FREQUENCY MODULATION

Practical Wireless

9D EVERY MONTH

Editor F. J. CAMM

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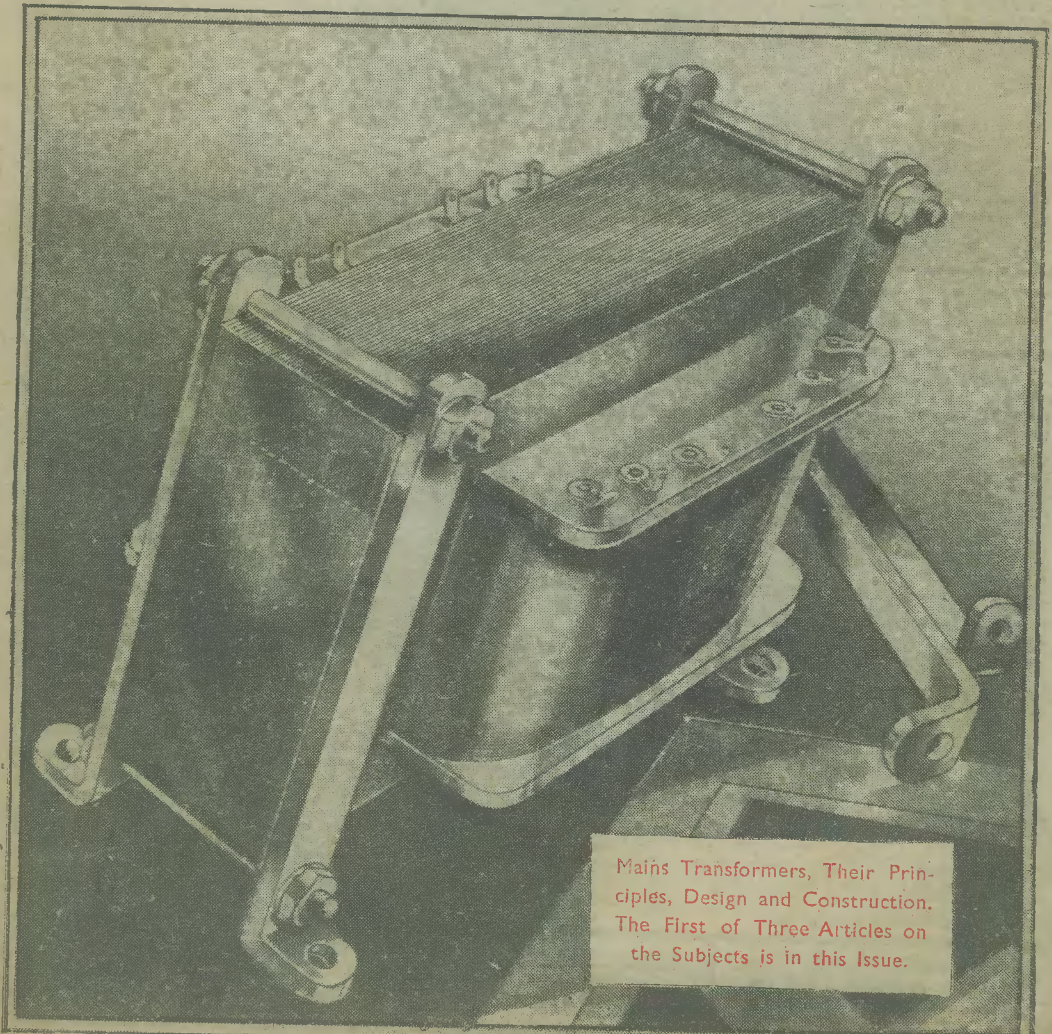
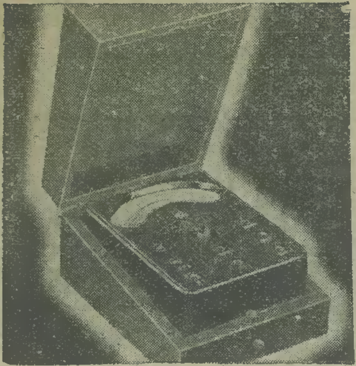


Mains Transformers, Their Principles, Design and Construction. The First of Three Articles on the Subjects is in this Issue.



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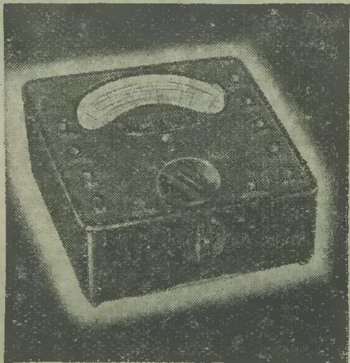

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04C	41.94 m. ...	2/6	06C	41.94 m. ...	2/6
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Battery Model S.W. Receiver, complete with 2-volt Valve, 4 Coils, Covering 12-170 metres. Built on steel chassis and Panel. Bandspread tuning, **55/-** including tax.

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Push-Back Connecting Wire, 2½d. per yard.
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7-pin Ceramic Chassis Mtg. English Type Valveholders, 1/6 each.
Amphenol Octal Chassis Mounting Valveholders, International type, 1/3 each. English type, Octal, 1/3 each.

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Practical Wireless
and PRACTICAL TELEVISION
12th YEAR OF ISSUE
Vol. XX. EVERY MONTH. No. 456. JUNE, 1944.
Editor F. J. CAMM

Comments of the Month

By F. J. C.

Wanted—An International Radio Language

THERE is an implied criticism in the design of wireless apparatus, in that broadcasters have to resort to phonetics in order to make themselves understood and avoid possibilities of error. The pip-emmas, and ack-emmas, and the G for George, O for orange, H for Harry code, not only complicates the work of uttering a simple sentence, but it causes delay. It is also rather cheap-jack and amateurish, and we suggest that the time has come to abolish it, as well as the slang used by amateurs, such as "old man," a term of endearment which they use to utter strangers.

Mr. Churchill has made the suggestion that we should endeavour to produce a basic English. From the examples of it which we have seen basic English would necessitate the use of more words than standard English in order to express a simple statement, and in any case, whatever standard of English is adopted individuals will continue to invent their jargon. The word "jeep" for example, is merely a corruption of the two initial letters G.P.—General Purpose. People associated with particular hobbies, interests or industries, love to invent new words. It is not so much a basic English which is required as a Government Committee to licence words, and to permit or refuse to permit the use of new words where existing words would suit.

In television we have suffered the introduction of such horrors as *wobbulation* and *raster*, which are mere Cockneyisms. Yet they appear in glossaries of technical words. Wireless has been a particularly unfortunate industry in this respect. Almost anyone has been permitted to invent words. The word *picafarad* is a good example. The farad is sub-divided on the metric system, and yet someone was permitted to introduce this word, to designate *micro-microfarad*. It is not so much a basic English which we require in this scientific age as a Committee to approve technical nomenclature. Whilst we do not wish to belittle the work of amateurs, they are not necessarily the people to whom should be entrusted the coining of technical nouns. Words should be based on some recognised root. The coining of words should not be left to those without scientific or technical education, and who merely have a pastime interest in a science.

Readers' Queries—Special Notice

WE regret that for the time being we are compelled to suspend our Query Service. This is purely a temporary measure due to staff shortage and the fact that queries are coming in at a more rapid rate than they can be handled under existing conditions. This service we have rendered to our readers, free of charge, from the first issue of this journal—a task cheerfully undertaken and backed by promptitude. War conditions, however, make it impossible for us to deal with queries as promptly as we would wish, and our staff must confine its attention to producing the paper until those conditions change. Readers may rest assured that it will be reinstated at the earliest possible moment. An examination of many of the queries indicates that some readers could help themselves by consulting past issues. Large numbers of queries arrive like a recurring decimal, and although we have answered them literally hundreds of times readers still ask the same questions. For their guidance we produce an index to every volume, and these may be obtained for 10d. each, from The Publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. We do ask our readers' indulgence and co-operation in this matter.

Outstanding queries are being dealt with as promptly as possible.

As most readers of this journal are regular readers and undoubtedly keep a file of back issues, we suggest that they obtain indexes to help them to consult articles and replies to queries.

"The Slide Rule Manual"

WE have just published from the offices of this journal (address as above), "The Slide Rule Manual" at 5s., by post 5s. 6d. This handy volume of over 100 pages, cloth bound, indexed, and well illustrated, explains the principle of the slide rule, how to use it, and how to make various calculations. There are numerous worked examples relating to most branches of industry. There is also a useful chapter on logarithms, upon which the slide rule is based, whilst another chapter deals with circular slide rules. The book is a companion to our "Refresher Course in Mathematics" (8s. 6d., by post 9s.), and our "Mathematical Tables and Formulae," a vest pocket book which costs 3s. 6d., by post 3s. 9d.

The Forces Programme

ACCORDING to a recent Gallup Poll, only 20 per cent. of the British public like the General Forces Programme. It would be more interesting, and certainly more valuable, to have the views of those for whom the programmes are designed—members of the Forces. The B.B.C state that they are not interested in the views of civilians on these programmes. The main criticism of members of the Forces is that they have not a sufficient number of receivers to be able to listen to the programmes, and thus to form an opinion.

In any case, the B.B.C. must conduct experiments in programme construction, although it should not forget that the General Forces Programme is the only alternative to the Home Service Programme.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

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

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

ROUND THE WORLD OF WIRELESS

New Director-General of B.B.C.

THE director-general of the B.B.C., Mr. Robert W. Foot, has been released to become chairman of the Mining Association of Great Britain. He joined the B.B.C. in 1941 as general adviser on its wartime organisation and became director-general in September last year.

Mr. Foot is succeeded by Mr. W. J. Haley, who since September last has been editor-in-chief of the B.B.C. Mr. Haley has been joint managing director of the *Manchester Guardian* and *Evening News*, Ltd., and a director of Reuters and the Press Association.

Dr. Anton F. Philips.

Radio Pirates

ACCORDING to a recent official report, Scotland appears to have more wireless "pirates" than England and Wales. It is believed that about one in every six receivers north of the Border is unlicensed. Free libraries *and* free wireless, eh?

Lord Reith's New Appointment

LORD REITH was recently elected to the Court of Cable and Wireless, and the Board of the Associated Companies, and this new post marks his return to the wireless field which he left on resigning from the director-generalship of the B.B.C. in 1938.

New Radio Girdle

A REPORT from New York states that Government engineers are studying a "global girdle" for world radio communications.

An "electric conveyor belt" in latitude 20 degrees North—which cuts through Mexico, North Africa and India—would escape electronic disturbances from the Aurora Borealis, equatorial dampness, and station interference caused by overloaded radio wavelengths, they believe.

International transmitters would beam communications to the nearest relay point on the belt for transmission around the globe.

Radio From a Grave

ACCORDING to a recent report from the Federal Communications, German spies were found sending messages to U-boats at sea with a transmitter installed at the bottom of a grave. The transmitter, which was located by portable detectors, was small enough to be carried in a pocket.

Dr. Anton F. Philips

DR. ANTON F. PHILIPS, co-founder and head of Philips Radio and Electrical Organisation, celebrated his seventieth birthday on March 14th, and received congratulations from prominent persons all over the world.

Speaking at an interview, Dr. Philips expressed great pride in the effectiveness with which the Philips factories in the British Empire and the United States and other free countries had been able to contribute to the United Nations war effort.

He added that his full energies were being directed to the employment of his company's resources in the cause of victory.

"Kay On the Keys"

KAY CAVENDISH, whose programmes, "Kay on the Keys," are such favourites with members of the Forces as well as their relatives at home, is shortly going on an ENSA tour to North Africa, Palestine, Italy and Sicily. The party includes Florence Desmond, Johnny Lockwood, and the pianist and composer, Jack Strachey.

This small band of artists will be entertaining all branches of the Services; they will pay visits, too, to all the Malcolm Clubs founded for the R.A.F. in North Africa in memory of Wing Commander H. G. Malcolm, who won the V.C. there.

"Kay on the Keys" has been running now for nearly two years. Listeners in the Forces who are unable to see and hear Kay Cavendish during her trip need not worry; they will still be able to hear her in the General Forces Programme, as she is making sufficient recordings of "Kay on the Keys" to last until she returns to Britain.

"The Old Town Hall"

"THE Old Town Hall" returned to the air on April 27th. Many of its popular features are retained, including "Can You Beat the Band?" In this the Master of Ceremonies, Clay Keyes, asks the band a question sent by a listener, to which the answer is a song title. If the band cannot guess the tune and play it, too, its members must throw a penny on the drum. Listeners are invited to join in and, if they fail to guess the tunes, to throw pennies on their home drums for charity. They are also invited to send questions to beat the band.

Old Ebenezer, the night watchman, played as before by Richard Goolden, again sat by his old fire bucket, as he has done for years past. "The Old Town Hall" is designed primarily for Forces listeners overseas, where listening conditions are not conducive to concentration. Because of this the sketch in which Old Ebenezer introduces the mystery star who later recounts his or her most beautiful memory, now takes a different form.

The programme ends in "Clay's Canteen," a cheerful rendezvous where everybody is welcome, everybody is happy, and gags without number are the order of the day.

The stage version of "The Old Town Hall" has been on an ENSA tour in North Africa for some months past and has had a tremendous reception. Now the Forces are able to hear the original version, with Gladys and Clay Keyes, who also write the script, Richard Goolden, Susan Scott, the Old Town Hall Orchestra and two well-known guest stars each week.

"They Call 'Em Leathernecks"

"THEY CALL 'EM LEATHERNECKS," to be broadcast on May 9th, is the story of the United States Marines, who got their nickname from the black leather neckpiece that was part of their uniform round about the eighteen hundreds.

Marines were recruited in America and served in the ships of the British Navy long before the War for Independence. The U.S. Marine Corps, as such, first appeared in 1775. Its members are picked men, tough, trained to the last hair, and each an expert rifle shot. The marine calls his rifle his sweetheart "because it's the one thing he has he can rely on." U.S. Marines, a tough professional corps with a hundred and sixty-nine years' experience behind them, have seen service in this war in most of the major actions in the Pacific area, in Guam, Midway and Wake Islands, Guadalcanal, Tarawa, Kwajalein and many more.

"They Call 'em Leathernecks," written by Merrill Denison, with music by Richard Arnell, and produced in New York by B.B.C. producer, Roy Lockwood, shows how the Leathernecks came into being, the kind of training they receive and the type of men who go to make the force the magnificent fighting machine it is. The programme ends with the Marine hymn, the official Marine Corps song:

From the Halls of Montezuma
To the shores of Tripoli
We fight our country's battles,
In the air, on land and sea.

First to fight for right and freedom,
And to keep our honour clean;
We are proud to claim the title,
Of United States Marines.

Bow Bells and the B.B.C.

MANY listeners in this country are curious about several aspects of the General Forces Programme. The most frequent queries are "Why do we hear Bow Bells so often?" and "Why do the announcers say, 'This is the British Broadcasting Corporation?' Surely it is enough to say 'B.B.C.'?"

There are good reasons for both these things. Firstly, Bow Bells. This is not an interval signal, but an identification signal, used to distinguish the General Forces programme from other B.B.C. short-wave transmissions. The General Forces Programme, which, as part of the General Overseas Service, is radiated all over the world, is for engineering purposes called the Green Network, and uses Bow Bells as an identification signal. Three other services, which provide direct transmission specifically to Africa, the Pacific area and North America, comprise the Red Network. The identification for *this* service is the notes "B.B.C.," not played by the brass quartet, which home listeners used to hear, but "B.B.C." played on a celeste or novachord.

Red and Green Network

IN some parts of the world, notably in Africa, both a Red and Green network service can be received simultaneously. It is therefore particularly necessary that each service should have an easily recognisable identification signal, repeated at fairly short intervals. Both services have their public and purpose, but, broadly speaking, the General Forces Programme Green Network is directed to exiles from the home country, mainly men and women in the Forces longing to hear the voice of home, whilst the Red Network Services are directed to English-speaking peoples resident in the areas served.

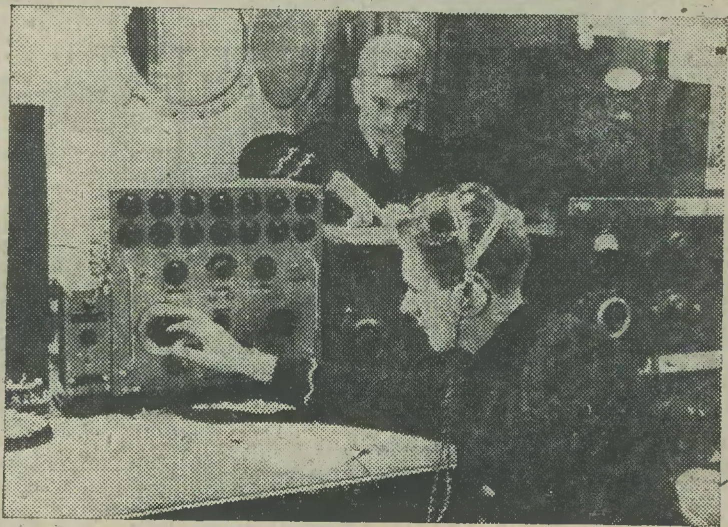
Word Cue To Engineers

THE second query is "Why do the announcers say 'British Broadcasting Corporation?'" These words are not an identification signal, but a word cue to engineers in various parts of the world who receive B.B.C. programmes and rebroadcast them in their own areas.

The announcement "This is the British Broadcasting Corporation" is so timed that the final syllable of the word "Corporation" falls on the twentieth second past the penultimate minute. Engineers all over the world are listening intently for those words, checking their clocks, and standing by, for they know those words mark the end of the current programme, and that exactly forty seconds later the next B.B.C. programme will come on the air.

The French Merchant Navy

LITTLE has been said about the Free French Merchant Navy. General de Gaulle has placed at the disposal of the United Nations a considerable tonnage of the merchant fleet who were able to escape from Vichy France. The French Merchant Navy has been doing great work in helping Britain in their Mediterranean and African campaign. Ships from the Middle East and from French Colonies have been transporting valuable cargoes, and were even in active warfare against Italian warships in Africa. At present they are doing convoy work in the Atlantic. During all this work the wireless operators are doing twenty-four hours uninterrupted service (see accompanying illustration).



Wireless operators in the French Merchant Navy listening to distress signals.

The "Radio Eye"

ACCORDING to Sir William Lawrence Bragg, Professor of Experimental Physics at the famous Cavendish Laboratory, Cambridge, the huge strides made in radio science during the war will soon enable crews of ships and planes to see for hundreds of miles in any direction. Professor Bragg stated that "there are adventures and discoveries in the realm of physical science, in the structure of this world, and indeed of the whole universe, awaiting us just round the corner.

"The radio eye will enable you to see all that is going on around you, like a searchlight casting its beam ahead so that you can see some distant place or scene.

"It will be possible, for example, I believe, for the mariner at sea and the navigator of aircraft actually to see what lies ahead of him, not merely for miles, but for hundreds of miles ahead."

The Low-cost Quality Three

An Easy-to-build Receiver Capable of Giving Good Results for a Small Outlay.

By F. G. RAYER

THIS receiver was constructed with components obtained from firms whose advertisements regularly appear in PRACTICAL WIRELESS. The total cost, including all parts and valves, is very low, yet the circuit is capable of giving good reproduction—this being partly due to the characteristics of the 8in. Celestion moving coil speaker, and partly due to the careful selection of the component values of the L.F. couplings. Volume was found to be ample for all normal occasions, and the set was made to tune quite sharply by winding a tuning coil with a loosely coupled aerial winding. As a "family" receiver, the set has much to recommend it. Fig. 1.

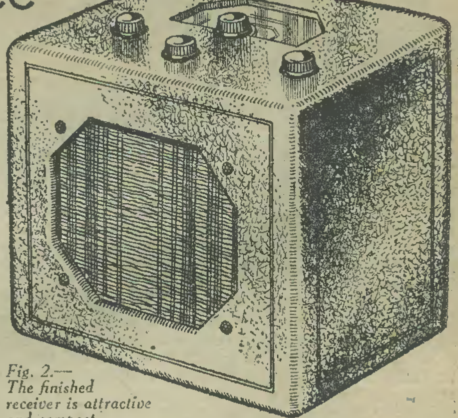


Fig. 2.—The finished receiver is attractive and compact.

The Cabinet

This was made from ½in. thick wood—except for the top and front, which are 3-ply—and covered with leather cloth which was pasted to the cabinet, care being taken to keep it free from wrinkles. It is 8in. deep by 10½in by 10½in. Fig. 2. The controls are on the top of the receiver; they are four in number—combined on/off and wave-change-switch, reaction, L.F. volume control, and tuning, the layout of which will depend on the tuning dial used. Fig. 4. One model was made with a large 0-180 degree dial fitted to the tuning condenser as no reduction drive was to hand. This was perfectly satisfactory. The chassis is made from plywood, with ½in. thick wood for the runners which are 1½in. deep. The chassis fits round the speaker, while space is left for high tension and grid bias batteries beside the chassis. There is not sufficient space for an accumulator, and this is best outside the cabinet, anyway, as it can then be more easily changed, and the fumes from it will not corrode the parts in the set. Fig. 3.

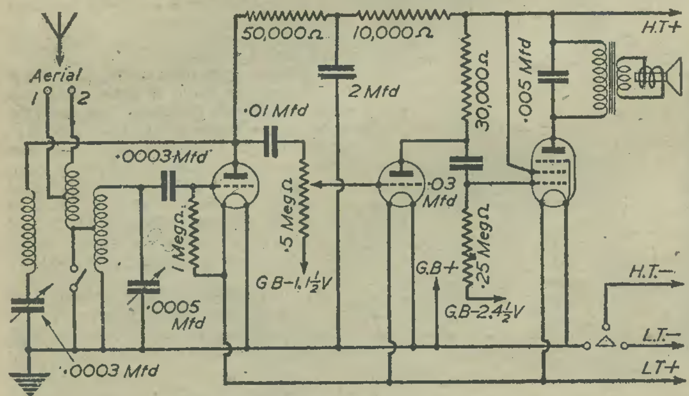


Fig. 1.—The theoretical circuit of the receiver.

Constructional Details

It will be seen that the receiver chassis and the control panel are separate items. Flexible connections are made between them—there are only five or six of these—one to the fixed plates of the tuning condenser, one to the wave-change switch, two to the volume control (the third wire of which goes to G.B. minus 1½ volts) and one for reaction and earth return. Comparing the circuit and wiring plan, Fig. 5, will make these details clear. These connections should be left until last.

Wiring is straightforward. Lengths of insulated sleeving should be slipped over the exposed lengths of connecting wires and wire ends of the condensers and resistors. All connections were soldered except those to the aerial and earth terminals. Lengths of flex fitted with suitable connectors are used for the battery leads. The large

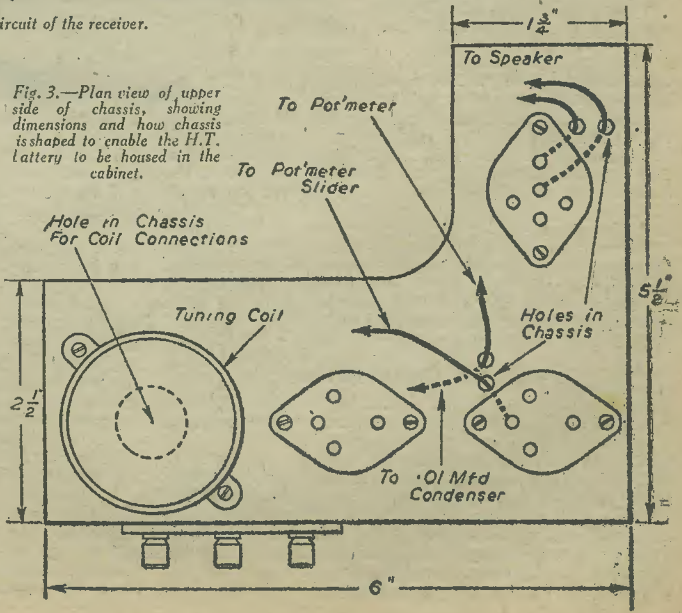


Fig. 3.—Plan view of upper side of chassis, showing dimensions and how chassis is shaped to enable the H.T. battery to be housed in the cabinet.

LIST OF COMPONENTS

Celestion 8in. moving coil speaker with pentode output transformer.
Three valve holders (two 4-pin, one 5-pin).
.0003 mfd. Reaction condenser.
.0005 mfd. Air dielectric tuning condenser and dial.
Fixed condensers: .01 mfd. (mica), .03 mfd., .005 mfd., and .0003 mfd.
Resistors: 1 megohm, ½ megohm, 10,000, 30,000, and 50,000 ohms.
½ megohm potentiometer.
Double-pole double-throw switch. Three small knobs.
2 mfd. decoupling condenser.
Wire for coil, terminals, etc.
Valves: Osram HL2, Lissen K30C, and Cossor 220HTP (or similar types).

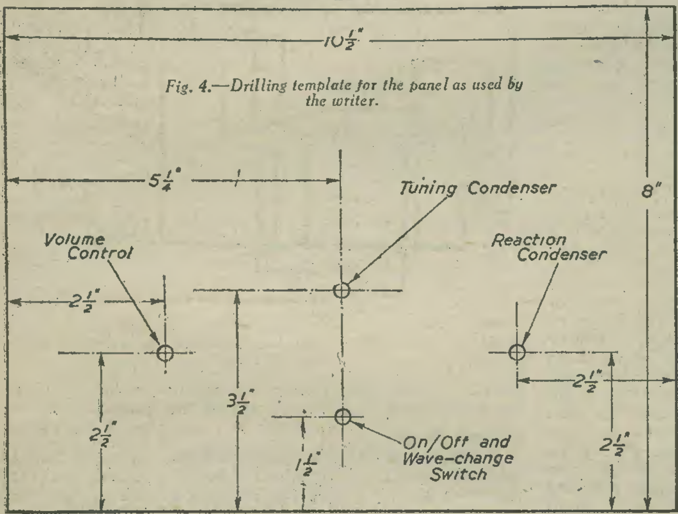


Fig. 4.—Drilling template for the panel as used by the writer.

decoupling condenser is anchored to the side runner.

The speaker is bolted to the front of the cabinet and connected by flexible leads. The .005 mfd. condenser shown in the circuit diagram is soldered directly on to the speaker connecting tags.

The switch on the panel is of the double-pole, double-throw type, and switches the set to medium and long-waves, or, when in its central position, off.

The Tuning Coil

This is home-made, and is designed to give rather sharper tuning than a standard commercially made coil. This is not obtained without some loss of signal strength, but there is ample L.F. gain to make up for this. See Fig. 6.

The coil is wound upon a 3½in. length of 2in. diameter tubing. Starting from the bottom the windings (all in the same direction) are as follow: Long-wave coil, 180 turns of 38 S.W.G. wire in two piles of 90 turns with ¼in. between them; reaction, 70 turns side by side of 38 S.W.G. wire, it is ¼in. from both the medium and long-wave windings; medium-wave winding, 80 turns of 26 S.W.G. wire; coupling coil, 28 turns of 38 S.W.G. wire with a tapping point for *aerial* 1 at 10 turns.

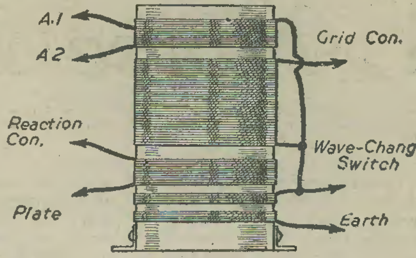


Fig. 6.—Showing location of and the connections for the coil windings.

The coupling coil is ¼in. from the top of the grid winding. The diagram of the coil shows the connections. It will be seen that the aerial coil is returned to the bottom of the medium-wave winding, not to earth, so that it is automatically cut out when the receiver is operated on the long-wave band. This is preferable, as the highest efficiency is required upon the medium-wave band.

Notes on Operation

The valve type used in the L.F. stage was found to have a great influence upon the results obtained. A detector valve (as is often used in a first L.F. stage) is not very suitable. The best valve is one of the general purpose type of not too high impedance. A valve such as the Osram HL2 is very suitable for use in the detector stage. The output pentode is of the high amplification type (e.g., Cossor 220 HTP or Mullard PM22A).

The 120-volt H.T. battery should be used. With the valves mentioned the grid-bias is 1½ and 4½ volts for L.F. and output stages respectively.

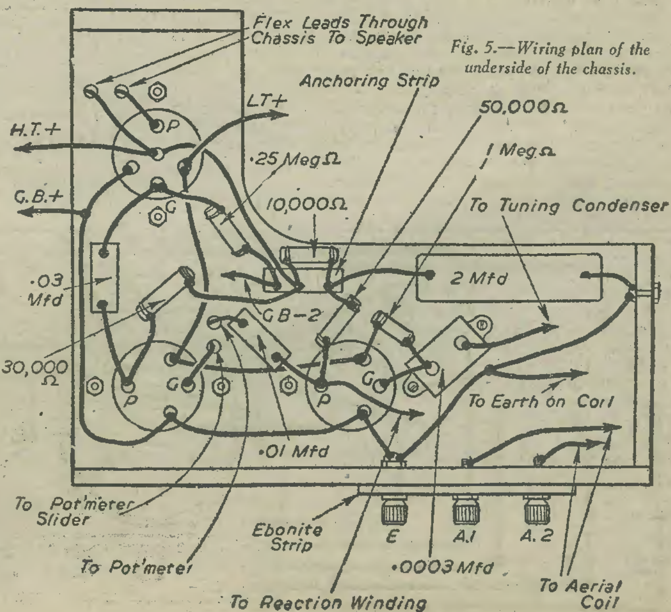


Fig. 5.—Wiring plan of the underside of the chassis.

A Morse Practice Set

A Compact Unit Incorporating an L.F. Oscillator and Amplifier. By R. L. GRAPER

THE valve oscillator was designed by the writer as a morse practice set to go into the kit-bag, therefore its size was cut down to a minimum, namely 8½in. long, by 4in. by 5in. This is quite small considering that two distinct arrangements have been incorporated. 1, A single valve oscillator working from a 9-volt grid-bias battery, for use with morse key and 'phones, and 2, the same valve oscillator, plus an amplifying section, for use when loudspeaker results are desired.

The circuit, Fig. 1, consists of an ordinary 2-volt triode valve as oscillator, followed by a Class B valve as amplifier, its two sections acting as a resistance coupled amplifier and transformer coupled output stage. A simple selector panel and shorting panels are fitted to allow of the alternative uses above described.

A filament resistance is incorporated for the oscillator valve to reduce the voltage when it is desired to work the low power section from two dry cells connected in series, its value being sufficient to drop the 1 volt. If the valve has a filament current rating of .1 amp., the resistance should have a value of 10 ohms. When the high power section is to be used an accumulator will be needed, and the filament resistance can be shorted.

Constructional Details

The chassis is constructed from ½in. thick hardwood or five-ply, as also are the back and front. The front, or panel, and baseboard, are covered with copper foil or metallised paper, and this is best fitted previous to screwing the uprights to the baseboard as the metallised covering can then be turned over to make good electrical contact. The baseboard is 7in. by 4in., and the two uprights are 5½in. by 4in.

The general layout and the wiring can clearly be seen from Fig. 2, the wiring diagram, which also shows the panel and rear upright in developed plan for clearness. The length of the leads, therefore, will in most cases be much shorter than shown.

The L.F. transformers may be other than those shown, i.e., Ferranti 3-1, and Graham-Farish "PiP," but before fitting the transformers to the baseboard, it is best to connect the leads—which should be flex—to the selector and shorting panels and the valve holders. Also, as it may be found necessary to reverse one or other of the primary connections if the valve fails to oscillate, the leads should be made long enough to allow of this. The battery leads are best soldered, and after marking their ends to ensure accurate identification, can be bunched and clamped to the baseboard.

It will be noted that both the selector and shorting panels are chassis type valve holders. The pattern is immaterial so long as the required number of sockets is available. Thus an ordinary 7-pin holder would do for the selector panel in place of the continental type shown. An 8-pin type might be used here with advantage, so that four sockets could be used for the morse-key and

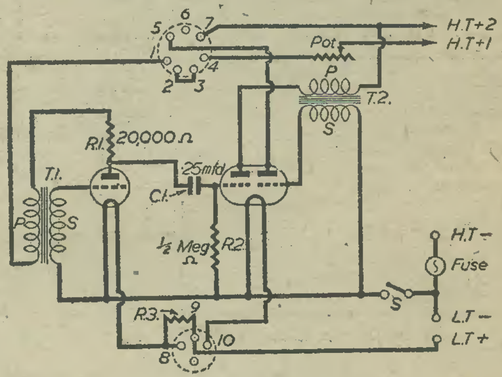


Fig. 1.—The circuit of the L.F. oscillator, together with the amplifier section.

speaker in the high power section, instead of using a common centre socket as shown in the illustrations.

Selector Panel

When using the low power section, with key and 'phones only, the lower four sockets, numbered for reference 1, 2, 3 and 4 respectively, are used, the key leads to 1 and 2, and the 'phone leads to 3 and 4. The top three sockets, 5, 6, and 7, are unused in this instance.

When it is desired to use the oscillator plus amplifier, the following connections are made. The key leads go, one to No. 5 and one to No. 6. Speaker leads go, one to No. 6 and the other to No. 7. It will be noted that in both cases the key and 'phones, and key and speaker are in series with the H.T. lead.

The sockets 1 to 4 must be shorted when using the high power, as also must be sockets 9 and 10 of the shorting panel (see below).

Shorting Panel

This is purely a shorting panel and no connections

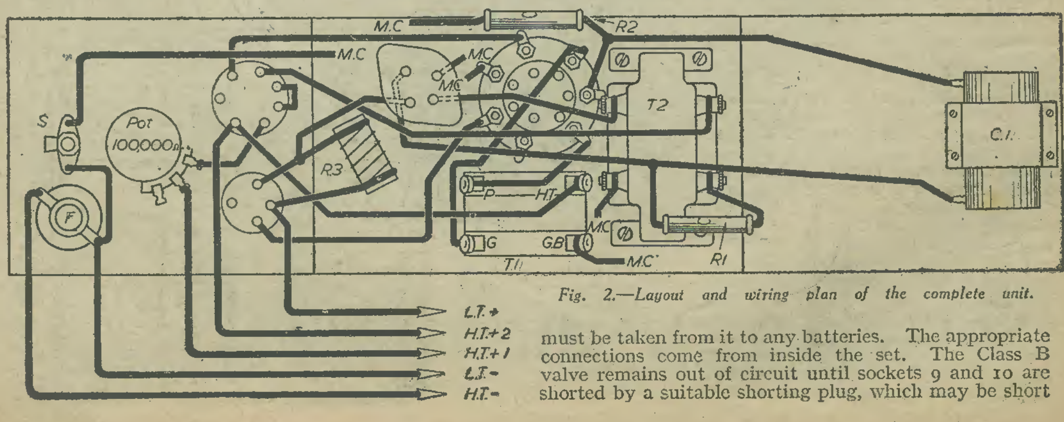


Fig. 2.—Layout and wiring plan of the complete unit.

must be taken from it to any batteries. The appropriate connections come from inside the set. The Class B valve remains out of circuit until sockets 9 and 10 are shorted by a suitable shorting plug, which may be short lengths of flex complete with two plugs. Sockets 8 and 9 are shorted only if the filament resistance is not needed.

Results

The oscillator was found to give comfortable earphone signals with a grid-battery using 4½ volts positive, and the potentiometer varied the note of the signal quite satisfactorily.

Using 5, 6 and 7 sockets, with a key and midget L.S. (moving-coil), with an H.T. of 120 volts, the oscillator gave a sufficiently loud signal for a small room. H.T.+1 still remains at the 4½, and as a 4½ tap is not provided in H.T. batteries, it is necessary to use the grid-bias battery and an H.T. battery when using high power. Care should be taken to see that a *positive* 4½ volts is given and not a negative potential, otherwise the valve will not oscillate. When using the two batteries a connecting lead should join the two negatives. To simplify matters H.T.− lead might be fitted with two plugs for this purpose. Or to avoid any confusion two separate H.T. leads could be incorporated.

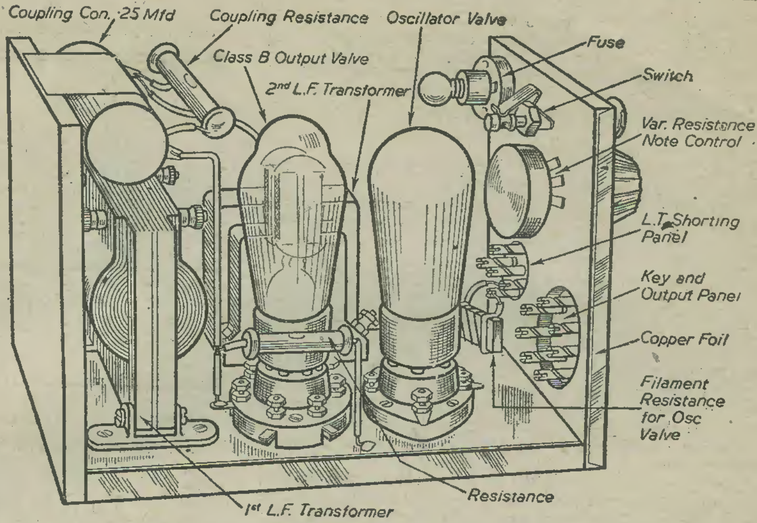


Fig. 3.—This is how the complete unit should look. A metal cover can easily be made to protect valves, etc.

A Variable H.T. Supply

A Power Unit Possessing Distinctive Features. By W. BACON, B.Sc.

A PIECE of equipment which every radio experimenter needs at one time or another is a power supply, the output of which is continuously variable from zero to maximum. This may be achieved by means of variable autotransformers such as the "Variac," but these are expensive and in these days not readily obtainable. Below is described a variable voltage power supply using only simple, standard components which are in many cases already to hand.

How Results are Obtained

The method of achieving the desired supply may be seen from Fig. 1. V1 is a triode valve connected to act as a half-wave rectifier. The main H.T. supply comes from winding 1 on the transformer T. There is, however, an additional winding on the transformer which applies an opposite voltage to the grid of V1 through the potentiometer P. The potentiometer thus controls the maximum current passing through the valve, and hence varies the output voltage. Unlike most controls of this nature, the potentiometer does not in itself carry much current.

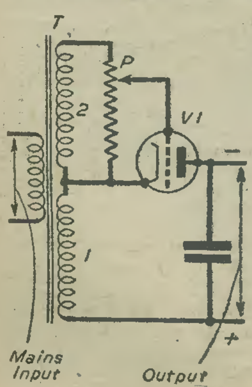


Fig. 1 (left).—A triode used as a half-wave rectifier with potentiometer current control.

Practical Details

The circuit of a practical instrument is shown in Fig. 2, in which the triode has been replaced by a tetrode; suppressors have been included, and the voltage range has been divided into two.

The input is fed from the mains via a fuse and switch to the mains transformer. This has three

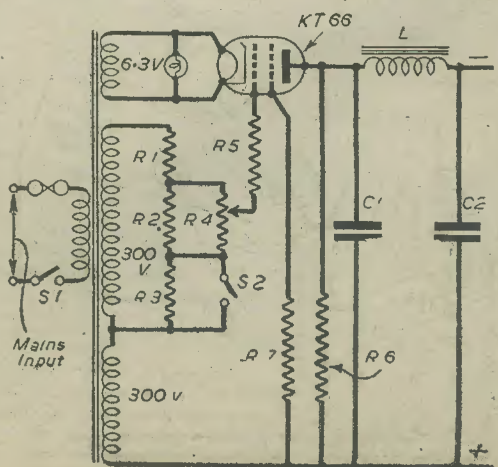


Fig. 2 (right).—The circuit of a practical arrangement in which the triode has been replaced by a tetrode.

secondaries, two giving 300 volts R.M.S. output and the third 6.3v. The valve heaters and an indicator lamp are connected to this last winding.

The secondary which provides the controlling effect is connected to a chain of three resistances, the bias potentiometer being connected across the middle one of these. When S2 is open the first voltage range is available, from zero upwards.

Closing S2 gives the second voltage range, up to the maximum obtainable.

The choke L and the condensers C1 and C2 are the conventional smoothing circuit. It is desirable that smoothing should be considerable, since only half-wave rectification is employed, and for certain work it would be advisable to add a second choke and condenser. R6 is a bleeder resistance, obviating the condensers remaining charged or excessive voltages when switching on with no load.

The Valve

The valve used is an Osram KT66. R5 and R7 are grid and screen stopper resistances, and it is essential that they are included. The value of R7 in particular is important and it should be capable of carrying several milliamperes.

The valve is being used in an *extremely unconventional* manner and trouble might be expected, but in practice the writer has found that the life of the valve is good; an instrument of this type has been giving reliable service for some time.

For heavier currents a second valve may be added in parallel with the first.

Constructional Details

Fig. 3 shows the general arrangement of the instrument, built up in a wooden box with sloping front. The on-off switch is placed centrally on the short vertical portion with the indicator light above it. The output and range controls are to the left and right of this respectively. The mains connector is mounted on the left-hand side of the box, with the fuses in an easily accessible position near it.

A meter was built in to measure the output current and this can be seen above the output and range controls. It is, of course, a refinement which is useful but not essential to the successful functioning of the instrument.

Fig. 4 shows the rear view. The back of the instrument was made as a sliding door, and in the figure this is shown half removed. A deck is screwed to the sides of the box about 3in. up, and on this are mounted the condensers, valve, mains transformer and choke. The electrolytic condenser is mounted behind the valve but not too close to it to be affected by the heat dissipated.

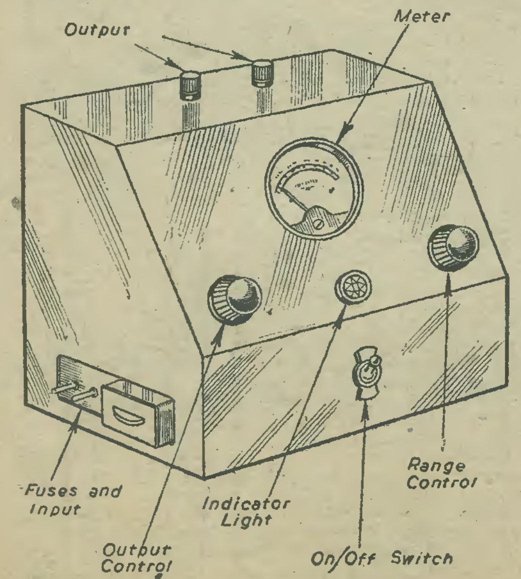


Fig. 3.—The general layout of the unit made by the writer.

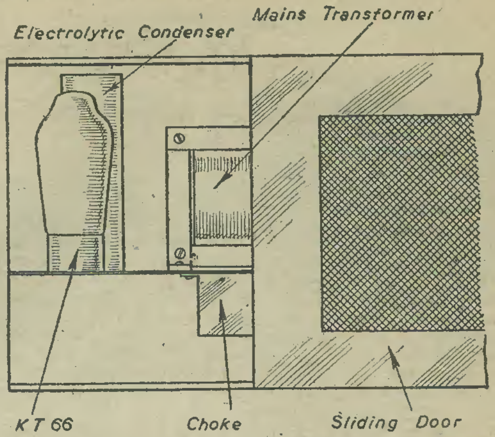


Fig. 4.—Rear view of Fig. 3, showing sliding door and part of assembly.

Output

The unit gives a maximum output, on no load, of 350 volts. At 50 m.a. this falls to 250 volts, and at 85 m.a. becomes 200 volts. The maximum current the instrument can supply is just under 100 m.a. on short circuit. Due to the regulating action of the valve, temporary shorts do not cause damage.

Applications

The uses of the device are legion. The writer has used it for testing relays. For this application it possesses the interesting property that current does not change greatly with output load. Thus, whether the relay is low resistance or high resistance, more or less the same result can be obtained.

PRIZE PROBLEMS

Problem No. 456

JACKSON had a three-valve battery-operated receiver, to which he wished to connect a pick-up for the reproduction of records. He obtained the component, and after making initial tests found that it could be connected to the detector circuit and fairly satisfactory results obtained without applying any grid-bias to the detector grid; therefore he decided to use the pick-up by connecting it direct to the grid and the common-negative earth line. To simplify matters and avoid long leads, Jackson soldered one P.U. lead to the grid socket on the detector valve holder, and the other to one side of the nearest decoupling condenser. On making another test he failed to obtain any signals from the P.U., in spite of the fact that the component was perfect and the connections electrically sound. Can you explain why?

Three books will be awarded for the first three correct solutions opened. Address your solution to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem 456 in the top left-hand corner, and must be posted to reach these offices not later than the first post on Monday, May 15th, 1944.

Solution to Problem No. 455.

The trouble Walters experienced was due to a defective volume control. The moving arm did not return to the actual zero point on the resistance element, therefore a low bias voltage was being applied to the grid of the valve even when the control was turned to the maximum volume setting.

The three following readers successfully solved Problem No. 454, and books have accordingly been forwarded to them: T. E. Foreman 831005 Dvr./Mech., Depot R.A.; Rfm. H. A. Baxter, 6847238, Cumberland; F. T. Cooper, 23, Mawson Street, Ardwick, Manchester 13.

Post-war Radio

Some Speculations and Arguments Regarding the Position of Broadcasting, and of Amateur Wireless Activities After the War

A NUMBER of keen pre-war amateurs recently met and, in an informal way, discussed the probabilities of radio in the post-war world. They tried to answer each other's questions—a sort of brains trust, if you like. There were many points on which differences of opinion were expressed, and very few on which unanimity was reached. The general opinion was, however, that there would be something in the nature of a boom in amateur activities. Many of those who joined in the discussion are now engaged in activities connected with radio in the Services, and they all thought that the experience gained during the war would be invaluable afterwards.

Several had been barred from taking out a transmitting licence before the war because of their inability to cope with the Morse code. During their stay in the Services they had learnt the code, of necessity, and therefore that bar would no longer be a deterrent. In addition, there were several who found that their all-round wireless training in the Army, R.A.F. and Royal Navy had made them far fitter persons to take up experimental work more seriously than before, and hence to gain a greater amount of satisfaction from it.

THE writer of this article has long been associated with the amateur radio movement, and the points raised during the discussion are those which are in the minds of most enthusiasts who, and quite rightly so, are concerned as to the future of amateur radio and broadcasting in general.

We shall be pleased to receive for publication short letters from readers giving concise accounts of their views on "post-war radio."

Broadcast Frequencies

After many reminiscences, one of the first questions which came in for a good deal of discussion was that of the frequencies which would be used for post-war broadcasting. Whereas several were of the opinion that short-wave work would predominate, others thought that medium waves would continue to be used for normal broadcasting, short waves being used only for commercial telegraphy and for world broadcasts; the term "world" was used to replace the previous term "Empire."

One suggestion advanced was that medium waves should be used for about three broadcasts intended for the more rural areas of this country and for the Continent, whilst short waves should be employed not only for world transmissions, but also to provide local services in the regions of large cities or populous areas. These latter transmissions would be on low power, and would be given a wide frequency band so that "quality" transmission would be possible.

Others in the party held precisely the opposite view, considering that medium-wave transmissions on low power should be retained for "local" use, and that short waves should be used for all other forms of broadcasting. The reason given was that short waves often behave peculiarly over very short ranges, although being perfectly satisfactory over greater distances. This question was dropped after one ex-amateur transmitter pointed out that certain frequencies, in the region of 4,000 kc/s, could be used satisfactorily over short ranges, although frequencies above about 10,000 kc/s were not so reliable in such circumstances.

Television

When the question of television was raised, there appeared to be complete agreement on one point: that it would become as popular as "sound" broadcasting within 10 years of the end of the war. Moreover, it was believed that colour television would come along more quickly than many people have yet realised. Although television as such has appeared dormant during the war, an enormous amount of experimental work has been done on sciences closely allied to television, and the tremendous progress which has been made will be a big help in giving television an entirely new start. It was feared, by those who still own a television receiver, that the new techniques might well render existing receivers obsolete, or perhaps in need of major modification. However, it would be better to make a new start on the "right foot" than to shuffle through with half measures which may allow Britain to lose the clear lead which it has so far maintained in television.

It is almost certain that ultra-short-wave transmissions will continue as essentials to television broadcasting because of the very wide video-frequency channel which will still be required. It might well be found a good plan to go well below the 7-metre wavelength of previous television broadcasting, and to use wavelengths of 2 or 3 metres.

But how are we to overcome the limitation of range due to these frequencies being suitable only for use over "visual" distances? Perhaps it would be necessary to have a central television transmitter with numerous relay stations around the country. It would, of course, be a pretty formidable task to provide one transmitter for every 50-mile circle over the whole of the British Isles.

There would also be the difficulty of providing sufficient frequency channels, since the synchronisation of frequency of all transmitters would be well-nigh impossible.

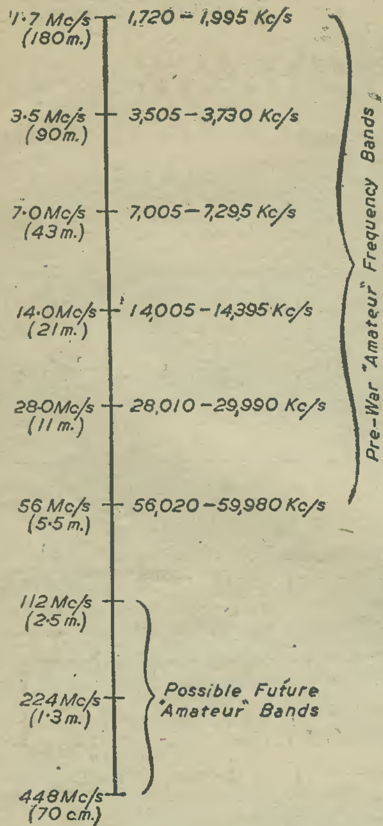
A Radical Departure

One suggestion put forward was that if we had comparatively few powerful television transmitters, each having an aerial several hundred feet above ground level, it may be possible to employ a system of "dispersal reflectors" (also mounted on very high masts) in the centres of cities. The purpose of these would be to act as re-radiators over the particular built-up area. This idea was countered by the remark that losses in re-radiation would be so great that the scheme could not possibly succeed. But it was felt that none of those present knew sufficient about the reflection and radiation of ultra-short waves to be able to comment authoritatively on the matter.

F.M. and A.M.

An ex-schoolmaster who is now a keen wireless "fan" asked for the views of others on the probabilities of a change-over to frequency modulation from amplitude modulation for post-war broadcasting. This question provoked lively discussion—and many stupid remarks—until it was found that one of the company had spent some time in the United States during the war, and had taken the opportunity of studying F.M. at first hand. It might be mentioned here that F.M. has already come into fairly wide use on the other side of the Atlantic, and was, in fact, used by amateurs and others before the war.

He stated that the quality of reception obtainable when using frequency modulation had to be heard to be believed. On short waves, in particular, it gave excellent reception. Being free from the effects of man-made static, the signal-to-noise ratio was far higher than he had ever known before. He also claimed that the type of selective fading which often made short-wave reception over long distances far from pleasurable was



This table shows the frequency bands allotted to amateur transmitters in 1939, and possible future frequencies. The details on the left of the vertical line are the frequencies by which the bands are generally known and the approximate corresponding wavelengths.

It will be seen that the higher frequencies are approximate multiples of the lower ones. Thus, one crystal can be used on practically any band by the use of frequency-multiplying stages.

almost entirely absent when using F.M. The reason he gave for this was that the different frequencies which constitute any F.M. transmission are reflected differently by the upper ionised layers, with the result that signals never faded out, and that "flutter" could not be detected. This seems rather a strange story, but there was nobody present who could definitely prove it to be wrong. But it would appear that distortion must occur even if fading did not.

The Value of F.M.

In any case, the party generally agreed that F.M. was worthy of trial for broadcasting in town and city areas where man-made static is invariably troublesome on the short and ultra-short waves. Whether or not the advantages would justify the scrapping or modification of existing receivers could not be decided. Perhaps F.M. will have to come along gradually, and perhaps amateur transmitters may be allowed to pioneer the system, just as they pioneered short-wave work in the past. They would not find much difficulty in replacing the detector stage of a receiver by a discriminator stage, nor of fitting the necessary reactor stage in their transmitters.

If A.M. continues to be used for normal broadcasting, and if greater use is made of short waves, it is certainly to be hoped that the fitting of suppression devices on electrical machinery will be made compulsory by an Act of Parliament. Until that is done, the "powers that be" might consider the use of F.M. for television, if new receiving equipment is made necessary by changes in technique.

Post-war "Hams"

After discussion of these more general aspects of post-war radio, talk drifted back to the probable position of the amateur transmitter. One or two "ex-hams" whose work in the Services has been concerned entirely with what was their hobby previously, thought that they would have "had enough" by the time "this business" is over. But at least twice as many who were strangers to radio four years ago made it quite clear that they had no intention of dropping the subject after the war. In fact, they were really keen "hams" in embryo. They were very interested in the stories of field days, conventions "ham-feasts" and the like, as related by the old hands.

Tx Licences

They inquired about the conditions governing the issue of Tx licences in pre-war days, and about the type of equipment that was used, the maximum power permitted and the availability of constructor parts. It seemed that there would be a far greater number of prospective amateur transmitters after the war than ever there were before it.

But what decisions would be taken by the Post Office about the issue of licences, the allocation of amateur frequency bands and the granting of permission to use more power than 10 watts? It was thought that the conditions governing the issue of a licence may be more stringent than before. It should be possible to insist on a higher Morse speed than the old 10 words a minute, and it might well be that there would be an insistence upon higher technical qualifications. Reasons for wishing to set up a transmitting station may require to be stated in greater detail, and special licences may be required if one wished to use "phone"; this requires a much wider frequency channel than does C.W.

Microwaves for Amateurs?

There has been a gradual forcing of the amateur down the wavelength scale; from, it was remembered, 440 metres in 1921 to 5-point-something metres in 1939. The 5-metre band was only one of those in use by amateurs, of course, and there were five others, up to around 180 metres. But would the higher wavelength bands be taken away in favour of others going down into the centimetre region? Perhaps so, but the amateur would still manage to use them, and might, in fact, find work on centimetre waves highly interesting for short-range working. And the simplicity of both transmitter and receiver on centimetre wavelengths is a strong point in favour of microwave work. Different valves would be required, but manufacturers are already fully conversant with the technical details, and would not be slow to provide suitable equipment.

Cadets of the Royal Signals O.C.T.U. making up radio receivers in one of their wireless laboratories. It is highly probable that many of them will become enthusiastic amateurs in post-war years.

Mains Transformers

In this, the First of Three Articles Dealing with Transformers, the Writer Deals with the Elementary Principles Governing Their Design. By D. BARBER.

IN 1831 Faraday discovered that if a bar magnet was suddenly thrust into a coil of wire or solenoid, a voltage or "e.m.f." (electro-motive-force) appeared at the terminals of the coil. This e.m.f. was only present as long as the magnet was in motion and it was observed that the magnitude of this voltage was directly proportional to the speed of movement of the magnet. Furthermore, the "polarity" of the e.m.f. depended on the direction of movement, that is to say, that if one of the terminals became positive when the magnet was inserted into the coil, that terminal became negative when the magnet was withdrawn. This effect was called *electromagnetic induction* and is the basic principle underlying all transformer operation.

Faraday's experiment may be performed easily if a sensitive milliammeter is to hand. An old wireless transformer coil having several thousand turns may be used and the milliammeter which should, if possible, be of the centre zero type, is connected across the ends of the coil. If a bar magnet is inserted and withdrawn, the principle of electromagnetic induction will be proved, as the needle will kick first to one side and then to the other, according to whether the motion of the magnet is into or away from the coil.

This experiment also shows up clearly a most important point. If the magnet is held stationary in the coil no movement of the meter pointer will result, showing that there is no induced current, but if the *coil* is now moved over the stationary magnet a current will once more be set up. The point to note, then, is that no electromagnetic induction can take place unless there is some *relative motion* between magnet and coil.

Summing up then:

1. An e.m.f. will be induced if some relative motion takes place between the coil and the magnet.
2. The direction or polarity of the e.m.f. will depend on the direction of the relative motion.
3. The magnitude of the e.m.f. will be proportional to the speed of the relative movement.

Permanent Magnets

It is generally acknowledged that emanating from the poles or ends of a magnet are numerous invisible "lines of force," which seem to fill the space in the immediate neighbourhood. These lines are capable of exerting a definite force on any suitable body which is brought within range of their influence. Everyone has seen proof of this in the manner in which a magnet causes a piece of iron or steel to jump towards it.

Another striking property of these lines is that rather than pass through air, they always show a preference for passing through magnetic materials, such as iron and steel; in fact, were it not for this, a piece of iron would not be attracted to a magnet from a distance.

The term used for these lines of force is "magnetic flux" or merely "flux" and it is measured by the number of lines of force it involves. Thus a large magnet will produce a larger flux with consequently more lines than a smaller magnet, providing other factors are the same.

The function of the permanent magnet in Faraday's experiment was to provide a convenient source of magnetic flux; an alternative source of flux, even more convenient, will now be considered.

The Electro-magnet

If a current from an electric battery is passed through a solenoid, the latter behaves as a weak bar magnet as long as the current is maintained. Just as a bar magnet has two poles, North and South, so will the solenoid, and it will be found that by reversing the direction of current flow in the coil, the magnetic polarity can also be reversed, so that the end previously of North polarity now becomes South.

If a bar of soft iron is now placed inside the coil and the experiment repeated, the effect is extraordinary; the formerly weak magnet now becomes extremely powerful, capable of supporting many times its own weight. What is the cause of this phenomena? It was stated earlier, that magnetic lines of force pass more easily through magnetic materials than they do through air, so that it will be appreciated that the addition of the iron core will result in many more lines finding their way down the centre of the coil. In effect the core serves to concentrate more flux lines into the coil, which at the same time becomes more effective. This piece of apparatus, the current carrying coil with its soft iron core, is called an electro-magnet.

The Transformer Principle

Having considered the electro-magnet, the experiment on electromagnetic induction previously described can now be modified to show the actual transformer principle. Fig. 1 illustrates this and it will be seen that the only

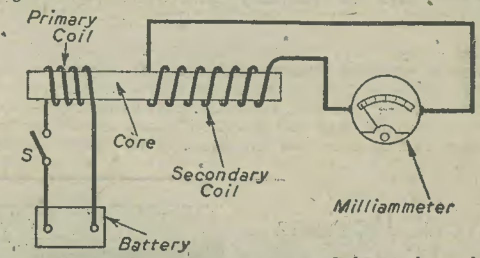


Fig. 1.—A simple circuit arrangement which can be used to demonstrate the fundamental principle of the transformer.

change is the substitution of a long electro-magnet for the permanent magnet used originally. The coil, which is fed from the battery, serves to "excite" the iron core and is called the *primary* coil, whilst the other one, which is connected to the milliammeter, is known as the *secondary coil*.

If switch S is closed, the iron core becomes magnetised and if it is inserted and withdrawn suddenly from the secondary coil, the meter pointer will kick in exactly the same manner as it did with the permanent magnet. If, however, the core is placed inside the coil and switch S is operated rapidly, violent movements of the milliammeter pointer will result, the kick being in one direction when closing, and in the opposite direction when opening the switch.

At first glance this may appear to contradict the rule of electromagnetic induction which demands that some relative motion must exist before e.m.f.s can be induced. If it is remembered that switching off the current in the primary coil results in the collapse of the flux in the core, it becomes clear that this is really only the equivalent of withdrawing the magnetised core altogether and will have the same effect on the secondary coil, namely, to induce an e.m.f.

It is this *change of flux* linking the two coils which constitutes the necessary relative motion and the more rapid the flux change, the larger the magnitude of the secondary induced e.m.f. becomes. Only very rarely, however, is an actual switch used to cause the primary current to die away; one of the few practical cases

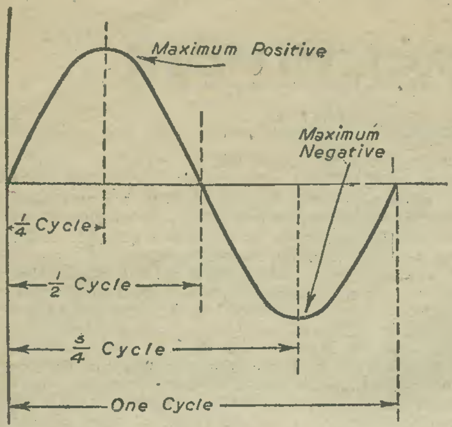


Fig. 2.—Shows graphically the manner in which an alternating voltage or current varies during one cycle.

where this is done is to be found in the motor-car ignition coil, where the primary current is broken by a high speed contact breaker, the resulting, rapid collapse of flux inducing a very high voltage in the secondary winding.

It does not make the slightest difference to the *magnitude* of the induced voltage whether the flux is increasing or decreasing; so long as it is changing at the same rate, the secondary e.m.f. will have the same magnitude.

Mains Supply.

The alternating current (A.C.) mains supply which is now almost universal, is really a very variable voltage supply. Every instant it is changing its value, from zero, up to a maximum in one direction, down to zero, up to a maximum in the other direction, down to zero again and so on. The number of times this cycle is repeated per second is called the *frequency* or *periodicity* of the supply; the usual frequency, which has been standardised in this country is 50 cycles per second. Fig. 2 shows graphically the manner in which an alternating voltage or current varies over one cycle. One might suppose that a lamp connected to an alternating current supply would show a noticeable flicker, and indeed were the frequency reduced sufficiently this would actually occur. The filament of the lamp cannot, however, heat up and cool off fifty times a second, so it maintains a steady average temperature. In any case, the human eye cannot respond to such rapid fluctuations.

Imagine now that the primary coil of the experimental transformer is connected to some suitable A.C. supply. This supply voltage, the current in the primary coil, and, of course, the magnetic flux in the core, are all varying "in step" so to speak with the frequency of the supply. It has been shown previously that any change in the value of the flux in the core must be accompanied by an induced e.m.f. in the secondary winding of the transformer. Thus a secondary voltage is being developed which will also be in step with the supply voltage frequency. This explains why a transformer cannot change A.C. into D.C.

There are two ways in which an increased secondary e.m.f. can be obtained; the first is by causing the flux in the core to vary at a higher rate, that is, by increasing the supply frequency. As, however, this is usually fixed, the second method is always used; this involves winding more turns on to the secondary coil, thereby causing the flux to link with more secondary turns. The secondary induced e.m.f. is directly proportional to the secondary turns so that if these were doubled, twice the original voltage would become available.

As there are no moving parts in a transformer, it is easy to obtain a very strong mechanical design with a simple form of construction. This is of great value to the amateur experimenter and the next article will deal with the actual design of transformers for any given output, together with methods of building.

(To be continued.)

New Regional Director

THE Postmaster-General has approved the appointment of Major P. B. W. Stanley, Deputy Regional Director, to be Regional Director, London Postal Region, on the retirement of Mr. J. Davidson, C.B.E., at the end of June next.

Major P. B. W. Stanley commenced his career at the C.T.O. as a telegraphist in October, 1903. On the outbreak of the first World War, he enlisted as a sapper in the Royal Engineers—Signals—in 1914. When he was demobilised, in May, 1919, he had attained the rank of captain, and was appointed Major, R.E. Signals (Supplementary Reserve) in April, 1926.

In February, 1934, he became Assistant Postmaster, Northern District, London, and in July, 1942, he was appointed Deputy Regional Director, London Postal Region.

Miss Eve Grey, of Star Sound Studios, London, seen here supervising a disc recording, is believed to be the first professional woman recordist in Great Britain, as she was actively engaged in this work some years before the outbreak of war. Of course, at the present time there are about 500 women engaged as operators at B.B.C. recording rooms, studio control centres and transmitting stations.

YOUR SERVICE WORKSHOP—14

Servicing Receivers

Testing Superhets. By STANLEY BRASIER

(Continued from page 230 May issue)

If no results are obtained it is evident that the fault lies somewhere between pick-up input and the speaker. Now this input usually feeds into the grid circuit of the detector (if the set is T.R.F.), or into the triode grid of the double-diode-triode (if a superhet) so that if, when the A.F. signal is transferred to the grid of the output valve and chassis, a signal is obtained we know that the fault is in the previous stage. An examination of wires and connections will show if any obvious fault exists, so failing this the components comprising the L.F. coupling between the output valve and the previous one may be tested by applying the A.F. signal to the anode of the preceding valve. If, under these conditions, no signal is obtainable, the search has been narrowed down to a few components, and a few moments with the ohmmeter should be sufficient to spot the trouble.

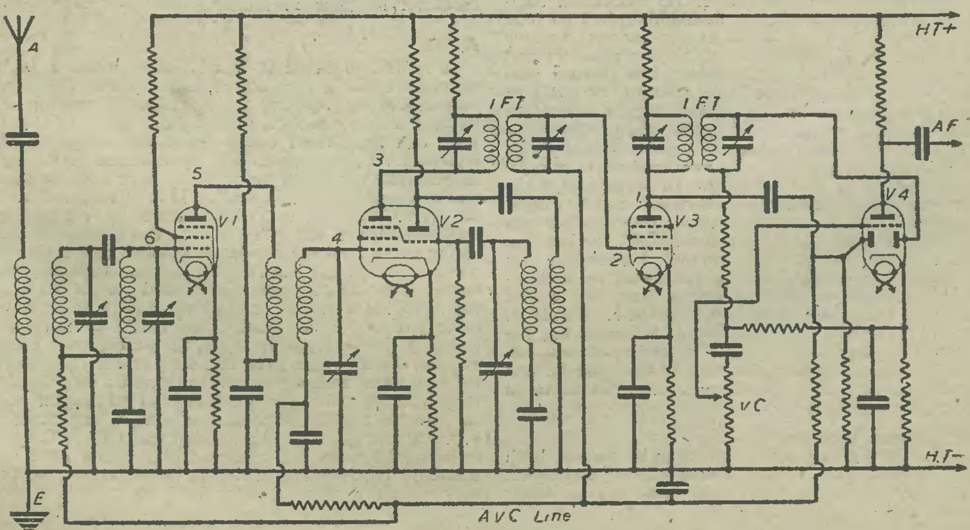
For the purpose of this article, however, we must again assume that the fault has not yet been found, so having worked back to the anode of the detector (or the L.F. amplifier) we find that it would be necessary to check the H.T. voltage on the valve anode and, if a pentode, on the screen also. If nil, apply continuity test between anode pin and H.T. distribution point (X in Figs. 1, 2 or 3, May issue), check all resistors en route, also testing any coupling or de-coupling condensers for short or open circuit. An indication of whether the lack of H.T. is due to a faulty series resistor or to a short circuit may be gained by noting whether or not voltage exists at other valve pins. If not, it may be assumed that it *is* due to a short or, of course, a break prior to the H.T. distribution point. In the case under discussion, however, we have already obtained signals from the output stage and H.T. must therefore be getting to it, so the trouble would no doubt be due to a burnt-out resistor in the anode or screen circuit of the stage we were testing. Now, suppose that the H.T. supply *was* in order. We would then check the anode current of the valve or remove it for test in the valve tester. If in order it now remains only to check the grid or "gramo" input circuit, including the switch and any other components with which the stage is associated. By then the fault should have been found.

During the foregoing tests we found that the output stage was responsive to signals. Had it not been, the procedure of systematic checking would, of course, have been applied to that stage.

H.F., I.F. and Detector Stages

We can now pass on to methods of detecting possible faults in H.F., I.F. and detector stages, so once more we are faced with a lifeless receiver, but this time a slight hum is heard in the speaker, and we are not surprised to find that signals fed into the pick-up sockets are reproduced well from the loudspeaker, which proves that the fault is in the earlier stages.

The set should now be tried on its various wave bands in an attempt to obtain signals, because in this way a valuable clue to the fault may often be found and the method of dealing with it is usually quite obvious. However, if the response to this treatment is nil, we can proceed with the work of elimination. One quick and simple way—if the set is of the T.R.F. type—is to remove the aerial from its socket and tap it into various parts of the circuit. For instance, if the receiver has a bandpass input circuit, any fault existing in the aerial coil or in the wiring to the aerial terminal may be by-passed by tapping the aerial into the grid of the H.F. valve. Likewise, the complete H.F. stage may, in effect, be removed by tapping, via a fixed condenser, into the anode of the H.F. valve. If signals are then heard the H.F. stage is at fault, if not, the detector stage is in error. Having found the affected area, so to speak, we can proceed to check it over in much the same way as outlined in the L.F. section, but here there will also be coils to deal with. To check these, a low-reading ohmmeter is invaluable. It should be joined between the grid end of the coil under test and chassis and, with the



Skeleton circuit diagram of a superhet illustrating testing points referred to in this article.

wave-change switch set to the medium-wave position, a reading between 5 and 10 ohms should be obtained. On switching to long waves, the reading should rise to approximately 30 to 50 ohms, the exact value, as with medium wave coils, varying according to the specification of the coils. Incidentally, this checks the wave-change switch also. If a reading is not obtained, do not jump to the conclusion that the coil is open-circuited or burnt out, for it is necessary to remember that sometimes a condenser is interposed between the earth end and chassis (see diagram). It is easy to overlook this, especially if the condenser is incorporated in the coil can.

Using the Service Oscillator

The idea of "jumping" the aerial lead cannot be applied very successfully to the superhet, except to check the aerial coil and the H.F. stage, if any. For these purposes the aerial would be tapped into the grid of the H.F. valve, and the grid of the frequency changer respectively, but the only satisfactory means of servicing the superhet is by the use of a signal generator or service oscillator. Going back to our faulty receiver which, this time, is a superhet, we find that it is in order from the pick-up input onwards, so we can either work backwards from this point or forwards from the aerial. However, since we started working backwards, we may as well continue to do so, and remembering that the pick-up input was assumed to feed into the grid of the double-diode-triode valve, our next test would be to find out whether the diode detector is operating. To do this, the service oscillator is brought into use and adjusted to give a modulated R.F. signal of the same frequency as that of the intermediate frequency of the receiver under test. This information would be given in the service sheet.

The skeleton diagram shown on the previous page is of a typical superhet receiver as far as the diode detector, and will be useful in illustrating the testing points. If the output lead of the oscillator is now joined between chassis and point 1, and results are obtained, then obviously the fault is in an earlier stage. On the other hand, if the result of this test is nil, then the fault can be assumed to be in the detector stage or in the second I.F. transformer and once more a systematic search must be carried out. The transformer windings may be given an ohmmeter test, the result of which should suggest trouble or otherwise. Trimmers across these windings should also be suspected. The D.D. triode valve will have already been tested, so failure of the stage to operate would be due to its associated components. Particular attention should therefore be paid to the diode load resistor—often the manual volume control—and all decoupling or stabilising resistors and condensers. If the I.F. signal injected at point 1 produces a corresponding result in the speaker, we could be forgiven for taking a short cut by injecting the modulated I.F. into point 4, which is the signal grid of the mixer section of the frequency changer valve. Usually this connection is the top cap, so it is convenient to remove it before joining up the oscillator. In doing this, however, we have interrupted the bias circuit and it will be necessary to join a resistor of about 0.5 megohm between signal grid and chassis. At the same time, the internal oscillator stage might be rendered inoperative by shorting out, say, the grid coil. If results are not obtainable, the service oscillator's output can be moved forward first to point 3, and then to point 2. But if all is in order, it means that the mixer section of V2, the complete I.F. amplifier and the following stages, are all correct. Any remaining fault will therefore be due to trouble in the radio frequency tuning circuit or in the receiver's oscillator circuit.

Testing Internal Oscillator

Now, for the set to produce signals in its output, both circuits must be correct, so if, when testing the signal circuits—having removed the short from the oscillator coil—no results are heard from the speaker, we cannot jump to the conclusion that here lies the fault, because, even assuming that R.F. signals *are* reaching signal grid, nothing will be heard if the oscillator stage is not working. But if we can *prove* that signals are reaching the grid of V2, then the oscillator must be at fault. The next procedure, then, would be to adjust the service oscillator to give a modulated output of some frequency suitable for the medium wave-band. This output is injected, via a dummy aerial lead, into the A and E terminals of the receiver and the tuning control adjusted roughly to the frequency of the oscillator.

The valve voltmeter is now brought into service, and set to its lowest range is connected to the signal grid of V2 and chassis. The receiver's tuning control is now varied slightly so that resonance can be obtained with the input signal and thus to obtain a reading on the valve voltmeter. If there is not, then a fault has been located and the valve voltmeter should be connected to positions nearer the input, say, to points 5 and 6, in an endeavour to localise it. Having proved that signals are reaching the grid of the mixer valve and knowing that the receiver is functioning correctly from this point onwards, our wholehearted attention can be paid to the oscillator stage. The frequency changer valve will have already been tested, also the voltages thereto, so that the trouble is due to its associated component.

The purpose of the oscillator stage is to produce oscillations. We can see if this state of affairs exists by inserting a milliammeter (shunted by an 0.1 mfd. condenser) in its anode circuit and noting whether the current varies when the grid coil or condenser is shorted to earth. Another method is to watch for any variation in current as the oscillator tuning condenser is rotated throughout its range. If the value is not oscillating, no change or variation in current will be produced, and the cause must be found by searching for open or short circuits, dry joints, shorted coil turns, poor earth connections and anything that is likely to prevent oscillation. Another method of testing the oscillator stage is to replace it by the service oscillator. Under these conditions it is necessary to put out of action the stage in the receiver so that it cannot have any effect on the test. This is done, as mentioned before, by shorting the grid coil. The external oscillator is then connected to oscillator grid and chassis. The tuning control of the receiver is now set to receive a local station, the frequency of which must be ascertained. The oscillator is then tuned to that frequency plus the intermediate frequency of the receiver, and adjusted to give its full unmodulated output. If this arrangement produces signals it is then known that the receiver's oscillator stage is at fault.

A.V.C.

If A.V.C. is fitted it is advisable, when a fault is proving difficult to detect, to render the system inoperative by shorting the A.V.C. load resistor or by making a disconnection at the diode pin. In this way tests can be carried out without the confusing effect which A.V.C. sometimes has upon them. Also by its inoperation we would know whether or not the system was responsible for the fault. If it is required to test the A.V.C. circuit it can be done by connecting a milliammeter in the H.T. feed to the controlled valves as far away from the anodes as possible and shunted by a condenser. Next, the receiver is tuned to the strongest signal available and the effect noted on the meter. If the A.V.C. is working correctly the steady anode current indicated under no-signal conditions will fall as the signal is slowly tuned in until, as the resonant point is passed, it rises again to its standing value. This happen because when a strong signal is received a comparatively large voltage is developed across the load resistor which, in turn, is applied as negative bias to the controlled valve or valves. The bias applied via the A.V.C. system is in addition to the standing bias which each valve normally receives and which is developed in the usual way across a fixed resistor in each valve's cathode. Therefore, when the anode current drops (due to the increased A.V.C. bias voltage) it follows that a similar current drop will occur in the standing bias resistor.

Some Applications of Thyratrons in Radio Engineering

A Paper Read Before the Institution of Electrical Engineers

By A. J. MADDOCK, M.Sc., Associate Member

(Continued from page 233, May issue.)

THE schematic is given in Fig. 6, from which it will be seen that the input wave is applied to both grids simultaneously and that the two thyratrons are released alternately, the one stopping the other through the intermediary of condenser C_1. Since the potential drop across anode and cathode jumps regularly (as the frequency of the input voltage is constant) between the applied anode voltage and the normal valve drop, an alternating e.m.f. is available whose waveform and amplitude are constant and whose frequency is determined by the input signals. This e.m.f. from one of the thyratrons is passed on through a high-impedance A.C. circuit, after which it is amplified and then applied to a meter for indication. A high-impedance circuit is used in order that the main thyratron circuits shall not be disturbed.

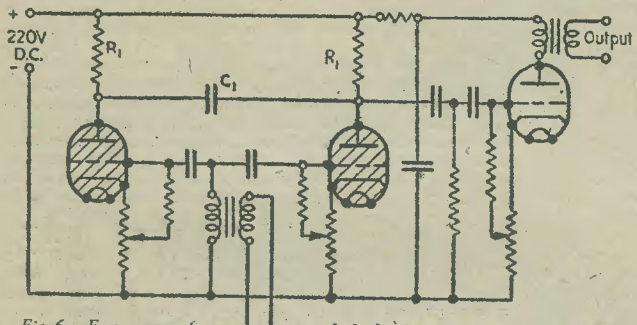


Fig. 6.—Frequency meter, in which the input wave is applied to both grids simultaneously.

This circuit has been used satisfactorily with mercury-vapour valves up to 3,000 signals per second. If the signal consists of a group of waves of nearly equal magnitude and separated by a time-interval greater than the resolution time, the circuit may respond to the separate peaks and not once to a group if the time constant is too small Adjustment for this can be made in the selection of C_1 and R_1 and it is generally preferable for the higher speeds to reduce C_1R_1 by reducing R_1 rather than C_1, otherwise the extinction process becomes erratic.

A similar circuit, but one in which the output is taken from both valves, rectified by a double-diode valve and the average rectified current read on the indicating meter, has been described. Since the magnitude of this current is proportional to the number of pulses delivered per second, it follows that the current is proportional to the input frequency; a linear relation up to 7,000 c/s was obtained.

Applications as Instantaneous Switches: Pulse and Oscillation Generators

Single- and Multiple-pulse Square-waveform Generator.—A square-wave single-pulse generator or heavy-duty time-switch is shown in Fig. 7. It was originally developed for research on thermionic emission of oxide-coated cathodes in which the anode potential for measuring emission could only be applied for very brief periods. Numerous other applications are readily apparent where it is desired to switch a direct current for an accurately determined period without distorting the waveform in the switching device, the generator, however, being capable of use over a very wide range of current values.

The basic D.C. stopping circuit (referred to under frequency meter) is used, thyratron A being the switching valve and rated accordingly, whilst B acts to stop current flow in A after the predetermined time interval has elapsed. R_L represents the load. The timing of

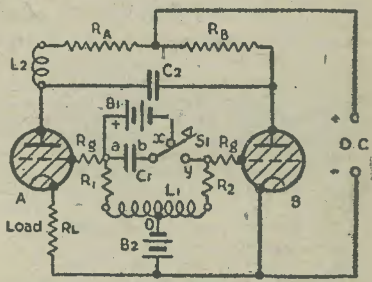


Fig. 7.—Generator of square-wave single pulses.

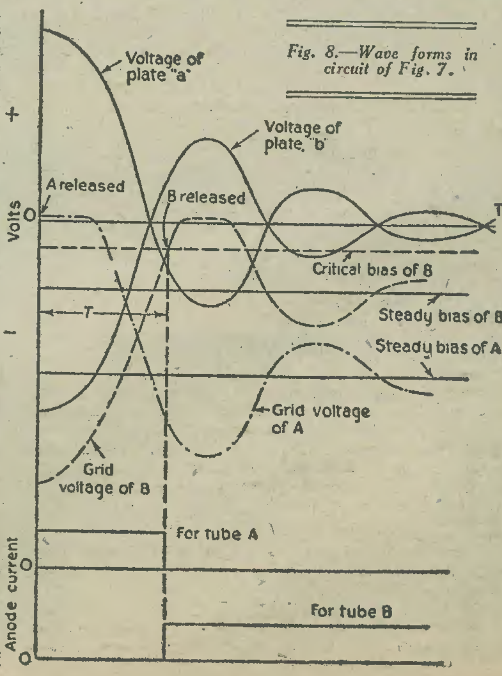


Fig. 8.—Wave forms in circuit of Fig. 7.

the passage of current is determined by the damped oscillatory circuit composed of $L_1C_1R_1R_2$, the action being as follows: Condenser C_1 is charged to the potential of the supply B_1, the plate "a" being positive, and the two thyratrons are biased by B_2 so that no current flows.

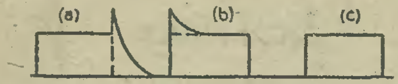


Fig. 9.—Current wave forms in circuit of Fig. 7. (a) current in RA with L2 absent. (b) current in RL with L2 absent. (c) current in RL with L2 in circuit.

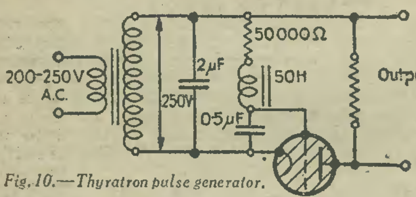


Fig. 10.—Thyratron pulse generator.

When spring key S_1 is depressed, C_1 is connected in parallel with L_1, and A is immediately released owing to the positive voltage between "a" and "o" bringing the bias of A below the critical value whilst, at the same time, the bias of B is made more negative. After approximately one-quarter period of the oscillation, plate "b" of condenser C_1 becomes positive and hence thyratron B is released, thus stopping A through the intermediary of condenser C_2 in the manner already described. If the damping of the circuit is so chosen by correct selection of the resistors R_1, R_2, it can be arranged that the grid of A is not again brought below the critical bias and so only one pulse of current passes through A, though B continues to conduct until its anode supply is switched off (see Fig. 8).

Owing to the charge and discharge current of condenser C_2, the wave shapes of the currents in R_A and R_L are different. Thus if L_2 is not present and R_A, R_B and R_L are resistive the wave shape of current in R_A is as shown in Fig. 9(*a*), the exponential "tail" being due to the discharge and charge in the reverse direction of C_2, this current flowing through B and the D.C. supply. In R_L the wave shape is as in Fig. 9(*b*), the top peak being due to the charging current of C_2, which flows through R_B, A and the D.C. source. Insertion of the choke L_2 delays the growth of the current in R_A at "make" in equal and opposite sense and magnitude to the condenser charging current, and a square-wave pulse of current in the load R_L results. It is for this reason that the load is placed in the cathode lead of thyratron A, resistor R_A being provided only for the purpose of obtaining a potential to which C_2 is charged. To obtain the desired condition the component values must be related by $R_A = R_B$ and $L_2 = C_2R_A^2$.

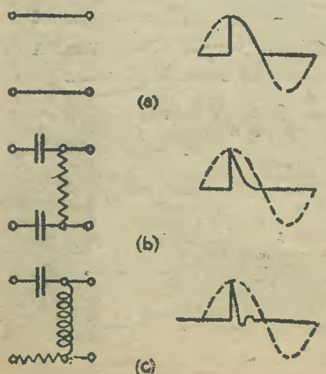


Fig. 11. — Wave form in generator of Fig. 10, and modifications.

Times of current flow down to 1 millisec. were readily obtainable and extension of the circuit for times up to 20 sec. is possible, the timing then being effected by the charging of a condenser and its sudden discharge through a neon lamp or a further thyratron.

These remarks on the current wave shapes have been given in some detail as they apply not only to this particular application but whenever this D.C. stopping circuit is used. Although in many applications the exact wave shape is immaterial, in others account may have to be taken of this and compensation applied as indicated.

If the grid circuit is driven by an alternating voltage in place of the oscillatory circuit, then square-wave pulses occurring at regular frequency and of duration equal to a half-period of the driving frequency may be obtained.

Peaked-pulse Generators.—For investigations on the ionosphere, in altitude meters, etc., which depend, in essence, on measurement of the time-interval between transmission and reception of a radiated pulse, it is necessary to have a very peaked pulse of short duration (1-100 microsec. depending on the particular purpose), so that accurate measurement can be made between corresponding points of the transmitted and received pulses.

When the recurrence frequency is that of the A.C. mains supply a thyratron, with its grid so phased with respect to the anode voltage that ignition occurs at the peak value of the anode alternating voltage, gives a useful and stable means of producing such pulses. A suitable circuit is shown in Fig. 10. The output voltage, which would be of the shape of Fig. 11(*a*) is modified by the addition of a condenser and resistor as in (*b*)

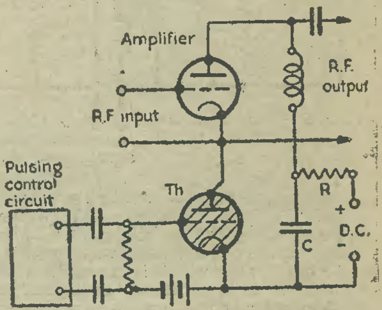


Fig. 12—Series control of H.T. supply in pulse amplifier.

or by a series circuit approximately critically damped which gives the form of (*c*). Such pulses are often applied to the control of a "squegger" oscillator, the thyratron controlling the commencement of oscillation and the oscillator itself the instant of cessation. The voltage from the trigger circuit may be supplied in series with the bias to the "squegger" oscillator valve, which latter is fed with raw alternating current on the anode and so operates only at the peak of the A.C. wave (owing to the setting of the thyratron release), or a series modulator valve may be inserted in the H.T. lead to the oscillator valve, the modulator being controlled by the trigger circuit.

With the advent of the high-voltage thyratrons now available it becomes possible to connect a thyratron directly as a switch in the anode H.T. lead to an oscillator or amplifier valve so that current flows only during the interval in which the thyratron is conducting, this being far more efficient than the modulator valve referred to above, owing to the negligible voltage drop across the thyratron. A simplified circuit is shown in Fig. 12, in which the thyratron Th is triggered by a pulse generator, e.g., by the circuit of Fig. 10, fed with voltage to the primary of the input transformer at the desired frequency of recurrence (not necessarily 50 c/s) so that condenser C, which was charged to the value of the D.C. supply, is discharged rapidly through the amplifier valve and thyratron in series. The con-

(*Continued on page 283.*)

denser volts fall below the ionisation potential of the thyratron and current is cut off from the amplifier. Thus the pulse width is determined by the rate of discharge of C, this being controllable by the resistance presented by the amplifier valve. During the periods of non-conduction C charges up again and the values of R and C are chosen to allow this to occur between successive pulses.

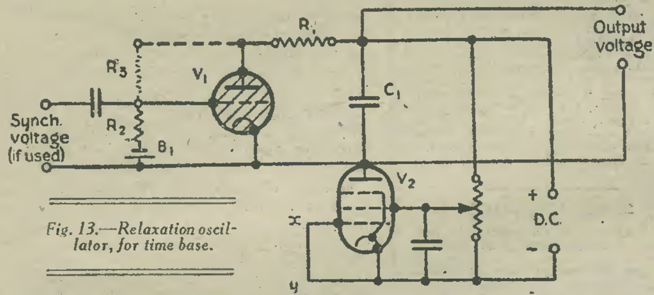


Fig. 13.—Relaxation oscillator, for time base.

Relaxation Oscillators.—When applied to relaxation oscillators the thyratron has a great advantage over the neon tubes first employed, owing to the much greater range available between the extinction voltage and voltage at which the arc can be struck, the latter being under the control of the bias applied to the grid. If the charging resistance is replaced by a pentode, which acts to maintain the charging current constant, a linear relation between time and condenser potential may be obtained with a "flyback" time so short that the trace is generally invisible on the screen of a cathode-ray tube and is thus well suited for use as a linear time-base.

Investigation of a thyratron for this purpose was made in 1932 by Reich, and further investigation has recently been made by Puckle. Both authors find that the upper limit of frequency of oscillation is not set entirely by the de-ionisation time of the valve but is due to the necessity of reducing the charging current as the capacitance is reduced in order to obtain extinction of the discharge.

A typical circuit on the above lines is shown in Fig. 13 in which the pentode V_2, operated above the knee of the anode-voltage/anode-current characteristic, acts to maintain constant the charging current to condenser C_1 from the D.C. supply. The voltage across C_1 eventually reaches such a value—determined by the bias applied to the grid of thyratron V_1—that a discharge passes through the thyratron, the condenser C_1 is rapidly and almost completely discharged, and the voltage falls below the ionisation potential of V_1 so that charging of the condenser then recommences. R_1 limits the discharge current of C_1 to a value within the emission capabilities of the thyratron. The bias on the grid of the thyratron determines, principally, the voltage amplitude of the time-base sweep, and the circuit as shown constitutes a self-operating time base.

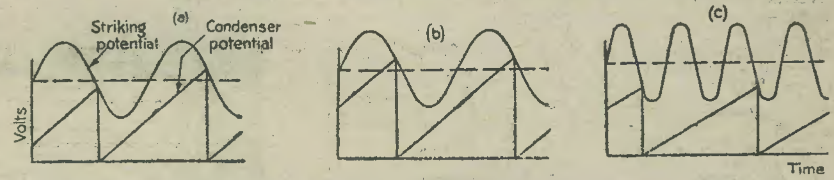
When the time base is to be synchronised with some signal occurring at predetermined intervals, this signal is applied to the grid of V_1, at the terminals shown, and has the effect of altering the value of anode potential at which the valve strikes; such a signal should, whenever possible, have a steep wave-front in order to give precision of timing. It is necessary, of course, to ensure that the time base, in the unsynchronised condition, is relatively free of frequency drift. One common type of synchronising signal, however, is of sinusoidal form and it is obvious that the striking of the discharge must occur at exactly the same anode voltage in each successive cycle; in general this can occur only if the period of the synchronising signal is equal to, or some integral multiple of, the period of the relaxation oscillation. Fig. 14(*a*) shows the condition when the synchronising signal is of too low a frequency and synchronisation cannot be obtained since the thyratron does not fire at similar points of the synchronising cycle; Fig. 14(*b*) shows the correct condition when synchronising and time-base signals are of equal periodicity; and Fig. 14(*c*) the case when the synchronising signal is a multiple of the time-base recurrence frequency. This question has been fully investigated by Builder and Roberts and independently by Guljaev, these investigators arriving at similar conclusions.

A simple means of stabilising such an oscillator and making the circuit more independent of changes of ignition potential—e.g., due to temperature changes—is to connect a resistor R_3, as shown dotted in Fig. 13, between anode and grid of the thyratron so that the grid potential is dependent on the anode-cathode potential of V_1. By increasing the value of R_2, and increasing the value of bias from source B_1 to correspond, it was possible to bring the frequencies generated by two valves which were of such widely differing characteristics as to give, originally, frequencies of 500 and 850 c/s respectively to a common value around 650 c/s within a few per cent. Another advantage is that the circuit is more stable as regards spurious voltages, e.g., at A in Fig. 15; in the normal circuit this would fire the thyratron but here the bias is too great as, when the condenser discharges, the grid starts at a low negative value (from B_1) and the bias approaches the critical value only near the point where the synchronising pulse is applied. Resulting also from the large negative bias on the grid at the time of the condenser discharge is the advantage that positive ions are cleared more rapidly and so possible use at higher frequencies is indicated.

(Courtesy of the Institution of Electrical Engineers.)

(To be continued)

Fig. 14.—Voltages in sinusoidally-synchronised time base.



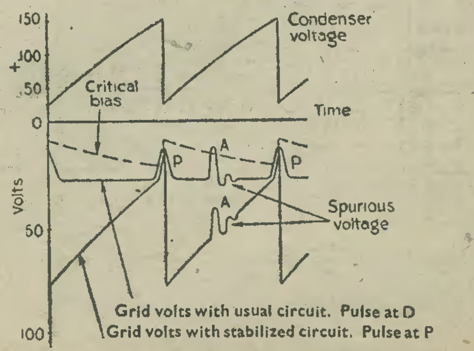


Fig. 15.—Stabilised relaxation oscillator voltages.

Practical Hints

A Bandsetting Unit

I WANTED to construct a short-wave receiver utilising "band spread" tuning, but I was short of a "band-setting unit." Looking through my junk-box I came across an old Lissen filament rheostat, and this I converted to a bandset unit in the following manner:

I removed the ebonite former, on which the resistance wire was wound, and replaced it by a strip of aluminium. On this I filed the appropriate number of location marks—in my case, there were 12. Great care must be taken when doing this, to see that the location marks are accurately spaced, and only cover 180 deg.

The contact arm was fixed to the spindle by a large-headed screw, the head of which was filed flat and then tinned. The tip of the contact arm was then bent so as to fit comfortably into the location marks. To complete the unit a short length of $\frac{1}{4}$in. dia. brass rod was soldered firmly to the head of the screw. The method of assembly is shown in the accompanying sketch. The bandset unit is mounted on the panel, the condenser being mounted on a bracket, and this is coupled by a flexible coupler to the extension brass rod on the unit.

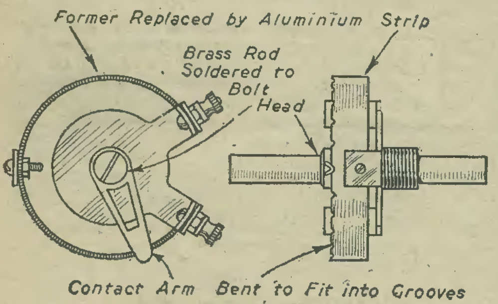
If the unit is fitted with a knob with a pointer, a piece of ivorine can be fixed under the control, and marked as desired.—D. A. SNOWDEN (Lincoln).

THAT DODGE OF YOURS!

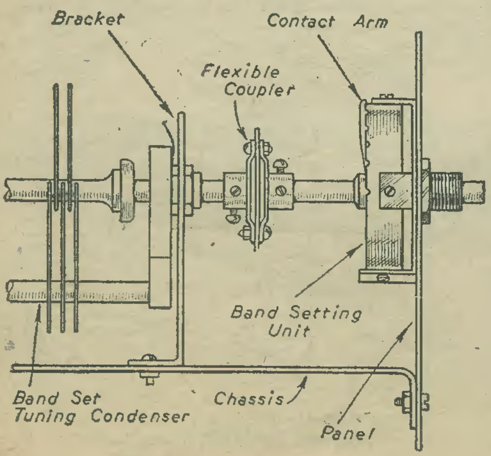
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending 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.



Side elevation of the bandsetter.



The complete bandsetting unit.

Tracking Gear for Home Recording

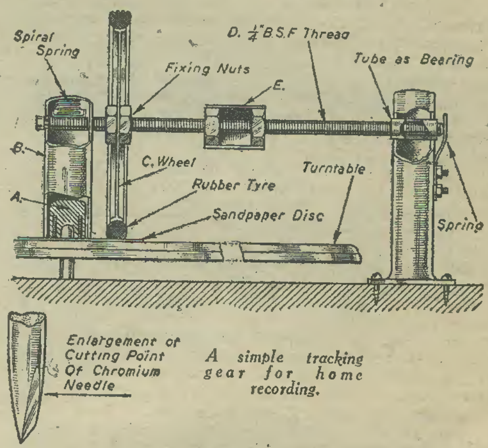
DETAILS of a simple but effective tracking gear for home recording are given in the sketch below.

On the record spindle is placed part A, which is a brass boss screwed to a 3in. diameter iron disc covered on both sides by a sandpaper disc to increase friction on the record, and also on the wheel C.

Over the boss is placed a close-fitting tube, B, with two holes opposite each other about $\frac{1}{2}$in. from the top as a bearing for the threaded rod D. A small spiral spring assures a good bearing, as the end of D is flanged.

As the turntable revolves the rubber-tyred wheel C, which is firmly fixed to D, revolves by contact with disc A, and this moves E (two nuts $\frac{1}{2}$in. apart inside a hexagonal tube), to which is attached a moving iron pick-up. E moves *outwards* as the record revolves, so tracing a groove in the record.

The bearing for the other end of D consists of a tube placed horizontally across two holes in an upright $\frac{3}{4}$in. pipe. The end of D is kept in position by a spring.



A simple tracking gear for home recording.

This method gives a track of approximately 50 grooves to the inch as compared with 100 on commercial records. D is threaded with $\frac{1}{4}$in. B.S.F. thread with 25 turns to the inch.

As aluminium discs are unobtainable, I am experimenting with waxes. A mixture of paraffin wax (candles) and pitch (H.T. battery) shows most promising results.

The cutting needle used is a chromium "long-playing" needle sharpened to a cutting edge on an oilstone.

The finished records are coated with thin shellac, and if fibre needles are used for playing back they are very durable. The base of the records is thin card, 8in. in diameter, and the wax is applied while the disc is inside a tin lid, and gently warmed in a cool oven, when a very smooth surface results.—D. T. G. HARRIS (Horsham).

ON YOUR WAVELENGTH

By THERMION

Abolish the Brains Trust

ONCE again I invite the B.B.C. to abolish that fantastic waste of public money and programme time—the Brains Trust. It is not a Brains Trust, and as a form of entertainment it does not justify itself. If we subscribe to the doctrine that one is either thoroughly amused or thoroughly annoyed by public entertainment, then for one I am thoroughly annoyed with the Brains Trust. As a means of airing personal views I suppose it is highly successful, but my main objection to it is that, judging from the answers given, the Brains Trust lacks brains. Very few of its members are able to speak cohesively and coherently. The answers are plenteously punctuated with er-ers, as if the speakers are uncertain of themselves. A question the other day was: "How do you define cleverness?" None of the speakers gave a good answer.

The Trust sessions are nothing more than the sort of idle badinage and persiflage which spices the average drawing-room dialogues in the homes of the opulent, where conversation and a discussion of the opera is an indication that you lead a really useful life.

You remember the words in Oscar Wilde's "An Ideal Husband." Lord Goring, in that famous play, is accused by his father of living an idle and useless life. His fiancée retorts: "But he rides in the park three times a day. He changes his clothes three times a day, and he attends the opera throughout the season every night! Surely that is not leading a useless life?"

Some members of the Trust are idols with feet of clay. Particularly I resent the quick-fire back-chat of some of the females, who seem afflicted with that most terrible of female afflictions, wagging tongues. Perhaps you recall the story of the man who applied to the Court for a separation order against his wife. "Upon what grounds?" asked the magistrate. "She just talks, and talks, and talks at me all day long," replied the husband. "What does she say?" asked the magistrate. "She won't tell me," replied the husband. You also remember the story of the schoolboy who wrote an essay. When it went to the schoolmaster for marking purposes, the latter remarked: "I congratulate the writer of this essay, who has diligently filled in 12 pages without saying anything." These two stories summarise my opinion of the Brains Trust, whose title is a gross libel on brainy people. The cacophonous laughter with which they greet their feeble jokes has an effect upon me similar to treacle running down my neck, and I want to dive feet first through my loudspeaker. I still think it should be called the "Brines Trust," because you have to take a large pinch of salt with its answers. The continued selection of stupid questions, the answers to which can never be right and never be wrong, is another point which the B.B.C. should take into consideration.

The stuttering manner in which the questions are put gives me the fidgets and the jimjams.

Our Roll of Merit

Readers on Active Service—Forty-second List.

D. Allan (A.C.1, R.A.F.).
G. Clouston (L.A.C., R.A.F.).
W. A. Bassi (Cpl., Home Forces).
J. W. Nott (L.A.C., R.A.F.).
S. G. Burrage (Cfn., R.E.M.E.).
F. Mumford (Cpl., R.A.F.).
J. L. Bedford (A.C.1, R.A.F.).
H. Frigg (L.A.C., R.A.F.).

The Wireless Valve as a Weapon of War

EXAMPLES from his own experience of how the wireless valve was used during the last war to aid in intercepting enemy messages and to locate the radiating stations provided some of the high spots in a most interesting talk given by Captain H. De A. Donisthorpe—introduced by the chairman of the squadron, Mr. A. H. Whiteley—to the boys of No. 384 (Mansfield) Squadron A.T.C. on March 22nd, in the canteen of Messrs. Whiteley Electrical Radio Co., Ltd.

After describing the evolution of the valve from the days of the first filament electric lamp and its later application to such peacetime tasks as broadcasting, long-distance telephony, television and talking pictures, Captain Donisthorpe went on to describe its services to the B.E.F. in the last war. He then outlined the greatly increased scope and importance of the valve in the present conflict, which has seen radio installed in all ships and aircraft, and in nearly all mobile transport, and which has presented problems in the detection of mines and submarines, and the development of radiolocation that the modern valve has done so much to solve. A clear picture of the basic principles of radiolocation and radio detection finding was given by a practical demonstration employing light waves in place of radio short waves.

Adults present were most impressed by the way Captain Donisthorpe commanded the enthralled attention of the boys throughout his talk, and there can be no doubt that he imparted to many young minds something of his enthusiasm for the fascination of radio.

An informal reception was held after this talk, and among those present were Flying Officer R. P. Marchant, R.A.F.V.R., adjutant of the Mansfield Squadron; Mr. Orange, principal of the County Technical College; and Squadron-Leader Ball, who represented the Nottingham Wing.

WE SHOULD BE THE BOSS

[Press Item—There is a suggestion that the B.B.C. is anxious to cut expenses and to employ cheaper artists. No doubt they will suitably reply to this.]

There's a doubt about that—
That isn't their way,
One fears explanations
Will not come our way.
They'll do as they like,
As they always have done,
And the programmes in future
Grow ever more glum!

They laugh up their sleeves
At our futile complaints,
And insist that they function
As cultural saints;
And all that we do
Is grizzle and moan,
Too spineless to fight
For what is our own.

The remedy's obvious.
We're wilfully blind,
Or a way to improvement
We quickly would find.
Make them learn from this maxim
They are not immune,
That as we pay the piper,
We'll settle the tune.

"TORCH."

Frequency M

F.M. Transmissions are, at the Present, Purely
but this Article will Prepare Readers for Any F

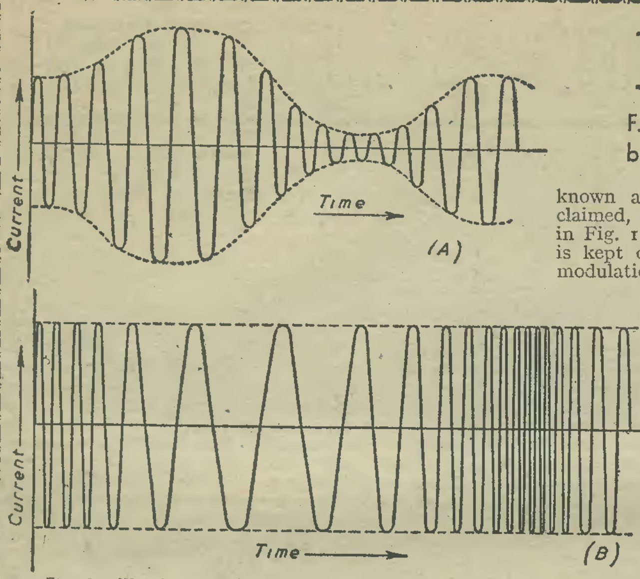


Fig. 1.—Waveforms of (A) Amplitude and (B) Frequency Modulation.

THE type of broadcast transmission to which we are accustomed in this country is known as the amplitude-modulated (A.M.) system. In this, the waveform of the current in the transmitting aerial —and therefore also in the receiving aerial—is as shown in Fig. 1 (A). The amplitude of the current is varying in sympathy with the audio-frequency signal being broadcast, and we know that one effect of modulating a carrier in this way is to produce sidebands, which extend in the case of a high-fidelity broadcast transmitter up to 10 kc/s above and below the carrier frequency so that the transmitter occupies a bandwidth 20 kc/s wide in the ether spectrum.

Broadcasting authorities in the U.S.A. have been using for a number of years now a system of modulation known as frequency modulation (F.M.), which, it is claimed, has great advantages over A.M. As shown in Fig. 1 (B) the carrier amplitude in the F.M. system is kept constant, but its frequency is varied by the modulation, being swung above and below its average value, the number of swings made per second corresponding with the audio-frequency signal. This system also generates sidebands and in considerable numbers and they occupy a total bandwidth of about 240 kc/s in the case of the American system. It is this fact which has restricted the use of F.M. to the ultra-short wavelengths and we find in the U.S.A. that the carrier frequencies used by the F.M. transmitters lie generally between 40 and 50 mc/s (i.e., between 6 and 7.5 metres). F.M. receivers may be "straight" or superhet, but the chief features of both types are these: they must be capable of tuning to the very high carrier frequencies used; they must be capable of accepting the wide bandwidth of 240 kc/s and finally—this being the chief difference between an F.M. and an A.M. receiver—in order to supply an output suitable for operating a normal A.F. amplifier an F.M. detector has to convert *frequency fluctuations* into *voltage fluctuations*. Such detectors are known as *discriminators* and they are familiar to us even in A.M. receiver design for they are also used in circuits for automatic frequency control (A.F.C.).

A block schematic diagram of a typical superhet F.M. receiver is given in Fig. 2 (A) and this may be directly compared with the diagram for a conventional A.M. superhet which is given in Fig. 2 (B). The limiter which is included in the chain of the F.M. receiver has the desirable effect of rendering the receiver immune to voltage fluctuations in the receiving aerial such as those caused by natural and man-made static. Let us now consider the differences between F.M. and A.M. receivers in greater detail to see how they will affect the home-constructor of F.M. receivers.

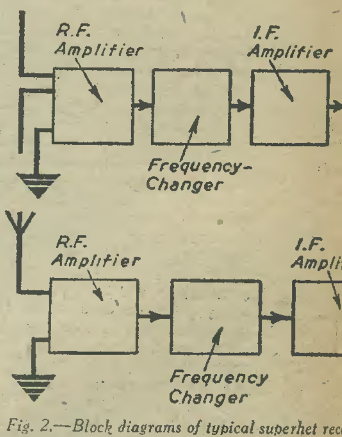


Fig. 2.—Block diagrams of typical superhet rec

The R.F. Amplifier

Firstly, the fact that very high carrier frequencies are used for F.M. transmissions simply means that we have to use ultra-short wave technique in reception, and it is, therefore, advisable to use low-loss components and high-slope valves such as the types developed for television reception. Suppose we wish to receive an F.M. transmission on, say, 45 mc/s (6.67 metres). The first tuned circuit of the R.F. amplifier which is employed to give a good signal-to-noise ratio at the frequency changer grid, could very well consist of a coil of .25 μH inductance and a short-wave tuning condenser of

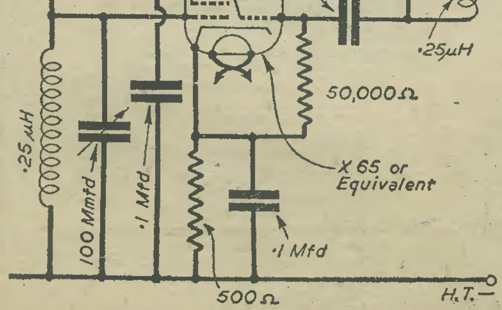


Fig. 4.—A typical frequency changer stage of an F.M. superhet.

Modulation

of Academic Interest in this Country, ...re Developments. By S. O. MAWS

100 m.mfd. maximum capacity. This will give the correct tuning point with the variable condenser at about its middle setting. The aerial to be employed is likely to be a horizontal dipole as indicated in Fig. 3, and the coupling to the first tuned circuit can be by means of the usual mutual inductance as shown. Notice the screened down-lead. In Fig. 3, which illustrates the complete circuit of the R.F. amplifier, the values of all components are given.

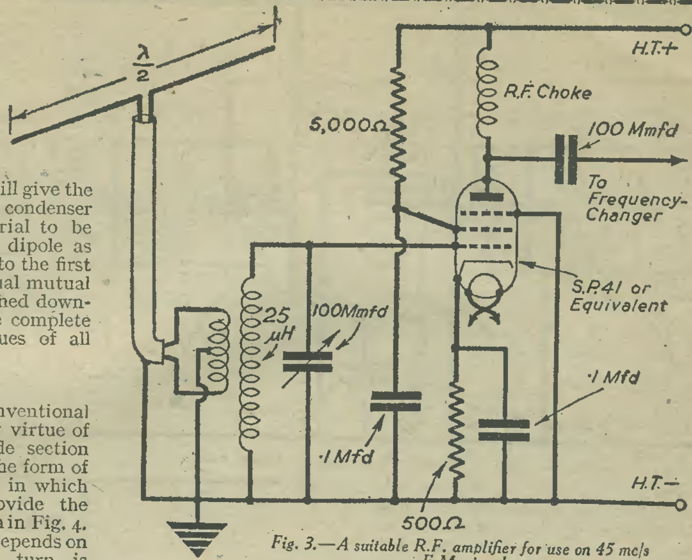
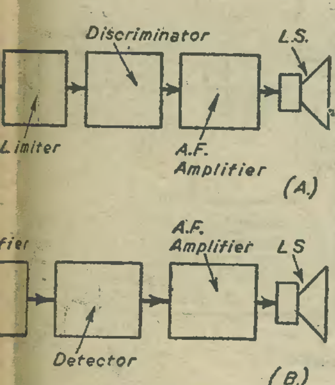


Fig. 3.—A suitable R.F. amplifier for use on 45 mc/s F.M. signals.

The Frequency Changer

The frequency changer may be a conventional triode-hexode of the X65 type, and by virtue of the high frequency at which the triode section is required to oscillate, this may take the form of a special variety of Colpitt's oscillator in which the triode inter-electrode capacities provide the necessary feedback. The circuit is given in Fig. 4. The value of the oscillator components depends on the frequency required and this, in turn, is dependent upon the value of the intermediate frequency employed. A usual value for the latter is 4.5 mc/s, which gives the oscillator frequency as 49.5 mc/s. The same values of L and C which were mentioned previously may be used for both the input and oscillator sections of the frequency-changer, and unless the tuning of the receiver is to be preset, a ganged condenser should be employed with three sections, one for R.F. tuning, and the other two for the signal frequency and oscillator sections of the frequency-changer.



...eivers for (A) F.M., and (B) A.M. transmissions

I.F. Amplifier

The tuned windings of the I.F. transformers must resonate at 4.5 mc/s and in addition must have an effective band-width of 240 kc/s. The former condition can be realised by using a tuned circuit comprising an inductance of 25μH and a condenser of 100 m.mfd. maximum capacity, resonance occurring with the condenser about half engaged. The wide bandwidth can be obtained by using a close coupling between each primary and secondary winding (i.e., by letting them be fairly close together) and by connecting resistances across each winding. The close coupling gives widely separated peaks in the bandpass response, as shown by the dotted curve in Fig. 5, and the resistances (values of 20,000 ohms will be suitable) damp the response so that the curve is substantially flat, as shown by the solid lines in Fig. 5. These resistances have the rather unfortunate effect of reducing the amplification considerably and so at least two, and preferably more stages of I.F. amplification will be necessary in the receiver. One stage, with the values of all essential components, is illustrated in Fig. 6. The valve should again be a high-slope television type of R.F. pentode, unless A.V.C. is employed when a variable-mu type will be essential.

The Limiter

A limiter is not an essential feature of an F.M. receiver; that is to say, the receiver will work without it, but it does give the receiver that very quiet background which is such an attractive feature of F.M. reception, and high quality F.M. superhets often use two limiters in cascade. The limiter may take the form shown in Fig. 7. An R.F. pentode operating with an abnormally low anode and screen potentials (about 50 volts) will reach the saturation value of anode current with a grid input of about 3 volts. Any increase in grid signal beyond this value does not affect the anode current, and if the valve is normally operated with an input signal greater than this, the receiver will not respond to voltage fluctuations in the aerial but only to fluctuations in frequency. In some F.M. receivers the limiter

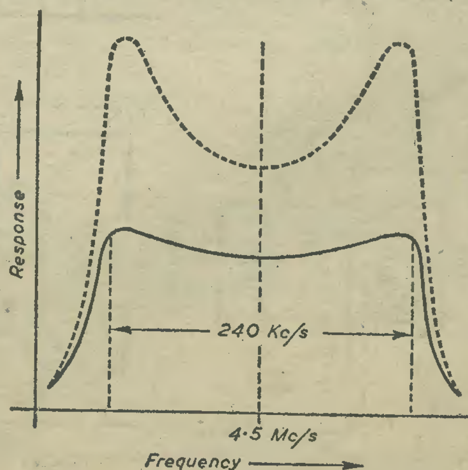


Fig. 5.—Frequency response curves of the I.F. transformer when damped and undamped.

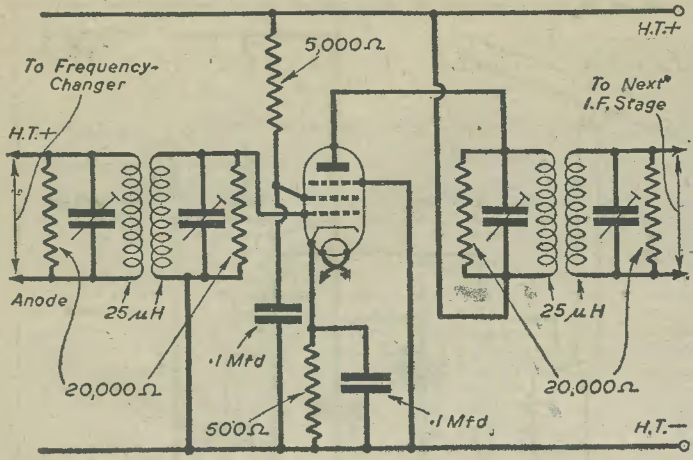


Fig. 6.—One of the I.F. stages with component values.

incorporates a grid-condenser and grid-leak and operates as a sort of leaky-grid detector, the negative potential developed across the grid-leak being used as an A.V.C. voltage by the valves of the I.F. amplifier, which therefore have to be of the variable-mu variety.

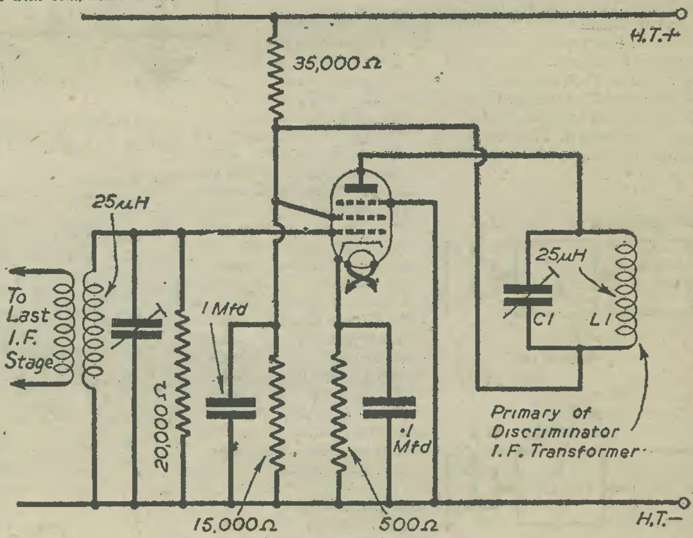


Fig. 7.—One form of limiter circuit.

The Discriminator

Possibly the most convenient type of discriminator is that illustrated in Fig. 8. Though rather difficult to explain it is by far the simplest type to build and adjust, as the tuned circuits L_1C_1 and L_2C_2 are both aligned to 4.5 mc/s. The circuit comprises two diodes which may be contained in a single bulb, provided that they have independent cathodes. They function as normal diode detectors but are arranged to give equal and opposite voltage outputs which cancel, giving a net output of zero volts for signals of exactly 4.5 mc/s. Due to the phase relationship between primary and secondary windings, when both tuned circuits are lined up to 4.5 mc/s, exact cancellation of output does not occur for signals, which are applied to the discriminator, and which are not exactly 4.5 mc/s in frequency. In fact the net output is proportional to the deviation from 4.5 mc/s being positive (say) for frequencies above 4.5 mc/s and negative for frequencies below that value. In A.M. receivers with automatic frequency control this discriminator output is utilised to apply a correction to the oscillator section of the frequency changer so that the oscillator frequency is slightly altered and the mistuning of the receiver is automatically corrected. In an F.M. receiver, however, the discriminator output provides the input for the audio-frequency amplifier and as this follows conventional practice there is little point in describing such amplifiers here. The same remark could, with equal truth, be said about the power pack. One point about the A.F. amplifier should be stressed, however, and this is that F.M. is used generally for extremely high-fidelity transmissions (the U.S.A. transmitters have a response up to 15,000 c/s) so that the A.F. amplifier should have an extremely good frequency response.

It is, therefore, very necessary to pay much more attention to the design and characteristics of the L.F. section of the receiver, and, incidentally, the response curves of the loudspeaker, than in the case of an A.M. receiver, even if the latter is of the high-fidelity type.

The requirements outlined above are a step in the right direction, and designers will welcome the opportunity of coping with a wide audio-frequency band rather than the clipped range now available with A.M. transmissions.

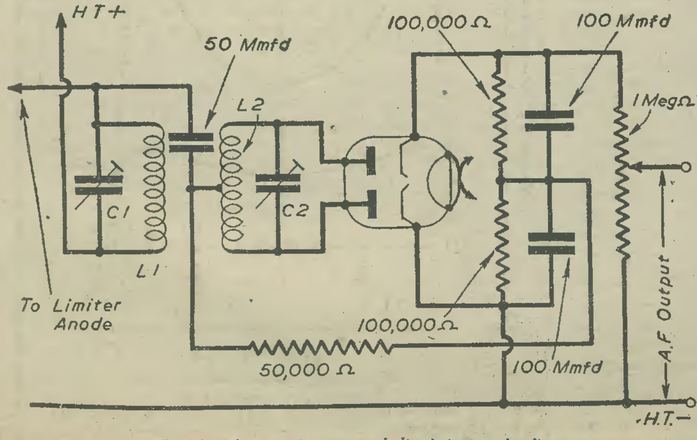


Fig. 8.—A convenient type of discriminator circuit.

Radio Examination Papers—30

Another Set of "Test Yourself" Questions, With Representative Answers.

By THE EXPERIMENTERS

1. Morse Reception

IN order to receive continuous-wave morse it is necessary to produce a beat note, at audible frequency, with the incoming signal, or with the intermediate-frequency signal derived from it. This is necessary because the receiver radio-frequency will not actuate telephones or a loud speaker. In addition, some form of H.F. stopper is normally fitted after the detector stage to prevent radio-frequencies from entering the L.F. amplifier.

To produce a beat note in a superhet it is necessary to mix with the I.F. signal an oscillation of slightly different frequency. The audio-frequency note generally found most pleasant, and to which the ear is most responsive, has a frequency of about 1,000 cycles per second. This means that if the intermediate frequency is at 465 kc/s an oscillation of approximately 464 or 466 kc/s must be mixed with the output from the last I.F. stage.

In practice, we make an oscillator to operate at the same frequency as the I.F. amplifier and provide a small tuning condenser so that the exact frequency generated can be varied a few kilocycles on each side of that frequency. The reason for providing a variable output is that the I.F. may not be at exactly the nominal frequency. Additionally, it is sometimes found that interference can be reduced by altering the beat frequency to a certain extent.

The beat-frequency oscillator (as it is called) can have any type of oscillator circuit such as Hartley, Colpitts or electron-coupled, and all these three are employed in different designs of communications receiver. The last-mentioned is the simplest, and a circuit is shown in Fig. 1. It will be seen that a single, tapped coil is used, and that this is shunted by a small variable condenser. The tapping is situated about one-fifth of the way up the coil, and is connected to the cathode of the oscillator valve. Self-bias is provided by means of the usual grid condenser and leak.

Output from the oscillator is taken from the grid, and coupling to the I.F. transformer is by means of a single turn of wire round the I.F. transformer. An alternative method of coupling is by twisting the output lead round the "grid" lead from the I.F. transformer, so that a low-capacity coupling is obtained. In use, the oscillator tuning condenser is first turned through its full range; it will be found that a "hiss" will be heard over most of the movement, but that the "hiss" will cease at one setting of the condenser. At that setting the oscillator will be tuned to the same frequency as the I.F. To obtain the required beat note, the condenser setting should be slightly removed from this; the optimum position is found by trial after tuning in a C.W. transmission.

It should be mentioned in passing that oscillator-coil assemblies are made for use in a circuit of this kind. They are generally complete with the grid condenser and leak, and sometimes with the tuning condenser. If a suitable component is not available, it is not difficult to modify one winding of an I.F. transformer and to mount the condenser and leak inside the screening can.

QUESTIONS

1. *How may a normal type of broadcast receiver, of superhet type, be modified for the reception of C.W. morse?*
2. *By what means can a wireless transmission be made directional?*
3. *If it were found that an all-wave receiver with regenerative detector produced a mains hum when at or near the oscillation point, what steps would you take to overcome the trouble?*
4. *What is the difference between C.W., M.C.W. and I.C.W.?*
5. *What is a cathode-follower valve stage, and what advantages and disadvantages does it show over a normal amplifier stage?*

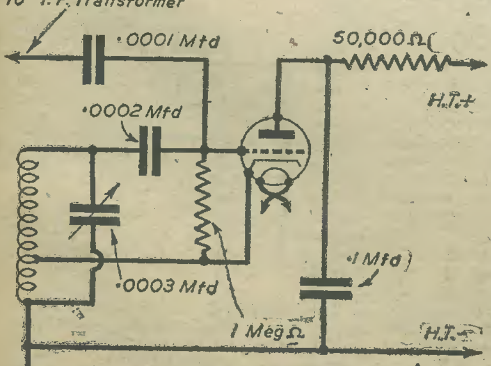


Fig. 1.—An oscillator circuit suitable for use as a beat-frequency oscillator with a superhet "broadcast" receiver.

2. Directional Transmission

Perhaps the most obvious method of providing directional transmission is by arranging a metal reflector behind the aerial. One simple arrangement is illustrated in Fig. 2, where it will be seen that a rod slightly longer than the aerial itself is situated one-quarter wavelength behind a vertical quarter-wave aerial.

This gives only a slight directional effect, and a very wide beam. The beam can be narrowed by placing "directors" in front of the aerial; these are rods slightly shorter than the aerial itself, and they are spaced by one-quarter wavelength. The greater the number of directors, the narrower is the transmitted beam; in other words, the greater is the directional effect. This type of aerial is known as the "Yagi."

Another method of providing directional transmission is by the use of multiple dipole aerials, spaced by one-half wavelength and arranged one above the other, as shown in Fig. 3.

This arrangement is known as a "stacked-dipole" array, for fairly obvious reasons. It produces a broadside directional effect, but beam in two diametrically-opposite

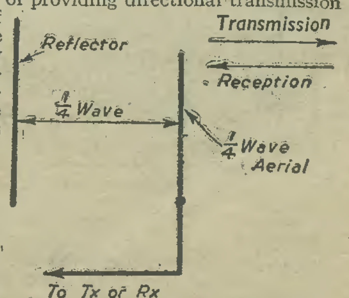


Fig. 2.—A simple method of providing directional transmission and reception with a quarter-wave vertical aerial.

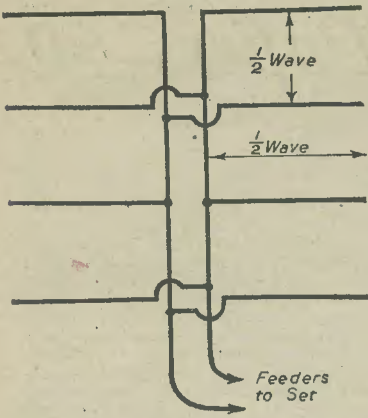


Fig. 3.—A stacked dipole or broadside aerial array.

directions. In order to cut out the backward radiation it is necessary to place a metal-network reflector three-quarters of a wavelength behind them.

The two forms of directional aerial described are applicable principally to short-wave transmissions. Directional transmission on medium and long waves is very difficult because of the physical size of the aerial and its reflectors. On ultra-short waves directional transmission is still easier to provide, since the aerial may be so small that it can be fitted within a parabolic reflector not unlike the reflector of a motor-car headlamp, only much larger.

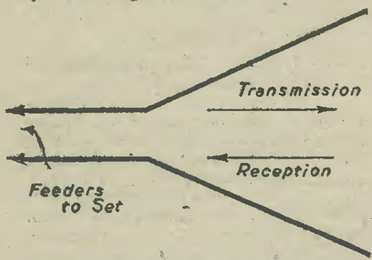
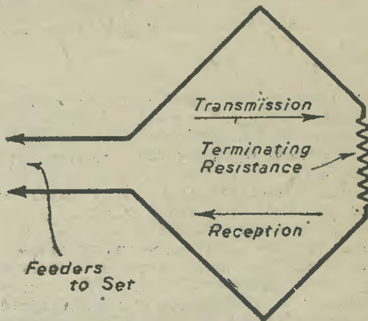


Fig. 4 (Left).—Plan view of a directional aerial.

Fig. 5 (Right).—Diagrammatic form of a so-called rhombic aerial array.



Reasonable directional effect can be obtained on short-medium waves by the use of a "V" aerial system, as shown in Fig. 4. The maximum radiation (or pick-up in the case of a receiver) takes place along a line emerging from the centre of the open end of the "V" but the angle is normally fairly wide. Another form of aerial suitable for use on short-medium waves is the so-called rhombic, as shown diagrammatically in Fig. 5. This has maximum directional effect along the longer axis of the diamond and away from the terminating resistor.

In the case of both of the two aerial systems just described, the angles of the various arms and the lengths of these arms in relation to the frequency on which transmission or reception is to take place, are somewhat critical and have to be worked out accurately. It is not possible to give full details in the space available here.

3. Mains Hum on Oscillation

The mains hum referred to could be due to two entirely different causes. In one case—most likely where a battery set is concerned—it is due purely and simply to pick-up from nearby mains leads by the grid circuit of the detector valve. The remedy may lie in moving the receiver to a different position, or in screening the grid lead to the detector; it is assumed that the grid coil employed is already screened.

In the case of a short wave receiver, in particular, it may be found that slight re-routeing of the aerial lead-in will overcome the trouble; it might even be necessary to use screened or co-axial cable for the few feet of the lead-in between the wall and the receiver.

Where a mains-operated receiver is concerned it is more probable that the hum is being fed into the set via the heater leads, but the methods already explained should be tried before making any further alterations. If screening the grid lead and removing the aerial lead do not affect the hum, it can fairly safely be assumed that a modification to the heater wiring is called for. See that the leads to the valve holders are twisted together and that they do not run very close to a grid lead, or to the grid condenser.

If adjustment here is in vain it will probably be necessary to connect a .01 mfd. fixed condenser between one or both of the heater leads and earth. Make sure in the first place that the centre-tap of the heater winding on the mains transformer is correctly earthed and try the effect of connecting a fixed condenser between first one side and then the other of the heater supply. The condensers should be placed close to the detector valve holder and the leads connected, if possible, to the valve holder terminals themselves. Make sure also that the chassis is adequately earthed, and that all earth-bonding is sound.

4. C.W., M.C.W. and I.C.W.

Just to make sure that the terms are understood, it will be well to point out that the initials stand for: continuous wave, modulated continuous wave, and interrupted continuous wave, respectively. The first type of transmission was mentioned in the answer to question one above, where it was pointed out that the oscillation is at signal frequency. In order to produce morse characters the transmission is chopped up by means of the morse key, but at comparatively low frequency—probably no more than 10 per second.

The transmission is therefore in the form of a series of short bursts of C.W., and it can be made audible at the receiver only by producing a beat frequency. The series of oscillations produced are of sine-wave form.

Modulated continuous wave is more like radio-telephony in that the signal frequency oscillation has imposed upon it, at the transmitter, an audio frequency oscillation. Thus, the carrier wave may be modulated by a 1,000-cycle note. The morse key is again used to "stop-and-start" the transmission, but at the receiver the 1,000-cycle note is audible after normal detection. There is no need to use a second oscilla-

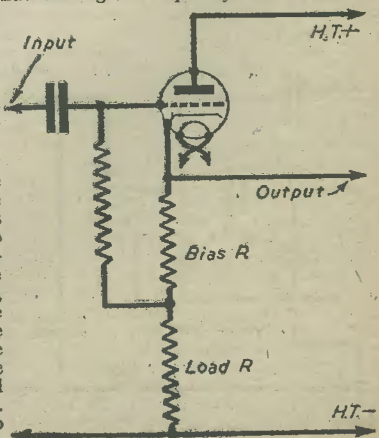


Fig. 6.—Skeleton circuit of a cathode-follower stage.

tion to produce a beat note. Interrupted continuous wave is very similar to M.C.W., except that the received note is not quite as pleasant and "smooth." It is produced by interrupting the keying circuit of the transmitter at an audible frequency. Thus, in addition to the transmitter output being broken up by the morse key to produce dits and dahs, it is also interrupted at audio frequency. This means that the dits and dahs are audible after detection, and that a beat-frequency oscillator is not required in the receiver.

5. The Cathode Follower

This type of valve stage differs from the usual amplifier in that the whole of the load is inserted in the cathode, instead of the anode circuit, as shown in Fig. 6. The output is also taken from the cathode. As a result, there is no phase inversion in the valve, as there is when an anode load is employed and the output is taken from the anode.

Additionally, however, since the load resistor is not by-passed, there is 100 per cent. negative feed-back. Because of this the valve does not produce any amplification; in fact, there is a certain amount of attenuation, the normal output being between .9 and .99 of the input.

Because of the method of connection followed, there is no "Miller Effect" capacity, and therefore the input capacity to the stage is negligible. (This point will more readily be understood by those who read the recent series of articles on "Low-Frequency-Amplifier Design".) In addition, however, the valve will tolerate a high output capacity without loss of either output or "quality."

Due to the negative-feedback properties the output remains sensibly constant over a range of input voltages and output loads, and the output is practically independent of the voltage amplification factor of the valve.

This type of circuit was often used in ultra-high-frequency television amplifiers, and was interposed between pairs of amplifier stages. It can also be used as an output stage from an aperiodic amplifier placed near to an aerial which is coupled to the receiver through a very long co-axial feeder. Such a case may be met when reception free from man-made static was required, and when the aerial had to be sited a long way from the receiver; the aerial may be on a hill remote from electric cables and the like while the receiver was in a room in a large block where there was electrical machinery, for example.

The Testing of Radio Equipment and Its Treatment to Meet Extreme Climatic Conditions

Précis of a Discussion at a Meeting of the Wireless Section of the Institution of Electrical Engineers

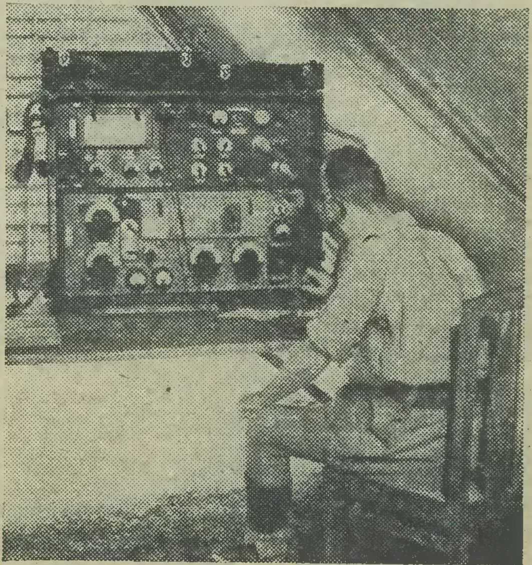
THE discussion was opened by Mr. P. R. Coursey, B.Sc., in place of Mr. E. M. Lee, who had originally promised to introduce the subject. Mr. Lee was, however, able to be present and to contribute to the discussion.

It is increasingly being realised that radio equipment often has to operate under severe climatic conditions. Contrary to some views, these are no more severe to-day than they were some few years ago. In the early days of the war radio equipment was constructed with components which were readily available without consideration being given to the ability of these components to give good service under the climatic conditions in which the equipment was ultimately used. It is not surprising, therefore, that the performance of some of this early equipment proved unsatisfactory, although on the whole it has not been as bad as some would imply. The term "radio equipment" here covers the multitudinous electrical equipment currently used by the Fighting Services, much of which would not be included in the hitherto accepted definition of radio-communication apparatus.

Extreme climatic conditions usually involve large ranges of temperature, pressure and humidity. The maximum temperature range so far envisaged is from minus 40 deg. C. to plus 110 deg. C., and the pressure range from 1,000 mm. to 160 mm. of mercury, and the humidity range up to 100 per cent. Fortunately, the most extreme of these three conditions never occurs simultaneously. The worst probable combination will differ as between one component or material and another, which doubtless accounts for some of the differences of opinion expressed regarding the efficiency of any particular testing technique.

The temperature range to which a piece of equipment may be exposed is controlled not only by the atmospheric temperature range of the location of service, but also by that obtaining in any vehicle, craft or enclosure in which the equipment may be conveyed or used and which may superimpose temperature conditions of its own. Two temperature ranges need therefore to be recognised, namely, that of storage and that of use. Next in order of importance is the range of atmospheric pressure liable to be encountered in service, and thirdly the range of atmospheric humidity both in storage and in service.

The effects of these extreme climatic conditions on a component or material can be considered under different heads, each of which has an important effect on the ultimate performance of the equipment. These are, first, the ability of the component or material to withstand the combination of extreme conditions, and secondly the manner in which the materials of which the component is built up age with time under the



This equipment, forming a mobile transmitting station in Ceylon, is subjected to high temperatures and humidity.

combined actions of heat, humidity, electric stress, etc. The second effect determines the extent or manner in which the component will behave, not now, but at some later stage during service.

Where electrical performance only is concerned, the following must be considered: adequate sealing against moisture; the ability of materials to withstand applied stress, voltage, current, etc., over the temperature range; the effects of high or of low temperature on the mechanical ageing of the materials, which in turn affects their electrical performance, either directly or because ageing destroys the ability of the materials to retain their resistance to moisture penetration; and lastly the effects of low atmospheric pressure on the breakdown strength of the surrounding atmosphere. Where mechanical performance is concerned other factors may be of importance, such as lubrication and the influence of temperature, etc., on this property.

Every component, every instrument and every piece of equipment presents its own problems in each and every one of these directions.

From the manufacturer's point of view a matter of vital importance is the manner in which the various components can be tested to simulate in a short time the actual service conditions. Time does not permit the slow process of trial and error in actual use, and methods of making accelerated tests must be developed which will give results either comparable with actual service conditions or which can be correlated with them.

Many test methods have been proposed from time to time, but inadequate data exists to enable correlation to be made with actual conditions. The net result is a complexity of testing specifications, although some effort is being made to achieve simplification and unification.

Prominent among the tests normally envisaged are heat tests, cold tests, humidity tests and low-pressure tests. These are usually made separately, and their effects on the articles and materials under tests are judged usually by the changes resulting in electrical properties (e.g., power factor, resistance or insulation) of the material as measured under controlled atmospheric conditions after each climatic test. Frequently electrical stress or loading is applied during the climatic tests.

The effect of the test equipment on performance, particularly in the case of humidity tests, has been discussed by this institution and elsewhere. As a result, a specification of test apparatus has been included in the latest edition of the humidity conditioning specification K110; recently, further changes have been

In the Cassino area, radio and communication apparatus has had to withstand very widely varying climatic conditions.

proposed. Heat, cold and low-pressure tests are less likely to be influenced by the type of apparatus used; equipment has been designed for the application of predetermined cycles of climatic variation and its automatic control.

Experience alone will demonstrate whether existing test methods will prove adequate for long-term adoption. In this connection it must not be overlooked that changes in test methods, although often desirable on theoretical grounds, may destroy the background of information accumulated by manufacturers as a result of the extensive employment of standard tests. In wartime a much shorter "life" for the equipment is usually required than in peacetime, but good storage properties are imperative to ensure that the equipment is available for immediate use when required.

Mr. Lee, after recalling the previous discussion in November, 1941, the results of which, he said, had greatly surpassed the hopes of those who organised that meeting, urged caution in making changes in testing methods, notwithstanding that a great deal had been learned in the intervening period. The Inter-Services Technical Committee had a sub-committee working on the revision of Specification K110 and, moreover, a series of Service specifications was about to be issued dealing with components. He regarded conditions of storage as more onerous than conditions of use, and considerable improvement was called for in methods of packing, having regard to the fact that components might be stored for periods of from six months to perhaps two years.

The general discussion was appropriately opened with an account of experiences with the Army in tropical climates, and it was pointed out that there had been very few major failures of components under North African tropical conditions. Looking to future war conditions, however, and especially in the Pacific, the point was made that with the Forces fighting farther away from their base and apparatus having to remain packed for transit for several months, there were some special problems which needed consideration. In the Pacific area the conditions as regards damp and dust were very much worse than those in North Africa, Norway and Europe generally. Normal packing systems using paper were more or less useless for keeping out damp, and without the evidence of a satisfactory life test performance of some 1,000 hours it might well be that when the apparatus reached the Forces it would be useless or faulty.

Varying views were expressed as to the nature of the life test that was called for and ideas were put forward for devising means to increase the severity of conditions and so to expedite results. This would assist manufacturers to reduce the testing period in the interests of production.

The Electrical Research Association is carrying out a considerable amount of work in collaboration with manufacturers and it was made clear that some definite ideas on testing procedure have been formed, which should play an important part in any modifications that may be made to Specification K110. Attention was drawn to the difference between an "all-in" test, reproducing tropical conditions and waiting a long period to see what happened, and a method of testing in which an analysis is made of the mechanism of the failure of the different components, after which the individual components are subjected to a series of tests expressly designed to exaggerate the effects. The E.R.A. is pursuing the latter approach and although it was admitted that it might not be capable of adoption by the Services, it should be valuable to manufacturers for post-war purposes.

The question was asked: "What is hermetic sealing?" and the comment was made that putting a component into an enclosure having an automatic mechanical grip for the seal did not prevent dust or water vapour getting it. An all-welded enclosure or a complete glass enclosure were recommended as necessary to prevent the ingress of dust and moisture in tropical climates. Again, there were problems associated with the actinic power of light, ozone effects and transport difficulties, to which attention was drawn. A warning was given against speaking too generally of tropical conditions, having regard to the great variations that are to be encountered in tropical areas. Alternations of great dryness and wetness were mentioned as being met with in certain parts of the world. A point of some interest was that unless varnish finishes are applied by the manufacturers under definite conditions of humidity, the varnishes would not adhere permanently, and might peel off under conditions overseas.

The absence of systematic data on the deterioration of components under tropical conditions was mentioned, and it was suggested that Specification K110 must be regarded as a compromise until such information was available.

Corrosion received a good deal of attention, and it was inferred that the Services might be bringing the effect of sunlight in this connection into their specifications. Electrolytic corrosion was also mentioned.

Coupled with the suggestion that tests should be carried out under working conditions and not artificial conditions, the plea was made that in order to develop export trade after the war we must manufacture two classes of apparatus, one for the home market and another for the export market, with special reference to tropical conditions. Hitherto, one more or less standard set, slightly modified to meet tropical conditions, had frequently been offered.

Various suggestions were made for modification of Specification K110 and the desirability of obtaining more data on several points was emphasised. Certain changes in the specification were held to be desirable but differences of opinion clearly existed as to the precise details involved.—(Courtesy of the Institution of Electrical Engineers.)

B.B.C. Year Book for 1944

MR. ROBERT FOOT, until recently the Director-General of the B.B.C., in an article "Looking Forward" in the B.B.C. Year Book 1944, discusses such vital post-war problems as the return of Television, Regional Broadcasting, the allocation of wavelengths and the future of the B.B.C. when the Charter comes up for renewal. He shows how intimately such problems are bound up with decisions on both national and international questions; for that reason they are stated but not solved. He makes it clear, for example, that "the future of the B.B.C. itself is not for the B.B.C. to decide," and that the final decision on such a matter as the introduction of advertising programmes "will rest with Parliament."

It is worth recording that the time of the B.B.C.'s biggest effort when, as the Introduction states, "its will and purpose were wholly devoted to the tasks of war," should also mark its coming-of-age.

An article, "Twenty-first Anniversary," tells of the message of congratulation from His Majesty the King (reproduced facing page six) and the friendly comments by newspapers up and down the country. Sir Ernest Barker, in an article "Twenty-one Years of Broadcasting" discusses the effects of the activities of the B.B.C. on our national life. He finds that it "has been objective in presenting news, and fair in presenting views," a notable tribute.

The address by the Chairman of the B.B.C., Sir Allan Powell, to the Conference of the British Association for the Advancement of Science (Radio and Cinema Section), on March 20th, 1943, is reprinted in the Year Book because so much of the ground he covered needs the consideration of everyone interested in the future of broadcasting. For, as he made clear, the problems involved cannot be solved by the B.B.C. alone. In pleading for the "help of science to the fullest degree," he added: "It is indeed not too much to hope that science, which is universal and has no national boundaries, and scientists throughout the world, with their work for mankind as a whole, may in radio communication as in many other directions lead the way to international co-operation in the post-war world."

An account of the engineering development of the B.B.C.'s European and Overseas services during the war, by the Chief Engineer of the B.B.C., Harold Bishop, provides answers to many questions which have not hitherto been made public. He reveals that the B.B.C. had only eight short-wave transmitters before the war and that by December, 1943, there were 34 in operation. He deals sympathetically with the questions which the ordinary listener frequently asks: Why so many programmes, why so many transmitters; and shows the great difference between listening conditions inside and outside Europe. When he writes that "in most areas of the world the listener has the choice of two or more programmes from London," some idea of the magnitude of the task achieved in wartime may be realised. Incidentally, the value of rationing, as a wartime measure, was never more happily illustrated, for Home listeners are restricted to two programmes so that the whole world may hear the story of Britain and the Allied story from Britain.

The story of Regional activity is told by the Director of Publicity, Kenneth Adam, in "Regions in Wartime," and it may surprise many who think that because the Regions, as separate programmes, ended at the outbreak of war, they have, effectively, ceased to exist. He defends programmes telling of the "front behind the front-line" and those of the workers providing entertainment at their midday break. "With all their faults," he writes, "both types of programmes had a common denominator which gave them grace. They were genuine. They were part of wartime Britain."

Some 20 pages of "Radio Review 1943" give in compact form under subject headings the major activities of the Programme Departments. Mention may be made of "Special Night," a development of feature broadcasting in 1943 in which a planned sequence of programmes illustrates one central theme. Examples which come readily to mind are R.A.F. Night, Russia Night, Workers' Gala Night. A new formula has been created to which many programme departments contribute—music, straight talk, dramatic feature, variety. Thus the monodiet listener is lured into sampling hors d'œuvres.

In the section on variety, John Watt is quoted as saying: "We cast producers even more carefully than we cast actors," and the Baily-Fawcett-Groves team for "Everybody's Scrapbook" and "Travellers' Tales," and the Worsley-Kavanagh combination for "Itma" are instanced.

"Calling Europe" deals with the activities of the European Service. B.B.C. transmissions to Europe were increased by 40 per cent. during 1943. An interesting item of news for lend-lease discussions is the fact that the "America Calling Europe" broadcasts have been greatly increased during 1943, and they are now relayed every week in 18 European languages for 107 periods. "Through this arrangement, which may be described as reverse lend-lease, the B.B.C. enables American views to be heard throughout Europe."

Perhaps the most interesting part of the section dealing with the Overseas Services is the Postscript by three overseas listeners. From Australia: "The B.B.C. often provokes more than momentary nostalgia in Australians who have served in Britain since 1939 and then returned home." From India: "The B.B.C.'s policy of giving an unbiased, accurate, and balanced presentation of the important news—often dull—has been of immense help to India." From the Middle East: "To-day it can be said with perfect truth that nearly all Muslim and Arab listeners regard the B.B.C. as the only trustworthy source of broadcast news."

The Year Book is, as usual, fully illustrated. The price is 2s. 6d. (2s. 10d. post free), and it may be obtained from the B.B.C. Publications Department, The Grammar School, Scarle Road, Wembley, Middlesex, or from any bookstall.

Cathode-ray Tubes—6

Test Meters. Gas-focused and Electromagnetic Control Tubes. By LAURENCE ARTHUR

(Concluded from page 251, May issue)

IF sensitivity is within the prescribed limits, the spot is returned to the line by switching in the 50-cycle frequency. The time base is switched in until the effective area of the screen is covered with a raster, as shown in Fig. 31. The raster may be shortened in each direction by "amplitude" controls (Figs. 32A and B), and the vertical lines thinned out or brought closer together by means of "velocity" controls (Figs. 33A and B). In most tubes note must also be taken that the outline of the raster is rectangular, that is, free from trapezium distortion. Fig. 34 shows this fault, which is due to the effect of one pair of deflector plates on the other pair, and can be obviated by plate design and accurate assembly.

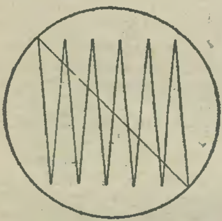


Fig. 31.—A normal raster.

A final test is of the leak between cathode and heater after the tube has become thoroughly warmed up. With the heater alight a voltage ranging from 25 to 100 is applied between cathode and heater, positive to cathode. The current flowing is measured on a sensitive microammeter, and must not exceed 25 to 100 microamperes, according to the type of tube.

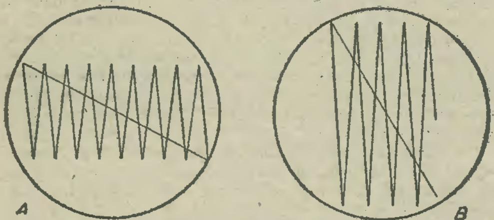


Fig. 32.—Rasters obtainable by adjusting amplitude controls.

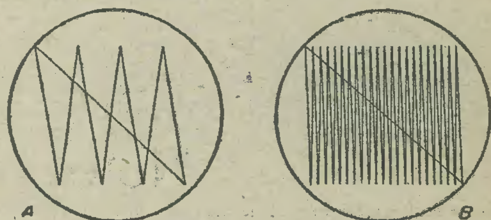


Fig. 33.—The rasters produced by adjusting velocity controls.

The Test Meters

The meters of the test boards must be checked at frequent intervals to ensure accuracy in testing. A standard milliammeter, carrying a National Physical Laboratory certificate of accuracy, is used in conjunction with wire-wound shunts and series resistances to obtain various voltage and current ranges. This standard is kept in a safe place, and sub-standards are checked against it daily. These latter are taken round to the test boards, and check readings taken directly at the contacts of the tube holders. Any meters showing an error larger than permissible are removed from the test boards and adjusted in the meter room. A small percentage of each batch of cathode ray tubes is submitted to a life test of 500 hours continuous running at working voltages and at standard brilliance. At the end of the period the results obtained on re-test must still come within the specification figures.

Each tube after testing is examined to see that there are no loose particles in the bulb, no loose electrodes on the mount and no cracks or flaws in the bulb. The base must be on straight and firm, and the soldering to the pins or contacts satisfactory. The glass is cleaned and polished with methylated spirits, and the type designation marked on the neck of the bulb. This marking may be indelibly etched into the glass with silver nitrate or ammonium bifluoride. Alternatively, it may be printed on in white or coloured printer's ink, using either a small offset printing machine or a hand stamp. Finally, the tube is packed, always individually, in a carton or crate, in such a manner that it is suspended away from the sides and ends of the container.

Gas-focused Tubes

The descriptions so far given have been principally related to high vacuum, indirectly heated, electrostatically deflected cathode ray tubes, but there is a considerable amount of equipment still using older types. the "soft" or gas-focused tube is an earlier form still much used. The bulb, after exhaustion, has a low pressure of argon admitted. To ensure that the gas filling is satisfactory it is usual to complete it with the tube connected by temporary wiring to a time base so that a raster is produced on the screen. The gas is admitted until the lines are sharply focused.

The construction of the gas-focused tube is much simpler than the usual high vacuum type as there is only one accelerating anode, which is fitted immediately above the grid (or shield as it is frequently named), and there is no focusing anode. The application of negative voltage on the grid compels practically the whole of the electron stream to pass through the hole in the anode in the form of a narrow beam having relatively low divergence. A proportion of the electrons in transit from anode to screen strike molecules of the argon and cause them to ionise. These ions, being comparatively slow moving, remain for an appreciable

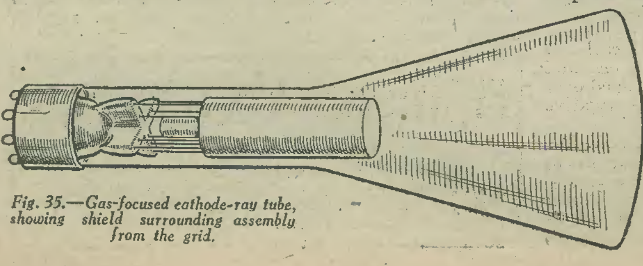


Fig. 35.—Gas-focused cathode-ray tube, showing shield surrounding assembly from the grid.

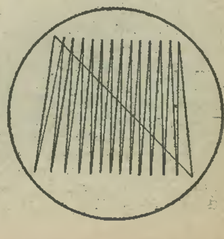


Fig. 34. (Right).—Indicating trapezium distortion.

time within the beam and so produce a column of positive charge along it. This has the effect of drawing the outside electrons in towards the centre of the beam.

In practice the tube is focused as follows: With the filament alight and the grid voltage at its maximum negative value the anode volts are switched in. Grid voltage is reduced until a sharp spot is obtained on the screen. If focus is unobtainable it is necessary to increase the filament current until it is just possible to render focusing practically independent of filament control. It is generally found that if focus is obtained on a spot the grid control must be adjusted if the spot is opened out into a line.

Features

The principal advantage of the gas-focused tube is that it may be operated at a lower accelerating voltage than a comparable high vacuum tube. The big disadvantage is that when investigating very high frequency phenomena there is a tendency for the focus to deteriorate owing to the comparatively slow movement of the heavy positive ions. Tubes of this type are almost always directly heated so that a quicker focus response is obtained from filament control. Another feature of gas-filled tubes is the absence of wall coating on the interior of the glass. This is frequently substituted by a long metal tube surrounding the whole assembly above the grid. Fig. 35 shows the method. The tube is directly connected to the accelerating anode and it is sufficient to collect nine-tenths of the return current from the screen.

Electro-magnetic Control

Cathode-ray tubes using electromagnetic deflection were frequently used in pre-war television receivers. Instead of internal deflector plates movement of the beam is achieved by four external electromagnet coils, with or without iron cores, which fit closely on the neck of the bulb above the accelerating anode (Fig. 36). The electron beam moves at right angles to the axis of each magnetic field and the movement is directly proportional to the magnitude of the field. Some tubes utilise both electrostatic and electromagnetic deflection, a method which sometimes is of advantage when current effects rather than voltage effects are being investigated.

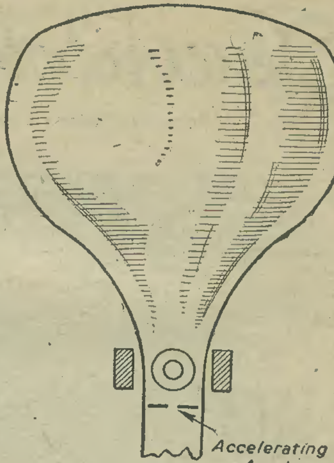


Fig. 36.—Electromagnetic coil for spot deflection.

An interesting development is the double beam tube in which the electron beam is divided by a splitter plate placed between the final accelerating anode and the Y deflector plates. By this means the examination in an oscilloscope of two phenomena simultaneously may be done. Each Y plate affects one half of the beam and the X plates are common to both beams. This tube is of the high vacuum, indirectly heated type.

All cathode-ray tubes should be run with the brilliance kept as low as is consistent with the observations being made as the life of the tube is dependent upon the current which the cathode is caused to emit. The apparent brilliance of the spot, line or raster on the screen is considerably increased by operating the equipment in a darkened room, or, at any rate, in such a position that a minimum of direct light falls upon the screen. A viewing hood is of great help. A very bright spot or line should never remain stationary for any length of time or a permanent burn will be left on the screen.

Servicing Notes

Repairing Electrolytic Condensers

ELECTROLYTIC condensers are often needed during servicing work, and as replacements are in very short supply, I have recently repaired several, so perhaps the following hints may be of use to readers of PRACTICAL WIRELESS. It should be noted that my remarks refer to the cardboard type of electrolytic only.

Great care should be exercised in taking them to pieces and the method of assembly carefully noted, as that of different makers varies, although the principle is the same.

First open the outer container and run out the wax filling (in a warm oven into a tin), remove the interior and take off the "stopper" from each end of same. Very carefully unroll a portion of the cylinder to expose the foils and tissues, and again note carefully how the lugs are formed and the tissues folded back, to prevent a "short." If the connecting wires are not broken away from the foil lug, the fault is due to chemical action eating away the foil, as will be seen by discoloration.

Cut away as much as is necessary but no more, leaving a good overlap of tissue and cut a new strip of each foil about ¾in. wide to within ¾in. of the top of one and bottom of the other, to form a new lug when folded over projecting from either end. The outer foil is negative I have found. This can be verified.

Roll up again tightly, taking care to fold back the ends of the tissues over the foils, and either wrap round with the original oiled paper, or as I do, use new grease-proof paper; then comes the final wrapper of a stiff paper, which must be 1in. wider than the rolled foils and tissues so that a space of ½in. is left at each end for the "stoppers." For these I prefer to run in melted sealing wax, heated and poured in hot from the lid of an old tin. Care must be taken not to damage the projecting foil lugs at ends.

Now connection has to be made to the red and black flexible leads and soldering is out of the question. Most makers seem to use eyelets, but as few of us have a punch, I think my method is as good as any.

I use press-button fasteners, and the ends of the flex can be soldered to one portion and the foil then gripped between the two, and if the wire end of the flex is threaded through the holes of the half press-button before soldering, good close contact will be obtained.

The foil and press-button connection should now be folded over the top of the sealing wax stopper and a little more run over to hold it firmly. This applies to each end, of course. Place in outer cardboard box, thread leads through holes and run in the wax to completely fill box.

If care has been taken condenser should test out O.K. The capacity will, of course, be very slightly lower than the original, but not sufficient to worry about.

No great skill is required, no "tools," and the use of press-button dress fasteners solves the problem of sound connections.—(H. S. G. BRAY.)

Secondary Batteries—10

Buckled Plates. General Faults. By G. A. T. BURDETT, A.M.I.I.A.

(*Continued from page* 255, *May issue.*)

THE thickness of the board will depend upon the distance between the plates, but since plates are easily broken by the insertion of a board of this thickness it is advisable to insert a thinner board first and then make up the difference gradually by the insertion of thin strips of wood, e.g., plywood.

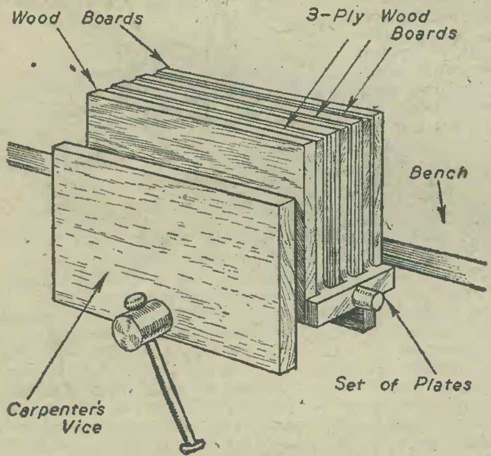


Fig. 1.—A set of plates, with plywood pieces in position, being straightened in a vice.

The block is then placed in a vice with a further block of wood between each jaw and either plate. A special vice or, if not available, a carpenter's vice, should be used, as a narrow jaw fitter's vice is more likely to damage the plates. The vice is then gradually tightened until the plates straighten. Leave plates in the vice for 4-5 minutes. Figs. 1 and 2.

The positive plates, being more brittle than the negative, are easily broken when attempting to straighten them, therefore extra care should be taken when handling these. Before any attempt is made to straighten plates, they should first be closely examined for serviceability. For instance, badly sulphated plates should be scrapped, or should one set of plates require renewal, e.g., the positive set, due to loss of active material, broken plates, or very bad buckling, both sets should be renewed. Rarely is it advisable to renew the plates of one cell only in a battery except where the trouble is due to mechanical damage. Other than this a complete renewal of plates is indicated.

Internal Shorts

The most usual cause of internal shorts is the "treeing" of the active material between the plates, which leads to the complete disintegration of the positive plates, Fig. 3. This is due to excessive gassing during periods of overcharging. Shorts are also caused by the sediment in the bottom of the case reaching such a level that it shorts the plates, Fig. 4. Since most containers are designed with wells to house the sediment, it rarely reaches a level to cause internal shorts until sufficient active material is removed from the positive plate to render the cell practically useless and a renewal of plates is advised. Premature shorts are caused by pieces of foreign material entering the cell, often in the form of straw from the carboys when sufficient care is not taken in handling electrolyte and distilled water. Active material from the positive plates adheres to the straw and causes internal shorts. Internal shorts are indicated by excessive "self-discharging" of battery immediately after charge and when not in use. In some instances straw, etc., may be removed by inserting in the cell a strip of wood between the plates, but usually the cell must be dismantled. Where the S.G. of the electrolyte of a cell is consistently low and not due to diluted acid, an internal short is indicated which is in fact one of the

(*Continued on page* 299.)

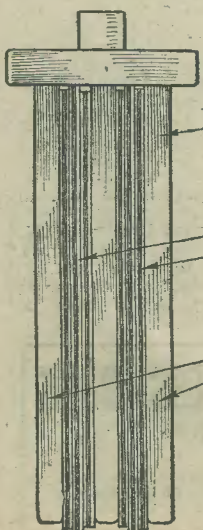
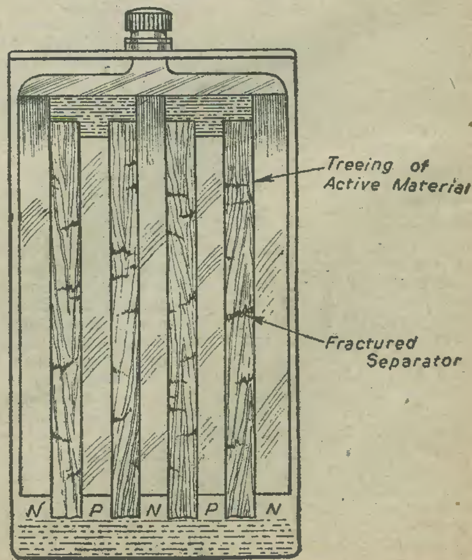


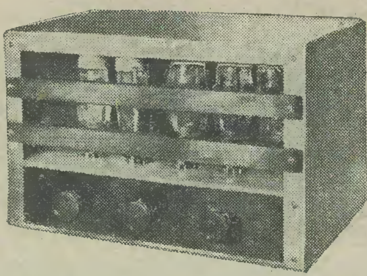
Fig. 2 (Left).—The plates free from distortion after removal from vice.

Fig. 3 (Right).—A common cause of internal shorts is "treeing," as shown here.



FINE QUALITY P.A. AMPLIFIERS

Output 15 watts, 6 valves, 200-250 A.C. Pre-Amplifier for microphone, gramophone and radio terminals. Multi-range output, 2.5 ohms to 15 ohms. Fitted two volume controls and tone control. In metal cabinet as illustrated.



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2 mfd., 4 x 1¾ x 2in.	4/6
2 mfd., 4 x 1 x 1¾in.	2/6
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.02 mfd. Size 4⅜ x ½ x 1½in.	1/6
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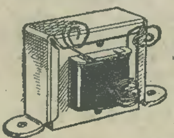
Also 250 mfd., 25 v., in Bakelite Case	2/6
500-v. wkg. 2 mfd., 2½ x 2 x ⅞in. ...	5/6
10 mfd. 350-v. wkg.	10/6



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Well made and efficient. Suitable for Small Speakers Size 1¾x1⅛x1½ins., **7/-**

MANUFACTURERS' STOCK: HEAVY DUTY MAINS TRANSFORMERS

Input 200-250 v. A.C., 350-0-350 v. 120 m.a., 4 v. 2 a., 4 v. 3 a., 6.3 v. 4 a. Weight 11 lbs. 33/6.

OAK SWITCHES

2½in. spindle, complete with knob. 4-way, 2-bank with connecting block, **4/-**
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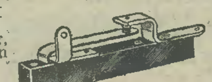
For Yaxley type wave-change and other switches, see March advt.

EXTENSION SPEAKERS. Brand new, first-class P.M., in beautifully polished cabinets, 52/6. In Rexine covered cabinets, 50/-.

PLATINUM CONTACTS Double Spring, mounted on ebonite, **1/6**



LOUDSPEAKERS. Rola 10in. P.M., 35/-. Celestion 8in., with transformer, 29/6. Goodmans P.M. without transformers: 5in., 21/-; 8in., 30/-; 10in., 47/6. Post and packing 1/6 each extra

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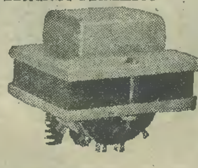

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CHASSIS drilled for 4 valves only. 10½ x 7¼ x 3in. (ends and sides). Grey finish, 5/-.

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VALVE-HOLDERS. Paxolin, 5-, 7- and 9-pin, 7d. each, 6/- doz.

VITREOUS ENAMELLED RESISTANCES, 10,000 ohm, 10 w., 3/6.

ELECTRIC RAZOR RESISTANCES, universal input, in strong metal case, 10/- each.

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TUBULARS. Wire-end tubular condensers, 0.1 and 0.01 mfd., 400 v. working, 1/-.

COSSOR 0.025 CONDENSERS, 8,000 v., 7/6.

T.C.C. TUBULAR CONDENSERS, 0.1 mfd., 6,000 v. D.C. test, 8/9; 0.04 mfd., 350 v., 2/-.

T.C.C. CONDENSERS in metal cases, special offer, much reduced to clear, 4 x 4 mfd., 70 v. working, 2/6 each.

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PHILIPS POTENTIOMETERS. 100,000 ohm. With switch, 4/6.

CARBON POTENTIOMETERS, 50,000 ohm, 5/6.

DIAL LAMPS. Philips' screw type dial lamps for dial illumination, 15 watt, 1/9 each.

SPEECH COIL RIBBON WIRE, enammelled copper, gauge approx. 20 thou. by 5½ thou., 3/3 per lb. reel; also 23 s.w.g. d.c.c. wire, 100 yd. coils, 5/6.

FLEXIBLE DRIVES. Ideal for remote control in radiograms, etc., approx. 2ft. lengths, 4/3.

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PUSH-BUTTON UNITS. 8-switch unit (no coils), 4/6 each; 12-switch unit (no coils or switches), 2/6 each.

CERAMIC VALVE-HOLDERS, brand new, low loss, 7-pin, 1/5 each.

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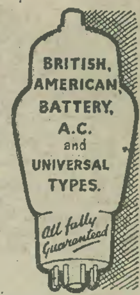
This is part of our current stock of valves and if all their equivalents were mentioned it would be found that we can supply either the exact valve or a suitable replacement for almost any type. Wherever possible please order C.O.D. Stamp with enquiries please.



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BATTERY. 210HL, LD210 5/10; P220, PM2A 7/4; 210DDT, HD24, TDD2A 9/2; 210SPT, 210VPA, 210VPT, 215SG, 220HPT, 220/OT, HP210, K50M, KT2, KT24, PM12M, PM22A, SP2, SP210, VP210, VP2B, W21, Z21, Z22 11/-; 210PG, FC2, FC2A, X24 12/10.

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AMERICAN. OZ4, 1A5, 1B5, 1H5, 2A6, 2A7, 2B7, 2P, 5U4, 5Y3, 5Z3, 5Z4, 6A3, 6A4, 6A6, 6AG6, 6A7 conversion, 6C5, 6C6, 6D6, 6C8, 6E6, 6F5, 6F6, 6F8, 6H6, 6G5, 6J7, 6K6, 6K7, 6K8, 6L6, 6L7, 6P5, 6Q7, 6R7, 6SA7, 6SC7, 6SF7, 6V6, 6X5, 6Z5, 10, 1, 12A5, 12Q7, 17, 12SF5, 12Z5, 15, 19, 24, 25, 25A6, 25L6, 25Y5 conversion, 25Z4, 25Z5 conversion, 25Z6, 32, 33, 34, 35, 37, 38, 42, 46, 47, 48, 50, 53, 57, 71A, 75, 76, 78, 80, 81, 82, 85, 89, 185R8 (Ballast).

VALVES & ADAPTORS

In the cases where we cannot supply the exact valve or equivalent, we can get your set going with a valve and adaptor, the additional cost being 4/6.

SPARES

KIT OF 12 TRIMMER TOOLS in American cloth folder. Very handy, 30/-. Speakers 5in. W/Trans., 32/6. **LINE CORD.** .3 amp. 3 core 60 ohms per ft., extremely good quality, 6/9 per yd. **CELLULOSE CEMENT** for speaker valve and most other repairs, 5/- tin. **SERVISOL,** more than a switch cleaner, 5/- tin. **MAINS TRANSFORMER.** 350-0-350 4 volt heaters, 29/3. **VOLUME CONTROLS** with switch, 7/6. **VALVE EQUIVALENTS CHARTS,** 1/7 post free. **BOOKLET ON AMERICAN MIDGETS,** 2/7.

J. BULL & SONS,

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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).

Bond-slaves to State

SIR,—The two new Orders in Council by the Board of Trade for controlling the sales of radio sets imported from U.S.A. must be added to the 10,000 or more of such "Orders" in force, dealing with every aspect of our daily lives, and help to make the State the largest trading concern in the land, to the serious detriment of our British manufacturers and public alike.

Many of our Ministries have made colossal purchases, both in this country and abroad, which have later resulted in considerable loss, or even entire waste, all of which has to be made good out of the tax-payers' purse, and there can be no assurance that the same will not be the result of the Board of Trade dabbling in the radio trade. As you have pointed out, there are several technical reasons why American sets and valves may cause much dissatisfaction when used in Great Britain and, as such sets are to be sold without any guarantee, many buyers may prefer not to purchase such sets, and wait until British-made sets are available. If this transpires, the Board of Trade will not worry very greatly, for any of these imported sets left on its hands will have already been paid for by the tax-payers. And, later on, as in the case of various "Utility" manufactures of the State which some people fight shy of buying, the imported radio sets may be taken out of storage and disposed of at specially reduced prices to the people of the occupied countries when the war ends. A "Savee Facee" plan of considerable value!

Now, if State trading was a purely wartime measure, and would come to an end on the conclusion of the war, it might be endured as patiently as possible, but we are repeatedly assured that it must continue for some years later. Are we to imply from this that British radio set manufacturers are to produce their sets under Government control, and its approved specifications? What progress, development, or new inventions could we hope for from the dead hand of the State? Rather would stagnation in all these directions be the inevitable result. Let no one imagine that the "powers that be" are too ignorant or stupid to appreciate all this. They known the facts as well as anyone else, but they also know that "State Control" means their retention of their own well-paid and cushy bureaucratic jobs, and, at all hazards they will cling, limpet-like, to these till the last possible moment. The B.B.C. used to have 3,500 employees on its pay rolls; it has now 11,500. Most of our Ministries have positive army corps in their employ. Where are we drifting to? The State providing not only our radio programmes, but also the radio sets we need to listen to them (if we do?). That would be a fine end to our fight for liberty and freedom. Let us be warned in time. Let us insist on the State ceasing to insert its fingers into the radio (and all other) trades, and give our British manufacturers the freedom and encouragement they require if we are to hold our own when the war at last is ended.—K. T. H. (Birkenhead).

Northern Radio Club

SIR,—Having been a reader of PRACTICAL WIRELESS since the early days of radio and being a member of B.L.D.L.C., I would like to make known the fact that The Northern Radio Club has vacancies for a few members. It is a club formed by members of the radio fraternity of amateurs in the north, and I can think of no better way to bring the fact to members of the amateur and professional fraternity than through the B.L.D.L.C., which has done so much to further the amateur movement. We are also affiliated to R.S.G.B., many of our members are also R.S.G.B. members.

All information and applications can be obtained from me at the address given below.—W. HALEY, Hon. Sec., Northern Radio Club, 43, Hyde Terrace, Gosforth, Newcastle-on-Tyne, Northumberland.

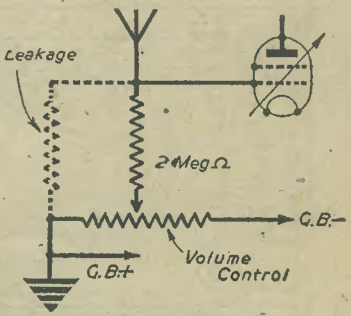
(*What are the Rules, and Terms of Membership?*—ED.)

An Interesting Problem

SIR,—A peculiar problem cropped up during some experimental work, the solution of which took me some time, although it was so obvious once it was seen. I am sending it to you in case it may prove of interest to other readers.

Problem.—Smith had a short-wave set in which he used a va. mu screen grid valve as a buffer stage. There was a 2 megohm resistor between grid and earth, and the aerial, an outside one of average efficiency, was connected direct to the grid. A good earth was used. One wet afternoon Smith decided to fit a va. mu volume control. He disconnected the earthy end of the 2 megohm resistor which he connected instead to the slider of a 25,000 ohm potentiometer connected across a grid bias battery. The components were sound, the battery in perfect condition, and the wiring correct, but adjustment of the volume control had practically no effect of any sort. Why was this and what was the cure?

Answer. — The D.C. leakage path between aerial and earth was much less than 2 megohms on a wet day. This leakage resistance in series with the two megohm resistor forms a potentiometer across the volume control, and the grid of the valve is connected to this potentiometer at a point much nearer to earth than the volume control. Consequently there is only a very small bias applied to the grid for all positions of the volume control. The cure is to put a small fixed condenser between the grid of the valve and the aerial terminal, the 2 megohm resistance remaining connected to the grid, as shown in the accompanying sketch.—D. B. HALL (Mkushi, N. Rhodesia).



An interesting problem, by D. B. Hall.

Women Announcers

SIR,—Never before have I had the displeasure of reading such pompous and selfish drivel as that written by "Anti-Blue-Eyes" on the subject of women announcers. He apparently has plenty of leisure in which to listen in his own home and is therefore in an ideal position to know the feelings of those members of the Forces who are stuck in "God-forsaken" places, and for whom the General Forces Programme is largely intended.

Any man who has been far from civilisation in desert or jungle for many months welcomes the sound of female voices, particularly such pleasant voices as those of the B.B.C.'s young ladies, who receive many hundreds of letters of appreciation from wild parts of the world; is not this in itself sufficient justification for them, if justification be needed. As to A. B. E.'s suggestion that the B.B.C. employs women announcers simply to protect them from more arduous employment, the only fitting description of it is, absolute rubbish.

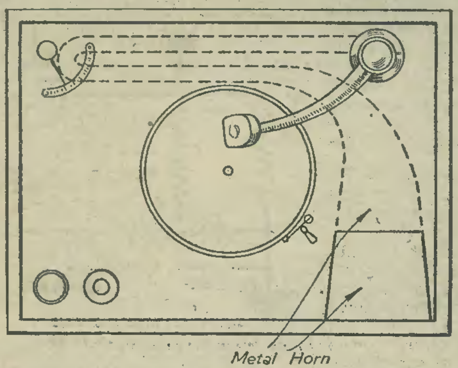
Maybe instead of writing all this I should simply have suggested, in the approved Service manner, that A. B. E. should "belt up."—PILOT, R.A.F. (Dumfries).

SIR,—I should like to reply to the letters of "Anti-Blue-Eyes" and also E. Jones, published in your May issue.

In "Anti-Blue-Eyes'" first paragraph he makes a statement which is surely fantastic. To write that the B.B.C. takes a "perverse delight in thwarting the wishes of licence holders," is absolute rubbish! What does he think the Listener Research Department is for? Nearly 600,000 interviews were made on behalf of this Department in the first two years of its survey.

No doubt many male and female announcers of the B.B.C. do part-time war work and I doubt whether Mr. Bevin needs "Anti-Blue-Eyes" to remind him that the number of announcers available has been increased. To suggest that the B.B.C. instituted the G.F.P. "as a measure of some protection for its own female staff," is, once again, rubbish! Is he not aware that announcers are, like anyone else, subject to call-up under various Acts?

The public and the Forces in general have, through the medium of the Press, made known their partiality to women announcers, who, contrary to "Anti-Blue-Eyes'" apparent beliefs, do not announce dance band programmes only, but perform innumerable other tasks in addition. I do not think that many readers will agree that "a hateful state of affairs" exists as is suggested by "Anti-Blue-Eyes." Does this person seriously believe that, if all dance band leaders announced their own programmes, it would eliminate female announcers?



Adding a pick-up to a portable gramophone. (See Northern Reader's letter.)

Your contributor, who prefers to hide behind a pseudonym, makes rather a sweeping and thoughtless statement when he writes "nobody wants these women announcers." He should endeavour to speak for himself in such matters and not for the public in general.

With reference to the letter of E. Jones and various others that have appeared in your columns of late, complaining of the B.B.C. transmissions, it seems that many listeners do not appreciate the problems which B.B.C. engineers are constantly trying to solve. In a recent article entitled "Listening In Britain Now," the B.B.C. endeavours to explain the reasons for bad reception in some parts of the country, and states: "No listener realises more clearly than does the B.B.C. Engineering Division, however, that the problem of providing an adequate signal to all parts of the country is not completely solved, and a satisfactory solution, subject always to the needs of national security, is being sought unremittingly." This article also gives some helpful advice to persons whose programme reception is poor.—E. H. TROWELL (Sheerness).

Gramo. Pick-up

SIR,—I have a portable gramophone with tonearm and wanted to fit a pick-up in the same cabinet. In the only corner available, i.e., opposite the tonearm (as shown in the accompanying sketch), the end of the metallic horn comes to the surface, so that I shall have to cut away the metal in order to fix the pick-up to the bottom of the cabinet. I hesitate to do so for fear of spoiling reproduction when the tonearm is used. Has any reader tried this before, and what has been the result? The motor is a spring one, otherwise I should have taken the tonearm out altogether and used the pick-up only.—NORTHERN READER (Wigan).

Good DX Reception

SIR,—I have been a regular reader of PRACTICAL WIRELESS for many years (since 1937), and a DX fan for the same time, and have found your journal most useful, and have seen several DX logs from readers and thought the following news might be of some general interest. Since September, 1943–March, 1944, I have listened on the medium waveband between 200-350 metres from 0300–0500 B.S.T. on several odd occasions and logged the following: WTOP (Washington), WBNS (Columbus, Ohio), WMEX (Boston), WKBW (Buffalo, N.J.), WEAW (Eau Claire, Wisconsin), WNEL (San Juan, Puerto Rico), WPRP (Ponce, Puerto Rico), CBA (Sackville, New Brunswick, Canada), ZP7 (Asuncion, Paraguay, South America), LR-1 (Radio El Mundo, Argentina).

All reception on headphones, 5-valve battery all-wave straight receiver, 100ft. inverted-L aerial.

I should be pleased to hear from any other readers interested in *medium* or *short* wave DX.—T. B. WILLIAMSON (Purley).

Logged on a 1-v-2

SIR,—It is a long time since I wrote to you and informed you of my activities, but I have not been slack all the same. In between times, that is when I can spare a moment in these busy days, I have constructed a 1-v-2 set on 2CHW's ideas, and find the performance first class. I have logged WRCA, WBOL, WBOS, WCW, WNUR, WRUS, PRLH, TRLE, WLWK, WLWO, WGEO, WRUW, TAP (Ankara), and many other stations. I have found reception better since I remodelled my set. My aerial points due south.

Although I asked for contacts some time ago I am still a lone wolf. I dare say the younger members only desire to contact the youngsters. My age is 47, and I am as keen as most amateurs on short-wave radio. I find the present PRACTICAL WIRELESS first class and I congratulate you on a very fine monthly journal. Keep it up in its present form.—J. J. EARLER (Tunbridge Wells).

Radio Nacional

SIR,—I thought readers might like some "gen" about Radio Nacional, as there has been much talk about it lately. The Radio Nacional of Rio de Janeiro is the largest and most powerful transmitting station in Brazil, and in South America, taking its stand as one of the most powerful of the continent. It contains seven studios of recent construction on the very latest lines of modern acoustics, the materials used being the last word in modern production and now used for the first time in Brazil. The studios are installed in the imposing edifice the "Noite Building," in the Mauá Square, 22 storeys high. Radio Nacional occupies the top two storeys, where in addition to the studios and auditoriums, all other broadcasting and departmental offices are installed.—G. R. NOCKIE (Kelso).

"Economy DX Three": A Correction

IN the wiring diagram for the "Economy DX Three," which appears on page 235 of the May issue, the holes for the valve pins in the holder for the detector valve are shown in the wrong position. All four holes should, of course, be given a quarter turn so that they come opposite their respective marked terminals. The wiring connections would then be correct.

RADIO SPARES

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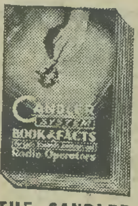

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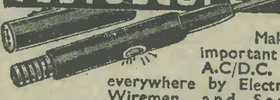

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THESE blueprints are drawn full size. The issues containing descriptions of these sets are now out of print, but an asterisk beside the blueprint number denotes that constructional details are available, free with the blueprint.

The index letters which precede the Blueprint Number indicates the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to *Amateur Wireless*, W.M. to *Wireless Magazine*.

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

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