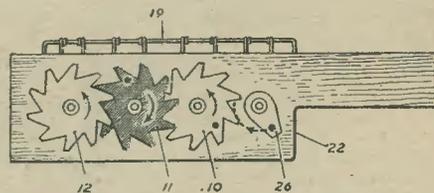


Fig. 4.—Bottom view of the turn counter.

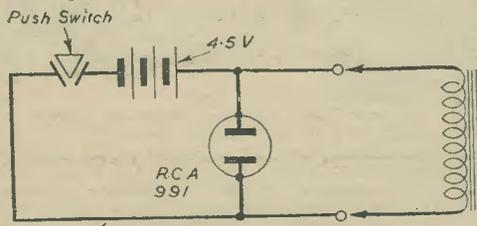
three pieces being necessary for each: a central tin tube about  $\frac{1}{16}$  in. long, shaped and soldered to slide freely on the spindle; a circular tin disc, about  $\frac{3}{16}$  ins. diameter, to form the flat side or base of the cone, to the centre of which the tube is soldered (if the hole in the disc is punched rather than drilled the burred edges will hold the tube for soldering), and a shallow cone made from a larger sector of tin and soldered around the edge to the flat disc and at the centre to the tube. Make sure that all rough edges of tin or solder are filed off. When placed with the flat sides inwards, these cones virtually increase the size of the ends of the bobbin from which the wire is being taken, thus preventing the wire from winding around the axle if the winding spindle should stop rotating suddenly for any reason without a correspondingly sudden check on the bobbin spindle. When placed with the conical faces inwards the cones will grip and centre an open-ended transformer or coil former for unwinding purposes, again providing large "ends" to keep loose turns in place. The cones are held between two small brass cylinders fitted with grub-screws. When finished, the wooden parts of the winder should be enamelled black except a wide strip down the middle of the baseboard, which should be finished with white gloss paint or white enamel so that the work may be watched more easily. Alternatively, the whole baseboard may be blackened and a strip of white paper pinned to form a background. In use, the wire passes over the index finger of the left hand, which rests lightly on the table in front of the winder.

## Testing L.F. Chokes

**O**FTEN one has to test an L.F. choke when it is not convenient to put it into a set or test it under working conditions. A resistance test is of little help, as it gives no indication whether the choke is in working order. It will only show up an open circuit or severe short.

The following simple test rig will give a more satisfactory test.

The choke is wired in series with a battery and push switch (a bell push), and across the choke is connected a neon lamp. The neon lamp has no series resistor. The battery can be of any suitable type about 4.5 volts, providing it has not too low a capacity. A 4.5 volt bell



Circuit of the test rig for L.F. chokes.

battery is best. The unit can be very neat if built into a small cigar box, and two leads with crocodile clips on their ends used for connecting to the choke under test.

### How it Works

When the push button is depressed the current through the inductance builds rapidly up to a maximum which is limited by the resistance of the choke. The core of the choke is then magnetised by the current. On releasing the button the current ceases to maintain this magnetism and the magnetic field collapses. This sudden fall in magnetic field causes a high E.M.F. to be built up across the choke, and this strikes the neon lamp and it gives a momentary flash.

The higher the inductance and the better the power factor of the choke the brighter the flash from the lamp.

This simple piece of test equipment may also be used to test windings of L.F. and mains transformers. Do not try to test low voltage windings on mains transformers as the current drawn from the battery would be excessive. A resistor of about 10 ohms may be inserted in the circuit, at the point marked "x" on the circuit diagram, to safeguard the battery from damage due to such things as the shorting of the crocodile clips whilst the switch is pressed.

An R.C.A. 991 voltage regulator tube is ideal for use as indicator, for it is quite small and has a low striking voltage. There are many British neon indicator lamps which will do.—JOHN C. THWAITES (S.E.A.A.F.).

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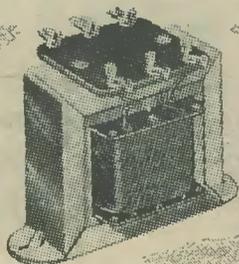
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# The Inverted Amplifier

"DYNATRON" Here Explains an Interesting Type of Circuit

**A** TYPE of amplifier which has definite advantages at frequencies of 20 mc/s and upwards is that shown, in simplified form, in Fig. 1. With the cathode follower, it has been used to some extent in television circuits, and, particularly, short-wave transmitters.

The cathode follower is, in a sense, an "inverted" form of amplifying stage, where the output is taken off a load resistance (say) on the cathode side, Fig. 1(b). From the -H.T. end of R there is 100 per cent. negative feedback of the output voltage  $V_o$ , in consequence of which the overall voltage gain is less than unity. But Fig. 1(a) shows a stage completely turned "upside down," or inverted. A somewhat odd feature is that the grid appears short-circuited to -H.T.,—or, in common parlance, "earthed"!

Then, the input E.M.F.,  $E_g$ , is applied across a resistance  $R_2$ , in the cathode circuit. This may not be so unfamiliar, since we have heard before of cathode injection methods, e.g., of applying negative feedback to a stage. We shall consider it in detail presently.

The anode circuit looks straightforward. The output voltage  $V_o$  is taken off the anode end of the resistance  $R_1$ . In common with the cathode follower,  $V_o$  will not be phase-reversed as in a straightforward stage with anode load. But, unlike the cathode follower, the overall voltage gain will not be something less than r.o. Actually, the gain will be a little larger than an ordinary amplifying stage with anode load, even though there is a degree of negative feedback which depends on the internal A.C. resistance of the driver stage.

A disadvantage which restricts the use of inverted

where high-power triodes have to be used, for example, in S.W. transmitters. Causes of instability are numerous, and careful neutralising is generally essential with most layouts.

## The Basic Circuit

If we omit the resistance  $R_2$  and show the driving source as an equivalent alternator in series with the valve, on the cathode side, Fig. 1(c), we get a clearer picture of the circuit.

The meaning of the earthed grid should be pretty evident. A driving E.M.F. may be applied to the valve, by tying the cathode to the fixed potential of H.T.—and varying the grid potential, or by earthing the grid and varying the cathode potential.

Thus, suppose over a given half-cycle (say the "positive") the alternator E.M.F. is acting away from the cathode, and towards H.T.—. The grid has the fixed potential of H.T.—, but this direction of E.M.F. makes the cathode negative in relation to the earth line, and, therefore, relative to the grid. The result is the same as making the grid more positive in relation to a fixed cathode potential. Therefore, we shall call this a "positive half-cycle" of  $E_g$ . Conversely, when the cathode becomes more positive with respect to -H.T. in the next half-cycle, it is equivalent to a negative grid half-cycle.

## Why No Phase-reversal?

This inversion of the driving E.M.F. explains why the output voltage  $V_o$ , taken off the anode, will be of the same phase as  $E_g$ .

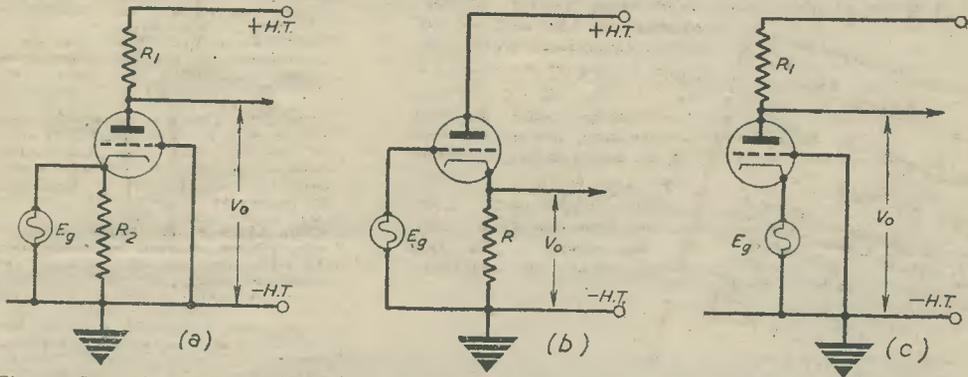


Fig. 1.—Inverted amplifier schematic (a). Cathode follower (b). The inverted amplifier is equivalent to a driving E.M.F.  $E_g$  in series with the driven stage as in (c), and the driving source has thus to supply part of the main output power.

amplifiers for general purposes is the comparatively low input impedance. The driving stage is shunted by the resistance  $R_2$ , or, in the absence of this, the internal A.C. resistance of the driven stage. This rules out an inverted amplifier immediately following a high-impedance voltage amplifying stage. But no real disadvantage exists if the driver is a power valve capable of handling the load imposed by the driven stage.

As will be seen in a moment, the driver must be a power valve capable of giving considerable output. Then, the inverted type of amplifier has one very important advantage for H.F. power work. Good stability can be obtained, using a triode, at frequencies of 20 mc/s and upwards, and little or no neutralising is necessary to prevent self-oscillation. This is a substantial advantage

Under ordinary driving conditions, the grid potential varies in a "positive" sense when  $E_g$  is acting away from the earth line, towards the grid, Fig. 2(a). The anode current then rises, causing an increased voltage-drop across the anode load resistance, and a corresponding fall of potential across the valve. Therefore,  $V_o$  appears phase-reversed relative to  $E_g$ .

Now, if the alternator, having this same direction of E.M.F., were transferred to the cathode side, Fig. 2(b), we see that it is making the cathode more positive, or, results in a negative grid half-cycle, as stated above.

For the same direction of E.M.F., therefore, the anode current increases in (a), but decreases in (b). Thus the potential across the valve will be rising in (b). The output voltage will be rising in (b), and will have a phase opposite to  $V_o$  in (a), i.e., the output voltage

in the inverted amplifier will have the same phase as  $E_g$ .

Stated very simply: for a given half-cycle, cathode-driving will give a potential sign opposite to direct driving, relative to grid-cathode, and the anode current, therefore, undergoes an opposite change.

### Negative Feedback

The diagrams also show that the alternator is acting in series with the valve to supply part of the output power, i.e., the driving stage must deliver enough

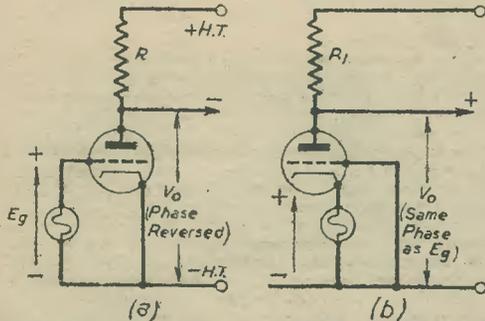


Fig. 2.—Moving the alternator from the normal position (a), to cathode (b), will, for a given direction of  $E_g$ , give an alternating grid-cathode potential of opposite sign, hence there is no phase-reversal of the output voltage  $V_o$  in the inverted amplifier (b).

power to supply, in part, the main output load. Consequently, the total output is the sum of the power from the inverted amplifier and driving stages, minus any power from the latter which may be dissipated in the amplifier circuit.

The relative amounts of power from the two stages will be in the same ratio as the voltages across  $R_1$  and  $R_2$ , respectively, i.e., Power Supplied by Driver: Power Supplied by Main Amplifier = Voltage across  $R_2$ : Voltage across  $R_1 = E_g: V_o$ , or:

Part of Output supplied by the Driving Stage = Main Amplifier Output  $\times E_g/V_o$ .

Note that  $V_o$  is the anode to cathode voltage, across the valve, not from anode to earth—the latter is the sum of  $E_g$  and  $V_o$ , and only the part  $V_o$  exists across the output load.

Since the driver stage has internal resistance, and is supplying A.C., there will be an internal voltage-drop owing to this cause, which subtracts from the useful driving voltage  $E_g$ . Therefore, in effect, the drop in the internal resistance of the driving source is of opposite sign to  $E_g$ , and is a form of negative feedback. It may sound strange to treat ordinary voltage-drop as "negative feedback," but the idea is by no means new.

Back-coupling effects due to the internal resistance of a common H.T. source, for instance, can be positive or negative—depending on the number of stages or phase-shifts in an amplifier—the internal A.C. drop being fed back to previous stages. Here, any resistance in the grid (or cathode) driving source is common to the main amplifier, and its grid-cathode circuit, and the resulting voltage-drop is in phase-opposition to  $E_g$ .

In high-power stages, the driver is connected to the amplifier through an H.F. feeder-line, when the degree of feedback is apt to vary under modulating conditions, because it is difficult to ensure that this line shall be exactly terminated at both ends.

### "Screening Grid"

Reference has already been made to the fact that little or no neutralising is necessary in an inverted stage. The reason should now be fairly clear.

The "live" control electrode is the cathode—it is at a higher H.F. potential than earth, just like the grid in

an ordinary stage. Thus any internal feedback through inter-electrode capacities takes place from anode to cathode, i.e., the anode to cathode inter-electrode capacity takes the place of the anode-grid capacity in an ordinary stage.

But the earthed grid acts as a fairly effective electrostatic screen to any feedback in this direction. The result is that there is no tendency to self-oscillation due to this form of feedback, though neutralising and balancing of various stray reactances will be essential for other reasons. The fact that the grid is earthed makes it partly a screening grid at the same time.

A schematic of an H.F. circuit is given in Fig. 3, using single-ended stages for simplicity. While, as explained, the grid of the inverted amplifier is earthed, therefore largely eliminating feedback from anode to cathode, it will be observed that the anode to grid internal capacity is in parallel with the main output tuning condenser C.

At the high frequencies for which inverted amplifiers are used, the A.C. reactance of the anode-grid capacity will be relatively low—comparable to C—which means that this part of the valve itself is carrying an appreciable proportion of the circulating current in the output tank circuit.

There is always the possibility in S.W. transmitting circuits that the internal valve capacities may thus be called upon to carry heavy H.F. currents, which have been known to overheat and melt spots on the glass envelope surrounding grid and anode leads, etc.

### Neutralising Reactances

In the inverted amplifier, the anode-grid capacity must necessarily carry an appreciable proportion of the output tank circuit current, since, as stated it forms part of the main tuning capacity.

The lead connecting the grid to earth has to carry this comparatively large H.F. current, and, here, we have one complication which demands a form of "neutralising"—much simpler and easier to adjust than ordinary balancing of the anode-grid capacity in a straight-forward amplifier.

The grid lead has inductance, as represented by L in Fig. 4. At a frequency of only 20 mc/s., the A.C. reactance if L was of the order of 120 ohms, will be of the order of 120 ohms, and 120 ohms carrying, say, 1 ampere of H.F. current, will have a potential-difference across it of 120 volts.

The figures are somewhat exaggerated, but it is not difficult to see that this 120 volts is going to be fed-back somewhere.

We cannot trace out all the phase-angles at present. The important thing to understand is that L is a reactance common to the input and output circuits, and will result in positive feedback tending to cause self-oscillation, i.e., we have a state similar to an oscillator, where the grid (or cathode, in the present case) will be self-excited by voltage fed-back from the anode circuit.

Fortunately, it is very easy to get over this difficulty due to the grid-lead inductance. All that is necessary is to apply elementary A.C. ideas. The trouble is caused by the inductive reactance of the grid-lead, which can be got over very neatly by connecting a capacitive reactance in series—or small variable condenser C, Fig. 4(b), adjusted, say, to give minimum voltage from grid to earth.

In practice, this condenser will be adjusted very

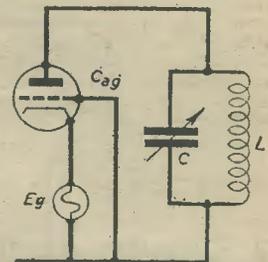


Fig. 3.—Schematic, omitting H.T. supplies. The valve anode-grid capacity,  $C_{ag}$ , is in parallel with the main tuning condenser, C, and carries part of the oscillating current in the tank circuit.

much like a neutralising condenser, to give stable working conditions, though the adjustment is by no means so critical.

The impedance of the grid-lead will now be resistance only, as in ordinary acceptor tuning circuits, since  $+120-120=0$  [reactive ohms]. The resistance will generally be negligible, so, in effect, the grid is efficiently earthed.

There is a similar possibility of feedback owing to the inductance of the cathode (or filament) leads inside the valve. Since the cathode circuit must carry D.C., this inductance cannot be neutralised simply by inserting condensers *in series*! Nevertheless, the principles are similar to balancing the grid-lead inductance.

#### Other Points About Inverted Amplifiers

We have previously referred to the fact that the driving stage has to supply part of the main H.F. output.

This means that the power output of the driver is determined, not only by the driving power required for the inverted stage, but also by the operating voltages, or anode current of the latter. Anything that alters the anode current will change the loading of the driving stage.

A consequence of these facts is, if anode-modulation of the output is necessary, it must be applied to *both* the driven, and the driving stages. If the driver had zero internal resistance, modulation of the inverted amplifier would be sufficient, but, otherwise, the effect of the variable loading during a modulation cycle would be to cause severe distortion.

#### "Phase Modulation"

In any anode-modulated amplifier, with a constant drive applied to the grids, and with the anode voltage swinging at modulating frequencies, there is another very important reason why even slight feedback from anode to grid (or cathode) circuits cannot be permitted.

If a small E.M.F. is fed-back to the grid in such phase that it arrives at the grid at 90 deg. to the driving voltage  $E_g$ , it can be shown that *phase modulation*, with anode modulation, will result. It will take us too far afield to explain the point in detail, but, very briefly: the voltage fed-back will depend upon the amplitude modulation, and consequently the resultant vector for  $E_g$  will have a "phase-swing," as well as varying in magnitude.

It is not a peculiarity of inverted amplifiers, but these are more liable to risk of phase modulating if adjustments have not been carefully done, e.g., if the outputs of the main and driver stages are not modulated correctly.

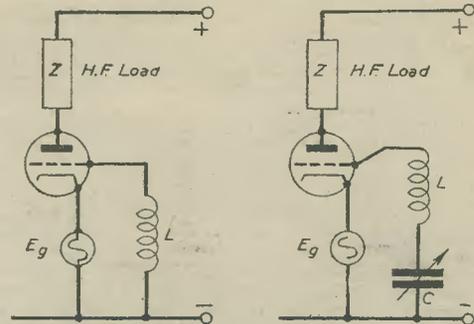


Fig. 4.—At v.h.f., the small inductance  $L$  of the grid lead can cause positive feedback and instability. This inductance is tuned-out by a small series condenser  $C$ , as in (b).

#### Summary

We may sum-up the principal properties of an inverted amplifier, as follows:

- (i) The output voltage is not phase reversed—a point of importance in itself for some television circuits.
- (ii) The voltage gain is not "unity," but somewhat greater than in a simple amplifier.
- (iii) The driving stage supplies part of the main output, and must be modulated if the driven stage is modulated.
- (iv) The grid is earthed and acts as a screen between anode and cathode.
- (v) Ordinary neutralising is thus eliminated, but parts of the valve and connecting leads are carrying appreciable H.F. currents, and their self-inductances must be neutralised.
- (vi) The input impedance is low, which makes the circuit largely ineffective for ordinary purposes.

## Radar for Merchant Ships

THE advantages and limitations of ship-borne radar are outlined in *Radar for Merchant Ships*, published recently by His Majesty's Stationery Office on behalf of the Ministry of Transport.

Probably the most important contribution is to be found in the appendices, which give the performance specification for a general-purpose marine radar set. The Government hope the specification will be generally adopted by manufacturers. The specification prescribes, among other matters, the minimum range on which the set should operate and calls for the inclusion of means for the non-technical operator to determine rapidly and continuously that his instrument is giving its full performance; these are both points of great importance in ensuring that the set shall contribute to safety of life at sea. There are powers for preventing the use of instruments which will create added dangers at sea, and radar sets which do not provide adequate safeguards might have to be regarded as coming within this category.

To safeguard shipowners and seafarers, the Ministry of Transport is arranging that manufacturers may submit designs or sets to the Admiralty Signal Establishment for certification that they comply with the standards of the performance specification.

An amending slip is included in the booklet to bring the specification into line with decisions reached at the

International Meeting, held recently in London, on Radio Aids to Marine Navigation.

#### Characteristics Explained

*Radar for Merchant Ships* opens with a brief account of what a radar set is and does. It then explains how the performance specification originated in the minds of the scientists working on radar during the war and the steps taken by the Admiralty Signal Establishment at the conclusion of the war to prove that the specification could be met.

The characteristics of the set made by the Admiralty are explained in some detail, partly as a means of defining the technical terms used in navigational radar and in the performance specification. Photographs of the plans shown on the screens of the radar set reveal how great is the advance on the set introduced even in the last year or so of the war, and appreciation of the pictures is helped by an accompanying outline chart of the area of the Thames Estuary in which the photographs were taken.

A note of warning is sounded to those who are looking to this new advance of engineering science to solve all their navigational difficulties. While radar can help to make the sea and the air a safer place for transport and travel it can, in the hands of careless people, be a source of danger.

*Radar for Merchant Ships* has been edited for the Ministry of Transport by Mr. L. S. Harley, head of the Central Radio Bureau, and can be obtained from all branches of His Majesty's Stationery Office, or through any bookseller, price 9d.

# Analysis of the Television Receiver

The First of a Series of Articles Written to Assist Those Who Contemplate Building Their Own Television Receiver. By S. A. KNIGHT

**N**OW that the television programmes have resumed from Alexandra Palace many readers will no doubt turn their attentions to the construction of their own television receiver.

The object of this short series of articles is to "run through" the construction of a small vision receiver employing an electrostatically focused and deflected cathode-ray tube, giving theory as well as practical hints and tips on design procedure. The writer is at present engaged on the refurbishing of his own receiver and the erection of an efficient aerial system to cope with signals emanating from a distance of 67 miles. The reliable range of the new programmes is given as 45 miles, but no great difficulty should be experienced by anyone living within 70 miles of Alexandra Palace. Much, of course, depends upon the nature of the surrounding countryside, the aerial array, and the type of vision receiver in use. Readers living a few miles from the transmitter could no doubt employ a simple straight receiver and take liberties with their aerial system, but most of the remarks in these articles apply to receiving stations situated, or to be situated, at distances on and beyond the estimated reliable range of 45 miles.

## The General Design

Fig. 1 shows the complete general circuit of a vision receiver employing an electrostatically focused and deflected tube. Circuit values are not indicated, for these depend upon the valve types and the voltage supplies in use in a particular case, but methods of arriving at component values for given conditions will be outlined in the following sections, together with alternative design of certain units. The survey of this typical receiver will commence at the aerial and work through to the cathode-ray tube and the power circuits.

## The Vision Signal

A modulated vision carrier-wave has certain important differences from a modulated sound carrier-wave. In the latter the radio-frequency carrier has a fixed mean amplitude and this amplitude is increased or decreased by the modulation at a rate depending on the modulation frequency; in the case of the vision signal no mean fixed value is given to the carrier, only the maximum value is fixed. Fig. 2 illustrates the waveform radiated from Alexandra Palace and will make the method of vision modulation clear. A modulation depth of 30 per

cent. of the maximum represents complete darkness of the image; the range between this and 100 per cent. represents brightening portions of the image, and 100 per cent. itself corresponds to full white. The carrier amplitude therefore corresponds to the intensity of illumination at any instant. The carrier amplitude below 30 per cent. is reserved for the synchronising pulses, being of no value to the picture content, since it represents an illumination blacker than black. During the synchronising pulses the carrier is completely suppressed and a negative-going rectangular period is inserted on the waveform.

The fact that the image modulation occurs in the region above 30 per cent. and the synchronising pulses entirely below this level is made use of in the solution of the problem of the separation of the synchronising pulses from the image signal by the employment of a simple amplitude filter. This will be fully discussed in the appropriate sections.

Each complete picture, or frame, consists of 405 lines, repeated 25 times per second. Interlaced scanning is employed in the interests of definition and low flicker, resulting in the reception of 50 half-frames, each of 202.5 lines per second. At the end of each line the modulation falls to the 30 per cent. black level and remains there for one-half per cent. of the total line time; the object of this is to ensure that the signal always returns to the black level before the onset of the synchronising impulse. It then falls to zero, producing the synchronising pulse proper, remaining there for 10 per cent. of the total line time. At the end of this period it again rises to the 30 per cent. black level and remains there for 5 per cent. of the line time; after this the image signal again scans another complete line. Summing up the complete black and synchronising pulse periods, it will be seen that the actual image signal is only transmitted over 84.5 per cent. of each line. In a similar manner, 10 lines are given over to synchronising pulses at the end of each frame, leaving 192.5 effective lines for each frame, or 385 for each complete picture. Fig. 3 depicts what happens at the end of each half-frame, (a) showing the signal variations at the completion of even frames, and (b) those at the completion of odd frames.

The frequency band required to transmit a picture having appreciable detail is very large; the worst case arises when the image takes on a chessboard pattern of

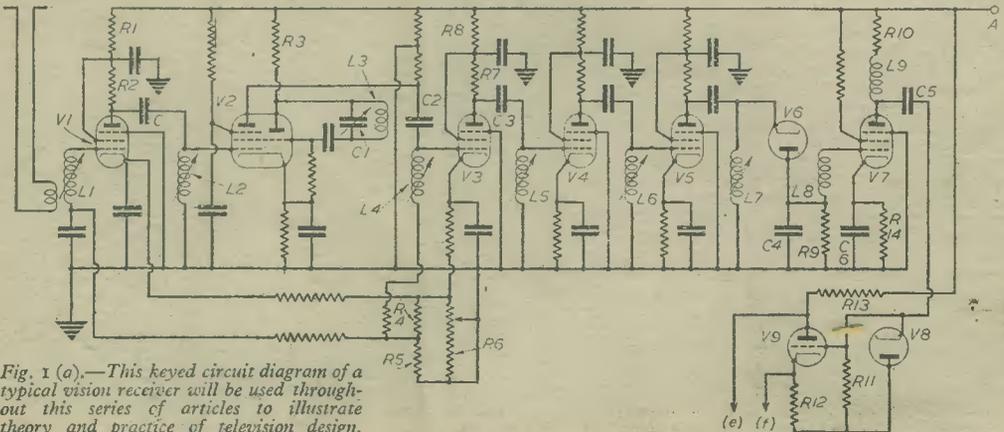


Fig. 1 (a).—This keyed circuit diagram of a typical vision receiver will be used throughout this series of articles to illustrate theory and practice of television design.

alternate black and white elements. Vertically the picture consists of 385 active lines and assuming equal definition in the vertical and horizontal directions the number of elements per line is equal to the product of the lines and the ratio of the width to the height of the complete picture (=5/4). For 25 pictures per second the frequency band required must therefore be capable of dealing with  $385^2 \times 5/4 \times 25$  elements per second. Taking one cycle of the output from the scanning device to be equal to two picture elements, one complete white and one complete black square of the extreme chessboard pattern, then the actual frequency band required is

$$\frac{385^2 \times 5 \times 25}{2 \times 4} \text{ cycles per second}$$

$$= 2.32 \text{ megacycles per second.}$$

Radiating both sidebands gives a total width of 4.7 mc/s. The actual signal transmitted from Alexandra Palace contains side-band frequencies up to about 3 megacycles per second. As a result of this still comparatively large side-band requirement, the carrier frequency itself must be extremely high, and 45 mc/s (=6.67 metres) is radiated in practice so that the modulation frequency is not too high a percentage of it.

**The Aerial System**

In order to reduce echo effects and distortion due to the sky and other reflections, the transmitted signal is vertically polarised, and is therefore best received on a vertical aerial array. The simplest and best aerial system consists of a half-wave vertical dipole chosen to resonate at the vision carrier frequency, or, if both sound and vision are being received on the one array, at some frequency intermediate between the vision (45 mc/s) and the sound (41.5 mc/s) frequencies. Fig. 4 shows a good typical design consisting of a centre-connected active dipole with a reflector placed one-quarter of a wavelength behind it. This system is directional and must be erected so that the active aerial faces the transmitter; the receiving polar diagram is seen on the right of the figure.

The usual construction is to employ rigid copper or aluminium tube for the aerial and reflector, held together by a hard wooden crosspiece in the centre as sketched. The middle of the crosspiece is fixed to the top of an ordinary mast. The length of the reflector should be half a wavelength (for vision signals this is about 10.0ft.), and must consist of a straight metal rod insulated and not connected to anything. The aerial itself consists of two metal rods one-quarter wavelength in front of the reflector, with their inside ends well insulated from one another and an inch or so apart. The total length of the aerial should be rather less than one-half wavelength, 10.5ft. being a good measure. The all-important consideration is height, however, and liberties can be taken in the actual assembly and member lengths of a vertical dipole provided that it is raised well clear of all surrounding objects. The received signal strength continually increases as the aerial is raised and the question of height therefore becomes of considerable importance for receiving stations situated at extreme distances from London. A golden rule to remember is that a simple array at a great height is always preferable to an elegant affair situated close to the ground.

The signals received on the dipole have to be fed to the receiver in the house, and to do this a special feeder line is employed. For the half-wave dipole described above the feeder is connected to the centre of the active aerial as Fig. 4 depicts, and consists generally of a concentric line of 80Ω impedance. For correct results, the impedance of the feeder must be equal to the centre impedance of the dipole, which in this case can be shown to be about 80Ω. Several manufacturers produce 80Ω feeder lines suitable for centre output aerial arrays, these consisting either of a cable with a largely air-spaced centre conductor in a semi-flexible metal tube which forms the outer conductor, this outer conductor being earthed, or of two wires embedded in an insulating compound such as rubber or Telcothene. Such feeders have low characteristic impedances suitable for centre matching. Belling Lee produce feeders for almost all

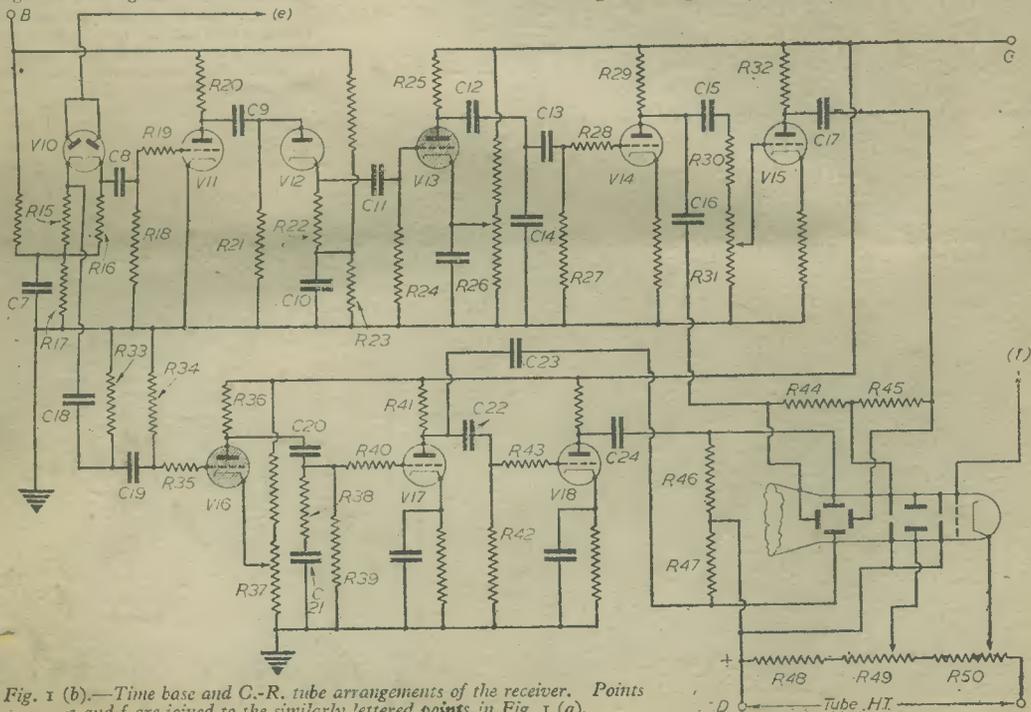


Fig. 1 (b).—Time base and C-R. tube arrangements of the receiver. Points e and f are joined to the similarly lettered points in Fig. 1 (a).

purposes covering a wide range of characteristic impedances.

The length of the feeder is not important, within reason, and at the receiver must be correctly terminated in its own impedance, say  $80\Omega$ . This is obtained by the transferred impedance of the first radio-frequency stage of the receiver, and it is general to have a single-turn aerial coupling coil at this end of the feeder. No earth point is provided on this coil (Fig. 5a), but interference

types, but for distances greater than this the super-heterodyne should be invariably chosen.

The receiver of Fig. 1 consists of a single radio-frequency stage, a triode-hexode mixer, and three intermediate-frequency stages. Such a receiver will prove suitable for reception up to a distance of at least 50 miles, and will, therefore, form the basis of the following explanation. For greater sensitivity, a second R.F. stage may be added, after which it becomes easier

to make an improvement on the aerial array than to add more valve stages. The limiting factor is valve noise, and more than three I.F. stages generally results in an excessive background which manifests itself on the tube screen in no uncertain manner!

**The R.F. Stage.**—The radio-frequency stage of the television receiver has to deal with a frequency of 45 mc/s and must, therefore, be designed accordingly. The object of using a radio-frequency stage at all is to keep the signal to noise ratio at a high value.

When the stage gain of a receiver exceeds a certain minimum value the signal to noise ratio is determined almost entirely by the first valve. Were no radio-frequency stage to be employed, not only would the sensitivity of the whole receiver suffer, but because a mixer valve gives a much lower stage gain than an R.F. amplifier for the same current consumption it would introduce some three to five times as much noise. This means that the signal input would have to be from three to five times as great when fed directly to the mixer stage as it would were a radio-frequency stage interposed between the aerial and the frequency changer. The radio-frequency stage should only be

omitted by those constructors who live within a comparatively short distance of Alexandra Palace, say 10 to 15 miles, and can be confident of receiving a strong aerial signal.

The valve used in such a stage will be one of the special high-slope television pentodes manufactured by various British and American firms. Suitable types are the Osram Z62, the Mazda S.P.41, the Cossor 4T.S.P., or the American 1852. These valves have much in common, particularly a mutual conductance of some 8.5 mA. per volt, and a low input capacitance.

(To be continued.)

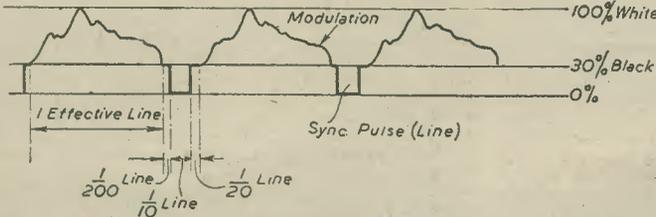


Fig. 2.—The vision signal, after detection, as radiated from Alexandra Palace during a typical transmission.

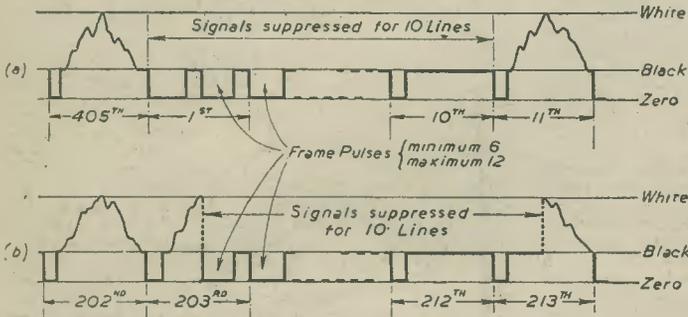


Fig. 3.—The signal at the end of even frames (a), and at the end of odd frames (b).

may sometimes be reduced by the provision of a centre-tap earth connection as shown in Fig. 5b. The coupling of this coil may be made variable with respect to the main tuned circuit and feeder matching is then ensured.

The commercial television receiver is generally built to provide the highest usable gain economically obtainable, and so, with only one or two exceptions, takes the form of a superheterodyne. The home constructor, on the other hand, is in a position to judge whether a superheterodyne will have any advantage over a straight receiver, depending upon the locality in which he lives. For receivers situated within ten miles of Alexandra Palace there is not a lot to choose between the two

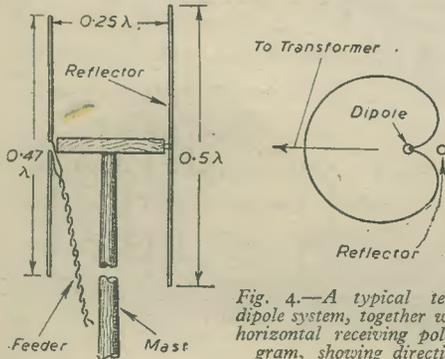


Fig. 4.—A typical television dipole system, together with the horizontal receiving polar diagram, showing directivity.

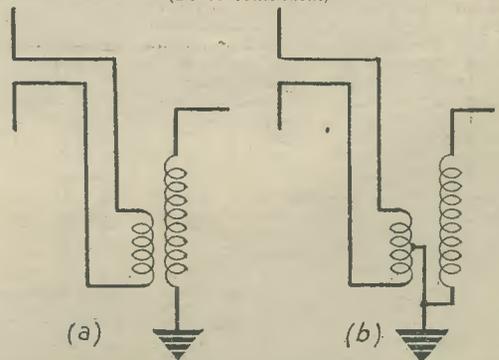


Fig. 5.—Two methods of coupling the aerial feeder to the receiver tuned circuit.



# ON YOUR WAVELENGTH

By THERMION.

## Reintroduction of Television

AS one of the earliest television experimenters, you would expect me to have put the vacuum cleaner over my 1939 television receiver and to have had it in working order for the first programme in the reintroduced television service on Victory Day. I had expected that my tube might have lost some of its sensitivity, but having carefully wiped the cobwebs from the time-base and used a feather duster on the rest of the wiring I was pleasantly surprised to find that it functioned just as efficiently as it did in 1939. I did not discern that the transmission was any improvement on the 1939 variety, but it was extremely good. Although the Press made a great fuss about it we must remember that it was a transmission put out to placate the few thousand existing owners of 1939 receivers and by no stretch of the imagination therefore could the transmission be considered as one of national service. As soon as stations are set up all over the country for the rediffusion of television programmes the public will become more intensely interested in the type of programme which is radiated.

At present the few thousand people owning television receivers are understandably delighted that once again they are able to use a machine on which they lavished much cash but which they have been unable to use for the past six years. We must also remember the limitation of the 1939 system, and that television had a long way to go in that year. Whatever progress has been made (and this has been considerable) it will not be evinced in the present programmes. Still, a start has been made, and I gather the developments are tied up not only with the question of the erection of provincial stations but also with the manufacture of receivers. It seems unlikely that television receivers will be available to the public in any considerable quantities until the late autumn, and equally it will be unavailing to erect television stations throughout the country until the public purchase receivers.

The expected war between the stage interests and the B.B.C. has, of course, had its opening gambit. A lady conductor of a band of lady musicians was prevented at the last moment from appearing on the television screen because, it was said, it would destroy the balance of a stage programme in which she was to appear. This would seem to indicate that the B.B.C. is still experiencing difficulty in televising events requiring any depth of focus; for a dance band is practically stationary except for the movements necessary to provide the elements of showmanship in connection with their cacophony. Who wants to see a dance band on the television screen? A dance band, unlike the small child of the Victorian era, should be heard and not seen. A dance band is not a suitable item for television. A conjurer, a clown, a trick cyclist or any of the set stage acts apart from dance bands are suitable.

Theatrical managements are, I understand, taking the same lines as newspapers and the gramophone companies did when I.O. laid the foundations of modern broadcasting. They think it is going to damage their interests. Everyone now knows that the sales of gramophone records and of newspapers have increased since broadcasting started and I am astonished that theatrical managers should be so narrow-minded as to plough that old fatuous and well-worn furrow. Such an attitude is bound to invite the B.B.C. to produce its own television dance bands and similar turns suitable for televising.

The B.B.C., as a fact, faced with the opposition of theatrical managers in its early days, did go out of its way to produce and to publicise its own competitive turns. Murgatroyd and Winterbottom, Flotsam and Jetsam, Elsie and Doris Waters, these are but a few of the turns who almost entirely owe their renown to the B.B.C. Many of these turns have since been welcomed by theatrical managers.

I do not think that any great loss will be suffered by the viewing public if the theatrical profession decides to black-ball television. The advantage is to them and not to television, which would enlarge their public and enhance their value to the stage. If they seek to oppose progress the loss is theirs. Others will fill their places, and they will suffer for their narrow-mindedness.

As far as I am concerned the fact that any of the dance bands refuses to be televised will please me. I do not want to hear them, let alone to see them. I, for example, do not want to see those whom I know do not know one note of music, and who cannot play a single musical instrument, on my television screen conducting bands, and I am astonished that the B.B.C. does not employ its own resident band of musicians. At the present time it is thoroughly discouraging to the real musicians who have spent a lot of time and a lot of money mastering the subject. Things worth seeing are not necessarily the same as things worth hearing, and things worth hearing and seeing are in a class apart. Broadcasting, therefore, finds itself in the same position to-day as the silent films did when the talkies knocked at the door. Who wants to go to a silent film to-day? Who, in twenty years' time, will wish to have a sightless broadcast except for such item as the news? For television is inevitable and none of the efforts to suppress it can succeed.

## "Quid Pro Quo"

(*Literal translation: Something for something*)

Press Item: The increased fee of £1 for radio licences came into force on June 1st.

Fork out your quid! Fork out your quid!  
Let's have no grousing and do as you're bid.  
B.B.C. has huge staff and they all want their pay,  
And though many may bore you they've just got  
to stay.  
Fork out your quid! Fork out your quid!  
Though of lots of our programmes you'd like to be  
rid.  
True, they're not what you like, but what we  
think best.  
And those who complain are to us quite a pest.

Fork out your quid! Fork out your quid!  
We've made our decision. It shall not be hid.  
Wouldn't listeners get uppish if they'd any  
choice—  
And in picking the programmes we gave them a  
voice?  
Don't argue! Don't argue! We'll have our own  
way.

They've only one function, and that is to pay!  
Listeners consulted? We strictly forbid.  
Fork out your quid! Fork out your quid!

"TORCH."

# More About the R.-C. Amplifier

Frequency Response Experiments on the Resistance-coupled Amplifier are here described

IN a simple experiment to demonstrate the effect of circuit component values on the frequency response curve of a typical resistance-coupled amplifier, the circuit of Fig. 1 was wired as shown, the input voltage being obtained from a beat-frequency oscillator (to 11,000 c.p.s.), while the output voltage was measured on a screen-calibrated cathode-ray oscilloscope.

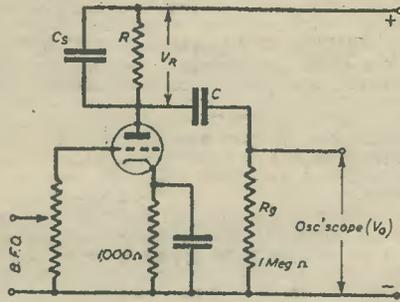


Fig. 1.—The resistance-coupled circuit used in the response experiment.

A triode valve was used (6C5), with coupling condenser C, anode resistance R, grid leak resistance R<sub>g</sub>, and condenser C<sub>g</sub> across the anode load to simulate the effect of the stray and interelectrode capacities discussed in the previous article. Graphs were then plotted of the input frequency (constant voltage) against the output voltage across R<sub>g</sub> for the following combinations of the circuit component values:

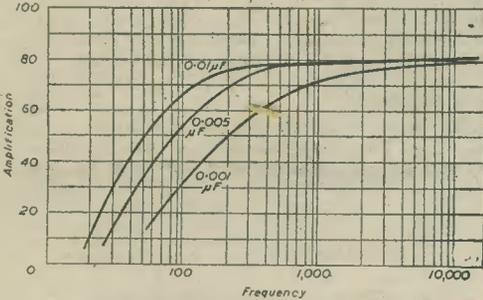


Fig. 2.—The effect of varying the coupling capacity on the low-frequency response.

- (i) Fixed anode load, coupling condenser C variable;
- (ii) Fixed coupling condenser, variable anode load;
- (iii) Fixed coupling condenser and anode load, "strays" condenser C<sub>g</sub> variable;
- (iv) Fixed component values, variable H.T. voltage supply.

With the anode load at 60,000 ohms, the coupling condenser was given values of 0.001, 0.005 and 0.01 mfd. in turn, the resulting response curves in each case being shown in Fig. 2. The capacities 0.005 and 0.01 mfd. gave reasonably level response curves above 200 c.p.s., although the 0.001 mfd. produced a considerably inferior curve due to its reactance becoming comparable with the 1 MΩ grid leak R<sub>g</sub>. The following simple calculations show, in addition to the response curves, how the value of the coupling condenser becomes of

increasing importance as the lower audio-frequencies are approached. As can be seen from Fig. 1 the input voltage developed across R, V<sub>R</sub>, is applied to C and R<sub>g</sub> in series, that part of the voltage developed across R<sub>g</sub> representing the useful output of the stage. Taking the valve R<sub>a</sub> to be small compared with R, then:

$$\frac{V_0}{V_R} = \frac{V_0}{Z} = \frac{R_g}{\sqrt{R_g^2 + (1/\omega C)^2}}$$

$$V_0 = V_R \cdot \frac{R_g}{\sqrt{R_g^2 + (1/\omega C)^2}}$$

Taking the actual 0.001 mfd. experimental case above, and working in megohms for the reactance of C and the resistance of R<sub>g</sub>, we have the reactance of C at 50 cycles to be:

$$X_c = \frac{1}{2\pi f C} = \frac{1}{2\pi \cdot 50 \cdot 0.001} = 3.184 \text{ M}\Omega$$

and at 500 cycles to be:

$$\frac{50}{500} = \frac{1}{10} \text{ of } 3.184 \text{ M}\Omega = 0.3184 \text{ M}\Omega$$

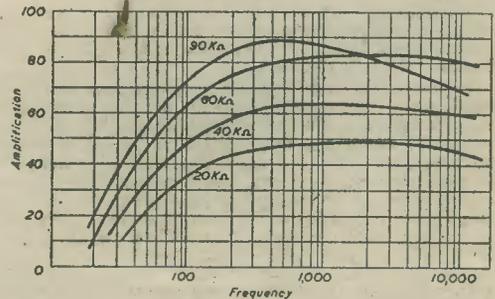


Fig. 3.—The effect on the amplification and high-frequency response as the anode resistor is increased in value.

Therefore, at 50 cycles:

$$V_0 = V_R \cdot \frac{1}{\sqrt{1^2 + (3.184)^2}} = 0.301 V_R$$

and at 500 cycles:

$$V_0 = V_R \cdot \frac{1}{\sqrt{1^2 + (0.3184)^2}} = 0.95 V_R$$

The considerable fall, for any given value of V<sub>R</sub>, of the useful output voltage across R<sub>g</sub> as the frequency becomes smaller and smaller is at once apparent from these typical results.

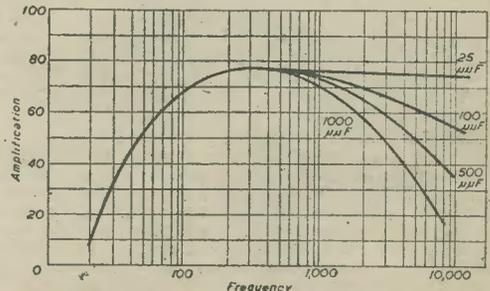


Fig. 4.—Depicting how the high-frequency response falls off as the shunting capacities increase.

The effect of varying the anode load, keeping C constant at 0.01 mfd., is shown in the second family of response curves of Fig. 3. The increase in amplification as R increases in value is apparent from these results, but for values of R greater than 80,000 ohms the increase in the valve  $R_a$  due to the fall of anode potential offsets this gain somewhat, and causes a fall in the response at high frequencies.

The high-frequency response of the amplifier is determined, as we have seen previously, by the shunting effect of the stray capacities, and known values of  $C_s$  were therefore added to the circuit to simulate the effect of these. The stray capacities already present amounted to some 25 micro-microfarads, and capacities were added to make this total up to 100, 500 and 1,000 micro-microfarads in turn. The corresponding response curves depicted in Fig. 4 show how the high-frequency response becomes better as the shunting capacity becomes less.

Finally, the effect of increasing the available H.T. voltage on the valve resulted in the curves of Fig. 5, where the anode resistance was fixed at 60,000 ohms and the coupling condenser at 0.01 mfd. Increasing the voltage had the effect of lifting the response curve bodily up the amplification scale, and did not affect the useful frequency coverage to any noticeable extent.

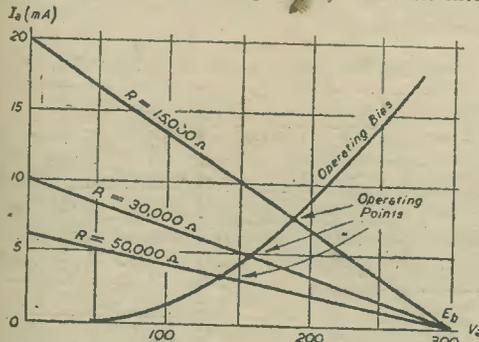


Fig. 6.—A graphical method of determining the correct operating point for a resistance-coupled triode.

**Considerations in Practical Design**

A consideration of the above results enable us to draw up a table of points necessary to the successful practical design of a resistance-coupled amplifier. For a given H.T. supply, the choice of a suitable valve becomes a matter of looking up the manufacturer's lists, and normally a high- $\mu$  triode or a pentode of the R.F. type having a sharp cut-off (6J7, EF36, etc.) should be chosen. The pentode is preferable, and ordinarily gives a better performance at high frequencies. Having selected the valve, the choice of a suitable anode coupling resistance is the next step, having due regard to the available H.T. and the anode voltage requirements of the valve. With pentodes it is general to operate the anode at about 40-50 per cent. of the H.T. supply, and this leads to fairly high anode resistances, 100,000 to 300,000 ohms being quite customary. With triodes, the resistance depends upon the amplification factor of the valve, and for high- $\mu$  types will generally equal from one to two times the valve A.C. resistance.

Some difficulty arises with triode valves when the correct operating point between anode current and anode voltage is being determined, for the anode current depends upon the anode voltage, but the anode voltage itself is a function of the voltage drop in the load resistance due to the flow of anode current. One way of overcoming this difficulty is by the trial and error method of calculating a large number of anode voltages resulting from various anode loads when various anode currents are assumed to flow. A more satisfactory method is to start with the manufacturer's  $I_a/V_a$

characteristic curves for the chosen valve and find the exact operating point as the intersection of the appropriate characteristic and the load line for the particular anode resistance. Fig. 6 will illustrate this procedure. The H.T. supply voltage  $E_b$ , which is known, determines the value of the anode voltage  $V_a$  when the anode current  $I_a$  is zero. Now for any given value

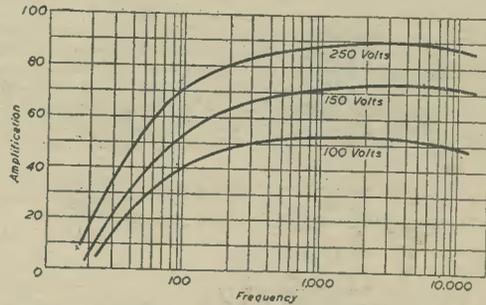


Fig. 5.—Increasing the available H.T. does not affect the frequency range but increases the amplification.

of load resistance, a point can be drawn on the characteristic sheet showing the fall of anode potential for an increasing anode current. For example, taking  $E_b$  to be 300 volts, and the anode resistance 30,000 ohms, then when:

- $I_a = 10 \text{ mA}, V_a = 0 \text{ volts.}$
- $I_a = 5 \text{ mA}, V_a = 150 \text{ volts.}$
- $I_a = 1 \text{ mA}, V_a = 270 \text{ volts.}$

and so on. Thus, a Load Line can be drawn across the characteristic as Fig. 6 depicts. The points  $I_a, V_a$  are connected by the simple relation:

$$V_a = E_b - I_a R$$

and since  $E_b$  and R are constant, this is the equation of a straight line. As R increases in value the slope of this line decreases. Fig 6 shows the load lines for R=50,000 ohms and 15,000 ohms, as well as the 30,000 ohms example discussed above.

With the coupling resistance selected, the matter of grid bias is next on the list. With triode valves the minimum bias necessary should be used, generally from -1.5 to -2 volts for high- $\mu$  types. For pentodes, somewhat higher voltages are required, and normally from -2 to -3.5 volts are employed. The screen is then given a potential that appears to be satisfactory from the point of view of the correct anode current. The bias requirements are best selected in conjunction with the anode load, and must be such that under no circumstances is grid current permitted to flow.

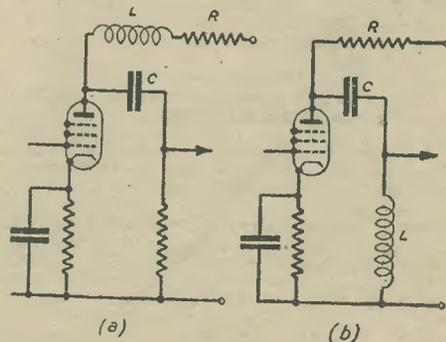


Fig. 7.—Methods of improving respectively the high and low-frequency responses of an amplifier.

The choice of the remaining components, coupling condenser and grid leak depend upon the lowest frequency

The effect of varying the anode load, keeping C constant at 0.01 mfd., is shown in the second family of response curves of Fig. 3. The increase in amplification as R increases in value is apparent from these results, but for values of R greater than 80,000 ohms the increase in the valve  $R_a$  due to the fall of anode potential offsets this gain somewhat, and causes a fall in the response at high frequencies.

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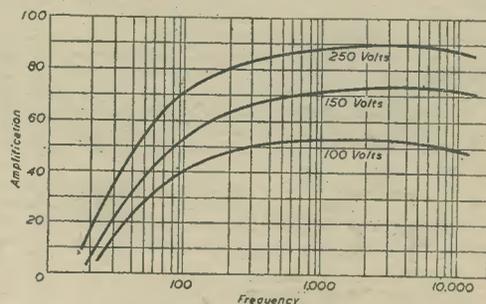


Fig. 5.—Increasing the available H.T. does not affect the frequency range but increases the amplification.

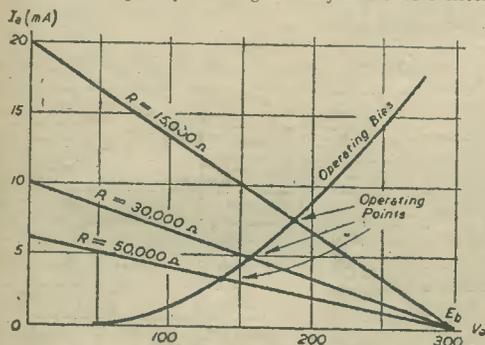


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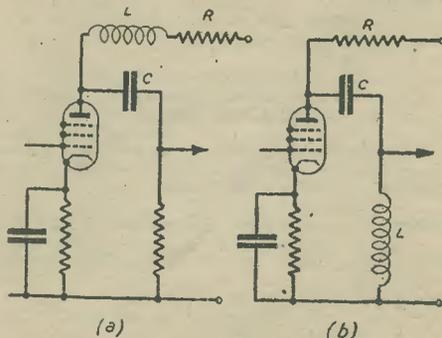


Fig. 7.—Methods of improving respectively the high and low-frequency responses of an amplifier.

The choice of the remaining components, coupling condenser and grid leak depend upon the lowest frequency

it is desired to handle and the input characteristics of the following stage. The leak should have the highest value that can safely be inserted in the grid circuit of the succeeding valve, for then the shunting effect of it upon the anode resistance of the amplifier in the middle range of frequencies is smallest, and its value is still high enough compared with the reactance of the coupling condenser to receive most of the output voltage at the lowest frequency. The maximum permissible value of the leak for a given succeeding valve should be obtained from the maker's recommendations. The coupling condenser must have a high leakage resistance and a capacity which will make the amplification hold up to the lowest frequency that is to be amplified, but which will allow a falling off at lower frequencies. The table of reactances at the end of this article may be of value in this direction.

Finally, attention must be paid to wiring procedure to keep stray capacities at a minimum and so preserve the high-frequency response of the amplifier.

#### High-and Low-frequency Boost

Various devices are sometimes employed to improve the high- and low-frequency responses of a resistance-coupled amplifier. These do not come under the heading of "tone" controls, which simply accentuate certain frequencies by getting rid of others and lead to those alarming reproductions variously labelled "bass," "mellow" and "brilliant," but are methods of extending the useful frequency coverage of an amplifier by lifting the normally falling response curve at the low- and high-frequency ends of the scale. Particularly in television video-amplifiers the upper frequency response has to extend beyond 2 megacycles per second, and the design procedure is then modified to take account of the stray capacities before the selection of the anode resistance. The highest coupling resistance (which seldom exceeds 10,000 ohms in such amplifiers) is then selected that will give the desired high-frequency characteristic with these capacities. Generally, a small inductance  $L$  is included in the anode circuit of the amplifier as shown in Fig. 7 (a). At medium and low frequencies the reactance of this inductance is so small as to be negligible, so that the amplifier characteristics are then the same as an ordinary resistance-coupled case. At high frequencies, however, the reactance of the inductance becomes appreciable, and due to resonance with the stray capacities, the normally falling characteristic of the amplifier is maintained at a

reasonably good level up to much higher frequencies. Such an amplifier, when properly designed, can be made to give substantially uniform amplification of frequencies that would correspond to the 50 per cent. point if the coupling inductance were omitted. With a pentode valve of the R.F. variety, the value of the inductance to produce a level response curve up to a frequency  $f_1$  should be such that its reactance at this frequency is half that of the coupling resistance, and the coupling resistance should itself be equal to the reactance of the stray capacities at  $f_1$ .

Fig. 7 (b) shows a similar device for providing a low-frequency boost to the amplifier response curve. A high-inductance choke  $L$  is inserted in place of the customary grid lead of the following valve; since no direct current flows in this circuit a high inductance is not difficult to obtain. The value of  $L$  is chosen so that its reactance at a given low frequency  $f_2$  equals the resistance  $R$  and the valve resistance  $R_a$  in parallel  $\left\{ = \frac{RR_a}{R+R_a} \right\}$ ; and then the coupling condenser is selected of such a value that series resonance is obtained with  $L$  at  $f_2$ . In formulae:

$$C = \frac{1}{4\pi^2 f_2^2 L} ; L = \frac{R}{2\pi f_2}$$

This results in a slightly humped low-frequency response curve about the frequency  $f_2$ .

TABLE OF CONDENSER REACTANCES.

Capacity (mfd.)	Frequency (c.p.s.)			
	50	100	1,000	5,000
0.0005	—	3.184MΩ	.3184MΩ	63,700Ω
0.001	3.184MΩ	1.59MΩ	.159MΩ	31,850Ω
0.005	.637MΩ	.318MΩ	31,850Ω	6,370Ω
0.01	.318MΩ	.159MΩ	15,900Ω	3,180Ω
0.05	63,700Ω	31,850Ω	3,180Ω	637Ω
0.1	31,850Ω	15,900Ω	1,590Ω	318Ω
0.25	12,700Ω	6,370Ω	637Ω	127Ω
0.5	6,370Ω	3,185Ω	318Ω	64Ω

## News from the Clubs

### Salisbury and District Short-wave Club

THE Salisbury and District Short-wave Club was formed in 1936 with the late Sir Oliver Lodge, famous scientist and radio pioneer, as its foundation-patron.

Activities have been recommenced after the war, and the club is now again in full swing. Groups have been formed to cover transmitting, receiving, aerial design, amplifiers, Morse class, beginner's section, and U.H.F., including television. A modern short-wave superhet receiver is in the course of construction, and application has been made for a transmitting licence. At a recent meeting Mr. W. Homer gave a talk on radar.

Meetings are held on Tuesdays and Thursdays at 7.30 p.m., although the clubroom and workshop is available to members at any time. The subscription has been fixed at 3s. per quarter, and prospective members should get in touch with the secretary, Mr. C. A. Harley, at 85, Fisherton Street, Salisbury, Wilts.

### Slade Radio

AT a recent meeting Mr. Jones, of Messrs. Wilkins and Wright, gave a lecture and demonstration of the "Coil" pick-up. This proved to be of exceptional interest and displayed very fully the capabilities and

wide frequency range of their product. The subject attracted a record attendance.

Sec.: L. A. Griffiths, 47, Welwyndale Road, Sutton Coldfield, Birmingham.

### Grafton Radio Society

MEMBERS having requested an additional evening, Grafton are now meeting three evenings per week, namely, Mondays, Thursdays, and Fridays, 7.30 p.m.-9.30 p.m.

Three Morse classes are making good progress, and seven "AA" licence-holders are taking full advantage of three evenings every week in preparation for the G.P.O. examination. An extra section is being opened so that every speed from absolute beginners to advanced are catered for.

Two new sections have commenced, namely, Radio Servicing and Aerial Propagation Group. Transmitting on all amateur bands will be in operation directly the licence is granted.

Grafton membership fee is two shillings per term, which is less than 2d. per week. A canteen provides light refreshments at cost price. A number of ex-R.A.F. personnel have joined, and secretary W. H. C. Jennings particularly invites ex-Navy and ex-Army radio enthusiasts to membership.

Secretary: W. H. C. Jennings, A.M.I.R.E., 82, Craven Park Road, London, N.15.

# Practical Hints

## Portable Test Set

HERE is a novel piece of "test equipment," which I have found very useful when repairing radios in the homes of the owners.

An old portable gramophone case was obtained, together with a baffle board which took up about half of the available space (see illustration). I then obtained a permanent-magnet moving-coil speaker with matching transformer. This speaker was fixed to the baffle board, and four terminals were also fixed to the board; one pair was connected directly to the speech coil, while the remaining two were connected to

### THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay half-a-guinea for every hint published on this page. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be original. Mark envelopes "Practical Hints."

### SPECIAL NOTICE

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

## Morse Practice Oscillator

OTHER readers might be interested in this idea for an easily assembled morse practice oscillator.

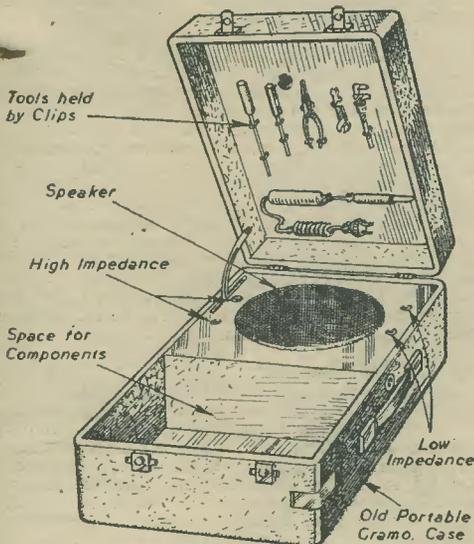
The apparatus consists of one pair of headphones, one morse key, and any ordinary household receiver. The apparatus is set up as shown in the accompanying illustration.

The pitch can be altered by varying the distance between the loudspeaker and the 'phones.—J. R. MCKENZIE (Glasgow, S.4).

## Mains Rectifier Unit

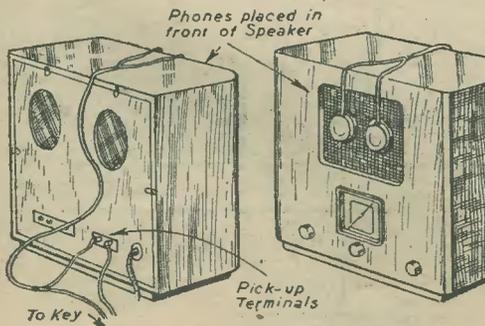
I RECENTLY devised a simple method of converting 240 v. D.C.

into approximately 70-100 v. A.C. The components are few and easily obtained.

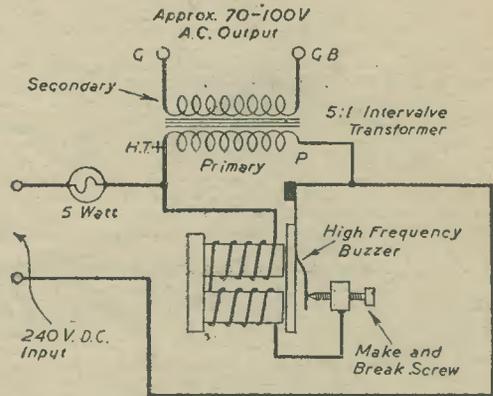


A neat Portable Test Set.

the primary of the transformer. The remaining space can be taken up by fixed condensers and resistors, electrolytics, spare transformers (for testing), etc. To the lid of the case were fixed spring clips for screwdrivers, pliers, etc. The uses of this "gadget" will be self-evident.—A. WADSWORTH (Manchester).

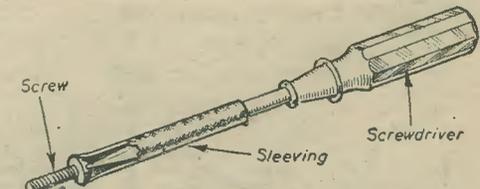


Mr. McKenzie's Oscillator Scheme.



D.C. from A.C. is obtained by this circuit.

A 5 : 1 interval transformer is connected in series with a 5 watt lamp, and a good high-frequency buzzer is connected in parallel with the primary winding of the transformer. The strength of the current from the output of the secondary winding can be varied by the adjustment of the make-and-break screw.—R. GEE (Macclesfield).



Using Systoflex for screw location as described by G. G. Smith last month.

## NEWNES TELEVISION MANUAL

By F. J. CAMM

6/-, or 6/6 by post.

From GEORGE NEWNES, LTD., Tower House, Southampton Street, Strand, London, W.C.2.



If you live quite near a broadcast station you can dispense with the L.F. valve altogether and with good 'phones get sufficient signals from the detector alone. In Portsmouth, however, this is only the case with the West of England Regional on 514 metres and the B.B.C. European Service on 267 metres.

**A One-valve Circuit.**

The detector circuit used as a one-valver can be run from a three-volt cycle battery. The circuit is shown in Fig. 2, the aerial coil being of course unchanged. The rheostat should be mounted alongside the cycle battery on the baseboard, so that the control knob of the former is not normally available. Use an accumulator while getting the set going, then turn back the rheostat and connect up the three-volt battery. Finally, advance the rheostat by stages till the set is oscillating exactly as it was with the two-volt accumulator. Insulation tape could be bound round the wire of the rheostat in such a way as to prevent anybody giving the valve a fatal overload of filament heating in some absent-minded moment.

Possibly, such an H.T.-less circuit could be made to oscillate on the short waves, paying particular attention to insulation, and using good quality S.W. components.

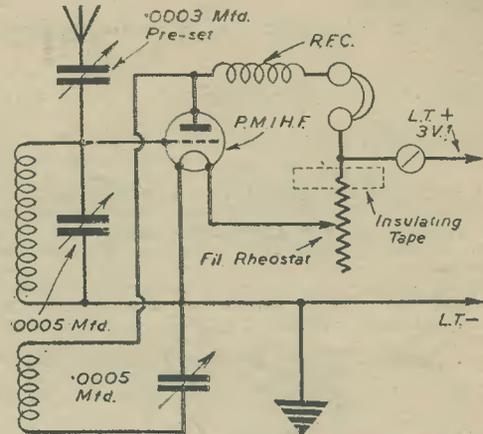


Fig. 2.—The detector stage—arranged as a one-valve set.

# Amplifier Power Filters

Theoretical and Practical Considerations of the Filter Circuit

Described by A. BUCKLEY

**T**O obtain a reasonably level supply of direct current from an alternating current source there are several factors to be taken into consideration. The subject is not very involved, but there are a number of possible arrangements. It is therefore desirable that the method of determining how to design any particular unit should, in many cases, be based on first principles, and not by trial and error.

The two primary points which have a distinct bearing on the performance of power filters are ripple frequency and percentage ripple. The former depends fundamentally on the frequency of the supply source and the type of rectification; the latter means the ratio of the ripple volts to the average output volts of the unit concerned. Simply put, the ripple frequency of single phase circuits is  $f$  for half-wave rectification and  $2f$  for full-wave rectification. Of course, there are in-

variably present other frequencies—usually a percentage of various harmonics—but these are normally taken care of by the arrangement designed for percentage ripple. The percentage ripple is found from a simple formula:

$$\% \text{Ripple} = \frac{\text{R.M.S. or virtual voltage of ripple} \times 100}{\text{D.C. voltage of output.}}$$

The ripple voltage is the R.M.S. voltage of the A.C. component in the supply filter output, and may be measured by means of a valve voltmeter. Reference to Fig. 1 will clarify these remarks.

The maximum percentage ripple depends entirely on the type of work involved, for whereas in power stages one can allow a fair amount of ripple—which is not noticeable in reproduction—in high-gain voltage or pre-amplifiers ripple must almost be non-existent; in the former we can allow up to 1 per cent., and for the voltage amplifier not more than .001 per cent. Intermediate stages should not contain more than .1 per cent.

**Inductance and Capacitance**

Most power filters are similar in one basic respect—they make use of inductance and capacitance in one form or another; in cases where currents are minute—say in television or oscilloscope work—often the inductances are replaced by resistances. Simply, the inductances (or resistances, when substituted) tend to smooth out the current ripple, and the condensers serve to smooth the voltage variations.

Filters fall into two classes, depending whether the element immediately following the rectifier is an inductance or a capacitance. If the inductance comes first it is called a choke input filter: if the capacitance comes first it is called a  $\pi$  (pi), or condenser input filter. The characteristics vary somewhat and will be treated separately.

In Fig. 2 we have the simplest form of filter which makes use of a choke and condenser; this is known as the "choke input filter." In Fig. 3 we have a double arrangement, called a "two section choke input filter."

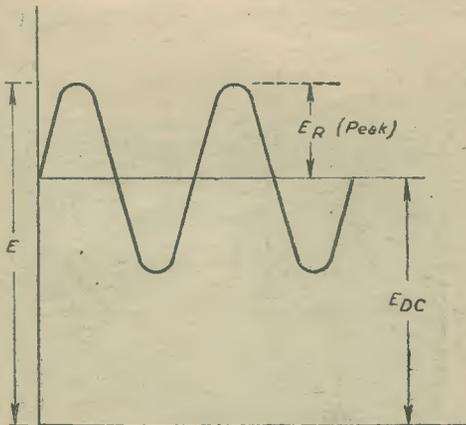


Fig. 1.—Curve showing the ripple voltage in the filter circuit.

**Critical Value**

The ideal value of an inductance in a choke input filter is:

$$L = \frac{r_2 R}{f r}$$

where

L is in henries,  
R is load resistance in ohms, and  
fr is ripple frequency.

Examining the formula, it will be seen that under "no load" conditions the value of inductance would have to be very high, therefore to eliminate the virtual open-circuit condition, a "bleeder" resistance is placed across the output (R); the resistance value of this determines the highest value of inductance in the choke. This bleeder should have a value which will enable it to take about 5 per cent. of the full load current.

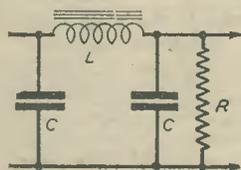


Fig. 2.—A simple form of filter.

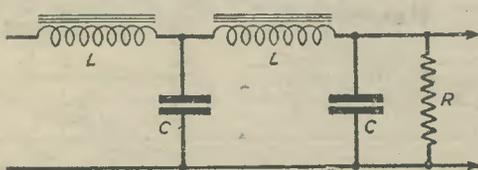


Fig. 3.—A two-section choke input filter circuit.

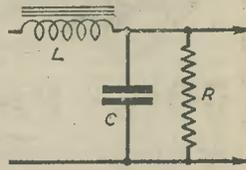


Fig. 4.—A "brute force" filter.

The "regulation" of the filter unit will be vastly improved by the inclusion of such a resistance.

Having dealt briefly with the inductance required we will now discuss simply the method of determining the condenser capacitance. Any audio-frequency amplifier—if it is to perform well—must be fed with a reasonably constant voltage. This means that the condenser (which filters out voltage variations) must be sufficiently large to do its job properly. The formula is simple:

$$C = \frac{10,000,000}{\pi f_m R_L}$$

where

C=capacitance in microfarads,  
 $\pi = 3.1416$ ,  
 $f_m$ =lowest audio frequency required from amplifier,  
 $R_L$ =value in ohms of bleeder resistance.

The filter condenser should have a D.C. working voltage a little higher than the peak voltage of one half of the transformer secondary—in full-wave rectification.

In a condenser input filter we have at least two large

condensers and a choke—or, in some cases, a resistance. As in the choke input filter, it is better to place a bleeder across the output, for the improvement of regulation.

**Regulation**

The regulation of a choke input filter is very good and the voltage remains very steady under varying loads: that is because the choke inductance varies according to the current passing. When a heavy current is being taken the inductance of the choke is lowered, and when a light load is applied it is almost maximum; in fact, it is sometimes called a "swinging choke," as its inductance swings according to the load. The output voltage of this type of filter is approximately .9 of one-half of the secondary in full-wave rectification, and .9 of the whole secondary in half-wave rectification. For a given type of rectifier the output volts of a choke input filter will be less than a condenser input type.

**Different Behaviour**

A pi ( $\pi$ ), or condenser input filter, behaves somewhat differently and the values of components are not so critical. Sometimes it is called a "brute force" filter, as it employs large values of inductance and capacitance. See Fig. 4.

At first sight it would appear that there should be very little difference between the two types, but a rather important point is the choke input job is fed by pulsating D.C.—which acts in some ways like raw A.C.; whereas the same job preceded by a large condenser receives partly smoothed D.C.—which behaves in a different manner.

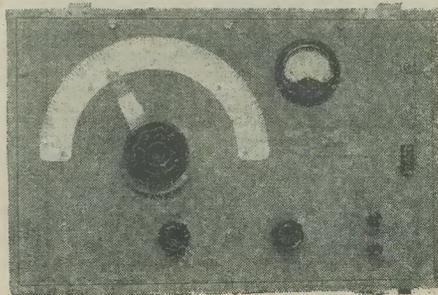
The voltage of the condenser type filter varies from 1.4 of the effective secondary volts on no load, to .9 on full load.

If we were going to use a filter on low voltage with a more or less constant load—as in radio receivers or small amplifiers, the condenser type filter would be the choice; but where the load was subject to some variation then we should consider the choke input filter.

## G.E.C. B-F OSCILLATOR

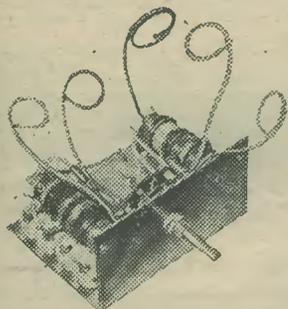
THE G.E.C. Beat Frequency Oscillator, M.925B, is designed for general audio-frequency testing and frequency measurement in the audio-frequency range. It operates on the well-known principle of combining two radio-frequency oscillators through a mixing stage; the difference in frequency between these oscillators produces an audio-frequency note, which, when filtered and amplified, gives a pure audio-frequency output. Special precautions are taken to ensure that the two oscillators are working under identical conditions, all the components in the oscillator circuit being mounted on a thermal stabilising platform. The heat-producing elements are placed away from this circuit, and a thermosiphon device ensures the lowest possible operating conditions in the oscillating section.

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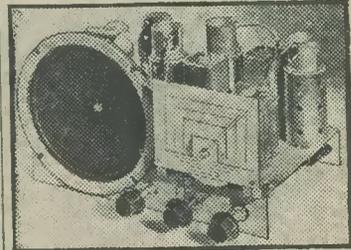
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# Underneath the Dipole

Television Pick-ups and Reflections.

By "THE SCANNER"

**T**HERE have been many estimates made of the number of television receivers in use in the London area in 1939. Some authorities have said 30,000; others, more cautious, have put the figure at a mere 10,000. But whatever number of sets were actually in operation at that time, it is probable that only a small proportion are in serviceable condition, chiefly owing to the deterioration through lack of use of certain components on the sets, such as electrolytic condensers. And if the set is prematurely switched on in such a condition, there is a serious risk of damage to the mains transformers. Far better *not* to switch on, but to change, or have changed, the electrolytic condensers before even thinking of trying the set out. However, as with most things these days, we have to wait our turn in the queue at the local television service-man's shop, and in due course our set will be returned and tuned in to the signals from the Alexandra Palace. The fortunate owners will consider themselves as being amongst the elite, veterans of pre-war television.

## The Interference Bugbear

Another war will now start—but this time between the users of television and the perpetrators of man-made static. Nothing is more annoying than the flickers and scratches on the picture and the excruciating noises on the sound, which automobile magnetos, sparking plugs, trolley buses and other electrical appliances cause. With the British standards of definition and synchronisation, good pictures and sound can be picked up well outside the 30-mile service area, provided there is not too much electrical interference. Apart from the obvious course of making it a criminal offence to use a motor-car without suppressors fitted to the sparking plugs, and also inflicting heavy penalties upon all other persons who are responsible for radiating man-made static (including Trolley Bus managements!), there are a few other courses which will all partially eliminate the trouble, where it is bad at present. The television set owner can raise his aerial to a higher position, use a reflector and orientate it to use the reflector as a screen against the source of the static, or he might even *lower* his aerial very slightly, if by so doing a building will come in between his aerial and the cause of the trouble. Then again, local interference would be much reduced if the transmission radiation was considerably increased at the Alexandra Palace, either by increasing the power of the transmitter, or by considerably (very considerably!) increasing the height of the transmitting aerial array.

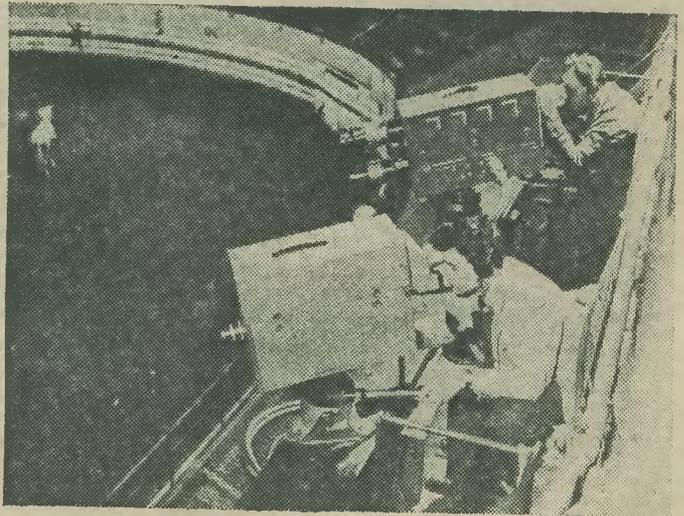
## The Great Exhibition

This brings me to a practical suggestion which has long been a "special pet" of mine! Most of us have read of the great exhibition of British Industry that it is proposed shall be held in London in a year or two's time, which is to be somewhat on the lines of the Wembley Exhibition of about twenty years ago. Various sites have been mooted, including Heathrow aerodrome, and... wait for it!... the Alexandra Palace! Some of the sites at present have doubtful railway or Underground access. If the Alexandra Palace was selected—a choice which would, I understand, be

welcomed by the Trustees—then modifications could be made which would not only improve that 100-year-old building and its park, but might also give television an opportunity of making itself seen (and heard) over a much larger service area, with practically no man-made static trouble in London itself.

## The Great Television Tower

What would more naturally fit into such a scheme than the erection in the centre of the Great Exhibition, on the highest piece of ground in the Metropolis (which is at the Alexandra Palace, on the site of the old "New Summer Pavilion" of years ago), of a great *Tower*. In these days of Bailey Bridges and high-speed ship-building, it surely would not be impossible to build, within two years, a tower as high as the Eiffel Tower, or the Woolworth Building in New York. Or if that is too high, the tower could be at least as high as the Blackpool Tower, an edifice which the Corporation of that enterprising borough regard with pride. Such a tower would not only become an elevation from which visitors could view all London, but its silhouette, integral with that of the (we hope!) reconstructed Alexandra Palace buildings, would become a trade mark of the very exhibition itself! And, symbolic of the progress in industry represented by the exhibition, the tower could well support a very high television aerial array, capable of tripling the pre-war service



R.C.A. in New York recently picked up a scene at a rodeo on their new television camera, whilst a conventional camera also took the scene for comparative purposes.

area. Thus, without undue expenditure of labour and material, the old buildings could be converted and the new great Television Tower erected to serve several purposes. Are there any snags, do you think?

## The Tax on Hobbies

The prices of television sets are naturally on a higher level than before the war, and there is, in addition, the imposition of the purchase tax. While it is early to hope for the removal of this tax, I feel that there is a strong case for the reduction or abolition of the tax on

raw materials or component parts for home-made articles, whether they are clothes, furniture or—radio sets. It is good national policy to encourage hobbies which are of a constructive type. Leisure hours are longer than they used to be, and the continued discouragement of hobbies by taxation has turned many a creative mind towards other fields which are frequently not at all constructive—including politics! Ask your local M.P. his opinion!

#### Television Technique

When one considers the stage that was reached in the development of the presentation of television entertainment in 1939, immediate prospects are most interesting. Viewers can look forward to the gradual evolution of a type of entertainment which will steadily separate itself from the special techniques of production peculiar to the dramatic film, the stage play, the cabaret and the newsreel. Plays were one of the most popular items televised, but they suffered somewhat owing to the fact that they were produced, with a few exceptions, in exactly the same form as they were written for the stage. The filming of a play which was, in fact, a faithful recording of its stage presentation, would be unendurable by a cinema audience. The stage has certain fundamental limitations which are accepted by theatre audiences, who occupy the "fourth wall" themselves and are content to observe a continuous passage of time between the "curtains" of each scene. The film, however, with montages and dissolves and with the great flexibility of the camera, can transport the cinema audience where it wills. Television, too, will find its own technique, in which the film, I think, is going to play an integral part.

Such purely practical difficulties as changes of costume for actors who appear in successive scenes in television plays can be "covered" by the previous filming of intermediate scenes, and the film can also be used for real atmosphere or scenic shots which form part of a production, and for the connecting links. On the other hand, there is no particular objection to the division of a television play into three or four acts, with intervals between the acts. The special adaptation or, better still, special writing of dramatic material for the new medium is bound to come. The television playwright who makes himself familiar with the multitude of technical devices now available and uses them, will evolve new dramatic conventions which will, in due course, become as familiar as the "sound mixing" of ordinary radio plays. And yet, the Dramatic Control Panel was installed for nearly a whole year at the B.B.C.'s old Savoy Hill studios before a writer and producer was bold enough to make full use of it! Cecil Lewis was that pioneer.

Whatever technique is developed, I hope that it will not diminish the extraordinary sense of presence which television close-ups give, especially when viewed directly on the end of the cathode ray tube and not via a mirror. Mirror viewing always seems to me to lose something, but what it is I can't decide.

Radio dealers have told me that they have had a very busy time overhauling and re-installing sets, and that the interest of the public in new sets has already been aroused. I am sure that the fine team of producers and technicians now assembled at the Alexandra Palace will justify that interest.

## New Dielectric and Insulating Materials

Abridged Précis of a Discussion at a Recent Meeting of the Radio Section of the I.E.E.

By J. C. SWALLOW, Ph.D., and G. P. BRITTON, B.Sc. (Eng.) Graduate

**P**OLYTETRAFLUORETHYLENE, a new plastic which may find a considerable field of use as a radio-frequency dielectric, was among the materials—most of which were introduced during the war years—recently discussed by the Radio Section of the Institution of Electrical Engineers. This and some of the other materials considered are not yet available commercially, and the full techniques of the use of some of them have yet to be devised.

In opening the discussion, J. C. Swallow, Ph.D., and G. P. Britton, B.Sc., said that the most important of the new materials are based on high polymers and ceramics.

Plastics based on hydrocarbons possess, on account of their non-polar structure, the desirable properties of low permittivity and power factor combined with low water absorption. Polystyrene, polythene, high-molecular-weight polyisobutylene and butyl rubber are examples having widely different mechanical properties. Early attempts to obtain intermediate mechanical properties by mixing these materials in different proportions led to no useful technical mixture other than that of polythene-polyisobutylene, used to a considerable extent in the insulation of high-frequency cables. The usefulness of hydrocarbon plastics may be increased by the production of new forms such as film, and also in the case of polythene by the production of fibres of reasonable strength which can be applied in thin layers on wire. The hydrocarbon structure which confers these desirable electrical properties leads to weak secondary forces between the chains, and therefore the temperature resistance is not as high as in the case of materials with polar groups, unless the chains are packed in a crystalline arrangement as in polythene. The temperature resistance can be raised within limits by increasing the chain length, or in polythene by increasing the crystallinity by

modifying the conditions of synthesis. The need for materials with higher moduli of elasticity and temperatures above room deg. C. has led to attempts to modify the chains chemically by the introduction of other chemical groups into the hydrocarbon structure to give symmetrical or balanced dipoles, examples being poly-dichlorostyrenes and polyvinyl carbazol.

#### Other Developments

Work has also been carried out on cross-linking hydrocarbon chains to give three-dimensional non-polar polymers, an example being polystyrene cross-linked with divinyl benzene. Attempts have also been made to fill thermoplastics with inert low-loss fillers to increase the moduli of elasticity, with no marked improvement of performance at higher temperatures, owing to the absence of reinforcing action.

In the field of composite dielectrics there have appeared the new low-pressure laminating resins which, when used with glass cloth, give a good combination of mechanical and electrical properties for radar fairings. With the advances being made in synthetic fibres, new laminated materials with improved properties may be expected in which the silicones may play an important part. Polyvinyl-chloride compositions have been successfully introduced for normal insulation, and have the advantages of freedom from ageing, non-inflammability and colouring for identification purposes.

Materials based on magnesium silicate (soapstone or talc) are almost universally used for insulators where moderate permittivity and low power factor are required. There have recently been no radical changes in materials of this class, but mention should be made of a technique which considerably widens their application. Insulators can readily be coated with firmly adherent metallic films to which metal parts may be soldered.

# The Vacuum Condenser

Details of the Construction and Operation of this Component By E. G. BULLEY

**A** KNOWLEDGE of condensers is probably the most general attribute of the amateur radio experimenter as well as the skilled engineer. They will have noted and studied the very many types—mica, air, oil or electrolytic and, perhaps, another type which is becoming very popular, the vacuum condenser or capacitor.

This type of condenser exists in various capacities, dependent upon specific design and commercial or industrial demands. Capacitance values are obtainable from a few micro-micro-farads to several hundred micro-micro-farads at a working voltage of many thousands.

## Main Features

A typical vacuum condenser is depicted in the diagram showing some of the fundamental principles.

The basic construction of any vacuum condenser can be described as of two or more coaxial electrodes sealed into a glass bulb, such electrodes being connected to the outside of the bulb by means of a vacuum-tight metal to glass seal. This type of seal has become extremely popular in the electronic field, and can be seen on many of the latest valve designs. Just as in radio valve practice, the electrode assemblies are subjected to similar degassing and cleansing processes to ensure that grease and occluded gases are removed. This is an essential measure in the production of a good vacuum.

The electrodes are usually made from metals that can easily be degassed, and have the property of withholding occluded gases, unless, of course, they are subjected to a heat much higher than that of the processing temperatures. Materials used in the manufacture of these electrodes are low oxygen content copper, nickel and tantalum, although molybdenum has been tried with some success.

After processing, these electrode assemblies are sealed into the bulb in more or less the same way as are the electrode assemblies in radio valve manufacture. During the sealing operation, it is possible to adjust the capacitive value of the condenser. Why this is so can easily be understood if one appreciates that the overlap of the electrodes is one of the deciding factors in the capacitive value of the finished condenser.

With the electrodes sealed into the bulb, the condenser is then exhausted to a fine degree of vacuum. This fine degree is essential to the efficient working of this type of condenser.

## Some Advantages

Air, mica and oil dielectrics have certain limitations, whereas a vacuum dielectric does overcome such limitations as it is considered more or less to be the perfect dielectric. For instance, the dielectric in the vacuum condenser may break down if the specified working volts are exceeded; still, if the circuit in which the condenser is incorporated is switched off immediately, the condenser recovers and is good as new again.

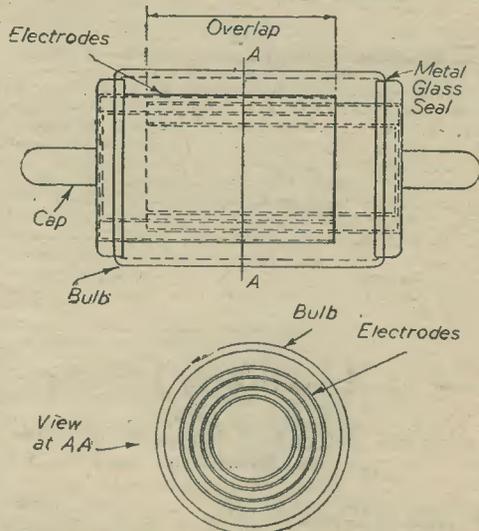
At the same time, extreme care should be taken, as a continuous application of potentials that are in excess will result in the total destruction of the condensers. Destruction of the condenser also can result from cracked seals or the releasing of occluded gases from the metal electrodes—the latter are recognisable by presence of a blue glow (ionisation).

If the vacuum has been partially destroyed, it is possible that arcing may occur between the different electrodes when operated at very high voltages; this can be understood when one appreciates that the spacing between the electrodes is in the order of 1.0 to 2.0mm.

It is important to remember that the capacitance depends upon the spacing between the electrodes, their area and the overlap when sealed in. The electrodes, therefore, must be free from any deformity such as

cracks, dents or strains, as any deformity is likely to have ill effect on the correct value of the condenser.

Vacuum condensers are capped in a variety of ways, dependent entirely upon the equipment into which they are to be incorporated. The most common cap in use to-day is of cylindrical shape suitable for pushing into a spring clip. This type of condenser is finding its way into many electronic equipments such as radio transmitters, RF heating and medical equipments where economy of space is an important factor.



Details of construction of the vacuum condenser.

## Advantages

Advantages of the vacuum condenser can be classified in order of importance:

(a) They require very little attention, as their electrodes are safe from corrosion and are not affected by atmospheric conditions, such as obtain in tropical or damp climates.

(b) Ability to withstand high voltages without undue fear of its destruction; and lastly, but not of least importance

(c) The storage of electrical energy in an extremely small space.

The last named desideratum can be appreciated when one realises the size of the vacuum condenser. The size naturally depends upon the capacitive value, but the overall length of a condenser whose capacity is in the order of several hundred micro-micro-farads is approximately 5 to 6ins.

So much for the description of this type of condenser. The actual working of a vacuum condenser is as follows.

The coaxial electrodes become charged with electrons, one set in common becoming positively charged, whereas the others in common become negatively charged.

These charges are collected and stored, and then released back into the circuit in which the condenser is incorporated, their release being controlled until the energy in the circuit is in excess of that stored in the condenser.

This point reached, the condenser becomes recharged, and so the phenomena of the releasing of energy back into the circuit continually takes place during the operation of the circuit.

# Programme Pointers

The Music of To-morrow is the Subject of this Article by MAURICE REEVE

**S**UMMER is with us, but there seems little letting up of musical activities. You will be hearing some broadcasts of the first post-war—and the twentieth in all—Festival of the International Society for Contemporary Music being held in London.

The works for presentation are most carefully vetted, and the final list was chosen by the Selection Board in April. As well as the recognised Continental masters of ingenious and ingenuous noises, all the young and near-young English bloods will be there with their latest examples in harmonic horrors, contrapuntal cacophonies and tonal turpitudes.

But the big event in the musical lives of countless enthusiasts—three hundred thousand last year—will follow shortly after, to wit, the Promenade Concerts. Here, in the crowded, smoky, exciting atmosphere engendered by hero-worship and satisfied expectations, we shall be able to contemplate what Beethoven, Wagner or Debussy might have seemed like to the International Society of Contemporary Music of their days. Strange to believe that such adored classics of to-day as the Seventh Symphony, *Tristan* or *l'Après Midi d'une Faune* ever aroused feelings of bellicosity or animus in any man's breast. And to-day we actually stand wedged together in thousands, with the prostrate bodies of the fainting and the weak being passed out over our heads, reveling in the exquisite and mellifluous music. Is it possible that our forefathers and foremothers called this gorgeous and palpating stuff "heresy," "profanity" and what not?

Yet we know they did. Rossini ousted Beethoven—for a time—from the boards in Vienna, Brahms and Tchaikowsky couldn't abide each other's work, whilst Debussy referred to Grieg's music as "bon bons stuffed with snow."

## The Music of To-morrow

Exactly, says the iconoclast of to-day. Precisely the same will happen with the music of A, B and C. What you revile to-day will be the accepted canons to-morrow. To which our American friend might respond "Oh yeah!" If the example of the 1914-18 war is any criterion to refer back to, the answer is more likely to be "no." After that holocaust there was a spate of "modern" music, much of which was considered, indubitably and without question, my dear chap, as bound to set all future standards. The war-sated public of that time certainly lapped it up for a few seasons, and the writer can well remember Scriabin drawing much larger houses than Beethoven. To-day, alas! most of it is little more than museum pieces.

That taste as well as standards do change, however, no one can deny. With the latter it is amazing, but as it is a very controversial subject I won't join issue with it here. One astonishing proof, though, can be cited. Tchaikowsky dedicated his B flat minor concerto to the one and only Anton Rubinstein—that legendary figure of the keyboard who joins company with Liszt and Paderewski in the "direct line of succession." But to the composer's astonishment and pique, it was returned with the comment that it was un pianistic and far too difficult!

To-day there must be 50 pianists playing in public, and we can hear it, somehow and somewhere, at least once every week of the year!

The great boom in Tchaikowsky and Beethoven still persists. The latter is understandable and has always existed to a greater or less degree. After all, Beethoven, like Shakespeare, embodies the whole range of human emotion, and to him all men can turn for inspiration and comfort, exaltation and solace, no matter what his thoughts, opinions or station in life may be. The great-

ness of the man lies in just that ability to administer to our emotional, spiritual or temporal existences and to render them complete satisfaction. The sublime harmonic and melodic content supplies the one; whilst the architectural splendours and perfections of the works furnishes the other. Masterpieces like the *Eroica*, *Seventh* and *Ninth Symphonies*, the *Missa Solemnis*, *Leonora* and *Fidelio* overtures, the *Concertos*, the major piano works, etc., etc., cover a wider field of thought and feeling, in terms of music, than any series of works known before or since.

## A Comparison with Tchaikowsky

But Tchaikowsky is an entirely different kettle of fish. By comparison, his is almost a one-track mind—the emotional. His melodies are reared in the hothouse and are as luscious as most conservatory products usually are. Only a little of his really best work is to be found in his symphonies—Nos. 4, 5 and 6, and two concertos, one for piano and one for violin; a very small output compared to Beethoven's nine and six respectively, all of which range from first class to the world's greatest.

It is essentially escapist music, and even as such it only affords an escape down the avenue of least resistance which doubtless largely accounts for its present enormous vogue. Another contributory factor is bound to be the regrettable, but we trust temporary, eclipse of Wagner, undoubtedly the greatest "escapist" music extant, but music which, alas, opens the door wide open to flight down unwanted paths.

But Wagner will come back and Tchaikowsky will retire; that is certain, when our lives regain their normal stability and equilibrium.

A third powerful reason for the "Tchaiko" vogue—and a much greater one than the rush for all things Russian—is that many of his themes, notably the first subject of the first movement of the piano concerto and the love theme (second subject) from the "*Romeo and Juliet*" *Symphonic Poem*—have been plugged, bawdlerised, anything-you-will, by successful films. The rage for the former began before the war, when it formed the background of the film, "*The Great Lie*." Later, it was published, as a separate "work" of two pages in length, after being converted from its original "three" time to "four" time. It sold over a million copies!

The latter has often formed the motto for screen lovers, especially love of the unrequited variety—and always popular film, when we get it, though very different from the love that originally inspired Tchaikowsky's work!

## B.B.C.'s Third Wavelength

No more seems to have been heard of the B.B.C.'s "third," or "highbrow," wavelength. I believe it was intended to promote, or relegate (?) everything likely to appeal to the "intelligentsia" to this programme, so that our various tastes need never clash or our tempers get frayed.

In the absence of definite information, I would suggest that such a policy would be much less practical than to "stagger" the type of programme over the three. Taking 18 hours as our standard daily ration of broadcasting—6 a.m. till midnight—it might be a wise policy to have six hours of "highbrow" items per week on each of the three programmes alternately—presuming that our quota of such listening material is to be one third of the total programmes broadcast. If not, then, naturally, pro rata.

"Highbrow" is not a nice term, even if only for the fact that it inevitably implies that everyone else is "lowbrow," i.e., inferior to ourselves. But the type of item I am referring to will be understood sympathetically and indulgently.

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# Impressions on the Wax

## Review of the Latest Gramophone Records

### Orchestral

**T**HERE are no doubt many readers who listen to the delightful music played by Albert Sandler and his Palm Court Orchestra in his Sunday night broadcasts, and this month he has recorded the "Three-Fours Valse Suite (Op. 71), Nos. 2 and 6," on *Columbia DB2212*. These two waltzes by Coleridge-Taylor are ideal for Albert Sandler, as this composer was particularly happy in his suites, such as "Three-Fours" for small orchestras. They are well contrasted and make perfect listening for your quiet mood. Coleridge-Taylor was of African negro descent, and was still almost a student when his Cantata "Hiawatha's Wedding Feast" brought him fame. Although he died in his early thirties, he had already established himself as a writer of particularly graceful music of originality and charm.

"Job"—A Masque for Dancing—has been recorded by the B.B.C. Symphony Orchestra under the able baton of Sir Adrian Boult. The recording consists of a set of five records—*H.M.V. DB6289-DB6293*, which are sold in an attractive album.

It is astonishing how the music of Chopin, generally regarded as one of the most "unorchestral" of composers, seems to reveal new beauties in its orchestral dress for the purpose of the ballet "Les Sylphides." This very attractive classical ballet claims no particular story—it is not a *ballet d'action*; its charm depends on perfect execution, the masterly choreography which continually leads the dancers into lovely groupings, and, of course, Chopin's delicious melodies. Tchaikovsky's "Sleeping Beauty" is one of the main attractions in the Covent Garden ballet season. "Les Sylphides" has been recorded by the London Philharmonic Orchestra, conducted by Dr. Malcolm Sargent, on *H.M.V. C2781-3*.

"The Great Elopement" is a ballet of which Sir Thomas Beecham has written the story and scenario. It consists of seventeen pieces, and the music is founded upon various numbers taken mostly from the operas of Handel, all of them re-scored for modern orchestra.

The operas and other works from which the seventeen pieces of the ballet have been chosen are "Rodrigo," "Il Pastor Fido," "Ariodante," "Il Parnasso in Festa," "Teseo," and the posthumous suites for harpsichord.—*H.M.V. DB6295-7*.

The Philharmonic Orchestra, under the baton of Walter Susskind, have made a delightful recording of Weber's "Der Freischutz"—Overture Part I and II" on *Columbia DX1244*.

I conclude the orchestra records for this month with the B.B.C. Symphony Orchestra's recording of "Enigma Variations" by Elgar—*H.M.V. DB2800-2*. Elgar used this wonderful set of orchestral variations as a kind of portrait gallery of his friends, and from the first performance under Richter in 1899, they have held an important place in the repertoire of leading orchestras. The title "Enigma" is a reference to a supposed second "theme" which runs through the whole set, but is never actually heard. Elgar never revealed it, and it remains one of the unsolved mysteries of music.

The performance by the B.B.C. Symphony Orchestra under Sir Adrian Boult is a fine tribute to the memory of this great British composer.

To lovers of the piano I have no hesitation in recommending a recording made by that famous pianist, Benno Moiseiwitsch, who gives a very polished performance of Debussy's "Toccata" on *H.M.V. C3487*.

### Vocal

**I** START off the vocal recordings with two arias from world-famous operas—Rigoletto and The Bartered Bride. From Rigoletto we have "Women is Fickle,"

sung by James Johnston, tenor, accompanied by the Sadler's Wells Orchestra, conducted by Vitem Tausky. The coupling is "Why Should he Think," sung by the same artist—*Columbia DB2217*.

For his new record Heddle Nash has given us two arias from operas rather less known than some. Not much is now heard of Donizetti's "L'Elisir d'Amore," but the aria "Una furtiva lagrima" (Down her Pale Cheek) is a most attractive romance for tenor. It has a captivating orchestral introduction, in which bassoons carry the melody. Gounod's "Romeo et Juliette" is still often given in France, where its reputation is nearly equal to that of "Faust." The plot is taken over from Shakespeare, and it is the second act of the opera that the balcony scene occurs, in which "Tis Love" is sung by Romeo. The record is *H.M.V. C3492*.

My next selection features a soprano and baritone. "Strange Music" (from "Nocturne" and "Wedding in Troldhaugen") has been recorded by Janet Hamilton-Smith and John Hargreaves, accompanied by the Palace Theatre Symphony Orchestra, conducted by Gideon Fagan. On the reverse side is "Three Loves" (from "Albumblatt" and "Poem Erotique").

For my next record I introduce a new Irish singer, Christopher Lynch, who came to the notice of the late John McCormack when the great tenor heard him sing in a Dublin Hotel. From that time he and Lynch sang duets together, and McCormack declared him to be a really outstanding singer of Irish songs.

In this new record Lynch selects two typically Irish songs, one of them being the attractive "Macushla," whilst the other is "Oft in the Stilly Night"—*H.M.V. DA1858*. He is accompanied by Gerald Moore at the piano.

Finally, "Amor Ti Vieta" (Love doth Forbid) and "Come un Bel di di Maggio" (As some Fair Day in May), is sung by that famous tenor Jussi Bjorling on *H.M.V. DA1836*.

### Variety

**T**HE new film "The Bells of St. Mary's" stars Ingrid Bergman as the head of a religious establishment, and it carries a theme song with the same title, here recorded by Billy Thorburn's delightful combination—The Organ, the Dance Band and Me. It is recorded on *Parlophone F2143*.

That evergreen "Stardust" is once again recorded this month by Andre Kostelanetz and his Orchestra, on *Columbia DX1243*, with an equally famous coupling, "Mood Indigo."

If you like dance music you can take your pick from the following. "Knees up Mother Brown" and "The Lambeth Walk," by Harry Roy and his Band, on *Parlophone F2149*; "I'll Dance at Your Wedding" and "Kay-Ud Meelah Falta," by Jack Simpson Sextet, on *Parlophone F2153*; "The World is Waiting for the Sunrise" and "Shine," by the Benny Goodman Sextet, on *Parlophone R3002*; "Eli-Eli" and "Music Makers," by Harry James and his Orchestra, on *Parlophone R3001*; and "Good, Good, Good" and "Oh! What it Seemed to Be," by Joe Loss and his Orchestra, on *H.M.V. BD5930*.

There is a new "Tin Pan Alley Medley," by Ivor Moreton and Dave Kaye, on *Parlophone F2154*, which introduces such popular tunes as "Chichery, Chick," "Seems Like Old Times," "Good, Good, Good," "Along the Navajo Trail," "Homesick—that's all" and "I Fall in Love too Easily."

My last record for this month is a vocal by Dorothy Squires, who has recorded "I'd Like to get you Alone" and "It's a Pity to say Goodnight" on *Parlophone F2146*. She is accompanied by Billy Reid's Orchestra.

# 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).

## Supplies in India

**SIR**,—With reference to the letter of Mr. T. Sivagnanasunderam of Ceylon published in the May issue of PRACTICAL WIRELESS, we have to state that we carry stocks of wireless components, testing instruments, etc., and if any of your readers in India, Burma and Ceylon cannot obtain wireless parts, we will be only too pleased to take care of their requirements, and in case the exact parts are not available we will offer them nearest equivalents. We also carry stocks of technical books and are particularly interested in meeting the demands of amateur experimenters.—INDIA TRADERS (Bombay 3).

## Short-wave Working

**SIR**,—Herewith details of my station:—  
Type RX. 0-V-F HL2 det., KT2 output.  
Circuit: Battery. F. G. Raver's 5-50 metre Rx. February issue, 1946, PRACTICAL WIRELESS.

Aerial: Inverted L, 20ft. long, 25ft. high, direction N.W. to S.E., lead in N.W. end. BEST RECEPTION: British Isles on 28 mc/s. Canada and U.S.A., 17, 15, 11 mc/s. Sweden, 14 mc/s.

Time of operating: 7 p.m. to 10.30 p.m. G.M.T. approximately, 16 hours listening per week, including Sundays. Keen S.W. enthusiast since 1940.

The above RX has been in operation since February 6th, 1946, and I am enclosing a list taken from my log from February 6th, 1946 onwards, giving 14 mc/s and 28 mc/s amateurs only. I have not seen a log published from London area for 14 mc/s and 28 mc/s. I would like to contact a reader of my own age (20-26) living in this district.—L. H. COX (Wandsworth).

Extracts from log, 28 mc/s, 10 metre band.

- 6.2.46 WJS calling DHTB2.
- 9.2.46 G5QC, G5KJ, G6CL, G4CG, G6CU, G6CJ, G8KZ.
- 10.2.46 W3HN, W3FCP, G3KL, G3LJ, W2JH, G6RH, G4CQ, G8RN.
- 24.2.46 W4YA, G5LI, G5XA calling ZC4C, G2CV (CW), G4CI, Z52AL, G4CI working W0QKB, G2MV working W2MDB, G2VZ (CW), G6NF, WEQ2 (CW), W4YN, W8TAP calling D4OCC, G2NH, G2DP.
- 8.3.46 W2MNY, G4KY, W2HEN, W2MEG, G6OF, W2MDB, G6KO.
- 13.3.46 G5AW, G8QM.
- 15.3.46 W3IRL, G8ZD, DA4IR, G5BC.
- 16.3.46 W2QF, G5PY, W2IXY, G6YD, G3ST, W8UDR, G2GP, G3DP, W8NRC, W8LAC, W9LQR, G8SS.
- 18.3.46 W1KAO, W8CL, W1CC, W1COX, W1FMP, W3DIC, W8RAX, W2MNX, G4UU, G2GP, C5RU, LX1DP, G5RU, G8IJ.

14mc/s.

- 16.4.46 SM5OX.
- 19.4.46 HB9CD, SM5OH, SM3IK.
- 21.4.46 LX1BO, SM5OK, SM5WU, SM5WT, SM4QU, IIMX working SM7PP, G2AC, SM5UN, YV5AE calling SM5OK.
- 26.4.46 IILA, IIAZB, SM5IW working GI2PM.

28 mc/s.

- 5.5.46 G5KH, G4LS, G8KC, G5JR, G6SJ, G8FO, G5PT, G5GT, G3PW, G4DN, G3BR, G5DT, G8RN, G6RH, G8IP, G5LC, G6RH and 8IP at 5LC's QRA, G5LO, G5OO, G5SH.

## Correspondents Wanted

**SIR**,—May I take the liberty to thank you for an excellent journal during these troubled times. I am a regular reader of your journal since 1933. During my service in the Forces your journal followed me to B.A.O.R. and the C.M.F., and in all my campaigning it gave me many excellent leisure hours of reading. I am once more in Civvy Street and would like to

contact the readers who corresponded with me until we lost contact with one another.

I make an appeal through "Open to Discussion" for correspondence from Mr. E. G. Moyes, Horrings Court, Bury St. Edmunds, and to Bill Connolly (unfortunately I have lost Mr. Connolly's address); and to any reader who would care to correspond with me. All letters will be answered. My former address for the Old Pen Friends to know was: J. E. Pickin, 16, Michaels Road, Blaencwinn, Treorchy, S. Wales. I would appreciate a letter of another B.L.D.L.C. member. In conclusion may I thank PRACTICAL WIRELESS and its staff for keeping us up to the date with radio and wishing PRACTICAL WIRELESS all the best for 1946 and the future years.—J. E. PICKIN (65, Longfield Road, Trowbridge, Wiltshire).

## Station Details Wanted

**SIR**,—The call sign of the "American Telegraph and Telephone Company" (Magnetism, etc.), is WDO; it was calling IQD recently.

Can any reader supply information on: WGO, WNRI (both New York) and GBS?

I have been a regular reader of PRACTICAL WIRELESS for eight months and think it is excellent.

However, I would very much like to see a design for a tuned H.F. unit which could be coupled to an existing short-wave receiver. I am sure it would be very popular.—P. W. KEMP (North Harrow).

**SIR**,—Whilst listening out on V.H.F., around 100 megacycles, I came across what seemed to be an amateur transmission. The call signs in use were G9EF and G9CF. Is it at all possible for you to give me any information about this? Perhaps from the call signs you could tell me the address or whereabouts of the transmitters.

It was so unusual to hear anything but Service traffic on such a high frequency that my curiosity was aroused, hence this letter.—H. CARKEHAM (Hillingdon).

## Civilian versus Radio Mechanics

**SIR**,—I have followed with interest the discussion on Civilian versus Service Radio Mechanics, and although W. Percival's letter in the June issue of PRACTICAL WIRELESS raises some sound points in the favour of the Service mechanic, I must admit that I am inclined myself to the opinion expressed by the Editor. I have had six years of Army service work (telecomm. and radar), and some eight years civilian servicing and factory development work before this, so I speak with some experience of both sides of the question. At the present time I am servicing anything up to 30 civilian receivers of all makes and types per week, and I must state emphatically that this work demands more skill than is generally required of the Army-trained mechanic, specialised in a few types. As W. Percival states, there are good servicemen in the Army—but, oh, how many are not! I have met few men in the Forces who could tackle a modern super-heterodyne for a fault—even a comparatively simple one—intelligently. Those who could were in nearly all cases men with long civilian experience.

No—there is only one thing which makes a radio engineer in the fullest sense of the term, and that is that intimate contact with radio which comes only after years of hard, logical practical experience. A six-months' course in theory, followed by practical work which is more in the nature of a "muddle through," does not make a radio engineer and never will. Such people in

civilian work brandish a condenser and a screwdriver in the bowels of a receiver and pretend to work miracles with them when actually they have no idea of correct procedure, and cannot interpret symptoms of failure in any intelligent manner.

An interesting fault—a receiver was on the bench for service a few days ago suffering from distortion. Checking grid circuits revealed that something was wrong with the bias on the output pentode. The bias resistance was measured and its value was found to be excessively high. This was rather surprising as the component was wire-wound; after complete removal, however, it was discovered that the resistance was, in fact, open-circuited, the high resistance reading being obtained through the bias electrolytic condenser which was more than usually leaky. Replacing both components immediately restored the receiver to normal operation.—S. A. KNIGHT (Wellingboro).

### A.C. Shock

**SIR**,—A friend of mine a short time ago decided to renew the earth wire connection from his A.C. commercial wireless set to outside earth; the set was plugged to mains with switch in on position while the set itself was switched off. When he handled the new connection from the earth on set and the outside earth wire he received a heavy shock of current through arms and body. This puzzled me, but not knowing all the situation re the set, I let the matter fade into background. Last week, however, my notice was personally aroused by a heavy shock of A.C. in identical circumstances.

I could not at first understand how it was possible for current to find a path to earth with switch on set "off." A neon tester showed a decided leak, but the mains transformer windings had no D.C. leakage to core.

The trouble arose from a two-pin plug to mains which could be reversed, thus bringing the live wire from mains straight to transformer winding (primary) instead of to the switch.

The A.C. was using the transformer as a large condenser and the core was one side of it. With the set switched on, no leak to earth occurred and the set worked all right. The A.C. current was finding its path via the neutral wire, coupled to the switch, through wrong plugging.

I hope this may interest readers who may have had similar trouble.—J. F. HOLLWAY (Caversham).

### Log Corrections

**SIR**,—Re your correspondent's recent letters on the discussion page concerning CHTA, I should like to draw the attention of your readers, R. Aldridge and C. Richards, to the fact that the Canadian transmission is now on CKLX, 19.83 metres, 15.09 mc/s.—A. ALLUM (Hammersmith).

### An Amateur Station

**SIR**,—During the months of March and April I have concentrated my short-wave listening on the 10-metre band, and although conditions appear to be falling off somewhat of late, there is plenty to be heard. By the way, why do readers appear to shun amateur stations in their logs? Surely they can be considered a better "bag" than commercial TXs, as they are of comparatively low power and are often working under primitive conditions. But there is one exception; I think I saw OQ5BJ mentioned a month or two ago.

My set is an O-V-2 on a zinc chassis. The components are mostly Eddystone's. Pentode output is used (KT2), so that the L.S. can be used if wanted, but I prefer 'phones in the first L.F. circuit, as everybody is not a radio fan!

I have the choice of two aerials—an inverted "L" pointing west, and a 10-meter doublet beamed north-south, using "Eddystone" crossfeeder blocks. Both are 25-30ft. high.

I am about to experiment with an O-V-1. Super-

regeneration will be used, with self-supporting coils for 5 and 10 metres only. There isn't much doing on 5 metres here in the Birmingham area (according to our local amateur TXs), but things will have livened up—I hope—by the time I get "on the air."—HERBERT BROOKES (Birmingham).

### "The Hole in My Hat"

**SIR**,—Your correspondent, S. A. Knight, of Wellingboro, says that I am talking through a very large hole in the crown of my hat, and attempting to turn your correspondence page into a political forum, at which Mr. Knight feels very much hurt.

I am sorry if I have offended his hyper-sensitive political ideas, but if the dear chap will restrain himself, and consider things in a calmer spirit, it may break in upon him that you would not permit any correspondent to abuse the freedom of your pages in the manner he suggests. And whilst under the influence of a more generous and wider outlook, perhaps he will tell us how we can keep "politics" out of any aspect of our daily lives, for we now live in an era when those we have set in power say to us, in so many words: "You have to have it, want it or not, 'Pay Up' and 'Shut Up,'" and I think that many readers may agree with me that the B.B.C. are amongst the world's best exponents of this autocratic attitude. I suppose that I incur a certain amount of danger for making this criticism outside of the House of Commons privileges, for prospects of dire results have been suggested for those critics not so protected.

It has also been suggested in the House of Commons that steps should be taken to prevent British licence holders being able to listen to foreign sponsored programmes, and, if the words liberty and freedom mean the same to Mr. Knight as they do to the rest of us, he may be induced to admit that this has a very wide political aspect and implications. Up to the defeat of Germany and Italy there was the death penalty for the natives of those countries who listened to British broadcasts... is it an attempt (on my part) to introduce politics into your pages by asking what our own fate may yet be if caught listening to any foreign sponsored programme?

Greatly daring (not being a M.P.), I repeat my original demand that if I must pay 20s. a year instead of 10s., I have the right to insist on something much better than the dreary stodge which has been our fate for years past at the lower figure. If not, even Mr. Knight's hat may develop a fair-sized hole.—K. T. HARDMAN (Birkenhead).

### An Amateur's Views

**SIR**,—I would like to thank all your readers for the very helpful information which they gave for receiver calibration purposes. Since I wrote my previous letter, however, I have totally abandoned commercial DX-ing. How anyone can sit down and listen to high-power commercial transmissions when there are hundreds of amateur transmitters on the air is quite beyond me!

Ten metre DX seems to be past its best at the moment, although stations in the Far East are to be heard, i.e., Burma and the Philippines. Stations frequently heard include XACR (Salonika, Greece), SU1MW ("Pyramids Road" (!), Cairo) and ZB1E. The latter puts in an R9 signal some days! I recently heard him working one of the Sutton Coldfield amateurs with a very nice signal! He eliminated all trace hiss from my super-regen. O-V-r.

Some days we hear VOs and VEIs on short skip, VERID being notable.

Just lately, 10 metres has been a band of local ground-wave working at nights, in fact I am just about to leave it in disgust and move to 1.9 mc/s!

There seems to be a great deal of pirating on 20 and 40 just lately!

Perhaps the Post Office will cure this pirating the easy way, namely, restore 7 and 14 mc/s.—G. C. BAGLEY (Ironbridge).

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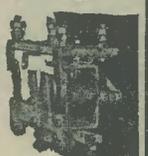
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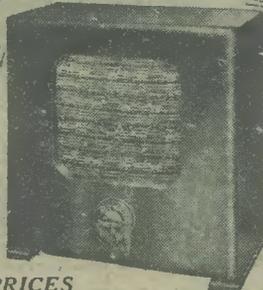
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